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Distributed RTU™ Network Instruction Manual

Remote Automation Solutions

EMERSON.
Process Management

Revision Tracking Sheet

May 2013

This manual may be revised periodically to incorporate new or updated information. The revision date of each page appears at the bottom of the page opposite the page number. A change in revision date to any page also changes the date of the manual that appears on the front cover. Listed below is the revision date of each page (if applicable):

Page	**Revision**
Initial issue	May-13

Contents

Chapter 1 – General Information

This manual describes the hardware (the FloBoss™ 107-based Distributed RTU™ CPU and the Network Radio module, or "NRM"), the software (the defined nodes and the network access point) components of Remote Automation Solutions' Distributed RTU™ Network, and the software tool – ROCLINK 800 – you use to configure the components into a network and to define the flow of data in and out of the network.

This chapter details the structure of this manual and provides an overview of the pieces of the Distributed RTU Network ("DRN") solution.

In This Chapter

1.1 Overview

Production pads with multiple wells (typically used in shale gas or oil production) present special challenges to gathering and controlling process variables. Often the wells are distributed over a wide geographic area, making wired connectivity difficult and control and remote point monitoring problematic.

Remote Automation Solutions' Distributed RTU Network (DRN) solution provides a unique and cost-effective resolution to this challenge. The DRN structures data acquisition and transmission in a true peer-to-peer network (rather than a more traditional master-slave arrangement), uses wireless technology to improve data transmission, and enables you to design – and quickly re-design – both the network structure and the flow of data through the network.

1.1.1 DRN Components

A DRN has two primary pieces: at least one **node** and a **network access point** (NAP). The **node** collects information from wired or wireless

HART devices or standard I/O points located at critical locations on the production pad and wirelessly transmits that information into the network. The **network access point** enables you to open a software "window" into the data network and extract, configure, manipulate, or otherwise manage the transmitted data as necessary using ROCLINK 800.

Node

A node is typically a four-slot FB107 chassis with a focused-functionality CPU and an installed Network Radio module (NRM). By removing support for several standard FB107 functions, the CPU can manage the input and output traffic from up to 32 wired or *Wireless*HART® devices per minute. To acquire these signals, you install a HART® module (for wired devices) and/or an IEC 62591 Wireless Interface module wired to a Smart Wireless Field Link (for wireless devices).

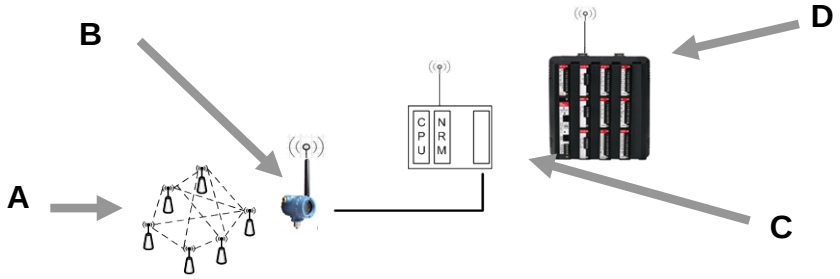
Each node supports **one** NRM, which wirelessly transmits data to and receives data from up to either 11 or 23 other nodes, depending on the system configuration model (12-node or 24-node) you select.

Note: Although a HART module can support up to 20 HART devices and an IEC 62591 module (wired to a Smart Wireless Field Link) can support up to 20 *Wireless*HART devices, that cumulative load exceeds the 32-device functional limit of the DRN node. Each node is designed to transmit a **maximum** of 30 export values (or "events") per second and to receive a maximum of 128 import values per second.

Network Access Point (NAP)

Each DRN has **one** network access point (NAP), through which you initially configure and subsequently modify the nodes and the network of nodal data relationships. Typically, you install an NRM into a fully functioning FB107, ROC800, or ROC800L to create a network access point. You can then use ROCLINK 800 to access the FB107 or ROC800 and view, manage, or collect the information provided by the nodes on the DRN.

Figure 1-1 shows a simple DRN with one node (with an installed IEC 62591 module) and one network access point (a ROC800 with an NRM).



A *Wireless*HART field devices (in mesh field network)
B Smart Wireless Field Link (wired to IEC 62591 module)
C Node with CPU, NRM, and IEC 62591 Wireless Interface module
D Network Access Point (ROC800 with NRM)

Figure 1-1. Simple DRN with Single Node and Network Access Point

1.1 Scope of Manual

This manual contains the following chapters:

Chapter 1 General Information	Provides an overview of the hardware and software for the Distributed RTU Network solution.
Chapter 2 Installation	Provides information on installing the physical network of nodes.
Chapter 3 Commissioning and Designing	Provides information on using Field Tools software to commission the network nodes and design the data network.
Appendix A: Glossary	Provides a general listing of acronyms and terms.
Appendix B: Optimizing Wireless Communications	Provides general information on wireless networks and how to structure and place components for maximum results.
Index	Provides an alphabetic listing of items and topics contained in this manual.

1.2 Hardware

Each node has two basic components: the Distributed RTU™ CPU (CPU) module and a Network Radio module (NRM).

Note: Although nodes are **most often** a focused-functionality FB107 with a DRN CPU and an NRM, you can also install a NRM in a ROC800 or a full-function FB107 and define that device as a node. Refer to *Section 1.2.3* for more information.

1.2.1 CPU Module

The firmware in the CPU module designed for use in the DRN has been modified to specifically manage the input and output from the peripheral HART devices associated with the node. To accomplish this

requirement and to support HART Pass-Through, the following functionality has been disabled:

- Support for meter runs
- Support for standard history
- Support for DS800
- Support for the expanded backplane.

However, the following critical functionality has been retained:

- Support for I/O scanning for all types of I/O modules (including the HART and IEC62591 Wireless module)
- Support for User C application programs
- Support for one PID loop
- Support for one FST
- Support for expanded history
- Support for alarm and event logging
- Support for the FB107 LCD local display
- Support for user lists

You power the CPU (and the node) using a standard 8-30 Vdc power source. For further information on wiring the CPU, refer to *Chapter 3* of the *FloBoss™ 107 Flow Manager Instruction Manual* (Form A6206).

1.2.2 Network Radio Module (NRM)

The Network Radio module is designed to be plug-and-play and requires no wiring. Depending on the enclosure you choose to surround the node and protect it from the environment, you may need additional cabling between the antenna and the connection on the module itself.

Installing a NRM in the node provides the wireless connectivity among nodes and the NAP in the network. See *Figure 1-2*; the ROC800-specific NRM is on the left and the FB107-specific module is on the right.

Module Placement

The NRM is a communications module. In a ROC800-Series, you can only install it in slots 1, 2, or 3 (the slots immediately to the right of the CPU). In an FB107, you can install the NRM in either slot 1 or 2 (the slots immediately to the right of the CPU) of the **base** unit. You cannot install the NRM in **any** slot on an FB107 expansion unit. Both the ROC800 and FB107 support only **one** NRM.

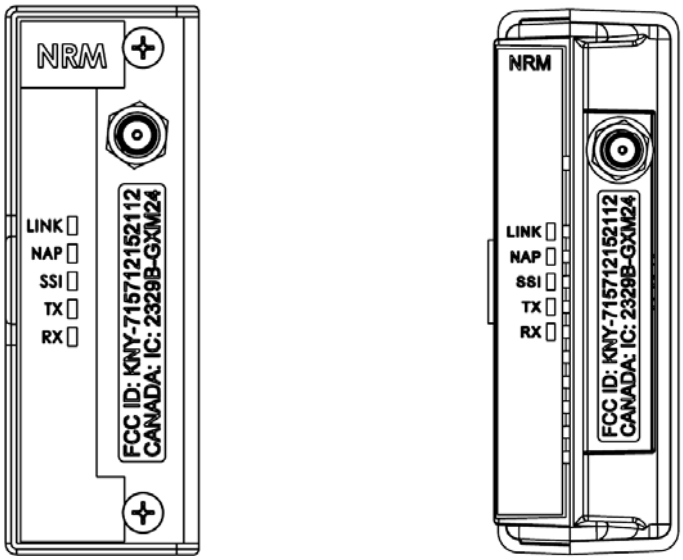


Figure 1-2. Network Radio Modules (for ROC800 and FB107)

Note: Only a ROC800 using a Series 2 CPU supports the NRM.

LEDs The five LEDs on the NRM's faceplate provide useful diagnostic information.

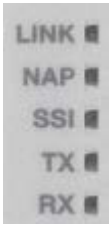


Table 1-1. Module LEDs

LED Label	If Installed in NAP	If Installed in Node
LINK	Always on	On (non-blinking)=joined network and commissioned Blinking=joined to network but not commissioned Off=Not joined to network
NAP	Always on	Always off
SSI	Always on	On (non-blinking)=good signal-to-noise ratio (signal is strong) Blinking=adequate signal-to-noise ratio (signal is adequate) Off=poor signal-to-noise ratio (signal is weak)
TX	Blinking=TX activity on radio	Blinking=TX activity on radio
RX	Blinking=RX activity on radio	Blinking=RX activity on radio

1.2.3 Nodes

A node is usually a four-slot FB107 chassis with a focused-functionality CPU and an installed Network Radio module (NRM). The remaining two empty slots on the FB107 chassis support any other FB107 I/O module.

For example, if you have a number of *Wireless*HART devices to support, you may choose to install an IEC 62591 Wireless Interface module (wired to a Smart Wireless Field Link). For wired HART devices, you can install a HART module, or you may just choose to install two I/O modules for additional I/O capability.

Node Characteristics

Each node can process and transmit a maximum of **30** data variables each second. Once connected, nodes communicate in a true peer-to-peer network, rather than a poll-response relationship.

Any node can receive up to **128** variables per second from a transmitting node; you determine the flow of data in the network. Since the DRN supports either a 12-node or 24-node configuration, the network can be as simple or as complex as your data needs require. Finally, when you add a node to the network (using the Network Access Point), the network automatically recognizes the node.

Note: Although nodes are most often a focused-functionality FB107, you can also install a NRM in a ROC800 or a full-function FB107 and define that device as a node. Refer to *Chapter 2* for more information.

1.2.4 Network Access Point (NAP)

Each DRN has only **one** network access point through which you initially configure and subsequently modify the nodes and nodal data relationships network. Typically the network access point is a ROC800, ROC800L, or full-featured FB107 with an installed Network Radio module. Using Field Tools software, you connect through the network access point and configure and define the network. NAPs can receive up to **128** variables per second and transmit up to **30** variables per second.

Module Placement

The NRM is a communications module. In the ROC800-Series, you can only install it in slots 1, 2, or 3 (the slots immediately to the right of the CPU). In the FB107, you can install the NRM in either slot 1 or 2 (the slots immediately to the right of the CPU) of the **base** unit. You cannot install the NRM in **any** slot on an FB107 expansion unit.

1.2.5 Firmware/Software Versions

Table 1-2 shows the software and firmware versions required to support the DRN:

Table 1-2. Firmware/Software Versions

Product	Firmware/Software Version
FloBoss 107	1.60
Distributed RTU CPU	1.00
Network Radio Module (NRM)	1.00

Product	Firmware/Software Version
ROCLINK 800	2.10
ROC800-Series	3.50
ROC800L	1.30
Enhanced Communications Module (ECM)	1.01

Note: If you use a FB107 with an installed ECM as a network access point, you **must** upgrade the ECM module to firmware version 1.01. This upgrade increases the wait time in the ECM to specifically accommodate the longer response times for the nodes.

1.3 System Security

Security in control systems is a critical concern. Using the security features within ROCLINK 800, you can provide a SCADA (Supervisory Control and Data Acquisition) system with access to all nodes in the network by defining permissions for a specific comm port. Using those same features, you can restrict technician access to specific nodes (control points). Refer to *Chapter 2, Installation,* for specific instructions.

1.4 SCADA Systems and the Distributed Network

The presence of a SCADA system installed in conjunction with the Distributed RTU Network requires special considerations.

Conflicts in data traffic can occur if the Network Access Point (NAP) and one or more nodes are also equipped with SCADA radios (also known as “long-haul” radios, which have more power and operate at lower frequencies than the radios installed on the Network Radio modules). If the SCADA system tries to acquire information at the same time as the DRN system, data traffic conflicts can occur as signals attempt to pass through the same devices at the same time.

To manage this situation, you can disable the SCADA data pass-through activity in select DRN nodes. This prevents the NAP from passing SCADA requests it receives to nodes in its network. (The individual nodes can still respond to requests directly from the SCADA system.) Refer to *Chapter 3, Commissioning and Designing*, for specific instructions on disabling or enabling SCADA activity on nodes equipped with long-haul radios.

Note: Which DRN nodes you disable is a function of the overall design of your network, in association with the data requirements of your SCADA system.

ROCLINK 800 Access

Another possible conflict with SCADA data pass-through may occur when you connect ROCLINK 800 to the Network Access Point. For this reason, the DRN software automatically disables SCADA pass-through on the port (LOI or Ethernet) while you are connected. The DRN software automatically restores pass-through between the NAP and the nodes when you close the ROCLINK 800 session.

Note: If the individual nodes have long-haul SCADA radios, the nodes can continue to receive and respond to SCADA requests while ROCLINK 800 is connected to the NAP. Only the pass-through between NAP and nodes is suspended when ROCLINK 800 is connected.

SCADA White Papers

For more information on SCADA and how it affects your DRN, refer to the following white papers:

- *Distributed RTU Network Basics*
- *Single SCADA Long-haul Radio Connected to a Distributed RTU Network*

1.5 Configuration/Commissioning Software

Once you have installed the individual nodes, you use ROCLINK 800 to interconnect the nodes. Refer to *Chapter 3, Configuring and Commissioning*, for specific instructions.

1.5.1 System Diagnostics

The ability to monitor the processing “health” of any component of the Distributed RTU Network is a critical diagnostic tool.

Once you open a ROCLINK 800 session, select a node’s **Advanced** tab to display essential operating components: noise level, signal strength, the percentage of good packets received, and the current network status:

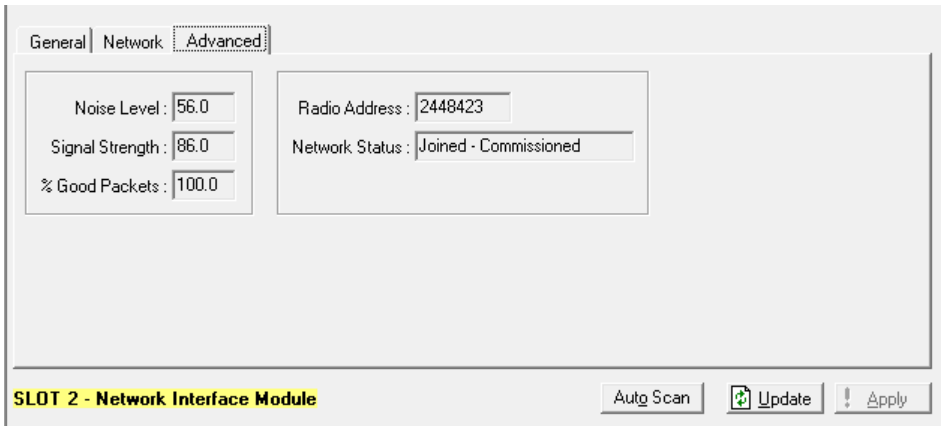


Figure 1-3. Node Diagnostics

Accessing this same information through the Network Access Point opens a single-screen summary of these values for each node in either a 12- or 24-node network:

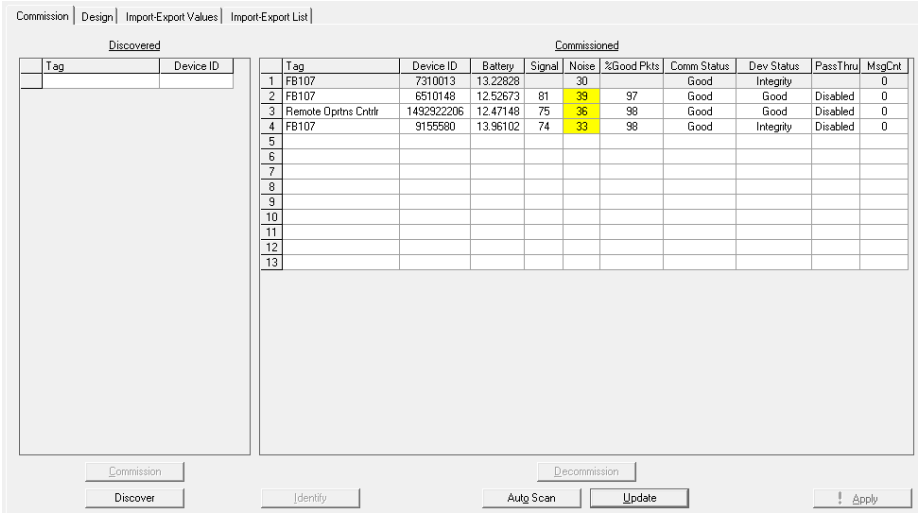


Figure 1-4. Diagnostics from the Network Access Point

Using this screen, you can scan the general system health and identify individual nodes which may be problematic. For further information on the diagnostic options this screen provides, refer to *Chapter 3*.

1.6 Additional Technical Information

Refer to the following documents for additional technical information:. The most current versions of these technical publications are available at *www.EmersonProcess.com/Remote*.

