

User's Guide

DRV8329AEVM User's Guide



ABSTRACT

This document is provided with the [DRV8329 customer evaluation module \(EVM\)](#) as a supplement to the DRV8329 data sheet ([DRV8329 4.5-V to 60-V 1000/2000mA 3-phase gate driver](#)). This User's Guide details the implementation of the EVM and shows how to set up and power the board.

Note

The DRV8329AEVM comes automatically populated with and configured for the DRV8329A. It is also compatible for the DRV8329B variants (see [Section 4.4.1](#)), but the user will need to replace the DRV8329A with the DRV8329B for compatibility.

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1 Cautions and Warnings

Observe the following cautions and warnings as printed on the EVM board.

CAUTION:



Read the User's Guide before use.

HOT SURFACE:



Caution Hot Surface! Contact may cause burns. Do not touch. Please take the proper precautions when operating.

2 Introduction

The DRV8329 is a 4.5-V to 60-V triple half-bridge gate driver IC for motor drive applications. It provides a bootstrap architecture to drive 3 high-side and 3 low-side N-channel MOSFETs with up to 1-A peak source and 2-A peak sink current and can support up to 100% PWM duty cycle inputs with a trickle charge pump. All variants are in compact QFN packages with hardware configurations and provide ultra-low sleep mode current. Additionally, variants offer a variety of optional features including a dead time pin, overcurrent level pin, driver shutoff pin, and integrated LDO capable of driving 3.3 V and 80 mA. A summary of the variants below can be seen in [Table 2-1](#).

Table 2-1. DRV8329 device variant names and descriptions (default of EVM in bold)

Device Name	LDO Output	DRVOFF pin	DT pin and VDSLVL pin	PWM_MODE
DRV8329A	3.3 V	Yes	Available	6x
DRV8329B	3.3 V	Yes	Available	3x

The DRV8329AEVM can be interfaced with the [TMS320F280049C](#) microcontroller on the [LAUNCHXL-F280049C LaunchPad](#) in correspondence with the reference software to provide the algorithm to the DRV8329 to control the BLDC motor.

This document serves as a startup guide to supplement the DRV8329AEVM + LAUNCHXL-F280049C BLDC motor control demo kit. It also is intended to help engineers design, implement, and validate reference hardware and software for the LaunchPad MCU and DRV8329. For step by step details on connecting the LAUNCHXL-F280049C + DRV8329AEVM, refer to [Hardware Setup](#).

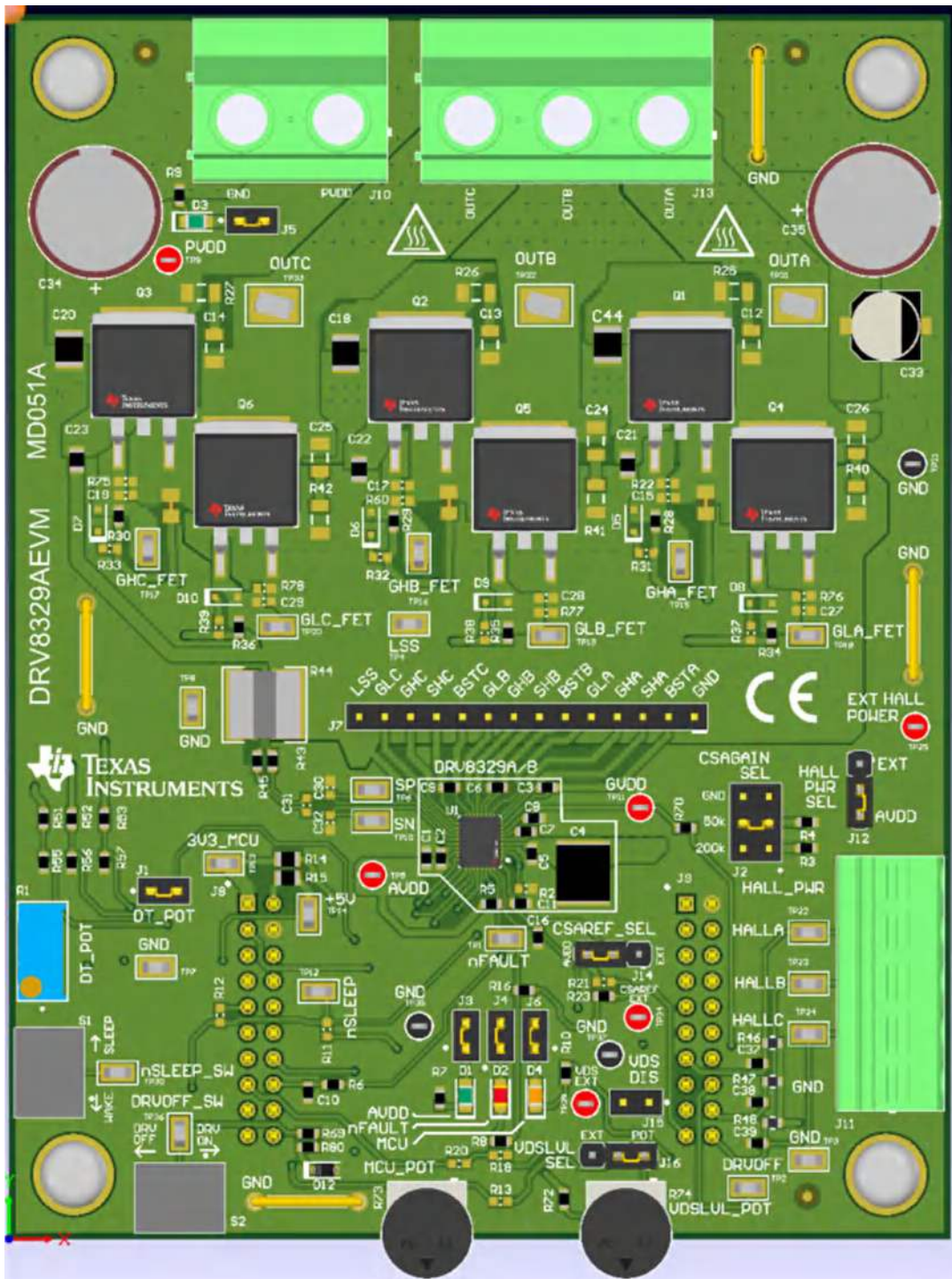


Figure 2-1. DRV8329AEMV PCB Layout

3 Quick Start Guide

The DRV8329AEVM requires a power supply with a recommended operating range from 4.5-V to 60-V. To setup and power the EVM, follow the sequence below:

1. Connect the power supply ground to the GND of the 2-pin power connector J10 and the power supply positive terminal to the PVDD pin of J10. Ensure jumpers JP1, JP2, and JP3 of the LAUNCHXL-F280049C are not populated (DNP) to ensure that the LaunchPad is powered by the DRV8329AEVM and the motor supply is isolated from the USB.
2. Connect the motor phases to OUTA, OUTB, and OUTC in the correct order to connector J13. For sensed applications, connect the Hall sensors to the appropriate locations on the 5-pin connector J11 as shown in [Figure 4-2](#). Select AVDD or EXT on jumper J11 to choose the Hall power source voltage.
3. Mate the DRV8329AEVM onto the top half of the LAUNCHXL-F280049C (LaunchPad Headers J1/J3 and J2/J4) as shown in [Figure 4-3](#). The motor and power connectors should face the same direction as the Micro-USB connector on the LaunchPad.
4. Place nSLEEP switch in WAKE position and DRVOFF in ON position.
5. Power on the DRV8329AEVM.
6. Connect a Micro-USB cable from the computer into the Micro USB connector on the top of the LAUNCHXL-F280049C as shown in [Figure 4-4](#).

4 Hardware and Software Overview

4.1 Hardware Connections Overview – DRV8329AEM + LAUNCHXL-F280049C

Figure 4-1 shows the major hardware blocks of the DRV8329AEM. The DRV8329AEM is designed for an input supply from 4.5-V to 60-V.

