CY3271-EXP1 PSoC® Environmental Sensing Kit

Spec. # 001-49259 Rev. **

Cypress Semiconductor
198 Champion Court
San Jose, CA 95134-1709
Phone (USA): 800.858.1810
Phone (Intnl): 408.943.2600
http://www.cypress.com

Copyrights

Flash Code Protection

Cypress products meet the specifications contained in their particular Cypress PSoC Data Sheets. Cypress believes that its family of PSoC products is one of the most secure families of its kind on the market today, regardless of how they are used. There may be methods, unknown to Cypress, that can breach the code protection features. Any of these methods, to our knowledge, would be dishonest and possibly illegal. Neither Cypress 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."

Cypress is willing to work with the customer who is concerned about the integrity of their code. Code protection is constantly evolving. We at Cypress are committed to continuously improving the code protection features of our products.

Contents

1. Introduction **5**

1.1 Welcome 5
1.2 CY3271-EXP1 System Overview 5
1.2.1 CY3271-EXP1 Hardware Overview 5
1.2.1.1 Weather Station Expansion Board 5
1.2.1.2 Pigtail Thermistor Expansion Board 6
1.2.2 CY3271-EXP1 Software Overview 6
1.2.2.1 PSoC Designer 6
1.2.2.2 PSoC Programmer 7
1.2.2.3 Cypress Sense and Control Dashboard (SCD) 8
1.3 Document Revision History 8
1.4 Documentation Conventions 9

2. Installation Guide **11**

2.1 CY3271 Installation Instructions 11

3. Design Examples **17**

3.1 Design Example Summary Table 17
3.2 Out of Box Design Examples 17
3.2.1 Weather Station Expansion Board 17
3.2.2 Pigtail Thermistor Expansion Board 22

4. Firmware **23**

4.1 Weather Station 23
4.1.1 Weather Station Interface Definition 23
4.2 Pigtail Thermistor Expansion Board 24
4.2.1 Pigtail Thermistor Interface Definition 24

5. Calibrating Sensors **25**

5.1 Calibrating Sensors 25
5.2 Calibrating the Sensor 27
5.3 Wired Sensor Support 28
5.4 Alarms and Data Aggregation Intervals 29
5.5 Data Export 30
5.6 Saving a Configuration 30

1. Introduction

1.1 Welcome

Thank you for purchasing the CY3271-EXP1 Environmental Sensing Kit. The CY3271-EXP1 is designed to quickly evaluate the flexibility, integration, and mixed signal capabilities of Cypress' Programmable System-on-Chip (PSoC®) when interfacing with sensors.

Use the sample projects to explore:

- PSoC's programmable analog and digital blocks 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

If you have questions about or need help with the CY3271-EXP1 kit, visit our online support center at http://www.cypress.com/support for support options, or contact your local Cypress sales representative or authorized distributor.

1.2 CY3271-EXP1 System Overview

1.2.1 CY3271-EXP1 Hardware Overview

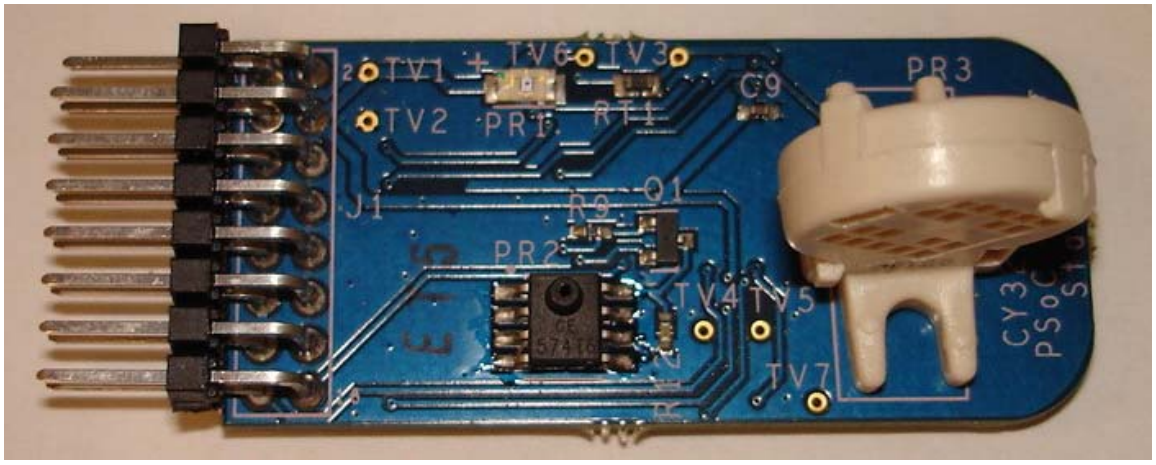
The CY3271-EXP1 kit hardware consists of a Weather Station Expansion Board and a Pigtail Thermistor Expansion Board.

1.2.1.1 Weather Station Expansion Board

The Weather Station Expansion Board features a PSoC device, and several sensors:

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

Figure 1-1. Weather Station Expansion Board



The Weather Station Expansion Board sends the sensor data over I^2C to the RF Expansion Card, which is contained in the CY3271 PSoC FirstTouch Start Kit.

1.2.1.2 Pigtail Thermistor Expansion Board

The Pigtail Thermistor Expansion Board features a thermistor on a 3 foot cable. The thermistor at the end of the cable is identical to the thermistor used on the RF Expansion Board allowing dual temperature readings.

The Pigtail Thermistor Expansion Board does not have a PSoC on board, rather it uses the PSoC from the RF Expansion Board to read the sensor.

