ECHELON®

2.0

Mini FX/PL Examples Guide

Table of Contents

Welcome

The Mini FX/PL Evaluation Kit is a complete hardware and software platform for evaluating the LONWORKS® 2.0 platform and developing LONWORKS devices based on PL 3150® and PL 3170 Smart Transceivers. The Mini kit lets you build Neuron® C applications and download them to LONWORKS devices, and test LONWORKS devices.

You can use the Mini kit to develop prototype or production devices, particularly in the rapidly growing, price-sensitive mass markets of smart light switches, thermostats, and other simple devices and sensors.

Purpose

This document describes the Neuron C example applications included with the Mini FX/PL Evaluation Kit that you can run on your PL 3150/PL 3170 EVBs. You can use these examples to test the I/O devices on the Mini Gizmo I/O Boards that you can attach to your PL 3150/PL 3170 EVBs, and create simple managed and self-installed LONWORKS networks. You can browse the Neuron C code used by these examples to learn how to develop your own device applications.

Audience

This guide is intended for device and system designers with an understanding of control networks.

Hardware Requirements

Requirements for computers running the Mini FX/PL Evaluation Kit are listed below:

- Microsoft® Windows Vista® or Microsoft Windows® XP. Echelon recommends that you install the latest service pack available from Microsoft for your version of Windows.

- Intel® Pentium® III 600MHz processor or faster, and meeting the minimum Windows requirements for the selected version of Windows.

  o 120 to 350 megabytes (MB) free hard-disk space, plus the minimum Windows requirements for the selected version of Windows.

  o The Mini FX Application requires 90 MB of free space.

  o Microsoft .NET Framework 3.5 SP1, which is required to run the Mini kit, requires 30 MB of free space.

  o The LonScanner™ Protocol Analyzer (Demo Edition), which is included with the Mini kit software, requires 26 MB of free space.

  o If you install Adobe® Reader 9.1 from the Mini FX Evaluation Kit CD, you need an additional 204 MB of free space. You need Adobe Reader or another PDF viewer to view the Mini FX/PL Evaluation Kit documentation.

- 512 MB RAM minimum.

- **Note**: Windows Vista testing for the Mini FX Application has been performed on computers that have a minimum of 2 GB of RAM. For complete Windows Vista requirements, refer to

www.microsoft.com/windows/windows-vista/get/system-requirements.aspx. You can use Microsoft's Vista Upgrade Advisor to determine upgrade requirements for a particular computer. To download this tool, go to the Microsoft Web site at *www.microsoft.com/windows/windows-vista/get/upgrade-advisor.aspx*.

- CD-ROM drive.

- 1024x768 or higher-resolution display with at least 256 colors.

- Mouse or compatible pointing device.

- LNS® network interface or IP-852 router. If an LNS network interface is used, it may be a local or remote interface.

  o Compatible local network interfaces include the U20 USB network interface (included with the Mini FX/PL Evaluation Kit); PCC-10, PCLTA-20, or PCLTA-21 network interfaces; and the SLTA-10 Serial LonTalk Adapter.

  o Compatible remote network interfaces include the *i*.LON® SmartServer, *i*.LON 100 *e*3 Internet Server, *i*.LON 600 LONWORKS-IP Server, or *i*.LON 10 Ethernet Adapter.

  o Compatible IP-852 routers include the *i*.LON SmartServer with IP-852 routing, *i*.LON 100 *e*3 Internet Server with IP-852 routing, or an *i*.LON 600 LONWORKS-IP Server. If you are using an IP-852 router, your computer must have an IP network interface such as an Ethernet card or modem with PPP software. In addition, the *i*.LON software must be installed on your computer, and the IP-852 channel must be configured using the LONWORKS-IP Configuration Server application software.

Content

This guide includes the following content:

- *Connecting the Mini FX/PL Hardware*. Describes how to power your PL 3150 and PL 3170 EVBs and connect them to a LONWORKS PL-20 channel and to your development computer.

- *Mini FX/PL Hardware Details*. Describes the service pin and reset buttons and LEDs, jumper settings, stand-alone power line coupler connector, and I/O connector on the PL 3150/PL 3170 EVBs. Describes the I/O devices on the Mini Gizmo I/O Board.

Related Manuals

The documentation related to the Mini kit is provided as Adobe PDF files and online help files. The PDF files are installed in the **Echelon Mini** program folder when you install the Mini kit. You can download the latest Mini FX documentation, including the latest version of this guide, from Echelon's Web site at *www.echelon.com/docs*.

The following manuals provide supplemental information to the material in this guide. You can download these documents from Echelon's Web site at *www.echelon.com*.

Introduction to the LONWORKS® Platform	Provides a high-level introduction to LONWORKS networks and the tools and components that are used for developing, installing, operating, and maintaining them.

I/O Model Reference for Smart Transceivers and Neuron Chips	Describes the many different I/O models that are available for use with the Neuron Chips and Smart Transceivers.
ISI Programmer's Guide	Describes the ISI protocol, which provides for easy development of devices that do not require installation tools.
ISI Protocol Specification	Describes the typical ISI network architecture, the procedures that take place in an ISI installed network, and the messages that are defined by the ISI protocol.
LonMaker® User's Guide	Describes how to use the LonMaker Integration Tool to design, commission, modify, and maintain LONWORKS networks.
LONWORKS® USB Network Interface User's Guide	Describes how to install and use the U20 USB Network Interface, which is included with the Mini FX/PL Evaluation Kit.
Mini FX/PL Hardware Guide	Describes the hardware included with the Mini FX/PL Evaluation Kit, including assembly instructions and other information you will need when using the Mini FX/PL Evaluation Kit.
Mini FX User's Guide	Describes how to use the Mini FX Evaluation Kit to develop and build simple Neuron C device applications, download the device applications to LONWORKS devices, and test the LONWORKS devices
Neuron® C Programmer's Guide	Describes how to write programs using the Neuron® C Version 2.2 language.
Neuron® C Reference Guide	Provides reference information for writing programs using the Neuron C Version 2.2 language.
PL 3120® / PL 3150® / PL 3170™ Smart Transceiver Data Book	Provides detailed technical specifications on the electrical interfaces, mechanical interfaces, and operating environment characteristics for the PL 3120, PL 3150, and PL 3170 Power Line Smart Transceivers.

