EVM User's Guide: TMAG3101EVM

TMAG3101-Q1 Evaluation Module

Description

The TMAG3101EVM is an easy-to-use platform to evaluate the main features and performance of the TMAG3101-Q1 device, which is a configurable linear 3D Hall-effect sensor with SENT, Triggered SENT, PWM, and analog output options. The evaluation module (EVM) includes one magnet and a TMAG3101EVM daughterboard. The EVM works with a sensor controller board (SCB), TI-SCB (sold separately), which enables the accompanying GUI.

Get Started

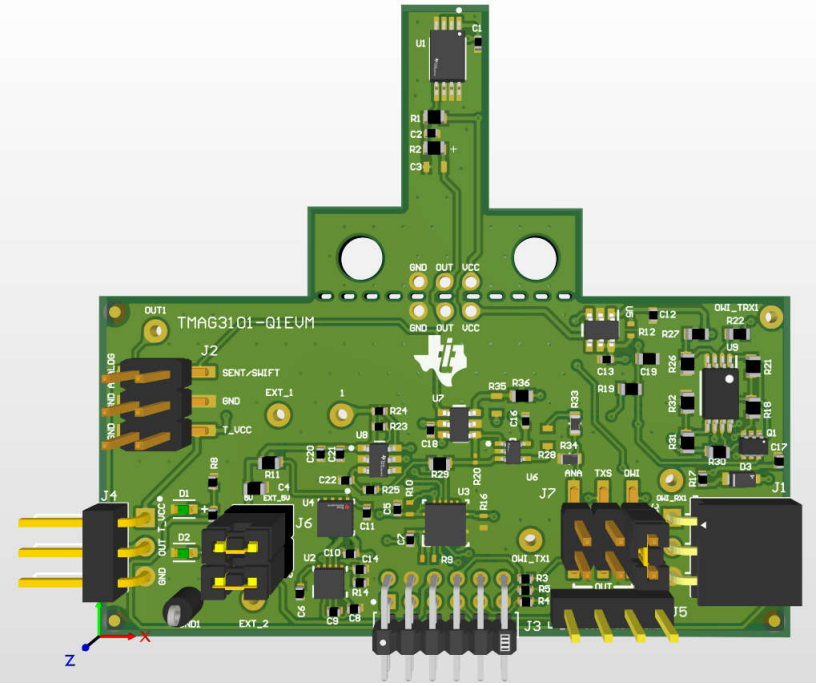
1. Order the TMAG3101EVM.
2. Order the TI-SCB (sold separately) and connect the TMAG3101EVM to the TI-SCB.
3. Download and install the latest firmware for the TMAG3101EVM to the TI-SCB.
4. Connect the USB to the TI-SCB.
5. Evaluate the EVM using the TMAG3101EVM GUI.

Features

- Easy-to-use platform for evaluating the main features and performance of the TMAG3101-Q1
- GUI support to read and write device EEPROM and registers, as well as view and save measurement results
- Compatible with 3D print rotate and push module (sold separately) for generating magnetic fields in the x, y, and z directions
- Detachable EVM for custom use cases
- Conveniently powered from a common micro USB connector

Applications

- Steering angle
- Brake position
- Torque sensing
- Actuator valve position
- E-shifter
- Battery cooling
- Chassis level sensing
- Seat comfort



TMAG3101-Q1 Evaluation Module

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1 Evaluation Module Overview

1.1 Introduction

The TMAG3101-Q1 is a 3-axis (3D) linear Hall-effect sensor. This device has three independent Hall sensors on the X, Y, and Z axes. The integrated EEPROM memory enables storage of configuration and linearization data inside the sensor. A precision analog signal-chain along with integrated 20-bit ADC enables high accuracy and low drift magnetic field measurements. The device can be calibrated and programmed using the one-wire SWIFT™ interface. The device supports user selectable SENT, Triggered SENT, PWM, and Analog interfaces. TMAG3101-Q1 Evaluation Module shows the TMAG3101EVM.

1.2 Kit Contents

Table 1-1 lists the contents of the EVM kits. Contact the nearest Texas Instruments Product Information Center if any component is missing.

Table 1-1. Kit Contents

ITEM	QUANTITY
TMAG3101EVM	1
Handheld magnet	1

1.3 Specifications

Table 1-2 lists the EVM specifications.

Table 1-2. TMAG3101EVM Specifications Summary

PARAMETER	CONDITIONS	TYP	UNIT
I/O CHARACTERISTICS			
TMAG3101-Q1 V_{CC} supply voltage, V_{VCC}		5	V
Magnetic Characteristics			
Linear Magnetic Range, B_{Range}	_RANGE = 0h	±50	mT
Linear Magnetic Range, B_{Range}	_RANGE = 1h	±100	mT
Linear Magnetic Range, B_{Range}	_RANGE = 2h	±150	mT

Table 1-3 lists the specifications for the included magnet.

Table 1-3. Handheld Magnet Specifications

Magnet Feature	Description
Dimension	3/8" diameter × 1/2" thick
Material	NdFeB, Grade N42
Magnetization Direction	Axially Magnetized
Link to Magnet	D68PC-RB, K&J Magnetics, Inc.

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1.4 Device Information

The TMAG3101EVM can be used with the Rotate and Push 3D print module (sold separately). Table 1-4 provides the summary of the sensitivity range options for available for the TMAG3101-Q1 device. The TMAG3101-Q1 has 50mT, 100mT, and 150mT variant options that can be selected from. The appropriate range is chosen so that the range is larger than the desired maximum magnetic flux density to sense. Selecting the smallest range setting that is larger than the maximum magnetic flux density to sense provides the best accuracy. For example, if the maximum-sensed flux density in a system is 65mT, then select the 100mT range of the device because the 50mT range is not able to sense the maximum magnetic flux density seen in the system.

Table 1-4. TMAG3101-Q1 Device Summary

PRODUCT	MAGNETIC RANGE OPTIONS
TMAG3101-Q1	±50mT, ±100mT, ±150mT

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2 Hardware

2.1 TMAG3101-Q1 EVM Components

This section describes the main TMAG3101-Q1 device and supporting components. The EVM has the following components:

- U1 is the TMAG3101-Q1 device.
- C1 and C23 are decoupling capacitors placed near the sensor to help mitigate power-supply noise. C2 is a decoupling capacitor on the device output pin. C3 (DNP) is optional for analog mode up to 330nF. R1 is a pullup resistor for the device output and R2 can be used to meet ESD requirements.
- U3 is the TXS0104ERGYR voltage level translator to translate the 5V output signal to 3.3V logic for the SCB. This level translator is selected along the digital path when R35 is populated, R36 is depopulated, and J7 is set to TXS. Alternatively, populating R36, depopulating R35, and setting J7 to OWI selects the OWI transceiver circuit for the digital translation path instead. The digital path is used for SWIFT, SENT, and PWM communication.
- U8 is an external ADC, ADC121C021CIMK/NOPB, used to measure the output of the TMAG3101-Q1 when operating in analog output mode. This ADC is selected along the analog path when R29 is populated and R28 is depopulated. Alternatively, populating R28, depopulating R29, and setting J7 to ANA selects the internal ADC in the MSP432E401Y on the SCB instead. The analog path is intended to be used when the device is programmed into analog output mode.
- C20 and C21 are decoupling capacitors for the external ADC supply/reference voltage. R25 and C22 are a filter for the external ADC input. R23 and R24 are pull up resistors for the I2C interface to the external ADC. R33 and R34 create a voltage divider to divide the 5V output down to 3.3V for the internal ADC.
- U2and U4 are a TPS61093DSKR boost regulator and TPS7B8450QWDRBRQ1 low-dropout linear regulator, respectively, which are used to step the 5V USB supply up to 12V and then down to 5V to generate a low noise 5V supply for the external ADC, the TMAG3101-Q1, and the level shifting circuit when a jumper is placed on pins 1 and 2 of header J6.
- U9A and U9B is an automotive dual comparator used to create a discrete level translation circuit.
- U7 is a TS5A3159DBVR SPDT analog switch to select between the digital or analog signal path from the SCB to the TMAG3101-Q1 OUT pin.
- U6 is a buffer for the analog output signal when the device is configured in analog output mode instead of SWIFT, SENT, or PWM mode.
- U5 is a TPS22917DBVR loads switch for enabling/disabling power to the TMAG3101-Q1 device.
- J3 are the main header pins that connect the digital and power pins of the TMAG3101-Q1 to the SCB controller.
- J2 is a CGS programmer connector for programming the device via CGS programmer, which is an alternative option to programming the device than using the TI-SCB.
- J5 is a header connection to the load switch, which enables connecting one load switch signal from the MCU to multiple TMAG3101EVMs.
- J6 is used to supply 3.3V and 5V power to the EVM. If either or both of the jumpers are removed, an external 3.3V and/or 5V supply can be connected and used to power the EVM.
- J7 is used to select the desired signal path from the SCB to the TMAG3101-Q1 OUT pin. OWI selects the OWI transceiver circuit and can be used for SWIFT, SENT, and PWM output modes. TXS selects the external level translator circuit and can be used for SWIFT, SENT, and PWM output modes. ANA selects the analog signal path and can be used when the device is in ANALOG output mode.
- J1 and J4 are socket and plug connectors, respectively, for connecting additional TMAG3101EVMs together on the same bus. Multiple TMAG3101EVMs can communicate on the same bus while in SWIFT mode and while in Triggered SENT mode.
- D1 and D2 are LEDs indicating 5V and 3.3V supplies, respectively.

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2.2 SCB LEDs

Two LEDs on the SCB board are used to indicate status:

- LED *D5* is a green LED that is ON whenever the USB is connected to the SCB, which also powers the SCB and any connected TMAG3101-Q1 devices.
- LED *D1* is a green LED that indicates that the TMAG3101-Q1 EVM firmware is loaded on the board and the EVM is not in DFU mode. If the EVM enters DFU mode, whether through software or hardware, this LED is turned off while LED D5 remains on.

2.3 Hardware Jumper J7 and Resistor Configurations for Different Operating Modes

Certain jumpers and resistors on the board must be configured depending on the desired TMAG3101-Q1 operating mode. Table 2-1 and Figure 2-1 through Figure 2-4 summarize these configurations. One advantage of the external ADC option when operating in analog output mode is that it does not require moving jumper J7 when switching back to SWIFT mode.

Table 2-1.

Operating Mode	Data Path	J7	R28	R29	R35	R36
SWIFT Mode SENT Mode Triggered SENT Mode PWM Mode	OWI transceiver	OWI	Don't care	Don't care	Depopulated	Populated
	Integrated level translator	TXS	Don't care	Don't care	Populated	Depopulated
Analog Mode	External ADC	Don't care	Depopulated	Populated	Don't care	Don't care
	Internal ADC	ANA	Populated	Depopulated	Don't care	Don't care

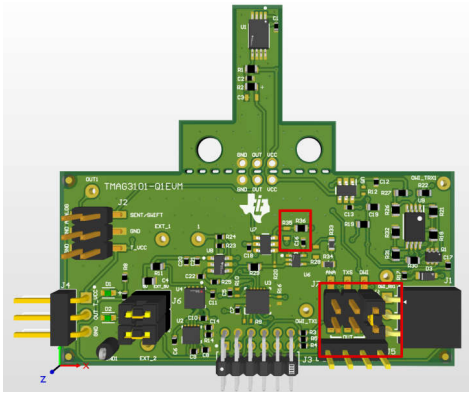


Figure 2-1. Resistor and J7 Configuration for OWI Transceiver Datapath for SWIFT, SENT, and PWM Operating Modes

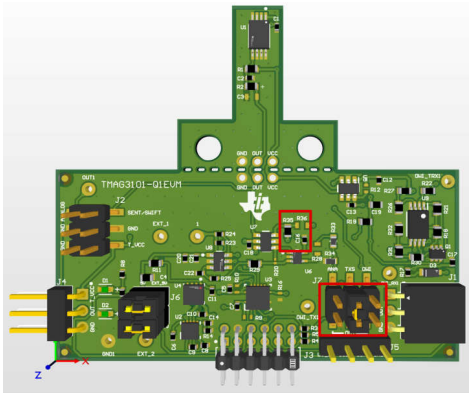


Figure 2-2. Resistor and J7 Configuration for Integrated Level Translator Datapath for SWIFT, SENT, and PWM Operating Modes

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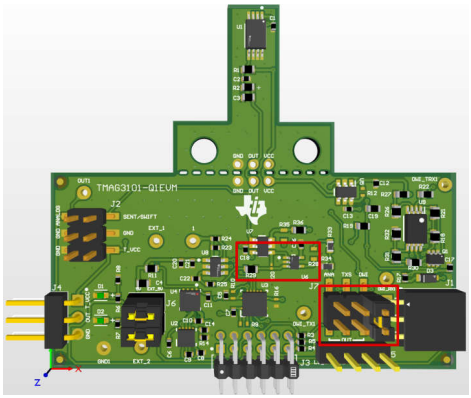


Figure 2-3. Resistor and J7 Configuration for External ADC Datapath for Analog Operating Mode

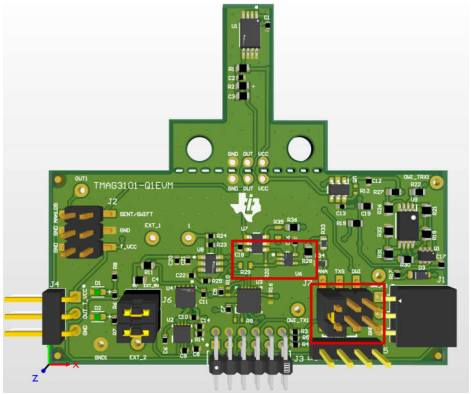


Figure 2-4. Resistor and J7 Configuration for Internal ADC Datapath for Analog Operating Mode

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3 Software

3.1 Quick Start Setup

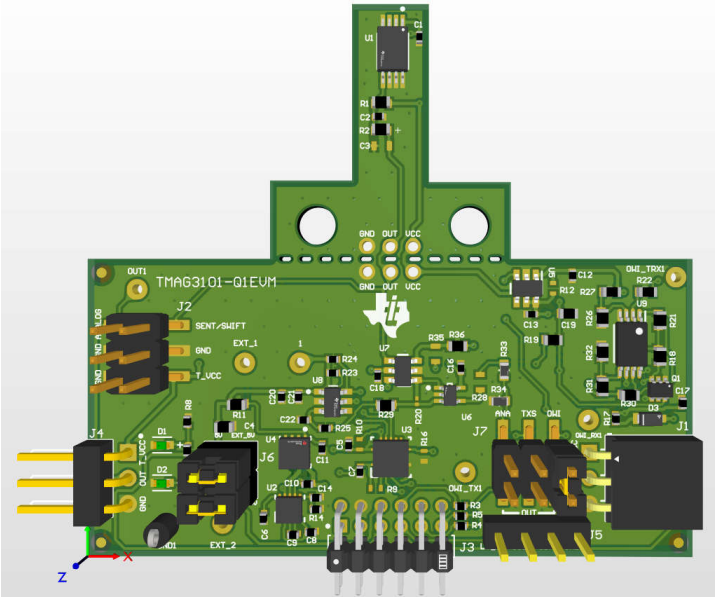


Figure 3-1. TMAG3101EVM

To set up and use the EVM, follow these steps:

1. Download and install the driver as a one-time step per PC: https://www.ti.com/tool/download/SBAC253.
2. Attach the TMAG3101EVM to the SCB.
3. Use a USB cable to connect the SCB to a PC:
   a. Insert the micro USB cable into the USB receptacle J2 that is on the SCB controller onboard.
   b. Plug the other end of the USB cable into a PC.
4. Access the GUI in either the Google Chrome® or Firefox® browser by clicking on the following link: https://dev.ti.com/gallery/info/PositionSensing/TMAG3101EVM_GUI.
5. To quickly view results on the GUI, do the following:
   a. Select the desired operating mode (SENT, Triggered SENT, Analog, or PWM) from the operating mode drop-down box in the configuration tab of the GUI.
   b. Modify the MAG_CH_EN bits, ANGLE_EN bits, and DATA_SEL bits to enable the desired channels and select the desired data output. The GUI has drop-down boxes to configure these bits on each of the operating mode pages.

