MCP2140 IrDA® Standard Wireless Temperature Sensor Demo Board User's Guide

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MCP2140 IrDA® STANDARD WIRELESS TEMPERATURE SENSOR DEMO 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 MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board. Items discussed in this chapter include:

- About This Guide
- Recommended Reading
- The Microchip Web Site
- Customer Support

MCP2140 IrDA® Standard Wireless Temp Sensor Demo Board

ABOUT THIS GUIDE

Document Layout

This document describes how to use the MCP2140 IrDA® Standard Wireless Temperature Sensor Demo Board User's Guide.

The manual layout is as follows:

- **Chapter 1: Product Overview** – Information about the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board.
- **Chapter 2: MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board** – This chapter includes a detailed description of the hardware instructions on how to get started with this demo board, a description of functions of the demo board and instructions on running the demos.
- **Appendix A: Schematic and Layouts** – Shows the schematic and layout diagrams for the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board.
- **Appendix B: Bill of Materials** – Lists the parts used to build the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board.
- **Appendix C: Connection Sequence** – Shows the high-level connection sequence between a Primary device and the MCP2140 (Secondary device). This connection sequence is shown at an overview level and does not detail exact operation.
- **Appendix D: 250 Byte Transmit Table** – This table shows the data that is transmitted by the program when in 250 Byte Transmit mode.
- **Appendix E: Alternative Optical Transceiver Selection** – This board was designed to support the Vishay® TFDU 4100 (default selection), TFDU 4300 and the Agilent® HSDL 3000. This section describes what needs to be done to implement one of the other two options.
- **Appendix F: Using AN888 Program with a Palm™ PDA** – Shows how to use the Palm PDA and Application Note 888, "Programming the Palm OS® for Embedded IR Applications" (DS00888), to demonstrate the demo 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
'b*nnnn*	A binary number where *n* is a digit	'b00100, 'b10
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier font:		
Plain Courier	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`
Italic Courier	A variable argument	`file`.o, where `file` can be any valid filename
0x*nnnn*	A hexadecimal number where *n* is a hexadecimal digit	`0xFFFF, 0x007A`
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)`
		`{ ...`
		`}`

MCP2140 IrDA® Standard Wireless Temp Sensor Demo Board

RECOMMENDED READING

This user's guide describes how to use the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

MCP2140 Data Sheet (DS21790)

This data sheet provides detailed information regarding the MCP2140 device.

THE MICROCHIP WEB SITE

Microchip provides online support via our WWW site at www.microchip.com. This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site 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 (FAQ), technical support requests, online discussion groups and the 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

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- 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

Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MCP2140 IrDA® Standard Wireless Temperature Sensor Demo Board and covers the following topics:

- What is the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board?
- What the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board kit includes

1.2 WHAT IS THE MCP2140 IrDA STANDARD WIRELESS TEMPERATURE SENSOR DEMO BOARD?

The MCP2140 IrDA Standard Protocol Stack Controller device allows the system designer to implement a low-cost wireless IR port in any application, providing support for the IrDA standard protocol stack and IrDA standard bit encoding/decoding.

The MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board is used to evaluate and demonstrate the MCP2140 device in a data-logging application by transmitting ambient temperature to a PDA (e.g., Palm™ PDA) or laptop computer. It is intended to serve as an example to assist system designers in developing an IrDA standard node using the MCP2140 device.

1.3 WHAT THE MCP2140 IrDA STANDARD WIRELESS TEMPERATURE SENSOR DEMO BOARD KIT INCLUDES

This MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board Kit includes:

- The MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board
- Demo Board Firmware
- MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board User's Guide

NOTES:

Chapter 2. MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board

2.1 INTRODUCTION

The MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board demonstrates the MCP2140 device in a real-world application. In addition, the system designer will be able to use this design as an example of how to integrate an IR port into their system.

2.2 FEATURES

The MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board has the following features:

- Demo board communicates directly to Primary device (PDA or laptop computer) running a terminal emulation application program
- Data is transmitted in an easy-to-read format
- Reprogrammable PIC18F1320 with In-Circuit Debugger (ICD) interface for user application development
- Header that allows either several board signals to be monitored or allows the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board to be interfaced to user's system
- Three LEDs that indicate MCP2140 status (CTS, DSR and PHACT activity)
- Powered by three AAA batteries
- Power jumper and power LED indicator

2.3 GETTING STARTED

The MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board is fully assembled and tested for evaluation and demonstration of the MCP2140 features. A block diagram of the demo board is shown in Figure 2-1. Refer to **Appendix A. "Schematic and Layouts"** and **Appendix B. "Bill-Of-Materials (BOM)"** for more detailed circuit information.

FIGURE 2-1: MCP2140 DEMO BOARD BLOCK DIAGRAM
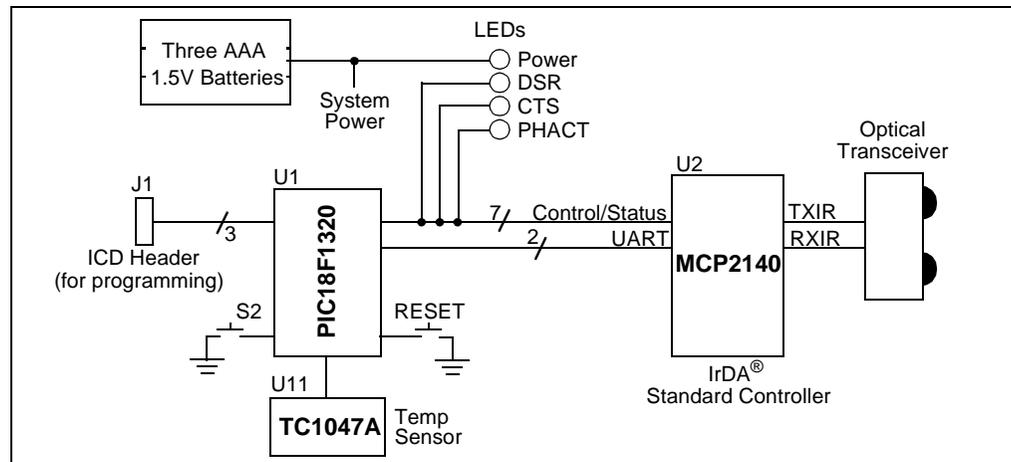
MCP2140 IrDA® Standard Wireless Temp Sensor Demo Board

2.3.1 The Hardware

Figure 2-2 shows the layout of the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board with points of interest encircled.

Figure 2-3 shows the switches used to reset the PIC18F1320 and selects one of two demo programs. The **RESET** switch resets the PIC18F1320, while switch **S2** is used for program selection.

FIGURE 2-2: **MCP2140 IrDA® STANDARD WIRELESS TEMP SENSOR DEMO BOARD**
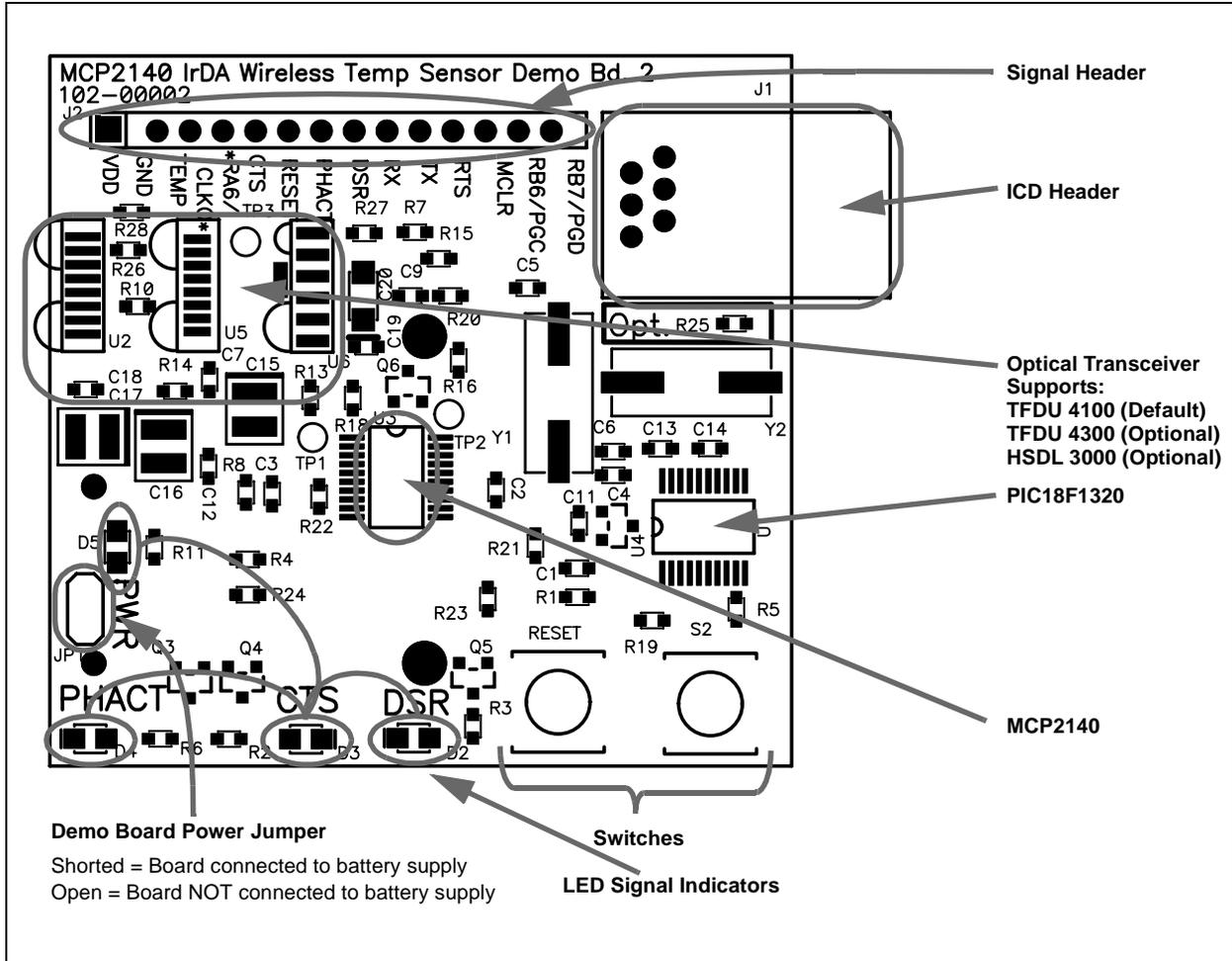
FIGURE 2-3: MCP2140 IrDA® STANDARD WIRELESS TEMP SENSOR DEMO BOARD

When RESET switch → Depressed to not Depressed

If: S2 = Depressed: temperature sensor firmware routine is initialized.

S2 = Not depressed: data upload firmware routine is initialized.
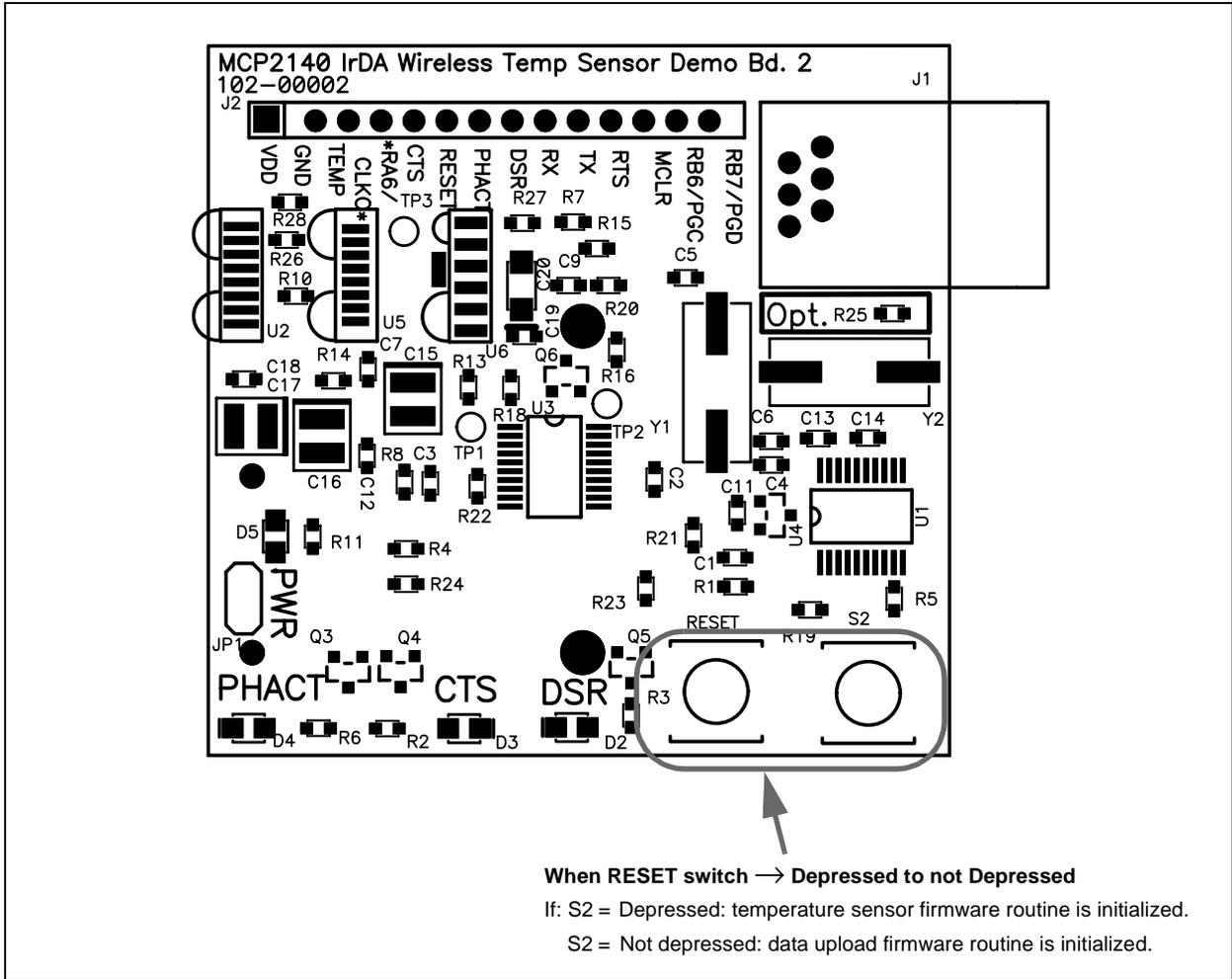
2.3.2   The Embedded System Firmware

There are two programs that can be demonstrated on the demo board. These are:

• The transmission of a 250 byte data string from a table in the PIC18F1320 to the Primary device.
• The transmission of the "temperature" reading of the TC1047A to the Primary device.

