User Guide

MagVector^{TM} Evaluation Kit (EVKT-MV-RP-PICO)

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Overview

Introduction

The EVKT-MV-RP-PICO is an evaluation kit for MPS's MagVector™ 3D magnetic sensor family. This kit is designed to work alongside the TBMV300-Q-LT I²C or SPI test boards and the MagVector™ evaluation app software. The software allows users to visualize the magnetic vectors and interact with the sensor's register settings. The evaluation app can be downloaded on the MPS website.

The EVKT-MV-RP-PICO does not include the MagVector™ 3D sensor test board, which means that the sensor board must be ordered separately. This evaluation kit communicates with the 3D sensor via either an I²C or serial peripheral interface (SPI) interface.

Items Included in the Kit

The kit includes the items listed below.

#	Item	Description	Quantity
1	EVKT-MV-RP-PICO	Microcontroller (MCU) board	1
2	Ribbon cable	Connects the EVKT-MV-RP-PICO to the TBMV300-Q-LT I²C or SPI test board	1
3	USB cable	Connects the EVKT-MV-RP-PICO to the computer	1

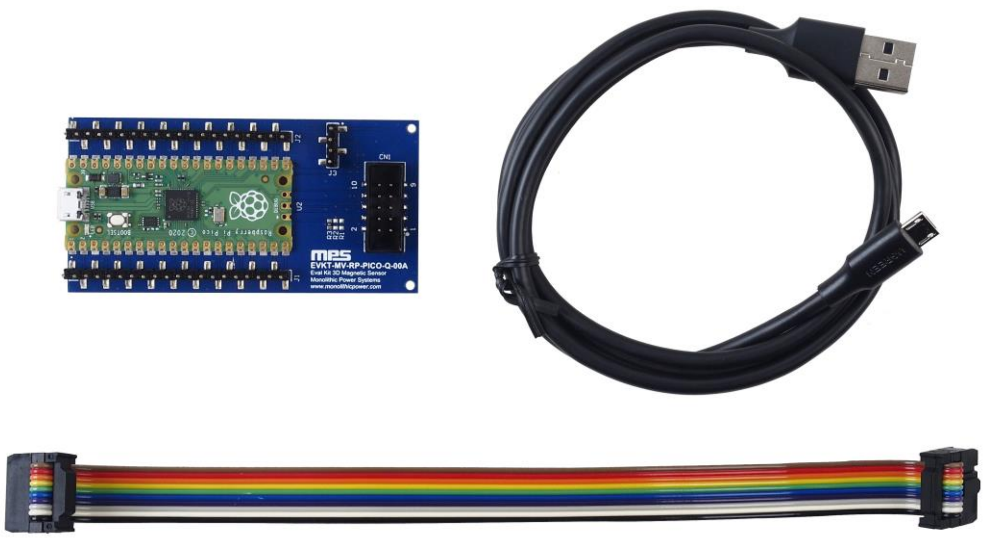


Figure 1: MagVector™ Evaluation Kit Contents

Items Compatible with the Kit

The table below list all items that are compatible with the MagVector™ evaluation kit (items below must be ordered separately):

#	Part Number	Item
1	TBMV300-Q-LT-I2C	MV300 I²C test board (not included with the EVKT-MV-RP-PICO, and must be ordered separately)
2	TBMV300-Q-LT-SPI	MV300 SPI test board (not included with the EVKT-MV-RP-PICO, and must be ordered separately)
3	MagVector™ Evaluation App	Software that communicates with the EVKT-MV-RP-PICO. Can be downloaded from the MPS website