Figure 1-2. Pigtail Thermistor Expansion Board

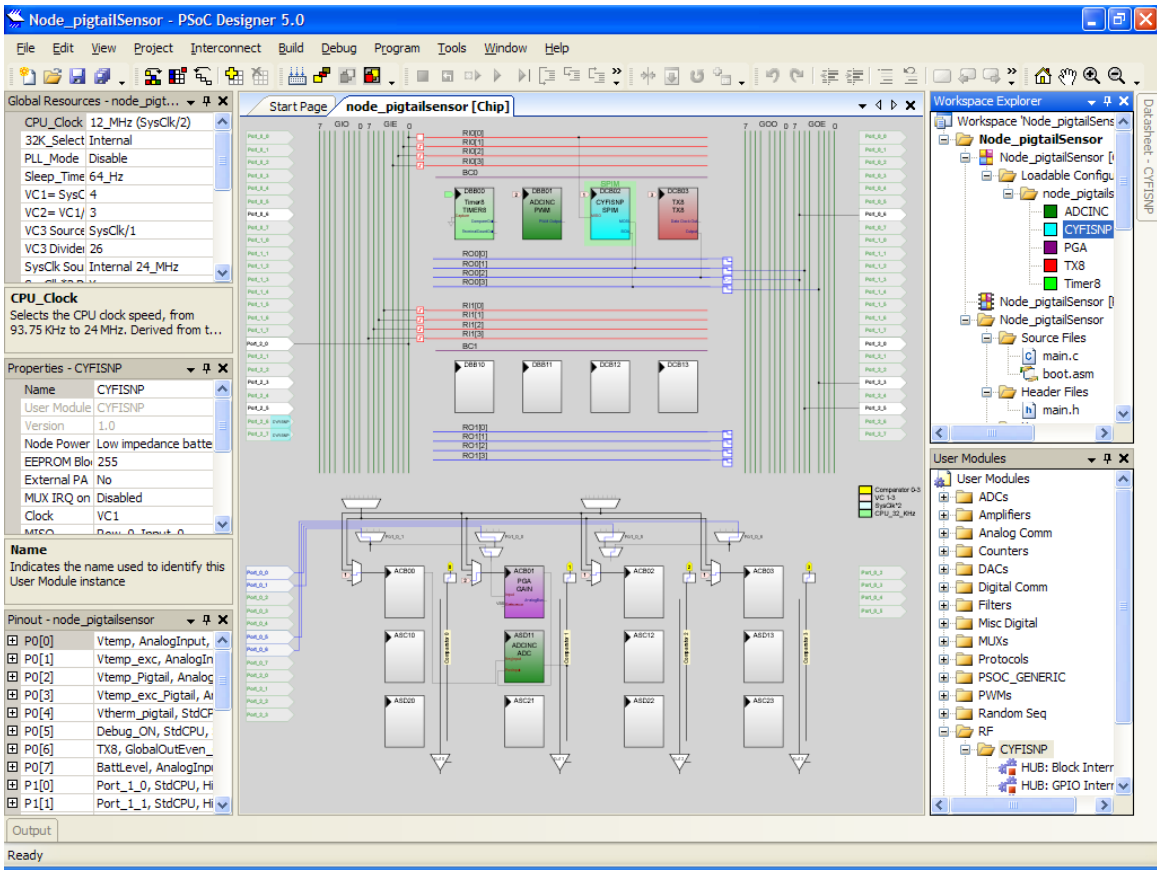
1.2.2 CY3271-EXP1 Software Overview

The software noted in this section is not included in the CY3271-EXP1 Kit, but instead, is located on the CY3271 PSoC FirstTouch Starter Kit CD.

1.2.2.1 PSoC Designer

PSoC Designer is the integrated development environment (IDE) where all PSoC projects are created, edited, built, and debugged. You are able to open all firmware examples included with the CY3271-EXP1 kit in PSoC Designer.

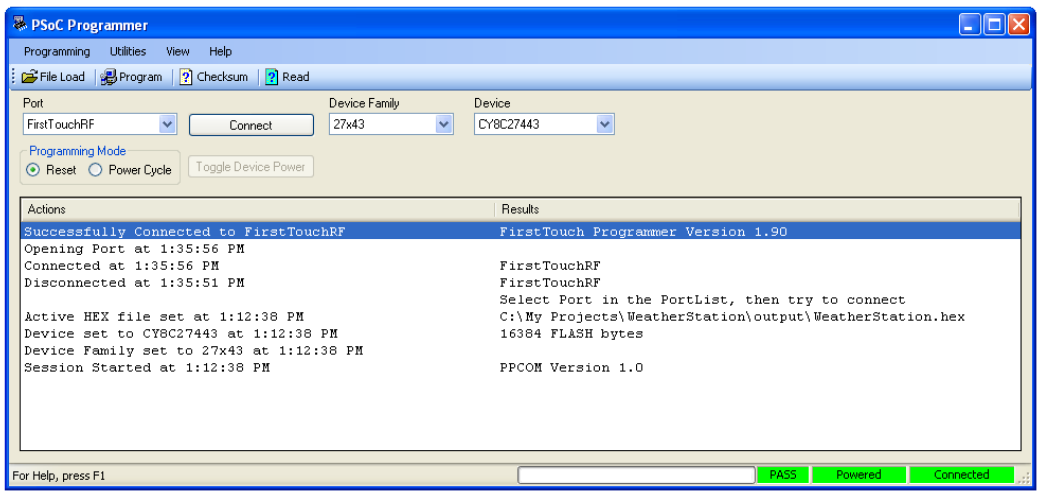
Figure 1-3. PSoC Designer



1.2.2.2 *PSoC Programmer*

After a PSoC project is built, the PSoC Programmer tool (along with the PC Bridge board) programs the target PSoC.

Figure 1-4. PSoC Programmer

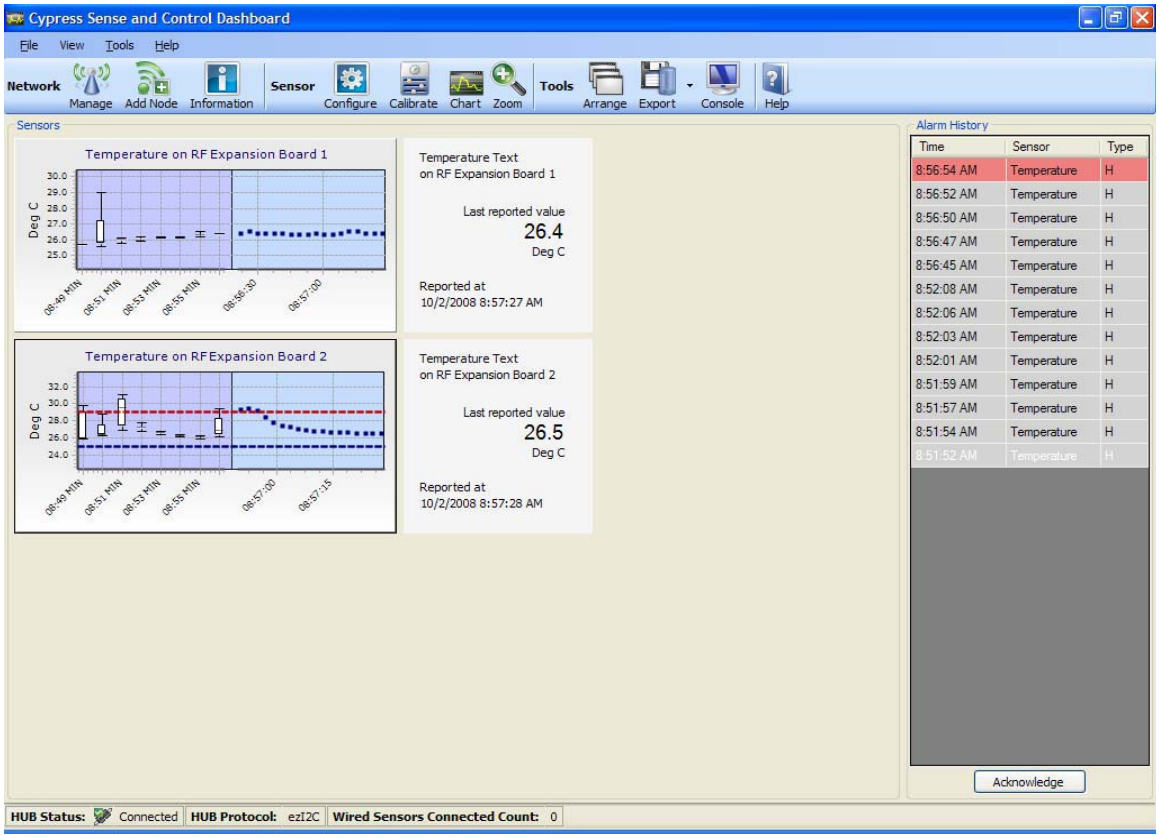


1.2.2.3 *Cypress Sense and Control Dashboard (SCD)*

SCD enables data logging and monitoring of wired and wireless sensors created using PSoC. The features include data logging, calibration, alarms, and data aggregation from hundreds of sensors.

