MCP16503 Evaluation Board User Guide

EV05A95A

Introduction

The MCP16503 Evaluation Board has been developed to test the capabilities of the MCP16503 and to control and monitor it through the USB interface (via the I2C Monitor GUI).

The MCP16503 Evaluation Board is designed to simplify the evaluation and testing of all the MCP16503 capabilities. The V_{IN} supply has a 2.7V-5.5V range and VOUT has a 1.2V-3.7V range for Buck1 and the two LDOs and 0.6-1.85V for Buck2, Buck3 and Buck4.

An on-board MCP2221, which is a USB 2.0 to I^2C/UART Protocol Converter with GPIO, is placed on the board to simplify the configuration of the MCP16503.

The application allows for both manual control of power state pins through 3-pin jumpers on PWRHLD, LPM and HPM pins, as well as software control using the I^2C Monitor GUI.

The MCP16503 is an optimally integrated PMIC, for general purpose eMPUs (Embedded Microprocessor Units), requiring Dynamic Voltage Scaling (DVS). The regulators' startup voltages are adjustable using selection resistors and the regulators can be fully adjusted by using I_2C.

The MCP16503 integrates four DC-DC buck regulators and two auxiliary LDOs, and provides a comprehensive interface to the MPU, which includes an interrupt flag and a 1 MHz I_2C interface.

All buck channels can support loads up to 1A and are capable of operating at a 100% duty cycle.

Two 300 mA LDOs are provided to support sensitive analog loads.

Unlike MCP16502, the MCP16503 comes with a simple logic level EN pin, which simplifies the start-up procedure, being able to start even when the input voltage ramps slowly or when the input voltage is unstable and suddenly drops below UVLO. After the initial Start-up, the PMIC can be shutdown and started by the MPU, using the PWRHLD pin.

The default power channel sequencing is built-in according to the requirements of the MPU, starting from buck1 and LDOx, buck2, buck3, and buck4. A dedicated pin (LPM) facilitates the transition to Low-Power mode and the implementation of Backup mode with DDR in self-refresh (Hibernate mode).

The MCP16503 features a low no-load operational quiescent current and it draws less than 10 µA in full shutdown.

Active discharge resistors are provided on each output. All buck channels support safe start-up into pre-biased outputs.

The MCP16503 is available in a 32-pin 5 mm x 5 mm VQFN package with an operating junction temperature range from -40°C to +125°C.

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Figure 1. Typical Application Schematic of MCP16503 with eMPU and DDRx

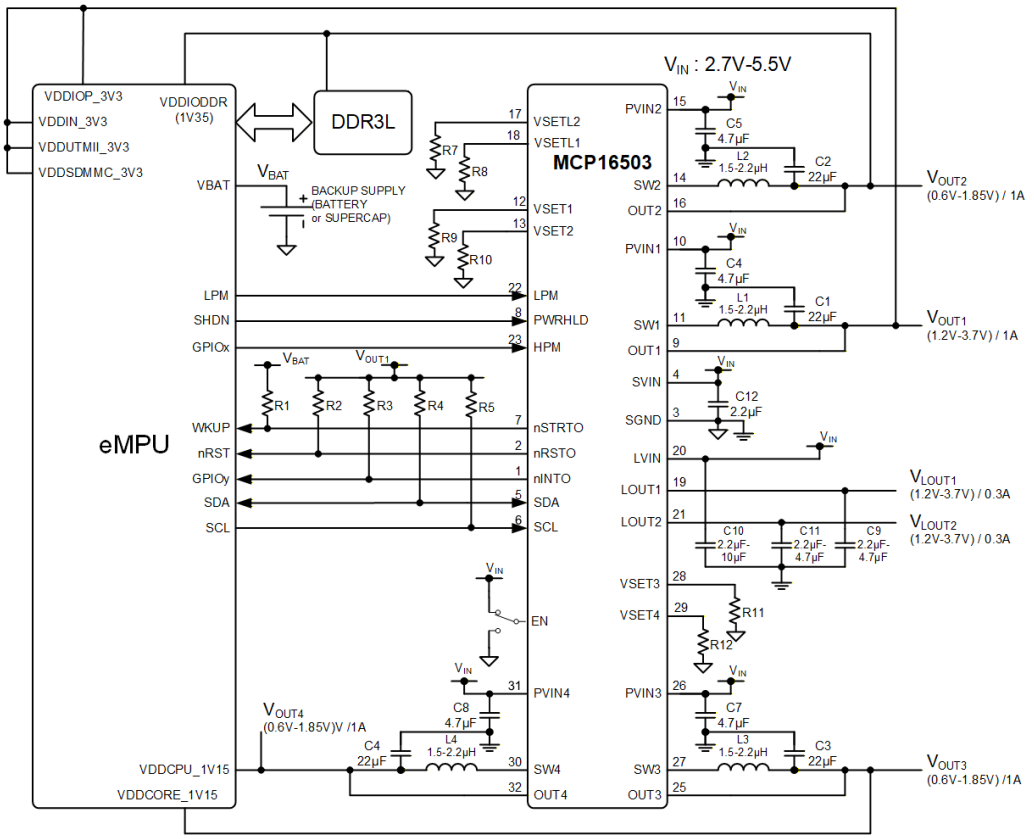
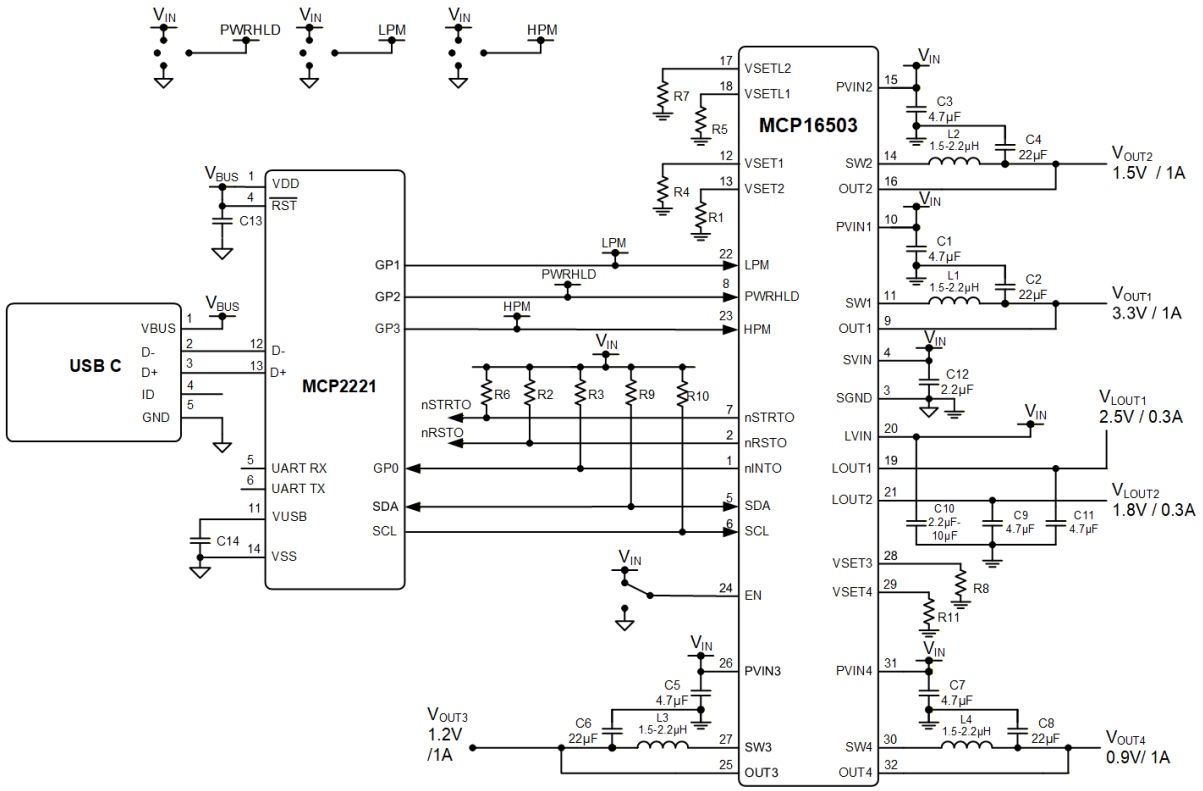


Figure 2. MCP16503 Evaluation Board with MCP2221 I2C Bridge



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Features

The MCP16503 Evaluation Board (EV05A95A) has the following features:

- Input Voltage: 2.7V to 5.5V
- Four 1A Output Current Buck Channels With 100% Maximum Duty Cycle Capability
- 2 MHz Buck Channels PWM Operation
- Two Auxiliary 300 mA Low Dropout Linear Regulators (LDOs)
- ±1% Voltage Accuracy for DDR (Buck2 Output), Core (Buck3 Output) and CPU (Buck4 Output)
- Resistor Selectable Output Voltage for Each Channel
- Adjustable Output Voltage From 0.6V to 1.85V (Only for Buck2, 3 and 4)
- Adjustable Output Voltage From 1.2V to 3.7V (Only for Buck1, LDO1 and LDO2)
- Shutdown Input Pin (EN)
- MPU-Specific Built-in Default Channel Sequencing and nRSTO Assertion Delay
- Support of MPU Hibernate, Low-Power and High-Performance Modes With DVS
- 1 MHz I_2C Interface for Programming and Diagnostics
- Low Noise, Forced PWM (FPWM) and Low IQ, Light Load, High-Efficiency Mode Available
- I_2C-Selectable Displacement (±16.5%) of PWM Switching Frequency
- Leakage-Free Interfacing to MPU in Any Operating Condition Through Optimized ESD Protection
- Less Than 300 µA Low-Power Mode Typical Quiescent Current Bucks and LDO1 ON, No Load
- 10 µA Maximum Shutdown Current (VIN = 4.5V, TJ = +105°C)
- Cost and Size-Optimized BOM
- Thermal Shutdown and Current Limit Protection
- User-Programmable Overcurrent Fault Response
- 32-Pin 5 mm × 5 mm VQFN Package

Kit Contents

The MCP16503 Evaluation Board (EV05A95A) kit includes:

- MCP16503 Evaluation Board (EV05A95A)
- USB-to-USB-C Cable

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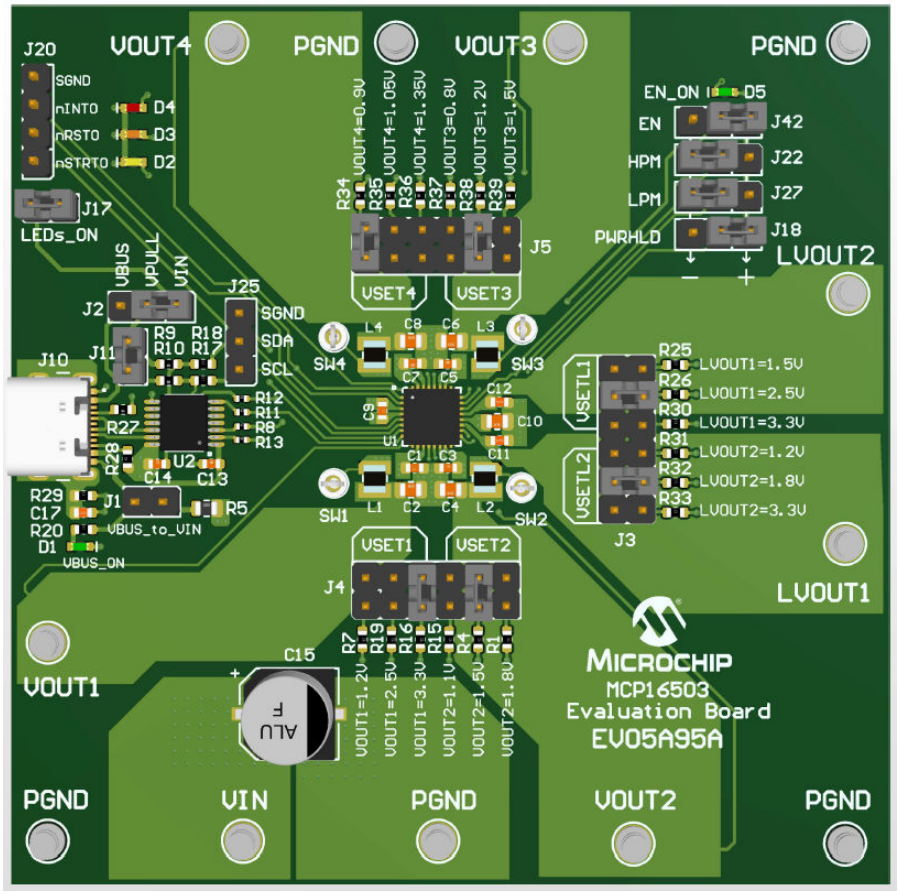
Figure 3. MCP16503 Evaluation Board (EV05A95A)



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1. Setup and Configuration

The MCP16503 Evaluation Board is fully assembled and tested to evaluate and demonstrate the MCP16503 product. This board requires a single power supply with at least 3A current capability if multiple channels are tested under load. The MCP16503 Evaluation Board can be powered directly from the USB connector[1] by connecting jumper J1.

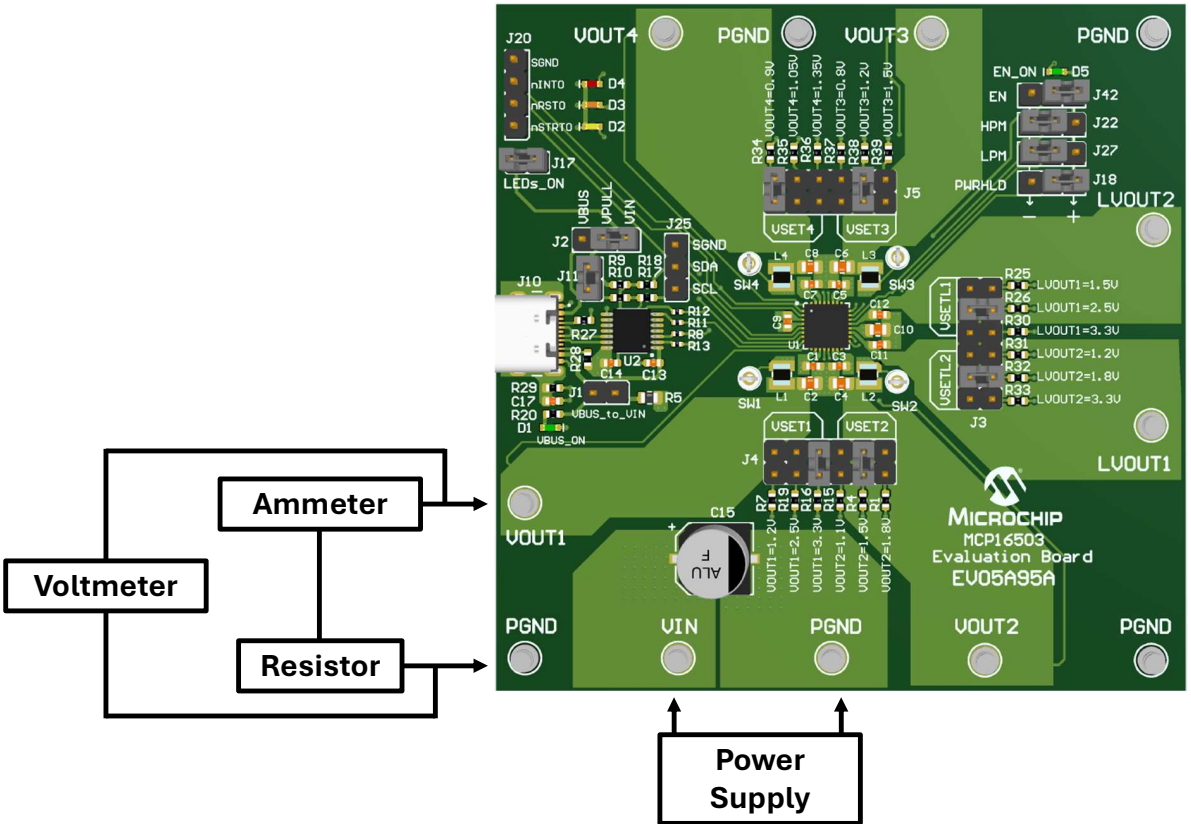
[1] The output power in this configuration is hardware limited by the R5 resistor. This setup is intended solely for testing purposes using the GUI for sequencing and various register settings.

1.1. Powering the MCP16503 Evaluation Board

Complete the following steps to power up the MCP16503 Evaluation Board:

1. Connect a power supply to the VIN and PGND terminals (remove the J1 jumper if present). An ammeter may be placed between the input supply and the VIN terminal of the Evaluation Board. Ensure that the supply voltage is monitored at the VIN terminal. The ammeter and/or power lead resistance can reduce the voltage supplied to the input.