Typical Primary devices include Palm or Pocket PC PDAs and Laptop PCs with an IrDA standard infrared port.

The PIC18F1320 source code for the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board is available for download from the Microchip web site at www.microchip.com.

2.3.2.1   "TRANSMIT 250 BYTE DATA STRING" PROGRAM DESCRIPTION

This program will be selected when the **RESET** switch is depressed and then released (with the **S2** switch not pressed). The PIC18F1320 will initialize the system and wait to receive a data byte. Once a data byte is received, the PIC18F1320 will transmit a 250-byte table from memory to the MCP2140.

The PIC18F1320 follows the flow control of the MCP2140 to ensure that data is not lost.

The MCP2140 handles all the IrCOMM protocol for the data packets that it receives from the PIC18F1320.

Once the table has completed transmission, the PIC18F1320 will wait to receive the next character that will cause the 250-byte table to be transmitted (again).

The 250-byte data table transmitted from the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board to the Primary device is shown in **Appendix D. "MCP2140 250 Byte Data Transmit Table"**. These values will be displayed in the Primary device's Terminal Emulation program window.

2.3.2.2   "TRANSMIT TEMPERATURE" PROGRAM DESCRIPTION

This program will be selected when both the **RESET** and **S2** switches are depressed, the **RESET** switch is released and the **S2** switch is held momentarily. The PIC18F1320 will initialize the system and wait to receive a data byte. Once a data byte is received, the PIC18F1320 will continuously transmit the following string:

> "Temp = xx" to the MCP2140, approximately once per second, where xx is the temperature in °C.

The PIC18F1320 follows the flow control of the MCP2140 to ensure that data is not lost.

The "measured" temperature will vary as a result of the system voltage of the demo board. This is due to the PIC18F1320 being powered directly from the AAA batteries and the A/D module using V_{DD} as its reference voltage.

The current firmware implementation will transmit a larger value to the Primary device as the battery voltage decreases, given a constant temperature.

A firmware technique to correct for this would be to use the PIC18F1320 LVD module. A hardware technique would be to use a voltage regulator to ensure that the system voltage remains constant, regardless of the voltage output of the batteries.

2.4   RUNNING THE DEMOS

This demo board can interface to any Primary device that implements the IrCOMM 9-wire "cooked" protocol layer. Some typical Primary devices include:

1. Palm PDA
2. Pocket PC PDA
3. Laptop PC with IrDA Standard Port

To communicate with the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board, these devices must run a terminal emulation program (such as HyperTerminal® on the PC).

For the Palm OS® devices, there is a program called `Online`. For more information about Online and the setup of this application, refer to page 23 of Application Note 858, "Interfacing the MCP215X to a Host Microcontroller", or go to the Mark Space web site (www.MarkSpace.com).

Microchip has not evaluated any Terminal Emulation programs for Pocket PC OS devices at this time. Refer to **Section 2.4.1 "Alternative Primary Device Programs"** for an alternative Primary device program.

For a Windows® XP system, a 3rd-party driver needs to be installed to "create" the "virtual port" that HyperTerminal needs to connect to that allows it to use the IR port for communications. This driver is called IrCOMM2K and is available at www.IRCOMM2K.de. Please evaluate this product before installing onto your system to ensure that it will meet your requirements.

Microchip does not imply any suitability to your system requirements of any of these 3rd-party products. Please evaluate each product's specifications and requirements before installing onto your system.

Two step-by-step examples for this demo will be presented. **Section 2.4.2 "Using a Palm PDA or Equivalent as the Primary Device"** shows the steps using a Palm PDA, while **Section 2.4.3 "Using a Laptop PC as the Primary Device"** shows the steps using a Windows® XP based laptop with IR port.

2.4.1   Alternative Primary Device Programs

Microchip also has some example Primary Device programs that could be used to demonstrate the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board. These programs were not developed for this demo board and may not display all modes of operation in a straight-forward manner (such as the "Transmit Temperature" program). These programs are discussed in the following application notes:

- For Palm OS - Application Note 888, *"Programming the Palm OS® for Embedded IR Applications"* (DS00888)
- For Pocket PC OS - Application Note 926, *"Programming the Pocket PC OS for Embedded IR Applications"* (DS00926)
- For Windows XP - Application Note 941, *"Programming Windows® XP for Embedded IR Applications"* (DS00941)

Appendix F. "Using AN888 Program with a Palm™ PDA" shows how to use the Palm PDA and AN888 to demonstrate the demo board. The operation for the Pocket PC and Windows XP applications are similar and are discussed in AN926 and AN941.
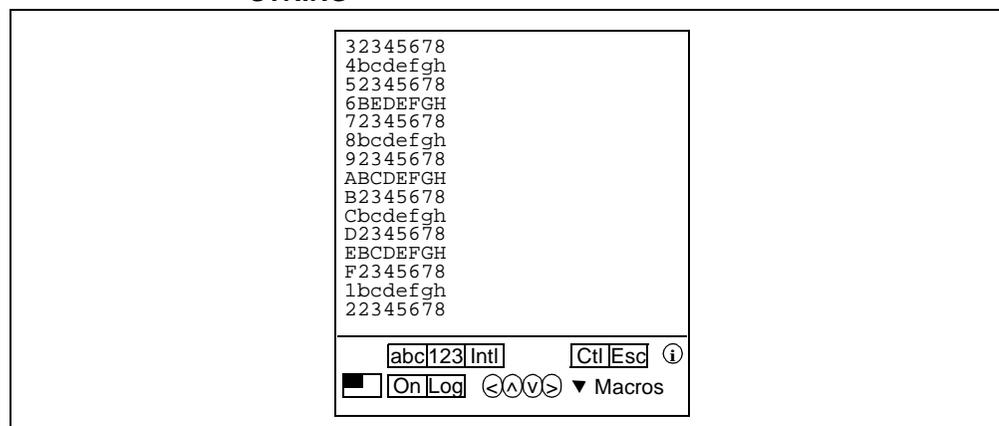
2.4.2   Using a Palm PDA or Equivalent as the Primary Device

Section 2.4.2.1 "Operating the "Transmit 250 Byte Data String" program" discusses how to operate the "Transmit 250 Byte Data String" program, while **Section 2.4.2.2 "Operating the "Transmit Temperature" Program"** discusses how to operate the "Transmit Temperature" program.

2.4.2.1   OPERATING THE "TRANSMIT 250 BYTE DATA STRING" PROGRAM

1. Ensure 3 AAA batteries are properly inserted into the battery holder.
2. Connect JP1 (closed position). The power LED (D5) will turn on. After a few seconds, the PHACT LED (D4) will also turn on, indicating that the MCP2140's protocol handler is in the Non-Discovery Mode (NDM) state or the MCP2140 is in the Low-power mode.
3. Depress and release the **RESET** button.
4. Turn on the Palm (or equivalent) PDA.
5. With both devices on a flat surface, place the Palm PDA about 25 cm (10") away from the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board, pointing the IR port of the Palm PDA (dark red window at the top of the PDA) toward the two clear LEDs (D1, D6) on the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board.
6. Open the Online program on the Palm PDA.
7. Tap the **ON** button.
8. Tap the **123** button.
9. Tap any number (**0-9**). This is the command that will be received by the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board, instructing the program to send a data string back to the Palm PDA. At this time, the DSR (D2), CTS (D3) and PHACT (D4) LEDs are turned off.
10. Send the command by tapping the **DONE** button. Once the **DONE** button has been tapped, the DSR and PHACT LEDs will turn on and the CTS LED will strobe until all the data has been transmitted.
11. The Palm PDA window should receive a string of data as shown in Figure 2-4.

FIGURE 2-4:   ONLINE WINDOW AFTER RECEIVING 250 BYTE DATA STRING

```
32345678
4bcdefgh
52345678
6BEDEFGH
72345678
8bcdefgh
92345678
ABCDEFGH
B2345678
Cbcdefgh
D2345678
EBCDEFGH
F2345678
1bcdefgh
22345678

         abc 123 Intl        Ctl Esc  ⓘ
 ■      On Log  ⊲⌃⌄⊳ ▼ Macros
```

12. Repeating steps 8 through 10 will cause the Palm PDA to transmit another data byte and receive another data string.
13. In the Palm window, tap the **ON** button (it becomes unshaded - normal display). The DSR and CTS LEDs will immediately turn off and the PHACT LED will turn on in about 10 seconds.

2.4.2.2 OPERATING THE "TRANSMIT TEMPERATURE" PROGRAM

1. Ensure 3 AAA batteries are properly inserted into the battery holder.
2. Connect JP1 (closed position). The power LED (D5) will turn on. After a few seconds, the PHACT LED (D4) will also turn on, indicating that the MCP2140's protocol handler is in the NDM (Non-Discovery Mode) state or the MCP2140 is in the Low-power mode.
3. Depress the **RESET** and **S2** buttons, then release the **RESET** button (keep the **S2** button depressed).
4. Release the **S2** button.
5. Turn on the Palm (or equivalent) PDA.
6. With both devices on a flat surface, place the Palm PDA about 25 cm (10") away from the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board, pointing the IR port of the Palm PDA (dark red window at the top of the PDA) toward the two clear LEDs (D1, D6) on the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board.
7. Open the Online program on the Palm PDA.
8. Tap the **ON** button. (it becomes shaded - reverse video).
9. Tap the **123** button.
10. Tap any number (**0-9**). This is the command that will be received by the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board, instructing the program to begin sending temperature data to the Palm PDA. At this time, the DSR (D2), CTS (D3) and PHACT (D4) LEDs are turned off.
11. Send the command by tapping the **DONE** button. Once the **DONE** button has been tapped, the DSR and PHACT LEDs will turn on and the CTS LED will strobe until all the data has been transmitted.
12. The Palm PDA window should receive a string of data about every second, as shown in Figure 2-5.

FIGURE 2-5:   **ONLINE WINDOW AFTER RECEIVING TEMPERATURE DATA STRING**


```
Temp = 28
Temp = 28
Temp = 28
```

```
abc 123 Intl        Ctl Esc  ⓘ
■  On Log  <∧v>  ▼ Macros
```
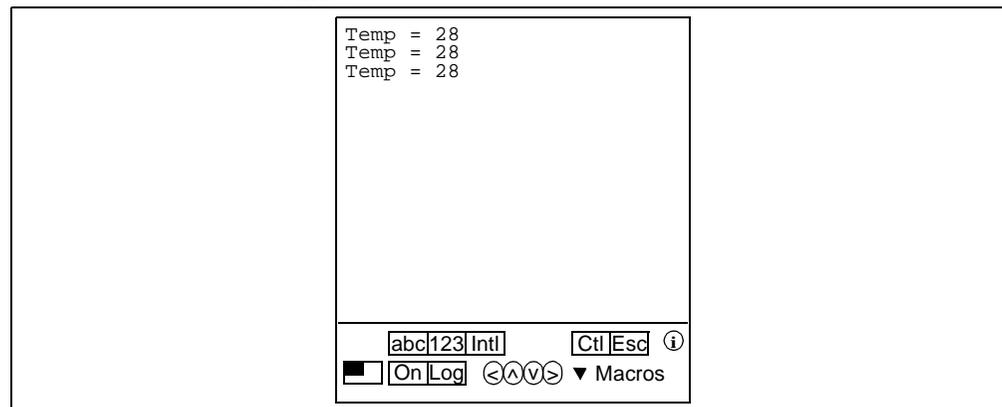
13. Device U4 is the TC1047A temperature sensor device. The output is connected to an A/D channel of the PIC18F1320. Changing the temperature of this device will effect the "temperature" value that is transmitted to the Primary device.
14. In the Palm window, tap the **ON** button (it becomes unshaded - normal display). The DSR and CTS LEDs will immediately turn off and the PHACT LED will turn on in about 10 seconds.

> **Note:** Temperature value transmitted by the PIC18F1320 will be dependent on battery voltage (see **Section 2.3.2.2 ""Transmit Temperature" Program Description"**).

### 2.4.3   Using a Laptop PC as the Primary Device

To use a Laptop PC with an IrDA standard port as the Primary device, the Terminal Emulation program needs to be able to "connect" to the IR port. In Windows 2000 and Windows XP systems, this requires the installation of a 3rd Party driver. One 3rd Party driver is called "IrCOMM2K (www.IRCOMM2K.de). Once the IrCOMM2K driver is installed, it creates a "new" com port (such as COM7). This is a virtual serial port that the PC Terminal Emulation application program (such as HyperTerminal) can be connected to. Then HyperTerminal needs to be configured. Refer to **Section 2.4.3.1 "Configuring HyperTerminal"**.

After configuring HyperTerminal, **Section 2.4.3.2 "Running the Demo Using HyperTerminal"** discusses how to operate the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board via HyperTerminal.

2.4.3.1   CONFIGURING HYPERTERMINAL

1. Start the HyperTerminal Emulation program (usually located under the *Programs > Accessories > Communications* directory.

