

# MCP8063
# 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board Kit
# User's Guide

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USA

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Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA

Derek Carlson
VP Development Tools

12-Sep-14
Date

**NOTES:**


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# Preface

## NOTICE TO CUSTOMERS

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**Documents are identified with a "DS" number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is "DSXXXXXXXXA", where "XXXXXXXX" is the document number and "A" is the revision level of the document.**

**For the most up-to-date information on development tools, see the MPLAB® IDE online help. Select the Help menu, and then Topics to open a list of available online help files.**

## INTRODUCTION

This chapter contains general information that will be useful to know before using the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board Kit. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Recommended Reading
- The Microchip Web Site
- Customer Support
- Document Revision History

## DOCUMENT LAYOUT

This document describes how to use the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board Kit as an evaluation tool to debug on a target motor system. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board Kit.
- **Chapter 2. "Installation and Operation"** – Includes instructions on how to get started with the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board Kit.
- **Appendix A. "Schematics and Layouts"** – Shows the schematic and layout diagrams for the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board Kit.
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board Kit.

## CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

**DOCUMENTATION CONVENTIONS**

| Description | Represents | Examples |
|---|---|---|
| **Arial font:** | | |
| Italic characters | Referenced books | *MPLAB® IDE User's Guide* |
| | Emphasized text | ...is the *only* compiler... |
| Initial caps | A window | the Output window |
| | A dialog | the Settings dialog |
| | A menu selection | select Enable Programmer |
| Quotes | A field name in a window or dialog | "Save project before build" |
| Underlined, italic text with right angle bracket | A menu path | *File>Save* |
| Bold characters | A dialog button | Click **OK** |
| | A tab | Click the **Power** tab |
| N'Rnnnn | A number in verilog format, where N is the total number of digits, R is the radix and n is a digit. | 4'b0010, 2'hF1 |
| Text in angle brackets < > | A key on the keyboard | Press <Enter>, <F1> |
| **Courier New font:** | | |
| Plain Courier New | Sample source code | `#define START` |
| | Filenames | `autoexec.bat` |
| | File paths | `c:\mcc18\h` |
| | Keywords | `_asm, _endasm, static` |
| | Command-line options | `-Opa+, -Opa-` |
| | Bit values | `0, 1` |
| | Constants | `0xFF, 'A'` |
| Italic Courier New | A variable argument | *`file`*`.o`, where *`file`* can be any valid filename |
| Square brackets [ ] | Optional arguments | `mcc18 [options]` *`file`* `[options]` |
| Curly brackets and pipe character: { \| } | Choice of mutually exclusive arguments; an OR selection | `errorlevel {0\|1}` |
| Ellipses... | Replaces repeated text | `var_name [, var_name...]` |
| | Represents code supplied by user | `void main (void) { ... }` |


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## RECOMMENDED READING

This user's guide describes how to use the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board Kit. Another useful document is listed below. The following Microchip document is available and recommended as a supplemental reference resource.

- **MCP8063 Data Sheet** – ***"3-Phase Brushless Sinusoidal Sensorless Motor Driver"*** **(DS20005257)**

## THE MICROCHIP WEB SITE

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- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
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- Technical Support

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Technical support is available through the web site at:
http://www.microchip.com/support.

# DOCUMENT REVISION HISTORY

## Revision B (June 2015)

- Added **Section 1.3 "MCP8063 Daughter Board"** to **Chapter 1. "Product Overview"**
- Updated **Section 2.1.1 "Software Installation"**
- Updated **Appendix A. "Schematics and Layouts"** to include the MCP8063 Daughter Board.
- Updated **Appendix B. "Bill of Materials (BOM)"** with the list of parts necessary to build the MCP8063 Daughter Board.

## Revision A (March 2014)

- Initial Release of this Document.


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# Chapter 1. Product Overview

## 1.1 INTRODUCTION

The MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board allows the control and monitoring of Microchip 12V fan driver devices, such as the MCP8063 or MTD6501. The MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board is controlled by PC software via a USB connection.

The MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board software provides several features, such as fan driver power supply control and monitoring, pulse-width modulation (PWM) control as well as speed and current consumption monitoring. It also allows automatic application testing.

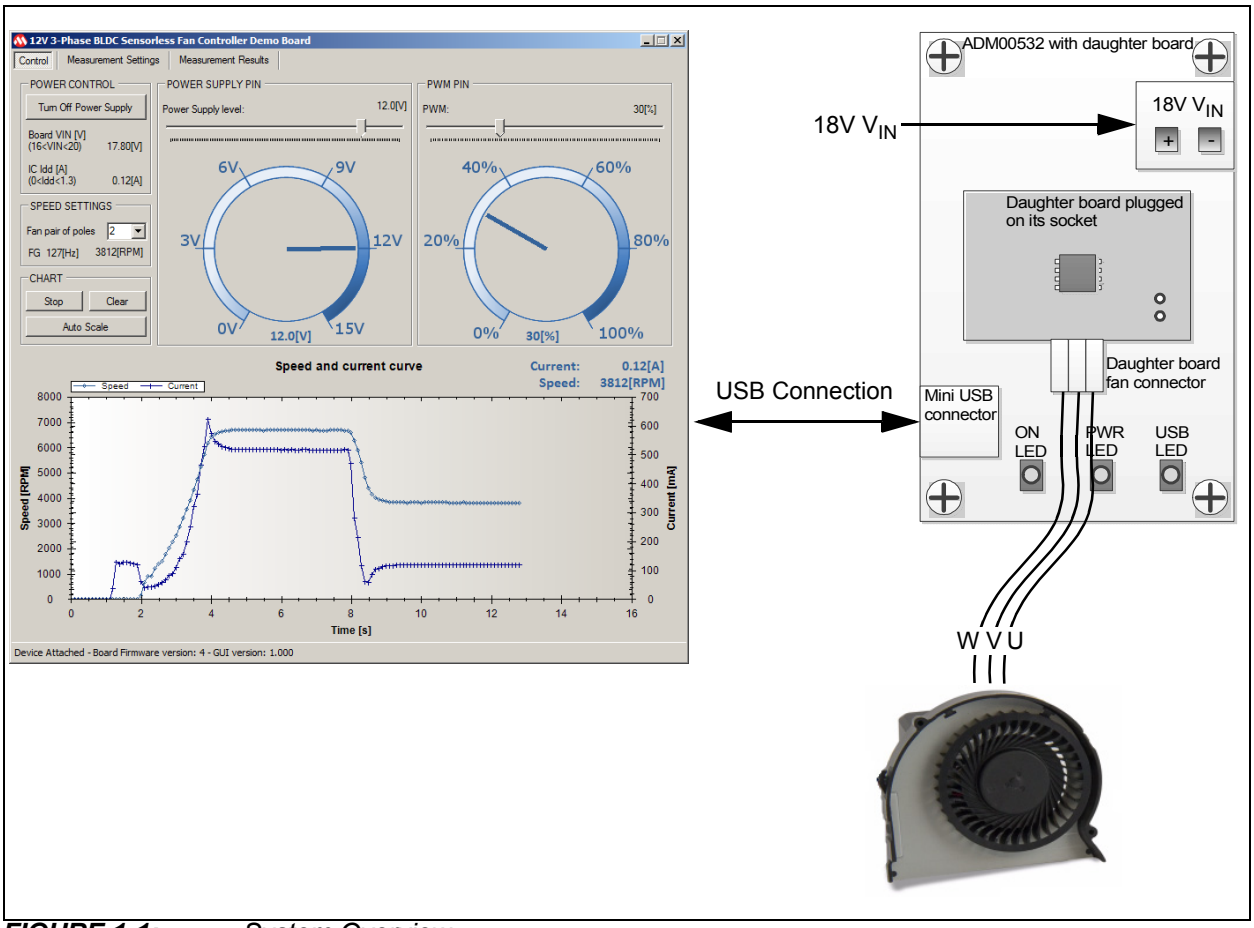



***FIGURE 1-1:*** *System Overview.*

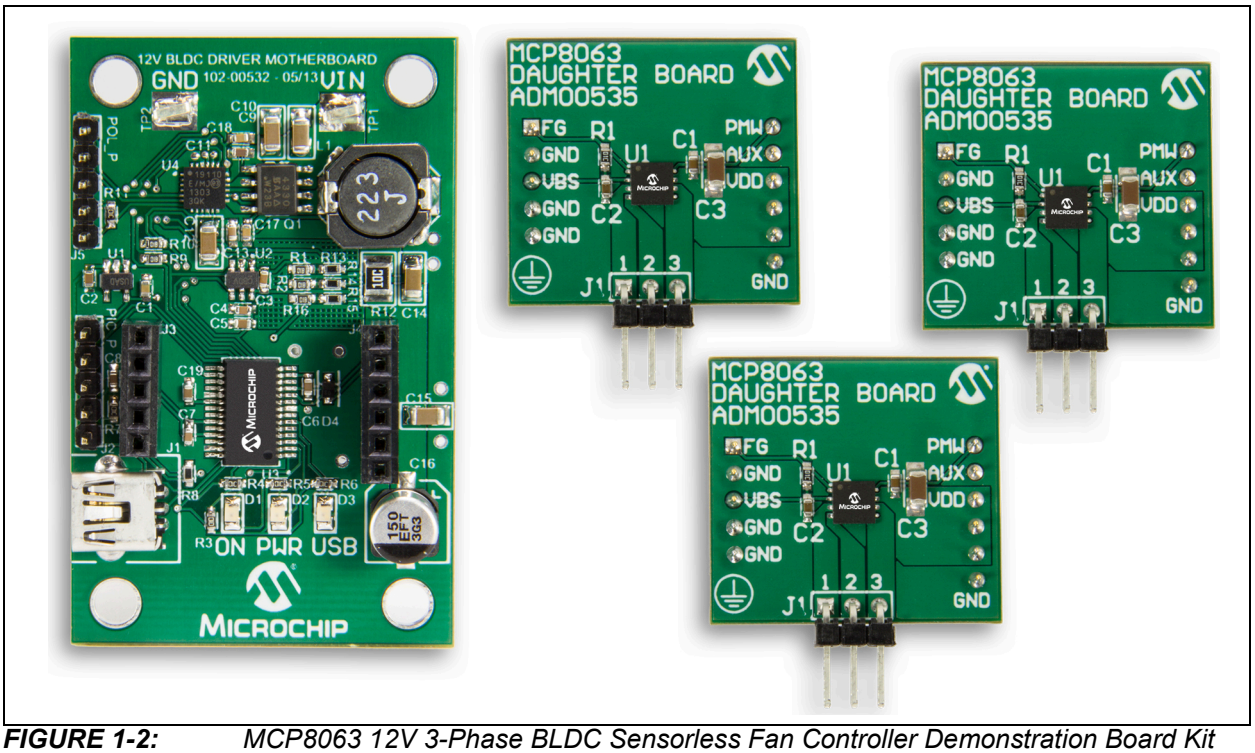



***FIGURE 1-2:*** *MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board Kit Overview.*

## 1.2 MCP8063 12V 3-PHASE BLDC SENSORLESS FAN CONTROLLER DEMONSTRATION BOARD HARDWARE DESCRIPTION

The MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board contains several components:

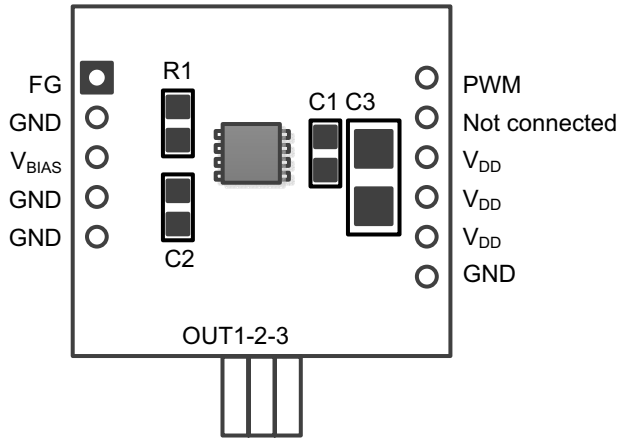
- PIC24FJ64GB002 microcontroller for USB connection, PWM generation, FG frequency measurement, $V_{DD}$ measurement, activation of other signals and component communication
- MCP1824 LDO regulator to provide 3.3V to the microcontroller
- MCP19110 buck regulator to provide power supply to the fan driver
- MCP3421 Delta-Sigma ADC for sensing the fan driver current consumption

More details on the schematic are available in **Appendix A. "Schematics and Layouts"**.


