EV6632A-R-00A

50V, 3-Phase BLDC Motor Driver with 1A Gate Driver and 120° Modulation Evaluation Board

DESCRIPTION

The EV6632A-R-00A is an evaluation board designed to demonstrate the capabilities of the MP6632A, a three-phase brushless DC (BLDC) motor driver controller with 1A of driving current. The MP6632A drives 3-phase BLDC motors, with a 6V to 50V input voltage (V_{IN}) range.

The MP6632A controls the motor speed through the pulse-width modulation (PWM) signal, or by controlling the DC signal on the PWM/DC pin. It also provides closed-/open-loop control and a built-in configurable speed curve function, as well as 120° modulation for good dynamic response and high-speed operation.

The MP6632A also includes the rotational speed detection. The rotational speed detector (FG/RD pin) is an open-drain output. FG/RD outputs a high or low voltage relative to the Hall sensor comparator's output. In addition to rotational speed detection, the direction is controlled via the DIR pin's input.

Rich protection features include under-voltage lockout (UVLO), locked-rotor protection, over-current protection (OCP), and thermal shutdown protection.

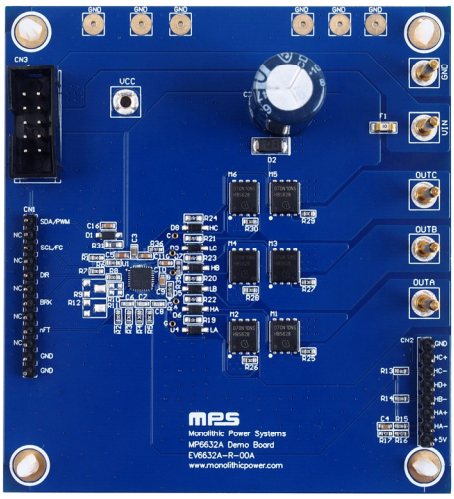
The MP6632A is available in a QFN-32 (4mmx4mm) package.

PERFORMANCE SUMMARY

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

Parameters	Conditions	Value
Input voltage (V_{IN}) range		6V to 50V
Input PWM frequency		50Hz to 100kHz
Switching frequency (f_{SW})		25kHz

EVALUATION BOARD



LxWxH (9.1cmx8.4cmx2.2cm)

Board Number	MPS IC Number
EV6632A-R-00A	MP6632AGR-0001

QUICK START GUIDE

Quick Start Using the Communication Interface (MPS Fan Driver Communication Kit):

1. Preset the DC power supply, then turn off the power supply.
2. Connect the power supply output terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
3. Connect the communication interface to the EV6632A-R-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 motor's Hall sensor outputs to the corresponding connectors.
6. Connect the communication interface to the computer.
7. Turn on the power supply.
8. Run the "MPS BLDC Virtual Bench" GUI and select the MP6632A. (1)

Figure 1 shows the equipment set-up with the communication interface.

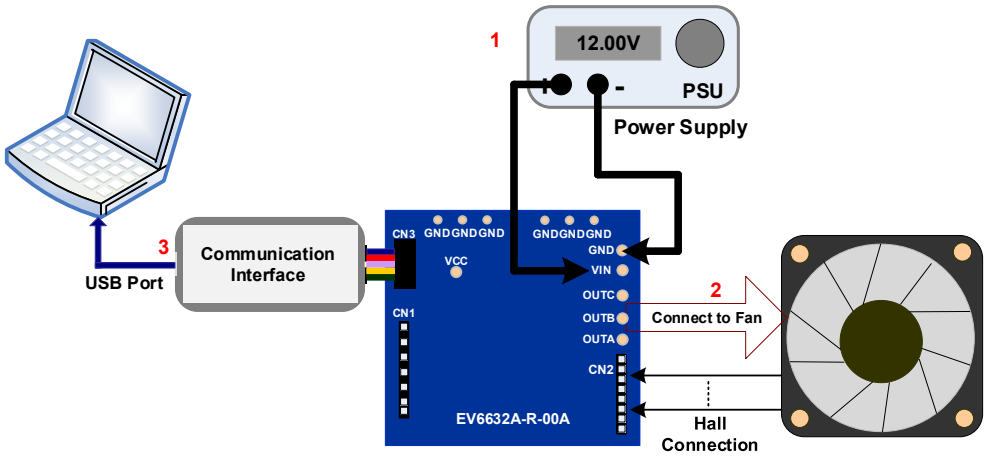


Figure 1: EVB Connection with Communication Interface

Note:

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

Quick Start without the Communication Interface:

1. Connect the power supply output terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
2. Connect the motor phase terminals to:
   a. Motor phase A: OUTA
   b. Motor phase B: OUTB

c. Motor phase C: OUTC

3. Connect the motor's Hall sensor outputs to the corresponding connector. See the Hall Connection section for more details.
4. Turn on the power supply. 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 adjust the motor's speed.