Table 1-3. Additional Technical Information

Name	Form Number	Part Number
FloBoss™ 107 Distributed RTU Network Bundle	FB107:DRN	D301730X012
ROC800-Series Network Radio Module	ROC800:NRM	D301732X012
FloBoss™ 107 Network Radio Module	FB107:NRM	D301731X012
FloBoss™ 107 Flow Manager Instruction Manual	A6206	D301232X012
ROC800-Series Remote Operations Controller Instruction Manual	A6175	D301217X012
ROC800-Series IEC 62591 Wireless Interface Module	ROC800:62591	D301689X012
FloBoss™ 107 IEC 62591 Wireless Interface Module	FB107:62591	D301713X012
IEC 62591 Wireless Interface Instruction Manual	A6321	D301708X012
FloBoss™ 107 HART® Module	FB107:HART	D301639X012

Chapter 2 – Installation

This chapter provides guidelines on designing your RTU network and describes how to configure and then install the nodes of the Distributed RTU Network.

Note: Because the structure of any particular DRN is tailored to your specific geographic site, we can only present an idealized model of a DRN and use it to explain the processes of installing, configuring, and commissioning. Consult with your Remote Automation Solutions representative to determine the optimal configuration for your particular site.

In This Chapter

2.1 Planning the Network

You can install the DRN either with a maximum of 12 nodes or with a maximum of 24 nodes. Which version you install is based on how you anticipate data should flow through the network.

2.1.1 Mapping the Network

By mapping out your network before you install any nodes, you can anticipate and resolve potential issues (such as locations which might need an antenna mast, placement of solar panels, and so on) as well as streamline the actual installation process. As *Figures 2-1* and *2-2* show, the DRN is flexible enough to accommodate a variety of physical configurations. Additionally, you can add and field-configure nodes (within the limitations for your chosen DRN size) as your data needs change, as well as change how data flows through the network.

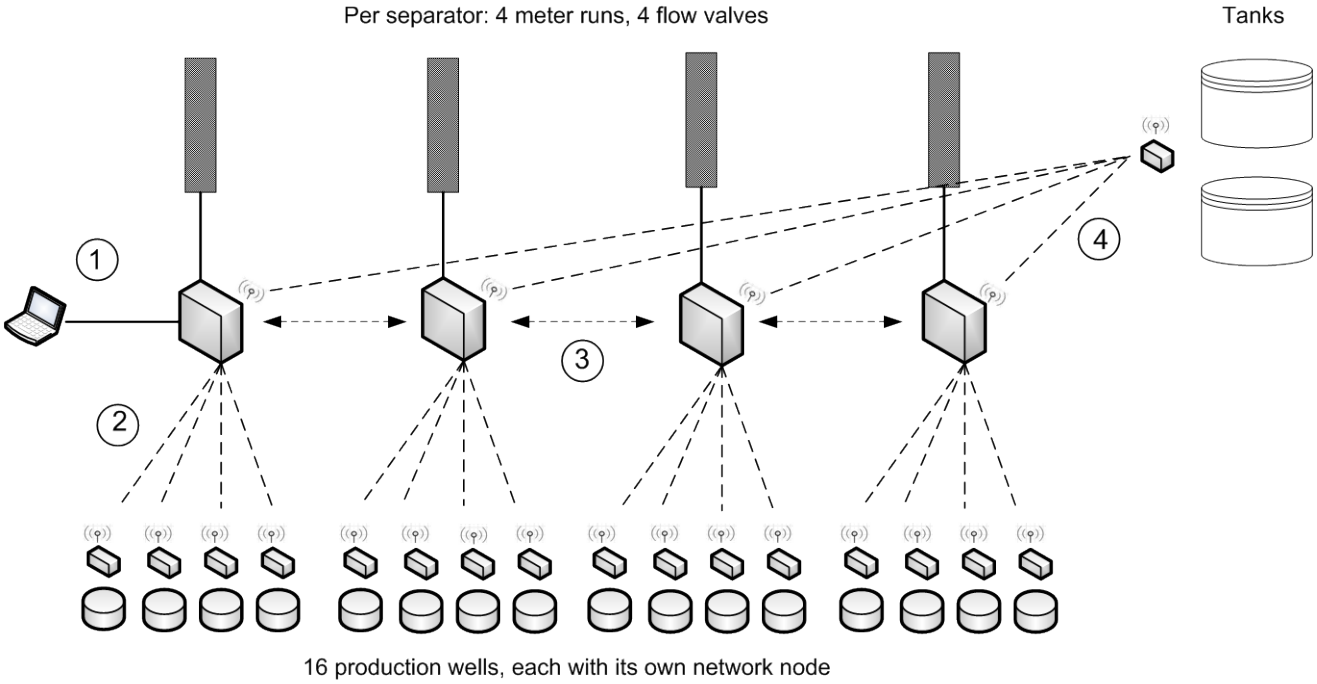
Note: For further information on power requirements, refer to the product data sheets *FB107:DRN*, *FB107:NRM*, or *ROC800:NRM*. For further information on how to optimally locate nodes for maximum communication, refer to *Appendix B, Optimizing Wireless Communications.*

Review *Figure 2-1* and *Figure 2-2*. Both show the same physical wellpad structure configured in two different ways.

2.1.2 Example: 21-Node Network

Figure 2-1 shows a 16-well pad with one node per well. Each separator (with its own meter run and flow value) is wired to its own flow computer (a ROC800 or FB107). Each flow computer has an installed Network Radio module (NRM). An additional node provides data from the storage tanks. Using 21 nodes, this network also shows the network access point (NAP), peer-to-peer, many-to-one, and one-to-many data relationships (which you define when you configure the network).

1. Network access point (NAP): Field Tools permits access and storage of configuration data from all the DRN nodes.
2. Many-to-one data flow: a single node can receive data from multiple nodes in the network at each update period. Information from the individual production wells flows to the RTU.
3. Peer-to-peer network: any node can receive or send data to any other node in the network without passing through the Network Access Point. Information flows between RTUs.
4. One-to-many data flow: one node within the network can send data to multiple other nodes each update period. Information from the storage tanks flows to each RTU.

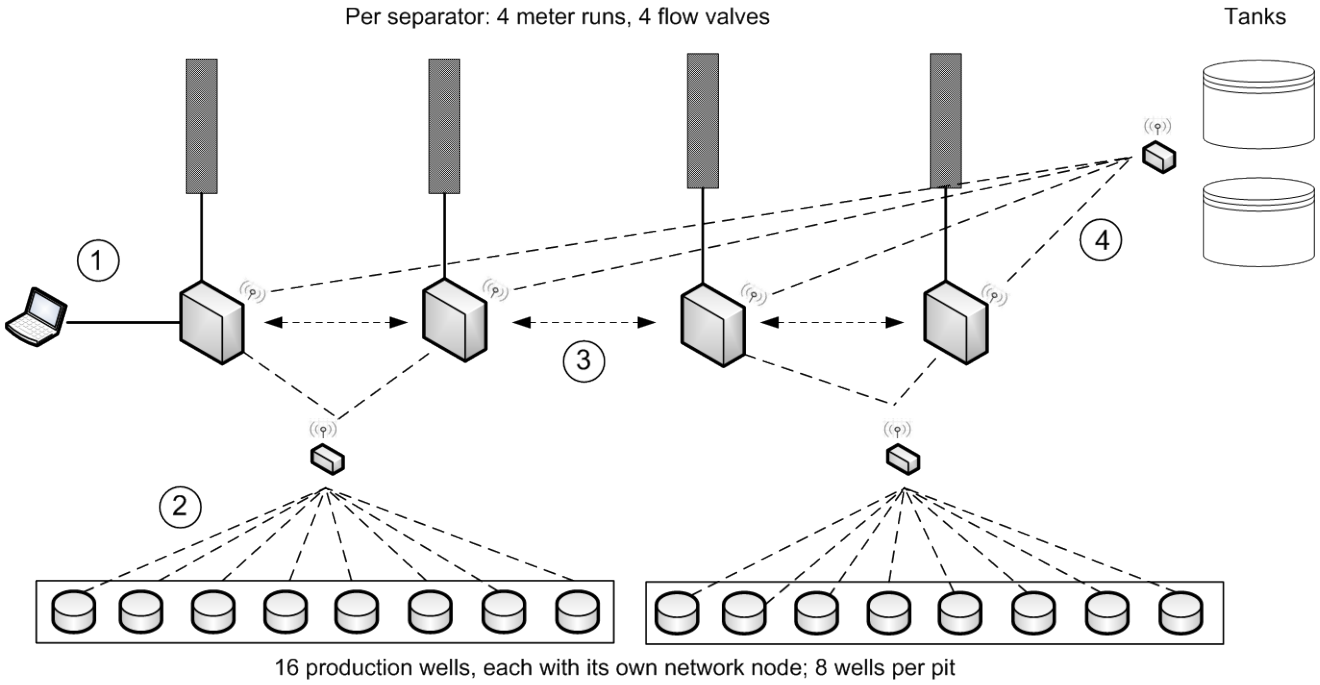


1 Network access point (NAP)
2 Many-to-one data flow
3 Peer-to-peer network
4 One-to-many data flow

Figure 2-1. 21-Node Network: Multi-well Pad with One Node per Well

2.1.3 Example: Multi-well Pad with One Node per Eight Wells

Figure 2-2 shows the same physical well pad as in *Figure 2-1* but structured as a 7-node network. In this case a node acquires data from eight wells (grouped as a pit). Each node then communicates with two RTUs.



1 Network access point (NAP)
2 Many-to-one data flow
3 Peer-to-peer network
4 One-to-many data flow

Figure 2-2. 7-Node Network: Multi-well Pad with One Node per Eight Wells

2.1.4 System Security

You want a SCADA system to transparently access all the nodes in your network. Alternately, you may want to restrict access if technicians need to service individual nodes. The Distributed RTU Network can provide both the transparency and the restrictions you require, and you can change these settings as your requirements change. *Figure 2-3* presents a simple usage scenario.

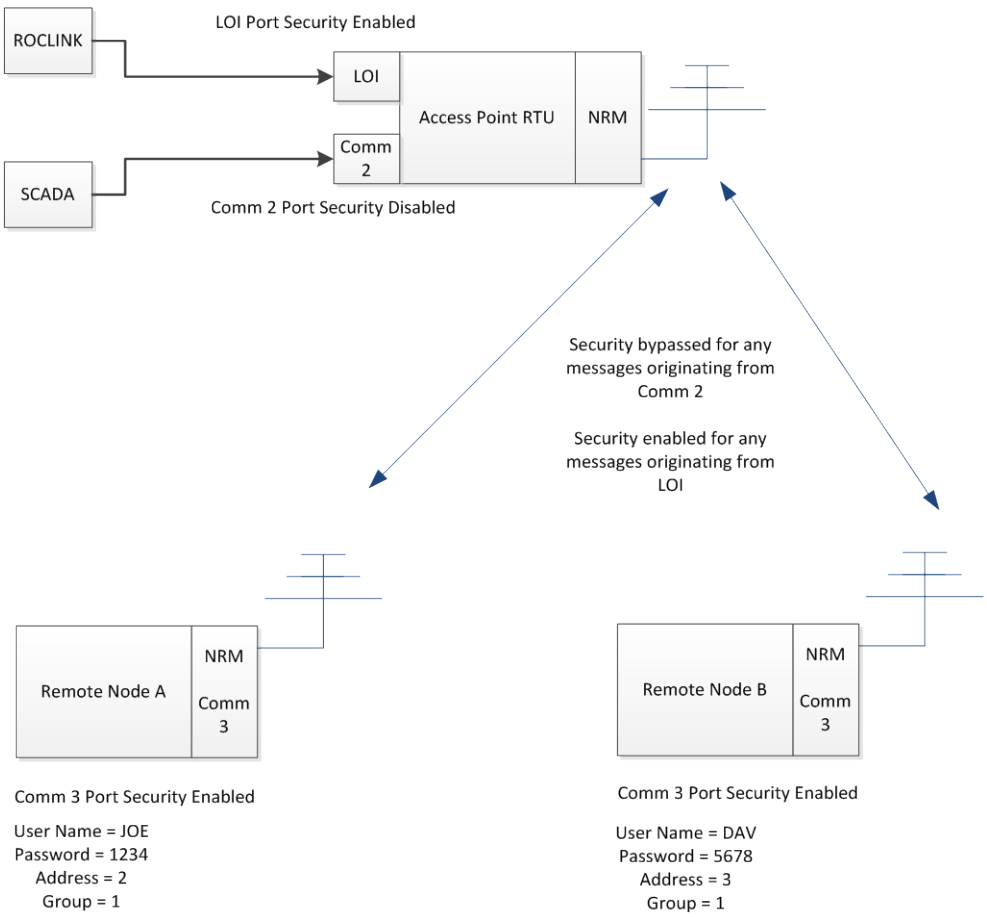


Figure 2-3. DRN Security

In this scenario, the SCADA system uses the Comm2 port, for which security has been disabled. Any messages from Comm2 pass immediately to the nodes and vice versa.

On the other hand, a technician connects to the NAP using the LOI, for which User ID level-security has been enabled. Similar, each node **also** has User ID level-security enabled. For Node A, the correct User ID/password is **JOE/1234**. For Node B, the correct User ID/password is **DAV/5678**.

This arrangement permits technician JOE (using the “Connect to Device” option) to log onto Node A with secure over-the-air access. If JOE tries to access Node B using JOE/1234, Node B rejects the attempt. Only technician DAV using password 5678 can successfully access Node B.

Note: Remember that the position of the NRM dictates the comm port used. Placing the NRM in slot 1 of the FB107 activates Comm3; placing the NRM in slot 2 activates Comm2. This example assumes the NRM is placed in slot 1 of the nodes.

Defining Access

You define these communication port-based security settings using the Device Security screen in ROCLINK 800.

Select **ROC** > **Security** on the ROCLINK toolbar to display the Device Security screen:

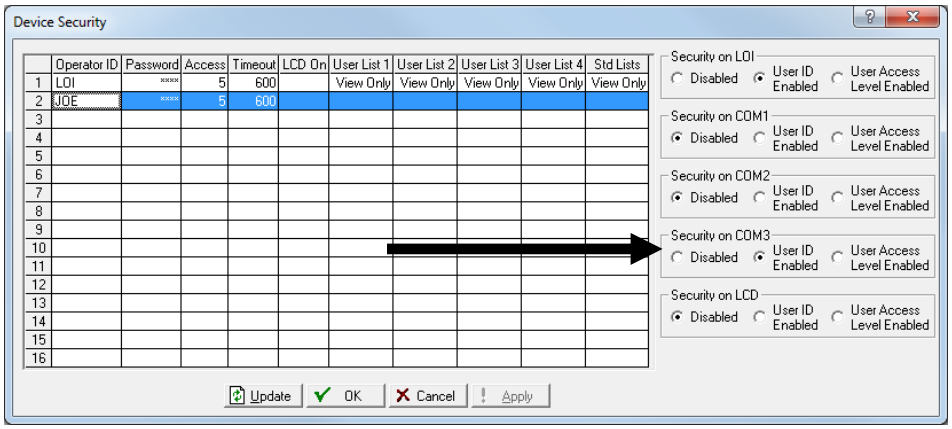


Figure 2-4. Device Security (FB107)

Select the **User ID Enabled** option for the appropriate communication s port, define the technician's ID and password, and click **Apply**.

2.2 Configuring Nodes

Once you have determined the size of your DRN, assemble your nodes. You need to configure each node individually with four pieces of network-specific information: Network ID, Channel, Radio Transmit Power, and whether the node is a network access point.

Note: Although you can field-configure nodes, it may be easier to perform the configuration on a bench or other protected location.

To configure a node, you need a PC running ROCLINK 800 (Version 2.10 or higher). Connect to the node using the LOI port and start ROCLINK. Once ROCLINK starts, click on the Network Radio module to display the NRM configuration screens. Select the **Network** tab to display the network configuration values:

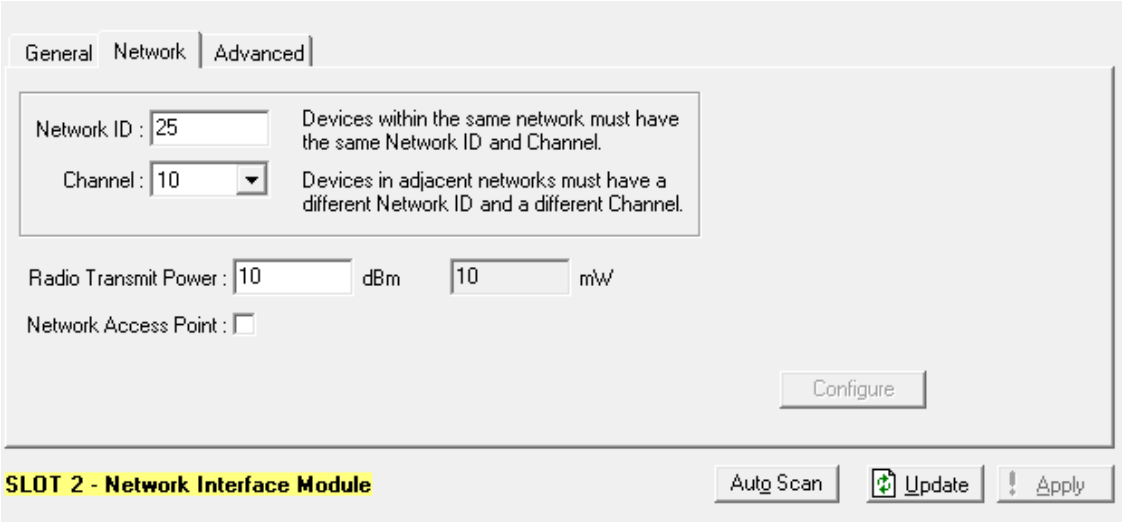


Figure 2-5. Node Configuration Screen

Complete the following fields:

Field	Description
Network ID	Enter a valid Network ID (between 0 and 255). The network ID identifies all the devices (nodes and network access point) belonging to that network, so all devices on a network must have the same network ID.
Channel	Enter a valid channel (between 0 and 14). As with the network ID, all devices belonging to the same network must have the same channel.
Radio Transmit Power	Indicates, in decibels of measured power, the relative strength of the radio signal for this node. Although all nodes in a network typically have the same value for this field, you can adjust this value to “boost” the signal for nodes in more remote or less-than-optimal situations. The system calculates the draw in mW and completes this field based on the value you enter. **Note**: The higher the value in this field, the more power the node draws from its battery when it transmits data.
Network Access Point	Leave this check box blank for nodes.
Configure	Click to apply the indicated values to the node.

