EVM User's Guide: DRV81008-Q1EVM, DRV81602-Q1EVM, DRV81242-Q1EVM, DRV81080-Q1EVM, DRV81004-Q1EVM, DRV81620-Q1EVM

DRV81xxx-Q1 Evaluation Module

TEXAS INSTRUMENTS

Description

The DRV81xxx-Q1 evaluation module allows for easy evaluation of the DRV81xxx-Q1 family of devices. The EVM has been programmed and configured to work out of the box and begin driving loads right away. DRV81xxx-Q1 family of devices have multiple devices low-side and high-side switch with integrated protection and diagnostics.

Get Started

1. Order the EVM from the tools page on ti.com.
2. Use the web based GUI: https://dev.ti.com/gallery/view/MotorDriversBSM/DRV81xxx/ver/0.2.1/
3. Connect the EVM with USB cable provided and external power supply.
4. Launch the GUI and select the appropriate device variant on the home page.

Features

- Main signal header with removable shunts to disconnect main signals going to DRV81xxx-Q1 device from MCU
- GUI software to control the EVM and DRV

Applications

- Automotive body control module
- HVAC control
- Automotive lighting
- HEV-EV battery management system
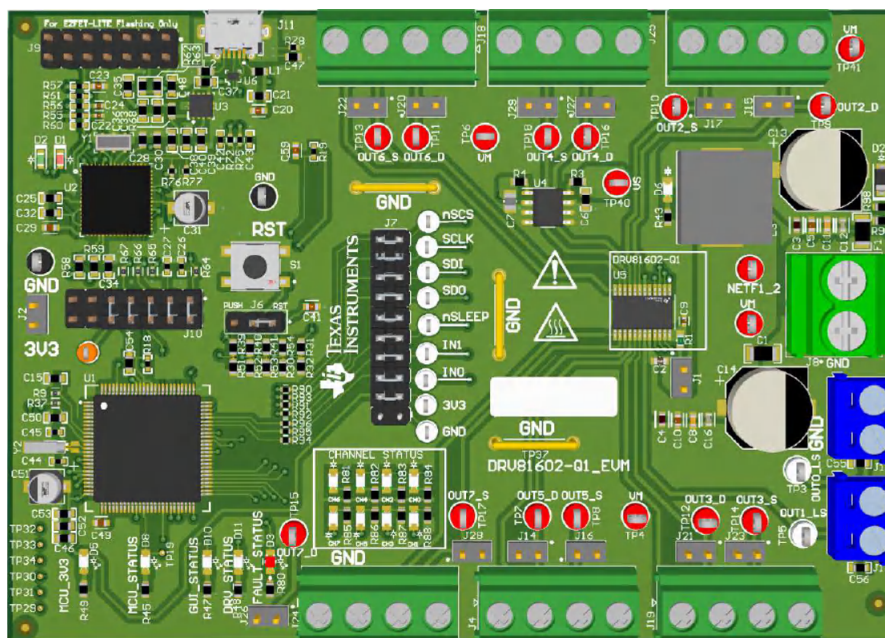
DRV81602-Q1 EVM

1 Evaluation Module Overview

1.1 Introduction

The DRV81xxx-Q1 devices has low-side and high-side drivers with integrated protection and diagnostics to control relays, LEDs, lamps and motors in automotive and industrial applications. This document is designed to be used as a start-up guide and to supplement the DRV81xxx-Q1 evaluation modules. This user's guide covers EVM hardware setup instructions, GUI installation and usgae instructions.

1.2 Kit Contents

The contents of the EVM kit is mentioned in Table 1-1.

Table 1-1. Kit Contents

Item	Quantity
DRV81xxx-Q1	1
3ft White USB-A to Micro-USB Cable	1

1.3 Specification

The DRV81xxx-Q1 EVM connects to a local computer USB port through a USB-A to Micro-USB cable. A 3.3V LDO generates a 3.3V rail on the EVM from the USB 5V supply which powers the microcontroller. The J8 terminal can be used to provide the supply voltage (VM) of the device. Another 3.3V LDO powered from Vm generates the VDD required by the device in the EVM. Certain EVMs require jumper configurations to connect the device to the corresponding power rail. Be sure to verify jumper configurations before operation.

1.4 Device Information

DRV81xxx-Q1 family of devices has low-side and high-side drivers. The table shows the number of low-side, high-side and configurable channels in the DRV81xxx-Q1 family of devices.
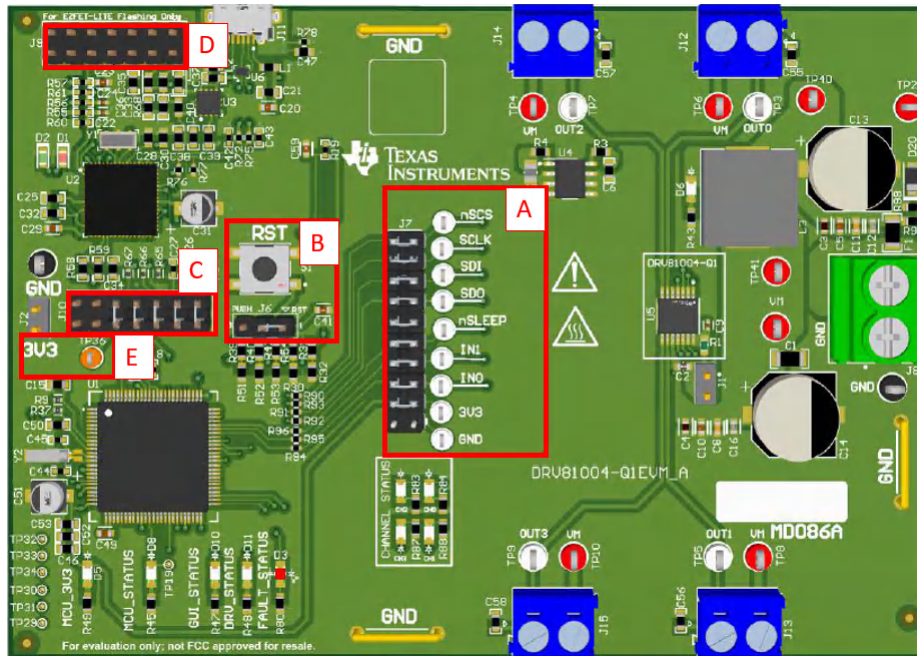
Table 1-2. DRV81xxx-Q1 Device Configuration

Device	Number of Low Side Channels	Number of High Side Channels	Number of Configurable Channels
DRV81004-Q1	4	0	0
DRV81008-Q1	8	0	0
DRV81602-Q1	2	0	6
DRV81242-Q1	2	4	2
DRV81620-Q1	0	2	6
DRV81080-Q1	0	8	0

2 Hardware

2.1 Header Information

This section describes the headers and test points for each variant of the DRV81xxx-Q1 family of devices.

Figure 2-1. DRV81004-Q1EVM Headers and Test Point Information

Component Label	Description
A	Main signal header: • nSCS: Serial chip select. • SCLK: Serial clock input. • SDI: Serial data in. • SDO: Serial data out. • nSLEEP: Sleep mode input. • IN1: Control input IN1. • IN0: Control input IN0. • 3V3: 3.3V from LDO. • GND: GND test point.
B	Reset/PUSH button can have two functions based on the location of the SHUNT in J6 (below RST button): • RST (SHUNT in position 1): pressing the button resets the MCU. • PUSH (SHUNT in position 3): pressing the button does a suser defined action. Currently not implemented in firmware.
C	JTAG connector between MSP430F5338 and MSP430F5528.
D	Connector for programming MSP430F5528 used in the eZ-FET lite debugger circuit. Only used one time by PCB manufacturer to programmed eZ-FET lite debugger MCU.
E	3V3 LDO connector.

Note

All of the DRV81xxx-Q1EVMs have the same layout structure for A, B, C, D, and E as seen above.

2.2 Connector and Jumper Information

The DRV81xxx-Q1 family of devices is designed to drive low-side, and high-side loads. The following section explains how each EVM must be configured to drive the desired load.

Figure 2-2. DRV81004-Q1 Jumper Configuration

J1: Connects 3.3V to VDD.

The DRV81004-Q1 has four low-side switch outputs. Loads must be connected across blue output terminals OUT0-OUT3 accordingly.

Figure 2-3. DRV81008-Q1 Jumper Configuration

The DRV81008-Q1 has eight low-side switch outputs. Loads must be connected across blue output terminals OUT0-OUT7 accordingly.
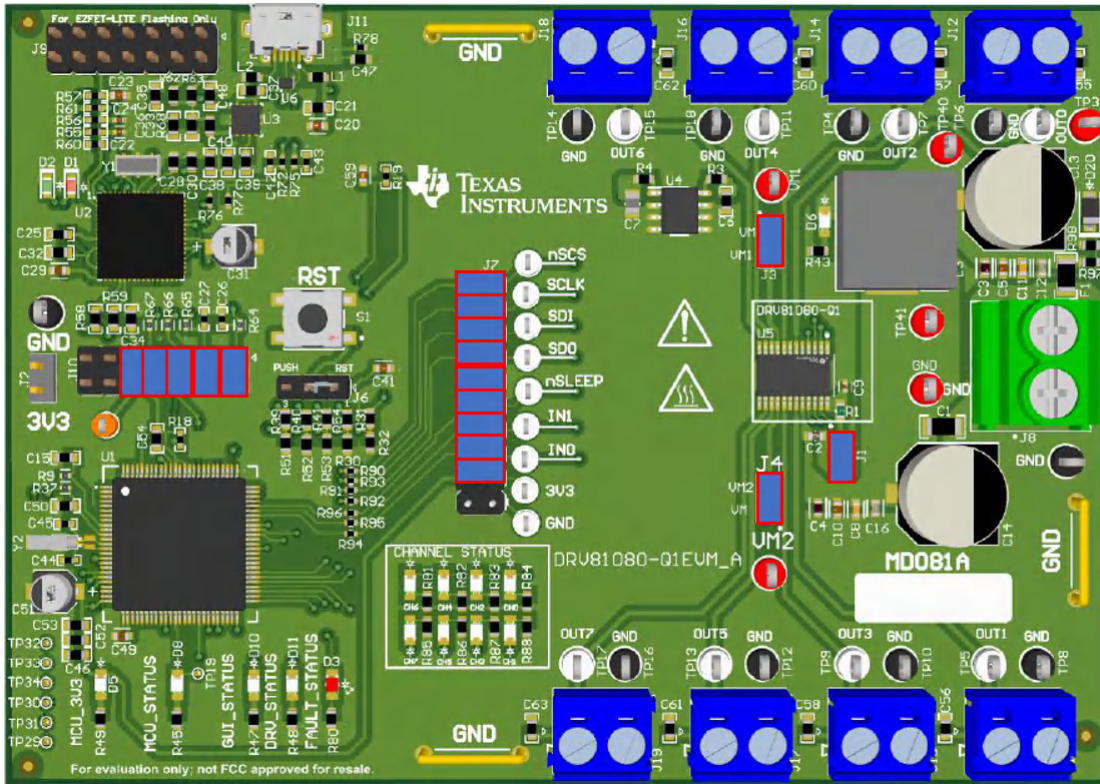

