



# 8-Bit Wireless Development Kit

## User's Guide

---

**Note the following details of the code protection feature on Microchip devices:**

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

---

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights.

#### Trademarks

The Microchip name and logo, the Microchip logo, dsPIC, KEELOQ, KEELOQ logo, MPLAB, PIC, PICmicro, PICSTART, PIC<sup>32</sup> logo, rPIC and UNI/O are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.


FilterLab, Hampshire, HI-TECH C, Linear Active Thermistor, MXDEV, MXLAB, SEEVAL and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Analog-for-the-Digital Age, Application Maestro, chipKIT, chipKIT logo, CodeGuard, dsPICDEM, dsPICDEM.net, dsPICworks, dsSPEAK, ECAN, ECONOMONITOR, FanSense, HI-TIDE, In-Circuit Serial Programming, ICSP, Mindi, MiWi, MPASM, MPLAB Certified logo, MPLIB, MPLINK, mTouch, Omniscent Code Generation, PICC, PICC-18, PICDEM, PICDEM.net, PICKit, PICtail, REAL ICE, rLAB, Select Mode, Total Endurance, TSHARC, UniWinDriver, WiperLock and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

All other trademarks mentioned herein are property of their respective companies.

© 2011-2012, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.

ISBN: 978-1-61341-991-5

*Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.*

**QUALITY MANAGEMENT SYSTEM**  
**CERTIFIED BY DNV**  
**== ISO/TS 16949:2009 ==**

---



---

## Table of Contents

---

|  |    |
|--|----|
| <b>Preface</b> .....   | 5  |
| <b>Overview</b> .....  | 9  |
| Introduction .....   | 9  |
| 8-Bit Wireless Development Kit Contents .....                      | 9  |
| Wireless Daughter Boards .....                                     | 9  |
| 8-Bit Wireless Development Kit .....                               | 10 |
| <b>PIC18 Wireless Development Board</b> .....                      | 11 |
| Board Layout and Features .....                                    | 11 |
| <b>Getting Started</b> .....                                       | 15 |
| Introduction .....   | 15 |
| Hardware Requirements .....  | 15 |
| Demo Setup .....   | 15 |
| Pre-programmed Tutorial Operation .....                            | 16 |
| <b>Additional Tutorials</b> .....                                  | 21 |
| Introduction .....   | 21 |
| Extended 8-bit WDK Demo with Hyper-terminal Program .....          | 21 |
| Network Freezer .....  | 23 |
| Reduced Function Device (RFD) Demonstrating Sleep Capability ..... | 25 |
| Chat Window Demo .....   | 27 |
| Ping-Pong Demo .....   | 29 |
| 8-bit Wireless Development Kit with Additional Nodes .....         | 32 |
| Introduction .....   | 33 |
| PIC18 Wireless Development Board Schematic .....                   | 33 |
| PIC18 Wireless Development Board PCB Layout .....                  | 36 |
| PIC18 Wireless Development Board Bill of Materials .....           | 38 |
| <b>Worldwide Sales and Service</b> .....                           | 41 |

NOTES:

---

## 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](http://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 “DSXXXXA”, where “XXXX” 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 8-bit Wireless Development Kit User's Guide. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Warranty Registration
- Recommended Reading
- The Microchip Web Site
- Development Systems Customer Change Notification Service
- Customer Support

## DOCUMENT LAYOUT

This document describes how to use the 8-Bit Wireless Development kit to evaluate and experiment with Microchip wireless solutions. The manual layout is as follows:

- **Chapter 1. “Overview”**: This chapter describes the 8-bit Wireless Development Kit and how it works.
- **Chapter 2. “PIC18 Wireless Development Board”**: This chapter details the hardware information of the PIC18 Wireless Development Board.
- **Chapter 3. “Getting Started”**: This chapter describes what you need to know to start using the 8-bit Wireless Development Kit.
- **Chapter 4. “Additional Tutorials”**: This chapter provides additional tutorial programs that demonstrate the additional features of 8-bit Wireless Development Kit.
- **Appendix A. “PIC18 Wireless Development Board Schematic”**: This appendix provides the PCB layout, BOM and PIC18 Wireless Development Board schematics.

## CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

### DOCUMENTATION CONVENTIONS

| Description                                      | Represents  | Examples  |
|--|---|---|
| <b>sArial font:</b>                              |   |   |
| Italic characters                                | Referenced books  | <i>MPLAB<sup>®</sup> IDE User's Guide</i>                   |
|  | Emphasized text   | ...is the <i>only</i> 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   | <u><i>File&gt;Save</i></u>                                  |
| Bold characters                                  | A dialog button   | Click <b>OK</b>   |
|  | A tab   | Click the <b>Power</b> 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>   |
| <b>Courier New font:</b>                         |   |   |
| Plain Courier New                                | Sample source code  | #define START   |
|  | Filenames   | autoexec.bat  |
|  | File paths  | c:\mcc18\h  |
|  | Keywords  | _asm, _endasm, static                                       |
|  | Command-line options  | -Opa+, -Opa-  |
|  | Bit values  | 0, 1  |
|  | Constants   | 0xFF, 'A'   |
| Italic Courier New                               | A variable argument   | <i>file.o</i> , where <i>file</i> can be any valid filename |
| Square brackets []                               | Optional arguments  | mcc18 [options] <i>file</i> [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)<br>{...<br>}                               |

## WARRANTY REGISTRATION

Please complete the enclosed Warranty Registration Card and mail it promptly. Sending in the Warranty Registration Card entitles users to receive new product updates. Interim software releases are available at the Microchip web site.

## RECOMMENDED READING

This user's guide describes how to use 8-bit Wireless Development Kit User's Guide. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

### Readme Files

For the latest information on using other tools, read the tool-specific Readme files in the Readmes subdirectory of the MPLAB IDE installation directory. The Readme files contain update information and known issues that may not be included in this user's guide.

## THE MICROCHIP WEB SITE

Microchip provides online support via our web site at [www.microchip.com](http://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 (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

### DEVELOPMENT SYSTEMS CUSTOMER CHANGE NOTIFICATION SERVICE

Microchip's customer notification service helps keep customers current on Microchip products. Subscribers will receive email notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, access the Microchip web site at [www.microchip.com](http://www.microchip.com), click on Customer Change Notification and follow the registration instructions.

The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers and other language tools. These include the MPLAB C18 and MPLAB C30 C compilers; MPASM™ and MPLAB ASM30 assemblers; MPLINK™ and MPLAB LINK30 object linkers; and MPLIB™ and MPLAB LIB30 object librarians.
- **Emulators** – The latest information on Microchip in-circuit emulators. This includes the MPLAB ICE 2000 and MPLAB ICE 4000.
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debugger, MPLAB ICD 2.
- **MPLAB® IDE** – The latest information on Microchip MPLAB IDE, the Windows® Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB SIM simulator, MPLAB IDE Project Manager and general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include the MPLAB PM3 and PRO MATE® II device programmers and the PICSTART® Plus and PICKit™ 1 development programmers.

### CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

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

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

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



## DOCUMENT REVISION HISTORY

### Revision A (March 2011)

This is the initial release of the document.

### Revision B (January 2012)

This revision includes the following updates:

- Added MRF89XAM8A868 MHz PICtail/PICtail Plus Daughter Boards or MRF89XAM9A915 MHz PICtail/PICtail Plus Daughter Boards in **1.3 “Wireless Daughter Boards”**
- Added rows, MRF24J40MC and MRF89XAM9A PICtail/PICtail Plus Daughter Board, in **Table 1-1: “Compatible PICtail™ Daughter Boards”**
- Added a new bullet in **3.3 “Demo Setup”**, **4.2.1 “Set up”**, **4.3.1 “Setup”**, **4.5.1 “Setup”**, **4.6.1 “Set up”**
- Updated **4.3 “Network Freezer”**
- Replaced all instances of MRF24J40MA Daughter Boards with Radio Daughter Boards



---

## Chapter 1. Overview

---

### 1.1 INTRODUCTION

This chapter introduces the 8-Bit Wireless Development Kit features and its requirements.

The topics discussed in this chapter include:

- 8-Bit Wireless Development Kit Contents
- Wireless Daughter Boards
- 8-Bit Wireless Development Kit

### 1.2 8-BIT WIRELESS DEVELOPMENT KIT CONTENTS

The 8-Bit Wireless Development Kit contains the following items:

- Two PIC18 Wireless Development Boards with PIC18F46J50 XLP Microcontroller
- Two PICtail™/PICtail Plus Daughter Boards (See [Table 1-1](#))
- Two LCD Serial Accessory Boards
- Two RS232 Serial Accessory Boards
- Two USB A to Mini-B 1 meter Cables
- Two RS232 Serial Cables

### 1.3 WIRELESS DAUGHTER BOARDS

The 8-Bit Wireless Development Kit, includes either MRF24J40MA 2.4 GHz IEEE 802.15.4 complaint PICtail/PICtail Plus Daughter Boards or MRF89XAM8A 868 MHz PICtail/PICtail Plus Daughter Boards or MRF89XAM9A 915 MHz PICtail/PICtail Plus Daughter Boards. The PIC18 Wireless Development Board is compatible with many other wireless PICtail daughter Boards. [Table 1-1](#) lists the part number of the wireless PICtail daughter boards that are compatible with the PIC18 Wireless Development Board.

**TABLE 1-1: COMPATIBLE PICtail™ DAUGHTER BOARDS**

| Description  | Part Number |
|--|-------------|
| MRF24J40MA PICtail/PICtail Plus Daughter Board           | AC164134-1  |
| MRF24J40MB PICtail/PICtail Plus Daughter Board           | AC164134-2  |
| MRF24J40MC PICtail/PICtail Plus Daughter Board           | AC164134-3  |
| MRF49XA PICtail Plus Daughter Board (433.92 MHz)         | AC164137-1  |
| MRF49XA PICtail Plus Daughter Board (868/915 MHz)        | AC164137-2  |
| MRF89XAM8A PICtail/PICtail Plus Daughter Board (868 MHz) | AC164138-1  |
| MRF89XAM9A PICtail/PICtail Plus Daughter Board (915 MHz) | AC164138-2  |

The PIC18 Wireless Development Board provides PICtail connectivity, which is compatible with the existing and future radio and sensor daughter boards from Microchip. For more information on compatibility, refer to the Microchip website <http://www.microchip.com/wireless>

**Note:** Individual Wireless PICtail Daughter Boards require .hex files for the specific RF transceiver. For more information, refer to the 8-Bit Wireless Development Kit product web page at <http://www.microchip.com/wireless>.

### 1.4 8-BIT WIRELESS DEVELOPMENT KIT

The Wireless Development Kit allows developers to evaluate and experiment with sub-GHz and 2.4 GHz RF solutions from Microchip. The Wireless Development Kit provides two RF hardware nodes which can be used to create a simple two-node wireless network. More nodes can be added by purchasing 8-Bit Wireless Development Kit or individual components.

The 8-Bit Wireless Development Kit is pre-programmed with a wireless demo program that allows multiple operational configurations to be tested without writing any firmware. For more information on how to operate the pre-programmed demo program and how to develop other applications, see [Chapter 3. "Getting Started"](#). It also enables customer to evaluate Microchip's proprietary wireless stacks. The Microchip wireless stacks and additional application demo source codes can be downloaded from the Microchip web site <http://www.microchip.com/wireless>.

