

CY3271-EXP1

Environmental Sensing Kit

Spec. # 001-49259 Rev. *B

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Thank you for your interest in the CY3271-EXP1 Environmental Sensing Kit. This is an expansion kit for the CY3271-PSoC FirstTouch Starter Kit with CyFi Low-Power RF (CY3271-FTRF). The CY3271-EXP1 kit includes two boards: the Weather Station Expansion Board (atmospheric pressure, humidity, temperature, and ambient light) and the Pigtail Thermistor Expansion Board. The Sense and Control Dashboard (SCD) enables users to quickly set up and monitor a wired or wireless sensor network through an intuitive visual dashboard. The CY3271-EXP1 demonstrates features such as data logging, data aggregation, alarms, and sensor calibration for different sensor types. The CY3271-FTRF kit can be purchased separately at http://www.cypress.com/go/CY3271-FTRF.

The code examples enable using:

- The programmable analog and digital blocks of PSoC[®] to interface to common sensors such as thermistors and ambient light sensors.
- PSoC Designer[™] integrated development environment (IDE) to create embedded designs in two methods: traditional chip level designs that involve writing code and code-free system level designs.
- PSoC's flexible analog to allow multiple sensors to connect the same internal resources.

1.1 Kit Contents

The CY3271-EXP1 kit hardware consists of the following components:

- Weather Station Expansion Board
- Pigtail Thermistor Expansion
- CY3271-EXP1 kit CD/DVD
 - **D** PSoC Designer installation file
 - PSoC Programmer installation file
 - □ Bridge Control Panel installation file (packaged along with PSoC Programmer)
 - Sense and Control Dashboard (SCD)
 - Code examples
 - □ Hardware files
 - Kit guide
 - Quick start guide
 - Release notes

Inspect the contents of the kit. If any parts are missing, contact your nearest Cypress sales office for further assistance.

1.2 Prerequisites

The CY3271-FTRF Kit is required to operate this kit. This kit can be purchased separately at http:// www.cypress.com/go/CY3271-FTRF.



1.3 Additional Learning Resources

Visit http://www.cypress.com for additional learning resources in the form of data sheets, technical reference manual, and application notes.

- For more information regarding PSoC Designer functionality and releases: http://www.cypress.com/go/psocdesigner
- For more information regarding PSoC Programmer, supported hardware and COM layer: http://www.cypress.com/go/psocprogrammer
- For a list of PSoC Designer-related trainings: http://www.cypress.com/?rID=40543

1.4 Document Revision History

Table 1-1. Revision History

Revision	PDF Creation Date	Origin of Change	Description of Change
**	10/07/2008	YUR	New Guide
*A	07/07/2011	OWEN	Removed reference to HiTech compiler installation. Installation instructions and screenshots modified to match the latest installer. Added schematic level block diagrams for hardware and firmware description. Added Appendix.
*В	09/27/2011	RKPM	Extensive content updates

1.5 Documentation Conventions

Table 1-2. Document Conventions for Guides

Convention	Usage			
Courier New	Displays file locations, user entered text, and source code: C:\cd\icc\			
Italics	Displays file names and reference documentation: Read about the sourcefile.hex file in the PSoC Designer User Guide.			
[Bracketed, Bold]	Displays keyboard commands in procedures: [Enter] or [Ctrl] [C]			
File > Open	Represents menu paths: File > Open > New Project			
Bold	Displays commands, menu paths, and icon names in procedures: Click the File icon and then click Open .			
Times New Roman	Displays an equation: 2+2=4			
Text in gray boxes	Describes Cautions or unique functionality of the product.			





This chapter describes how to install and configure the CY3271-EXP1 kit.

2.1 Kit Installation

To install the kit software, follow these steps:

1. Insert the kit CD/DVD into the CD/DVD drive of your PC. The CD/DVD is designed to auto-run and the kit installer startup screen appears.

Note You can also download the latest installer from http://www.cypress.com/go/CY3271-EXP1. Three different types of installers are available for download:

- a. CY3271-EXP1_ISO: This file (ISO image) is an archive file of the optical disc provided with the kit. You can use this to create an installer CD/DVD or extract information using WinRar or similar tools.
- b. CY3271-EXP1_Single Package: This executable file installs the CD/DVD contents, which includes PSoC Programmer, PSoC Designer, code examples, kit hardware files, and user documents.
- c. CY3271-EXP1_Single Package (without prerequisites): This executable file installs only the kit contents, which includes kit code examples, hardware files, and user documents.
- 2. Click Install CY3271-EXP1 to start the installation, as shown in Figure 2-1.

Figure 2-1. Kit Installer Startup Screen





Note If auto-run does not execute, double-click *cyautorun.exe* file on the root directory of the CD/DVD, as shown in Figure 2-2.