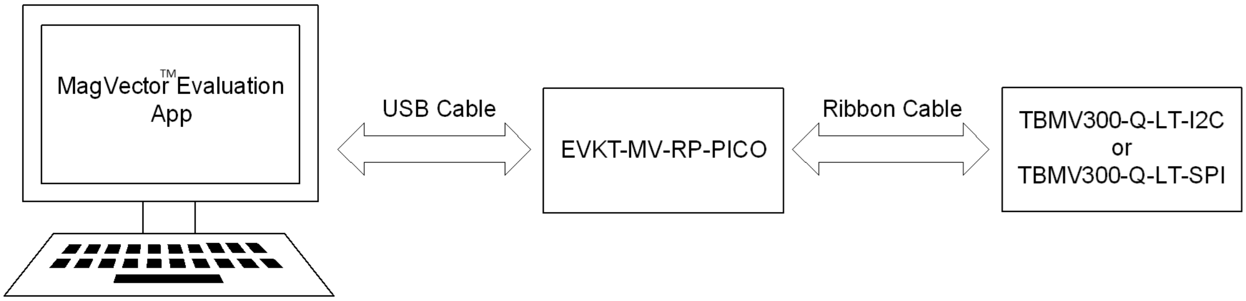


Figure 2: MagVector^{TM} Evaluation Kit Set-Up

Section 1. Hardware

1.1 3D Top View

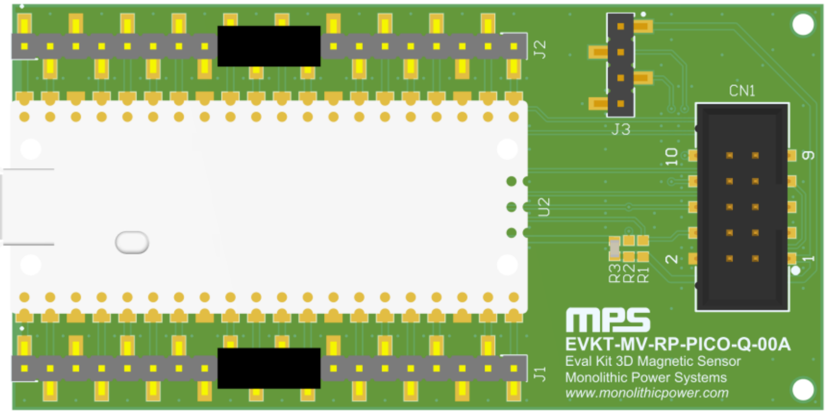


Figure 3: EVKT-MV-RP-PICO

1.2 Schematic

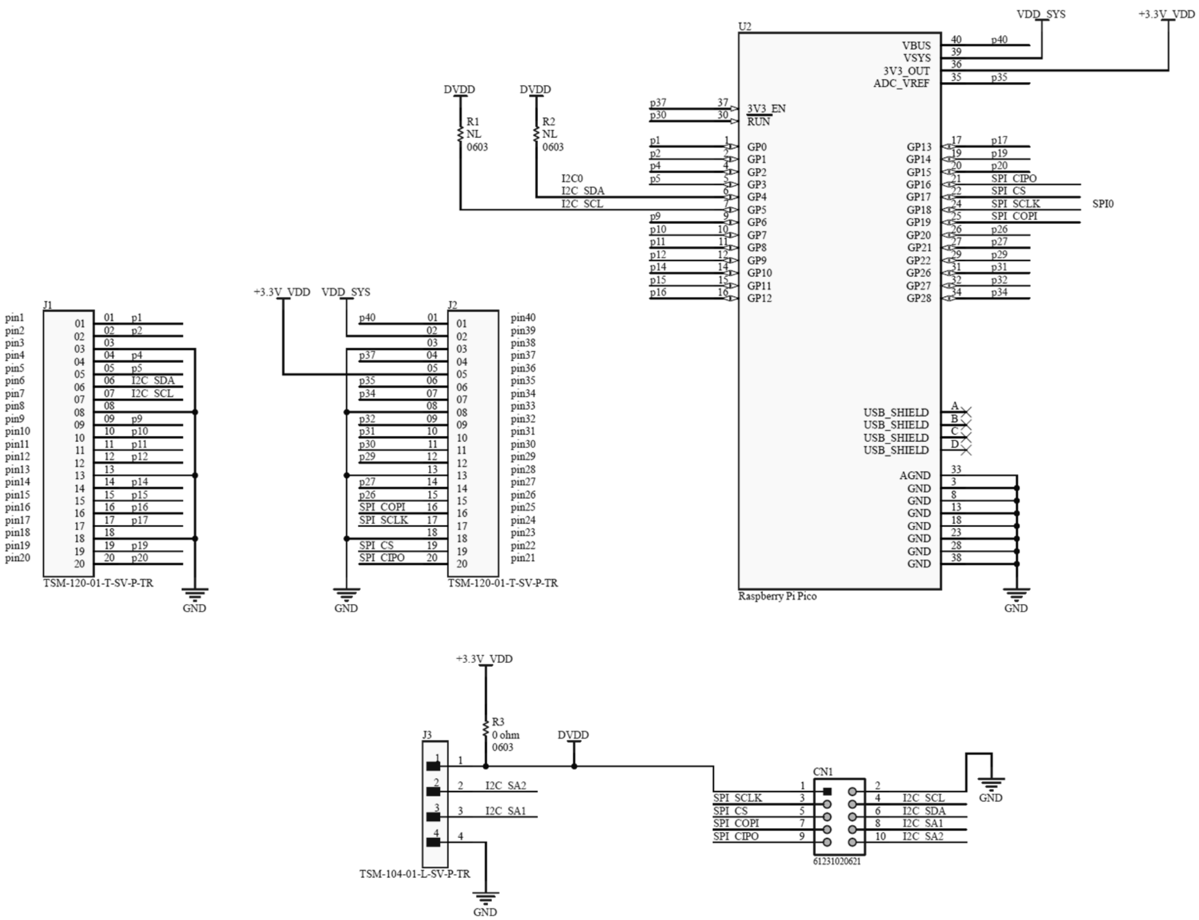


Figure 4: EVKT Schematic

R1 and R2 are not loaded by default due to the I²C pull-up resistors on the MagVector™ test boards. If a custom sensor board is used, ensure that the I²C lines (SDA and SCL) have the required pull-up resistors assembled. If the required resistors are not assembled, it is recommended to solder a 1.5kΩ resistor each to both R1 and R2.

When an I^2C test board is connected to the evaluation kit, it is possible to overwrite the configured I^2C device address by tying the SA1 signal on pin 3 and the SA2 signal on 2 (both on the J3 connector) to either VDD or GND. This connection must have a smaller impedance than the pull-up or pull-down resistors used on the test board (like R3, R4, R5, R6 on the TBMV300-Q-LT-I2C). These connections could be made using jumper wires for instance.