For More Information and Technical Support

The **Mini FX ReadMe** document provides descriptions of known problems, if any, and their workarounds. To view the **Mini FX ReadMe**, click **Start**, point to **Programs**, point to **Echelon Mini**, and then select **Mini FX ReadMe First**. You can also find additional information about the Mini kit at the Mini FX Web page at *www.echelon.com/mini*.

If you have technical questions that are not answered by this document, the Mini FX online help, or the Mini FX ReadMe file, you can contact technical support. Free e-mail support is available or you can purchase phone support from Echelon or an Echelon

support partner. See *www.echelon.com/support* for more information on Echelon support and training services.

You can also view free online training or enroll in training classes at Echelon or an Echelon training center to learn more about developing devices. You can find additional information about device development training at *www.echelon.com/training*.

You can obtain technical support via phone, fax, or e-mail from your closest Echelon support center. The contact information is as follows (check *www.echelon.com/support* for updates to this information):

Region	Languages Supported	Contact Information
The Americas	English Japanese	Echelon Corporation Attn. Customer Support 550 Meridian Avenue San Jose, CA 95126 Phone (toll-free): 1.800-258-4LON (258-4566) Phone: +1.408-938-5200 Fax: +1.408-790-3801 *lonsupport@echelon.com*
Europe	English German French Italian	Echelon Europe Ltd. Suite 12 Building 6 Croxley Green Business Park Hatters Lane Watford Hertfordshire WD18 8YH United Kingdom Phone: +44 (0)1923 430200 Fax: +44 (0)1923 430300 *lonsupport@echelon.co.uk*
Japan	Japanese	Echelon Japan Holland Hills Mori Tower, 18F 5-11.2 Toranomon, Minato-ku Tokyo 105-0001 Japan Phone: +81.3-5733-3320 Fax: +81.3-5733-3321 *lonsupport@echelon.co.jp*

Region	Languages Supported	Contact Information
China	Chinese English	Echelon Greater China Rm. 1007-1008, IBM Tower Pacific Century Place 2A Gong Ti Bei Lu Chaoyang District Beijing 100027, China Phone: +86-10-6539-3750 Fax: +86-10-6539-3754 *lonsupport@echelon.com.cn*
Other Regions	English Japanese	Phone: +1.408-938-5200 Fax: +1.408-328-3801 *lonsupport@echelon.com*

1

Using the Mini FX/PL Example Applications

This chapter introduces the four Neuron C example applications included with the Mini FX/PL Evaluation Kit. It describes how to load these example applications on a PL 3150/PL 3170 EVB using the Mini FX Application. It describes how to bind the example applications in a self-installed or managed network. It explains how to browse the Neuron C code used by these examples so that you can begin developing your own device applications.

Introduction to the Mini FX/PL Examples

The Mini FX/PL Evaluation Kit includes the following four Neuron C example applications that you can load into your evaluation boards and use to create simple LONWORKS networks: *MgDemo*, *MgSwitch*, *MgLight*, and *MgKeyboard*.

The PL 3150 EVB comes pre-loaded with the *MgDemo* example application; the PL 3170 EVB comes pre-loaded with the *MgSwitch* example application. With these pre-loaded example applications, you can create a simple self-installed LONWORKS network where the push buttons on the PL 3170 EVB are connected to the LEDs on the PL 3150 EVB.

All four example applications use the Interoperable Self-Installation (ISI) library. ISI is an application-layer protocol that allows installation of devices and connection management without using a separate network management tool. For more information on ISI, see the *ISI Protocol Specification* and *ISI Programmer's Guide* documents.

Table 1-1 summarizes the *MgDemo*, *MgSwitch*, *MgLight*, and *MgKeyboard* applications:

Table 1.1 Mini FX/PL Example Application Summary

Example Application	Description		
MgSwitch	Summary	Demonstrates how you can use switch devices in a LONWORKS network. You can connect a PL 3150 EVB or PL 3170 EVB running the *MgSwitch* application to the following applications: 1. The *MgLight* application running on a PL 3150 EVB or PL 3170 EVB. 2. The *MgDemo* application running on a PL 3150 EVB.	
	Program IDs	PL 3150 EVB (CENELEC disabled)	9F:FF:FF:20:00:04:04:03
		PL 3150 EVB (CENELEC enabled)	9F:FF:FF:20:00:04:04:03
		PL 3170 EVB (CENELEC disabled)	9F:FF:FF:20:00:05:10:03
		PL 3170 EVB (CENELEC enabled)	9F:FF:FF:20:00:05:10:02