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## 1.3 MCP8063 DAUGHTER BOARD

This section provides a brief description of the daughter board (ADM00535) which is included in the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board Kit. The MCP8063 Daughter Board has been designed to be used with a motherboard. However, it can also be used independently as a standalone board. The board overview is represented in Figure 1-3.




**Note 1:** R1 is the FG pull-up resistor

**2:** C1 and C3 are the $V_{DD}$ decoupling capacitors.

**3:** C2 is the $V_{BIAS}$ decoupling capacitor.

***FIGURE 1-3:*** *MCP8063 Daughter Board Overview.*

The daughter board also features a 3-phase BLDC motor connector that can be used to attach a fan.

More details on the schematic are available in **Appendix A. "Schematics and Layouts"**

## 1.4 WHAT THE MCP8063 12V 3-PHASE BLDC SENSORLESS FAN CONTROLLER DEMONSTRATION BOARD KIT INCLUDES

The MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board Kit (ADM00575) includes:

- MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board (ADM00532)
- 3 x MCP8063 Daughter Boards (ADM00535)
- One mini-USB cable
- Important Information Sheet

**NOTES:**


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# Chapter 2. Installation and Operation

## 2.1 GETTING STARTED

The following sections describe how to use the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board.

### 2.1.1 Software Installation

Download the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board software installer from the Microchip website at www.microchip.com. The GUI can be downloaded from this web page as well.

**Note:** This application requires Microsoft®.NET Framework 3.5 or later.

1. Unzip the archive and click on the `.exe` file. The MCP8063 Demo Board GUI Setup will initiate. Click **Next** to start the installation.

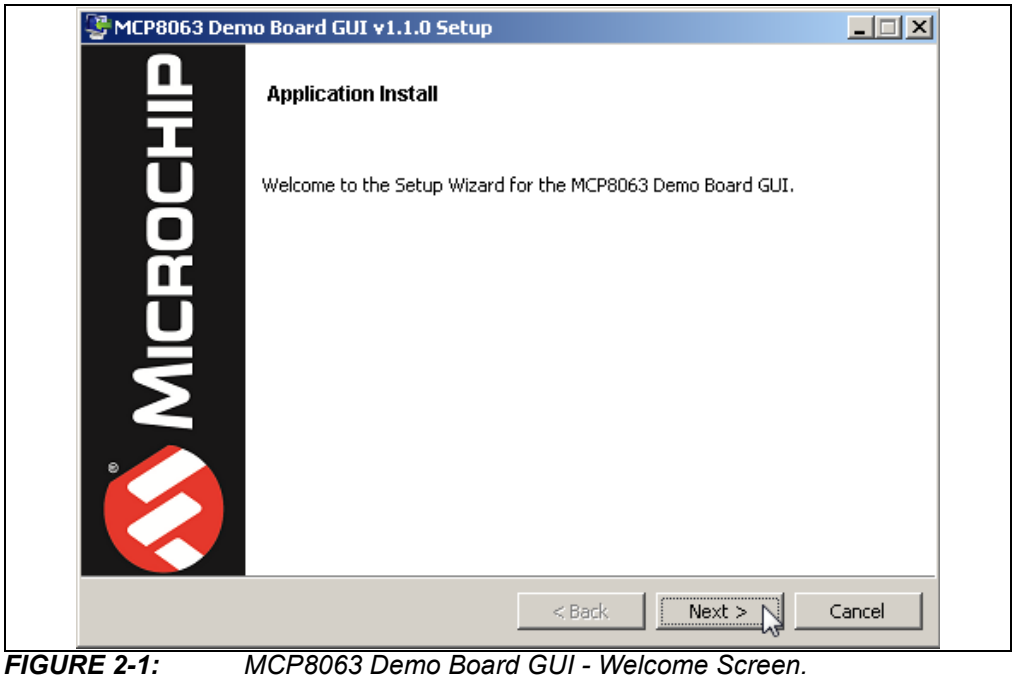



***FIGURE 2-1:*** *MCP8063 Demo Board GUI - Welcome Screen.*

2. To proceed with the installation, read the License Agreement. Accept by clicking the radio button corresponding to **I accept the agreement**, then click **Next**.

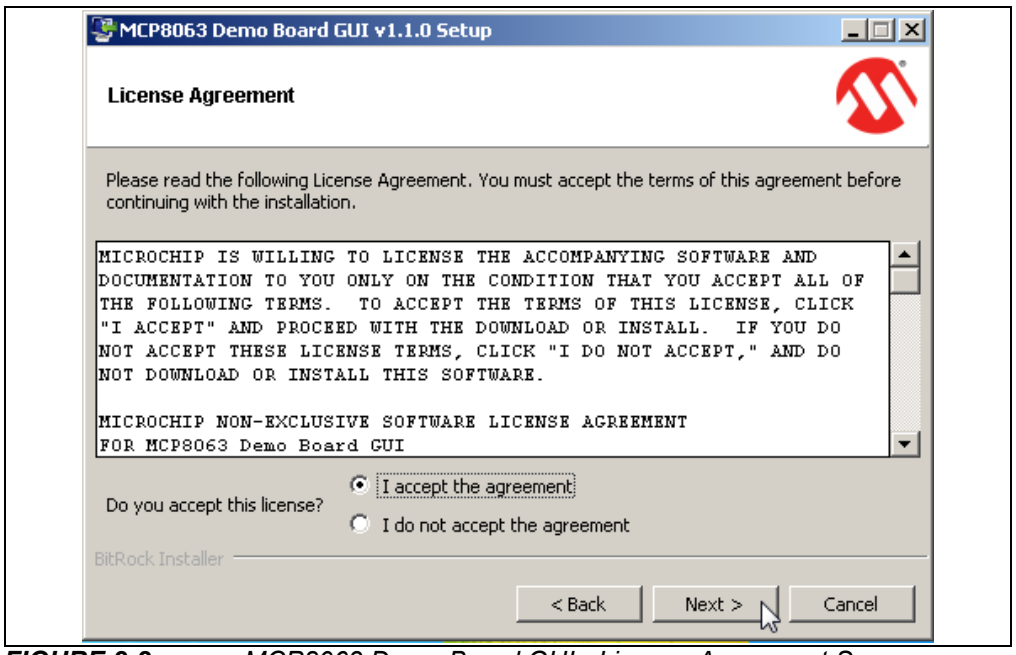



***FIGURE 2-2:*** *MCP8063 Demo Board GUI - License Agreement Screen.*

3. On the Installation Directory dialog, browse for the desired location, or click **Next** to install in the default location.

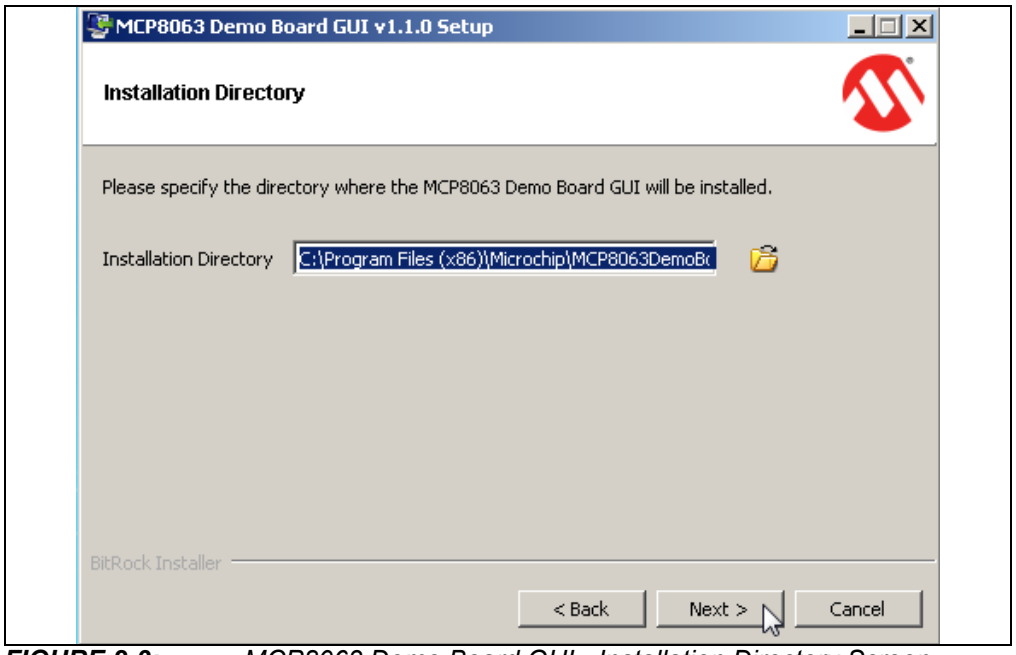



***FIGURE 2-3:*** *MCP8063 Demo Board GUI - Installation Directory Screen.*


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4. Once the path is chosen, the software is ready to install. Click Next to proceed. The installation status window appears, showing the installation progress. Click **Next** to proceed.