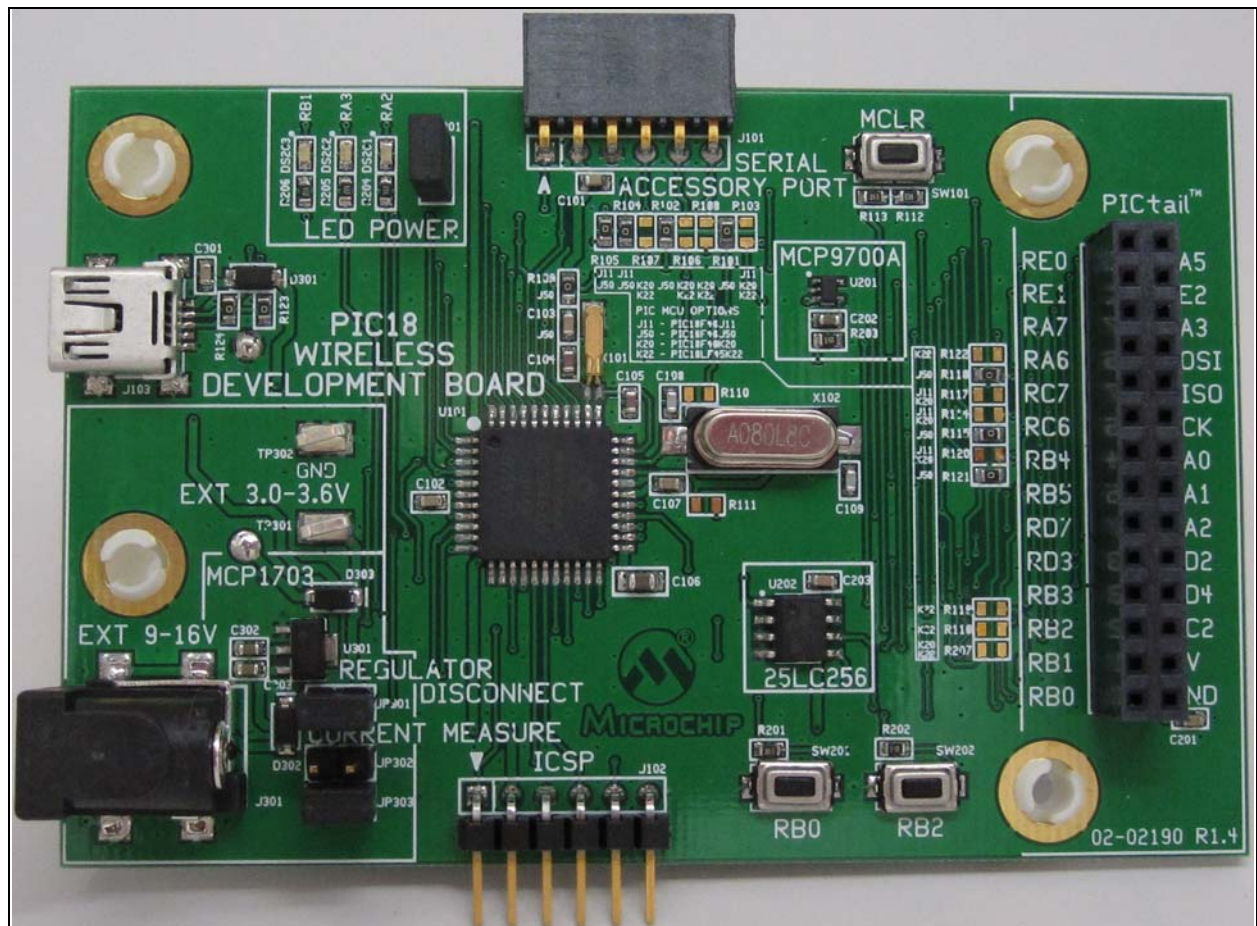
The PIC18 Wireless Development Board provides all the necessary components required to build an extreme low-power wireless sensor application. The Serial Accessory Port can interface external sensors or modules, like LCD Serial Accessory Board or RS232 Serial Accessory Board. The platform provides USB connectivity and supports different XLP microcontroller options.

## Chapter 2. PIC18 Wireless Development Board

### 2.1 BOARD LAYOUT AND FEATURES

This chapter describes the PIC18 Wireless Development Board hardware. It also features the components shown in [Figure 2-1](#).

**FIGURE 2-1: PIC18 WIRELESS DEVELOPMENT BOARD**



The PIC18 Wireless Development Board supports the XLP microcontroller options such as PIC18F46J11, PIC18F46J50, PIC18F46K20 and PIC18LF45K22.

The default microcontroller option is PIC18F46J50. Different microcontroller options require different components to populate on the PIC18 Wireless Development Board.

- Note 1:** Missing components on the PIC18 Wireless Development Board does not indicate a defect. Population of these missing components depend on the Microcontroller being used. For more information about using different Microcontrollers, see the [Section A.2 “PIC18 Wireless Development Board Schematic”](#).
- 2:** Take precautionary measure while changing the microcontroller option as improper tools or poor handling could harm the copper tracks on the surface of the Board, it might destroy it.

The following main blocks are defined on the Board:

- Serial Accessory Port
- USB Interface Port
- PICtail Port
- Push Buttons
- Onboard Temperature Sensor
- Onboard Serial EEPROM
- Debug LEDs
- Power Supply

### 2.1.1 Serial Accessory Port

Serial Accessory Port provides a simple serial interface for the external modules. These modules may be either external sensor or accessory board. For more information about existing accessory boards refer to the <http://www.microchip.com> or “LCD Serial Accessory Board User's Guide” (DS70650) or “RS232 Serial Accessory Board User's Guide” (DS70649).

The following interfaces are supported by the Serial Accessory Port:

- 3 or 4 wire SPI
- I<sup>2</sup>C™
- USART

These interfaces are selected by the software without modifying the hardware. User should be attentive when different interfaces use the same hardware or share the same port pins of the microcontroller. For more information on the port pin assignment, see [Figure A-1](#).

### 2.1.2 USB Interface Port

The PIC18F46J50 microcontroller provides USB v2.0 compliant full-speed Universal Serial Bus (USB) interface, which helps supplying power to the PIC18 Wireless Development Board. The relevant USB components are included with the PIC18F46J50 microcontroller option.

## 2.1.3 PICtail Port

PICtail Port is a 28-pin interface port that supports Microchip's RF based daughter cards. PICtail Port provides the following interfaces to the daughter cards:

- Power supply
- SPI interface
- Interrupt request lines

**Note:** User must be careful about the PICtail port pins that share different functions of the board. The user needs to check the schematics before assigning functions for any port pins.

## 2.1.4 Push Buttons

PIC18 Wireless Development board contains two push buttons, RB0 and RB2. These buttons are assigned to the individual interrupt lines of the microcontroller and are not driven by external pull-up circuitry to save power consumption. The user software must enable the Port B pull-ups of the microcontroller before evaluating the button state. [Example 2-1](#) illustrates a possible solution to evaluate the state of RB2.

### EXAMPLE 2-1: CODE EXAMPLE FOR EVALUATING THE STATE OF RB2

```
//Initialize RB2
TRISBbits.TRISB2 = 1;      // RB2 is an input
ANCON1 |= 0x01;           // RB2 is a digital pin

/*
   User code
*/

//Evaluating RB2
INTCON2bits.RBPU = 0;      // PortB pull ups are enabled
if (PORBbits.RB2 == 0)     // RB2 is pushed
{
    /*
       RB2 PB code...
    */
}
INTCON2bits.RBPU = 1;      // PortB pull ups are disabled
```

## 2.1.5 Onboard Temperature Sensor

The temperature sensor used is the Microchip's MC9700A, which is a low-power Linear Active Thermistor™ IC. To minimize power consumption, the sensor is powered from a port pin. After powering up, the sensor output can be measured after a minute. The internal AD converter of the microcontroller is used to measure the temperature value.

## 2.1.6 Onboard Serial EEPROM

The Onboard Serial EEPROM is a low-power, Microchip's 25LC256 256K SPI Bus Serial EEPROM, which shares the SPI interface with the PICtail port. But Onboard Serial EEPROM has its own active low chip select line connected to the RD5 port pin.

## 2.1.7 Debug LEDs

The PIC18 Wireless Development Board contains three LEDs for debug purposes. To conserve battery power, LEDs power can be disconnected by removing the JP201 and LED power jumper.

### 2.1.8 Power Supply

The board can be powered from any one of these sources:

- 2xAA onboard battery pack is available at the bottom of the PIC18 Wireless Development Board
- USB port
- External 9-16V charger power supply through the standard coaxial power connector
- External 3.0-3.6V power source through test points TP301 and TP302

USB Port and external coaxial port power are stabilized by MCP1703, 250 mA, 3.3V, low quiescent current LDO regulator. The battery operated applications that do not require LDO can be disconnected by removing the JP301, Regulator Disconnect jumper.

**Note:** The 9V wall adapter is not included in the kit. A 9V wall adapter may be ordered from <http://www.microchipdirect.com/>. The part number of the 9V wall adapter is AC162039.

#### 2.1.8.1 CURRENT CONSUMPTION MEASUREMENT

The PIC18 Wireless Development Board contains two jumpers, JP302 and JP303, to measure the current consumption of the kit. These jumpers can measure current consumption of the entire kit without disturbing it.

Measuring the operational current:

1. Ensure that either JP302 or JP303, has one jumper connected to it. Only one jumper is required.
2. Connect the current meter to the jumper that is empty. Because the jumpers are electrically parallel, it can be either JP302 or JP303.
3. Set the current measure range of the current meter above 250 mA.
4. Remove the jumper.

**Note:** Some current meters set the measuring range automatically, which can cause interruptions in the power line while changing the range. If interruption in the power line occurs, use manual range settings.



---

## Chapter 3. Getting Started

---

### 3.1 INTRODUCTION

This chapter provides a tutorial to familiarize users with the 8-bit Wireless Development Kit. It also explains how to run the pre-programmed demo. The source code for the demo is available along with the MiWi™ stack. After unzipping the latest version of the MiWi stack, by default the file is saved at the following location `C:\Microchip Solutions\MiWi DE Demo\8-bit Wireless Development Kit - (Transceiver)\8-bit WDK Demo`.

The demo programs use the MiWi Development Environment. For more information about MiWi, refer to [www.microchip.com/MiWi](http://www.microchip.com/MiWi).

**Note:** To run the demo using the PIC18 Wireless out of the box demo boards, the user need not re-program them. Otherwise, the user needs to program this with the 8-bit WDK Demo.hex file.

The following topics are discussed in this chapter:

- Hardware Requirements
- Demo Setup
- Pre-programmed Tutorial Operation

### 3.2 HARDWARE REQUIREMENTS

The following hardware are required to run the pre-programmed demo application:

- Two pre-programmed PIC18 Wireless Development Boards
- Two Radio Daughter Boards
- Two LCD Serial Accessory Boards
- Four fresh AA batteries or a two 9V external power supply or two USB cables