Figure 2-4. DRV81080-Q1 Jumper Configuration

The DRV81080-Q1 has eight high-side switch outputs. Loads must be connected across blue output terminals OUT0-OUT7 accordingly.
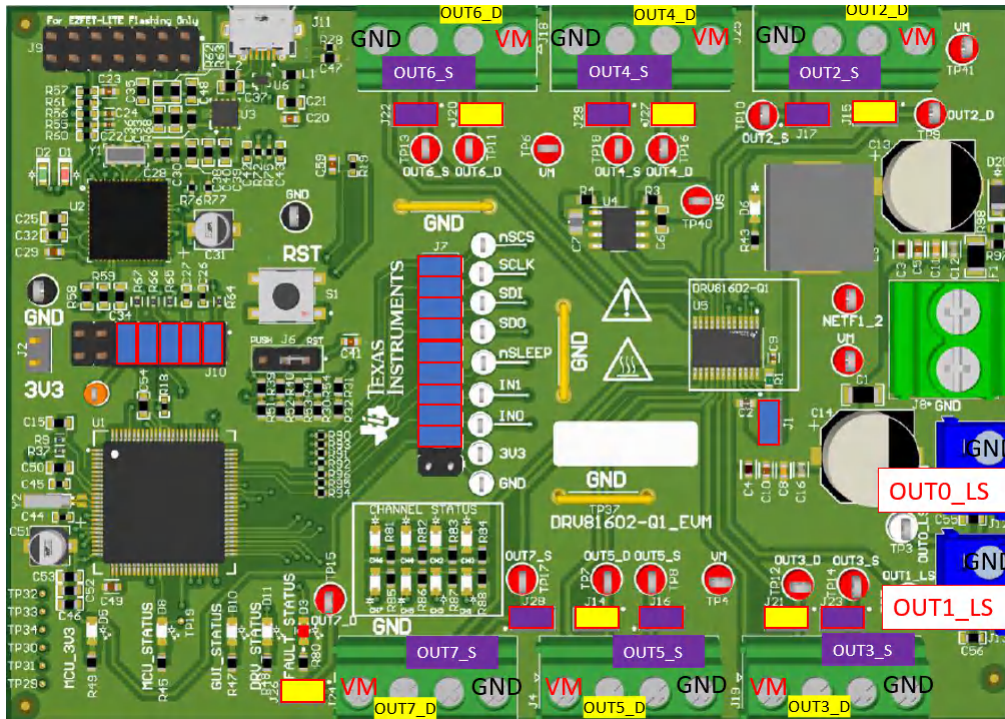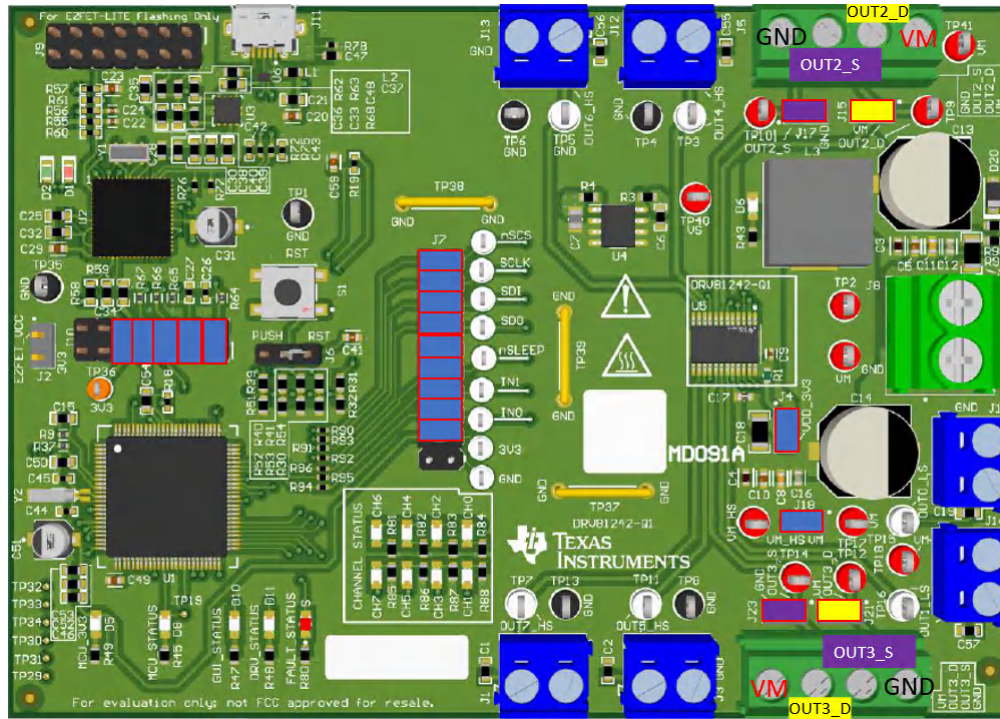

Figure 2-5. DRV81602-Q1 Jumper Configuration

The DRV81602-Q1 has six configurable outputs that can be used as a high-side switch or a low-side switch. If an output is being used as a high-side switch then the *yellow* jumpers need to be populated and the load connected from OUTx_**S** to GND. If driving low-side loads, then the purple jumpers need to be populated and the corresponding load connected from OUTx_S to VM. If an output is being used as a low-side switch then the *purple* jumpers need to be populated and the load connected from OUTx_**D** to VM.

Figure 2-6. DRV81242-Q1 Jumper Configuration

The DRV81242-Q1 has two configurable outputs that can be used as a high-side switch or a low-side switch. If an output is being used as a high-side switch then the *yellow* jumpers need to be populated and the load connected from OUTx_**S** to GND. If driving low-side loads the purple jumpers need to be populated and the corresponding load connected from OUTx_S to VM. If an output is being used as a low-side switch then the *purple* jumpers need to be populated and the load connected from OUTx_**D** to VM.
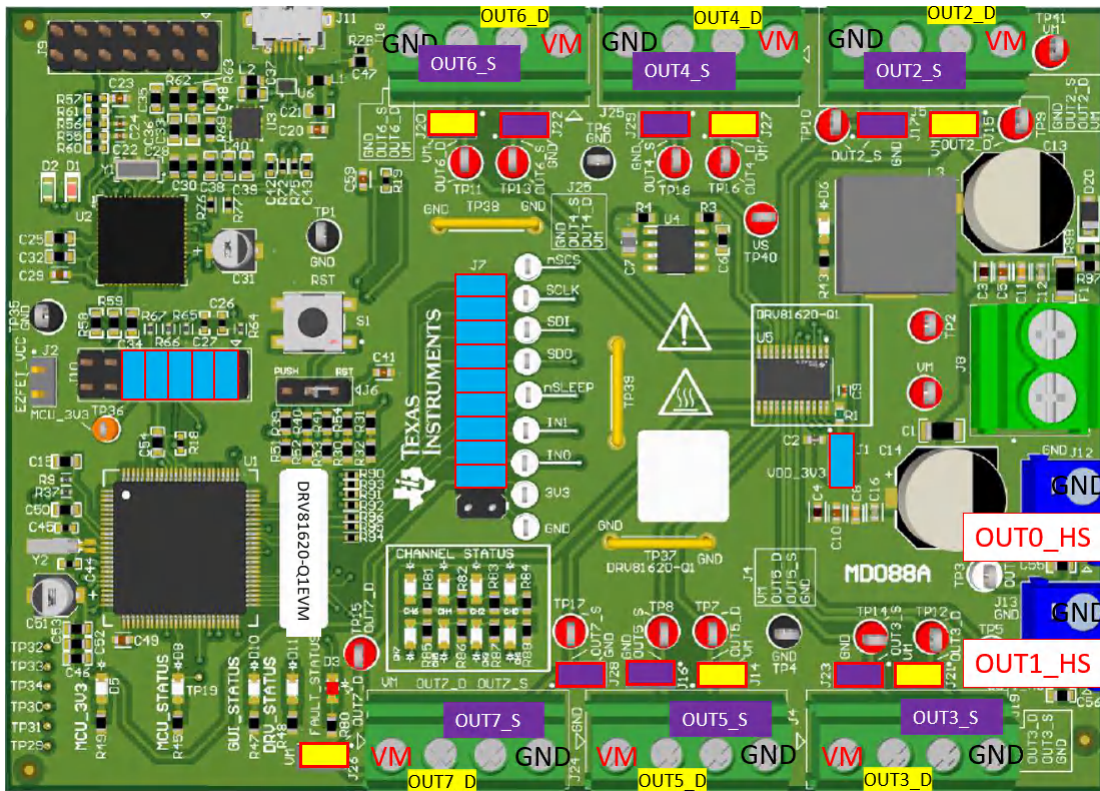
Figure 2-7. DRV81620-Q1 Jumper Configuration

The DRV81620-Q1 has six configurable outputs that can be used as a high-side switch or a low-side switch. If an output is being used as a high-side switch then the *yellow* jumpers need to be populated and the load connected from OUTx_**S** to GND. If driving low-side loads the purple jumpers need to be populated and the corresponding load connected from OUTx_S to VM. If an output is being used as a low-side switch then the *purple* jumpers need to be populated and the load connected from OUTx_**D** to VM.

All EVMs require a VDD power supply for digital logic. Some of the configurable and high-side switch drivers require a jumper placement for additional power supply. See the table below for a description the device and jumper requirements.

Table 2-1. Power Jumper Configurations

| Device	Jumpers	Description
DRV81004	J1	Connects 3.3V to VDD
DRV81008	J1	Connects 3.3V to VDD
DRV81080	J1	Connects 3.3V to VDD
	J3	Connects VM to VM1
	J4	Connects VM to VM2
DRV81602	J1	Connects 3.3V to VDD
DRV81242	J1	Connects 3.3V to VDD
	J18	Connects VM to VM_HS
DRV81620	J1	Connects 3.3V to VDD

2.3 Hardware Setup

The EVM hardware is designed and kitted to simplify setup and begin spinning motors. The EVM comes with the jumpers placed at the appropriate location in the headers. The location of the jumpers, also called shunts, are shown in Section 2.2.

Note

Before using the EVM, check that the shunt location matches the location shown in Section 2.2.

Before connecting the EVM to the GUI software, follow these steps:

1. Connect EVM to PC via USB connector. D2 (EZFET), D5 (3.3V), must be solid ON.
2. Connect power supply (less than 40V) to power connector. Make sure terminals are connected correctly to avoid damage due to reverse battery connection.
3. Turn ON power supply D6 is solid ON.
4. Connect motor to the appropriate output connector.
5. Set up is now complete (see Figure 2-8).
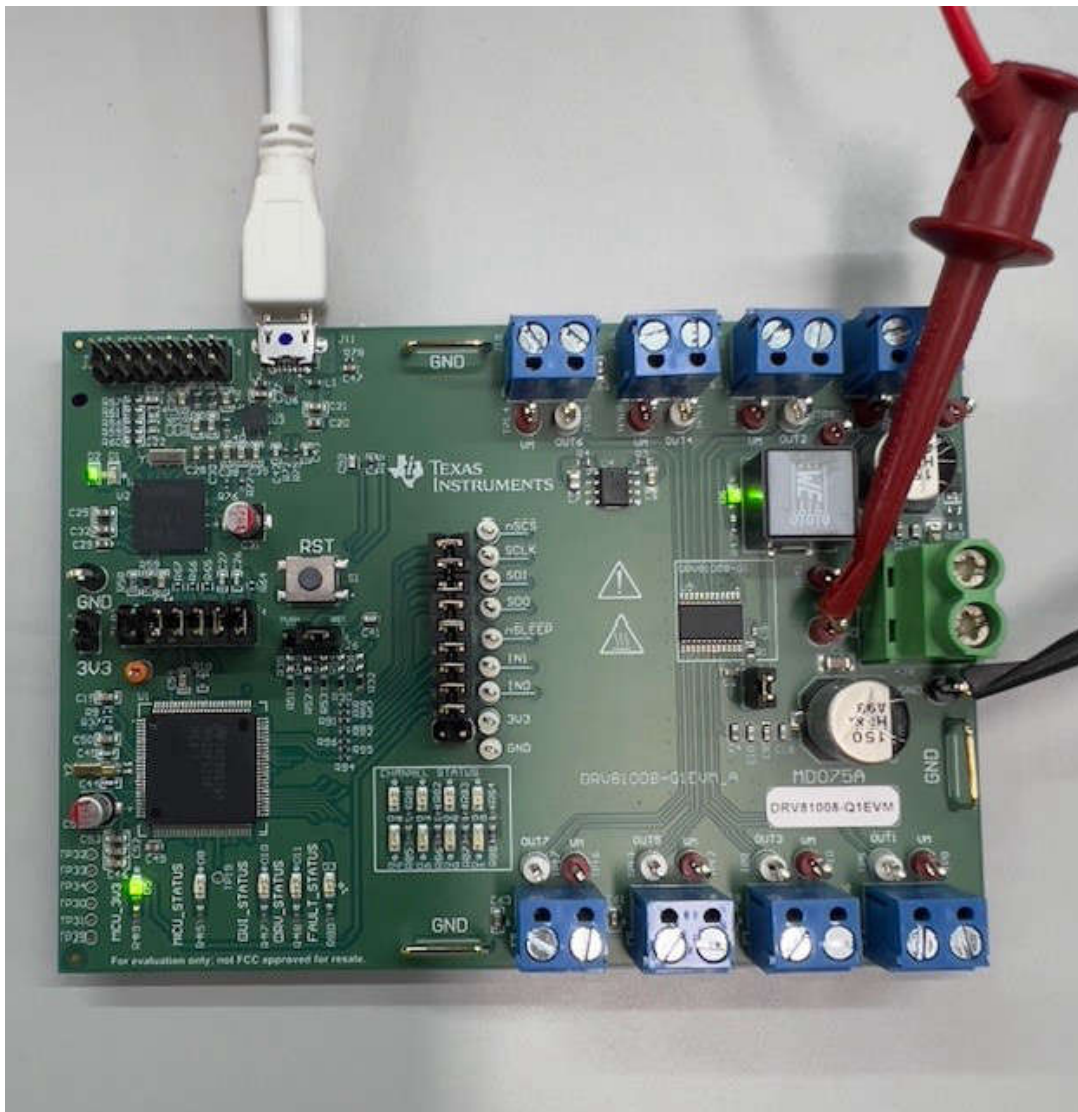
Figure 2-8. DRV81008-Q1EVM Hardware Setup

3 Software

3.1 Software Setup

1. Install the TI MSP430 USB driver from MSP430 FET Drivers.
   a. Click on the first driver download link, *ti_msp430driver_setup_1.0.1.1-windows.zip | Windows Installer*.
   b. Please log in with myTI credentials when prompted and provide the requested information. The approval to access the download is automatic and immediate as long as the U.S. Government export approval requirements are complied with.
   c. Click on the download button to download the installer to your PC.
   d. Double-click on the downloaded zip file and run the installer by double-clicking on the *.exe* file. Complete the installation to install the required USB drivers to use the EVM on the PC.
      i. Follow proper safety precautions working with sensitive electronics as well as high voltage and high current hardware.
      ii. Power sequencing: The USB cable must be plugged in first between the EVM and the computer. Then turn on the power supply to the EVM. Powering the EVM external bench supply before connecting the USB cable can cause the USB device to not start up properly and result with driver error.
      iii. Set up the bench supply to <=40V with current limit set to appropriate requirements of the motor.

3.2 Web GUI Access or Local GUI Installation

The EVM is controlled via a GUI application and can be used via a chrome-based browser or installed locally to a PC. The web-based GUI can be found at this link: GUI download.

To use the Web GUI (recommended), follow these steps:

1. Open the latest version of the GUI at this link: DRV81xxx-EVM-GUI
   a. Alternatively, log into https://dev.ti.com/gallery/ and search for *DRV81xxx* sorting by *Recently updated*.
   b. Click on the title or blank space of the first search result to open the Web-Based GUI.
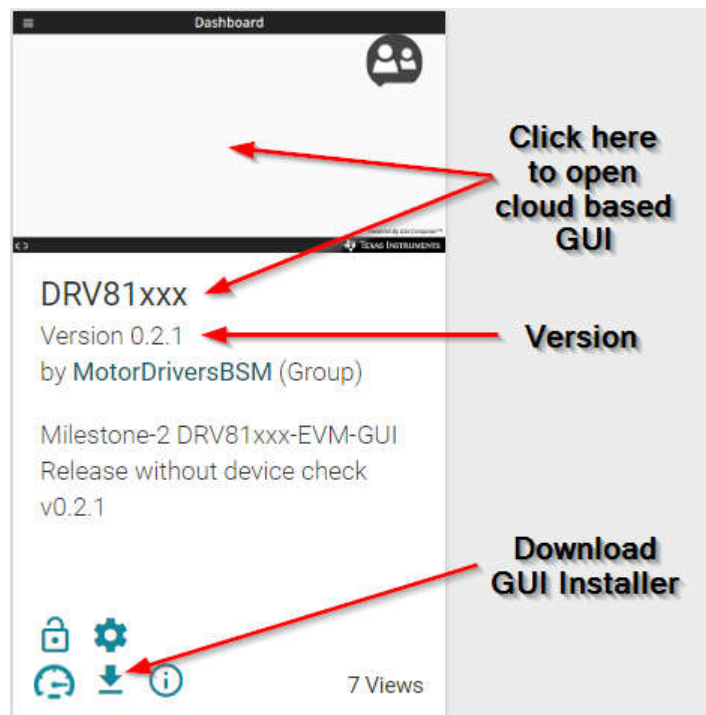
**Figure 3-1. TI GUI Composer Gallery Results for Launching or Downloading Local Installer**

To install the GUI locally follow these steps:

1. Log in to https://dev.ti.com/gallery/ using myTI log in credentials. Note that the GUI composer log in searches for a very specific username match including case input at the time of sign up.
2. Open the latest version of the GUI at this link: DRV81xxx-EVM-GUI
   a. Alternatively, log into https://dev.ti.com/gallery/ and search for *DRV81xxx* sorting by *Recently updated*.
3. Hover the mouse over the *Download* icon and select the installer for the relevant operating system from the top list. Refer back to the previous section for a visual depiction of the gallery page.
4. Extract the ZIP folder with the installer and run the installer. The installer contents is self-explanatory and look slightly different for each OS.
5. Click *Next* and then agree to the terms and conditions on the following page.
6. Keep the application and runtime directory to the default locations.Click *Next* to install GUI.
7. Select *Download from Web* to download the GUI Composer Runtime if prompted, then click *Next*.
   a. If a network firewall prevents Runtime download from the web, then the Runtime installer can be downloaded at this link: Runtime installer.
8. Check the box to create a desktop shortcut and click *Finish* to complete installation. GUI is now installed.
9. GUI is now installed.

3.3 Connecting EVM to GUI

Now, that the EVM hardware setup and GUI installation is complete, the EVM can now be connected to the GUI. The following steps outline how to connect the EVM to GUI:

• With the EVM connected to the PC, open the GUI. The home page or landing page of the GUI is shown in Figure 3-2.
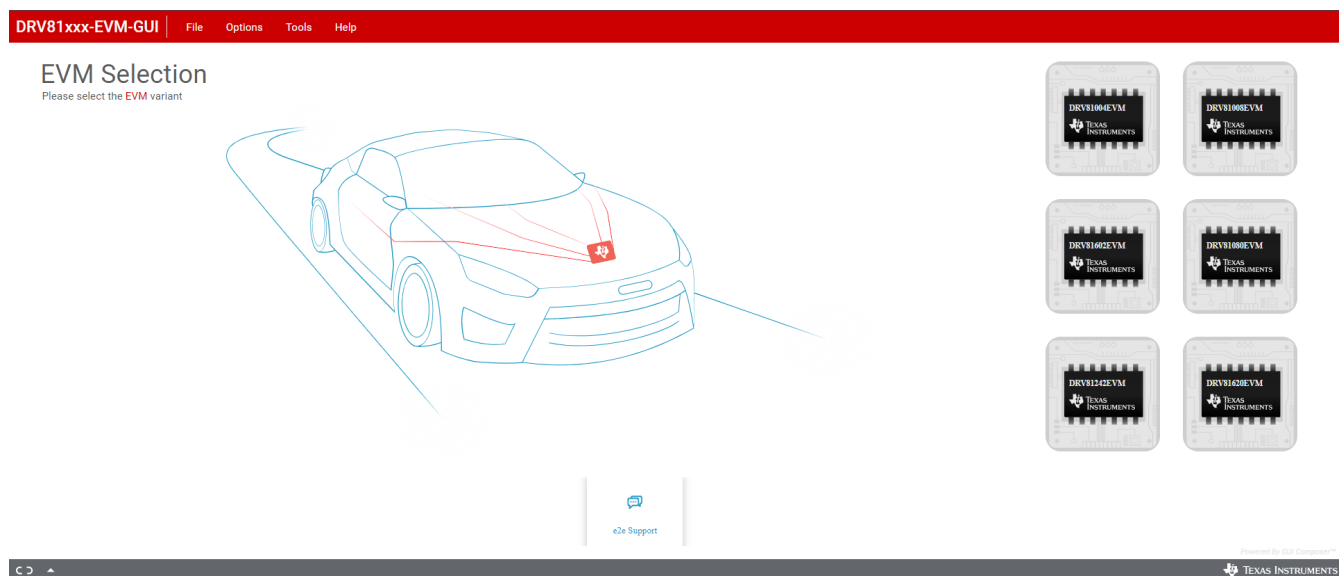
Figure 3-2. GUI Landing Page