1.3 Bill of Materials

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	U2	32-bit	Raspberry Pi Pico board	51mmx21mm	Raspberry Pi	Raspberry Pi Pico
1	CN1	2 x 5 pins	Male header, 10 pins	Dual-row, 2.54mm pitch, SMD header	CNC Tech or Wurth	3020-10-0300-00 or 61231020621
5	J1, J2	1 x 20 pins	Male header, 20 pins	Single-row, 2.54mm pitch, SMD header	Samtec	TSM-120-01-T-SV
1	J3	1 x 4 pins	Male header, 4 pins	Single-row, 2.54mm pitch, SMD header	Samtec	TSM-104-01-T-SV
1	R3	0Ω jumper	Resistor	0603	Yageo	RC0603JR-070RL
2	R1, R2		NL resistor	0603		

1.4 Connector Pin Functions

CN1 Pin #	Name	Description
1	+3.3V_VDD	3.3V supply
2	GND	Supply ground
3	SPI_SCLK	SPI serial clock
4	I2C_SCL	I^2C serial clock (open drain) and interrupt (indicating data ready status)
5	SPI_CS	SPI chip selection
6	I2C_SDA	I^2C serial data (open drain)
7	SPI_COPI	SPI controller's output peripheral input
8	I2C_SA1	I^2C serial address definition
9	SPI_CIPO	SPI controller's input peripheral output
10	I2C_SA2	I^2C serial address definition

1.5 Raspberry Pi Pico Pin Functions

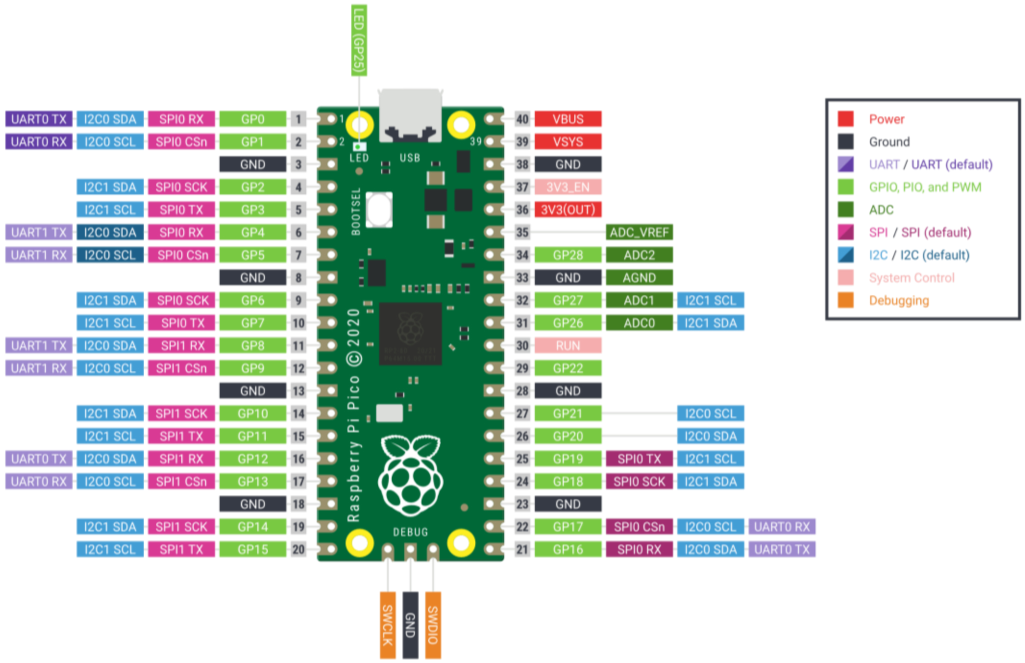


Figure 5: Raspberry Pi Pico Pinout

Figure 5 is from the Raspberry Pi website. For more information about this board, refer to https://www.raspberrypi.com.

1.6 Layout

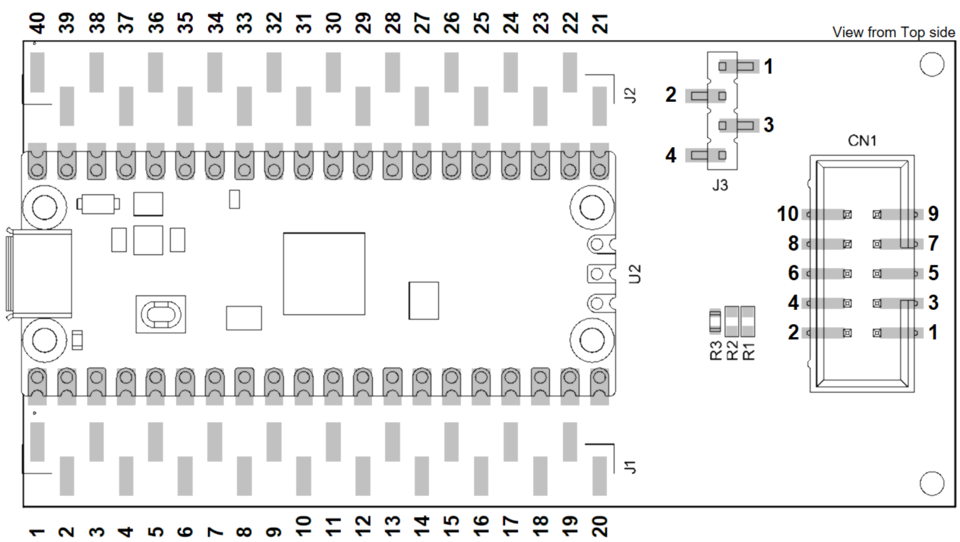


Figure 6: EVKT Layout with Pin Numbers

1.7 Hardware Set-Up

The hardware must be properly configured prior to use. Follow the instructions below to set up the evaluation board:

1. Connect the EVKT-MV-RP-PICO to the TBMV300-Q-LT I^{2}C or SPI board using the ribbon cable.
2. Connect the EVKT-MV-RP-PICO to the computer using the USB cable.