Figure 1-1. MCP16503 Evaluation Board Connection



Note: Keep the power supply disabled; do not apply power before Step 5.

2. Connect the loads to the VOUTx for buck converters or LVOUTx for LDO regulators and PGND terminals. The load can be either passive (resistive) or active (electronic load). An ammeter can be placed between the load and each output terminal. Ensure that the output voltage is monitored at the output terminals.
3. Make sure the jumpers are connected as shown in Figure 1-1 (HPM = LPM = LOW, PWRHLD = VPULL= VIN, and remove the J1 jumper if present), except for the EN pin, which should be pulled LOW. Each regulator on this board can be set to one of three output voltages. To choose the

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output voltage for a channel, find the terminals labeled VSETx or VSETLx for that channel. Place a jumper on the pair of pins that correspond to the desired output voltage. Every channel shall be configured via the VSETx/VSETLx pins at the end of this step.

4. To change the PMIC parameters or to monitor the device, connect the Evaluation Board to the PC using a USB-to-USB-C cable.
5. Set the power supply to 5V and turn it on. Alternatively, if no power supply is available, a jumper can be connected to J1, so that the board is powered from the USB connection.
6. Move the EN jumper to the VIN position.
7. Verify that the output voltages are regulated to the desired VOUT setting for each channel.
8. The PMIC settings can be modified using the GUI. For details on how to use the I2C Monitor, see I2C Monitor Graphical User Interface Uninstall.

1.2. Layout Considerations

The MCP16503 PMIC requires at least nine vias from the ICs Exposed Pad to the ground (GND) plane, to dissipate the generated heat. The GND plane can be increased or decreased based on the ambient temperature, air flow or other devices that generate heat. The rule of thumb is that the GND plane must be as big as possible. It is also recommended to connect the input and output capacitor GND connections.

See Board Design for a PCB layout example. For low EMI (Electromagnetic Interference) emissions, the switching node of the Buck regulators should be routed on an internal plane, surrounded/enclosed by input supply voltage distribution or GND planes.

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2. Graphical User Interface (GUI) Installation and Operation

In order to install, use and evaluate the product, several software and hardware tools are required.

Required Software

- I²C Monitor Graphical User Interface (minimum v.TBD)
- Microsoft®.NET Framework 4.5 or higher
- Adobe Acrobat Reader

Required Hardware

- MCP16503 Evaluation Board (EV05A95A)
- USB-to-micro-USB Cable

2.1. Graphical User Interface Installation

The following steps describe how to install the I²C Monitor Graphical User Interface:

1. If Microsoft®.NET Framework is already installed, go to Step 3. If not, download Microsoft®.NET Framework from www.microsoft.com and follow the installation instructions.
2. If Adobe Acrobat Reader is already installed, go to Step 3. If not, download Adobe Acrobat Reader from http://get.adobe.com/reader/ and follow the installation instructions.
3. Download the I²C Monitor Graphical User Interface (v.4.0) archive from www.microchip.com/MCP16503 under “Documentation & Software.”
4. Unzip the I²C Monitor Graphical User Interface archive, which contains the `setup.exe` file.
   Note: If an older version or a corrupted version of the current I²C Monitor Graphical User Interface is already installed on the computer, please see I2C Monitor Graphical User Interface Uninstall before proceeding with the installation.
5. Double click the `setup.exe` file to open the InstallShield Wizard window and wait for the extraction to complete. If required, the installation can be stopped by pressing the **Cancel** button.
6. In the Welcome to the InstallShield Wizard for I2CMonitor window, click the **Next** button to start the installation.

Figure 2-1. Starting the I²C Monitor Graphical User Interface Installation

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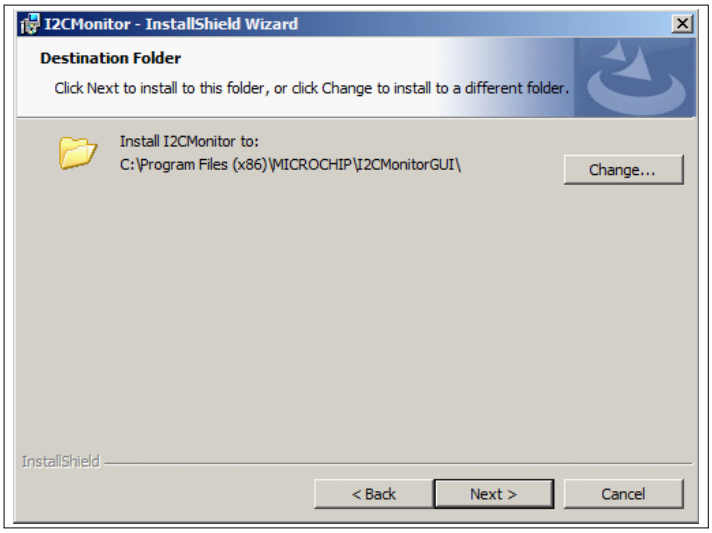
7. The installation path can be changed, although it is recommended to keep the default path. Click **Next** to continue.

Figure 2-2. Selecting the Destination Folder



8. In the Ready to Install the Program window, click the **Install** button and wait for the application to proceed with the installation. The progress can be observed in the “Status” bar.

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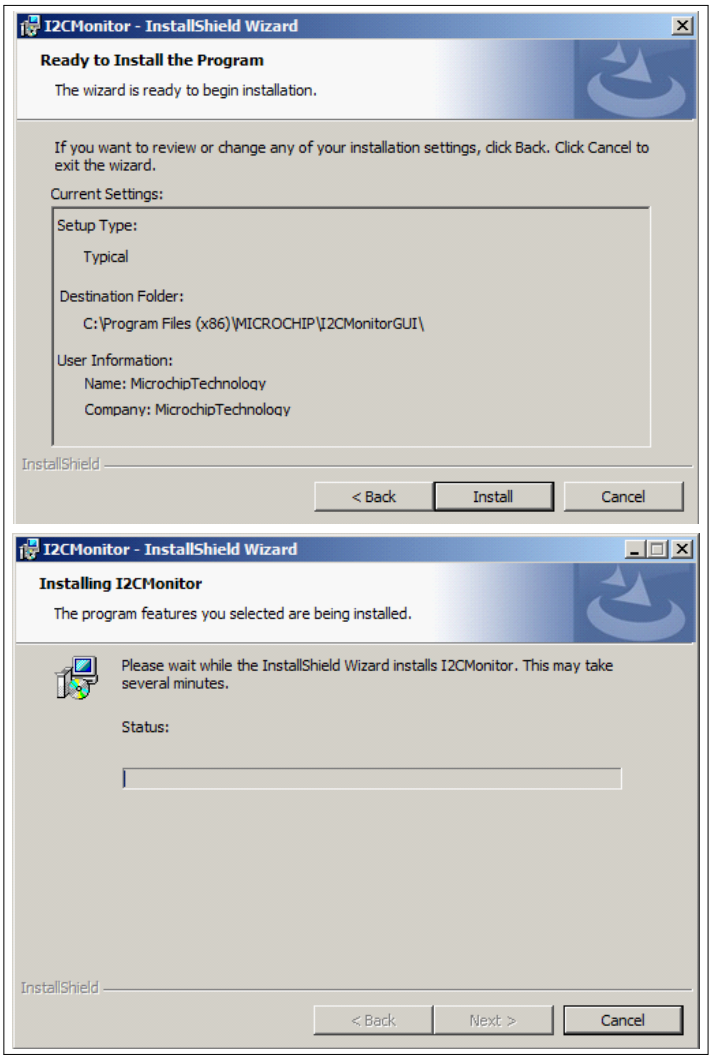
Figure 2-3. Installing the I²C Monitor Graphical User Interface



9. Once the installation is complete, leave the “Launch the program” box checked to automatically start the I2C Monitor GUI, or deselect this check box to start the GUI at a later stage. Click **Finish** to end the installation.
   To start the GUI at a later stage, either click the desktop icon or browse to *Windows Start>All Programs>Microchip>I2C Monitor*.