- Program EVM with latest software by clicking on *File -> Program Device* (See)Figure 3-3. This needs to be done the first time the user sets up the EVM, as a software update can have been released since the EVM was initially programmed.
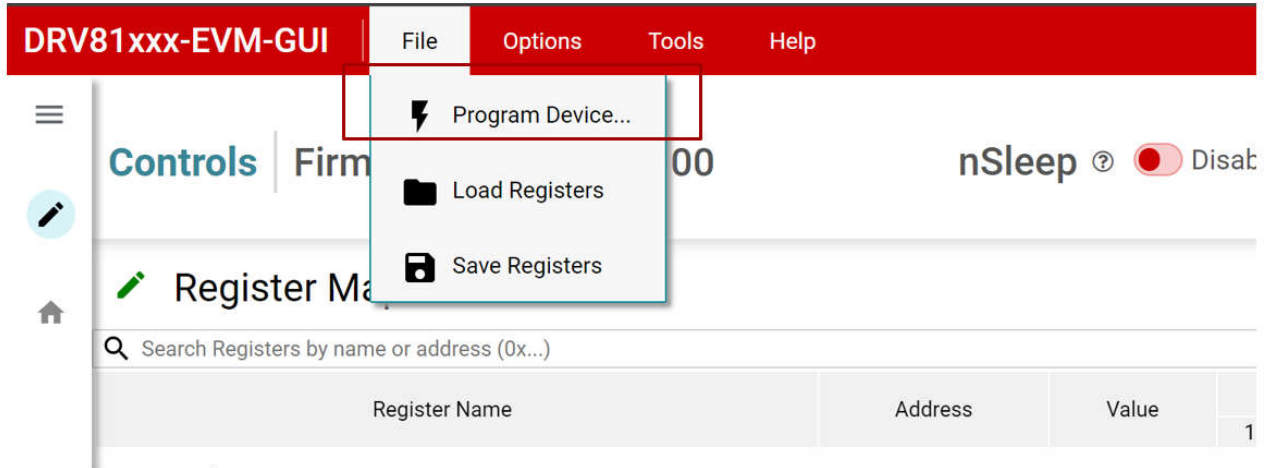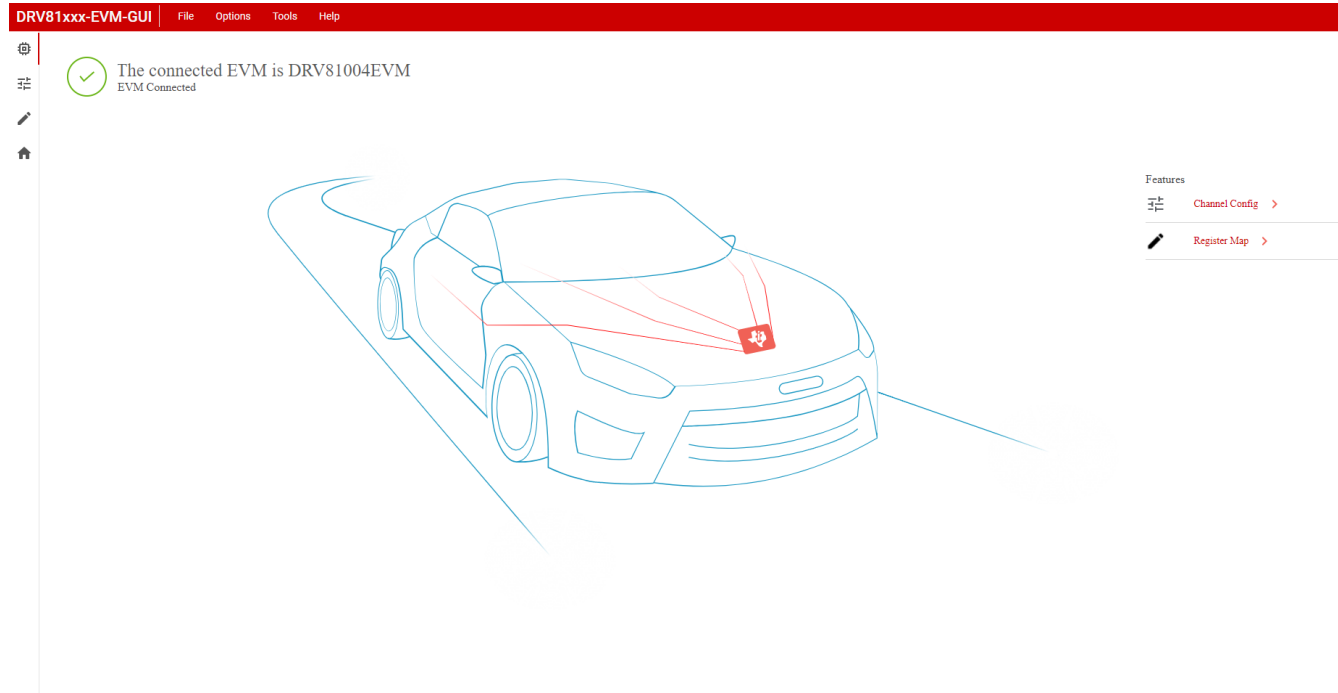

Figure 3-3. Program Device

- Select the appropriate GUI variant from the six options for the EVM (see Figure 3-4).
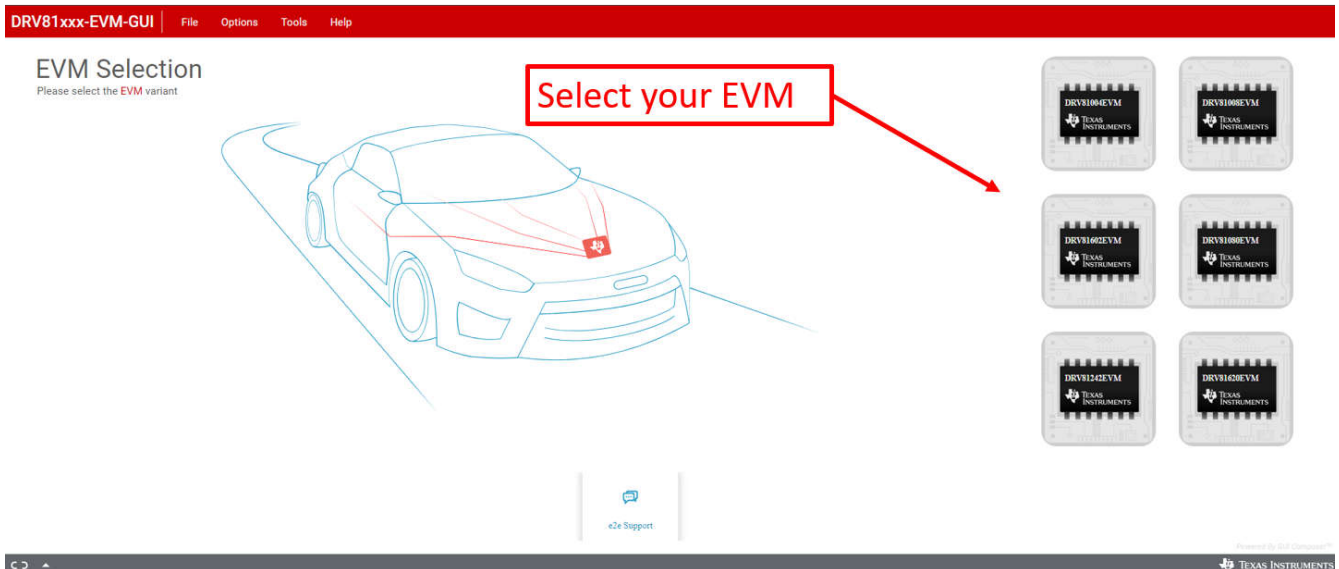
Figure 3-4. EVM Selection

- The GUI attempts to connect with EVM. The GUI displays the following once successfully connected. If there is no successful connection, then double check the correct steps are followed in Section 2.3.

Figure 3-5. Successful GUI Connection

- Once successfully connected, click on *Quick Start* to open the Channel Config. page under Features section to open the main control page.

- The GUI setup is now complete. The following section provides an overview of the GUI and how to use the GUI to control EVM.

3.4 GUI Overview

These following sections provides an overview for each of the GUI variants from the DRV81xxx-Q1 family of devices. The GUI variant is selected in the GUI home page.

3.4.1 Low-Side Drivers: DRV81004-Q1 and DRV81008-Q1

The DRV81004-Q1 and DRV81008-Q1 are multi-channel low-side drivers with integrated protection and diagnostic functions. The following images and table can be used as a guide to configure the motor driver through the GUI to control relays and LEDs in automotive and industrial applications.
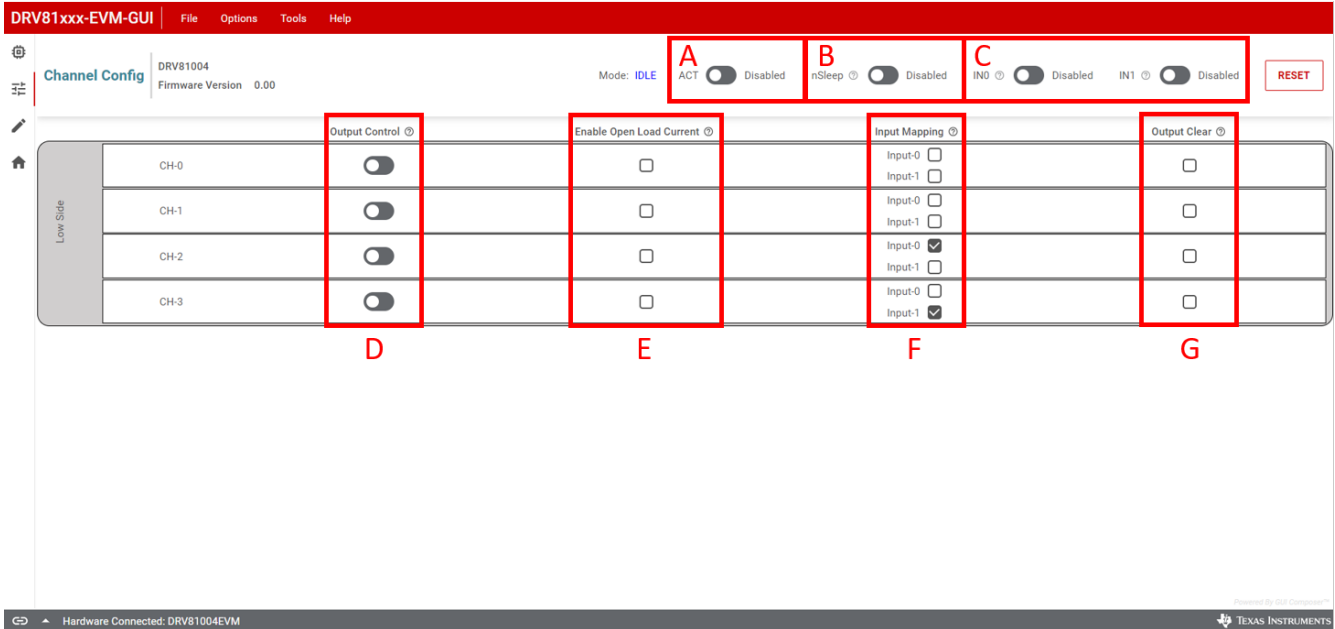

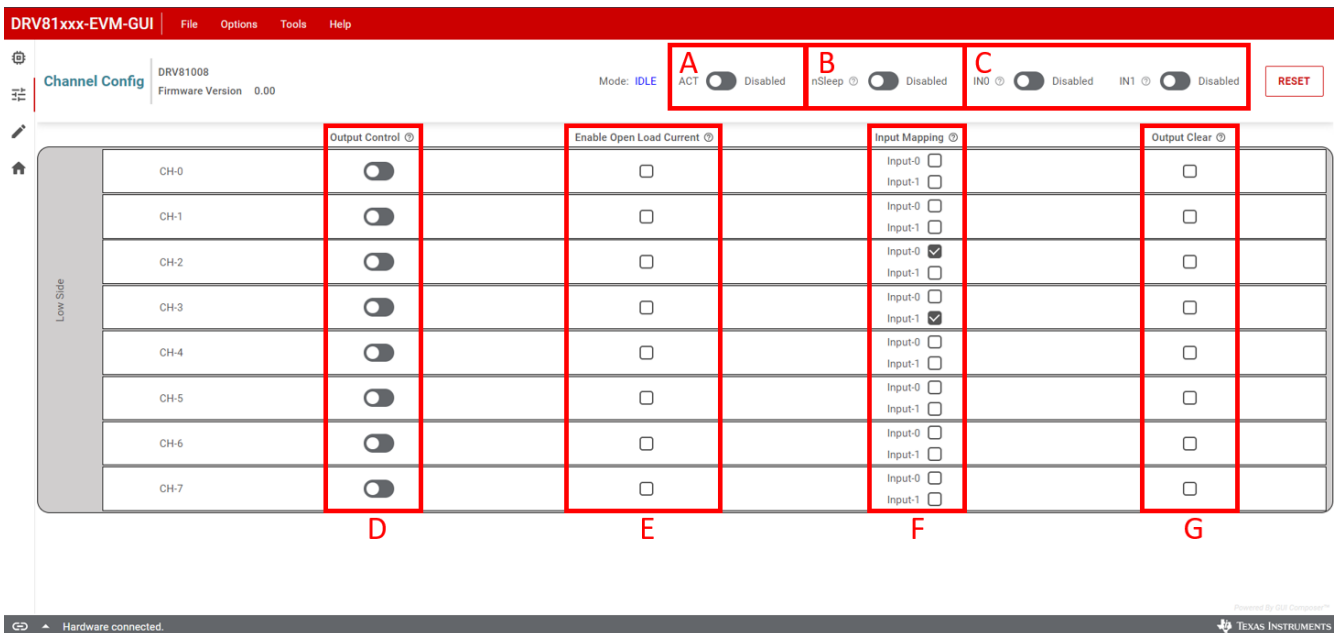**Figure 3-6. DRV81004-Q1 GUI Channel Configuration Page**

Figure 3-7. DRV81008-Q1 GUI Channel Configuration Page

Table 3-1. DRV81004-Q1 and DRV81008-Q1

Component	Description
A	Active Mode • Disabled (default): device in Idle Mode. • Enabled: device in Active Mode.
B	nSLEEP • Disabled (default): low-current sleep mode. • Enabled: activates Idle mode.
C	Input Pins (IN0 and IN1) • Disabled: the input pin is set to logic low. • Enabled: the input pin is set to logic high.
D	Output Control • Disabled (default): output x is OFF. • Enabled: output is ON.
E	Enable Open Load Current • Disabled (default): IOL current source not enabled. • Enabled: IOL current source enabled.
F	Input Mapping • Disabled (default): Output x is not connected to the input pin. • Enabled: Output x is connected to the input pin. **Note** By default, IN0 is connected to CH-2 and IN1 is connected to CH-3.
G	Output Clear • Disabled (default): normal operation. • Enabled: clear the error latch for the selected output.

