DM160232
Serial Memory Single-Wire
Evaluation Kit User's Guide

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- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.

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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 website (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 DM160232 Serial Memory Single-Wire Evaluation Kit. Items discussed in this chapter include:

- Document Layout
- Conventions Used in This Guide
- Recommended Reading
- The Microchip Website
- Customer Support
- Revision History

DOCUMENT LAYOUT

This document describes how to use the DM160232 Serial Memory Single-Wire Evaluation Kit as a tool to demonstrate the best in class features, functionality, and low-power operation of the AT21CS Series single-wire Serial EEPROM devices. The document is organized as follows:

- **Chapter 1. "Product Overview"**
- **Chapter 2. "Installation and Operation"**
- **Chapter 3. "Graphical User Interface (GUI)"**
- **Chapter 4. "USB Base Board Firmware Upgrade"**
- **Chapter 5. "Troubleshooting Guide"**
- **Appendix A. "Schematics"**
- **Appendix B. "Bill of Materials (BOM)"**

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 DM160232 Serial Memory Single-Wire Evaluation Kit. The following documents are available and recommended as supplemental reference resources.

- **Serial Memory Single-Wire Quick Start Guide – "***Serial Memory Single-Wire Evaluation Kit Quick Start Guide***" (DS20005780)** – This quick start guide provides a brief overview on the DM160232 Evaluation Kit's functionalities, features and capabilities.
- **AT21CS01/AT21CS11 Data Sheet – "***Single-Wire, I/O Powered 1-Kbit (128 x 8) Serial EEPROM with a Unique, Factory-Programmed 64-Bit Serial Number***" (DS200005857)** – This document provides all the necessary information on the AT21CS01/AT21CS11 Serial EEPROM single-wire devices including features, general description, device operation, specifications and ordering information.
- **AN8976 – "***AT21CS Series Reset and Discovery***"** – This document provides information on the AT21CS Series Reset function and the AT21CS Series Discovery function. Additionally, a comparison between the Single-Wire Interface (SWI) Discovery event and the Maxim/Dallas One-Wire Discovery event is discussed to facilitate the understanding of which device type is on the bus.

THE MICROCHIP WEBSITE

Microchip provides online support via our website at www.microchip.com. This website is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the website contains the following information:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **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.

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 website at:

http://www.microchip.com/support.

REVISION HISTORY

Revision A (02/2018)

- Initial release of this document.

Chapter 1. Product Overview

1.1 INTRODUCTION

Microchip Technology's DM160232 Serial Memory Single-Wire Evaluation Kit allows the user to read, write and verify the AT21CS Series Serial EEPROM devices using the single-wire bus protocol.

This chapter introduces the DM160232 Serial Memory Single-Wire Evaluation Kit and provides an overview of its features. Topics covered include:

• AT21CS Series Device Overview
• DM160232 Evaluation Kit Overview
• DM160232 Evaluation Kit Contents
• Supported Devices

1.2 AT21CS SERIES DEVICE OVERVIEW

The AT21CS Series is a family of Serial Electrically Erasable and Programmable Read-Only Memory (EEPROM) that utilizes the Single-Wire Interface (SWI) protocol.

The family software addressing scheme allows up to eight devices to share a common single-wire bus. The device is optimized for use in many industrial and commercial applications where low-power and low-voltage operation are essential. Some applications examples include analog sensor calibration data storage, ink and toner printer cartridge identification, and management of after-market consumables. The family is available in space-saving package options and operates with an external pull-up voltage on the SI/O line.

1.3 DM160232 EVALUATION KIT OVERVIEW

The Serial Memory Single-Wire Evaluation Kit (DM160232) is an easy-to-use interactive user tool to demonstrate the best in class features, functionality and low-power operation of the AT21CS Series Serial EEPROM devices. The evaluation kit is for engineers, developers and decision makers to allow for fast system prototyping using the Single-Wire Interface (SWI) protocol. The Serial Memory Single-Wire Evaluation Kit includes a Graphical User Interface (GUI) which allows the user to configure, demonstrate and personalize the single-wire Serial EEPROM device.

1.4 EVALUATION KIT CONTENTS

The Serial Memory Single-Wire Evaluation Kit includes the following:

- SWI Socket Board (02-10681) (Figure 1-1)
- USB Base Board (02-10682) (Figure 1-2)
- Five AT21CS01-STUM10-T devices, with one installed in the SWI Socket Board's SOT23 socket
- Important Information Sheet

FIGURE 1-1:   **SWI SOCKET BOARD (02-10681)**
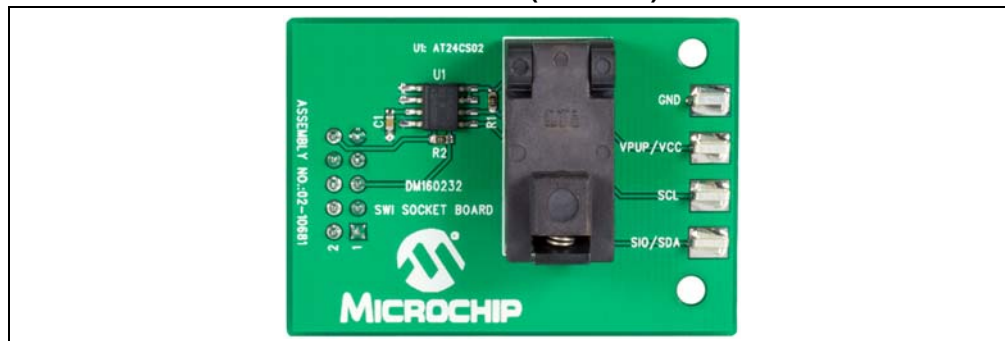
FIGURE 1-2:   **USB BASE BOARD (02-10682)**
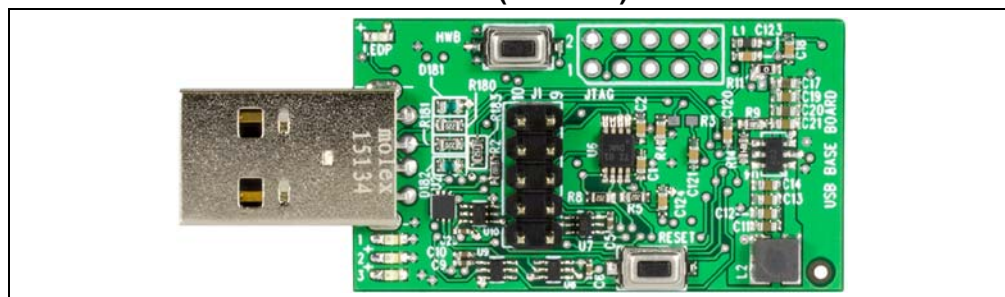
1.5 SUPPORTED DEVICES

The following table indicates the supported devices for the DM160232 Serial Memory Single-Wire Evaluation Kit.

TABLE 1-1:   **SUPPORTED DEVICES**

Device	Protocol	Package Type	Voltage Range	Communication Speed
AT21CS01-STUM##-T	Single-Wire	3-lead SOT23	1.7V-3.6V	15.4 or 125 kbps

Note: ## indicates one of eight slave address combinations. Please see the corresponding device data sheet for more information about these slave address combinations.

1.6 OPERATIONAL REQUIREMENTS

For the Serial Memory Single-Wire Evaluation Kit to function properly, the following hardware and software requirements must be met:

- PC compatible system
- An available USB port on PC
- At least 1.8 MB of free disk space
- Windows® 7 or higher operating systems[1]

Note 1: Testing has been performed on a 64-bit Windows® 7 operating system.

DM160232 SERIAL MEMORY SINGLE-WIRE EVALUATION KIT USER'S GUIDE

Chapter 2. Installation and Operation

2.1 INTRODUCTION

Setup for the Serial Memory Single-Wire Evaluation Kit is straightforward. To start, both the USB Base Board driver and the SWI Graphical User Interface (GUI) will need to be downloaded and installed on the user's PC. Once both are installed, the user should perform a simple hardware setup sequence. Once completed, simply plug in the USB Base Board to an available USB port on the user's PC and launch the SWI GUI.

WARNING

Read the DM160232 Serial Memory Single-Wire Evaluation Kit User's Guide (this document) fully before proceeding to evaluation kit setup.

2.2 INSTALLING THE USB BASE BOARD DRIVER

The following steps are needed to successfully install the USB Base Board driver:
1. Go to http://www.microchip.com/DM160232 to download the USB Base Board driver.
2. Navigate to Documentation and Software and select the *USB Base Board Driver*.
3. Download and open the setup file indicated below.
   `driver-atmel-bundle-7.0.888.exe`
4. If the Open File – Security Warning pops up, press the **Run** button.
5. Once prompted, read the license terms and conditions. When ready, click the checkbox and press the **Install** button (Figure 2-1).

Note: If prompted, allow the program to make changes to your PC.

FIGURE 2-1: LICENSE TERMS AND CONDITIONS

"I Agree" checkbox / Install button
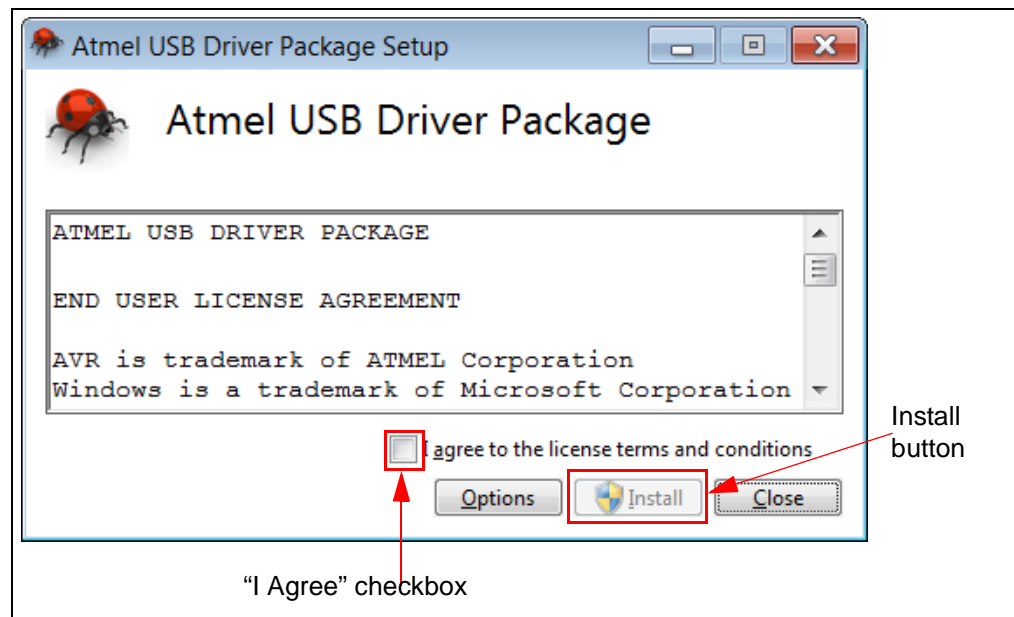
6. Let the program setup the driver. A progress or status bar is included to show the overall progress of the installation. Once completed, press the **Close** button to complete the USB Base Board driver installation (Figure 2-2).

FIGURE 2-2: USB DRIVER INSTALLATION COMPLETE

Close button
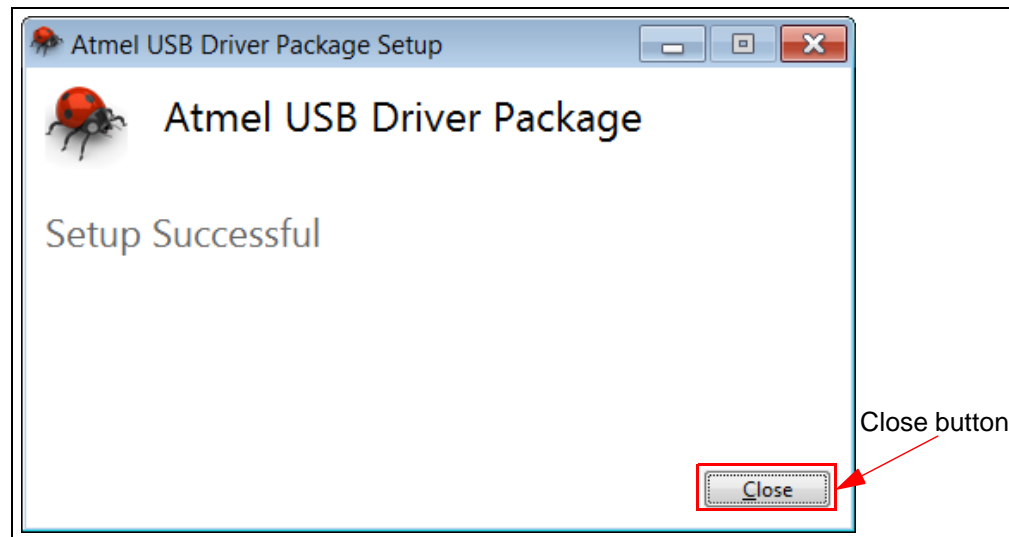
2.3 INSTALLING THE GRAPHICAL USER INTERFACE (GUI)

The following steps are needed to successfully install the GUI software:

> **Note:** If an earlier version of the DM160232 SWI Evaluation Kit GUI was previously installed, it is recommended to uninstall the previous version before installing the new version. This will ensure robust GUI operation.

1. Go to http://www.microchip.com/DM160232 to download the GUI software.
2. Navigate to Documentation and Software and select the *DM160232 SWI Evaluation Kit GUI* software.
3. Download and open the setup file: `DM160232_x.x.x_setup.exe`, where `x.x.x` indicates the GUI version.
4. If the Open File – Security Warning pops up, press the **Run** button.

> **Note:** If prompted, allow the program to make changes to your PC.

5. Select the Installation Destination Location from the Graphical User Interface (GUI). Press the **Next** button when ready (Figure 2-3). The default Destination Location is:

   `C:\Program Files (x86)\Microchip\Serial Memory Evaluation Kits\Single-Wire`.

> **Note:** When referring to location of files on the user's PC, this document is assuming that the default installation was used when the GUI was installed. If the default installation is not used, it is the user's responsibility to determine the reference file location.

FIGURE 2-3:   **GUI INSTALLATION LOCATION**
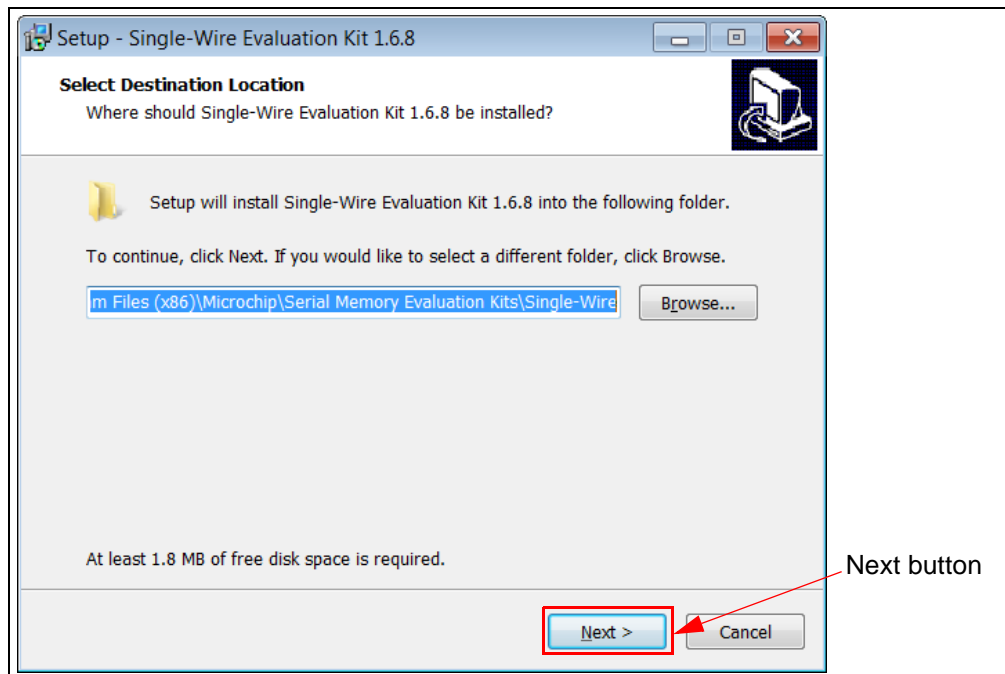
6. The next step is to select the Start Menu folder. By default, the setup will create a Start Menu folder named *Microchip* if one is not already present on the user's PC. Press the **Next** button when ready to continue (Figure 2-4).