The CY3271-EXP1 Kit uses the SCD application to wirelessly log data from the sensors connected to the PC Bridge using the CY3271 PSoC FirstTouch Starter Kit.

Figure 1-5. SCD



1.3 Document Revision History

Table 1-1. Revision History

Revision	PDF Creation Date	Origin of Change	Description of Change
**	10/07/2008	YUR	New Guide

1.4 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.

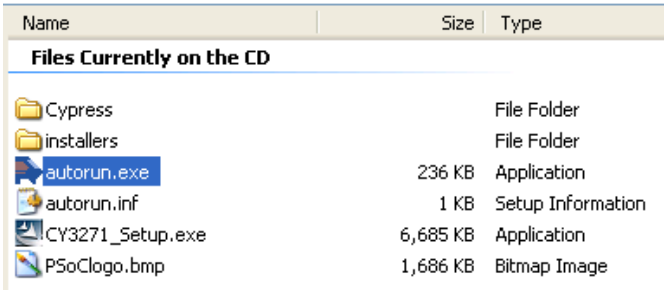
2. Installation Guide

The CY3271-EXP1 uses the same software as the PSoC FirstTouch™ Starter kit. If you have installed the software for your FirstTouch kit, then no additional installation is necessary. If, however, you did not install the PSoC FirstTouch™ Starter kit then follow these instructions.

2.1 CY3271 Installation Instructions

Insert the CY3271 kit CD into your CD drive. This automatically launches the installer. If the autorun fails, then manually choose "autorun.exe" on the root of the CD, as shown in Figure 2-1.

Figure 2-1. Selecting autorun.exe



The installer presents three options. The first option launches the kit installer, which installs the following:

- PSoC Designer 5.0
- PSoC Programmer 3.00
- Cypress Sense and Control Dashboard
- Kit Contents

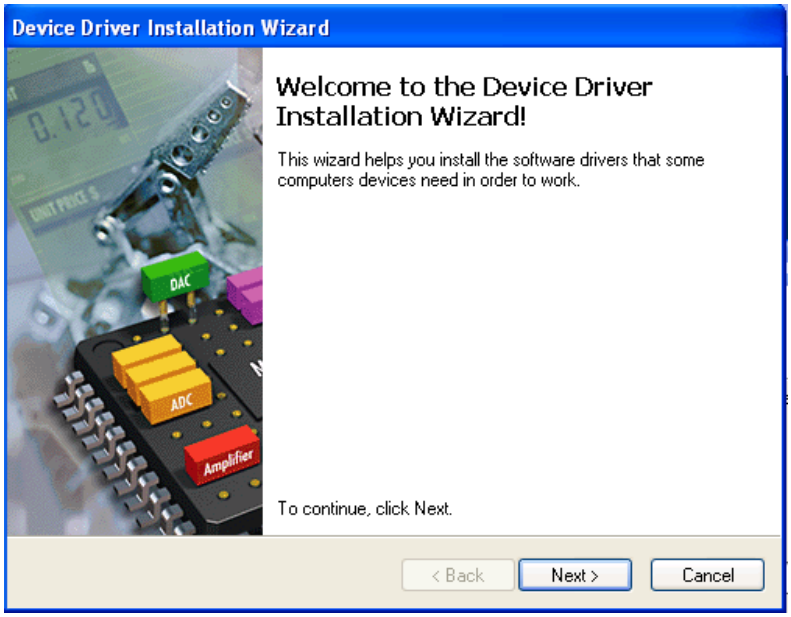
Figure 2-2. Kit Installer

Click **Install CY3271 Kit and Tools** to start the kit installations. Click **Next** to start the installer and then choose **Install** to launch the PSoC Designer installer.

Click **Next** through the next several screens.

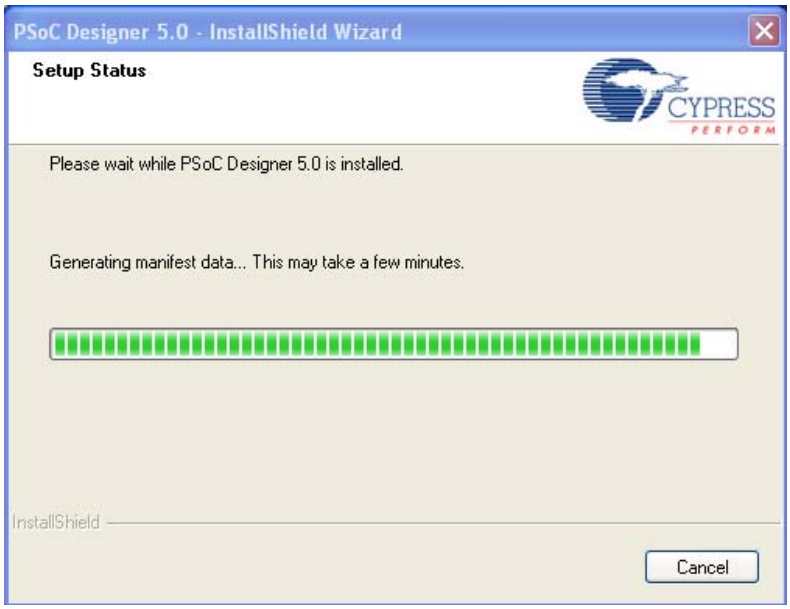
When the Device Driver screen appears, click **Next** and then **Finish**.

Figure 2-3. Device Driver Screen



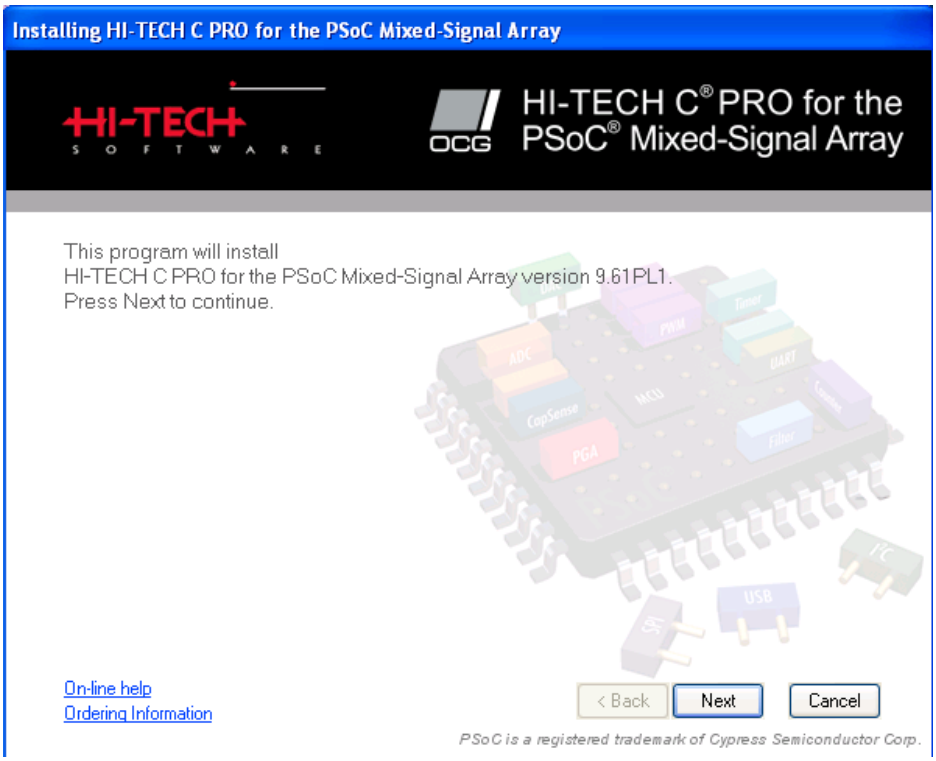
Wait for the Setup Status screen to complete. Then select **Finish** to complete the installation of PSoC Designer 5.0.