Figure 2 shows the equipment set-up without the communication interface.

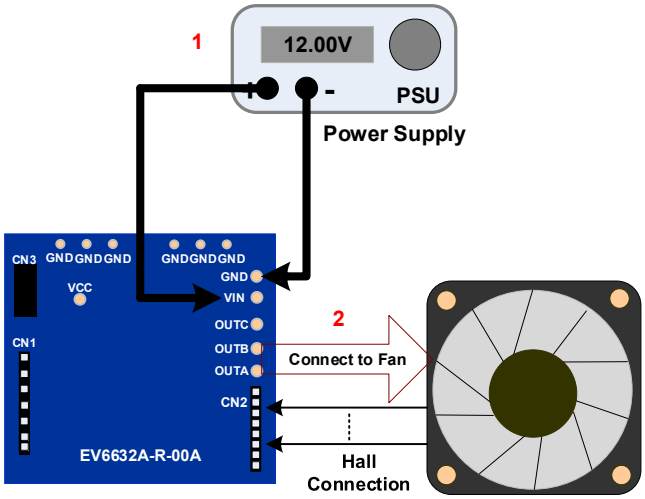


Figure 2: EVB Connection without Communication Interface

Hall Connection

The EV6632A-R-00A supports either a Hall IC (logic polarity input) or a Hall element (differential input) as the Hall input signal. Figure 3 shows the Hall IC that outputs a logic polarity signal.

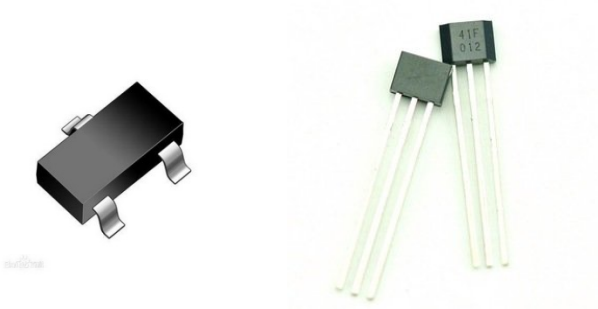


Figure 3: Hall IC (Outputs Logic Polarity Signal)

Figure 4 shows a Hall element that outputs a differential signal.

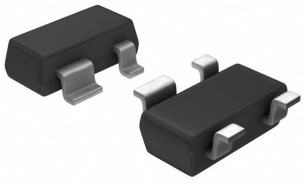


Figure 4: Hall Element (Outputs Differential Signal)

Hall IC Connection

1. Connect CN2 5V to the Hall IC's supply terminal.
2. Connect CN2 GND to the Hall IC's ground.
3. Connect the CN2 terminals (HA+, HB+, and HC+) to their corresponding terminals in the Hall IC's output. Do not make connections for HA-, HB-, and HC-.

Figure 5 shows the Hall IC connection circuit.

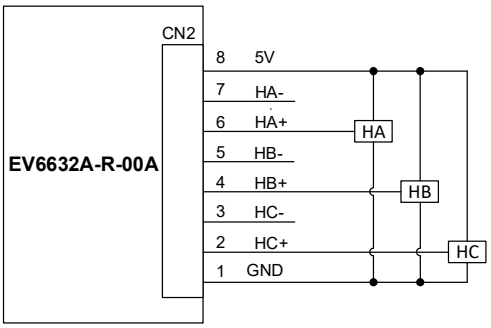


Figure 5: Hall IC Connection

Hall Element Connection

1. Connect CN2 5V to the Hall element's supply terminal.
2. Connect CN2 GND to the Hall element's ground.
3. Connect the CN2 terminals to:
   a. Hall element positive (+) output: HA+, HB+, and HC+
   b. Hall element negative (-) output: HA-, HB-, and HC-
4. Remove the series resistors (R3, R4, R5) between the CN2 PCB's 5V pin and the HA+, HB+, HC+ pins, as well as the resistors (R13, R14, and R15) connected to the CN2 HA-, HB-, and HC- pins (see Figure 10).

