

## 2.4 GHz 802.15.4 DEMONSTRATION SOFTWARE USER'S GUIDE

### 1. Introduction

The Silicon Laboratories 2.4 GHz 802.15.4 Development Kit includes all hardware and software to demonstrate and design a two-node 802.15.4 link. The hardware includes two development boards, each with a Silicon Laboratories C8051F121 microcontroller, CP2101 USB interface, Chipcon CC2420 2.4 GHz 802.15.4 transceiver, and antenna. Each includes a variety of pushbutton switches, LEDs, and a trimpot for demonstration applications, as well as a programming interface compatible with the Silicon Laboratories serial and USB Debug Adaptors.

This document describes installation and operation of the 2.4 GHz 802.15.4 Demonstration application. Refer also to "AN222: 2.4 GHz 802.15.4/ZigBee Development Board Hardware Users Guide" for a hardware description of the development board.

### 2. Hardware and Software Installation

This section describes the first-time software and hardware installation procedure.

#### 2.1. Install Software

Insert the CD, which will automatically launch the installer shown in Figure 1. Click *Install 802.15.4/ZigBee Tools* to install the 2.4 GHz 802.15.4 Demonstration Software.

The software can be launched by the desktop shortcut or from the *Start → All Programs → Silicon Laboratories → 2.4 GHz 802.15.4 Development Kit* menu after installation.

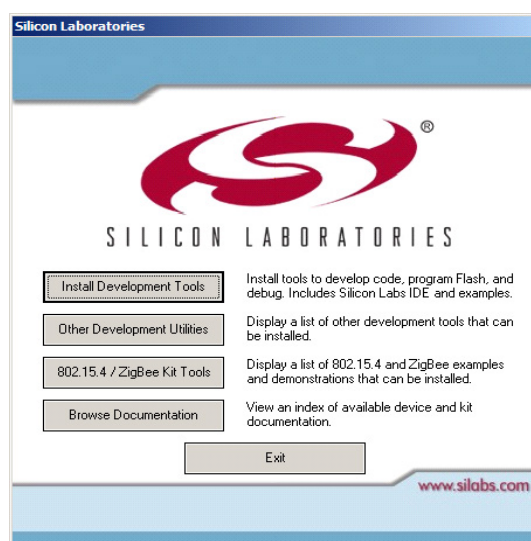


Figure 1. Installer

#### 2.2. Set up Hardware and PC Interface

Before first use, each node must be individually configured and installed as a new Windows USB device as follows:

1. Attach the supplied antenna to the SMA connector on the PCB. Orient the antenna upright and perpendicular to the board.
2. Connect the development board to the PC's USB interface. This interface provides both communication to the GUI and power for the board.
3. Install the USB drivers. The Windows "Found New Hardware Wizard" will automatically start when the board is connected. The Wizard will run twice for each new development board: first to install the USB driver and second to install a virtual COM port driver. Follow the default settings for both as shown in Figure 2.

