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MCP8025 TQFP BLDC Motor Driver Evaluation Board User's Guide

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Object of Declaration: MCP8025 TQFP BLDC Motor Driver Evaluation Board

EU Declaration of Conformity

Manufacturer: Microchip Technology Inc.
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USA

This declaration of conformity is issued by the manufacturer.

The development/evaluation tool is designed to be used for research and development in a laboratory environment. This development/evaluation tool is not intended to be a finished appliance, nor is it intended for incorporation into finished appliances that are made commercially available as single functional units to end users. This development/evaluation tool complies with EU EMC Directive 2004/108/EC and as supported by the European Commission's Guide for the EMC Directive 2004/108/EC (8th February 2010).

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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

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site (www.microchip.com) to obtain the latest documentation available.

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 MCP8025 TQFP BLDC Motor Driver Evaluation Board. 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 MCP8025 TQFP BLDC Motor Driver Evaluation Board as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the MCP8025 TQFP BLDC Motor Driver Evaluation Board.
- **Chapter 2. "Installation and Operation"** – Includes instructions on how to get started with this user's guide and a description of the user's guide.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the MCP8025 TQFP BLDC Motor Driver Evaluation Board.
- **Appendix B. "Bill of Materials"** – Lists the parts used to build the MCP8025 TQFP BLDC Motor Driver Evaluation Board.
- **Appendix C. "Software"** – Provides information about the application firmware and where the source code can be found.

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) { ... }`

RECOMMENDED READING

This user's guide describes how to use the MCP8025 TQFP BLDC Motor Driver Evaluation Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

- **MCP8025 – *"3-Phase Brushless DC (BLDC) Motor Gate Driver with Power Module"* (DS20005339) —** This data sheet provides detailed information regarding the MCP8025 product family.
- **dsPIC33EPXXXGP50X, dsPIC33EPXXXMC20X/50X and PIC24EPXXXGP/MC20X – *"16-Bit Microcontrollers and Digital Signal Controllers with High-Speed PWM, Op Amps and Advanced Analog"* (DS70000657) —** This data sheet provides detailed information regarding the dsPIC33EP256MC504 product family.
- ***"dsPIC33E/PIC24E Family Reference Manual"* (DS70573)**
- ***"dsPIC33EPXXXGP50X, dsPIC33EPXXXMC20X/50X, and PIC24EPXXXGP/MC20X Family Silicon Errata and Data Sheet Clarification"* (DS80000533G) —** This data sheet contains anomalies and clarifications for the dsPIC33EPXXXMC504 processor.
- **AN1078 – *"Sensorless Field Oriented Control of a PMSM"* (DS01078)**
- **AN1160 – *"Sensorless BLDC Control with Back-EMF Filtering Using a Majority Function"* (DS01160)**
- **AN992 – *"Sensorless BLDC Motor Control Using dsPIC30F2010"* (DS00992)**
- **AN1292 – *"Sensorless Field Oriented Control (FOC) for a Permanent Magnet Synchronous Motor (PMSM) Using a PLL Estimator and Field Weakening (FW)"* (DS01292)**
- **AN901 – *"Using the dsPIC30F for Sensorless BLDC Control"* (DS00901)**

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- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

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The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers, assemblers, linkers and other language tools. These include all MPLAB C compilers; all MPLAB assemblers (including MPASM assembler); all MPLAB linkers (including MPLINK object linker); and all MPLAB librarians (including MPLIB object librarian).
- **Emulators** – The latest information on Microchip in-circuit emulators.This includes the MPLAB REAL ICE™ and MPLAB ICE 2000 in-circuit emulators.
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debuggers. This includes MPLAB ICD 3 in-circuit debuggers and PICkit 3 Debug Express.
- **MPLAB IDE** – The latest information on Microchip MPLAB IDE, the Windows Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB IDE Project Manager, MPLAB Editor and MPLAB SIM simulator, as well as general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include production programmers such as MPLAB REAL ICE in-circuit emulator, MPLAB ICD 3 in-circuit debugger and MPLAB PM3 device programmers. Also included are nonproduction development programmers such as PICSTART Plus and PICkit 2 and 3 programmers.

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

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

DOCUMENT REVISION HISTORY

Revision A (September 2014)

- Initial Release of this Document.

Chapter 1. Product Overview

1.1 INTRODUCTION

The MCP8025 TQFP BLDC Motor Driver Evaluation Board is used to demonstrate the drive capabilities of the MCP8025. The board uses the MCP8025 3-Phase Brushless DC (BLDC) motor gate driver and dsPIC33EP256MC504 processor to implement a 6-step trapezoidal BLDC motor controller.

The MCP8025 TQFP BLDC Motor Driver Evaluation Board is used to evaluate Microchip's MCP8025 in a BLDC motor application. As provided, the MCP8025 TQFP BLDC Motor Driver Evaluation Board is ready to operate a BLDC motor using one on-board push button to start and stop the motor plus one on-board potentiometer to set motor speed. The evaluation board can drive a BLDC motor with a supply voltage of up to 19V and a motor current up to 15 amps. The MCP8025 TQFP BLDC Motor Driver Evaluation Board provides a 6-step trapezoidal control algorithm along with a 750 mW buck converter, 5V and 12V LDO, high-to-low level voltage translators, current sense operational amplifiers, LIN transceiver and Hall-effect inputs. The evaluation board provides a status indication for the power supplies and the six on-board Pulse-Width Modulation (PWM) inputs.