3.4.2 High-Side Driver: DRV81080-Q1

The DRV81080-Q1 is a eight channel high-side driver with integrated protection and diagnostics. The following image and table can be used as a guide to configure the motor driver through the GUI to control relays, LEDs, Lamps and motors in automotive and industrial applications.
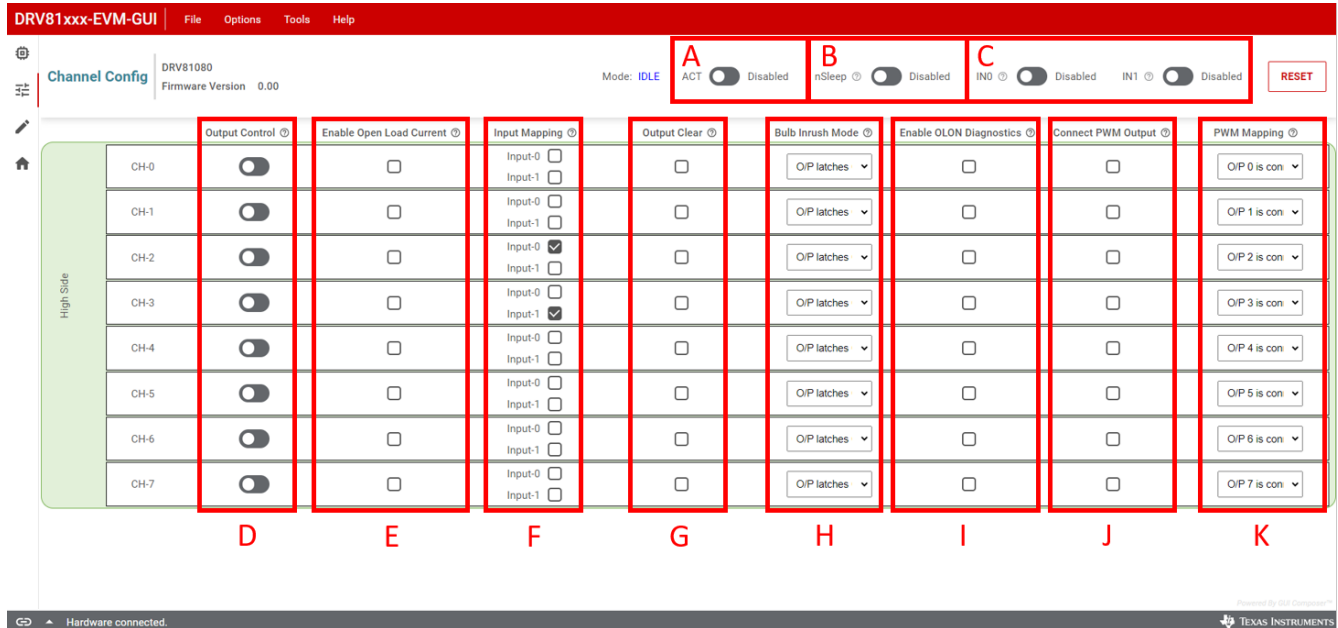

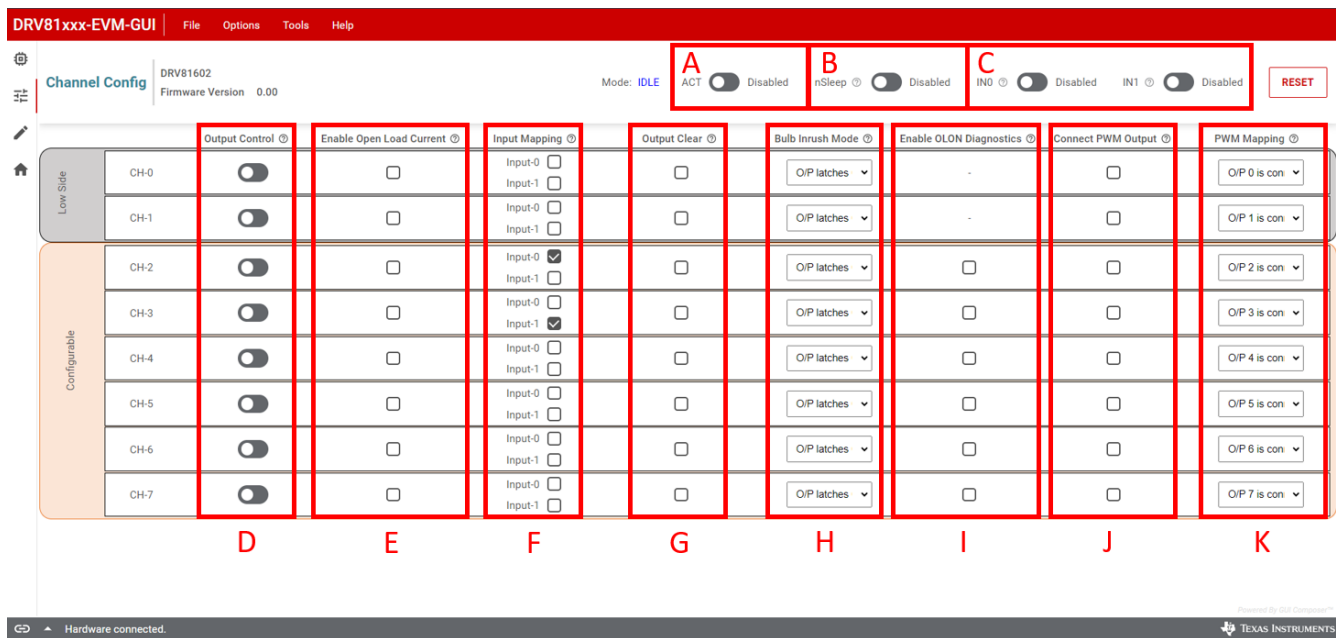**Figure 3-8. DRV81080-Q1 GUI Channel Configuration Page**

Table 3-2. DRV81080-Q1

Component	Description
A	Active Mode • Disabled (default): device in Idle Mode. • Enabled: device in Active Mode.
B	nSLEEP • Disabled (default): low-current sleep mode. • Enabled: activates Idle mode.
C	Input Pins (IN0 and IN1) • Disabled: the input pin is set to logic low. • Enabled: the input pin is set to logic high.
D	Output Control • Disabled (default): output x is OFF. • Enabled: output is ON.
E	Enable Open Load Current • Disabled (default): IOL current source not enabled. • Enabled: IOL current source enabled.
F	Input Mapping • Disabled (default): output x is not connected to the input pin.. • Enabled: output x is connected to the input pin. **Note** By default, IN0 is connected to CH-2 and IN1 is connected to CH-3.

Table 3-2. DRV81080-Q1 (continued)

Component	Description
G	Output Clear • Disabled (default): normal operation. • Enabled: clear the error latch for the selected output.
H	Bulb Inrush Mode • Disabled (default): output latches OFF in case of errors. • Enabled: output restarts automatically in case of errors.
I	Enable OLON Diagnostics • Disabled (default): normal operation or diagnosis performed on channel OFF. • Enabled: open load at ON detected.
J	Connect PWM Output • Disabled (default): PWM generator not connected to output. • Enabled: PWM generator connected to output.
K	PWM Mapping • 0: Output connected to PWM generator 0. • 1: Output connected to PWM generator 1.

3.4.3 Configurable HS/LS: DRV81602-Q1, DRV81242-Q1, and DRV81620-Q1

The DRV81602-Q1, DRV81242-Q1, and DRV81620-Q1 are configurable high-side and low-side drivers with integrated protection and diagnostics. The configurable driver GUIs are set up in the same configuration and offers many of the same features and functionalities as the DRV81080-Q1 high-side driver. Minor differences include exclusion of Enabling OLON Diagnostics for dedicated low-side drivers in certain variants.

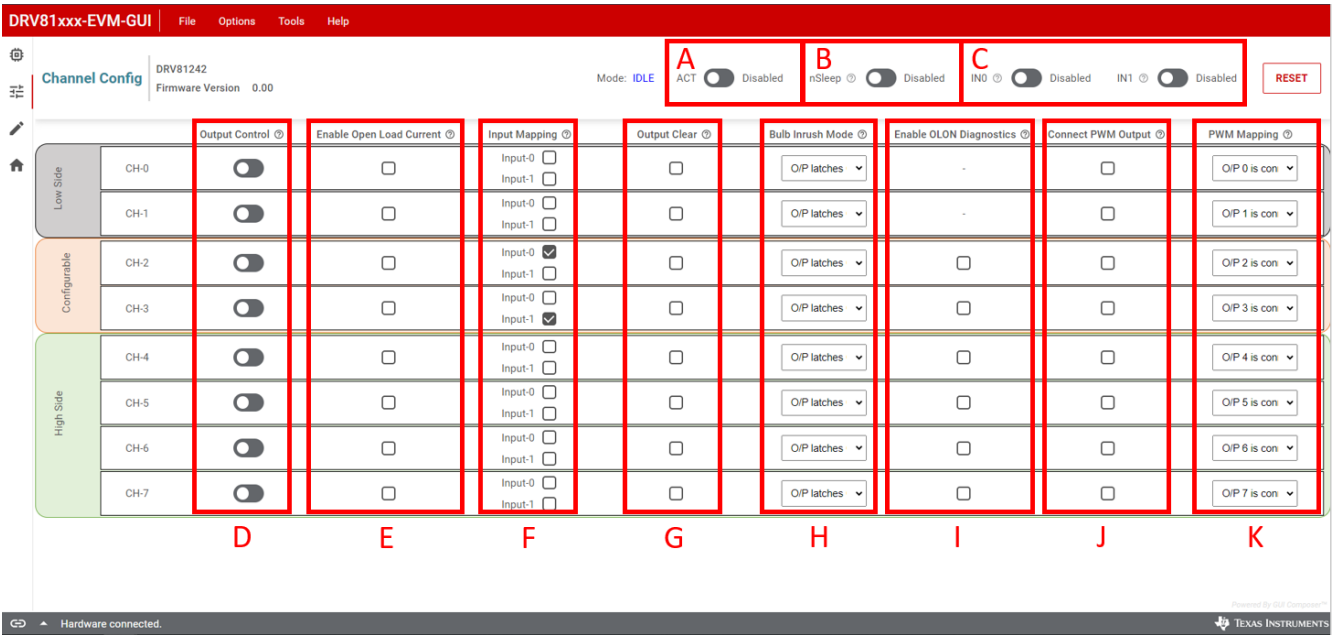**Figure 3-9. DRV81602-Q1 GUI Channel Configuration Page**