Figure 2-4. Setup Status Screen



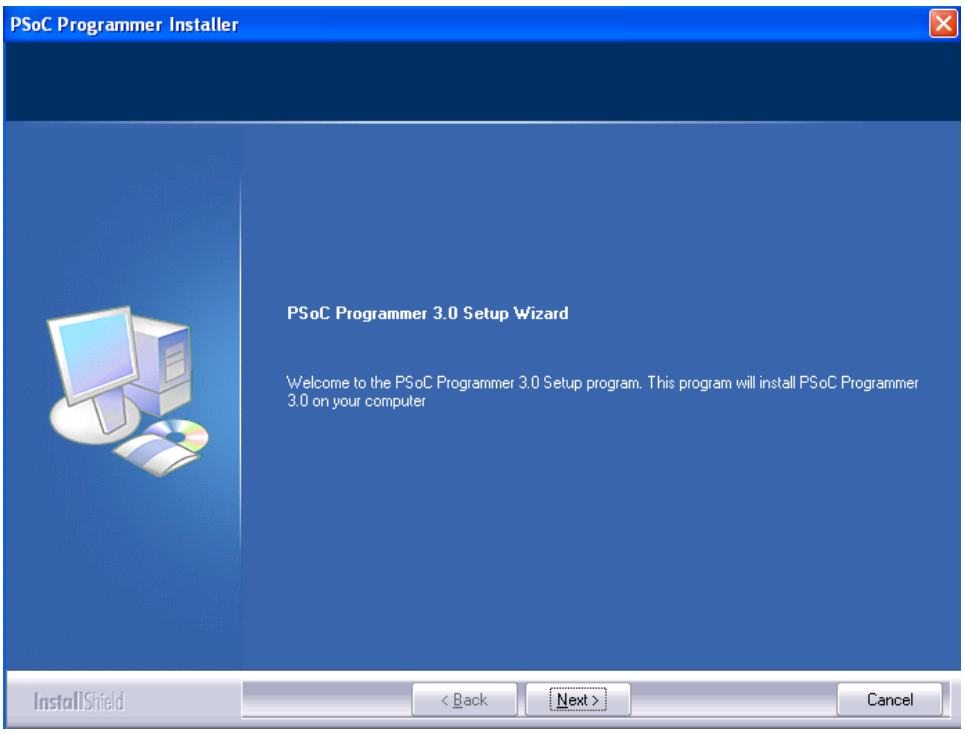
The Hi-TECH compiler for PSoC Designer begins installation.

Figure 2-5. Hi-TECH Compiler



PSoC Programmer 3.0 begins to install. Click **Next** through the next several screens.

Figure 2-6. PSoC Programmer Installer



Another Device Driver Installation Wizard appears. Click **Next** and **Finish** to complete the installation of PSoC Programmer.

The Sense and Control Dashboard Software setup wizard appears. Click **Next** through the next several screens to install the default configuration. This installer also installs Microsoft SQL server.

Figure 2-7. Installing SCD Software

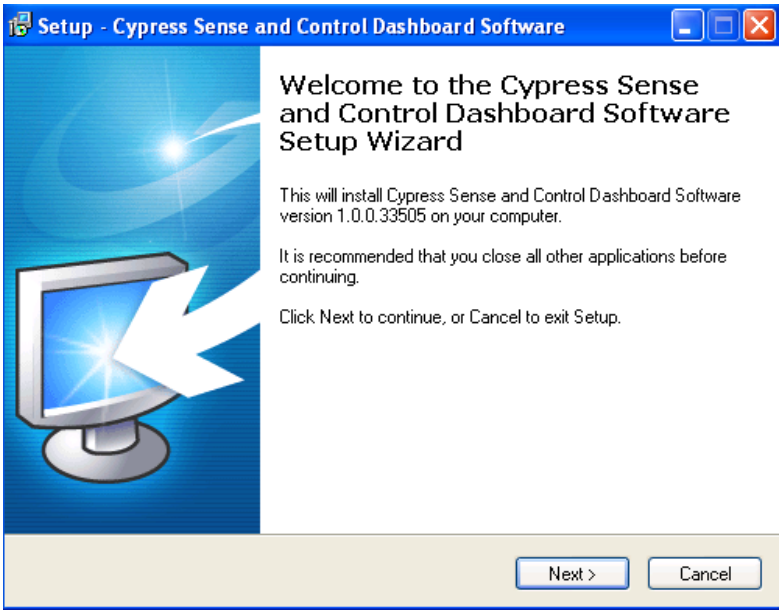
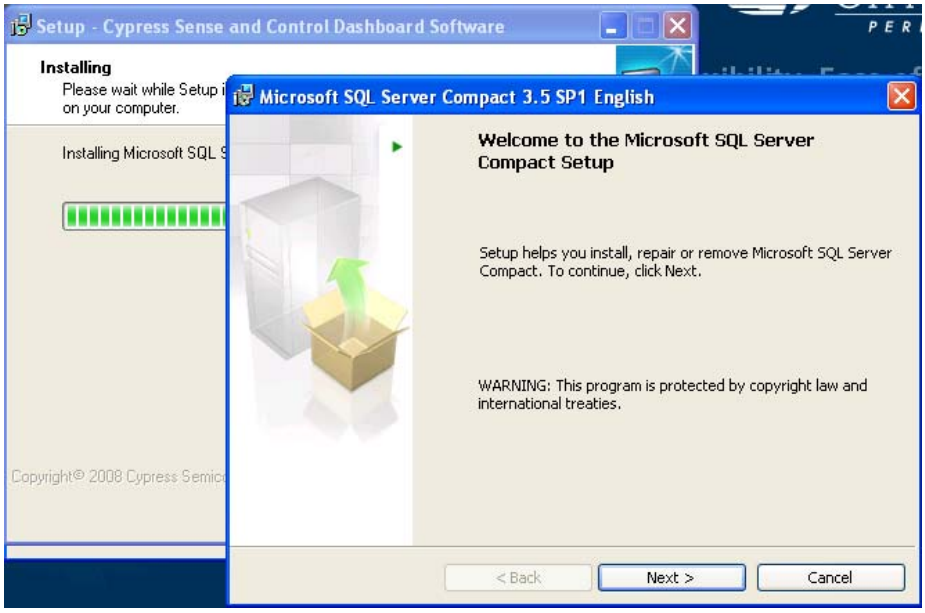


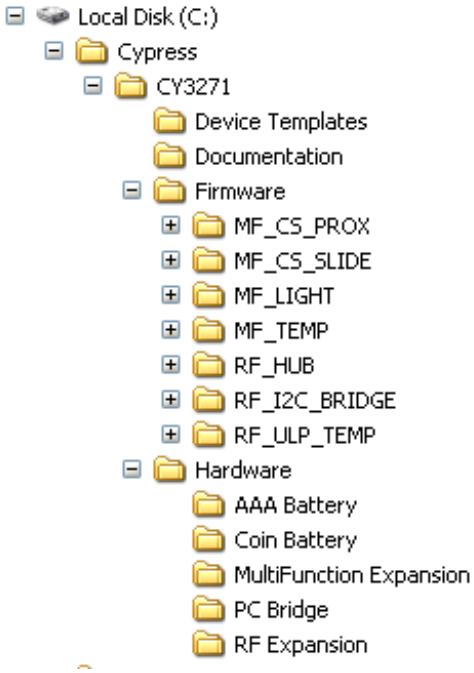
Figure 2-8. Installing Microsoft SQL Server



Click **Finish** to complete installing the CY3271 kit.