Figure 6 and Figure 7 show the series and parallel Hall element connections.

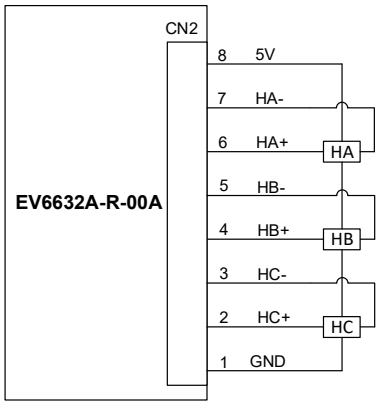


Figure 6: Series Hall Elements Connection

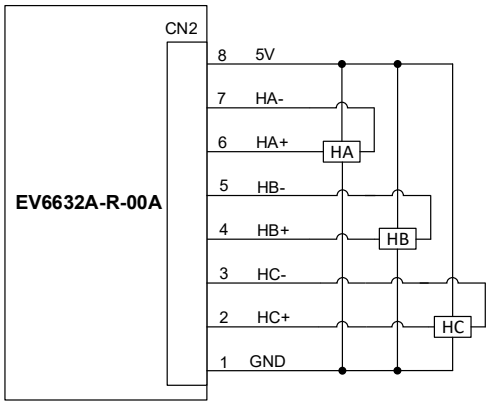


Figure 7: Parallel Hall Elements Connection

GUI Operation Guide

1. Install the MPS BLDC Virtual Bench GUI. (2)
2. Double-click “MPSFan.exe” to start the GUI, then click “Select Chip” (see Figure 8).

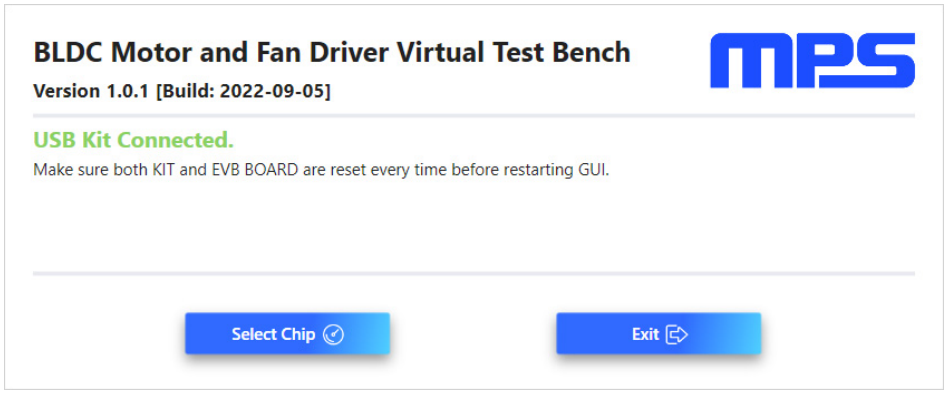


Figure 8: MPS BLDC Virtual Test Bench

3. Click “Details” to enter the test mode interface (see Figure 9).

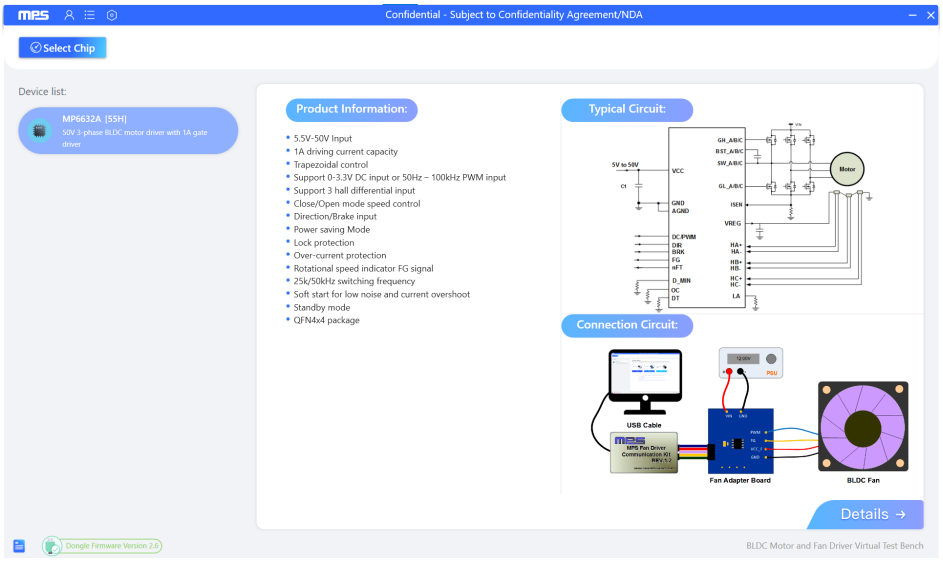


Figure 9: MPS BLDC Virtual Test Bench

Note:

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

EVALUATION BOARD SCHEMATIC

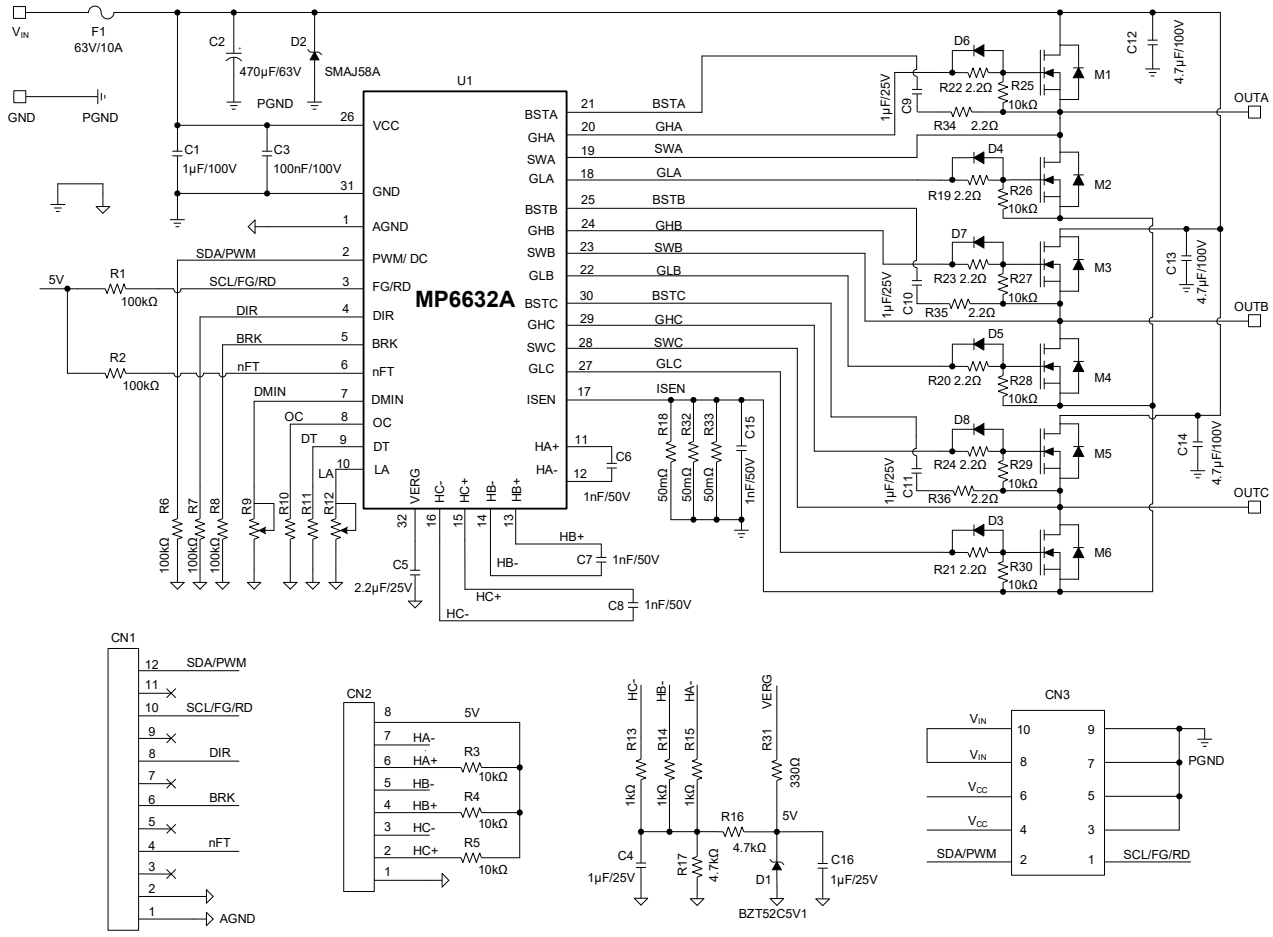


Figure 10: Evaluation Board Schematic

EV6632A-R-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	C1	1μF	Ceramic capacitor, 100V, X7R	0805	Murata	GRM21BC72A105KE01L
1	C2	470μF	Electrolytic capacitor, 63V 470μF	DIP	Jianghai	CD263-63V470
1	C3	100nF	Ceramic capacitor, 100V, X7R	0603	Murata	GRM188R72A104KA35D
5	C4, C9, C10, C11, C16	1μF	Ceramic capacitor, 25V, X7R	0603	Murata	GCM188R71E105KA64D
1	C5	2.2μF	Ceramic capacitor, 25V, X7R	0603	Murata	GRM188C71E225KE11D
4	C6, C7, C8, C15	1nF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM1885C1H102JA01D
3	C12, C13, C14	4.7μF	Ceramic capacitor, 100V, X7R	1206	Murata	GRM31CC72A475KE11L
5	R1, R2, R6, R7, R8	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
3	R3, R4, R5	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
3	R13, R14, R15	1kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-071KL
2	R16, R17	4.7kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-074K7L
3	R18, R32, R33	50mΩ	Resistor, 1%, 1W	2512	Yageo	RL2512FK-070R05L