This chapter covers the following topics:

- What is the MCP8025 TQFP BLDC Motor Driver Evaluation Board?
- What does the MCP8025 TQFP BLDC Motor Driver Evaluation Board Kit include?

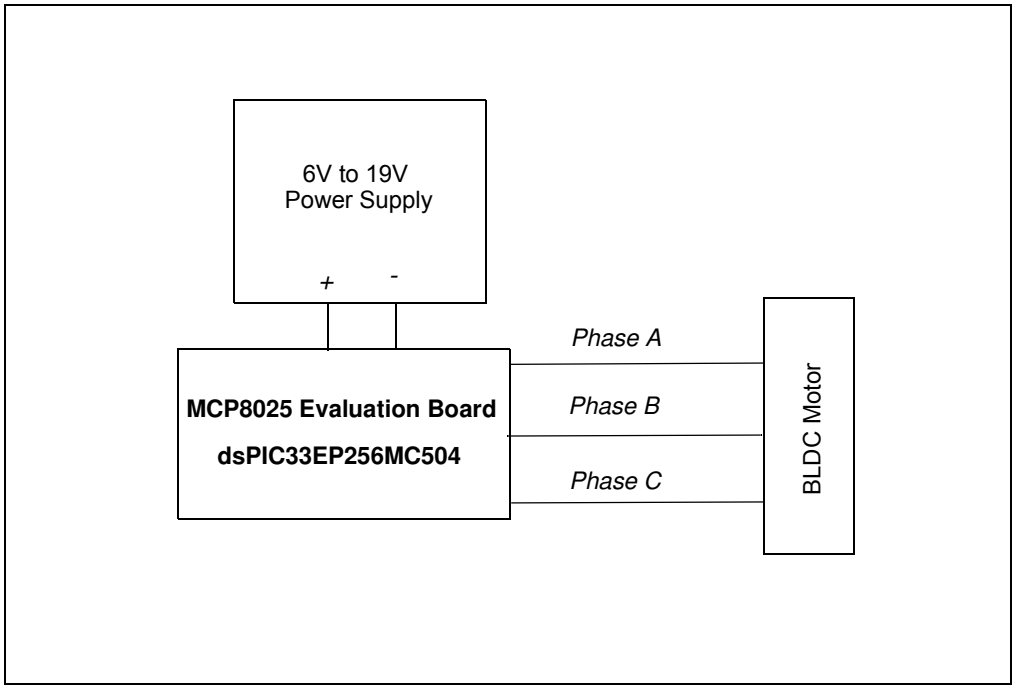

FIGURE 1-1: *MCP8025 TQFP BLDC Motor Driver Evaluation Board Block Diagram.*

1.2 WHAT IS THE MCP8025 TQFP BLDC MOTOR DRIVER EVALUATION BOARD?

The MCP8025 TQFP BLDC Motor Driver Evaluation Board is a complete stand-alone motor controller for brushless DC motors (BLDC). The board is capable of driving a three-phase brushless DC motor rated at up to 15 amps and 19V. The input voltage range for the board is 6V to 19V. The on board MCP8025 generates 5V and 12V using internal voltage regulators. The MCP8025 also contains an internal buck regulator which generates the power for the attached dsPIC33EP256MC504 host microcontroller.

An input terminal block is provided to apply the input voltage to the board. An output header and plated Printed Circuit Board (PCB) through-hole pads are also provided as a means to connect the external motor. Two programming headers are available for updating the firmware contained in the dsPIC33EP256MC504 using either a PICkit 3 programmer/debugger or an MPLAB® ICD3 in-circuit debugger.

An input terminal block is also supplied on the board to allow users to create LIN communication connections to the MCP8025 LIN transceiver.

1.3 WHAT DOES THE MCP8025 TQFP BLDC MOTOR DRIVER EVALUATION BOARD KIT INCLUDE?

This MCP8025 TQFP BLDC Motor Driver Evaluation Board kit includes:

- The MCP8025 TQFP BLDC Motor Driver Evaluation Board, ADM00600
- Information Sheet

Chapter 2. Installation and Operation

2.1 INTRODUCTION

The MCP8025 TQFP BLDC Motor Driver Evaluation Board demonstrates Microchip's 3-Phase Brushless DC (BLDC) Motor Gate Driver with Power Module, MCP8025, used in a BLDC motor drive application. When used in conjunction with a microcontroller, the MCP8025 will provide the necessary drive signals to drive for a 3-Phase BLDC motor. The MCP8025 contains the high-side and low-side drivers for external N-channel MOSFETs. A dsPIC33EP256MC504 processor is used to supply the PWM inputs to the MCP8025 as well as handle the high-speed Analog-To-Digital Conversion (ADC) required for 50 kHz PWM operation.