Figure 2-2. Root Directory of CD/DVD

🕞 CY3271-EXP1 (F:)			
<u>File E</u> dit <u>V</u> iew F <u>a</u> vorites	<u>T</u> ools <u>H</u> elp		20
🌀 Back 🔹 🕥 🕤 🏂	🔎 Search 🌔 Folders 🔲 🛛		
Address 🗣 F:\			🔽 🔁 Go
Сүз271-ЕХР1	Documentation	Firmware	Hardware
Prerequisite	PSoC Designer	PSoC Programmer	Sense And Control Dashboard
autorun Setup Information 1 KB	cyautorun DAT File 1 KB	Cypress Autorun Applet. Cypress Semiconductor	setup 48 x 48 ICO File

- 3. The **InstallShield Wizard** screen appears. On this screen, choose the folder location to install the setup files. You can change the location using **Change**, as shown in Figure 2-3.
- 4. Click **Next** to launch the kit installer.

Figure 2-3. InstallShield Wizard

CY3271-EXP1 - InstallShie	ld Wizard 🛛 🗙
	Welcome to the InstallShield Wizard for CY3271-EXP1 The InstallShield Wizard will install CY3271-EXP1 on your computer. To continue, click Next.
	Select folder where setup will install files. Install CY3271-EXP1 to: C:\\Cypress
	< <u>B</u> ack Next > Cancel

- 5. On the **Product Installation Overview** screen, select the installation type that best suits your requirement. The drop-down menu has three options **Typical, Custom,** and **Complete**, as shown in Figure 2-4.
- 6. Click **Next** to start the installation.



Figure 2-4. Installation Type Options

👶 Cyinstaller for CY3271-EXP1 1.0	?×
Product Installation Overview Choose the install type that best suits your needs	
Choose the type of installation Produce: CY3271-EXP1 Installation Type: Typical Installs the most common features of CY3271-EXP1 The following products need to be installed manually Adobe Reader	
Contact Us Next > Can	icel

- 7. When the installation begins, a list of packages appears on the **Installation Page**. A green check mark appears adjacent to every package that is downloaded and installed; see Figure 2-5.
- 8. Wait until all the packages are downloaded and installed successfully.

Cylnstaller for CY3271-EXP1 1.0 ? X Installation Page Please wait while setup installs/configures CY3271-EXP1 on your computer Caching ~ 🖋 PSoCProgrammerSetup PSoCProgrammer3.13.0.961 ClockProgrammer1.3.0.961 VSBBootloader.961 Get the inside scoop BridgeControlPanel1.3.0.961 00 on Cypress products. ExampleCode.961 🎺 DeviceDatabase.961 Check out Cypress blogoshpere at ✓ PSoCDesignerSetup www.cypress.com/go/blogs PSoCDesigner_Core5.1.2306.0 PSoCDesigner_Content5.1.2306.0 PSoCDesigner_Doc5.1.2306.0 < > Status Contact Us <u>C</u>ancel

Figure 2-5. Installation Page

9. Click Finish to complete the installation, as shown in Figure 2-6.







Advanced users can go to Code Examples chapter on page 23.



2.2 **PSoC Designer**

- 1. Click Start > All Programs > Cypress > PSoC Designer <version> > PSoC Designer <version>.
- Click File > New Project, to create a new project; click File > Open Project to work with an existing project.

Figure 2-7. PSoC Designer Interconnect View



3. To experiment with the code examples, go to Code Examples chapter on page 23.

Note For more details on PSoC Designer, see the PSoC Designer IDE Guide located at: <Install_Directory>:\Cypress\PSoC Designer\<version>\Documentation.

See Additional Learning Resources on page 6 for links to PSoC Designer training. The PSoC Designer quick start guide is available at: http://www.cypress.com/?rID=47954.



2.3 **PSoC Programmer**

- 1. Click Start > All Programs > Cypress > PSoC Programmer <version> > PSoC Programmer <version>.
- 2. Select the MiniProg from Port Selection, as shown in Figure 2-8.

Figure 2-8. PSoC Programmer Window

PSoC Programmer					
File View Options Help	Program Power				
🧀 💫 💿 BB 🕻					
Port Selection	rogrammer Utilities JTAG				
MINIProg1/08215B0C331A	Programming Parameters File Path: EXBriss_Opress1\Data\CY3210-PSOCEVAL1\Firmware\ASM_Example_LED_Logic\ASM_Example_LED_Logic.hex Programmer: MINIProg1/08215B0C331A Programming Mode: O Reset @ Power Oycle Verification: @ 0.0				
	AutoDetection: On O Off Clack Speed: 16 MHz				
Device Pamily 29x66 ▼ Device CY8C29466-24PXI ▼	Programmer Characteristics Status Protocol: JTAG SwD ● ISSP 12C Voltage: ● 5.0 V 3.3 V 2.5 V 1.8 V Voltage: NA				
Actions	Results	^			
Power On at 1:14:10 Pl	M MINIProg1/08215B0C331A				
1:11:05 PM	Programming Succeeded Doing Checksum Doing Protect Verify Succeeded Verify Starting Programming Succeeded Programming Starting Erges Succeeded	11			
Device set to CY8C29466-24PXI at 1:10:00 PM Device Family set to 29x66 at 1:10:00 PM	32768 FLASH bytes				
	Automatically Detected Device: CY8C29466-24PXI	~			
For Help, press F1	Com	nected			

- 3. Click File Load to load the hex file.
- 4. Use the **Program** button to program the hex file on to the chip.
- 5. When programming is successful, **Programming Succeeded** appears in the Actions pane.
- 6. Close PSoC Programmer.