Example Application	Description		
MgLight	Summary	Demonstrates how you can use light devices in a LONWORKS network. You can connect a PL 3150 EVB or PL 3170 EVB running the *MgLight* application to the following applications: 1. The *MgSwitch* application running on a PL 3150 EVB or PL 3170 EVB. 2. The *MgDemo* application running on a PL 3150 EVB.	
	Program IDs	PL 3150 EVB (CENELEC disabled)	9F:FF:FF:1E:28:04:04:03
		PL 3150 EVB (CENELEC enabled)	9F:FF:FF:1E:28:05:10:03
		PL 3170 EVB (CENELEC disabled)	9F:FF:FF:1E:28:04:04:04
		PL 3170 EVB (CENELEC enabled)	9F:FF:FF:1E:28:05:10:02
MgDemo	Summary	Demonstrates how to interface with I/O hardware, use network variables to communicate on a LONWORKS network, and use the ISI library to install devices on a LONWORKS network. **Note**: You can only run the *MgDemo* application on a PL 3150 EVB. This application is too big for the on-chip EEPROM used by the PL 3170 Smart Transceiver. You can connect a PL 3150 EVB running the *MgLight* application to the following applications: 1. The *MgSwitch* application running on a PL 3150 EVB or PL 3170 EVB. 2. The *MgLight* application running on a PL 3150 EVB or PL 3170 EVB. 3. The *MgKeyboard* application running on a PL 3150 EVB or PL 3170 EVB.	
	Program IDs	PL 3150 EVB (CENELEC disabled)	9F:FF:FF:05:01:04:04:04
		PL 3150 EVB (CENELEC enabled)	9F:FF:FF:05:01:05:10:04

Example Application	Description		
MgKeyboard	Summary	Demonstrates how to use automatic network variable connections with the ISI protocol.	
		You can connect a PL 3150 or PL 3170 running the *MgKeyboard* application to the following applications:	
		1. The *MgDemo* application running on a PL 3150 EVB.	
	Program IDs	PL 3150 EVB (CENELEC disabled)	9F:FF:FF:05:25:04:04:03
		PL 3150 EVB (CENELEC enabled)	9F:FF:FF:05:25:04:10:03
		PL 3170 EVB (CENELEC disabled)	9F:FF:FF:05:25:04:04:04
		PL 3170 EVB (CENELEC enabled)	9F:FF:FF:05:25:05:10:02

Note: The CENELEC EN 50065-1 standard is a European-standard protocol for controlling access to a power line used for communication. It is required for power line communication in most CENELEC member states, which include most of Europe and some neighboring countries. For operation outside states governed by the CENELEC committee, you should disable the CENELEC access protocol for optimum performance and reliable communication. See Chapter 8 of the *PL 3120 / PL 3150 / PL 3170 Smart Transceiver Data Book* for more information on the CENELEC protocol. To view this book, click **Start**, point to **Programs**, point to **Echelon Mini**, point to **Smart Transceiver Data Books**, and then click it.

You can download the Mini FX/PL example applications to the PL 3150/PL 3170EVBs using the Mini FX Application included with the Mini kit. Pre-built downloadable application image files for the Mini FX/PL examples are stored in the **LONWORKS\NeuronC\Examples\Mini EVB\ReleasedBinaries** directory. You can use the Mini FX Application to download the **.NDL** application image files to your EVBs. If you have the LonMaker tool, you can download the pre-built binary application image files (**.APB** extension) to your EVBs. This folder also contains a pre-built text device interface file (**.XIF** extension) that exposes the example application's device interface so that the LonMaker tool can manage the example application. Figure 1-1 displays the downloadable application image files for the PL 3150/PL 3170 EVBs that are stored in the **LONWORKS\NeuronC\Examples\Mini EVB\ReleasedBinaries** directory.
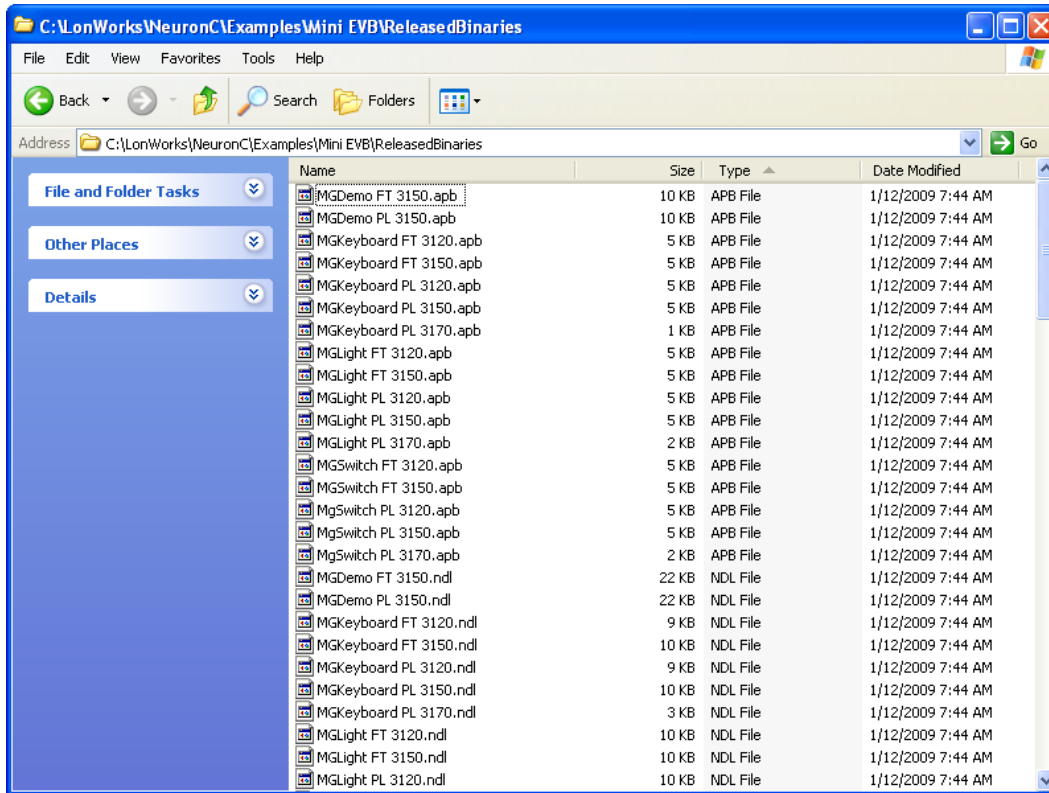
Figure 1.1 Mini FX/PL Example Application Image File Location