Duplicating Node Configurations

If you have a number of nodes in the same network to configure, you can define one node, copy the .800 configuration file from that node, and then install that file into other nodes.

To mass-configure nodes:

1. Connect to the node containing the configuration you want to copy.
2. Select **File** > **Save Configuration** from the ROCLINK menu.

3. Save the .800 file. (Use a filename such as “Node_Config” to uniquely identify the .800 file.)
4. Attach to the LOI port on the next node.
5. Select **File** > **Download** and select the name of the .800 file from step 2.
6. Click **Open**. ROCLINK copies the indicated configuration file into the new node.
7. Repeat until all nodes are configured.

Device Group and Address

All devices in a Distributed RTU Network **must** belong to the same group. Additionally each device in a network **must** have its own unique address. (Essentially, the group number identifies the network “family,” while the address is the individual device’s “given” name.)

Station Name

The station name is a unique name for the selected device. The station name (sometimes referred to as the “device tag”) appears in many places on the RTU Network screens. It is a good practice to assign a unique name for each device to help differentiate the devices on your network.

To check the group, address, and station name for a device, select **ROC** > **Information** from the ROCLINK 800 menu bar. The Device Information screen displays.

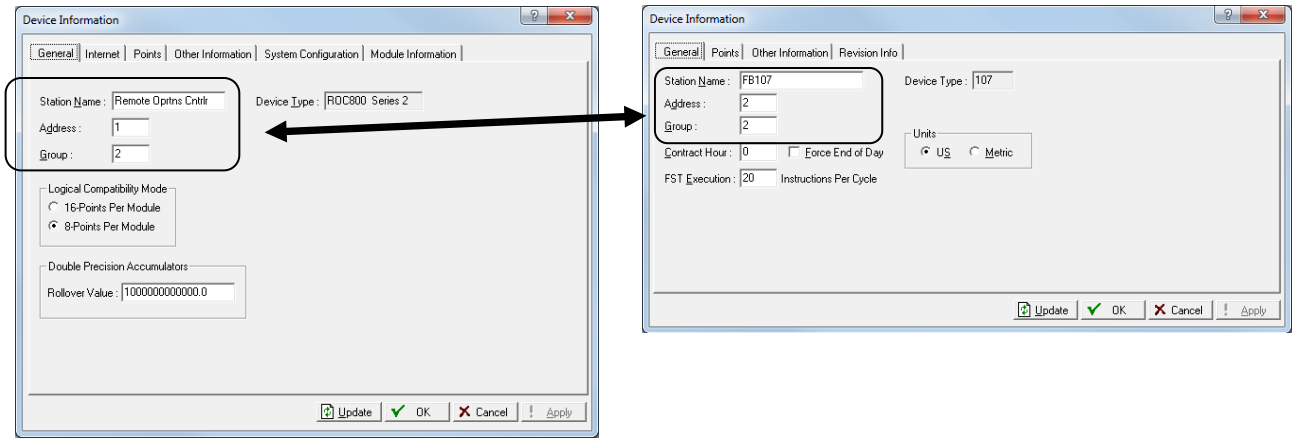


Figure 2-6. Device Information Screen (ROC800 and FB107)

2.2.1 Configuring a ROC800 or FB107 as a Node

If required for your organization’s data needs, you can install a Network Radio module in a ROC800 or FB107 already in the field and define that ROC800 or FB107 as a node in a network.

Note: You must install the NRM in a **communications** slot on the ROC800 (slot 1, 2, or 3) or FB107 (slot 1 or 2).

Connect a laptop to the LOI port on the ROC800 or FB107 and start ROCLINK 800. Click on the image of the NRM to begin the

configuration process. As shown in *Figure 2-3*, use the **Network** tab for a FB107. For a ROC800, the configuration information appears on the **Module/Network** tab.

Provide the same information (Network ID, channel, and Radio Transmit Power) as for any other node on the same network. Click **Apply** to save the network configuration values to the NRM.

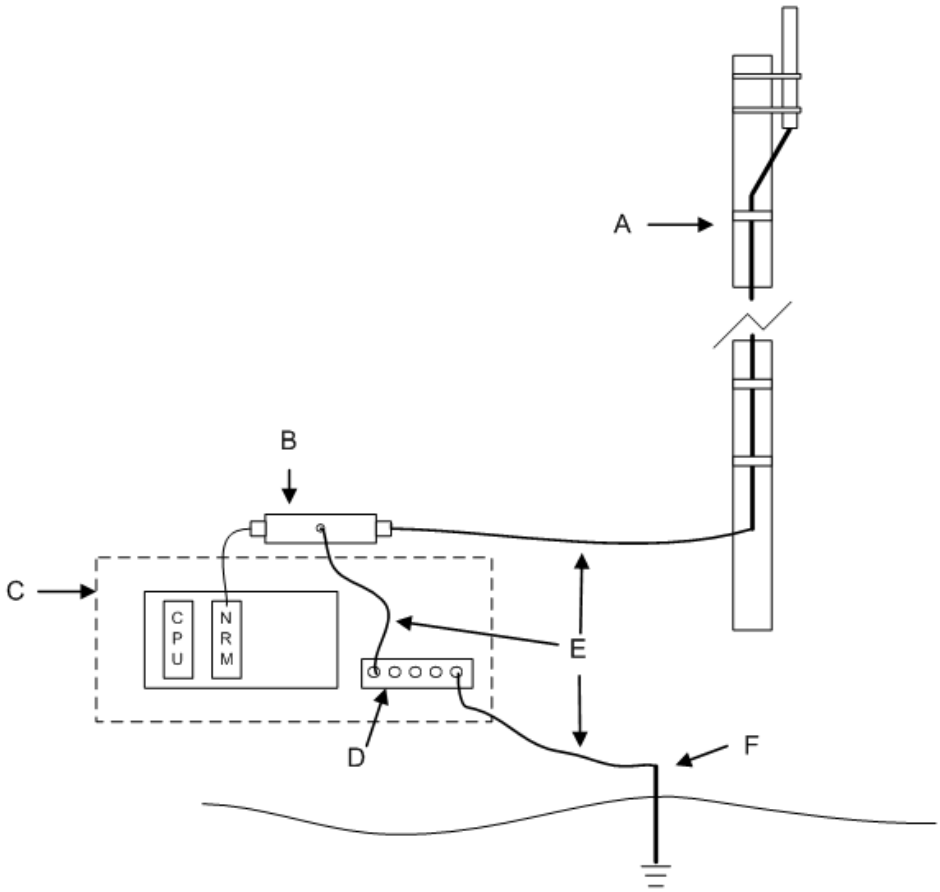
2.3 Field Installation

Once you have configured all nodes, you can perform the field installation. Refer to the site map you have prepared indicating the location of all nodes, as well as power requirements (DC, battery, or solar panels).

Bench-configure the individual nodes with ROCLINK 800, identifying the Network ID, Channel, Radio Transmit Power, and yes/no to Network Access Point. Attach to the LOI port on node, start ROCLINK 800, and access the Module/Network tab.

2.3.1 Grounding Considerations

Grounding any electronic device is essential to successful operation. Ensure that the field installation of your Distributed RTU Network components addresses and manages any potential electrical discharges (as shown in *Figure 2-7*).



A	Antenna mast assembly
B	Surge protection device
C	Customer-provided weatherproof enclosure for Distributed RTU Network
D	Grounding bar
E	Heavy-gauge solid wire
F	Earth grounding method

Figure 2-7. A Grounding System

Caution **Ensure a secure, low-impedence electrical connection between the surge protector, the housing, the grounding bar, and the earth grounding method.**

For further information on grounding guidelines, refer to:

- *Standards and Guidelines for Communications Sites*, Motorola Publication 68F81089E50-B, Motorola, Inc., 1995

  Note: This publication is also known as the "R56 manual."

- *Lightning Protection & Grounding Solutions for Communications Sites*, Ken R. Rand, Polyphaser®, 2000

2.4 Calculating Power Requirements

Because you place the Distributed RTU Network in an isolated environment, device autonomy – how long a device can function solely on either battery or solar power – is an essential operational concern.

Caution **Temperature and other environmental conditions can affect how a battery or solar panel functions. Adjust any autonomy requirements and calculations based on site conditions.**

The following table assumes a typical FloBoss 107 Distributed RTU Network bundle: a four-slot FB107 chassis loaded with a Distributed RTU Network CPU (non-isolated with on-board I/O) and a Network Radio module.

Table 2-1. Module Power Information

Slot	Module Description	Base Idle (No Load)	Max Active (Full Load)	Loading Factor	Module Power in mW
0	CPU Non-isolated with I/O	396 mW	476 mW	100%	476
1	Network Radio Module	288 mW	720 mW	100%	720
2	empty	--	--	--	
3	empty	--	--	--	
	Totals	684 mW	1196 mW	100%	1196

Note: If you choose to install additional modules (such as a 6-point I/O module), refer to *Section 3.2, Determining Power Consumption* in *Chapter 3* of the *FloBoss 107 Flow Manager Instruction Manual* (Form A6206) for additional power requirements.

Table 2-2 is the worksheet used to determine power requirements:

Table 2-2. Blank Power Consumption Worksheet

	Power		
	A Field Power (mW)	----	
	B **Total Power**	----	
C	**Voltage**		
	Input Voltage (V dc)	----	
	Current		
	System Current mA	----	
	Communications mA (Average)	----	
	Total Current mA on Power System	----	D
E	**Miscellaneous**		
	Battery Voltage	----	
	Battery Capacity Amp/Hour	----	
	Depth of Discharge	----	
	Available Hours	----	
	Days of Autonomy	----	

A	**Field Power** is sum of the active load values for all modules	
B	**Total Power** is the maximum active load of all modules at all times.	
C	**Voltage** indicates the input voltage of the power source (in this case, typically a 12 Vdc battery)	
D	**Total Current mA on Power System** represents the **Total Power** value (B) divided by the **Voltage** value (C), expressed as mA. **Note**: When applicable, this value would also take into consideration any external current through communications devices.	
E	**Miscellaneous** represents several components:	
	Battery Voltage	A given value from the battery manufacturer
	Battery Capacity	A given value in Amp/Hr from the battery manufacturer
	Depth of Discharge	Maximum percentage of discharge for the battery
	Available Hours	Number of hours the unit can be powered without external charging of the power system. This value is the battery capacity (in Amp/Hrs) divided by the **Total Current mA on Power System** value.
	Days of Autonomy	Available hours divided by 24.

Using the values presented in *Table 2-1*, the completed Power Consumption worksheet looks like *Table 2-3*.

Note: *Table 2-3* assumes a typical FloBoss 107 Distributed RTU Network bundle: a four-slot FB107 chassis loaded with a Distributed RTU Network CPU (non-isolated with on-board I/O) and a Network Radio module.

Table 2-3. Completed Power Consumption Worksheet

Power			
Field Power (mW)	1196	A	
	B **Total Power**		1196
Voltage			
Input Voltage (V dc)	12	C	
Current			
System Current mA	99.7		
Communications mA (Average)	0		
Total Current mA on Power System			99.7 D
Miscellaneous			
Battery Voltage	12 v		
Battery Capacity Amp/Hour	7 x .80 = 5.6		
Depth of Discharge	80%	E	
Available Hours	56.17		
Days of Autonomy	2.34		

A	476 mW + 720 mW = 1196 mW
B	1196 mV
C	12 V
D	1196 / 12 = 99.666667
E	7 Amp/Hr x .80 (depth of discharge) = 5.6 Am/Hr =
	80% (100% - 20% reserve)
	(5.6 / 99.7) x 1000 (conversion from mW to W) = 56.17
	56.17 / 24 = 2.34 days of autonomy

Based on this example, we can expect the Distributed RTU to operate for a little more than two days without supplemental power. Use the worksheet to proactively anticipate and meet your power needs and keep your system operational.

2.5 Using an Enclosure

If you install the Distributed RTU in an enclosure, make sure that you provide sufficient space between the antenna connections on the Network Radio Module and the inside of the enclosure door. If the door impacts the antenna cables or connections, it can damage the module and affect your network's successful operation.

Caution **Provide enough space between the back of the enclosure door and the module's antenna connections and cabling. If necessary, use a right-angle SMA jack to ensure clearance.**

Chapter 3 – Commissioning and Designing

Once you have determined the physical structure of your network and installed the nodes and the Network Access Point (NAP) for your Distributed RTU™ Network (DRN), you can begin the process of adding the network components and determining how data flows through the network. Keep in mind that this network is entirely responsive to your needs: as your requirements change, you can easily change the flow of data between individual nodes and the NAP.

Note: The examples in this section are intended only as illustrations, and come from several different Distributed RTU Networks. The examples are not intended and should not be interpreted to represent the operation of one Distributed RTU Network.

In This Chapter

This chapter describes how you add (or “commission”) nodes to your network and how you design the flow of data throughout the network.

Note: The functions described in this chapter are available **only** through the network access point.

Auto-Discovery

When you configure nodes (described in *Chapter 2*), you provide them with a network ID and a channel. The NAP uses this information to "recognize" any nodes which you may subsequently add to the network.

Once you click **Discover** (on the **Commission** tab), the NAP starts searching for new nodes, which it adds to the Discovered column on that tab (see *Section 3.2, Commissioning*).

Design by Drag-and-Drop

Simplicity and flexibility are hallmarks of the design of the DRN. Selecting the **Design** tab opens a workspace. On the left of that workspace is a device tree representing the nodes defined to the network (based on the network ID and channel).

Click and drag an icon's label from the tree onto the workspace in the right half of the screen. Once an icon is on the workspace, a plus appears on the tree next to the icon's label. Click on the plus sign (+) to display all the inputs and outputs available for the selected device. Once you have two or more device icons on the workspace, you can select inputs and outputs and drag those selections to a device. Arrows help to indicate inputs and outputs (see *Section 3.3, Designing Data Networks*).

Note: Because you tailor the structure of a particular DRN to your geographic site and your reporting requirements, we can only present a simple model of a DRN and use it to explain the processes for commissioning nodes and designing data networks. Consult with your Remote Automation Solutions representative to determine the ideal configuration for your particular site.

Importing and Exporting Values

The **Import-Export Values** tab provides a tabular view of the data relationships for individual devices. You can select a device and quickly see what data you have defined as inputs to the device and what data you have defined as outputs. The **Import-Export List** tab provides a list of the currently defined imports/exports for the entire network. See *Sections 3.4* and *3.5*.

3.1 Displaying Module Information

Note: ROCLINK 800 displays module information differently depending on the device. The FB107 uses a screen with three tabs; the ROC800 uses a screen with four tabs.