Note For more details on PSoC Programmer, see the user guide at the following location: <Install_Directory>:\Program Files\Cypress\Programmer\<version>\Documents.



2.4 Configuring Sense and Control Dashboard

- 1. Click Start > All Programs > Cypress > Sense and Control Dashboard <version> > Sense and Control Dashboard <version> to open the SCD software.
- 2. Select Startup Action window; select the options Start new system configuration, Unbind all nodes, and Start logging data; click Continue.

Figure 2-9. Startup Action Window

Select Startup Action					
Choose the action:					
O Restore from Backup					
Import a system configuration from a file					
 Start a new system configuration 					
Unbind all nodes					
Validate the system configuration					
Start logging data					
Modify the system configuration					
O Exit					
Don't show again. Remember last action.					
Continue					

- 3. Select a location to save the configuration file (SDF).
- 4. Connect the PC Bridge (FTPC) USB dongle to a free USB port in the PC.
- 5. Connect the Multifunction board to the RF Bridge board. Power up this assembly using the AAA power pack board provided with the kit.
- 6. Attach a node to the wireless hub and configure the SCD to view the node data; to do this, follow these instructions.



7. Click the **Manage** button to add a new node, as shown in Figure 2-10.

Figure 2-10. Manage Button in SCD Dashboard



8. In the Manage System Configuration screen, click Add.

Figure 2-11. Manage System Configuration - Add

Ma	nage System Configuration						?	×
	System Nodes Actuator Rules	System Ir	nformation					
	Node Name	Sensors	Actuators	Signal	Radio ID	Node	VendorID	1
								L
								L
								L
								L
								L
								L
	<				1		>	
	2							
				Add		Edit	Remove	
	System Debug Console						ОК	

9. The Add Node Wizard opens up; Select the **Add Node** option and click **Next** in the Add Node Wizard; then, click on **Start Binding** in the subsequent window.



💥 Add Node Wizard 🛛 💽 🔀	💥 Add Node Wizard 🔹 💽
Select type	Node Binding (1 of 2)
• Add Node A Node is a wireless device composed of an RF interface and a PSoC (whether discrete or single-chip) which can have any combination of sensors and actuators on-board.	Step 1 # VendorID ProductID SerialN 0 0x0484 0xF115 0819DDC31321 Image: Step 2 Image: Step 2 Image: Step 2 Press the "Connect" button on the Node Remaining time: 00:00 Binding will timeout within 10-30 seconds if it is unsuccessful. Result
< Back Next > Cancel	< Back Next > Cancel

Figure 2-12. Add Node and Start Binding

10. Press the **Bind** button on the RF Bridge board; this ensures that the node is in Bind mode and allows the hub to discover the node.

Note Press the Bind button within 30 secs of pressing the button on the GUI; otherwise, binding does not occur and the result is shown as 'Time out'.

Figure 2-13. Bind Button



11. Verify the success of the bind and click Next.



Figure 2-14. Successful Bind

💥 Add Node Wizar	d	? 🛛				
Node Binding (1 of	F 2)					
Step 1						
# VendorID	ProductID	SerialN				
0 0x04B4	0xF115	0819DDC31321				
<	IIII					
	Start Binding					
Step 2						
Press the "Connect	" button on the Nod	e				
Remaining time:		00:00				
Binding will timeout	Binding will timeout within 10-30 seconds if it is unsuccessful.					
Besult						
SUCCESS		Betru				
Node bound with N	ode ID					
Found Node with B	adio ID	0x6565D741				
		0.00000741				
	< Back Ne	ext > Cancel				

12.On the next screen, assign a name to the node.

Figure 2-15. Enter Node Name

💥 Add Node Wizard 🛛 ? 🔀
Node Binding (2 of 2)
Node Information ID 1 Radio ID 0x6565D741
Hub Information Vendor ID Product ID Serial N Manufacturing ID 0x04B4 0xF115 0819DDC31321 0x2BA88A94
Assign a Unique Name to the NType a name to the Slider
Node Configuration Load Node configuration from a file
Make further edits to Node configuration
• Edit Node configuration manually
< Back Finish Cancel



- 13.In the Node Configuration section, the option Edit Node Configuration manually is selected by default. For this kit, the node configuration is completed and stored as xml files. On successful binding of the node, choose Load Node Configuration from a file option and select the appropriate xml file from <Install_Directory>:\Cypress\CY3271-EXP1\<version>\Firm-ware\DeviceTemplates. Click Finish.
- 14. To edit the node manually, select Edit Node Configuration manually and click Finish.
- 15. Click **Add** on the **Configure Node** screen to configure the sensor parameters.

Figure 2-16. Configure Sensor Parameters

Configure Node					? 🛛
Node Name Slider	Load/Save Load Save	Node Information Radio ID 0x6565D741 Bound Node ID 1	Signal 31	SNP Hub Info VendorID 0x0484 SerialN Manufacturing	mation ProductID 0xF115 0819DDC31321 g ID 0x2BA88A94
On-Board Sensors On-Board	Actuators				
Sensor	Starting Bit	Length	Format	Scaling	Physical Unit
			Ac	Id E	dit Remove
					ОК

- 16. The Configure Sensor window opens up. The following parameters can be configured for the sensor:
 - a. Sensor Data Format Unsigner Integer, Two's Complement Integer, and so on
 - b. Senor Bit Range
 - c. Data Length Bits or Bytes
 - d. Scaling/Multiplication Factor (if any)
 - e. Sensor Physical Unit KPa, Lux, and so on. This is used in the graphical display of node data. **Note** Figure 2-17 shows the default values.