FIGURE 2-4:   **GUI START MENU FOLDER**
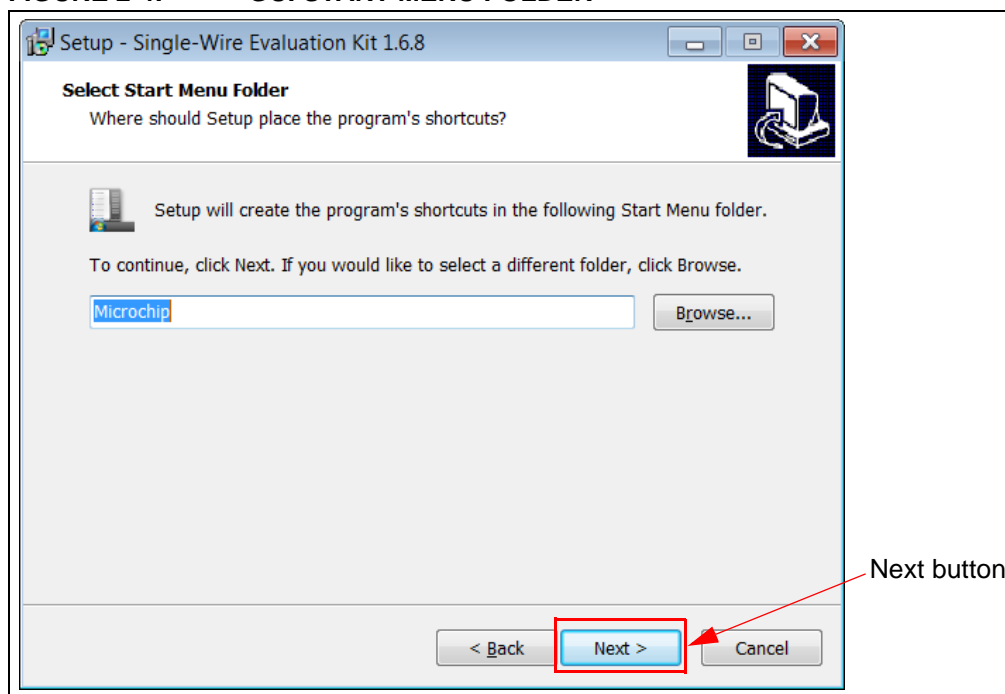
7. Once the Destination location and the Start Menu folder have been selected, the setup will prompt the user if they are ready to install the software. Press the **Install** button when ready (Figure 2-5).

FIGURE 2-5: **GUI READY TO INSTALL**
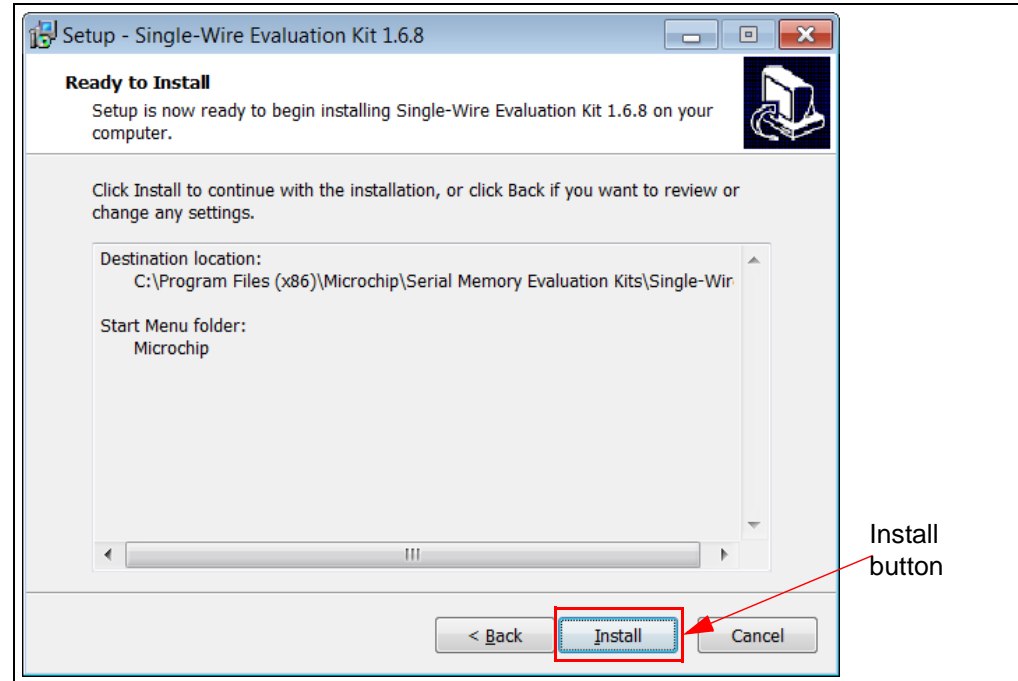
8. Let the program setup the SWI GUI. A progress or status bar is included to show the overall progress of the installation. Once completed, press the **Finish** button to complete the SWI GUI installation (Figure 2-6).

FIGURE 2-6: **GUI INSTALLATION COMPLETE**
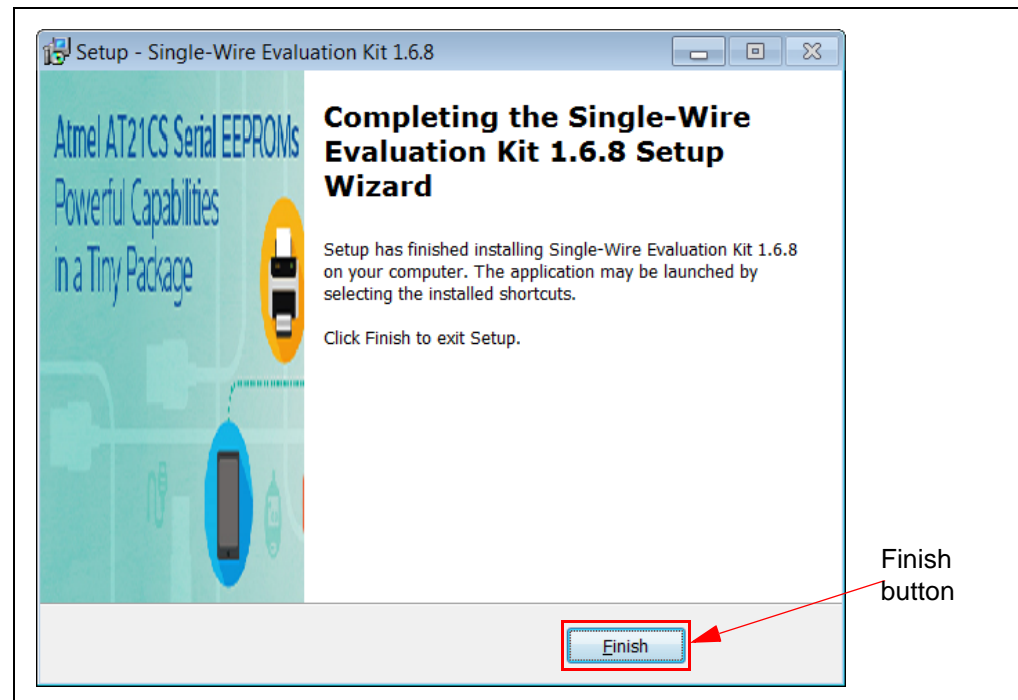
2.4   EVALUATION KIT SETUP PROCEDURE

In order to start using the evaluation kit, simply plug the SWI Socket Board into the USB Base Board using the H1 and J1 headers. See Figure 2-7 for illustration.

FIGURE 2-7:   DM160232 USB BASE BOARD AND SWI SOCKET BOARD
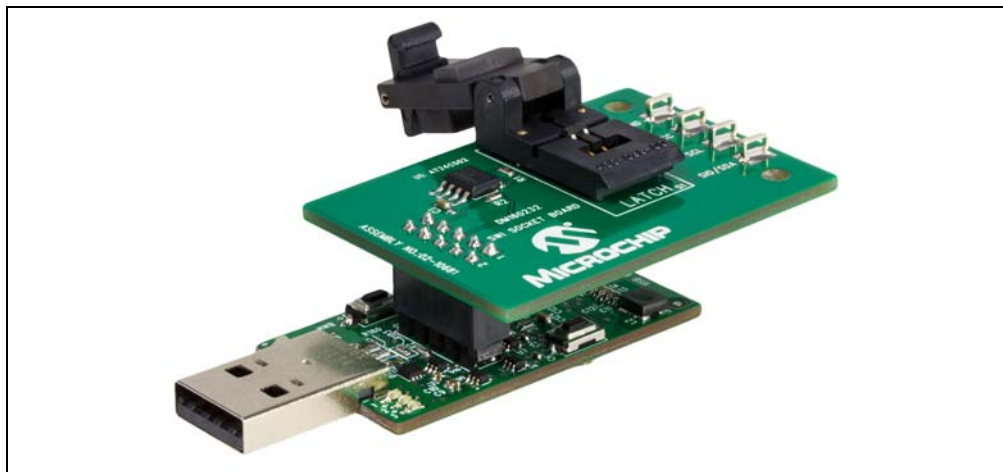
Once both the boards are connected, verify that there is a device correctly installed in the SOT23 socket on the SWI Socket Board. If there is not a device installed, the user must install a device from the supported device list into the SOT23 socket. To ensure robust GUI and hardware operation, it is recommended that when installing a supported device, the USB Base Board be disconnected from the user's PC.

> **Note:**   Due to the small size of the 3-lead SOT23 package, it is recommended to use tweezers in order to properly install the supported device into the SWI Socket Board socket.

Figure 2-8 illustrates a supported device which is properly seated in the SOT23 socket. Once the device is seated properly, close the socket lid to finish installing the supported device.

FIGURE 2-8:   SUPPORTED DEVICE IN SOT23 SOCKET

Device properly seated in SOT23 socket
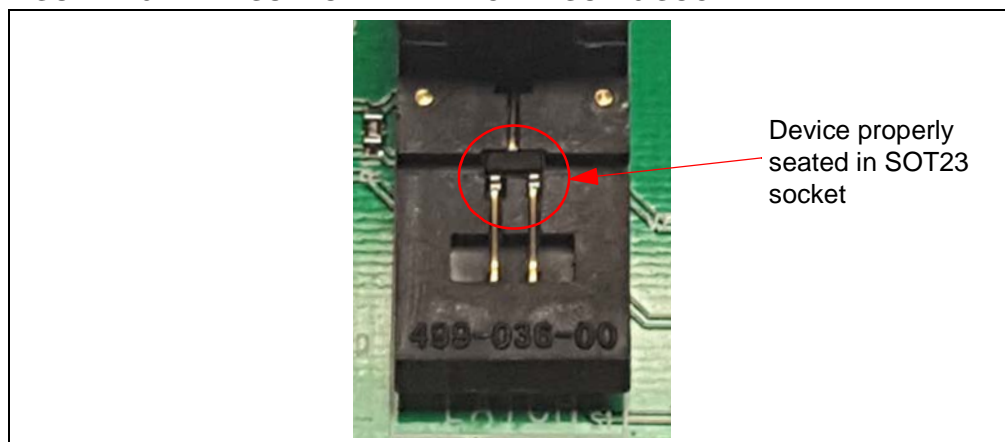
Once a supported device is installed in the SOT23 socket, the user can then plug in the USB Base Board into one of their computer's USB ports. Once the USB Base Board enumerates on the user's PC, open the GUI by selecting either the desktop icon (SWI GUI) or navigating to the Start Menu folder that was created when the DM160232 SWI Evaluation Kit GUI software was installed.

NOTES:

Chapter 3. Graphical User Interface (GUI)

3.1 INTRODUCTION

The Serial Memory Single-Wire Evaluation Kit includes a Graphical User Interface (GUI) which is used as an interface between the user's PC and the evaluation kit hardware. The GUI allows the user to easily interact with the single-wire Serial EEPROM using built-in read and write features. The GUI also highlights the value-added features of the installed supported device. In the subsequent sections, the GUI features and functions are explained in detail to help the user to interact with the installed single-wire Serial EEPROM.

The GUI version and USB Base Board firmware version must match in order to use the GUI. If the GUI and USB Base Board versions do not match and the USB Base Board has an earlier version programmed, perform a USB Base Board device firmware upgrade using the GUI version. Refer to the **Chapter 4. "USB Base Board Firmware Upgrade"** for details on the firmware upgrade process. If the GUI version is earlier than the USB Base Board, download the latest version of the GUI (refer to **Section 2.3 "Installing the Graphical User Interface (GUI)"** for additional information).

FIGURE 3-1: **GRAPHICAL USER INTERFACE**
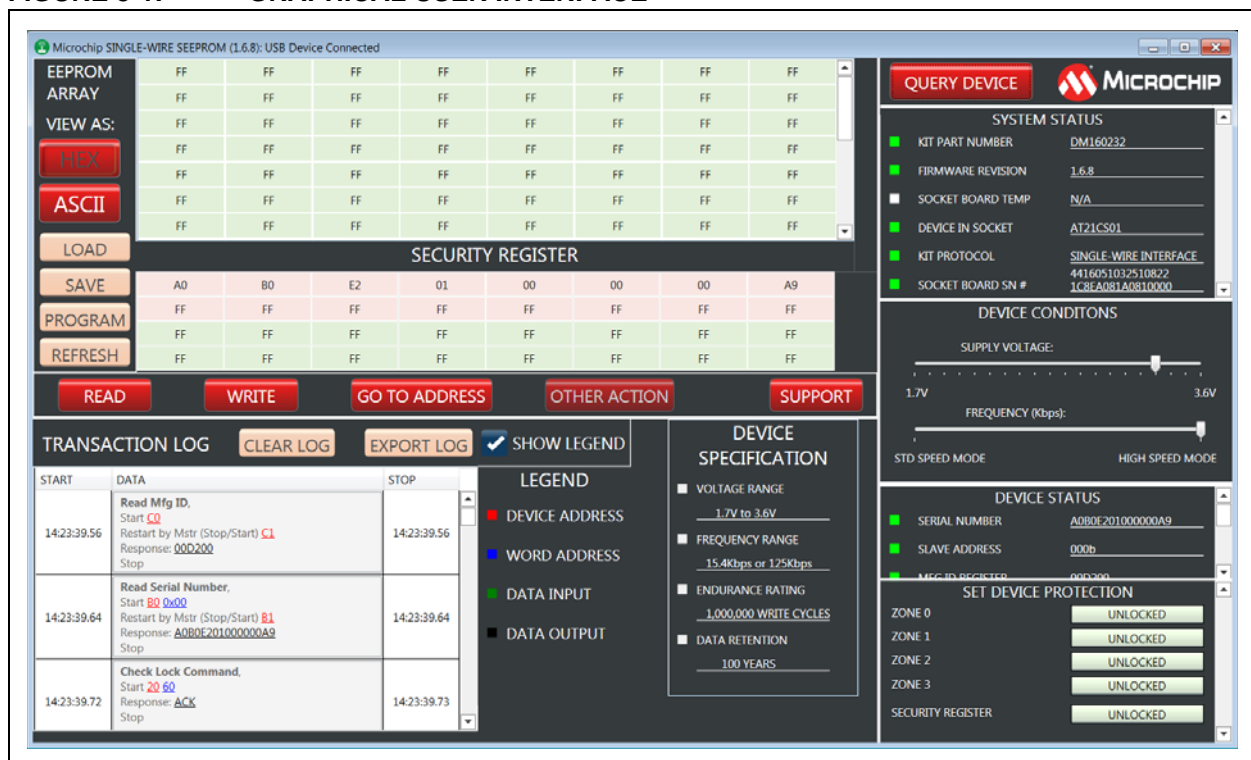
3.2   MAIN TITLE BAR

The title bar displays the GUI version and the USB Base Board connection status. Figure 3-2, shown below, illustrates a GUI version of 1.6.8.