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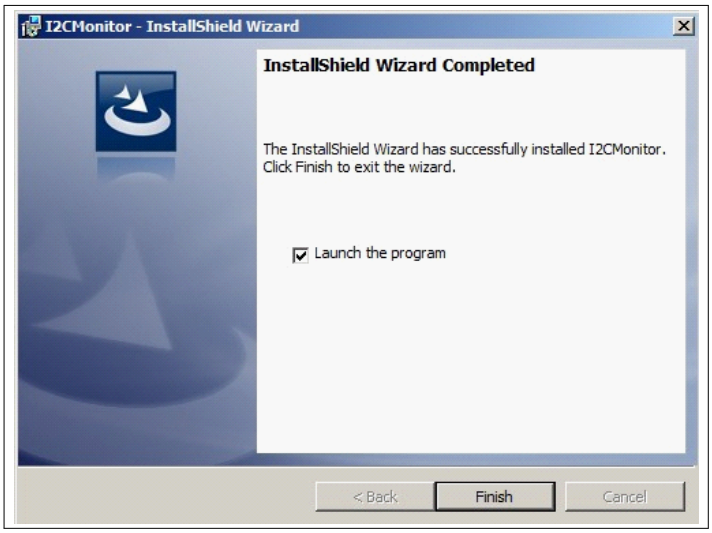
Figure 2-4. The Installation Complete Window

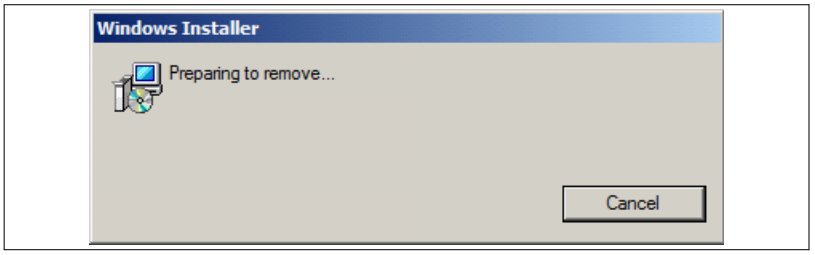


2.2. I²C Monitor Graphical User Interface Uninstall

In order to install a new version of the I²C Monitor Graphical User Interface, any previous version or corrupted version should be removed from the computer.

To uninstall, go to *Windows Start>Control Panel>Uninstall a program>I2CMonitor*. The I²C Monitor GUI will automatically close once the uninstallation process iscomplete.

Figure 2-5. *Uninstalling the I²C Monitor Graphical User Interface*



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3. GUI Description

The I2C monitor software provides a user-friendly graphical interface that simplifies device configuration on the I2C bus. Instead of manually reading and writing individual register values, users can easily adjust device settings through intuitive controls and visual elements.

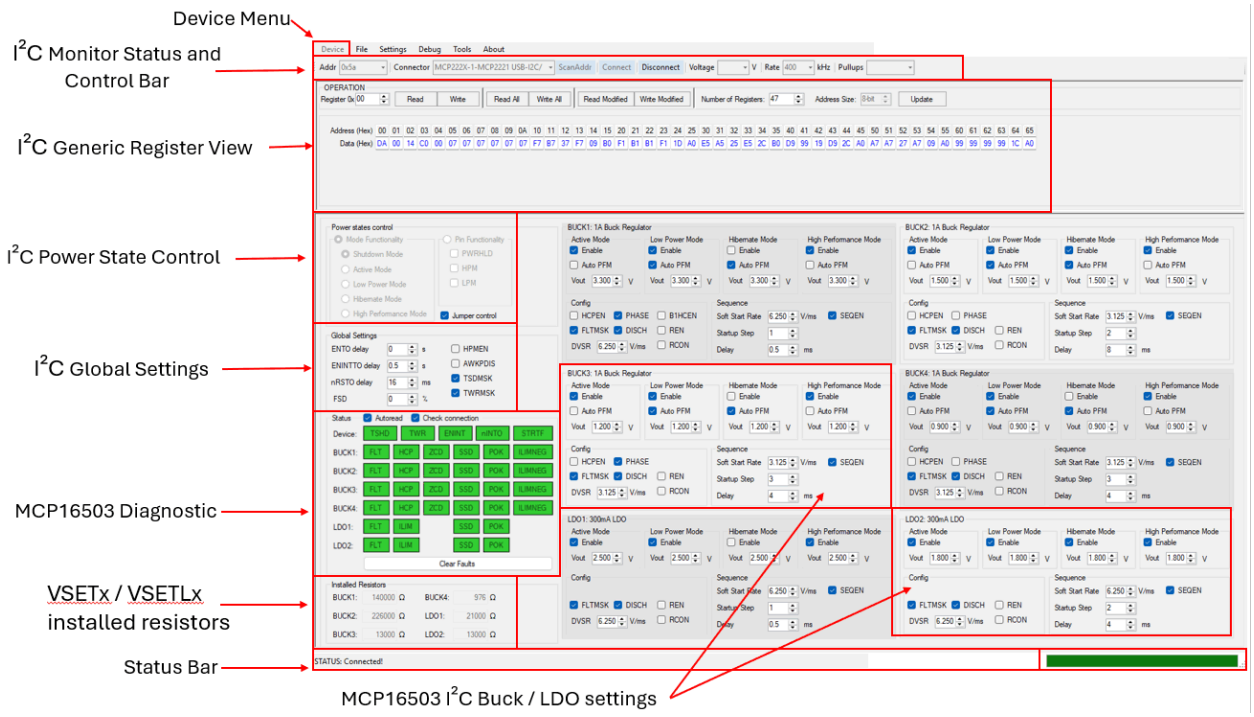
This approach offers a clear overview of the device's current configuration, allowing users to quickly understand and modify parameters without the need to inspect each register's content directly. This streamlines the setup process, reduces errors, and improves productivity during development and debugging.

3.1. Introduction

This chapter describes how to use the MCP16503 included in the kit with the provided GUI.

NOTICE This section provides information regarding the use of the GUI in the case of the MCP16503. For other devices using the I2C Monitor Graphical User Interface, see their specific Data Sheets and User Guides.

Figure 3-1. MCP16503 Main Window - MCP16503 View (Placeholder - To be updated with the final version)



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4. The Graphical User Interface

The following sections describe the items in the Graphical User Interface (GUI).

4.1. Device Menu

The Device drop-down menu allows the user to select the device to be evaluated.

4.2. I2C Monitor Status and Control

The “Status and Control” bar contains the items described in Table 4-1.

Figure 4-1. I²C Monitor Status and Control Bar

Table 4-1. Monitor Status and Control Bar

Item	Description
Addr	This drop-down menu shows the address of the available devices.
Connector	This drop-down menu shows the type of connector used to connect the board.
ScanAddr	This button is used to scan for a valid address.
Connect/Disconnect	These buttons are used to connect/disconnect the current selected device.
Voltage	This drop-down menu is used to select the voltage level of the communication when using PICkit™ Serial Analyzer.
Rate	This drop-down menu is used to select the corresponding communication rate for the device.
Pull Ups	This drop-down menu is used to activate the internal pull ups from the PICkit Serial Analyzer.
Note: Optional. PICkit Serial Analyzer should first be connected on the I2C pin header, on the MCP16503 Evaluation Board.	

In the “Status and Control” bar, choose the hardware tool for communication with the device and the settings it allows.

To connect to a device, follow the steps described in Setup and Configuration. After connecting the Micro-USB cable, make sure to scan for a valid address. Once a valid address is detected, clicking the **Connect** button will initialize the connection with the device and the registers will be available for read and write operations.

4.3. I²C Generic Register View

The I²C Generic Register View area contains the items in Figure 4-2. This section of the I²C Monitor GUI is common for any device evaluated.

Figure 4-2. Generic Register View Area

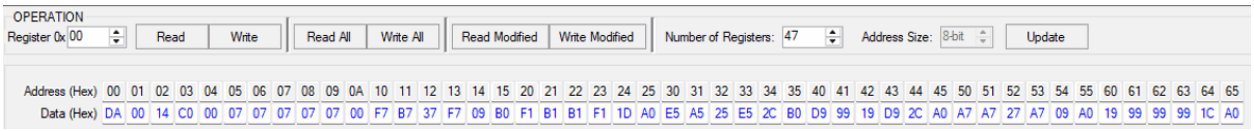

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Table 4-2. I²C Generic Register View Items

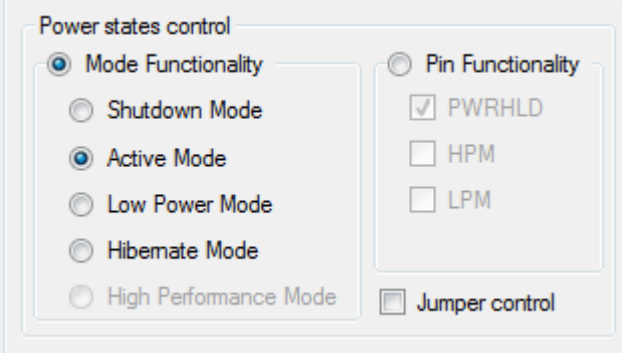
Panel	Item	Description
Operation	**Register**	This section shows the registers available for read/write operations.
	Read/Write	These buttons are used for single register read/write operations.
	ReadAll/WriteAll	These buttons are used for reading/writing all the available registers.
	Read Modified/Write Modified	These buttons are used to read or to write only the registers that have been modified.
	Number of Registers	This controls the number of available registers for read/write operations.
	Update	This button sets the number of available registers for read/write operations in the register area.
Register Area		This section shows the current status of the registers address and their content.