3.1.1 Module Information: FB107

When you click the NRM module on the graphic image of the FB107, the tabs in the lower half of the screen change to display the NRM options:

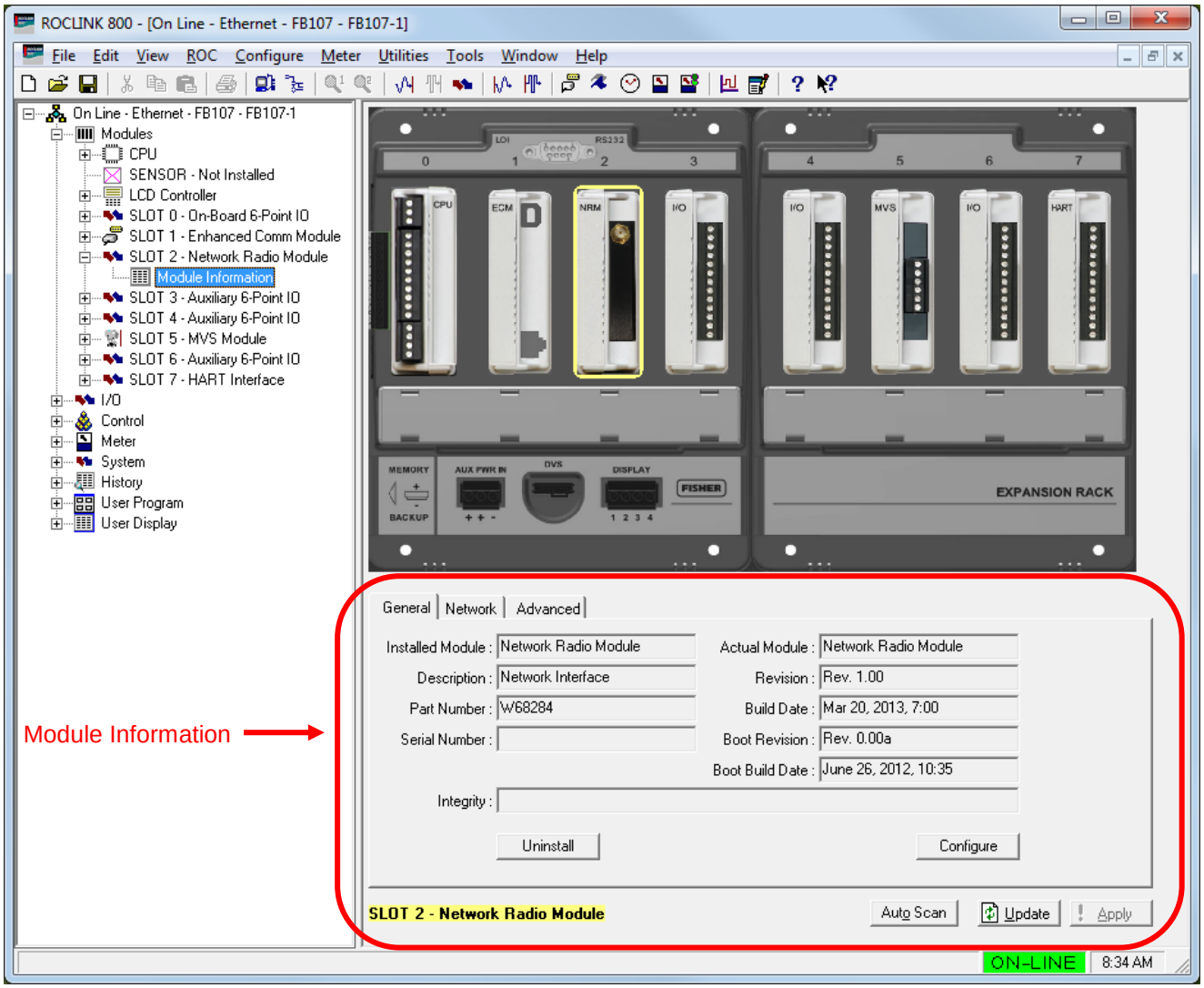


Figure 3-1. FB107 NRM Tabs

Tab	Description
General	Provides **read-only** information about the module, including build date, boot build date, and any module integrity messages. This tab displays when you first click the module.
Network	Defines network-specific settings, such as the Network ID, Channel, Network Size, and Radio Transmit Power.
Advanced	Provides **read-only** information on noise level, radio address, and the current status of the NRM in the network.
Configure	Click to access the RTU Network screen, which you use to commission nodes for the network, design the network and view import/export values for devices on your network.

General Tab

The read-only fields on this tab provide general information about the module.

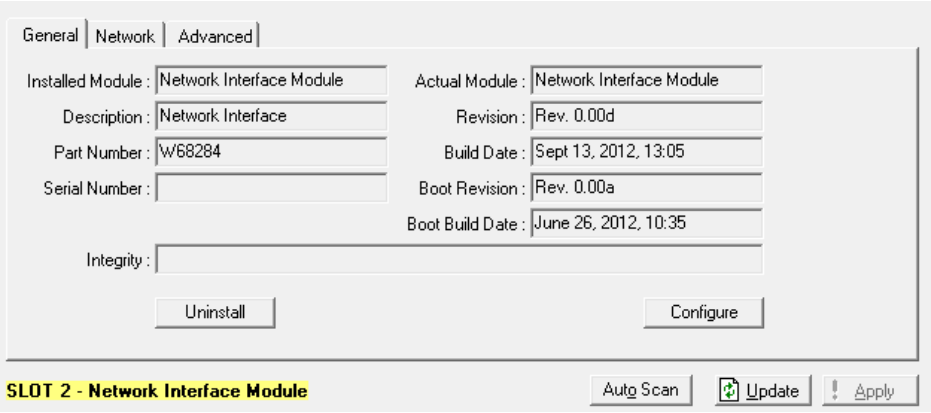


Figure 3-2. FB107 NRM General Tab

Field	Description
Installed Module	This **read-only** field shows the name of the module currently defined for this slot. ROCLINK 800 does not require that a module be physically installed to display.
Actual Module	This **read-only** field shows the name of the module physically installed in the slot.
Description	This **read-only** field shows a 20-character description of the module.
Revision	This **read-only** field shows the firmware revision number for the module currently installed.
Part Number	This **read-only** field shows the part number of the module currently installed.
Build Date	This **read-only** field shows the date the firmware was built for the module currently installed.
Serial Number	This **read-only** field shows the serial number of the module currently installed.
Boot Revision	This **read-only** field shows the version for the main startup (“boot”) firmware in the currently installed module.
Boot Build Date	This **read-only** field shows the build date for the main startup (“boot”) firmware in the currently installed module.
Integrity	This **read-only** field shows a message regarding the status of the currently installed module.
Uninstall	Click to uninstall the currently installed module. The Installed Module field displays the type of module the FB107 is using for point configuration. ROCLINK 800 does not require that the module is physically installed in the FB107 to display. The FB107 “remembers” the type of installed module until you use this button to uninstall it.

Field	Description
Configure	Click to access the RTU Network screen. **Note**: If the FB107 is defined as the network access point (NAP), this button accesses the RTU Network screen and displays all tabs. If the FB107 is defined as a node, this button accesses **only** the Import-Export Values tab on the RTU Network screen.

Network Tab

Use this tab to define operational parameters for your network:

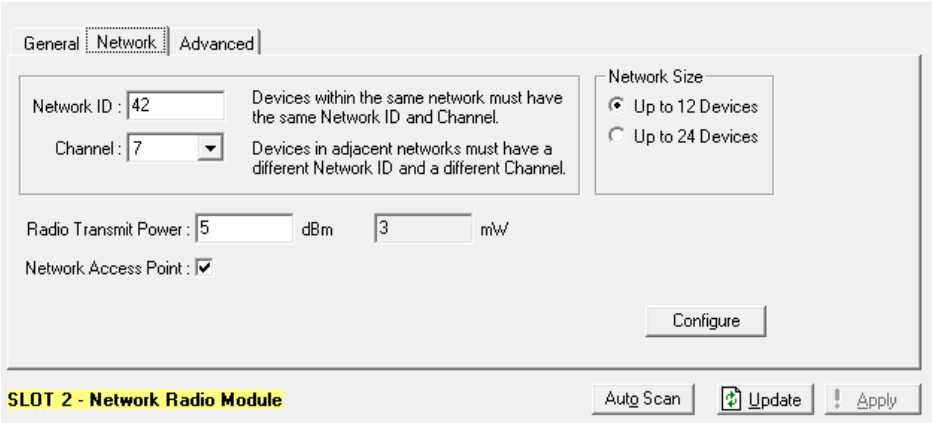


Figure 3-3. FB107 NRM Network Tab

Field	Description
Network ID	Defines the specific ID for this network. Valid values are 1-254. **Do not** use 0 as a network ID: it **turns off** the radio on the module. **Note**: The NAP and **all** nodes on the same network **must** have the same network ID.
Channel	Defines the channel for this network. Click ▼ to display all valid values. **Note**: The NAP and **all** notes on the same network **must** have the same channel number.
Network Size	Defines the total number of nodes in the network. **Note**: This field displays **only** when you configure the device as the NAP.
Radio Transmit Power	Defines, as decibels referenced to one milliwatt, the absolute power assigned to this node for transmission into the network. Valid values are 0-27. The mW field displays the milliwatts of power the selection represents The higher this value, the more power the network requires.

Field	Description
Network Access Point	Select this checkbox to configure this device is the network access point (NAP). Each network can have only one NAP. **Note**: Clear this checkbox to configure this device as a node.
Configure	Click to access the RTU Network screen.

Advanced Tab

The read-only fields on this tab provide additional information about the network.

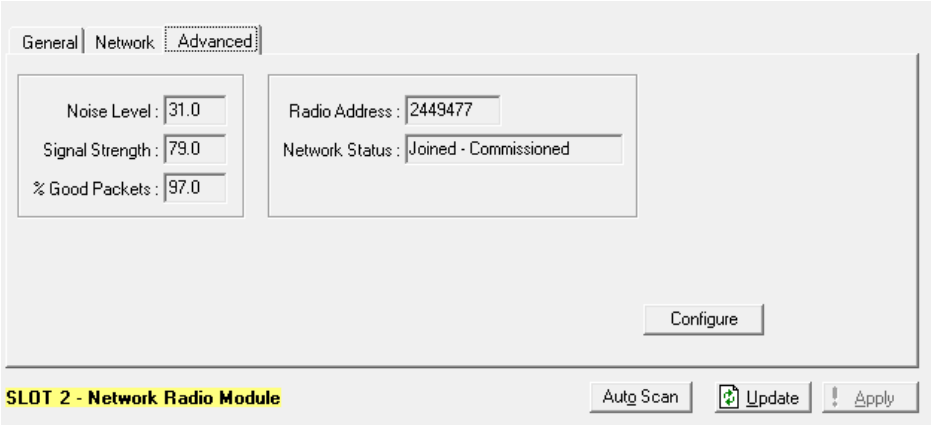


Figure 3-4. FB107 NRM Advanced Tab

Field	Description
Noise Level	This **read-only** field indicates the signal strength of this node based on ambient interference. The lower the noise level, the clearer the signal.
Signal Strength	This **read-only** field indicates the signal strength for the node's radio receiver. Valid values are 0 to 127; the higher the value the stronger the signal. **Note**: This field displays **only** if the device is configured as a node.
% Good Packets	This **read only** field indicates the percentage of good communication packets the node has received since being commissioned. The system continually updates this value as it receives packets. Valid values are 0 to 100. **Note**: This field displays **only** if the device is configured as a node.
Radio Address	This **read-only** field provides the manufacturer-provided 7-digit address associated with the radio on this module.
Network Status	This **read-only** field shows the device's status in the network. Valid values are: **Initializing** — Device is being recognized by the network.

Field	Description	
	Not Joined	Device has been initialized but has not joined the network.
	Joined – Not Commissioned	Device has joined the network but is not yet commissioned
	Joined - Commissioned	Node has joined the network and is commissioned.
Configure	Click to access the RTU Network screen.	

3.1.2 Module Information: ROC800

If you install a NRM in a ROC800, you can configure the ROC800 as either a node or as the NAP, depending on your network requirements. ROCLINK 800 adjusts the number of displayed tabs accordingly.

ROC800 as a Node

Click on the NRM to display the RTU Network screen. The Module/Network tab displays by default. Note that the Import-Export Values tab is the only other tab you can select.

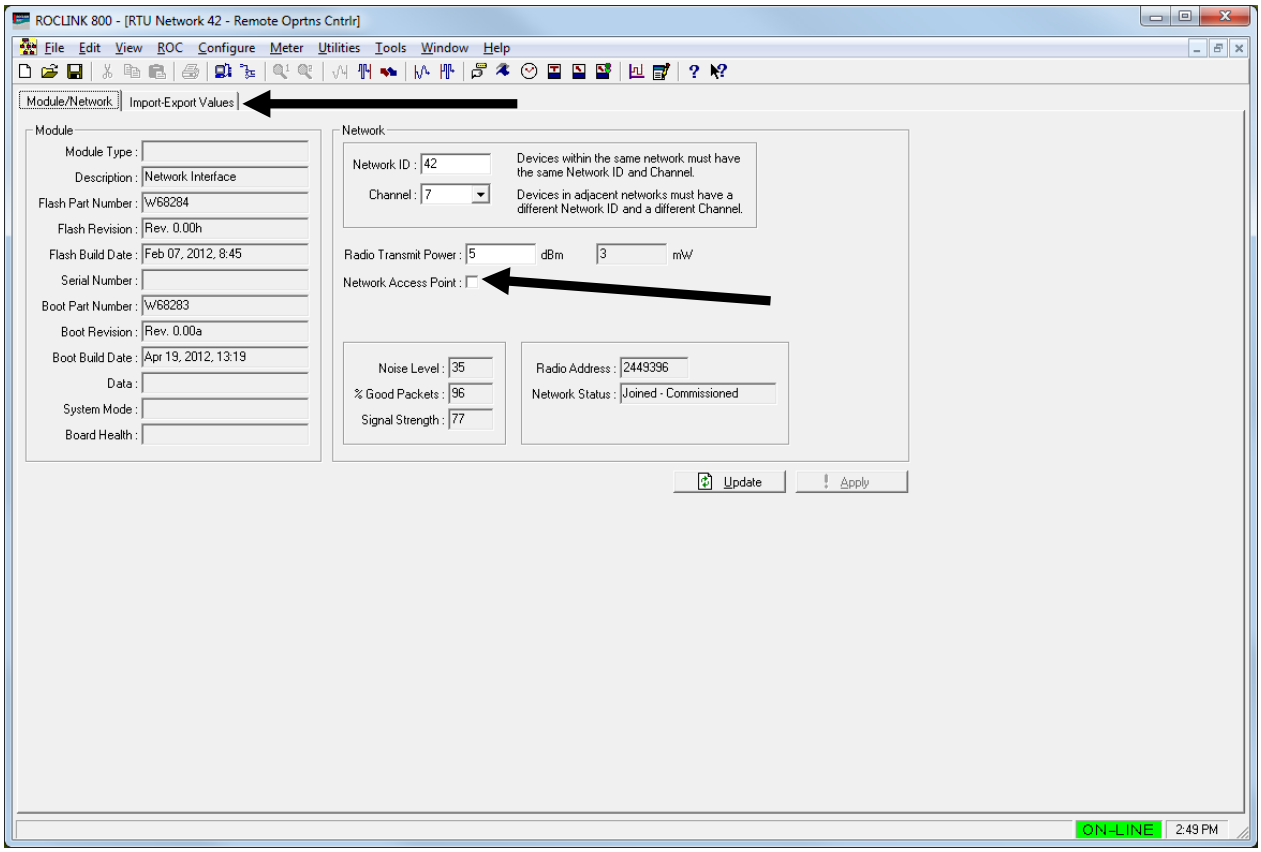


Figure 3-5. ROC800 Module/Network Tab (as a Node)

Field	Description
Module Type	This **read-only** field shows the name of the module currently defined for this slot.

Field	Description	
Description	This **read-only** field shows a 20-character description of the module.	
Flash Part Number	This **read-only** field shows the part number for this module's flash memory.	
Flash Revision	This **read-only** field shows the version of the module's flash memory.	
Flash Build Date	This **read-only** field shows the build date for the module's flash memory	
Serial Number	This **read-only** field shows the serial number for this module.	
Boot Part Number	This **read-only** field shows the part number for the module's boot (start-up) memory.	
Boot Revision	This **read-only** field shows the version of the module's boot memory.	
Boot Build Date	This **read-only** field shows the build date for the module's boot memory.	
Data	This **read-only** field shows any module-specific information.	
System Mode	This **read-only** field shows the module's interaction with the system. Valid values are:	
	Run Mode	Module is functioning correctly and running.
	Boot Mode	Module is updating the startup firmware.
	Module Failure	Module is not functioning correctly, is not running, and communications may have been lost.
Board Health	This **read-only** field shows the module's status. Valid values are:	
	OK	Module is functioning correctly.
	Module Not Installed	Module is not installed.
	Module Failure	Module is not functioning correctly, is not running, and communications may have been lost.
Network ID	Defines the specific ID for this network. Valid values are 1-254. **Do not** use 0 as a network ID: it turns off the radio on the module. **Note**: The NAP and all nodes on the same network **must** have the same network ID.	
Channel	Defines the channel for this network. Click ▼ to display all valid values. **Note**: The NAP and all nodes on the same network **must** have the same channel number.	

Field	Description
Network Size	Defines the total number of nodes in the network. This field displays **only** when the device is the NAP.
Radio Transmit Power	Defines, as decibels referenced to one milliwatt, the absolute power assigned to this node for transmission into the network. Valid values are 0-27. The mW field displays the milliwatts of power the selection represents The higher this value, the more power the network requires.
Network Access Point	Indicates whether this device is the network access point (NAP). Each network can have only **one** NAP.
Noise Level	This **read-only** field shows the signal strength of this node based on ambient interference. The lower the noise level, the clearer the signal.
% Good Packets	This **read-only** field indicates the signal strength for the node's radio receiver. Valid values are 0 to 127; the higher the value the stronger the signal. **Note**: This field displays **only** if the device is configured as a node.
Signal Strength	This **read only** field indicates the percentage of good communication packets the node has received since being commissioned. The system continually updates this value as it receives packets. Valid values are 0 to 100. **Note**: This field displays **only** if the device is configured as a node.
Radio Address	This **read-only** field shows the manufacturer-provided 7-digit radio address associated with the radio installed in this module.
Network Status	This **read-only** field shows the device's status in the network. Valid values are: **Initializing** — Device is being recognized by the network. **Not Joined** — Device has been initialized but has not joined the network. **Joined – Not Commissioned** — Device has joined the network but is not yet commissioned **Joined - Commissioned** — Node has joined the network and is commissioned.
Update	Click to save any changed information to the configuration.

ROC800 as a NAP Click on the NRM to display the RTU Network screen. The Module/Network tab displays by default. A full set of tabs is now available for selection, indicating that the ROC800 is configured as the NAP.