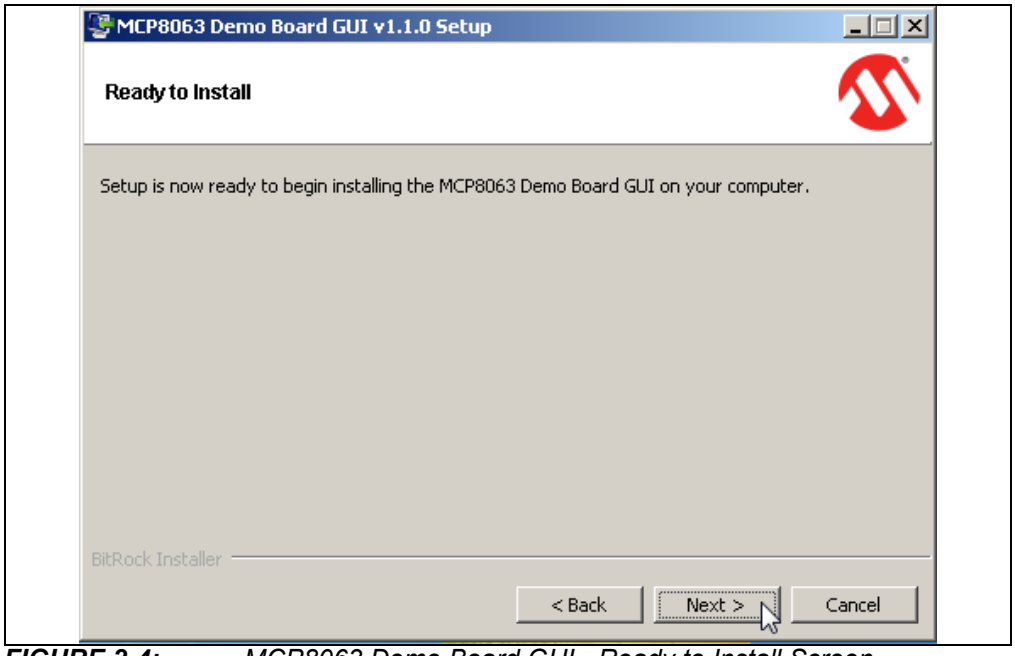



***FIGURE 2-4:*** *MCP8063 Demo Board GUI - Ready to Install Screen.*

5. Once the **Install Complete** screen appears, click **Finish** to exit the Installer.

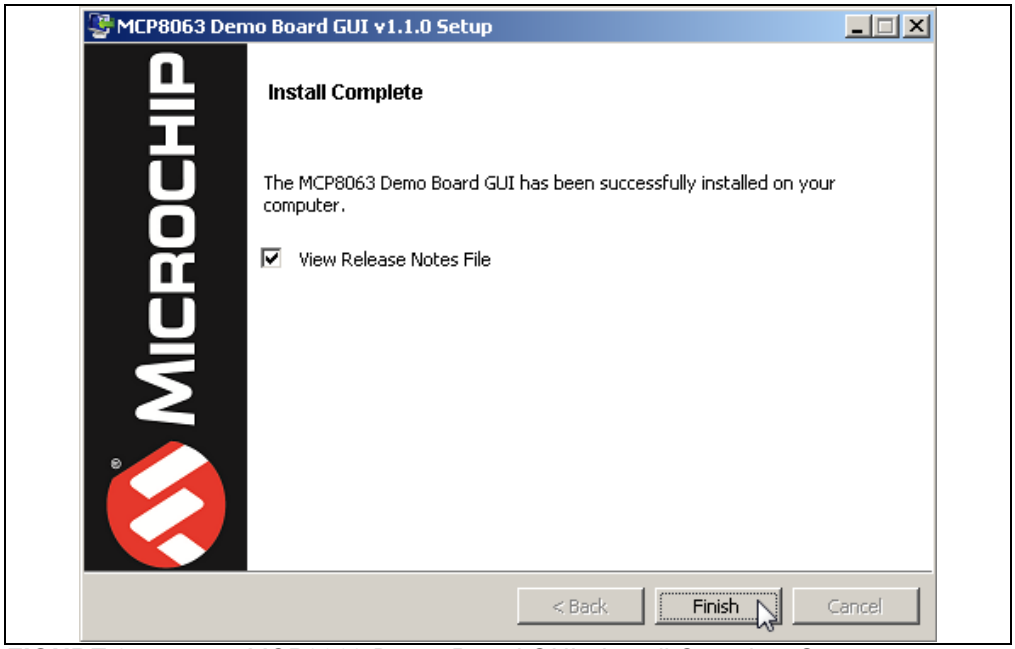
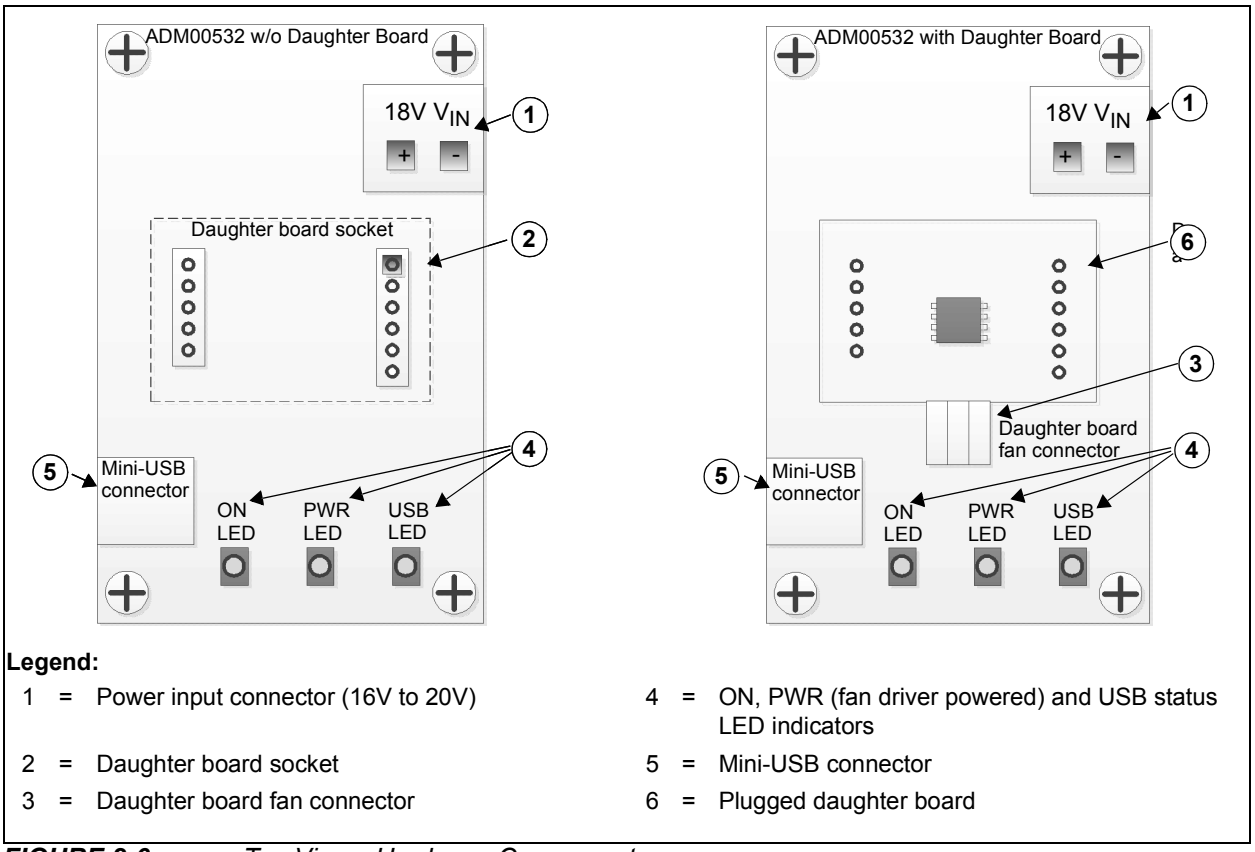



***FIGURE 2-5:*** *MCP8063 Demo Board GUI - Install Complete Screen.*

6. Start the software by either going to *Windows Start button > All Programs > Microchip > MCP8063DemoBoardGUI* or by double-clicking the software icon on the desktop.

### 2.1.2 Board Installation

Figure 2-6 identifies the required points for using the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board.




**Legend:**

| | | | | | |
|---|---|---|---|---|---|
| 1 | = | Power input connector (16V to 20V) | 4 | = | ON, PWR (fan driver powered) and USB status LED indicators |
| 2 | = | Daughter board socket | 5 | = | Mini-USB connector |
| 3 | = | Daughter board fan connector | 6 | = | Plugged daughter board |

***FIGURE 2-6:*** *Top View - Hardware Components.*

To use the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board Kit, these steps should be followed:

1. Plug in the MCP8063 Daughter Board on its socket (see Figure 2-6).
2. To plug in a 3-phase BLDC sensorless fan, use the MCP8063 Daughter Board fan connector. Note that the connection can be done in normal or reverse mode. If the fan rotates in reverse mode, the connector can be flipped to rotate in normal mode.
3. Start the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board software.
4. Plug the mini-USB cable from the USB port of a computer to the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board connector. The LED indicating a ON state will light up.
5. If required, let the computer identify the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board. Once the USB connection is ready, the USB LED will light up and remain on for as long as the USB connection is active.
6. Restart the computer, if required.
7. Connect the power supply to the $V_{IN}$ test point. The $V_{IN}$ value is 18V ±10%. The power supply should be able to deliver up to 1.0A. The GUI should report the $V_{IN}$ value of the board.

**Note:** The order of these steps is provided as an example and can be changed.


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## 2.2 MCP8063 12V 3-PHASE BLDC SENSORLESS FAN CONTROLLER DEMONSTRATION BOARD KIT SOFTWARE DESCRIPTION

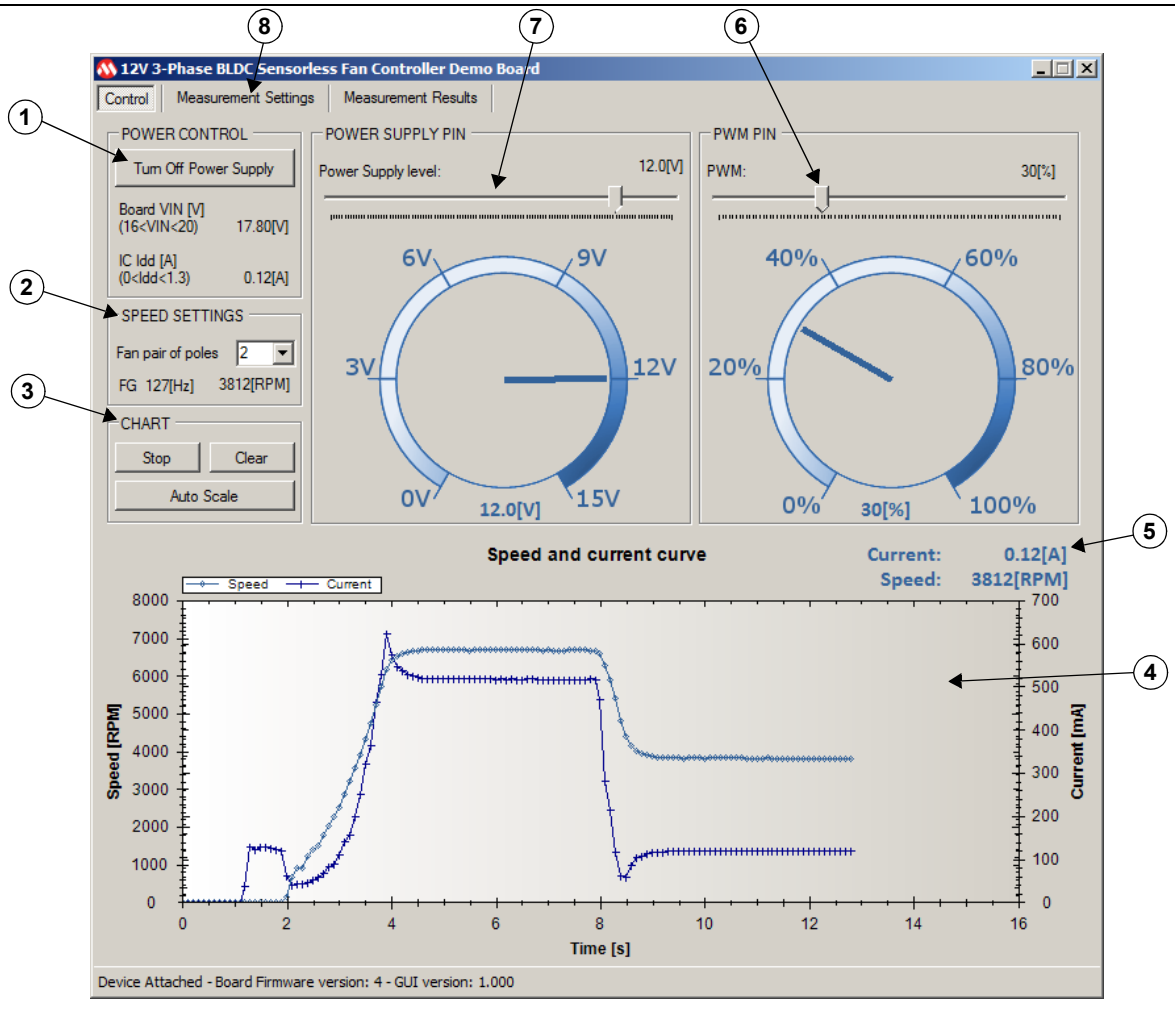
The MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board Kit software window contains three tabs:

- **Control**: provides the options available for controlling and monitoring the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board
- **Measurement Settings**
- **Measurement Results**

### 2.2.1 Control Tab

Figure 2-7 shows the options and functions available for controlling and monitoring the board.