The specific registers for MCP16503 are described in the MCP16503 Data Sheet.

4.4. MCP16503 Power State Control

The MCP16503 power states control area of the GUI allows the visualization or control of the device's power states.

Figure 4-3. Power States Control Area



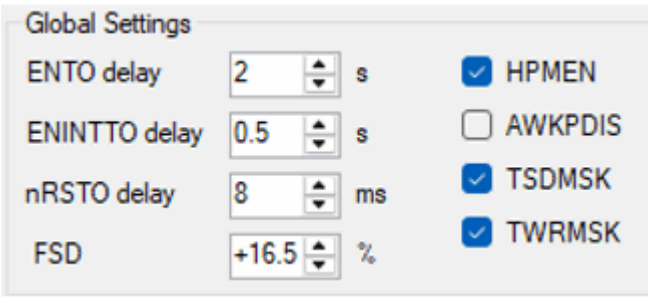
The GUI allows the visualization of the control pins state (PWRHLD, HPM, LPM) and the associated power state if "Jumper control" is activated, or to set the actual mode if "Jumper control" is not activated.

For the relation between each pin status and the corresponding mode, refer to the data sheet.

4.5. MCP16503 I²C Global Settings

These settings are used to modify device global features.

Figure 4-4. Global Settings



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4.6. MCP16503 I²C Diagnostic

The MCP16503 I²C Diagnostic area displays information contained in the STATUS register, including device conditions and faults.

Figure 4-5. I²C Diagnostic Area

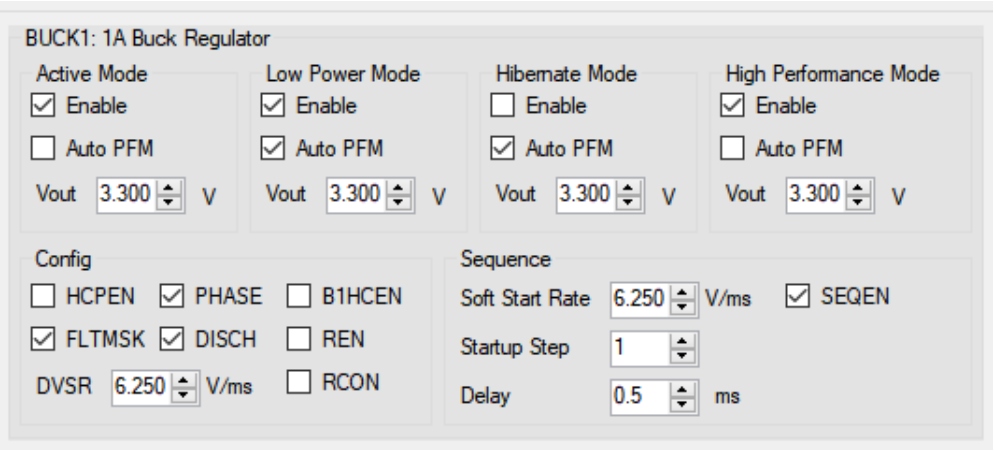
This region marks the status and faults of each corresponding bits in the registers. In the case of the SSD and POK status flags, green signals a '1' condition and red signals a '0' condition. In the case of the TSHD, TWR, ENINT, nINTO, FLT, HCP, ZCD, ILIM and ILIMNEG Fault Flags, green signals a '0' condition and red signals a '1' condition or an active Fault.

This information is refreshed once every two seconds. All Fault flags are reset on read, so the GUI memorizes the apparition of a Fault. To clear them from the GUI, the **Clear Faults** button must be clicked.

4.7. MCP16503 I²C Buck Channel Settings

These settings are used to modify the buck related features individually for each of the four buck channels.

Figure 4-6. I²C Buck Channel Settings



4.8. MCP16503 I²C LDO Channel Settings

These settings are used to modify the buck related features individually for each of the two LDO channels.

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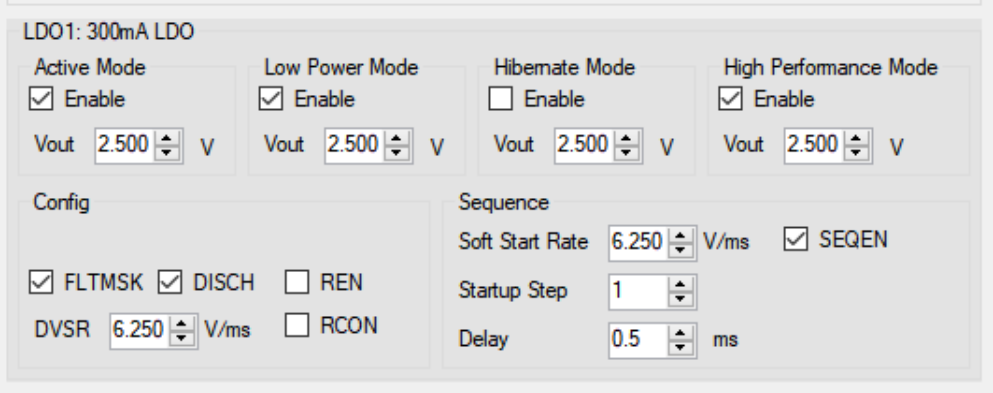
Figure 4-7. I²C LDO Channel Settings



4.9. Status Bar

The status bar provides information on the status of the device connected to the PC.

Figure 4-8. Status Bar

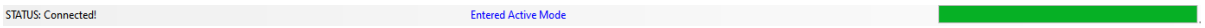


Table 4-3. Status Bar Items

Item	Description
Status Label	The label shows if there is any device connected to the board. Refer to Table 4-4 for a list of possible labels.
Progress Bar	This bar shows the level of completion for a given command.

Table 4-4. Status Labels

Status Label	Description
STATUS: Connected!	This message is shown when the GUI connects to a device.
STATUS: Disconnected!	This message is shown when the GUI does not detect a connected device.

The specific settings for all control areas are detailed in the register map available in the MCP16503 data sheet.

4.10. VSETx and VSETLx Resistor Decoder

The default start-up voltage for each power channel is configured using the VSETx/VSETLx pins. A resistor can either be connected from the pin to ground or short the pin to GND or SVIN. This provides 16 configuration options per channel:

- Pin shorted to GND: reserved to disable the corresponding power channel during the start-up sequence. The EN, SEQEN and RCON&REN bits are internally masked when the corresponding VSET[5:0] value is set to 0. To enable a channel that was disabled during the start-up phase, the user must program the corresponding VSET[5:0] register to the required output voltage, according to the selected mode of operation. For example, if the user changes only the VSET[5:0] value for Active mode, the channel will be enabled exclusively during Active mode. In the I²C Monitor graphical user interface, the VOUT associated with each operating mode will display “N/A” when the VSETx/VSETLx pin is shorted to ground. To enable this channel, the user should set VOUT to the desired value and then click Write Modified or Write All.
- All the other options: select 15 different start-up voltage levels (see the Configuring MCP16503 Default Start-Up Voltage Table from the Datasheet).

The resistor values connected to the VSETx/VSETLx pins are decoded only once during the initialization phase. Specifically, after power is applied and the Finite State Machine (FSM) enters the

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INIT (Initialization) state (see Finite State Machine (FSM) States Diagram), the device begins decoding the resistor configuration.

When the decoding process is complete, the detected start-up voltage settings are stored in the VSET[5:0] fields of the OUTx-A and LDOx-A registers. These values are then copied to the corresponding VSET[5:0] fields in OUTx-LPM, OUTx-HIB, OUTx-HPM, LDOx-LPM, LDOx-HIB and LDOx-HPM.After this point, each channel's output voltage can be changed only via I2C (see Voltage Codes Definition Bits VSET[5:0] from the Datasheet).