The Neuron C source files (**.nc** extension) for the Mini FX/PL examples are stored in separate folders within the **LONWORKS\NeuronC\Examples\Mini EVB** directory (for example, the *MgDemo* Neuron C application is stored in the **LONWORKS\NeuronC\Examples\Mini EVB\MgDemo** folder). Note that the default LONWORKS folder on your computer is typically C:\LONWORKS or C:\Program Files\LONWORKS. Figure 1-2 provides an example of the location of the Neuron C source file for the *MgDemo* example application.
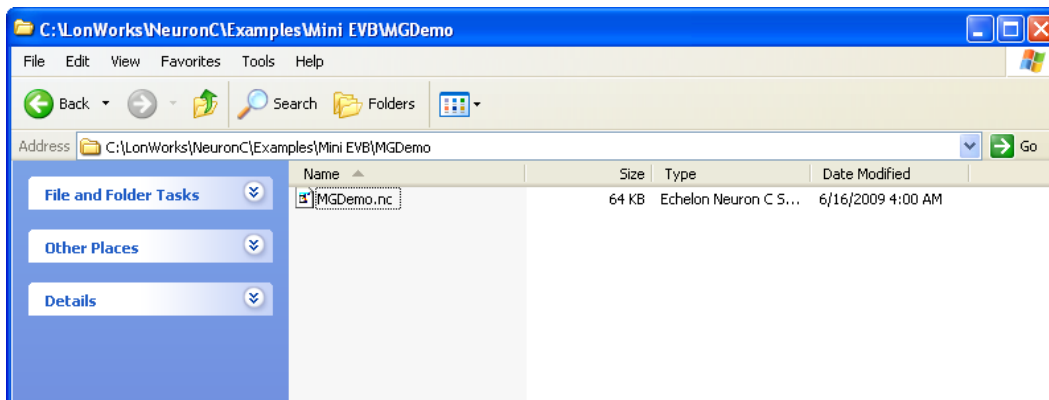

Figure 1.2 Mini FX/PL Example Source File Location

After you download an example application to the PL 3150/PL 3170EVBs, you can install and connect the network variables of the example applications in a self-installed network.

The following sections describe how to do the following:

1. Download the Mini FX/PL example applications with the Mini kit.
2. Use the Mini FX/PL example applications.

Loading the Mini FX/PL Example Applications

You can use the Mini FX Application to download the example applications to the PL 3150/PL 3170 EVBs. To do this, follow these steps:

1. Install the Mini FX software following Chapter 2 of the *Mini FX User's Guide*.

2. Connect your PL 3150/PL 3170 EVB boards following Chapter 1 of the *Mini FX/PL Hardware Guide*.

    After you plug in the power supplies, **LED1** will begin flashing, indicating that the PL Evaluation Board has entered CENELEC configuration mode. If **LED8** is on, then the CENELEC access protocol is enabled. If **LED8** is off, CENELEC is disabled. By default, CENELEC is enabled.

    You must enable the CENELEC access protocol when operating within one of the CENELEC member states. When operating outside the CENELEC member states, disable the CENELEC access protocol for optimum performance and reliable communications.

    If you want to change the current setting, you can press the **SW8** button on the MiniGizmo I/O Board to toggle CENELEC support. When you have made a selection, press the **SW1** button to confirm your selection and exit CENELEC configuration mode. Make sure that **LED8** is on before pressing **SW1** if you want CENELEC enabled, or off if you want CENELEC disabled. You will not be able to perform any network operations with the PL EVB until you have made a selection and exited CENELEC configuration mode.

    The CENELEC EN 50065-1 standard specifies an access protocol for C-band channels to allow multiple power line signaling devices from different manufacturers to operate on a common AC-mains circuit. See Chapter 8 of the *PL 3120 / PL 3150 / PL 3170 Smart Transceiver Data Book* for more information on the CENELEC protocol. To view this book, click **Start**, point to **Programs**, point to **Echelon Mini**, point to **Smart Transceiver Data Books**, and then click it.