      Once these selections have been made, select "Program Device."
   c. Select the desired result plots under the *Results to collect/show* box in the *Results Data* tab, and press *Collect Data* to trigger the read.

   These steps are the minimum steps needed to see results in the GUI. However, this assumes that the default register settings are used for the other registers. For more custom settings, modify the corresponding register bits according to the system requirements.
6. Apply a magnetic field to the sensor by doing one of the following:
   a. Wave the included hand held magnet around the sensor.
   b. Attach a Rotate and Push module (sold separately) to the EVM (see Figure 3-11). For more details on how to use these modules, see Section 3.2.2.
7. Observe the outputs in the GUI. See Section 3.2.1.3 for more information on GUI setup and operation.

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3.2 EVM Operation

Figure 3-2 shows how to connect the EVM to the included SCB.

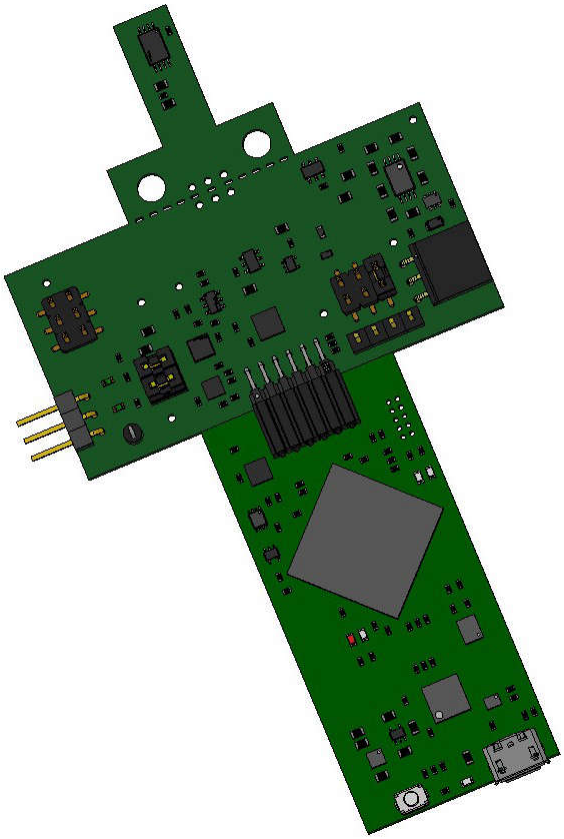


Figure 3-2. Sensor Control Board Connected to EVM

3.2.1 Setup

3.2.1.1 Driver Installation

Download and install this driver: https://www.ti.com/tool/download/SBAC253. This is a one-time step per computer. Unzip the folder and run the .exe file with administrator privileges.

3.2.1.2 Firmware

The firmware must be flashed onto the SCB to properly communicate to the TMAG3101EVM. After flashing the SCB with the TMAG3101EVM firmware, the firmware does not have to be flashed again on the SCB as long as the firmware is not erased or replaced with the firmware for a different EVM. If the firmware is erased or replaced, then the TMAG3101EVM firmware must be flashed onto the SCB again to communicate to the TMAG3101EVM.

The GUI can load firmware onto the TI-SCB as described in Updating Firmware on SCB. Firmware updates are pushed through the GUI (requires driver installation). Downloaded offline GUIs can check for GUI or firmware updates depending on the version.

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3.2.1.2.1 Updating Firmware on SCB

If the firmware gets corrupted or must be manually reinstalled for any reason, follow these steps to reinstall the firmware:

1. Configure the MCU on the SCB to be in Device Firmware Update (DFU) Mode.
   a. It is possible that the MCU has already entered DFU mode. If so, the GUI will notify you and try to update the firmware to the latest version after the GUI is connected to the PC
   b. DFU mode can be entered manually through one of the following methods while the SCB is powered on:
      - Through software:
        – Send the command "bsl" on the SCB's USB Serial (COM) port.
      - Through hardware:
        – Make sure the TI-SCB is connected to the PC through a USB.
        – Short the two test points labeled *DFU* (see Figure 3-3) with a pair of tweezers (or a wire) while pressing the RESET button. If this is done correctly, then LED D1 on the SCB turns off while LED D5 (the power LED) remains on. If LED D1 is still on, then the GUI firmware is still active and the device has not entered DFU mode.

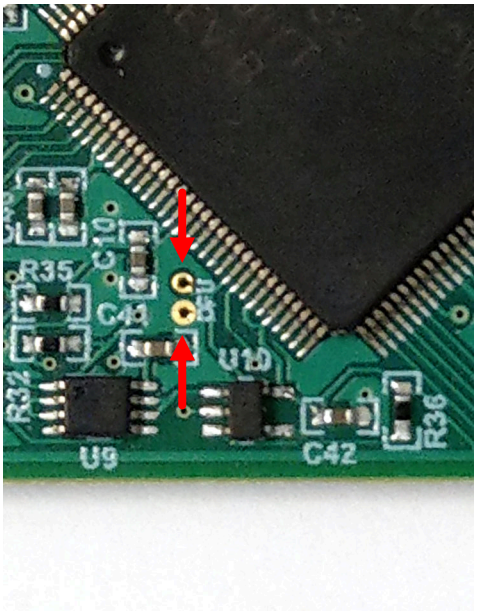


Figure 3-3. Test Points Used to Enter DFU Mode Manually

2. With the MCU in DFU mode, the firmware can now be updated through the GUI.
   a. Open the *File* menu and select *Program Device*.
   b. The firmware update initiates.
   c. After the GUI re-initializes, the TI-SCB automatically connects.

   If the firmware programming is unsuccessful, TI recommends to repeat the above steps with a different USB port connection on the machine.

3.2.1.3 GUI Setup and Usage

Access the GUI in either the Google Chrome or Firefox browser by clicking on the following link: https://dev.ti.com/gallery/info/PositionSensing/TMAG3101EVM_GUI

3.2.1.3.1 Initial Setup

To set up the GUI the first time, follow these steps:

1. Make sure that the previously-mentioned driver is installed successfully to verify everything works properly.
2. Plug the connected EVM and SCB unit to the PC and go to the GUI link provided earlier.
3. Select the GUI Composer application window shown in Figure 3-4 to launch the GUI from the web browser.

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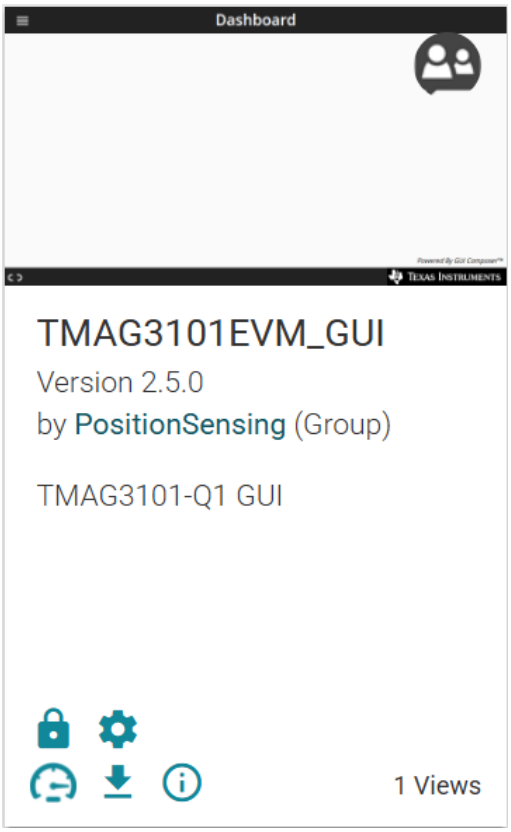


Figure 3-4. GUI Composer Application Window - Replace

- For first-time GUI Composer setup, follow the prompts to download the *TI Cloud Agent* and browser extension shown in Figure 3-5. These prompts appear after you close the README.md dialog.

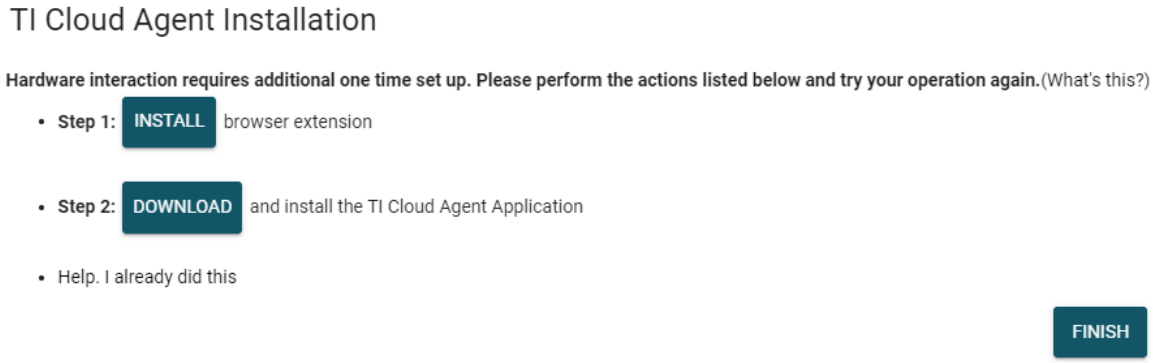


Figure 3-5. TI Cloud Agent

4. Select the icon in the *GUI Composer* window shown in Figure 3-4 to download the GUI offline (optional).

3.2.1.3.2 GUI Operation

To operate the GUI, follow these steps:

1. Connect to and launch the GUI as described in Section 3.2.1.3.1.

   Close the README.md file page that appears after the EVM connects to the GUI. The text near the bottom-left hand corner of the GUI reads as *Hardware Connected*.

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Figure 3-6. Hardware Connected

2. If *Hardware Connected* does not show in the bottom-left hand corner of the GUI, then check different hardware COM ports under *Options* >> *Serial Port*.

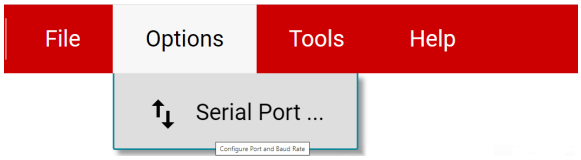


Figure 3-7. Change Serial Port

3. If the hardware still does not connect, then make sure the correct GUI and EVM combination is in use.
4. Select the *Registers* icon shown in Figure 3-8 (also available on the left-side menu) to view the EEPROM register map. The GUI performs a complete EEPROM read when the TMAG3101EVM is first connected. This typically takes a few seconds to complete. Once complete, all current EEPROM register settings within the device can be viewed on the Registers tab. You can see EEPROM registers organized into 10 different groups, as shown below. This tab is recommended for viewing register information only. To update the device configuration, use the configuration tab in the GUI. For questions about a register or register bit field, select the icon. For more questions about registers, check the datasheet.



Figure 3-8. Registers Page Icon

   a. EEPROM
   b. Status and Results

5. Select the *Configuration* icon shown in Figure 3-9 (also available on the left-side menu) to configure device settings and program different operating modes.

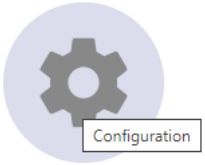


Figure 3-9. Configuration Page Icon

6. Select the *Plots* icon shown in Figure 3-10 (also available on the left-side menu) to view and save graphical data from the TMAG3101-Q1. This screen shows the x-axis, y-axis, z-axis, angle, magnitude, and temperature plots that are derived from the TMAG3101-Q1 output. These plots have been converted to real-world units of mT and degrees. Select the *SAVE PLOT* button on the corresponding plot to save any specific plot.



Figure 3-10. Plots Page Icon

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3.2.2 Rotate and Push Demo

The TMAG3101EVM can be used with the Rotate and Push 3D print (sold separately). To use the Rotate and Push Demo, follow these steps:

Attach the Rotate and Push Module to the EVM (see Figure 3-11 for an example on how this module is connected to the EVM).

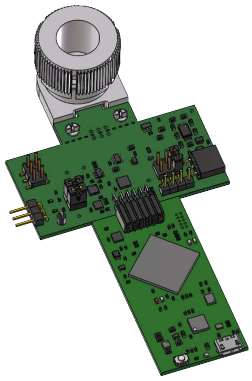


Figure 3-11. Rotate and Push Module on EVM

1. In the GUI configuration page:
   a. Select the desired operating mode from the operating mode drop down (SENT, Triggered SENT, Analog, or PWM).
      i. Make sure the drop-down menu option for the *MAG_CH_EN* register bits says X, Y channel enabled.
      ii. Make sure the drop-down menu option for the *ANGLE_EN* register bits says X-Y angle.
      iii. Make sure the drop-down menu option for the *DATA_SEL* register bits says 2D angle (no magnitude) or 2D angle and magnitude (SENT only)
      iv. Make sure to use either the 100mT or 150mT variant. Note that the demo is not able to work with the 50mT range because the magnetic flux density produced by the Rotate and Push Module is greater than 50mT, which is why the 100mT range is selected.
   b. Click "Program Device" to force the TMAG3101-Q1 into the selected operating mode.

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2. Go to the *Plots* tab inside the *Results Data* page (see Figure 3-12).

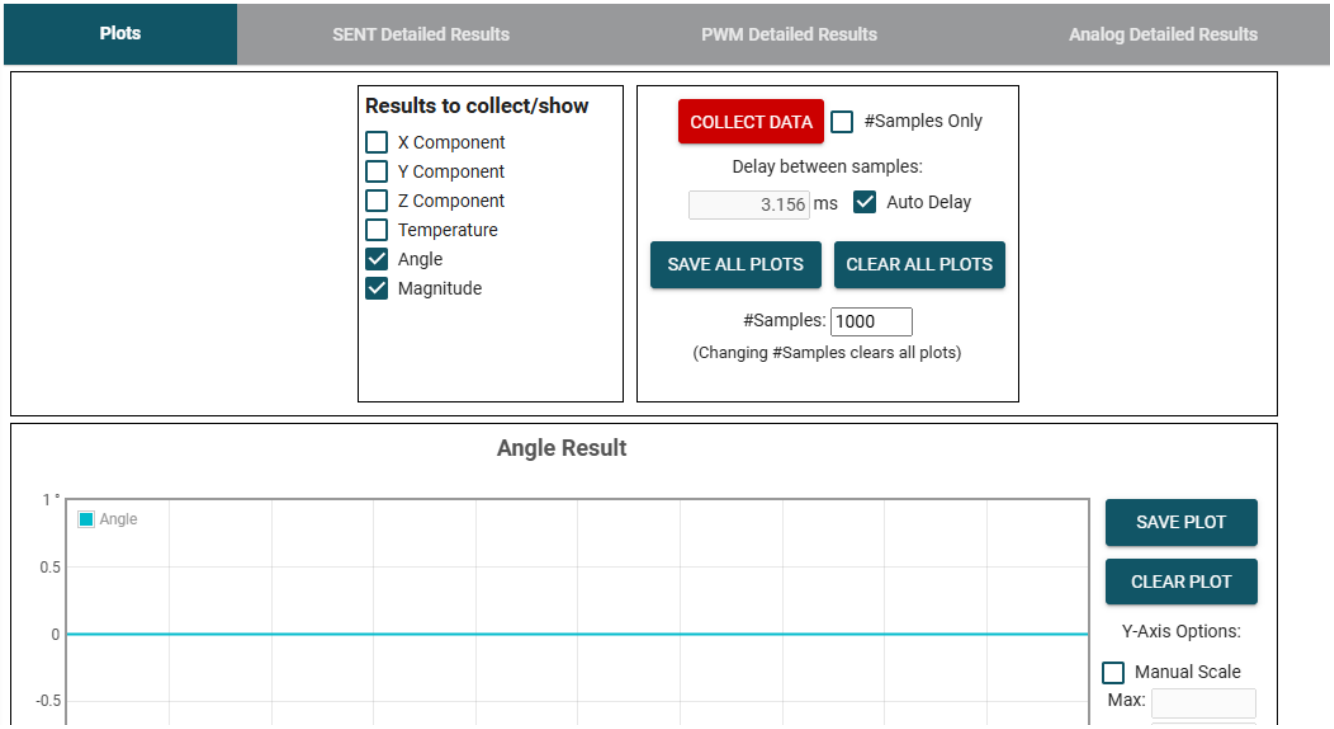


Figure 3-12. Plots GUI Page

3. Select *Collect Data* to see the resulting device angle measurement and magnitude, if enabled, (Figure 3-13) during this process.