9	R19, R20, R21, R22, R23, R24, R34, R35, R36	2.2Ω	Resistor, 1%, 0.1W	0603	Yageo	RC0603FR-072R2L
6	R25, R26, R27, R28, R29, R30	10kΩ	Resistor, 1%, 0.1W	0603	Yageo	RC0603FR-0710KL
1	R31	330Ω	Film resistor, 1%	0603	Yageo	RC0603FR-07330RL
1	F1	10A	Fuse, 63V, 10A	1206	Littelfuse	0458010.DR
1	D1	5.1V	Zener diode	SOD-123	Diodes, Inc.	BZT52C5V1-13-F
1	D2	58V	Zener diode	SMA	Diodes, Inc.	SMAJ58A
6	D3, D4, D5, D6, D7, D8	40V	1A diode	SOD-123	Diodes, Inc.	1N4148W
6	M1, M2, M3, M4, M5, M6	100V	N-channel MOSFET, 90A	PG-TDSON-8	Infineon	BSC070N10NS3GATMA1

EV6632A-R-00A BILL OF MATERIALS *(continued)*

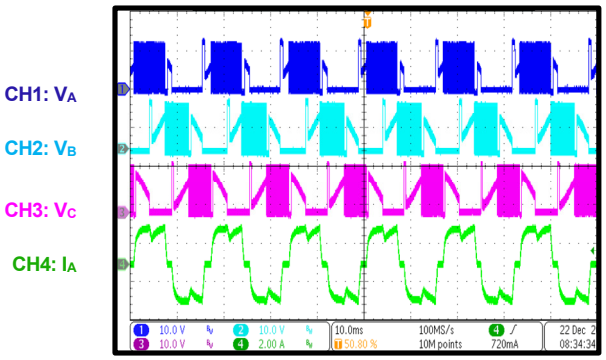
Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	CN1	2.54mm	1-row, 12-pin connector	DIP	Any	
1	CN2	2.54mm	1-row, 8-pin connector	DIP	Any	
1	CN3	2.54mm	5-pin, dual-row header	DIP	Wurth	61201021621
5	VIN, GND, OUTA, OUTB, OUTC	2mm	2mm male needle connector	DIP	Any	
1	U1	MP6632A	50V, three-phase BLDC motor driver with 1A gate driver and 120° modulation	QFN-32 (4mmx 4mm)	MPS	MP6632AGR-0001

EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, PWM frequency = 20kHz, with 3 external Hall sensors, unless otherwise noted.

