EVM User's Guide: MCT8315ZEVM
MCT8315Z Evaluation Module

Description

The MCT8315ZEVM allows users to evaluate the performance of the MCT8315Z motor driver. The EVM includes an onboard FTDI chip to convert USB communication from the micro-USB connector into UART. An onboard MSP430FR2355 MCU translates the UART communication and onboard potentiometers into control signals and a variable duty cycle for the PWM input of the MCT8315Z. The MCU can also provide SPI communication for the SPI variant of the MCT8315Z device. There are many user-selectable jumpers, resistors, connectors, and test points to assist with evaluating the many features of the MCT8315Z device and the configurable device-specific settings.

Get Started

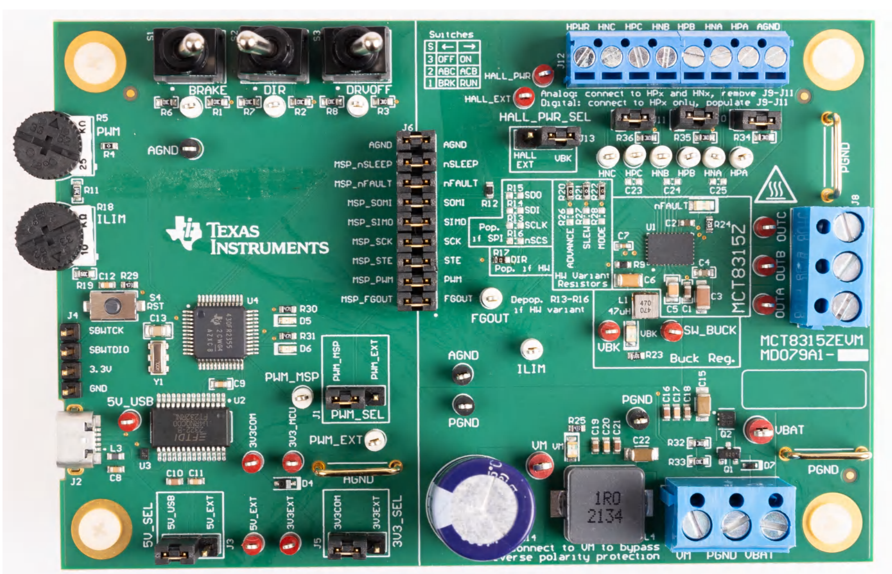
1. Download the latest design files from the MCT8315ZEVM tool page on ti.com.
2. Download or use the cloud hosted MCT8315Z GUI on dev.ti.com.
3. Download the latest firmware for the MCT8315ZEVM on ti.com.

Features

- GUI software with full configuration & control capability.
- MCU-to-MCx shunt jumper header with removable shunts to disconnect main signals going to the motor driver IC from the MCU.
  - The shunts can be removed if the user wants to control the MCT8315Z IC with an external MCU or to use the EVM MCU to control an external MCT8315Z IC.

Applications

- Brushless-DC (BLDC) Motor modules
- CPAP machines
- Printers
- Robotic vacuums
- Small home appliances
- Office automation machines
- Factory automation and robotics



MCT8315ZEVM Printed Circuit Board (PCB - Top View)

1 Evaluation Module Overview

1.1 Introduction

The MCT8315ZEVM comes automatically populated with and configured for the MCT8315ZH. The EVM is also compatible with the MCT8315ZR and MCT8315ZT variants, see Section 2.7.1 for MCT8315ZT compatibility and Section 2.7.2 for MCT8315ZR compatibility.

This document is provided with the MCT8315Z evaluation module (EVM) as a supplement to the MCT8315Z data sheet. This user's guide details the hardware setup instructions, GUI installation, and usage instructions.

CAUTION

Hot surface temperature

The EVM can have high surface temperatures marked by the FIRE triangular symbol on the EVM. Avoid touching the marked hot surface are when driving high currents to prevent potential burn damage.

1.2 Kit Contents

Table 1-1 lists the contents of the EVM kit. Contact the Texas Instruments Product Information Center nearest to you if any components are missing. TI highly recommends that users check the TI website at https://www.ti.com to verify that the latest version of the related software is being used.

Table 1-1. Kit Contents

Item	Quantity
MCT8315ZEVM	1
USB A Male-to-USB B micro male cable	1

1.3 Specification

The MCT8315ZEVM is rated for operation of 35 V maximum and up to 4 A peak. To prevent damage to the MCT8315Z IC and EVM, confirm that the voltage and current specifications are not exceeded.

1.4 Device Information

The MCT8315Z is a 4.5 V to 35 V, 4 A peak three-phase gate driver IC with sensored trapezoidal control for motor drive applications. The MCT8315Z provides three integrated half-bridges and a sensored trapezoidal control in a fixed-function state machine capable of directly driving a 3-phase brushless-DC motor without a microcontroller.

The MCT8315Z integrates a current sensing feature, which eliminates the need for external sense resistors, an LDO for powering external circuits, three analog hall comparators, and many protection features. The MCT8315ZH and MCT8315ZR variants include an integrated output adjustable buck for powering external circuits.

Table 1-2. MCT8315Z Variants

Device Name	Variant
MCT8315ZH	Buck regulator and Hardware
MCT8315ZR	Buck regulator and SPI
MCT8315ZT	Hardware

2 Hardware

2.1 Quick Startup Guide

The MCT8315ZEVM requires a power supply source, which has a recommended operating range from 4.5 V to 35 V. To setup and power the EVM, follow the sequence below:

1. Connect motor phases to A, B, and C on connector J8.
2. Connect Hall sensors to J12 and select Hall power supply to come from VBK or an external Hall supply using J13.
   a. If using digital Hall inputs, then populate J9–J11 with shunt jumpers to enable pullups. Connect the single-ended inputs to only the HPx pins on connector J12. This is the default configuration of the MCT8315ZEVM.
   b. If using analog Hall inputs, then remove J9-J11 and connect differential Hall inputs to HPx and HNx on connector J12.
3. If using the MCT8315ZH or MCT8315ZT, then make sure resistors are populated in HW variant resistors for desired device settings as described in Section 2.7.1.
4. Do not turn on the power supply yet. Connect the motor supply to VBAT or VM and PGND on connector J7.
   a. To enable the reverse polarity protection and Pi filter, connect to VBAT. Note that when connecting to VBAT, VM is VM – 0.7 V less due to a diode drop in the reverse-polarity protection circuit.
   b. To disable the reverse-polarity protection and the Pi filter, connect to VM.
5. Select J3 to 5V_USB and J5 to 3V3COM to power MSP430 from USB power supply.
6. Connect the micro-USB cable into the computer.
7. Turn the R5 potentiometer fully clockwise to set the motor to zero speed upon power up.
8. Flip the switch S1 to the right to configure BRAKE = RUN, switch S2 to the left to configure DIR = ABC, switch S3 to the right to configure DRVOFF = ON.
9. Turn on the motor power supply.
10. Use the R5 potentiometer to control the speed of the motor, the R18 potentiometer to control the cycle-by-cycle current limit, and the switches to disable the motor driver, change the motor's direction, or brake the motor. Optionally, use the MCF8315Z GUI, refer to Section 3.1, to monitor the real-time speed of the motor, put the MCT8315Z into a low-power sleep mode, and read status of the EVMs LEDs.

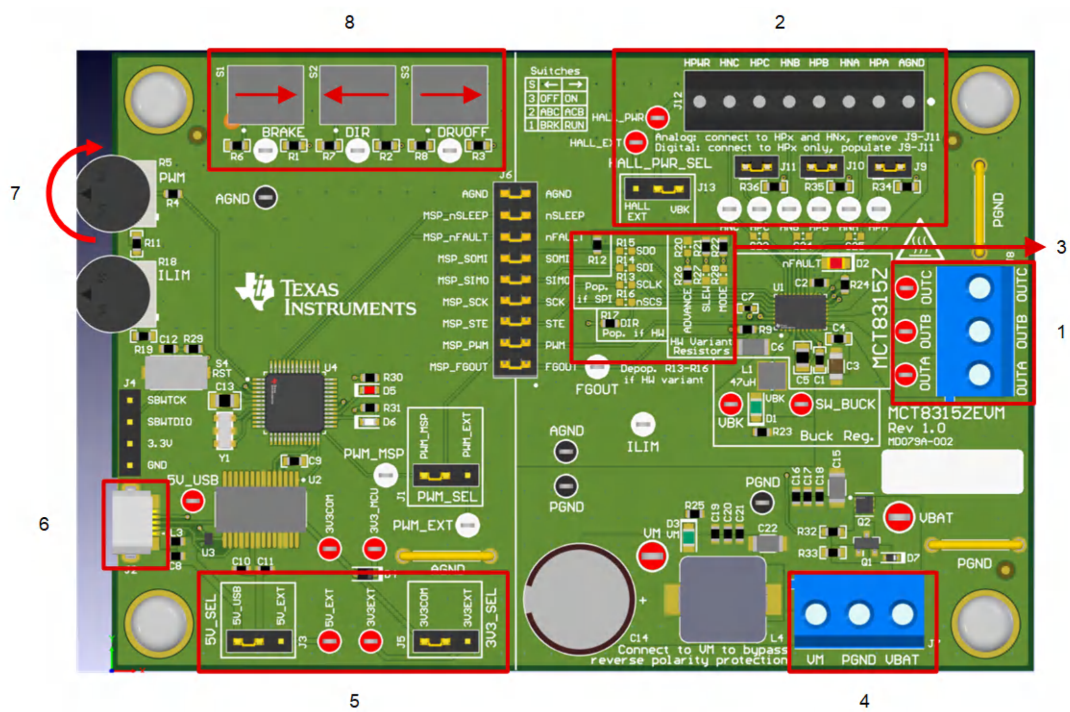


Figure 2-1. Reference for Quick Start Guide

2.2 Hardware Setup

The hardware required to run a motor is the MCT8315ZEVM, a micro-USB cable, and a power supply with a DC output from 4.5 V to 35 V. Follow these steps to start up the MCT8315ZEVM:

1. Connect the DC power supply to header J7. Connect to VBAT and PGND to apply reverse polarity protection and the Pi filter to the EVM. Otherwise, connect to VM and PGND to bypass the reverse polarity protection and Pi filter.
2. If using the MCT8315ZH or MCT8315ZT, populate the desired resistor settings in the “HW Variant Resistors” silk screen box, see Table 2-3. If using the MCT8315ZR populate the resistors R13-R16 in the "Pop. If SPI" silk screen box.
3. Apply user-configurable jumper settings. See the *Section 2.7* section for more information.
4. Flash the program into the MCU as described in Section 3.1. Launch the GUI in GUI Composer and disconnect the 4-pin JTAG connections.
5. Connect a micro-USB cable to the MCT8315ZEVM and computer.
6. Turn on the power supply and power up the PCB.

If using the MCT8315ZEVM with an external microcontroller, remove all shunt jumpers from jumper bridge J6. Connect with external jumpers to the left side of the jumper bridge from the external MCU.

2.3 Hardware Connections Overview

Figure 2-2 shows the major blocks of the MCT8315ZEVM. The MCT8315ZEVM is designed for an input supply from 4.5 V to 35 V and offers reverse-polarity protection and a Pi filter. The MCT8315ZEVM can support all variants of the MCT8315Z device with locations for Hardware resistors, SPI resistors, and buck components. Through the use of configurable shunts the MCT8315ZEVM can support many types of Hall sensor configurations. For interfacing with the MCT8315Z GUI the MCT8315ZEVM has a FTDI chip to support USB-to-UART and a MSP430.