> **Note:** All functions presented in Figure 2-7 are enabled only when the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board is connected to the PC via a USB connection.




**Legend:**

| | | | | | |
|---|---|---|---|---|---|
| 1 | = | Power Control group box | 5 | = | Instant current and speed measurement |
| 2 | = | Speed Settings group box | 6 | = | PWM duty cycle signal control |
| 3 | = | Chart group box | 7 | = | Fan driver power supply level control |
| 4 | = | Current and speed chart display | 8 | = | Buttons for access to other tabs |

***FIGURE 2-7:*** *GUI – Control Tab.*

#### 2.2.1.1 POWER CONTROL

The Power Control group box includes the **Turn On/Off Power Supply** button which allows the power supply of the fan driver to be enabled/disabled.

Before enabling the fan driver power, verify that the input voltage level indicated for the board is between 16V to 20V. Running outside this range may work but stability cannot be ensured. The power supply part on the board is not able to generate a voltage level above the input voltage level.

The current is monitored and the fan driver power supply will shut down if the current goes above 2.5A.

#### 2.2.1.2 SPEED SETTINGS

This group box allows monitoring the FG pin frequency from the fan driver in Hz. This frequency is converted to mechanical speed (Revolutions Per Minute - RPM). In order for the RPM mechanical speed to be displayed correctly, a 4P/6S fan (two pairs of poles) has to be plugged in. If the plugged motor contains a different number of poles, the value can be adapted so that the mechanical RPM is displayed correctly.

#### 2.2.1.3 CHART

This section activates and controls the chart described in **Section 2.2.1.4 "Display Chart"**. The chart adds 10 values per second. The three buttons have the following functions:

- **Start/Stop** – Allows the value acquisition to start or stop
- **Clear** – Removes all the values added to the chart
- **Auto Scale** – Allows the default scaling to be restored. In Default Scaling mode, the chart will automatically adjust the scaling to ensure the complete view of all the added values. In addition, when selecting a part of the chart with the mouse, it is possible to zoom in the selection. The mouse wheel zoom in/out is also enabled.

#### 2.2.1.4 DISPLAY CHART

Once enabled, the chart will display the speed curve in RPM and the measured current curve in mA over time. The chart adds 10 values per second.

#### 2.2.1.5 CURRENT AND SPEED INDICATOR

This part clearly shows the instant current consumption and the instant speed.

#### 2.2.1.6 PWM PIN

The PWM Pin box provides a slide bar to set the PWM duty cycle on the fan driver PWM pin. The gauge corresponding to the PWN function indicates the PWM duty cycle currently applied by the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board.

#### 2.2.1.7 FAN DRIVER POWER SUPPLY LEVEL CONTROL

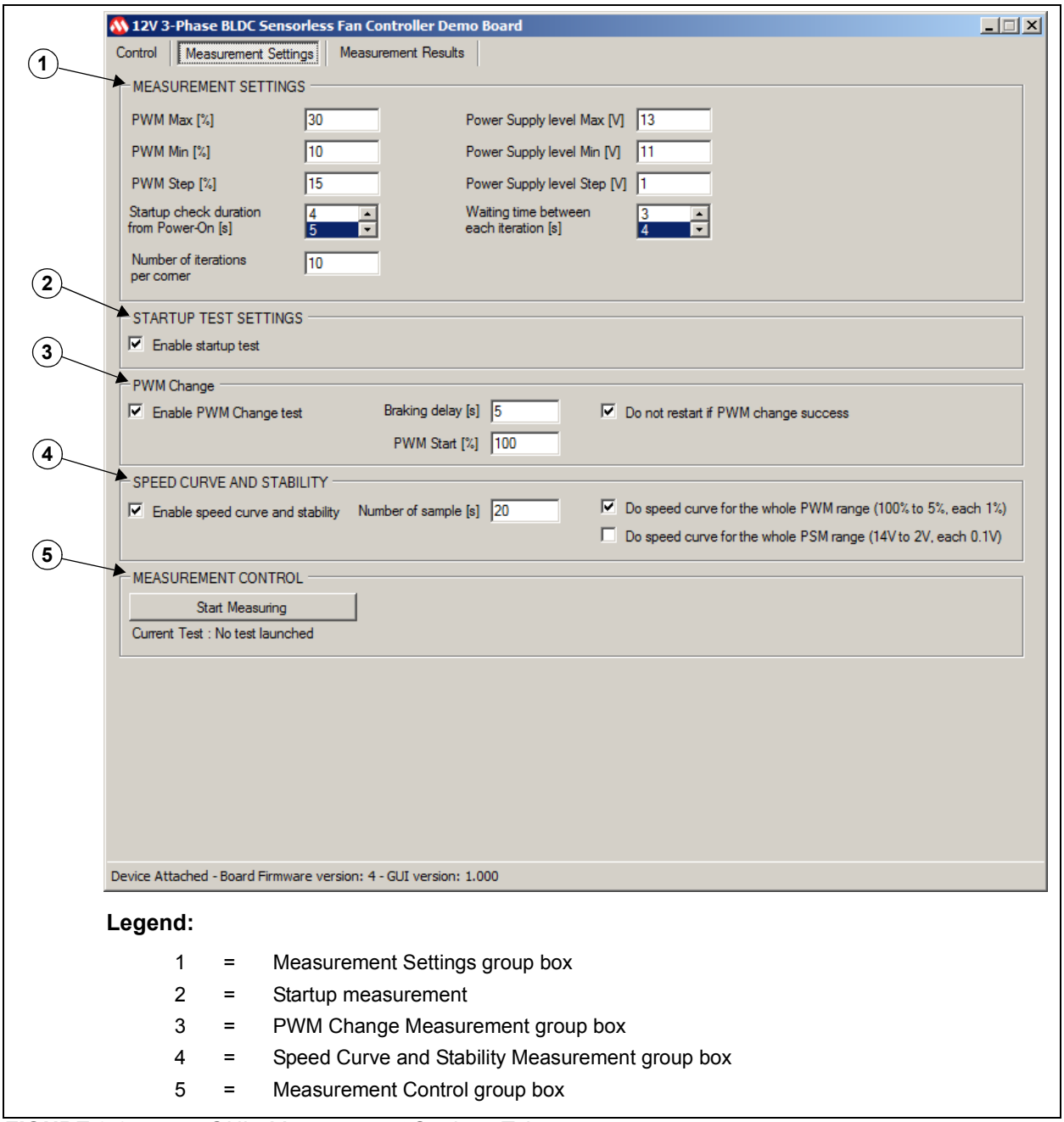
The fan driver Power Supply Pin box features a slide bar that allows setting the desired voltage value for the fan driver. The gauge corresponding to the Power Supply function indicates the instant fan driver power supply value measured by the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board.


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### 2.2.2 Measurement Settings Tab

The **Measurement Settings** tab features several tools for checking if the fan is correctly adapted to the fan driver by evaluating the fan behavior in different tests, several times and under different conditions.

Figure 2-8 shows the **Measurement Settings** tab. Next sections provide further details.




**Legend:**

| | | |
|---|---|---|
| 1 | = | Measurement Settings group box |
| 2 | = | Startup measurement |
| 3 | = | PWM Change Measurement group box |
| 4 | = | Speed Curve and Stability Measurement group box |
| 5 | = | Measurement Control group box |

***FIGURE 2-8:*** *GUI - Measurement Settings Tab.*

#### 2.2.2.1 MEASUREMENT SETTINGS

The **Measurement Settings** group box is used for defining the measurement corners required by the user. Once the automatic measurement starts (see **Section 2.2.2.5 "Measurement Control"**), all specified corners will be assessed for all selected tests. The list below details the available corner settings:

- **PWM Corners Measurement** – Requires the PWM Max (%), PWM Step (%) and PWM Min (%) values setting. The software will start with the maximum value entered and will decrease the PWM by the step value until it reaches the minimum entered PWM value.
- **Power Supply level corners** are similar to the PWM corners. A power supply level corner includes all PWM corners. This means that all PWM corners are measured for one power supply voltage level.
- **Startup check duration from Power-On [s]** – If the speed of the fan is measured as 0 RPM after this delay, the startup is considered a fail. The recommended value for this field is five seconds.
- **Waiting time between each iteration [s]** – This field specifies how many seconds are allocated for stopping the fan between two tests. This value will depend on the fan lag.
- **Number of iterations per corner** – This field designates the number of iterations for one corner.

#### 2.2.2.2 STARTUP TEST SETTINGS

When the **Enable startup test** box is checked, the startup measurements are enabled, measuring every corner for this test. If **Enable startup test** is not enabled, the startup test is skipped. The other tests will be executed if they have been enabled.

#### 2.2.2.3 PWM CHANGE

The PWM Change measurement starts with a PWM value of 100%. After the specified startup delay (entered in the **Startup check duration from Power-On [s]** field), the PWM changes depending on the PWM corner specified. The software will then verify if the fan is still running. If a delay value has been entered into the **Braking Delay [s]** field, this last check will be performed after the respective delay.

To reduce testing time, it is possible to skip the fan restart if the last PWM change has been successfully done by selecting the **Do not restart if PWM change success** check box.

#### 2.2.2.4 SPEED CURVE AND STABILITY

This measuring tool requires a specified number of samples under preset conditions to check speed stability. If the **Do speed curve for the whole PWM range (100% to 5%, each 1%)** and/or the **Do speed curve for the whole PSM range (14V to 2V, each 0.1V)** check boxes are not selected, the corners previously set are measured. For this test, the number of iterations will always be one. When one of these check boxes is selected, the software will override the specified settings.

This test will report the current average, the maximum and minimum measured speed, the stability in percentage (%) and the sigma variation.