A directory structure similar to that sown in Figure 2-9 is created during the installation process.

Figure 2-9. Device Templates Directory



The device templates directory contains templates for all of the FTRF Design examples as outlined in the Design Example Summary Table on page 21.

The firmware section contains the firmware projects for all of the projects used in this kit. Each project contains the source code as well as the compiled .HEX image enabling you to quickly pro-

gram each application into the hardware. It is advised to generate and build each project before making changes to the project source code.

The Hardware section contains the design files for the schematics and PCB layout. There are also in PDF format for ease of viewing.

3. Design Examples

3.1 Design Example Summary Table

Design Example	Overview
Weather Station Expansion Board	This example demonstrates the Weather Station Expansion Board talking to the RF Expansion Board. The RF Expansion Board transmits data from the sensors to the PC Bridge. The bridge receives this data and sends it to the host PC, which displays the data from all four sensors in text or graph form in the SCD program.
Pigtail Thermistor Expansion Board	This example demonstrates the RF Expansion Board reading two identical thermistors: one thermistor on the RF Expansion Board and the other on the Pigtail Thermistor Expansion board. The RF Expansion Board transmits data from both thermistors to the PC Bridge. The Bridge receives this data and sends it to the host PC, which displays the data from both sensors in text or graph form in the SCD program.

3.2 Out of Box Design Examples

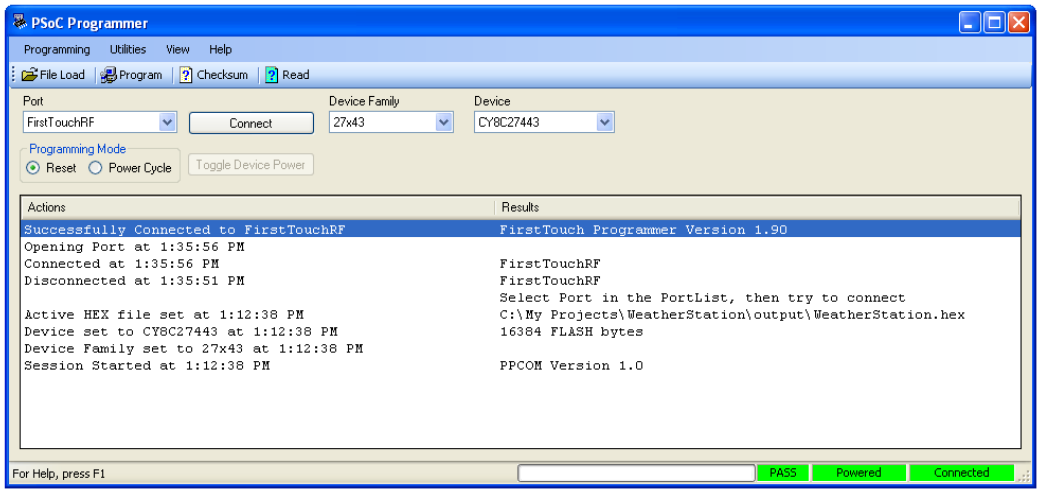
These demonstrations operate at +10dBm of RF output power. They are limited to +10dBm because of the RF power restrictions imposed in Europe and Japan. The power can be increased to +20dBm in the United States and Canada only. The process is explained in detail on pages 47 and 64 of the CY3271 PSoC FirstTouch Starter Kit Guide.

3.2.1 Weather Station Expansion Board

Operate the Weather Station demonstration by downloading the corresponding .hex file onto the RF Expansion Board.

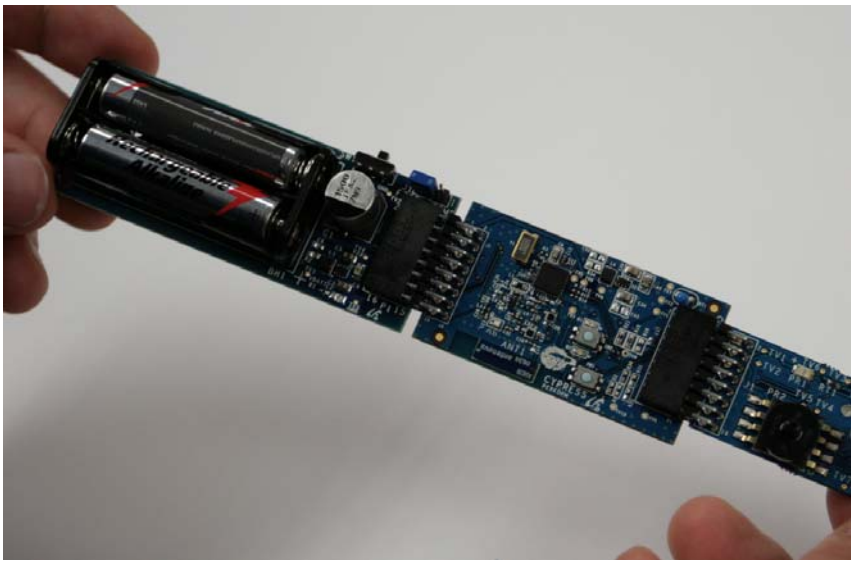
1. Connect the RF Expansion Board to the PC Bridge.
2. Insert the PC Bridge into any free USB port of your PC/laptop.
3. Open PSoC Programmer, and load RF_I2C_Bridge.hex from the Hex Files folder located on the CY3271-EXP1 Kit CD.
4. Set **Programming Mode** to Reset, **Device Family** to 27x43, **Device** to CY8C27443 and click **Program**.

Figure 3-1. PSoC Programmer Settings



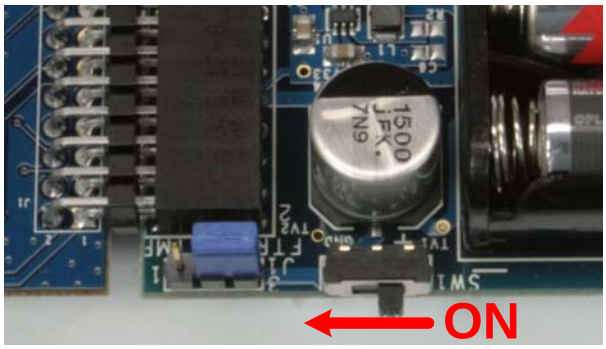
5. Disconnect the RF Expansion Board from the PC Bridge, leaving the Bridge connected to your computer.
6. Attach the Weather Station Expansion Board and the battery pack to the RF Expansion board as shown in Figure 3-2.