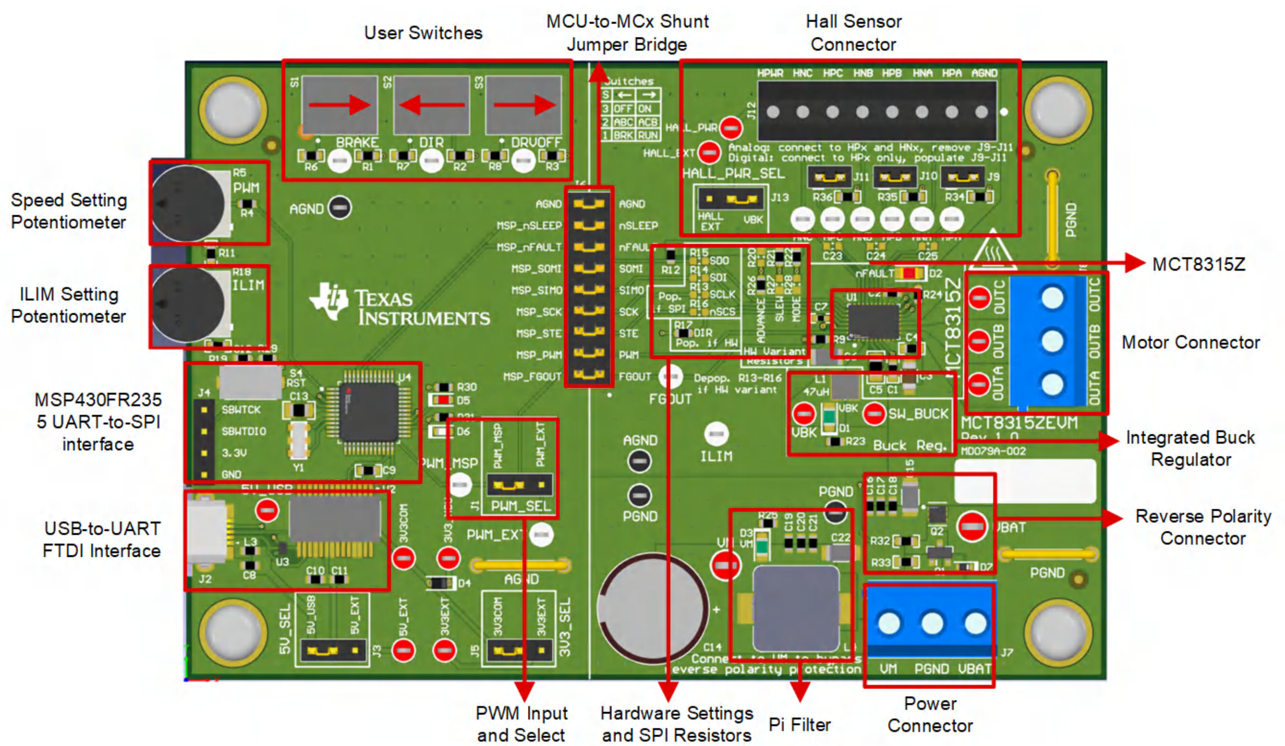


Figure 2-2. MCT8315ZEVM Major Hardware Blocks

2.4 Connection Details

Figure 2-3 shows the connections made to the MCT8315ZEVM to spin a 3-phase sensored brushless-DC motor.

A 4.5-V to 35-V power supply or battery is connected to VBAT or VM and PGND terminals on connector J7. There is a reverse-polarity protection and Pi filter implemented on the VBAT and PGND terminals, resulting in a 0.7-V diode voltage supply drop to VM. To bypass the reverse-polarity protection and Pi filter, connect the power supply directly to the VM terminal or VM test point on the board and PGND.

The three phases of the BLDC motor connect directly to the A, B, and C terminals of the screw terminal connector J8 on the MCT8315ZEVM.

Use connector J12 on the MCT8315ZEVM to connect single-ended digital or analog differential Hall inputs. Use HPWR for Hall power and AGND for Hall ground. If connecting analog inputs from a Hall element, connect to the HPx and HNx pins for each respective phase and remove jumpers J9-11. Otherwise, if using single-ended input from a Hall sensor, connect to only the HPx pins for each phase and populate jumpers J9-J11.

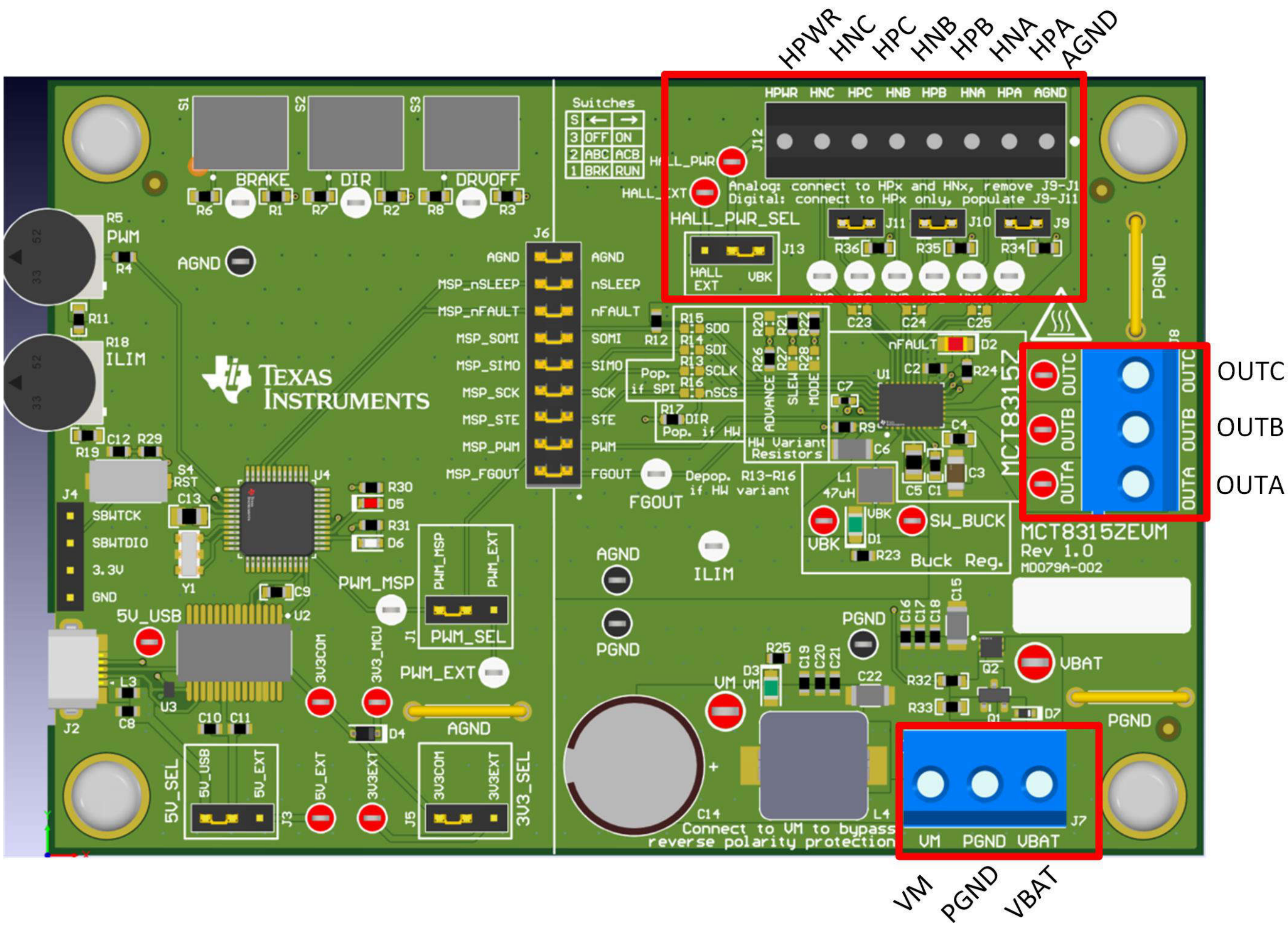


Figure 2-3. Connections from Motor to MCT8315ZEVM

Figure 2-4 shows where the micro-USB cable is plugged into the MCT8315ZEVM to provide communication between evaluation module and GUI. The USB data and 5-V power from the USB is converted, by the FTDI chip, into UART data and 3.3-V power, which is used to power the MSP430FR2355 microcontroller. The 5 V from the USB power is limited to 500 mA and the 3.3 V from the FTDI chip is limited to 30 mA. If the user wishes to supply more current to these rails, then the user can use the 5V_SEL jumper J3 and 3V3_SEL jumper J5 to connect external power rails.

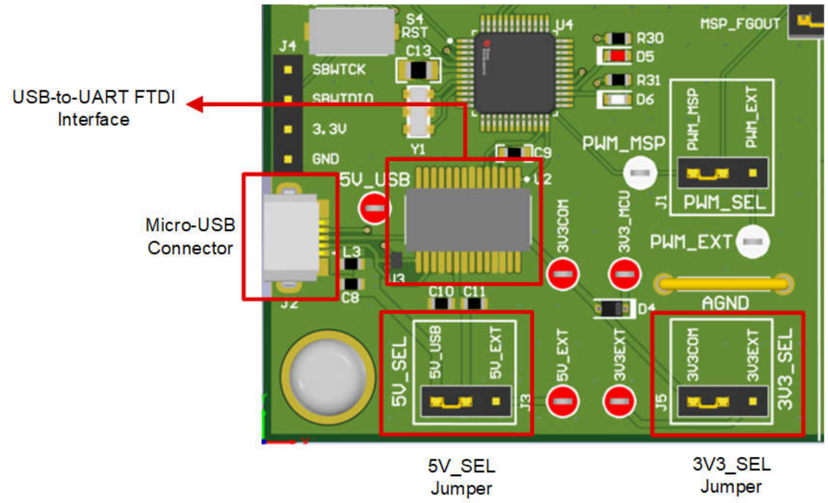


Figure 2-4. Micro-USB Connector and UART for MCT8315ZEVM

2.5 MSP430FR2355 Microcontroller

The MCT8315ZEVM includes a MSP430FR2355 low-power MCU, shown in Figure 2-5, to provide the pulse-width modulation (PWM) signal required to commutate the motor. The MCU outputs a 20-kHz PWM signal (PWM_MSP), and the duty cycle (ranging from 0–100%) is controlled by the potentiometer R5. The motor speed increases the more the potentiometer is turned counterclockwise, and decreases when turned clockwise. To select whether the PWM signal from the MSP or an external PWM is sourced to the MCT8315Z, use the PWM_SEL jumper J1.

To program the MSP430FR2355, an external MSP430 FET programmer must be connected to the Spy-Bi-Wire (SBW) interface connector J4. Many MSP430 LaunchPads™ provide an onboard eZ-FET Debug Probe that can be jumper-wired to the MCT8315ZEVM to flash the firmware into the MSP430FR2355 microcontroller.

The user can use the Reset (RST) button at any time to restart the MCU program. Two active-low LEDs, D5 and D6, can be used for debug purposes as well.

The 18-pin shunt jumper bridge J6 ties all signals between the microcontroller and the MCT8315Z device. These jumpers can be inserted or removed as needed to isolate the microcontroller from the gate driver. This allows for microcontroller signal debugging or using the MCT8315ZEVM as a standalone gate driver with an external microcontroller.

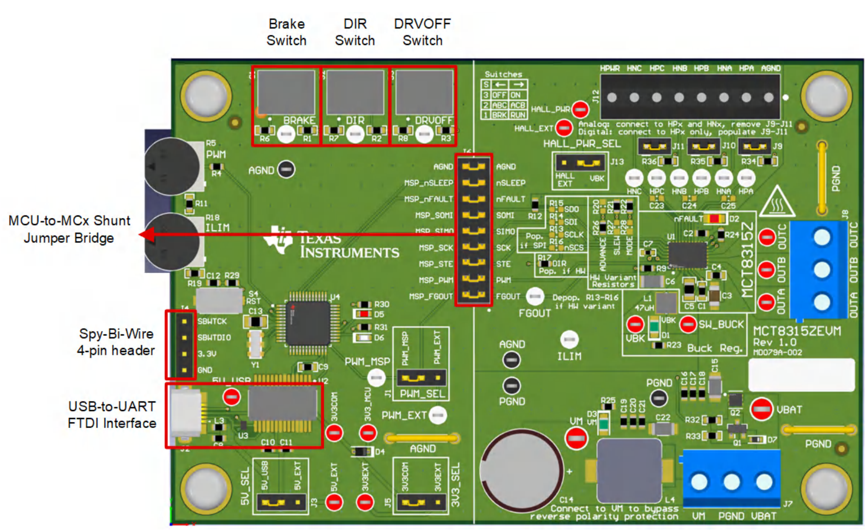


Figure 2-5. MSP430FR2355 MCU on MCT8315ZEVM

2.6 LED Lights

The MCT8315ZEVM has five status LEDs that provide the status of power supplies and functions of the evaluation module. By default, the VM LED and VBK LED lights up when the board is powered and the firmware has been flashed onto the microcontroller. Table 2-1 shows LED descriptions including those that are on during power up in bold and Figure 2-6 shows the locations of the LEDs.