The MCP8025 UART interface is used to configure the MCP8025 device and to send fault information to the dsPIC® Digital Signal Controller (DSC). The evaluation board firmware, available on the Microchip web site, uses a 6-step trapezoidal drive control algorithm to demonstrate the MCP8025 capabilities.

2.2 FEATURES

The MCP8025 TQFP BLDC Motor Driver Evaluation Board has the following features:

- Input Operating Voltage Range: +6.0V to +19V
- Maximum of 500 mA of gate drive current for external N-Channel MOSFETs
- Drives up to a 15A BLDC motor
- 750 mW Buck Regulator with resistor-programmable output voltage
- ON/OFF momentary contact switch
- Reset momentary contact switch
- Spare user-programmable momentary contact switch
- PWM signal LED indicators
- PICkit 3 and MPLAB ICD 3 debugger interfaces
- Speed control potentiometer
- Terminal block for 5V and 12V Hall-effect sensors
- LIN terminal block for user communications use
- Programmable external MOSFET overcurrent protection
- Programmable PWM dead-time protection
- Programmable PWM blanking time for current switching spikes
- Complete "C" source code (provided on the board web page)

2.3 GETTING STARTED

The MCP8025 TQFP BLDC Motor Driver Evaluation Board is fully assembled and tested for driving a BLDC motor. This board requires the use of an external voltage source capable of supplying 6V to 19V at the rated motor current. A BLDC motor is also required to evaluate the motor driver.

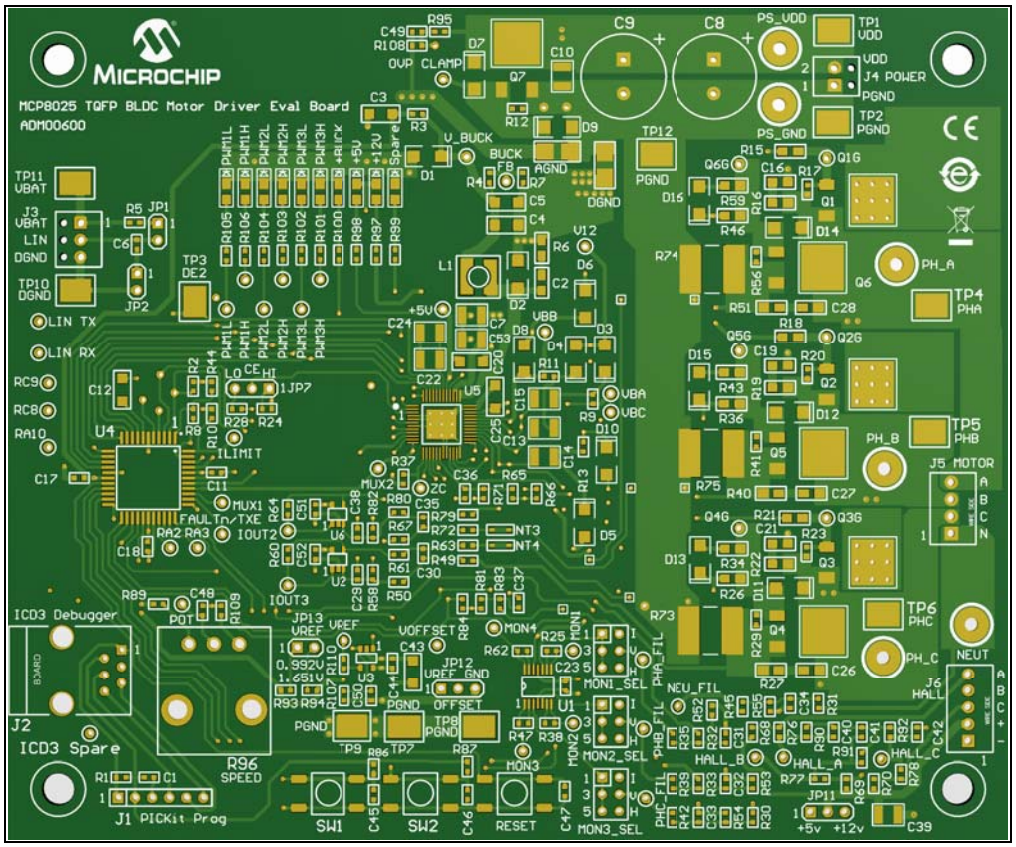

FIGURE 2-1: *MCP8025 TQFP BLDC Motor Driver Evaluation Board PCB.*

2.3.1 Connections

2.3.1.1 JUMPER SETTINGS

The MCP8025 TQFP BLDC Motor Driver Evaluation Board has several user-configurable jumpers. The jumpers are described in Table 2-1 below.