Figure 3-2. RF Expansion Board Connected to the Battery Pack and Weather Station Boards



7. Switch on power to the RF Expansion Board by sliding the ON/OFF switch on the battery pack towards the RF Expansion Board.

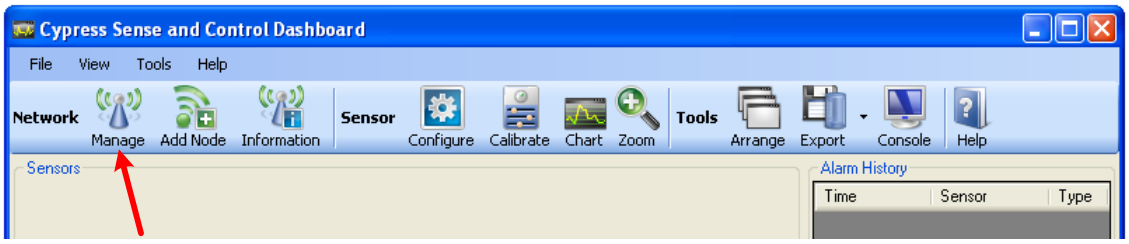
Figure 3-3. Turning ON the Switch



8. Open the SCD software.
9. Place the PC Bridge in Bind mode using the SCD software.

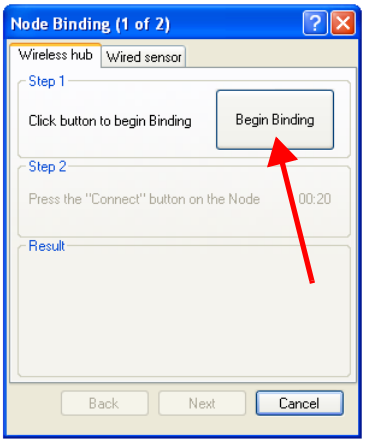
- Click **Manage** to set up the sensor network.

Figure 3-4. Manage Network within the SCD



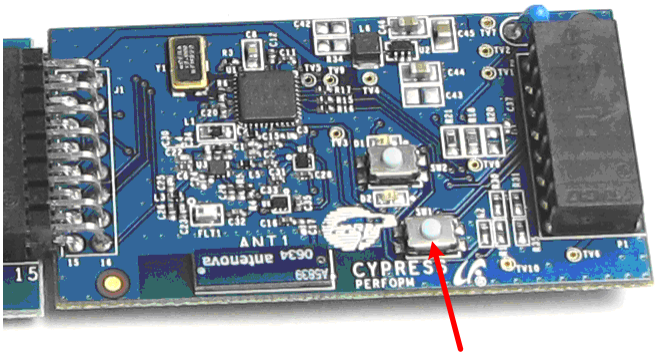
- In the Manage Network screen, click **Add** to add a new node.
- On the Node Binding screen, click **Begin Binding**.

Figure 3-5. Node Binding Window



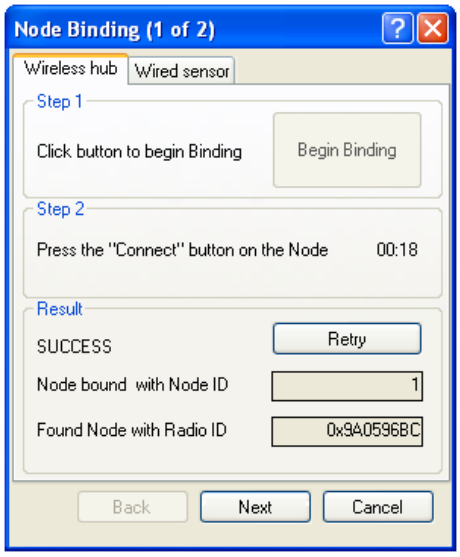
- After activating this function, you have aproximately 20 seconds to press the bind button on the RF Expansion Board.

Figure 3-6. Press the Bind Button



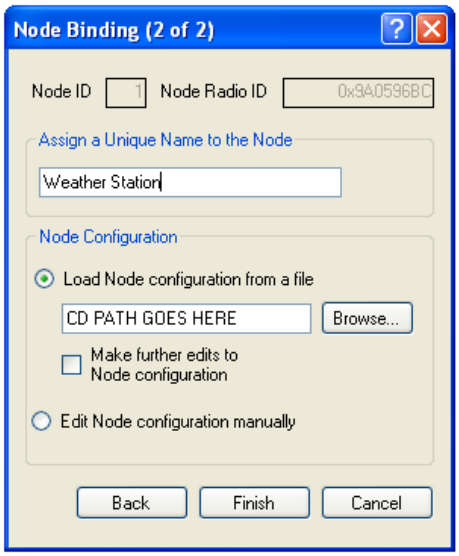
- Verify the success of the bind. A successful bind window looks similar to Figure 3-7.

Figure 3-7. Successful Bind Window



9. 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.xml from the Configuration Files folder.

Figure 3-8. Node Configuration



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.

3.2.2 Pigtail Thermistor Expansion Board

The Pigtail Thermistor demonstration can be operated by downloading the corresponding .hex file onto the RF Expansion Board.

1. Connect the RF Expansion Board 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_Therm_Bridge.hex from the Hex Files folder.
4. Set **Programming Mode** to Reset, **Device** Family to 27x43, **Device** to CY8C27443 and click **Program**.
5. Disconnect the PC Bridge and the RF Expansion Board and connect the battery pack and Pigtail Thermistor boards to the latter.
6. Switch on power to the RF Expansion Board by sliding the ON/OFF switch on the battery pack towards the RF Expansion Board.
7. Open the SCD software.
8. Place the PC Bridge in Bind mode using the SCD software. This is described below:

- Click **Manage** button to set up the sensor network.
- In the Manage Network screen, click **Add** to add a new node.
- On the Node Binding screen, click on **Begin Binding**.
- After this function is activated, the user has about 20 seconds to press the bind button on the RF Expansion Board.
- Verify the success of the bind.

9. 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** radio button and load Pigtail_Thermistor_Dashboard_Configureation.xml from the Configuration Files folder located on the CY3271-EXP1 Kit CD
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.

4. Firmware

4.1 Weather Station

4.1.1 Weather Station Interface Definition

The board interfaces to the FirstTouch RF unit using the standard hardware interface defined for FirstTouch RF Expansion Boards. This interface is an augmented I^2C interface that transmits data in 8 byte packets. The Weather Station board is an I^2C slave device that presents the eight bytes of data on a virtual register interface. The eight bytes are interpreted as four 16-bit, 2's compliment data values, each corresponding to one of the four sensors monitored by the onboard PSoC. The 16 bit values are presented in this order:

- Humidity
- Temperature
- Ambient light
- Pressure

The following sections specify the exact definition of the engineering units provided for each sensor.

In addition to the I^2C interface, the board uses two hardware signals to control interaction with the FirstTouch PC Bridge: Board Select and Board Ready. The Board Select line is controlled by the Bridge and signals the PSoC on the weather station board to obtain readings. When readings are received, the PSoC sets the Board Ready line high to indicate to the PC Bridge that the values presented are stable.