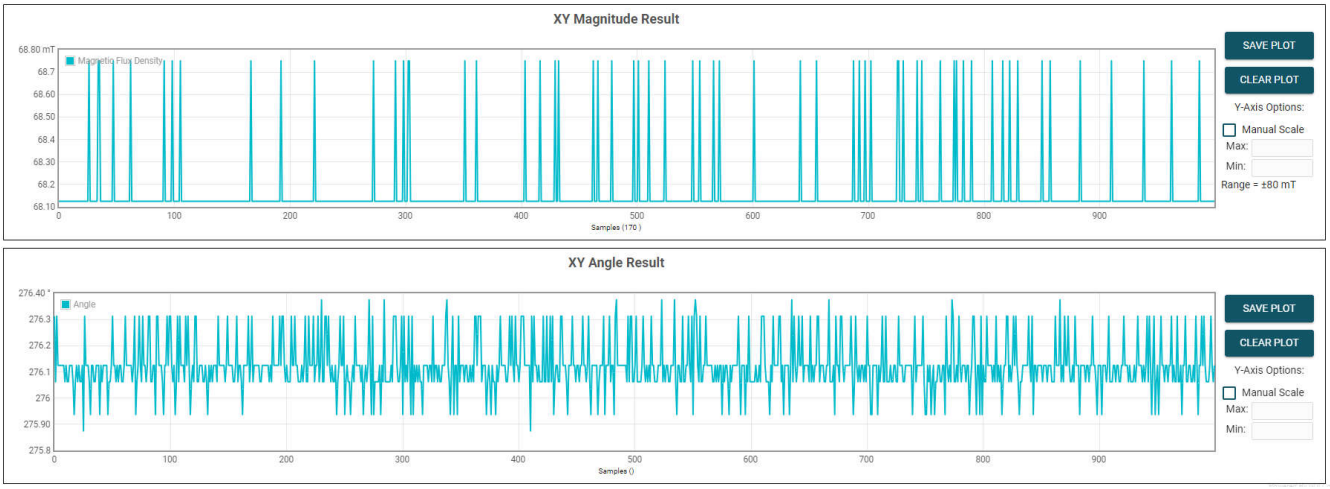


Figure 3-13. Angle Measurement and Magnitude Plot of the Device

4. Select the *STOP COLLECT* button to stop collecting data.

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3.2.3 SENT and Triggered SENT Operating Modes

Follow the steps below to program the TMAG3101EVM into a SENT or Triggered SENT operating mode and view results.

1. Verify the TMAG3101EVM is configured for SWIFT operating mode as described in Section 2.3.
2. Connect to and launch the GUI as described in Section 3.2.1.3.2. When the TMAG3101EVM first connects to the GUI, the firmware performs a read of the full TMAG3101-Q1 EEPROM registers. This typically takes a few seconds to complete. When complete, the EEPROM contents are shown on the Register tab of the GUI.
3. In the Configuration tab, click the Operating Mode drop-down box and select the desired SENT or Triggered SENT operating mode. "Sync Continuous Conversion Trigger SENT" and "Async Continuous Conversion Continuous SENT" are non-triggered, continuous SENT output modes. "Sync Trigger Conversion Trigger SENT" and "Async Continuous Conversion Trigger SENT" are Triggered SENT output modes. After the operating mode is selected, the GUI displays relevant configuration settings for the desired output mode.

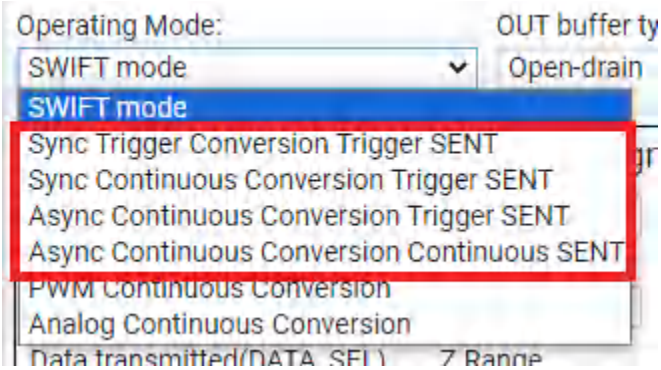


Figure 3-14. SENT and Triggered SENT Operating Modes

4. Configure the desired Magnetic Configuration settings, as shown in Figure 3-15. Select the magnetic channels to enable, angle calculation (if desired), and desired data output from the device. Use the X, Y, and Z range drop-downs to configure the desired sensing range for each axis. If desired, alter the polarity of any axis, enable different levels of filtering or averaging, or alter the angle polarity. If ALPHA-BETA angle outputs are desired, be sure to set both the ANGLE_EN and DATA_SEL registers to ALPHA-BETA angle.

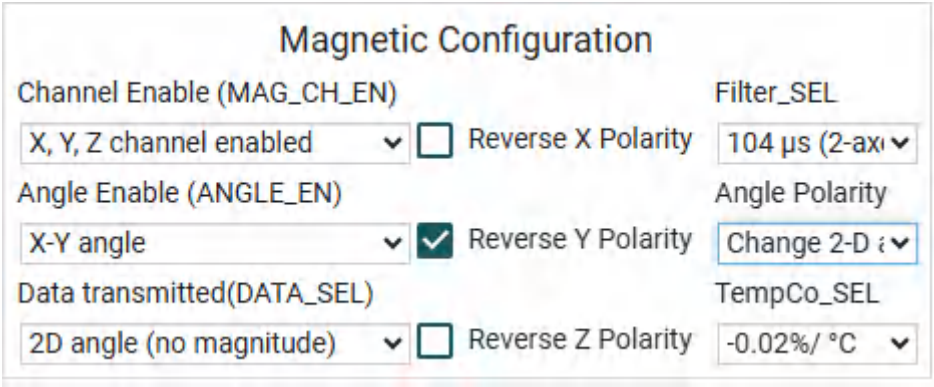


Figure 3-15. Magnetic Configuration Settings

5. Configure the SENT specific fast channel configuration settings, as shown in Figure 3-16. These settings are used to configure the SENT tick time, enable the inverted Data1 MSN nibble to be transmitted, alter the order of the Data2 nibbles, enable or disable the SENT rolling counter or data consistency counter, select the data resolution, configure the pause pulse, and enable or disable temperature data to be transmitted through the fast channel. For more information on different configuration settings, please see the TMAG3101-Q1 datasheet.

The GUI cannot support faster SENT tick times such as 0.25us due to the processing overhead and speed of transmission. This is a limitation of the GUI and the TI-SCB, not the TMAG3101-Q1. The recommended tick time for the GUI is 3.0us.

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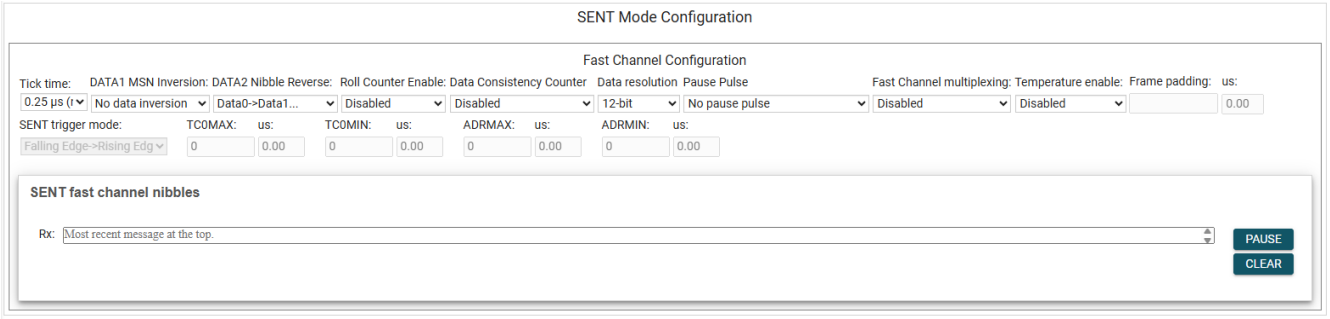


Figure 3-16. SENT Fast Channel Configuration Settings

6. If a Triggered SENT mode is selected, configure the SENT trigger settings, as shown in Figure 3-17. The TC0MAX, TC0MIN, ADRMAX, and ADRMIN register values are used to determine the valid trigger pulse for the TMAG3101-Q1. The input boxes are in terms of ticks. In each adjacent box, the time in microseconds for each value is displayed based on the selected tick time. For more information on the different Triggered SENT configuration options, please see the TMAG3101-Q1 datasheet.

   a. **Note**

   The GUI requires a certain range for TC0MAX and TC0MIN and ADRMAX and ADRMIN to make sure valid triggers are sent by the TI-SCB. This is a limitation of the GUI and the TI-SCB, not the TMAG3101-Q1.

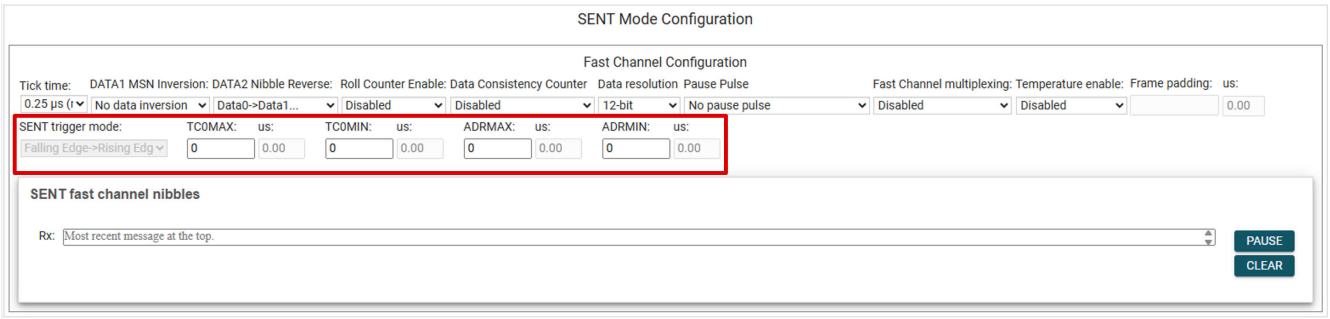


Figure 3-17. Triggered SENT Configuration Settings

7. Select "Program Device" and the GUI programs the TMAG3101EVM according to the configuration and force the EVM into the selected SENT or Triggered SENT output mode using the SWIFT interface.

   a. To return the TMAG3101-Q1 to SWIFT mode, select "SWIFT mode" from the "Operating Mode" drop-down list and press "Program Device".

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8. To view the data output from the device, go to the Results data tab. Select the desired result plots under the *Results to collect/show* box in the *Results Data* tab, and select *Collect Data* to begin collecting data.



9. In SENT and Triggered SENT modes, data can also be viewed in the SENT detailed results tab. If data collection has not begun, click "Start Collection" to begin collecting data. Timestamps and data begins appearing in the Rx textbox containing hexadecimal values of the status pulse, the CRC, and any other data configured to be output in the SENT fast channel frames, as shown in Figure 3-18. In Triggered SENT modes, one-shot trigger commands can be sent using the "SENT Trigger" button, or commands can be sent continuously with a fixed delay in between using the "Start Collection" button.

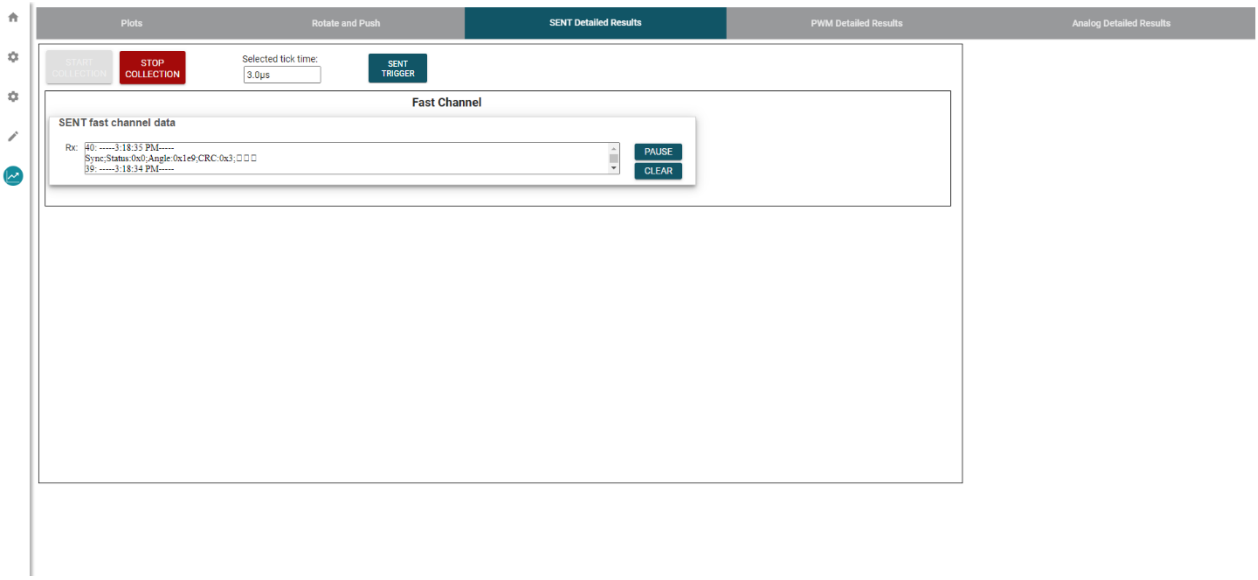


Figure 3-18. SENT Detailed Results

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3.2.4 Analog Operating Mode

Follow the steps below to program the TMAG3101EVM into an analog operating mode and view results.

1. Verify the TMAG3101EVM is configured for SWIFT operating mode as described in Section 2.3.
2. Connect to and launch the GUI as described in Section 3.2.1.3.2. When the TMAG3101EVM first connects to the GUI, the firmware performs a read of the full TMAG3101-Q1 EEPROM registers. This typically takes a few seconds to complete. When complete, the EEPROM contents are shown on the Register tab of the GUI.
3. In the Configuration tab, click the Operating Mode drop-down box and select the "Analog Continuous Conversion" operating mode.