Figure 2-17. Configure Sensor Parameters

Configure Sensor	? 🛛
Configuring Sensor On Node: Slider Sensor Name Sensor #0	Sensor Bit Range Define the bit range in the Node's incoming data packets that contain this sensor's data. Starting Bit 0 🗢
Sensor Data Format Define how the binary data in the sensor's bit range is to be interpreted.	Length 2 Bytes Scaling/Multiplication Factor If the sensor's data is multiplied by a scaling factor before transmission, specify that multiplication factor bere
Format Sign-Magnitude Integer	Factor No Scaling - x 1
	OK Cancel Restore Defaults

- 17. The SCD GUI provides the options to calibrate the sensor, specify the conversion expression, and display options (Tile options). Click on the respective buttons to enter the context specific menus and options.
- 18. After configuring the node, click **OK** on all subsequent screens to return to the main screen where the data logging has started.
- 19. Configuring the sensor can even be done at a later time by clicking on the appropriate button in the main menu

Figure 2-18. Main Menu Buttons

🚾 Cypress Sense and Control Dashboard - Configuratio	m #0	
<u>Eile Vi</u> ew <u>T</u> ools <u>H</u> elp		
Manage 🛗 Export - 💽 Console 🔘 Stop	Configure 🗾 Tile Options 🚔 Calibrate	Send Command

2.5 Kit Operation

The CY3271-FTRF Kit is required to operate this kit. The kit operation for the CY3271-EXP1 kit is explained with the help of two code examples using the weather station board and the pigtail thermistor board. See Code Examples chapter on page 23 for details.

The code examples operate at +10 dBm of RF output power. They are limited to +10 dBm because of the RF power restrictions imposed in Europe and Japan. The power can be increased to +20 dBm in the United States and Canada only. The process to increase power is explained in detail in the CY3271-PSoC FirstTouch Starter Kit Guide, available at http://www.cypress.com/go/CY3271-FTRF.





The CY3271-EXP1 kit hardware consists of a weather station expansion board and a pigtail thermistor expansion board.

3.1 Weather Station Expansion Board

The weather station expansion board features a PSoC device and several sensors such as:

- Thermistor
- Ambient light sensor
- Humidity sensor
- Atmospheric pressure sensor

Figure 3-1. Hardware Block Diagram for Weather Station Board









The weather station expansion board sends sensor data over I2C to the RF expansion card, which is included in the CY3271-FTRF kit.

PSoC CY8C24894 silicon

The CY8C24894-24LTXI PSoC device on the weather station expansion board converts the analog data from the sensors to I2C data. This sensor data is sent over I2C to the CY3271-RF expansion card.



Sensor data is located in the kit CD/DVD under \Documentation folder or in the default install location: <Install_Directory>:\Cypress\CY3271-FTRF\<version>\Documentation



3.2 Pigtail Thermistor Expansion Board

The pigtail thermistor expansion board features a thermistor on a three-foot cable. The thermistor at the end of the cable is identical to the thermistor used on the RF expansion card allowing dual temperature readings. The pigtail thermistor expansion board does not have a PSoC on board; instead, it uses the PSoC from the RF expansion board to read the sensor. Resistors are chosen to remove offset errors from the thermistor measurement; see AN2017 - PSoC 1 Thermistor-Based Thermometer.





Figure 3-4. Pigtail Thermistor Expansion Board













4.1 My First Example Project

See the CY3271-FTRF kit user guide at http://www.cypress.com/go/CY3271-FTRF for a detailed explanation of how to create a PSoC Designer project. All code examples are available on the CY3271-FTRF kit CD/DVD or at: <Install_Directory>:\Cypress\CY3271-FTRF\<version>\Firmware.

4.2 Weather Station Code Example

4.2.1 Project Objective

This example demonstrates how the weather station expansion board talks to the RF expansion card. The weather station board has sensors for light, temperature, humidity, and pressure. The data from the weather station board is read by the RF_I2C_Bridge board (from CY3271-FTRF kit) through an I2C protocol and transmitted to the PC hub (PC dongle from CY3271-FTRF kit) wirelessly using the CyFi SNP protocol.

The hardware has a capacitive humidity sensor to detect humidity. Because the CY8C24894 PSoC device has only two rows of analog blocks, the dynamic reconfiguration feature of PSoC Designer is used to read the data of all four sensors. See the PSoC Designer User Guide for more information on dynamic reconfiguration.