TABLE 2-1: MCP8025 TQFP BLDC MOTOR DRIVER EVALUATION BOARD JUMPERS

Jumper	Default	Position	Description
JP1	OFF	ON	Enable LIN Bus 1 kΩ pull up
JP2	ON	ON	Enable LIN Bus 220 pF capacitor
JP7	2-3	1-2	CE 47 kΩ pull up to +3.3V
		2-3	CE 47 kΩ pull down to DGND
JP8 (MONITOR1) JP9 (MONITOR2) JP10 (MONITOR3)	3-4	1-2	Connect phase current to MONITORn
		3-4	Connect filtered phase to MONITORn
		5-6	Connect Hall Sensor to MONITORn
JP11	1-2	1-2	Supplies 5V to the Hall Sensors
		2-3	Supplies 12V to the Hall Sensors

TABLE 2-1: MCP8025 TQFP BLDC MOTOR DRIVER EVALUATION BOARD JUMPERS (CONTINUED)

Jumper	Default	Position	Description
JP12	1-2	1-2	Current Sense offset = JP13 selection
		2-3	Current Sense offset = 0.0V
JP13	OFF	ON	Current Sense reference = 1.651V
		OFF	Current Sense reference = 0.992V

2.3.1.1.1 The jumpers and their use are described in Table 2-2.

TABLE 2-2: JUMPER DESCRIPTION

Jumper	Name	Position	Description
JP1	LIN Bus Master Select Resistor	ON	Connects 1K resistor from terminal block J3-2 (LIN Bus) to LIN terminal block J3-1 (LIN V_{BAT})
JP2	LIN Bus Capacitor	ON	Connects 220 pF capacitor from terminal block J3-2 (LIN Bus) to LIN terminal block J3-3 (LIN GND)
JP7	MCP8025 CE	1-2	Connects CE pin to +3.3V through 47K pull-up resistor
		2-3	Connects CE pin to DGND through 47K pull-up resistor
JP8	Monitor 1 Input Selection (A/D Channel AN0)	1-2	Connects Phase A Current to Monitor 1 net
		3-4	Connects Filtered Phase A Voltage to MONITOR1 net
		5-6	Connects Hall Sensor A to Monitor 1 net
JP9	Monitor 2 Input Selection (A/D Channel AN1)	1-2	Connects Phase B Current to Monitor 2 net
		3-4	Connects Filtered Phase B Voltage to MONITOR2 net
		5-6	Connects Hall Sensor B to Monitor 2 net
JP10	Monitor 3 Input Selection (A/D Channel AN2)	1-2	Connects Phase C Current to Monitor 3 net
		3-4	Connects Filtered Phase C Voltage to MONITOR3 net
		5-6	Connects Hall Sensor C to Monitor 3 net
JP11	—	1-2	Supplies 5V to the Hall Sensors
		2-3	Supplies 12V to the Hall Sensors
JP12	—	1-2	Current Sense Offset Voltage = JP13 selection
		3-4	Current Sense Offset Voltage = 0.0V
JP13	—	1-2	Current Sense Reference Voltage = 1.651V
		3-4	Current Sense Reference Voltage = 0.992V

The jumper settings for use with the sensorless trapezoidal drive firmware are as described in Table 2-3.

TABLE 2-3: JUMPERS USED BY SENSORLESS TRAPEZOIDAL FIRMWARE

Jumper	Position	Description
JP7	2-3	Enable 47 kΩ CE pull down to DGND
JP8 (MONITOR1) JP9 (MONITOR2) JP10 (MONITOR3)	3-4	Connect filtered phase voltage to MONITORn

2.3.1.2 POWERING THE MCP8025 TQFP BLDC MOTOR DRIVER EVALUATION BOARD (REFERENCE Figure 2-2)

1. Apply the input voltage to the input power terminal block, J4. The input voltage source should be limited to the 0V to +19V range. For nominal operation the input voltage should be between +6.0V and +19V.
2. Connect the positive side of the input power source (+) to pin 2 of J4. Connect the negative or return side (-) of the input source to pin 1 of J4. Refer to Figure 2-2.