FIGURE 2-6:   CONNECTION DESCRIPTION WINDOW
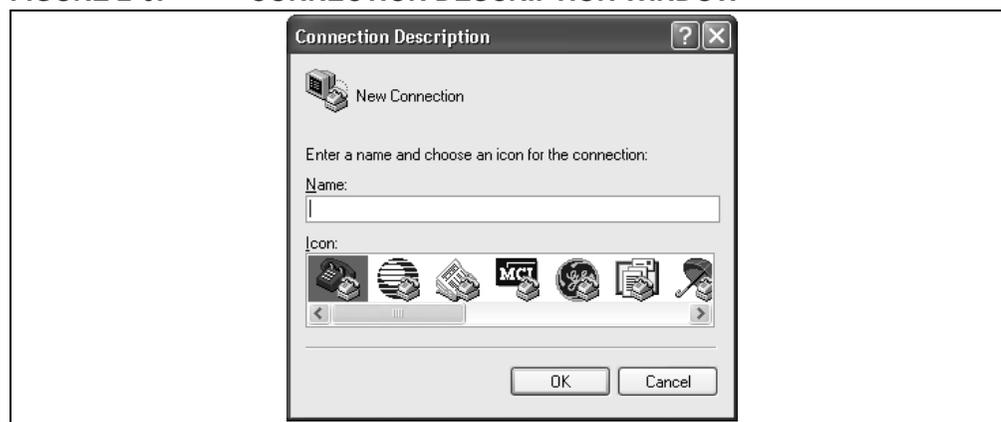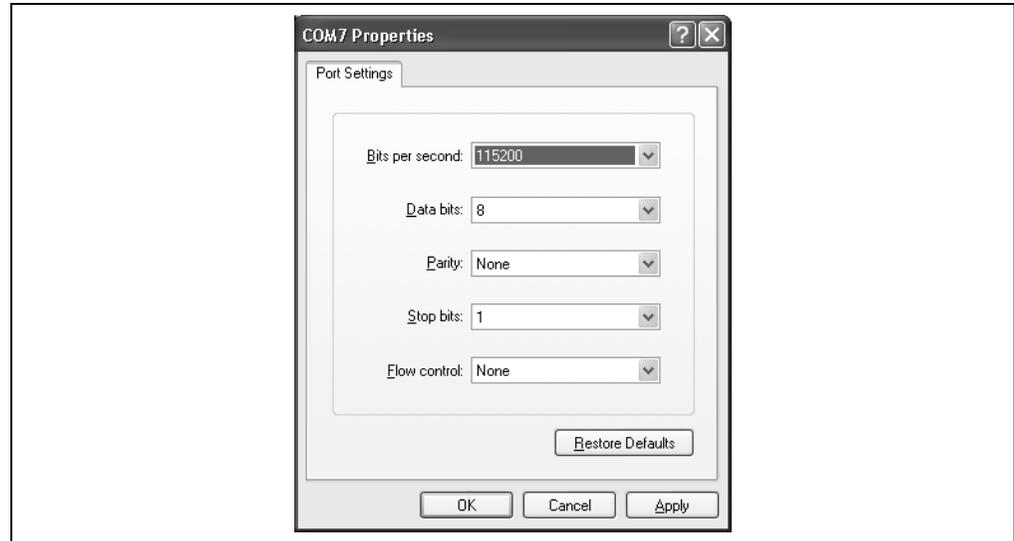

2. In the **Connection Description** window, select the **Cancel** button.
3. In the programs menu, select *File > Properties*.
4. In the **New Connection Properties** window on the **Connect To** tab, go to the "*Connect Using*" pull-down and select the virtual serial port created by the IrCOMM2K driver installation (such as COM7).

FIGURE 2-7:   NEW CONNECTION PROPERTIES WINDOW

5. Select the **Configure** button.

FIGURE 2-8: COM7 PROPERTIES WINDOW

6. In the **COMx (COM7) Properties** window, configure the Port Setting for:
   - *"Bits per second:"* = 115200
   - *"Data Bits:"* = 8
   - *"Parity:"* = None
   - *"Stop Bit:"* = 1
   - *"Flow Control:"* = None
7. Select the **OK** button.
8. In the **New Connection Properties** window, select the **Settings** tab.

FIGURE 2-9: NEW CONNECTION PROPERTIES WINDOW - SETTINGS TAB
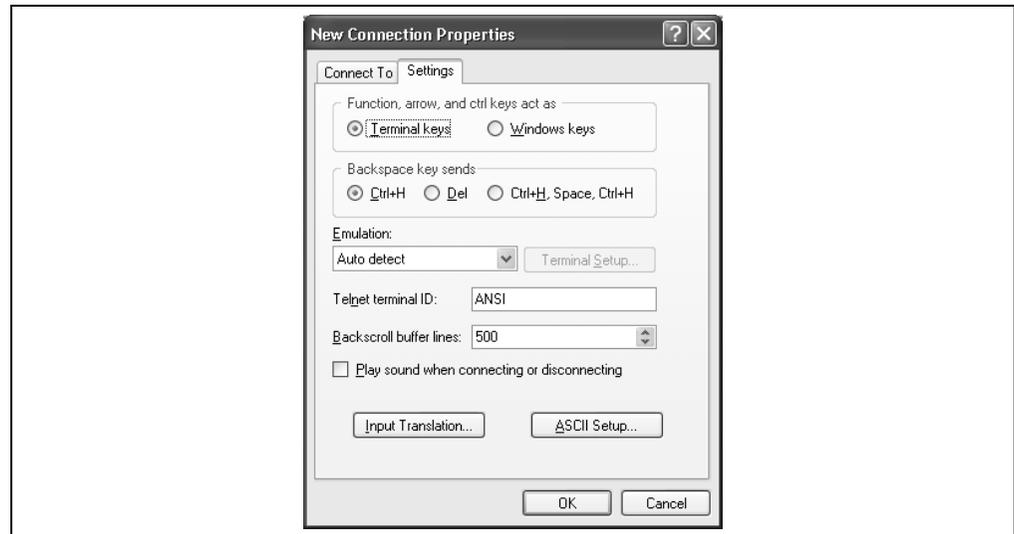
9. Configure the New Connection Properties Settings.
   - Under the "*Function, arrow and control keys act as"* item, select the Terminal Keys radio button.
   - Under the "*Backspace key sends"* item, select the Ctrl+H radio button.
   - From the "*Emulation*" pull-down menu, select Auto-detect.
   - For *"Telnet Terminal ID"*, enter ANSI.
   - For "*Backscroll buffer lines"*, select 500 from the pull-down menu.

10. Select the **ASCII Setup** button, this will open a new window.

FIGURE 2-10: NEW CONNECTION PROPERTIES - ASCII SETUP
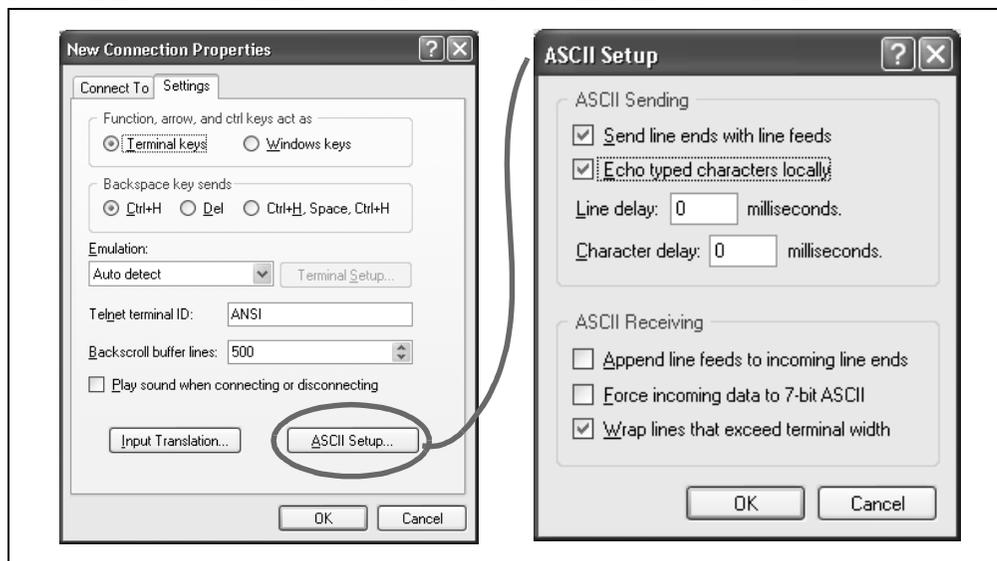
11. In the "*ASCII Sending"* portion of the window:
    - Check "*Send Line ends with line feeds".*
    - Check "*Echo typed characters locally".*
    - Set the "*Line Delay*" and the "*Character Delay"* to '0' milliseconds.
12. In the "*ASCII Receiving*" portion of the window:
    - Uncheck "*Append line feeds to incoming line ends".*
    - Uncheck "*Force incoming data to 7-bit ASCII".*
    - Check "*Wrap lines that exceed terminal width".*
13. Select the **OK** button.
14. Select the **Input Translation** button.
    - In the "*Host System Encoding Method*" window, select Shift-JIS. Then select the **OK** button in the **New Connection Properties** window.

FIGURE 2-11: NEW CONNECTION PROPERTIES - HOST SYSTEM ENCODING METHOD
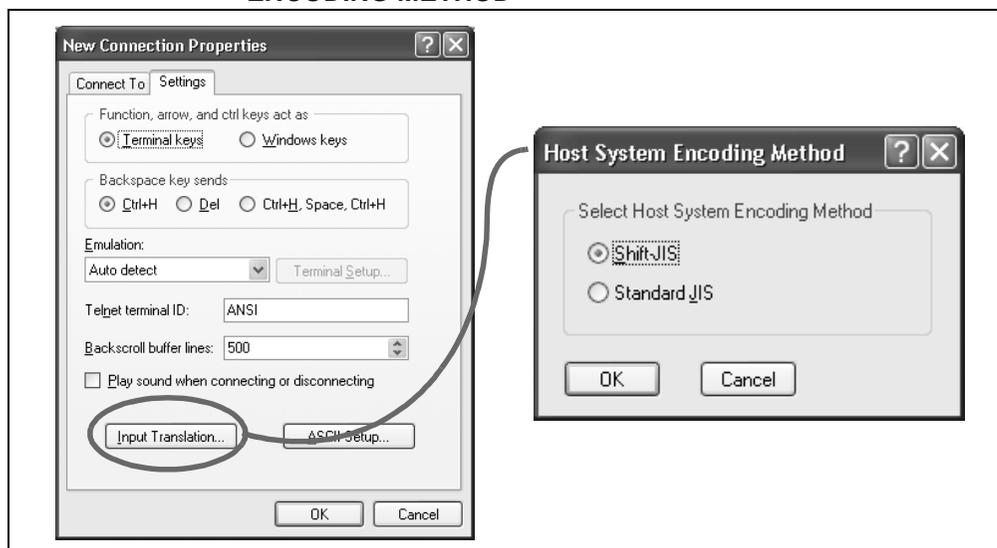
15. Now that all the settings are configured, in HyperTerminal's pull-down menu, select *File > Save As*. Select the name that you wish.

2.4.3.2 RUNNING THE DEMO USING HYPERTERMINAL

Now that the HyperTerminal application program is configured, the PC can communicate with the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board. **Section 2.4.3.2.1 "Operating the "Transmit 250 Byte Data String" Program"** discusses how to operate the "Transmit 250 Byte Data String" program, while **Section 2.4.3.2.2 "Operating the "Transmit Temperature" Program"** discusses how to operate the "Transmit Temperature" program.

> **Note:** Hyperterminal® should be disabled before establishing a connection between the PC and the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board. Make sure that any other programs (e.g., HotSync®) connected to the IR ports are disabled.

2.4.3.2.1   Operating the "Transmit 250 Byte Data String" Program

1. Ensure 3 AAA batteries are properly inserted into the battery holder.
2. Connect JP1 (closed position). The power LED (D5) will turn on. After a few seconds, the PHACT LED (D4) will also turn on, indicating that the MCP2140 is in the Non-Discovery Mode (NDM) state.
3. Depress and release the **RESET** button.
4. Turn on the PC laptop.
5. With both devices on a flat surface, place the Palm PDA about 25 cm (10") away from the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board, pointing the IR port of the PC toward the two clear LEDs (D1, D6) on the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board.
6. If the PC is configured to show the IR icon in the system tray, a single IR LED icon will be displayed. Placing the mouse cursor over this icon will display the message "MCP2140 A5 is in range", where "MCP2140 A5" is the Device ID of the MCP2140.
7. Start the HyperTerminal program using the saved setting from **Section 2.4.3.1 "Configuring HyperTerminal"**. When HyperTerminal starts, it is in the connected state. To disconnect, click on the telephone icon (4th icon from left on toolbar). To connect, click on the telephone icon (3rd icon from left). Depending on the current state of the HyperTerminal session, only one of the two telephone icons will be active (the other will be grayed out).
8. Ensure that the HyperTerminal session indicates "Connected" (lower-left of HyperTerminal window) and the icon in the system tray changes to two IR LEDs facing each other and "talking".
9. Place the mouse cursor over the IR icon in the system tray. The message displayed now says "Wireless link with MCP2140 A5 at 9600 bps". This shows that a link is established for data communication and that the IR communication rate is 9600 bps (even though the HyperTerminal program is "talking" to the driver at 115200, the IrDA standard hardware is communicating at the rate negotiated with the MCP2140.
10. Type any number (**0-9**) in the HyperTerminal window. The MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board requires a receive byte before transmitting its data. This is due to the requirement of most PDAs needing to transmit a data byte before opening the IR Link. The data byte is sent as it is typed. At this time, the DSR (D2), CTS (D3) and PHACT (D4) LEDs are turned off.
11. The HyperTerminal window should receive a string of data as shown in **Appendix D. "MCP2140 250 Byte Data Transmit Table"**.
12. Repeating steps 10 and 11 will cause the PC to transmit another data byte and to receive another data string.
13. Disconnect (close) the HyperTerminal session. The DSR and CTS LEDs will immediately turn off and the PHACT LED will turn on in about 10 seconds.

2.4.3.2.2   Operating the "Transmit Temperature" Program

1. Ensure 3 AAA batteries are properly inserted into the battery holder.

2. Connect JP1 (closed position). The power LED (D5) will turn on. After a few seconds, the PHACT LED (D4) will also turn on, indicating that the MCP2140 is in the NDM (Non-Discovery Mode) state.