1.8 Powering up the EVKT and TBMA

The EVKT-MV-RP-PICO is powered through the USB cable. The 5V from the USB cable powers a DC/DC converter. This converter then generates the 3.3V that supplies the Raspberry Pi Pico and the TBMV300 test board.

It is possible to power the TBMV300-Q-LT board with an external supply. To power the TBMV300-Q-LT board with an external supply, follow the steps below:

1. Unsolder the 0Ω resistor (R3).
2. Connect the external power supply to J3's pin 1 (+3.3V_VDD) and pin 4 (GND).

Section 2. Software Installation

2.1 Computer Requirement

The following must be minimally met to use this evaluation kit:

- Operating system of Windows 8, 64-bit or later
- PC with a minimum of one available USB port
- At least 220MB of free space

2.2 Software Installation Procedure

Follow the instructions below to install the software:

1. Double click the “magvector-evaluation-app-X.X.X-windows-installer-x64.exe” file.
2. Follow the prompts in the set-up guide.
3. Wait for the status screen to verify that installation is complete (see Figure 11 on page 11).
4. Windows should automatically install the driver when the EVKT is first connected to the computer.

Figure 7 shows the installation guide’s welcome page.

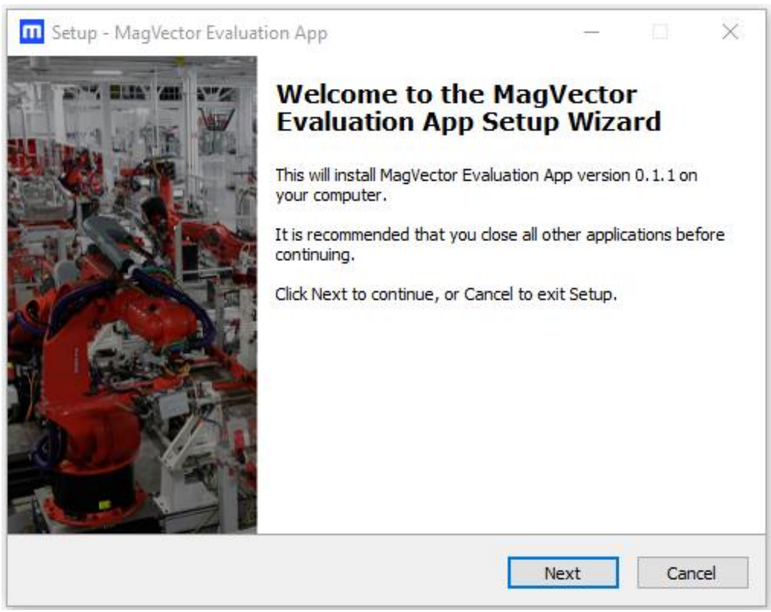


Figure 7: Set-Up Welcome Page

Figure 8 on page 10 shows the license agreement.

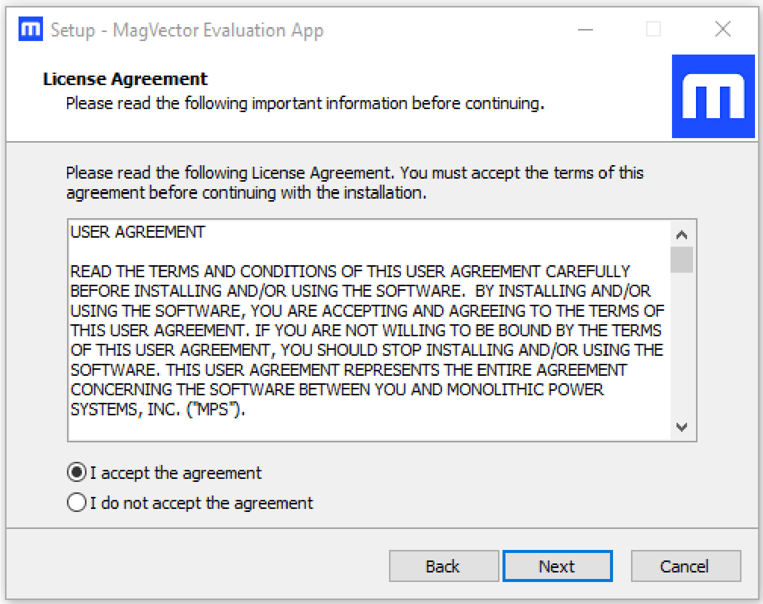


Figure 8: License Agreement

Figure 9 shows the prompt to create a desktop shortcut.