3. Start the Mini FX Application. To do this, click **Start** on the taskbar, point to **Programs**, point to the **Echelon Mini FX** program folder, and then click **Mini FX Application**. The **Mini FX Application** opens with the **Application** tab selected.
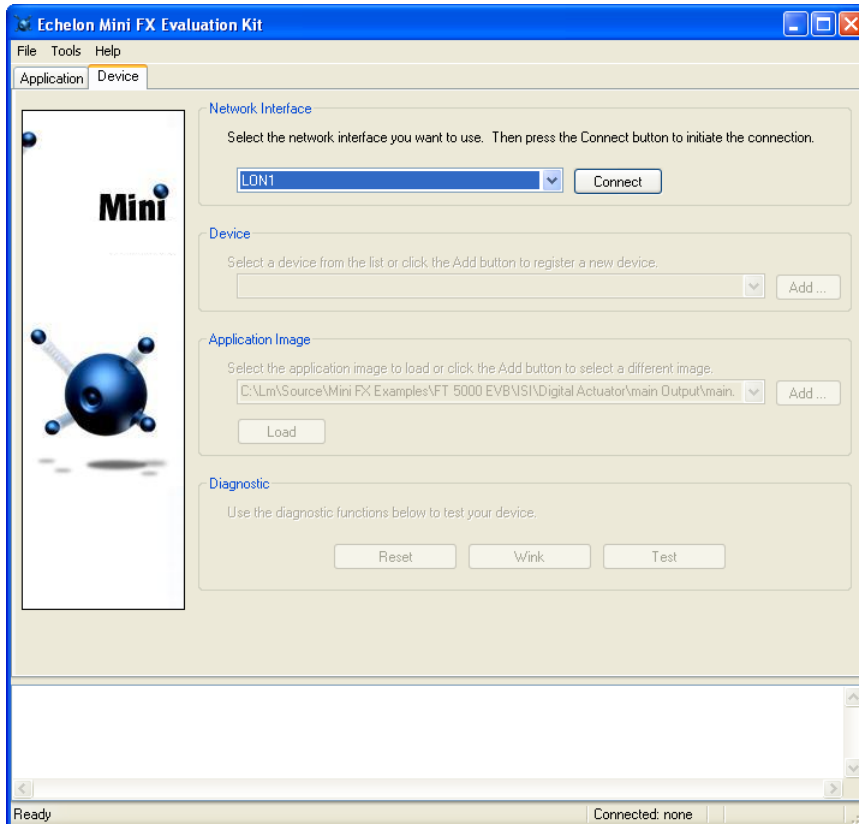
4. Click the **Device** tab.

Figure 1.3 Mini FX Application—Device Tab

5. In the **Network Interface** property, select a network interface to be used for communication between the Mini FX Application and the PL 3150/PL 3170 EVB over the LONWORKS channel, and then click **Connect**.

You can use the U20 USB Network Interface included with the PL 3150/PL 3170 EVB, or you can use another network interface such as a *i*.LON 10 Ethernet Adaptor, *i*.LON 100 *e*3 plus Internet Server, or *i*.LON SmartServer. If you are using the U20 USB Network Interface included with the PL 3150/PL 3170 EVB and you have not installed any other network interfaces on your computer, select **LON1**.

For more information on installing and configuring the U20 USB Network Interface, and on using it to attach your computer to a network channel, see the *LONWORKS USB Network Interface User's Guide*.

Note: Only one application can use a network interface at a time; therefore, if you connect the Mini FX Application to a network interface, you cannot use that network interface with other applications. You must exit the Mini FX Application to make a connected network interface available to other applications. Multiple LNS applications can share a network interface, but they cannot share a network interface with applications that are not based on the LNS network operating system such as the Mini kit.

6. Press the Service button on the PL 3150/PL 3170 EVB. The Service button on the PL 3150/PL 3170 EVB is a black button that is located near the lower right-hand corner of the board and is labeled "**SERVICE**."

7. The **Service Pin Message** dialog opens. The Neuron ID of the PL 3150/PL 3170 EVB appears in the **Neuron ID** box and its program ID in the **Program ID** box.
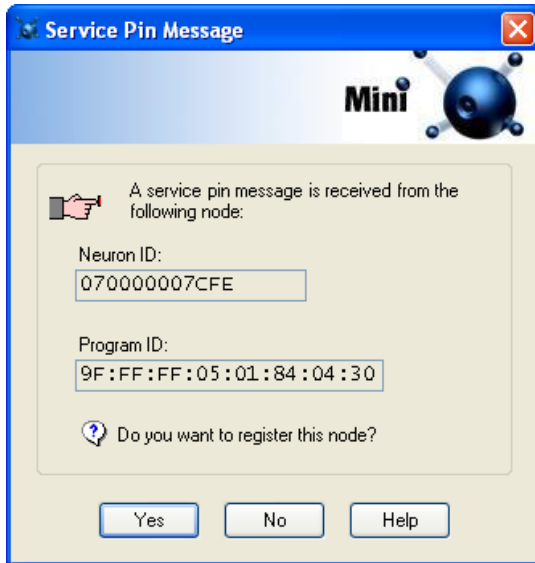
Figure 1.4 Mini FX Application—Service Pin Message Dialog

The **Neuron ID** is a unique 48-bit (12-hex digit) identifier contained in every LONWORKS device. The Mini kit uses the Neuron ID to communicate with your selected device. For more information on Neuron IDs, see the *Introduction to the LONWORKS System* document in the **Echelon Mini FX** program folder.

The **Program ID** is a unique, 16-hex digit ID that uniquely identifies the device application.

8. Click **Yes** to register the device with the Mini FX Application.

9. The PL 3150/PL 3170 EVB device is added to the **Device** list, which includes devices that you have added. The device will remain in the Device list until you close the Mini FX Application, or connect to a new network interface. You will need to add the device again when you restart the Mini FX Application, or when you connect to a different network interface.