3. Depress the **RESET** and **S2** buttons, then release the **RESET** button (keep the **S2** button depressed).

4. Release the **S2** button.

5. With both devices on a flat surface, place the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board about 25 cm (10") away from the PC (dark red window at the front or sides of the PC) toward the two clear LEDs (D1, D6) on the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board.

6. If the PC is configured to show the IR icon in the system tray, a single IR LED icon will be displayed. Placing the mouse cursor over this icon will display the message "MCP2140 A5 is in range", where "MCP2140 A5" is the Device ID of the MCP2140.

7. Start the HyperTerminal program by using the saved setting from **Section 2.4.3.1 "Configuring HyperTerminal"**. When HyperTerminal starts, it is in the connected state. To disconnect, click on the telephone icon (4th icon from left on toolbar). To connect, click on the telephone icon (3rd icon from left). Depending on the current state of the HyperTerminal session, only one of the two telephone icons will be active (the other will be grayed out).

8. Ensure that the HyperTerminal session indicates "Connected" (lower-left in HyperTerminal window) and that the icon in the system tray changes to two IR LEDs facing each other and "talking".

9. Place the mouse cursor over the IR icon in the system tray. The message displayed now says "Wireless link with MCP2140 A5 at 9600 bps". This shows that a link is now established for data communication, and that the IR communication rate is 9600 bps (even though the HyperTerminal program is "talking" to the driver at 115200, the IrDA standard hardware is communicating at the rate negotiated with the MCP2140).

10. Type any number (**0-9**) in the HyperTerminal window. The MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board requires a receive byte before transmitting it's data. This is due to the requirement of most PDAs needing to transmit a data byte before opening the IR Link. The data byte is sent as it is typed. At this time, the DSR (D2), CTS (D3) and PHACT (D4) LEDs are turned off.

11. The PC HyperTerminal window should receive a string of data about every second. This data string has the format "Temp = xx", where xx is the measured temperature in °C.

12. Device U4 is the TC1047A Temperature Sensor device. The output is connected to an A/D channel of the PIC18F1320. Changing the temperature of this device will effect the "temperature" value that is transmitted to the Primary device.

13. Disconnect (close) the HyperTerminal session. The DSR and CTS LEDs will immediately turn off and the PHACT LED will turn on in about 10 seconds.

Note: Temperature value transmitted by the PIC18F1320 will be dependent on battery voltage (see **Section 2.3.2.2 ""Transmit Temperature" Program Description"**).

2.5 MCP2140 IrDA STANDARD WIRELESS TEMPERATURE SENSOR DEMO BOARD DESCRIPTION

The MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board is designed to demonstrate and evaluate an IR port implementation using the MCP2140 device. The following sections describe each element of this demo board in further detail.

2.5.1 Power

The MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board is powered by three AAA batteries, generating a nominal voltage of 4.5V. Jumper JP1 is the power switch on the board. LED D5 is the power indicator, turning on when power is applied via JP1.

2.5.2 MCP2140 IrDA Protocol Stack Controller Device

This demo board highlights the MCP2140 IrDA Protocol Stack Controller device (U2) to demonstrate the implementation of an IR port in an embedded system application. The MCP2140 device handles all IrDA standard protocol tasks, while allowing the system designer to easily interface the device to a microcontroller via a standard UART port.

The key signals for the MCP2140-to-microcontroller interface are shown in Table 2-1. Further information on the Host Controller interface may be obtained from the MCP2140 data sheet (DS21790).

TABLE 2-1: MCP2140 HOST UART INTERFACE PINS

Pin Name	Pin Number (SSOP)	Pin Type	Buffer Type	Description
TX	8	I	TTL	Asynchronous receive; from Host Controller UART
RX	9	O	—	Asynchronous transmit; to Host Controller UART
RI	10	I	TTL	Ring Indicator. The state of this bit is communicated to the IrDA® standard Primary device. `1` = No Ring Indicate Present `0` = Ring Indicate Present
DSR	11	O	—	Data Set Ready. Indicates that the MCP2140 has established a valid infrared link with a Primary device. This signal is locally emulated and not related to the DTR bit of the IrDA standard Primary device. (**Note 1**) `1` = An IR link has not been established (No IR Link) `0` = An IR link has been established (IR Link)
DTR	12	I	TTL	Data Terminal Ready. Indicates that the embedded device connected to the MCP2140 is ready for IR data. The state of this bit is communicated to the IrDA Primary device, via the IrDA standard DSR bit carried by IrCOMM. `1` = Embedded device not ready `0` = Embedded device ready
CTS	13	O	—	Clear to Send. Indicates that the MCP2140 is ready to receive data form the Host Controller. This signal is locally emulated and not related to the CTS/RTS bit of the IrDA standard Primary device. `1` = Host Controller should not send data `0` = Host Controller may send data
RTS	14	I	TTL	Request to Send. Indicates that a Host Controller is ready to receive data from the MCP2140. This signal is locally emulated and not related to the CTS/RTS bit of the IrDA standard Primary device. `1` = Host Controller not ready to receive data `0` = Host Controller ready to receive data
CD	19	I	ST	Carrier Detect. The state of this bit is communicated to the IrDA standard Primary device via the IrDA standard CD bit. `1` = No Carrier Present `0` = Carrier Present

Legend: TTL = TTL compatible input   ST = Schmitt Trigger input with CMOS levels
         I = Input   O = Output

Note 1: The state of the DTR output pin does not reflect the state of the DTR bit of the IrDA standard Primary device.

The key signals for the MCP2140-to-IR transceiver circuit are shown in Table 2-2. Further information on the IR transceiver interface may be obtained from the MCP2140 data sheet (DS21790).

TABLE 2-2:   MCP2140 IR INTERFACE PINS

Pin Name	Pin Number (SSOP)	Pin Type	Buffer Type	Description
RXPDREF	1	I	A	IR Receive Photo Detect Diode reference voltage. This voltage will typically be in the range of VDD/2.
TXIR	2	O	—	Asynchronous transmit to IrDA® standard transceiver.
RXPD	20	I	A	IR RX Photo Detect Diode input. This input signal is required to be a pulse to indicate an IR bit. When the amplitude of the signal crosses the amplitude threshold set by the RXPDREF pin, the IR bit is detected. The pulse has minimum and maximum requirements as specified in the MCP2140 data sheet, Electrical Characteristics table, Parameter IR131A.

Legend: A = Analog   P = Power
               I = Input   O = Output

In addition to the signals described in Tables 2-1 and 2-2, the PHACT (Protocol Handler Active) output signal indicates which mode the MCP2140 IrDA standard protocol controller state machine is in (0 = NDM or Low-power mode , 1 = Discovery or NRM) and is connected to the PHACT LED (D4); the RESET input is connected to the RESET output of the Host Controller (I/O pin RA4), which asserts low after the RESET push-button switch is asserted; the RI (Ring Indicator) input is pulled to ground; and the OSC1 and OSC2 pins are connected to an external 7.3728 MHz oscillator, as specified in the MCP2140 data sheet (allowing the device to transmit at 9600 baud).

2.5.2.1   MCP2140 OPERATION

The MCP2140 (U3) implements the 9-wire "cooked" service class in the IrCOMM application layer protocol of the IrDA standard specification. IrCOMM is the IrDA standard specification for the replacement of the communication ports (serial and parallel) of a PC. The MCP2140 allows the replacement of the serial cable with a wireless interface. The MCP2140 implements the entire protocol layer, and the Host Controller (PIC18F1320) "talks" to the MCP2140 as if it were a serial port with flow control.

The MCP2140 operates as a Secondary device only, so it will not initiate IrDA standard communication with other IrDA standard devices (neither a Secondary device nor a Primary device).

Appendix C. "MCP2140 Connection Sequence Overview" shows the connection sequence between a Primary device and the MCP2140 (Secondary device). This connection sequence is shown at an overview level and does not show exact operation.

2.5.3   PICmicro® Microcontroller Functions

The MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board interfaces to the PIC18F1320 microcontroller (U1). This device was chosen for this application because it has a UART port, an A/D Converter (ADC) for the temperature sensor analog output, Flash memory for reprogrammability, a small footprint (package) and is low-power.

The PIC18F1320 interfaces to the MCP2140 as described in **Section 2.5.2 "MCP2140 IrDA Protocol Stack Controller Device"**.

The TC1047A temperature sensor indicates the temperature by outputting an analog signal whose magnitude corresponds to the temperature of the device. This signal is input on analog channel AN0 (pin 1).

The MCLR input of the PIC18F1320 is connected to the RESET push button switch. The device is reset when the RESET push button is depressed.

I/O pin RB0 is connected to the S2 push button switch. The state of the switch is polled immediately after the device is reset (via the RESET push button), allowing the microcontroller to determine which firmware program ("Data String Transmit" or "Temperature Transmit") to execute.

The PIC18F1320 is connected to a standard In-Circuit Serial Programming™ (ICSP™) header (J1) to allow easy program access to the device.

2.5.4   IR Transceiver Circuit

The IR transceiver circuit utilizes an integrated optical transceiver. The circuit allows any one of three devices to be used. These are:

1. Vishay® TFDU 4100 (default device)
2. Vishay TFDU 4300
3. Agilent® HSDL 3000

If you wish to test with either of the other optical transceivers, the TFDU 4100 and associated components need to be removed and the components for the desired optical transceiver need to be installed (see the **Appendix B. "Bill-Of-Materials (BOM)"**).

Figure 2-12 shows the circuit that is used to shape the waveform of the optical Transceiver's RXD output. This is done to ensure that the RXD pulse width does not exceed the specifications of the MCP2140 RXPD input (IR131A) (refer to Parameter IR131A in the MCP2140 data sheet, DS21790). The resistor divider R18 and R13 sets the RXPDREF reference threshold. Transistor Q8 (MMUN2111LT1) has internal resistors. If you wish to evaluate a simple PNP device, Q8 can be replaced and resistors for R15 and R20 may need to be added. If R20 is added, do not forget to cut the trace that shorts-out the resistor.

FIGURE 2-12:   **MCP2140 RXPD WAVEFORM SHAPING CIRCUIT**
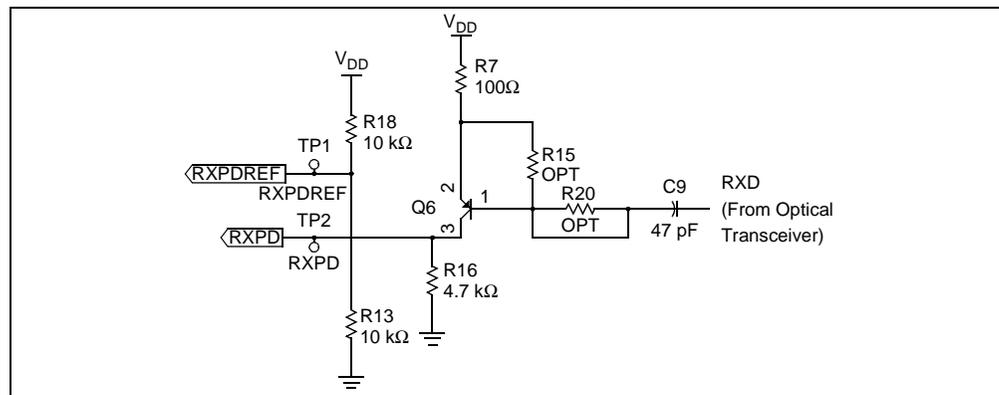
2.5.5 Signal Header

To allow easy access to many of the system signals, a header (J2) was placed on one of the edges of the board. This allows the signals from the MCP2140, PIC18F1320 and other system signals to be accessed.

The header (J2) RESET signal is the RESET pin of the MCP2140 and not the signal from the RESET switch.

If desired, the PIC18F1320 could be electrically removed, and the remaining MCP2140 circuitry could be interfaced to another system board for quick system validation. The PIC18F1320 can be electrically removed by either:

1. Physically removing the device.
2. Erasing the PIC18F1320's program memory (after device reset, all pins are inputs).

NOTES:

Appendix A. Schematic and Layouts

A.1   INTRODUCTION

This appendix contains the following schematics and layouts for the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board:

- Board Schematic - Digital circuitry
- Board Schematic - Analog circuitry
- Board - Top Layer
- Board - Bottom Layer
- Board - Ground Layer
- Board - Power Layer

A.2   SCHEMATICS AND PCB LAYOUT

Figure A-2 shows the schematic of the digital circuitry, while Figure A-3 shows the analog circuitry for the MCP2140 receiver circuitry and transmitter circuitry.

Figure A-4 through Figure A-7 show the layout for the four different layers of the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board. The layer order is shown in Figure A-1.

FIGURE A-1:   **LAYER ORDER**
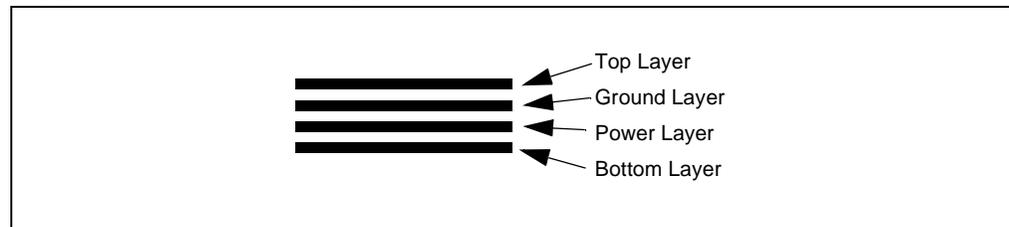
A.2.1   Electronic Change Notice (ECN)

There are 3 ECNs to the Rev. 1 version of the board. Two relate to the use of alternate optical transceivers and are discussed in **Appendix E. "Alternate Optical Transceiver Implementation"**. The third relates to the pinout of transistor Q6 (MMUN2111LT1). An incorrect pinout was specified, so the device needs to be rotated 1 pin in the clockwise direction. Figure A-8 shows how this change will appear.