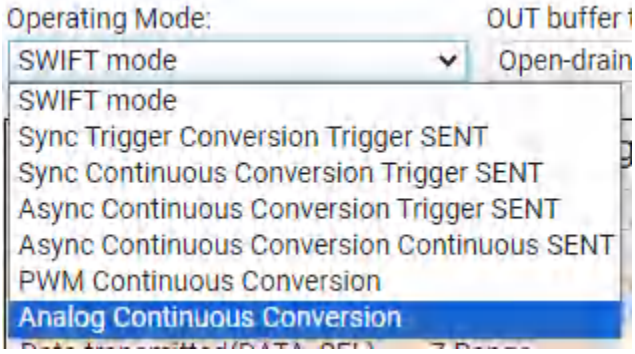


Figure 3-19. Analog Operating Mode

4. Configure the desired Magnetic Configuration settings, as shown in Figure 3-20. Select the magnetic channels to enable, angle calculation (if desired), and desired data output from the device. Use the X, Y, and Z range drop-downs to configure the desired sensing range for each axis. If desired, alter the polarity of any axis, enable different levels of filtering or averaging, or alter the angle polarity.

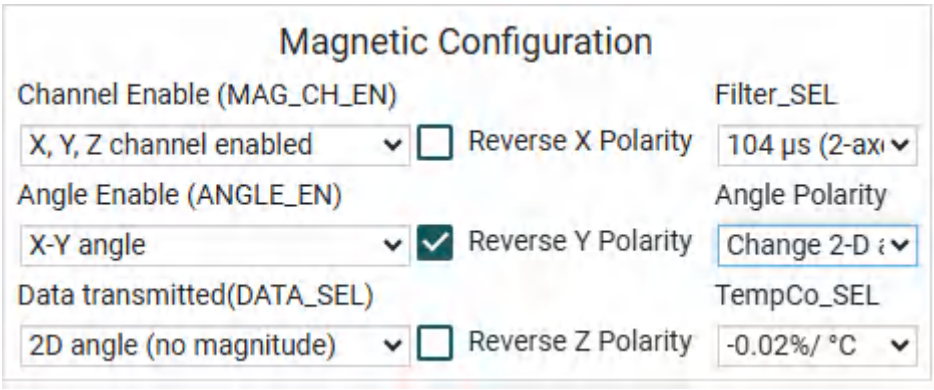


Figure 3-20. Magnetic Configuration Settings

5. Configure the analog specific configuration settings, as shown in Figure 3-21. Select the desired load drive and enable or disable dynamic scaling on the analog output. For more information on analog output configuration options, please see the TMAG3101-Q1 datasheet.

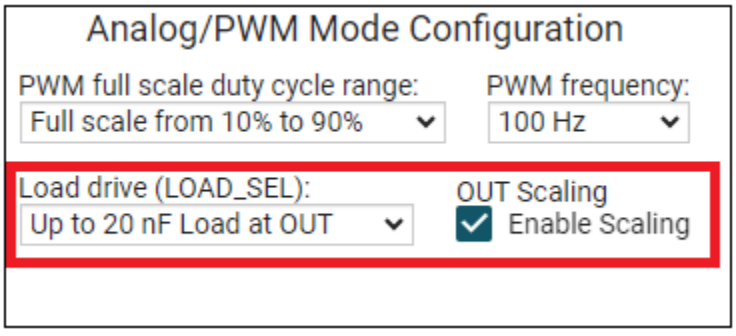
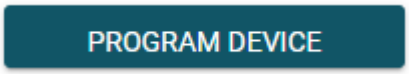


Figure 3-21. Analog Output Configuration Settings

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6. Select "Program Device" and the GUI programs the TMAG3101EVM according to the configuration and force the EVM into the analog output mode using the SWIFT interface.



   a. To return the TMAG3101-Q1 to SWIFT mode, select "SWIFT mode" from the "Operating Mode" drop-down list and press "Program Device".

7. To view the data output from the device, go to the Results data tab. Select the desired result plots under the *Results to collect/show* box in the *Results Data* tab, and select *Collect Data* to begin collecting data.



8. In analog mode, data can also be viewed in the "Analog Detailed Results" tab. Select the appropriate ADC sensing option from the drop down--ADC121C021 for the external ADC or the SCB internal ADC. Remember that these options are only valid depending on which of resistors R5 and R6 are populated or depopulated on the board. This displays the ADC reference voltage for the selection. Select "Start Collection" to see the analog OUT voltage displayed on the meter, as well as the ADC range percentage used.

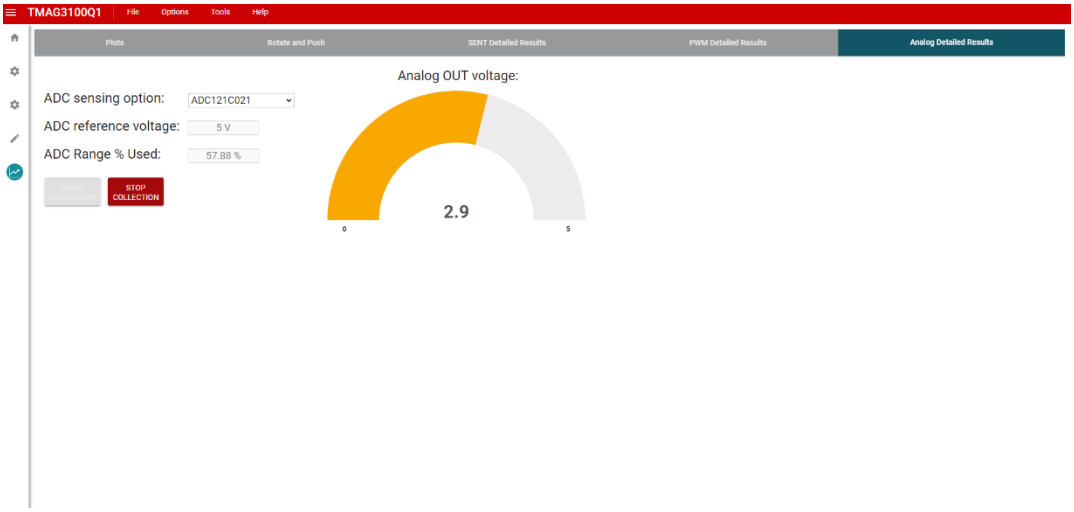


Figure 3-22. Analog Detailed Results

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3.2.5 PWM Operating Mode

Follow the steps below to program the TMAG3101EVM into a PWM operating mode and view results.

1. Verify the TMAG3101EVM is configured for SWIFT operating mode as described in Section 2.3.
2. Connect to and launch the GUI as described in Section 3.2.1.3.2. When the TMAG3101EVM first connects to the GUI, the firmware performs a read of the full TMAG3101-Q1 EEPROM registers. This typically takes a few seconds to complete. When complete, the EEPROM contents are shown on the Register tab of the GUI.
3. In the Configuration tab, select the Operating Mode drop down box and select the "PWM Continuous Conversion" operating mode.

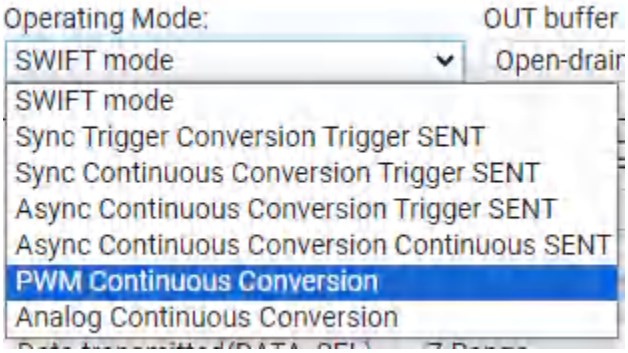


Figure 3-23. PWM Operating Mode

4. Configure the desired Magnetic Configuration settings, as shown in Figure 3-24. Select the magnetic channels to enable, angle calculation (if desired), and desired data output from the device. Use the X, Y, and Z range drop-downs to configure the desired sensing range for each axis. If desired, alter the polarity of any axis, enable different levels of filtering or averaging, or alter the angle polarity.

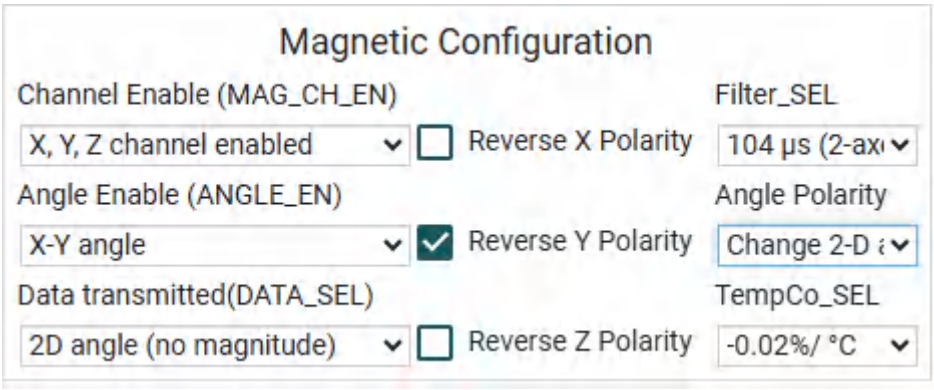


Figure 3-24. Magnetic Configuration Settings

5. Configure the PWM specific configuration settings, as shown in Figure 3-25. Configure the full scale duty cycle range for the PWM output, the PWM frequency, the load drive, and enable or disable dynamic scaling of the PWM output. Please see the TMAG3101-Q1 datasheet for more information on different PWM output configuration options.

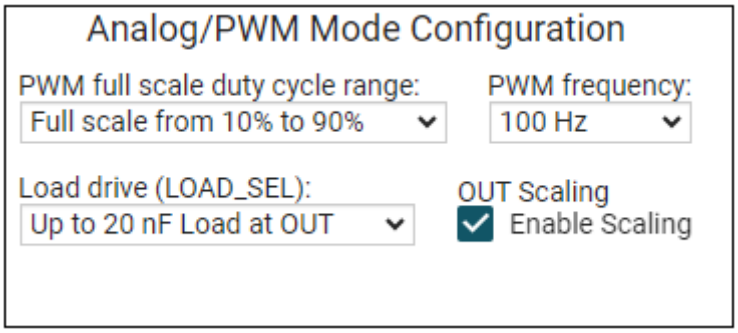
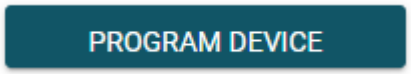


Figure 3-25. PWM Output Configuration Settings

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6. Select "Program Device" and the GUI program the TMAG3101EVM according to the configuration and force the EVM into the PWM output mode using the SWIFT interface.



   a. To return the TMAG3101-Q1 to SWIFT mode, select "SWIFT mode" from the "Operating Mode" drop-down list and press "Program Device".

7. To view the data output from the device, go to the Results data tab. Select the desired result plots under the *Results to collect/show* box in the *Results Data* tab, and select *Collect Data* to begin collecting data.



8. In PWM mode, data can also be viewed in the "PWM Detailed Results" tab. This page displays the selected PWM frequency, calculated PWM frequency, period duration, high-time duration, and low time duration. Click "Start Collection" to see the PWM duty cycle displayed on the meter.

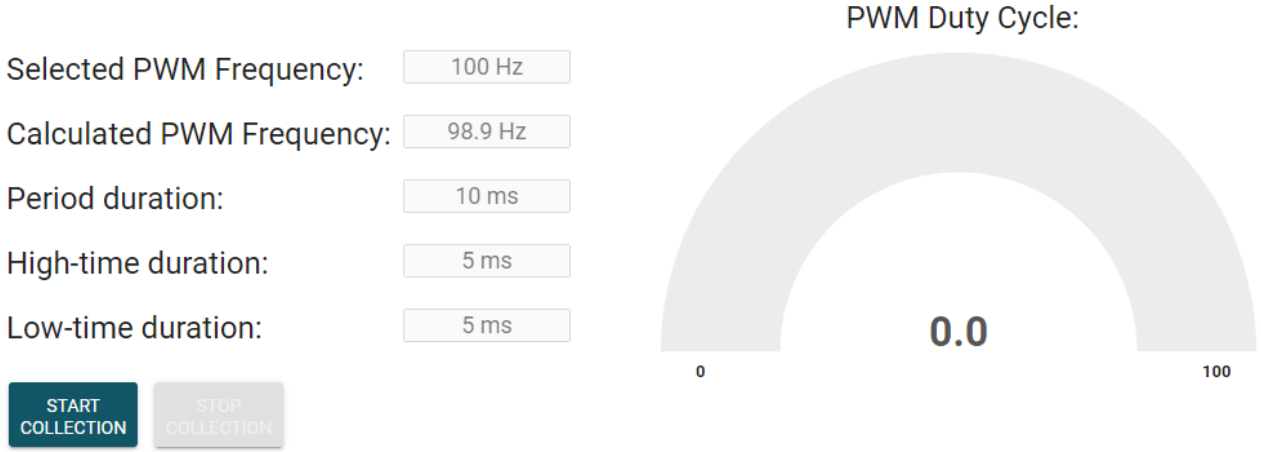


Figure 3-26. PWM Detailed Results

3.2.6 Direct EVM Serial Communication

If desired, the SCB can communicate directly with the EVM without the use of the GUI through the USB serial (COM) port. Simply send the desired command string over the serial port and receive the results. This is useful for interfacing the EVM with custom setups, scripts, or GUIs. Note that the TMAG3101EVM must be connected to the SCB to receive any command responses from the SCB.

To read and write registers, follow the below format:

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- Read EEPROM or user register command format: **rreg ADR**
  - Must give ADR values in increments of 4 (0, 4, 8, and so forth), returns 32-bit value in hex
  - Where ADR is the address in hex, and rreg is always lower case
  - Register addresses can be in upper or lower case, and do not need to be led by "0x". 0 padding register addresses is also optional. For example, to read register address 0xC, some valid commands include:
    - rreg c
    - rreg 0C
    - rreg 0x0C
      - When "0x" is used, the "x" must be lower case.
  - Figure 3-27 is an example response to this command:

```
{"acknowledge":"rreg 0x0C"}
{"register":{"address":12,"value":"0x38000004"}}
{"evm state":"idle"}
```

Figure 3-27. Example Register Read Response

The number to the right of value represents the value read from the register. Note that this value is represented in hexadecimal.