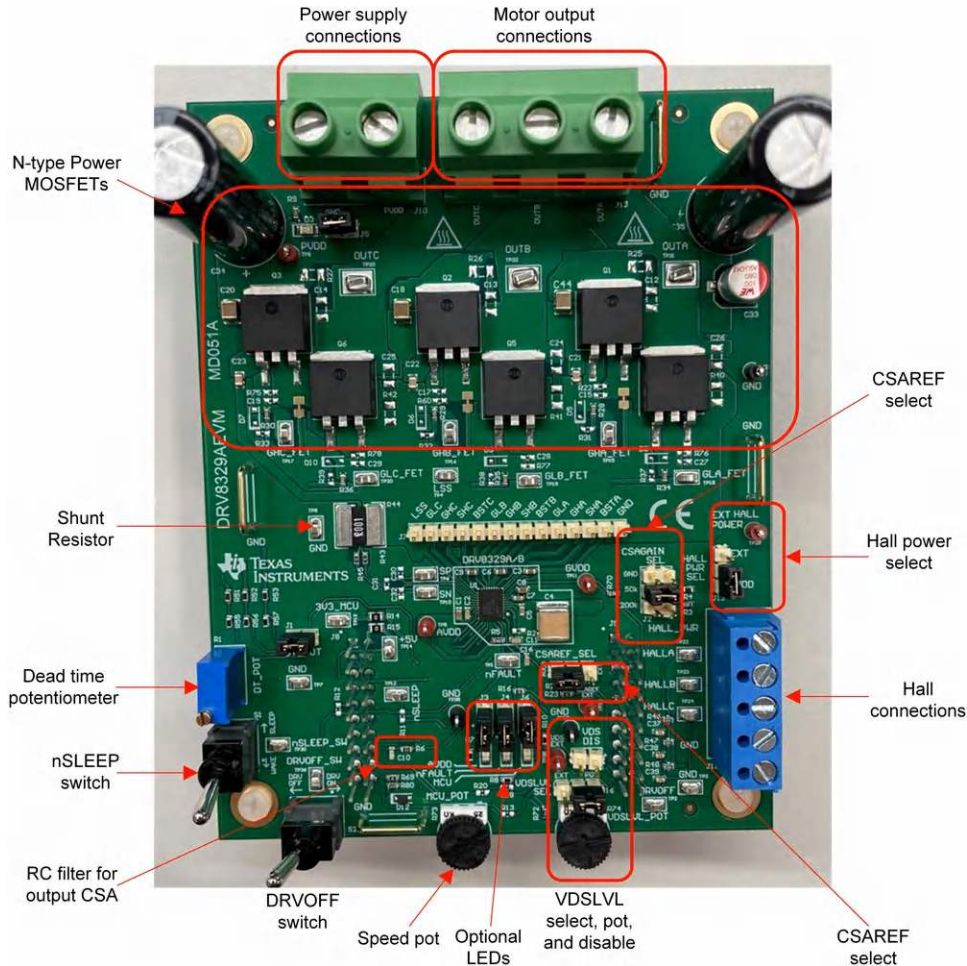


Figure 4-1. Major hardware blocks of the DRV8329AEM

4.2 Connection Details

Figure 4-2 shows the power supply and motor connections made to the DRV8329AEM in order to spin a 3-phase sensored or sensorless Brushless-DC motor.

A 4.5-V to 60-V power supply or battery is connected to the PVDD and GND terminals. The three phases of the BLDC motor connect directly to the OUTA, OUTB, and OUTC terminals of the screw terminal J13 provided on the DRV8329AEM.

For sensored applications, to connect the Hall sensor outputs to the Hall connectors on the DRV8329AEM, push down on the respective terminals to open the sockets and insert the Hall sensor wires into connector J11.

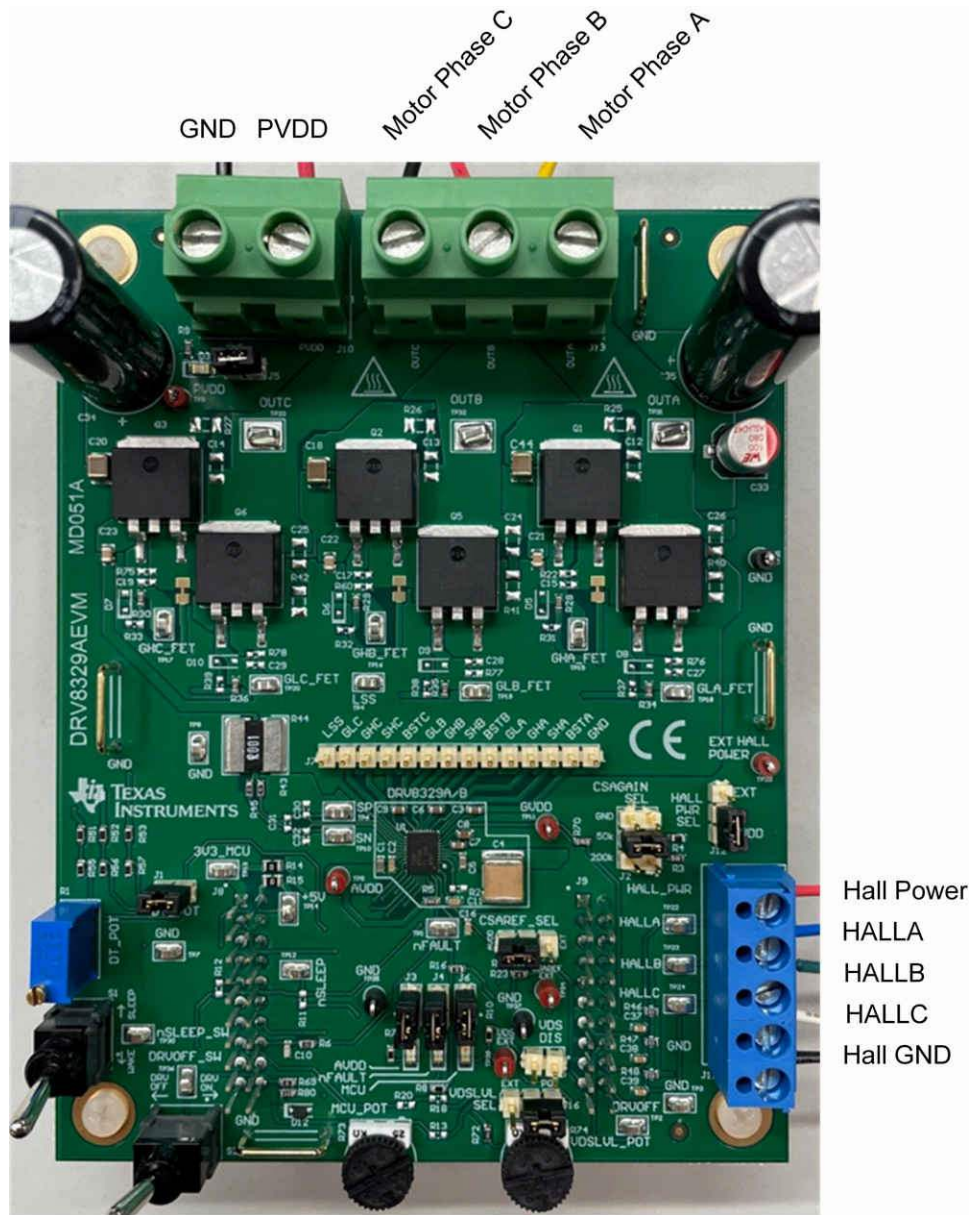


Figure 4-2. Connections from motor to DRV8329AEVM

Figure 4-3 and Figure 4-4 shows where the Micro-USB cable is plugged in to the LAUNCHXL-F280049C to provide communication between the LaunchPad firmware and GUI as well as the correct installation of the DRV8329AEVM to the J1/J3 and J2/J4 headers of the LaunchPad.