FIGURE 3-2:   TITLE BAR

Microchip SINGLE-WIRE SEEPROM (1.6.8): USB Device Connected
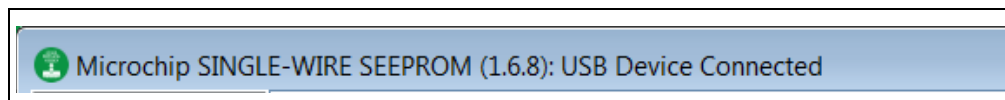
3.3   QUERY DEVICE

The GUI will perform an auto-query when the GUI is launched or when the USB Base Board is initially connected to the PC. Afterwards, the user can initiate a device query at any time with the **QUERY DEVICE** button (Figure 3-3). The Device Query feature utilizes the Single-Wire Interface (SWI) Reset and Discovery Response feature in order to determine whether the supported device was installed properly. Querying the device will populate or re-populate the GUI with the content read from the installed device.

FIGURE 3-3:   QUERY DEVICE

Query Device button

QUERY DEVICE   MICROCHIP

FIGURE 3-4:   DEVICE QUERY PROGRESS BAR

KIT DETECTION: DM160232

QUERYING DEVICE
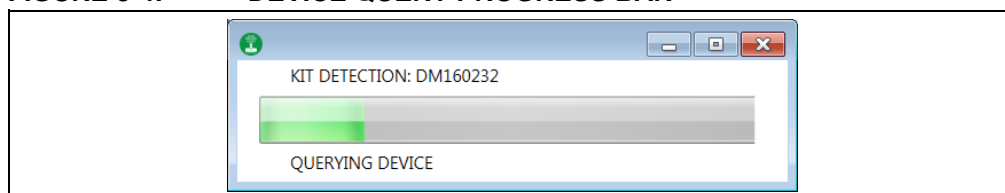
3.4   SYSTEM STATUS

The System Status pane is populated with information related to the evaluation kit hardware. These include the "Kit Part Number", "Firmware Revision", the installed supported device or "Device In Socket", the "Kit Protocol", and the "Socket Board Sn #" (serial number).

FIGURE 3-5:   SYSTEM STATUS PANE

SYSTEM STATUS	
KIT PART NUMBER	DM160232
FIRMWARE REVISION	1.6.8
SOCKET BOARD TEMP	N/A
DEVICE IN SOCKET	AT21CS01
KIT PROTOCOL	SINGLE-WIRE INTERFACE
SOCKET BOARD SN #	4416051032510822 1C8EA081A0810000

3.4.1   Kit Part Number

This displays the evaluation kit part number.

3.4.2 Firmware Revision

This is the version of the firmware programmed in the USB Base Board.

3.4.3 Socket Board Temp

This is not utilized in the DM160232 Serial Memory Single-Wire Evaluation Kit.

3.4.4 Device in Socket

The GUI identifies the installed supported device by reading the Manufacturer ID register of the installed device.

3.4.5 Kit Protocol

Identifies the communication protocol used by the evaluation kit's socket board.

3.4.6 Socket Board SN

The SWI Socket Board serial number is retrieved from the AT24CS02 serialized Serial EEPROM located on the SWI Socket Board. Every SWI Socket Board will have its own unique serial number.

3.5 DEVICE CONDITIONS

The Device Conditions pane (Figure 3-6) allows the user to set the supply voltage to the SWI Socket Board and the communication speed or frequency of the Single-Wire Interface (SWI) protocol.

FIGURE 3-6:   DEVICE CONDITIONS PANE
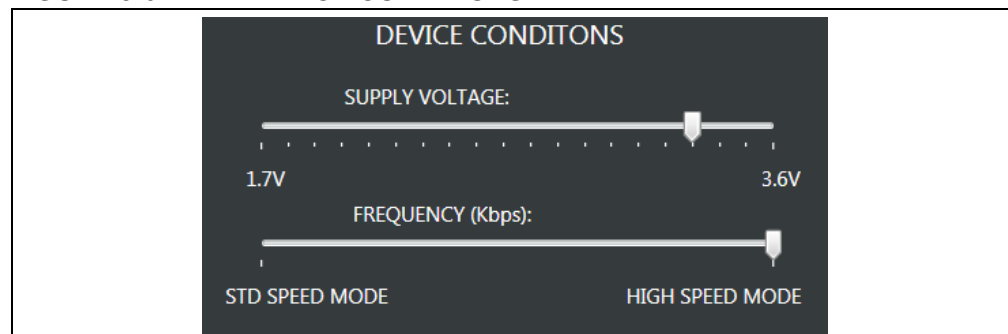
3.5.1 Supply Voltage Slider

The voltage slider provides the ability to change the supply voltage to the SWI Socket Board along with the installed device V_{PUP} voltage. The V_{PUP} refers to the voltage used to pull up the SI/O line. The user can change the V_{PUP} by either clicking along the slider or dragging the indicator to the desired V_{PUP}. The upper and lower limits of the V_{PUP} are determined by the installed device specification. Because the supply voltage is common between every device on the SWI Socket Board, a test point is included to measure V_{PUP} to the installed device and V_{CC} supply to the AT24CS02. Whenever the GUI is initially started, the voltage slider will default to 3.3V to ensure the installed supported device has sufficient V_{PUP} to communicate.

3.5.2   Frequency (Kbps) Slider

The frequency slider provides the ability to change the I/O or communication speed between the host controller (USB Base Board) and the installed device. The user can change the I/O speed by either clicking along the slider or dragging the indicator to the desired I/O speed. The upper and lower frequency limits of the frequency slider are determined by the installed device specification. Whenever the GUI is initially started, the frequency slider will default to High-Speed mode to ensure the installed supported device is able to communicate with the host controller.

> **Note:** The Device Query feature communicates with the Serial EEPROM using High-Speed mode. Therefore, whenever the Device Query feature is used, it will revert the installed device back to High-Speed mode regardless of the current frequency slider setting.

3.6   DEVICE STATUS

The Device Status pane shows various Serial EEPROM device features including the serial number, the device slave address, the Manufacturer (MFG) ID register, the lock state of the Security register, and the lock state of the memory zones (Zone 0 -Zone 3) (Figure 3-7).

FIGURE 3-7:   **DEVICE STATUS PANE**

3.6.1   Serial Number

Displays the serial number read from the Security register of the installed supported device. The serial number is displayed in hexadecimal.

3.6.2   Slave Address

Displays the preprogrammed device slave address of the installed device. The slave address is populated with A2 bit first, A1 bit second, and A0 bit last. The slave address is displayed in binary.

3.6.3   MFG ID Register

Reports the content of the installed device's Manufacturer ID register. The data is displayed in hexadecimal.

3.6.4   Security Register User Space

Displays the lock state of the Security register. If the register is not locked, UNLOCKED is displayed. If the register is locked, LOCKED is displayed.

3.6.5   Zone X Lock State

Displays the lock state for the respective memory zones (Zone 0 through Zone 3). If the zone is not locked, UNLOCKED is displayed. If the zone is locked, LOCKED is displayed.

3.7   SET DEVICE PROTECTION

The Set Device Protection pane (Figure 3-8) allows the user to independently lock the four memory zones and the Security register based on the user's preference. The user locks a zone or the Security register by pressing the button to the right of that memory region. The button also indicates the current lock status of that zone or the Security register and the button shading is based on the current lock status. Once a button is pressed, a warning message is displayed to make sure the user intends to lock that zone or the Security register.

Note: Once the Security register or a memory zone is locked, it cannot be unlocked and is permanently set to ROM (Read-Only-Memory).

FIGURE 3-8:   **SET DEVICE PROTECTION PANE**

3.8   DEVICE SPECIFICATION

The Device Specification pane (Figure 3-9) displays key device parameters, which can be found in the installed device's data sheet. These parameters include "Voltage Range", "Frequency Range", "Endurance Rating", and "Data Retention".

FIGURE 3-9:   **DEVICE SPECIFICATION PANE**
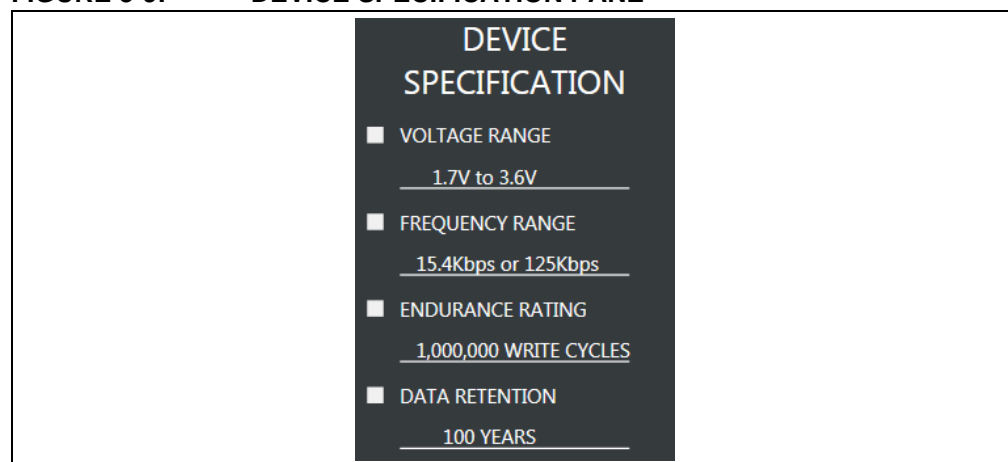
3.9   TRANSACTION LOG

The Transaction Log records all single-wire communication with the installed device as well as highlights the communication protocol according to the legend. The Transaction Log reports the data on the single-wire bus in hexadecimal. The Transaction Log can be used in conjunction with an oscilloscope connected to the SI/O and GND test points to help the user decode the captured protocol.

> **Note:** The Transaction Log does not capture the Reset and Discovery Response sent to the installed device. The Reset and Discovery Response can be observed by performing a device query while monitoring an oscilloscope connected to the SI/O and GND test points.

FIGURE 3-10:   TRANSACTION LOG
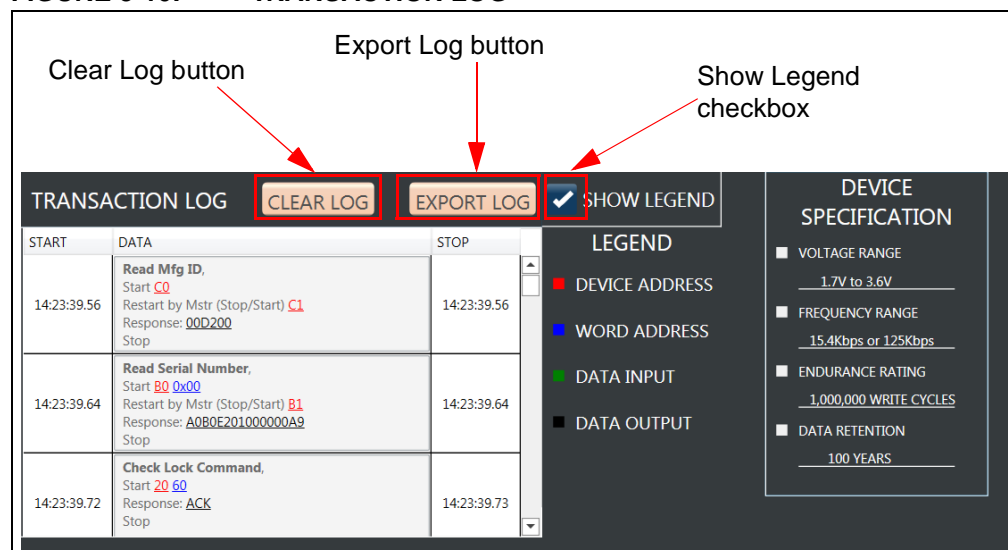
3.9.1   Clear Log

The **CLEAR LOG** button clears the Transaction Log. The Clear Log function is helpful when the user wants to look at a specific type or group of single-wire protocol.

3.9.2   Export Log

The **EXPORT LOG** button exports the Transaction Log in HTML format. The exported Transaction Log can be used as a reference without having to resend protocol to the installed device.

3.9.3   Legend

The Transaction Log legend highlights the different data bytes in the single-wire protocol that is being sent/received; the device address byte is shown in *red*, the word address byte is shown in *blue*, data input byte(s) is shown in *green*, and data output byte(s) or the response is shown in *black*. The Show Legend function can either show or hide the Transaction Log legend.

3.10 GUI MEMORY ARRAY

The GUI memory array is initially populated with the data read from the installed Serial EEPROM. The data of the GUI memory array is organized in 8-byte rows, left to right, and in ascending order. The GUI memory array will always be displayed in 8-byte row lengths regardless of the installed device's page size. The GUI memory array data can be modified by the user by using various GUI features which are outlined in the subsequent sections.

The GUI memory array features memory cell shading that is used to highlight the different state of that memory cell or cells. *Green* shading indicates that the cell or cells have not been locked and the user can write to that word address or range of word addresses. *Red* shading indicates that cell or cells have been locked and now functions as Read-Only-Memory (ROM). *Yellow* shading indicates that the memory array cell or cells have been changed in the internal GUI buffer and have not been written to the Serial EEPROM (see **Section 3.11.5 "PROGRAM"** for additional information).

FIGURE 3-11: **MEMORY ARRAY**

When the user hovers the mouse cursor over the GUI memory array, a pop-up appears to show the data in *HEX*, data in *ASCII*, *Address*, *Zone: #*, and Zone Protection state of that particular memory cell. This is illustrated in Figure 3-12.

FIGURE 3-12: **ARRAY HOVER**

The user can change the content of a cell by double-clicking a word address or memory cell in the GUI memory array or GUI Security register (see Figure 3-13). In order to change the content of a cell, the user should update the value, followed by pressing the **Update Cell** button. Once the cell is updated, the cell shading will become yellow. This indicates to the user that they must then program the device using the Program Feature (see **Section 3.11.5 "PROGRAM"** for additional information).