Table 2-1. Description of MCT8315ZEVM LEDs (Default in Bold After Power Up)

Designator	Name	Color	Description
D1	VBK	Green	Internal buck regulator is outputting
D2	nFAULT	Red	Lights up when fault condition has occurred on MCT8315Z
D3	VM	Green	Motor power is supplied to the board
D5	MSP_LED0	Red	Used for UART or debugging
D6	MSP_LED1	Green	Used for UART or debugging

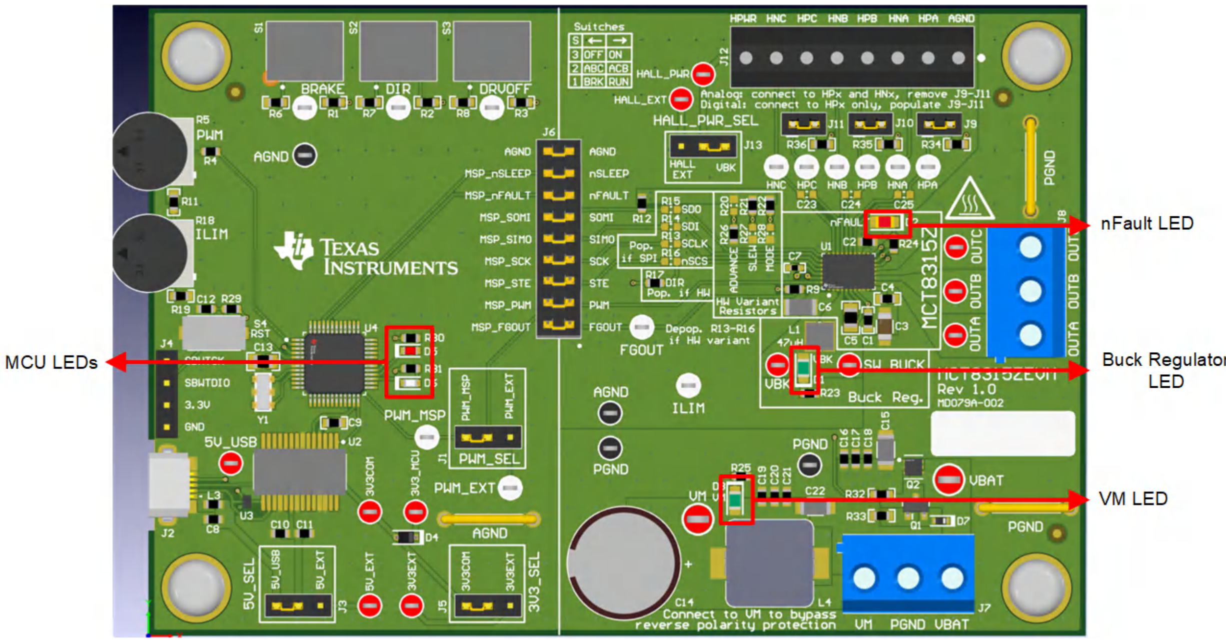


Figure 2-6. MCT8315ZEVM LEDs

2.7 User-Configurable Settings

The MCT8315ZEVM includes a variety of user-selectable jumpers, switches, and resistors on the entirety of the evaluation board to configure settings. Table 2-2 summarizes the configurable settings on the MCT8315ZEVM.

Table 2-2. Description of User-Selectable Settings on MCT8315ZEVM (Default in Bold)

Designator	Setting Name	Description	Layer	Position	Function
L1, L2, R1	3.3-V Buck Inductor	User populates L1, L2, or R1 to choose switching component for buck regulator	Top	**L1 = 47 µH Inductor**	**Inductor Mode**
			Bottom	L2 = 22 µH	Inductor Mode
			Bottom	R1 = 22 Ω	Resistor Mode
J5	3V3_SEL	Select 3.3 V for MCU power	Top	J5 = 3V3EXT	External
				J5 = 3V3COM	**From FTDI (30 mA)**
J3	5V_SEL	Select 5 V for FTDI power	Top	J3 = 5V_EXT	External
				J3 = 5V_USB	**From USB power (500 mA)**
J1	PWM_SEL	Selects PWM source	Top	J1 = PWM_EXT	External PWM
				J1 = PWM_MSP	**PWM from MSP430**
J13	HALL_PWR_SEL	Selects Hall power source	Top	J13 = HALL_EXT	External Hall power
				J13 = VBK	**Hall power from VBK**
J9	HPA pullup	Enables pullup on Hall positive A (HPA)	Top	**J9 is inserted**	**Pullup, use for Digital Hall inputs**
				J9 is removed	Floating, use for Analog Hall inputs
J10	HPB pullup	Enables pullup on Hall positive B (HPA)	Top	**J10 is inserted**	**Pullup, use for Digital Hall inputs**
				J10 is removed	Floating, use for Analog Hall inputs
J11	HPC pullup	Enables pullup on Hall positive C (HPC)	Top	**J11 is inserted**	**Pullup, use for Digital Hall inputs**
				J11 is removed	Floating, use for Analog Hall inputs
J6	MSP to MCT Shunt jumper bridge	Connects signals from MCU to MCT8315Z when jumpers are inserted	Top	**FGOUT**	**MSP_FGOUT**
				PWM	**MSP_PWM**
				STE	**MSP_STE**
				SCK	**MSP_SCK**
				PICO	**MSP_PICO**
				POCI	**MSP_POCI**
				nFAULT	**MSP_nFAULT**
				nSLEEP	**MSP_nSLEEP**
				AGND	**AGND**
S1	BRAKE	Turns on all low-side MOSFETs	Top	Left	Brake enabled
				Right	**Brake disabled**
S2	DIR	Controls direction of motor	Top	**Left**	**Clockwise**
				Right	Counterclockwise
S3	DRVOFF	Disables gate drivers	Top	Left	MCT8315Z disabled
				Right	**MCT8315Z enabled**

2.7.1 Hardware Variant Resistor Settings

The MCT8315ZH and MCT8315ZT devices uses configurable resistor dividers to control the MODE, SLEW, and ADVANCE settings. When using the MCT8315ZH or MCT8315ZT:

- SPI enable resistors in the *Pop. if SPI* silkscreen box needs to be depopulated (R13–R16).
- DIR resistor R17 in the *Pop. if HW* silkscreen box needs to be populated.
- The resistor dividers in the *HW Variant Resistors* silkscreen box needs to be populated according to the desired settings (R20–R22 and R26–R28).

This setup is shown in Figure 2-7.

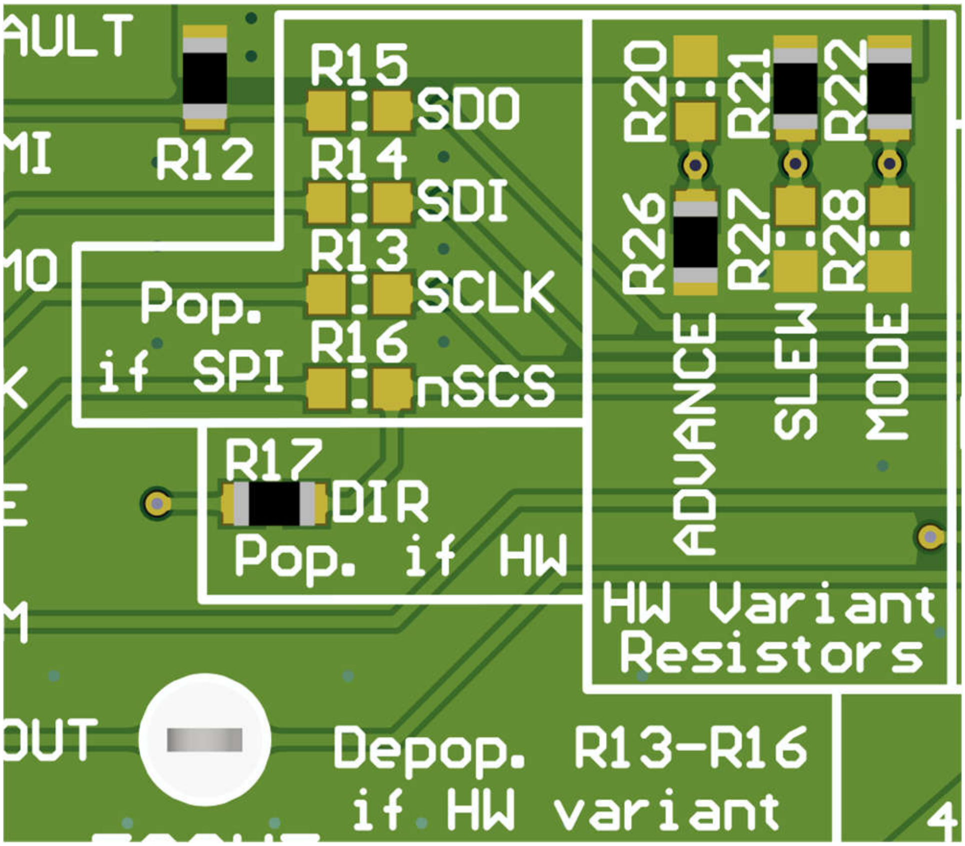


Figure 2-7. Resistor Divider Settings for MCT8315ZH or MCT8315ZT (Hardware Variants)

Table 2-3 shows the user-adjustable resistor divider settings when using the MCT8315ZH or MCT8315ZT. R20–R22 resistors connect to AVDD and R26–R28 resistors connect to AGND. The default resistor divider configurations are in bold.

Table 2-3. User-Adjustable Resistor Divider Settings for MCT8315ZH or MCT8315ZT (Defaults in Bold)

Setting	Name	Description	Resistors (AVDD and AGND)	Configuration	Setting
MODE	PWM Control Mode	Selects the Hall configuration, modulation, Asynchronous Rectification (ASR), and Automatic Asynchronous Rectification (AAR) settings	R22 and R28	R28 = 0 Ω	Analog Hall Input, Asynchronous modulation, ASR and AAR Disabled
				R28 = 22 kΩ	Digital Hall Input, Asynchronous modulation, ASR and AAR Disabled
				R28 = 100 kΩ	Analog Hall Input, Synchronous modulation, ASR and AAR Disabled
				R22 = R28 = DNP	Digital Hall Input, Synchronous modulation, ASR and AAR Disabled
				R22 = 100 kΩ	Analog Hall Input, Synchronous modulation, ASR and AAR Enabled
				R22 = 22 kΩ	Digital Hall Input, Synchronous modulation, ASR and AAR Enabled
				R22 = 0 Ω	**Digital Hall Input, Asynchronous modulation, ASR and AAR Enabled**
SLEW	Slew Rate	Phase pin slew rate switching low to high (10-90%) and high to low (90-10%)	R21 and R27	R27 = 0 Ω	25 V/µs
				R21 = R27 = DNP	50 V/µs
				R21 = 47 kΩ	125 V/µs
				R21 = 0 Ω	**200 V/µs**
ADVANCE	Advance	Advances the lead angle by a selectable value (in electrical degrees)	R20 and R26	**R26 = 0 Ω**	**0°**
				R26 = 22 kΩ	4°
				R26 = 100 kΩ	11°
				R20 = R26 = DNP	15°
				R20 = 100 kΩ	20°
				R20 = 22 kΩ	25°
				R20 = 0 Ω	30°

2.7.2 SPI Variant Resistor Settings

The MCT8315ZR replaces the MODE, ADVANCE, and SLEW pins with SPI pins (SDI, SDO, SCLK, nSCS) to configure control registers and read status registers. When using the MCT8315ZR:

- SPI enable resistors in the *Pop. if SPI* silkscreen box needs to be populated (R13-R16)
- The resistor in the *Pop. if HW* silkscreen box (R17) needs to be depopulated
- Resistor dividers in the *Hardware Variant Resistors* silkscreen box needs to be depopulated (R20-R22, R26-R28).

This setup is shown in Figure 2-8.

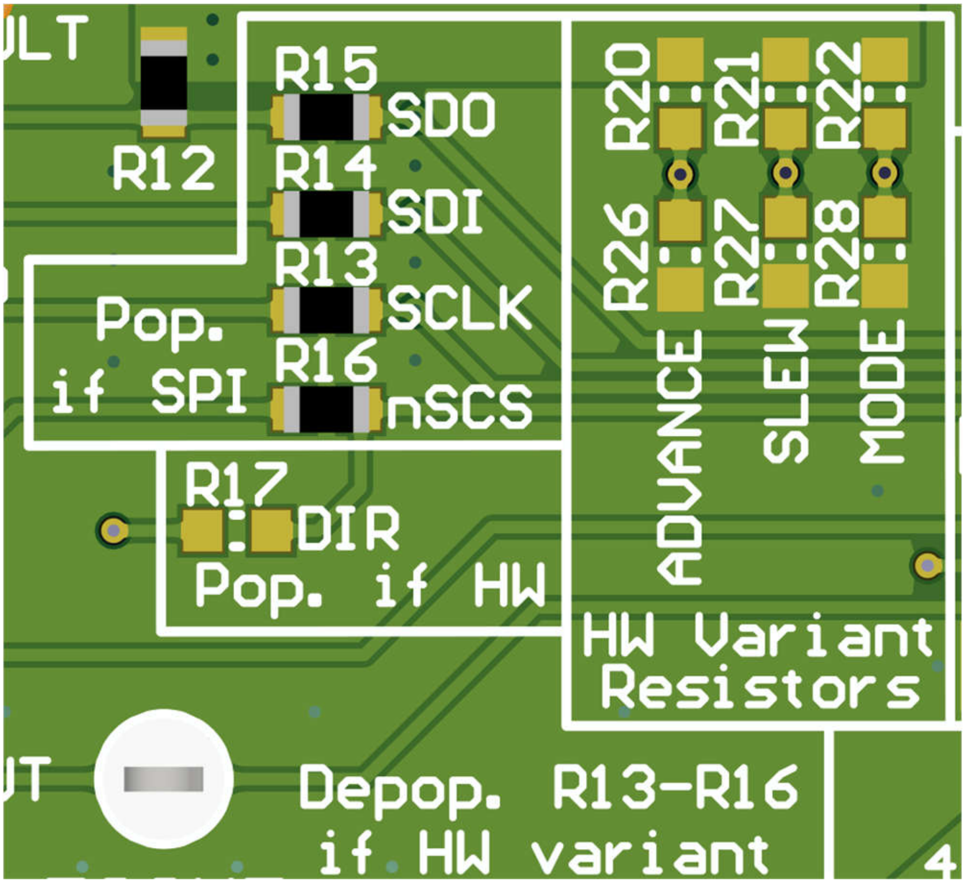


Figure 2-8. Resistors for MCT8315ZR (SPI variant)

Table 2-4 shows the recommended resistor values to use when using a MCT8314ZR.