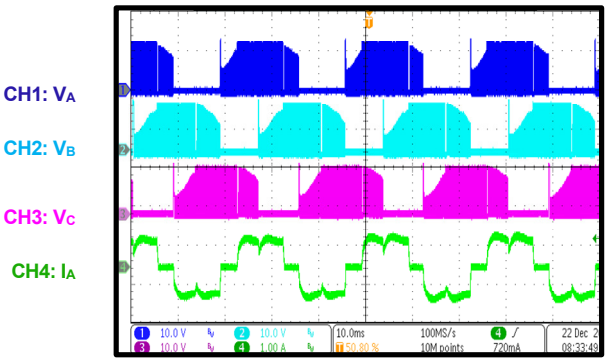
Steady State

PWM duty cycle = 100%, DIR = low, counterclockwise



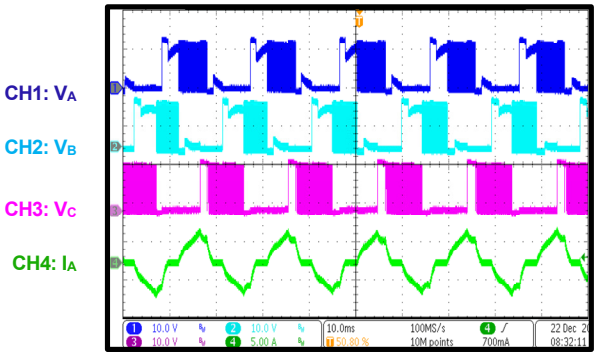
Steady State

PWM duty cycle = 50%, DIR = low, counterclockwise



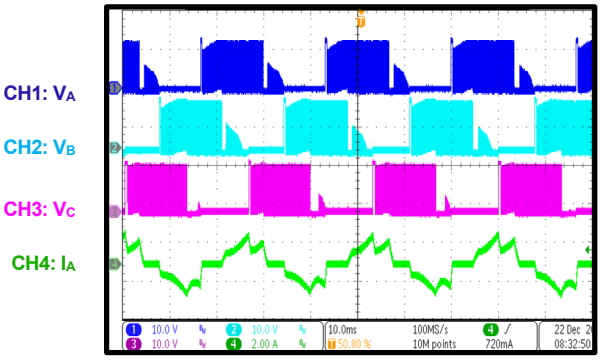
Steady State

PWM duty cycle = 100%, DIR = high, clockwise



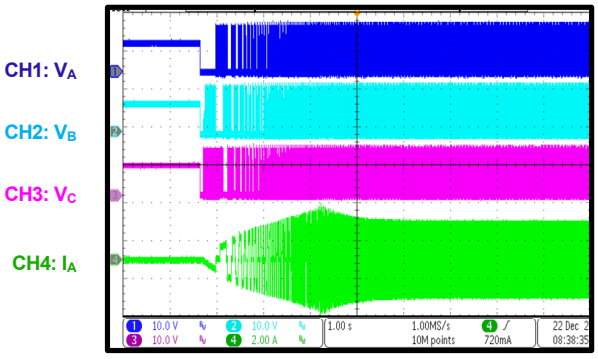
Steady State

PWM duty cycle = 50%, DIR = high, clockwise



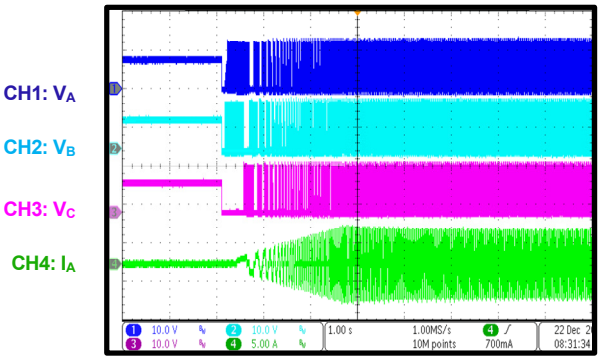
PWM On

PWM duty cycle = 0% to 100%, 3 Hall sensors, DIR = low, counterclockwise



PWM On

PWM duty cycle = 0% to 100%, 3 Hall sensors, DIR = high, clockwise

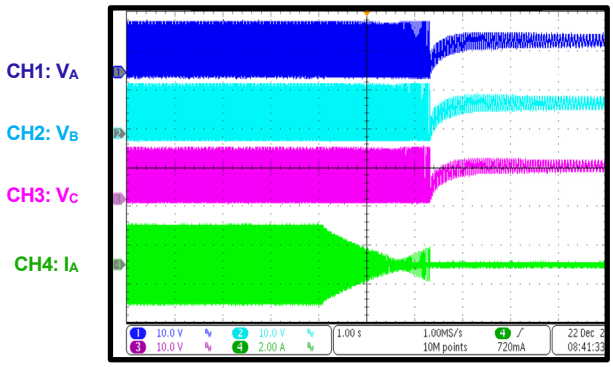


EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, PWM frequency = 20kHz, with 3 external Hall sensors, unless otherwise noted.