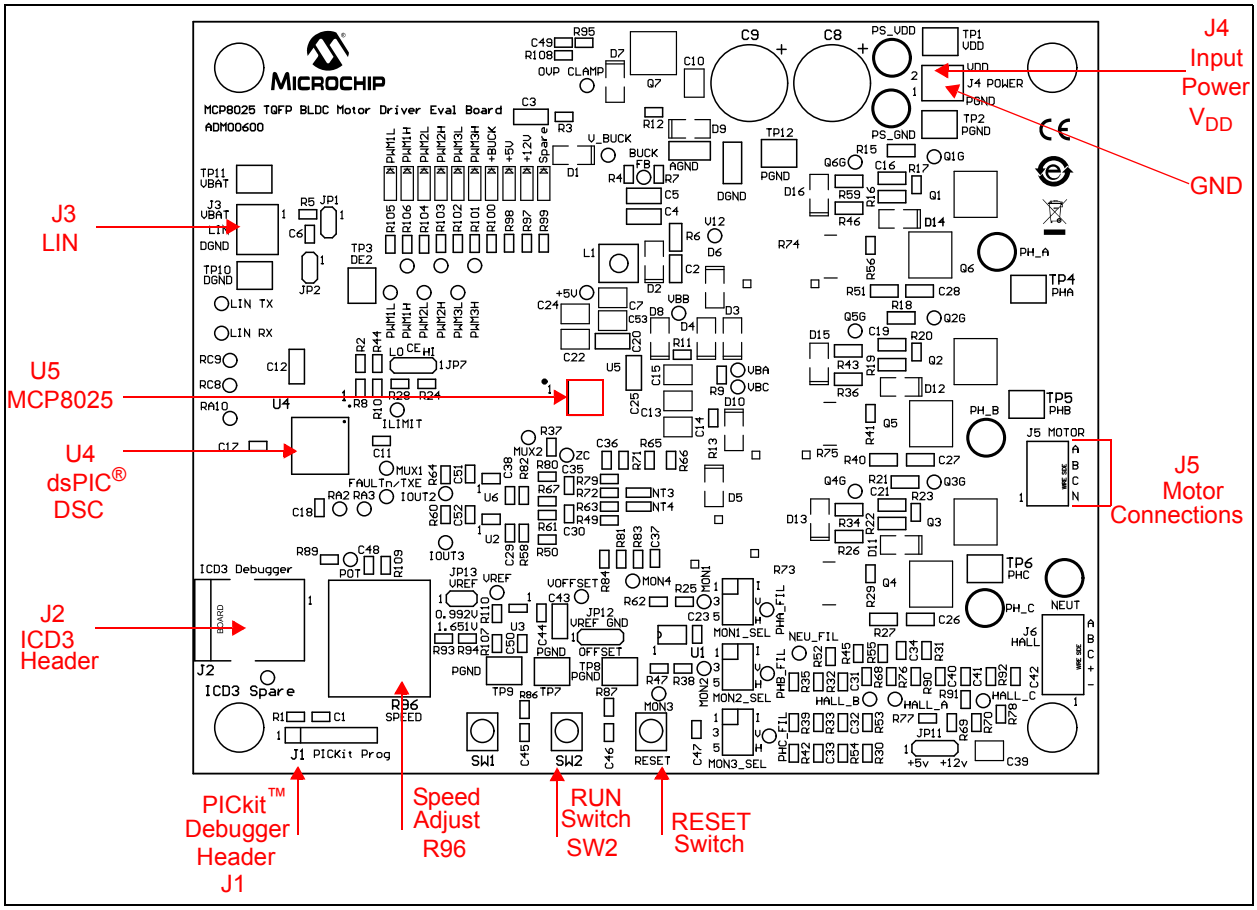

FIGURE 2-2: *Connection and Operation Diagram.*

2.3.1.3 CONNECTING A MOTOR TO THE MCP8025 TQFP BLDC MOTOR DRIVER EVALUATION BOARD

Connect each phase winding of a three-phase BLDC motor to the appropriate terminal of the motor terminal block, J5, terminals A,B,C. The neutral winding, terminal N, is not necessary for the sensorless trapezoidal drive firmware provided for the evaluation board.

2.3.2 Operating a Motor

1. Turn the speed adjust potentiometer (R96) fully counter-clockwise to obtain the slowest speed setting. Now turn the speed adjust approximately ¼ turn clockwise to allow for 25% motor speed.
2. Turn on the power supply.
3. Press and release the RUN switch (SW2) to start the motor.
4. Turn the Speed Adjust potentiometer clockwise to increase motor speed, counter-clockwise to decrease motor speed. The Speed Adjust changes the PWM duty cycle of the PWM signals being sent to the MCP8025.
5. Press and release the RUN switch again to stop the motor.

2.3.3 Indicator LEDs

The MCP8025 TQFP BLDC Motor Driver Evaluation Board has ten LEDs to indicate system status. Table 2-4 lists the LED indicators and their descriptions.

TABLE 2-4: LED INDICATORS

PCB Location	Name	Description
D17	SPARE	Spare LED on dsPIC DSC RA4 port
D18	+12V	+12V LDO voltage operating
D19	+5V	+5V LDO voltage operating
D20	+Buck	+3.3V Buck output voltage operating
D21	PWM3H	PWM Phase 3 high-side input to MCP8025
D22	PWM3L	PWM Phase 3 low-side input to MCP8025
D23	PWM2H	PWM Phase 2 high-side input to MCP8025
D24	PWM2L	PWM Phase 2 low-side input to MCP8025
D25	PWM1H	PWM Phase 1 high-side input to MCP8025
D26	PWM1L	PWM Phase 1 low-side input to MCP8025

2.3.4 Test Points

There are several test points on the board to allow probing of voltages, currents and signals. An abridged listing is shown in Table 2-5.

TABLE 2-5: TEST POINTS DESCRIPTION

Test Point	Name	Description
TP1	V_{DD}	Power supply (+)
TP2	PGND	Power supply ground (-)
TP3	DE2	MCP8025 DE2 communications signal
TP4	PHA	Motor Phase A connection
TP5	PHB	Motor Phase B connection
TP6	PHC	Motor Phase C connection
TP7	PGND	Power supply ground (-)
TP8	PGND	Power supply ground (-)
TP9	PGND	Power supply ground (-)
TP10	LIN GND	LIN Bus ground connection
TP11	LIN +12V	LIN Bus +12V supply connection

TABLE 2-5: TEST POINTS DESCRIPTION (CONTINUED)