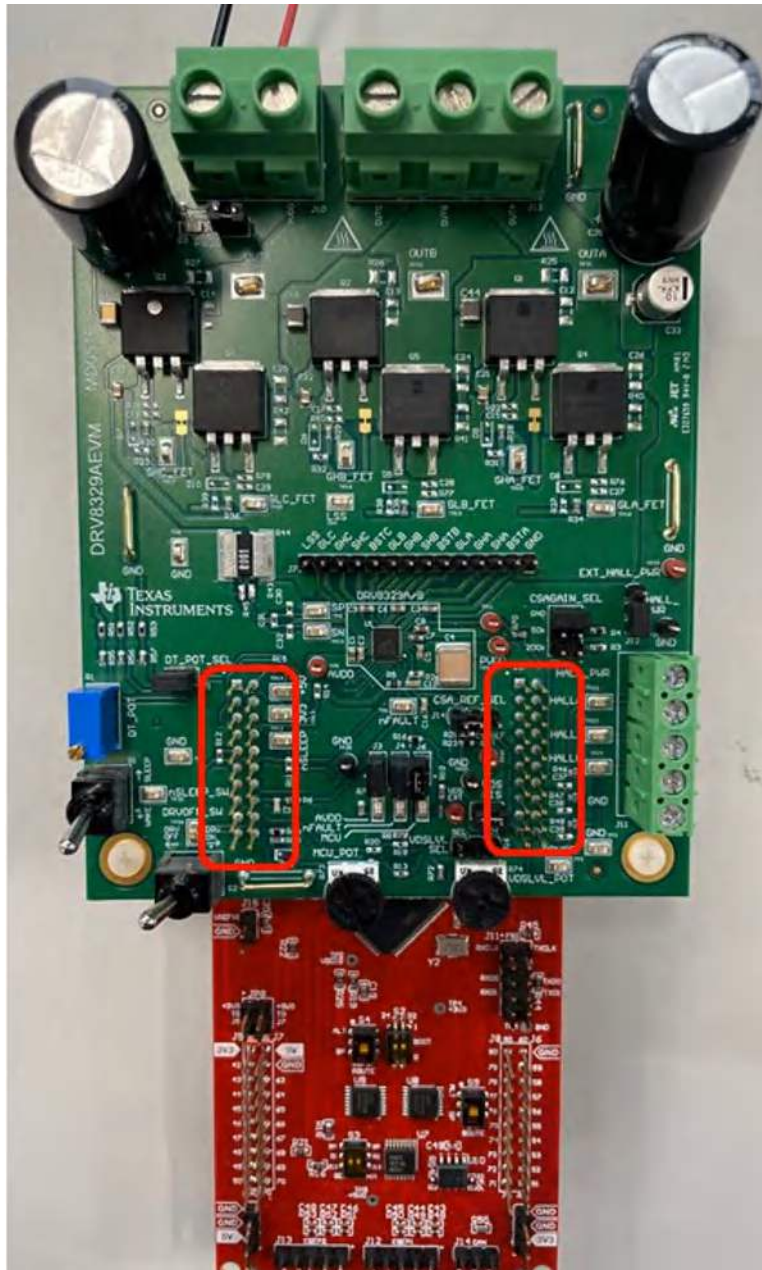


Figure 4-3. DRV8329AEVM on headers J1/J3 and J2/J4 of LaunchPad

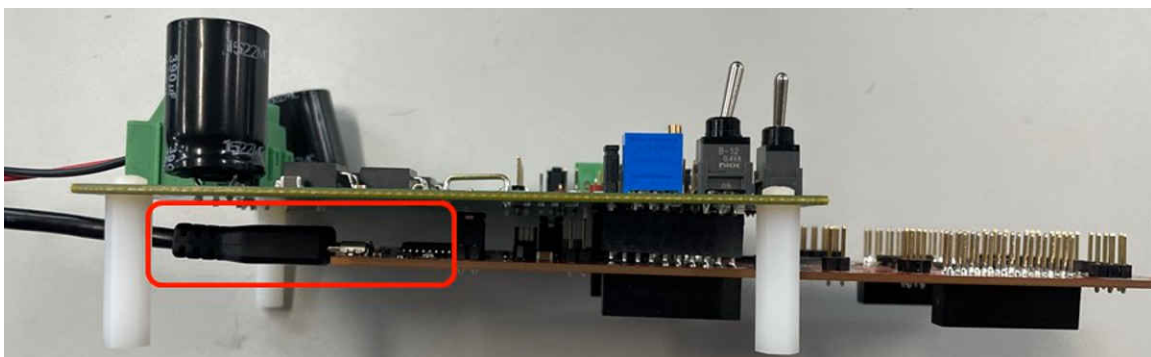


Figure 4-4. Micro-USB plugged into LaunchPad

4.3 LED Lights

There are LED indicators on both the LAUNCHXL-F280049C and DRV8329AEVM when power is provided and the micro USB cable is plugged in to the LaunchPad.

The DRV8329AEVM has 4 status LEDs on the board. By default, the PVDD and AVDD LEDs will light up when the board is powered on. The fault LED will light up when the driver reports a fault, and the MCU LED (tied to GPIO59) can be used for debugging and validation. [Table 4-1](#) shows the LED descriptions, with the LEDs that are on during power up indicated in bold. [Figure 4-5](#) shows the LED locations on the EVM. These LEDs all have removable jumpers to reduce power consumed by the EVM.

Table 4-1. Description of DRV8329AEVM LEDs (on during power up in bold)

Designator	Jumper	Name	Color	Description
D1	J1	AVDD	Green	AVDD is outputting 3.3 V
D2	J2	nFAULT	Red	Lights up when fault condition has occurred on DRV8329
D3	J3	PVDD	Green	Power is supplied to the board
D4	J4	MCU_LED	Orange	MCU debugging

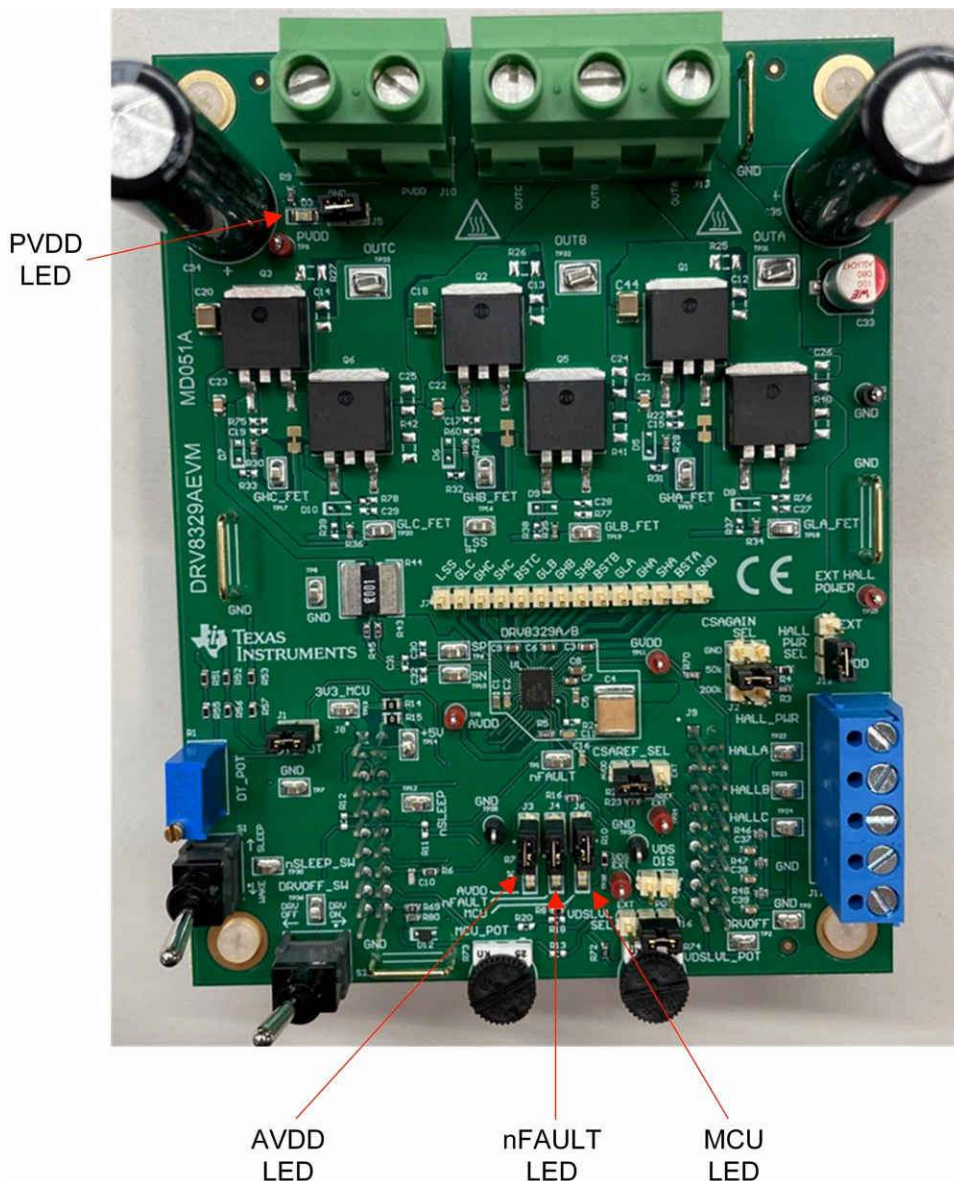


Figure 4-5. DRV8329AEVM LEDs

4.4 DRV8329AEVM Configurability

The DRV8329AEVM includes a variety of user-selectable jumpers and unpopulated components on the PCB to choose user settings and evaluate the DRV8329A, DRV8329B, DRV8329C, or DRV8329D device. A summary of those selectable settings is listed in Table 4-2 (defaults in bold) and can be seen on the board in Figure 4-6.