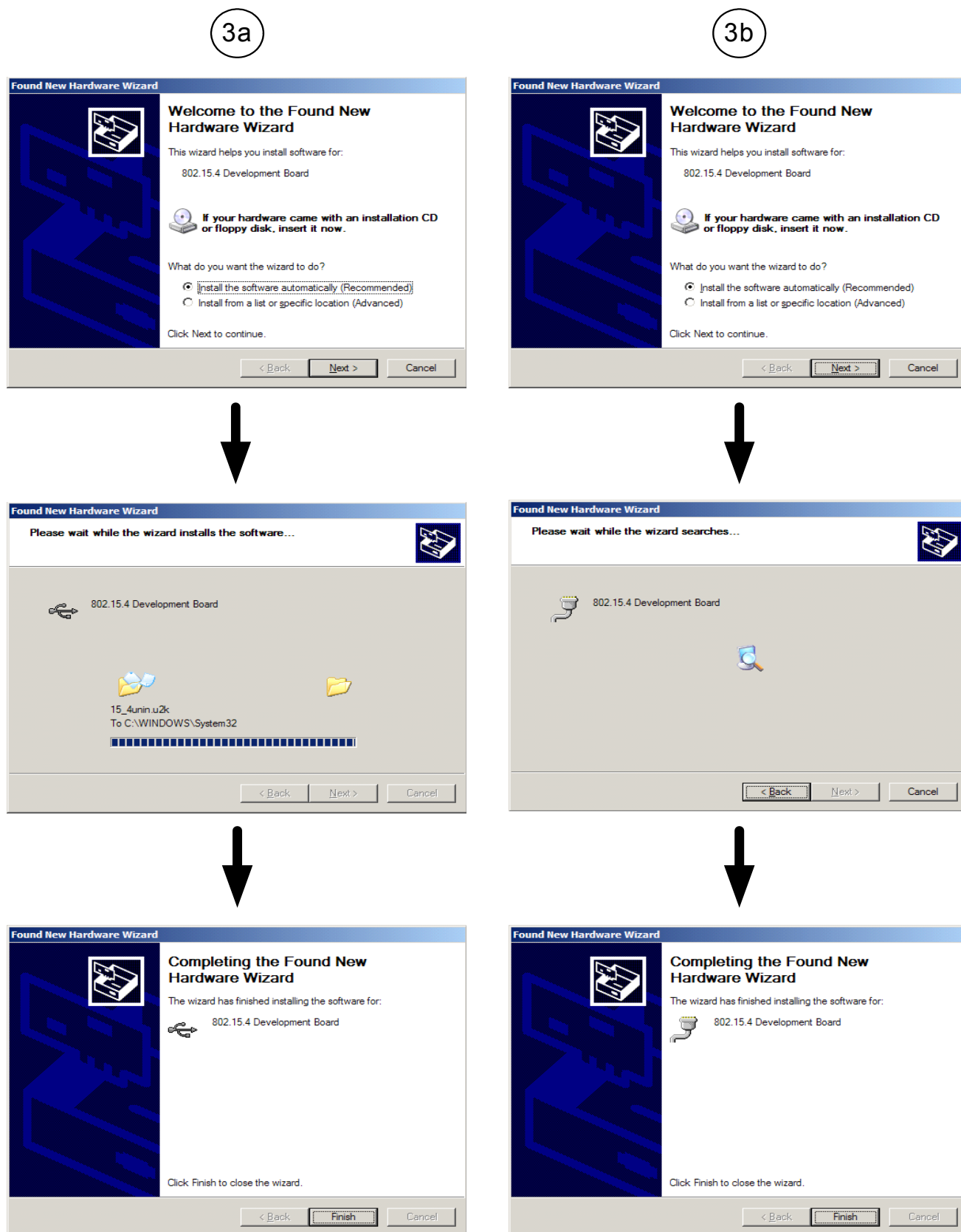
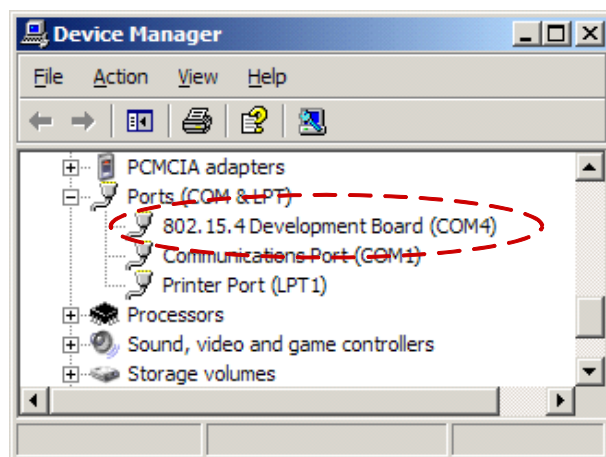


Figure 2. USB Installation

4. Determine the COM port assigned to the development board. This assignment is unique for each development board on each PC. The COM port assignment may be determined by the following steps:
- Connect and install the development board as described above.
  - Open the Device Manager:
    - Right click on the My Computer desktop icon:
    - Select Properties.
    - Select Hardware.
    - Select Device Manager tab.
  - Open the Ports subsection, find the attached 802.15.4 Development Board device (assigned to COM4 in this example; see Figure 3.)
  - Note the COM port assignment for future reference. It may prove useful to label this information on each board.



**Figure 3. Determining COM port from the Device Manager**

5. Disconnect from the PC and repeat for the second board.

## 3. Demonstration

This section describes how to establish a basic 802.15.4 Personal Area Network (PAN) and use the 2.4 GHz 802.15.4 Demonstration Software to demonstrate communication between the PAN Coordinator and networked End Devices.

### 3.1. Controls and Indicators

The PCB controls and indicators are defined differently for PAN Coordinators and End Devices.