10. In the **Application Image** property, click **Add**, browse to the **LONWORKS\NeuronC\Examples\Mini EVB\ReleasedBinaries** folder, and then select the desired Neuron C application image file (**.ndl** extension). The application image is added to the list of those recently added and it will remain there even after you close the Mini kit.
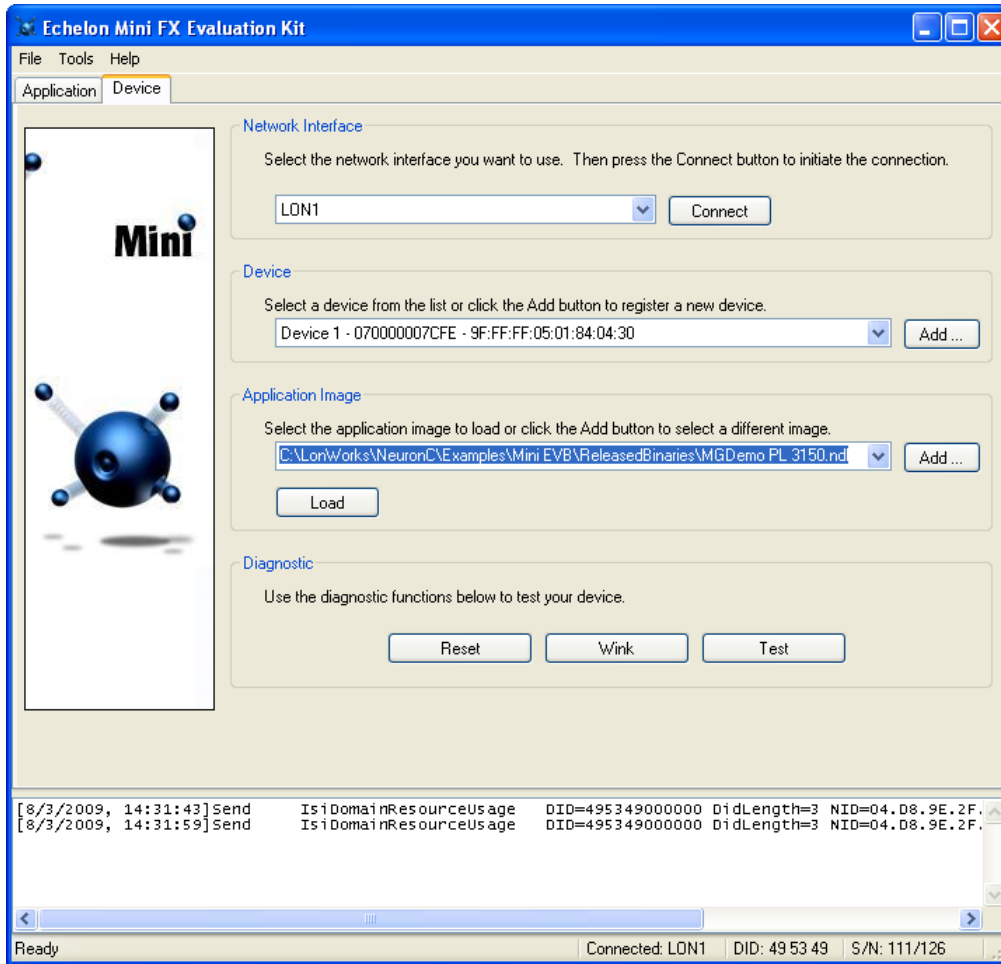
Figure 1.5 Mini FX Application—Application Image Selected

11. Click **Load** to load the selected Neuron application image into the PL 3150/PL 3170 EVB. The **Status** box informs you when the application image has been successfully loaded into the device, and also informs you of any load errors.
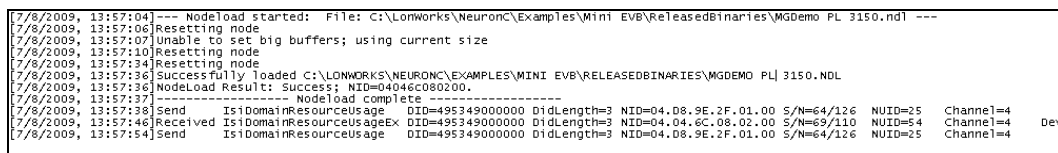
Figure 1.6 Mini FX Application—Status Box

Using the Mini FX/PL Example Applications

You can use the Neuron C example applications to demonstrate how to use Neuron C to interface with I/O hardware, how to use network variables in Neuron C to communicate on a LONWORKS network, and how to use the ISI library to install devices on a LONWORKS network.

You can load the Neuron C example applications into up to 32 evaluation boards on a LONWORKS network (the ISI protocol supports up to 200 devices, but the version used in the evaluation boards supports up to 32), connect the evaluation boards via the ISI protocol, and then use the applications to exchange data through input and output

network variable updates between the evaluation boards. These steps are summarized below. Further details are provided in the sections following this summary:

1. Start the Mini FX Application, and then load the example applications (*MgDemo*, *MgSwitch*, *MgLight*, or *MgKeyboard*) you want to use into the evaluation boards, as described in the previous section, *Loading the Mini FX/PL Example Applications*.

2. Push one of the push buttons labeled **SW5 – SW8** on a MiniGizmo attached to an evaluation board with the *MgDemo* application loaded, or push the button labeled **SW8** on a MiniGizmo attached to an evaluation board with the *MgSwitch* or *MgLight* applications loaded. This starts a new connection. The buttons used to start the connection are referred to as the *Connect buttons*, and the LEDs next to the Connect buttons are referred to as the *Connect lights*.

   The Connect light next to the Connect button that you pressed will start blinking. The Connect lights on devices that can join the connection will also start blinking. The *MgKeyboard* example application does not have a Connect button because it automatically connects without waiting for the installer to push a button. You can skip to step 5 if you are only connecting an *MgKeyboard* device.

3. Push one of the Connect buttons next to a blinking Connect light on any of the other devices to join the connection. The device's Connect light, as well as the Connect light on the evaluation board used to initiate the connection in step 2, will both illuminate without flashing, indicating they are ready to join the connection.

   Repeat this step until you have added all the devices you want to the connection.

4. Push the Connect button that you used to initiate the connection in step 2 again. This completes the connection.

5. You can now use the example applications.

   Note: You can also download the Monitoring & Control Example Application from the Echelon Web site and use it to monitor and control a 3150 EVB running the *MgDemo* application. The Monitoring & Control Example Application is a C# application that monitors ISI messages and uses the OpenLDV API to monitor and control network variables.