Table 2-4. Recommended SPI Resistor Values for MCT8314ZR (Defaults in Bold)

Setting	Name	Description	Resistor	Configuration
SDO	Serial Data Out	Serial out of the MCT8315Z	R15	**R15 = 0 Ω**
SDI	Serial Data In	Serial input of the MCT8315Z	R14	**R14 = 0 Ω**
SCLK	Serial Clock	Clock generated by the MCU	R13	**R13 = 0 Ω**
nSCS	Chip Select	Pulled low by the MCU to enable communication	R16	**R16 = 0 Ω**

Table 2-5 show the status of populated and DNP resistors for the MCT8315Z variants.

Table 2-5. Status of Resistors for MCT8315Z Variants

Device	R13-R16 Status	R17 Status	HW Variant Resistors Status
MCT8315ZH or MCT8315ZT	DNP	Populated	User adjustable
MCT8315ZR	Populated	DNP	DNP

3 Software

3.1 Firmware and GUI Application

The MCT8315ZEVM includes a USB-to-UART interface, using a MSP4302355 microcontroller, that serves as a communication bridge between a host PC and the MCT8315Z device for configuring various device settings and reading fault diagnostic information. The MCT8315Z GUI is available to monitor the motor the MCT8315Z device and in the case of the MCT8315ZR configure the device.

The MCT8315Z GUI is available on the dev.ti.com/gallery. The MCT8315Z GUI supports all variants of the MCT8315Z. The MCT8315Z GUI is able to measure the speed of the motor by monitoring the duty cycle of the 20-kHz PWM waveform and the frequency of the FGOUT output. Providing the number of poles the motor has to the GUI, the GUI calculates the speed of the motor in revolutions per minute (RPM). The GUI also allows for the ability to control the nSLEEP signal to put the MCT8315Z into a low power sleep mode. For the MCT8315ZR the GUI also includes a register map and the ability to read and write over SPI to configure the devices registers.

By default, the MSP430 already contains the firmware required for the EVM to be able to connect and communicate with the MCT8315Z GUI. If there is a FW update or the GUI does not connect to the EVM, then the user must flash the code onto the MSP430.

Flashing the firmware onto the EVM requires an external MSP430 LaunchPad™ that includes the eZ-FET Debug Probe and Code Composer Studio™ (CCS). The example in Section 3.4 uses the MSP-EXP430FR2355 LaunchPad Development Kit to provide the eZ-FET Debug Probe.

3.2 MCT8315Z GUI

The following features are enabled in the MCT8315Z GUI:

PWM or Duty Cycle Settings

- Use the R5 potentiometer on the MCT8315ZEVM to control the duty cycle of the 20-kHz PWM waveform from the MSP430FR2355. The slider and gauge updates real-time with the duty cycle from 0–100%.

Motor Settings and Calculations

- Update the number of motor poles in the motor using the *Motor Poles* drop-down box.
- The FGOUT frequency is measured and updated real time in the FGOUT Freq (Hz) box.
- The value in the *FGOUT freq. (Hz)* and *Motor poles* boxes are used to calculate and update the value in the *Motor Speed (RPM)* box. The value for the RPM speed is calculated by the formula in Equation 1. Note that the FGOUT frequency is multiplied by 120 to achieve the frequency of one electrical cycle, in Hz.

$$1\ Motor\ Speed\ (RPM) = \frac{120 \times FGOUT}{\#\ Motor\ Poles} \tag{1}$$

Status LEDs and nSLEEP Control

- The status of the programmable MCU LEDs are shown by LED1 and LED2.
- To place the MCT8315Z into a low-power sleep mode, click the *nSLEEP* button into the right position. This causes the MSP430 to send an active-low signal to nSLEEP on the device.

3.3 Running the GUI

The MCT8315Z GUI can be run directly inside a web browser (supported in Google Chrome® and Firefox®). To run the GUI inside of a web browser, follow the steps below:

1. Connect the MCT8315ZEVM, as described in Section 2.2.
2. Access the latest version of the MCT8315Z GUI through the Gallery
3. The GUI launches a screen similar to the one shown in Figure 3-1.

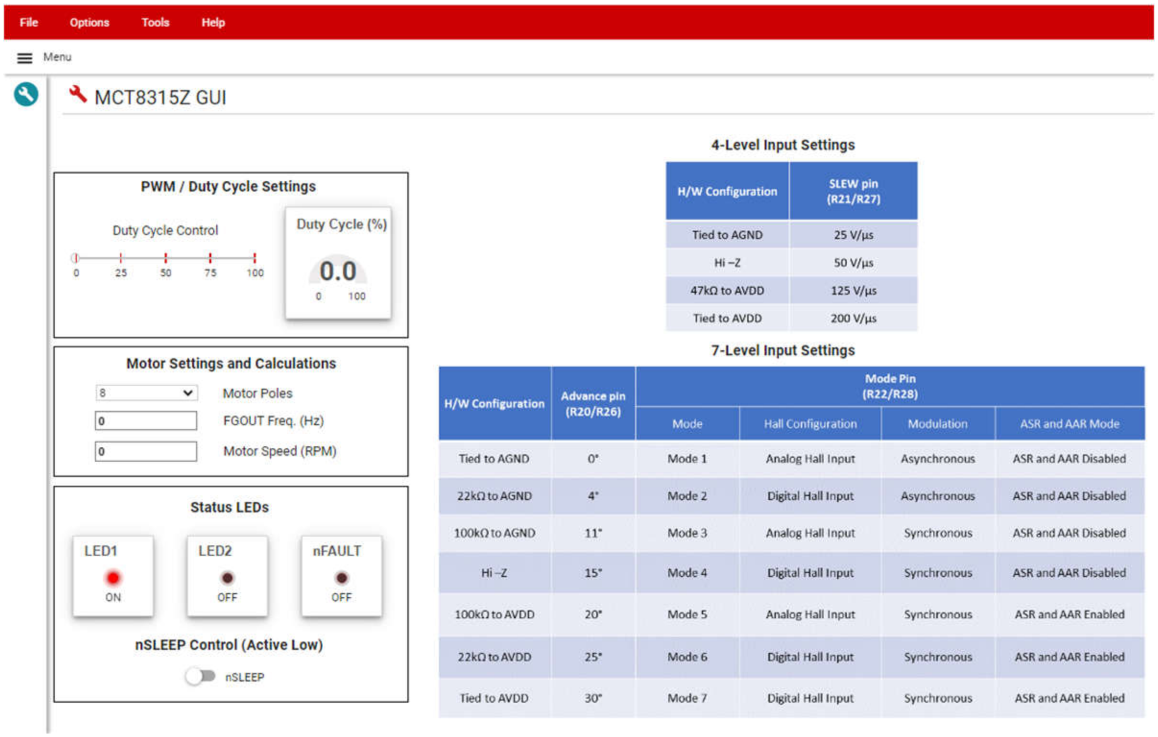


Figure 3-1. MCT8315Z GUI

Alternatively, the MCT8315Z GUI can be downloaded and installed for offline use using the download feature in the TI Cloud Gallery.

Figure 3-2. MCT8315Z GUI Download Feature

3.4 Downloading Code Composer Studio and Importing GUI Firmware

1. Download and extract the MCT8315ZEVM firmware to a location on the computer.
2. Download the latest version of Code Composer Studio. This sets up a folder at the directory C:\ti.
   a. Accept all agreements, default install locations, and select *Next* to proceed through menus.
   b. In the *Select Components* window, make sure to check *MSP430 Low-Power MCUs* to install the required packages for the MSP430 LaunchPad Evaluation Kits.
3. After installing, run CCS and select a folder or the default to use as the workspace to store any new projects. The location and naming convention can be changed based on the user's preference. Click the OK button to accept.
4. In CCS, click on the Project tab and select *Import CCS Projects*. Click on *Browse*. Select the folder created in step 1 by extracting the MCT8315Z firmware.
5. Import the project into the workspace as shown in Figure 3-3.

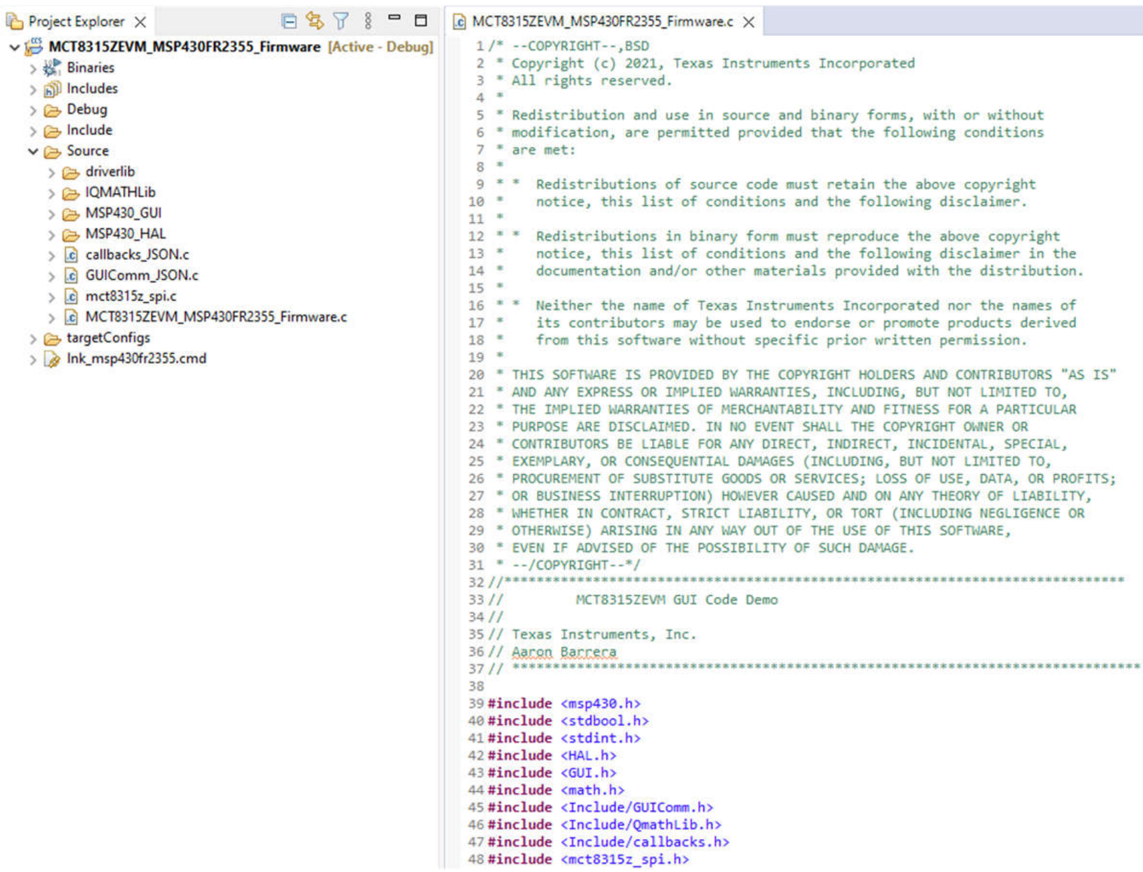


Figure 3-3. MSP430FR2355 Interface Firmware Code in Code Composer Studio

3.5 Using the eZ-FET to Program the MSP430FR2355

The eZ-FET Debug Probe on the MSP430FR2355 LaunchPad uses a Spy-Bi-Wire JTAG interface to program the MSP430FR2355 MCU on the MCT8315ZEVM. Consult the MSP430 LaunchPad Development Kits for MSP430 LaunchPads that include an onboard eZ-FET Debug Probe.

1. Remove the GND, 3V3, SBWTDIO, and SBWTCK jumpers from the MSP430 LaunchPad.
2. Connect the top pins on the eZ-FET side of the LaunchPad of the GND, 3V3, SBWTCK, and SBWTDIO signals to their respective pins on J4 of the MCT8315ZEVM as shown in Table 3-1 and Figure 3-4.
3. Connect a micro-USB cable to the MSP430 LaunchPad and the PC.
4. Click on the Build Project icon or CTRL + B to make sure the project builds successfully. Accept any updates if needed from the console.
5. Click on *Debug Project* to set up a debug session and press the Play button to run the code.
6. Stop the debug session, close Code Composer Studio, disconnect the Spy-Bi-Wire jumpers, and unplug the micro-USB cable from the MSP430 LaunchPad.