### 3.3 DEMO SETUP

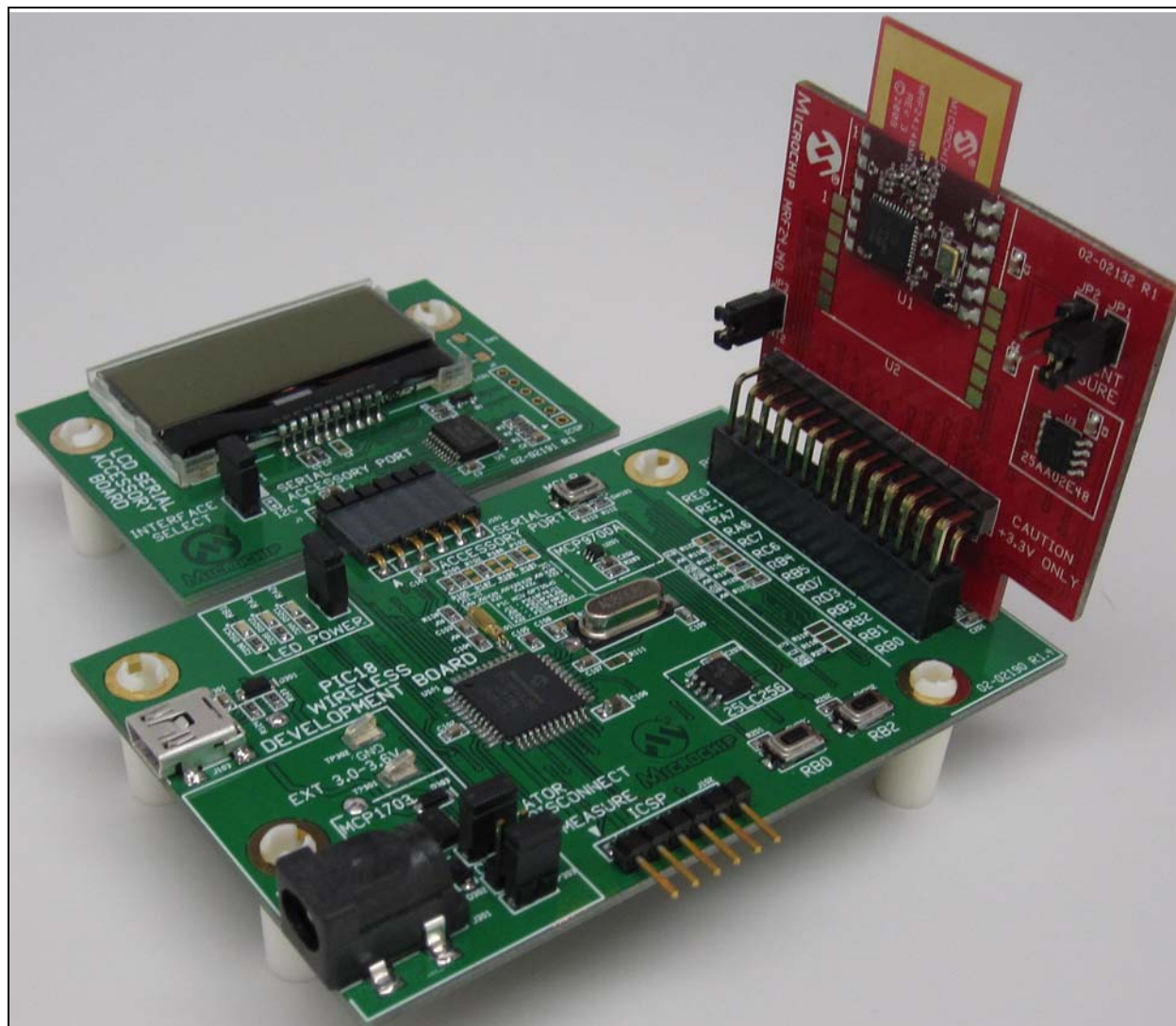
This section demonstrates how to create a two node MiWi Wireless Network. Create a network using the two push buttons (RB0 and RB2) available on the PIC18 Wireless Development board (RB0 to create the network and RB2 to join the network). After setting up the network the nodes in the network read the temperature sensor (MCP9700A) and broadcast this information over the network.

Follow these steps to set up the 8-bit WDK demo:

1. Connect the LCD Serial Accessory board J1 port to the J101 connector on the PIC18 Wireless Development Board (See [Figure 3-1](#)).
2. Plug in the Radio PICtail Daughter board at slot J201 on the PIC18 Wireless Development Board.
3. To power using AA batteries, remove the jumper at JP301 (Regulator Disconnect). To power through 9V external power supply or USB, ensure JP301 is connected (jumper installed).
4. Insert a jumper at JP201 (LED power) on the PIC18 Wireless Development Board.

5. Ensure that the jumper is disconnected at JP1 position on the LCD Serial Accessory Board. This ensures that the LCD Serial Accessory Board is used in I<sup>2</sup>C mode and not in SPI mode. The 8-bit WDK Demo program uses the LCD Serial Accessory board in I<sup>2</sup>C mode.
6. Wireless demo board can be powered using any of these options:
  - Two AA Batteries
  - 9V External Power Supply
  - USB port
  - External 3.0-3.6V power source through test points TP301 and TP302
7. Insert a jumper at either JP302 or JP303 (Current Measure) on the PIC18 Wireless Development Board.

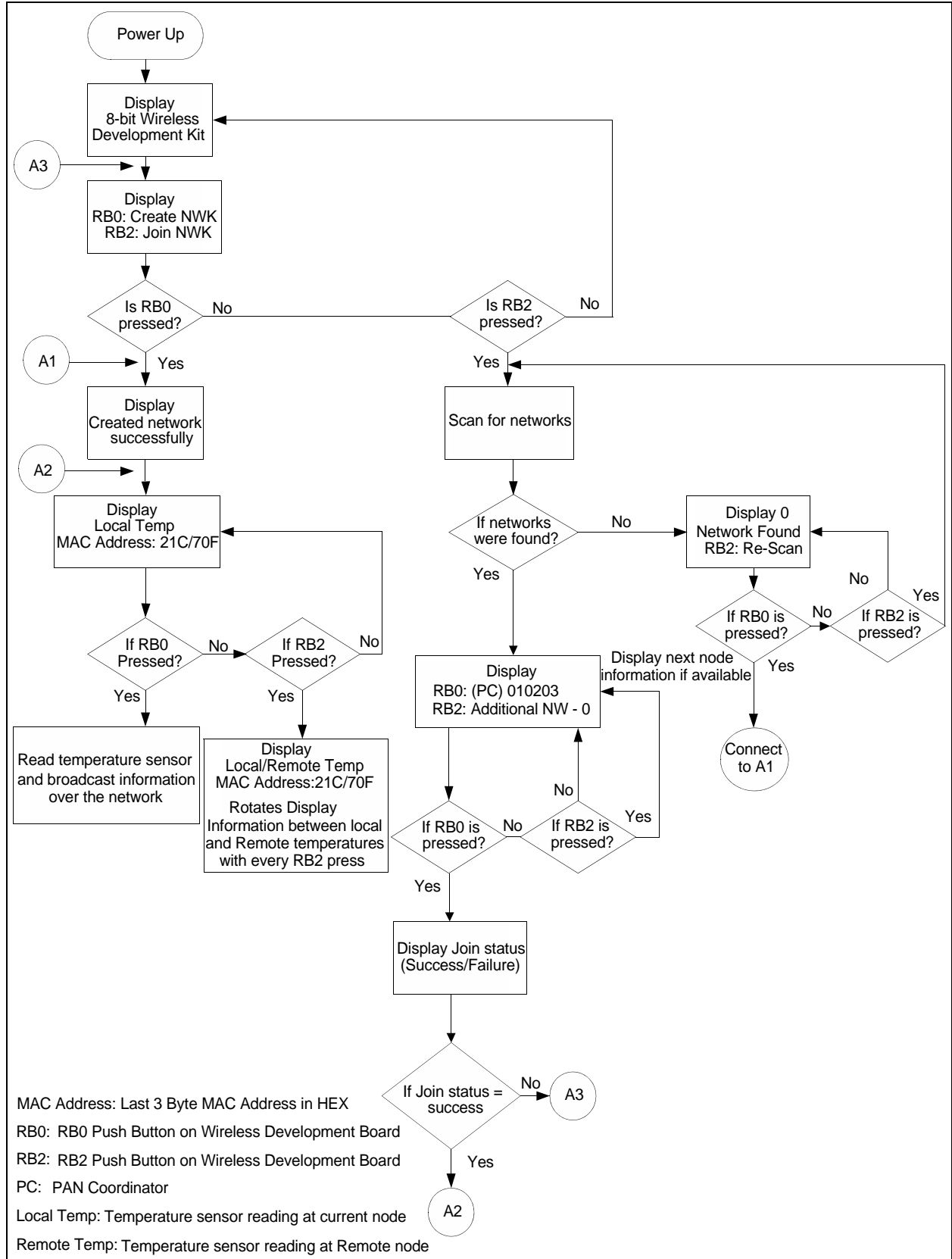
**FIGURE 3-1: PIC18 WIRELESS DEVELOPMENT BOARD CONNECTED TO LCD SERIAL ACCESSORY BOARD AND MRF24J40MA PICTAIL DAUGHTER BOARD**



### 3.4 PRE-PROGRAMMED TUTORIAL OPERATION

The pre-programmed demo is used to demonstrate the basic concepts of the MiWi networking and also to demonstrate the features of the 8-bit Wireless Development Kit. [Figure 3-2](#) illustrates the 8-bit Wireless Development Kit program flow.

**FIGURE 3-2: 8-BIT WIRELESS DEVELOPMENT KIT DEMO PROGRAM**



For more information on MiWi networking concepts, such as PAN Coordinator, Coordinator and RFD or End Device, refer to the application note, AN1066 *"Microchip MiWi Wireless Networking Protocol Stack"* (DS01066B).

This demo highlights the following features:

- Creating a MiWi Network
- MCP9700A Temperature Sensor
- MAC Address EEPROM on the Radio Daughter Boards
- LCD Serial Accessory Board

### 3.4.1 Creating a MiWi Network

#### 3.4.1.1 TO CREATE A MiWi NETWORK

Follow these steps to create a MiWi Network:

1. Configure one node as PAN Coordinator ("Create NWK") and another as Coordinator ("Join NWK").
2. Use the Coordinator to join the PAN Coordinator, "8-bit Wireless Development Kit" message will be displayed on the LCD after powering the nodes. After a few seconds the display changes to:
  - RB0: Create NWK
  - RB2: Join NWK

##### 3.4.1.1.1 To Configure the node as PAN Coordinator

Follow these steps to configure the node as PAN Coordinator

1. On one node press RB0 push button to create the network.

After the node is configured as PAN Coordinator, "Created Network Successfully" message will be displayed on the LCD. After the device is configured as PAN Coordinator, it measures the temperature sensor for every 30 seconds (the timer can be modified in the application) and updates the LCD with the temperature information in °C (Celsius) and °F (Fahrenheit). The last three bytes of the MAC address in HEX format are also displayed on the line two of the LCD:

- Local Temp
- 010203: 21C/ 70F

##### 3.4.1.1.2 To Join the network as Coordinator

Follow these steps for joining the network as Coordinator

1. On the second node press RB2 push button to join the available networks. This initiates an active scan command. The available network information will be displayed on the LCD:
  - RB0: (PC) 010203
  - RB2: Addtnl NW-0
2. Press RB0 to join PAN Coordinator, with the address of 0x010203, created in the previous step.

The LCD displays "Joined Network Successfully" message. After the node is successfully joined the PAN Coordinator, it measures the temperature sensor for every 30 seconds and broadcasts the information over the network along with its MAC Address. The LCD is also updated with the temperature sensor reading:

- Local Temp
- F1F2F3: 20°C/ 68°F

3. Press RB2 push button to display the remote temperature (PAN Coordinator):
  - Remote Temp
  - 010203: 21°C/ 70°F

### 3.4.2 MCP9700A Temperature Sensor

This demo uses the on-board MCP9700A Temperature Sensor. The readings are noted every 30 seconds and the information is broadcasted in the network. Both the nodes store the local and remote temperature data and display it on the LCD.

To re-measure the temperature value, press RB0 push button on the PIC18 Wireless Development Board. This also initiates the broadcast message to all the nodes in the network. To scroll through the rotating display of local temperature and remote temperature, use RB2 push button on the PIC18 Wireless Development Board. The two node network can also be expanded to a multi-node network, for more information, see tutorial in [Section 4.7 “8-bit Wireless Development Kit with Additional Nodes”](#).

### 3.4.3 MAC Address EEPROM on Radio Daughter Boards

All the Radio daughter cards have a MAC Address EEPROM. The 6 byte MAC Address in this EEPROM is used for the addressing scheme in MiWi.

### 3.4.4 LCD Serial Accessory Board

The LCD Serial Accessory board can be used either in the SPI mode or I<sup>2</sup>C mode. This demo uses the LCD Serial Accessory Board in I<sup>2</sup>C mode. The demo uses manual backlight mode versus the automatic backlight mode. With the manual backlight mode, the power consumption can be kept to the minimum.

NOTES:

---

## Chapter 4. Additional Tutorials

---

### 4.1 INTRODUCTION

This chapter covers the additional tutorial programs for the 8-bit Wireless Development Kit.

**Note:** To run few tutorials in this chapter, users must program the PIC18 Wireless Development Board with new .hex files. To program the PIC18 Wireless Development board, use either ICD3 or REAL ICE or PICKit™ 3 programmers. If using MPLAB® ICD3 or MPLAB REAL ICE, use AC164110 adapter board. For more information, refer to the tools User's Guides, "MPLAB® ICD 3 In-Circuit Debugger User's Guide" (DS51766B), "MPLAB REAL ICE In-Circuit Emulator User's Guide" (DS51616C) and "PICKit 3 Programmer/Debugger User's Guide" (DS51795).