FIGURE 3-13:   ARRAY UPDATE CELL
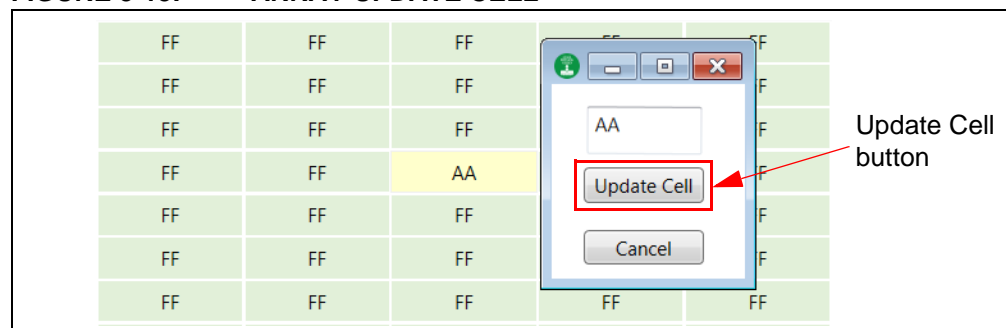
3.11   ARRAY ACTIONS

Array actions allow the user to manipulate the GUI memory array in terms of how the data is displayed (HEX or ASCII) and also allow the user to save the GUI memory array or load a previous array.

FIGURE 3-14:   ARRAY ACTIONS
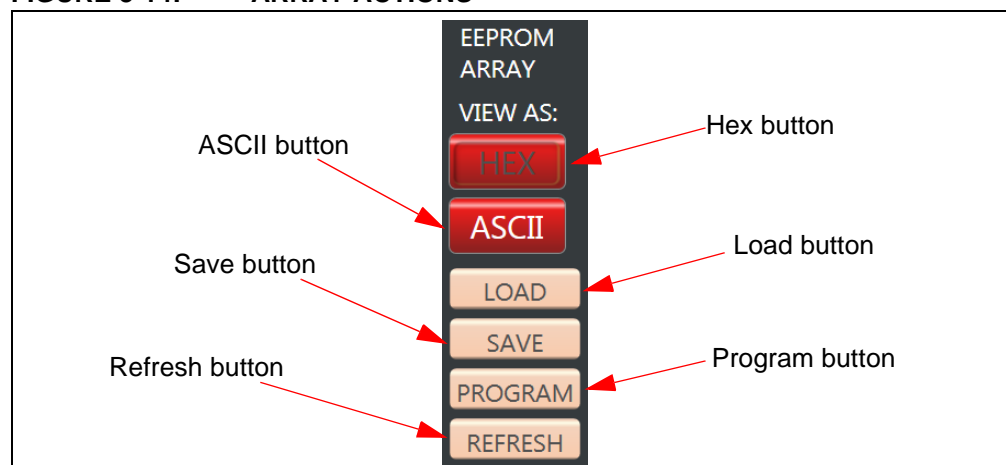
3.11.1   HEX

The **HEX** button displays the GUI memory array in hexadecimal (HEX) format.

3.11.2   ASCII

The **ASCII** button displays the GUI memory array in American Standard Code for Information Interchange (ASCII) format.

3.11.3   LOAD

The **LOAD** button gives the user the option to load a previous saved GUI memory array either HEX (.hex) or TEXT (.txt) file. The file, once loaded, will be used to populate the internal GUI buffer. Once the file is loaded in the GUI array buffer, the user must program the installed device using the **PROGRAM** button (see **Section 3.11.5 "PROGRAM"** for additional information).

> **Note:**   The loaded file must follow a specific format. In order to determine the correct file format, it is recommended to save a GUI memory array as a reference (see **Section 3.11.4 "SAVE"** for additional information) and refer to that file when formatting the data.

FIGURE 3-15: **LOAD**
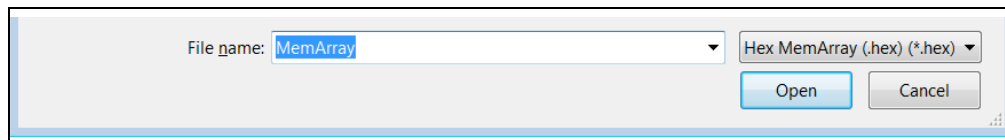
3.11.4 SAVE

The **SAVE** button gives the user the ability to save the current state of the GUI memory array. The GUI memory array can be saved as either a HEX (.hex) file or TEXT (.txt) file based on the user preference. Once a file type is selected, a file explorer will pop up prompting the user to specify the file directory and name of the file.

> **Note:** When using the Save feature, the software will create the data for the saved file based on the internal GUI buffer and not on the actual data from the Serial EEPROM.

FIGURE 3-16: **SAVE**

File type selection buttons
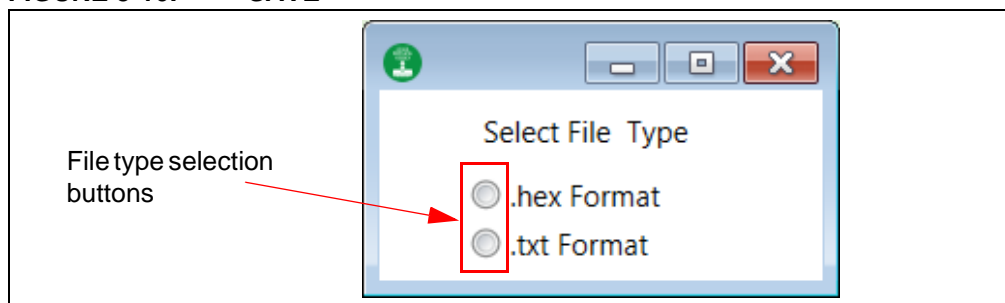
3.11.5 PROGRAM

The Program feature can be used to write to the Serial EEPROM memory array, Security register, lock Zone 0 to Zone 3, and lock the Security register. When the **PROGRAM** button is pressed, the current internal GUI buffer will be written to the Serial EEPROM memory. The Program feature must be used when a cell is updated (*yellow* shaded), or when a file (.hex or .txt) is loaded. If the Program feature is not used, the data in the internal GUI buffer will not be written to the Serial EEPROM.

The Program feature can also be used to lock the four memory zones and/or the Security register. Each zone and the Security register can be locked independently of each other by placing a check mark in the corresponding box.

When the Program feature is used to program the Serial EEPROM memory array or Security register, that entire memory region will be written with the current data in the internal GUI buffer rather than only the changed values. If a specific data byte or bytes are to be programmed, it is recommended to use the Write feature (see **Section 3.13.2 "Write"** for additional information).

> **Note:** By default, the memory array is selected. Therefore, if the user only wants to write the Security register or lock a zone or register, the user must unselect the memory array and select the particular operation to be performed.

FIGURE 3-17: PROGRAM

Write checkboxes

Lock checkboxes
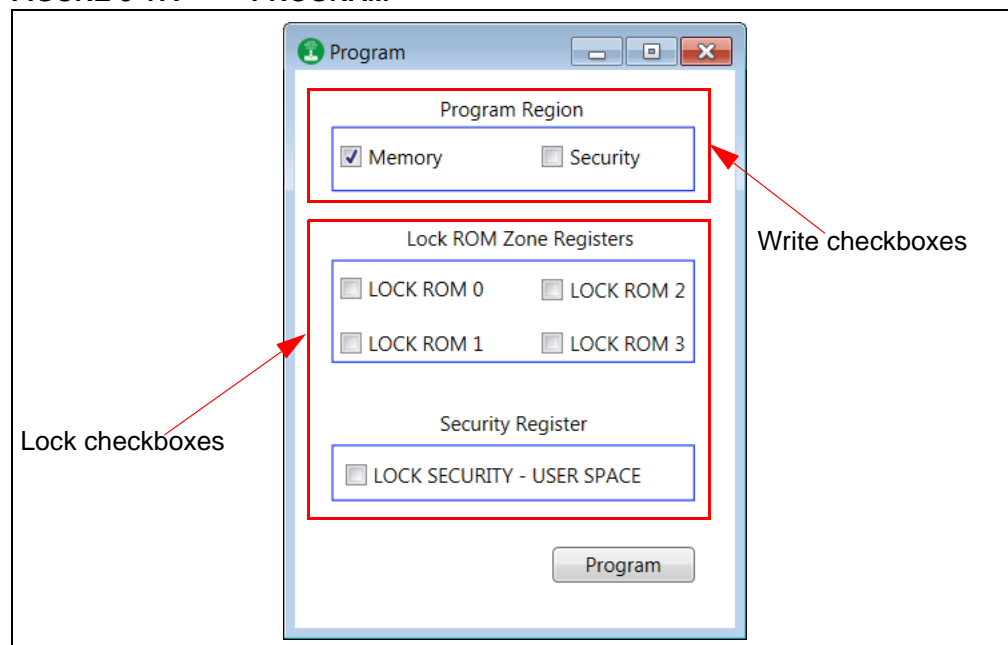
3.11.6 REFRESH

The **REFRESH** button reads the Serial EEPROM memory array and Security register of the installed device and then populates the GUI memory array and Security register with that data. If there is data in the internal GUI buffer (*yellow*-shaded cell) when the Refresh feature is used, that data will be replaced with the data read from the Serial EEPROM. After the completion of any write operation to the Serial EERPOM, the GUI will automatically update the GUI memory array and Security register using the Refresh feature.

Note: If a new device is installed while leaving the USB Base Board connected to the user's PC, it is recommended to use the Device Query feature instead of the Refresh feature to ensure robust GUI operation.

FIGURE 3-18: REFRESH

Refresh status bar
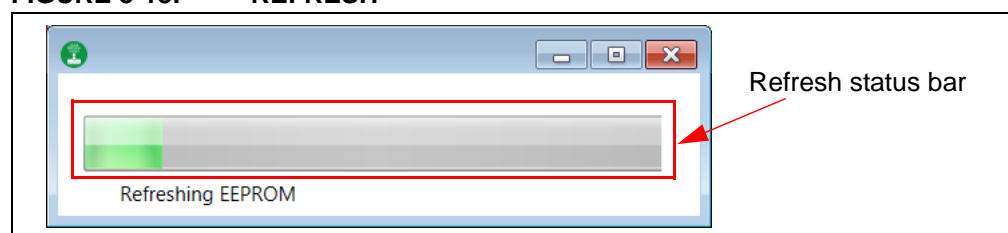
3.12 SECURITY REGISTER

The Security register consists of a factory-programmed unique serial number in the lower 8 bytes (address 0x00h to 0x07h), an 8-byte page that is reserved for future use with data of 0xFFh (address 0x08 to 0x0F), and a writable portion in the upper 16 bytes (address 0x10h to 0x1Fh) of the Security register. The *red*-shaded cells indicate they are locked and cannot be modified by the user; *green*-shaded cells indicate that the cell or cells are unlocked and can be modified by the user; *yellow* shading indicates that the memory array cell or cells have been changed in the internal GUI buffer and have not been written to the Serial EEPROM.

The entire Security register can be locked by either using the Program feature (see **Section 3.11.5 "PROGRAM"**) or using the Set Device Protection pane (see **Section 3.7 "Set Device Protection"**).

> **Note:** Once the Security register has been locked, it cannot be unlocked and is permanently set to ROM (Read-Only-Memory).

FIGURE 3-19: **SECURITY REGISTER**

SECURITY REGISTER							
A0	B0	E2	01	00	00	00	A9
FF	FF	FF	FF	FF	FF	FF	FF
FF	FF	FF	FF	FF	FF	FF	FF
FF	FF	FF	FF	FF	FF	FF	FF

3.13 ARRAY BUTTONS

The array buttons, which are located below the GUI Security register, allow the user to perform read and write operations to the Serial EEPROM, use the Go To Address feature to highlight a specific word address in the GUI memory array, and also provides various support functions.

FIGURE 3-20: **ARRAY BUTTONS**

3.13.1 Read

The Read feature allows the user to read the entire Serial EEPROM memory array, a specific word address or a range of word addresses, the serial number, and/or the Security register of the Serial EEPROM. When the **READ** button is pressed, a pop-up window appears allowing the user to enter details related of the read operation to be performed.

> **Note:** The Read feature will not update the GUI memory array or GUI Security register. To update the GUI, use the Refresh feature (see the **Section 3.11.6 "REFRESH"** for additional information).

The user can input a starting word address using the Memory Address field that the read operation will start at (in hexadecimal), the Read Count or the amount of bytes to be read, and the user can select what read operation is to be performed (*Memory Array*, *Serial Number*, or *Security Register*). Once all the input data has been filled, press the **READ** button to start the read operation. A status message is included at the bottom of the window to notify the user that the read operation is complete by displaying "Successful".

> **Note:** If the user performs a read operation to the Security register or reads the serial number, the GUI will automatically populate the starting memory address for the user stating at the first byte of either the writable portion (upper 16 bytes) of the Security register or the serial number depending on which is selected. The user can change the starting address, but the GUI will limit the word address to the Security register boundaries.

Once the read operation is complete, the data will be displayed in hexadecimal in the Data (Hex) field. The user can perform as many read operations as preferred from this window. For each new read operation, the Data field will be re-written using the data read from the current read operation being performed. Once all read operations are completed, the user can close the window by pressing the red button ([×]) in the top right hand corner of the pop-up window or pressing the **Close** button.

FIGURE 3-21: **READ OPERATION**

3.13.2 Write

The Write feature allows the user to write the entire Serial EEPROM memory array, a specific word address or a range of word addresses, and the writable portion of the Security register. When the **WRITE** button is pressed, a pop-up window appears allowing the user to enter details related to the write operation to be performed.
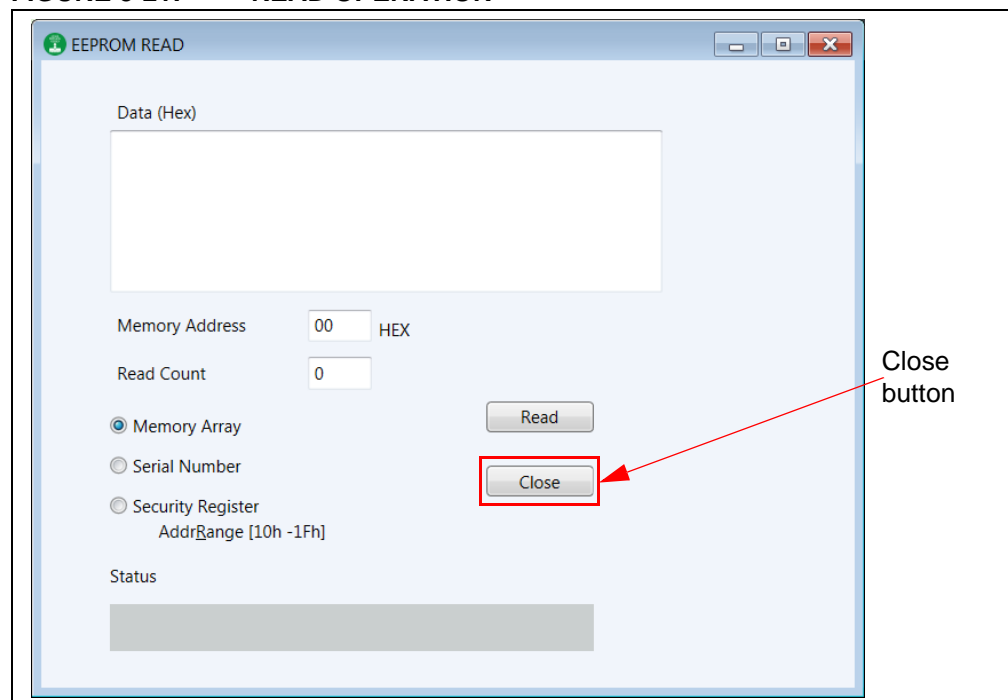
The user inputs the data that is to be written in the Data field (in hexadecimal). The user then selects the starting word address using the Memory Address (hex) field that the write operation will start at (in hexadecimal). The Count, or the number of bytes to be written, is filled automatically based on the amount of data bytes in the "Data" field. The user can also select whether the write operation will occur in the Serial EEPROM memory array or the Security register.

