# MCP43XXEV Evaluation Board User's Guide

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# MCP43XXEV EVALUATION BOARD USER'S GUIDE

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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 "DSXXXXXA", where "XXXXX" 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 on-line help. Select the Help menu, and then Topics to open a list of available on-line help files.**

## INTRODUCTION

This chapter contains general information that will be useful to know before using the MCP43XXEV Evaluation Board. Items discussed in this chapter include:

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

## DOCUMENT LAYOUT

This document describes how to use the MCP43XXEV 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 MCP43XXEV Evaluation Board.
- **Chapter 2. "Installation and Operation"** – Includes instructions on how to get started with this evaluation board.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the MCP43XXEV Evaluation Board.
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the MCP43XXEV Evaluation Board.

## 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> |


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## RECOMMENDED READING

This User's Guide describes how to use the MCP43XXEV Evaluation Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

**AN1080 Application Note, "*Understanding Digital Potentiometer Resistor Variations*", DS01080**

**AN1316 Application Note, "*Using Digital Potentiometers for Programmable Amplifier Gain*", DS01316**

These data sheets provide detailed information regarding the MCP43xx product family:

**MCP433X/5X Data Sheet, *"7/8-Bit Quad SPI Digital POT with Volatile Memory"*, DS22242**

**MCP434X/6X Data Sheet, *"7/8-Bit Quad SPI Digital POT with Non-Volatile Memory"*, DS22233**

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- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
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- Field Application Engineer (FAE)
- Technical Support
- Development Systems Information Line

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://support.microchip.com

In addition, there is a Development Systems Information Line which lists the latest versions of Microchip's development systems software products. This line also provides information on how customers can receive currently available upgrade kits.

The Development Systems Information Line numbers are:

1-800-755-2345 – United States and most of Canada

1-480-792-7302 – Other International Locations

## DOCUMENT REVISION HISTORY

### Revision A (July 2010)

- Initial Release of this Document.


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# Chapter 1. Product Overview

## 1.1 INTRODUCTION

This chapter provides an overview of the MCP43XXEV Evaluation Board and covers the following topics:

- What is the MCP43XXEV Evaluation Board?
- What the MCP43XXEV Evaluation Board kit includes

## 1.2 WHAT IS THE MCP43XXEV EVALUATION BOARD?

The MCP43XXEV Evaluation Board allows the system designer to quickly evaluate the operation of Microchip Technology's MCP4361 Digital Potentiometer device. This device is similar to the following devices:

- MCP4331
- MCP4332
- MCP4341
- MCP4342
- MCP4351
- MCP4352
- MCP4362
- MCP4231
- MCP4232
- MCP4241
- MCP4242
- MCP4251
- MCP4252
- MCP4261
- MCP4262

The board uses the TSSOP20EV Generic PCB and has been populated for the MCP4361. The 6-pin header (PICkit Serial) has been jumpered to the MCP4361's appropriate pins. This allows the PICkit Serial to communicate with the device.

Additional blank PCBs may be ordered by using the order number: TSSOP20EV. Each TSSOP20EV kit contains 5 PCBs.

Figure 1-1 shows the top view of the populated TSSOP20EV PCB, which creates the MCP43XXEV Evaluation Board.

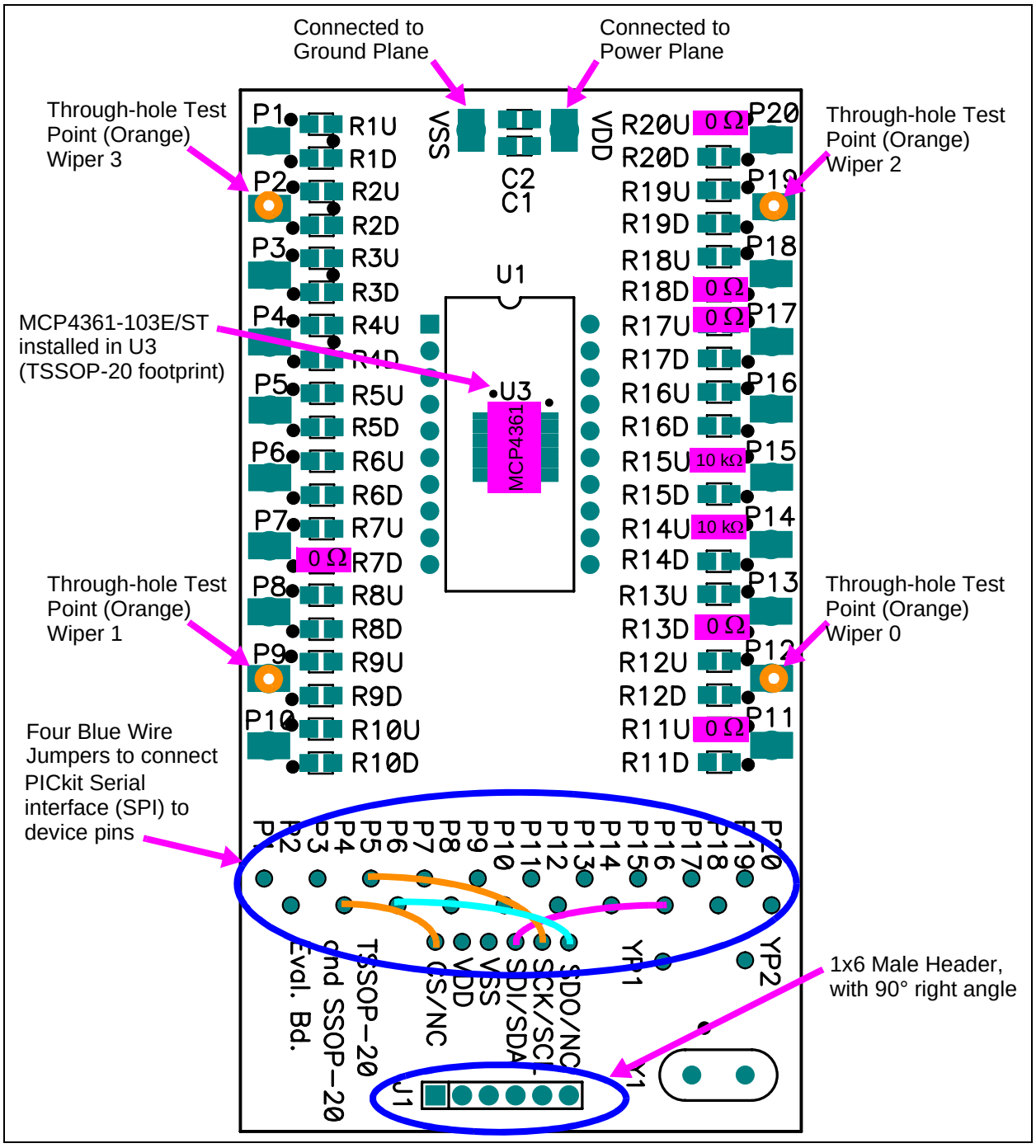


***FIGURE 1-1:*** *MCP43XXEV Evaluation Board Using the TSSOP20EV Evaluation Board (MCP4361 installed in U3).*

## 1.3 WHAT THE MCP43XXEV EVALUATION BOARD KIT INCLUDES

This MCP43XXEV Evaluation Board kit includes:

- MCP43XXEV Evaluation Board
- One TSSOP-20 and SSOP-20 Evaluation Board blank PCB, 102-00272. Extra blank PCBs can be ordered (order #: TSSOP20EV)
- Important Information Sheet


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# Chapter 2. Installation and Operation

## 2.1 INTRODUCTION

The MCP43XXEV Evaluation Board allows the system designer to quickly evaluate the operation of the MCP4361 10 kΩ (-103) Digital Potentiometer device using the PICkit Serial Analyzer. The PICkit Serial Analyzer is available separately (order number: DV164122).

This board is a minimum configuration for the device. As well as the device, other desired passive components (resistors and capacitors) and connection posts may be installed.

The board can also be very easily jumpered into a customer's existing circuit. This gives an indication of the MCP4361 device performance, but is affected by the jumper lead length and the EM noise that the jumpers pick up.

The device's resistor networks 0 and 2 have be configured in a potentiometer mode with the A terminal connected to $V_{DD}$ through a 0Ω resistor and the B terminal connected to $V_{SS}$ with a 0Ω resistor. Resistor networks 1 and 3 can be evaluated for rheostat operation.

The MCP43XXEV Evaluation Board uses the generic TSSOP20EV Evaluation Board PCB. The kit includes a second PCB which is blank for the user to populate as desired. Additional PCBs may be ordered (order number: TSSOP20EV). The TSSOP20EV kit includes 5 blank PCBs.

Other boards can easily be built up using the TSSOP20EV PCB to allow evaluation of other resistance options (5 kΩ, 50 kΩ, or 100 kΩ) or any of the other digital potentiometer devices in the following packages:

- TSSOP-20 package
  - MCP4331, MCP4341, MCP4351, or MCP4361
- TSSOP-14 package
  - MCP4332, MCP4342, MCP4352, MCP4362, MCP4231, MCP4241, MCP4251, MCP4261, MCP4631, MCP4641, MCP4651, MCP4661, MCP42010, MCP42050, or MCP42100

The board also has a 6-pin interface (PICkit Serial, ICSP, etc.) whose signals can easily be jumpered to any of the device's pins.

Additional information on using the TSSOP20EV Evaluation Board PCB or for modifying the MCP43XXEV board is available in the TSSOP20EV User's Guide (DS51875). **Appendix A. "Schematic and Layouts"** has information of the PCB schematic and layout while Figure 2-2 shows components that are installed on the PCB.

## 2.2 FEATURES

The MCP43XXEV Evaluation Board has the following features:

- MCP4361-103E/ST is installed
- 0Ω resistors connect MCP4361 $V_{DD}$ and $V_{SS}$ signals to the appropriate Power or Ground plane (see Figure 2-2)
- 0Ω resistors connect MCP4361's Resistor Network 0 and 2 A terminal signal to Power plane, Resistor Network is in a voltage divider configuration (see Figure 2-2)
- 0Ω resistors connect MCP4361's Resistor Network 0 and 2 B terminal signal to Ground plane, Resistor Network is in a voltage divider configuration (see Figure 2-2)
- Through-hole connection terminal (Orange) for all Wiper pins
- Connection terminal points for all device pins (either through-hole or surface-mount)
- Footprints for optional passive components (SMT 805 footprint) for:
  - Power supply filtering ($C_1$ and $C_2$ footprints)
  - Device bypass capacitor (RxD footprint for device pin connected to $V_{DD}$)
- Silk-screen area to write specifics of implemented circuit (on back of PCB), such as MCP4361 10 kΩ
- PICkit Serial Analyzer Header

The included TSSOP20EV Board has the following features:

- Connection terminals may be either through-hole or surface-mount
- Three package type footprints supported:
  - TSSOP-20
  - TSSOP-14
  - TSSOP-8
  - SSOP-20
  - DIP-20 (600 mil body)
- Footprints for optional passive components (SMT 805 footprint) for:
  - Power supply filtering ($C_1$ and $C_2$ footprints)
  - Device bypass capacitor (RxD footprint for device pin connected to $V_{DD}$)
  - Output filtering (RxD footprint)
  - Output pull-up resistor (RxU footprint)
  - Output pull-down resistor (RxD footprint)
  - Output loading resistor (RxD footprint)
- Silk-screen area to write specifics of implemented circuit (on back of PCB), such as MCP4361 10 kΩ
- PICkit Serial Analyzer / PICkit 2 Programming (ICSP) Header


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## 2.3 GETTING STARTED

The MCP43XXEV Evaluation Board allows quick evaluation of the MCP4361-103E/ST device. The understanding of the device characteristics (such as the resistor network) is applicable to any of the devices in the MCP43XX family. The MCP4361-103 device has a typically $R_{AB}$ resistance of 10 kΩ. Evaluation can be done by:

- Using the PICkit Serial Analyzer for interface communication
- Jumpering the MCP43XXEV Evaluation Board into your application circuit to control the MCP4361-103 device

This User Guide will discuss the steps needed to evaluate the MCP4361-103E/ST device using the PICkit Serial Analyzer (order number: DV164122).

**Section 2.5 "Configuring The PICkit Serial Analyzer"** shows the steps to configure the PICkit Serial Analyzer as well as create User Script files which are used to communicate with the MCP4361, based on the devices SPI communication protocol format.

## 2.4 MCP43XXEV EVALUATION BOARD DESCRIPTION

The MCP43XXEV Evaluation Board uses the flexible TSSOP20EV Evaluation Board PCB. This simple Evaluation Board allows the system designer to quickly evaluate the operation of the MCP4361-103 device ($R_{AB(TYP)}$ = 10 kΩ ) using the PICkit Serial Analyzer or by jumpering the board into their application system. The PICkit Serial Analyzer is available separately (order number: DV164122).