Table 3-1. Spy-Bi-Wire Connections Needed to Program MSP430FR2355

MSP430 LaunchPad™ (eZ-FET Debug Probe Side) (J101)	MCT8315ZEVM 4-pin Spy-Bi-Wire Header (J4)
GND	GND
3V3	3.3V
SBWTDIO	SBWTDIO
SBWTCK	SBWTCK

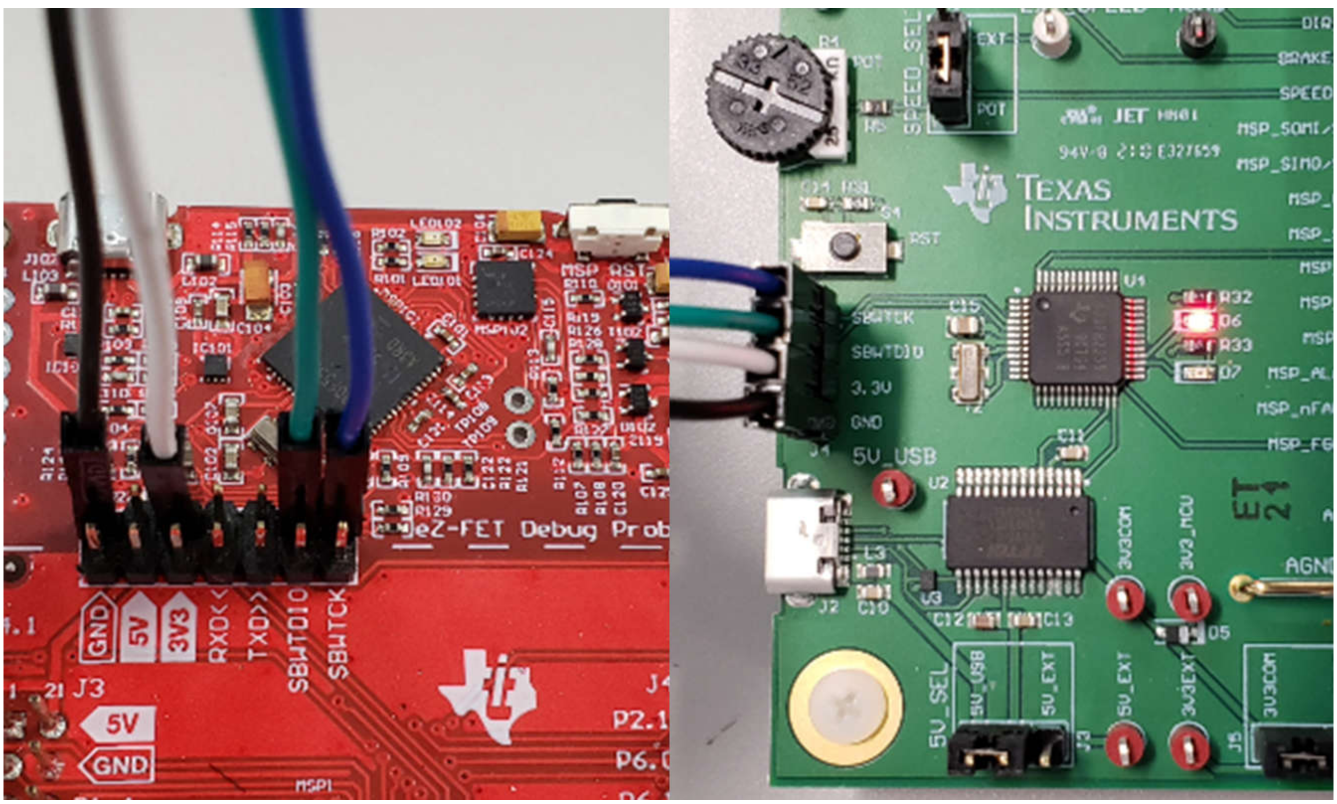


Figure 3-4. MSP430 LaunchPad™ eZ-FET Probe Connected to MCT8315ZEVM

4 Hardware Design Files

4.1 Schematics

4.1.1 MCT8315Z 3-Phase Sensored Trapezoidal Motor Driver

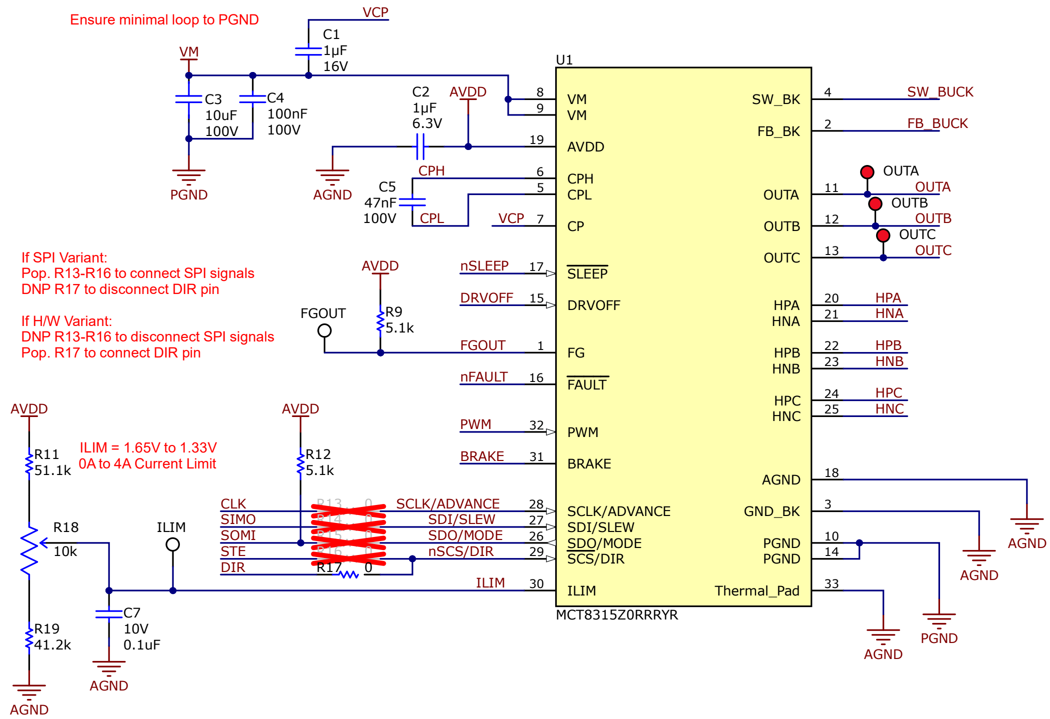


Figure 4-1. MCT8315Z 3-Phase Sensored Trapezoidal Motor Driver Schematic

4.1.2 Power Supplies

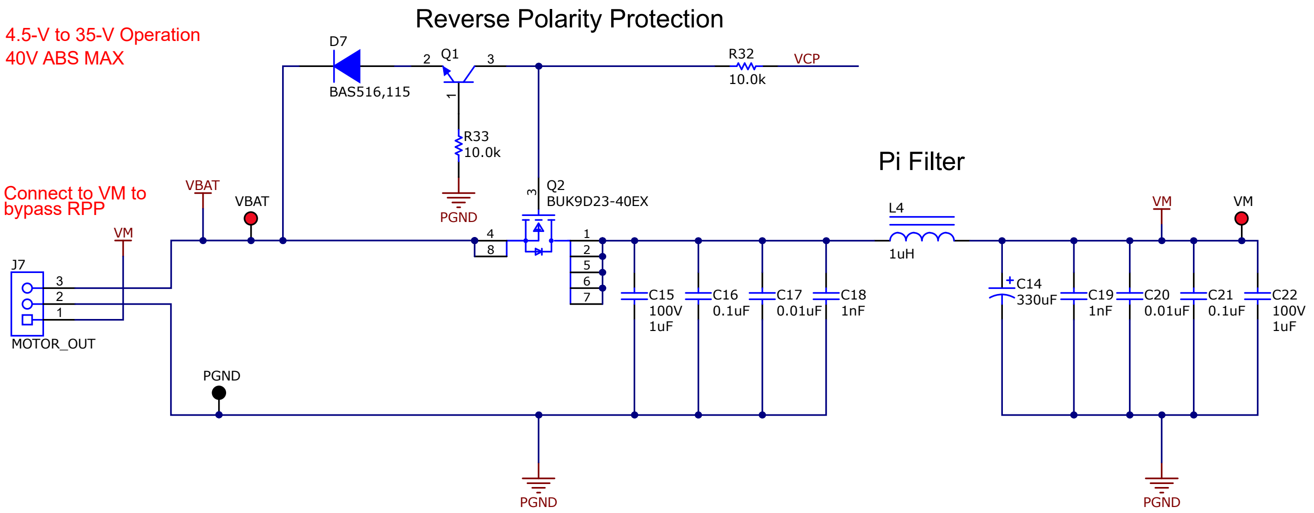


Figure 4-2. Main Supply

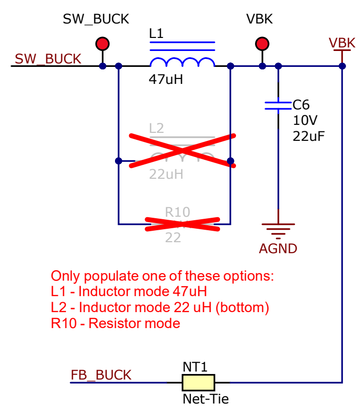


Figure 4-3. Buck Regulator Schematic

4.1.3 MCU Interface

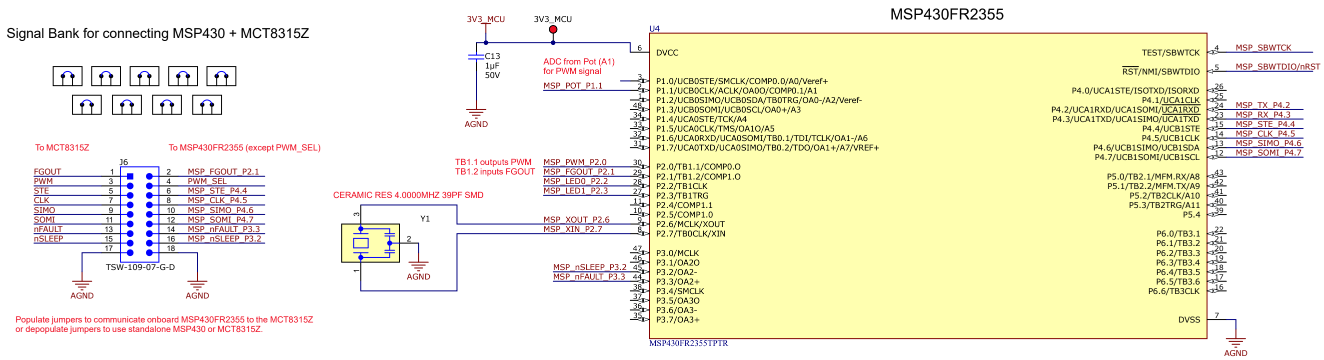


Figure 4-4. MSP430FR2355 MCU

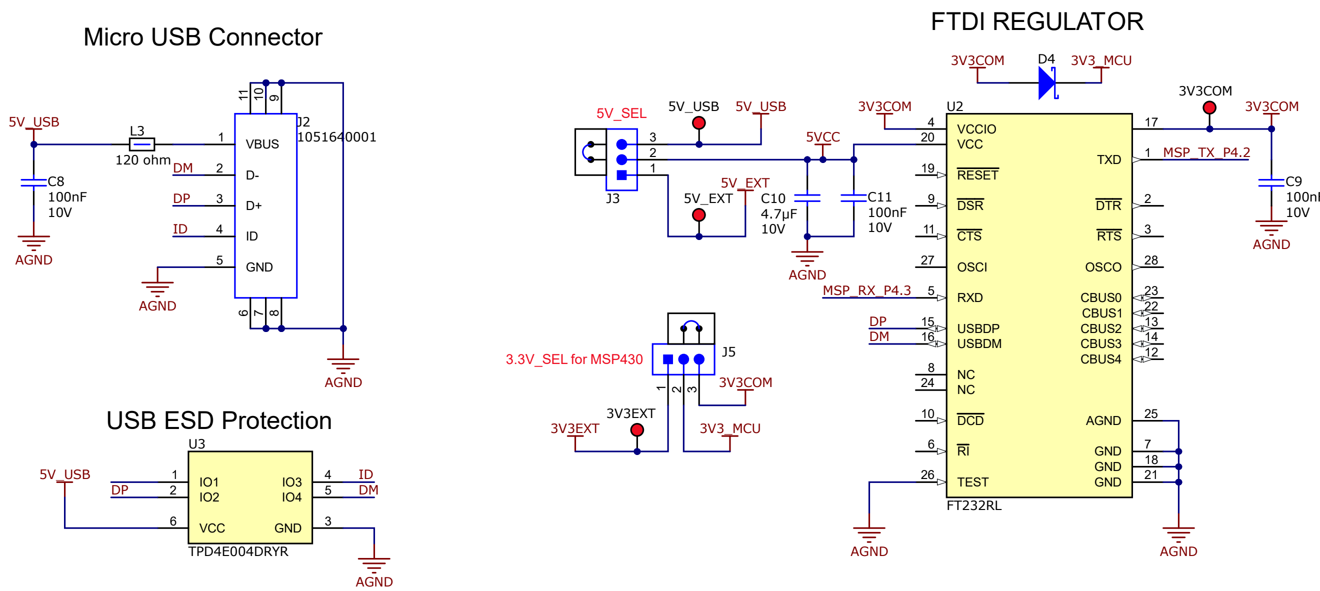


Figure 4-5. USB to UART Schematic

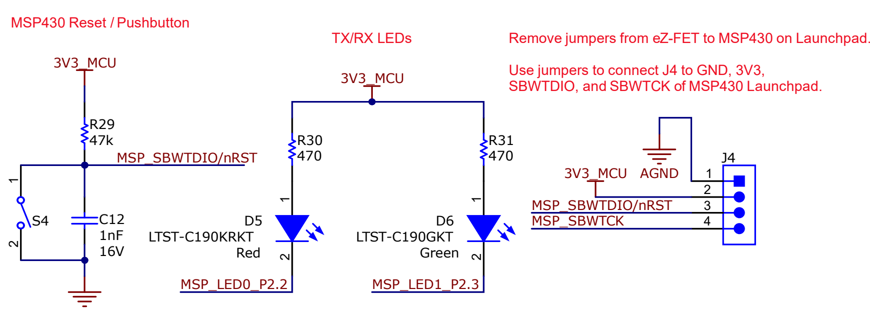


Figure 4-6. MCU Programming and Debug Schematic

4.1.4 User Interface

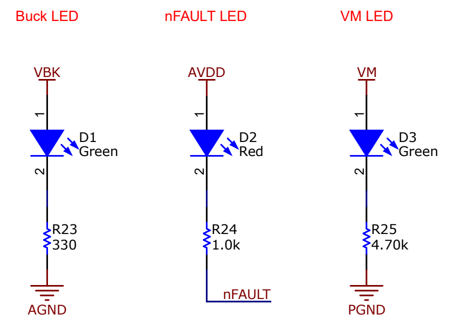
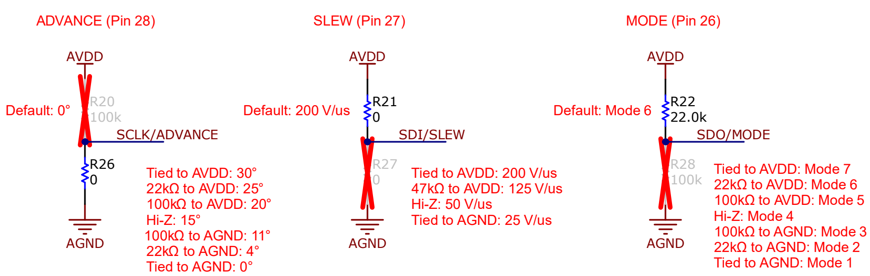


Figure 4-7. Status LEDs Schematic

Hardware Variant Resistors (use with MCT8315ZT/H only)



MODE Type	Hall Config	Modulation	ASR and AAR Mode
Mode 1	Analog Hall	Asynchronous	ASR and AAR Disabled
Mode 2	Digital Hall	Asynchronous	ASR and AAR Disabled
Mode 3	Analog Hall	Synchronous	ASR and AAR Disabled
Mode 4	Digital Hall	Synchronous	ASR and AAR Disabled
Mode 5	Analog Hall	Synchronous	ASR and AAR Enabled
Mode 6	Digital Hall	Synchronous	ASR and AAR Enabled
Mode 7	Digital Hall	Synchronous	ASR and AAR Enabled