The PAN Coordinator is controlled primarily through the PC software. The indicators are shown in Figure 4. The green LED D6 will indicate that the device has been configured as a PAN Coordinator. The red LED D9 will flash as data is transmitted or received. The yellow LED D7 will flash momentarily when an End Device associates, and the amber LED D8 will flash momentarily when an End Device disassociates.

The End Device is controlled by push-buttons on the board as shown in Figure 5. Pressing SW5 initiates a scan and association attempt with the first PAN Coordinator located. Successful association is indicated by the yellow LED D7. SW3 will request disassociation from the PAN Coordinator. Similar to the PAN Coordinator, the red LED D9 flashes as data is transmitted or received.

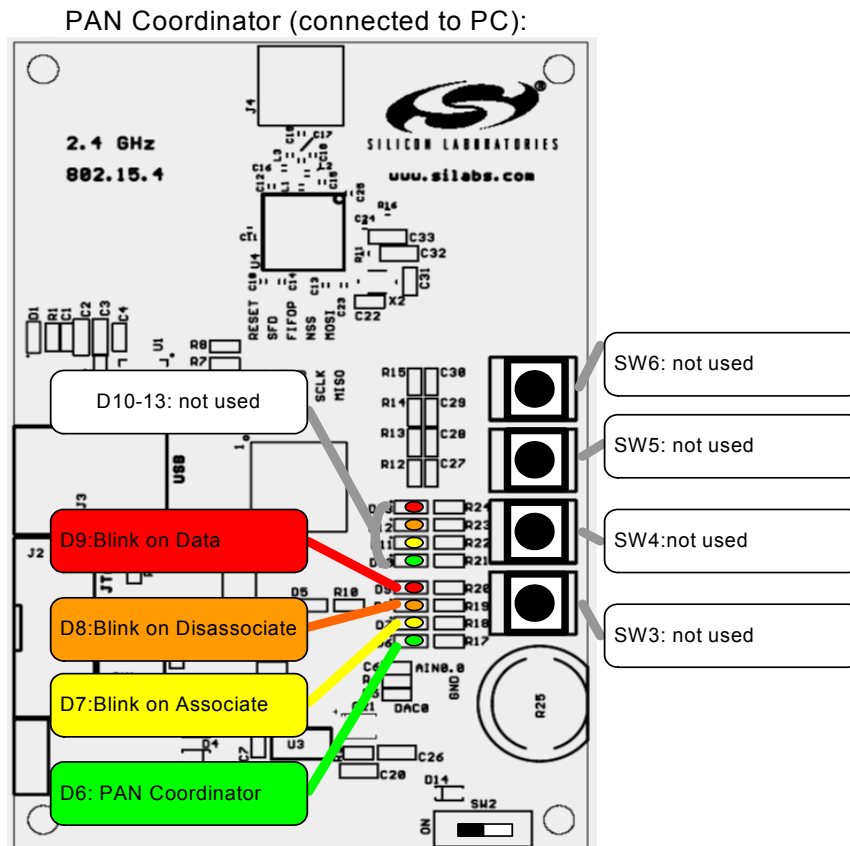


Figure 4. PAN Coordinator

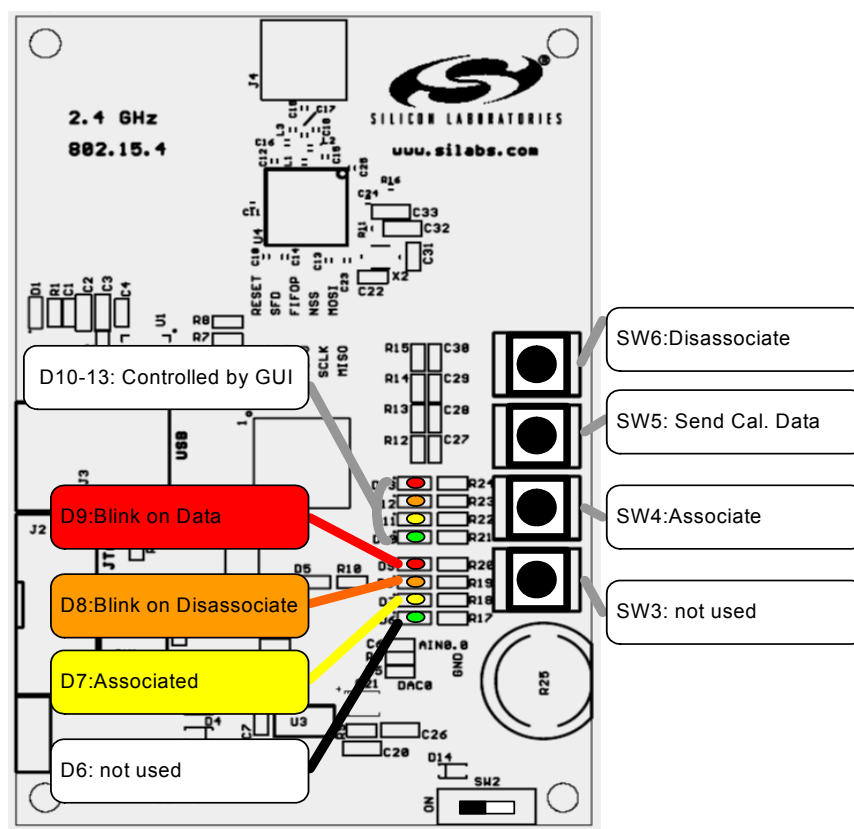


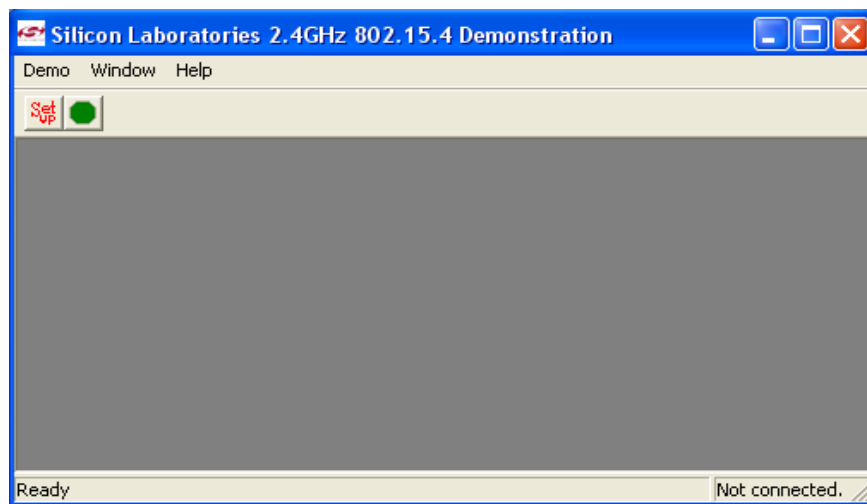
Figure 5. End Device