#### 2.2.2.5 MEASUREMENT CONTROL

This group box contains a check box and a button that allows the user to control the test work flow:

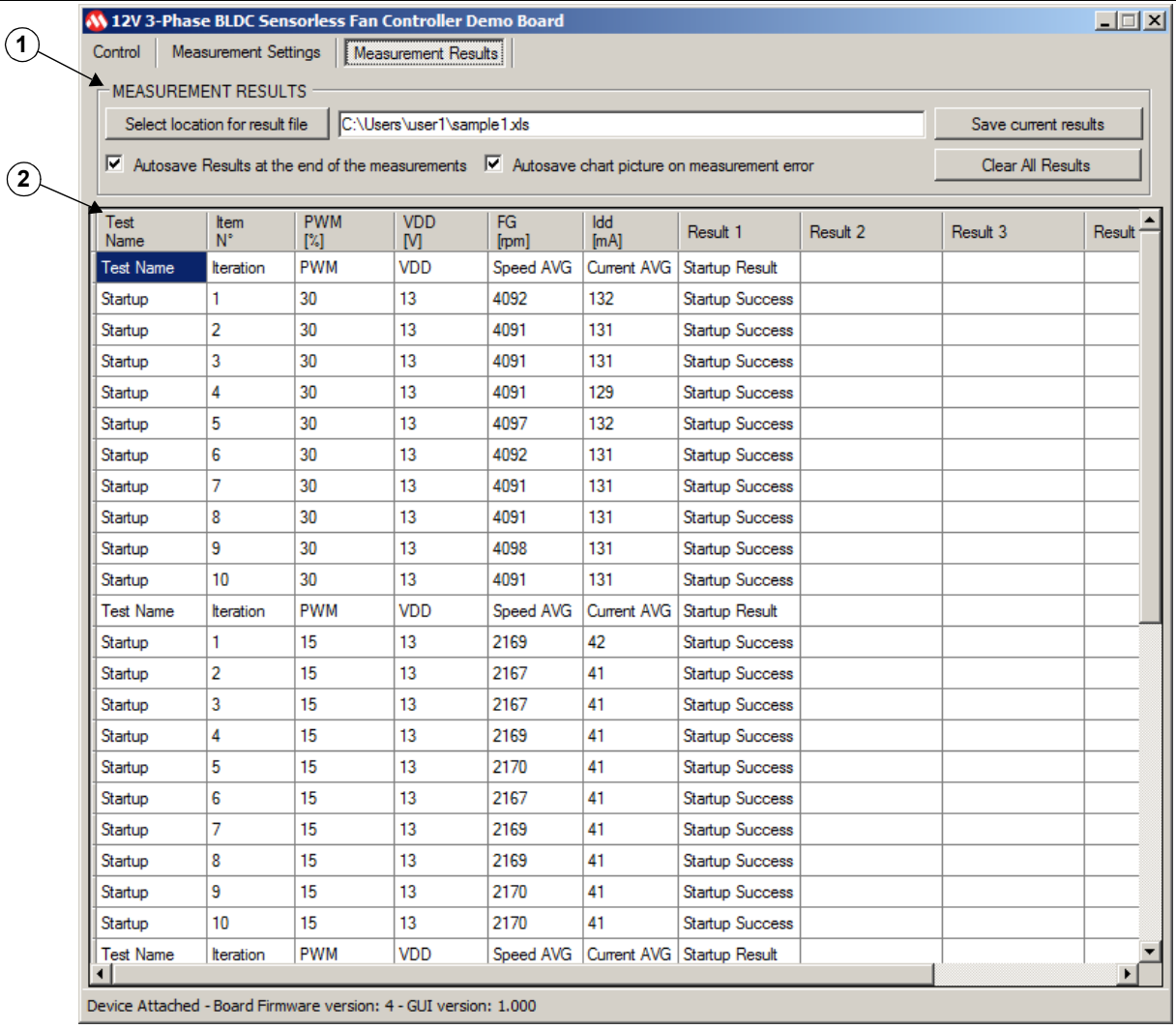
- **Stop Measuring** – Starts and stops the required tests.
- **Autosave at the end of the measurements** – If checked, a measurement result file will be automatically saved when all the tests have been done. See **Section 2.2.3.1 "Measurement Results"** for the file location.


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### 2.2.3 Measurement Results tab

The **Measurement Results** tab displays the test results. The user can manage from this tab where the data will be stored.

Figure 2-9 shows the **Measurement Results** sub-tab:




**Legend:**

1 = Measurement Results group box

2 = Measurement Results table

***FIGURE 2-9:*** *GUI - Measurement Results Tab.*

#### 2.2.3.1 MEASUREMENT RESULTS

The user can manage the results of the tests by means of the three buttons in this group:

- **Select location for result file** – This opens a window which allows the user to set where the test result file will be stored. The user has to make sure that the selected location has write access. In addition, Microsoft Office® Excel® 2003 or later has to be installed in order for the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board Software to create a Microsoft Excel file. If Microsoft Excel is not installed, it is possible to copy the data from the result table and paste it into the appropriate software.
- **Save current results** – This button stores the current measurements displayed in the result table in a Microsoft Excel file.
- **Clear All Results** – This clears the current results displayed in the result table.

#### 2.2.3.2 RESULT TABLE

The results are shown in this table.

The first six columns are common to all tests while the others are relevant only for a particular test.


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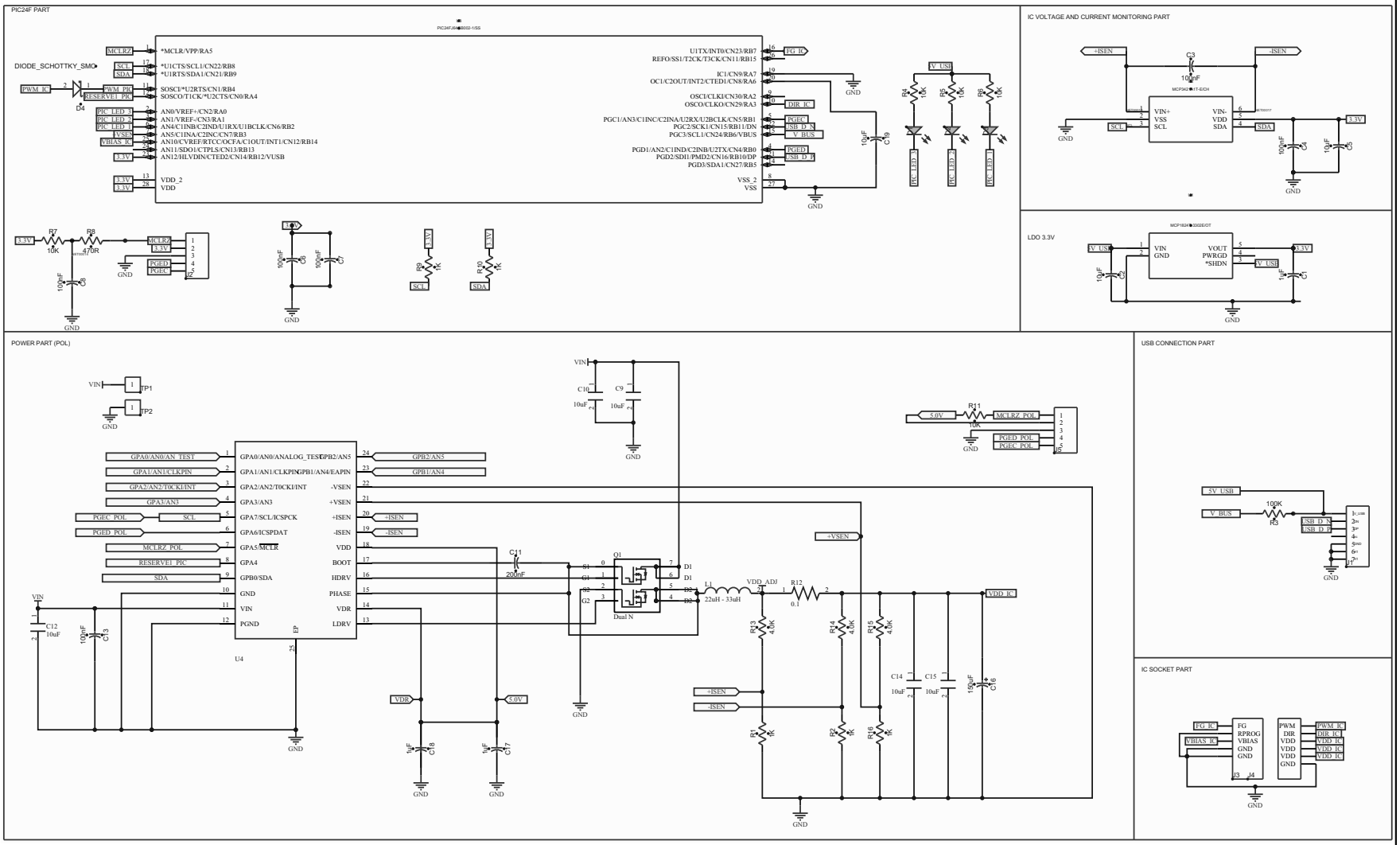
# Appendix A. Schematics and Layouts

## A.1 INTRODUCTION

This appendix contains the schematics and layouts for the following devices which are included in the MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board Kit (ADM00575):

- 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board (ADM00532):
  - Board – Schematic
  - Board – Top Silk
  - Board – Top Copper and Silk
  - Board – Top Copper
  - Board – Bottom Copper
  - Board – Bottom Copper and Silk
  - Board – Bottom Solder
- MCP8063 Daughter Board (ADM00535):
  - Daughter Board - Schematic
  - Daughter Board - Top Silk
  - Daughter Board - Top Copper and Silk
  - Daughter Board - Top Copper
  - Daughter Board - Bottom Copper
  - Daughter Board - Bottom Copper and Silk
  - Daughter Board - Bottom Solder