FIGURE A-2: MCP2140 IrDA® STANDARD WIRELESS TEMPERATURE SENSOR DEMO
BOARD SCHEMATIC - PAGE 1
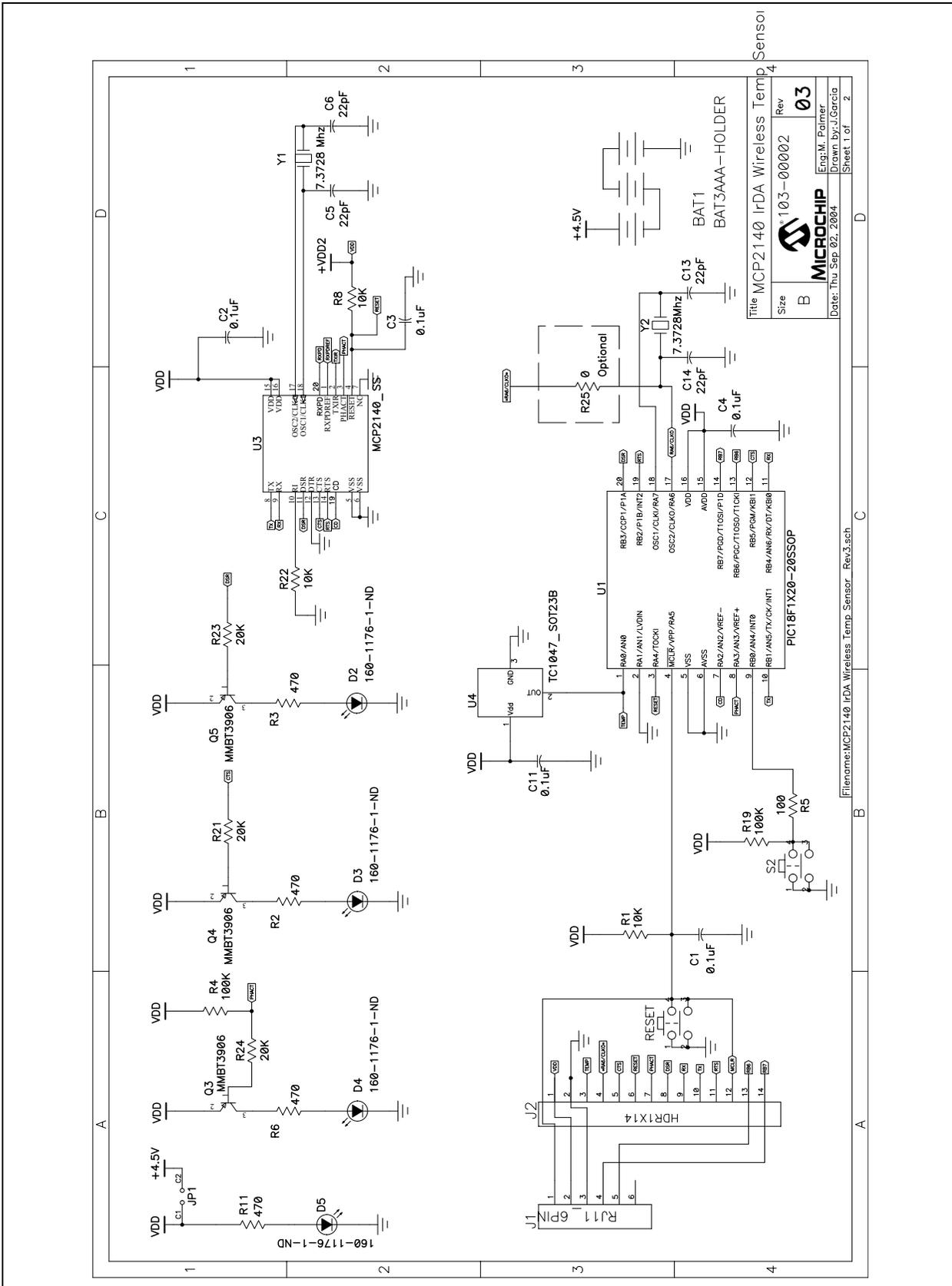
FIGURE A-4: **MCP2140 IrDA® STANDARD WIRELESS TEMPERATURE SENSOR DEMO BOARD LAYOUT - TOP LAYER**
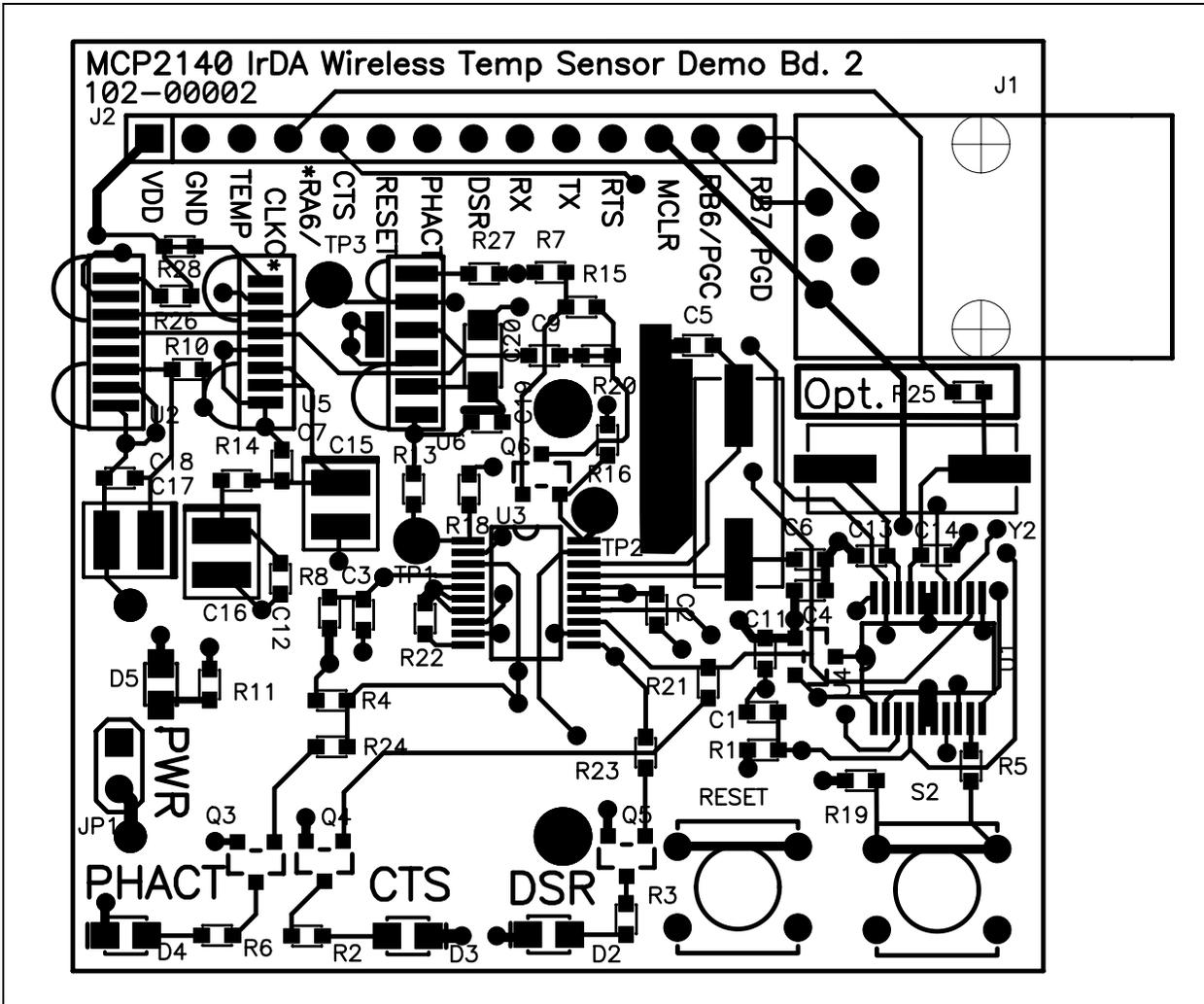
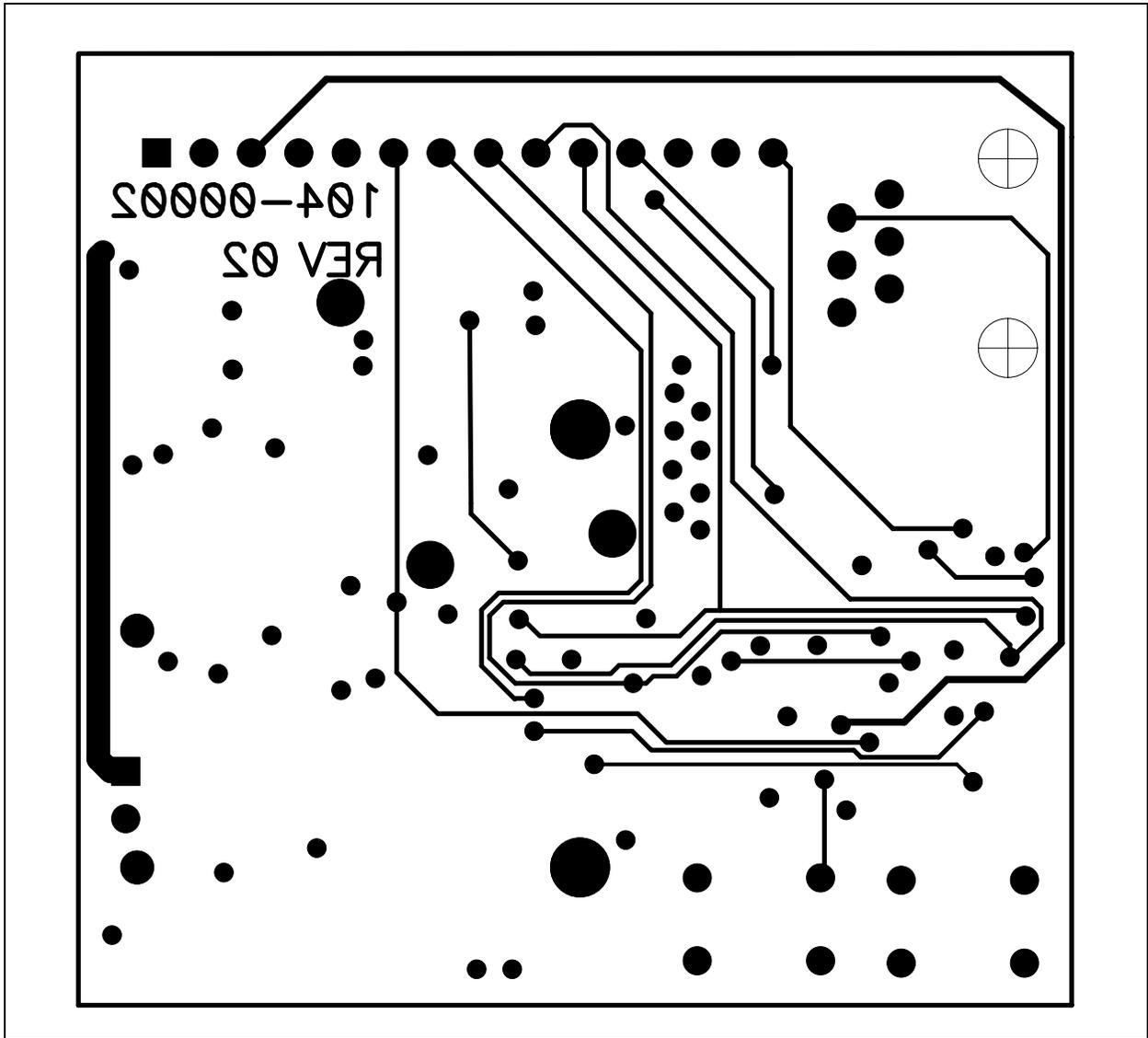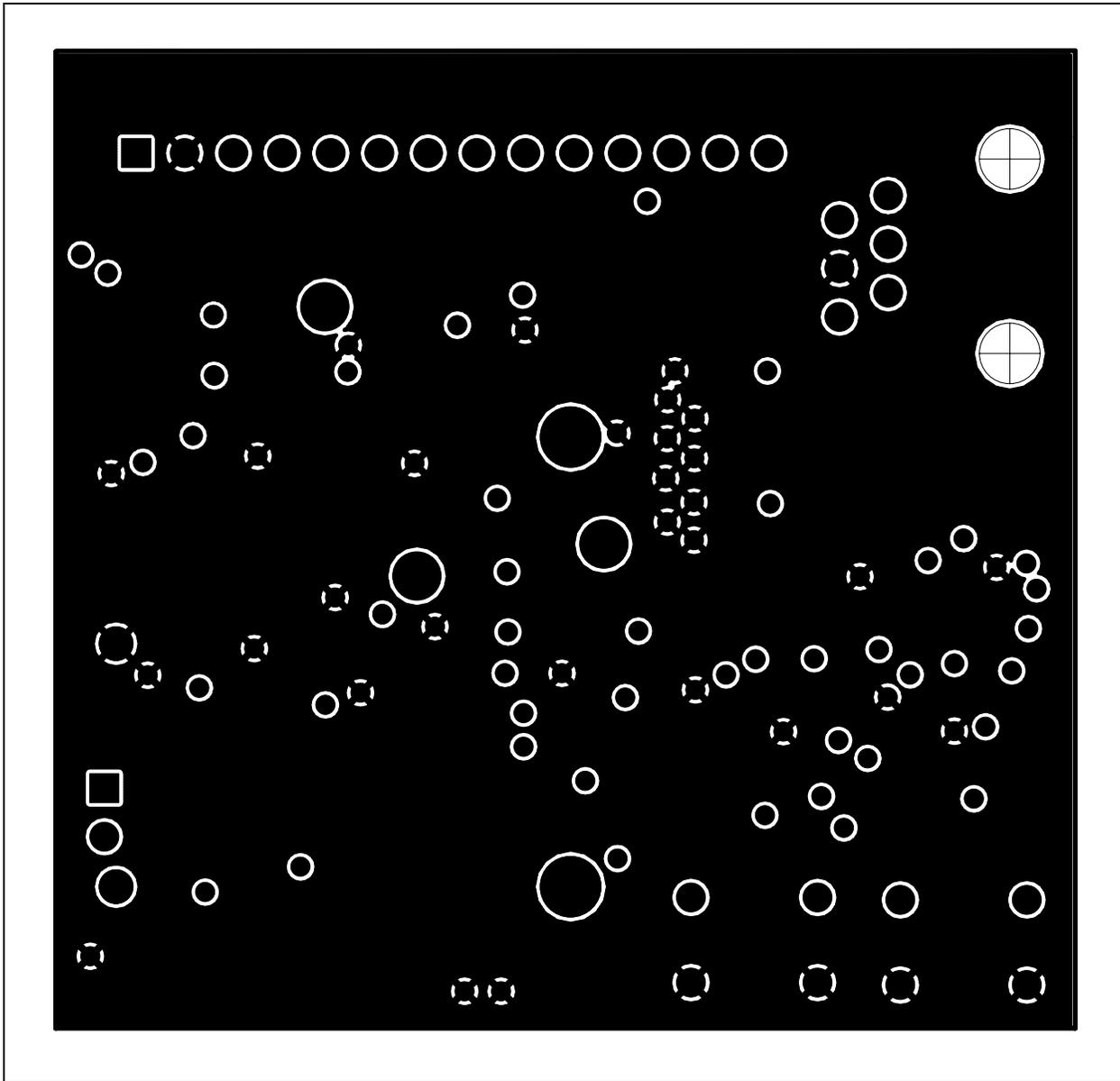**FIGURE A-5:** **MCP2140 IrDA® STANDARD WIRELESS TEMPERATURE SENSOR DEMO BOARD LAYOUT - BOTTOM LAYER**