MgSwitch and MgLight Example Applications

You can use the *MgSwitch* and *MgLight* example applications to demonstrate how simple switch and lamp devices work on a LONWORKS network, where the switch devices are used to activate or de-activate the lamp devices, or to set the lighting level for the lamp devices. When you use these applications, the evaluation boards running the *MgSwitch* application represent the switch devices. The evaluation boards running the *MgLight* application represent the lamp devices, and will respond to output from the *MgSwitch* devices.

To use the *MgSwitch* and *MgLight* applications, follow these steps:

1. Start the Mini FX Application, load *MgSwitch* into one or more of the evaluation boards as described in the *Loading the Mini FX/PL Example Applications* section earlier in this chapter, and then load *MgLight* into one or more evaluation boards. You can optionally load *MgDemo* into a 3150 EVB and use it with *MgSwitch* or *MgLight*.

2. Press the button labeled **SW8** on a MiniGizmo attached to any of the evaluation boards used in step 1 to start a new connection. It does not matter which evaluation board you use. For these example applications, the button labeled **SW8** is the

Connect button, and the LED next to the **SW8** button is the Connect light. The Connect light will start blinking to indicate that the connection has been initiated. The Connect lights on the other devices that can join the connection will also start blinking.

NOTE: You can press and hold the Connect button for 8 seconds to cancel the connection.

3. Choose a device you want to add to the connection, and push the device's Connect button to add the device to the connection. The device's Connect light, as well as the Connect light on the device you used to initiate the connection in step 2, will both illuminate without flashing, indicating they are ready to join the connection.

    Repeat this step for each device you want to add to the connection.

4. Push the first Connect button on the device used in step 2 to complete the connection

5. You can now use buttons **SW1 – SW7** on the evaluation boards running the *MgSwitch* application to activate or de-activate the LEDs on the evaluation boards running the *MgLight* application, just as the switch would be used to activate or de-activate the lamp devices it is connected to.

    For example, if you press **SW3** on the *MgSwitch* MiniGizmo, then **LED1**, **LED2,** and **LED3** will activate on the MiniGizmos attached to the evaluation boards running the *MgLight* application.   Then, you can press **SW3** again on the *MgSwitch* MiniGizmo to de-activate the LEDs, or press any other of the other buttons on the *MgSwitch* device to change to a different lighting level.

6. If you included an evaluation board running the *MgDemo* application in the connection, it will also respond to the *MgSwitch* application. The I/O LED on the MiniGizmo attached to the evaluation board running the *MgDemo* application will activate or de-activate each time the *MgSwitch* MiniGizmo sends an update.

    In addition, the *MgDemo* application implements **LED1 – LED4** as simple lights that cannot be dimmed. These LEDs will be illuminated whenever the lighting level on the *MgSwitch* evaluation board is more than zero.

    Note: You can remove an evaluation board running the *MgSwitch* or *MgLight* application from a connection by pressing and holding the device's Service button until the Reset light blinks (approximately 10 seconds). To remove an evaluation board running the *MgDemo* application from a connection, press and hold the Connect button for the connection for approximately 10 seconds.

MgDemo Example Application

You can use the *MgDemo* example application to demonstrate how to use Neuron C to interface with I/O hardware, how to use network variables in Neuron C to communicate on a LONWORKS network, and how to use the ISI library to install devices on a LONWORKS network. The *MgDemo* application can be run on a PL 3150 EVB, and it can interoperate with other evaluation boards running the *MgSwitch*, *MgLight*, and *MgKeyboard* applications, as well as with other 3150 EVBs running the *MgDemo* application.

The *MgDemo* example application implements three types of I/O:

*   A temperature sensor reads the local temperature, and stores this data in a pair of output network variables.

*   A piezo buzzer can be controlled with a pair of input network variables.

- Four switch/light pairs implement a switch that is hard-wired to a local light, where each pair may be connected to remote switches, remote lights, or remote switch/light pairs, on other devices.

The four pairs consist of one switch and one light each. Each switch is implemented with a **SFPTclosedLoopSensor** functional block, and each light is implemented with a **SFPTclosedLoopActuator** functional block. When you use the *MgDemo* example application in a self-installed environment, each pair is coupled and can only be connected as one atomic unit. That is, each **LED1 – LED4** light emulates a light bulb that is physically connected to the corresponding **SW1 – SW4** switch, while remote switches or remote lights (or remote switch/light pairs) can be added to extend the functionality to a lighting system. When you use the *MgDemo* example application in a managed environment, you can independently connect each of the switch and light functional blocks, demonstrating the additional flexibility provided in managed networks. For example, you can use the *MgDemo* example application with the LonMaker tool and connect each of the eight individual functional blocks independently from each other.

To use the *MgDemo* application, follow these steps:

1. Start the Mini FX Application, and then load the *MgDemo* application into one or more of the 3150 EVBs as described in the *Loading the Mini FX/PL Example Applications* section earlier in this chapter (this application will not run in a 3170 EVB). The evaluation board used in this step is referred to as the *MgDemo board* in this section.

2. Push any of the buttons labeled **SW5, SW6, SW7** or **SW8** on the *MgDemo* board to start a new connection. These buttons are the Connect buttons for *MgDemo*, and the corresponding LEDs next to the buttons are the Connect lights. The Connect light next to the Connect button that you pressed will start blinking. The Connect lights on the other devices that can join the connection also start blinking.

   Note: You can press and hold the Connect button for 8 seconds to cancel the connection.

3. Push the blinking Connect buttons on any of the other devices to add those devices to the connection. The device's Connect light, as well as the Connect Light on the *MgDemo* board, will both illuminate without flashing, indicating they are ready to join the connection.

   Repeat this step for any other devices that you want to add to the connection.

   Note: You can press and hold the Connect button on a device for 8 seconds to remove the device from the connection.