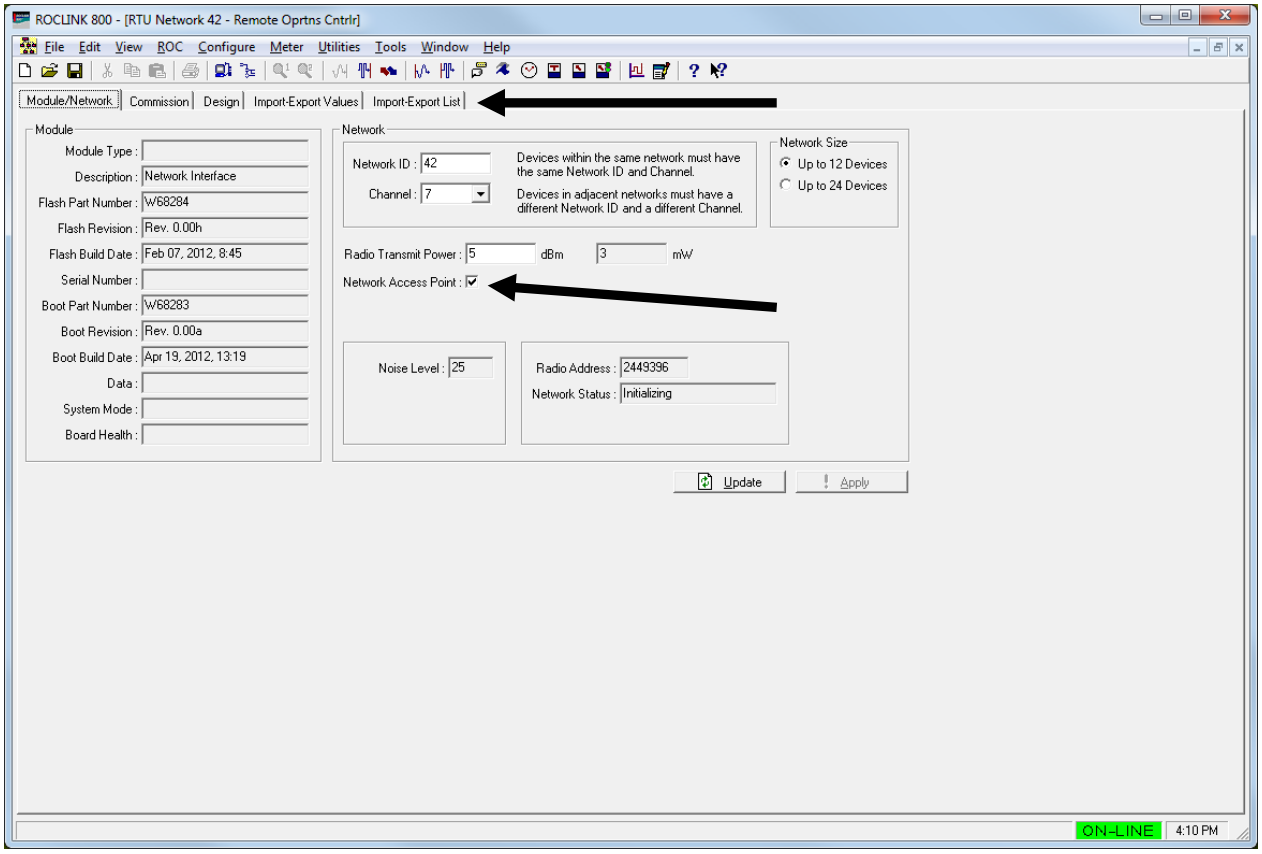


Figure 3-6. ROC800 Module/Network Tab (as the NAP)

Note: The remaining tabs – Commission, Design, Import-Export Values, and Import-Export List – are identical for either the ROC800 or FB107.

3.2 Commissioning

Use the Commission tab to commission and decommission devices on your data network and to enable pass-through functionality on a per-device basis.

Once you have determined the physical structure of your network and installed the nodes and the Network Access Point (NAP) for your Distributed RTU Network (DRN), you can begin the process of adding the network components and determining how data flows through the network. Keep in mind that this network is entirely responsive to your needs: as your requirements change, you can easily change the flow of data between individual notes and the NAP.

Note: This screen is available **only** through the Network Access Point, If your network access point is a FB107, click **Configure** and then select the **Commission** tab to access this screen. If your network access point is a ROC800, select the **Commission** tab.

When you first access this screen after defining the values for your NAP, the Discovered column should be empty and the Commissioned column should list only the NAP:

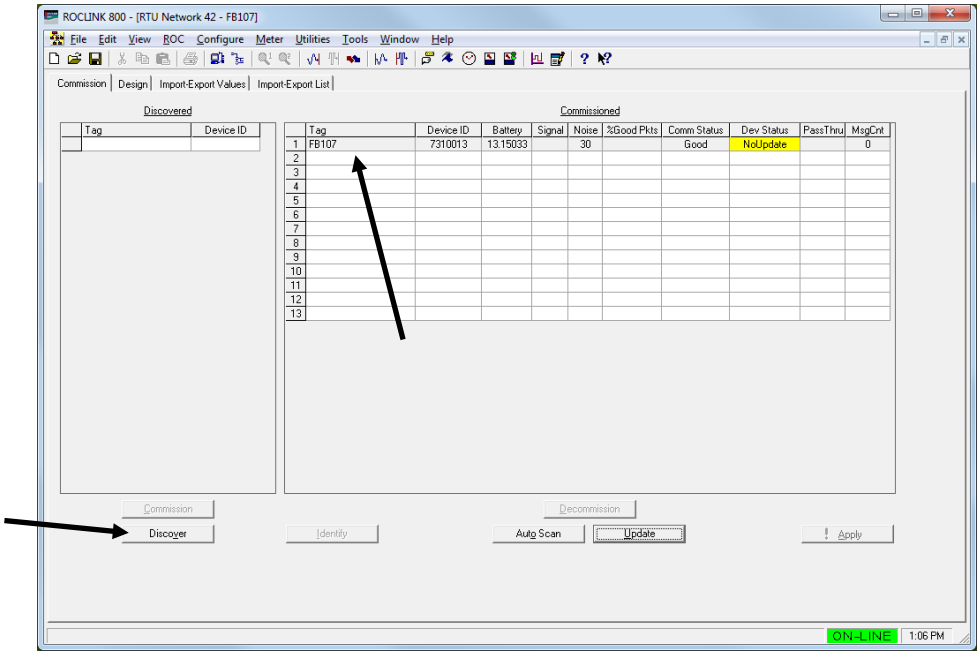


Figure 3-7. Undiscovered Network

Commissioning nodes into the network is a two-step process: *discovering* the nodes and then *commissioning* them. You cannot commission any node until the network access point has first discovered it.

Note: The network access point automatically displays in the Commissioned list, but is grayed out (see *Figure 3-7*). This prevents you from accidentally deleting or decommissioning the NAP.

3.2.1 Discovering Nodes

You must first discover the odes on your network before you begin designing the network.

To start the node discovery process, click **Discover** (see *Figure 3-7*). As the NAP “recognizes” nodes (based on the Network ID and Channel values you assigned them), it adds them to the Discovered list on the left side of the window. A display monitors the progress of the discovery process (see *Figure 3-8*).

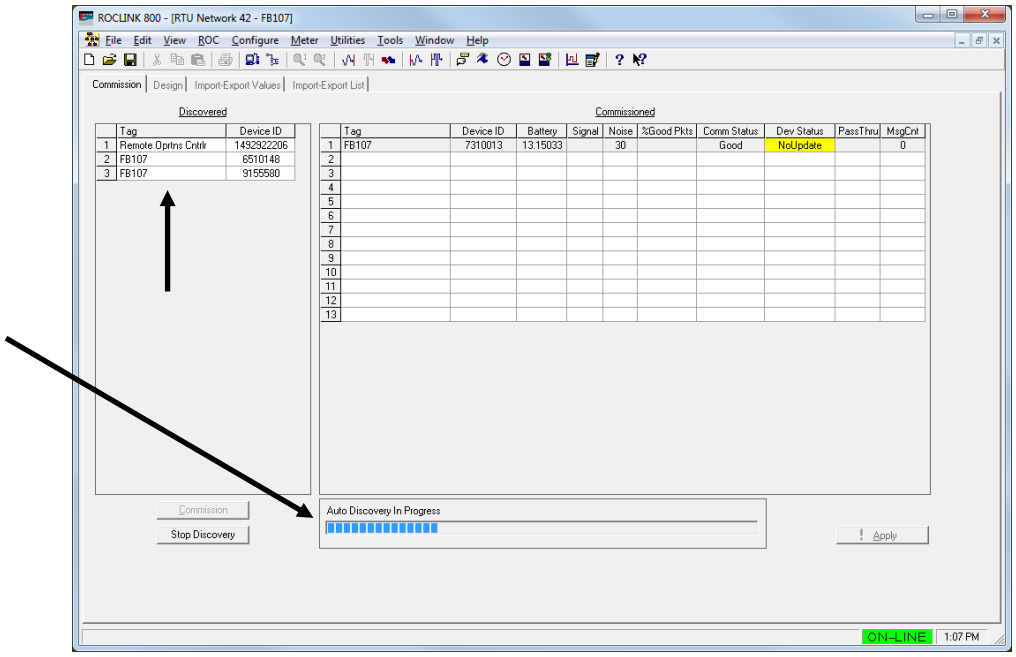


Figure 3-8. Discovering Nodes (in Progress)

You can wait for the discovery process to finish or click **Stop Discovery** once the discovery process has identified all the nodes in the network. As *Figure 3-9* shows, the program has discovered the nodes in this simple network and is ready to commission them.

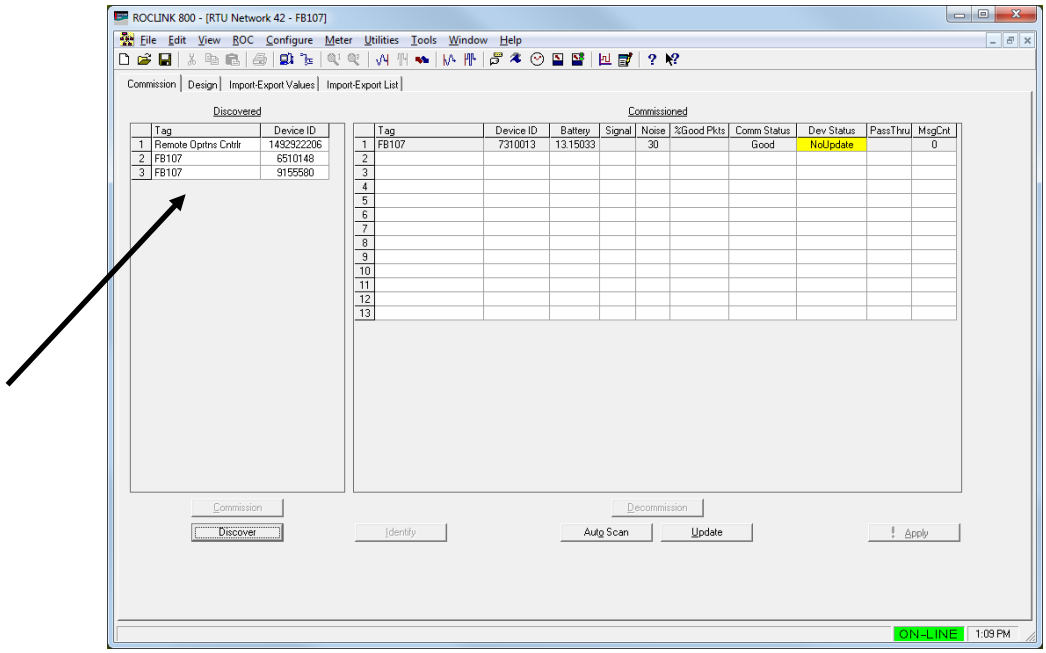


Figure 3-9. Discovering Nodes (Completed)

3.2.2 Commissioning Nodes

The commissioning utility enables you to select one or more devices to commission at a time.

1. Left-click a device to select it. To select multiple devices, press CTRL and left-click each device. If you are commissioning more than one device, your screen might look like *Figure 3-10*.

Note: You can also commission devices if you click and drag the device names from the Discovered list to the Commissioned list.

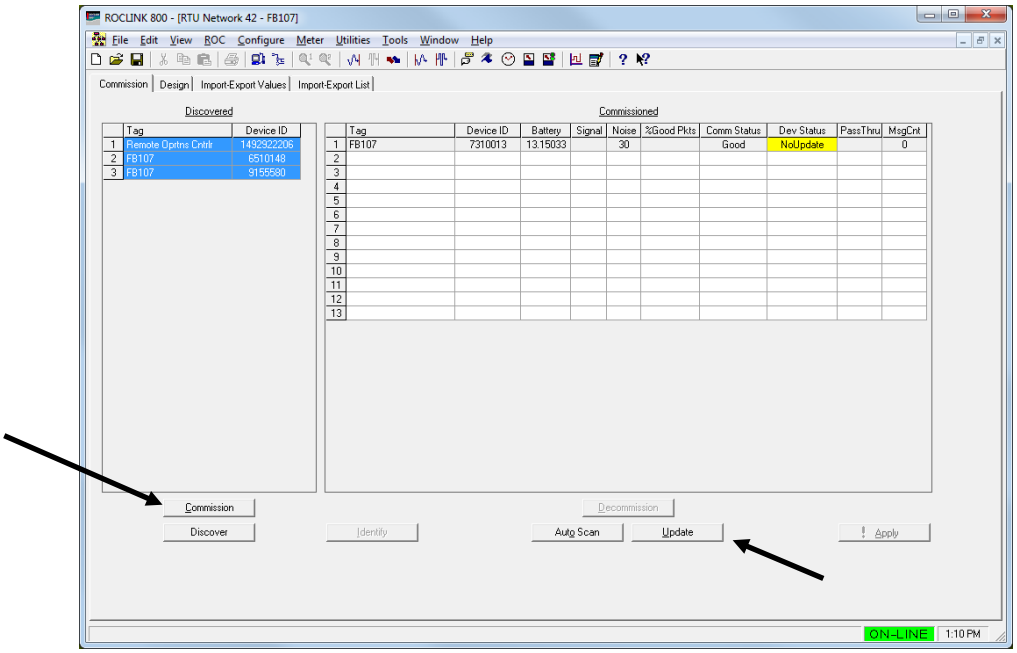


Figure 3-10. Nodes Selected for Commissioning

2. When you select one or more devices, the Commission button activates. Click it to start the commissioning process. Depending on the size of your network, this could take several minutes.

Note: The values in the Comm Status column should automatically change to indicate the commissioned status of the nodes. After several minutes you may want to click **Update** to manually update the status.

When the nodes are commissioned, the screen may look like *Figure 3-11*:

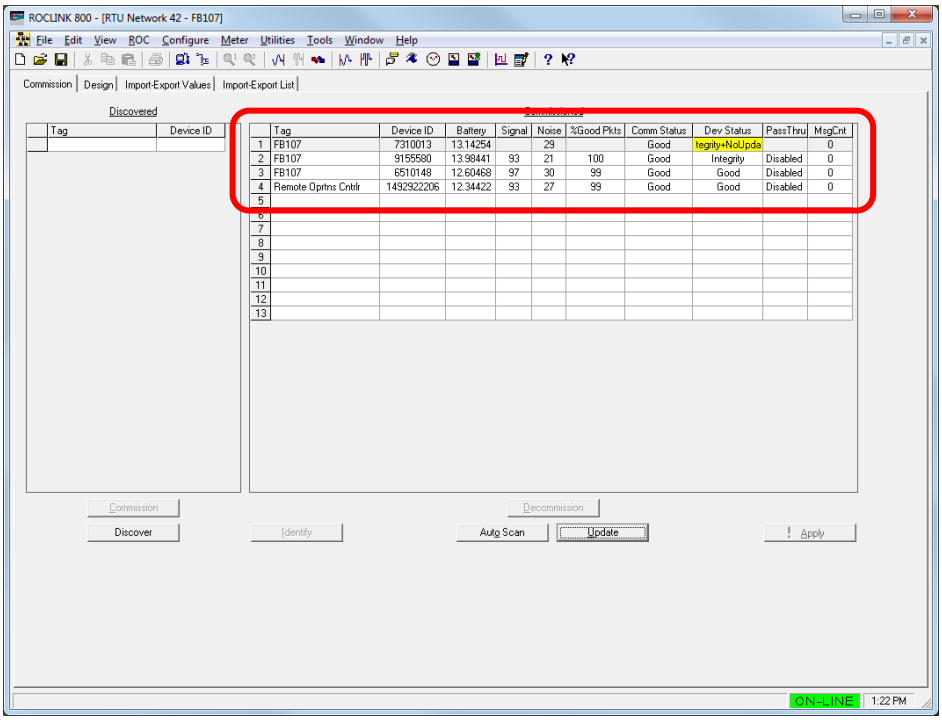


Figure 3-11. Nodes Commissioned

Field Values

Once you commission nodes, the individual **read-only** fields on this screen contain values and are easier to describe.

Field	Description	
Discovered	Table lists nodes that the NAP has discovered but which have not been commissioned. Fields include:	
	Tag	This **read-only** field shows the device in which the NRM is installed. This is the device's Station Name, as defined on the Device Information screen (**ROC** > **Information**).
	Device ID	This **read-only** field shows a manufacturer-provided identification code for the NRM.
Commissioned	Table lists devices that are currently commissioned on the network. Fields include:	
	Tag	This **read-only** field shows the device in which the NRM is installed. This is the device's Station Name, as defined on the Device Information screen (**ROC** > **Information**).
	Device ID	This **read-only** field shows a manufacturer-provided identification code for the NRM.
	Battery	This **read-only** field shows the current battery voltage for the node.