FIGURE A-6: **MCP2140 IrDA® STANDARD WIRELESS TEMPERATURE SENSOR DEMO BOARD LAYOUT - GROUND LAYER**

MCP2140 IrDA® Standard Wireless Temp Sensor Demo Board
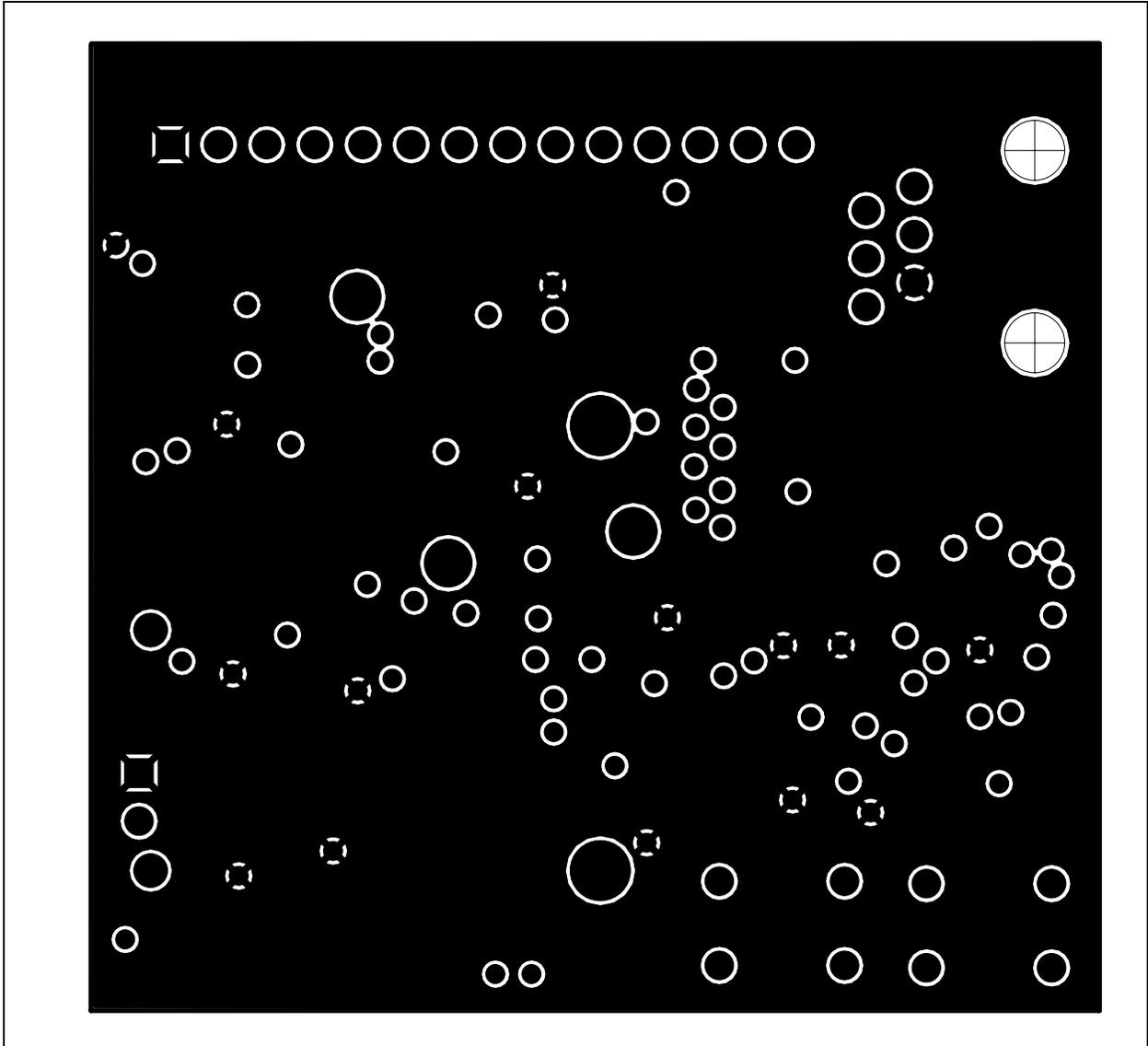
A.3   ECNS

This section discusses the ECNs for this board. There are three (3) ECNs associated with this board. Two are related to the alternate transceiver circuits and are discussed in **Appendix E. "Alternate Optical Transceiver Implementation"**.

The last ECN relates to all transceiver circuits. Transistor Q6 was laid out with the wrong pinout. To correct for this, transistor Q6 needs to be rotated clockwise by 1 pin. Figure A-8 shows how to connect transistor Q6 on the PCB.

FIGURE A-8:   **TRANSISTOR Q6 ECN**
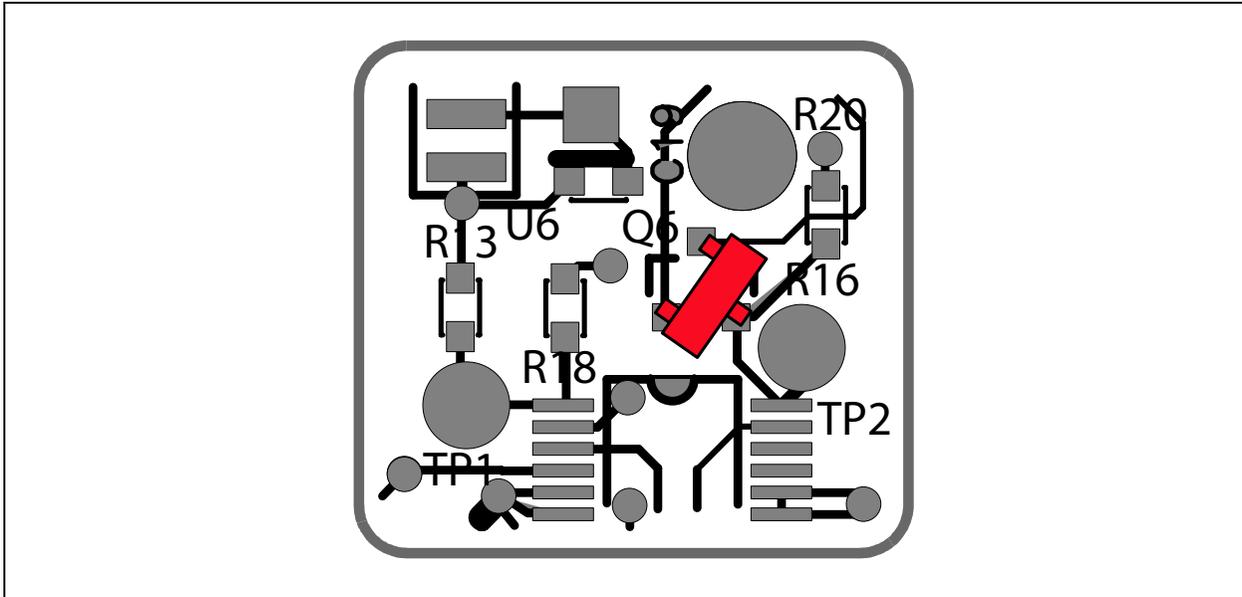
Appendix B. Bill-Of-Materials (BOM)

TABLE B-1:   BILL OF MATERIALS

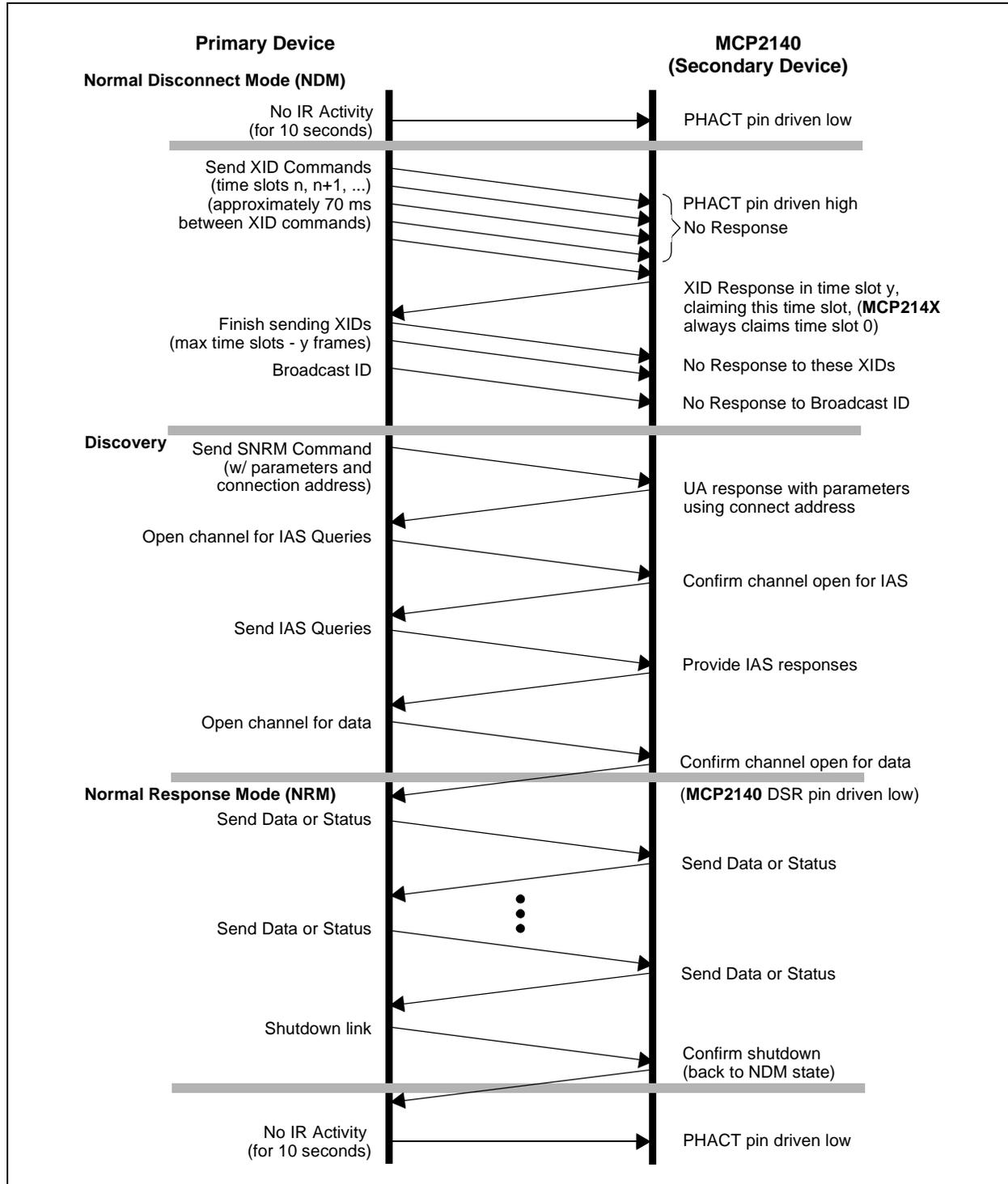| Qty	Reference	Description	Mfgr.	Part Number
5	C1, C2, C3, C4, C11	Capacitor, 0.1 µF, 25V, Ceramic, X7R 0603	Kemet®	C0603C104K3RACTU
4	C5, C6, C13, C14	Capacitor, Ceramic, 22 pF, 50V, NP0 0603	Yageo America	CAP CERAMIC 22PF 50V NP0 0603
1	C9	Capacitor, Ceramic, 33 pF, 50V, NP0 0603	Yageo America	0603CG330J9B200
2	R16	Resistor, 4.75 kΩ, 1/16w, 1%, 0603 SMD	Panasonic®	ERJ-3EKF4751V
3	R1,R8,R13,R18, R22	Resistor, 10.0 kΩ, 1/16w, 1%, 0603 SMD	Panasonic	ERJ-3EKF1002V
3	R21,R23,R24	Resistor, 20.0 kΩ, 1/16w, 1%, 0603 SMD	Panasonic	ERJ-3EKF2002V
2	R5,R7	Resistor, 100Ω, 1/16w, 1%, 0603 SMD	Panasonic	ERJ-3EKF1000V
4	R4,R19	Resistor, 100 kΩ, 1/16w, 1%, 0603 SMD	Panasonic	ERJ-3EKF1003V
4	R2,R3,R6,R11	Resistor, 475Ω, 1/16w, 1%, 0603 SMD	Panasonic	ERJ-3EKF4750V
2	R25	(Optional - Not Populated)	Not Used	NOT USED
4	D2, D3, D4, D5	Led, Red, Clear, 0805 SMD	Lite-on	LTST-C170CKT
3	Q3,Q4,Q5	Transistor, GP, PNP, AMP, SOT-23	Fairchild® Semiconductor	MMBT3906
1	Q6	RF, Bipolar Transistor, 50V Collector-Emitter Voltage, 5.0 mA Current Rating	ON Semi®	MMUN2111LT1
1	U1	PIC18F1320 Microcontroller	Microchip Technology Inc.	PIC18F1320-I/SS
1	U3	MCP2140, Infrared Communications Controller	Microchip Technology Inc.	MCP2140
1	U4	TC1047A, Linear Voltage Output Temperature Sensor	Microchip Technology Inc.	TC1047AVNB
2	Y1,Y2	Crystal, 7.3728 MHZ, 20 pF, SMD	Esc Inc.	ECS-73-20-5PDN
2	S2, Reset	Switch, Tact, 6MM, MOM, 100 GF	Omron®	B3F-1000
1	BAT1	Holder, Battery, 3-Cell, AAA, pc mount	Keystone Electronics®	2479
1	JP1	Conn, Header, 2-Pos .100 Vert Tin	Moldex/Waldom™	22-28-4020
1	J1	Conn, Mod Jack ,6-6 R/A PCB 50AU	AMP/Tyco Electronics	A9049-ND