## 3.2. Connect the 802.15.4 Network


First, designate one device as the PAN Coordinator and connect it to the PC USB port. This may be either board as both ship from the factory with identical Media Access Control (MAC) firmware. Second, power up the other devices by either inserting a 9 V battery and sliding SW2 to the “ON” position or connecting an external 9 V dc supply to the coaxial power jack.

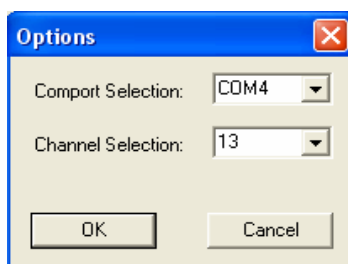
## 3.3. Execute and Configure the Demonstration 802.15.4 Demonstration Utility

Figure 6 shows what the 802.15.4 Demonstration Software should look like when executed.



**Figure 6. 802.15.4 Demonstration Software Window**


Before communication with the connected PAN Coordinator can begin there are two options that must be configured. The configuration selections are made through the ‘Options’ dialog which can be accessed using either the *Setup* button on the toolbar  , or the *Demo* menu *Options* command. The Options dialog is illustrated in Figure 7.



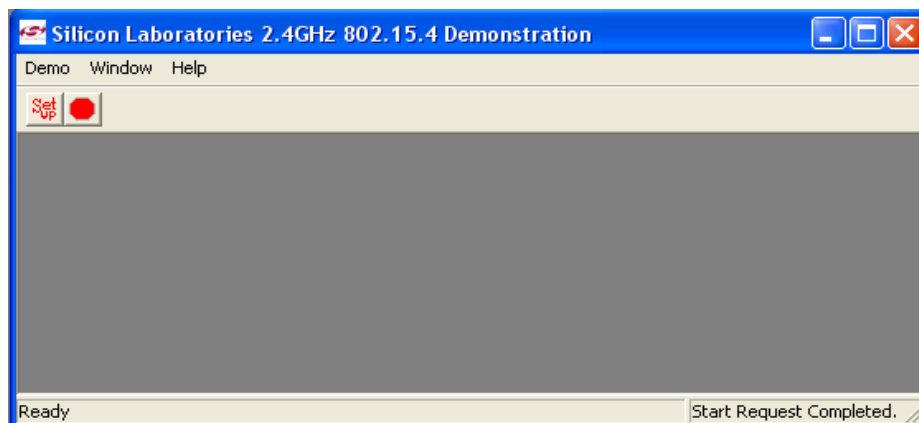
**Figure 7. Options Setup**

Once the Comport and Channel options have been configured the personal area network demonstration is ready to be started.