Field	Description	
	Signal	This **read-only** field shows the signal strength for the node's radio receiver. Valid values are 0 to 127; the higher the value the stronger the signal. **Note**: As a diagnostic tool, the system color-codes this field. Yellow indicates marginal signal strength values (16-30) and red indicates poor signal strength values (0-15).
	Noise	This **read-only** field shows the noise strength for the node's radio receiver. Valid values are 0 to 127; the higher the value the greater the noise. **Note**: As a diagnostic tool, the system color-codes this field. Yellow indicates marginal noise values (31-40) and red indicates unacceptable noise values (41-127).
	%Good Pkts	This **read-only** field shows the percentage of good communication packets the node has received since being commissioned. The system continually updates this value as it receives packets. Valid values are 0 to 100.
	Comm Status	This **read-only** field shows the device's current communication status. Valid values are:
	Good	The device is currently communicating on the network.
	Commissioning	The device is currently being commissioned on the network.
	Comm Fail	The device is currently not communicating with the network. **Note**: As a diagnostic tool, the system color-codes this field. Red indicates an unacceptable status (Comm Fail) which you must resolve.
	Dev Status	This **read-only** field shows the device's status. Valid values are Good, Integrity (some error exists with the I/O on the module), or Fault (an error exists with the communications on the module).

Field	Description		
		Good	The device is not reporting any errors.
		Integrity	An error exists on the device.
		Fault	An error exists with the communications with the device.
		No Update	One or more of the configured imports has failed to update during the previous 10 seconds. **Note**: As a diagnostic tool, the system color-codes this field. Yellow indicates a No Update condition.
	PassThru	ndicates how the NAP handles requests from a SCADA system to nodes in its network. Click ▼ (which displays when you mouse over the right end of the field) to select a value. Valid values are **Enabled** (the NAP passes SCADA requests through to individual nodes) or **Disabled** (the NAP **does not** pass SCADA requests it receives to nodes in its network, although individual nodes can respond directly to SCADA requests). The default is **Disabled**. **Note**: Refer to *Section 1.4, SCADA Systems and the Distributed Network*, for more information.	
	MsgCnt	This **read-only** field shows the number of pass-through messages sent to the selected device.	
Commission	Click to add the nodes selected in the Discovered list to the network.		
Discover/Stop Discovery	Click to begin the node discovery process. As the NAP “recognizes” nodes (based on the Network ID and Channel values you assigned them), it adds them to the Discovered list on the left side of the window. A display monitors the progress of the discovery process. Click **Stop Discovery** to end the discovery process.		

Field	Description
Identify/Stop Identifying	Click to cause the NRM's LEDs to repeatedly flash on the device selected in the Decommissioned or Commissioned lists. This is useful in identifying a device if the tag and device ID are unclear. The module's LEDs continue to flash until you click **Stop Identifying**.
Decommission	Click to remove the node selected in the Commissioned list from the network.
Auto Scan	Click to automatically request values from the hardware. Click **Stop Scan** to end automatic scanning.
Update	Click to update the contents of the active window from the device.

Once you have commissioned devices, you can begin creating the data network. Proceed to *Section 3.3, Designing Data Networks*.

3.2.3 Color Coding (Commissioned Table)

The Commissioned table uses color-coding to help you quickly diagnose and resolve potential problems with individual network nodes. Yellow indicates a marginal condition; red indicates a situation requiring resolution.

As the example screen in *Figure 3-12* shows, the third node has experienced a communications failure, while the noise levels for the first and third nodes may need to be addressed to ensure consistent signal strength.

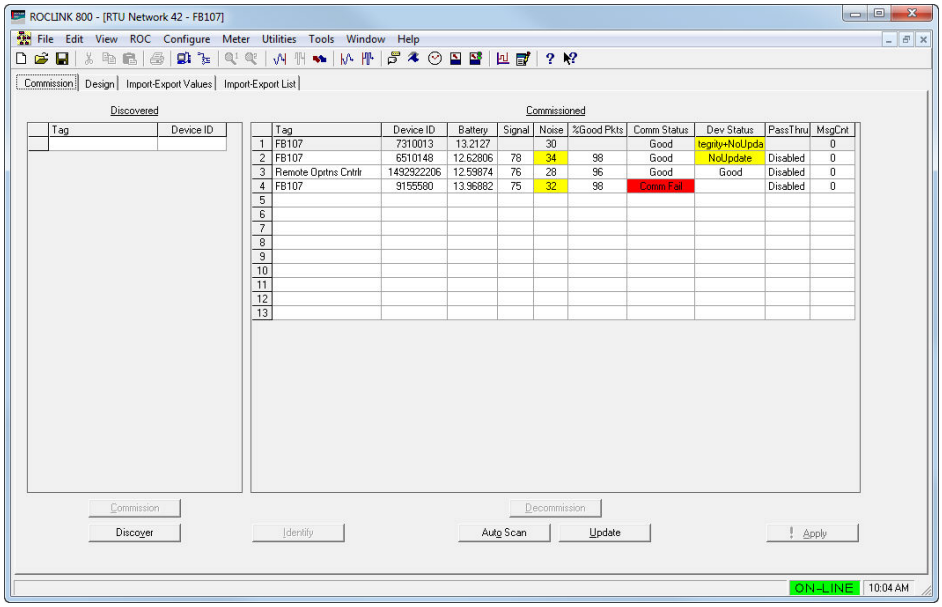


Figure 3-12. Color Coding Error Conditions

The following table correlates fields and their color values:

Field	Color Description
Signal	Yellow indicates marginal signal strength values (16-30); red indicates poor signal strength (0-15).
Noise	Yellow indicates marginal noise values (31-40); red indicates unacceptable noise values (41-127).
Comm Status	Red indicates an acceptable status (Comm Fail) which you must resolve.
Dev Status	Yellow indicates a No Update condition (one or more of the configured imports has failed to update during the previous 10 seconds).

3.2.4 De-commissioning Nodes

Occasionally you may need to decommission a node. This might be required if a node fails for some reason or if you need to reconfigure the physical location of one or more nodes.

Caution **ALWAYS assume that any node is part of an established data network. Document the node's import and export values so that you can restore – if necessary – that node's functions in the network. If you are removing a node, you may need to redefine value imports and exports from other nodes to maintain the data flow. Carefully consider all aspects of the data network BEFORE you decommission a node.**

1. To decommission a node, select it and click **Decommission**.

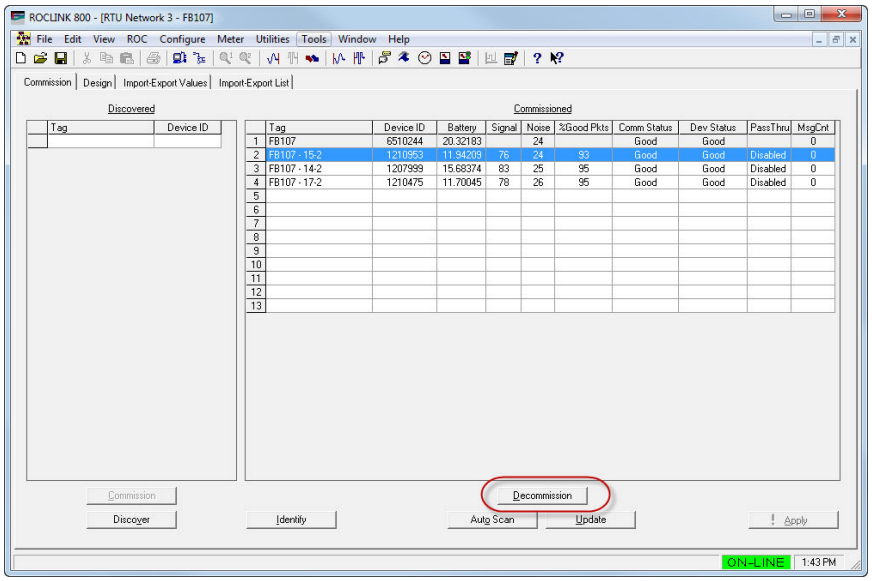
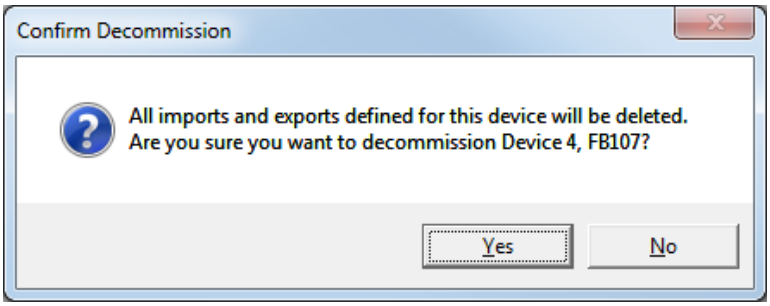


Figure 3-13. Node Selected for Decommissioning

The system displays a warning dialog.



2. Click **Yes** to continue. The system removes the node from both the Commissioned list and the design workspace.

Note: As a result of the decommissioning, the system adds asterisks to the labels for **all** devices on the design workspace, indicating that you should click **Download Changes** to preserve the new network configuration. See *Section 3.3.7, Saving a Network Configuration*.

3.2.5 Re-commissioning Nodes

Infrequently you may need to replace a non-operating or defective node. First you must configure the new node (setting its network ID, channel, and radio transmit power definitions for a typical node in the network) and then physically replace the defective node in the field. You then use ROCLINK 800 to decommission, discover, commission, and then download the import and export values for that node.

1. Access the network
   Start a ROCLINK 800 session and access the network through the NAP.
2. Discover the node
   Click **Discover** on the Commission screen to locate the new node.
3. Commission the node
   Drag the newly discovered node onto the Commissioned table and place it **on top of** the listing for the defective node. This tells the system that you want the newly discovered node to assume the network characteristics of the defective node. This also decommissions the defective node. Click **Update** to apply the old node's value to the new node.
4. Download the device configuration
   Access the design workspace. Right-click the defective node's label on the device tree and select **Download Device Configuration**. This sends the import and export values for the old node into the new node.
5. Download the network configuration
   Click **Download Changes** to save your changes to the NCF and download the changes to all affected devices in the network.

3.2.6 Duplicating Node Configurations

If you have a number of nodes to configure in the same network, you can define one node, copy the .800 configuration file from node, and then install that file into other nodes.

To mass-configure nodes:

1. Connect to the node having the configuration you want to copy.
2. Select **File** > **Save Configuration** from the ROCLINK menu.
3. Save the .800 file (use a filename such as “Node_Config” to uniquely and easily identify the .800 file).
4. Attach to the LOI port on the next node.
5. Select **File** > **Download** and select the name of the .800 file from step 3.
6. Click **Open**. ROCLINK opens the Download Configuration screen.

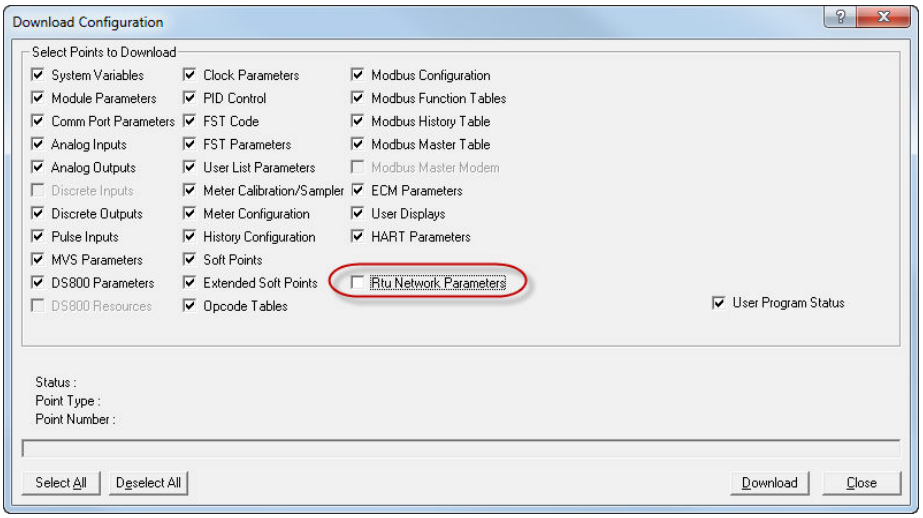


Figure 3-14. Download Configuration Screen

7. Select the configuration points to download to the new device, but **do not** download the RTU Network Parameters.

Caution **Do not download the RTU Network Parameters when duplicating nodes. Downloading these parameters creates errors on the network.**

8. Click **Download**. ROCLINK copies the indicated configuration file into the new node.
9. Repeat until all nodes are configured.

Note: Each node **must** have a unique address and station name. For more information, refer to *Section 2.2, Configuring Nodes*.

3.3 Designing Data Networks

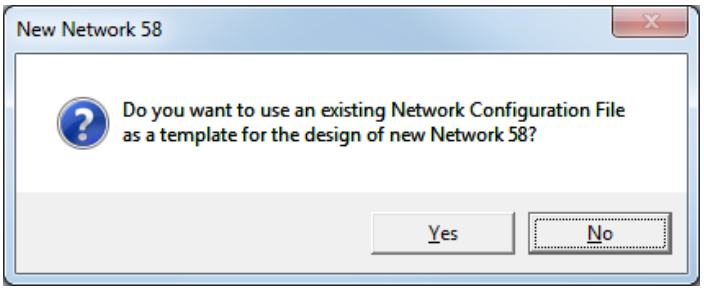
Once you have commissioned nodes, you are ready to begin designing data networks.

Note: This section uses a very simple network, presented to show the principles and process of design.

1. Select the **Design** tab to display the design workspace (see *Figure 3-15*).

Opening the Design Workspace

The first time you access this tab, ROCLINK 800 displays a dialog asking if you want to use an existing Network Configuration file as a template for your new network configuration.



Click **No** to create a new network configuration file or **Yes** to use an existing NCF as a template. For more information, refer to *Section 3.8, Copying a Configuration File* or *Section 3.9, Creating Configurations Offline*.

The Design Workspace screen is divided in two parts: the left side shows the device tree for the network. The device tree shows all of the devices currently commissioned on the network. The right side shows the design workspace. You use the design workspace to define the data relationships between all of the devices on your network. To design a network, you drag devices and data points from the device tree to the design workspace.

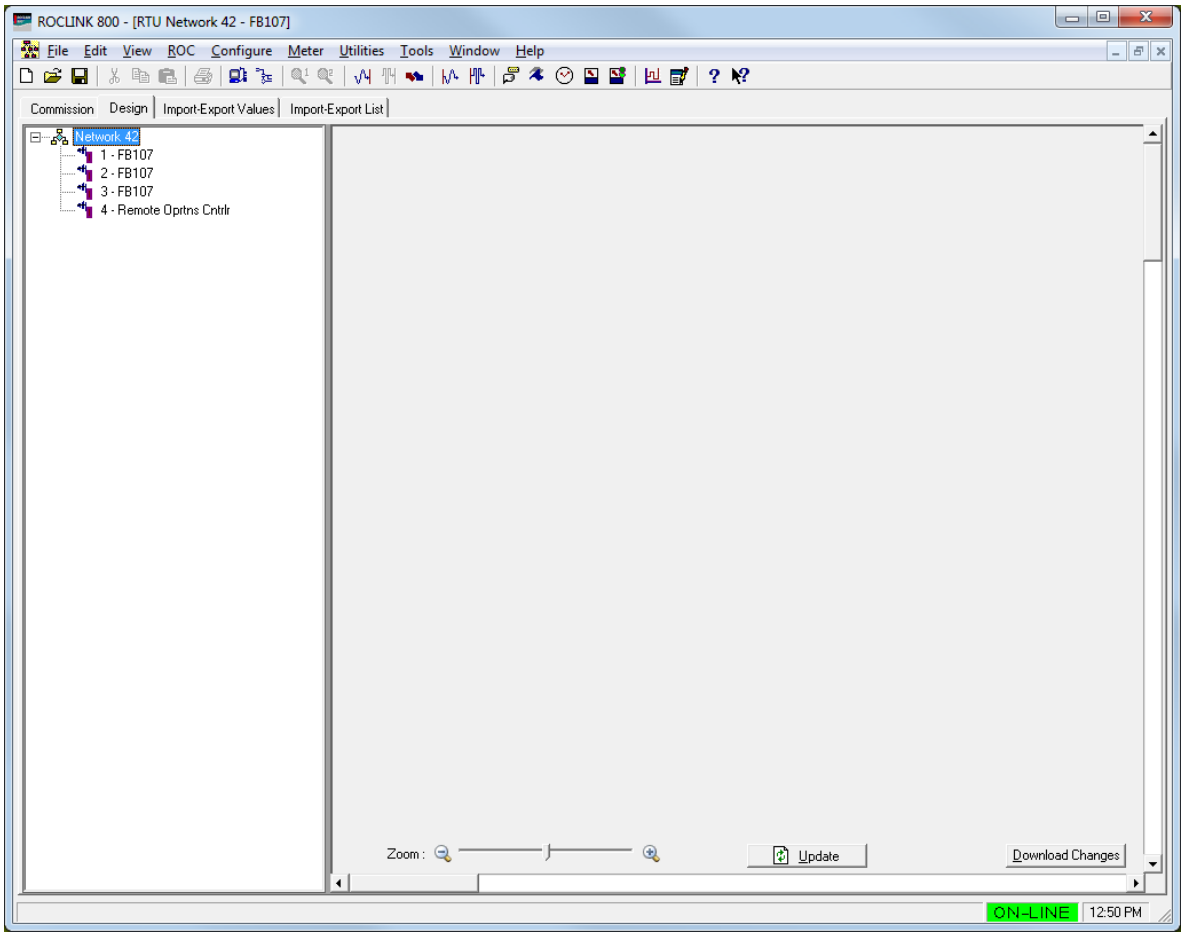


Figure 3-15. Blank Design Workspace

Control	Description
Device Tree	The device tree displays the devices currently commissioned on the network. You can drag devices from the device tree and place them in the design workspace. A plus sign (+) appears next to the device name in the design tree after you have added it to the design workspace. Click the plus sign to see to device parameters you can use to configure imports and exports.
Design Workspace	Use the Design Workspace to design your network configuration. Drag devices and parameters from the device tree on to the design workspace.
Zoom	Move slider to increase or decrease the size of your network on the design workspace.
Update	Click to update the device status and health. The device name is color-coded to provide you with a visual feedback about the health of a device. For more information, refer to *Color Coding*.
Download Changes	Click to download the current import and export configurations to each device.