Figure 4-8. Hardware Variant Resistors Schematic

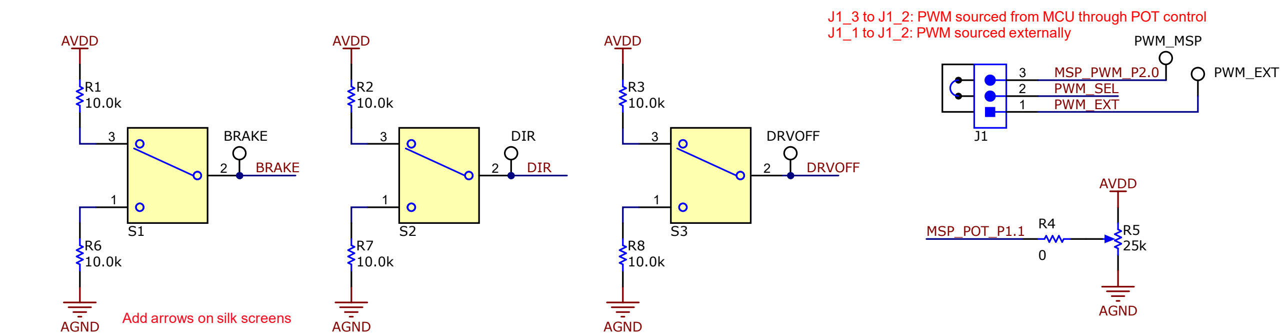


Figure 4-9. Switches and Speed Input Schematic

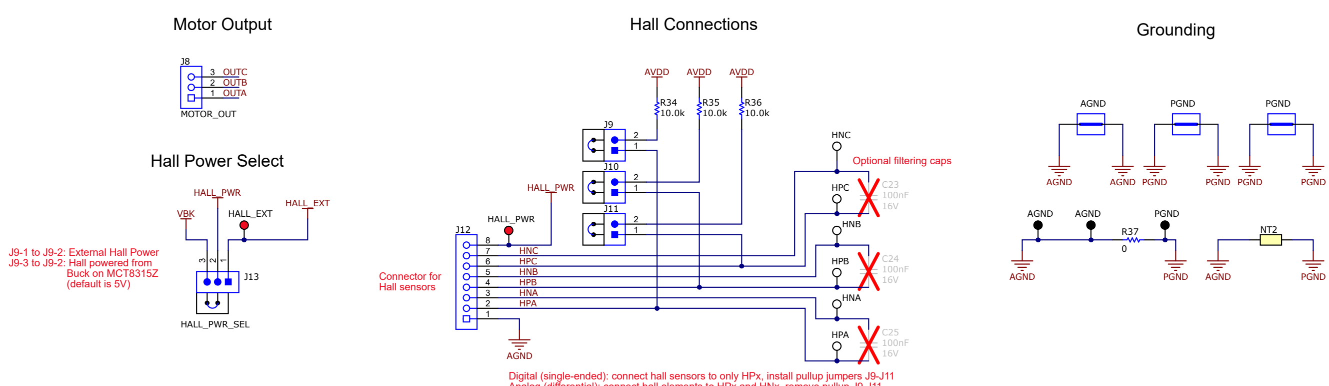


Figure 4-10. Connectors Schematic

4.2 PCB Layouts

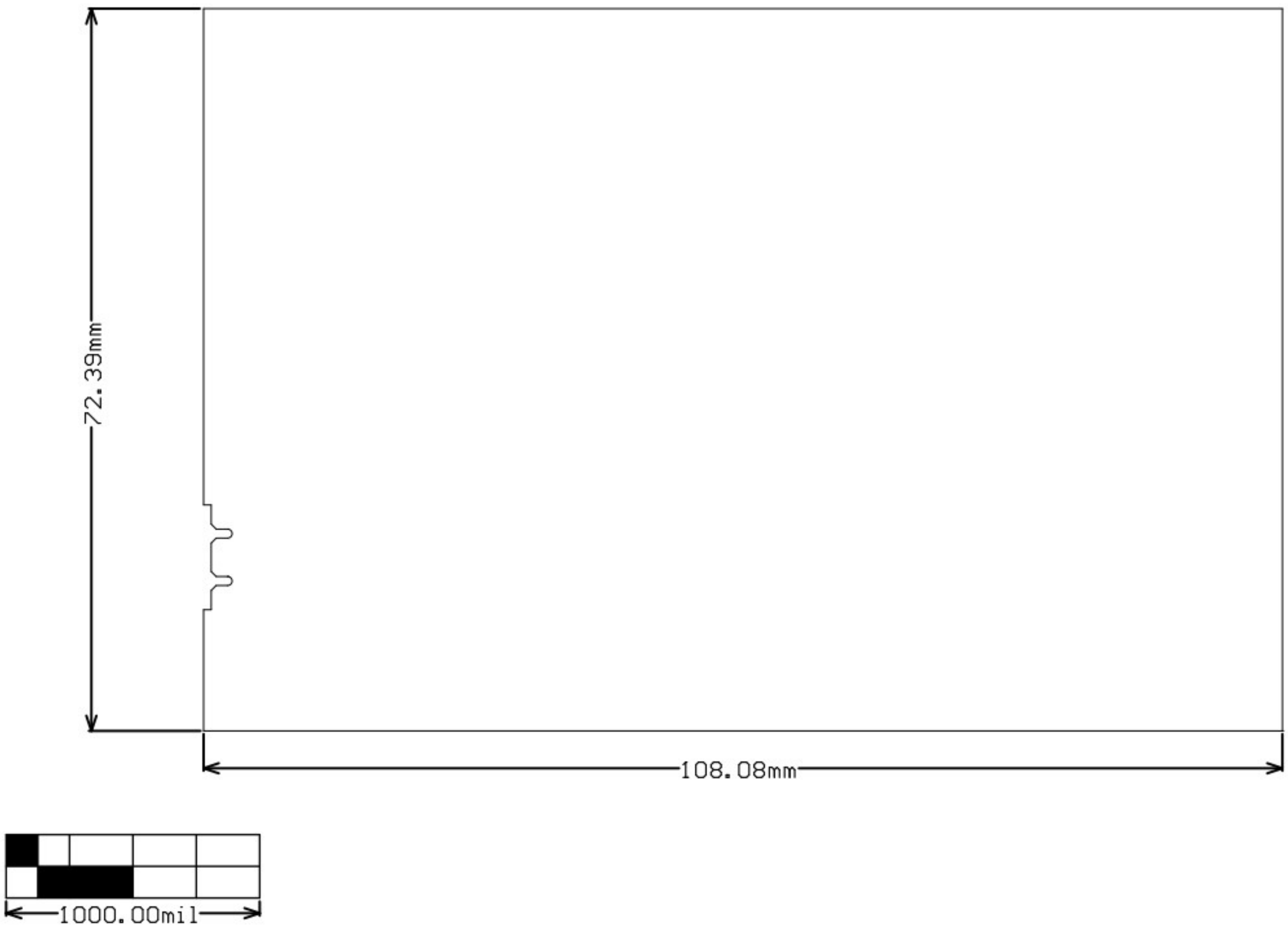


Figure 4-11. EVM Board Dimensions

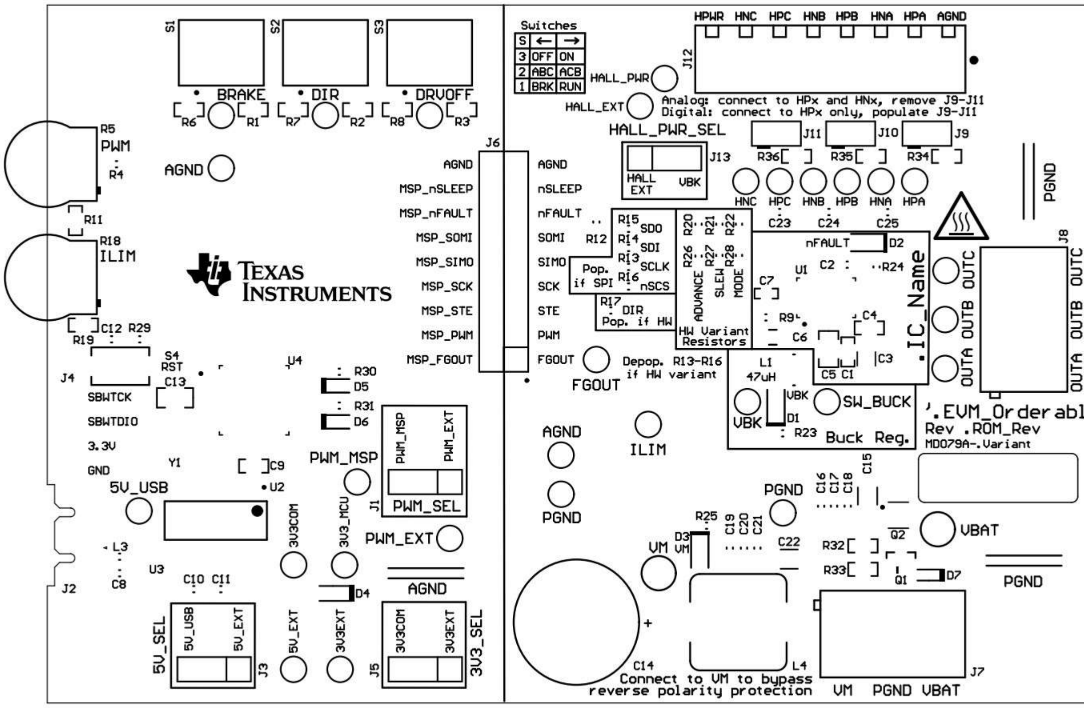


Figure 4-12. EVM Top Overlay

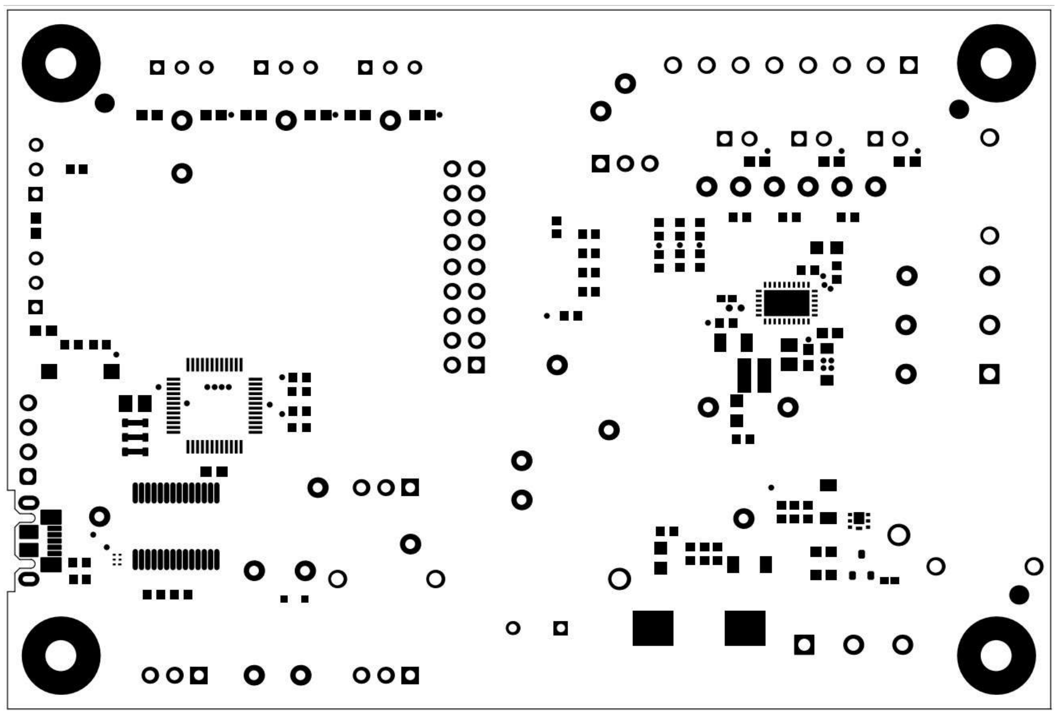


Figure 4-13. EVM Top Solder Mask

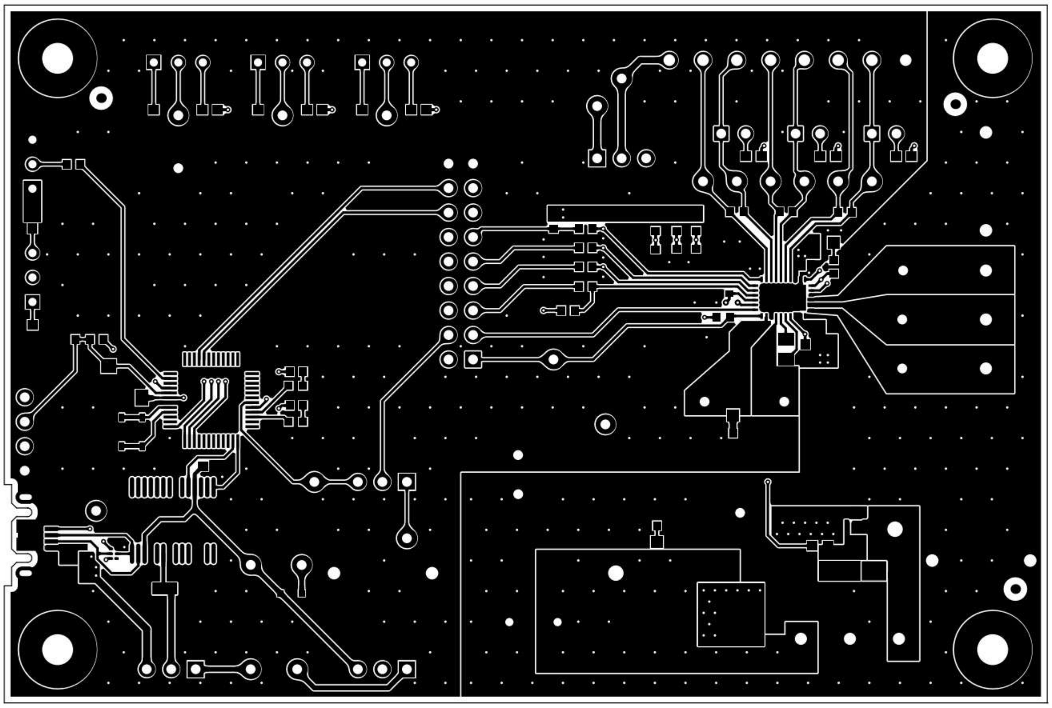


Figure 4-14. EVM Top Layer

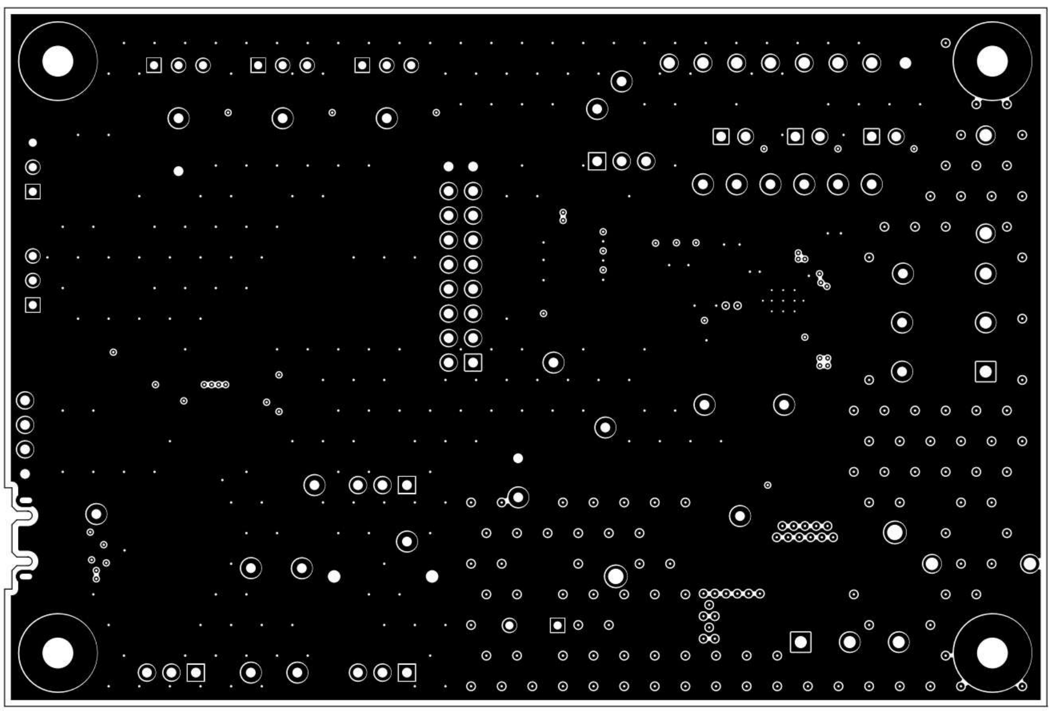


Figure 4-15. EVM Signal Layer 1

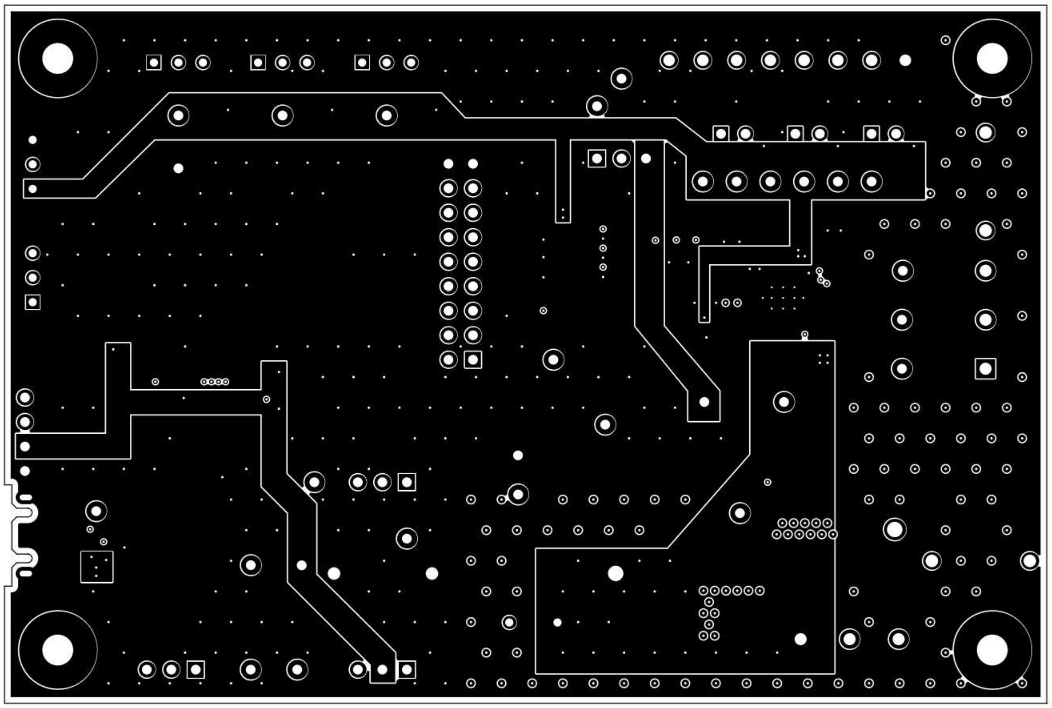


Figure 4-16. EVM Signal Layer 2

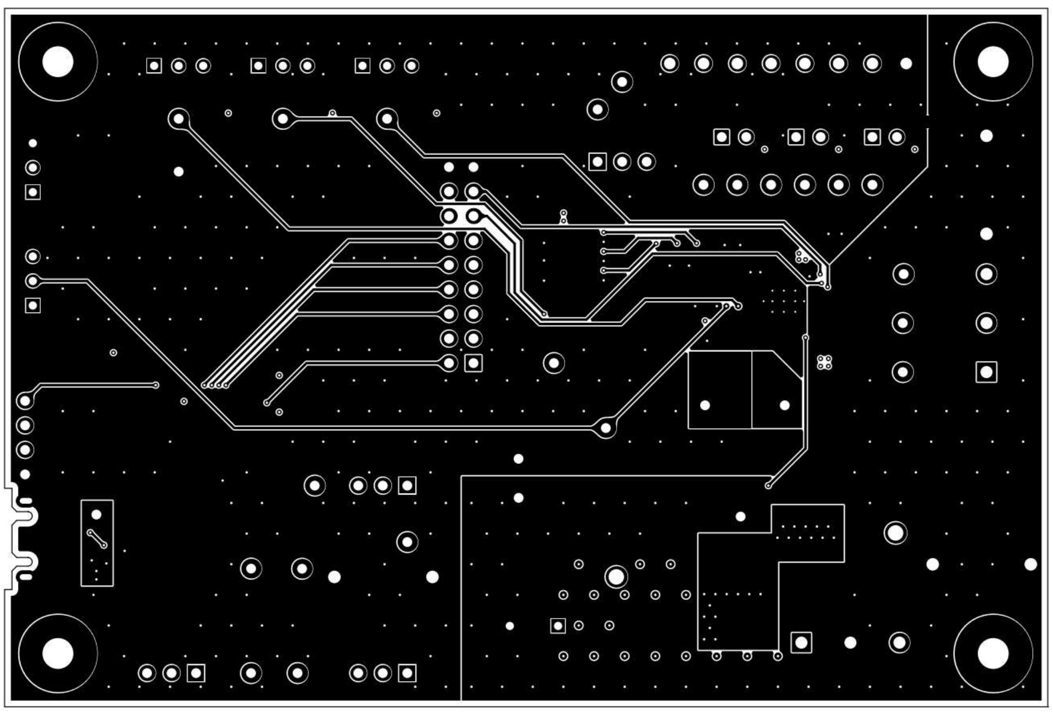


Figure 4-17. EVM Bottom Layer

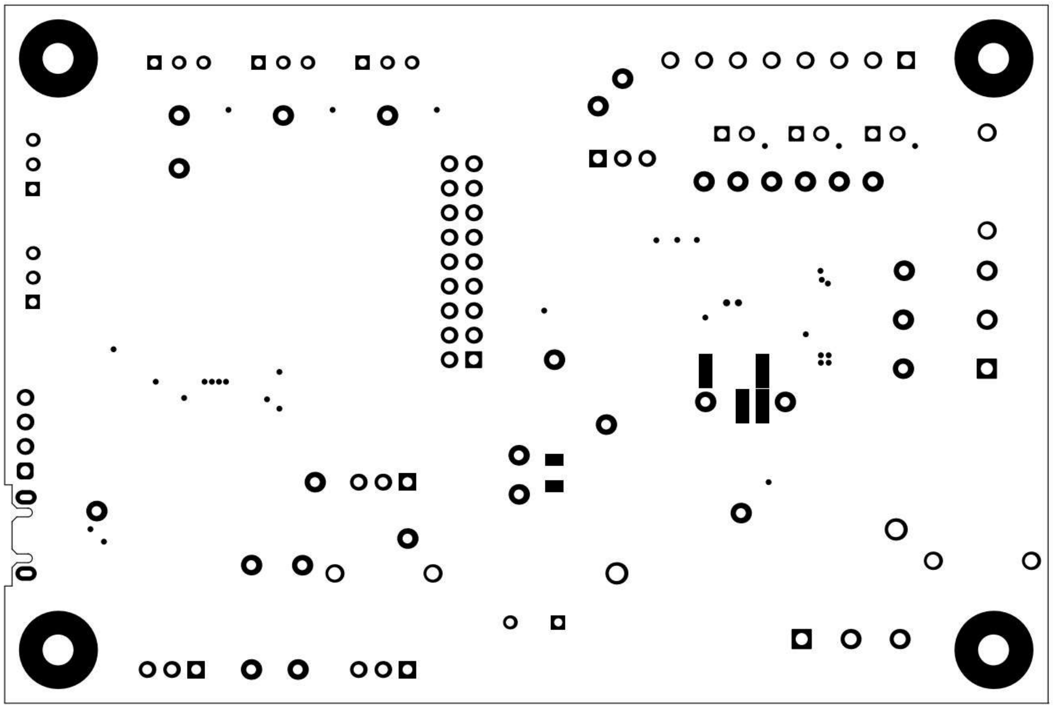


Figure 4-18. EVM Bottom Solder Mask

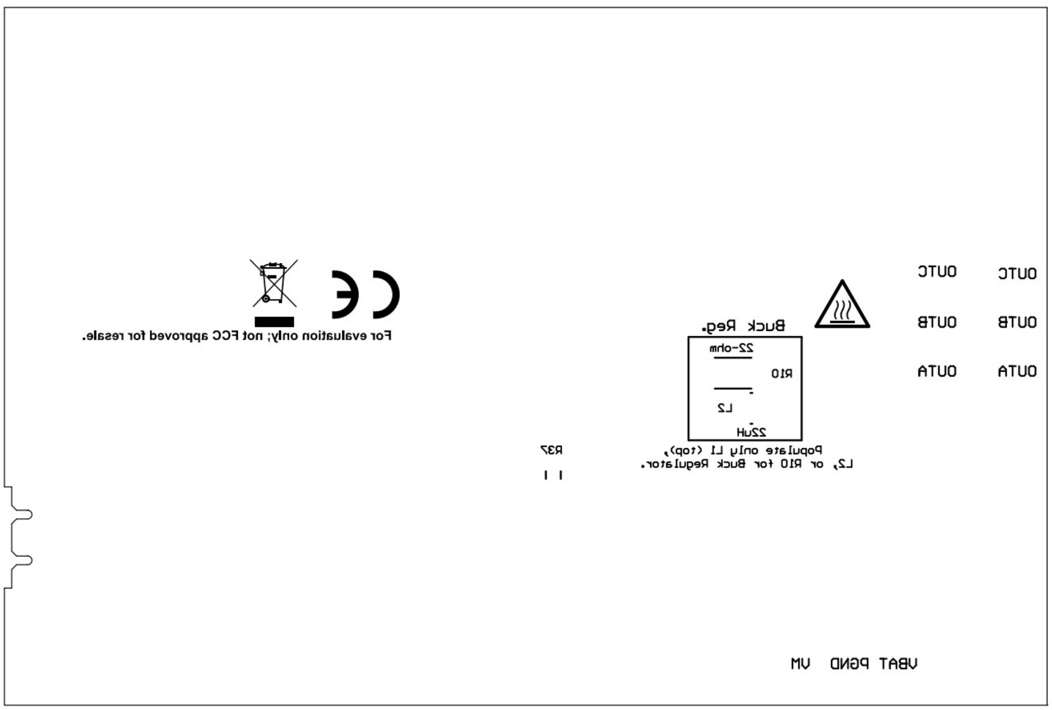


Figure 4-19. EVM Bottom Overlay

4.3 Bill of Materials (BOM)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
C1	1	1uF	CAP, CERM, 1 µF, 16 V,+/- 10%, X5R, 0603	603	0603YD105KAT2A	AVX
C2	1	1uF	CAP, CERM, 1 µF, 6.3 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	603	C0603C105K9RACAUTO	Kemet
C3	1	10 µF	10 µF ±10% 100 V Ceramic Capacitor X6S 1206 (3216 Metric)	1206	C3216X6S2A106K160AC	TDK
C4	1	0.1uF	CAP, CERM, 0.1 uF, 100 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	603	GCJ188R72A104KA01D	MuRata
C5	1	0.047uF	CAP, CERM, 0.047 uF, 100 V, +/- 10%, X7R, 0805	805	C2012X7R2A473K125AA	TDK
C6	1	22uF	CAP, CERM, 22 uF, 10 V, +/- 10%, X7R, 1206	1206	GRM31CR71A226KE15L	MuRata
C7	1	0.1uF	CAP, CERM, 0.1 uF, 10 V, +/- 10%, X5R, 0402	402	C1005X5R1A104K050BA	TDK
C8, C9, C11	3	0.1uF	CAP, CERM, 0.1 uF, 10 V, +/- 10%, X7R, 0603	603	C0603C104K8RACTU	Kemet
C10	1	4.7uF	CAP, CERM, 4.7 uF, 10 V, +/- 20%, X7R, 0603	603	GRM188Z71A475ME15D	MuRata
C12	1	1000 pF	CAP, CERM, 1000 pF, 16 V, +/- 10%, X7R, 0603	603	8.85012E+11	Wurth Elektronik
C13	1	1uF	CAP, CERM, 1 uF, 50 V, +/- 10%, X7R, 0805	805	C0805C105K5RACTU	Kemet
C14	1	330uF	CAP, AL, 330 uF, 63 V, +/- 20%, AEC-Q200 Grade 2, TH	D12.5xL20mm	ELXZ630ELL331MK20S	Chemi-Con
C15, C22	2	1uF	CAP, CERM, 1 uF, 100 V, +/- 10%, X7R, 1206	1206	GRM31CR72A105KA01L	MuRata
C16, C21	2	0.1uF	CAP, CERM, 0.1 uF, 100 V, +/- 10%, X7S, AEC-Q200 Grade 1, 0603	603	CGA3E3X7S2A104K080AB	TDK
C17, C20	2	0.01uF	CAP, CERM, 0.01 uF, 100 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	603	CGA3E2X7R2A103K080AA	TDK