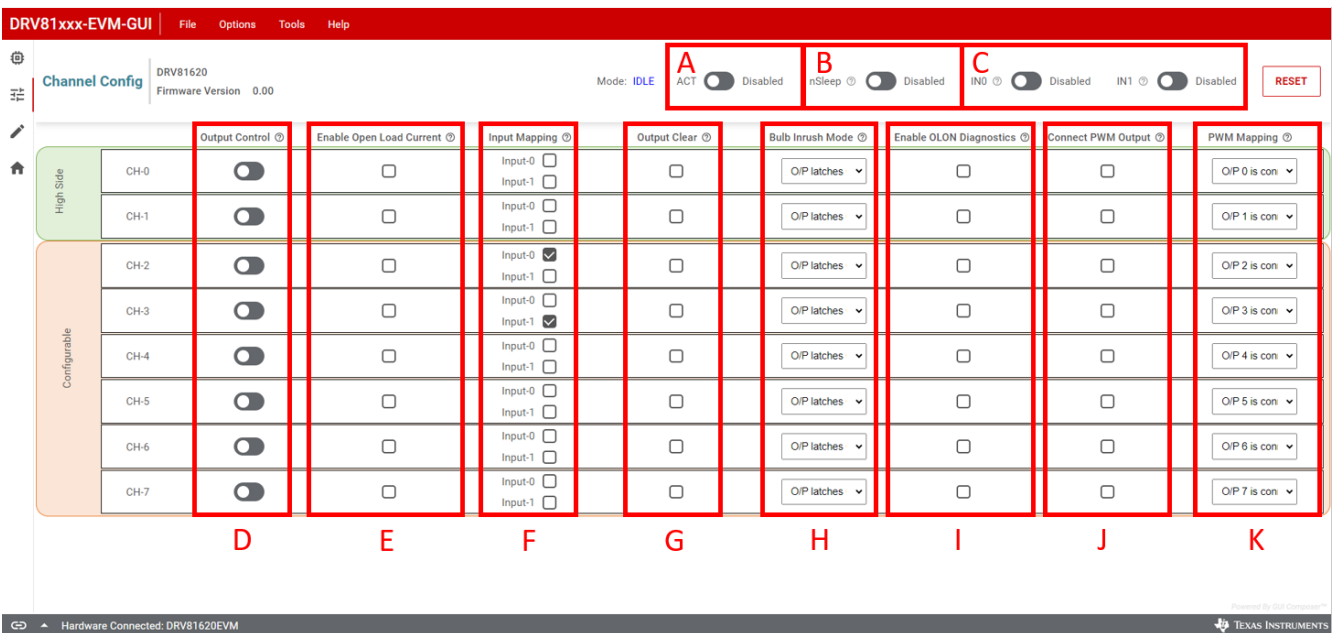**Figure 3-10. DRV81242-Q1 GUI Channel Configuration Page**

Figure 3-11. DRV81620-Q1 GUI Channel Configuration Page

Table 3-3. DRV81602-Q1, DRV81242-Q1, and DRV81620-Q1

Component	Description
A	Active Mode • Disabled (default): device in Idle Mode. • Enabled: device in Active Mode.
B	nSLEEP • Disabled (default): low-current sleep mode. • Enabled: activates Idle mode.
C	Input Pins (IN0 and IN1) • Disabled: the input pin is set to logic low. • Enabled: the input pin is set to logic high.
D	Output Control • Disabled (default): Output x is OFF. • Enabled: Output is ON.
E	Enable Open Load Current • Disabled (default): IOL current source not enabled. • Enabled: IOL current source enabled.
F	Input Mapping • Disabled (default): output x is not connected to the input pin.. • Enabled: output x is connected to the input pin. **Note** By default, IN0 is connected to CH-2 and IN1 is connected to CH-3.
G	Output Clear • Disabled (default): normal operation. • Enabled: clear the error latch for the selected output.
H	Bulb Inrush Mode • Disabled (default): Output latches OFF in case of errors. • Enabled: output restarts automatically in case of errors.
I	Enable OLON Diagnostics • Disabled (default): normal operation or diagnosis performed on channel OFF. • Enabled: open load at ON detected.
J	Connect PWM Output • Disabled (default): PWM generator not connected to output. • Enabled: PWM generator connected to output.
K	PWM Mapping • 0: output connected to PWM generator 0. • 1: output connected to PWM generator 1.

4 Hardware Design Files

The schematics, bill of materials (BOM), PCB layout, and 3D model STEP file for each EVM can be downloaded on the respective product folder page under the Design Files section.

- https://www.ti.com/tool/DRV81004EVM#design-files
- https://www.ti.com/tool/DRV81008EVM#design-files
- https://www.ti.com/tool/DRV81602EVM#design-files
- https://www.ti.com/tool/DRV81080EVM#design-files
- https://www.ti.com/tool/DRV81242EVM#design-files
- https://www.ti.com/tool/DRV81620EVM#design-files
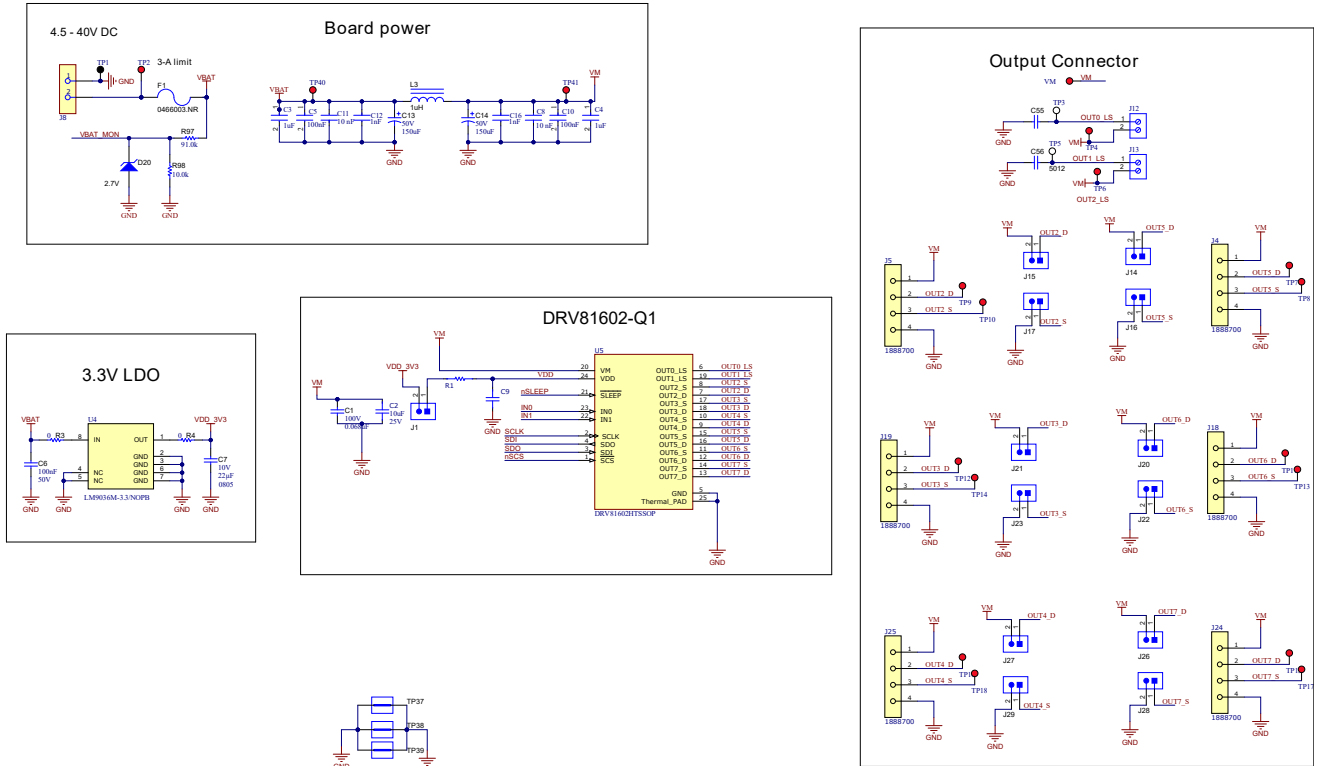
4.1 Schematics