### 3.4. Starting the Network Communication

Communication must be initiated between the PC and the PAN Coordinator by issuing a “Start” command. This can be done by pressing the green start button on the toolbar , or the *Demo* menu *Start* command.

When communication is established between the demonstration program and the PAN Coordinator the right hand side of the status bar will display a “Start Request Completed” status message as illustrated by Figure 8. The green LED D6 will light to indicate that the device has started as a PAN Coordinator.

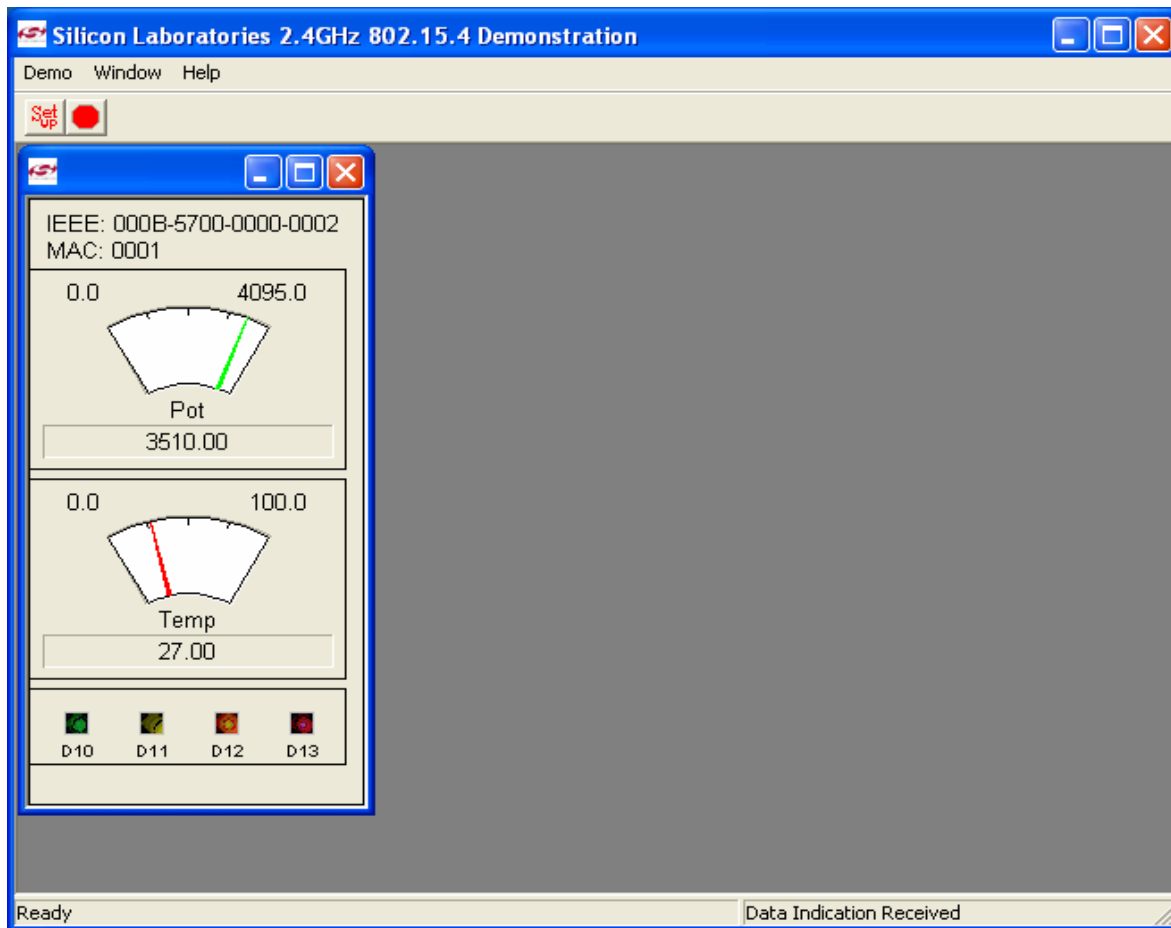


**Figure 8. PAN Successfully Connected to PC**

### 3.5. Adding the Networked Devices to the Demonstration

Once the program is communicating with the PAN Coordinator, other devices can be added to the demonstration.