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5. Board Design

This chapter contains the following schematic and layouts for the MCP16503 Evaluation Board (EV05A95A):

- Board - Schematic
- Board - Top Silk
- Board - Top Copper and Silk
- Board - Top Copper
- Board - Mid Layer 1
- Board - Mid Layer 2
- Board - Bottom Copper
- Board - Bottom Copper and Silk
- Board - Bottom Silk

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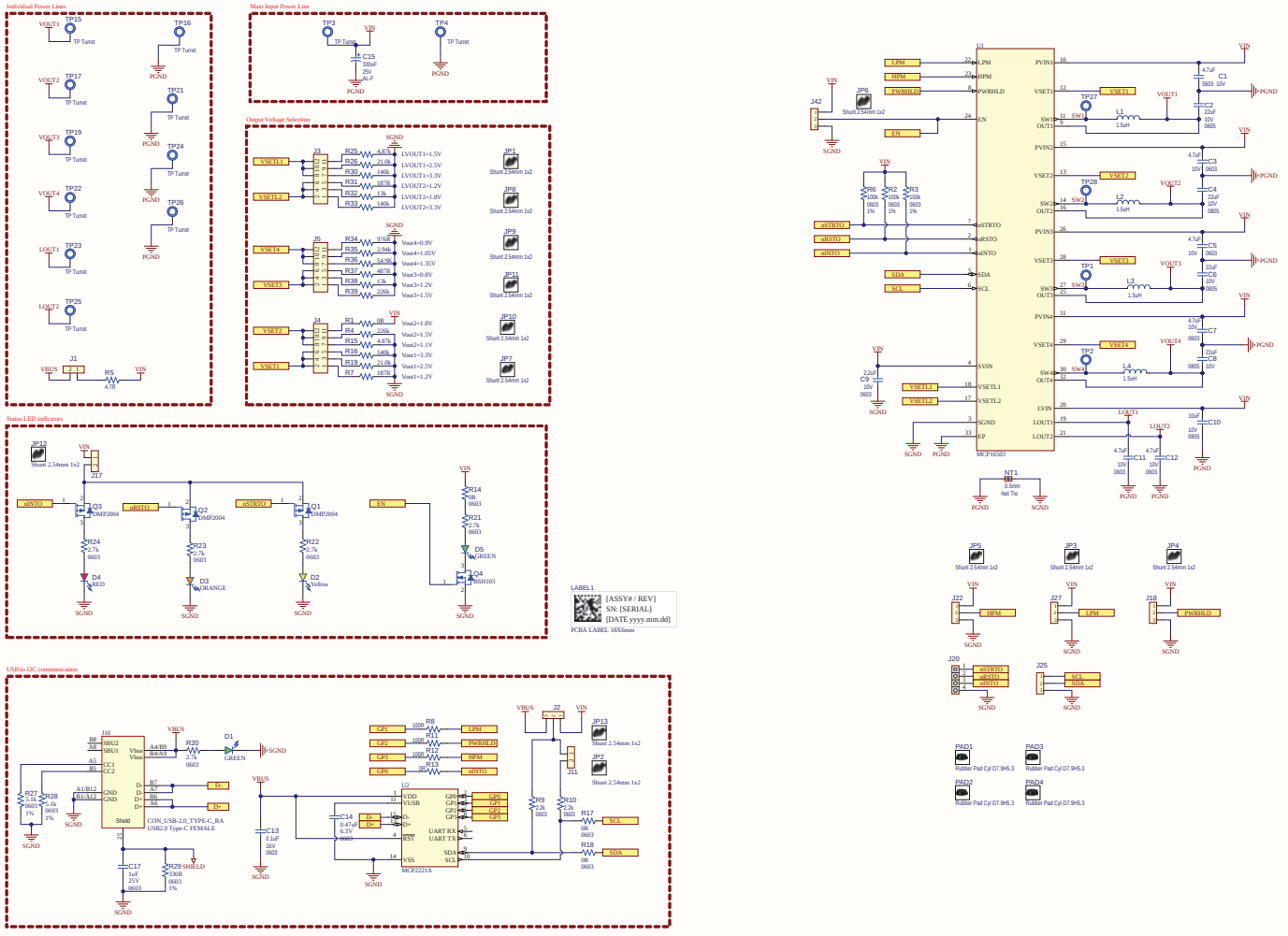
5.1. Schematic



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5.2. Layout

Figure 5-1. Board - Top Silk

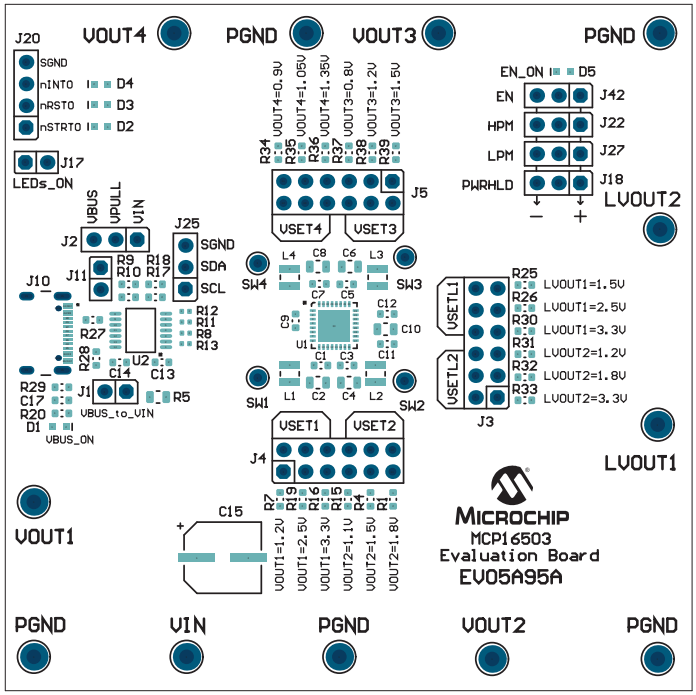

Figure 5-2. Board - Top Copper and Silk

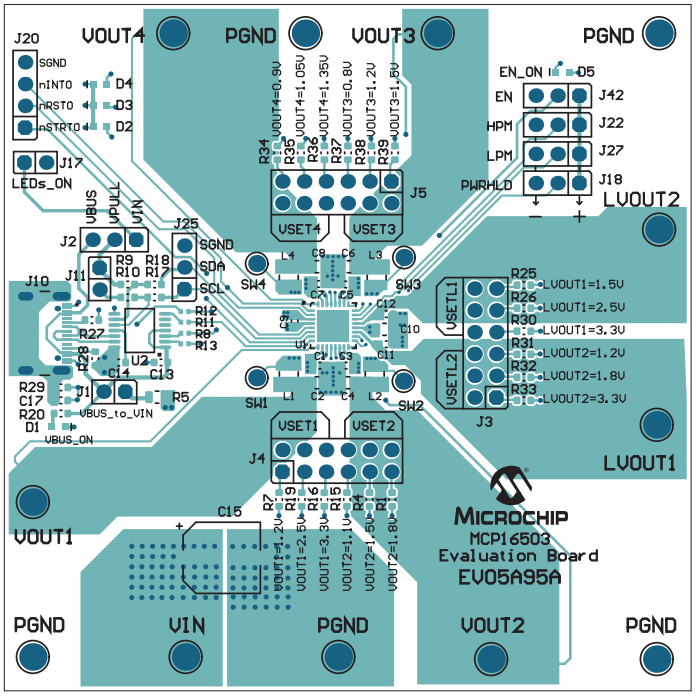

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Figure 5-3. Board - Top Copper