> **Note:** If the user performs a write operation to the Security register, the GUI will automatically populate the memory address for the user stating at the first byte of the writable portion (upper 16 bytes) of the Security register. The user can change the starting word address of the write operation, but the GUI limits the word address to the writable portion (upper 16 bytes) of the Security register.

The GUI limits write operations to the physical device boundary (address of 0x7Fh for the memory array and address of 0x1Fh for the Security register).The write operation will be aborted if the address boundary of that particular memory region is exceeded.

Once all the input data has been input, press the **WRITE** button to start the write operation. A status message is included at the bottom of the window to notify the user that the write operation is complete by displaying "Successful".

> **Note:** Due to the construction of the Serial EEPROM devices, the write operation is limited to the page size or boundary of the installed device. If the "Data" field exceeds the page boundary of the installed device, the GUI will automatically parse the data into the correct page size and perform multiple write operations until the entire data field has been written to the Serial EEPROM.

Once the entire write operation is complete, the user can close the window by pressing the red button (❎) in the top right-hand corner of the pop-up window or pressing the **Close** button. Once either is pressed, a progress bar for the Refresh feature is displayed and the entire GUI memory array and Security register are read and the GUI is updated accordingly.

FIGURE 3-22: **WRITE OPERATION**
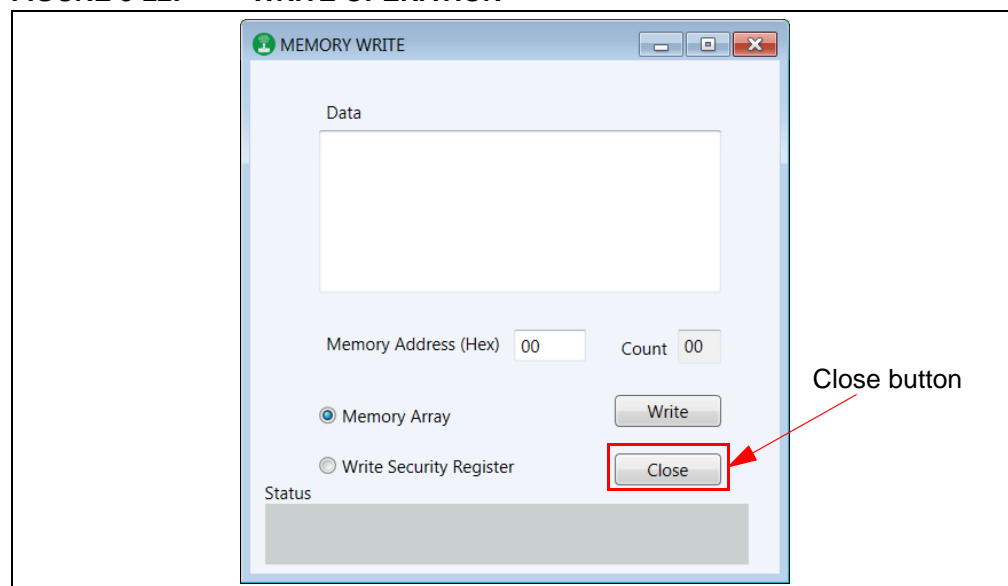
3.13.3 Go To Address

The Go To Address feature allows the user to jump to a specific word address in the GUI memory array. Once the **Go To Address** button is pressed, the memory address that was input will be highlighted in a black box in the GUI memory array.

> **Note:** The Go To Address feature does not work for the GUI Security register and only works for addresses within the GUI memory array.

FIGURE 3-23: **GO TO ADDRESS**
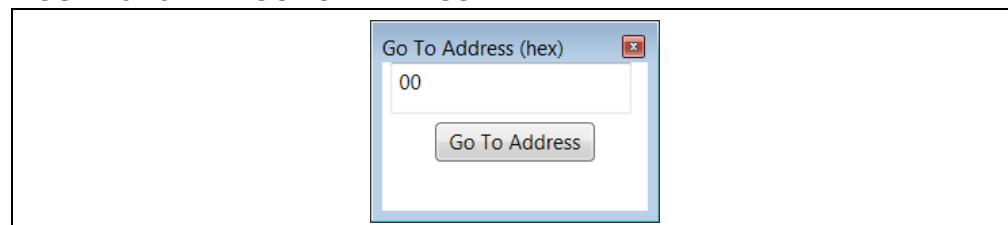
3.13.4 Other Actions

The **OTHER ACTIONS** button is reserved for future use (RFU) if future GUI enhancements are made.

3.13.5 Support

The **SUPPORT** button provides a hyperlink to various support pages. The support feature allows the user to select between three support classes.

- "Contact Support" which directs the user to the Microchip support portal
- "Order more Samples" which directs the use to microchipDIRECT
- "Find other Devices" which directs the user to Microchip Serial EEPROM memory page

FIGURE 3-24:   **SUPPORT**
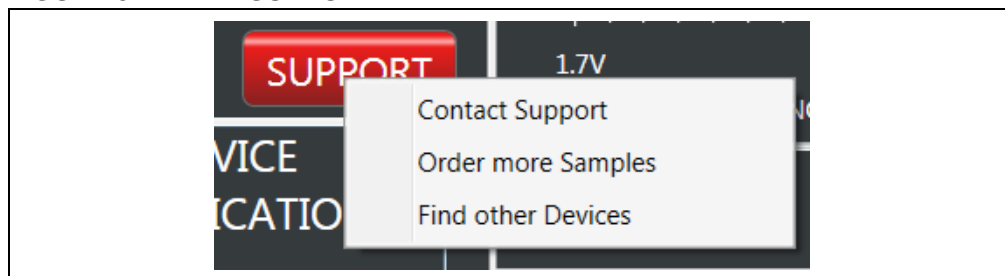
Chapter 4. USB Base Board Firmware Upgrade

4.1 INTRODUCTION

The Microchip Technology Serial Memory Evaluation Kits have a built-in ability to upgrade the USB Base Board using a sequence of steps along with using the Atmel **FL**exible **I**n-system **P**rogramming (FLIP) software.

The following steps are needed to successfully install the FLIP Software Utility:

1. Go to http://www.microchip.com/DM160232 to download the FLIP Software Utility

2. Navigate to Documentation and Software and select the FLIP Software Utility.

3. Download and open the setup file.
   `JRE - Flip Installer - x.x.x.xxx.exe` (x.x.x.xxx indicates the version)

4. Once the setup file is opened, if Java Runtime is already installed or a newer version is already installed, the setup will automatically start and you may skip to Step 8. If no Java Runtime or an older version is present on the user's PC, when prompted, press the **Install** button to start the Java Runtime installation.

Note: If prompted, allow the program to make changes to your PC.

FIGURE 4-1: JAVA RUNTIME ENVIRONMENT SETUP
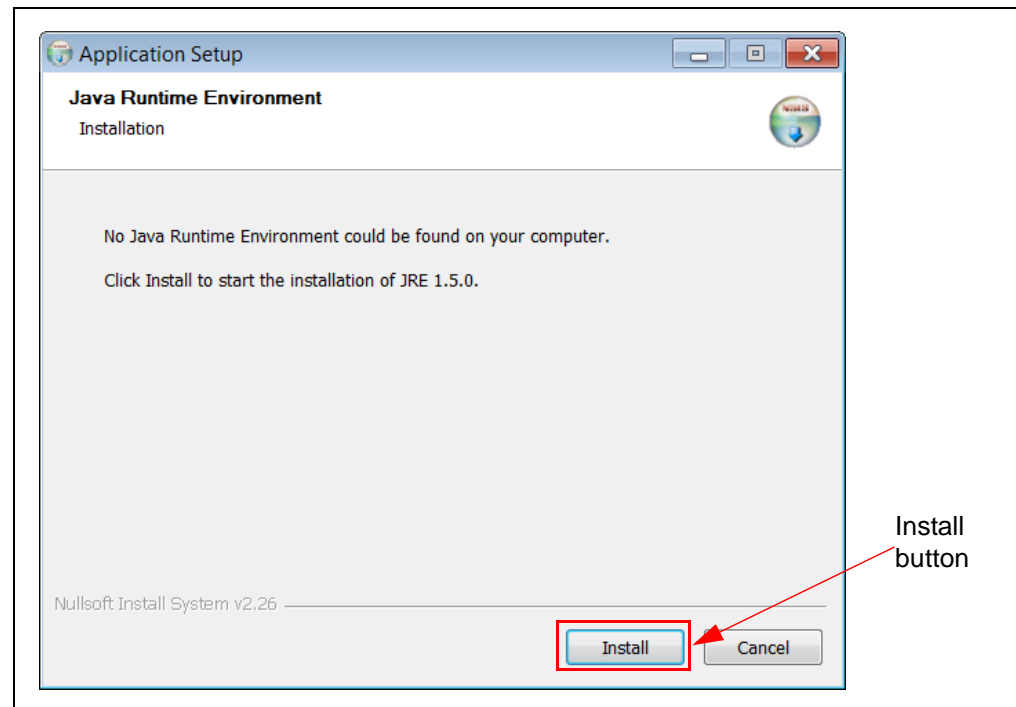
5. Let the program setup the Java Runtime. A progress or status bar is included to show the overall progress of the installation. Once completed, press the **Close** button.

FIGURE 4-2: JAVA RUNTIME INSTALLATION
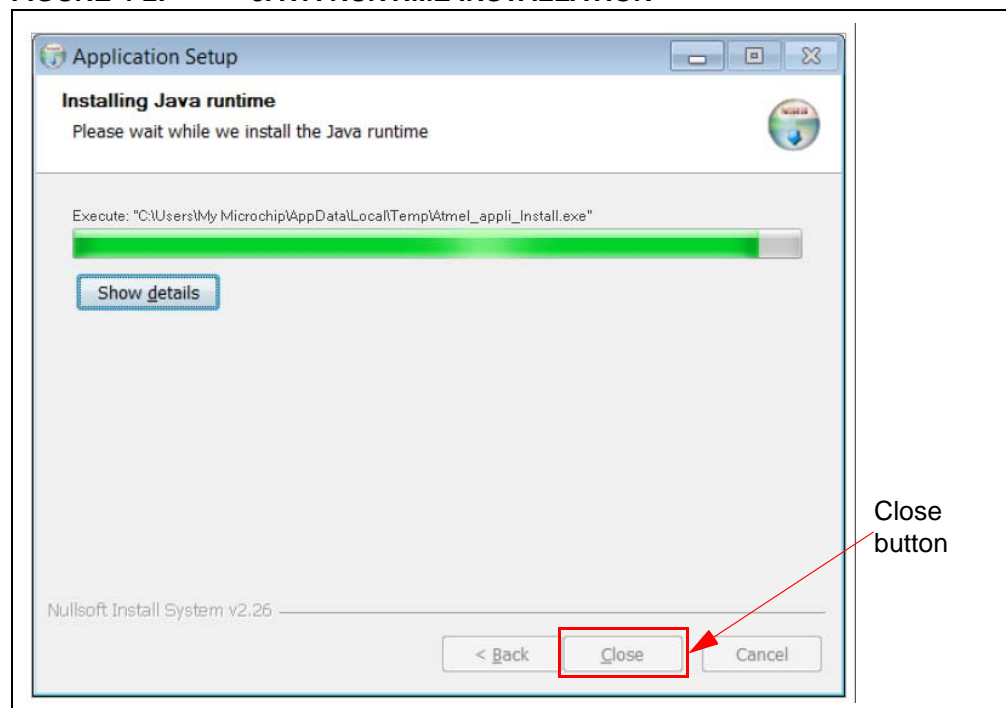
6. When prompted, select "Typical setup" and press the **Accept** button to accept the License Agreement.

> **Note:** For this example, the Typical setup was used. If the user selects a Custom setup, it is the user's responsibility to ensure the FLIP Software Utility is installed correctly.

FIGURE 4-3: JAVA RUNTIME TYPICAL SETUP
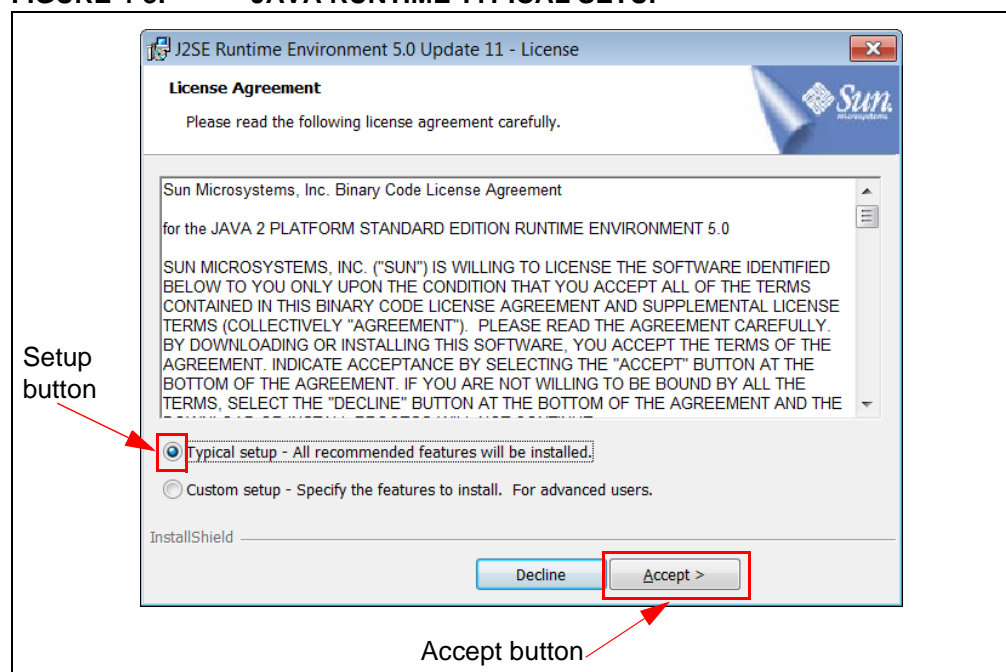
7. Let the program setup the Java Runtime. A progress or status bar is included to show the overall progress of the installation. Once completed, press the **Finish** button to complete the Java Runtime installation.