### 2.4.1 The Hardware

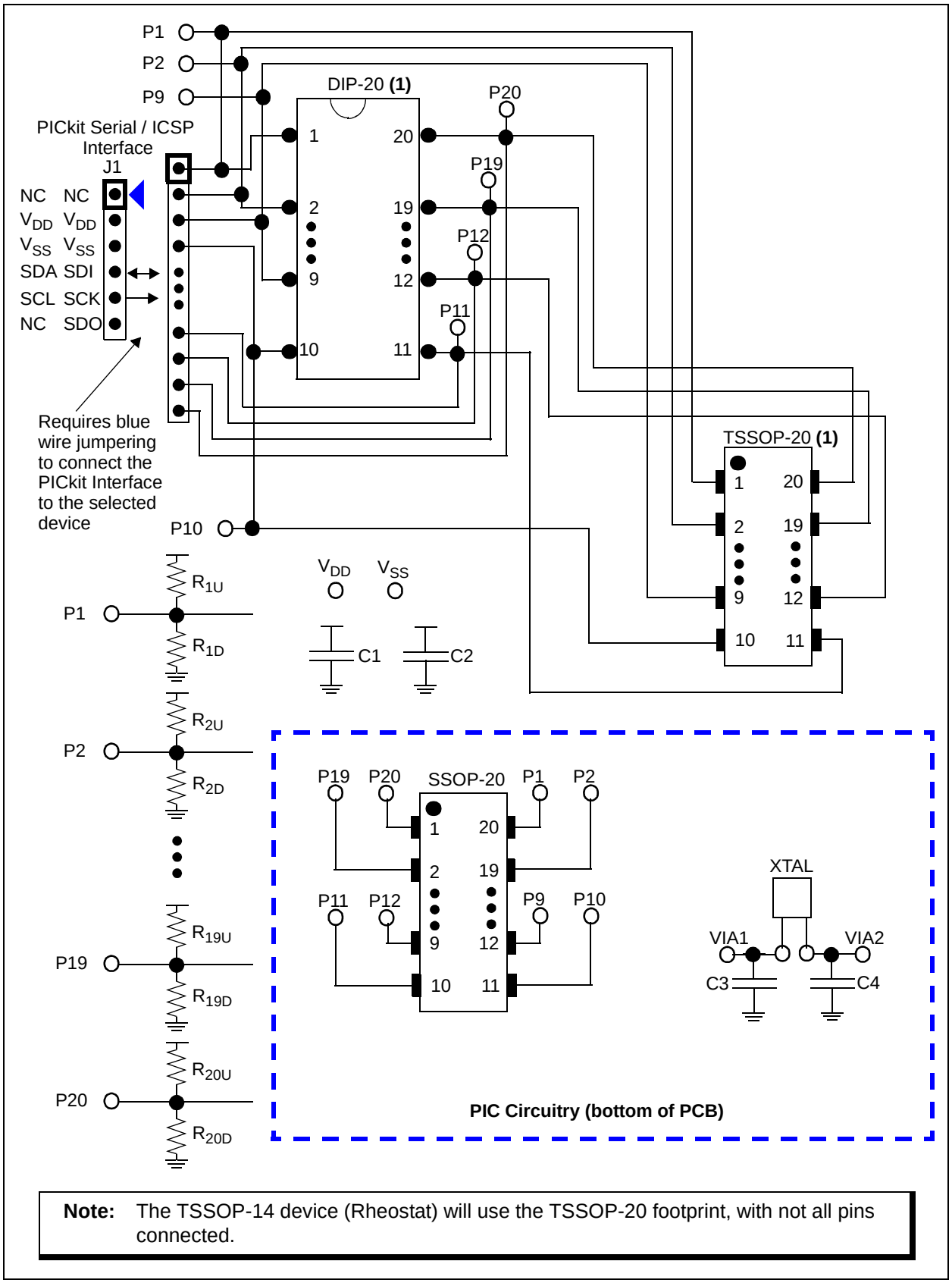
Figure 2-2 shows the component layout of the MCP43XXEV Evaluation Board. This is a small four-layer board ( 3.9" x 2.1" (99.06 mm x 53.34 mm)). There are twenty two connection points/pads that can use either through-hole or surface-mount connector posts.

The pad labeled $V_{DD}$ is connected to the PCB power plane, while the pad labeled $V_{SS}$ is connected to the PCB ground plane. All the passive components that are connected to $V_{DD}$ or $V_{SS}$ are connected to either the power plane or ground plane.

The twenty remaining PCB pads correspond to the device pins (i.e.; pad 1 connects to pin 1).

Each pad has two passive components associated with them: a pull-up resistor and a pull-down resistor. The pull-up resistor is always RXU and the pull-down resistor is RXD. The "X" is a numeric value that corresponds to a particular pad (1 to 8). As an example, Pad 5's pull-up resistor is R5U. Capacitor C1 and C2 are the power supply filtering capacitors. For whichever pin is the device's $V_{DD}$, the RxD component footprint can be used for the device's bypass capacitor. Table 2-2 describes the components.

A 6-pin header interface is available to support the PICkit Serial or the PIC MCU In-Circuit Serial Programming (ICSP) interface.




**Note:** The TSSOP-14 device (Rheostat) will use the TSSOP-20 footprint, with not all pins connected.

***FIGURE 2-1:*** *TSSOP20EV Evaluation Board Circuit.*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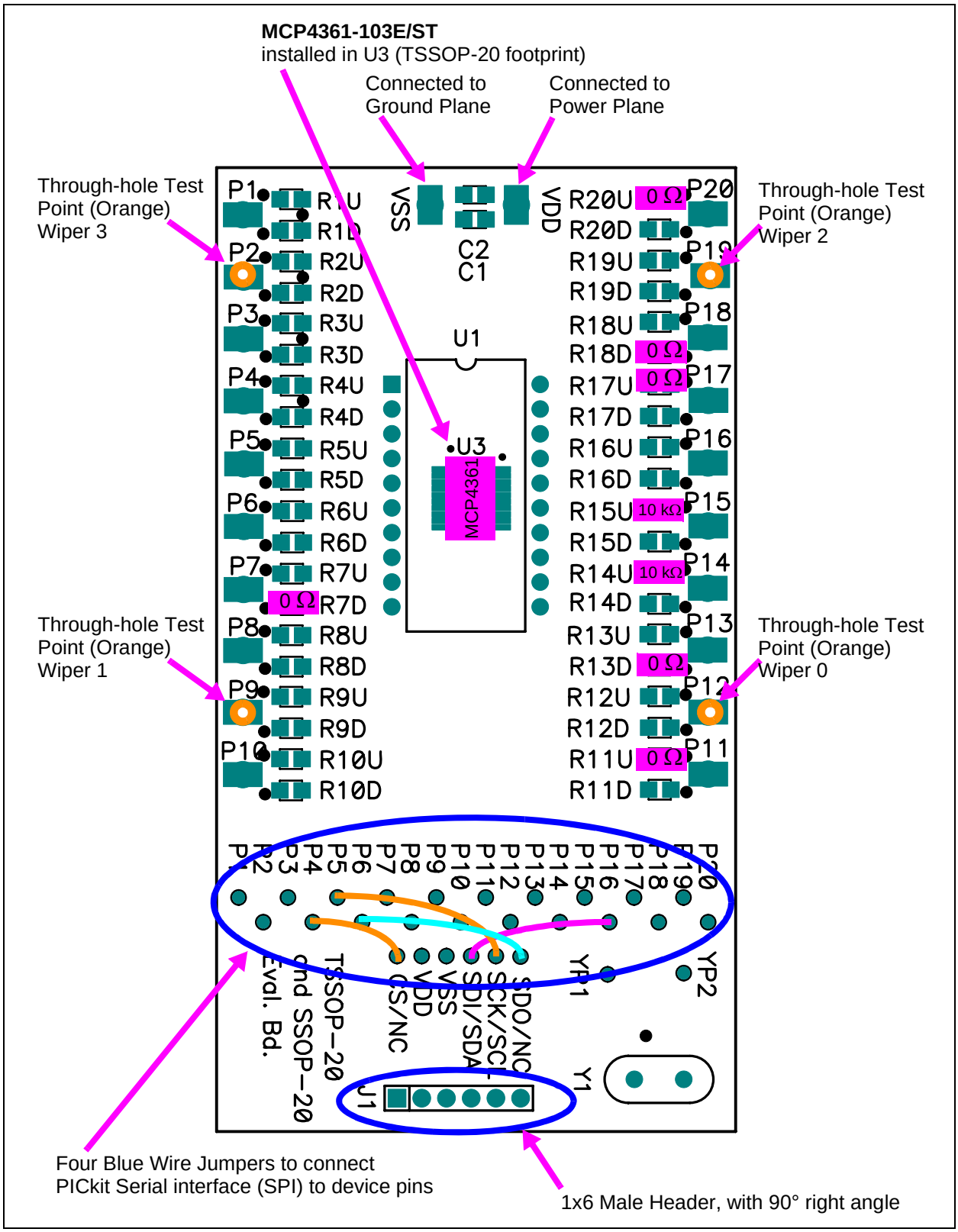


***FIGURE 2-2:*** *MCP43XXEV Evaluation Board Component Placement Using the TSSOP20EV Evaluation Board (Top).*

**TABLE 2-1: INSTALLED PASSIVE COMPONENTS (2)**

| Component | Description | Comment |
|---|---|---|
| R11U, R17U, R20U | 0Ω SMT 805 | Pull-up resistor |
| R14U, R15U | 10 kΩ SMT 805 | Pull-up resistor |
| R7D, R13D, R18D | 0Ω SMT 805 | Pull-down resistor (1) |
| U3 | MCP4361-103E/ST | $R_{AB(TYP)}$ = 10 kΩ |
| P2, P9, P12, P19 | Test Point - through-hole connector (Orange) | |
| J1 | 1x6 Male Header, 100 mil spacing 90° angle. | PICkit Serial / ICSP header |
| — | Blue Wire:<br>J1 CS/NC via to P4 via<br>J1 SDI/SDA via to P16 via<br>J1 SCK/SCL via to P5 via<br>J1 SDO/NC via to P6 via | See Figure 2-2 |

**Note 1:** Whichever pin is the device's $V_{DD}$ pin, that corresponding RXD footprint can be used for the device's bypass capacitor. So if Pin 8 is the device's $V_{DD}$ pin, then install the bypass capacitor in the R8D footprint.

**2:** All passive components use the surface mount 805 footprint.


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**TABLE 2-2: OPTIONAL PASSIVE COMPONENTS - NOT INSTALLED (2)**

| Component | Comment |
|---|---|
| C1, C2 | Power supply bypass capacitors (3) |
| C3, C4 | PIC Crystal capacitors |
| R1U, R2U, R3U, R4U, R5U, R6U, R7U, R8U, R9U, R12U, R13U, R16U, R18U, R19U | Pull-up resistor |
| R1D, R2D, R3D, R4D, R5D, R6D, R8D, R9D, R10D, R11D, R12D, R14D, R15D, R16D, R17D, R19D, R20D | Pull-down resistor (1) |
| U1, U2 | Alternate package footprints |
| VDD, GND | Power and Ground plane connection points |
| Y1 | Can connect to either PIC' main oscillator or to the Timer oscillator circuit. |
| P1, P3, P4, P5, P6, P8, P10, P11, P13, P14, P15, P16, P17, P18, P20 | Test Point connectors |

**Note 1:** Whichever pin is the device's $V_{DD}$ pin, that corresponding RXD footprint can be used for the device's bypass capacitor. So if Pin 8 is the device's $V_{DD}$ pin, then install the bypass capacitor in the R8D footprint.

**2:** All passive components use the surface mount 805 footprint.

**3:** If the board is powered via the $V_{DD}$ and GND connection points, the use of bypass capacitors on C1 and C2 may improve performance. The benefit is reduced if the board is powered via the PICkit Serial interface.

### 2.4.2 The MCP4361 Device

To make variations to the commands sent to the MCP4361 device (from the commands shown in the demo section), one must know the device memory map (see Table 2-3) and the command formats (see Figure 2-3). For additional device operational information, refer to the MCP4361 device data sheet (DS22233).

**TABLE 2-3: MEMORY MAP AND THE SUPPORTED COMMANDS**

| Address | Function | Memory Type | Allowed Commands | Disallowed Commands (2) |
|---|---|---|---|---|
| 00h | Volatile Wiper 0 | RAM | Read, Write, Increment, Decrement | — |
| 01h | Volatile Wiper 1 | RAM | Read, Write, Increment, Decrement | — |
| 02h | Non-Volatile Wiper 0 | EEPROM | Read, Write (1) | Increment, Decrement |
| 03h | Non-Volatile Wiper 1 | EEPROM | Read, Write (1) | Increment, Decrement |
| 04h | Volatile TCON0 Register | RAM | Read, Write | Increment, Decrement |
| 05h | Status Register | RAM | Read | Write, Increment, Decrement |
| 06h | Volatile Wiper 2 | RAM | Read, Write, Increment, Decrement | — |
| 07h | Volatile Wiper 3 | RAM | Read, Write, Increment, Decrement | — |
| 08h | Non-Volatile Wiper 2 | EEPROM | Read, Write (1) | Increment, Decrement |
| 09h | Non-Volatile Wiper 3 | EEPROM | Read, Write (1) | Increment, Decrement |
| 0Ah | Volatile TCON1 Register | RAM | Read, Write | Increment, Decrement |
| 0Bh - 0Fh | Data EEPROM | EEPROM | Read, Write (1) | Increment, Decrement |

**Note 1:** When an EEPROM write is active, these are invalid commands and will generate an error condition. The user should use a read of the Status register to determine when the write cycle has completed. To exit the error condition, the user must take the $\overline{CS}$ pin to the $V_{IH}$ level and then back to the active state ($V_{IL}$ or $V_{IHH}$).

**2:** This command on this address will generate an error condition. To exit the error condition, the user must take the $\overline{CS}$ pin to the $V_{IH}$ level and then back to the active state ($V_{IL}$ or $V_{IHH}$).

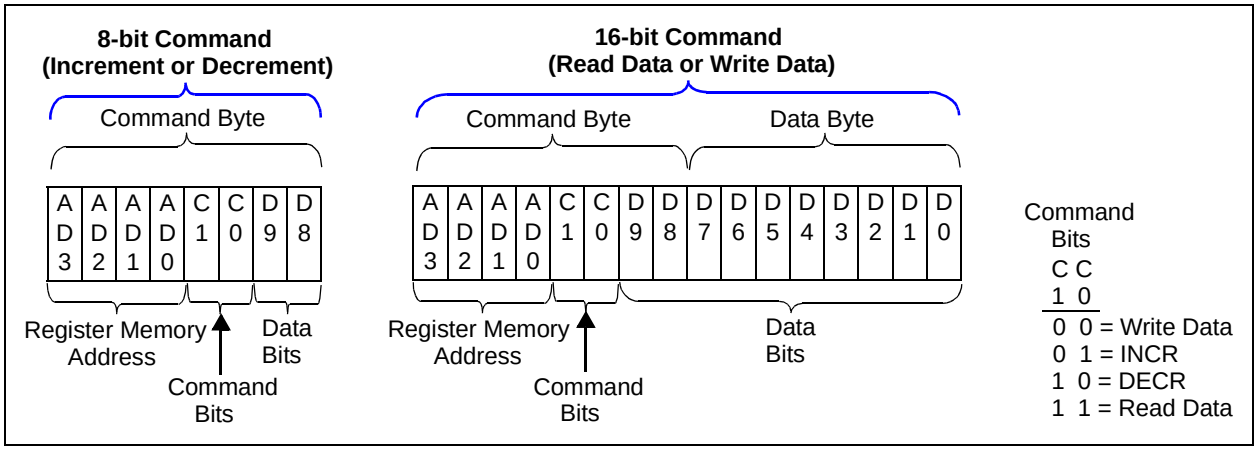


***FIGURE 2-3:*** *MCP43XX SPI Command Formats.*


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## 2.5 CONFIGURING THE PICKIT SERIAL ANALYZER

### 2.5.1 Modifying the “CommScripts.txt” file

Example 2-1 shows the User Scripts that need to be added to the PICkit Serial’s “CommScripts.txt “ file. The default install location of this file is:

C:\Program Files\Microchip\PICkit Serial Analyzer

Once these are saved in the “CommScripts.txt “ file and the Master SPI mode is selected as the communication mode, these user scripts will be available to select from.

**NOTICE**

**Note 1:** It is recommended that you make a backup of your “CommScript.txt” file before making any edits with a text editor.