C18, C19	2	1000 pF	CAP, CERM, 1000 pF, 100 V, +/- 5%, X7R, 0603	603	06031C102JAT2A	AVX
D1, D3	2	Green	LED, Green, SMD	LED_0805	LTST-C170KGKT	Lite-On
D2	1	Red	LED, Red, SMD	Red 0805 LED	LTST-C170KRKT	Lite-On
D4	1	40 V	Diode, Schottky, 40 V, 0.75 A, AEC-Q101, SOD-323	SOD-323	BAT165E6327HTSA1	Infineon Technologies
D5	1	Red	LED, Red, SMD	Red LED, 1.6x0.8x0.8mm	LTST-C190KRKT	Lite-On
D6	1	Green	LED, Green, SMD	1.6x0.8x0.8mm	LTST-C190GKT	Lite-On

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
D7	1	100 V	Diode, Switching, 100 V, 0.25 A, SOD-523	SOD-523	BAS516,115	Nexperia
FID1, FID2, FID3	3		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J1, J3, J5, J13	4		Header, 100mil, 3x1, Gold, TH	PBC03SAAN	PBC03SAAN	Sullins Connector Solutions
J2	1		Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT	Receptacle, USB 2.0, Micro B, 5 Pos, 0.65mm Pitch, R/A, SMT	1051640001	Molex
J4	1		Header, 100mil, 4x1, Gold, TH	4x1 Header	TSW-104-07-G-S	Samtec
J6	1		Header, 100mil, 9x2, Gold, TH	9x2 Header	TSW-109-07-G-D	Samtec
J7, J8	2		Terminal Block, 5.08 mm, 3x1, Brass, TH	3x1 5.08 mm Terminal Block	ED120/3DS	On-Shore Technology
J9, J10, J11	3		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions
J12	1		Terminal Block, 8x1, 3.5mm, TH	8x1 Terminal Block	OSTTE080161	On-Shore Technology
L1	1	47uH	Inductor, Shielded, Powdered Iron, 47 uH, 0.39 A, 2.3 ohm, AEC-Q200 Grade 1, SMD	SMD, 2-Leads, Body 3x3mm	78438335470	Wurth Elektronik
L3	1		Inductor, Ferrite Bead, Ferrite, 3 A, 120 ohm, AEC-Q200 Grade 1, SMD	603	BLM18SG121TZ1D	MuRata
L4	1	1uH	Inductor, Shielded, Powdered Iron, 1 uH, 18 A, 0.003 ohm, AEC-Q200 Grade 1, SMD	11x10mm	SRP1038A-1R0M	Bourns
LBL1	1			PCB Label 0.650 x 0.200 inch	THT-14-423-10	Brady
Q1	1	80 V	Transistor, NPN, 80 V, 1.5 A, AEC-Q101, SOT-23	SOT-23	FMMT620TA	Diodes Inc.
Q2	1		N-Channel 40 V 8 A (Ta) 15W (Tc) Surface Mount DFN2020MD-6	SOT1220	BUK9D23-40EX	Nexperia
R1, R2, R3, R6, R7, R8, R32, R33, R34, R35, R36	11	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	603	RC0603FR-0710KL	Yageo

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
R4, R17, R21, R26	4	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	603	ERJ-3GEY0R00V	Panasonic
R5	1	25k	Trimmer Potentiometer, 25kohm, 0.5W, TH	9.53x8.89mm	3352T-1-253LF	Bourns