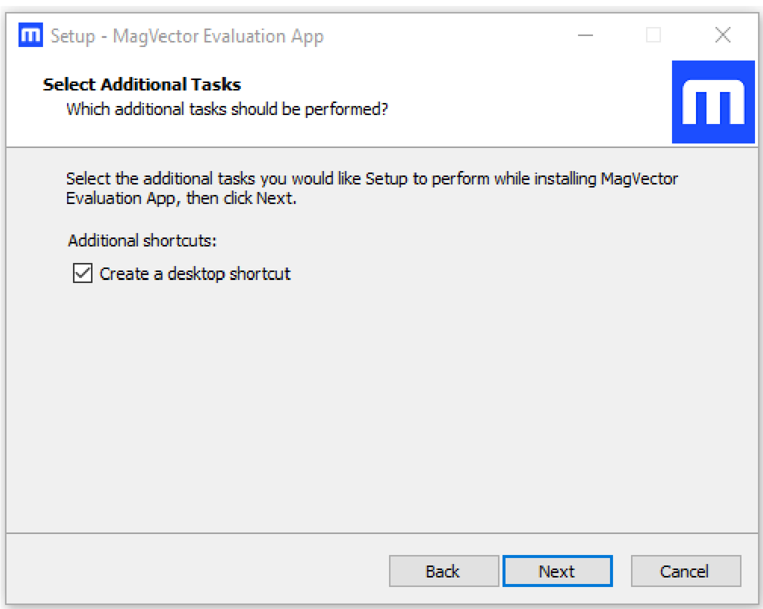


Figure 9: Creating a Shortcut

Figure 10 on page 11 shows the installation confirmation prompt.

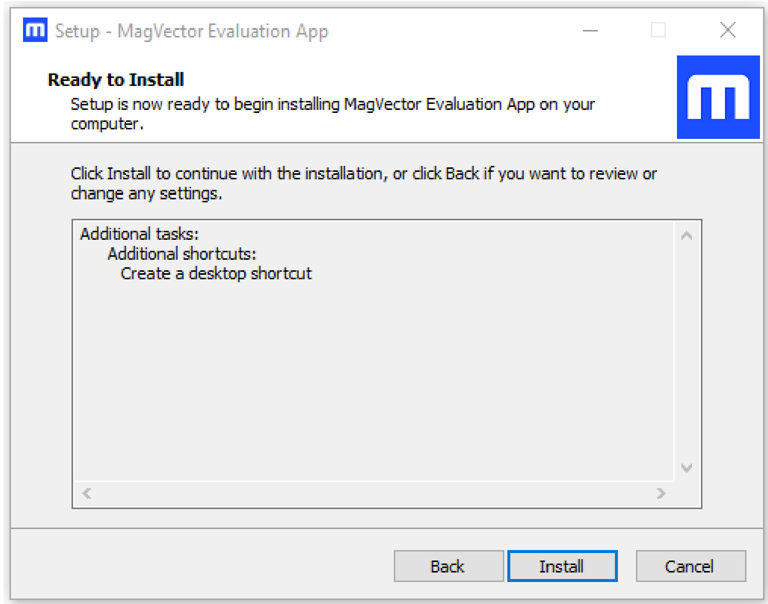


Figure 10: Installation Confirmation Prompt

Figure 11 shows the screen when installation is complete.

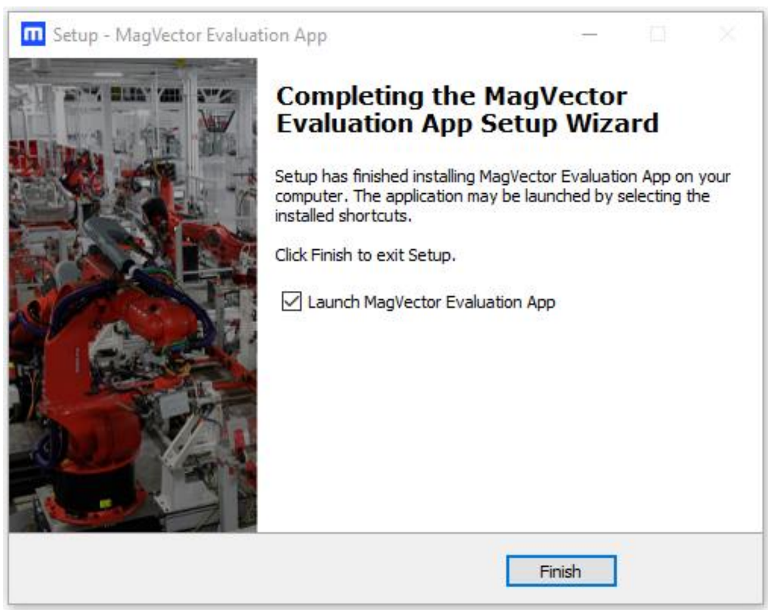


Figure 11: Installation Completed

Section 3. How to Use the Application

3.1 Software Launch

After connecting the hardware to the computer, follow the steps below to use the application software:

1. Start the software. It should automatically check for a compatible hardware connection.
    a. If the connection is successful, the application should start plotting the magnetic vectors.
    b. If no compatible hardware is found, an error message should appear and ask the user to connect the EVKT-MV-RP-PICO to the computer (see Figure 12).

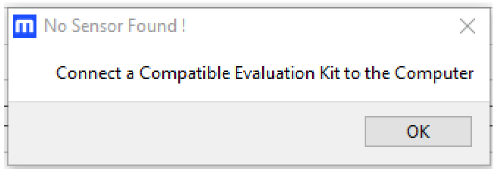


Figure 12: No Sensor Found Error Message

3.2 Software and Firmware Update

After start-up, the application searches for an application update online. If an update is available, a dialog window should pop up and propose an update. If the update is accepted, the application automatically downloads and installs the new version.

Then the application checks that the firmware version on the EVKT-MV-RP-PICO is the latest version. If a new firmware version is available, a dialog window should appear proposing the update to the user. If the update is accepted, the application automatically uploads the new firmware into the Raspberry Pi Pico Flash.