**2:** It has been observed that copying the text from this PDF and pasting into the PICkit Serial’s “CommScript.txt” file will cause errors due to the blank spacing used in the PDF file. Please copy from the “MCP43XX CommScript.txt” file available from the Microchip web site.

**EXAMPLE 2-1: MCP43XX SCRIPT FILE (COMMSCRIPTS.TXT)**

```
WriteWiper0     SPI     SPICSON  SPIDATOUT  0x02  0x00  0x3F  SPICSOFF
ReadWiper0      SPI     SPICSON  SPIDATIO   0x02  0x0C  0xA5  SPICSOFF
WriteWiper1     SPI     SPICSON  SPIDATOUT  0x02  0x10  0x3F  SPICSOFF
ReadWiper1      SPI     SPICSON  SPIDATIO   0x02  0x1C  0xA5  SPICSOFF
WriteWiper2     SPI     SPICSON  SPIDATOUT  0x02  0x60  0x3F  SPICSOFF
ReadWiper2      SPI     SPICSON  SPIDATIO   0x02  0x6C  0xA5  SPICSOFF
WriteWiper3     SPI     SPICSON  SPIDATOUT  0x02  0x70  0x3F  SPICSOFF
ReadWiper3      SPI     SPICSON  SPIDATIO   0x02  0x7C  0xA5  SPICSOFF
WriteWiper0NV   SPI     SPICSON  SPIDATOUT  0x02  0x20  0x3F  SPICSOFF
ReadWiper0NV    SPI     SPICSON  SPIDATIO   0x02  0x2C  0xA5  SPICSOFF
WriteTCON0      SPI     SPICSON  SPIDATOUT  0x02  0x40  0xFF  SPICSOFF
ReadTCON0       SPI     SPICSON  SPIDATIO   0x02  0x4C  0xA5  SPICSOFF
WriteTCON1      SPI     SPICSON  SPIDATOUT  0x02  0xA0  0xFF  SPICSOFF
ReadTCON1       SPI     SPICSON  SPIDATIO   0x02  0xAC  0xA5  SPICSOFF
ReadSTATUS      SPI     SPICSON  SPIDATIO   0x02  0x5C  0xA5  SPICSOFF
INCRWiper0      SPI     SPICSON  SPIDATIO   0x01  0x04  SPICSOFF
DECRWiper0      SPI     SPICSON  SPIDATIO   0x01  0x08  SPICSOFF
```

### 2.5.2 Working With the PICkit Serial Analyzer

Figure 2-4 shows the PICkit Serial Window after the program has started. The Transaction window indicates if the PICkit Serial GUI located the PICkit Serial Analyzer Hardware. When starting the PICkit Serial Analyzer for the first time, some setup questions may be asked. If you have any questions, please refer to the PICkit Serial Analyzer documentation, available at www.Microchip.com/PICkitSerial.

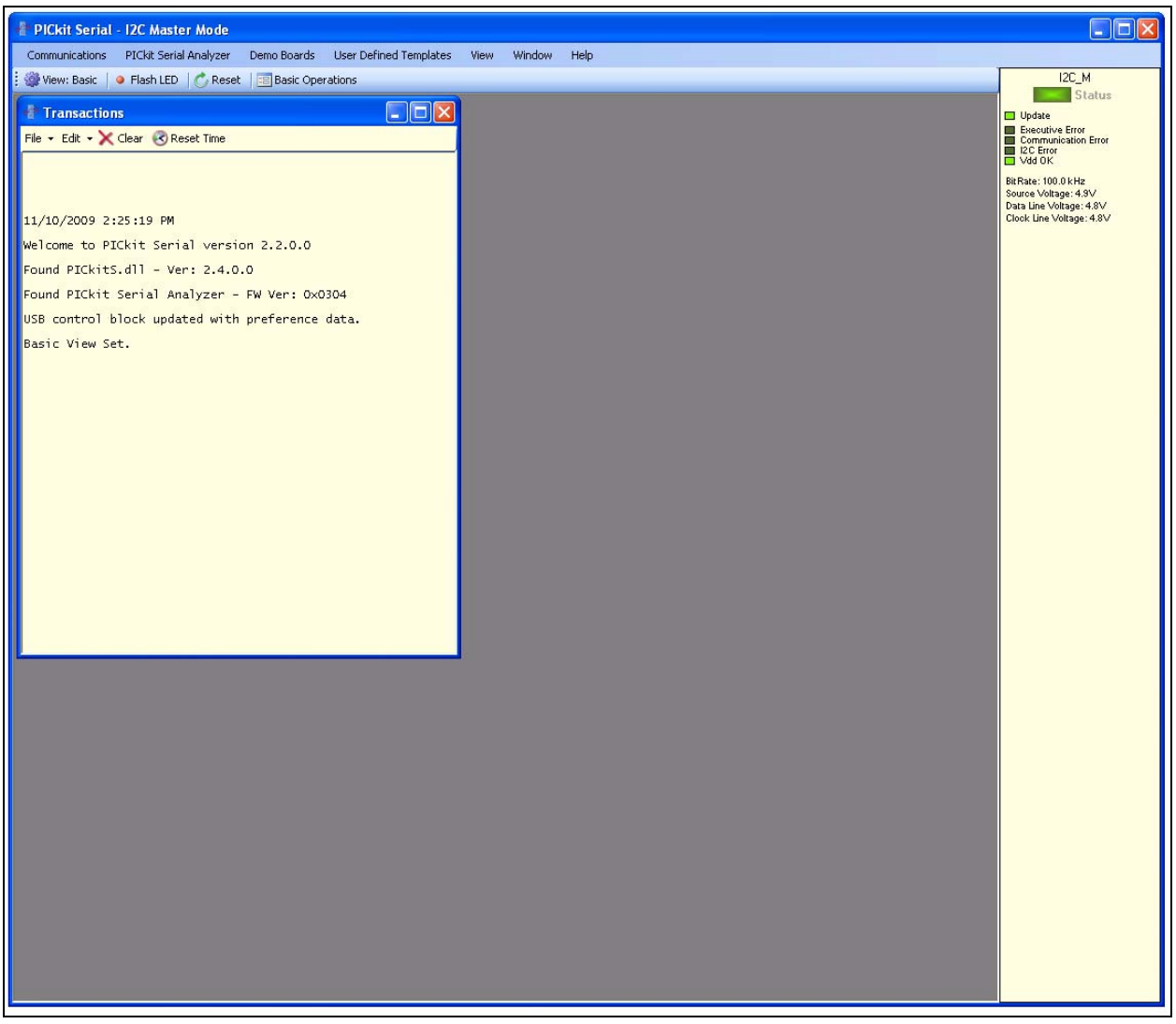


***FIGURE 2-4:*** *PICkit Serial Main Window at Startup.*


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We need to select the PICkit Serial Analyzer GUI to be in SPI Master mode. Figure 2-5 shows how to select the proper mode. Select *PICkit Serial Analyzer -> Select Communications Mode -> SPI Master* menu item (make sure the SPI Master item is checked).

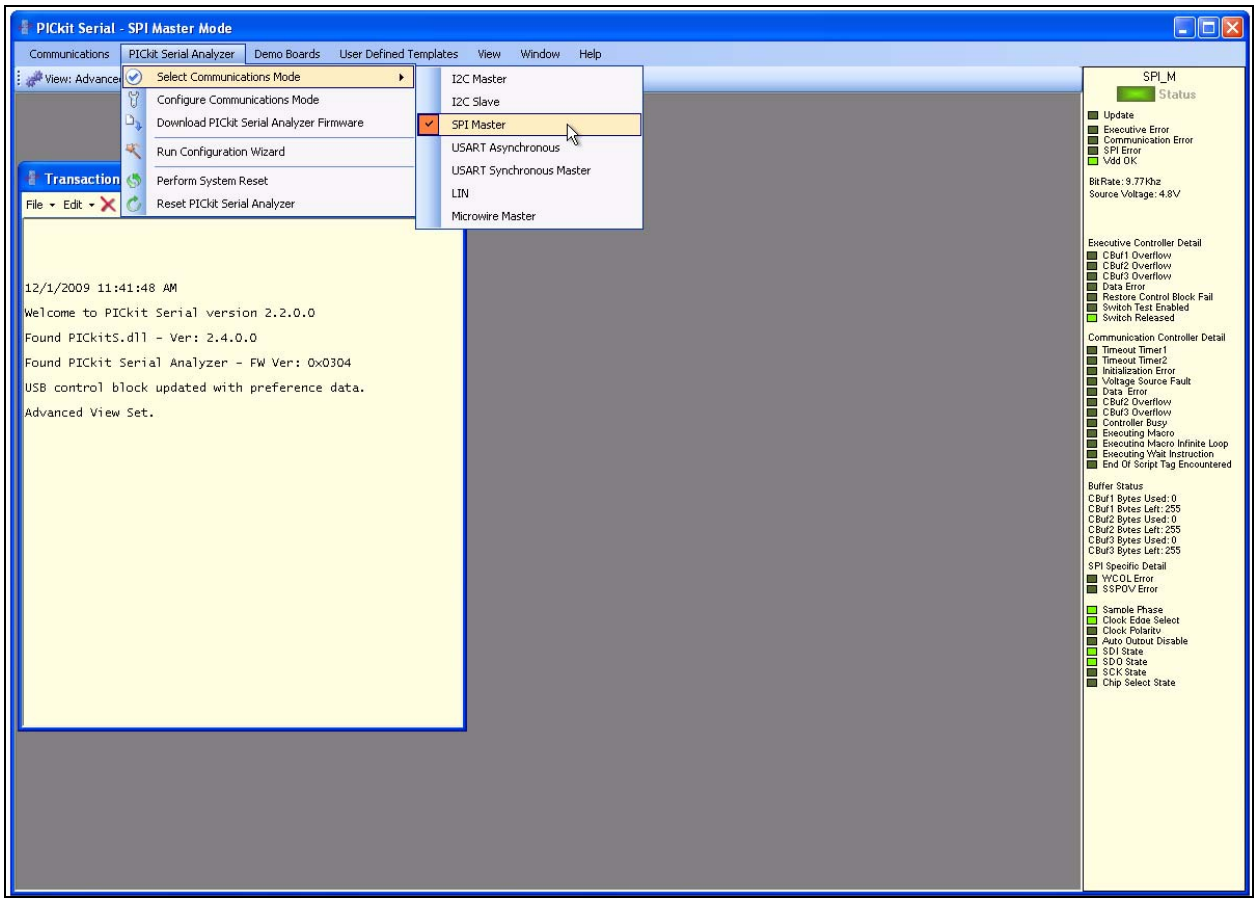


***FIGURE 2-5:*** *PICkit Serial Selecting Communications Mode.*

Now we need to configure the mode that we selected. Figure 2-6 shows how to configure the communications mode. Select *PICkit Serial Analyzer -> Configure Communications Mode* menu item. This will open a new window:

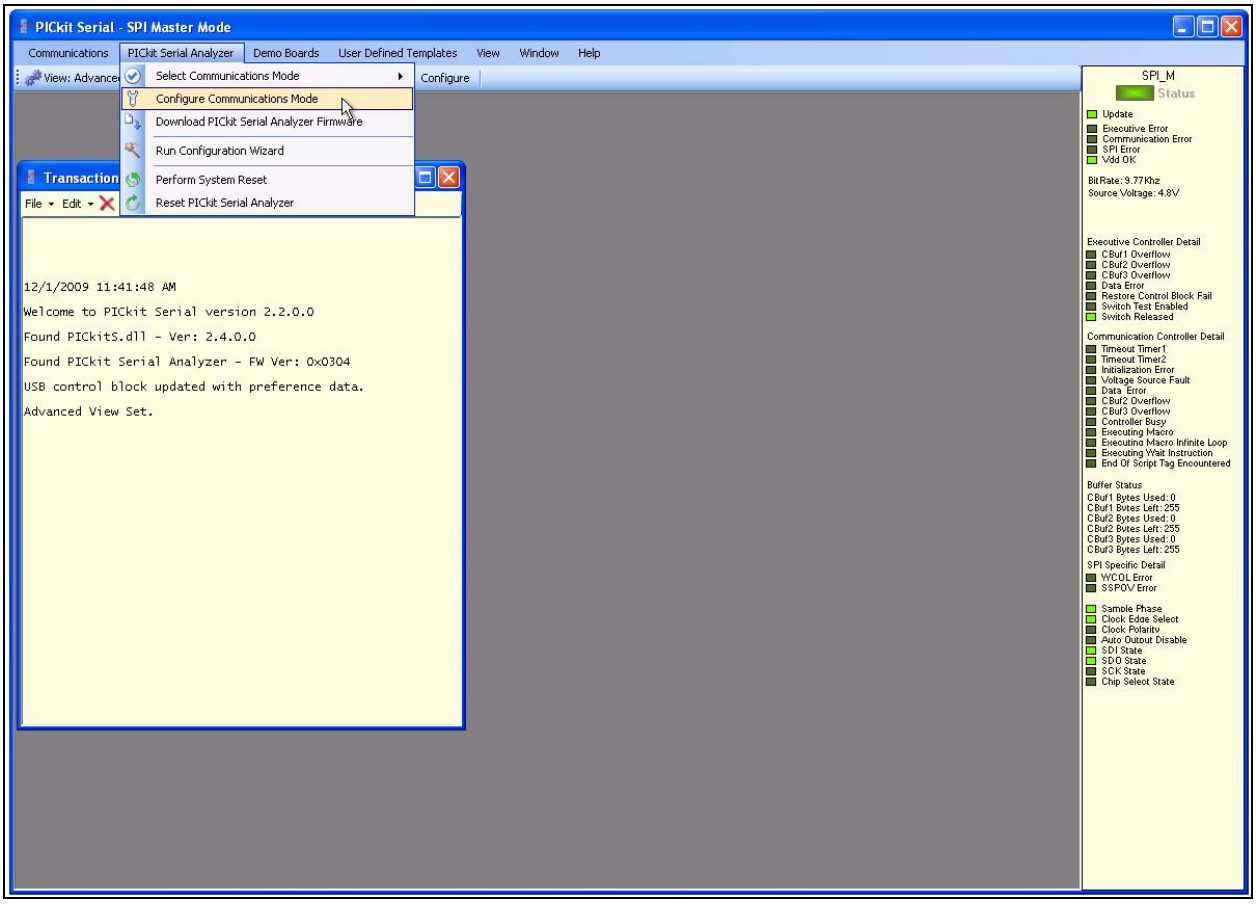


***FIGURE 2-6:*** *PICkit Serial Main Window at Startup.*


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Figure 2-7 shows the Configure Communications Mode window. Ensure that your window options and settings are the same as this window, and then select the “Save Changes” button. The “Configure Communications Mode” window may now be closed.