Table 4-1. Weather Station Interface Definition

Field	Size	Format	Units	Byte Offset
Humidity	16-bit	2's compliment	Percent relative	0
Temperature	16-bit	2's compliment	Degrees Celsius * 100	2
Ambient Light	16-bit	2's compliment	Lux	4
Pressure	16-bit	2's compliment	Inches of mercury * 100	6

4.2 Pigtail Thermistor Expansion Board

4.2.1 Pigtail Thermistor Interface Definition

The Pigtail Thermistor board does not have an onboard PSoC. Instead, the analog signal is routed directly to the PSoC on the RF Expansion Board. This PSoC handles the signal measurement and processing, and communicates the results to the PC Bridge.

Table 4-2. Pigtail Thermistor Interface Definition

Field	Size	Format	Units	Byte Offset
Temperature (RF EXP)	16-bit	2's compliment	Degrees Celsius *10	0
Temperature (Pigtail)	16-bit	2's compliment	Degrees Celsius *10	2

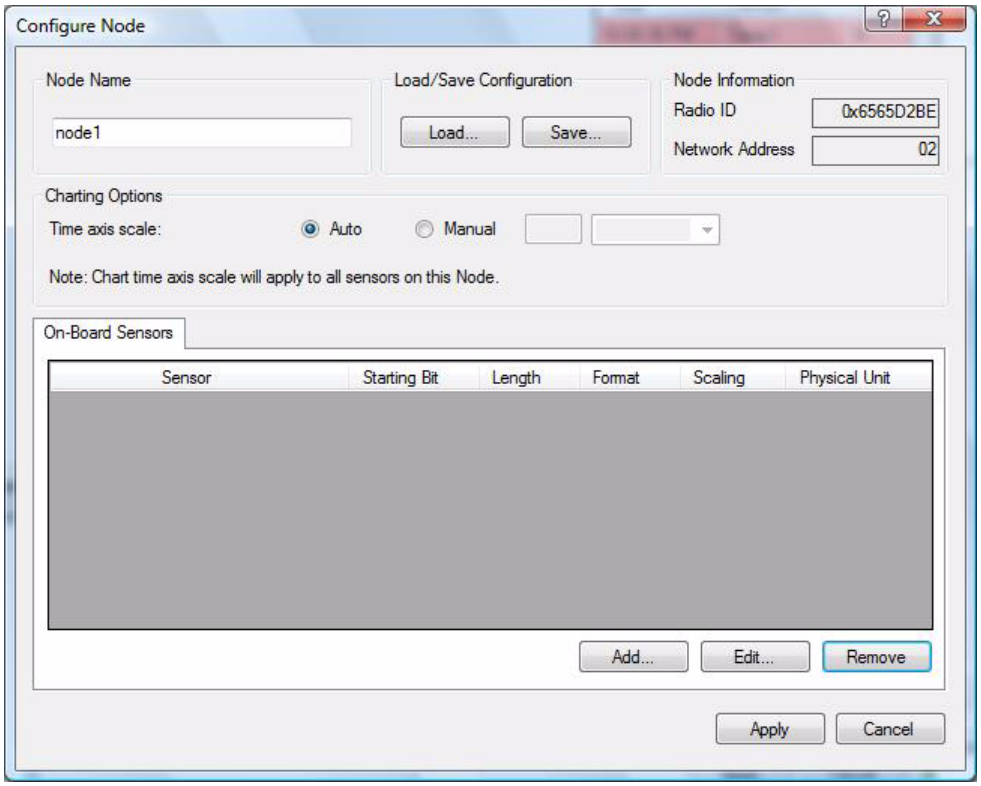
5. Calibrating Sensors

5.1 Calibrating Sensors

Selecting the manual configuration route in the second step of Node Binding Wizard activates the Configure Node dialog.

1. Click **Add** to add a new sensor and **Edit** to edit a selected sensor.

Figure 5-1. Configure Node

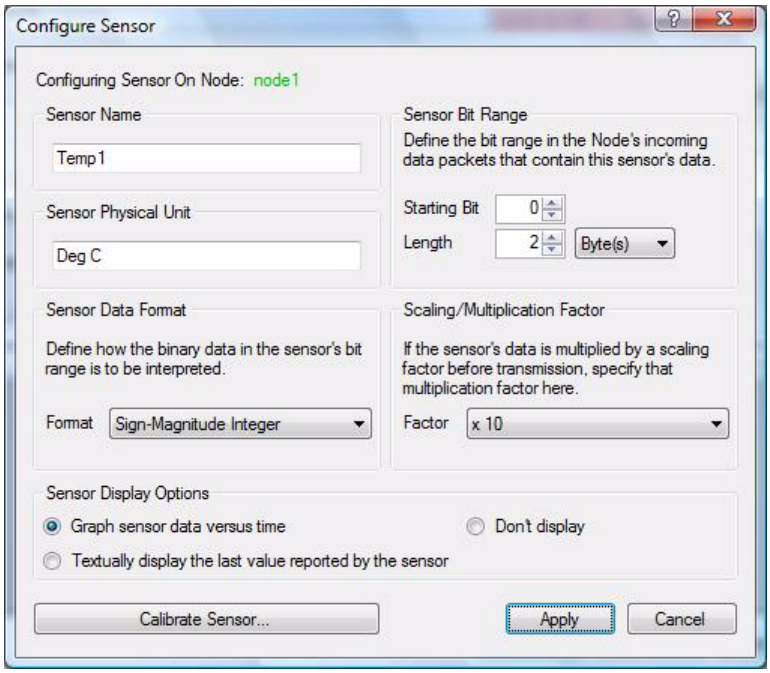


2. In the **Configure Sensor** dialog, specify:

- Sensor name
- Sensor physical unit
- Sensor data format
- Sensor bit range
- Scaling factor
- Sensor display option

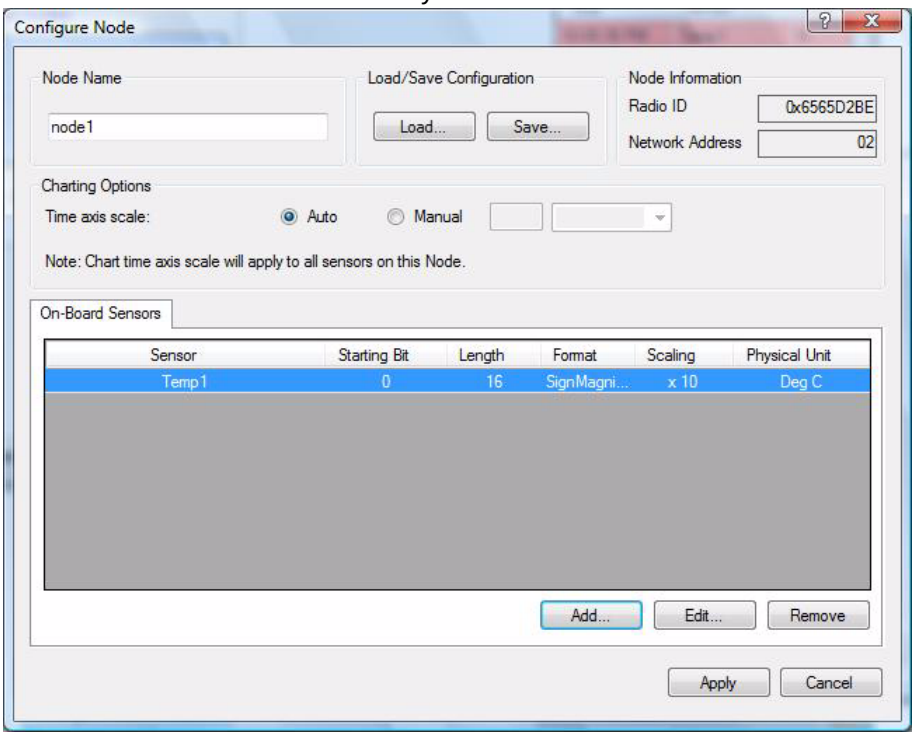
Click **Apply**.