Note that automatic firmware upload does not work on brand new Raspberry Pi Pico devices that were not previously configured with the EVKT-MV-RP-PICO firmware. If there are any issues with the firmware update, see section 3.3 below.

3.3 Manual Firmware Update

If the automatic firmware upload does not work, it is possible to manually force the Raspberry Pi Pico into firmware upload mode. To enter firmware update mode, follow the steps below:

1. Disconnect the Raspberry Pi Pico from the computer.
2. Press and hold the BOOTSEL button (see Figure 13).

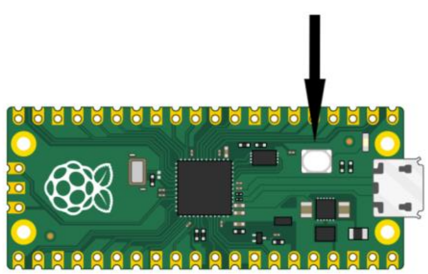


Figure 13: Raspberry Pi Pico BOOTSEL Button

3. Reconnect the Raspberry Pi Pico to the computer.
4. A new USB storage device named RPI-RP2 should appear on the computer. This storage device should contain two files: “INDEX.HTM” and “INFO_UF2.TXT” (see Figure 14).

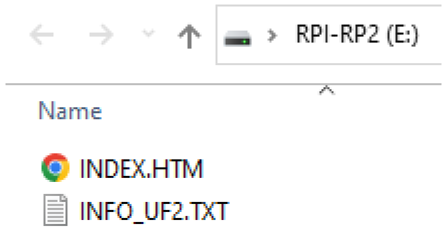


Figure 14: Raspberry Pi Pico USB Storage Device

5. To upload the new firmware into the Raspberry Pi Pico, drag and drop the firmware uf2 file (this file has a ".uf2" extension) into the RPI-RP2 USB Driver.
    a. The UF2 firmware file can be found in the MagVector Evaluation App folder in the following location:

        C:\Program Files\MPS\MagVector-Evaluation-App\bin\resources\firmware\evkt-mv-rp-pico-firmware-0.1.0.uf2

3.4 Expand Left Panel

Click on the expand button to increase or decrease the left panel's width and show the different page names (see Figure 15).

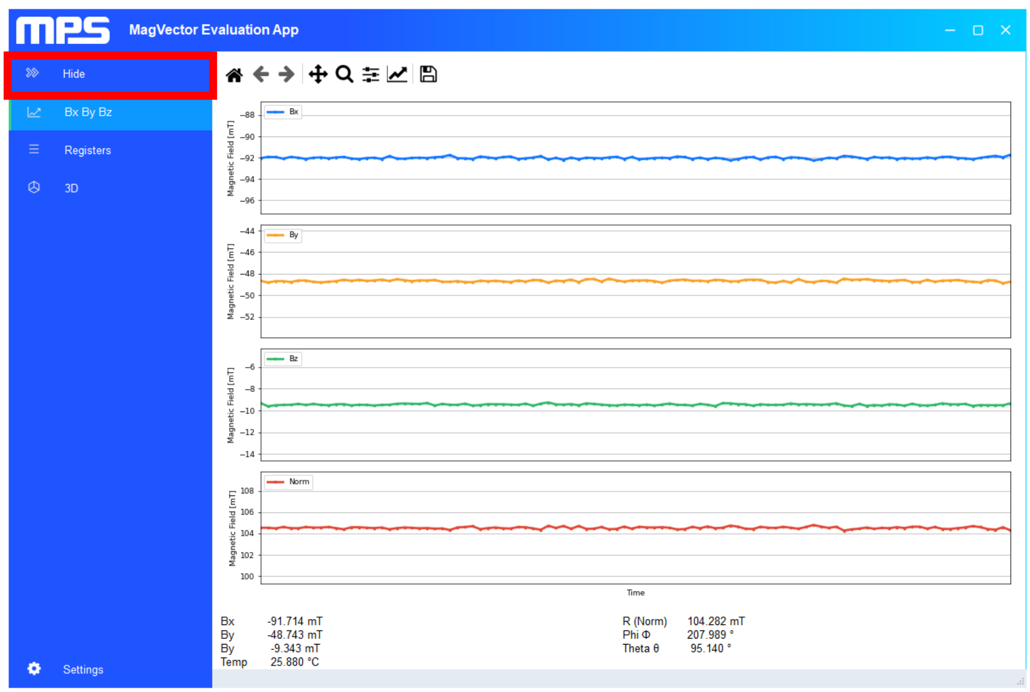


Figure 15: Click on the Expand Button to Increase or Reduce the Left Panel Width

3.5 Bx, By, Bz Page

Figure 16 shows the Bx, Byz, Bz page.