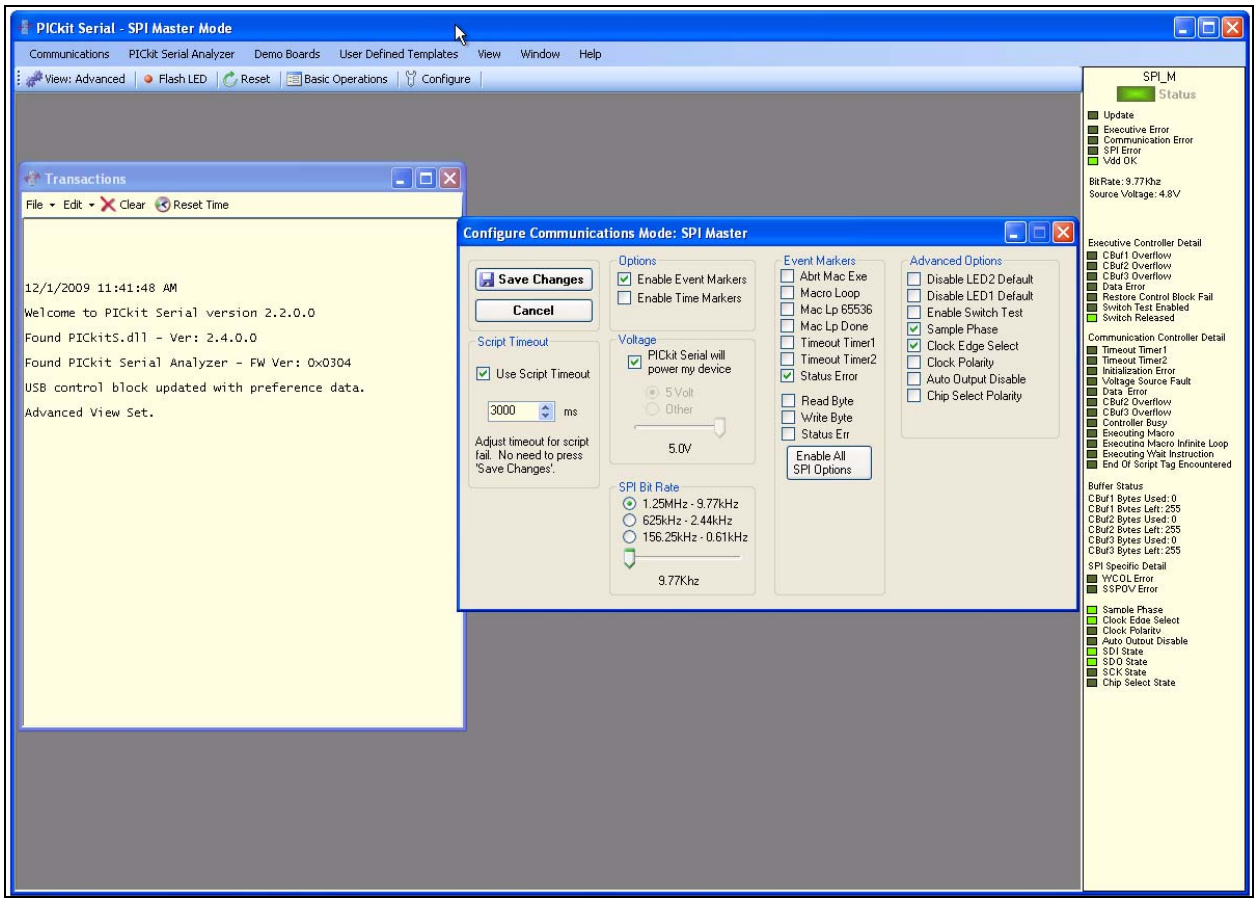


***FIGURE 2-7:*** *PICkit Serial Configure Communications Mode Window.*

Now we are going to open the Script Builder window, select the Communications -> Script -> Script Builder menu item (see Figure 2-8).

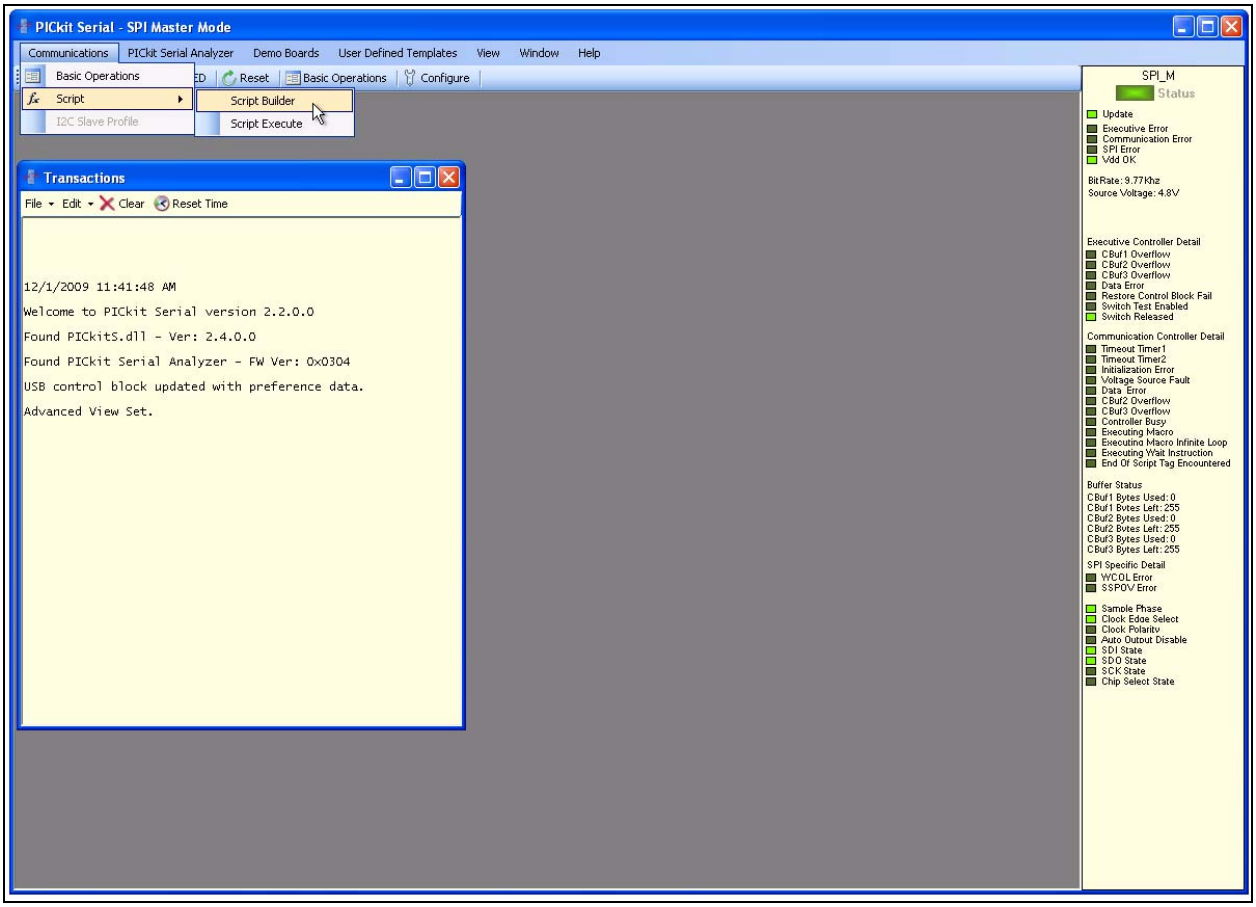


***FIGURE 2-8:*** *PICkit Serial - Script Builder Menu Selection.*


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The Script Builder window is shown in Figure 2-9. In this window we see the User SPI Scripts including the ones that were added to the “CommScripts.txt “ file.

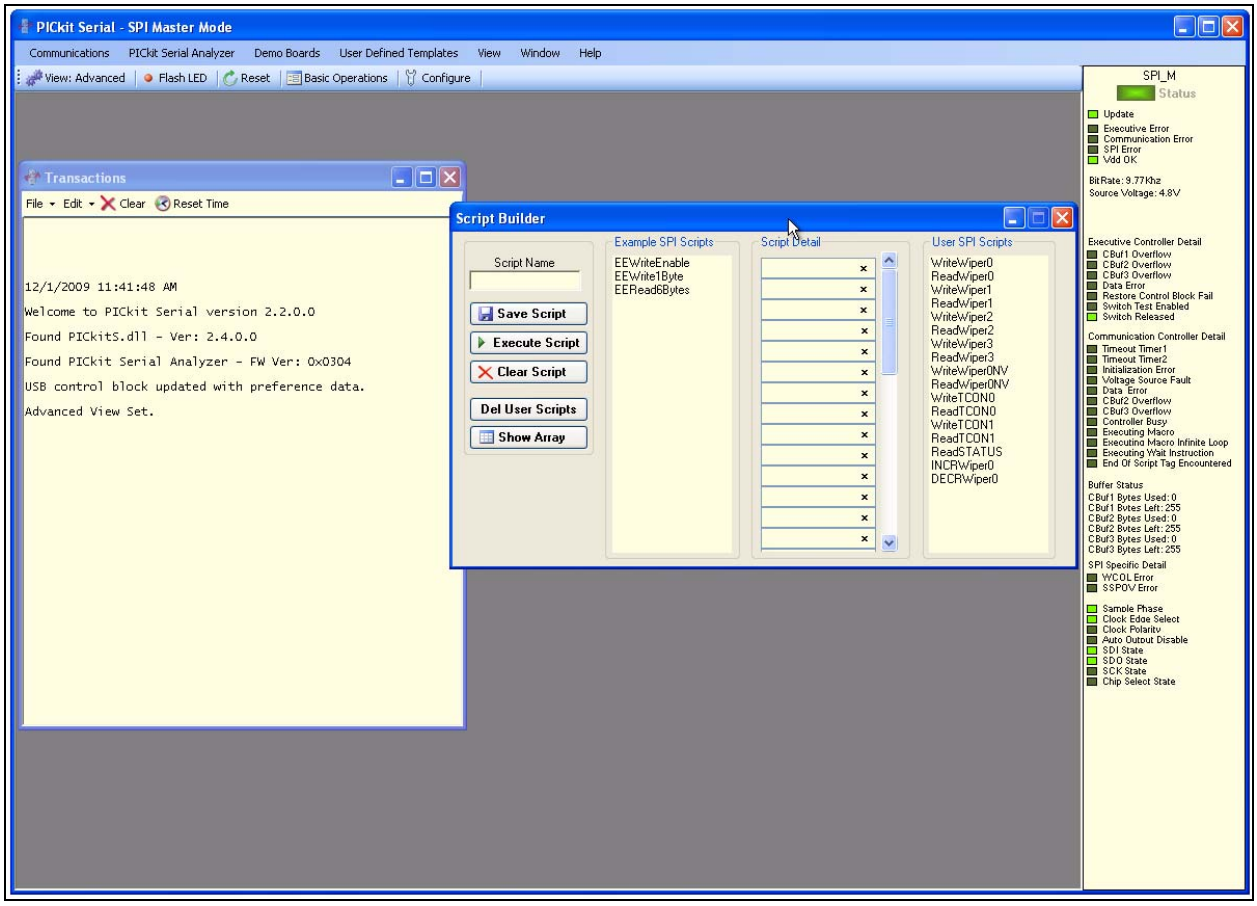


***FIGURE 2-9:*** *PICkit Serial Main Window at Startup.*

Double clicking on the WriteWiper0 User SPI Script will load the Script Details. Figure 2-10 shows what the values mean in the Script Details. These values are hex numbers.

The first value (02h), is the number of bytes that will be written. The second byte is a data byte and contains the Device Register Address, the Device Command, and the two Most Significant bits (MSb) of the write data. The third byte is the second data byte and contains the remaining 8 bits of the write data.

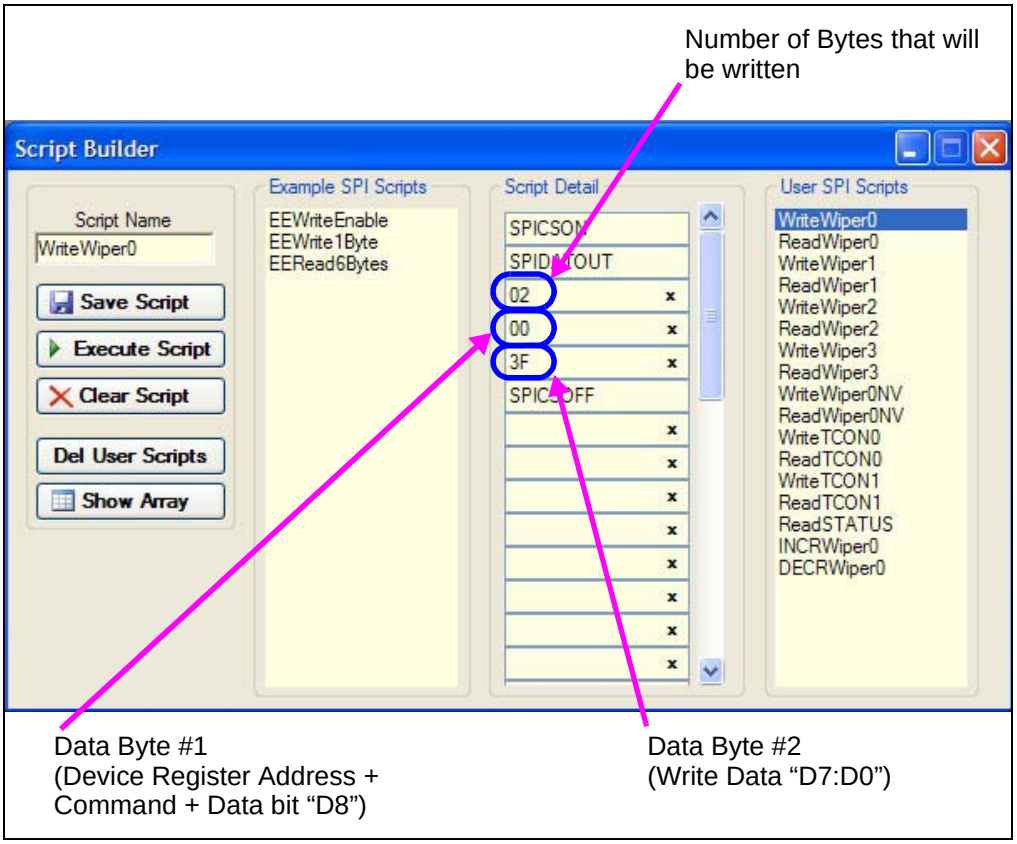


***FIGURE 2-10:*** *Example Write Script.*


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Double clicking on the ReadWiper0 User SPI Script will load the Script Details. Figure 2-11 shows what the values mean in the Script Details. These values are hex numbers.