The following tutorials are discussed in this chapter:

- Extended 8-bit WDK Demo with Hyper-Terminal Program
- Network Freezer
- RFD Device demonstrating Sleep Capability
- Chat Window Demo
- Ping-Pong Demo
- 8-Bit WDK Demo with Additional Nodes.

### 4.2 EXTENDED 8-BIT WDK DEMO WITH HYPER-TERMINAL PROGRAM

This tutorial demonstrates how to extend the functionality of the pre-programmed demo using the RS232 Serial Accessory Board. Using the hyper terminal program, users can view the connection status, battery status and recorded temperature sensor readings of the node. This demo uses the RS232 Serial Accessory Board to communicate with the PC.

To run this tutorial, no need to re-program the PIC18 Wireless Development Board, instead, a pre-programmed 8-bit WDK Demo.hex file can be used.

The following hardwares are required to run this tutorial:

- Two pre-programmed PIC18 Wireless Development Boards
- Two Radio Daughter Boards
- Two LCD Serial Accessory Boards
- Two RS232 Serial Accessory Boards
- Four fresh AA batteries or a Two 9V External Power Supply or two USB cables
- Two RS232 to USB adapter (if required)
- Computer with a terminal program

The following are the connection settings for terminal program:

- Baud Rate: 19200 kbps
- Data Bits: 8
- Parity: None
- Stop Bits: 1
- Flow Control: None

### 4.2.1 Set up

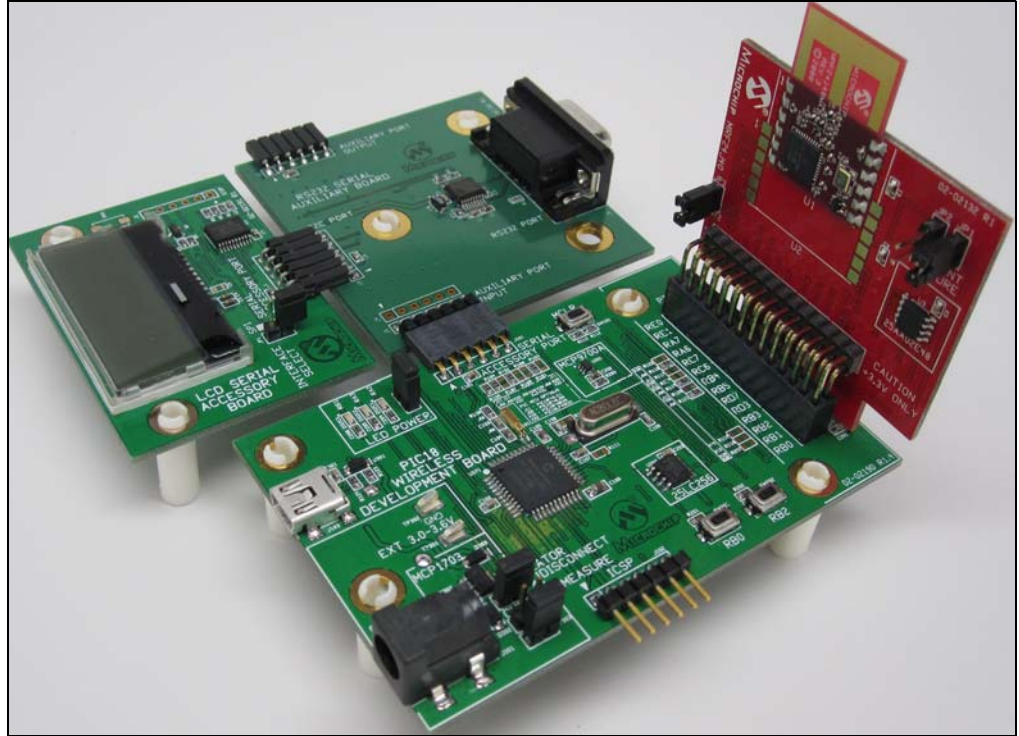
Follow these steps to set up the extended 8-bit Wireless Development Kit demo:

1. Connect the LCD Serial Accessory Board J1 port to the J2 or J3 I<sup>2</sup>C port of the RS232 Serial Accessory Board (see [Figure 4-1](#)).
2. Connect the J1 port on the RS232 Serial Accessory Board to the J101 connector on the PIC18 Wireless Development Board.
3. Plug in the Radio PICtail Daughter board at slot J201 on the PIC18 Wireless Development Board.
4. To power from an external power source (9V or USB), insert a jumper at JP301 (Regulator Disconnect) on the PIC18 Wireless Development Board. To power from batteries, remove the jumper at JP301.
5. Insert a jumper at JP201 (LED power) on the PIC18 Wireless Development Board.
6. Ensure that the jumper is disconnected at the JP1 position on the LCD Serial Accessory Board. This ensures that the LCD Serial Accessory Board is used in I<sup>2</sup>C mode and not in SPI mode. The 8-bit WDK demo uses the LCD Serial Accessory board in I<sup>2</sup>C mode.
7. Wireless demo board can be powered using any one of these options:
  - Two AA batteries
  - 9V external power supply
  - USB port
  - External 3.0-3.6V power source through test points TP301 and TP302
8. Insert a jumper at either JP302 or JP303 (Current Measure) on the PIC18 Wireless Development Board.
9. Connect a RS232 cable between the RS232 Port on RS232 Serial Accessory Board and the PAN Coordinator (PC).
10. Run the terminal program from the PC with the previous settings.

|   |
|---|
| <p><b>Note:</b> Windows 98 or Windows XP operating systems (OS) users can use the hyper-terminal program, and Windows 7 or any other OS users can download other terminal software programs from the web.</p> |
|---|



FIGURE 4-1: CONNECTING RS232 SERIAL ACCESSORY BOARD



## 4.2.2 Tutorial Operation

To use the demo program, set up the nodes as described in [Section 3.4 “Pre-programmed Tutorial Operation”](#).

### 4.2.2.1 USING THE HYPER-TERMINAL PROGRAM:

Follow these steps to use the hyper-terminal program:

1. Press 'Esc' key from the hyper-terminal program to switch to an interactive mode. The interactive mode provides these extended features:
  - Displays connection status: In this mode, the node displays the parent-child information.
  - Displays battery status: This mode can be used to estimate the duration of the battery lasts for that node.
  - Displays node's temperature sensor readings: In this mode, the node displays the previous 20 temperature sensor readings on the screen.
  - Scrolling display of all the node's temperature sensor readings: In this mode, the node displays the local and remote temperatures for every 30 seconds.
2. Press "Ctrl+Z" to exit from the interactive mode.

## 4.3 NETWORK FREEZER

The tutorial demonstrates the Network Freezer mode available in the MiWi stack. Network Freezer mode enables the device to save network setup time. After a network is established, if the network is powered down for any reason, the network freezer option aids in recovering the network to the original state.

To simulate the power down, use  $\overline{\text{MCLR}}$  and RB2 push buttons together. For more information about Network Freezer mode, refer to the Application Note, AN1284 *Microchip Wireless (MiWi™) Application Programming Interface* (DS01284A).

The following hardware is required to run this tutorial:

- Two pre-programmed PIC18 Wireless Development Boards
- Two Radio Daughter Boards
- Two LCD Serial Accessory Boards
- Four fresh AA batteries or Two 9V External Power Supply or two USB cables

This tutorial also highlights the 256 Kbit EEPROM that is available on the PIC18 Wireless Development Board. The Network Freezer mode uses the on-board EEPROM to store the network setup information.

To run this tutorial, no need to re-program the PIC18 Wireless Development Board instead, a pre-programmed "8-bit WDK Demo.hex" file can be used.

### 4.3.1 Setup

Follow these steps to set up the Network Freezer demo:

1. Connect the LCD Serial Accessory board J1 port to the J101 connector on the PIC18 Wireless Development Board (see [Figure 3-1](#)).
2. Plug in the Radio PICtail Daughter board at slot J201 on the PIC18 Wireless Development Board.
3. To power the PIC18 Wireless Development Board from external power (9V or USB), insert a jumper at JP301 (Regulator Disconnect) on the PIC18 Wireless Development Board. To power PIC18 Wireless Development Board from batteries, remove the jumper on JP301.
4. Insert a jumper at JP201 (LED Power) on the PIC18 Wireless Development Board.
5. Ensure that the jumper is disconnected at JP1 position on the LCD Serial Accessory Board. This ensures that the LCD Serial Accessory Board is used in I<sup>2</sup>C mode and not in SPI mode. The 8-bit WDK demo uses the LCD Serial Accessory board in I<sup>2</sup>C mode.
6. Wireless demo board can be powered using any one of these options:
  - Two AA Batteries
  - 9V External Power Supply
  - USB Port
  - External 3.0-3.6V power source through test points TP301 and TP302
7. Insert a jumper at either JP302 or JP303 (Current Measure) on the PIC18 Wireless Development Board.

## 4.3.2 Tutorial Operation

To use the demo program, follow these steps:

1. Create a MiWi network as described in [Section 3.4.1 “Creating a MiWi Network”](#).
2. Simulate Network Freezer mode by pressing and holding the  $\overline{\text{MCLR}}$  and RB2 push button, then release the  $\overline{\text{MCLR}}$  and wait for 10 seconds before releasing the RB2 button.
3. LCD display will prompt the following message:
  - Network Freezer?
  - Yes[RB0]/No[RB2]
4. Press RB0 push button to start the network setup information available in the EEPROM.

The Network will start functioning as it was set up previously before hitting the  $\overline{\text{MCLR}}$  push button.

## 4.4 REDUCED FUNCTION DEVICE (RFD) DEMONSTRATING SLEEP CAPABILITY

This tutorial program demonstrates the lowest sleep configuration for a device to extend battery life.

The following hardwares are required to run this tutorial:

- Two PIC18 Wireless Development Boards
- Two Radio Daughter Boards
- Four fresh AA batteries or Two 9V External Power Supply or two USB cables

To run this tutorial, program one of the PIC18 Wireless Development Boards with the RFD Demo.hex file. The RFD Demo.hex file is located in the 8-bit Wireless Development Kit - (Transceiver)\RFD Demo\. Program another board with the 8-bit WDK Demo.hex file.

### 4.4.1 Set up

Follow these steps to set up the RFD Sleep Capability demo:

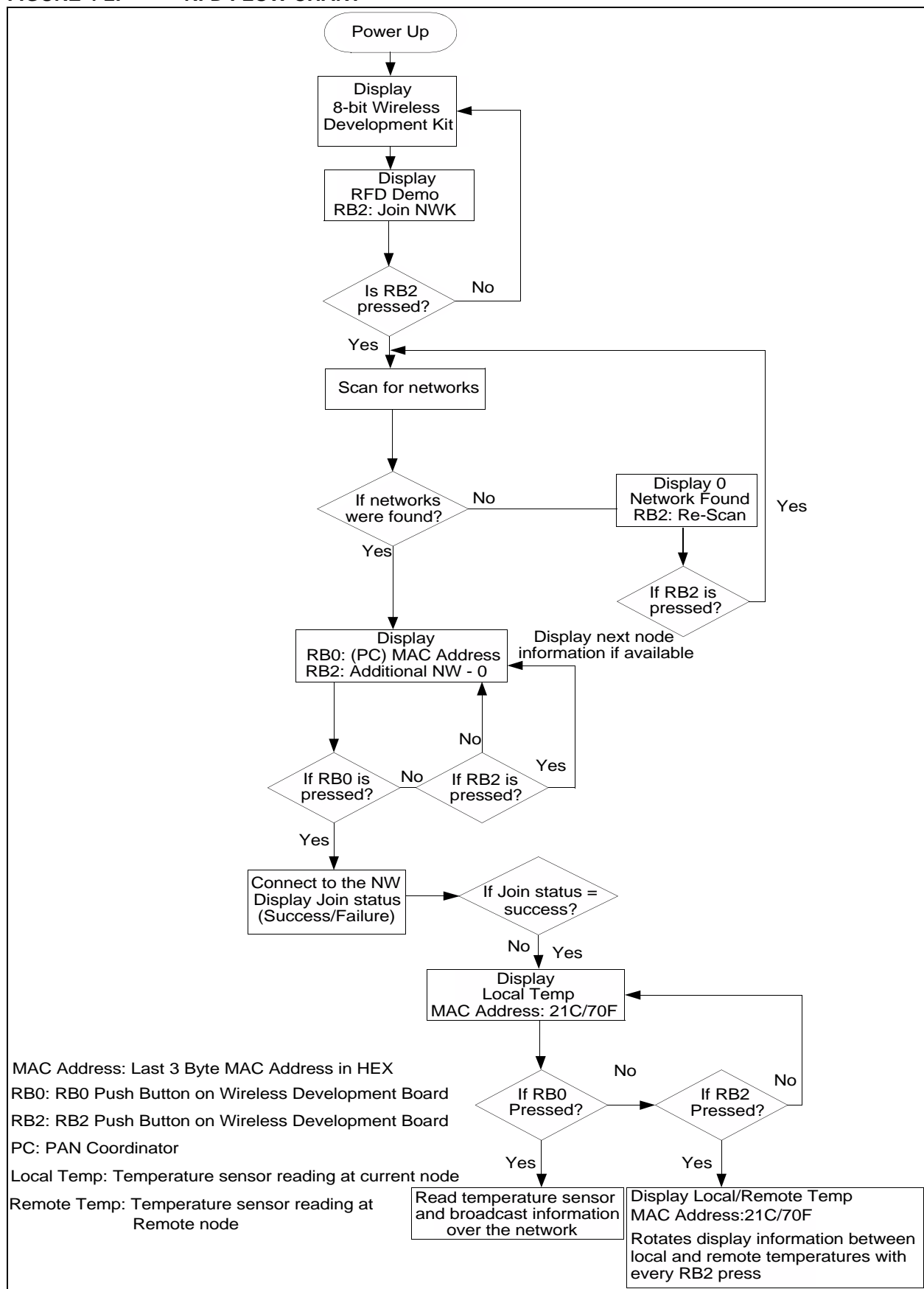
1. Plug in the Radio PICtail Daughter board at slot J201 on the PIC18 Wireless Development Board (See [Figure 3-1](#)).
2. To power from an external source (9V or USB), insert a jumper at JP301 (Regulator Disconnect) on the PIC18 Wireless Development Board. To power from batteries, remove the jumper on JP301.
3. Insert a jumper at JP201 (LED Power) on the PIC18 Wireless Development Board
4. Insert a jumper at either JP302 or JP303 (Current Measure) on the PIC18 Wireless Development Board.

### 4.4.2 Tutorial Operation

To run the program, use the node with the 8-bit WDK Demo.hex file to create the PAN Coordinator. To run the tutorial program, refer to [Section 3.4 “Pre-programmed Tutorial Operation”](#). From the second node (RFD Demo.hex) join the PAN Coordinator. By using the RFD node, user can estimate the lowest power profile for the board.

The program flow for the RFD Device is shown in [Figure 4-2](#).

**FIGURE 4-2: RFD FLOW CHART**



## 4.5 CHAT WINDOW DEMO

This tutorial program can be used to setup a wireless chatting service over the network. The Chat Window demo uses MiWi Peer-to-Peer (P2P) protocol and can be extended to use the MiWi protocol.

The following hardware are required to run this tutorial:

- Two PIC18 Wireless Development Boards
- Two Radio Daughter Boards
- Two LCD Serial Accessory Boards
- Two RS232 Serial Accessory Boards
- Four fresh AA batteries or Two 9V External Power Supply or two USB cables
- Computer with a terminal program

The following are the connection settings for terminal program:

- Baud Rate: 19200 kbps
- Data Bits: 8
- Parity: None
- Stop Bits: 1
- Flow Control: None

Program both of the PIC18 Wireless Development boards with "Chat Window Demo.hex" file located in "8-bit Wireless Development Kit\8-bit WDK Demo\".

### 4.5.1 Setup

Follow these steps to set up the Chat Window demo:

1. Connect the LCD Serial Accessory Board J1 port to the J2 or J3 I<sup>2</sup>C port of RS232 Serial Accessory Board.
2. Connect the J1 port on RS232 Serial Accessory Board to the J101 connector on the PIC18 Wireless Development Board (See [Figure 4-1](#)).
3. Plug in the Radio PICtail Daughter board at slot J201 on the PIC18 Wireless Development Board.
4. To power the PIC18 Wireless Development Board from external power (9V or USB), insert a jumper at JP301 (Regulator Disconnect) on the PIC18 Wireless Development Board. To power it from batteries, remove the jumper on JP301.
5. Insert a jumper at JP201 (LED Power) on the PIC18 Wireless Development Board.
6. Ensure that the jumper is disconnected at JP1 position on the LCD Serial Accessory Board. This ensures that the LCD Serial Accessory Board is used in I<sup>2</sup>C mode and not in SPI mode. The Chat Window demo uses the LCD Serial Accessory board in I<sup>2</sup>C mode.
7. Wireless demo board can be powered using any one of these options:
  - Two AA Batteries
  - 9V External Power Supply
  - USB Port
  - External 3.0-3.6V power source through test points TP301 and TP302
8. Insert a jumper at either JP302 or JP303 (Current Measure) on the PIC18 Wireless Development Board.

9. Connect a RS232 cable between the RS232 Port on the RS232 Serial Accessory Board and the PC.
10. Open two instances of the terminal programs from the PC with the previous settings.

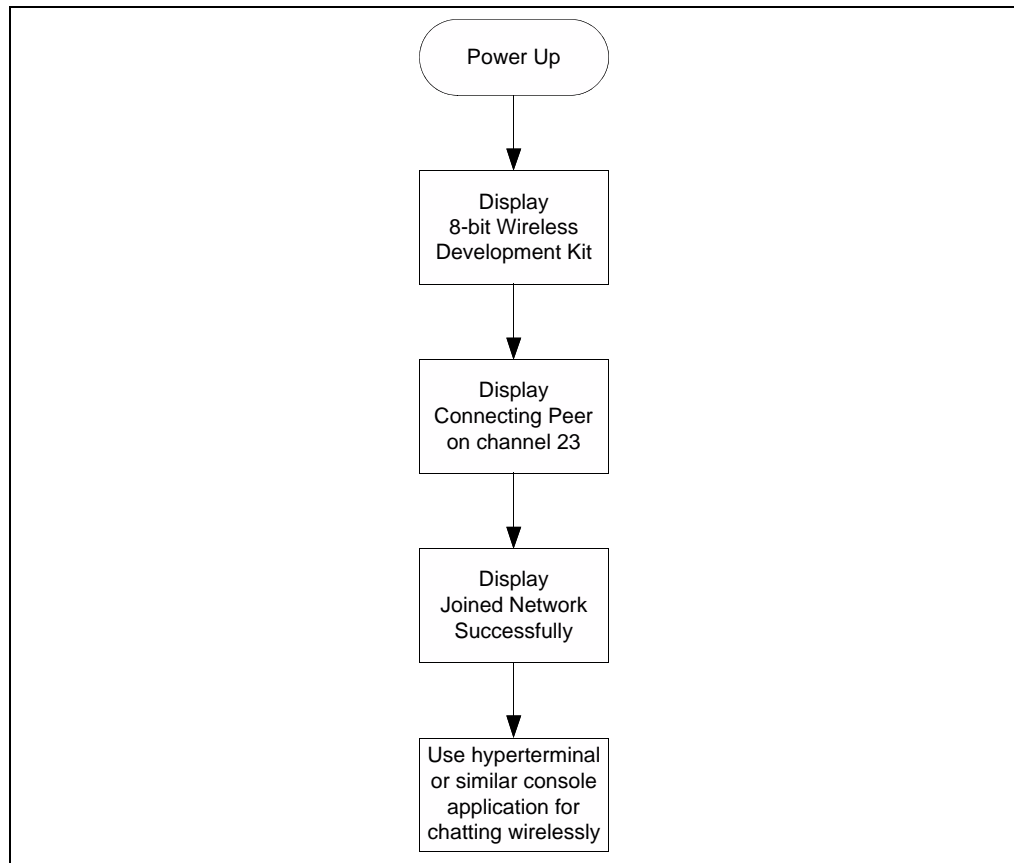
**Note:** Windows 98 or Windows XP OS users can use the hyper-terminal program. Windows 7 or any other OS users can download other terminal software programs available from the web.

### 4.5.2 Tutorial Operation

The Chat Window demo program flow is described in [Figure 4-3](#).

1. Press the MCLR push button on both the nodes to reset the program.  
(The demo uses a small window frame to scan and join the network, else it creates two separate networks. Therefore, both the nodes must be powered simultaneously, so that they can establish connection with one another.)
2. The LCD screen displays the welcome message “8-bit Wireless Development Kit” and then it changes to “Connecting peer on Channel 23”.
3. After the connection is established with the peer, the display changes to “joined network successfully”
4. Users can use the hyper-terminal program to chat with the peer node.

**FIGURE 4-3: CHAT WINDOW DEMO PROGRAM**



## 4.6 PING-PONG DEMO

This tutorial program is used for range testing and for measuring the Received Signal Strength Indication (RSSI). In the Ping-Pong demo, as the name indicates, one node transmits data while the other node receives data. After the transmission phase is complete (10 packets) they switch their roles.

The following hardware is required to run this tutorial:

- Two PIC18 Wireless Development Boards
- Two Radio Daughter Boards
- Two LCD Serial Accessory Boards
- Four fresh AA batteries or Two 9V External Power Supply or two USB cables

Program both the PIC18 Wireless Development boards with the `Ping-Pong Demo.hex` file from the 8-bit Wireless Development Kit - (Transceiver)\Ping-Pong Demo\.

### 4.6.1 Set up

Follow these steps to set up the Ping-Pong demo:

1. Connect the LCD Serial Accessory board J1 port to the J101 connector on the PIC18 Wireless Development Board (See [Figure 3-1](#)).
2. Plug in the Radio PICtail Daughter board at slot J201 on the PIC18 Wireless Development Board.
3. To power the PIC18 Wireless Development Board from external power (9V or USB), insert a jumper at JP301 (Regulator Disconnect) on the PIC18 Wireless Development Board. To power it from batteries, remove the jumper on JP301.
4. Insert a jumper at JP201 (LED power) on the PIC18 Wireless Development Board
5. Ensure that the jumper is disconnected at JP1 position on the LCD Serial Accessory Board. This ensures that the LCD Serial Accessory Board is used in I<sup>2</sup>C mode and not in SPI mode. The Ping-Pong demo uses the LCD Serial Accessory board in I<sup>2</sup>C mode.
6. Wireless demo board can be powered using any one of these options:
  - Two AA Batteries
  - 9V External Power Supply
  - USB Port
  - External 3.0-3.6V power source through test points TP301 and TP302
7. Insert a jumper at either JP302 or JP303 (Current Measure) on the PIC18 Wireless Development Board.