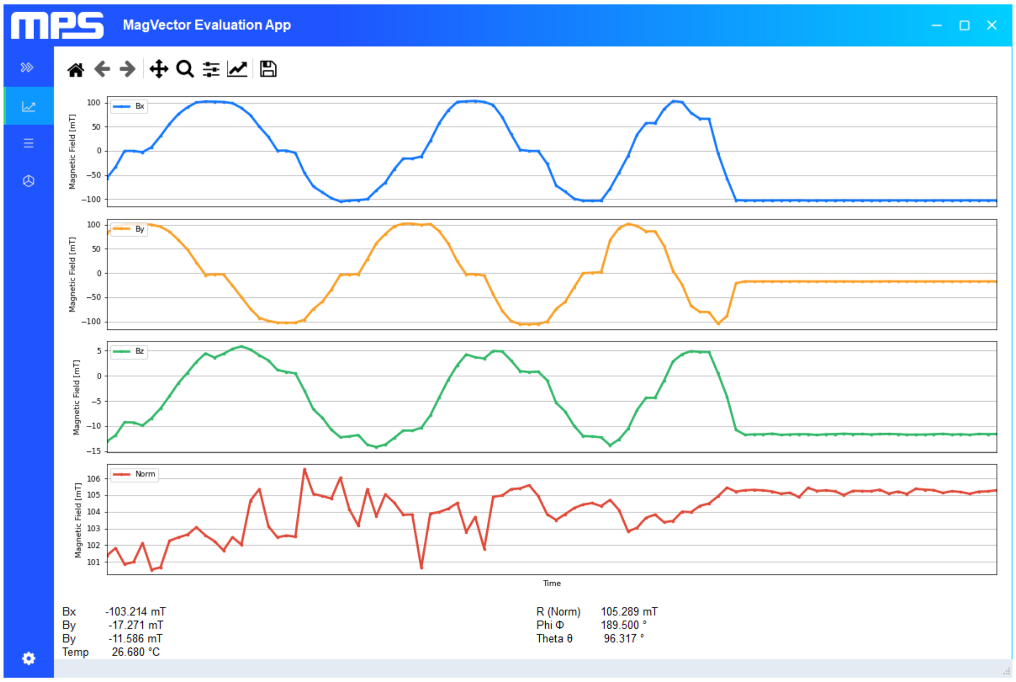
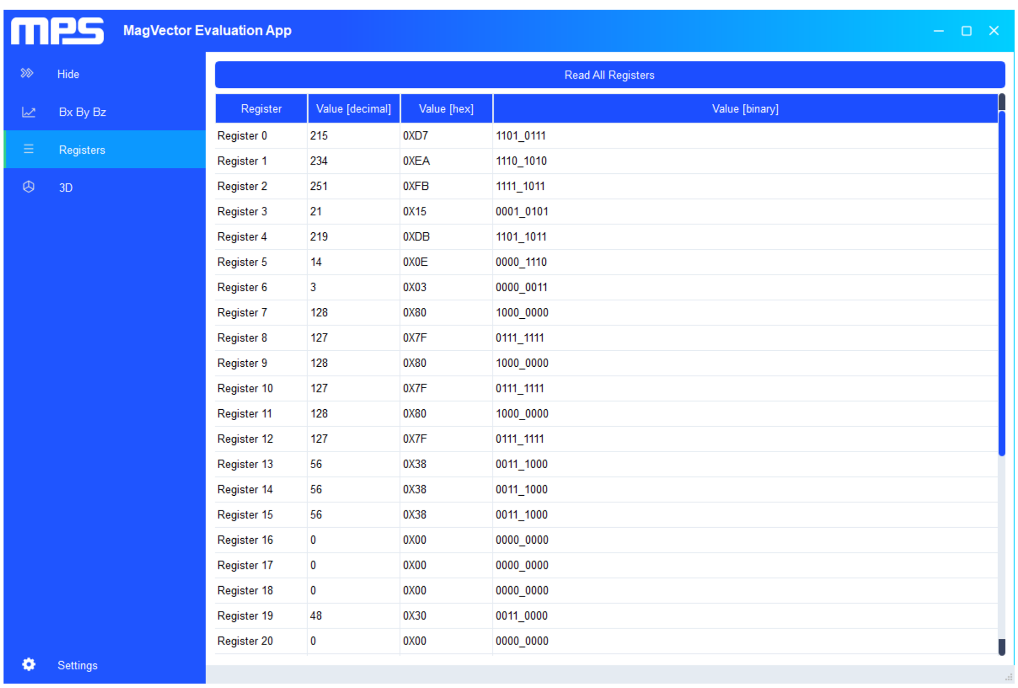


Figure 16: Bx, By, Bz Page

3.6 Registers Page

Figure 17 shows the Registers page.



Register	Value [decimal]	Value [hex]	Value [binary]
Register 0	215	0XD7	1101_0111
Register 1	234	0XEA	1110_1010
Register 2	251	0XFB	1111_1011
Register 3	21	0X15	0001_0101
Register 4	219	0XDB	1101_1011
Register 5	14	0X0E	0000_1110
Register 6	3	0X03	0000_0011
Register 7	128	0X80	1000_0000
Register 8	127	0X7F	0111_1111
Register 9	128	0X80	1000_0000
Register 10	127	0X7F	0111_1111
Register 11	128	0X80	1000_0000
Register 12	127	0X7F	0111_1111
Register 13	56	0X38	0011_1000
Register 14	56	0X38	0011_1000
Register 15	56	0X38	0011_1000
Register 16	0	0X00	0000_0000
Register 17	0	0X00	0000_0000
Register 18	0	0X00	0000_0000
Register 19	48	0X30	0011_0000
Register 20	0	0X00	0000_0000

Figure 17: Registers Page

3.7 3D Page

Figure 18 shows the 3D page.