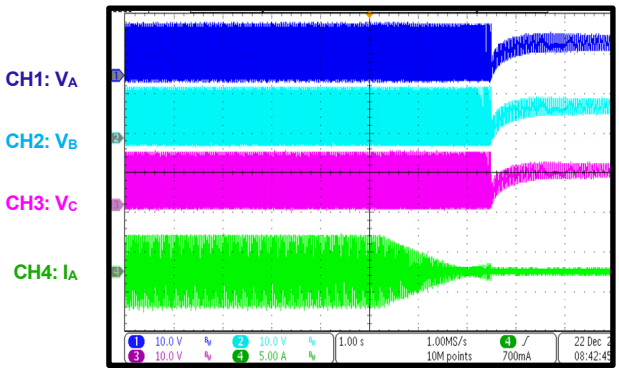
PWM Off

PWM duty cycle = 100% to 0%, 3 Hall sensors, DIR = low, counterclockwise



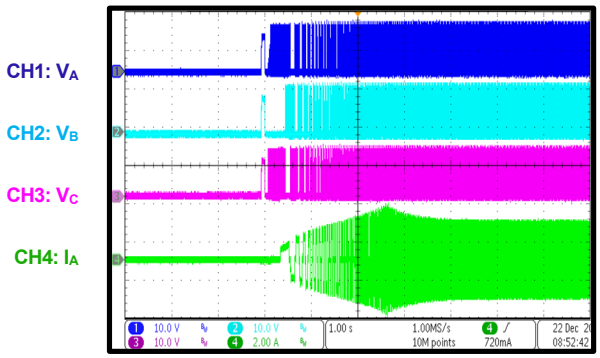
PWM Off

PWM duty cycle = 100% to 0%, 3 Hall sensors, DIR = low, counterclockwise



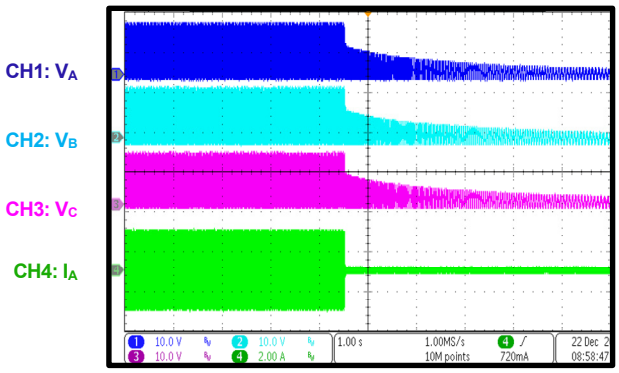
Start-Up through VCC

V_{CC} = 0V to 12V, PWM duty = 100%, 3 Hall sensors, DIR = low, counterclockwise



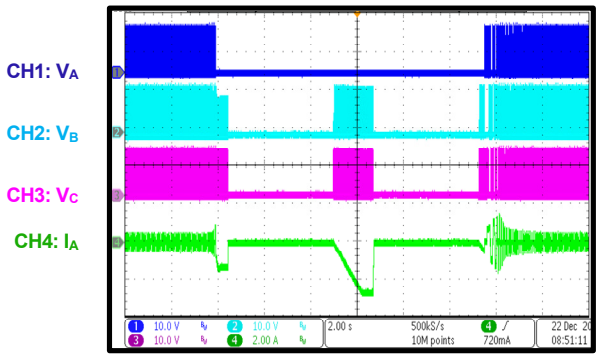
Shutdown through VCC