Table 4-2. User-Selectable Jumpers

Id.	Setting Name	Description	Position	Function
A	nSLEEP switch	Places DRV8329 in sleep mode	S2 = Left	Sleep mode
			S2 = Right	Operating mode
B	Dead time potentiometer, jumper, & resistor	Jumper to enable dead time control from potentiometer and potentiometer used to set the resistance for DT pin.	J1 = Populated	DT from pot is enabled
			J1 = DNP	DT from pot is disabled
			R1 (CW = more DT, CCW = less DT)	Sets dead time of gate driver outputs
			R2	Fixed resistor for DT pin

Table 4-2. User-Selectable Jumpers (continued)

Id.	Setting Name	Description	Position	Function
C	CSA input filter	Input filter to filter any Vsense switching transients at the current sense amplifier inputs.	R45 = R43 = 0 ohm C30, C31, C32 = DNP	CSA input filtering
D	Power stage MOSFETs and passive components	Optional passive components for tuning power stage, i.e. series gate resistors, RC snubbers, PVDD-GND capacitors, PVDD-LSS capacitors	R28, R29, R30, R34, R35, R36 = 10 ohm	Series gate resistors (GHA, GHB, GHC, GLA, GLB, GLC)
			R25/C12, R26/C13, R27/C14, R40/C26, R41/C24, R42/C25 = DNP	RC snubbers (HS FET A, HS FET B, HS FET C, LS FET A, LS FET B, LS FET C)
			C18, C20, C44 = 2.2uF	PVDD-VDRAIN bypass capacitor
			C21, C22, C23 = 0.01uF	PVDD-LSS bypass capacitors
G	CSA gain select	Selects the gain setting of the integrated CSA in V/V.	J2 = GND	CSAGAIN = 5 V/V
			J2 = 50 k	CSAGAIN = 10 V/V
			J2 = 200 k	CSAGAIN = 20 V/V
			J2 = DNP	CSAGAIN = 40 V/V
H	HALL_PWR select	Use J6 to supply Hall power from AVDD or external hall power.	J11 = AVDD	Supplies AVDD to Hall power
			J11 = EXT	Supply external hall power from EXT HALL POWER test point.
J	VDSLVL potentiometer, select and disable jumpers	Potentiometer to set VDSLVL between 0.1–2.5 V, VDSLVL_SEL to select voltage source, disable jumper to disable VDSLVL	J16 = POT	VDSLVL set from potentiometer
			J16 = EXT	VDSLVL set from VDS EXT test point
			J15 = Populated	VDSLVL is disabled (100 kΩ to GVDD)
			J15 = DNP	VDSLVL is enabled
			R74 (CCW = higher VDSLVL, CW = lower VDSLVL)	Sets VDSLVL from 0.1 V–2.5 V
K	CSAREF select	Jumper to select CSA reference voltage from AVDD or an external reference source.	J14 = AVDD	CSAREF = AVDD
			J14 = EXT	CSAREF = CSAREF EXT test point
L	Speed pot	Sets speed of the motor when potentiometer is enabled in the GUI.	R73 (CW = less speed, CCW = more speed)	Sets duty cycle from 0% to 100%.
M	External CSA output filter	RC output filter to suppress high frequency transients of CSA output from current shunt.	R59 = 330 ohms, C31 = 470 pF	Fc ~10 MHz
N	DRVOFF switch	Turns off the gate driver outputs.	S2 = Down	Drivers are on
			S2 = Up	Drivers are off (DRVOFF is enabled)

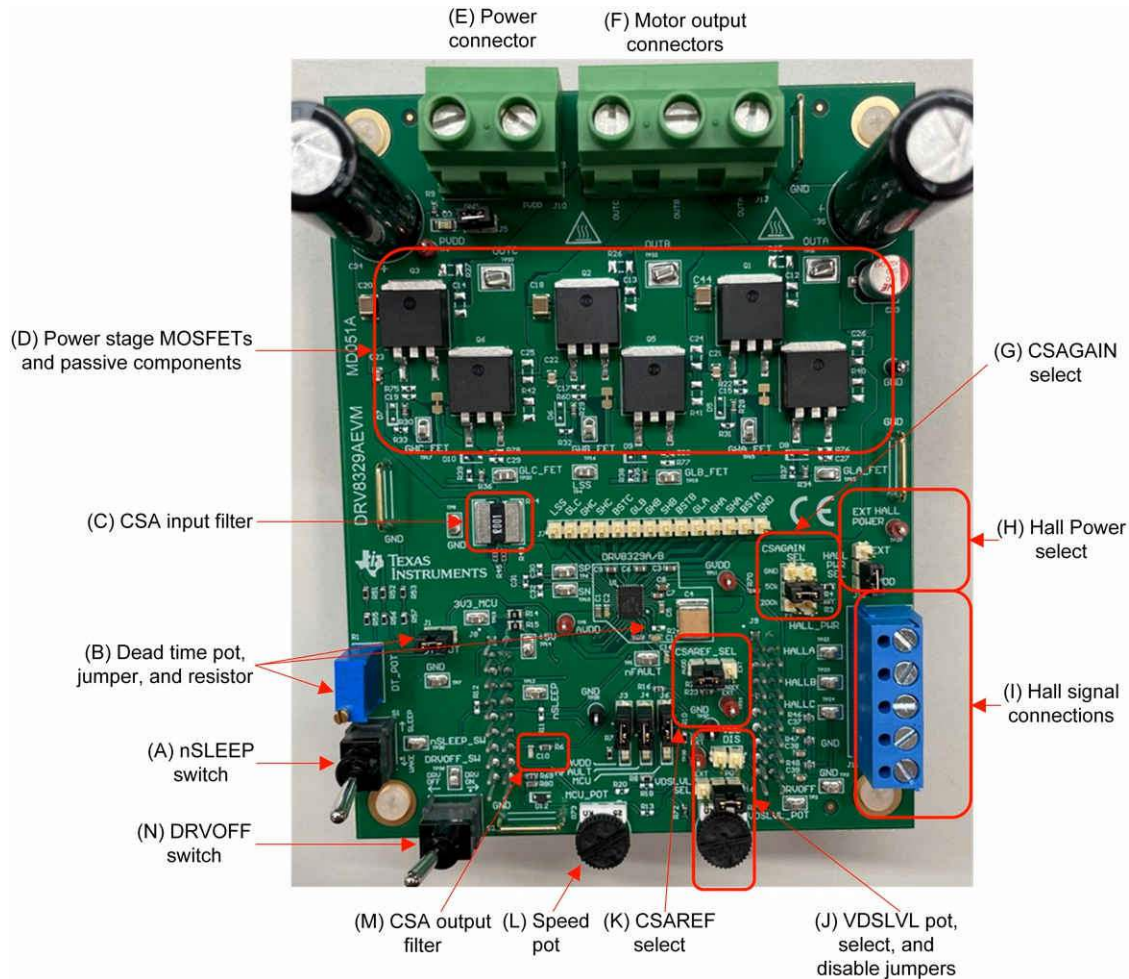


Figure 4-6. User-adjustable jumpers, resistors, and switches on DRV8329AEMV

4.4.1 DRV8329A/B Compatibility

The DRV8329AEMV default is the DRV8329A (Hardware variant), but can also be compatible with the DRV8329B. The main difference is that DRV8329A operates in 6x PWM mode and DRV8329B operates in 3x PWM mode. To use the DRV8329B, remove the DRV8329A from the EVM and replace with the DRV8329B. No extra hardware changes are required for 3x PWM operation.

4.5 Interfacing DRV8329AEMV and LAUNCHXL-F280049C LaunchPad

The DRV8329AEMV has 40 pins with different functions. These pins are interfaced with the LAUNCHXL-F280049C LaunchPad development kit and are mapped appropriately to receive the functionalities of the DRV8329 device. These 40 pins are grouped into 4 ports in respect to the LAUNCHXL-F280049C (J1 to J4). [Table 4-3](#) and [Table 4-4](#) list the interfacing of these ports of the DRV8329AEMV headers J3 and J4.

Table 4-3. Connections for Header J1 on DRV8329AEMV (DNP in bold)

J3 Pin Number	DRV8329AEMV Function	LAUNCHXL-F280049C Function	Description
1	AVDD (DNP)	+3.3 V	3.3 V LaunchPad Supply
2	+5 V	+5 V	5 V LaunchPad Supply
3	POT_MCU/NC_49C	PGA1/3/5_GND	Not used
4	GND	GND	GND connection
5	Not used	GPIO13/SCIBRX	Not used
6	VSENA	ADCINA5	Phase A Voltage Sense
7	Not used	GPIO40/SCIBTX	Not used

Table 4-3. Connections for Header J1 on DRV8329AEVM (DNP in bold) (continued)

J3 Pin Number	DRV8329AEVM Function	LAUNCHXL-F280049C Function	Description
8	VSENB	ADCINB0	Phase B Voltage Sense
9	nSLEEP_DFLT	NC	nSLEEP for internal use only.
10	VSENC	ADCINC2	Phase C Voltage Sense
11	CTAP	ADCINB3/DAC	Center tap voltage sense.
12	VSENPVDD	ADCINB1	PVDD Bus Voltage Sense
13	Not used	SPIACLK	Not used
14	NC_MCU/POT_49C	ADCINB2	General Purpose pot for MCU (R90)
15	nFAULT_DFLT	ADCINC4	nFAULT for internal use only.
16	ISENA	ADCINC0	LSS current sense
17	Not used	GPIO37	Not used
18	Not used	ADCINA9	Not used
19	Not used	GPIO35	Not used
20	VDSLVL/C_TAP	ADCINA1/DACB_OUT	VDSLVL from DAC. C_TAP for internal use only.