### 4.6.2 Tutorial Operation

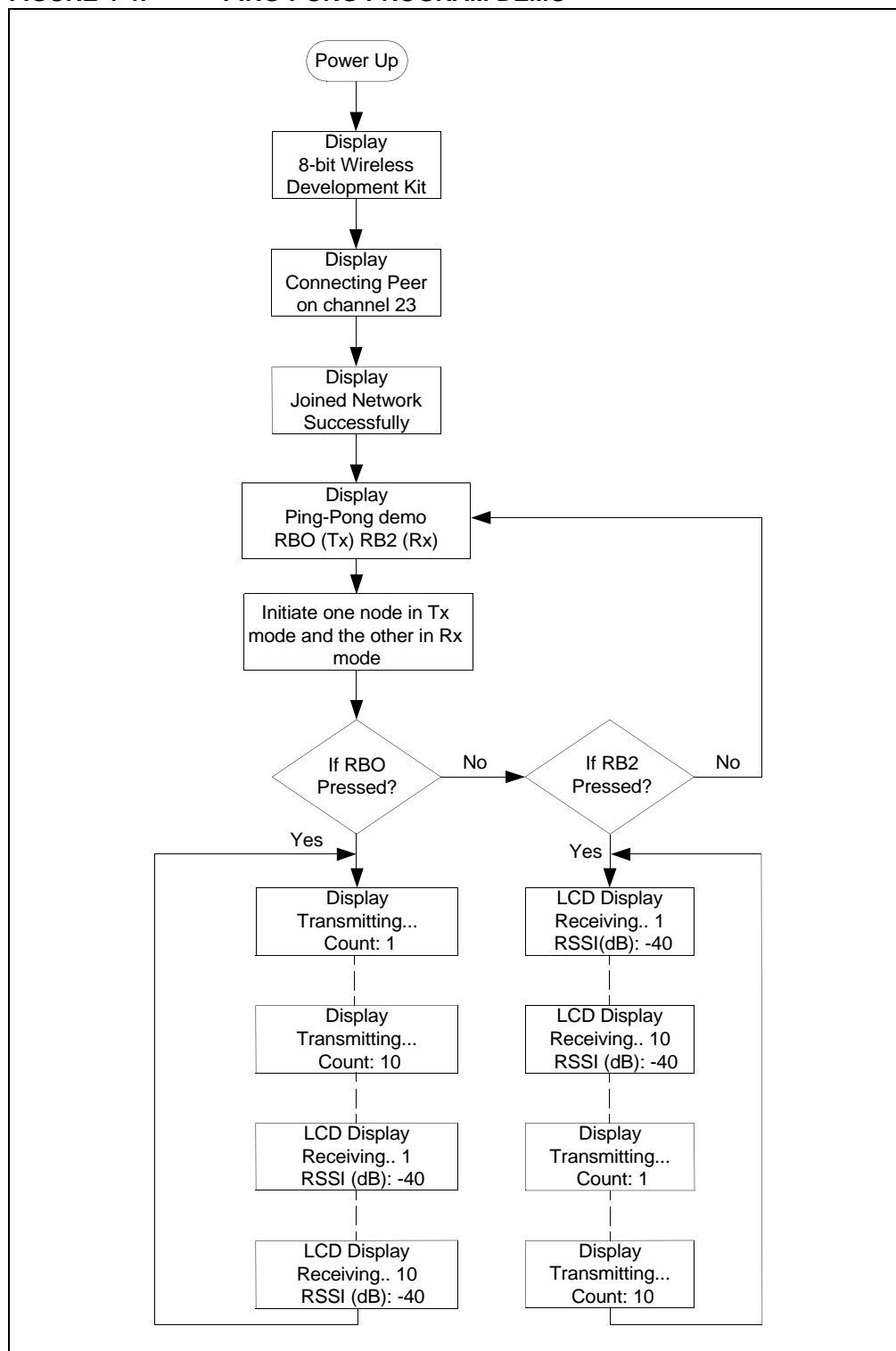
The Ping-Pong demo program flow is described in [Figure 4-4](#).

1. Power both the development kits simultaneously. This demo uses the MiWi P2P protocol, switching both the nodes simultaneously ensures that they connect with one-another.
2. After powering the demo board a welcome message "8-bit Wireless Development Kit" will be displayed on the LCD screen, and later it changes to "Connecting Peer on Channel 23".
3. After the MiWi P2P connection is established between the nodes, the LCD display on both the screens change to "Joined Network successfully".
4. After few seconds, the LCD screen prompts the user to initiate the Ping-Pong test with the following display:
  - Ping-Pong demo
  - RB0 (Tx) RB2 (Rx)
5. Initiate one node in Tx mode and the other node in Rx mode.
6. On one node (Node 1), press RB0 push button and then on the other node (Node 2) press RB2 push button. Both the nodes will start exchanging data immediately.
  - On Node 1:
    - LCD Display line1: Transmitting
    - LCD Display line2: Count: 1
  - On Node 2:
    - LCD Display line1: Receiving 1
    - LCD Display line2: RSSI (dB): -40

Count reads from 1-10 and then Node 2 moves to Transmit mode and Node 1 moves to Receive mode.



**FIGURE 4-4: PING-PONG PROGRAM DEMO**

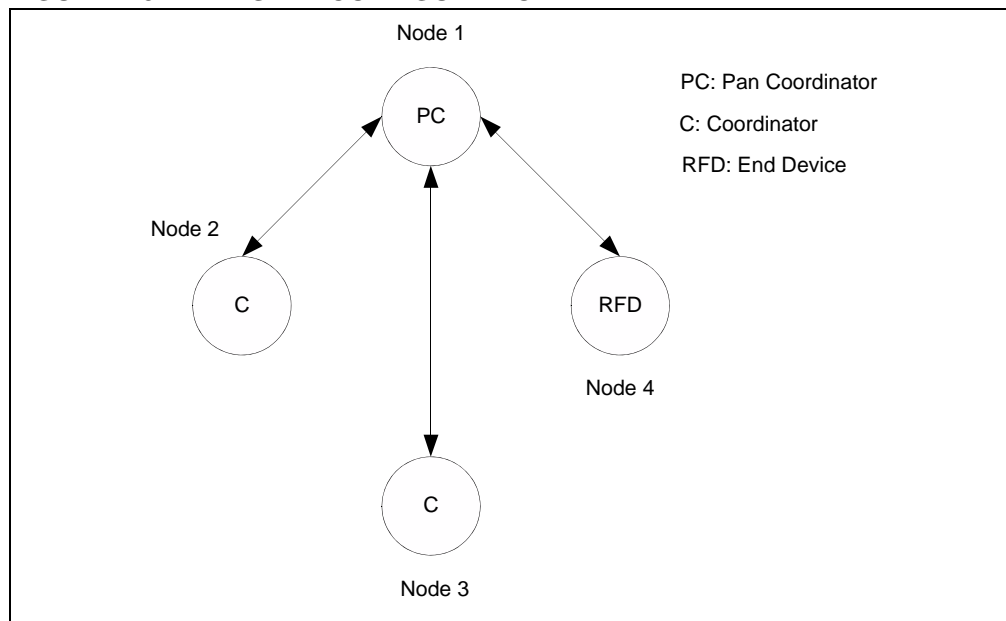


## 4.7 8-BIT WIRELESS DEVELOPMENT KIT WITH ADDITIONAL NODES

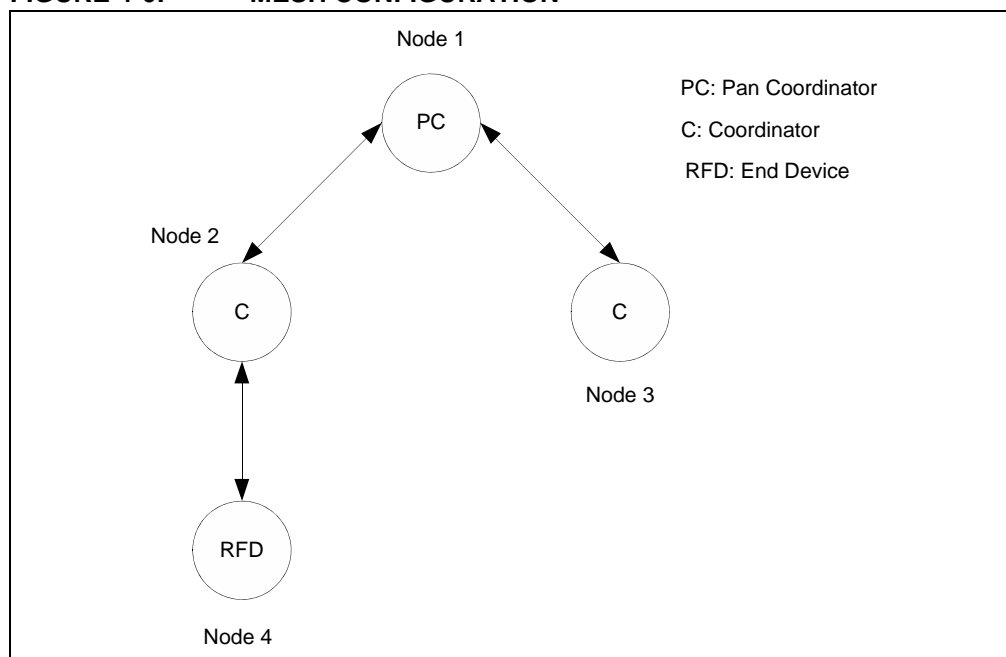
The 8-bit Wireless Development kit demo can be expanded using additional nodes. As 8-bit Wireless Development kit demo uses MiWi protocol (see AN1066), a network that can support up to four hops can be created. Users can create either a Star Network or a Mesh Network.

Figure 4-5 and Figure 4-6 illustrates the sample networks using two additional nodes. Program PIC18 Wireless Development board with the `8-bit WDK Demo.hex` file for creating a PAN Coordinator (PC) or Coordinator (C). Program PIC18 Wireless Development board with the `RFD Demo.hex` file to create a Reduced Function Device (RFD).

**FIGURE 4-5: STAR CONFIGURATION**



**FIGURE 4-6: MESH CONFIGURATION**



---

---

## **Appendix A. PIC18 Wireless Development Board Schematic**

---

---

### **A.1 INTRODUCTION**

This appendix includes:

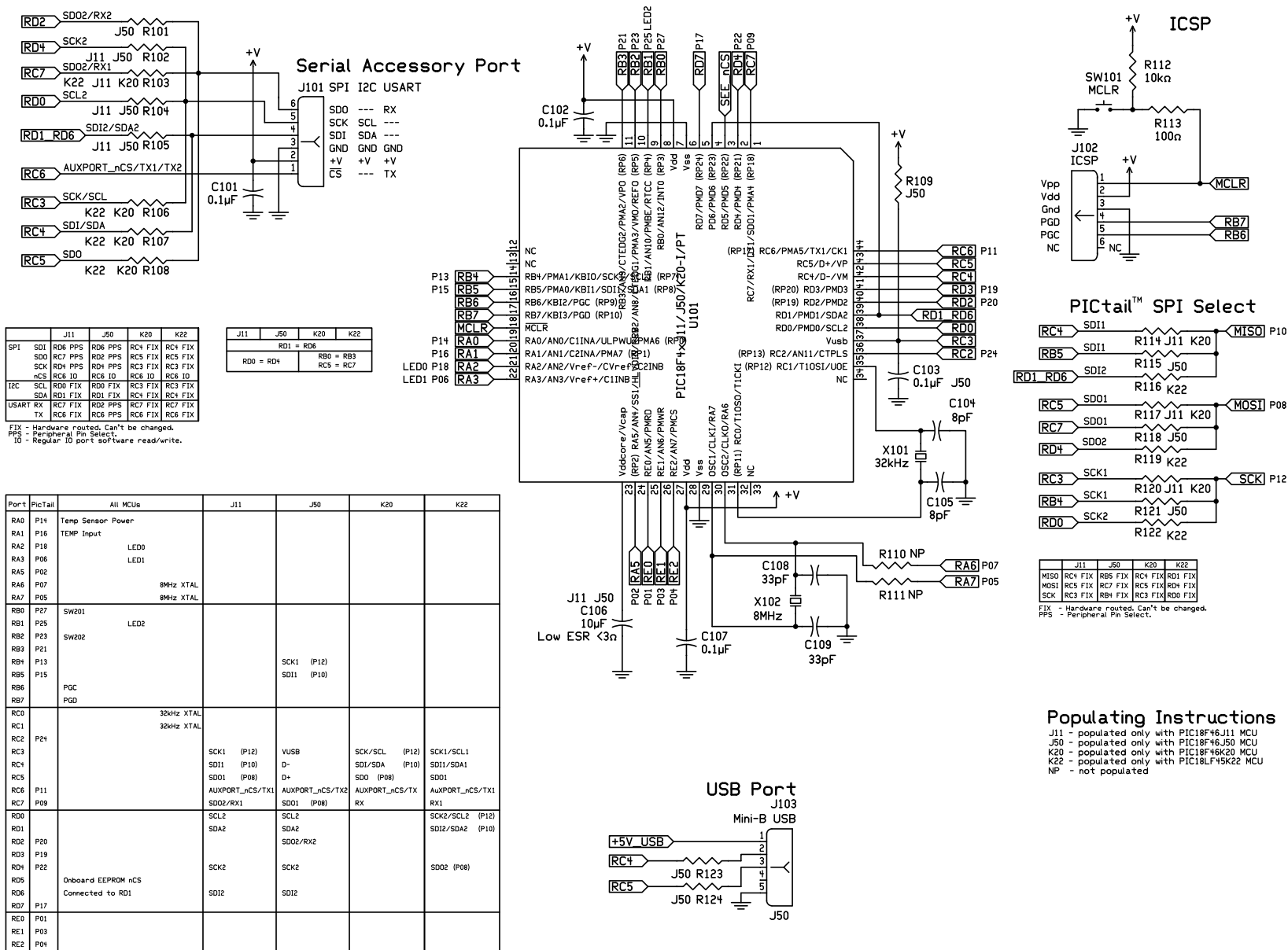
- PIC18 Wireless Development Board schematics
- PIC18 Wireless Development Board PCB Layout
- PIC18 Wireless Development Board Bill of Materials (BOM)

Component reference IDs are structured to help in finding them on the sheets of schematics. The first digit of the ID is the sheet number and the last second digits are reference IDs. For example, BT301 battery holder can be found on the third schematics sheet.