Test Point	Name	Description
FAULTn/TXE	$\overline{\text{FAULTn}}$/TXE	LIN Fault/Transmit enable signal
ILIMIT	ILIMIT	$\overline{\text{ILIMIT\_OUT}}$ signal from MCP8025
LIN RX	LIN RX	Received data from LIN transceiver
LIN TX	LIN TX	Transmitted data to LIN transceiver
MON1	MON1	Monitor Signal 1: connects to A/D input AN0
MON2	MON2	Monitor Signal 2: connects to A/D input AN1
MON3	MON3	Monitor Signal 3: connects to A/D input AN2
MON4	MON4	Monitor Signal 4: connects to A/D input AN5
NEU_FIL	NEU_FIL	Filtered neutral signal
OVP CLAMP	OVP CLAMP	Gate pin of supply overvoltage clamp
PHA_FIL	PHA_FIL	Filtered Phase A signal
PHB_FIL	PHB_FIL	Filtered Phase B signal
PHC_FIL	PHC_FIL	Filtered Phase C signal
POT	POT	Speed adjust potentiometer. Clockwise increases PWM duty cycle (speed), counter-clockwise decreases PWM duty cycle (speed).
PWM1H	PWM1H	PWM phase A high-side input to MCP8025
PWM1L	PWM1L	PWM phase A low-side input to MCP8025
PWM2H	PWM2H	PWM phase B high-side input to MCP8025
PWM2L	PWM2L	PWM phase B low-side input to MCP8025
PWM3H	PWM3H	PWM phase C high-side input to MCP8025
PWM3L	PWM3L	PWM phase C low-side input to MCP8025
Q1G	Q1G	Phase A high-side MOSFET gate
Q2G	Q2G	Phase B high-side MOSFET gate
Q3G	Q3G	Phase C high-side MOSFET gate
Q4G	Q4G	Phase C low-side MOSFET gate
Q5G	Q5G	Phase B low-side MOSFET gate
Q6G	Q6G	Phase A low-side MOSFET gate
RA2	RA2	dsPIC DSC spare I/O pin
RA3	RA3	dsPIC DSC spare I/O pin
RA10	RA10	dsPIC DSC spare I/O pin
RC8	RC8	dsPIC DSC spare I/O pin
RC9	RC9	dsPIC DSC spare I/O pin
V_BUCK	V_BUCK	Buck 3.3V output voltage

2.3.5 Reprogramming the On-Board dsPIC33EP256MC504

The on-board dsPIC33EP256MC504 may be reprogrammed with the user's desired firmware. The processor may be programmed by using an external power source and either a PICkit 3, MPLAB REAL ICE in-circuit emulator or MPLAB ICD3 programmer.

1. Connect the power source to the board as explained in **Section 2.3.1.2**.
2. Connect a PICkit 3 to the J1 header or connect an MPLAB ICD 3 or MPLAB REAL ICE in-circuit emulator to the J2 (RJ25) jack.
3. Startup up the MPLABX Integrated Development Environment (IDE) and load the MCP8025 TQFP BLDC Motor Driver Evaluation Board firmware project.

Note: Note that the following project options may need to be changed for the computer being used to build the firmware:

- Add Library `libdsp-elf.a` located in XC16 `???\src\Libdsp\lib` directory.
- Add XC16-as ASM Include Directory in XC16 `???\src\Libdsp\asm`.
- Set Hardware tool to "ICD 3", "REAL ICE", or "PICkit3".

4. Build the project.
5. Program the device.
6. Press the RESET switch on the board to reset the processor and allow the processor to execute the new firmware program.

2.3.6 Configuring the MCP8025

The MCP8025 has configuration registers that may be used to modify operating parameters of the device. The parameters are modified by sending commands to the MCP8025 using the DE2 communication bus. The DE2 communication bus is a half-duplex, 9600 baud, 8-bit, 1-stop bit, 1-start bit, no parity, serial communication link. The user may add code to the evaluation board firmware to communicate with the registers. The evaluation board software contains a subroutine which initializes the MCP8025 registers.

There are three configuration registers that may be written to. The registers are written to by sending a `SET_CFG_X` command byte followed by the desired register value byte. The configuration messages and their respective requests are listed in Table 2-6.