Table 4-4. Connections for Header J2 on DRV8329AEVM

J4 Pin Number	DRV8329AEVM Function	LAUNCHXL-F280049C Function	Description
1	INHA	GPIO10/PWM6A	PWM used to switch Phase A High-side FET
2	GND	GND	GND connection
3	INLA	GPIO11/PWM6B	PWM used to switch Phase A Low-side FET
4	MCU_LED	SPIASTE	Visual feedback for LaunchPad connection.
5	INHB	GPIO8/PWM5A	PWM used to switch Phase B High-side FET
6	nFAULT_DFLT	NC	nFAULT for internal use only.
7	INLB	GPIO9/PWM5B	PWM used to switch Phase B Low-side FET
8	Not used	NC	Not used
9	INHC	GPIO4/PWM3A	PWM used to switch Phase C High-side FET
10	Not used	XRSn	Not used
11	INLC	GPIO5/PWM3B	PWM used to switch Phase C Low-side FET
12	Not used	SPIASIMO	Not used
13	HALLA	GPIO58	Hall sensor A from motor
14	Not used	SPIASOMI	Not used
15	nSLEEP_49C	GPIO30	nSLEEP signal (active low)
16	DRVOFF	GPIO39	Active-high output to disable gate drivers
17	Not used	GPIO18*/XCLKOUT	Not used

Table 4-4. Connections for Header J2 on DRV8329AEVM (continued)

J4 Pin Number	DRV8329AEVM Function	LAUNCHXL-F280049C Function	Description
18	HALLB	GPIO23/LED4	Hall sensor B from motor
19	nFAULT_49C/CSAREF	GPIO25	nFAULT signal (active low)
20	HALLC	GPIO59	Hall sensor C from motor

Note

There are many resistors that are not populated for internal use only. Ensure the correct resistors are populated so every signal has only one signal path. If multiple signal paths are present, or no signal path is present, the device may not work as intended.

5 Hardware Setup

The hardware required to run the motor control is the LAUNCHXL-F280049C LaunchPad development kit, the DRV8329AEVM, a Micro-USB cable, and a power supply with a DC output from 4.5-V to 60-V. Follow these steps to set up the evaluation module:

1. Ensure all resistors, jumpers, and switches are set up accordingly.
2. Mate the DRV8329AEVM board to the top half of the LAUNCHXL-F280049C LaunchPad development kit (mates to J1/J3 and J2/J4 of LaunchPad, as in [Figure 4-3](#)). Observe the correct orientation when placing DRV8329AEVM to the LAUNCHXL-F280049C. The motor and power connectors should face to the LaunchPad's Micro-USB connector.
3. Connect the three phases from the brushless-DC motor to the 3-pin connector J12 on DRV8329AEVM. Phases OUTA, OUTB, and OUTC are labeled in white silkscreen on the PCB top layer. If using a sensored algorithm on the LaunchPad development kit, connect Hall sensors to the 5-pin connector J10.
4. Connect the DC power supply to header J9. Observe the correct polarity PVDD and GND connections on the DRV8329AEVM connector J9.
5. Connect a Micro-USB cable to the LaunchPad development kit and computer.
6. Turn on the power supply and power up the PCB.

If using the DRV8329AEVM with an external microcontroller, make the connections needed on the male headers on the top of the board or female connectors on the bottom side of the board.

6 Firmware and GUI Application

The DRV8329AEVM can implement sensored, sensorless, or Field-oriented control for commutating a 3-phase Brushless-DC motor. There are two GUIs to support DRV8329A (DRV8329A-EVM-GUI) and DRV8329B (DRV8329B-EVM-GUI) using sensored trapezoidal commutation with Hall sensor feedback. The GUIs allow for basic trapezoidal motor control functions such as acceleration, duty cycle control, PWM switching frequency, MCU dead time insertion, braking, and direction changes. The bus and phase voltage feedback circuits as well as the integrated CSA provide voltage and current feedback from the motor for over-current and motor voltage protection.

The following GUIs are available on the [Gallery](#):

Table 6-1. DRV8329x EVM GUIs available

Variant	GUI
DRV8329A	https://dev.ti.com/gallery/view/BLDC/DRV8329A_EVM_GUI/ver/1.0.0/
DRV8329B	https://dev.ti.com/gallery/view/BLDC/DRV8329B_EVM_GUI/ver/1.0.0/

6.1 Connecting to the DRV8329AEVM-GUI

Follow the instructions in [Section 5](#) and ensure the LAUNCHXL-F280049C is connected to the PC. Turned on the supply to power the DRV8329AEVM and LAUNCHXL-F280049C.

Access the [Gallery](#) and search for "DRV8329" as shown in [Figure 6-1](#). Click on the GUI for the variant.

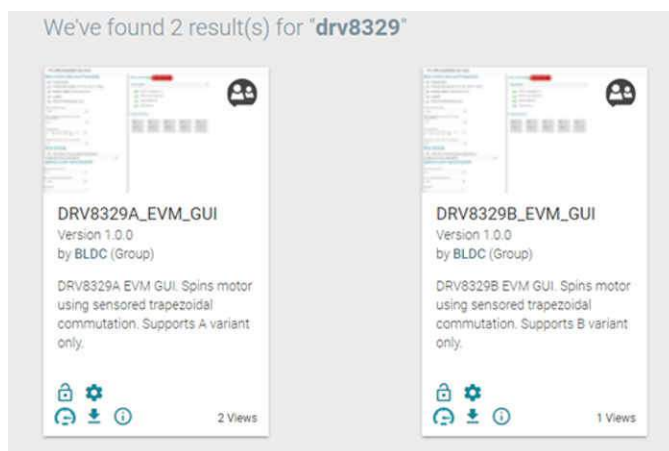


Figure 6-1. DRV8329A_EVM_GUI and DRV8329B_EVM_GUI on the Gallery

Accept the readme that appears. The GUI will detect the LAUNCHXL-F280049C and automatically download the program into the MCU. Once complete, the “Hardware Connected” message appears at the bottom left hand corner as shown in [Figure 6-2](#).

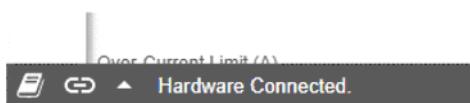


Figure 6-2. Hardware connected message

The following defaults should appear as shown in [Figure 6-3](#) when the GUI is connected:

- **Direction** – Enabled
- **PWM Frequency (Hz)** – 20000
- **MCU Dead Time (ns)** – 0
- **Acceleration Delay (ms/1% duty cycle)** – 50