The first value (02h), is the number of bytes that will be written. The second byte is a data byte and contains the Device Register Address, the Device Command, and the two Most Significant bits (MSb) of the read data. The third byte is the second data byte and contains the remaining 8 bits of the read data.

During read commands, the value of the two LSbs of Data Byte #1 and all of the bits of Data Byte #2 are not important. The bytes are required for the SPI clock generation.

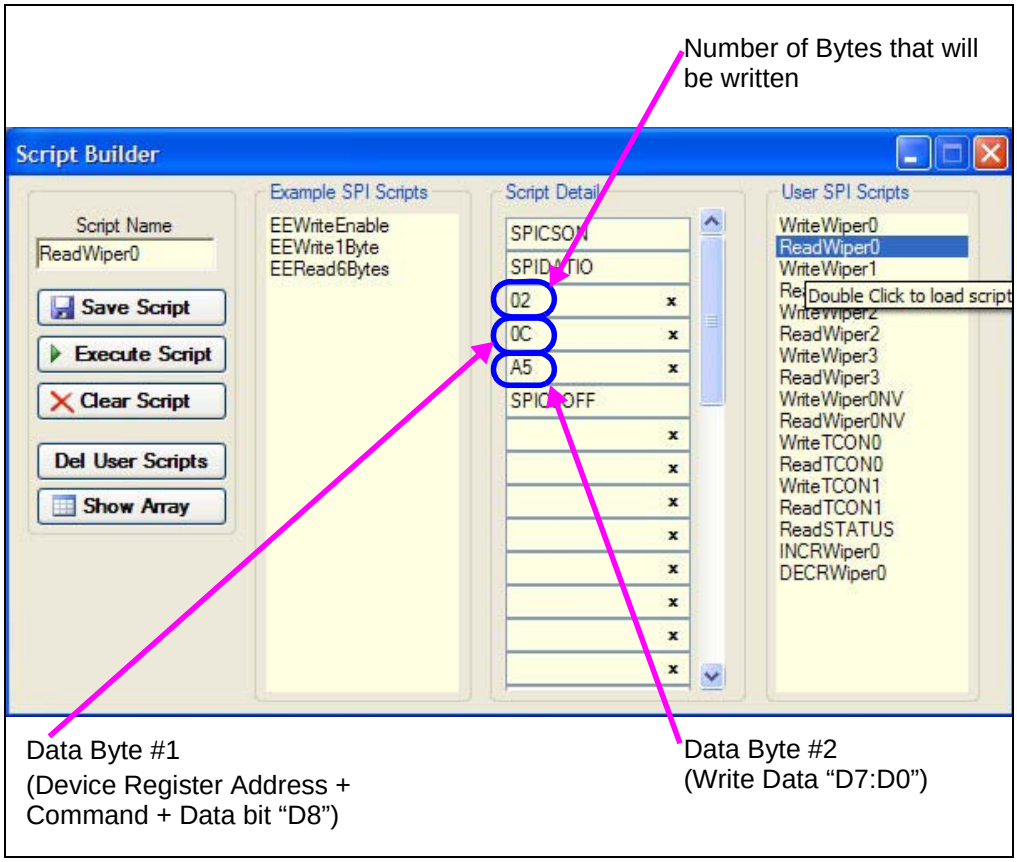


***FIGURE 2-11:*** *Example Read Script.*

## 2.6 MCP4361 DEMO STEPS

This demo assumes that you know how to configure the PICkit Serial Analyzer for Master SPI operation. See **Section 2.5 "Configuring The PICkit Serial Analyzer"** or the PICkit Serial Analyzer User's Guide (DS51647) for additional information.

1. Plug the PICkit Serial device into the PC's USB port.
2. Plug the MCP43XXEV board into the PICkit Serial.
3. Add the User Scripts (see Example 2-1) to the "CommScripts.TXT" file.
4. Start the PICkit Serial GUI.
5. Ensure the GUI is in Master SPI communication mode (see Figure 2-5).
6. Ensure that the Master SPI configuration is appropriately configured (see Figure 2-7).
7. Measure the Wiper 0 voltage on the MCP43XXEV board (see Figure 2-2) using an oscilloscope or digital multimeter. Measure voltage from the ground plane (GND) to the Wiper (P12). The voltage on the Wiper should be ~ $V_{DD}$/2 (~2.5V).
8. Open the Script Builder window (see Figure 2-8).
9. Double click on the "WriteWiper0" script in the "Example SPI Scripts" column. This loads the Script Detail column (see Figure 2-10).
10. Click on the **Execute Script** button. This executes the script shown in the script detail column, which will update the Wiper value to 3Fh. The Wiper voltage will now be ~$V_{DD}$/4 (~1.25V). The Transaction window (see Figure 2-14) will be updated to indicate the execution of the script.
11. Select the "ReadWiper0" script in the User SPI Scripts column. It should look like Figure 2-11.
12. Click on the **Execute Script** button. This executes the script shown in the script detail column. The Transaction window (see Figure 2-14) will be updated to indicate the execution of the script. The Data read is shown in the last line.
13. Double click on the "WriteWiper0" script in the "Example SPI Scripts" column. This loads the Script Detail column and modifies the Wiper 0 data to 1FFh (see Figure 2-12).
14. Click on the **Execute Script** button. This executes the script shown in the script detail column, which will update the Wiper value to 1FFh. The Wiper voltage will now be ~$V_{DD}$ (~5V). The Transaction window (see Figure 2-14) will be updated to indicate the execution of the script.
15. Select the "ReadWiper0" script in the User SPI Scripts column. It should look like Figure 2-11.
16. Click on the **Execute Script** button. This executes the script shown in the script detail column. The Transaction window (see Figure 2-14) will be updated to indicate the execution of the script. The Data read is shown in the last line.
17. Double click on the "WriteTCON1" script in the "Example SPI Scripts" column. This loads the Script Detail column.
18. Click on the **Execute Script** button. This executes the script shown in the script detail column. The Transaction window (see Figure 2-15) will be updated to indicate the execution of the script.
19. Select the "ReadTCON1" script in the User SPI Scripts column. It should look like Figure 2-13.
20. Click on the **Execute Script** button. This executes the script shown in the script detail column. The Transaction window (see Figure 2-15) will be updated to indicate the execution of the script. The Data read is shown in the last line.
21. In the Transaction window, click the **Clear** button.
22. On the PICkit Serial Analyzer command bar, click the **Reset** button.


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23. Select the “WriteWiper0” script in the User SPI Scripts column and then click on the **Execute Script** button.
24. Select the “ReadWiper0” script in the User SPI Scripts column and then click on the **Execute Script** button.
25. Select the “DECRWiper0” script in the User SPI Scripts column and then click on the **Execute Script** button three times.
26. Select the “ReadWiper0” script in the User SPI Scripts column and then click on the **Execute Script** button. The Transaction window shows the scripts that were executed and the current value of the Wiper 0 (see Figure 2-16).
27. In the Transaction window, click the **Clear** button.
28. On the PICkit Serial Analyzer command bar, click the **Reset** button.
29. Select the “WriteWiper0” script in the User SPI Scripts column and then click on the **Execute Script** button.
30. Select the “ReadWiper0” script in the User SPI Scripts column and then click on the **Execute Script** button.
31. Select the “INCRWiper0” script in the User SPI Scripts column and then click on the **Execute Script** button three times.
32. Select the “ReadWiper0” script in the User SPI Scripts column and then click on the **Execute Script** button. The Transaction window shows the scripts that were executed and the current value of the Wiper 0 (see Figure 2-17).
33. You can repeat the sequence of writing values to the Wiper register, or by Writing then Reading the values back.

**NOTICE**

**If at any time during script execution, an error message is generated in the transaction window, it is good practice to reset the PICkit Serial Analyzer (PKSA). The PKSA can be reset using the “Reset” toolbar icon. Verify that subsequent script operations do not generate errors.**