### **A.2 PIC18 WIRELESS DEVELOPMENT BOARD SCHEMATIC**

[Figure A-1](#), [Figure A-2](#) and [Figure A-3](#) illustrate the PIC18 Wireless Development Board schematics.

FIGURE A-1: PIC18 WIRELESS DEVELOPMENT BOARD SCHEMATIC



# PIC18 Wireless Development Board Schematic

FIGURE A-2: PIC18 WIRELESS DEVELOPMENT BOARD SCHEMATIC

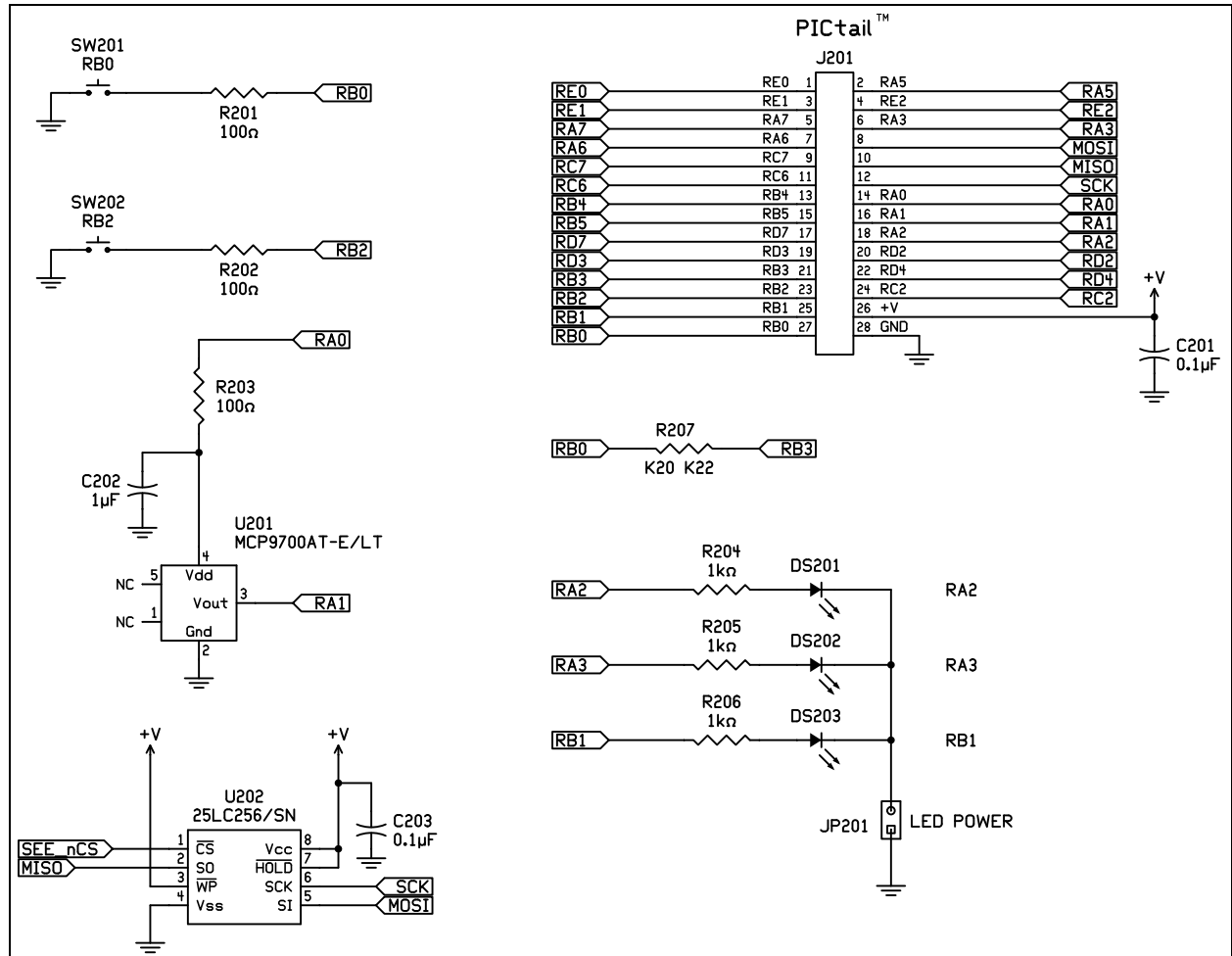
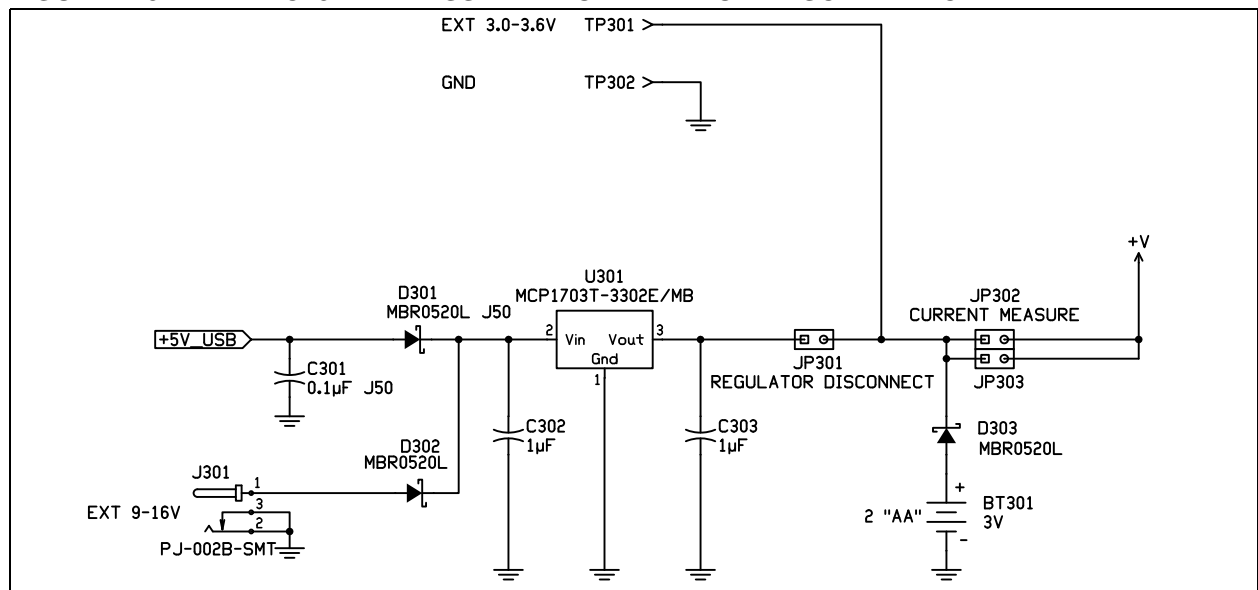