Figure 4-1. Motor Driver DRV81602-Q1, LDO, and Output Connectors
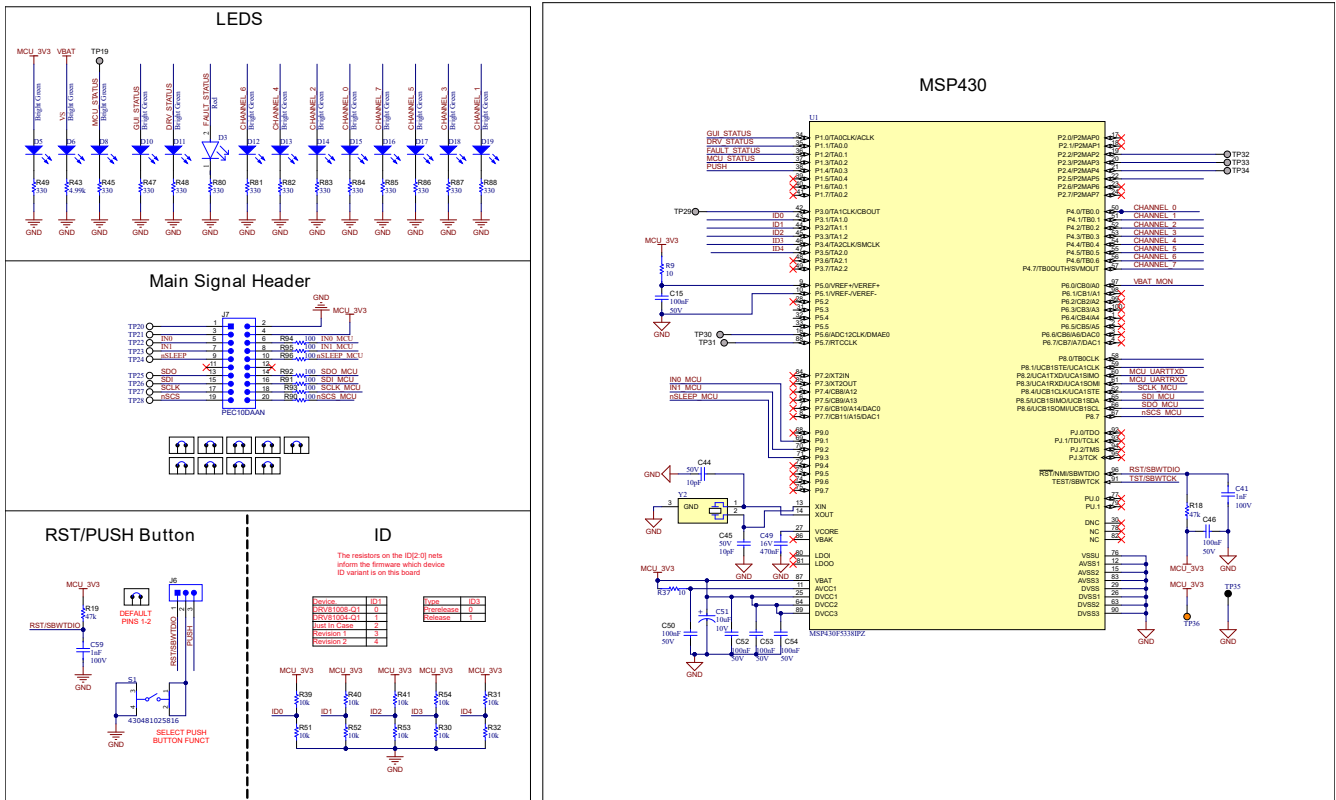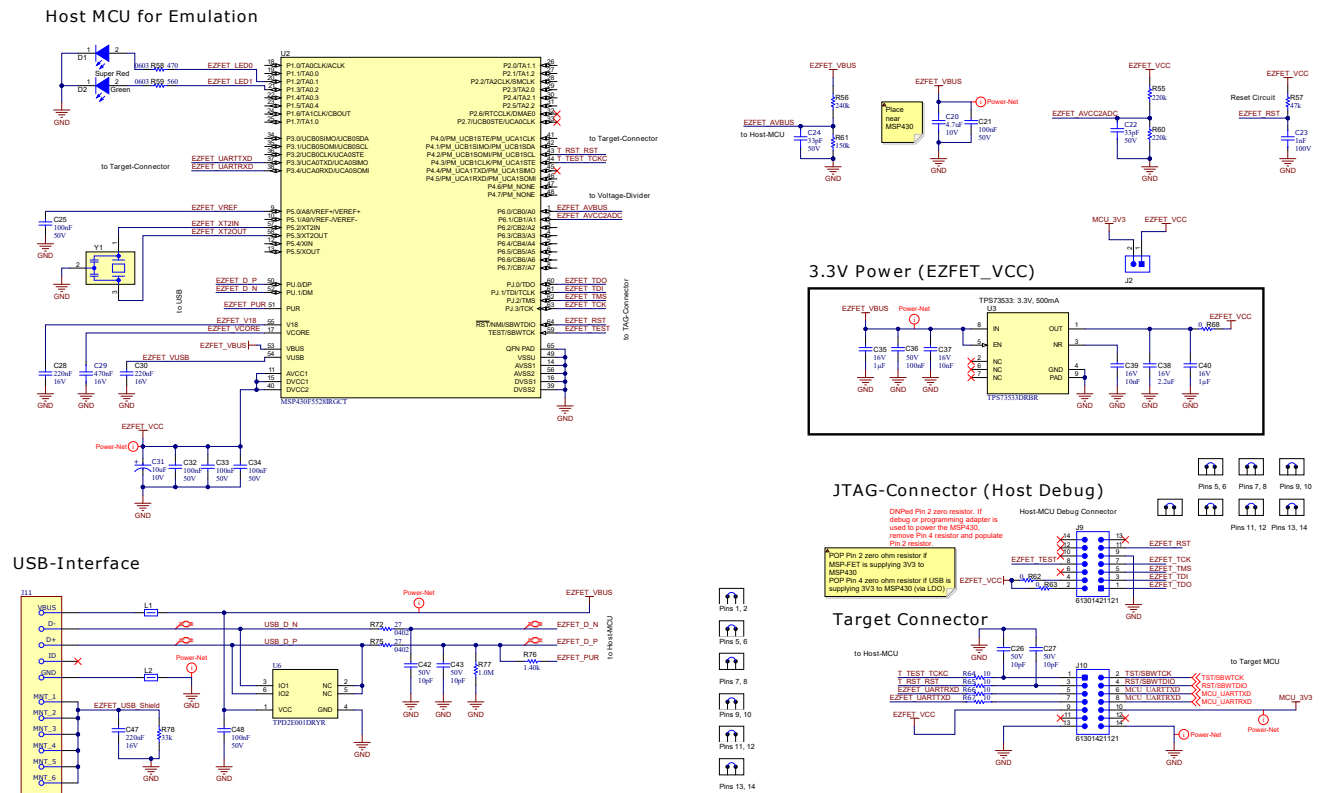
Figure 4-2. MSP430, ID Resistors, and LEDs

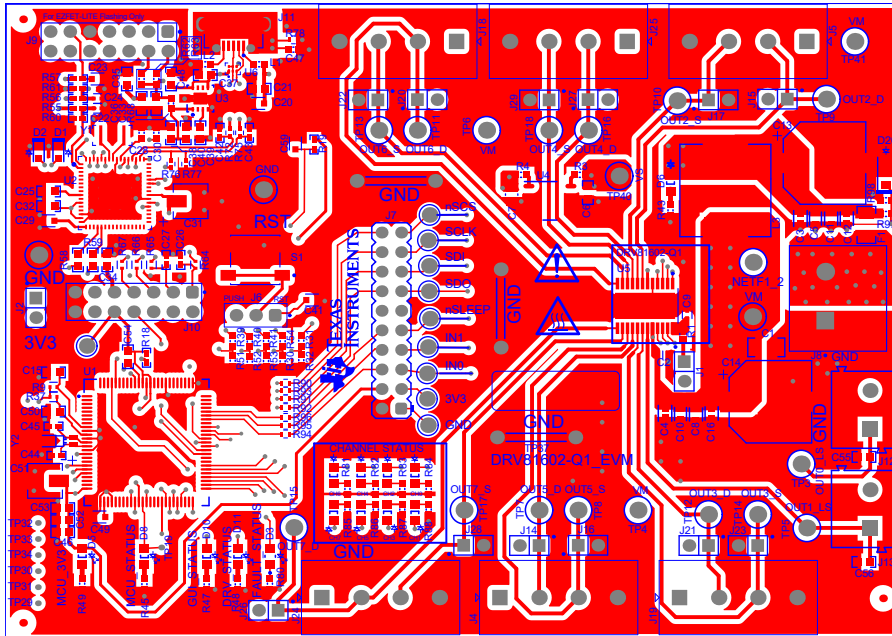**Figure 4-3. EZFET and USB**

4.2 PCB Layouts
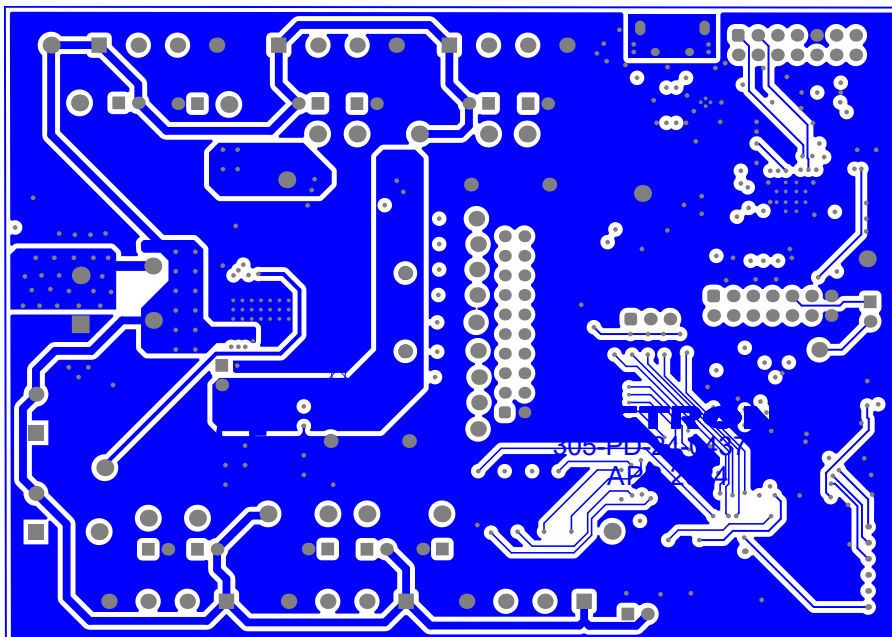

Figure 4-4. Top Layer

Figure 4-5. Bottom Layer

4.3 Bill of Materials (BOM)

Table 4-1. Bill of Materials (DRV81602-Q1EVM)

Designator	Quantity	Value	Description	Footprint	Part Number	Manufacturer
C1	1	0.068uF	CAP, CERM, 0.068uF, 100V, +/- 10%, X7R, 1206	1206	12061C683KAT2A	AVX
C2	1	10µF	10µF ±20% 25V Ceramic Capacitor X5R 0603 (1608 Metric)	FP-ZRB18AR61E106ME01L_0603-MFG	ZRB18AR61E106ME01L	Murata Electronics
C3, C4	2		Ceramic Capacitor General Use 1uF ±10% 50V X7R 0603	FP-0603-L_1_6_0_15-W_0_8-IPC_C	UMK107AB7105KA-T	Taiyo Yuden
C5, C10	2	100nF	CAP CER 0.1UF 50V X7R 0603	FP-885012206095-MFG	885012206095	Würth Elektronik
C6, C15, C21, C25, C32, C33, C34, C36, C46, C48, C50, C52, C53, C54	14	0.1uF	CAP, CERM, 0.1uF, 50V, +/- 10%, X7R, 0603	0603	885012206095	Wurth Elektronik
C7	1	22uF	CAP, CERM, 22µF, 10V,+/- 20%, X5R, 0805	0805_150	885012107011	Wurth Elektronik
C8, C11	2	10nF	CAP CER 10000PF 50V X7R 0603	FP-CC0603-DA-MFG	CC0603KPX7R9BB103	YAGEO
C9	1	100nF	0.1µF ±10% 10V Ceramic Capacitor X7R 0402 (1005 Metric)	FP-885012205018_0402-MFG	885012205018	Wurth Electronics
C12, C16	2	1,000 pF	CAP CER 1000PF 50V X7R 0603	FP-C0603C-CF-MFG	C0603C102J5RACAUTO	KEMET
C13, C14	2	150uF	CAP, AL, 150uF, 50V, +/- 20%, 0.18 ohm, AEC-Q200 Grade 2, SMD	SM_RADIAL_G	EEE-FK1H151P	Panasonic
C20	1	4.7µF	4.7µF ±20% 10V Ceramic Capacitor X5R 0603 (1608 Metric)	FP-885012106012_0603-MFG	885012106012	Wurth Electronics
C22, C24	2	33pF	33pF ±5% 50V Ceramic Capacitor C0G, NP0 0402 (1005 Metric)	FP-885012005058_0402-MFG	885012005058	Wurth Electronics
C23, C41, C59	3	1nF	1000pF ±5% 100V Ceramic Capacitor C0G, NP0 0603 (1608 Metric)	FP-885012006085_0603-MFG	885012006085	Wurth Electronics
C26, C27, C42, C43, C44, C45	6	10pF	CAP, CERM, 10pF, 50V, +/- 5%, C0G/NP0, 0402	0402	885012005055	Wurth Elektronik
C28, C30, C47	3	0.22uF	CAP, CERM, 0.22uF, 16V, +/- 10%, X7R, 0603	0603L	885012206048	Wurth Elektronik
C29, C49	2	470nF	0.47µF ±10% 16V Ceramic Capacitor X7R 0603 (1608 Metric)	FP-885012206050_0603-MFG	885012206050	Wurth Electronics

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Table 4-1. Bill of Materials (DRV81602-Q1EVM) (continued)