R9, R12	2	5.1k	RES, 5.1 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	603	CRCW06035K10JNEA	Vishay-Dale
R11	1	51.1k	RES, 51.1 k, 1%, 0.1 W, 0603	603	RC0603FR-0751K1L	Yageo
R18	1	10k	10 kOhms 0.5W, 1/2W Through Hole Thumbwheel Potentiometer Top Adjustment	PTM_PTH_8MM9_9MM5 3	3352T-1-103LF	Bourns
R19	1	41.2k	RES, 41.2 k, 1%, 0.1 W, 0603	603	RC0603FR-0741K2L	Yageo
R22	1	22.0k	RES, 22.0 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	603	ERJ-3EKF2202V	Panasonic
R23	1	330	RES, 330, 1%, 0.1 W, 0603	603	RC0603FR-07330RL	Yageo
R24	1	1.0k	RES, 1.0 k, 5%, 0.1 W, 0603	603	RC0603JR-071KL	Yageo
R25	1	4.70k	RES, 4.70 k, 0.1%, 0.1 W, 0603	603	RT0603BRD074K7L	Yageo America
R29	1	47k	RES, 47 k, 5%, 0.1 W, 0603	603	RC0603JR-0747KL	Yageo
R30, R31	2	470	RES, 470, 5%, 0.1 W, 0603	603	RC0603JR-07470RL	Yageo
R37	1	0	RES, 0, 5%, 0.25 W, AEC-Q200 Grade 0, 1206	1206	RCA12060000ZSEA	Vishay-Dale
S1, S2, S3	3		SWITCH TOGGLE SPDT 0.4VA 28 V	6.8x23.1x8.8mm	B12AP	NKK Switches
S4	1		Switch, Tactile, SPST, 12 V, SMD	SMD, 6x3.9mm	4.34121E+11	Wurth Elektronik
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10, SH-J11, SH-J12, SH-J13, SH-J14, SH-J15, SH-J16	16	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec
TP1, TP2, TP3, TP4, TP5, TP11, TP12, TP21, TP22, TP28, TP29, TP30, TP31	13		Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone Electronics
TP6, TP7, TP8, TP9, TP10, TP13, TP14, TP23, TP27, TP32, TP33, TP34	12		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone Electronics

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
TP15, TP16	2		Test Point, Compact, Red, TH	Red Compact Testpoint	5005	Keystone Electronics
TP17, TP24, TP25, TP26	4		Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone Electronics
TP18, TP19, TP20	3		1 mm Uninsulated Shorting Plug, 10.16mm spacing, TH	Shorting Plug, 10.16mm spacing, TH	D3082-05	Harwin
U1	1		MCT8315Z0HRRYR	WQFN32	MCT8315Z0HRRYR	Texas Instruments
U2	1		USB to Serial UART, SSOP28	SSOP28	FT232RL	FTDI
U3	1		4-Channel ESD Protection Array for High-Speed Data Interfaces, DRY0006A (USON-6)	DRY0006A	TPD4E004DRYR	Texas Instruments
U4	1		CPU16 MSP430™ FRAM Microcontroller IC 16-Bit 24 MHz 32 KB (32K x 8) FRAM 48-LQFP (7x7)	LQFP48	MSP430FR2355TPTR	Texas Instruments
Y1	1		Resonator, 4 MHz, 39 pF, AEC-Q200 Grade 1, SMD	4.5x1.2x2 mm	CSTCR4M00G55B-R0	MuRata

5 Additional Information

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