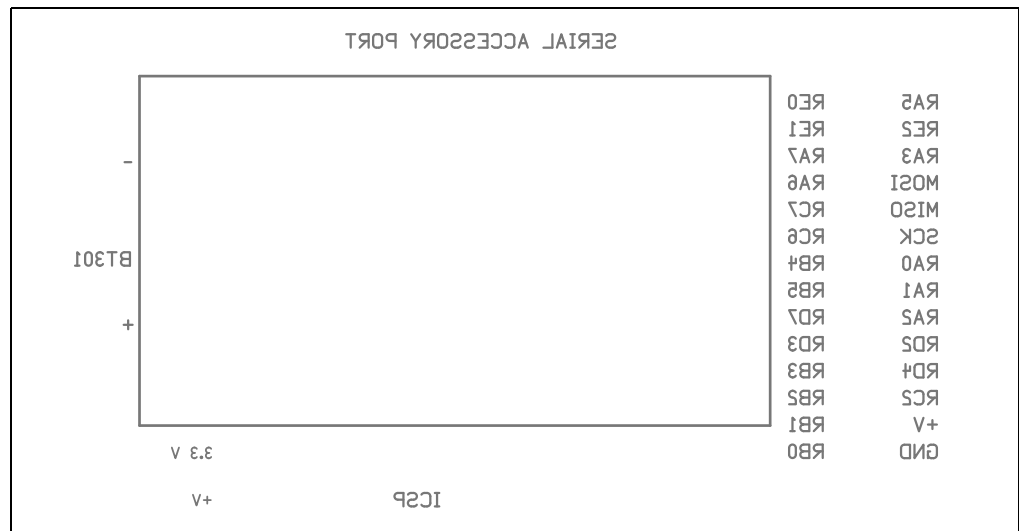
FIGURE A-3: PIC18 WIRELESS DEVELOPMENT BOARD SCHEMATIC



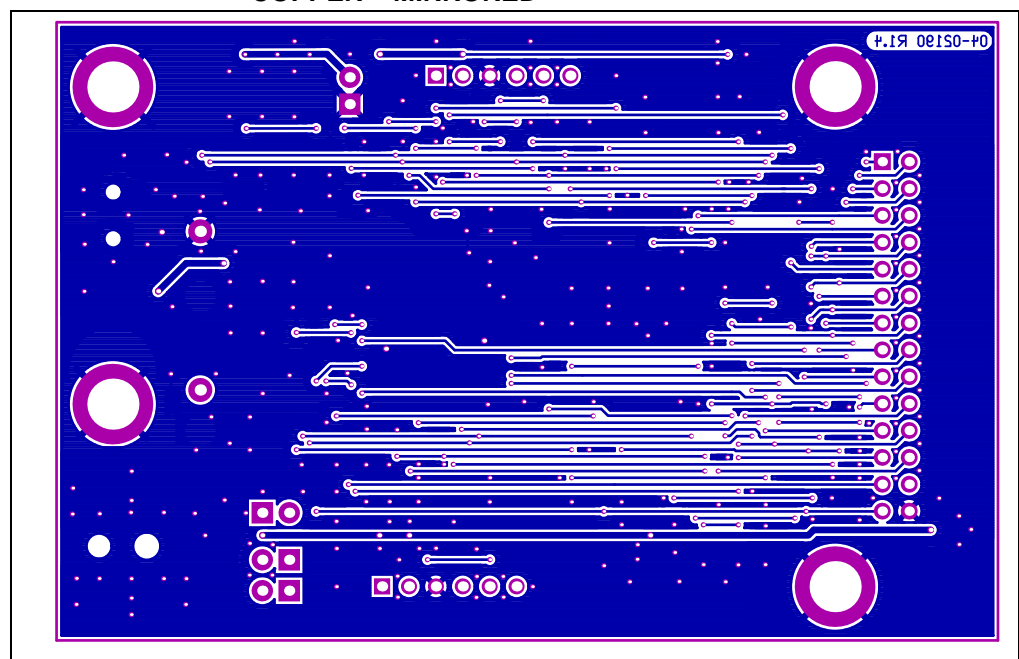


# PIC18 Wireless Development Board Schematic

**FIGURE A-6: PIC18 WIRELESS DEVELOPMENT BOARD BOTTOM SILK-SCREEN – MIRRORED**



**FIGURE A-7: PIC18 WIRELESS DEVELOPMENT BOARD BOTTOM COPPER – MIRRORED**



# PIC18 Wireless Development Board Schematic

## A.4 PIC18 WIRELESS DEVELOPMENT BOARD BILL OF MATERIALS

TABLE A-1: PIC18 WIRELESS DEVELOPMENT BOARD BILL OF MATERIALS

| Reference IDs  | Qty | Type/Value     | Description  | Manufacturer                  | Manufacturer P/N      |
|--|-----|----------------|--|-------------------------------|-----------------------|
| BT301  | 1   | 3V             | Battery Holder, 2 cell, AA, PC Mount                       | Keystone Electronics          | 2462                  |
| C104, C105   | 2   | 8 pF           | CAP CER 8.0PF 50V C0G 0603                                 | Murata                        | GRM1885C1H8R0DZ01D    |
| C101, C102, C103, C107, C201, C203, C301                   | 7   | 0.1 $\mu$ F    | Capacitor, Ceramic, 25V, 10%, X7R, SMT 0603                | Panasonic – ECG               | ECJ-1VB1E104K         |
| C106   | 1   | 10 $\mu$ F     | Capacitor, Ceramic, 6.3V, 20%, X5R, SMT 0805               | Panasonic – ECG               | ECJ-2FB0J106M         |
| C108, C109   | 2   | 33 pF          | Capacitor, Ceramic, 50V, 5%, C0G, SMT 0603                 | Murata                        | GRM1885C1H330JA01D    |
| C202, C302, C303   | 3   | 1 $\mu$ F      | Capacitor, Ceramic, 6.3V, 10%, X5R, SMT 0603               | Panasonic – ECG               | ECJ-1VB0J105K         |
| D301 D302 D303   | 3   | MBR0520L       | Diode, Schottky, 0.5A, 20V, SMT SOD-123                    | Fairchild Semiconductor       | MBR0520L              |
| DS201, DS202, DS203  | 3   | LED            | LED, SMT 0603, Green                                       | Osram Opto Semiconductors Inc | LG Q971-KN-1-0-20-R18 |
| J101   | 1   | Accessory Port | Connector, Socket, Right Angle, 0.100" spacing, 0.025" sq. | Mill-Max                      | 801-43-006-20-001000  |
| J102   | 1   | ICSP Port      | Connector, Header, Right Angle, 0.100" spacing, 0.025" sq. | Mill-Max                      | 800-10-006-20-001000  |
| J103   | 1   | USB Port       | Connector, USB, Mini-B, SMT                                | Kycon                         | KMBX-SMT-5S-S-30TR    |
| J201   | 1   | PICtail Port   | Connector, Header, 2x14 pin, 0.100" spacing, 0.025" sq.    | Samtec                        | SSW-114-01-G-D        |
| J301   | 1   | EXT 9-16V      | CONN POWER JACK 2.5X5.5MM SMD                              | CUI Inc                       | PJ002-B-SMT           |
| JP201, JP301, JP302, JP303                                 | 4   |                | Connector, Header, 2-pin, 0.100" spacing                   | SPC Technology                | SPC20481              |
| —  | 3   | Shunt          | Shunt  | Tyco Electronics              | 382811-6              |
| R101, R102, R104, R105, R109, R115, R118, R121, R123, R124 | 10  | 0 ohms         | Resistor, SMT 0603   | Stackpole Electronics Inc.    | RMCF 1/16 0 R         |
| R112   | 1   | 10k ohms       | Resistor, SMT 0603   | Stackpole Electronics Inc.    | RMCF 1/16 10K 5% R    |
| R113, R201, R202, R203                                     | 4   | 100 ohms       | Resistor, SMT 0603   | Stackpole Electronics Inc.    | RMCF 1/16 100 5% R    |
| R204, R205, R206   | 3   | 1k ohms        | Resistor, SMT 0603   | Stackpole Electronics Inc.    | RMCF 1/16 1K 5% R     |



# PIC18 Wireless Development Board Schematic

**TABLE A-1: PIC18 WIRELESS DEVELOPMENT BOARD BILL OF MATERIALS (CONTINUED)**

| Reference IDs          | Qty | Type/Value            | Description                                     | Manufacturer                 | Manufacturer P/N   |
|------------------------|-----|-----------------------|---|------------------------------|--------------------|
| SW101,<br>SW201, SW202 | 3   | —                     | Switch, Pushbutton,<br>Momentary, 6x3mm<br>SMT  | C&K Components               | PTS635SL25SMTR LFS |
| TP301, TP302           | 2   | —                     | 5016K Test Point, SMT                           | Keystone Elec-<br>tronics    | 5016               |
| U101                   | 1   | PIC18F46J50<br>-I/PT  | PIC18F46J50T-I/PT                               | Microchip<br>Technology Inc. | PIC18F46J50T-I/PT  |
| U201                   | 1   | MCP9700AT-<br>E/L     | Temperature Sensor,<br>SMT SC-70-5              | Microchip<br>Technology Inc. | MCP9700AT-E/LT     |
| U202                   | 1   | 25LC256-I/SN          | Serial EEPROM, 256K,<br>SPI, SOIC-8             | Microchip<br>Technology Inc. | 25LC256-I/SN       |
| U301                   | 1   | MCP1703T-3<br>302E/MB | LDO, 250 mA, 3.3V,<br>SMT SOT-89                | Microchip<br>Technology Inc. | MCP1703T-3302E/MB  |
| X101                   | 1   | 32 kHz                | Crystal, tuning-fork,<br>32.768 kHz, 9.0pF, SMT | Micro Crystal                | MS3V-T1R           |
| X102                   | 1   | 8 MHz                 | CRYSTAL 8.000MHZ<br>18PF FUND SMD               | Abrakon Corpora-<br>tion     | ABLS-8.000MHZ-B2-T |
| —                      | 4   | Stand-off             | SPACER STACKING #4<br>SCREW NYLON               | Keystone Elec-<br>tronics    | 8834               |
| —                      | 1   |                       | Double sided glue tape,<br>cca 2.5cm*2.5cm      | —                            | —                  |

| Unpopulated Board<br>Components   |    |       |                       |                               |               |
|---|----|-------|-----------------------|-------------------------------|---------------|
| R103, R106, R107, R108,<br>R110, R111, R114, R116,<br>R117, R119, R120, R122,<br>R207 | 12 | 0 ohm | Resistor, SMT<br>0603 | Stackpole<br>Electronics Inc. | RMCF 1/16 0 R |

## Worldwide Sales and Service

### AMERICAS

**Corporate Office**  
2355 West Chandler Blvd.  
Chandler, AZ 85224-6199  
Tel: 480-792-7200  
Fax: 480-792-7277  
Technical Support:  
<http://www.microchip.com/support>  
Web Address:  
[www.microchip.com](http://www.microchip.com)

**Atlanta**  
Duluth, GA  
Tel: 678-957-9614  
Fax: 678-957-1455

**Boston**  
Westborough, MA  
Tel: 774-760-0087  
Fax: 774-760-0088

**Chicago**  
Itasca, IL  
Tel: 630-285-0071  
Fax: 630-285-0075

**Cleveland**  
Independence, OH  
Tel: 216-447-0464  
Fax: 216-447-0643

**Dallas**  
Addison, TX  
Tel: 972-818-7423  
Fax: 972-818-2924

**Detroit**  
Farmington Hills, MI  
Tel: 248-538-2250  
Fax: 248-538-2260

**Indianapolis**  
Noblesville, IN  
Tel: 317-773-8323  
Fax: 317-773-5453

**Los Angeles**  
Mission Viejo, CA  
Tel: 949-462-9523  
Fax: 949-462-9608

**Santa Clara**  
Santa Clara, CA  
Tel: 408-961-6444  
Fax: 408-961-6445

**Toronto**  
Mississauga, Ontario,  
Canada  
Tel: 905-673-0699  
Fax: 905-673-6509

### ASIA/PACIFIC

**Asia Pacific Office**  
Suites 3707-14, 37th Floor  
Tower 6, The Gateway  
Harbour City, Kowloon  
Hong Kong  
Tel: 852-2401-1200  
Fax: 852-2401-3431

**Australia - Sydney**  
Tel: 61-2-9868-6733  
Fax: 61-2-9868-6755

**China - Beijing**  
Tel: 86-10-8569-7000  
Fax: 86-10-8528-2104

**China - Chengdu**  
Tel: 86-28-8665-5511  
Fax: 86-28-8665-7889

**China - Chongqing**  
Tel: 86-23-8980-9588  
Fax: 86-23-8980-9500

**China - Hangzhou**  
Tel: 86-571-2819-3187  
Fax: 86-571-2819-3189

**China - Hong Kong SAR**  
Tel: 852-2401-1200  
Fax: 852-2401-3431

**China - Nanjing**  
Tel: 86-25-8473-2460  
Fax: 86-25-8473-2470

**China - Qingdao**  
Tel: 86-532-8502-7355  
Fax: 86-532-8502-7205

**China - Shanghai**  
Tel: 86-21-5407-5533  
Fax: 86-21-5407-5066

**China - Shenyang**  
Tel: 86-24-2334-2829  
Fax: 86-24-2334-2393

**China - Shenzhen**  
Tel: 86-755-8203-2660  
Fax: 86-755-8203-1760

**China - Wuhan**  
Tel: 86-27-5980-5300  
Fax: 86-27-5980-5118

**China - Xian**  
Tel: 86-29-8833-7252  
Fax: 86-29-8833-7256

**China - Xiamen**  
Tel: 86-592-2388138  
Fax: 86-592-2388130

**China - Zhuhai**  
Tel: 86-756-3210040  
Fax: 86-756-3210049

### ASIA/PACIFIC

**India - Bangalore**  
Tel: 91-80-3090-4444  
Fax: 91-80-3090-4123

**India - New Delhi**  
Tel: 91-11-4160-8631  
Fax: 91-11-4160-8632

**India - Pune**  
Tel: 91-20-2566-1512  
Fax: 91-20-2566-1513

**Japan - Osaka**  
Tel: 81-66-152-7160  
Fax: 81-66-152-9310

**Japan - Yokohama**  
Tel: 81-45-471- 6166  
Fax: 81-45-471-6122

**Korea - Daegu**  
Tel: 82-53-744-4301  
Fax: 82-53-744-4302

**Korea - Seoul**  
Tel: 82-2-554-7200  
Fax: 82-2-558-5932 or  
82-2-558-5934

**Malaysia - Kuala Lumpur**  
Tel: 60-3-6201-9857  
Fax: 60-3-6201-9859

**Malaysia - Penang**  
Tel: 60-4-227-8870  
Fax: 60-4-227-4068

**Philippines - Manila**  
Tel: 63-2-634-9065  
Fax: 63-2-634-9069

**Singapore**  
Tel: 65-6334-8870  
Fax: 65-6334-8850

**Taiwan - Hsin Chu**  
Tel: 886-3-5778-366  
Fax: 886-3-5770-955

**Taiwan - Kaohsiung**  
Tel: 886-7-536-4818  
Fax: 886-7-330-9305

**Taiwan - Taipei**  
Tel: 886-2-2500-6610  
Fax: 886-2-2508-0102

**Thailand - Bangkok**  
Tel: 66-2-694-1351  
Fax: 66-2-694-1350

### EUROPE

**Austria - Wels**  
Tel: 43-7242-2244-39  
Fax: 43-7242-2244-393

**Denmark - Copenhagen**  
Tel: 45-4450-2828  
Fax: 45-4485-2829

**France - Paris**  
Tel: 33-1-69-53-63-20  
Fax: 33-1-69-30-90-79

**Germany - Munich**  
Tel: 49-89-627-144-0  
Fax: 49-89-627-144-44

**Italy - Milan**  
Tel: 39-0331-742611  
Fax: 39-0331-466781

**Netherlands - Druenen**  
Tel: 31-416-690399  
Fax: 31-416-690340

**Spain - Madrid**  
Tel: 34-91-708-08-90  
Fax: 34-91-708-08-91

**UK - Wokingham**  
Tel: 44-118-921-5869  
Fax: 44-118-921-5820

## Данный компонент на территории Российской Федерации

**Вы можете приобрести в компании MosChip.**

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

<http://moschip.ru/get-element>

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

### Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: [info@moschip.ru](mailto:info@moschip.ru)

Skype отдела продаж:

moschip.ru

moschip.ru\_4

moschip.ru\_6

moschip.ru\_9