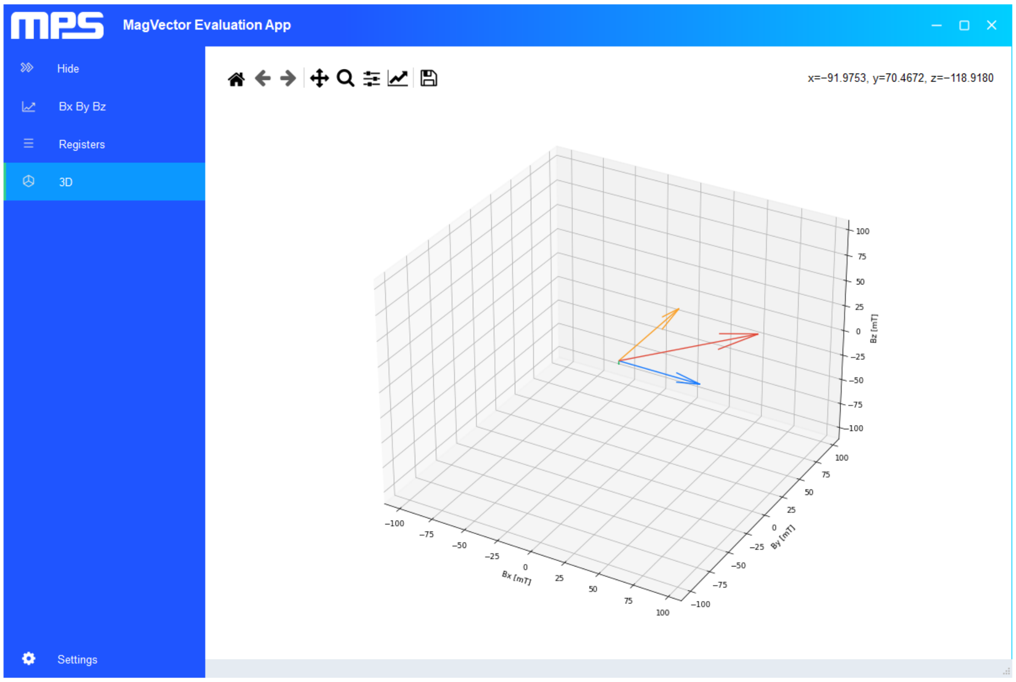


Figure 18: 3D Page

3.8 Settings Page

Figure 19 shows the Settings page.

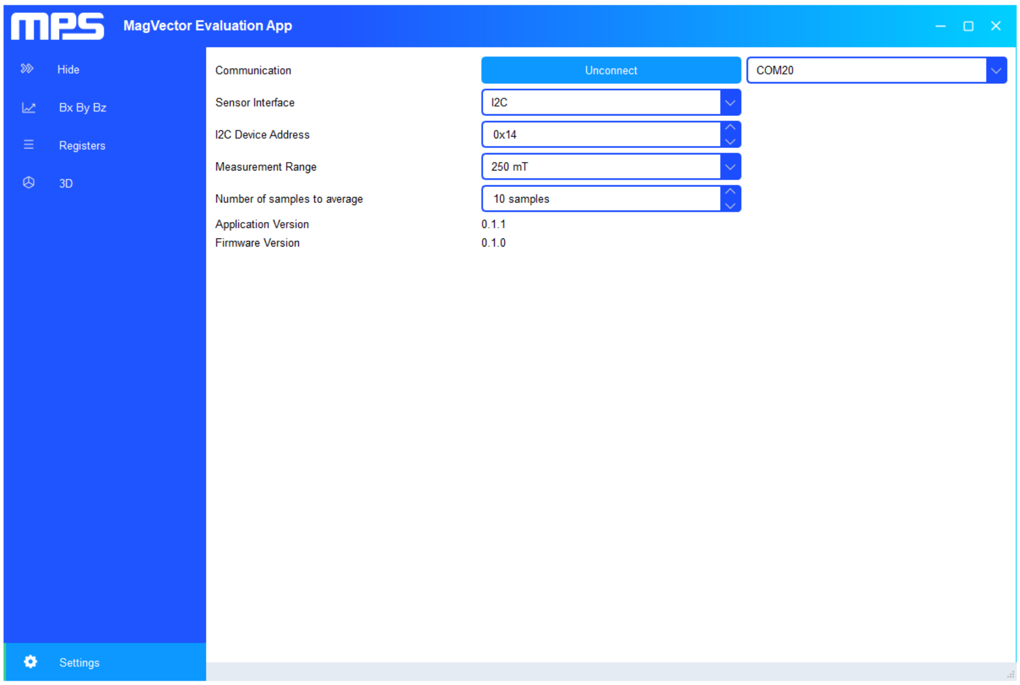


Figure 19: Settings Page

3.9 Troubleshooting Tips

No Device Connected

Even if the cables are connected correctly, the device may not be detected. If no device is detected, follow the steps below:

1. Right click on the Windows start button and select “Device Manager”.
2. Connect the EVKT-MV-RP-PICO to the PC with a USB cable.
3. A USB serial device should appear under “Ports (COM & LPT)” (see Figure 20).

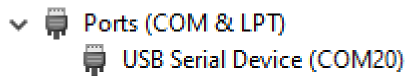


Figure 20: USB Serial Device

No Supply

If there is a no supply error, check the EVKT-MV-RP-PICO. Ensure that a 0Ω resistor is soldered on R3, or that there is an external 3.3V power supply connected to pin 1 and pin 4 on J3.

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	10/6/2022	Initial Release	-