FIGURE 4-4:   **JAVA RUNTIME COMPLETION**
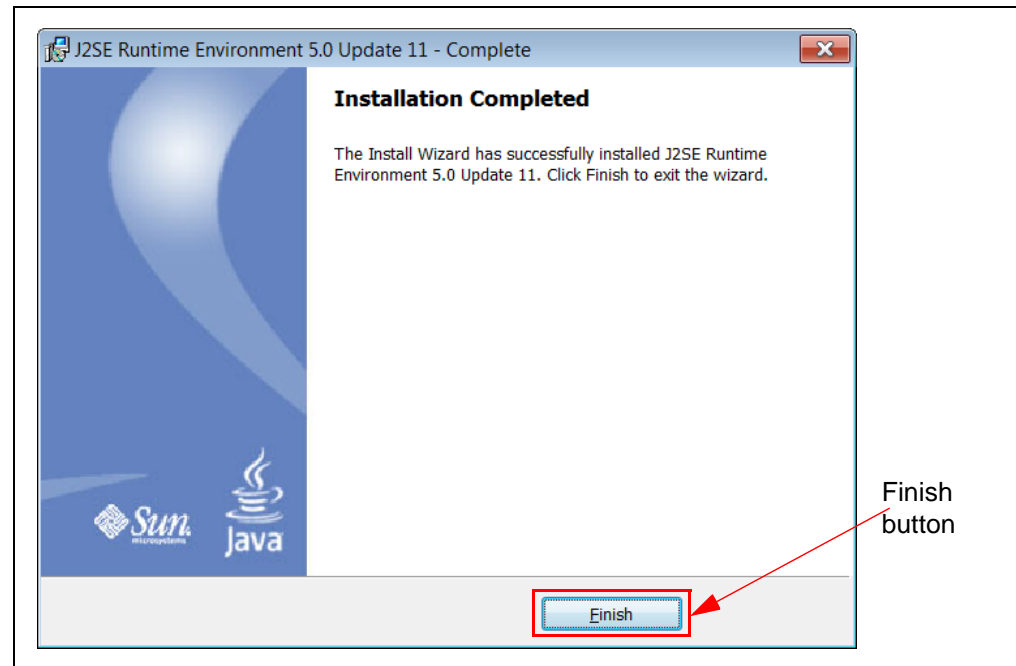
8. Once the Java Runtime is installed, the FLIP Setup Wizard is automatically started. Once ready, click the **Next** button to continue.

FIGURE 4-5:   **FLIP SETUP WIZARD**
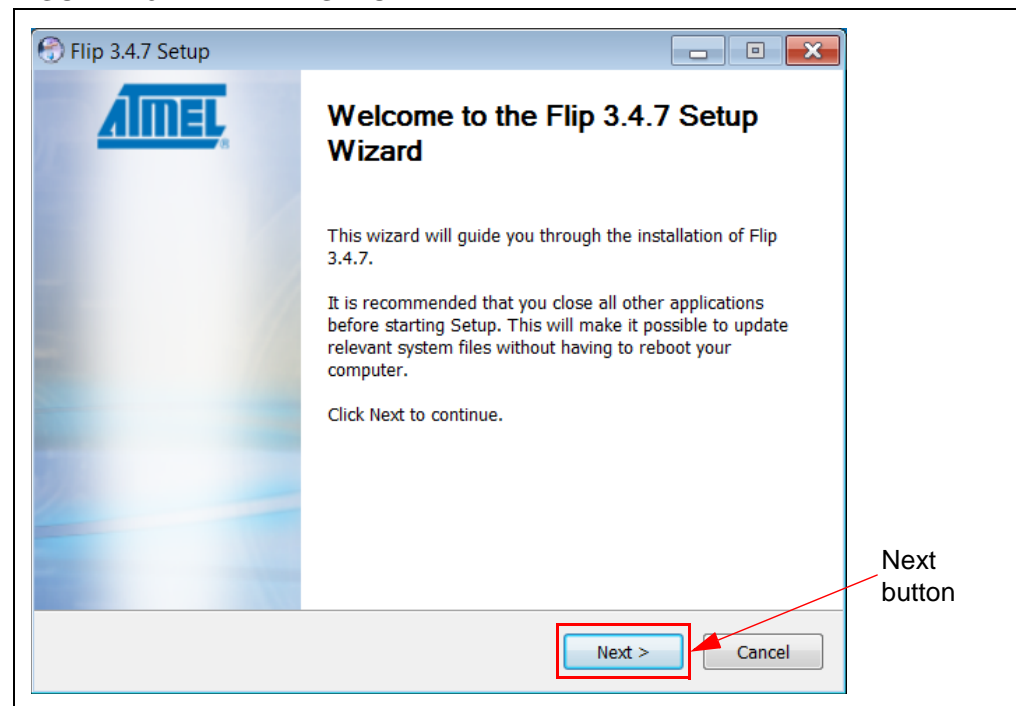
9. Read the License Agreement. When finished, accept the terms in the License Agreement by checking the box and press the **Next** button to continue.

FIGURE 4-6: **FLIP LICENSE AGREEMENT**
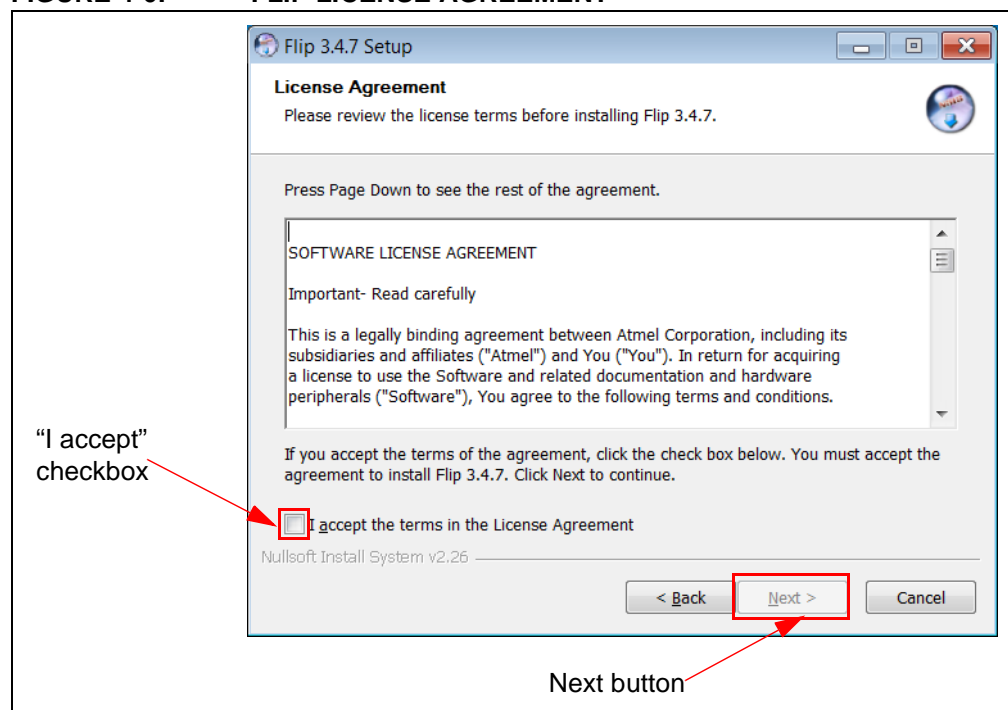
10. The next step is to select the installation location. The default installation location is set to `C:\Program Files (x86)\Atmel\Flip x.x.x` (x.x.x indicates the version). It is recommended that the default installation location is used. Once the installation location has been selected, press the **Next** button.

FIGURE 4-7: **FLIP INSTALLATION LOCATION**
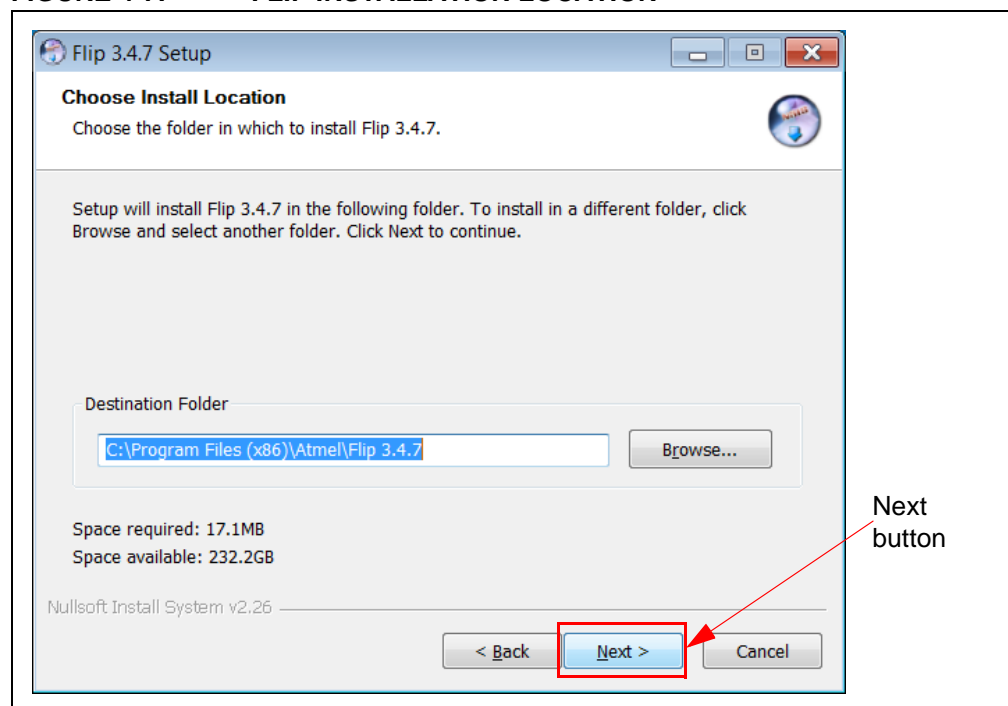
11. The next step is to choose a Start Menu folder. By default, the Start Menu folder is set to *Flip x.x.x*, where x.x.x indicates the FLIP version. It is recommended that the default Start Menu folder is used. Once ready, press the **Install** button to continue.

FIGURE 4-8: FLIP START MENU FOLDER
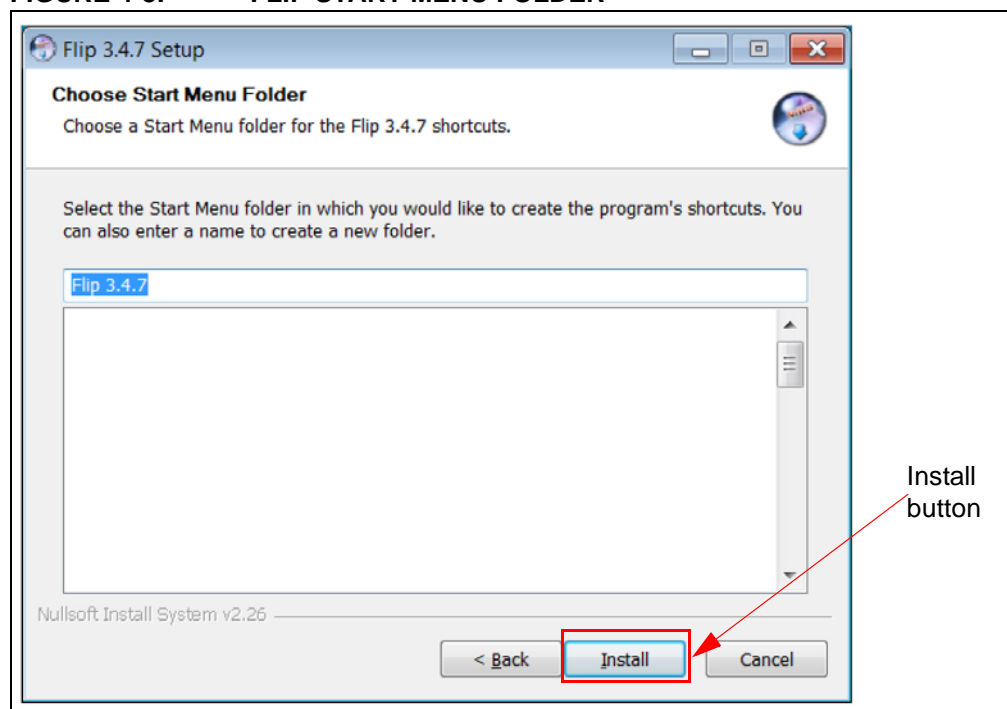
12. Let the program setup the FLIP Software Utility. A progress or status bar is included to show the overall progress of the installation. Click the **Next** button during the installation progress, if prompted. Once completed, press the **Finish** button to complete the FLIP Software Utility installation.

FIGURE 4-9: FLIP SOFTWARE UTILITY COMPLETE
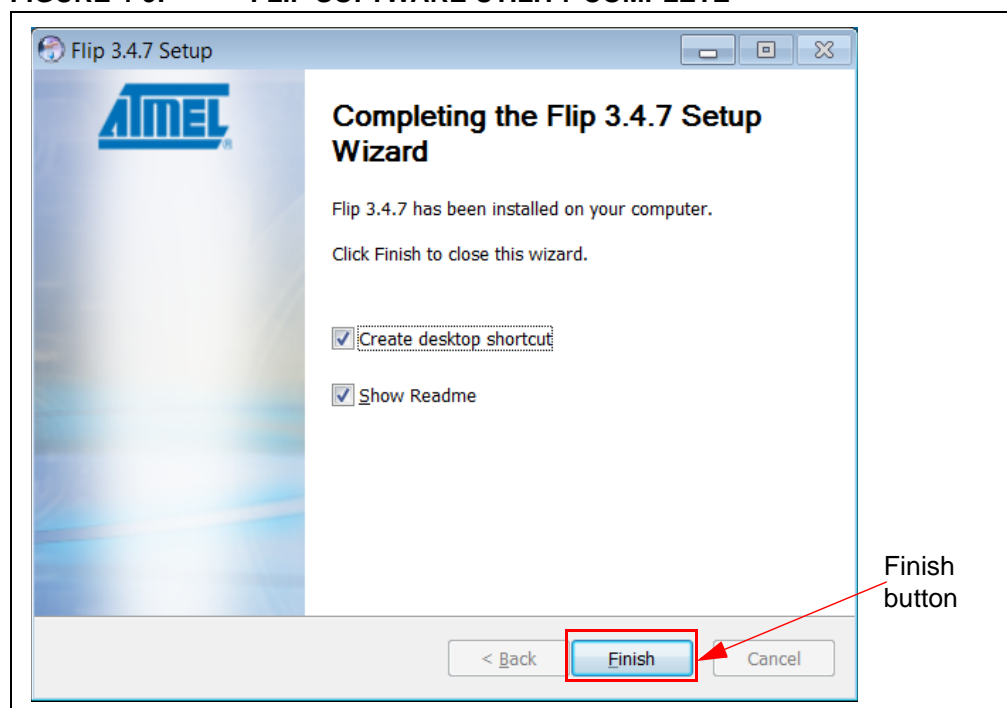
4.2   INSTALLING THE GRAPHICAL USER INTERFACE (GUI)

Once the FLIP Software Utility has been successfully installed on the user's PC, the next step is to download and install the latest version of the DM160232 SWI Graphical User Interface (GUI) software.

The following steps are necessary to successfully install the GUI software:

1.   Go to http://www.microchip.com/DM160232 to download the GUI software.

2.   Navigate to "Documentation and Software" and select the "DM160232 SWI GUI software".

3.   Download and open the setup file.
     DM160232_x.x.x_setup.exe (x.x.x indicate the GUI version)

4.   Install the GUI using the procedure outlined in **Section 2.3 "Installing the Graphical User Interface (GUI)"**.

> **Note:**   If an earlier version of the SWI GUI was previously installed, it is recommended to uninstall the previous version before installing the new version. This will ensure robust GUI operation.

4.3   USB BASE BOARD DFU MODE

Once the latest version of the GUI has been installed on the user's PC, the next step is to plug in the USB Base Board into a USB port without the SWI Socket Board connected. The PC will recognize the USB Base Board as "AVR MEGA Virtual Com Port" in the PC's Devices and Printers window from the Control Panel if there is firmware already loaded in the USB Base Board (Figure 4-10). Note that the COM port numeration may change based on the user's PC.

FIGURE 4-10:   **AVR MEGA VIRTUAL COM PORT**

AVR MEGA
Virtual Com Port
(COM34)

Once the USB Base Board is plugged in and recognized by the PC, the user should enable DFU mode on the USB Base Board. DFU mode is enabled by a specific sequence of **HWB** and **RESET** buttons. Refer to Figure 4-11 for locations of the **HWB** and **RESET** buttons.