4. Push the Connect button on the *MgDemo* board used in step 2 to complete the connection

5. The Connect buttons that you use to create a connection in steps 2 and 3 determine which button and LED will be used for I/O for the connection, as listed in Table 1.2.

Table 1.2 MgDemo Application

Connect Button	I/O Push Button	I/O LED
SW5	SW1	LED1
SW6	SW2	LED2
SW7	SW3	LED3
SW8	SW4	LED4

6. You can create ISI connections to other evaluation boards running the *MgDemo*, *MgSwitch*, or *MgLight* applications. When you press the I/O button on one of the evaluation boards running the *MgDemo* application, the I/O LEDs on all other connected evaluation boards running the *MgDemo* application will activate. When you press the I/O button again, the I/O LEDs will de-activate. For more information on the *MgSwitch* and *MgLight* applications, see *MgSwitch and MgLight Example Application* on page 10.

You can also use the *MgDemo* application to interoperate with evaluation boards running the *MgKeyboard* application, as described in the next section, *MgKeyboard Example Application*.

Notes:

The *MgDemo* application uses **LED1** and **LED2** to signal network and connection addressing conflicts. When a network address conflict is detected and resolved, **LED1** will start flashing. When flashing, **LED1** will not reflect any other input received from the network. Press the **SW1** button to cancel the notification and return **LED1** to its normal state. When a connection conflict is detected and resolved, **LED2** will start flashing, and **LED2** will not reflect any other input received from the network. Press the **SW2** button to cancel the notification and return **LED2** to its normal state.

Optionally, you can download the Monitoring & Control Example Application from the Echelon Web site and use it to monitor and control a 3150 EVB running the *MgDemo* application. The Monitoring & Control Example Application is a C# application that monitors ISI messages and uses the OpenLDV API to monitor and control network variables. You do not need to connect the evaluation board to any other evaluation boards (as described in steps 2–4 of this procedure) to use the Monitoring & Control Example Application.

MgKeyboard Example Application

You can use the *MgKeyboard* application with the *MgDemo* application to demonstrate the use of automatic network variable connections with the ISI protocol. The *MgKeyboard* application implements a simple musical keyboard using the 8 push buttons on the MiniGizmo. To use the *MgKeyboard* application, follow these steps:

1. Start the Mini FX Application and load *MgKeyboard* into a 3170 EVB as described in the *Loading the Mini FX/PL Example Applications* section earlier in this chapter.

2. Load the *MgDemo* application into a 3150 EVB as described in the previous section, *MgKeyboard Example Application*.

3. Wait for the ISI T_{auto} protocol timer to expire. This timer can take several minutes to expire. When the timer expires, the *MgKeyboard* application will start an automatic

connection process. The *MgDemo* application will automatically join this connection. No manual intervention is needed in this case.

The T_{auto} protocol timer is provided to avoid race conditions when a network segment, or the entire site, is powered up. The timer is only relevant the first time the device powers up with a new application, or when it is connected to a new network. Once the connection has been created, it will be immediately operational following a power-cycle or reset. For more information on the T_{auto} protocol timer, see the *ISI Programmer's Guide* and the *ISI Protocol Specification.*

4. Once *MgKeyboard* has connected with *MgDemo*, press any of the buttons labeled **SW1 – SW8** on the MiniGizmo connected to the evaluation board running the *MgKeyboard* application. This sends a network variable update that activates the piezo buzzer on the evaluation board running the *MgDemo* application. Each of the buttons causes the piezo buzzer to use a different frequency.

Getting Started with Device Development

The Mini FX/PL example applications were developed using Neuron C (Version 2.2), which is a programming language based on ANSI C that you can use to develop applications for Neuron Chips and Smart Transceivers. It includes network communication, I/O, and event-handling extensions to ANSI C, which make it a powerful tool for the development of LONWORKS device applications. For more information on the Neuron C programming language, see the *Neuron C Programmer's Guide* and the *Neuron C Reference Guide*.

You can view the Neuron C code used by the Mini FX/PL example applications to learn how to develop your own device applications. The Neuron C source files (**,nc** extension) are located in the **LONWORKS\NeuronC\Examples\Mini EVB**<*example*> folders on your computer. You can view a Neuron C source file by browsing to its example folder, and then opening the file with a text editor such as Notepad. Alternatively, you can access an example application's source file by clicking **Start**, pointing to **Programs**, pointing to **Echelon Mini FX**, pointing to **Examples,** pointing to **Mini EVB**, clicking the desired **Example Source Code** folder, and then clicking the Source folder.

After you view the Neuron C code in the example applications, you can create a new device application by modifying the existing example applications or by developing the device application from scratch. You can then use the Mini kit to build the device applications and download them to your PL 3150 EVB, PL 3170 EVB, or other LONWORKS device based on a PL 3150 or PL 3170 Smart Transceiver.

You can develop a simple device application by following the quick-start exercise in Chapter 3 of the *Mini FX User's Guide*. In the quick-start exercise, you will develop a non-interoperable device application with one sensor and one actuator. The sensor is a simple sensor that monitors the push buttons on the PL 3150/PL 3170 EVB. The actuator drives the state of the LEDs on the PL 3150/PL 3170 EVB based on the state of the push buttons. The quick-start guides you through all the steps of developing a device with the Mini kit, including creating, writing, compiling and building, and downloading the Neuron C device application.

After completing the quick-start exercise, you can view the programming samples included in Chapter 5 of the *Mini FX User's Guide* to learn Neuron C concepts such as input/output, timers, network variables, configuration properties, functional blocks, and interoperable self-installation (ISI). You can create and build the programming samples, and then download them to your PL 3150/PL 3170 EVB.

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