- Read EEPROM pages (64-bit) **swiftread ADR**
  - ADR is a valid address (0, 8, and so forth). If you give an invalid address, it rounds down to the valid address and returns that 64-bit value in hex
  - Register addresses can be in upper or lower case, and do not need to be led by "0x". 0 padding register addresses is also optional. For example, to read address 0xC, some valid commands include:
    - swiftread C
    - swiftread 0C
    - swiftread 0x0C

```
{"acknowledge":"swiftread 0x0C"}
{"SWIFTData":"0x2EC2000020020067"}
{"evm_state":"idle"}
```

Figure 3-28. Example SWIFT Read Response

- Write EEPROM and user register command format: **swiftprg ADR VALHIGH VALLOW**
  - Where ADR and VAL are in hex:
    - EEPROM writes require 64-bit words (VALHIGH and VALLOW are both 32-bit words)
    - User register writes require 32-bit words (ADR ≥ 0x200 only use VALLOW, VALHIGH is ignored)
  - Register addresses and values can be in upper or lower case, and do not need to be led by "0x". 0 padding register addresses and values is also optional. For example, to write register address 0x0 with the value 4, some valid commands include:
    - wreg 8 00C20000 20020067
    - wreg 08 0x00C20000 20020067
    - wreg 0x08 0x00C20000 0x20020067
      - When "0x" is used, the "x" must be lower case.
  - Figure 3-29 is an example response to this command:

```
{"acknowledge":"swiftprg 0x08 0x00C20000 0x20020067"}
{"evm_state":"idle"}
```

Figure 3-29. Example SWIFT Program Write Response

Other useful commands include the following:

- **reset**
  - This command resets the operating mode (power cycle the device by disabling and enabling the load switch)

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```
{"acknowledge":"reset"}
{"console":"resetting device"}
{"evm_state":"idle"}
```

Figure 3-30. Example Firmware Reset Device Response

- Firmware revision command format: **id**
  - This command prints the EVM the SCB is configured for (TMAG3101EVM in this case) and the date associated with the version of the firmware loaded on the SCB.
  - Figure 3-31 is an example response to this command:

```
{"acknowledge":"id"}
{"id":{"name":"TMAG3101Q1EVM","version":"2.2.0.0","date":"Oct  8 2026","time":"16:35:29"}}
{"evm_state":"idle"}
```

Figure 3-31. Example Firmware Revision Command Response

  - The date and time obtained from this command is the same date and time that appears in the *About* screen of the GUI (see Figure 3-32). Select the *About* option under the GUI's *Help* menu to view the *About* screen.

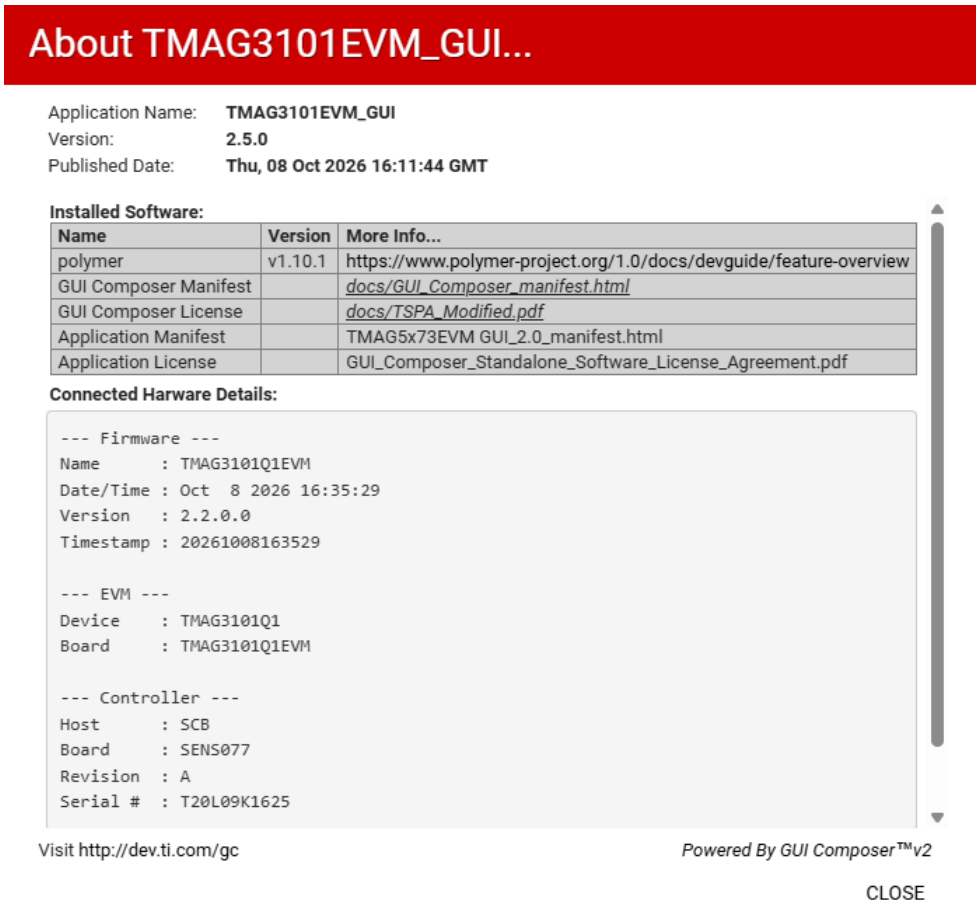


Figure 3-32. Firmware Revision Version in GUI About Screen

- BSL command format: **bsl**
  - This command puts the device in BSL mode, which is necessary before reflashing the SCB firmware. Another alternative to entering BSL mode is to do so using hardware as described in step 1b of Section 3.2.1.2.1. Before BSL is entered, LED D1 is on. If BSL mode is successfully entered, LED D1 is turned off so that only the Power LED (LED D5) is on. After entering BSL mode, the device does not accept any of the above commands.
  - Figure 3-33 shows an example response to this command:

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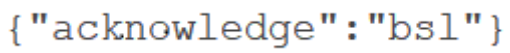


Figure 3-33. BSL Command Response

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4 Hardware Design Files

4.1 Schematics

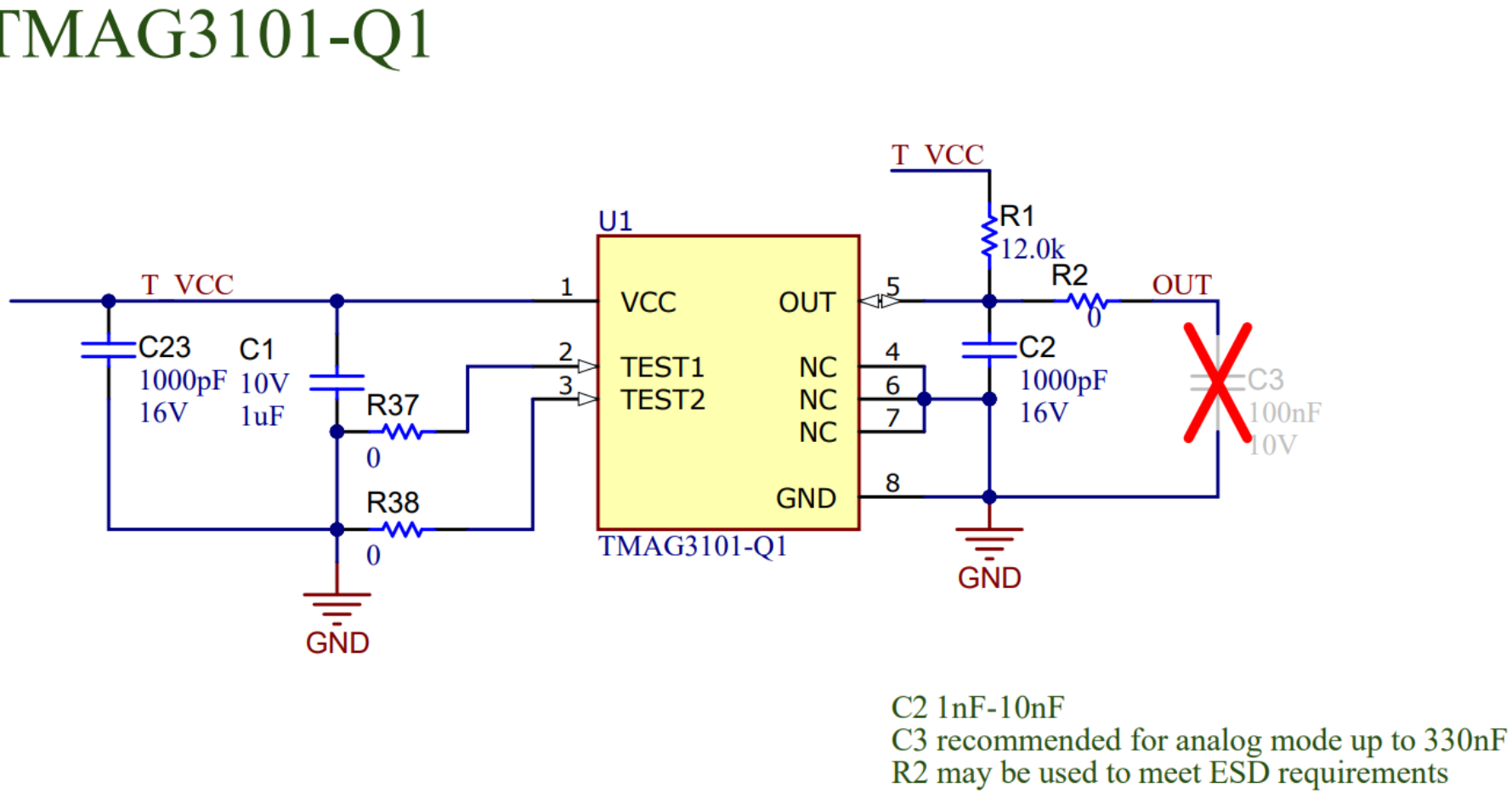


Figure 4-1. TMAG3101-Q1 Part of EVM Schematic

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TI-SCB Connector

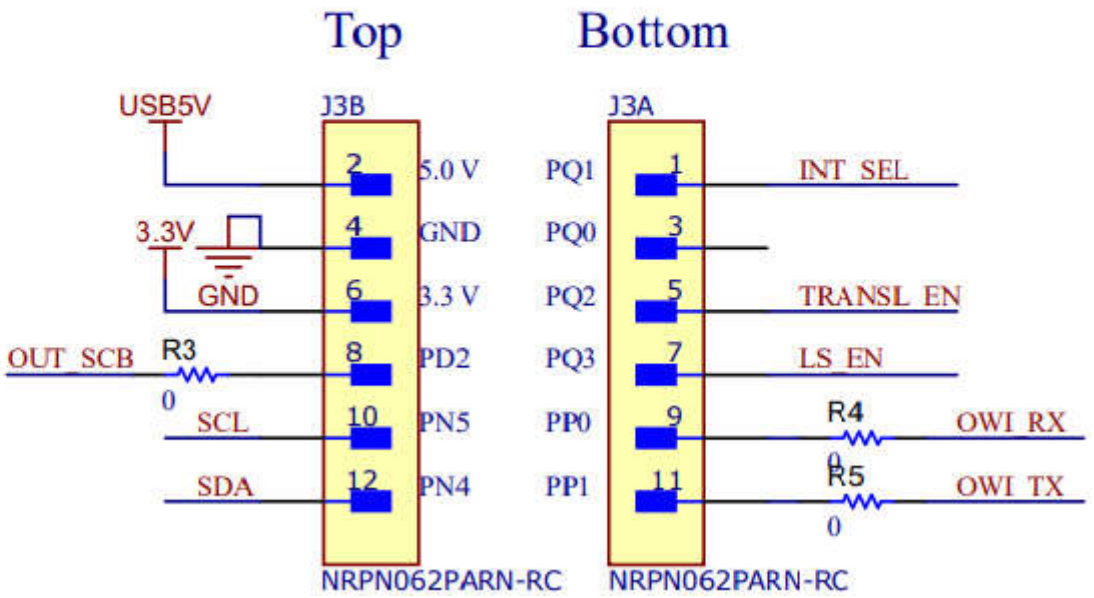


Figure 4-2. TI-SCB Connector Part of EVM Schematic

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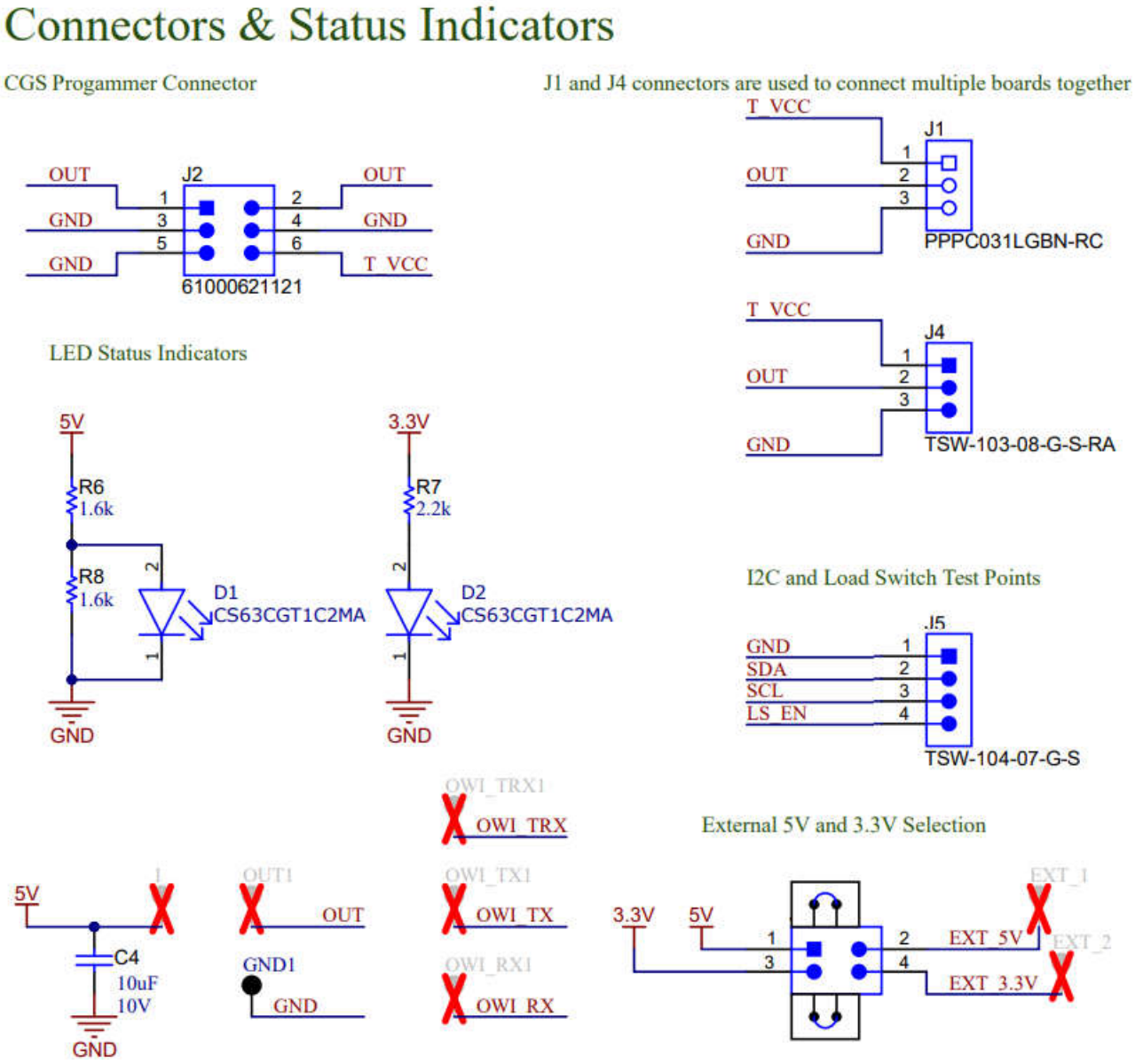


Figure 4-3. Connectors and Status Indicators Part of EVM Schematic

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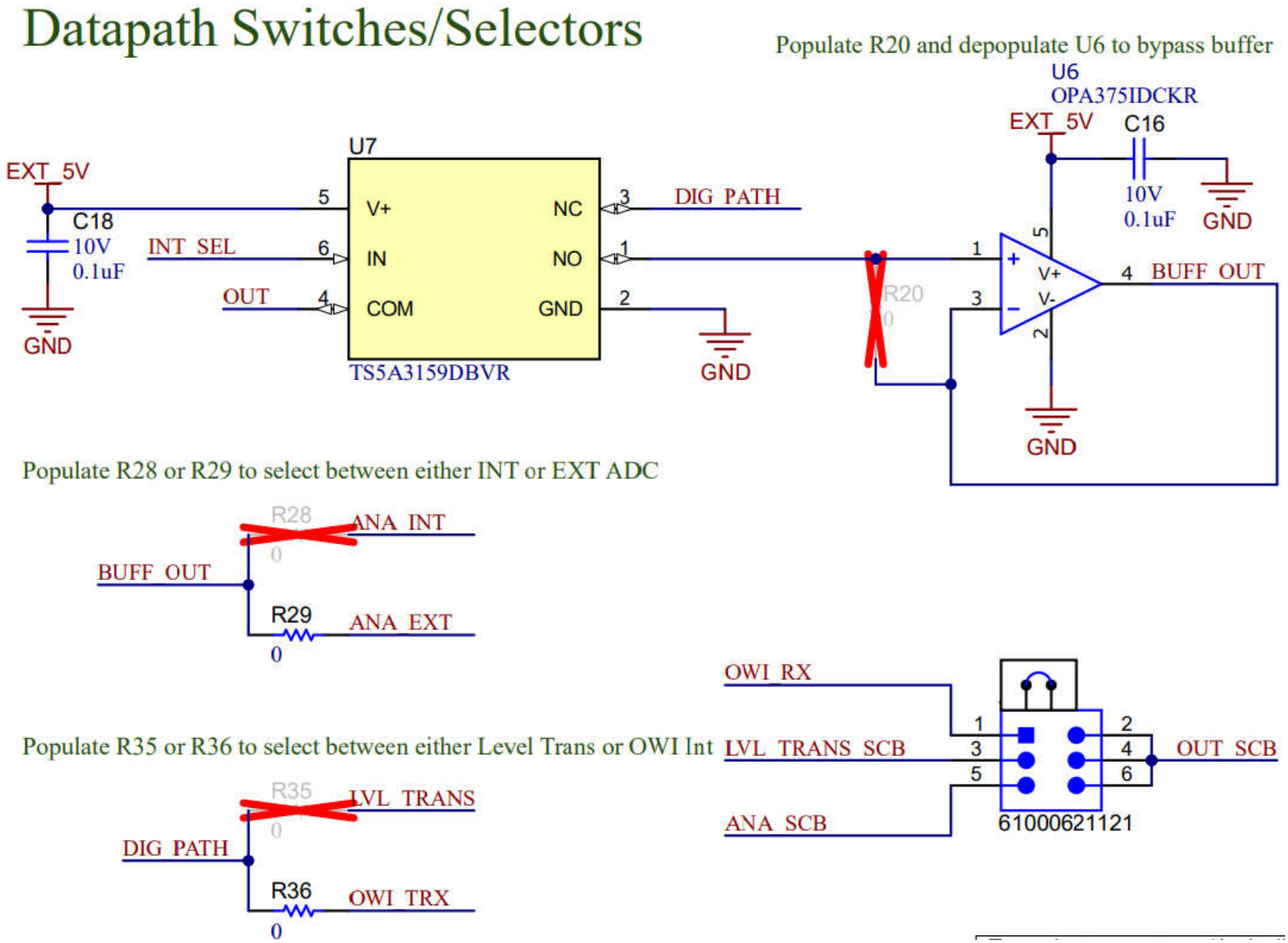


Figure 4-4. Datapath Switches and Selectors Part of EVM Schematic

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Internal & External Analog Output ADC

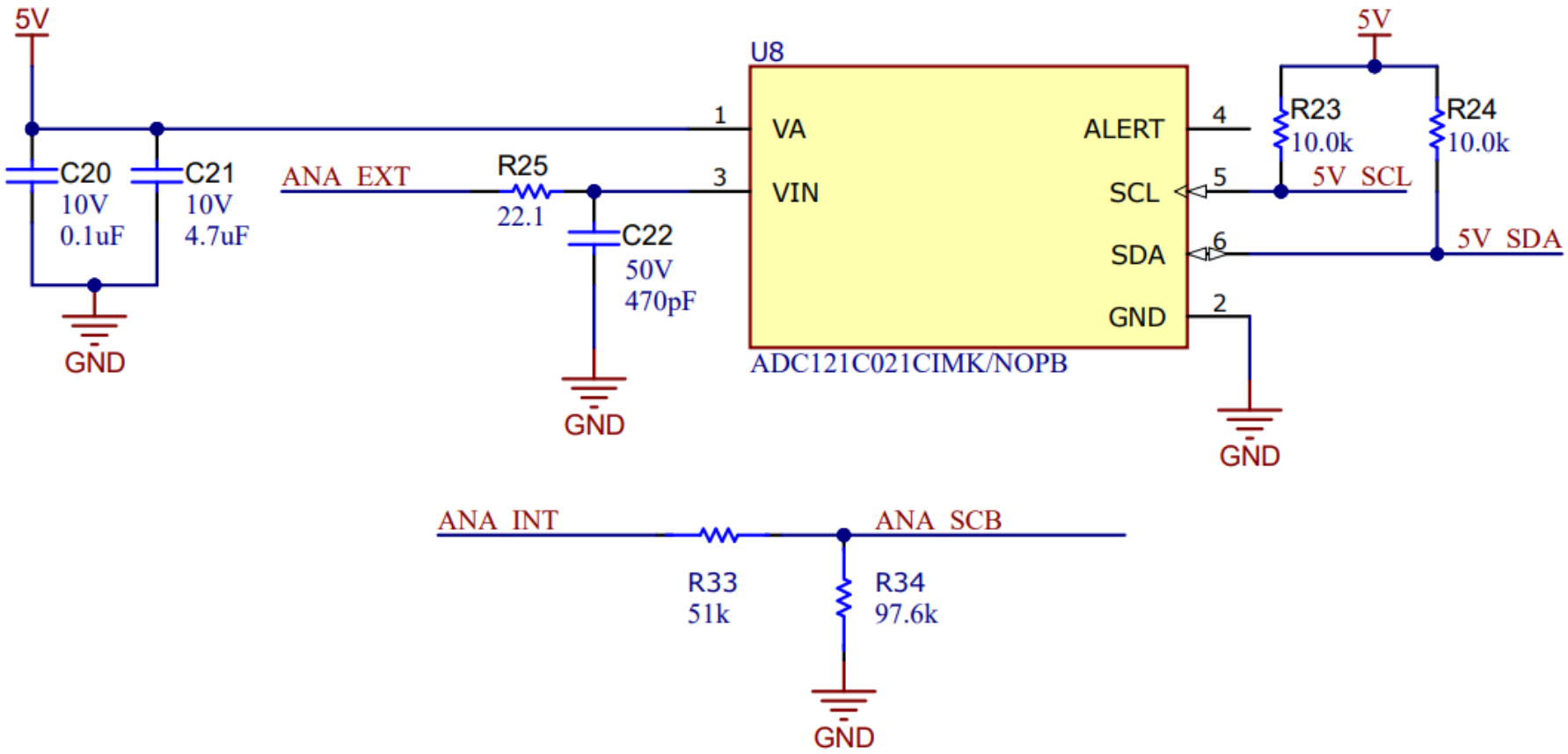


Figure 4-5. Internal and External ADC Part of EVM schematic

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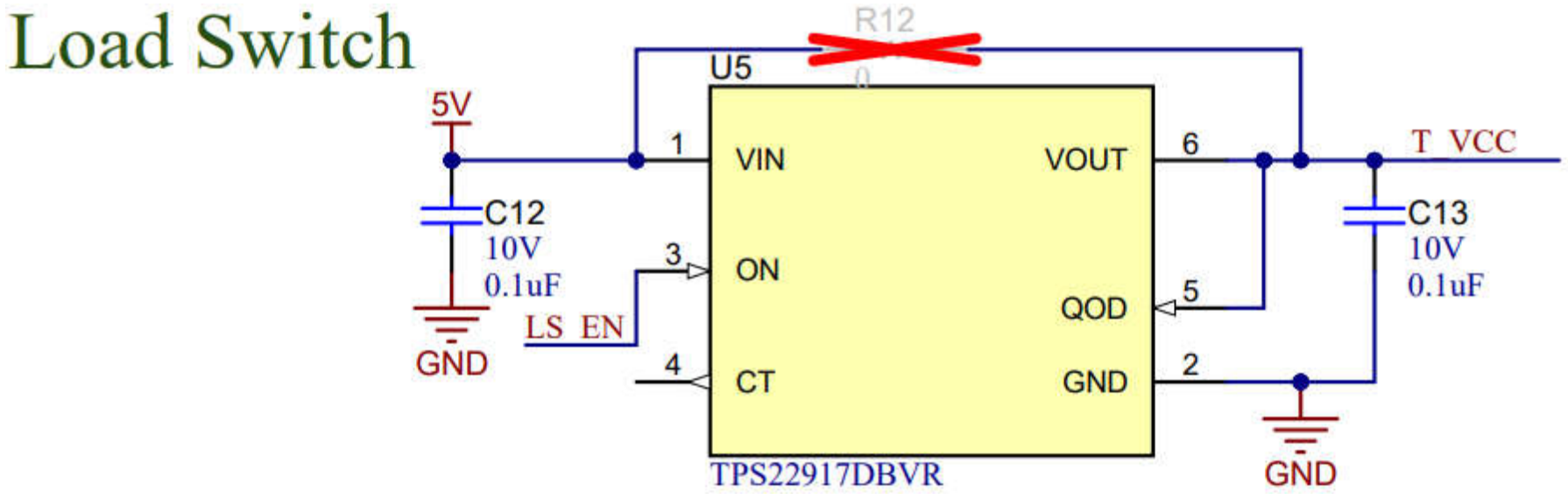


Figure 4-6. Load Switch Part of EVM Schematic

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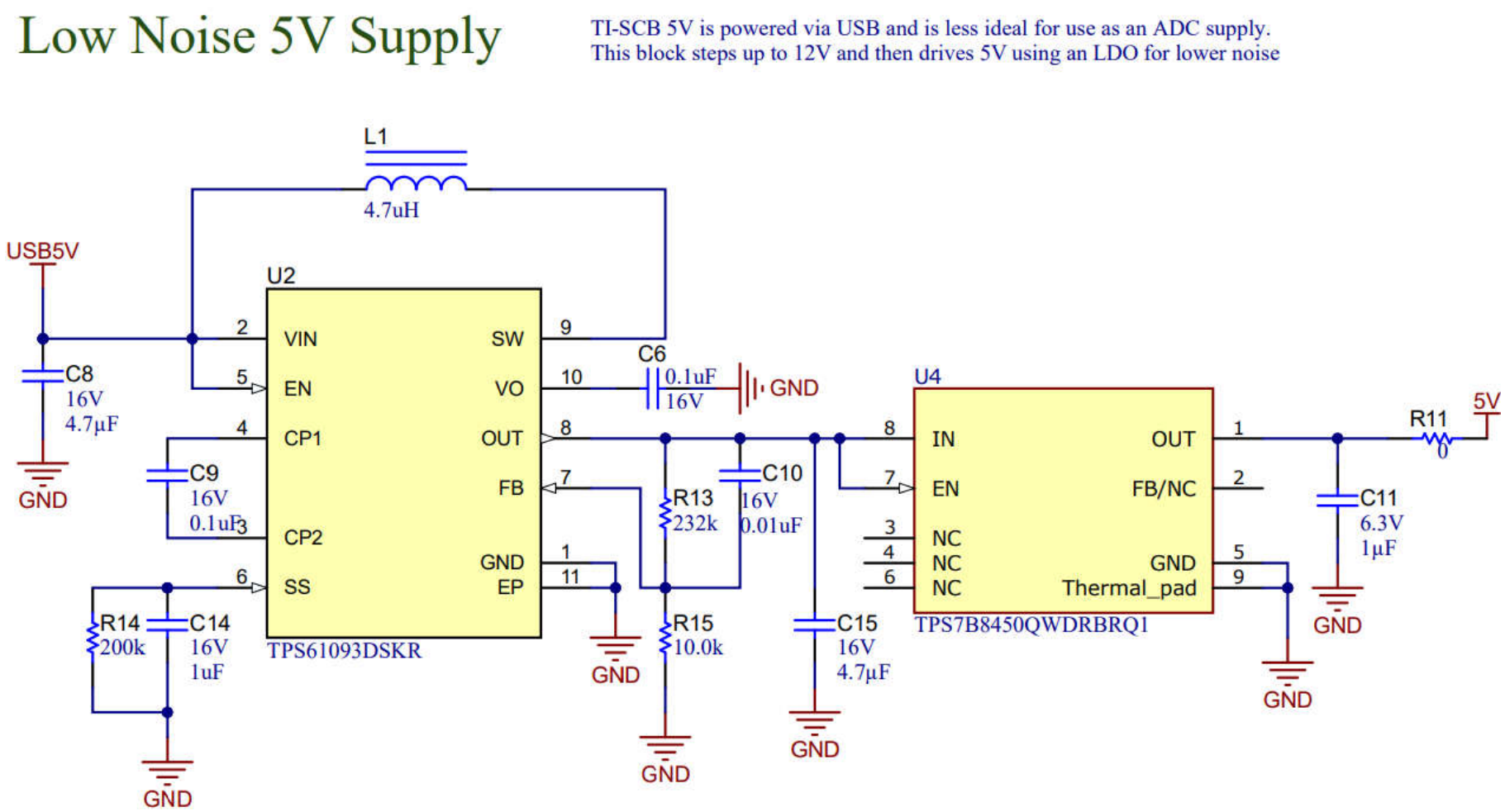


Figure 4-7. Low Noise 5V Supply Part of EVM Schematic

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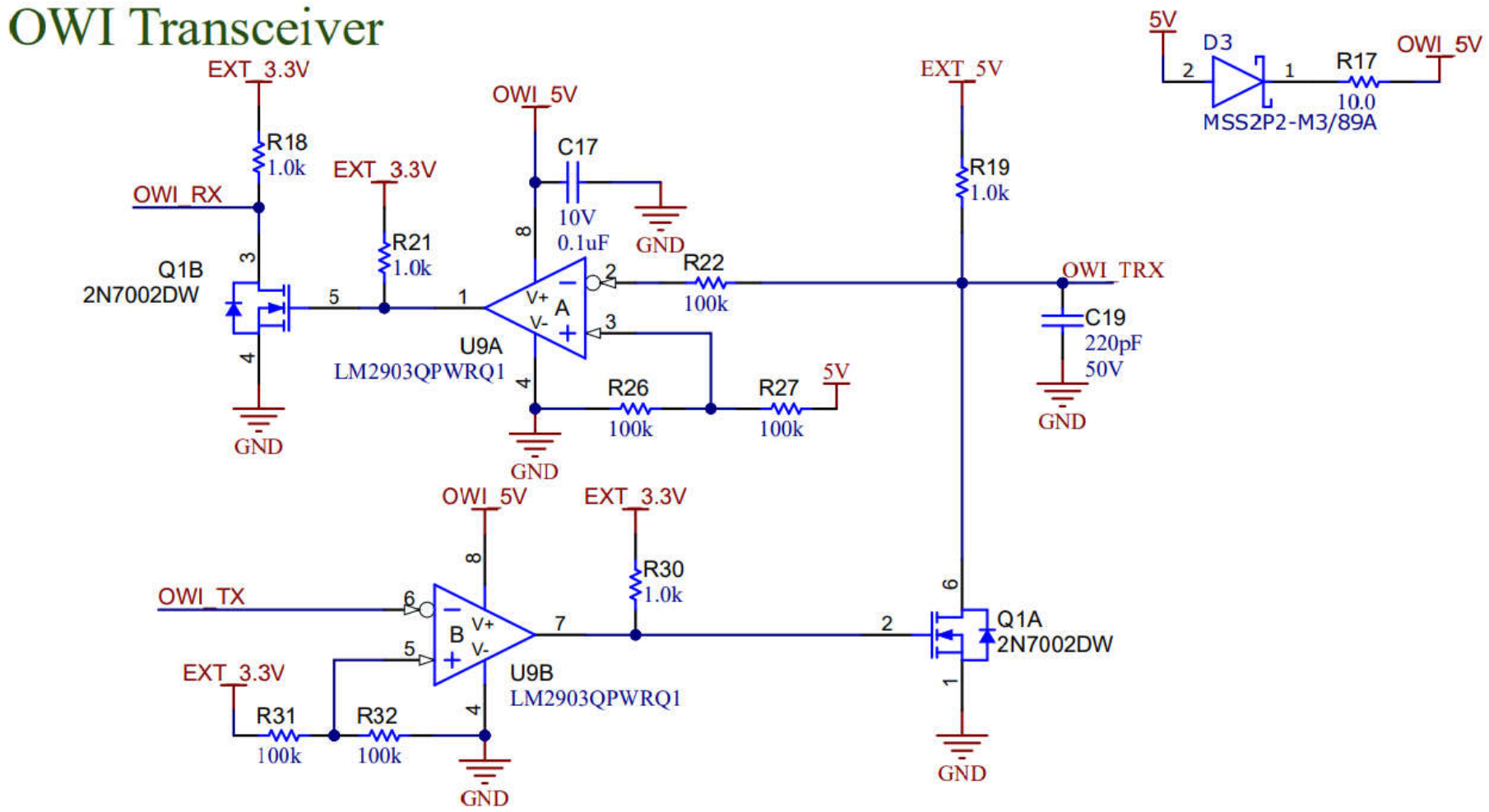


Figure 4-8. OWI Transceiver Part of EVM Schematic

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Voltage Level Translator

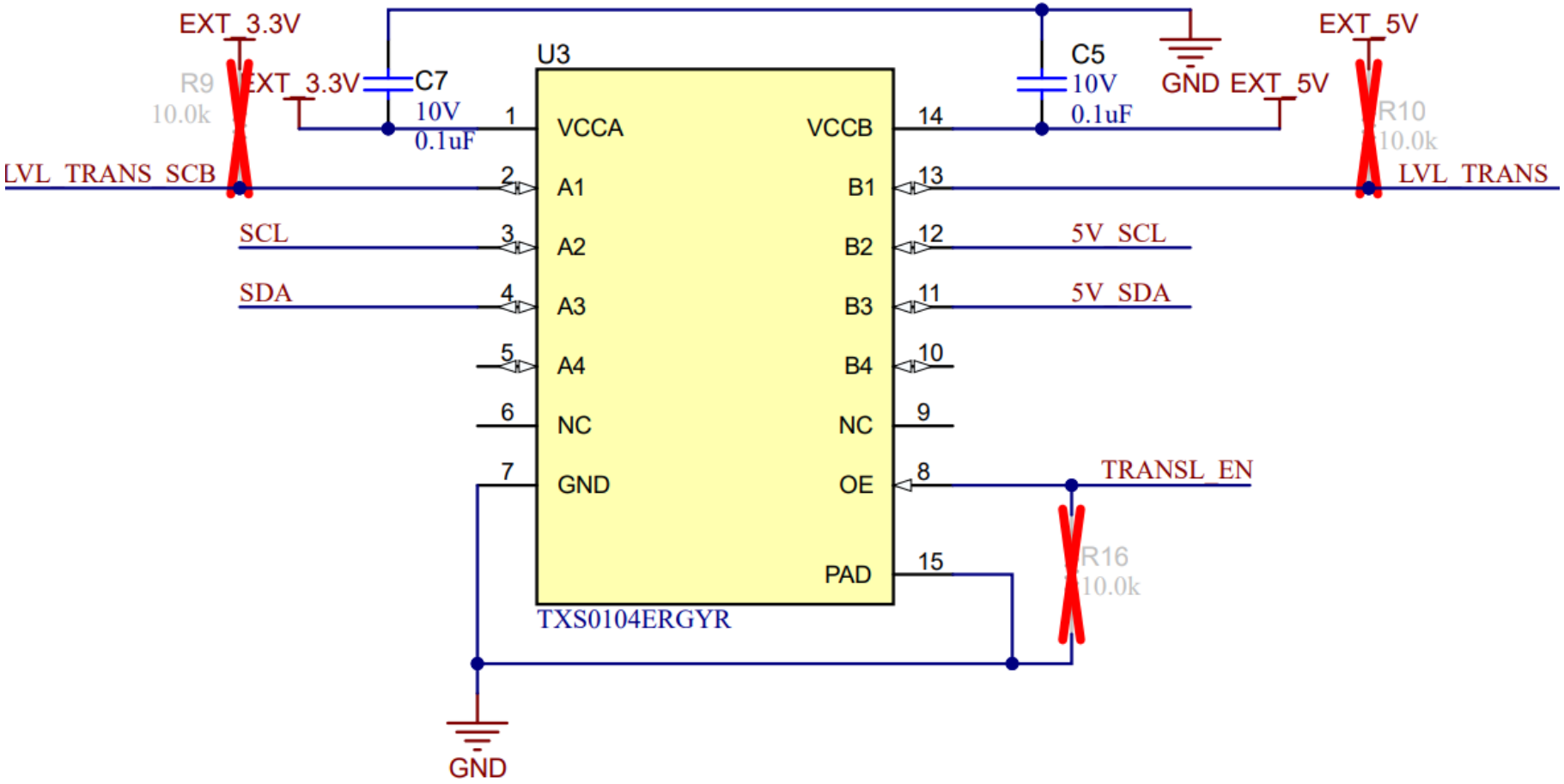


Figure 4-9. Voltage Level Translator Part of EVM Schematic

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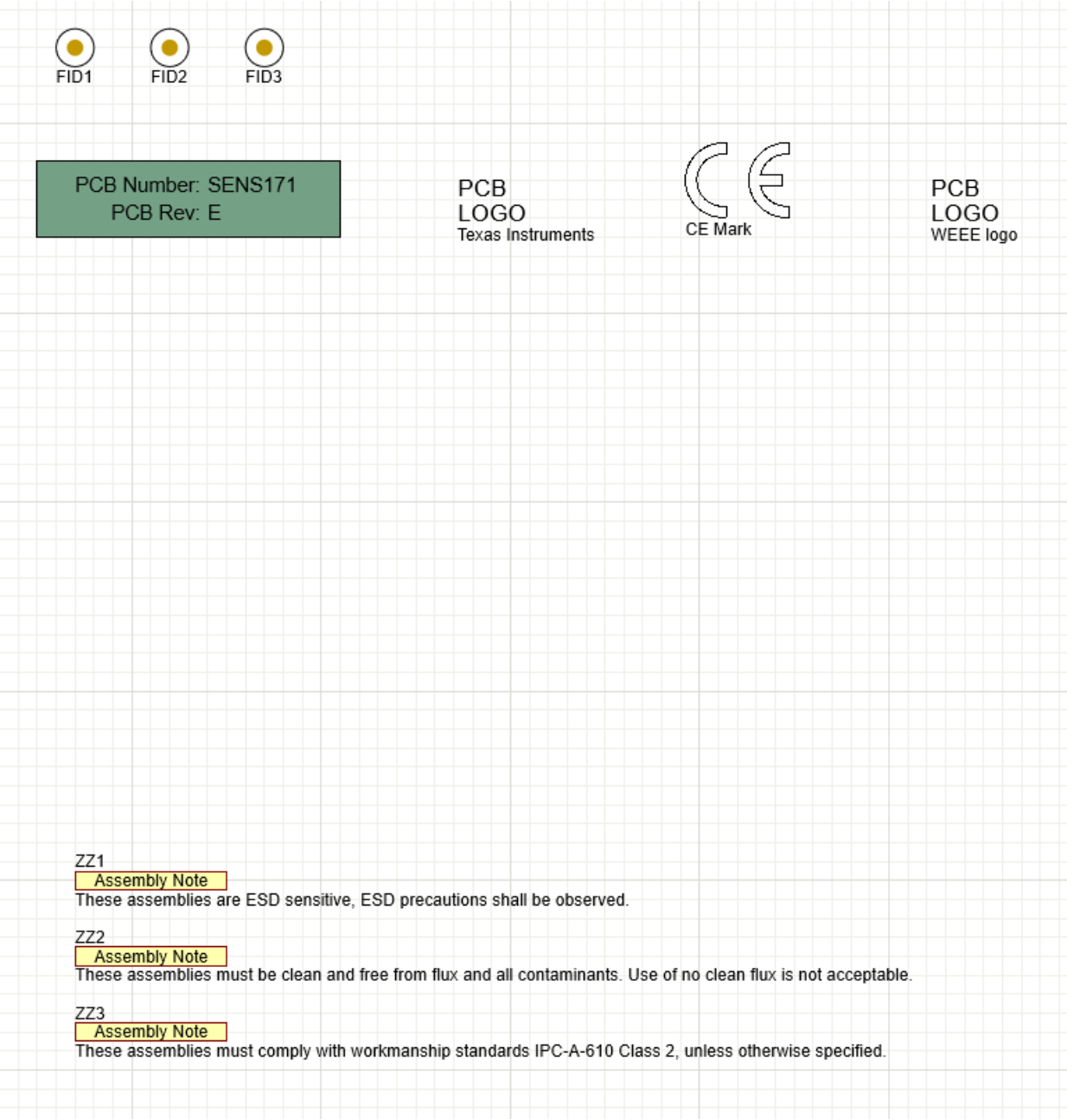


Figure 4-10. TMAG3101-Q1 Hardware Schematic

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4.2 PCB Layout

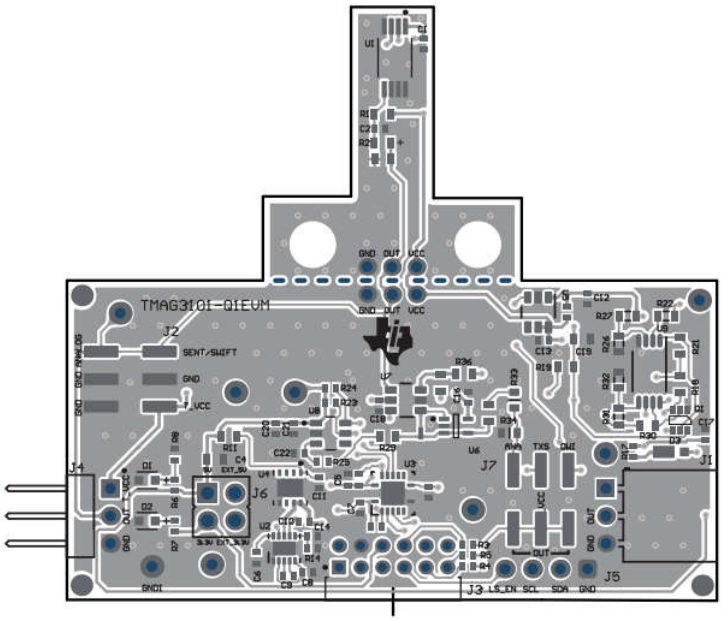


Figure 4-11. TMAG3101EVM Top View

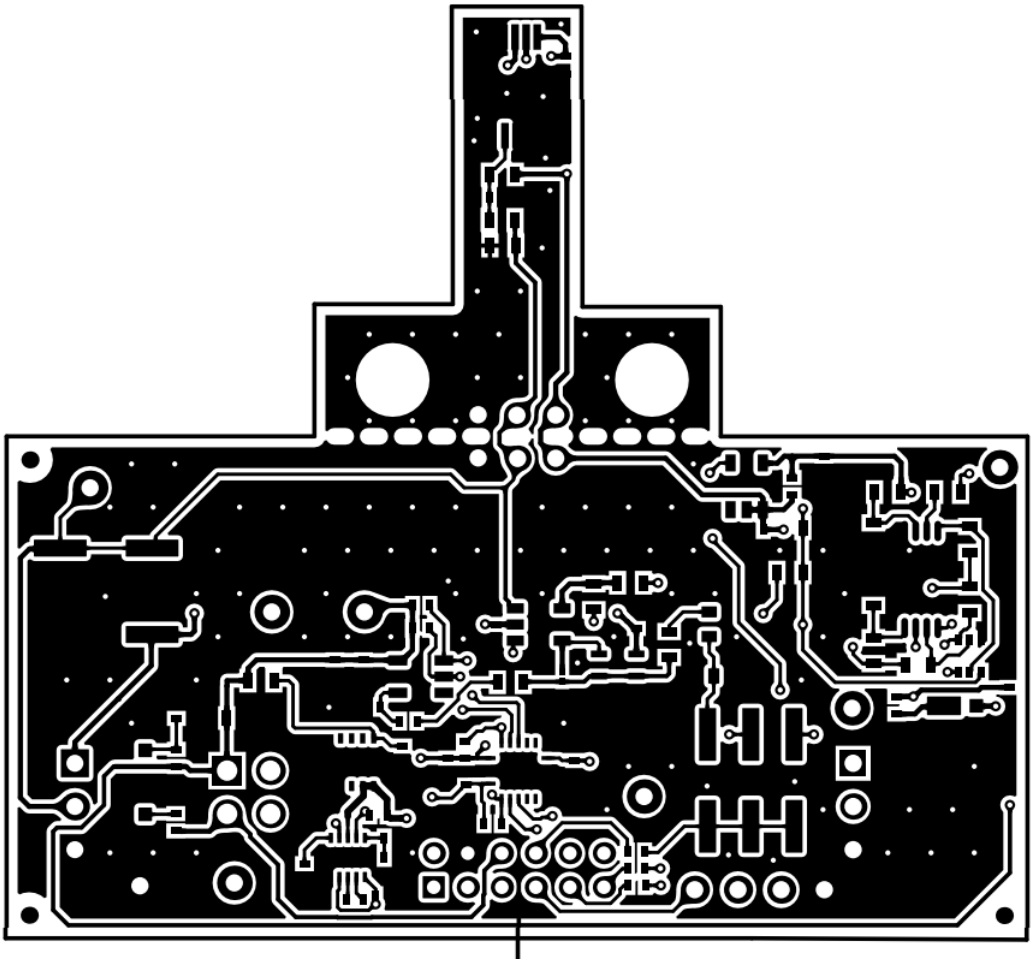


Figure 4-12. TMAG3101EVM Top Layer

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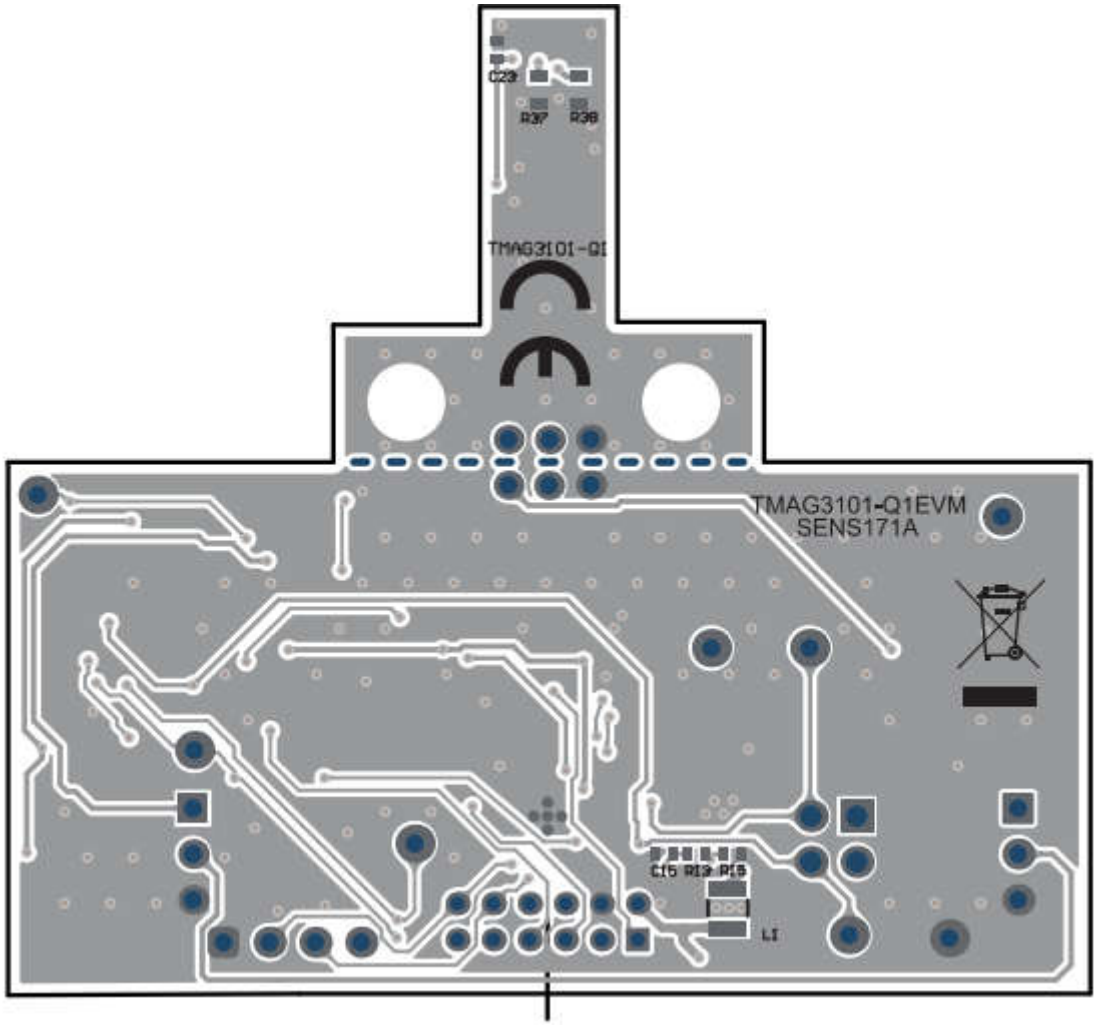


Figure 4-13. TMAG3101EVM Bottom View

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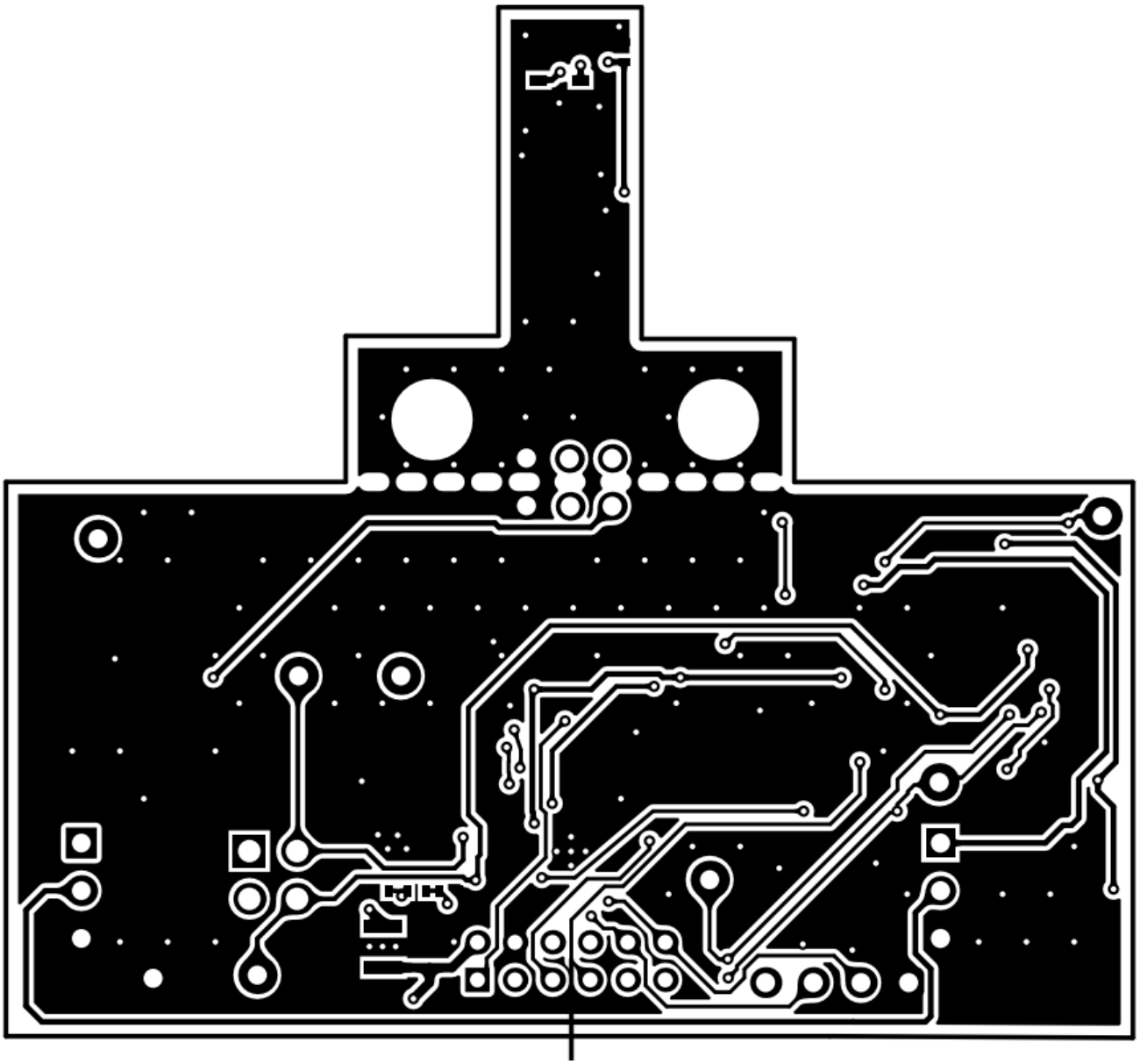


Figure 4-14. TMAG3101EVM Bottom Layer

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4.3 Bill of Materials

Table 4-1 provides the parts list for the TMAG3101EVM.

Table 4-1. TMAG3101EVM Bill of Materials

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
!PCB1	1		Printed Circuit Board		SENS171	Any