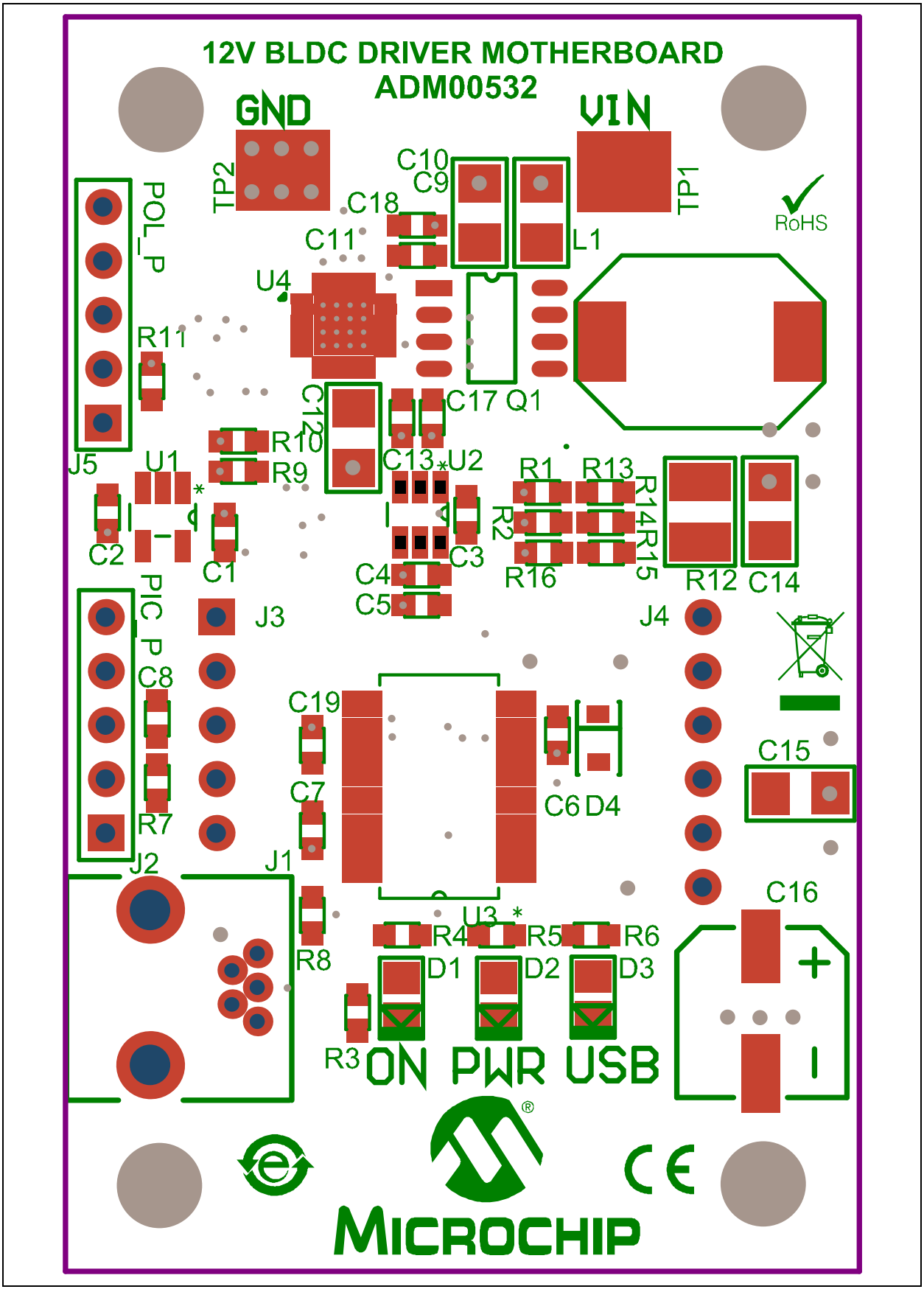
## A.2 BOARD – SCHEMATIC



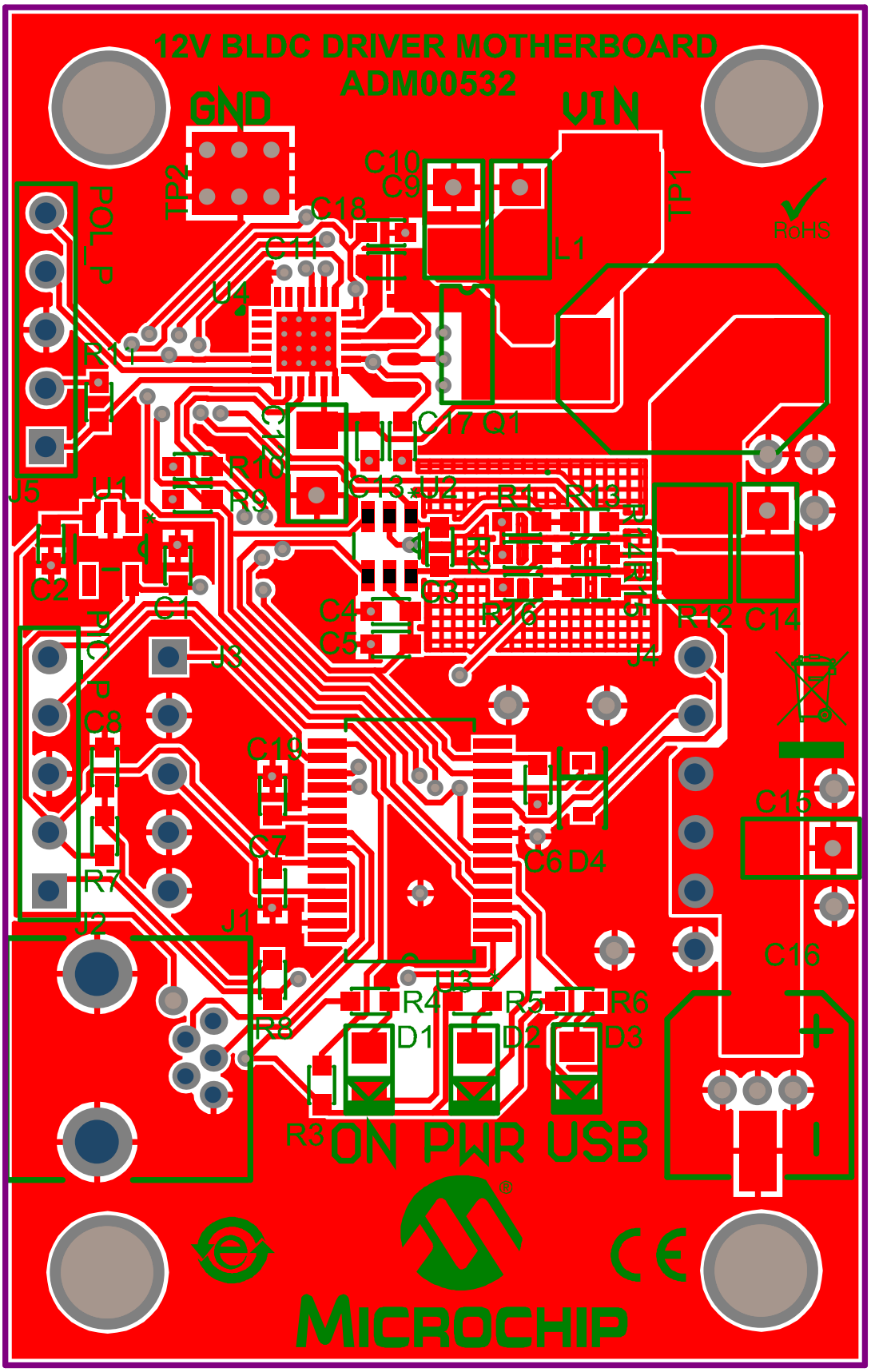



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## A.3 BOARD – TOP SILK



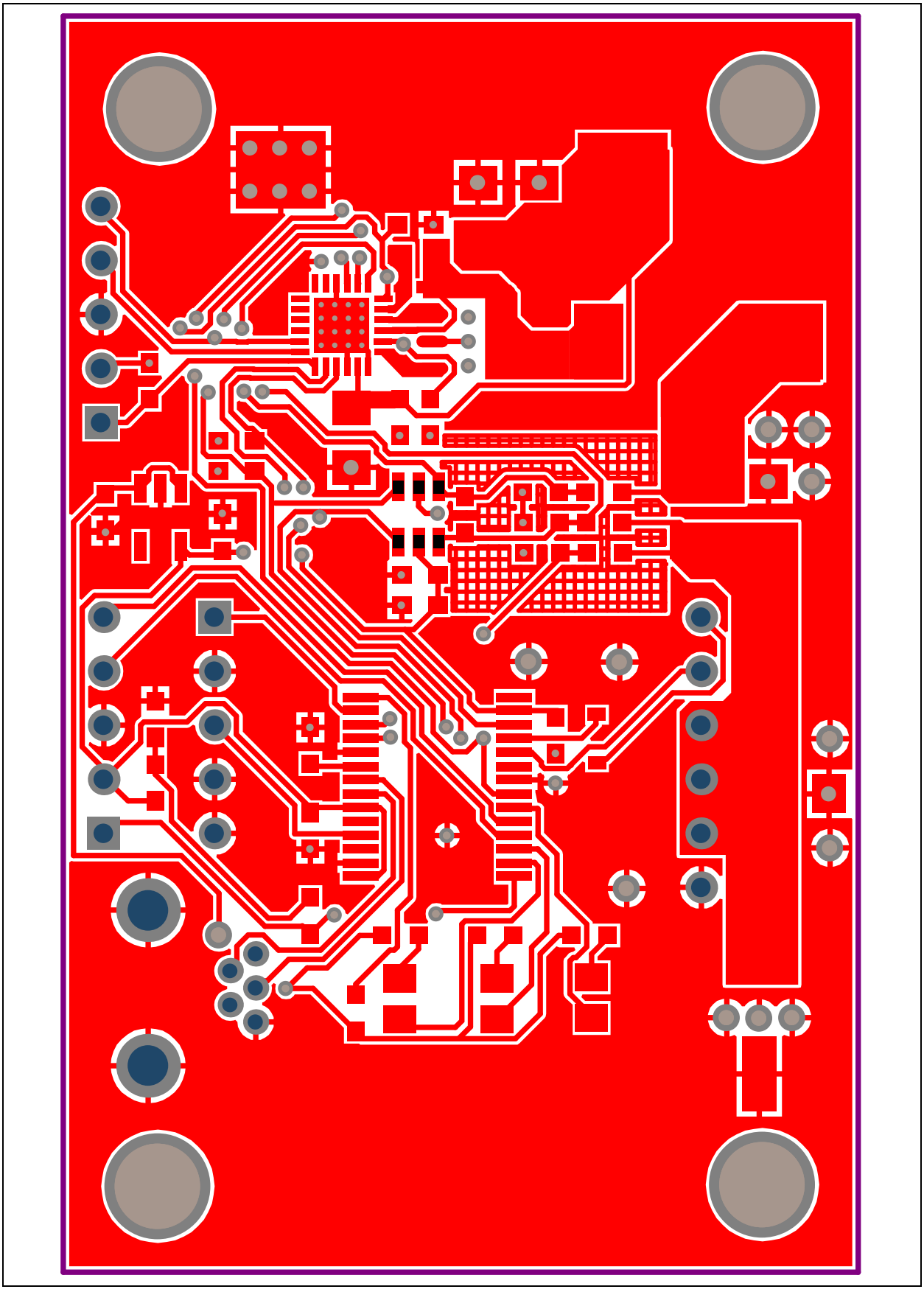
## A.4 BOARD – TOP COPPER AND SILK



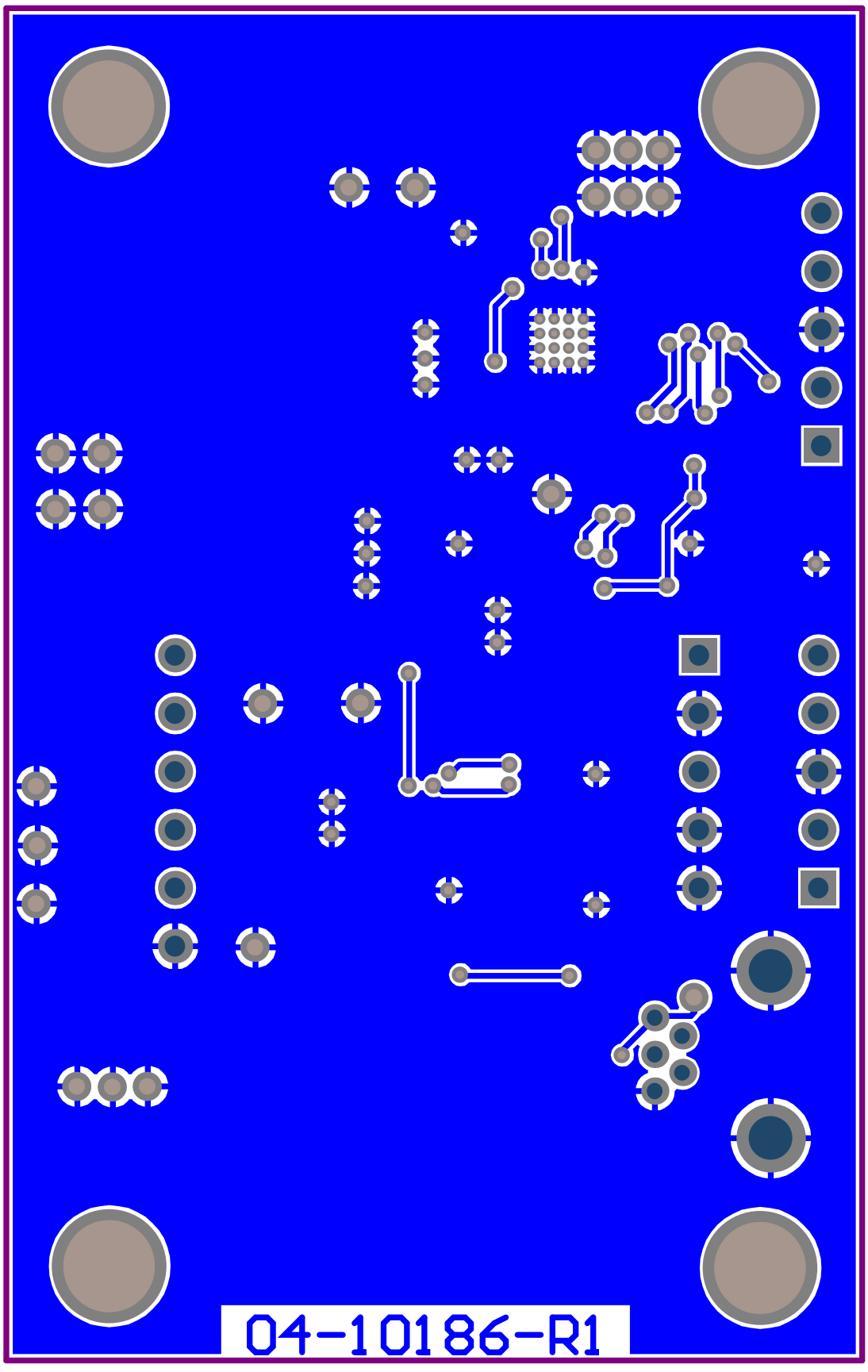