Designator	Quantity	Value	Description	Footprint	Part Number	Manufacturer
C31, C51	2	10µF	Alum. Polymer Cap 10µF 10V 5.5mmV-Chip WCAP-PSLP Series Lifetime 2000h +105°C	FP-875105240001_SMT_CAP_4MM3_4MM3-MFG	875105240001	Wurth Electronics
C35, C40	2	1uF	CAP, CERM, 1uF, 16V, +/- 10%, X7R, 0603	0603	885012206052	Wurth Elektronik
C37, C39	2	0.01uF	CAP, CERM, 0.01uF, 16V, +/- 10%, X7R, 0603	0603	885012206040	Wurth Elektronik
C38	1	2.2uF	CAP, CERM, 2.2uF, 16V, +/- 20%, X5R, 0603	0603	885012106018	Wurth Elektronik
C55, C56	2	0.01uF	CAP, CERM, 0.01µF, 100V,+/- 10%, X7R, 0603	0603	885012206114	Wurth Elektronik
D1	1	Super Red	LED, Super Red, SMD	WL-SMCW_RED	150060SS75000	Wurth Elektronik
D2	1	Green	LED, Green, SMD	WL-SMCW_GREEN	150060VS75000	Wurth Elektronik
D5, D6, D8, D10, D11, D12, D13, D14, D15, D16, D17, D18, D19	13		SMD mono-color Chip LED, WL-SMCW, Bright Green	0805_A	150080VS75000	Wuerth Elektronik
D20	1	2.7V	Diode, Zener, 2.7V, 500 mW, SOD-123	SOD-123	MMSZ4682-E3-08	Vishay-Semiconductor
F1	1		Fuse, 3A, 32VAC/VDC, SMD	1206	0466003.NR	Littelfuse
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial10-20	N/A	N/A
H1, H2, H3, H4	4		Bumpon, Hemisphere, 0.44 X 0.20, Clear	Bumpon_SJ5003Transparent	SJ-5303 (CLEAR)	3M
J1, J2, J14, J15, J16, J17, J20, J21, J22, J23, J26, J27, J28, J29	14		Header, 100mil, 2x1, Gold, TH	Samtec_HTSW-102-07-G-S	HTSW-102-07-G-S	Samtec
J4, J5, J18, J19, J24, J25	6		Conn; Term Blk; PCB; Screw; 4; 5.08mm; Front; 24-14 AWG; 16A; 250V; Solder	FP-1888700_HDR4-MFG	1888700	Phoenix Contact
J6	1		Header, 2.54mm, 3x1, Gold, TH	WURTH_61300311121	61300311121	Wurth Elektronik
J7	1		Header, 2.54mm, 10x2, Tin, TH	SULLINS_PEC10DAAN	PEC10DAAN	Sullins Connector Solutions
J8	1		2 Position Wire to Board Terminal Block Horizontal with Board 0.250" (6.35mm) Through Hole	FP-691250610002_CONN_TERM_BLOCK2-MFG	691250610002	Wurth Electronics
J9, J10	2		Header, 2.54mm, 7x2, Gold, TH	Wurth_61301421121	61301421121	Wurth Elektronik
J11	1		Conn Micro USB 2.0 Type AB RCP 5 POS 0.65mm Solder RA SMD 5 Terminal 1 Port T/R	FP-629105150921_CONN_PTH_USB_8MM0_5MM6-MFG	629105150921	Wurth Electronics

Table 4-1. Bill of Materials (DRV81602-Q1EVM) (continued)

Designator	Quantity	Value	Description	Footprint	Part Number	Manufacturer
J12, J13	2		Series 101 - 5.00mm Horizontal Entry Modular with Pressure Clamp WR-TBL, 2 pin	691101710002	691101710002	Wurth Elektronik
L1, L2	2	140 ohm	Ferrite Bead, 140 ohm at 100MHz, 0.55A, 0603	0603L	742792621	Wurth Elektronik
L3	1	1uH	Inductor, Shielded Drum Core, Ferrite, 1uH, 24A, 0.0012 ohm, SMD	WE-HCC_1210	7443320100	Wurth Elektronik
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	Label_650x200	THT-14-423-10	Brady
LBL2	0		Harsh Environment Multi-Purpose Polyester Labels for 3" Core Printers - 0.375" x 0.375", White	Label_375x375	THT-14-423-10	Brady
R1	1	100	100 Ohms ±5% 0.2W, 1/5W Chip Resistor 0603 (1608 Metric) Automotive AEC-Q200, Moisture Resistant, Pulse Withstanding Thick Film	FP-SG73S1JTTD101J_0603-MFG	SG73S1JTTD101J	KOA Speer
R3, R4, R45, R47, R48, R49, R62, R63, R68, R80, R81, R82, R83, R84, R85, R86, R87, R88	18	0, 330	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603, RES, 330, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603L	CRCW06030000Z0EA	Vishay-Dale
R9, R37, R64, R65, R66, R67	6	10	Thick Film Resistors 0402 10Ω ±1% 0.125W	FP-560050310009_0402-MFG	560050310009	Wurth Electronics
R18, R19, R57	3	47k	RES, 47 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040247K0JNED	Vishay-Dale
R30, R31, R32, R39, R40, R41, R51, R52, R53, R54	10	10k	RES, 10 k, 5%, 0.1 W, 0603	0603L	RC0603JR-0710KL	Yageo
R43	1	4.99k	RES, 4.99 k, 1%, 0.1 W, 0603	0603L	CRCW06034K99FKEAC	Vishay-Dale
R55, R60	2	220k	RES, 220 k, 1%, 0.0625 W, 0402	0402	RC0402FR-07220KL	Yageo America
R56	1	240k	RES, 240 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402240KFKED	Vishay-Dale
R58	1	470	RES, 470, 5%, 0.1 W, 0603	0603	RC0603JR-07470RL	Yageo
R59	1	560	RES, 560, 5%, 0.1 W, 0603	0603	RC0603JR-07560RL	Yageo

Table 4-1. Bill of Materials (DRV81602-Q1EVM) (continued)

Designator	Quantity	Value	Description	Footprint	Part Number	Manufacturer
R61	1	150k	RES, 150 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402150KFKED	Vishay-Dale
R72, R75	2	27	RES, 27, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402L	CRCW040227R0JNED	Vishay-Dale
R76	1	1.40k	RES, 1.40 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402L	CRCW04021K40FKED	Vishay-Dale
R77	1	1.0Meg	RES, 1.0M, 5%, 0.063W, AEC-Q200 Grade 0, 0402	0402L	CRCW04021M00JNED	Vishay-Dale
R78	1	33k	RES, 33 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402S	CRCW040233K0JNED	Vishay-Dale
R90, R91, R92, R93, R94, R95, R96	7	100	RES, 100, 1%, 0.063 W, 0402	0402S	RC0402FR-07100RL	Yageo America
R97	1	91.0k	RES, 91.0 k, 0.1%, 0.1 W, 0603	0603L	RG1608P-913-B-T5	Susumu Co Ltd
R98	1	10.0k	RES, 10.0 k, 0.1%, 0.1 W, 0603	0603L	RG1608P-103-B-T5	Susumu Co Ltd
D3	1		LED RED CLEAR 0805 SMD	FP-150080SS75000-MFG	150080SS75000	
S1	1		Tactile Switch SPST-NO Top Actuated Surface Mount	FP-430481025816_SMT_SW_6MM2_6MM2-MFG	430481025816	Wurth Electronics
SH-J1, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10, SH-J11, SH-J12, SH-J19, SH-J22, SH-J23, SH-J24, SH-J25, SH-J26, SH-J27, SH-J28, SH-J29, SH-J31, SH-J32, SH-J33, SH-J34, SH-J35, SH-J36	23		Shunt, 2.54mm, Gold, Black	Wurth_60900213421	60900213421	Wurth Elektronik
TP1, TP35	2		Test Point, Multipurpose, Black, TH	Keystone5011	5011	Keystone Electronics

Table 4-1. Bill of Materials (DRV81602-Q1EVM) (continued)

Designator	Quantity	Value	Description	Footprint	Part Number	Manufacturer
TP2, TP4, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP40, TP41, VM	18		Test Point, Multipurpose, Red, TH	Keystone5010	5010	Keystone Electronics, Keystone
TP3, TP5	2		Test Point, Multipurpose, White, TH	Keystone5012	5012	Keystone Electronics
TP20, TP21, TP22, TP23, TP24, TP25, TP26, TP27, TP28	9		Test Point, Miniature, White, TH	Keystone5002	5002	Keystone Electronics
TP36	1		Test Point, Miniature, Orange, TH	Keystone5003	5003	Keystone Electronics
TP37, TP38, TP39	3		1mm Uninsulated Shorting Plug, 10.16mm spacing, TH	Harwin_D3082-05	D3082-05	Harwin
U1	1		20MHz Mixed Signal Microcontroller with 256 KB Flash, 18432 B SRAM and 74 GPIOs, -40 to 85 degC, 100-pin QFP (PZ), Green (RoHS & no Sb/Br)	PZT0100A_N	MSP430F5338IPZ	Texas Instruments
U2	1		16-Bit Ultra-Low-Power Microcontroller, 128KB Flash, 8KB RAM, USB, 12Bit ADC, 2 USCIs, 32Bit HW MPY, RGC0064B (VQFN-64)	RGC0064B	MSP430F5528IRGCT	Texas Instruments
U3	1		500mA, Adjustable, Low Quiescent Current, Low-Noise, High-PSRR, Single-Output LDO Regulator, DRB0008A (VSON-8)	DRB0008A	TPS73533DRBR	Texas Instruments
U4	1		Ultra-Low Quiescent Current Voltage Regulator, 8-pin Narrow SOIC, Pb-Free	D0008A_N	LM9036M-3.3/NOPB	Texas Instruments
U5	1		8-channel Configurable Low-side and High-side Driver for Automotive Relay, Lighting and Motor Control	PWP0024T-MFG	DRV81602HTSSOP	Texas Instruments
U6	1		Low-Capacitance 2-Channel +/-15kV ESD Protection Array for High-Speed Data Interfaces, DRY0006A (USON-6)	DRY0006A	TPD2E001DRYR	Texas Instruments
Y1	1		Oscillator, 4MHz, 700ppm, 39pF, SMD	MuRata_CSTNR	CSTNR4M00GH5L000R0	MuRata
Y2	1		Crystal, 32.768kHz, 12.5pF, SMD	XTAL_MS3V-T1R	MS3V-T1R 32.768KHZ +/-20PPM 12.5PF	Micro Crystal AG

5 Additional Information

5.1 Known Hardware or Software Issues

If the EVM does not connect to the GUI, then read through this FAQ:[FAQ] Why won't my Motor Driver EVM connect to the GUI?.

On Rev A of the EVMs, the 10uF VM capacitor (C2 on DRV81602-Q1) is only rated for 25V, though the motor drivers are rated for 40V. Applying more than 24V to the EVM is likely to cause this capacitor to rapidly disassemble. This capacitor can be removed from the EVM without affecting the functionality of the device.

On Rev A of the EVMs, the input fuse F1 is rated for 32V. If >32V is applied this fuse can blow even under nominal current conditions. Connect VM to a VM test point after the fuse to bypass this fuse.

5.2 Trademarks

All trademarks are the property of their respective owners.

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

    1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

    1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2   *Limited Warranty and Related Remedies/Disclaimers*:

    2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

    2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

    2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits 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 shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:
EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION 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/lsds/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。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けて

いないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの

措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。 上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・イ

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3.3.3   *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

3.4 *European Union*

3.4.1   *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

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.

4   *EVM Use Restrictions and Warnings:*

4.1   EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2   User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3   *Safety-Related Warnings and Restrictions:*

4.3.1   User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

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.

4.4   User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

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