This example uses the following user modules:

CY3271_EXP1_Weather_Station Configuration

- ADCINC12: This user module converts the analog values from the sensors to digital value. The input to the user module is set to read the pressure sensor, light sensor, and temperature sensor one after the other in the firmware.
- DAC: This user module stalls the microprocessor until the input voltage is stabilized before the ADC conversion can take place.
- **E2PROM**: This user module stores the sensor data.
- **EzI2Cs**: This user module configures PSoC on weather station board as I2C slave. The slave data is available for acquisition using a bridge board that is configured as I2C master.
- **PGA**: Two instances of this user module is used to obtain a dual amplification of the analog input.

Humidity Configuration

CSD: This user module detects the capacitive changes due to changes in humidity.



4.2.2 Device Configuration







4.2.3 Flowchart



4.2.4 Verify Output

Operate the weather station demonstration by downloading the corresponding hex file to the RF expansion card. Note that the weather station board is pre-programmed and does not need to be programmed.

- 1. Connect the RF expansion card to the PC bridge.
- 2. Insert the PC Bridge into any free USB port of your PC/laptop.
- 3. Open PSoC Programmer and load *RF_I2C_BRIDGE.hex* provided with CY3271-FTRF kit. **Note** After installation, this file is available at <Install_Directory>:\Cypress\CY3271-FTRF\<version>\Firmware
- 4. Set **Device Family** to 27x43 and **Device** to CY8C27443. Click **Program**.



PSoC Programmer		
File View Options Help		
🗃 🗼 💿 BB 🕻 🗎		
Port Selection	er Utilities JTAG	
FirstTouchRF/8819DDC346	ning Parameters	
File Path:	C:\Test_Program.hex	
Program	ner: FirstTouchRF/8819DDC34	4615
Programm	<u>ning Mode:</u> 💿 Reset 🔿 Power Cycl	e 🔿 Power Detect
Verificatio	<u>ən:</u> 🔘 On 💿 Off	Connector: 💿 5p 🔿 10p
Device Family AutoDete	<u>ction:</u> 💿 On 🔘 Off	Clock Speed: 1.6 MHz 💉
27x43	ner Characteristics	Status
Protocol:	🔘 JTAG 🔵 SWD 💿 ISSP 🔘 I2C	Execution Time:
Voltage:	S.0 V ○ 3.3 V ○ 2.5 V ○ 1.8 V	Voltage: NA
Actions	ults	
Successfully Connected to Fir FirstTouchRF/8819DDC34615	stTouch Programmer Version	1.90
Opening Port at 2:53:35 PM		
Connected at 2:53:34 PM Fir	stTouchRF/8819DDC34615	
2		
For Help, press F1		- Powered Connected .:

Figure 4-1. PSoC Programmer Settings

- 5. Disconnect the RF expansion card from the PC bridge, leaving the bridge connected to your computer.
- 6. Attach the weather station expansion board and battery pack to the RF expansion card, as shown in Figure 4-2.

Figure 4-2. RF Expansion Card Connected to the Battery Pack and Weather Station Boards



7. Power the RF expansion card by sliding the ON/OFF switch on the battery pack towards the card.



Figure 4-3. Turning ON the Switch

- 8. Open the SCD software.
- 9. Place the PC bridge in Bind mode using SCD.
- 10. Click **Manage** to set up the sensor network.

Figure 4-4. Manage Network within SCD

🔜 Cypress Sense and Control Dashboard - Configuration #0
Eile <u>Vi</u> ew <u>I</u> ools <u>H</u> elp
Manage 🛅 Export - 🔍 Console 🔾 Stop 🛛 🔯 Configure 🔛 Tile Options 🚔 Calibrate 🚕 Send Command 📗 🔃 User Guide 🕽
🔋 Sensors 🛛 Zoom 100% 🕒 — 💿 🕼 😳 Page 1/1 💿 💿 Pages 🐥 Add 💢 Remove 🖓 Rename 🖷 Arrange Tiles 📮
Pane-1

- 11. In the Manage System Configuration screen, click **Add** to add a new node.
- 12.On the Node Binding screen, click Start Binding.

Figure 4-5.	Node Binding Window
-------------	---------------------

Add Node Wizard			? 🗙
Node Binding (1 of 2)			
Step 1			
#VendorID00x04B4	ProductID 0xF115	Seria 8819DDC	N 34615
<	1111		>
	Start Binding	~	
Step 2		νζ	
Press the "Connect" bu	utton on the Noo	le	
Remaining time:			00:00
Binding will timeout with	nin 10-30 secon	ds if it is unsuc	cessful.
Result			

13. After activating this function, you have approximately 10 to 30 seconds to press the bind button on the RF expansion card.

Figure 4-6. Press Bind Button

14. Verify the success of the bind. A successful bind window looks similar to Figure 4-7.

#	VendorID	ProductID	SerialN
0	0x04B4	0xF115	8819DDC34615
<			:
Step 2			
Step 2 Press Rema Bindir	the "Connect" t ining time: ng will timeout wi	button on the Nod thin 10-30 second	e 00:01 Is if it is unsuccessful.
Step 2 Press Rema Bindir Result	the "Connect" t ining time: ng will timeout wi	button on the Nod	e 00:01 Is if it is unsuccessful.
Step 2 Press Rema Bindir Result	the "Connect" b ining time: ng will timeout wi ESS	button on the Nod	e 00:01 Is if it is unsuccessful. Retry
Step 2 Press Rema Bindir Result SUCC	the "Connect" t ining time: ng will timeout wi ESS bound with Noo	thin 10-30 second	e 00:01 Is if it is unsuccessful. Retry

Figure 4-7. Successful Bind Window

15. Click **Next** to go to the Node Binding (2 of 2) window. In this window, assign a name to the newly bound node. On the Node Configuration pane, click **Load Node configuration from a file** and load *Weather Station Dashboard Configuration.node.xml* from the Device Template folder located on the CY3271-EXP1 kit CD/DVD.