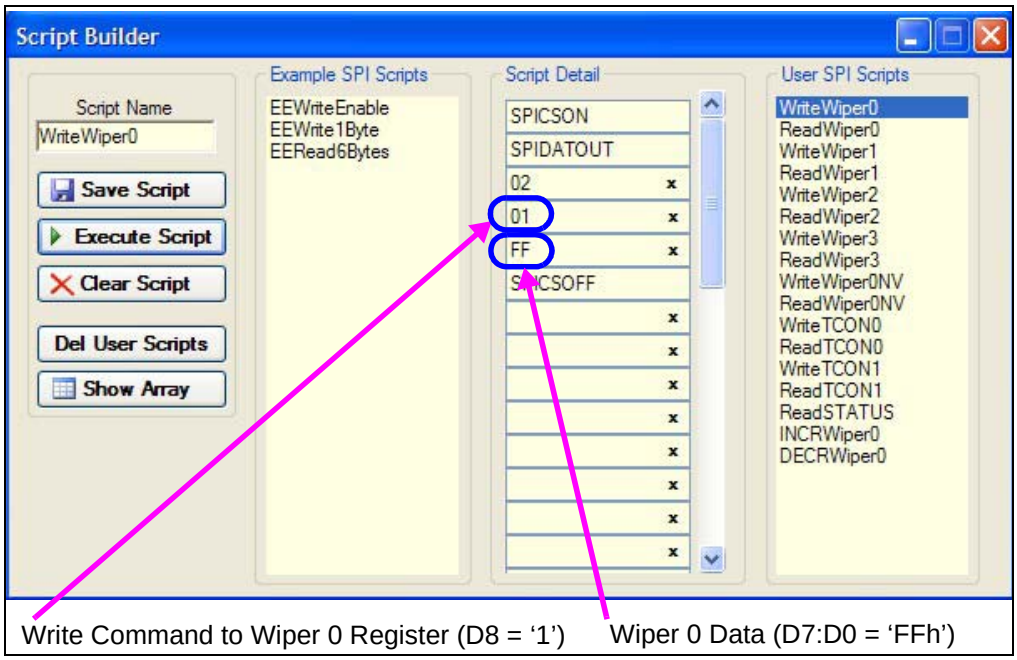


***FIGURE 2-12:*** *MCP43XX Write Wiper 0 Script File - Updating Wiper Value.*

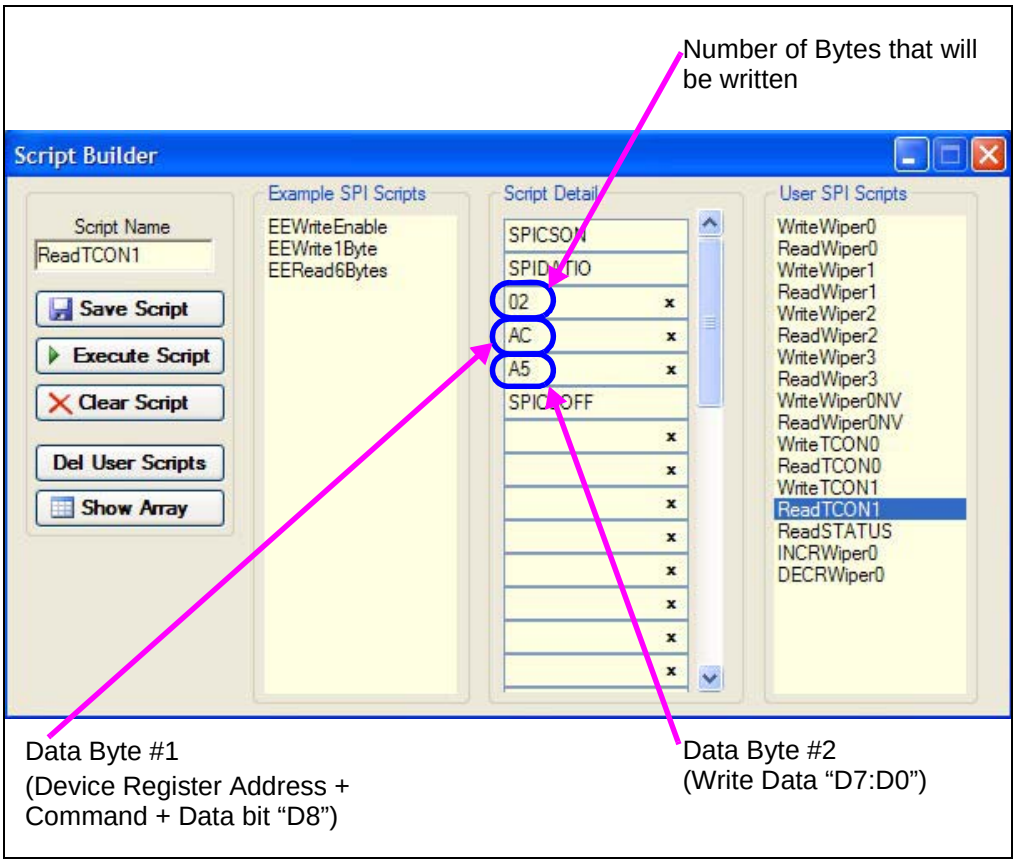


***FIGURE 2-13:*** *MCP43XX Read TCON1 Script.*

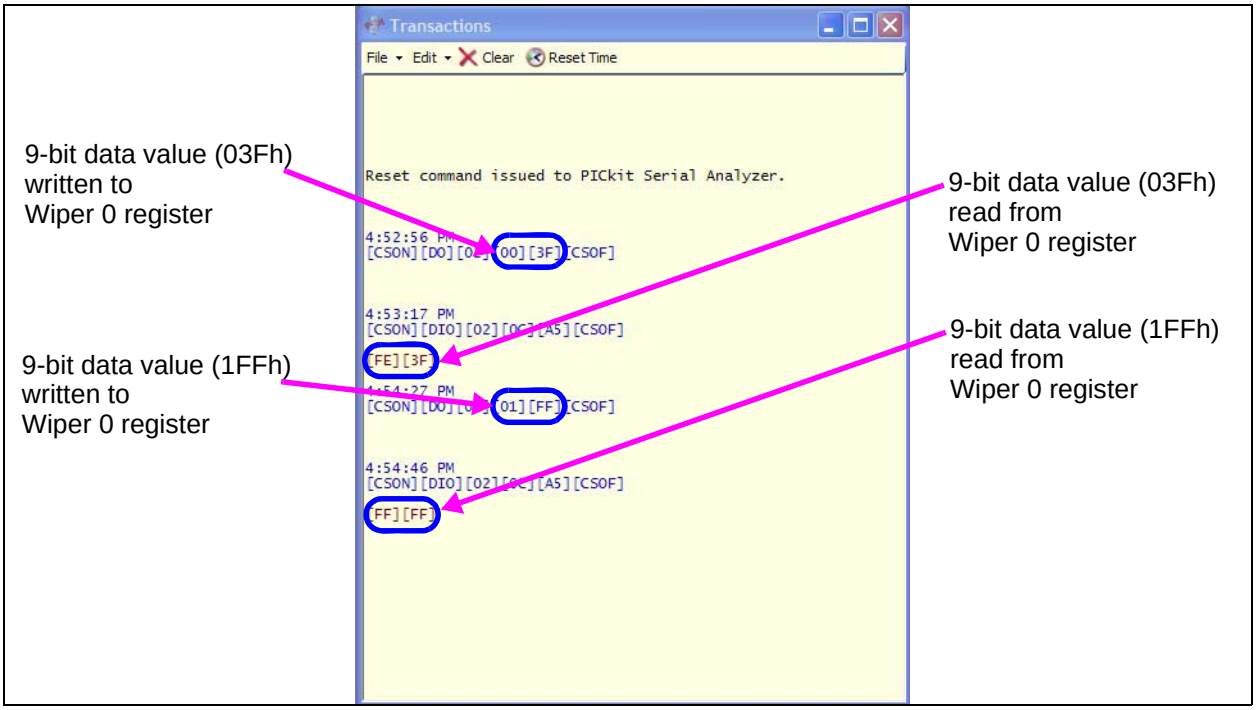


***FIGURE 2-14:*** *MCP4361 Transaction Window - Wiper 0 Writes and Reads.*


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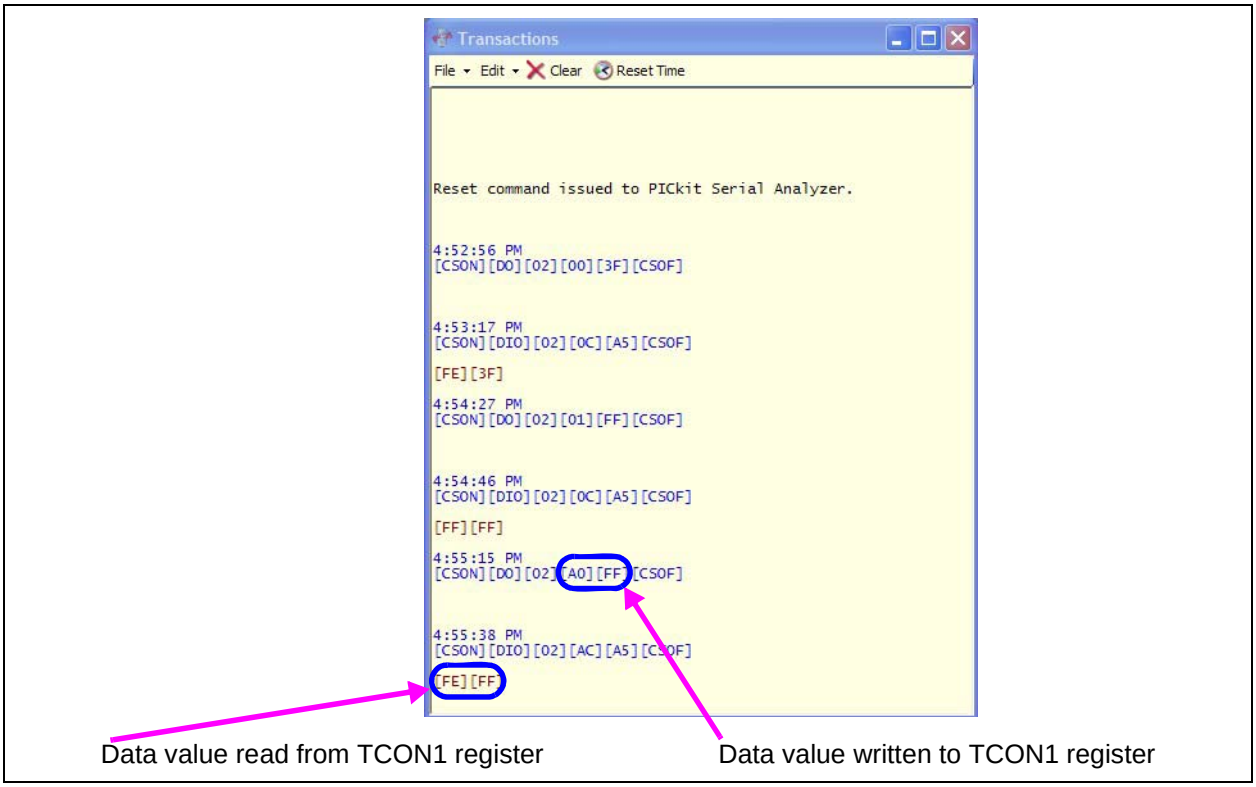


***FIGURE 2-15:*** *MCP4361 Transaction Window - TCON1 Writes and Reads.*

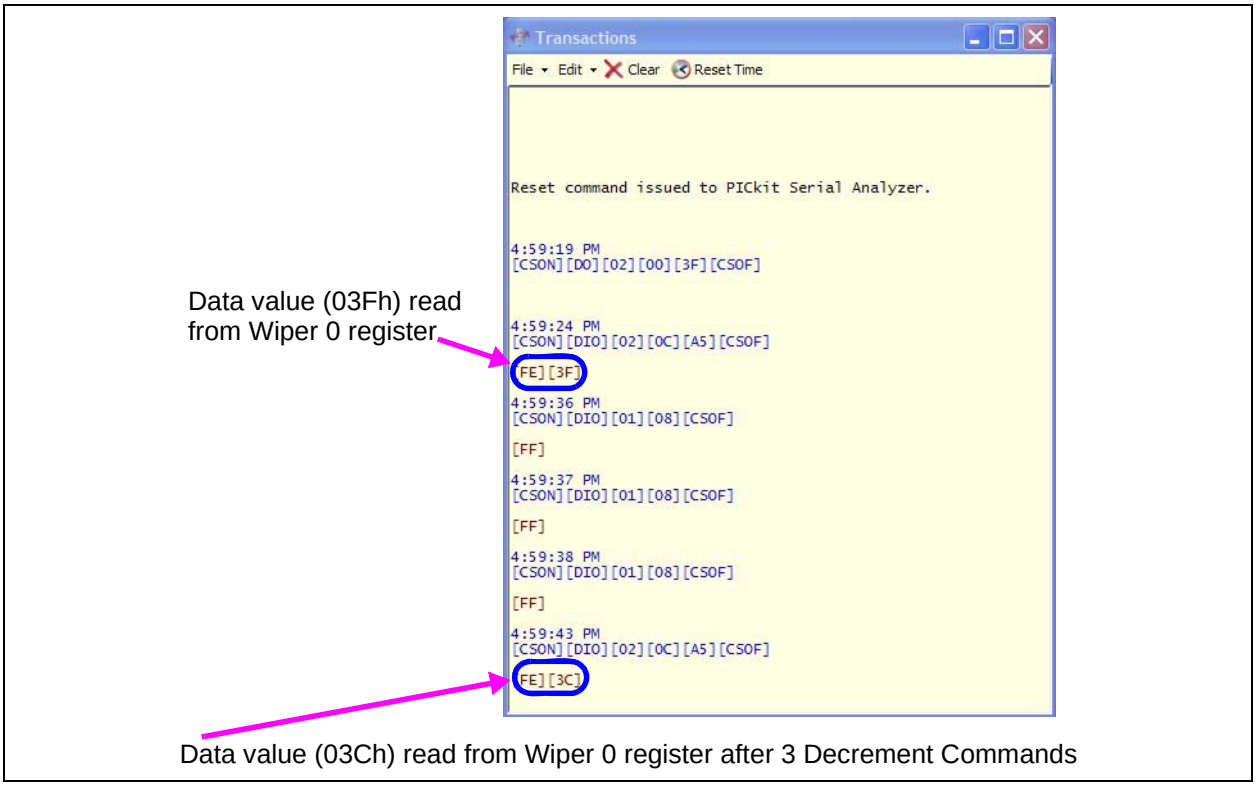


***FIGURE 2-16:*** *MCP4361 Transaction Window - Wiper 0 Decrements.*

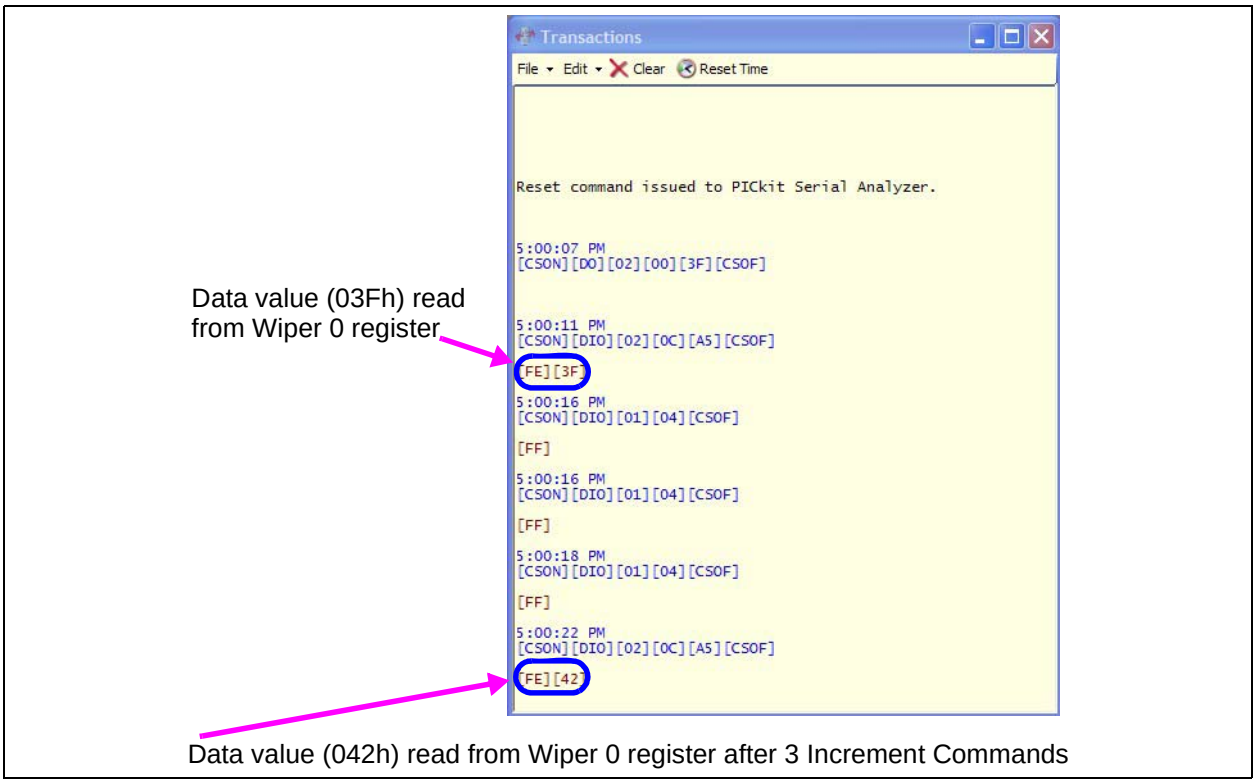


***FIGURE 2-17:*** *MCP4361 Transaction Window - Wiper 0 Increments.*

### 2.6.1 The TSSOP20EV PCB and Supported Digital Potentiometers

Table 2-4 shows the current Digital Potentiometers that are supported by the TSSOP20EV PCB.

**TABLE 2-4: TSSOP20EV PCB SUPPORTED DIGITAL POTENTIOMETERS**

| Device | TSSOP-20 | TSSOP-14 | Comment |
|---|---|---|---|
| **MCP4231** | — | Yes | Dual Pot, SPI Interface |
| **MCP4241** | — | Yes | Dual Pot, SPI Interface |
| **MCP4251** | — | Yes | Dual Pot, SPI Interface |
| **MCP4261** | — | Yes | Dual Pot, SPI Interface |
| **MCP4331** | Yes | — | Quad Pot, SPI Interface |
| **MCP4341** | Yes | — | Quad Pot, SPI Interface |
| **MCP4351** | Yes | — | Quad Pot, SPI Interface |
| **MCP4361** | Yes | — | Quad Pot, SPI Interface |
| **MCP4631** | — | Yes | Dual Pot, $I^2C$ Interface |
| **MCP4641** | — | Yes | Dual Pot, $I^2C$ Interface |
| **MCP4651** | — | Yes | Dual Pot, $I^2C$ Interface |
| **MCP4661** | — | Yes | Dual Pot, $I^2C$ Interface |
| **MCP42010** | — | Yes | Dual Pot, SPI Interface |
| **MCP42050** | — | Yes | Dual Pot, SPI Interface |
| **MCP42100** | — | Yes | Dual Pot, SPI Interface |


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# Appendix A. Schematic and Layouts

## A.1 INTRODUCTION

This appendix contains the schematics and layouts for the MCP43XXEV Evaluation Board. Diagrams included in this appendix:

- Board – Schematic
- Board – Top Trace, Silk and Pads
- Board – Bottom Trace and Pads
- Board – Layer 2 Ground Plane
- Board – Layer 3 Power Plane
- Board Layout – Top Components
- Board – Bottom Silk, Trace and Pads

## A.2 SCHEMATICS AND PCB LAYOUT

Board – Schematic shows the schematic of the MCP43XXEV Evaluation Board. The layer order is shown in Figure A-1.