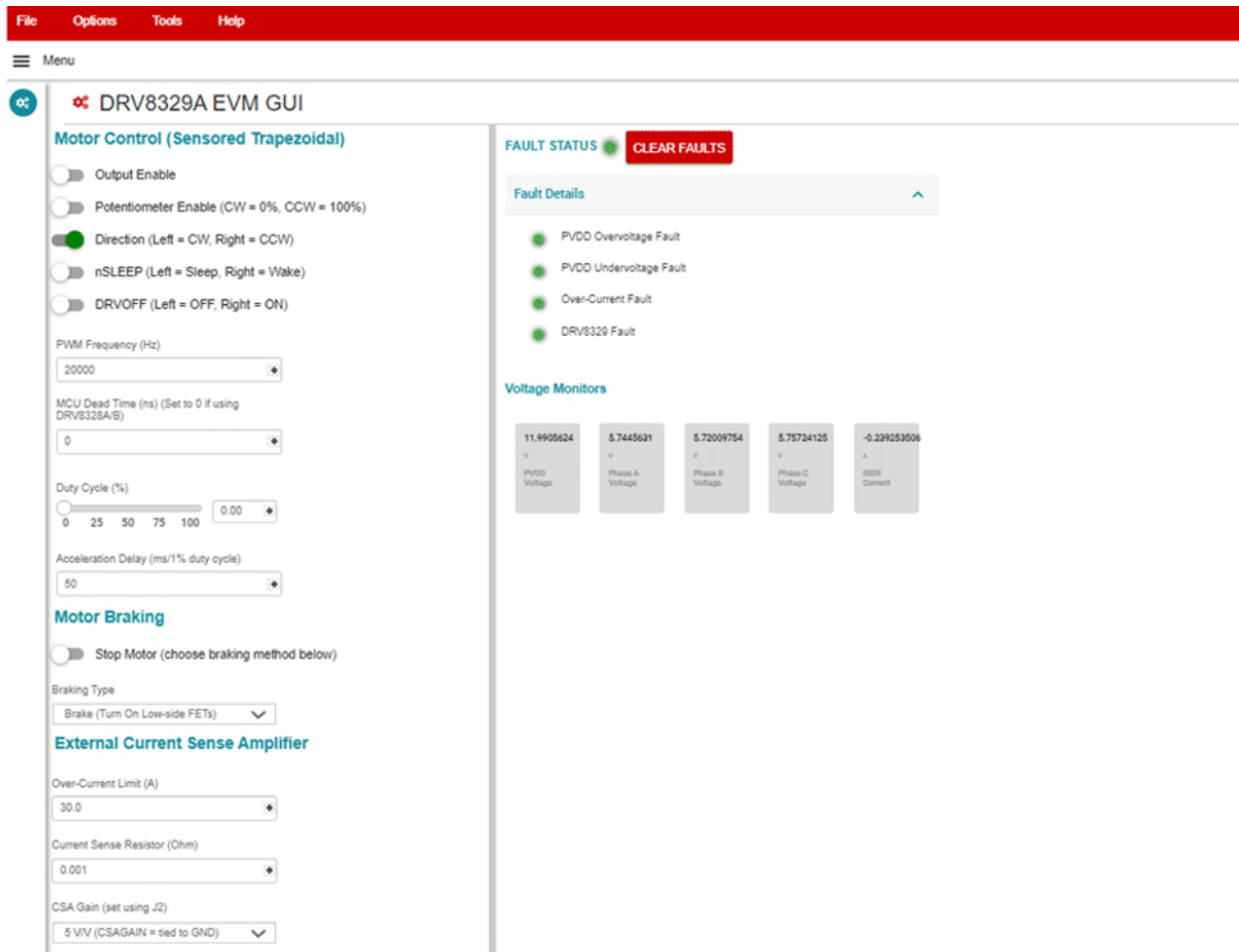


Figure 6-3. DRV8329A_EVM_GUI defaults when connected

6.2 DRV8329x EVM GUI Quick Start Guide

1. Click on the “Output Enable” switch.
2. Enter the PWM frequency in Hz using the “PWM Frequency (Hz)” text box. Press Enter.
3. Adjust the MCU dead time and Acceleration Delay values. You may also use the DT potentiometer to insert dead time from the DRV8329 rather than the MCU by setting the dead time potentiometer resistance, enabling the DT_POT jumper, and setting the MCU dead time to 0 ns.
4. To control the motor speed using the speed potentiometer, turn the potentiometer all the way counterclockwise to set to 0% speed. Click on the “Potentiometer Enable” switch. To not use the potentiometer to control the motor speed, skip this step.
5. Adjust the “Duty Cycle” slider or enter the duty cycle in the number box to control the speed of the motor from 0% to 100%.
6. Use the “Direction” switch to switch the direction of the motor.
7. Use the drop-down menu in “Motor Braking” to determine the motor braking type. Click on “Stop Motor” to stop the method with the selected braking type.
8. If R58 is populated and R11 is not populated, use the nSLEEP switch to put the driver into a low-power sleep mode.
9. If R69 is populated, use the DRVOFF switch to shut off the gate drivers and Hi-Z the gate driver outputs.

6.3 Using the DRV8329x EVM GUI

The GUI offers the following features:

MOTOR CONTROL SETTINGS

- **Output Enable** – Global enable flag to run the motor at the selected duty cycle.

- **Potentiometer Enable** – Enables potentiometer R90 to control the duty cycle of the motor. Duty cycle is updated in the Duty Cycle slider in real time. Turn all the way clockwise for 0% duty cycle, all the way counterclockwise for 100% duty cycle.
- **Direction** – Sets direction of the motor. When enabled, motor spins counterclockwise. When disabled, motor spins clockwise. When the direction is changed, the motor will coast to a stop, wait 1 second, then accelerate to the duty cycle in the opposite direction.
- **nSLEEP** – Places the DRV8329 in a low-power sleep mode. nSLEEP toggle switch only works when resistor R26 is populated and resistor R75 is DNP.
- **DRVOFF** – Disables all gate drivers in Hi-Z state.
- **PWM Frequency** – Sets the PWM switching frequency of the motor in Hz.
- **MCU Dead Time** – Sets the MCU deadband time for the PWM inputs in nanoseconds.
- **Duty Cycle** – Sets the duty cycle of the motor when potentiometer is disabled.
- **Acceleration Delay** – Sets the acceleration and deceleration ramp rate in ms per 1% duty cycle.

MOTOR BRAKING SETTINGS

- **Stop Motor** – Stops the motor when toggled according to the braking method in the drop-down menu. The two methods are brake (turn on all low-side MOSFETs) and coast (float all MOSFETs).

CSA SETTINGS

- **Over-current Limit** – Sets the overcurrent limit in amps. If ISEN is measured to be over the overcurrent limit, Over-Current fault is triggered.
- **Current Sense Resistor** – Sets the resistor value in ohms for the shunt resistor onboard the EVM. Default resistor populated is 0.001 ohm.
- **CSA Gain** – Gain of the integrated CSA on the EVM. Set the CSA gain setting to match the CSAGAIN setting on J2 of the EVM so the firmware can calculate the ISEN current correctly.

FAULT STATUS BITS

- **Fault Status** – Logical “or” of all faults. When a fault occurs, Output Enable is turned off, Duty Cycle is set to 0%, and the corresponding fault status LED is lit.
- **PVDD Overvoltage Fault** – PVDD is over 60 V. Configurable through firmware.
- **PVDD Undervoltage Fault** – PVDD is under 4.5 V. Configurable through firmware.
- **Over-Current** – Measured LSS current is over the Over-Current threshold.
- **DRV8329 Fault** – Fault indicated by the DRV8329. See DRV8329 datasheet.