Figure 4-8. Node Configuration

😤 Add Node Wizard 🔹 💽 🔀
Node Binding (2 of 2)
ID 1 Radio ID 0x94059D36
Hub Information Vendor ID Product ID Serial N Manufacturing ID 0x0484 0xF115 8819DDC34615 0x15114523
Assign a Unique Name to the Node Weather Station
Node Configuration Image: Configuration from a file
CD PATH GOES HERE
O Edit Node configuration manually
< Back Finish Cancel

- 16. Select graphical or textual mode of data display. The data is displayed in graphical or text format on the SCD screen.
- 17. Click **Apply** on all successive dialog boxes until the main SCD window reappears.

Note that the weather station expansion board is not calibrated. If more accurate measurements are required, then the board must be calibrated. The calibration process is described in Sensor Calibration chapter on page 35.

4.3 Pigtail Sensor Code Example

4.3.1 Project Objective

This project outputs the temperature values from two different sensors: the pigtail thermistor on the pigtail sensor board and the thermistor on the RF_I2C_Bridge board. The pigtail sensor board does not have a PSoC on board but the signal lines from the sensor are routed to the male header on the board. The CY8C27443 device on the RF_I2C_Bridge reads both the sensor values and outputs to the PC hub (PC dongle from CY3271-FTRF kit) wirelessly using the CyFi SNP protocol.

This project uses the following user modules:

- **CYFISNP**: This module implements the entire star network wireless protocol and all protocol modes, in addition to low level radio communication and radio control by the MCU.
- **ADCINC**: The incremental ADC is used to read the analog values from pigtail thermistor and on board thermistor one after the other in firmware.
- **PGA**: This module facilitates the route ability of the analog inputs to the ADC analog block.
- **TX8**: This module is used for serial communication with host and for debugging.
- **Timer8**: This module implements an 8-bit timer that is clocked by a divider of SysClk. It is used to calibrate the sleep timer that is clocked by the 32 kHz system oscillator.

4.3.2 Device Configuration

4.3.3 Flowchart

4.3.4 Verify Output

The pigtail thermistor demonstration can be operated by downloading the corresponding hex file to the RF expansion card.

- 1. Connect the RF expansion card to the PC bridge.
- 2. Insert the PC bridge into any free USB port of your computer.
- 3. Open PSoC Programmer and load *RF_I2C_BRIDGE.hex* provided with the CY3271-FTRF kit. **Note** After installation, this file is available at <Install_Directory>:\Cypress\CY3271-FTRF\<version>\Firmware.
- 4. Set Device Family to 27x43 and Device to CY8C27443. Click Program.
- 5. Disconnect the RF expansion card from the PC bridge, leaving the bridge connected to your computer.
- 6. Attach the pigtail thermistor expansion board and battery pack to the RF expansion card.
- 7. Power the RF expansion card by sliding the ON/OFF switch on the battery pack towards the card.
- 8. Open the SCD software.

- 9. Place the PC bridge in Bind mode using SCD as follows:
 - a. Click the Manage button to set up the sensor network.
 - b. In the Manage Network screen, click **Add** to add a new node.
 - c. On the Node Binding screen, click on **Begin Binding**.
 - d. After this function is activated, the user has about 10 to 30 seconds to press the bind button on the RF expansion card.
 - e. Verify the success of the bind.
- Click Next to go to the Node Binding (2 of 2) window. In this window, assign a name to the newly bound node. On the Node Configuration pane, click the Load Node configuration from a file option and load *Pigtail_Thermistor_Dashboard_Configuration.xml* from the Device Template folder located on the CY3271-EXP1 kit CD/DVD.

Note After installation, this file is available at <Install_Directory>:\Cypress\CY3271-EXP1\<version>\Firmware

- 10. Select graphical or textual mode of data display. The data is displayed in graphical or text format on the SCD screen.
- 11. Click **Apply** on all successive dialog boxes until the main SCD window reappears.

Note that the pigtail thermistor expansion card is not calibrated. If more accurate measurements are required, then the board must be calibrated. The calibration process is described in Sensor Calibration chapter on page 35.

Code Examples

5. Sensor Calibration

5.1 Overview

The SCD allows you to calibrate a sensor in the system using linear calibration. Calibration can improve measurement accuracy of sensors, such as the humidity sensor, whose accuracy is specified at $\pm 15\%$ relative humidity. SCD sensor calibration is based on data pairs (raw value versus adjusted value). Calibration of the humidity sensor is also possible in firmware. Calibration in firmware is useful when the hardware is sent without access to the local calibration settings in SCD, or when the SCD is not the target software.