The device tree on the left side of the workspace shows all the devices (NAP and nodes) you have currently defined for the network. The NAP is always numbered 1; nodes are numbered 2 to 13 (for a 12-node network) or 2 to 25 (for a 24-node network).

2. Left-click the NAP from the device tree and drag it to the workspace:

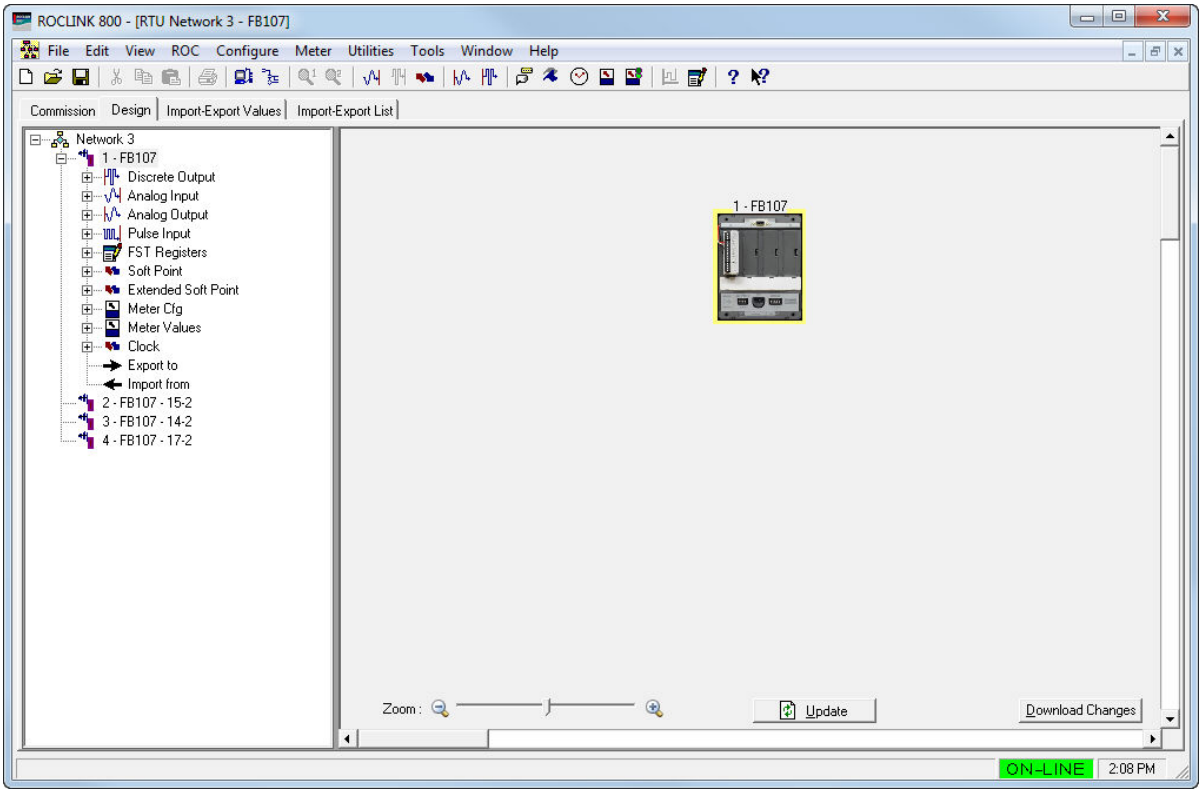


Figure 3-16. NAP in Design Workspace

Figure 3-16 shows the NAP on the workspace. The NAP has a yellow border, indicating that it is the currently selected device. The program has also expanded the device tree to show available import and export values.

Note: The workspace uses simplified images that do not show installed modules.

3. A network must have a NAP and at least one node. Left-click one of the nodes in the device tree and drag it onto the workspace (see *Figure 3-17*). Because the node is now the currently selected device, it has the yellow border. The program has also closed the device tree for the NAP and opened the device tree for the selected node.

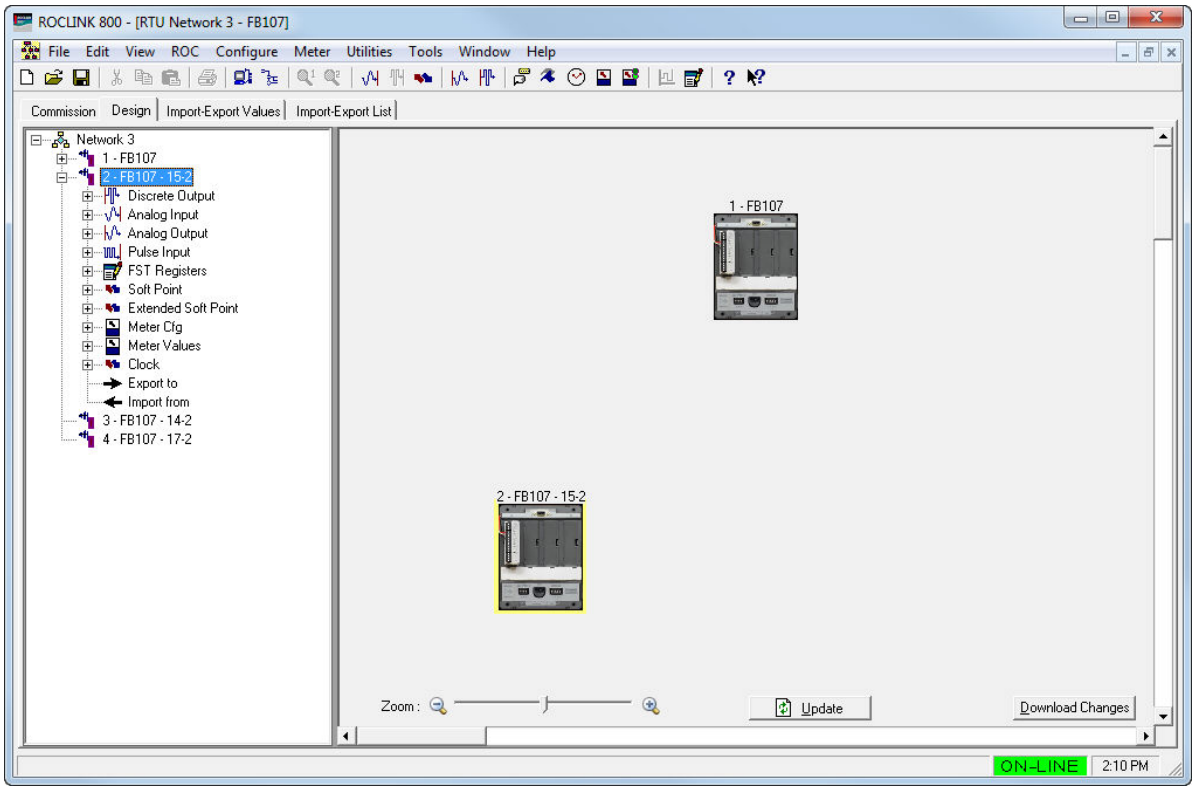


Figure 3-17. NAP and Node in Design Workspace

4. Repeat the drag-and-drop process to bring all the commissioned nodes onto the design workspace.

3.3.1 Adding Imports and Exports

The system adds a plus sign (+) next to the device label when you add that device to the workspace. To select the “imports” (data values the device **receives**) or “exports” (data values the devices **transmits**) for a device, you need to completely expand the tree to show all the values you can select.

1. Select the device in the design workspace. The device tree displays all the device point categories available to export to another device and all currently defined imports and exports (see *Figure 3-18*).

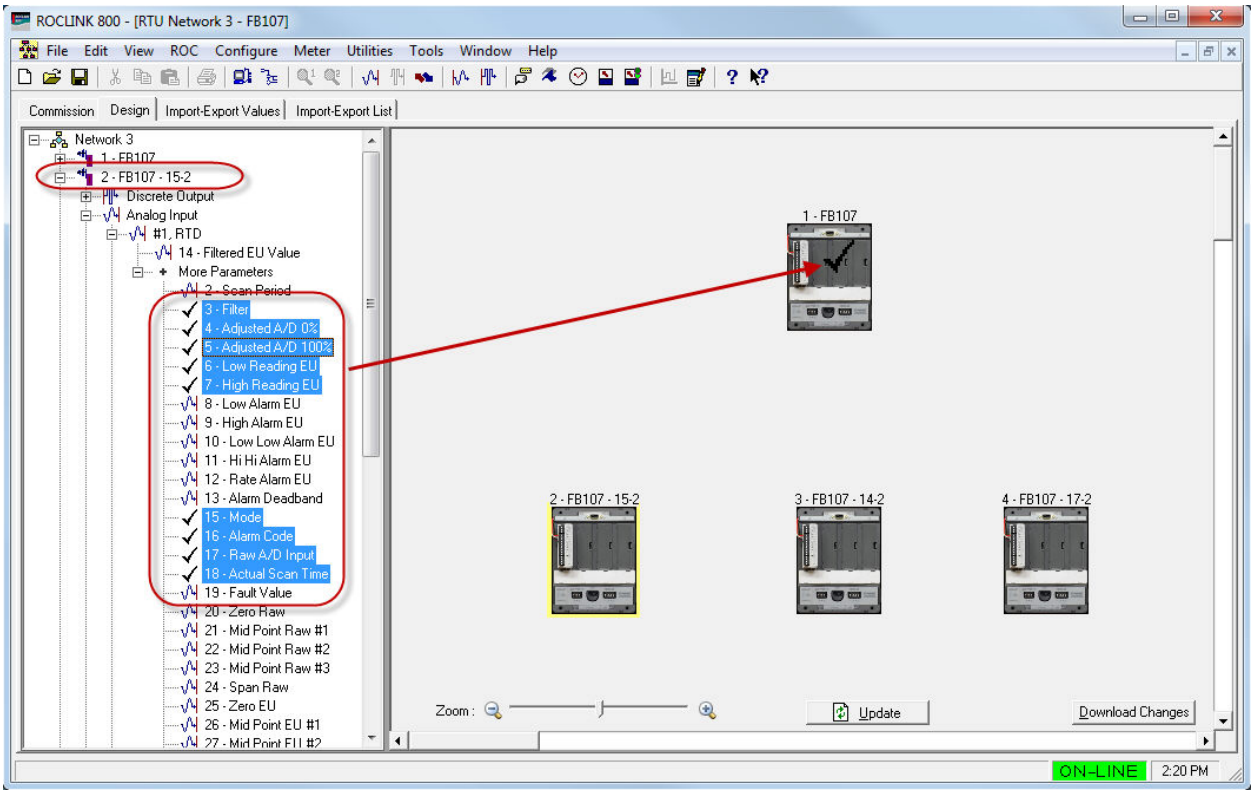


Figure 3-18. Expanded Values in Device Tree (1)

Note: Click on the plus (+) sign to expand a device point category and display point parameters. Double-click on the device to open the Import-Export Values tab for the device (see *Section 4.3, Import-Export Values Tab*).

Remember that the labels (such as Discrete Input or Discrete Output) are generic. You need to expand the tree further to access the specific value you want to select. To do that, click on the plus sign next to that value. *Figure 3-19* shows the Discrete Output further expanded to show several selectable values.

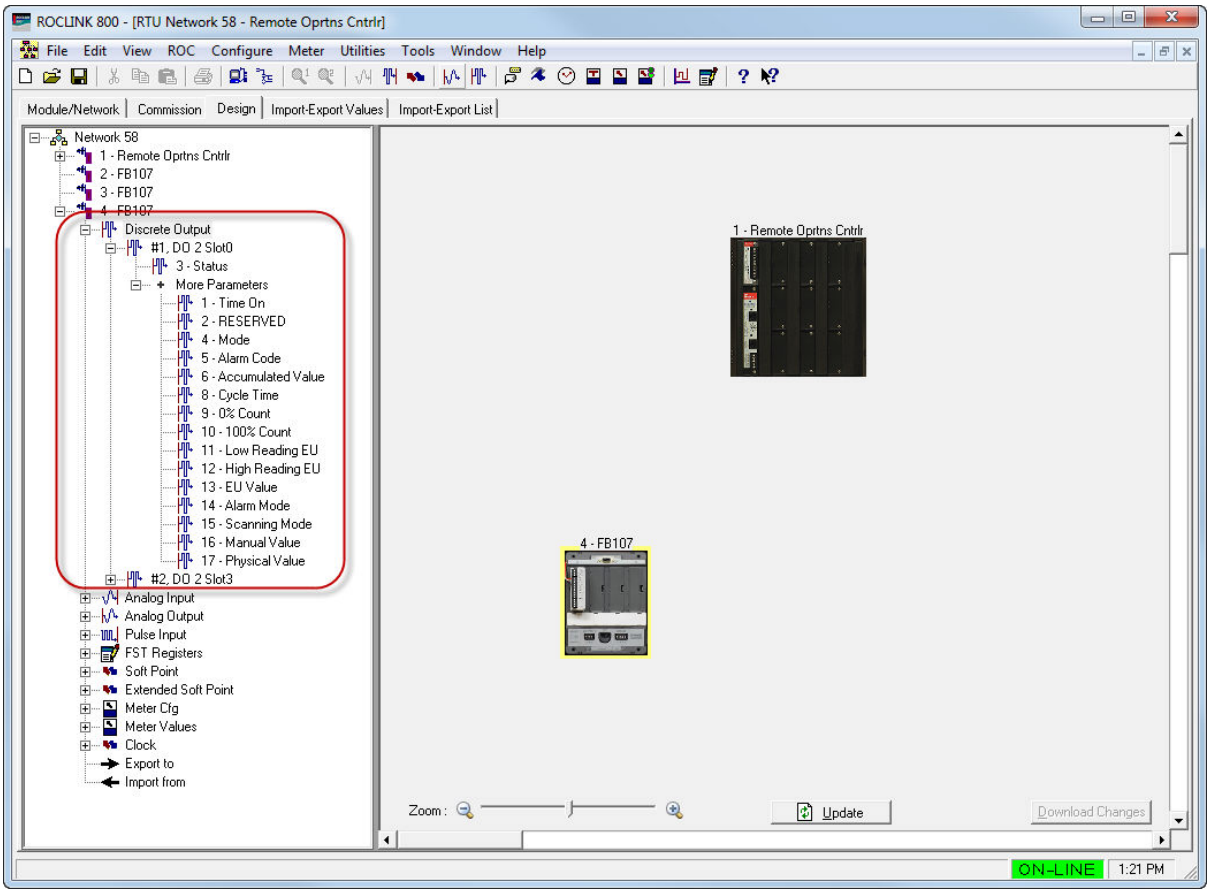
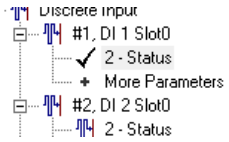


Figure 3-19. Expanded Values in Device Tree (2)



2. In the device tree, select the points you wish to export. Note that ROCLINK places a check mark (✓) in the device tree next to each parameter you select.

Notes:

- To select multiple parameters, hold down the **Ctrl** key and left-click each point.
- To select a range of parameters, select the first parameter in the range, hold down the **Shift** key, and select the last parameter in the range.
- If you select multiple parameters, all selected parameters must be located in the **same** logical. For example, if you select a parameter in the first Analog Input logical (#1, P2 Press), you cannot also select parameters in the second Analog Input (#2, RTD) at the same time.

3. Drag the selected value(s) to a device. A checkmark appears over a valid target device. Since the FB107 node is the currently chosen device, the system tags any values we choose as exports from the FB107 to the NAP.

As *Figure 3-20* shows, we select **Status** from DI #1 and drag it over to the NAP. When we "drop" the value onto the NAP, the system adds a connection arrow between the node and the NAP (indicating the direction of the data flow) and modifies the tree to include the new export.