7 Schematics

7.1 DRV8329A/B

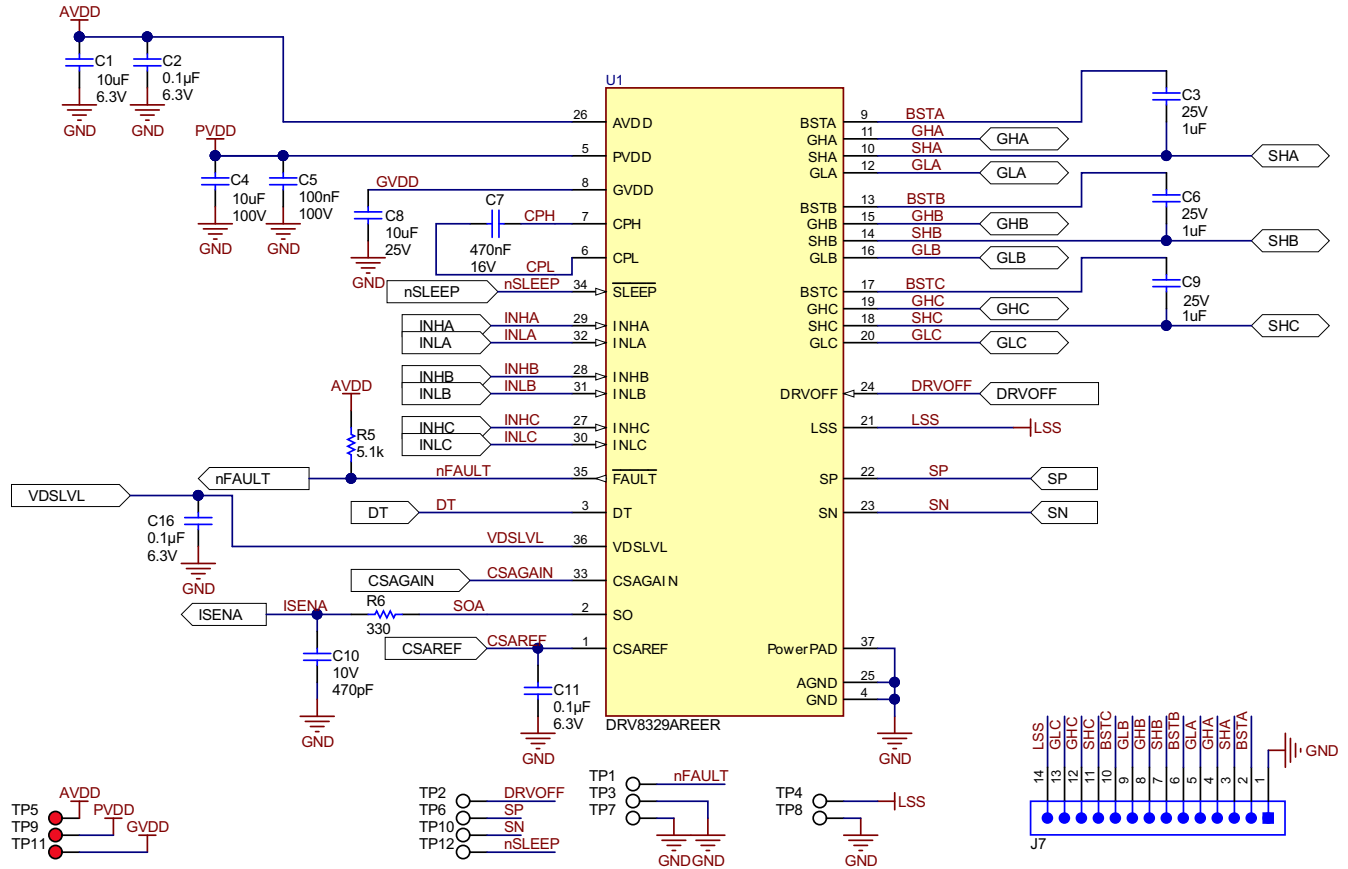


Figure 7-1. DRV8329A/B schematic

7.2 Status LEDs

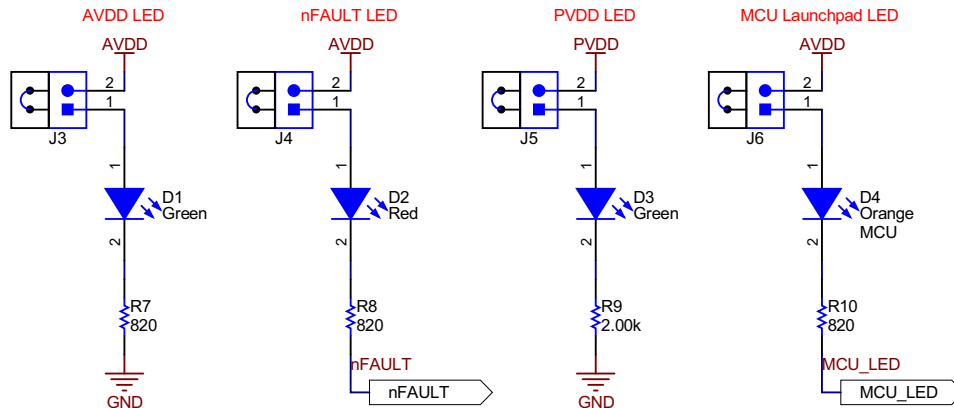


Figure 7-2. Status LEDs schematic

7.3 LaunchPad Connectors and Connections

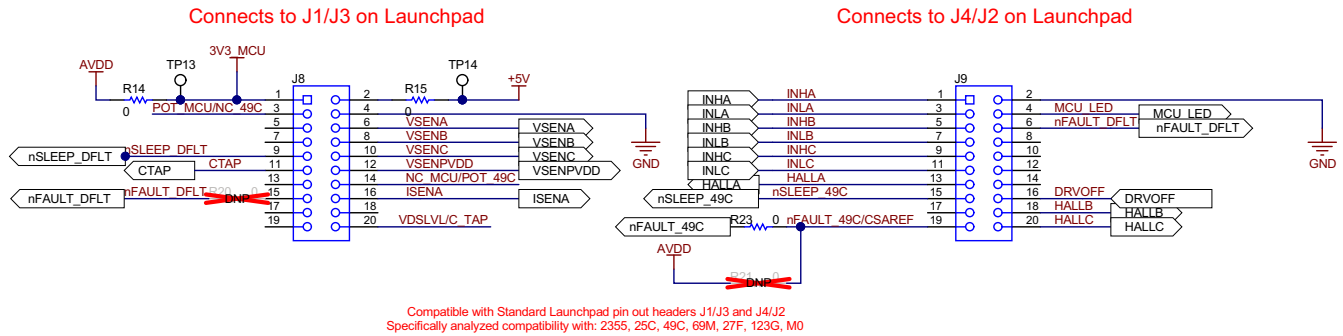


Figure 7-3. LaunchPad connectors schematic

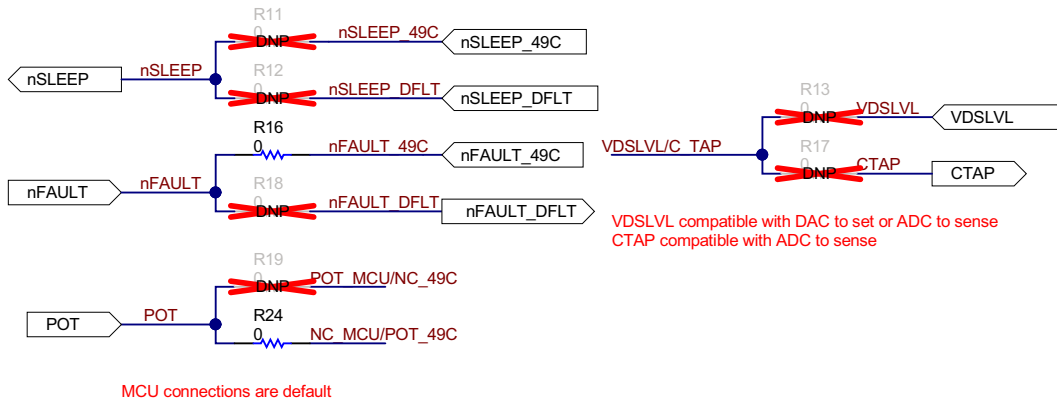


Figure 7-4. LaunchPad connections schematic

7.4 Power Stage and MOSFETs

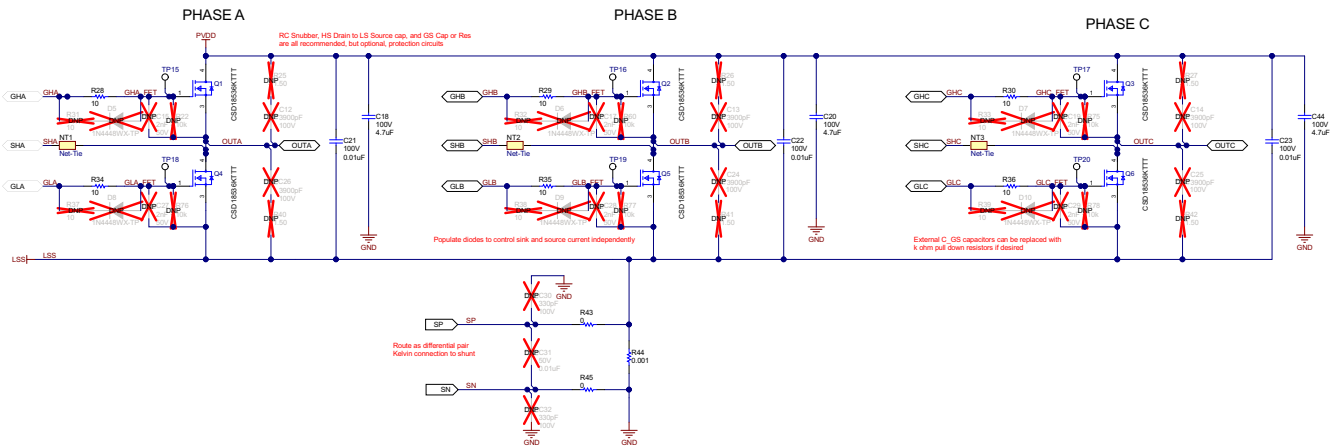


Figure 7-5. Powerstage and MOSFETs schematic

7.5 Main Supply Input

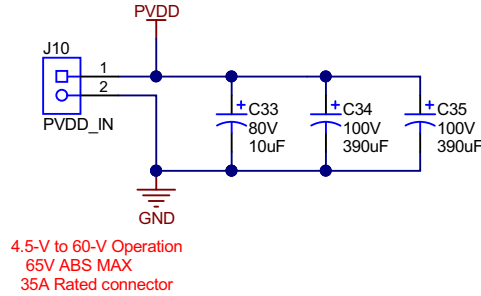


Figure 7-6. Main supply input schematic

7.6 Hall Sensor and Hall Power selection

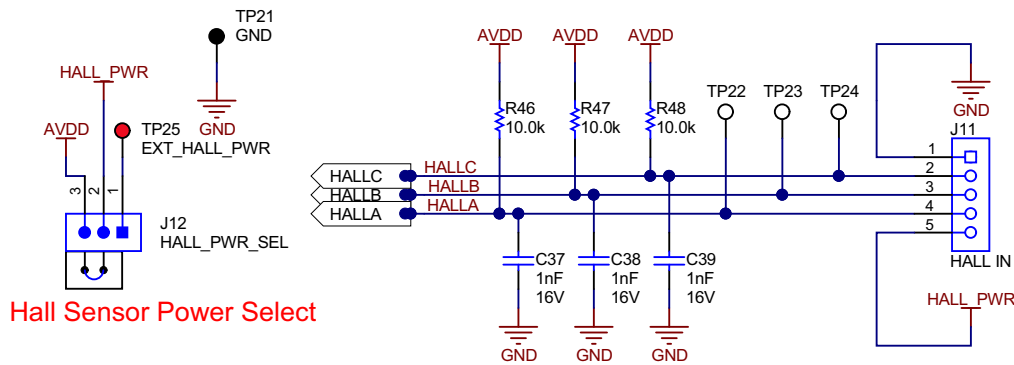


Figure 7-7. Hall Sensor and Hall Power selection schematic

7.7 Connectors, Selectors, and Analog Control Interface

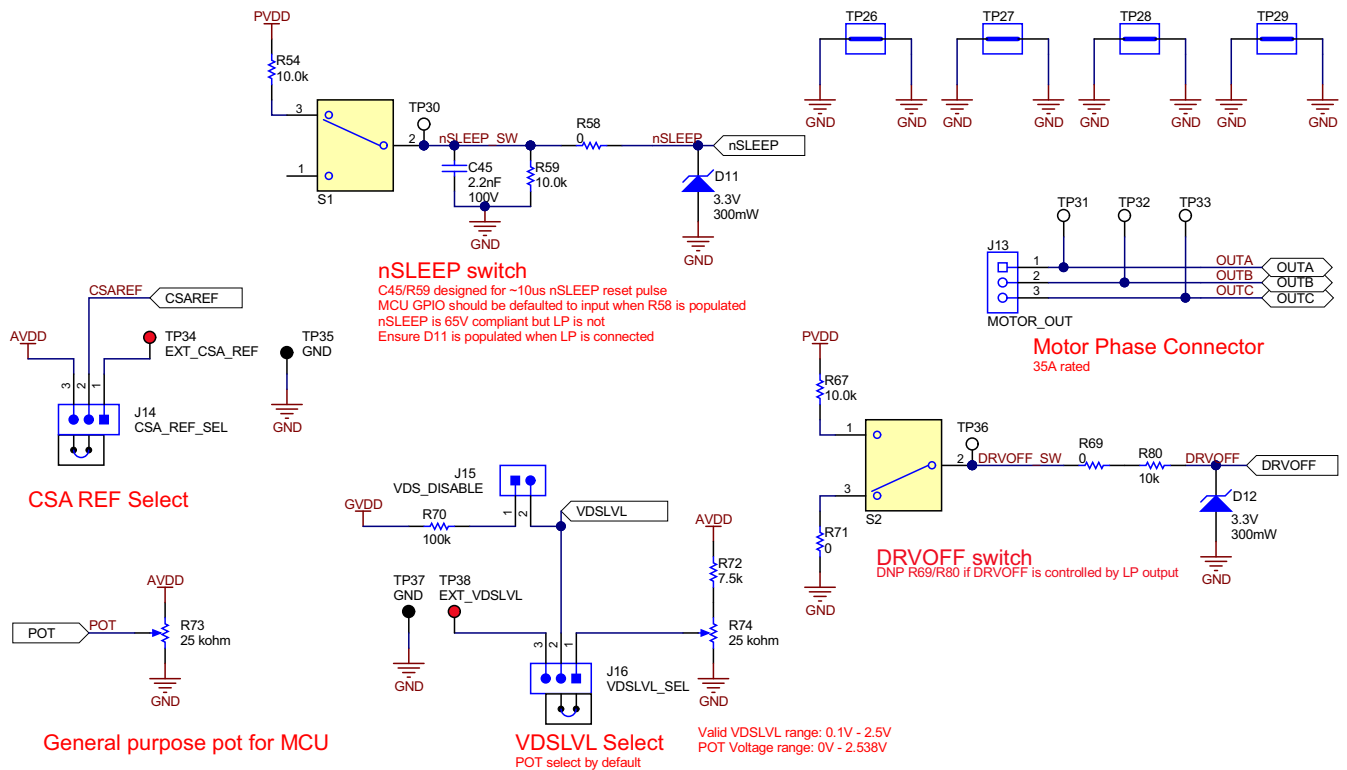