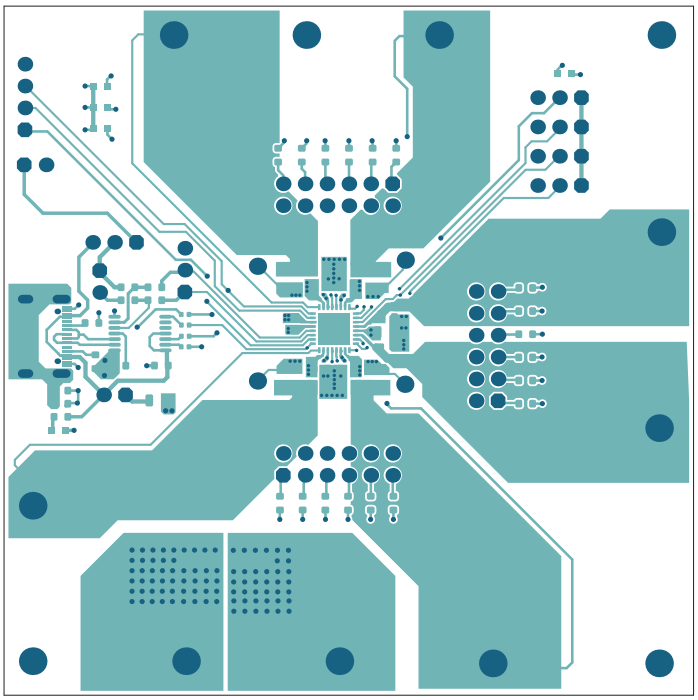

Figure 5-4. Board - Mid Layer 1

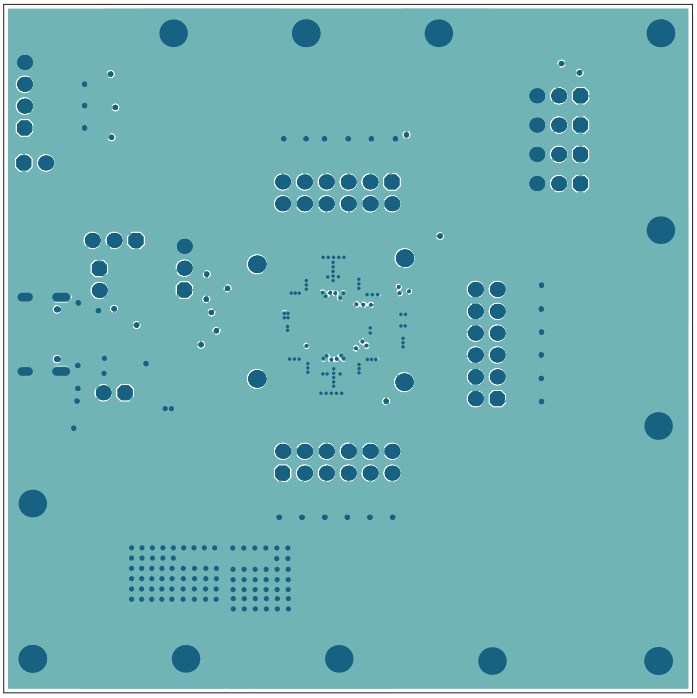

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Figure 5-5. Board - Mid Layer 2

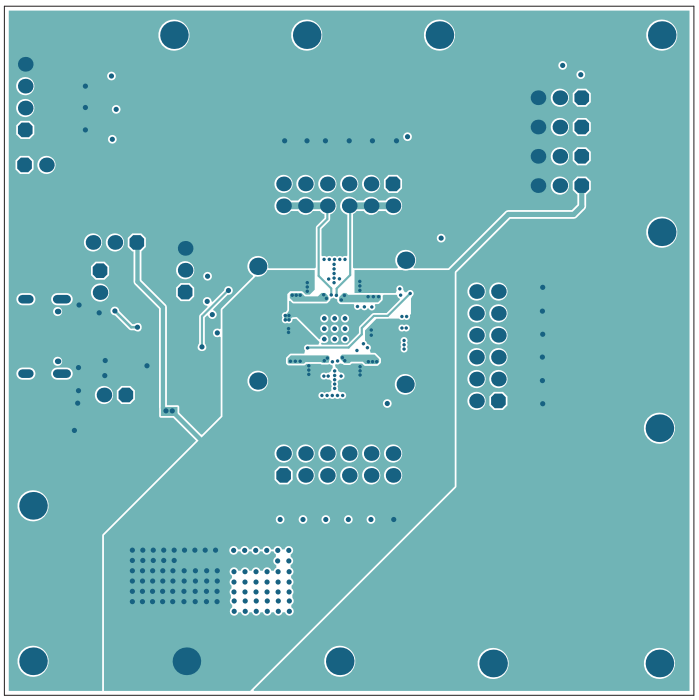

Figure 5-6. Board - Bottom Copper

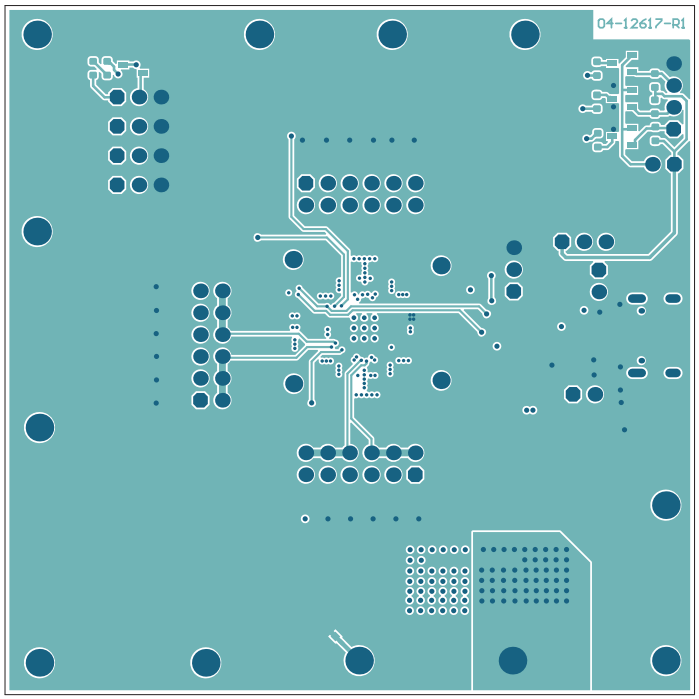

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Figure 5-7. Board - Bottom Copper and Silk

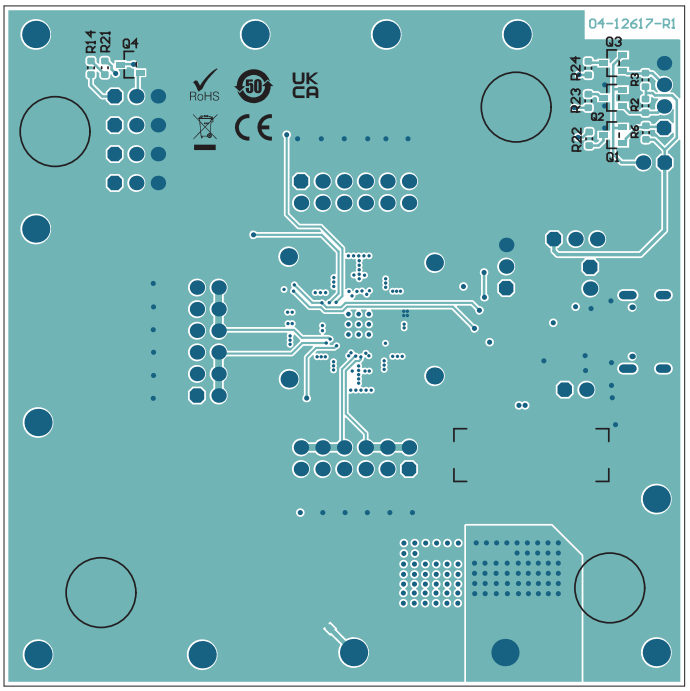
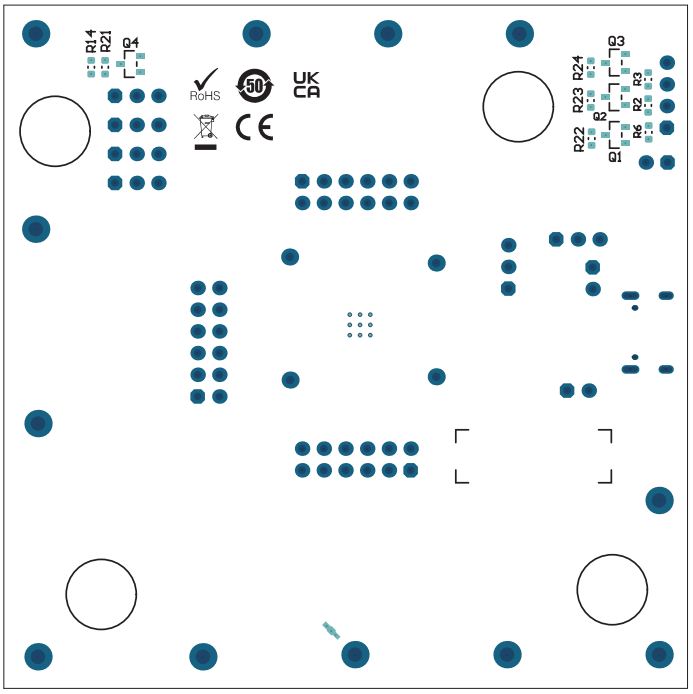