Figure 5-2. Adding a Sensor



The sensor entry appears in the **Configure Node** dialog:

Figure 5-3. Sensor Added Successfully



Click **Edit** to start sensor editing.

5.2 Calibrating the Sensor

- SCD allows you to calibrate any sensor in the system using linear calibration
- SCD sensor calibration is based on data pairs (raw value, adjusted value)
- To register a calibration data pair, the last reported raw value from a sensor is displayed. You are prompted to adjust the value.
- When you begin to calibrate a sensor, specify at least one calibration data pair. You can choose not to calibrate the sensor or you can calibrate the sensor using at least one calibration data pair. There is no upper limit on the number of data pairs; more data pairs mean more accurate calibration.
- If you provide one data pair, SCD computes the calibration equation of the form y = x + b using the provided data pair.

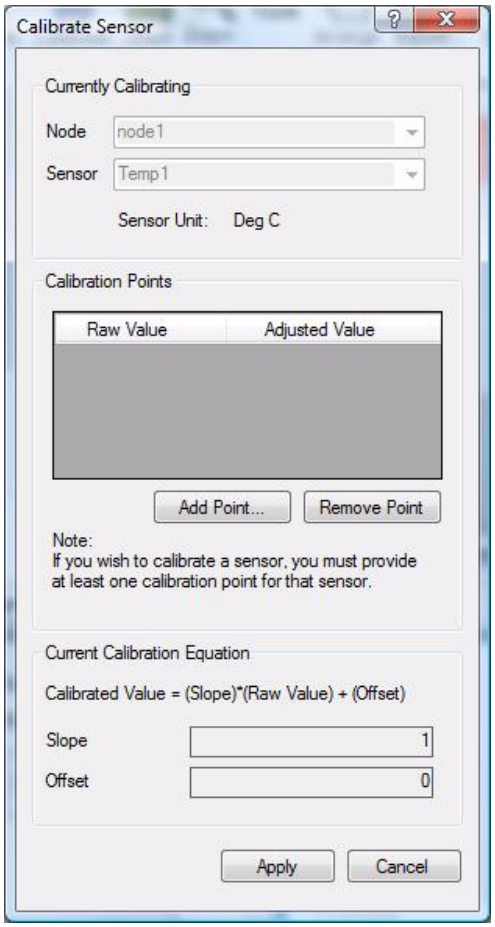
  Calibrated Value = Raw Value + Offset
- If you provide two or more data pairs, SCD computes the calibration equation of the form

  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 that sensor before displaying it in SCD.
- SCD records both raw and calibrated data for each sensor in its data log.

The **Calibrate Sensor** window is where you calibrate the sensor.

Figure 5-4. Calibrate Sensor Window



Open this dialog using the **Tools > Selected Sensor > Calibrate** menu item and **Calibrate Sensor** toolbar button. Use the buttons **Add Point** and **Remove Point** to add or remove calibration data pairs.

5.3 Wired Sensor Support

I^2C and USB are the two tyes of wired sensors supported in SCD. To bind a sensor to the network, go to **Tools > Manage Network** and click **Add** button in Network Nodes tab. The Node Binding window opens. Select the **Wired sensor** tab and click **Find Wired Sensor**.. All connected sensors are displayed in a box.

For I^2C sensors the status message appears like "Sensor @ I2C Address = N", were N is the wired sensor I^2C address. If you select I^2C sensor and **Next**, on the second window, sensor nodeID is automatically equal to I2C Address + 0x80. Enter a unique name and press Finish.

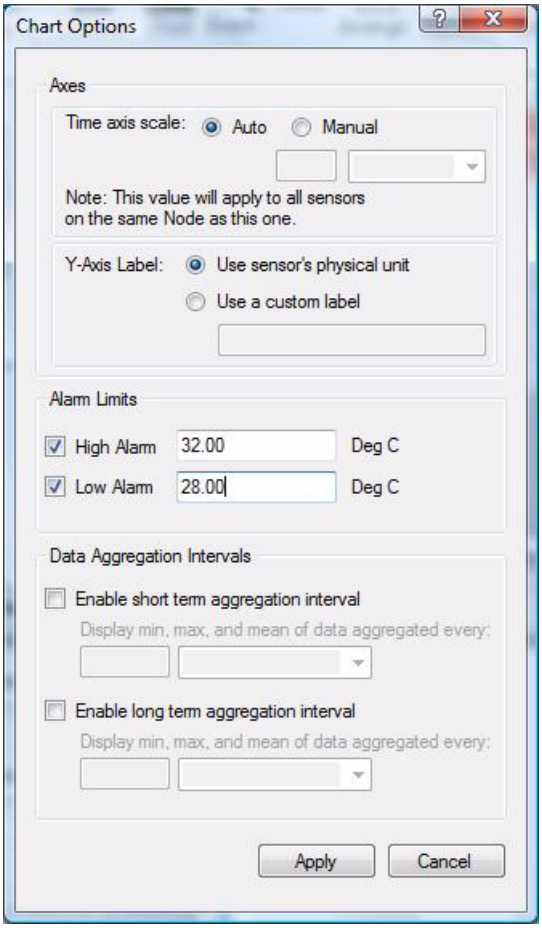
USB sensors are displayed by the name from the unique USB product string of less then 25 characters. You cannot change this name in SCD because this name is used to compare with the original for auto detect purpose. Node ID is automatically equal to sensor USB index + 0x40.

USB sensors count connected to network, are shown in the status tray.

5.4 Alarms and Data Aggregation Intervals

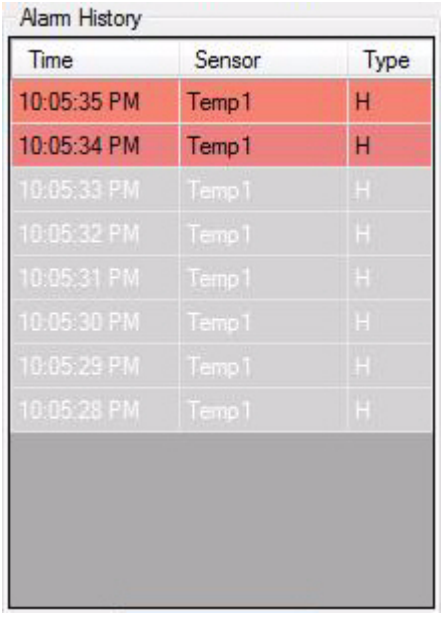
The **Chart Options** dialog provides a way to set low and high alarms for a selected sensor. This dialog is activated using **Tools > Selected Sensor > Chart Options** or by selecting **Chart Options** in the toolbar.

Figure 5-5. Chart Options for Setting Alarms



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

Figure 5-6. Alarm History



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.

5.5 Data Export

Selected sensor data, data reported by all sensors, and alarm history is exported to a file using comma separated values format. The corresponding menu items is in the main menu at **File > Export Data**.

5.6 Saving a Configuration

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