V_{CC} = 12V to 0V, PWM duty cycle = 100%, DIR = low, counterclockwise



Lock and Retry

PWM duty cycle = 25%, 3 Hall sensors, lock rotor then release



PCB LAYOUT

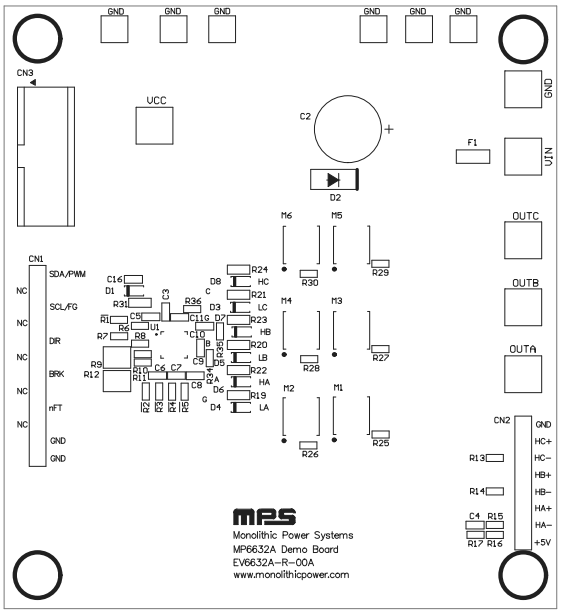


Figure 11: Top Silk

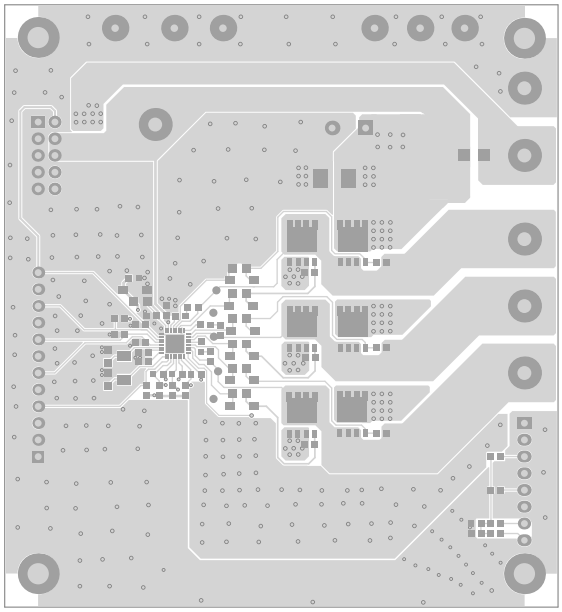


Figure 12: Top Layer

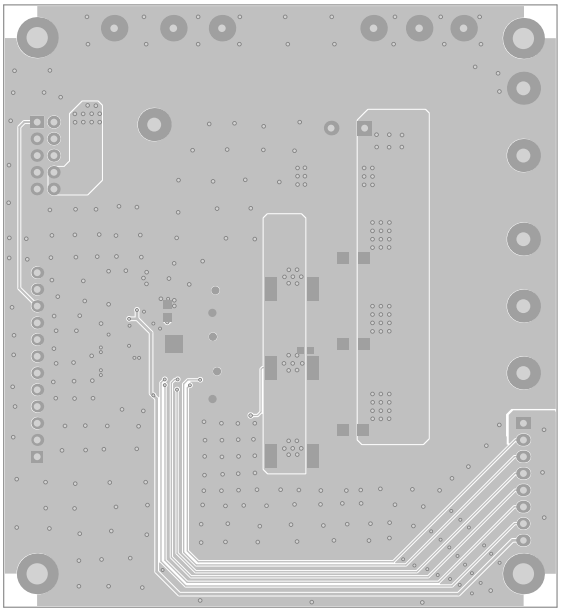


Figure 13: Bottom Layer

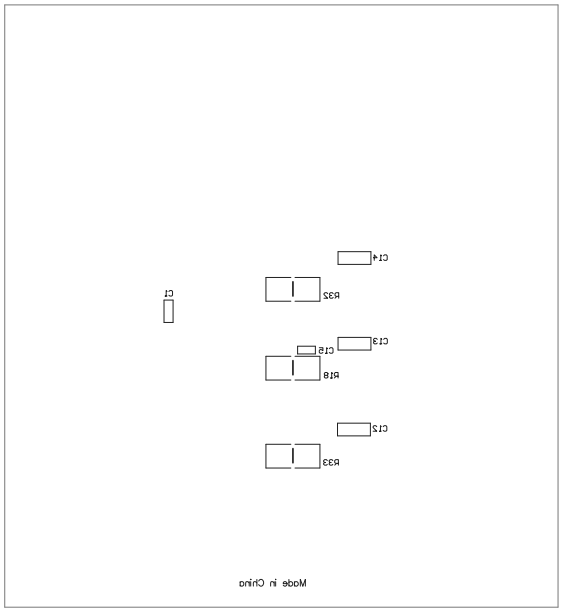


Figure 14: Bottom Silk

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	1/9/2024	Initial Release	-