TABLE B-1: **BILL OF MATERIALS (CONTINUED)**

Qty	Reference	Description	Mfgr.	Part Number
Default Optical Transceiver - TFDU 4100				
1	U2	TFDU4100-TR3, Infrared Transceiver, 900 nM, wavelength, 3	Vishay®	TFDU4100-TR3
1	R10	Resistor, 47.5Ω, 1/10w, 1%, 0805 SMD	Panasonic®	ERJ-6ENF47R5V
1	R26	Resistor, 14.0Ω, 1/10w, 1%, 0805 SMD	Panasonic	ERJ-6ENF14R0V
1	C17	Capacitor, Tantalum, 4.7 µF, 16V, 10% SMD	Kemet®	T491B475K016AS
1	C18	Capacitor, 0.1 µF, 25V, Ceramic, X7R 0603	Kemet	C0603C104K3RACTU
Alternate Optical Transceiver 1 - TFDU 4300				
1	U5	TFDU4300	Vishay	TFDU4300
1	R14	Resistor, 47.5Ω, 1/10w, 1%, 0805 SMD	Panasonic	ERJ-6ENF47R5V
1	R28	Optional Current limiting Resistor 1/16w, 1%, 0603 SMD	Panasonic	Application dependant
2	C7, C12	Capacitor, 0.1 µF, 25V, Ceramic, X7R 0603	Kemet	C0603C104K3RACTU
2	C15, C16	Capacitor, Tantalum, 4.7 µF, 16V, 10% SMD	Kemet	T491B475K016AS
Alternate Optical Transceiver 2 - HSDL 3000				
1	U6	HSDL-3000#007	Agilent® Technologies	HSDL-3000#007
1	R27	Resistor, 6.80Ω, 1/8w, 1%, 0805 SMD	Yageo America	9C08052A6R80FGHFT
1	C19	Capacitor, Ceramic, .47 µF, 10V, X5R 0603	Kemet	C0603C474K8PACTU
1	C20	Capacitor, 6.8 µF, 16V, Tantalum TE Smd	Panasonic	ECS-T1CY685R

Appendix C. MCP2140 Connection Sequence Overview

FIGURE C-1:   HIGH-LEVEL MCP2140 CONNECTION SEQUENCE

Primary Device

**MCP2140
(Secondary Device)**

Normal Disconnect Mode (NDM)

No IR Activity
(for 10 seconds) → PHACT pin driven low

Send XID Commands
(time slots n, n+1, ...)
(approximately 70 ms
between XID commands)

PHACT pin driven high
No Response

XID Response in time slot y,
claiming this time slot, (**MCP214X**
always claims time slot 0)

Finish sending XIDs
(max time slots - y frames)

No Response to these XIDs

Broadcast ID

No Response to Broadcast ID

Discovery   Send SNRM Command
(w/ parameters and
connection address)

UA response with parameters
using connect address

Open channel for IAS Queries

Confirm channel open for IAS

Send IAS Queries

Provide IAS responses

Open channel for data

Confirm channel open for data

Normal Response Mode (NRM)   (**MCP2140** DSR pin driven low)

Send Data or Status

Send Data or Status

Send Data or Status

Send Data or Status

Shutdown link

Confirm shutdown
(back to NDM state)

No IR Activity
(for 10 seconds)   PHACT pin driven low

NOTES:

Appendix D. MCP2140 250 Byte Data Transmit Table

TABLE D-1:   PIC18F1320 250 BYTE DATA TRANSMIT TABLE

```
TXTBL   DT      D'250'          ; the first byte is the byte count
                                ; 1 Characters
        DT      "12345678", 0x0D, 0x0A    ; 10 Characters
        DT      "2BCDEFGH", 0x0D, 0x0A    ; 10 Characters
        DT      "32345678", 0x0D, 0x0A    ; 10 Characters
        DT      "4bcdefgh", 0x0D, 0x0A    ; 10 Characters
        DT      "52345678", 0x0D, 0x0A    ; 10 Characters
        DT      "6BCDEFGH", 0x0D, 0x0A    ; 10 Characters
        DT      "72345678", 0x0D, 0x0A    ; 10 Characters
        DT      "8bcdefgh", 0x0D, 0x0A    ; 10 Characters
        DT      "92345678", 0x0D, 0x0A    ; 10 Characters
        DT      "ABCDEFGH", 0x0D, 0x0A    ; 10 Characters
        DT      "B2345678", 0x0D, 0x0A    ; 10 Characters
        DT      "Cbcdefgh", 0x0D, 0x0A    ; 10 Characters
        DT      "D2345678", 0x0D, 0x0A    ; 10 Characters
        DT      "EBCDEFGH", 0x0D, 0x0A    ; 10 Characters
        DT      "F2345678", 0x0D, 0x0A    ; 10 Characters
        DT      "1bcdefgh", 0x0D, 0x0A    ; 10 Characters
        DT      "22345678", 0x0D, 0x0A    ; 10 Characters
        DT      "3BCDEFGH", 0x0D, 0x0A    ; 10 Characters
        DT      "42345678", 0x0D, 0x0A    ; 10 Characters
        DT      "5bcdefgh", 0x0D, 0x0A    ; 10 Characters
        DT      "62345678", 0x0D, 0x0A    ; 10 Characters
        DT      "7BCDEFGH", 0x0D, 0x0A    ; 10 Characters
        DT      "82345678", 0x0D, 0x0A    ; 10 Characters
        DT      "9bcdefgh", 0x0D, 0x0A    ; 10 Characters
        DT      "a2345678", 0x0D, 0x0A    ; 10 Characters
;
; NOTE:  0x0D = Carriage Return, 0x0A = Line Feed
;
```

NOTES:

Appendix E. Alternate Optical Transceiver Implementation

E.1 INTRODUCTION

This appendix contains the description for implementing either of the other two optical transceiver implementations.

Note 1:	When performing either of these alternate optical transceiver implementations, please make sure to remove all of the components that are related to the TFDU 4100 implementation.
2:	Some component value modifications may be required to ensure that the IR131A electrical specification is met. This may require different values for the following components R13, R18, R16, R17, C9 and Q6 (which may then require R15 and R20).

E.2 HIGHLIGHTS

Diagrams included in this appendix:

- Vishay TFDU 4300 implementation
- Agilent HSDL 3000 implementation

E.3 VISHAY® TFDU 4300 IMPLEMENTATION

Figure E-1 shows the schematic for the TFDU 4300 circuit and the ECN change that needs to be implemented. Figure E-2 shows how to make this correction on the layout.

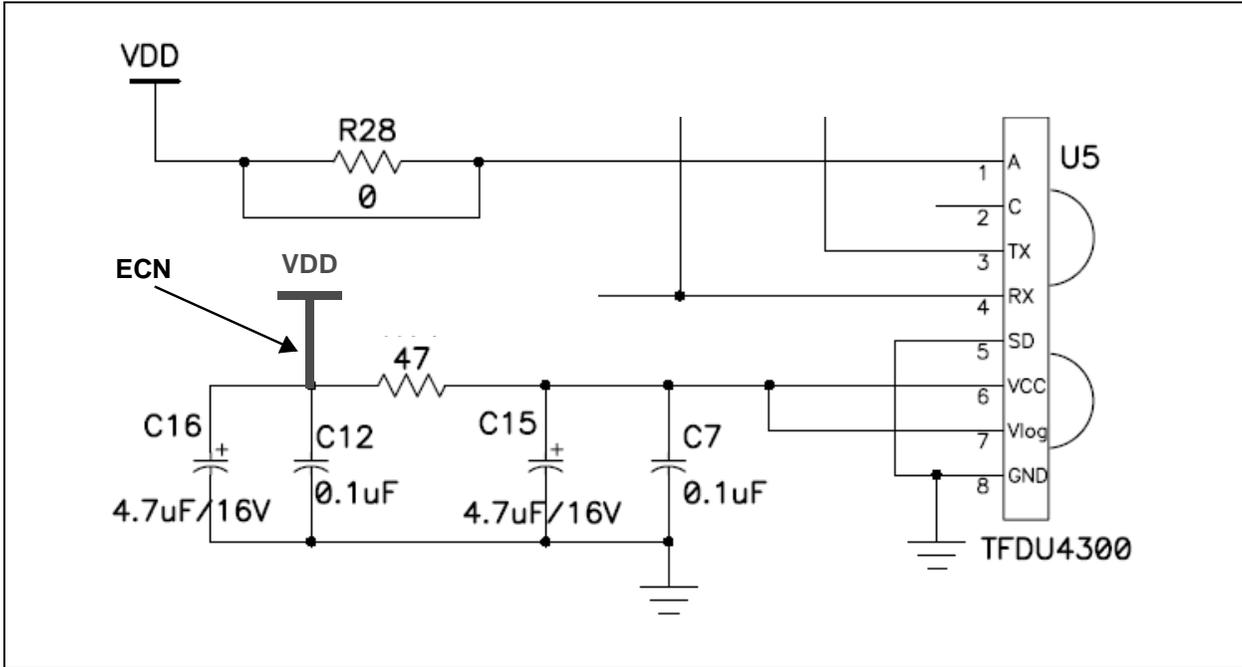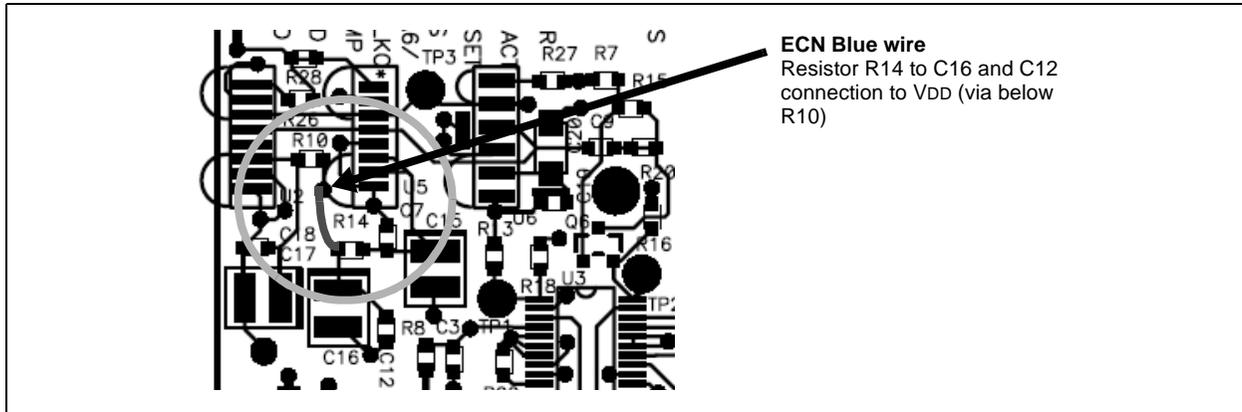**FIGURE E-1: TFDU 4300 OPTICAL TRANSCEIVER ECN - SCHEMATIC**

FIGURE E-2: TFDU 4300 OPTICAL TRANSCEIVER ECN - LAYOUT

ECN Blue wire
Resistor R14 to C16 and C12 connection to VDD (via below R10)

E.4 AGILENT® HSDL 3000 IMPLEMENTATION

Figure E-3 shows the correction to the schematic for the HSDL 3000 to be implemented. Figure E-4 shows how to make this correction on the layout.