To register a calibration pair, select a graph and click the **Calibrate** button. Click the **Add Point** button and enter the appropriate values. Raw Value is the value reported by the SCD and Adjusted Value is the data point value. There is no limit on the number of data pairs. More data pairs mean more accurate calibration and more accurate measurements from the SCD.

For one data pair, SCD computes the offset calibration equation in the form of y = x + b using the provided data.

Calibrated Value = Raw Value + Offset

For two or more data pairs, SCD computes the offset and gain calibration equation in the form of y = mx + b using a least squares best fit of the provided data:

Calibrated Value = (Slope) × (Raw Value) + Offset

This calibration equation is used to calibrate all incoming raw data from the sensor before displaying it in the SCD. The SCD also records both raw and calibrated data for each sensor in its data log.

To access the **Calibrate Sensor** window, highlight the sensor that you want to calibrate. Then, either click on the **Calibrate** button on the toolbar, or go to **Tools > Selected Sensor > Calibrate**.

Currently	Calibrating	
lode	Weather Station	~
Sensor	Humidity	~
	Sensor Unit: % Rel	
Calibratio	on Points	
Ra	w Value Adjusted Valu	e
Note:	Add Point Remo	ve Point
Note: If you v at least	Add Point Remo vish to calibrate a sensor, you must one calibration point for that senso	ve Point provide r.
Note: If you v at least	Add Point Remo vish to calibrate a sensor, you must one calibration point for that senso calibration Equation	ve Point provide r.
Note: If you w at least Current (Add Point Remo vish to calibrate a sensor, you must one calibration point for that senso Calibration Equation	ve Point provide r.
Note: If you w at least Current (Add Point Remo vish to calibrate a sensor, you must one calibration point for that senso Calibration Equation	ve Point provide r.
Note: If you v at least	Add Point Remo vish to calibrate a sensor, you must one calibration point for that senso Calibration Equation	ve Point provide r.

Figure 5-1. Calibrate Sensor Window

5.1.1 Calibrating Humidity Sensor in Firmware

Calibration of the humidity sensor is also possible in firmware. The process is similar to the calibration process in the SCD. Two types of calibration are possible in firmware: offset calibration and gain calibration. Offset calibration is easier and corrects most errors in the sensor reading; gain calibration can be used for high accuracy applications.

To calibrate the offset in firmware, you must know the relative humidity to a good degree of accuracy. Turn on and connect the kit; compare the readings it supplies with the actual relative humidity. Now, in the firmware package CY3271_EXP1_Weather_Station provided with the kit, open the *main.c* file. The conversion equation for the humidity measurement is in the ConvertHumidity function on line 185. Use the difference between the known value and reported value to correct the offset value in this equation. Next, compile and program the weather station board to complete the offset calibration.

Gain calibration is more involved, requiring data taken at a minimum of two points and some math. Gain calibration is usually not required for this sensor unless you want high accuracy. During at least two known accurate relative humidities, record the real relative humidity and the value reported by the Weather Station. Plot these values versus the known humidity values and determine the linear relationship between the two, with measured relative humidity as a function of real humidity. Use this equation, in the form y = m (x + b), and substitute the equation in *main.c*, line 185 for x. Simplify the resulting equation and replace the equation in the firmware. Compile and program your board. This completes gain calibration.

5.2 Alarms and Data Aggregation Intervals

The **Chart Options** dialog enables to set low and high alarms for a selected sensor. To view this window, highlight the sensor for which you want to set an alarm. Then, either click on the **Chart** button on the toolbar or go to **Tools > Selected Sensor > Chart Options**.

Figure 5-2. Ch	art Options fo	or Setting Alarms
----------------	----------------	-------------------

📕 Tile Options		? 🔀			
Axes					
Time axis scale:	Auto-scale	~			
Axes Y-Axis Label: •	Use sensor's phys Use a custom labe	ical unit			
Sensor Display Op	tions				
💿 Graph sensor d	ata versus time				
🔘 Textually displa	y the last value rep	orted by the sensor			
🔘 Don't display					
- Alarm Limite					
		% Rel			
Low Alarm		% Rel			
Data Aggregation I	ntervals				
Enable short te	rm addredation inter	val			
Display min, ma	ax, and mean of dat	a aggregated every:			
9	econd(s)	✓			
Enable long term aggregation interval					
Display min, max, and mean of data aggregated every:					
9	econd(s)	~			
ОК	Cancel	Restore Defaults			

If the application detects a triggered low or high alarm, it reports this event on the **Alarms** panel. The alarm values are also reflected on the sensor display tile if graph option is selected.

Figure 5-3. Alarm History

Alarm History				
Time	Sensor	Туре		
8:56:54 AM	Temperature	Н		
8:56:52 AM	Temperature	Н		
8:56:50 AM	Temperature	Н		
8:56:47 AM	Temperature	н		
8:56:45 AM	Temperature	Н		
8:52:08 AM	Temperature	Н		
8:52:06 AM	Temperature	н		
8:52:03 AM	Temperature	Н		
8:52:01 AM	Temperature	Н		
8:51:59 AM	Temperature	Н		
8:51:57 AM	Temperature	Н		
8:51:54 AM	Temperature	н		

Data aggregation intervals are also specified using the **Chart Options** dialog. To enable long or short term aggregation, select the corresponding check box and specify the data sampling period. The long term aggregation interval must be longer than the short term aggregation interval.