Figure 5-8. Board - Bottom Silk



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6. Bill of Materials (BOM)

Table 6-1. Bill of Materials (BOM)

Qty.	Reference	Description	Manufacturer	Part Number
6	C1, C3, C5, C7, C11, C12	Capacitor, Ceramic, 4.7 µF, 10V, 10%, X7S, SMD, 0603	TDK Corporation	C1608X7S1A475K080AC
4	C2, C4, C6, C8	Capacitor, Ceramic, 22 µF, 10V, 20%, X7S, SMD, 0805	TDK Corporation	C2012X7S1A226M125AC
1	C9	Capacitor, Ceramic, 2.2 µF, 10V, 10%, X7R, SMD, 0603	Taiyo Yuden Co., Ltd.	LMK107B7225KA-T
1	C10	Capacitor, Ceramic, 10 µF, 10V, 10%, X7R, SMD, 0805	Samsung Electro-Mechanics America, Inc.	CL21B106KPQNFNE
1	C13	Capacitor, Ceramic, 0.1 µF, 16V, 10%, X7T, SMD, 0603	Taiyo Yuden Co., Ltd.	EMK107B7104KA-T
1	C14	Capacitor, Ceramic, 0.47 µF, 6.3V, 10%, X5R, SMD, 0603	Wurth Elektronik	885012106001
1	C15	Capacitor, Aluminum, 330 µF, 25V, 20%, X5R, SMD, F	Nichicon Corporation	UWT1E331MNL1GS
1	C17	Capacitor, Ceramic, 1 µF, 25V, 10%, X7R, SMD, 0603	TDK Corporation	C1608X7R1E105K080AB
2	D1, D5	Diode, LED, Green, 1V, 30 mA, 3.2V, 430 mcd, Clear, SMD, 0603	Wurth Elektronik	150060GS75000
1	D2	Diode, LED, Yellow, 2.1V, 20 mA, 8 mcd, Clear, SMD, 0603	Kingbright Electronic Co., Ltd.	APT1608YC
1	D3	Diode, LED, Orange, 2V, 20 mA, 90 mcd, Clear, SMD, 0603	Lite-On®, Inc.	LTST-C191KFKT
1	D4	Diode, LED, Red, 1.8V, 20 mA, 17 mcd , Diffuse, SMD, 0603	Broadcom®	HSMH-H190
3	J1, J11, J17	Connector, HDR-2.54, Male, 1x2, Gold, 5.84 MH, Through Hole, Vertical	Amphenol ICC (FCI)	77311-118-02LF
6	J2, J18, J22, J25, J27, J42	Connector, HDR-2.54, Male, 1x3, Tin, 5.84 MH, Through Hole, Vertical	Samtec, Inc.	TSW-103-07-T-S
3	J3, J4, J5	Connector, HDR-2.54, Male, 2x6, Gold, 5.84 MH, Through Hole, Vertical	Sullins Connector Solutions	PBC06DAAN
1	J10	Connector, USB 2.0, Type-C, Female, SMD/TH, Right Angle	GCT Semiconductor Inc.	USB4105-GF-A
1	J20	Connector, HDR-2.54, Male, 1x4, Gold ,5.84 MH, Through Hole, Vertical	Wurth Elektronik	61300411121
4	L1, L2, L3, L4	Inductor, 1.5 µH, 3.5A, 20%, SMD, 1008	Murata Manufacturing Co., Ltd.	DFE252012P-1R5M=P2
3	Q1, Q2, Q3	Transistor, FET, P-Channel, 20V, 0.6A, 0.9R, 0.55W, SOT-23-3	Diodes Incorporated®	DMP2004K-7
1	Q4	Transistor, FET, N-Channel, 30V 0.85A, 0.54W, SOT-23-3	Nexperia	BSH103,215
4	R1, R14, R17, R18	Resistor, Thick Film, 0 Ohm, 1/10W, 0603	Bourns®, Inc.	CR0603-J/-000ELF
3	R2, R3, R6	Resistor, Thin Film, 100k, 1%, 1/8W, SMD, 0603	Vishay Intertechnology, Inc.	MCT06030C1003FP500

Note: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

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Table 6-1. Bill of Materials (BOM) (continued)

Qty.	Reference	Description	Manufacturer	Part Number
2	R4, R39	Resistor, Thick Film, 226k, 1%, 1/10W, SMD, 0603, AEC-Q200	Panasonic® - ECG	ERJ-3EKF2263V
1	R5	Resistor, Thick Film, 4.7R, 1%, 1/10W, SMD, 0805	Panasonic® - ECG	ERJ-B3BF4R7V
2	R7, R31	Resistor, Thick Film, 187R, 1%, 1/10W, SMD, 0603	Yageo Corporation	RC0603FR-07187RL
3	R8, R11, R12	Resistor, Thick Film, 100R, 1%, 1/10W, SMD, 0402	Panasonic® - ECG	ERJ-2RKF1000X
2	R9, R10	Resistor, Thick Film, 2.2k, 1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF2201V
1	R13	Resistor, Thick Film, 0R, SMD, 0402, AEC-Q200	Panasonic® - ECG	ERJ-2GE0R00X
2	R15, R25	Resistor, Thick Film, 4.87k, 1%, 1/10W, SMD, 0603	Yageo Corporation	RC0603FR-074K87L
3	R16, R30, R33	Resistor, Thick Film, 140k, 1% 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF1403V
2	R19, R26	Resistor, Thick Film, 21k, 1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF2102V
5	R20, R21, R22, R23, R24	Resistor, Thick Film, 2.7k, 1%, 1/10W, SMD, 0603, AEC-Q200	Vishay Intertechnology, Inc.	CRCW06032K70FKEA
2	R27, R28	Resistor, Thick Film, 5.1k, 1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF5101V
1	R29	Resistor, Thick Film, 330R, 1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF3300V
2	R32, R38	Resistor, Thick Film, 13k, 1%, 1/10W, SMD, 0603, AEC-Q200	Vishay Intertechnology, Inc.	CRCW060313K0FKEA
1	R34	Resistor, Thick Film, 976R, 1%, 1/4W, SMD, 0603	Panasonic® - ECG	ERJPA3F9760V
1	R35	Resistor, Thick Film, 2.94k, 1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERJ3EKF2941V
1	R36	Resistor, Thick Film, 54.9K, 1% 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF5492V
1	R37	Resistor, Thick Film, 487R, 1/10W, 1%, SMD, 0603, AEC-Q200	Panasonic® - ECG	ERJ-3EKF4870V
4	TP1, TP2, TP27, TP28	Test Point, Multi-Purpose. Mini White	Keystone® Electronics Corp.	5002
12	TP3, TP4, TP15, TP16, TP17, TP19, TP21, TP22, TP23, TP24, TP25, TP26	Connector, Test Point, PIN, Tin, Through Hole	Harwin Plc.	H2121-01

Note: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

Table 6-2. Bill of Materials (BOM) – Microchip Parts

Qty.	Reference	Description	Manufacturer	Part Number
1	U1	Analog, PMIC, Switcher Buck, ADJ, QFN-32	Microchip Technology Inc.	MCP16503
1	U2	Interface, USB, I^2C/UART, TSSOP-14	Microchip Technology Inc.	MCP2221AT-I/ST

Note: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

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Table 6-3. Bill of Materials (BOM) – Mechanical Parts

Qty.	Reference	Description	Manufacturer	Part Number
13	JP1, JP2, JP3, JP4, JP5, JP6, JP7, JP8, JP9, JP10, JP11, JP12, JP13	Mechanical, Headers & Wires, Jumper, 2.54 mm, 1x2	3M/ FCI	969102-0000-DA/ 63429-202LF
4	PAD1, PAD2, PAD3, PAD4	Mechanical, Headers & Wires, Rubber Pad, Cylindrical, D7.9 H5.3, Black	3M	SJ61A11

Note: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

Table 6-4. Bill of Materials (BOM) – Do not Populate Parts

Qty.	Reference	Description	Manufacturer	Part Number

Note: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

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7. References

Table 7-1. Recommended Reading

Source	Document Title	Literature Number	Available
Microchip Technology, Inc.	MCP16503 Data Sheet	DS-20007136A	ww1.microchip.com/downloads/aemDocuments/documents/APID/ProductDocuments/DataSheets/MCP16503-High-Performance-General-Purpose-PMIC-for-MPUs-DS20007136.pdf

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8. Revision History

Revision	Date	Section	Comments
A	5/2026		Initial release of this document.

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