Figure 7-8. Connectors, Selectors, and Analog Control Interface schematic

7.8 Dead Time and CSA Gain Selection

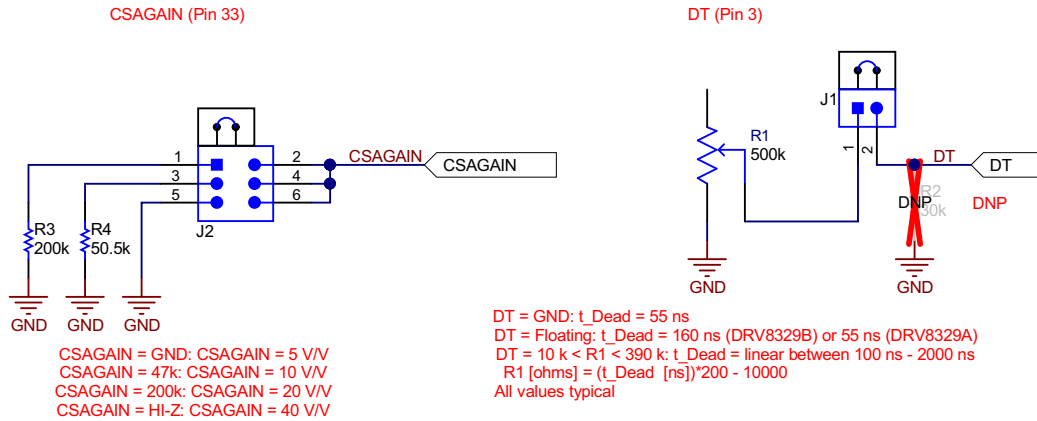


Figure 7-9. Dead time and CSA gain selection schematic

7.9 Voltage Sense and Protection

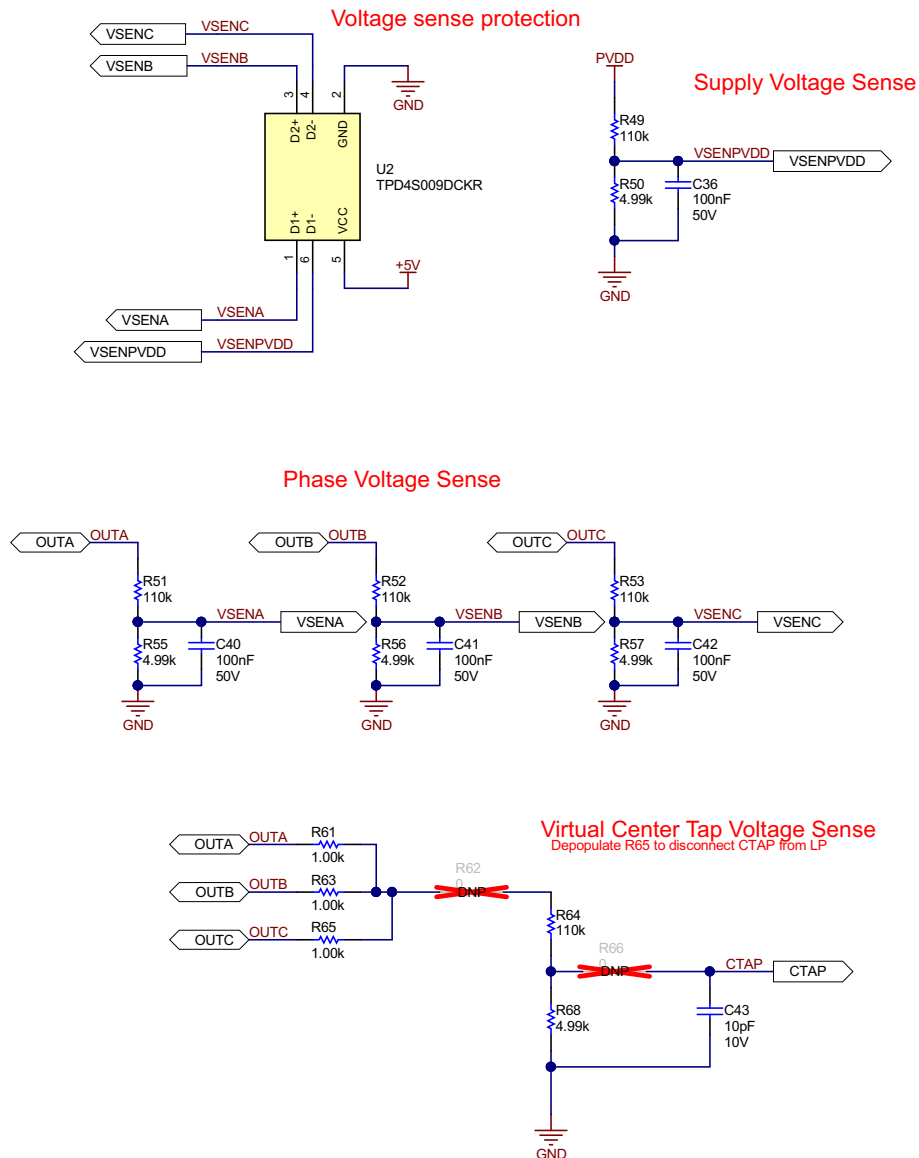


Figure 7-10. Voltage Sense and Protection schematic

8 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision * (March 2022) to Revision A (August 2022)	Page
• Updated images to production version of DRV8329AEVM.....	3

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NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 Regulatory Notices:

3.1 United States

3.1.1 Notice applicable to EVMs not FCC-Approved:

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

-
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 - 4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.
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