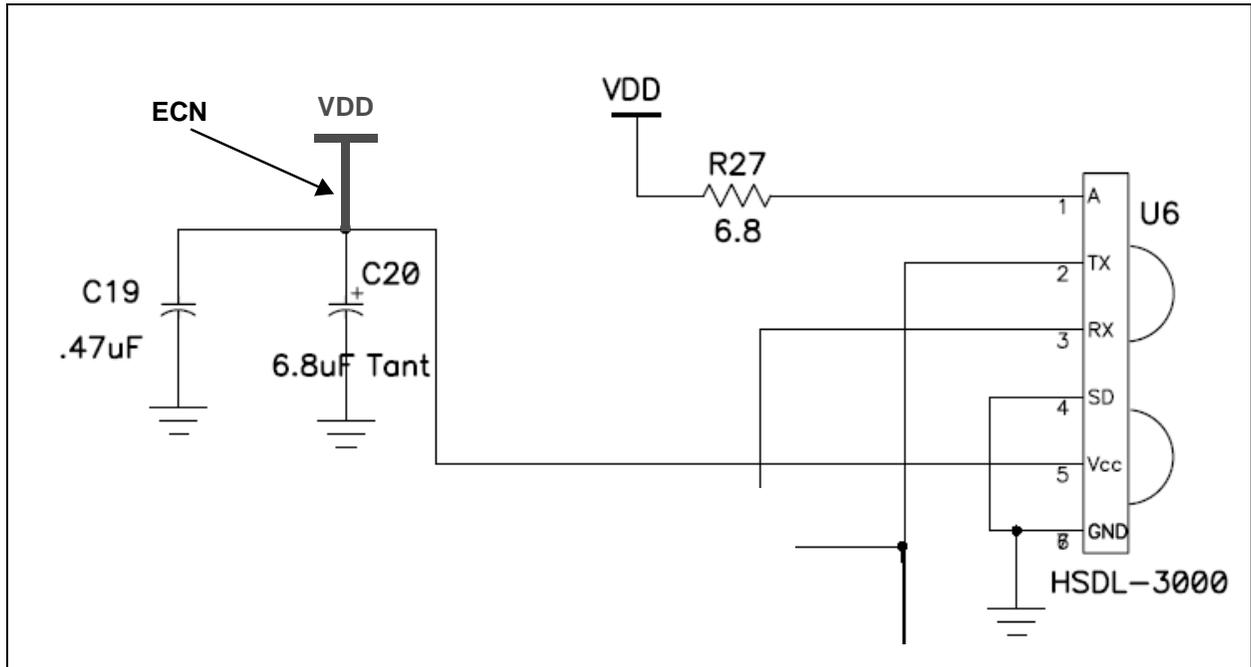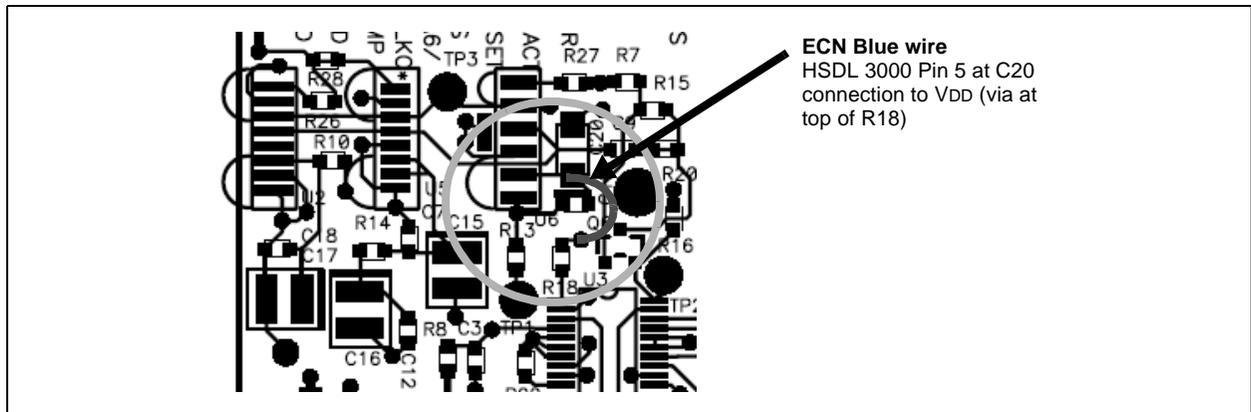**FIGURE E-3:** HSDL 3000 OPTICAL TRANSCEIVER ECN - SCHEMATIC

FIGURE E-4: HSDL 3000 OPTICAL TRANSCEIVER ECN - LAYOUT

ECN Blue wire
HSDL 3000 Pin 5 at C20 connection to VDD (via at top of R18)

NOTES:

Appendix F. Using AN888 Program with a Palm™ PDA

F.1 INTRODUCTION

Microchip also has some example Primary device programs that could be used to demonstrate the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board. These programs were not developed for this demo board and may not be straight-forward to display all modes of operation (such as the "Transmit Temperature" program). These programs are discussed in the following application notes:

- For Palm OS - Application Note 888, *"Programming the Palm OS® for Embedded IR Applications"* (DS00888)
- For Pocket PC OS - Application Note 926, *"Programming the Pocket PC OS for Embedded IR Applications"* (DS00926)
- For Windows XP - Application Note 941, *"Programming Windows® XP for Embedded IR Applications"* (DS00941)

F.1.1   Using the AN888 Program with a Palm PDA

It is recommended that you read Application Note 888 to better understand the operation of the program.

After installing the .PRC file on your PDA, launch the program (MCP215xDemo) and you will see the screen in Figure F-1.
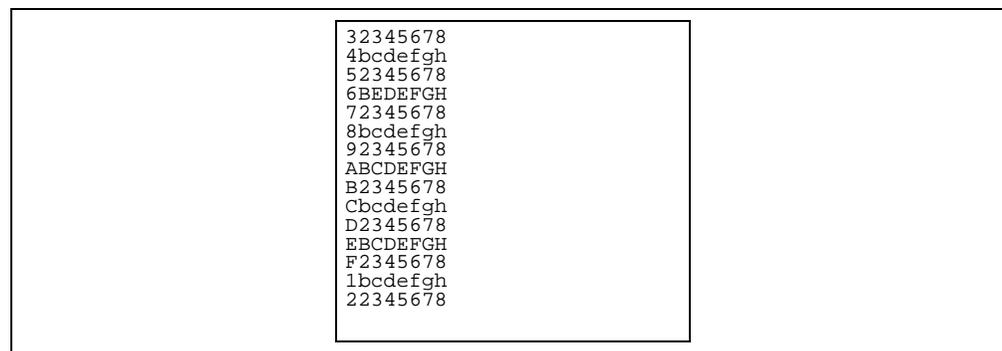
FIGURE F-1:   MCP215XDEMO MAIN FORM
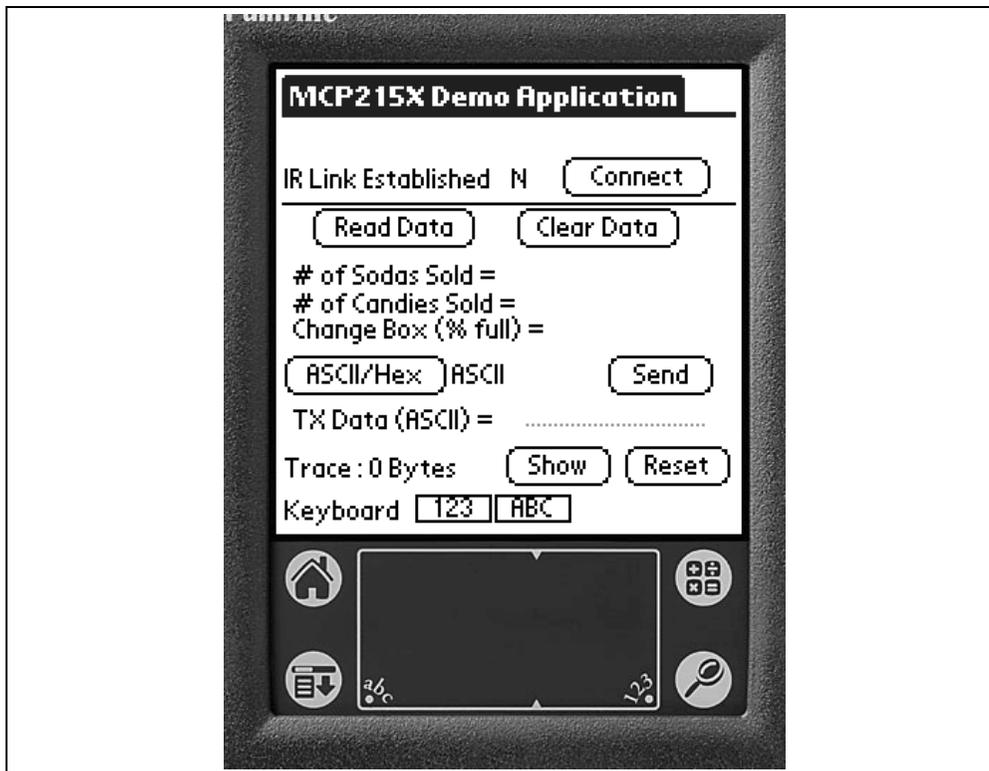
The following procedure describes how to operate the "Transmit 250 Byte Data String" program on the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board.

F.1.1.1   OPERATING THE "TRANSMIT 250 BYTE DATA STRING" PROGRAM

1. Ensure 3 AAA batteries are properly inserted into the battery holder.
2. Connect JP1 and JP2 (closed position). The power LED (D5) will turn on. After a few seconds, the PHACT LED (D4) will also turn on, indicating that the MCP2140 is in the Non-Discovery Mode (NDM) state.
3. Depress and release the **RESET** button.
4. Turn on the Palm (or equivalent) PDA.
5. With both devices on a flat surface, place the Palm PDA about 25 cm (10") away from the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board, pointing the IR port of the Palm PDA (dark red window at the top of the PDA) toward the two clear LEDs (D1, D6) on the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board.
6. Open the MCP215xDemo program on the Palm PDA.
7. Tap the **Connect** button.
8. Tap the **123** button.
9. Tap any number (**0-9**). This is the command that will be received by the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board, instructing the program to send a data string back to the Palm PDA. At this time, the DSR (D2), CTS (D3) and PHACT (D4) LEDs are turned off.
10. Tap on the **DONE** button. The number selected in step 9 will be displayed on the line "TX Data (ASCII) = x" (where x is the number). Notice that the line that shows "Trace:" indicates 0 bytes.
11. To transmit this data byte, tap on the **Send** button. Notice that the value in the trace buffer increases up to 250 bytes.
The DSR LED will turn on, the CTS LED will strobe until all the data has been transmitted and the PHACT LED will turn off.
12. To see the received data, tap on the **Show** button. This shows the contents of the trace buffer. The trace buffer window should display a string of data as shown in Figure F-2.

FIGURE F-2:   **MCP215XDEMO TRACE BUFFER WINDOW AFTER RECEIVING 250 BYTE DATA STRING**

```
32345678
4bcdefgh
52345678
6BEDEFGH
72345678
8bcdefgh
92345678
ABCDEFGH
B2345678
Cbcdefgh
D2345678
EBCDEFGH
F2345678
1bcdefgh
22345678
```
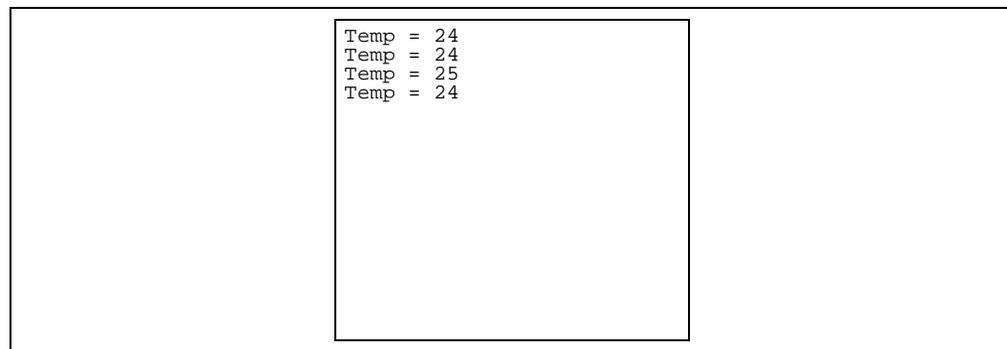
13. To close the trace buffer, tap the **OK** button.
14. Repeating steps 8 through 11 will cause the Palm PDA to transmit another data string of 250 byte. Notice that the trace buffer counter increments by 250 each time.
15. To clear the trace buffer, tap on the **Clear** button
16. To disconnect the IR link, tap the **Disconnect** button. The DSR and CTS LEDs will immediately turn off and the PHACT LED will turn on in about 10 seconds.

F.1.1.2   OPERATING THE "TRANSMIT TEMPERATURE" PROGRAM.

1. Ensure 3 AAA batteries are properly inserted into the battery holder.

2. Connect JP1 and JP2 (closed position). The power LED (D5) will turn on. After a few seconds, the PHACT LED (D4) will also turn on, indicating that the MCP2140 is in the Non-Discovery Mode (NDM) state.

3. Depress the **RESET** and **S2** buttons, then release the **RESET** button (keep the **S2** button depressed).

4. Release the **S2** button.

5. Turn on the Palm (or equivalent) PDA.

6. With both devices on a flat surface, place the Palm PDA about 25 cm (10") away from the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board, pointing the IR port of the Palm PDA (dark red window at the top of the PDA) toward the two clear LEDs (D1, D6) on the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board.

7. Open the MCP215xDemo program on the Palm PDA.

8. Tap the **Connect** button.

9. Tap the **123** button.

10. Tap any number (**0-9**). This is the "command" that will be received by the MCP2140 IrDA Standard Wireless Temperature Sensor Demo Board, instructing the program to send a data string back to the Palm PDA. At this time, the DSR (D2), CTS (D3) and PHACT (D4) LEDs are turned off.

11. Tap on the **DONE** button. The number selected in step 9 will be displayed on the line "TX Data (ASCII) = "x" (where x is the number). Notice that the line that shows "Trace:" indicates 0 bytes.

12. To transmit this data byte, tap on the **Send** button. Notice that the value in the trace buffer increases by 11 bytes approximately once every second.
The DSR LED will turn on and the CTS LED will strobe until all the data has been transmitted, and the PHACT LED will turn off.

13. To see the received data, tap on the **Show** button. This shows the contents of the trace buffer. The trace buffer window should display a string of data as shown in Figure F-3.

FIGURE F-3: **MCP215XDEMO TRACE BUFFER WINDOW AFTER RECEIVING 250 BYTE DATA STRING**

```
Temp = 24
Temp = 24
Temp = 25
Temp = 24
```

14. To close the trace buffer, tap the **OK** button.

15. To clear the Trace Buffer, tap on the **Clear** button

16. To disconnect the IR link, tap the **Disconnect** button. The DSR and CTS LEDs will immediately turn off and the PHACT LED will turn on in about 10 seconds.

> **Note:** Temperature value transmitted by the MCP2140 will be dependent on battery voltage (see **Section 2.3.2.2 ""Transmit Temperature" Program Description"**).

NOTES:

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