FIGURE 4-11: **USB BASE BOARD BUTTONS**
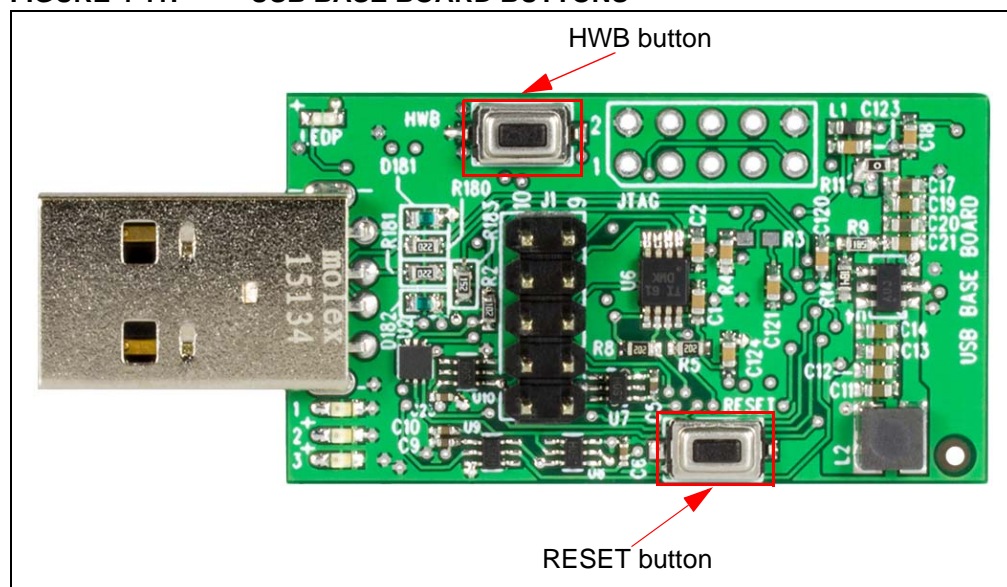
Once the **HWB** and **RESET** buttons have been located, use the specific press and hold sequence shown below to enable DFU mode on the USB Base Board.

• Press and hold the **HWB** button
• Press and release the **RESET** button
• Release the **HWB** button

Note: Once DFU mode is enabled on the USB Base Board, the rest of the firmware upgrade process must be completed in order to ensure robust USB Base Board operation.

Once the USB Base Board has DFU mode enabled, allow the PC to relearn the USB Base Board as "AT90USB128 DFU" (Figure 4-12). If the PC does not automatically recognize the USB Base Board as stated above and shown below, it is recommended to unplug the USB Base Board from the PC and restart the procedure.

FIGURE 4-12: **AT90USB128 DFU COM PORT**
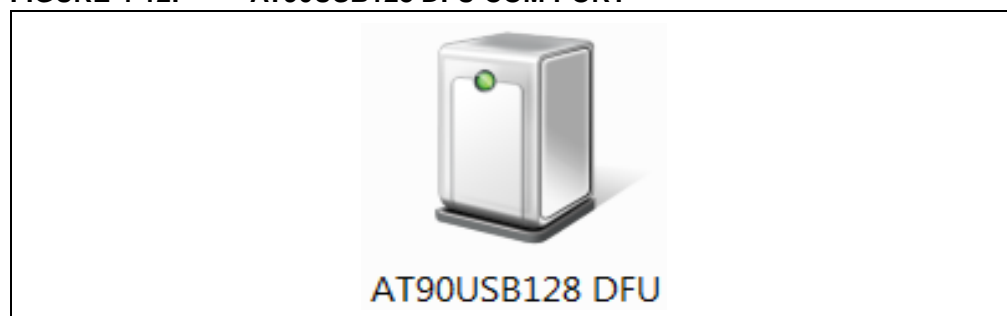
4.4 FLIP SOFTWARE UTILITY

Once the USB Base Board has DFU mode enabled and the COM port is relearned by the PC, perform the following sequence using the FLIP Software Utility to upgrade the USB Base Board firmware.

1. Open the FLIP Software Utility (Figure 4-13) by either selecting the desktop icon (if created) or selecting "Flip x.x.x" (x.x.x indicates the version) from the Start Menu folder.

FIGURE 4-13:   FLIP SOFTWARE UTILITY
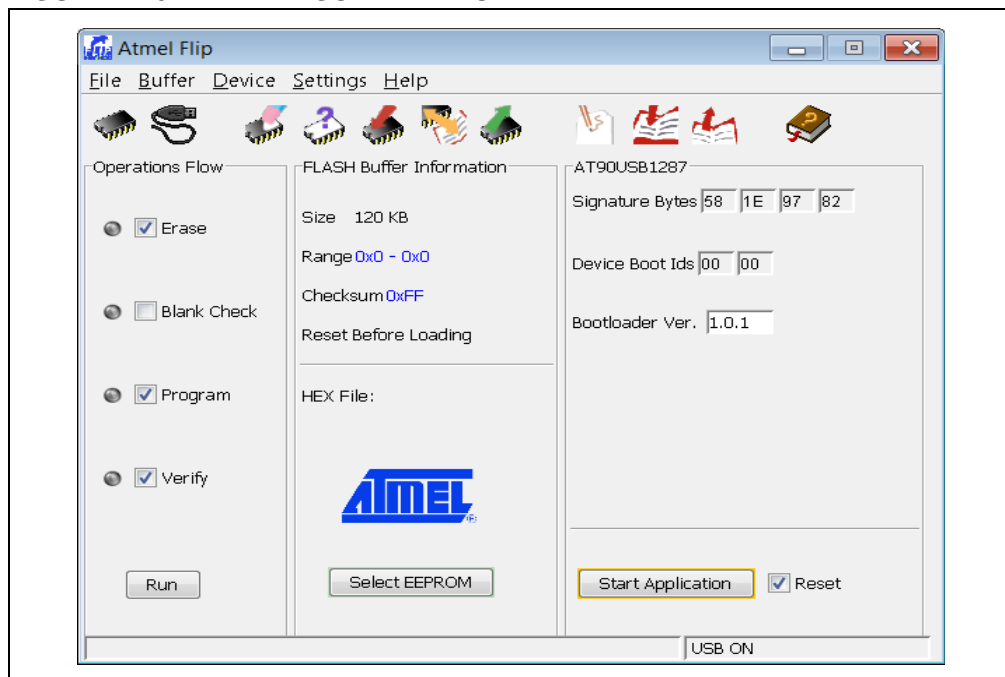
2. After opening the FLIP Software Utility, navigate to the Device Selection icon as shown below. Select the "AT90USB1287" as the device and press the **OK** button.

FIGURE 4-14: **DEVICE SELECTION**
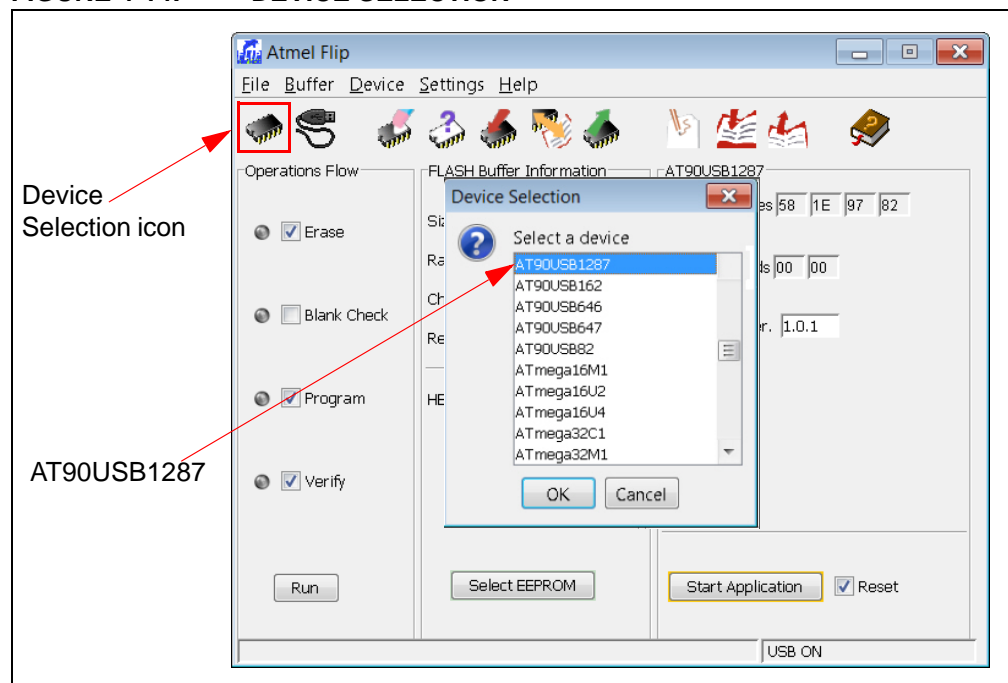
3. Once the target device has been selected, click on the Communication Medium icon as shown below and select "USB". Once "USB" is selected, an additional dialog box is displayed. Press the **Open** button to continue.

FIGURE 4-15:   COMMUNICATION MEDIUM SELECTION
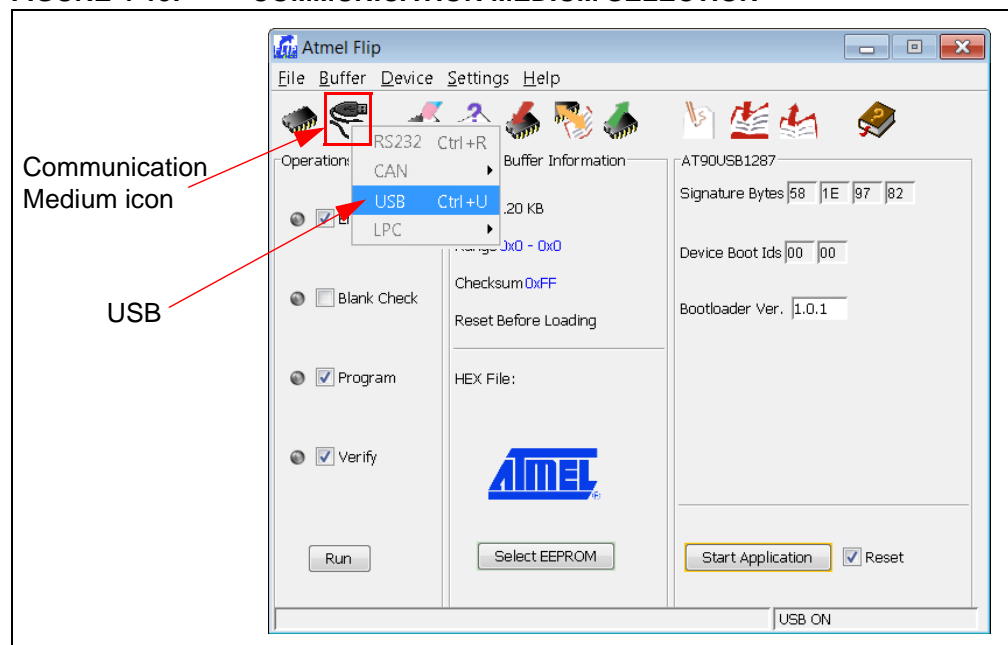
4. Once the communication between the PC and the AT90USB1287 (USB Base Board microcontroller) has been established, navigate to File and select "Load HEX Files" as shown in Figure 4-16.

FIGURE 4-16:   LOAD FILE
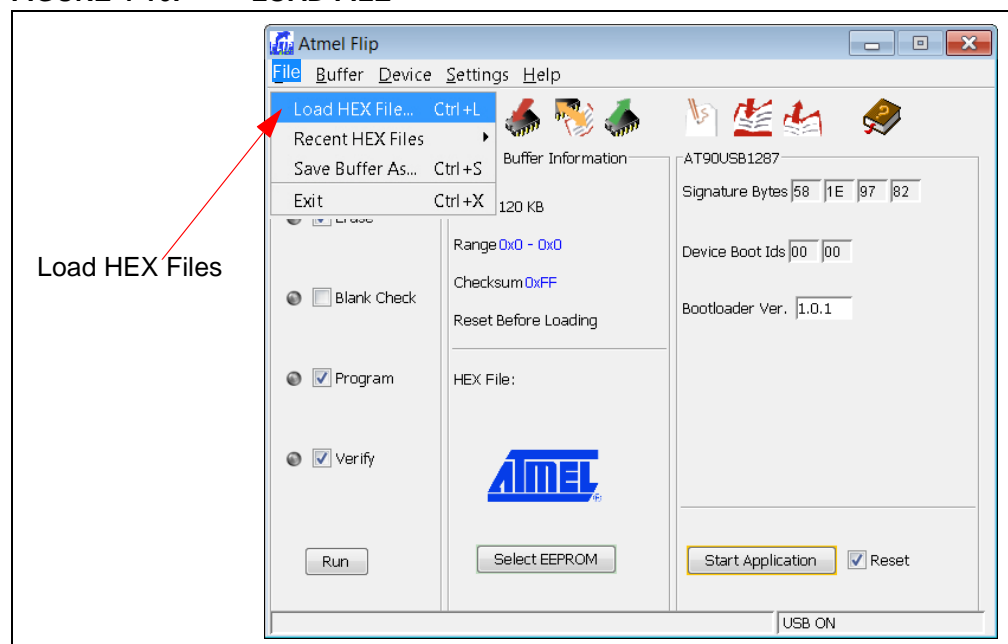
5. Proceed to load the SWI firmware. Navigate to the firmware found at:
   `C:\Program Files (x86)\Microchip\Serial Memory Evaluation Kits\Single-Wire\Firmware`

> **Note:** If the default installation was not used when the DM160232 SWI GUI was installed, it is the user's responsibility to determine the SWI firmware file location.

6. Once the HEX file has been loaded into the FLIP Software Utility, press the **Run** button to program the new firmware to the AT90USB1287 as shown below. A progress or status bar is included to show the overall progress of the hex image program.

FIGURE 4-17: **RUN FLIP SOFTWARE**
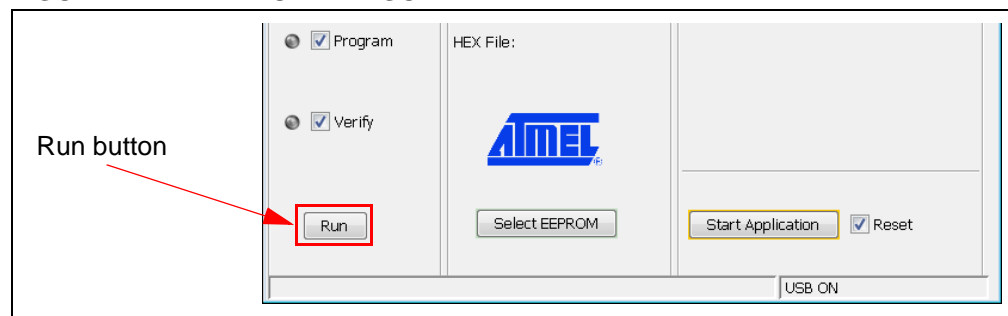
7. If the "Verified Pass" is reported in the FLIP Software Utility (see Figure 4-18), close the FLIP Software Utility and remove the USB Base Board from the PC. The USB Base Board Firmware Upgrade procedure is complete.

> **Note:** If the USB Base Board was updated successfully, the PC will recognize the USB Base Board as "AVR MEGA Virtual Com Port" (see Figure 4-10).