5.3 Data Export

Selected sensor data, data reported by all sensors, and alarm history are exported to a file using comma separated values format. To do this, click **File > Export Data**..

5.4 Save Configuration

To save a network configuration, use **File > Save Configuration** or **File > Save Configuration As**. The network configuration is saved as an XML file.

The schematic and board layouts are available on the CY3271-EXP1 kit CD/DVD. After installation, they are available at: <Install_Directory>:\Cypress\CY3271-EXP1\<version>\Hard-ware.

A.1 Schematics

A.1.1 Weather Station Board

A.1.2 Thermistor Board

NOTE: This Expansion Board Does Not Have An Onboard Voltage Regulator - DO NOT Power With > 5Vdc

A.2 Weather Station Board Layout

A.2.1 Top Layer

A.2.2 Bottom Layer

A.2.3 Primary Silkscreen

A.2.4 Secondary Silkscreen

A.3 Thermistor Board Layout

A.3.1 Top Layer

A.3.2 Bottom Layer

A.3.3 Primary Silkscreen

A.3.4 Secondary Silkscreen

A.4 Bill of Materials

A.4.1 CY3271-EXP1 Weather Station BOM

ltem	Qty.	Reference	Description	Manufacturer	Mfg. Part Number		
1	2	C1,C9	CAP .1UF 16V CERAMIC Y5V 0402	Panasonic - ECG	ECJ-0EF1C104Z		
1	1	C2	CAP 4.7UF 16V Tantalum 3216	Nichicon	F931C475MAA		
2	1	C5	CAP CERAMIC 47PF 50V 0603 SMD	Panasonic - ECG	ECJ-1VC1H470J		
3	1	C6	CAP CER 10000PF 25V C0G 0805	Kemet	C0805C103F3GACT U		
4	1	C7	CAP CERAMIC 100PF 100V NP0 0805	Panasonic - ECG	ECJ-2VC2A101J		
5	1	C8	CAP CERAMIC 150PF 100V NP0 0805	Panasonic - ECG	ECJ-2VC2A151J		
6	1	J1	CONN HEADER 16POS .100" R/A TIN	Molex/Waldom Electronics Corp	90122-0128		
7	1	PR1	IC AMBIENT LIGHT DETECTOR 1206	Microsemi-IPG	LX1972IBC-TR		
8	1	PR3	IC SENSOR CAPACITIVE HUMIDITY	Vishay/BC Components	2381 691 90001		
9	1	RT1	THERMISTOR NTC 3.3K OHM 5% 0603	Panasonic - ECG	ERT-J1VT332J		
10	2	R1,R2	RES 6.2K OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ622V		
11	1	R3	RES 4.99K OHM 1/16W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF4991V		
12	1	R4	RES CHIP 3.32K OHM 1/16W 1% 0603 SMD	Panasonic-ECG	ERJ-3EKF3321V		
13	1	R7	RES 2.2K OHM 1/16W 5% 0402 SMD	Panasonic - ECG	ERJ-2GEJ222X		
14	1	R13	RES ZERO OHM 1/16W 0402 SMD	Panasonic - ECG	ERJ-2GE0R00X		
15	1	U3	PSoC Mixed-Signal Array	Cypress Semiconductor	CY8C24894-24LFXI		
NO L	NO LOAD Components						
17	1	C3	CAP NO LOAD 0805	NA	NA		
18	1	Q1	TRANSISTOR PNP Low VCEsat SOT-23 NO LOAD	NXP Semiconductors	PBSS5350T		
19	4	R6,R9,R10,R 12	RES NO LOAD 0402 SMD	NA	NA		
20	1	R11	RES NO LOAD 0603 SMD	NA	NA		
21	7	TV1,TV2,TV3, TV4,TV5,TV6, TV7	TEST VIA 40 HOLE 20 PLATED	None			
Spec	Special Installation Components						
16	1	PR2	IC SENS PRES 15PSIA SO8 SMD	GE Sensing	NPP-301B-100A		

Item	Qty.	Reference	Part	Manufacturer	Mfg. Part Number	
1	1		PCB Rev 01	Cypress	PDCR-9438	
2	1	C1	CAP 4.7UF 16V Tantalum 3216	Nichicon	F931C475MAA	
3	1	J1	CONN HEADER 16POS .100" R/A TIN	Molex/Waldom Electronics Corp	90122-0128	
4	1	J2	CONN HEADER 2POS .100 R/A TIN	Molex/Waldom Electronics Corp	22-05-3021	
5	1	R1	RES CHIP 10.0K OHM 1/16W .1% 0603 SMD	Panasonic - ECG	ERA-3AEB103V	
6	1	R2	RES 390 OHM 1/16W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF3900V	
7	4	TV1,TV2,TV3,TV4	TEST VIA 40 HOLE 20 PLATED	None	None	
No Load Components						
8	1	C2	CAP 0402 NO LOAD			
9	1	R3	RES 0603 NO LOAD			

A.4.2 CY3271-EXP1 Thermistor BOM