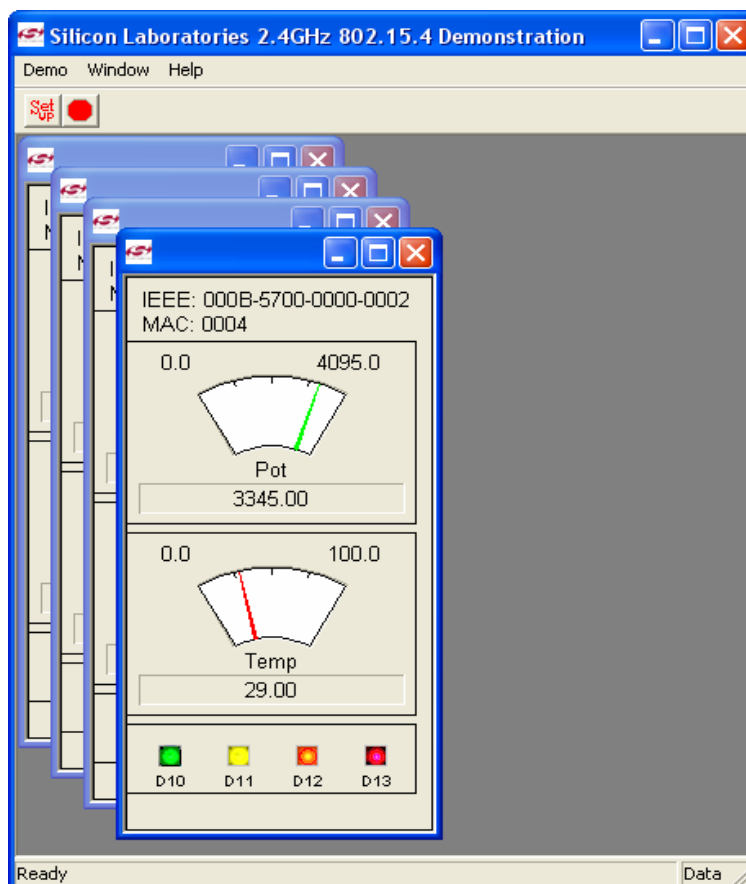
To add other devices to the demonstration press the “Board Association” button, SW5, on the End Device board. This will cause the board to initiate contact with the PAN Coordinator which will respond by adding the device to the network. The PAN Coordinator will communicate to the PC that a board has joined the network and a graphical representation of the board will be displayed. Yellow LED D7 will light on the End Device board indicating it is associated. Figure 6 illustrates what the demonstration should look like once a board has been added to the network. The display for each device includes the 64-bit IEEE address, the 16-bit short address assigned by the MAC, a potentiometer value, a temperature value, and four LED controls. The MAC firmware on the PAN Coordinator will maintain communication with all the networked devices and also communicate device status to the PC. This activity is shown by the red LED D9 on both boards.



**Figure 9. Node Successfully Associated**

This same procedure can be repeated to add other devices to the network as shown in Figure 10. A graphical representation of each board added to the network will appear in the display. The board displays may be cascaded using the *Window* menu *Cascade* command if the displays exceed the size of the window.





**Figure 10. Multiple Nodes Associated**

### 3.6. Changing the Potentiometer Value on a Networked Device

The firmware on the networked devices implements a typical ADC data acquisition application with values ranging from 0 to 4095. If the potentiometer on a board is changed, the updated value will be communicated to the PAN Coordinator, which will then communicate the new value to the PC so that the display for that device can be updated to reflect the new value.

### 3.7. Turning On and Off the LEDs of a Networked Device

The LED state on a networked device can be changed by clicking on the display with the mouse. The demo program will communicate the new LED state to the PAN Coordinator which will in turn communicate the desired state to the specified device.

### 3.8. Removing Networked Devices from the Demonstration

The demonstration can be ended at any time by closing the application. Devices can be selectively removed from the network by closing their display or by pressing the disassociate button on the board (SW3). Either of these actions will cause the device to disassociate from the network and its display will be removed from the demo. The demo can also be ended by pressing the red stop button on the toolbar, or the *Demo* menu *Stop* command.

## CONTACT INFORMATION

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