C1	1	1uF	CAP, CERM, 1 uF, 10 V, +/- 10% X5R, 0402	0402	C0402C105K8PACTU	Kemet
C2, C23	2	1000pF	CAP, CERM, 1000 pF, 16 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	AC0402KRX7R7BB102	Yageo
C4	1	10uF	CAP, CERM, 10 uF, 10 V, +/- 10%, X6S, 0603	0603	C1608X6S1A106M080AC	TDK
C5, C7, C16, C17, C18, C20	6	0.1uF	CAP, CERM, 0.1 uF, 10 V, +/- 10%, X5R, 0402	0402	GRM155R61A104KA01D	MuRata
C6, C9	2	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X5R, 0402	0402	C0402C104K4PACTU	Kemet
C8, C15	2	4.7uF	CAP, CERM, 4.7 µF, 16 V,+/- 20%, X5R, 0402	0402	CC0402MRX5R7BB475	Yageo America
C10	1	0.01uF	CAP, CERM, 0.01 uF, 16 V, +/- 10%, X5R, 0402	0402	GRM155R61C103KA01D	MuRata
C11	1	1uF	CAP, CERM, 1 µF, 6.3 V,+/- 10%, X6S, 0402	0402	CL05X105KQ5NNNC	Samsung Electro-Mechanics
C12, C13	2	0.1uF	CAP, CERM, 0.1 uF, 10 V, +/- 10%, X5R, 0402	0402	GRM155R61A104KA01D	MuRata
C14	1	1uF	CAP, CERM, 1 uF, 16 V, +/- 10%, X5R, 0402	0402	EMK105BJ105KVHF	Taiyo Yuden
C19	1	220pF	CAP, CERM, 220 pF, 50 V, +/- 10%, X7R, 0603	0603	C0603C221K5RACTU	Kemet
C21	1	4.7uF	CAP, CERM, 4.7 uF, 10 V, +/- 10%, X5R, 0402	0402	C1005X5R1A475K050BC	TDK
C22	1	470pF	CAP, CERM, 470 pF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	CGA2B2X7R1H471K050BA	TDK
D1, D2	2		Green 525nm LED Indication - Discrete 2.9V 0603 (1608 Metric)	0603	CS63CGT1C2MA	ChromeLED
D3	1		Schottky Diode 20V 2A Surface Mount MicroSMP (DO-219AD)	MicroSMP	MSS2P2-M3/89A	Vishay
FID1, FID2, FID3	3		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A

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Table 4-1. TMAG3101EVM Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
GND1	1		Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone Electronics
J1	1		Receptacle, 2.54 mm, 3x1, Gold, R/A, TH	Receptacle, 2.54 mm, 3x1, R/A, TH	PPPC031LGBN-RC	Sullins Connector Solutions
J2, J7	2		Header, 2.54mm, 3x2, Gold, SMT	Header, 2.54mm, 3x2, SMT	61000621121	Wurth Elektronik
J3	1			HDR12	NRPN062PARN-RC	Sullins Connector Solutions
J4	1		Header, 100mil, 3x1, Gold, R/A, TH	3x1 R/A Header	TSW-103-08-G-S-RA	Samtec
J5	1		Header, 100mil, 4x1, Gold, TH	4x1 Header	TSW-104-07-G-S	Samtec
J6	1		Header, 2.54mm, 2x2, Gold, TH	Header, 2.54mm, 2x2, TH	PBC02DAAN	Sullins Connector Solutions
L1	1	4.7uH	Inductor, Film, 4.7 uH, 1.6 A, 0.2 ohm, AEC-Q200 Grade 0, SMD	2.5x2mm	TFM252012ALMA4R7MTAA	TDK
Q1	1	60V	MOSFET, 2-CH, N-CH, 60 V, 0.115 A, SOT-363	SOT-363	2N7002DW	Fairchild Semiconductor
R1	1	12.0k	RES, 12.0 k, 1%, 0.1 W, 0603	0603	ERJ-3EKF1202V	Panasonic
R2, R11, R29, R36, R37, R38	6	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	ERJ-3GEY0R00V	Panasonic
R3, R4, R5	3	0	RES, 0, 5%, 0.063 W, 0402	0402	RC0402JR-070RL	Yageo America
R6, R8	2	1.6k	RES, 1.6 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04021K60JNED	Vishay-Dale
R7	1	2.2k	RES, 2.2 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04022K20JNED	Vishay-Dale
R13	1	232k	RES, 232 k, 1%, 0.063 W, 0402	0402	RC1005F2323CS	Samsung Electro-Mechanics
R14	1	200k	RES, 200 k, 1%, 0.1 W, 0402	0402	ERJ-2RKF2003X	Panasonic
R15, R23, R24	3	10.0k	RES, 10.0 k, 1%, 0.1 W, 0402	0402	ERJ-2RKF1002X	Panasonic
R17	1	10.0	RES, 10.0, 1%, 0.063 W, 0402	0402	CRCW040210R0FKED	Vishay-Dale

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Table 4-1. TMAG3101EVM Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
R18, R19, R21, R30	4	1.0k	RES, 1.0 k, 5%, 0.1 W, 0603	0603	CRCW06031K00JNEA	Vishay-Dale
R22, R26, R27, R31, R32	5	100k	RES, 100 k, 5%, 0.1 W, 0603	0603	CRCW0603100KJNEA	Vishay-Dale
R25	1	22.1	RES, 22.1, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040222R1FKED	Vishay-Dale