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## A.5 BOARD – TOP COPPER



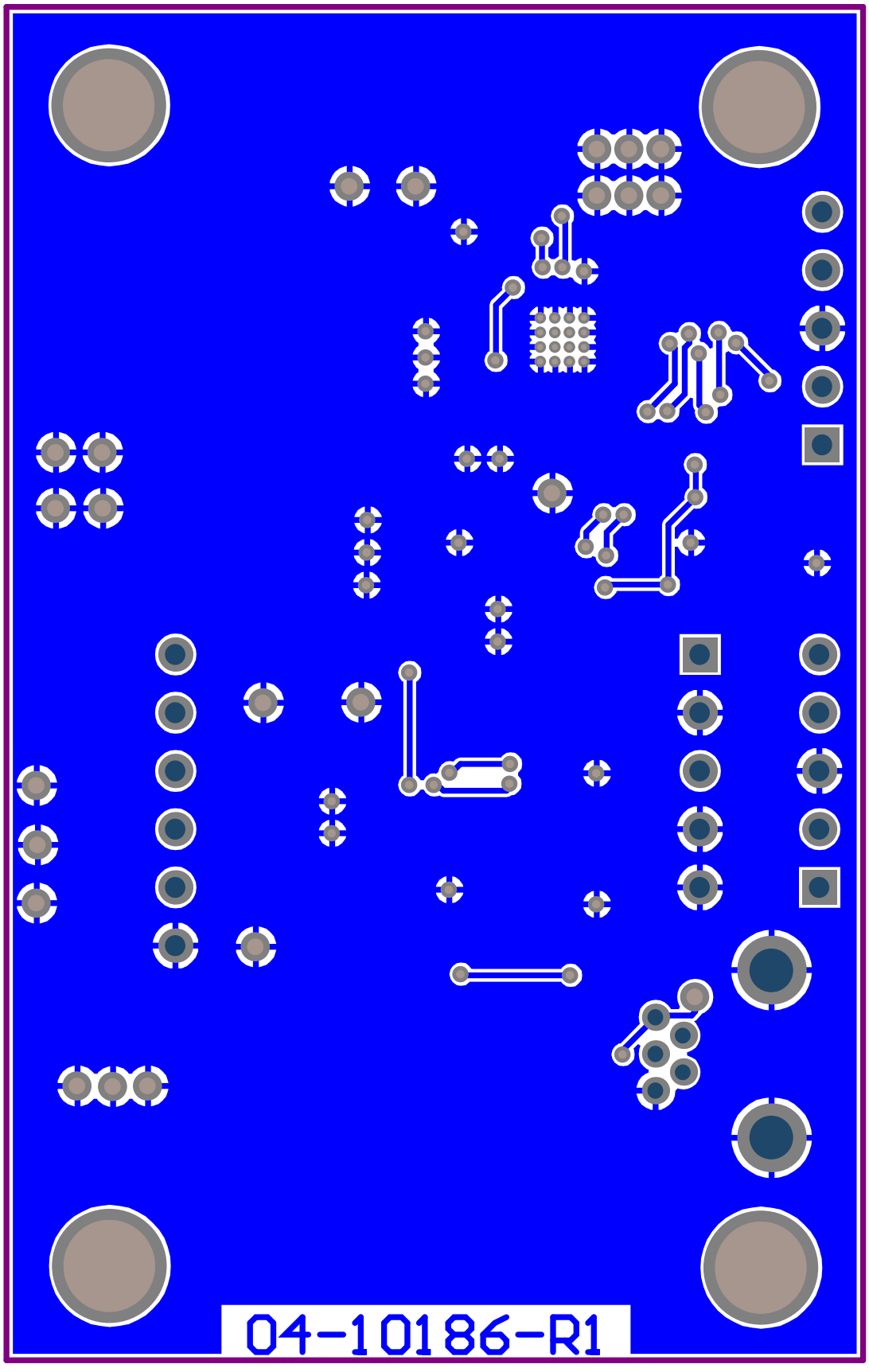
## A.6 BOARD – BOTTOM COPPER



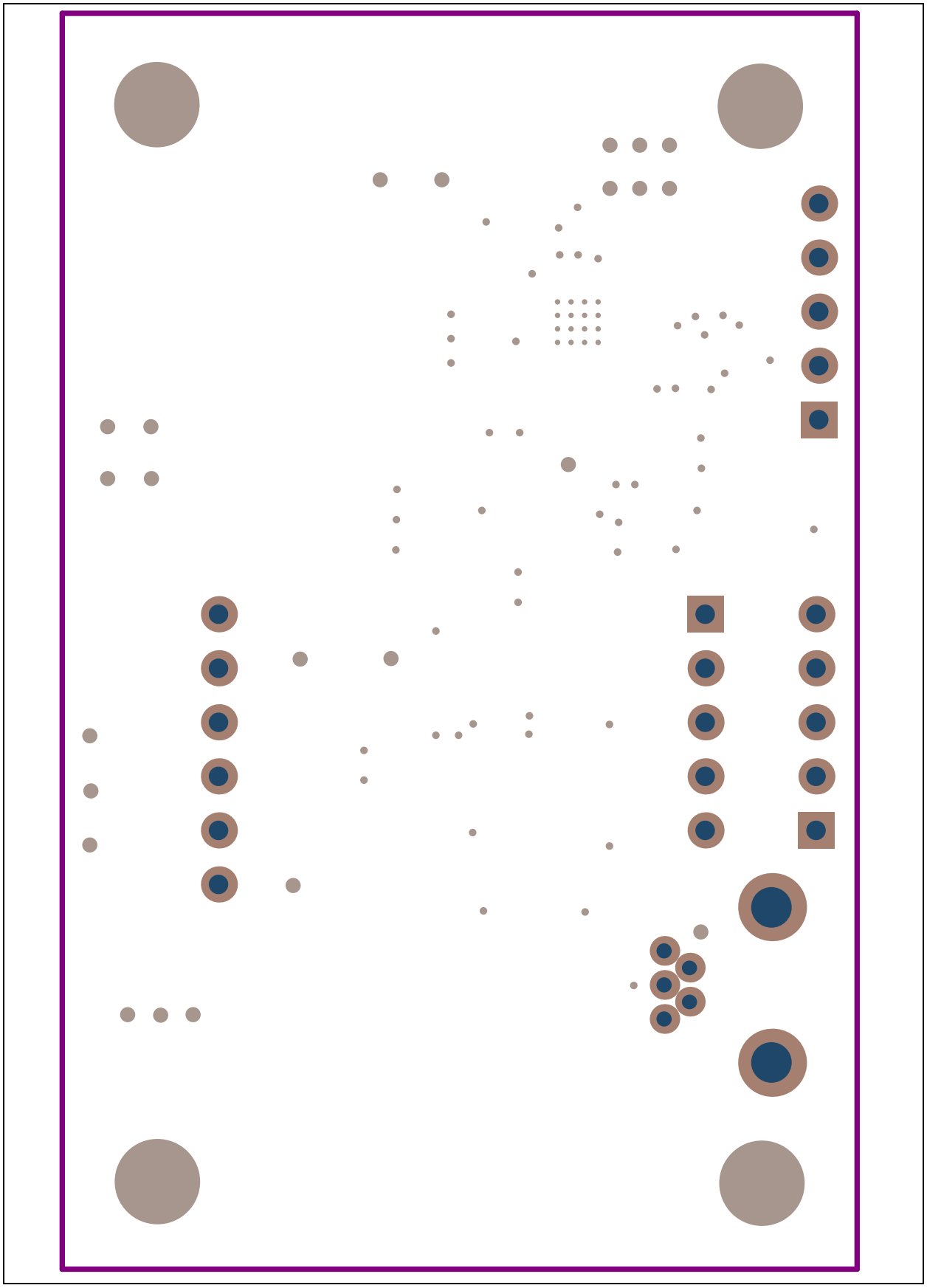


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## A.7 BOARD – BOTTOM COPPER AND SILK