TABLE 2-6: CONFIGURATION MESSAGE COMMANDS

Command	Byte	Bit	Value	Description
SET_CFG_0	1		10000001b (81H)	Set Configuration Register 0
	2	7	0	Reserved
		6	—	(Always '0' in SLEEP mode)
			0	Enable disconnect of 30 kΩ LIN Bus pull up when CE = 0 (Default)
			1	Disable disconnect of 30 kΩ LIN Bus pull up when CE = 0
		5	0	System enters Standby mode when CE = 0
			1	System enters Sleep mode when CE = 0 30 kΩ LIN Bus pull up disconnect always enabled
		4	0	Disable internal neutral simulator (Default)
			1	Enable internal neutral simulator
		3	0	Enable MOSFET Undervoltage Lockout (Default)
			1	Disable MOSFET Undervoltage Lockout
		2	0	Enable external MOSFET short circuit detection (Default)
			1	Disable external MOSFET short circuit detection
		1:0	00	Set external MOSFET overcurrent limit to 0.250V (Default)
			01	Set external MOSFET overcurrent limit to 0.500V
			10	Set external MOSFET overcurrent limit to 0.750V
			11	Set external MOSFET overcurrent limit to 1.000V
GET_CFG_0	1		10000010 (82H)	Get Configuration Register 0
SET_CFG_1	1		10000011 (83H)	Set Configuration Register 1 DAC motor current limit reference voltage
	2	7:0	00H – FFH	Select DAC Current Reference value (4.503V - 0.991V)/ 255 = 13.77 mV/bit 00H = 0.991 volts 40H = 1.872 volts (40H x 0.1377 mV/bit + 0.991V) (Default) FFH = 4.503 volts (FFH x 0.1377 mV/bit + 0.991V)
GET_CFG_1	1		10000100 (84H)	Get Configuration Register 1 Get DAC motor current limit reference voltage
SET_CFG_2	1		10000111 (87H)	Set Configuration Register 2
	2	7:5	00H	Reserved
		4:2	—	Driver Dead Time (For PWMH /PWML inputs)
			000	2000 ns (Default)
			001	1750 ns
			010	1500 ns
			011	1250 ns
			100	1000 ns
			101	750 ns
			110	500 ns
			111	250 ns
		1:0	—	Driver blanking time (ignore switching current spikes)
			00	4 µs (Default)
			01	2 µs
			10	1 µs
			11	500 ns
GET_CFG_2	1		10001000 (88H)	Get Configuration Register 2

2.3.7 MCP8025 Configuration Message Responses

Table 2-7 describes the messages sent to host in response to a host command message.

TABLE 2-7: CONFIGURATION MESSAGE RESPONSES

MESSAGE	BYTE	BIT	VALUE	DESCRIPTION
SET_CFG_0	1	7:0	00000001 (01H)	Set Configuration Register 0 Not Acknowledged (Response)
			01000001 (41H)	Set Configuration Register 0 Acknowledged (Response)
	2	7	0	Reserved
		6	—	(Ignored in SLEEP mode)
			0	Enable disconnect of 30 kΩ LIN Bus pull up when CE = 0 (Default)
			1	Disable disconnect of 30 kΩ LIN Bus pull up when CE = 0
		5	0	System enters Standby mode when CE = 0
			1	System enters Sleep mode when CE = 0, 30 kΩ LIN disconnect always enabled
		4	0	Internal neutral simulator disabled (Startup Default)
			1	Internal neutral simulator enabled
		3	0 1	Undervoltage Lockout enabled (Default) Undervoltage Lockout disabled
		2	0	External MOSFET overcurrent detection enabled (Default)
			1	External MOSFET overcurrent detection disabled
		1:0	00	0.250V external MOSFET overcurrent limit (Default)
			01	0.500V external MOSFET overcurrent limit
			10	0.750V external MOSFET overcurrent limit
			11	1.000V external MOSFET overcurrent limit
GET_CFG_0	1	7:0	00000010 (02H)	Get Configuration Register 0 Response Not Acknowledged (Response)
			01000010 (42H)	Get Configuration Register 0 Response Acknowledged (Response)
	2	7	0	Reserved
		6	—	(Ignored in SLEEP mode)
			0	Enable disconnect of 30 kΩ LIN Bus pull up when CE = 0 (Default)
			1	Disable disconnect of 30 kΩ LIN Bus pull up when CE = 0
		5	0	System enters Standby mode when CE = 0
			1	System enters Sleep mode when CE = 0, 30 kΩ LIN disconnect always enabled
		4	0	Internal neutral simulator disabled (Startup Default)
			1	Internal neutral simulator enabled
		3	0	Undervoltage Lockout enabled
			1	Undervoltage Lockout disabled
		2	0	External MOSFET overcurrent detection enabled
			1	External MOSFET overcurrent detection disabled
		1:0	00	0.250V external MOSFET overcurrent limit
			01	0.500V external MOSFET overcurrent limit
			10	0.750V external MOSFET overcurrent limit
			11	1.000V external MOSFET overcurrent limit

TABLE 2-7: CONFIGURATION MESSAGE RESPONSES (CONTINUED)