R33	1	51k	51 kOhms ±0.5% 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) Automotive AEC-Q200 Thin Film	0603	ERA-3AED513V	Panasonic
R34	1	97.6k	97.6 kOhms ±0.5% 0.2W, 1/5W Chip Resistor 0603 (1608 Metric) Automotive AEC-Q200, Pulse Withstanding Thick Film	0603	ERJ-PB3D9762V	Panasonic
SH-J1, SH-J2, SH-J3	3	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec
U1	1		TMAG3101-Q1	TSSOP8	TMAG3101-Q1	Texas Instruments
U2	1		Low Input, 20V/1.1A Step-Up DC/DC Converter with Integrated Power Diode and Input/Output Isolation, DSK0010A (WSON-10)	DSK0010A	TPS61093DSKR	Texas Instruments
U3	1		4-Bit Bidirectional Voltage-Level Shifter for Open-Drain and Push-Pull Applications, RGY0014A (VQFN-14)	RGY0014A	TXS0104ERGYR	Texas Instruments
U4	1		Linear Voltage Regulator IC Positive Fixed 1 Output 150mA 8-SON (3x3)	VSON8	TPS7B8450QWDRBRQ1	Texas Instruments
U5	1		5.5-V, 2-A, 80 mohm Low Leakage Load Switch with RCB and Programmable Rise Time, DBV0006A (SOT-23-6)	DBV0006A	TPS22917DBVR	Texas Instruments

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Table 4-1. TMAG3101EVM Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
U6	1		500-µV (Maximum), 10-MHz, Low Broadband Noise, RRO, Operational Amplifier	SC70-5	OPA375IDCKR	Texas Instruments
U7	1		1-Ohm SPDT Analog Switch, DBV0006A (SOT-23-6)	DBV0006A	TS5A3159DBVR	Texas Instruments
U8	1		I2C-Compatible, 12-Bit Analog-to-Digital Converter (ADC) with Alert Pin, 6-pin Tiny SOT23	TSOT23-6	ADC121C021CIMK/NOPB	Texas Instruments
U9	1		Dual Differential Comparators, PW0008A (TSSOP-8)	PW0008A	LM2903QPWRQ1	Texas Instruments
1, EXT_1, EXT_2	0		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone Electronics
C3	0	0.1uF	CAP, CERM, 0.1 uF, 10 V,+/- 10%, X7R, 0603	0603	885012206020	Wurth Elektronik
OUT1	0		Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone Electronics
OWI_RX1, OWI_TRX1, OWI_TX1	0		Test Point, Miniature, Blue, TH	Blue Miniature Testpoint	5117	Keystone
R9, R10, R16	0	10.0k	RES, 10.0 k, 1%, 0.1 W, 0402	0402	ERJ-2RKF1002X	Panasonic
R12	0	0	RES, 0, 5%, 0.063 W, 0402	0402	RC0402JR-070RL	Yageo America
R20	0	0	RES, 0, 5%, 0.05 W, 0201	0201	CRCW02010000Z0ED	Vishay-Dale
R28, R35	0	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	ERJ-3GEY0R00V	Panasonic

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5 Additional Information

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6 Related Documentation

This EVM user's guide is available from the TI website under literature number SBAU457. Any letter appended to the literature number corresponds to the document revision that is current at the time of the writing of this document. Newer revisions are available from www.ti.com or the Texas Instruments' Literature Response Center at (800) 477-8924 or the Product Information Center at (972) 644-5580. When ordering, identify the document by both title and literature number. Table 6-1 lists documentation related to the EVM. Click the links in Table 6-1 for further information. The device name links to the product web folder on www.ti.com. The literature number links to the document PDF.

Table 6-1. Related Documentation

DOCUMENT TITLE	DOCUMENT LITERATURE NUMBER
TMAG3101-Q1 datasheet	SBASAP1

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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。

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2. 実験局の免許を取得後ご使用いただく。
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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.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations*. IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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