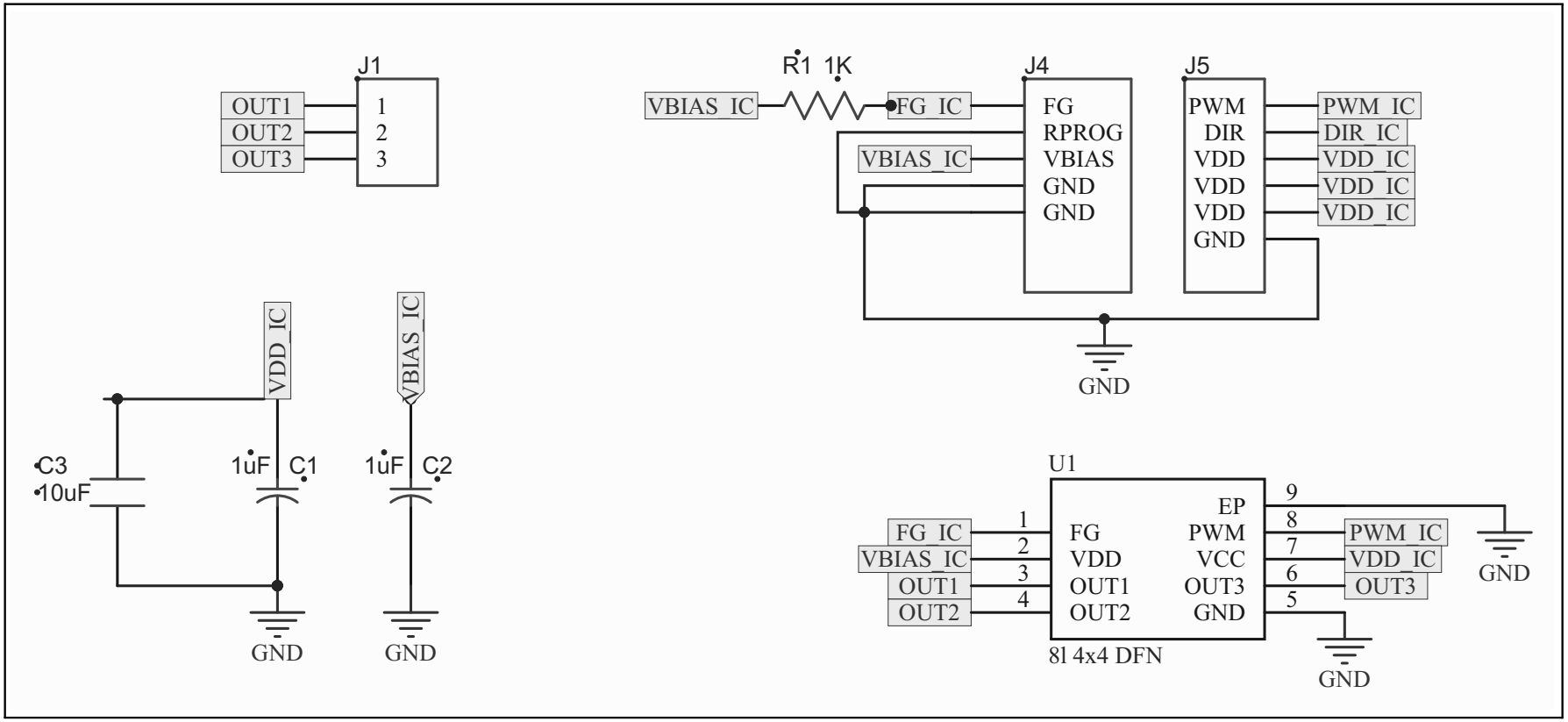
## A.8 BOARD – BOTTOM SOLDER



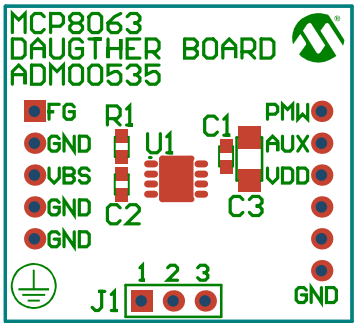

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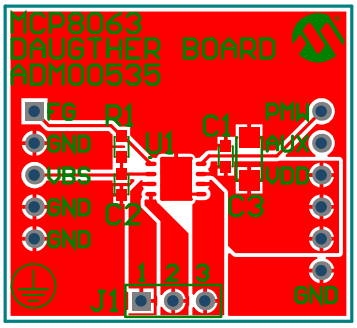
## A.9 DAUGHTER BOARD - SCHEMATIC



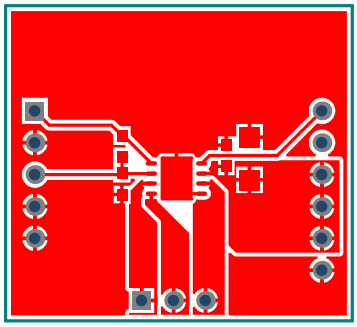
## A.10 DAUGHTER BOARD - TOP SILK




## A.11 DAUGHTER BOARD - TOP COPPER AND SILK

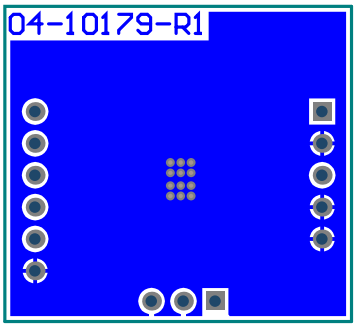



## A.12 DAUGHTER BOARD - TOP COPPER

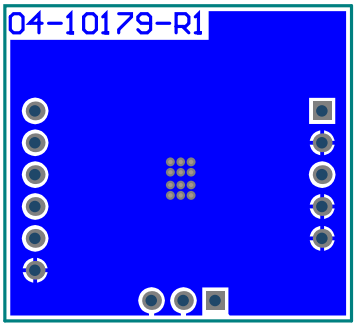



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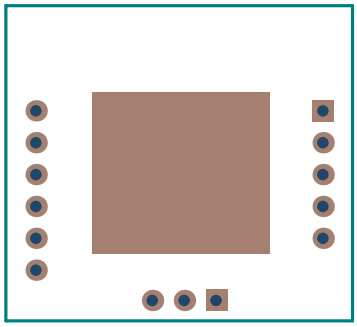
## A.13 DAUGHTER BOARD - BOTTOM COPPER




## A.14 DAUGHTER BOARD - BOTTOM COPPER AND SILK




## A.15 DAUGHTER BOARD - BOTTOM SOLDER



**NOTES:**


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# Appendix B. Bill of Materials (BOM)

**TABLE B-1: BILL OF MATERIALS (BOM) - 12V 3-PHASE BLDC SENSORLESS FAN CONTROLLER DEMONSTRATION BOARD (ADM00532)**

| Qty | Reference | Description | Manufacturer | Part Number |
|---|---|---|---|---|
| 3 | C1, C17, C18 | Cap. ceramic 1 µF 6.3V 10% X5R 0603 | TDK Corporation | C1608X5R0J105K |
| 3 | C2, C5, C19 | Cap. ceramic 10 µF 6.3V 20% X5R 0603 | TDK Corporation | C1608X5R0J106M080AB |
| 6 | C3, C4, C6 – C8, C13 | Cap. ceramic 0.1 µF 25V 20% X7R 0603 | TDK Corporation | C1608X7R1E104M080AA |
| 1 | C11 | Cap. ceramic 0.22 µF 16V 10% X7R 0603 | TDK Corporation | C1608X7R1C224K080AC |
| 5 | C9, C10, C12, C14, C15 | Cap. ceramic 10 µF 10V Y5V 1206 | TDK Corporation | C3216Y5V1A106Z/1.15 |
| 1 | C16 | Cap. alum. 150 µF 25V 20% SMD | Panasonic® - ECG | EEE-FTE151XAP |
| 3 | D1 – D3 | LED chip-led 633 NM red 0805 SMD | OSRAM Opto Semiconductors GmbH. | LS R976-NR-1 |
| 1 | D4 | Schottky diode 30V 0.2A SOD323 | NXP Semiconductor | 1PS76SB10,115 |
| 1 | J1 | Conn. USB recept. 5 POS rt. angle | Molex® | 548190519 |
| 2 | J2, J5 | Conn. header 5 POS 0.050" T/H gold | Samtec, Inc. | TMS-105-02-G-S |
| 1 | J3 | Conn. recept. 5 POS 0.100 vert. gold | TE Connectivity, Ltd. | 5-534237-3 |
| 1 | J4 | Conn. recept. 6 POS 0.100 vert. gold | TE Connectivity, Ltd. | 534237-4 |
| 1 | L1 | Inductor power 22 µH 30% shield SMD | Bourns®, Inc. | SRU1048-220Y |
| | PCB | Printed Circuit Board – MCP8063 12V 3-Phase BLDC Sensorless Fan Controller Demonstration Board | — | 104-00532 |
| 1 | Q1 | MOSFET N-Channel dual 30V 8-SOIC | Vishay Siliconix | SI4330DY-T1-E3 |
| 5 | R1, R2, R9, R10, R16 | Res. 1.00 kΩ 1/10W 1% 0603 | TE Connectivity, Ltd. | 1622866-1 |
| 1 | R3 | Res. 100 kΩ 1/10W 1% 0603 | TE Connectivity, Ltd. | 1622827-1 |
| 5 | R4 – R7, R11 | Res. 10.0 kΩ 1/10W 1% 0603 | TE Connectivity, Ltd. | 1622829-1 |
| 3 | R13 – R15 | Res. 4.02 kΩ 1/10W 1% 0603 SMD | Panasonic - ECG | ERJ-3EKF4021V |
| 1 | R8 | Res. 470Ω 1/10W 1% 0603 SMD | Panasonic - ECG | ERJ-3EKF4700V |
| 1 | R12 | Res. 0.1Ω 1/3W 1% 1210 SMD | Panasonic - ECG | ERJ-L14KF10CU |
| 2 | TP1, TP2 | PC test point mini SMD | Keystone Electronics Corp. | 5019 |

**Note 1:** 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 B-1: BILL OF MATERIALS (BOM) - 12V 3-PHASE BLDC SENSORLESS FAN CONTROLLER DEMONSTRATION BOARD (ADM00532) (CONTINUED)**

| Qty | Reference | Description | Manufacturer | Part Number |
|---|---|---|---|---|
| 1 | U1 | IC reg. LDO 3.3V 0.3A 5-lead SOT-23 | Microchip Technology Inc. | **MCP1824T-3302E/OT** |
| 1 | U2 | IC ADC 18 bit 3.75 SPS 1 ch. 6-lead SOT-23 | Microchip Technology Inc. | **MCP3421A1T-E/CH** |
| 1 | U3 | IC MCU 16 bit 64 KB Flash 28-lead SSOP | Microchip Technology Inc. | **PIC24FJ64GB002-1/SS** |
| 1 | U4 | IC reg. controller Buck PWM 24-lead QFN | Microchip Technology Inc. | **MCP19110-E/MJ-ND** |

**Note 1:** 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 B-2: BILL OF MATERIALS (BOM) - MCP8063 DAUGHTER BOARD (ADM00535)**

| Qty | Reference | Description | Manufacturer | Part Number |
|---|---|---|---|---|
| 2 | C1, C2 | Cap. ceramic 1UF 16V 10% X7R 0603 | AVX Corporation | 0603YC105KAT2A |
| 1 | C3 | Cap. ceramic 10UF 16V 10% X5R 1206 | AVX Corporation | 1206YD106KAT2A |
| 1 | R1 | Res. 10.0K OHM 1/16W 1% 0603 | TE Connectivity, Ltd. | 5-1879337-9 |
| 1 | J1 | Conn. header 3POS .100 R/A tin | Molex® | 22288030 |
| 1 | J2 | 5x1 header 100" SR straight | FCI | 68000-105HLF |
| 1 | J3 | Conn. header 6POS 100 STR 30AU | FCI | 68000-106HLF |
| 1 | U1 | MCP8063 | Microchip Technology Inc. | **MCP8063-E/MD** |

**Note 1:** 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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**NOTES:**

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