MESSAGE	BYTE	BIT	VALUE	DESCRIPTION
SET_CFG_1	1		00000011 (03H)	Set DAC Motor Current Limit Reference Voltage Not Acknowledged (Response)
			01000011 (43H)	Set DAC Motor Current Limit Reference Voltage Acknowledged (Response)
	2	7:0	00H – FFH	Current DAC Current Reference value 13.77 mV/bit + 0.991V
GET_CFG_1	1		00000100 (04H)	Get DAC Motor Current Limit Reference Voltage Not Acknowledged (Response)
			01000100 (44H)	Get DAC Motor Current Limit Reference Voltage Acknowledged (Response)
	2	7:0	00H – FFH	Current DAC Current Reference value 13.77 mV/bit + 0.991V
SET_CFG_2	1		00000111 (07H)	Set Configuration Register 2 Not Acknowledged (Response)
			01000111 (47H)	Set Configuration Register 2 Acknowledged (Response)
	2	7:5	00H	Reserved
		4:2	—	Driver Dead Time (For PWMH /PWML inputs)
			000	2000 ns (Default)
			001	1750 ns
			010	1500 ns
			011	1250 ns
			100	1000 ns
			101	750 ns
			110	500 ns
			111	250 ns
		1:0	—	Driver Blanking Time (ignore switching current spikes)
			00	4 µs (Default)
			01	2 µs
			10	1 µs
			11	500 ns
GET_CFG_2	1		00001000 (08H)	Get Configuration Register 2 Response Not Acknowledged (Response)
			01001000 (48H)	Get Configuration Register 2 Response Acknowledged (Response)
	2	7:5	00H	Reserved
		4:2	—	Driver Dead Time (For PWMH /PWML inputs)
			000	2000 ns (Default)
			001	1750 ns
			010	1500 ns
			011	1250 ns
			100	1000 ns
			101	750 ns
			110	500 ns
			111	250 ns
		1:0	—	Driver Blanking Time (ignore switching current spikes)
			00	4 µs (Default)
			01	2 µs
			10	1 µs
			11	500 ns

2.3.8 MCP8025 Status Messages

The host may also solicit MCP8025 status information by issuing a STATUS_0 or STATUS_1 command. The MCP8025 may send an unsolicited STATUS_0 or STATUS_1 command to the host in the event of a fault or warming. The status messages are listed in Table 2-8.

TABLE 2-8: STATUS MESSAGES

Command	Byte	Bit	Value	Description
STATUS_0	1	7:0	00000101 (05H)	Status Register 0 Response Not Acknowledged (Response)
			01000101 (45H)	Status Register 0 Response Acknowledged (Response)
			10000101 (85H)	Status Register 0 Command To Host (Unsolicited)
	2	7:0	00000000	Normal operation
			00000001	Temperature warning (T_J > 72% T_{SD_MIN} = 115°C) (Default)
			00000010	Overtemperature (T_J > 160°C)
			00000100	Input undervoltage (V_{DD} < 5.5V)
			00001000	Driver input overvoltage (20V < V_{DDH} < 32V)
			00010000	Input overvoltage (V_{DD} > 32V)
			00100000	Buck regulator overcurrent
			01000000	Buck regulator output undervoltage warning
			10000000	Buck regulator output undervoltage (< 80%,brown-out error)
STATUS_1	1	7:0	00000110 (06H)	STATUS Register 1 Response Not Acknowledged (Response)
			01000110 (46H)	STATUS Register 1 Response Acknowledged (Response)
			10000110 (86H)	STATUS Register 1 Command To Host (Unsolicited)
	2	7:0	00000000	Normal operation
			00000001	Reserved
			00000010	Reserved
			00000100	External MOSFET Undervoltage Lock Out (UVLO)
			00001000	External MOSFET overcurrent detection
			00010000	Brown-out Reset – Config Lost (start-up default = 1)
			00100000	5V LDO Under Voltage Lock Out (UVLO)
			01000000	Reserved
			10000000	Reserved

2.3.9 MCP8025 Register Definitions

The MCP8025 registers contain the bits operated on by the messaging system. The registers are only accessible via the various messages. The registers are listed on the following pages.

REGISTER 2-1: CFG0: CONFIGURATION REGISTER 0

U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	PU30K	SLEEP	NEUSIM	EXTUVLO	EXTSC	EXTOC1	EXTOC0
bit 7							bit 0

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
- n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 7 **Unimplemented**: Read as '0'

bit 6 **PU30K**: 30 kΩ level translator pull up
1 = Disable disconnect of 30 kΩ LIN pull up when CE = 0
0 = Enable disconnect of 30 kΩ LIN pull up when CE = 0

bit 5 **SLEEP**: Sleep mode bit
Bit may only be changed while in Standby mode
1 = System enters Sleep Mode when CE = 0. Disconnect of 30 kΩ LIN pull up always enabled.
0 = System enters Standby Mode when CE = 0

bit 4 **NEUSIM**: Neutral simulator
1 = Enable internal neutral simulator
0 = Disable internal neutral simulator

bit 3 **EXTUVLO**: External MOSFET Undervoltage Lockout
1 = Disable
0 = Enable

bit 2 **EXTSC**: External MOSFET short circuit detection
1 = Disable
0 = Enable

bit 1-0 **EXTOC<1:0>**: External MOSFET overcurrent limit value
00 = Overcurrent limit set to 0.250V
01 = Overcurrent limit set to 0.500V
10 = Overcurrent limit set to 0.750V
11 = Overcurrent limit set to 1.000V

REGISTER 2-2: CFG1: CONFIGURATION REGISTER 1

R/W-0	R/W-1	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
DACREF7	DACREF6	DACREF5	DACREF4	DACREF3	DACREF2	DACREF1	DACREF0
bit 7							bit 0

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
- n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 7-0 **DACREF<7:0>**: DAC current reference value
(4.503V - 0.991V)/255 = 13.77 mV/bit
00H = 0.991V
40H = 1.872V (40H × 0.1377 mV/bit + 0.991V)
FFH = 4.503V (FFH × 0.1377 mV/bit + 0.991V)