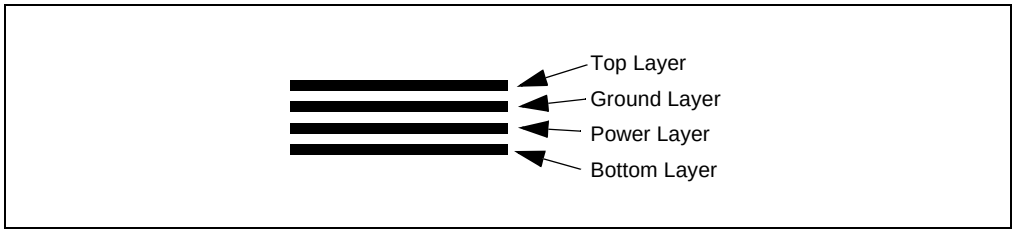
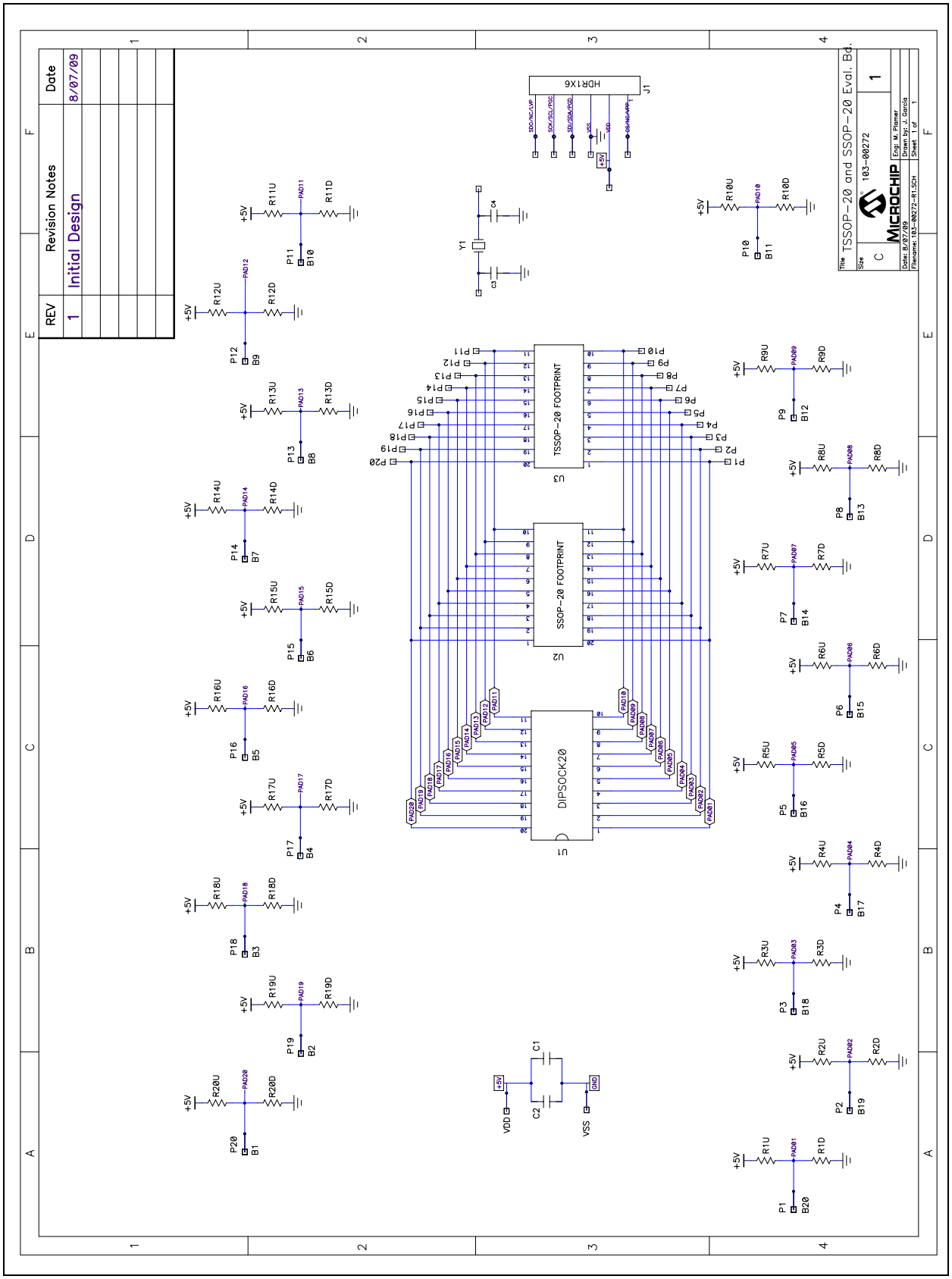



***FIGURE A-1:*** *Layer Order.*

## A.3 BOARD – SCHEMATIC





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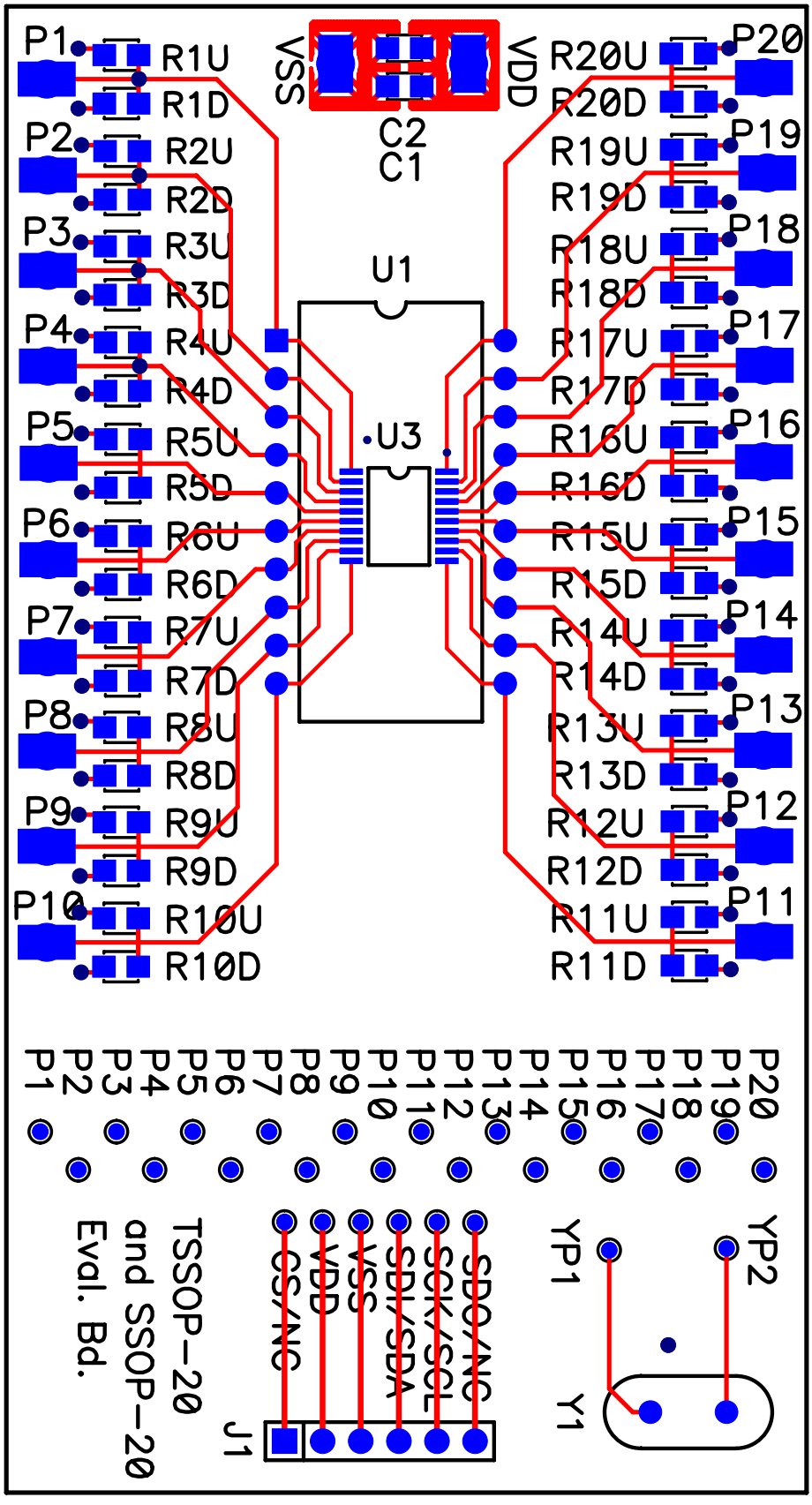
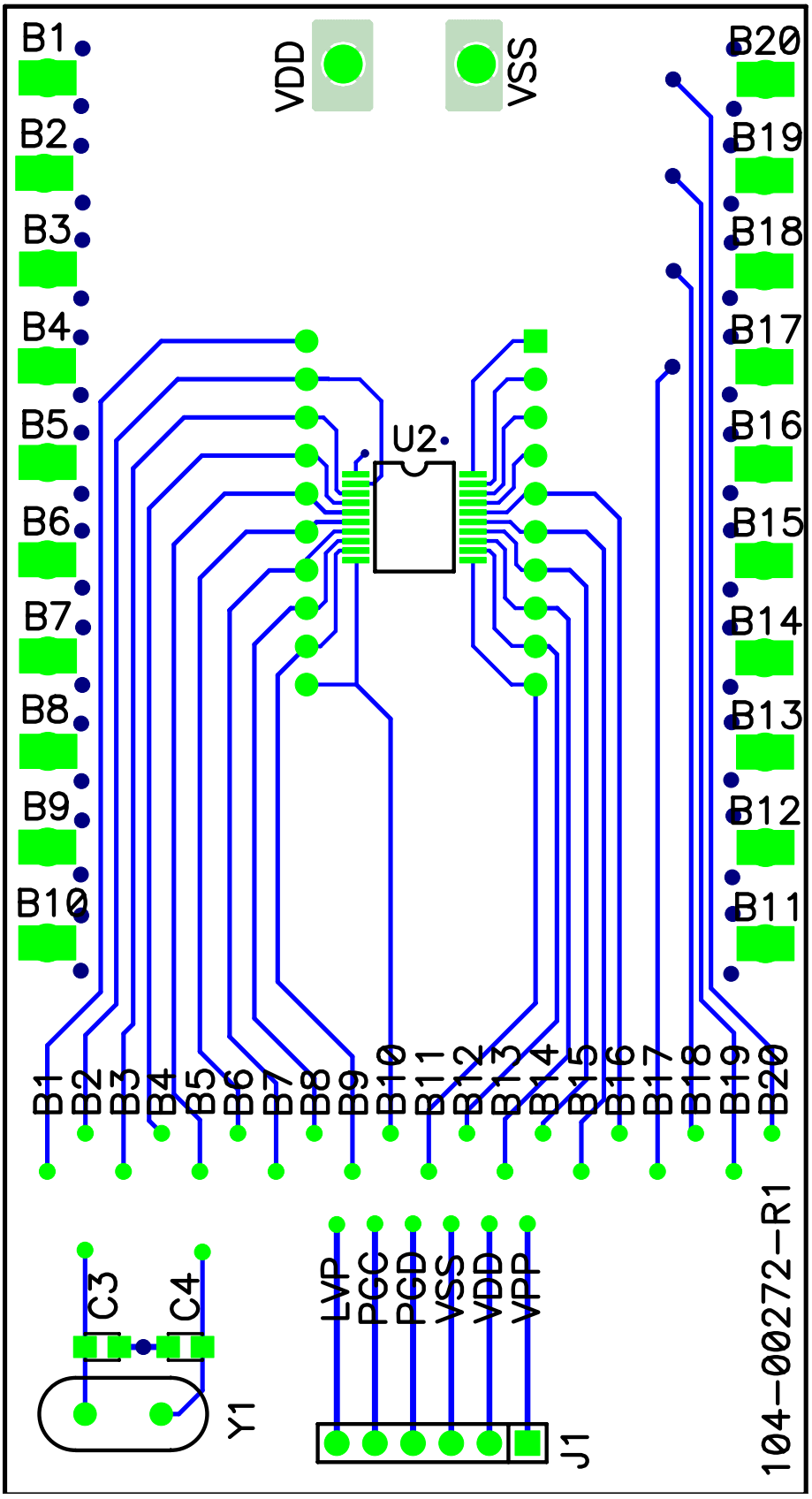
## A.4 BOARD – TOP TRACE, SILK AND PADS