If the "Verified Pass" is not shown, or any other error is displayed, it is recommended to unplug the USB Base Board from the PC and restart the entire firmware upgrade procedure.

FIGURE 4-18: **FLIP SOFTWARE COMPLETE**
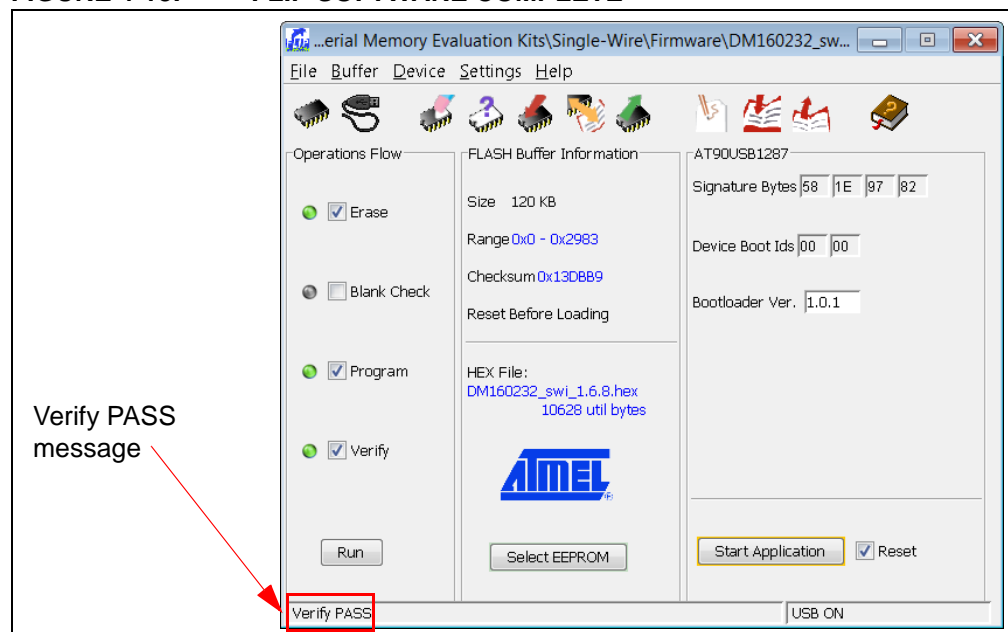
Chapter 5. Troubleshooting Guide

ISSUE: **USB BASE BOARD IS NOT RECOGNIZED BY THE USER'S PC**

SOLUTION: The USB Base Board driver is not installed or not installed properly. Download and install the USB Base Board driver using the procedure outlined in **Section 2.2 "Installing the USB Base Board Driver"**.

    The USB Base Board firmware was not programmed properly or has become corrupted. Perform the USB Base Board Firmware Upgrade using the procedure outlined in **Chapter 4. "USB Base Board Firmware Upgrade"**.

ISSUE: **GUI STATES THE USER MUST PERFORM A FIRMWARE UPDATE TO THE USB BASE BOARD**

SOLUTION: Perform the USB Base Board Firmware Upgrade using the procedure outlined in **Chapter 4. "USB Base Board Firmware Upgrade"**.

ISSUE: **GUI STATES THERE IS NO DEVICE INSTALLED IN THE SWI SOCKET BOARD**

SOLUTION: Close the GUI and remove the USB Base Board from the PC. Verify that the SWI Socket Board and the USB Base Board are connected properly. Also verify that the device is installed correctly in the SOT23 socket on the SWI Socket Board. Refer to **Section 2.4 "Evaluation Kit Setup Procedure"** for additional information. Make sure the socket lid is shut without any binding. Plug the SWI Socket Board into the USB Base Board and restart the GUI. If the problem persists, contact your local Sales representative for additional support or create a support ticket at www.microchip.com/support.

NOTES:

Appendix A. Schematics

A.1 INTRODUCTION

This appendix contains the following schematics for the DM160232 Serial Memory Single-Wire Evaluation Kit:

- SWI Socket Board (02-10681)
- USB Base Board (02-10682)

> **Note:** Electronic versions of the SWI Socket Board and USB Base Board schematics can be downloaded from http://www.microchip.com/DM160232 under "Documentation and Software".
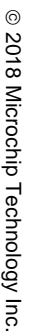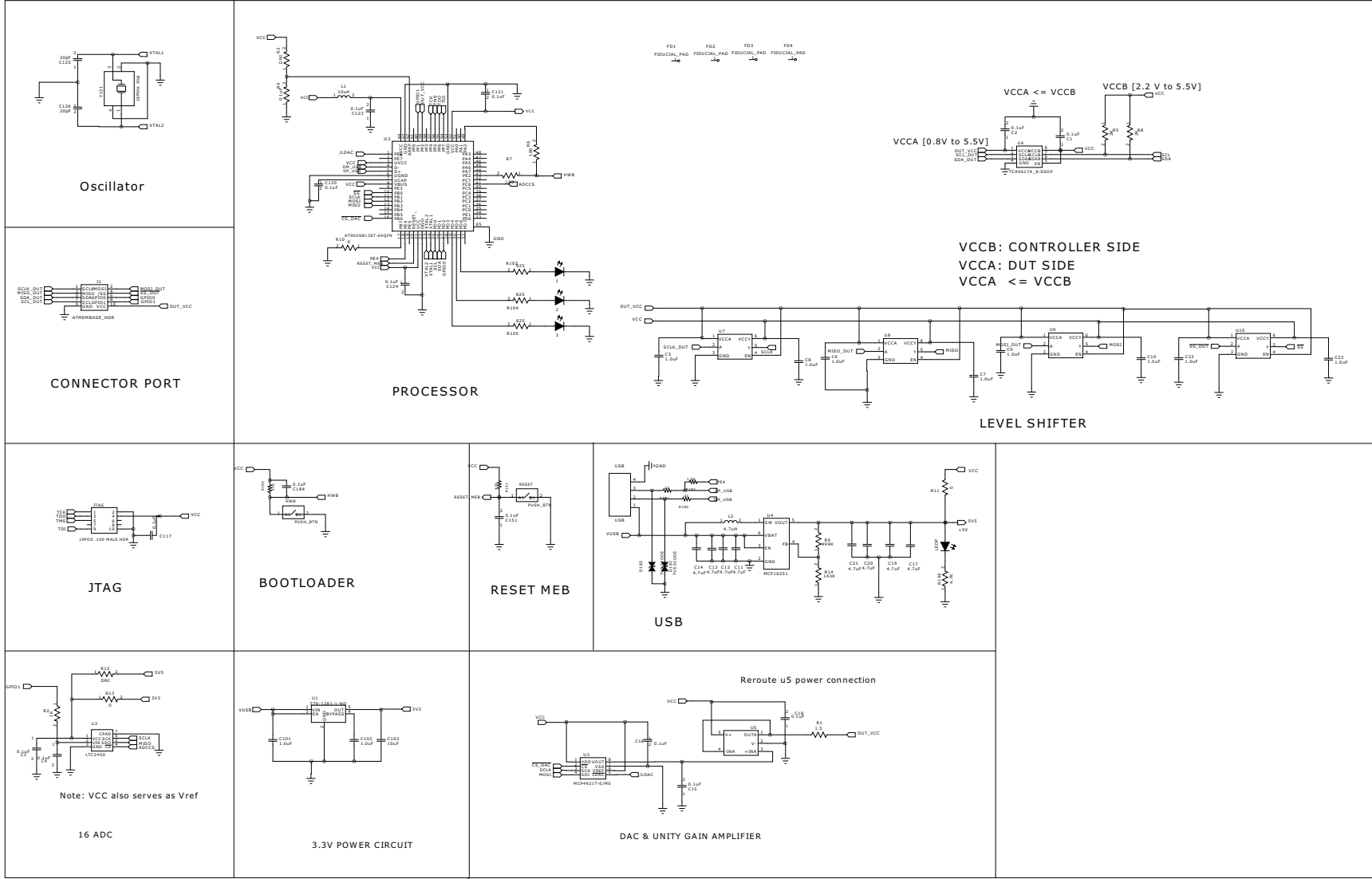
A.2 SWI SOCKET BOARD (02-10681)

Oscillator

CONNECTOR PORT

PROCESSOR

VCCA <= VCCB

VCCB [2.2 V to 5.5V]

VCCA [0.8V to 5.5V]

VCCB: CONTROLLER SIDE
VCCA: DUT SIDE
VCCA <= VCCB

LEVEL SHIFTER

JTAG

BOOTLOADER

RESET MEB

USB

GPIO1

Note: VCC also serves as Vref

16 ADC

3.3V POWER CIRCUIT

Reroute u5 power connection

DAC & UNITY GAIN AMPLIFIER

Appendix B. Bill of Materials (BOM)

TABLE B-1:   SWI SOCKET BOARD (02-10681)[1]

Qty	Reference	Description	Manufacturer	Part Number
1	C1	Ceramic Capacitor, 0.1 µF, 50V, 20% X5V SMD 0603	Yageo Corporation	CC0603ZRY5V9BB104
1	H1	Receptacle Connector, 100", 10 positions Dual Gold	Samtec Inc.	SSW-105-01-F-D
1	PCB	Printed Circuit Board – DM160232 SWI Socket Board	Microchip Technology Inc.	**01-10681**
2	R1, R2	Resistor-SMD, 330 Ohms, 5%, 1/10W, 0603	Yageo Corporation	RC0603JR-07330RL
1	S1	3-lead SOT23 Socket	Sensata Technologies (Wells-CTI)	499-P36-20
4	T1, T2, T3, T4	PC Test Point, Compact SMT	Keystone Electronics Corp.	5018
1	U1	Atmel 2 Kb Serialized 2-wire device SOIC-8	Microchip Technology Inc.	**AT24CS02-SSHM-T**
1	SOCKET	Installed Atmel 1 Kb Serialized SWI device SOT23	Microchip Technology Inc.	**AT21CS01-STUM10-T**
4	N/A	Loose Atmel 1 Kb Serialized SWI device SOT23	Microchip Technology Inc.	**AT21CS01-STUM10-T**

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:   USB BASE BOARD (02-10682) [1]

Qty	Reference	Description	Manufacturer	Part Number
3	1, 2, 3	LED RED CLEAR 0603 SMD	Lite-On® Technology Corporation	LTST-C191KRKT
15	C1, C2, C3, C4, C15, C16, C18, C117, C120, C121, C123, C124, C151, C184, R4	Ceramic capacitor, 0.1 µF, 50V Y5V 0603	Yageo Corporation	CC0603ZRY5V9BB104
10	C5, C6, C7, C8, C9, C10, C22, C23, C101, C102	Ceramic capacitor, 1 µF, 6.3V X5R 0402	Taiyo Yuden Co., Ltd.	JMK105BJ105KV-F
8	C11, C12, C13, C14, C17, C19, C20, C21	Ceramic capacitor, 4.7 µF, 6.3V X5R 0603	Taiyo Yuden Co., Ltd.	JMK107BJ475KA-T
1	C103	Ceramic capacitor, 10 µF, 6.3V X5R 0603	Taiyo Yuden Co., Ltd.	JMK107BJ106MA-T

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: USB BASE BOARD (02-10682) (CONTINUED)[1]

Qty	Reference	Description	Manufacturer	Part Number
2	C125, C126	Ceramic capacitor, 20 pF, 250V C0G/NP0 0603	Johanson Technology, Inc.	251R14S200GV4T
2	D181, D182	TVS Diode, 24VWM 150VC 0603	Littelfuse® Inc.	PGB1010603MR
2	HWB, RESET	Tactile switch SPST-NO 0.05A 12V	Apem, Inc.	ADTSM31NV
1	IC2	IC 8-bit MCU, 128 KB, Flash 64QFN	Microchip Technology Inc.	**AT90USB1287-MU**
1	J1	Connector – Header, 100" Dual STR, 10 positions	Sullins Connector Solutions	PRPC005DAAN-RC
3	JTAG, R12, R3	**DO NOT POPULATE**		
1	L1	Fixed inductor, 10 µH, 50 mA, 900 MOHM SMD	Murata Electronics North America, Inc.	LQM18FN100M00D
1	L2	Fixed inductor, 4.7 µH, 1.2A 105 MOHM	Wurth Electronics Inc.	744031004
1	LEDP	LED Blue Diffused, 0603 SMD	Osram Opto Semiconductors GmbH	LB Q39G-L2OO-35-1
1	PCB	Printed Circuit Board – DM160232 USB Base Board	Microchip Technology Inc.	**01-10682**
1	R1	Resistor SMD 1.5 Ohm, 5%, 1/10W 0603	Yageo Corporation	RC0603JR-071R5L
1	R2	Resistor SMD 1K Ohm, 5%, 1/10W 0603	Yageo Corporation	RC0603JR-071KL
2	R5, R8	Resistor SMD 2K Ohm, 5%, 1/10W 0603	Yageo Corporation	RC0603JR-072KL
2	R6, R7	Resistor SMD 180 Ohm, 5%, 1/10W 0603	Yageo Corporation	RC0603JR-07180RL
1	R9	Resistor SMD 499K Ohm, 1%, 1/10W 0603	Yageo Corporation	RC0603FR-07499KL
2	R10, R11	Resistor SMD 0.0 Ohm Jumper, 1/10W 0603	Yageo Corporation	RC0603JR-070RL
1	R13	Resistor SMD 0.0 Ohm Jumper, 1/16W 0402	Yageo Corporation	RC0402JR-070RL
1	R14	Resistor SMD 143K Ohm, 1%, 1/10W 0603	Yageo Corporation	RC0603FR-07143KL
3	R103, R104, R105	Resistor SMD 825 Ohm,1%, 1/10W 0603	Yageo Corporation	RC0603FR-07825RL
1	R144	Resistor SMD 4.7K Ohm, 5%, 1/10W 0603	Yageo Corporation	RC0603JR-074K7L
2	R151, R184	Resistor SMD 47K Ohm, 1%, 1/10W 0603	Yageo Corporation	RC0603FR-0747KL
2	R180, R181	Resistor SMD 22 Ohm, 5%, 1/10W 0603	Yageo Corporation	RC0603JR-0722RL
1	R183	Resistor SMD 1.5K Ohm, 5%, 1/10W 0603	Yageo Corporation	RC0603JR-071K5L
1	U1	Linear Regulator IC 3.3V, 0.5A, SOT23-5	Microchip Technology Inc.	**MIC5219-3.3YM5-TR**

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: USB BASE BOARD (02-10682) (CONTINUED)[1]

Qty	Reference	Description	Manufacturer	Part Number
1	U2	IC ADC 16-bit Sigma-Delta 6-DFN	Linear Technology Corporation	LTC2450CDC#TRMPBF
1	U3	IC DAC 12BIT SNGL W/SPI 8-MSOP	Microchip Technology Inc.	**MCP4921T-E/MS**
1	U4	Boost regulator adjustable IC 0.65A SYNC SOT23	Microchip Technology Inc.	**MCP16251T-I/CH**
1	U5	IC OPAMP GP 3 MHz RRO SOT23-5	Analog Devices, Inc.	AD8531ARTZ-REEL7
1	U6	IC V-Level XLATR FM+ I2C 8-VSSOP	Texas Instruments	TCA9617ADGKR
4	U7, U8, U9, U10	Translator bidirectional SGL LL SC70-6	Analog Devices Inc.	ADG3301BKSZ-REEL7
1	USB	Plug connector USB, 4 positions, right angle PCB	Molex® LLC	0480370001
1	Y121	Crystal 16.0000 MHz, 18 pF SMD	Abracon® LLC	ABM3B-16.000MHZ-B2-T

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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