## A.5 BOARD – BOTTOM TRACE AND PADS





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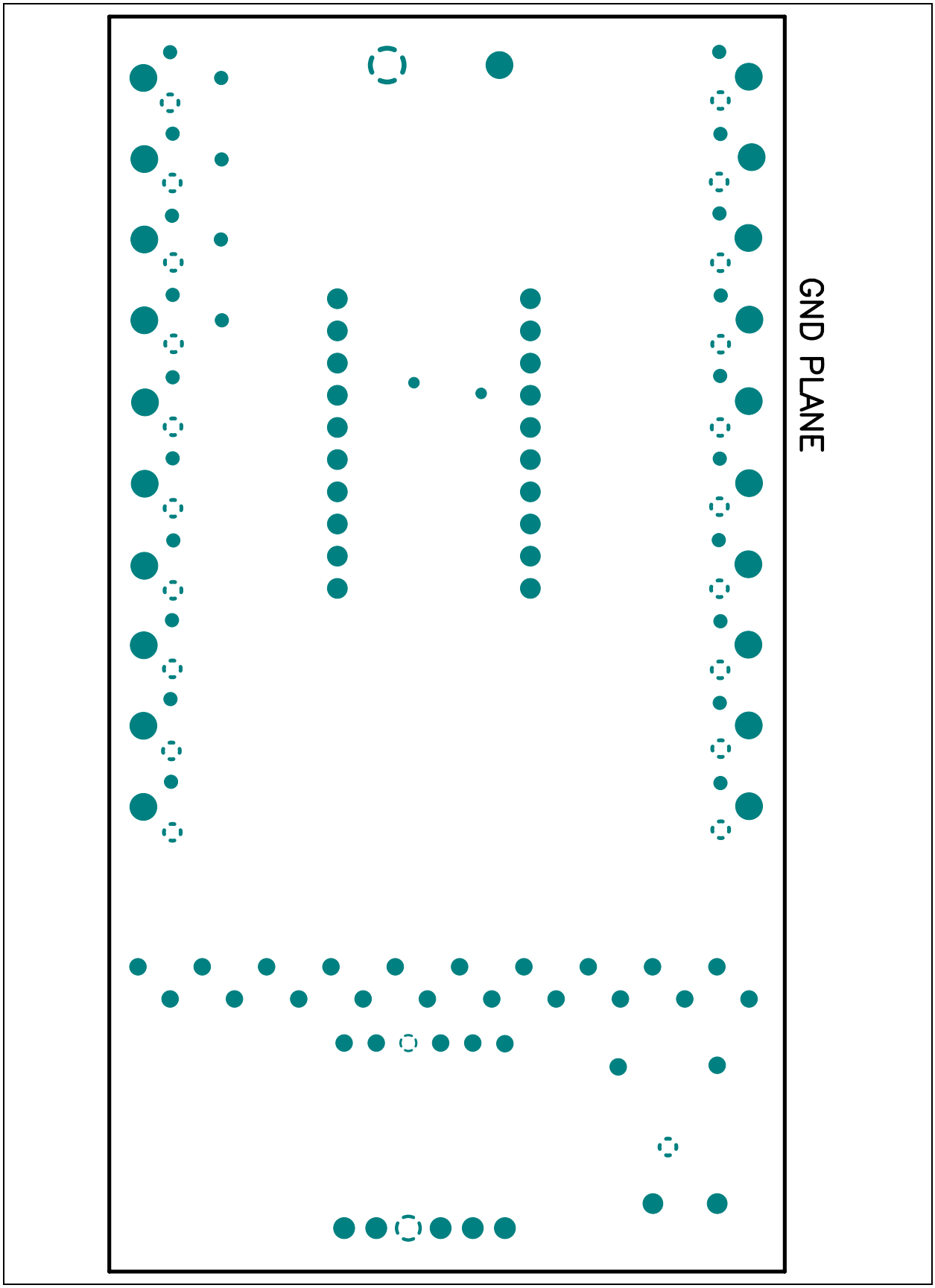
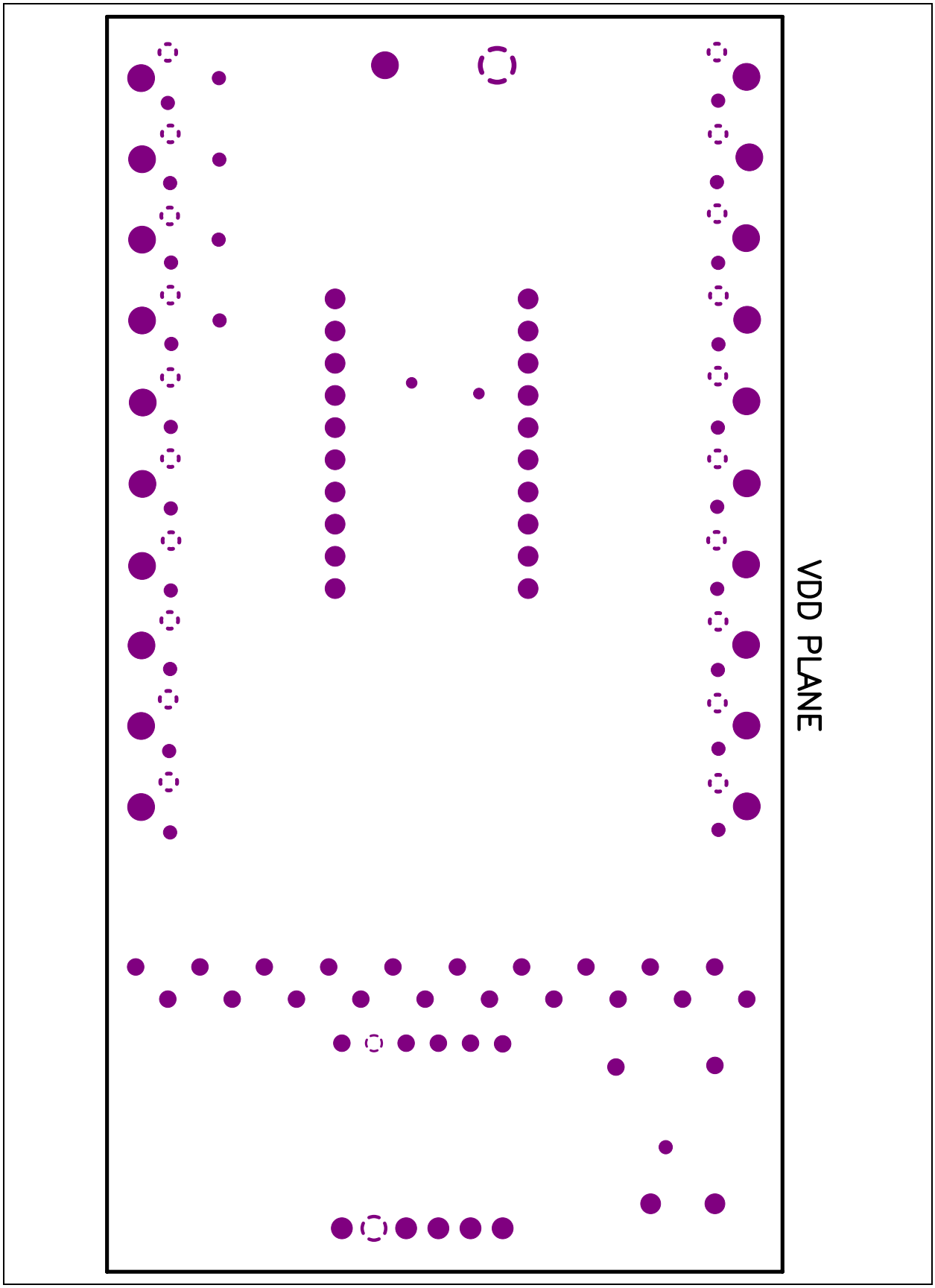
## A.6 BOARD – LAYER 2 GROUND PLANE



## A.7 BOARD – LAYER 3 POWER PLANE





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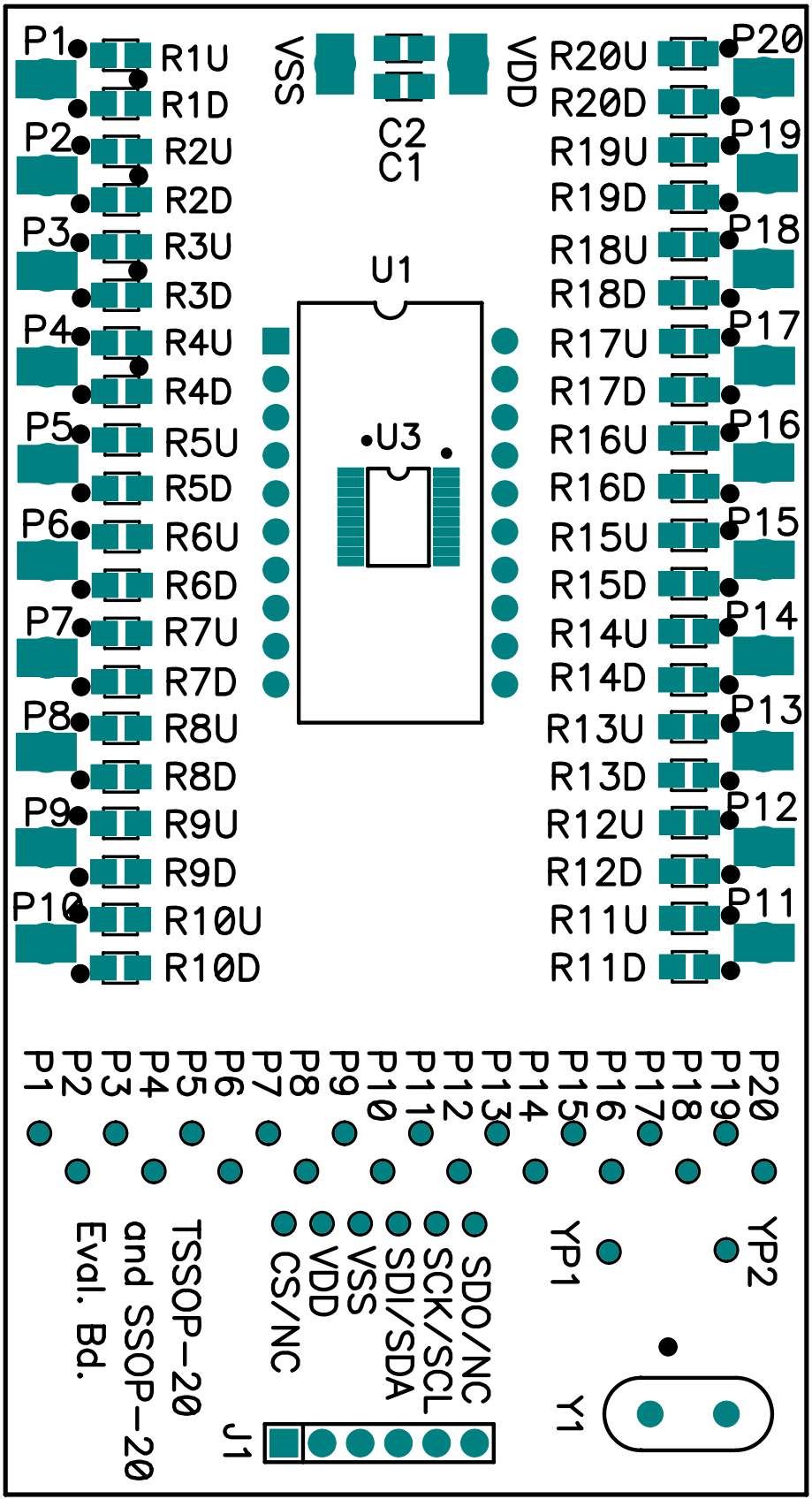
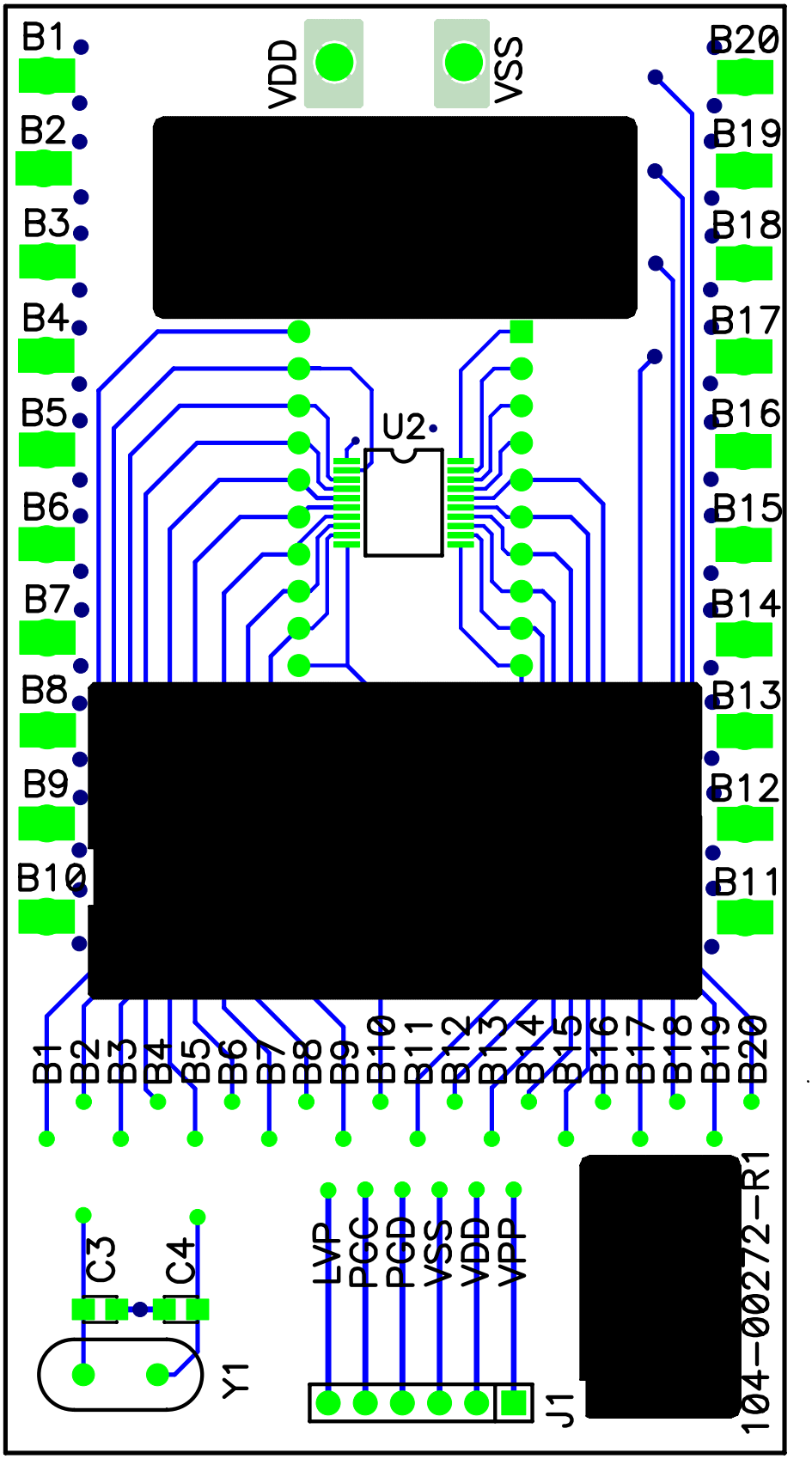
## A.8 BOARD LAYOUT – TOP COMPONENTS



## A.9 BOARD – BOTTOM SILK, TRACE AND PADS





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# Appendix B. Bill of Materials (BOM)

**TABLE B-1: BILL OF MATERIALS**

| Qty | Reference | Description | Manufacturer | Part Number |
|---|---|---|---|---|
| 1 | PCB | **Note 1** | Microchip Technology Inc. | 104-00272 |
| 8 | R1U, R3D, R7D R8D, R10U, R17U R15U, R14U | RES 0.0 OHM 1/8W 5% 0805 SMD | Panasonic® - ECG | ERJ-6GEY0R00V |
| 2 | R14U, R15U | RES 10.0K OHM 1/8W 1% 0805 SMD | Panasonic - ECG | ERJ-6ENF1002V |
| 1 | U3 | MCP4361 Quad SPI Digi-Pot (10K Ohm version ) | Microchip Technology Inc. | MCP4361-103E/ST |
| 4 | P2, P9, P12, P19 | TEST POINT PC MULTI PURPOSE ORG | Keystone Electronics® | 5013 |
| 1 | J1 | CONN HEADER 6POS .100 R/A GOLD | Molex/Waldom Electronics Corp. | 22-28-8062 |

**Note 1:** This assembly uses RoHS Compliant TSSOP-20 to DIP-20 Evaluation Board.

**2:** 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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**ООО «ЛайфЭлектроникс»** **“LifeElectronics” LLC**

*ИНН 7805602321 КПП 780501001 Р/С 40702810122510004610 ФАКБ "АБСОЛЮТ БАНК" (ЗАО) в г.Санкт-Петербурге К/С 30101810900000000703 БИК 044030703*

*Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.*

*С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров*

*Мы предлагаем:*

- *Конкурентоспособные цены и скидки постоянным клиентам.*
- *Специальные условия для постоянных клиентов.*
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- *Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.*

- *Приемлемые сроки поставки, возможна ускоренная поставка.*
- *Доставку товара в любую точку России и стран СНГ.*
- *Комплексную поставку.*
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- *Сертификаты соответствия на поставляемую продукцию (по желанию клиента).*
- *Тестирование поставляемой продукции.*
- *Поставку компонентов, требующих военную и космическую приемку.*
- *Входной контроль качества.*
- *Наличие сертификата ISO.*

*В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.*

*Конструкторский отдел помогает осуществить:*

- *Регистрацию проекта у производителя компонентов.*
- *Техническую поддержку проекта.*
- *Защиту от снятия компонента с производства.*
- *Оценку стоимости проекта по компонентам.*
- *Изготовление тестовой платы монтаж и пусконаладочные работы.*

*Тел: +7 (812) 336 43 04 (многоканальный)*
*Email: org@lifeelectronics.ru*

***www.lifeelectronics.ru***