Note: As you drag the selected value to a device, the program identifies a valid target device by placing a check mark over the device. If the device is not valid, the program displays an international No symbol (⃠)

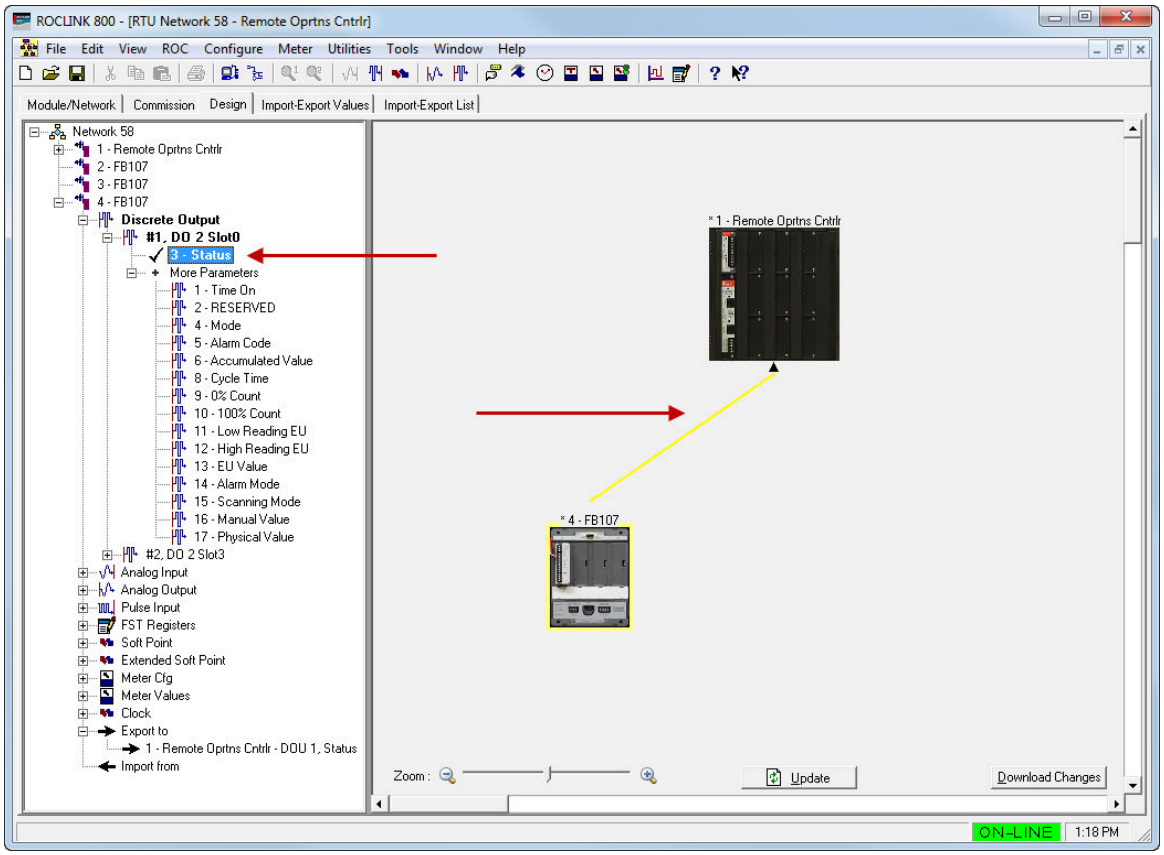


Figure 3-20. Defined Export (Node to NAP)

The system creates Import and Export points under each device in the device tree:

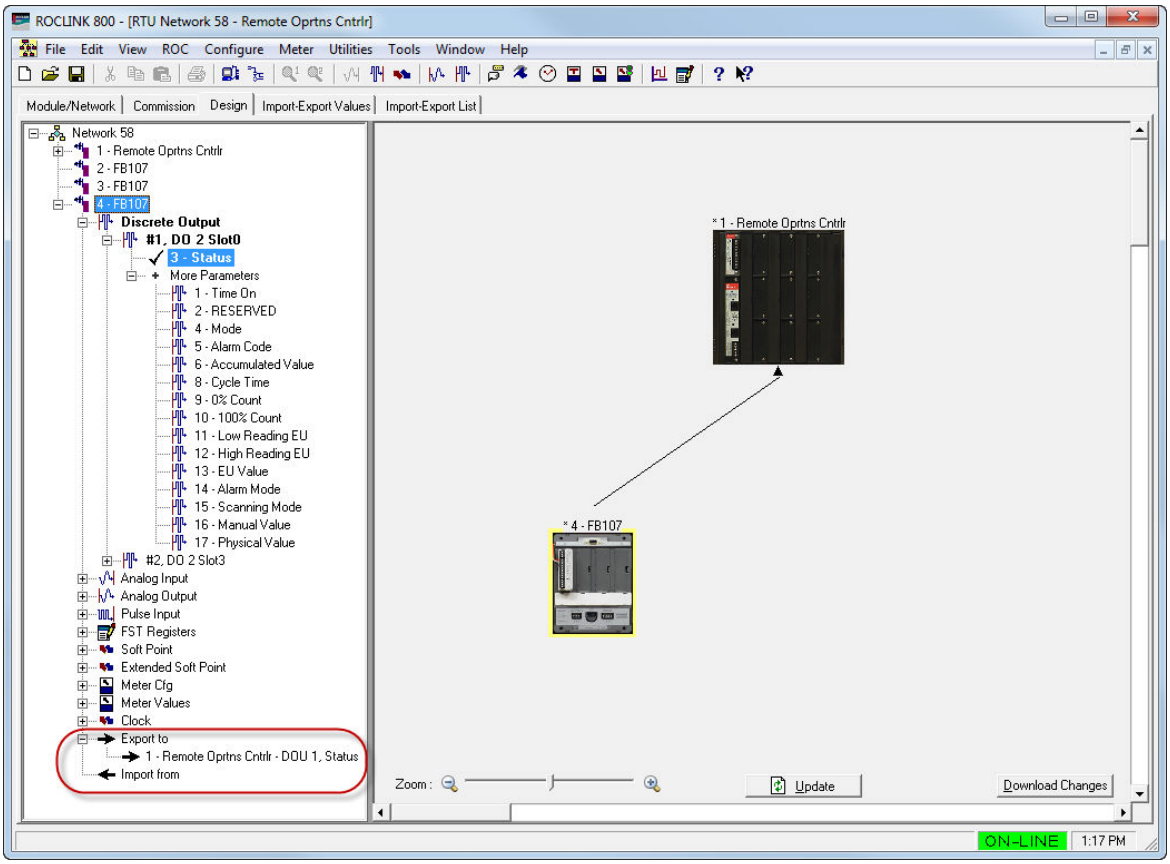


Figure 3-21. Import and Export Points

Note: The labels for the NAP and node in *Figure 3-21* now begin with an asterisk (*). The design workspace adds these to remind you that you have modified imports and exports for these devices. The asterisks appear until you download the changed device configurations to the devices (see *Section 3.3.7, Saving the Network Configuration*).

4. Defining an import to the node is just as simple. Select the NAP, expand the device tree, and drag-and-drop a value onto the node (see *Figure 3-22*):

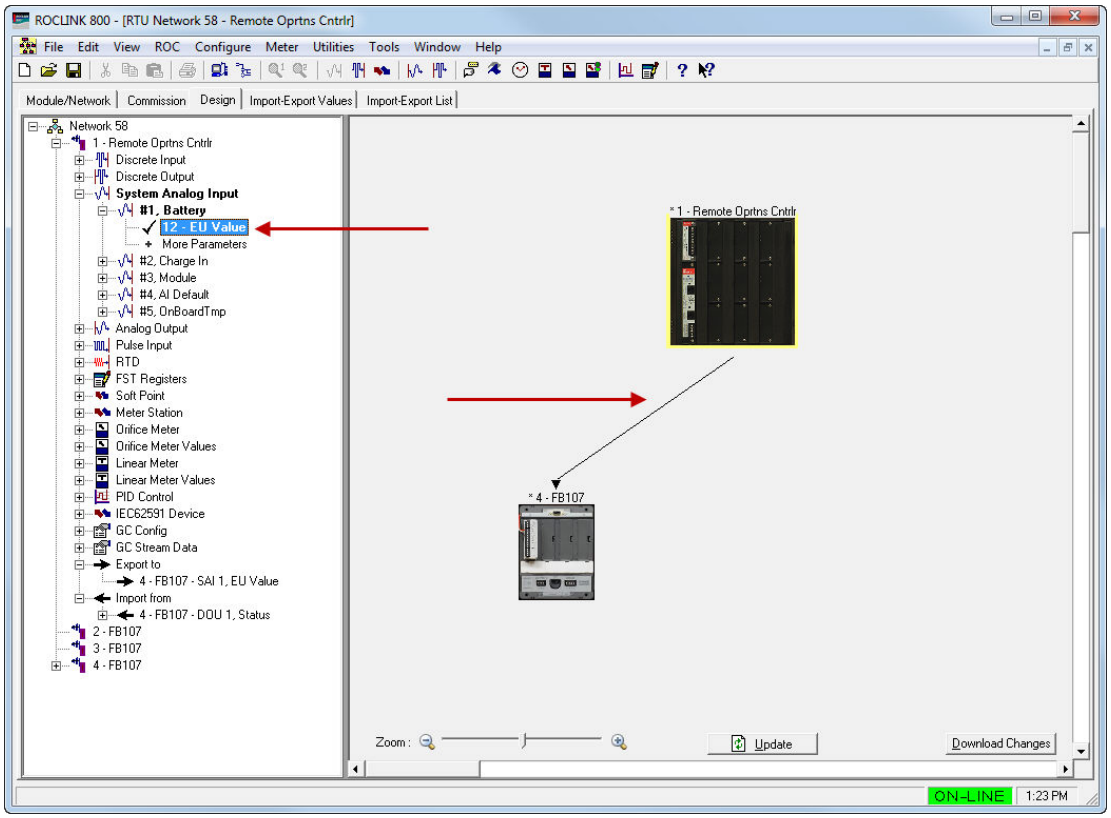


Figure 3-22. Defined Export (NAP to Node)

Again, the system modifies the device tree to show the added export. Since the NAP is the selected device, we see only the export from the NAP to the node. To see the directional data flow of imports **and** exports for **all** devices, click anywhere other than a device in the design workspace. This removes the selection (yellow highlighting) from a device and shows **all** imports and exports (see *Figure 3-23*).

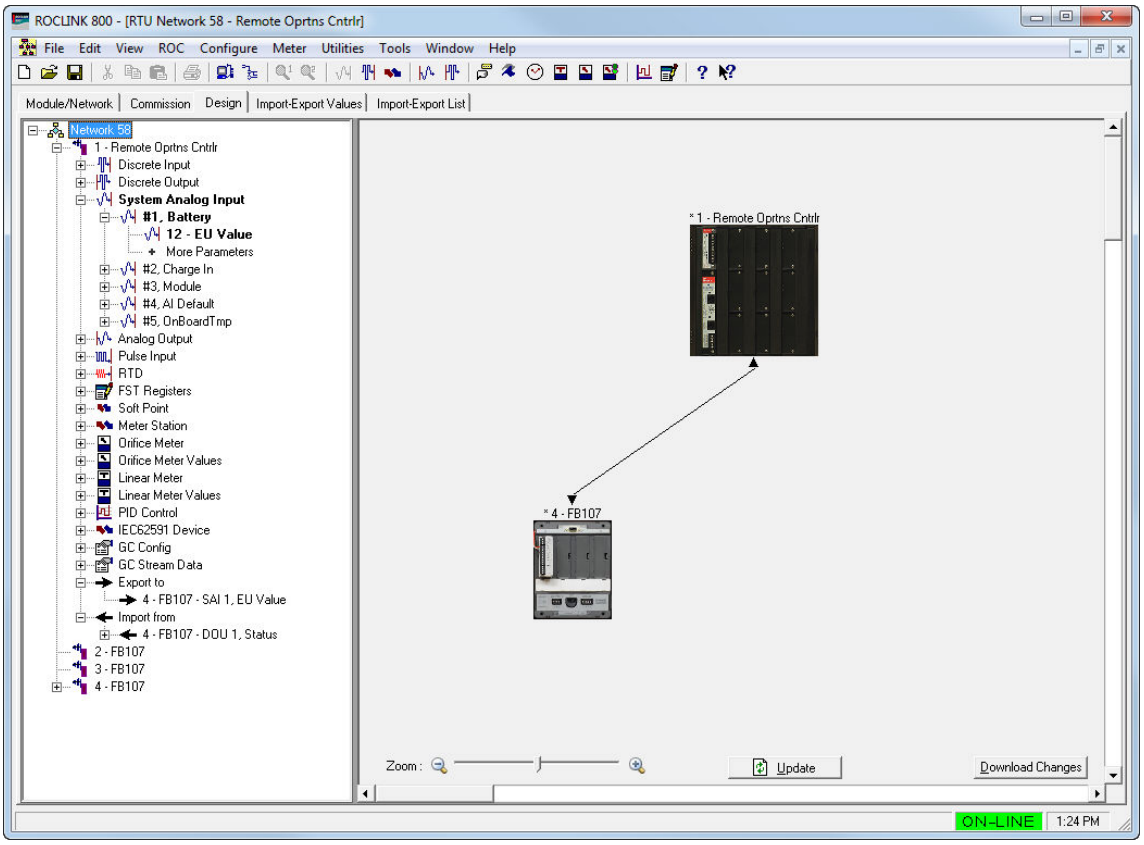


Figure 3-23. Defined Exports and Imports

5. To build a data network, repeat the process of selecting a device, selecting a value, and then dragging that value to the target device. *Figure 3-24* shows a very simple example data network.

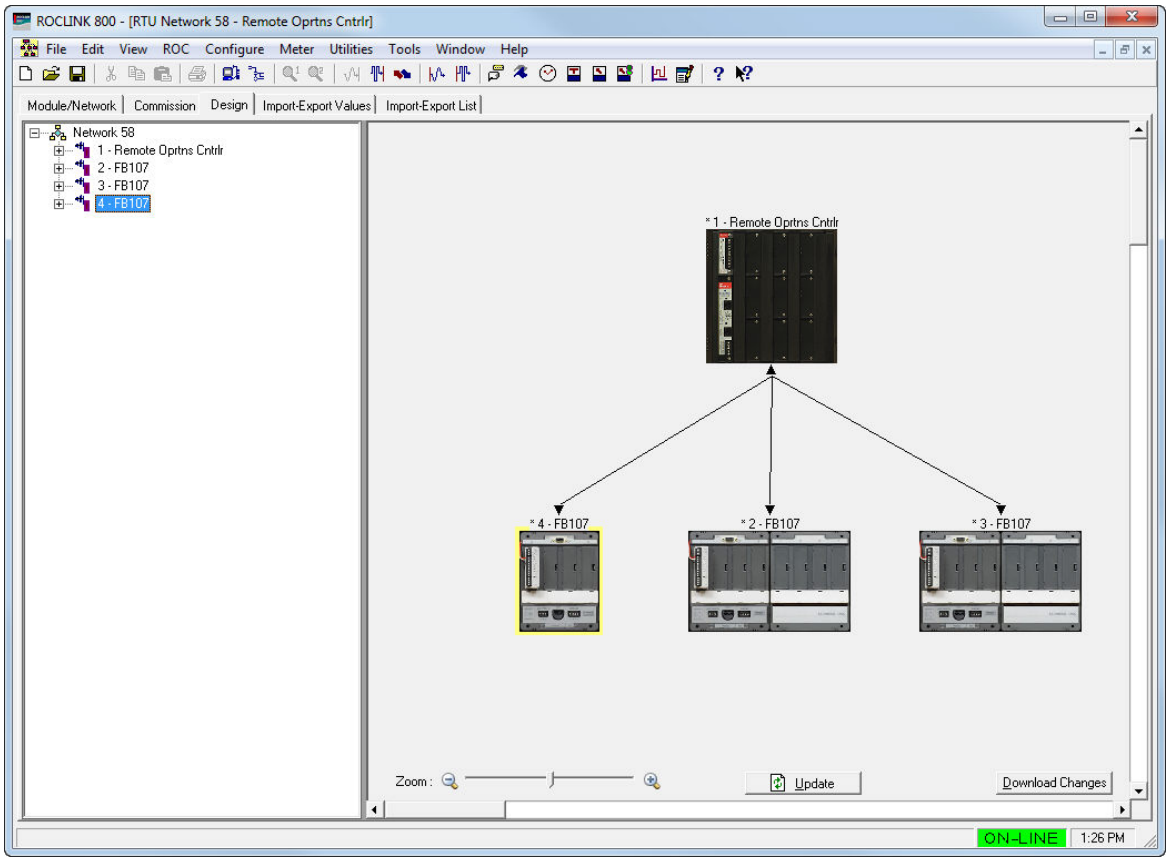


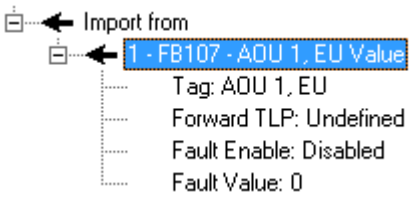
Figure 3-24. Defined Data Network

The network now contains three nodes and a more complex data flow.

3.3.2 Configuring Data Imports

You can customize how the system stores data imports on a device. To configure an import:

1. Double-click the device name in the device tree.
2. Double-click **Import** in the device tree.
3. Double-click a specific import in the device tree.



4. Double-click a specific import value in the device tree. The system displays the Import Point Configuration screen:

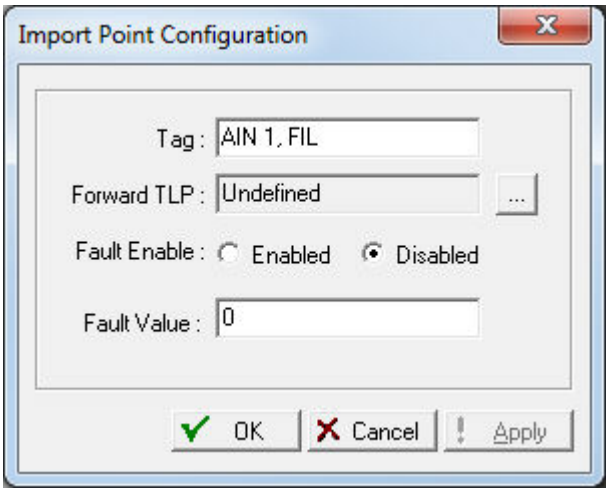


Figure 3-25. Import Point Configuration Screen

Use this screen to modify the configuration parameters for that import value. You can modify the Tag, forward to value to a specific TLP, enable fault handling, and specify a fault value.

5. Once you click **Apply**, the system updates the values displayed in the device tree.
6. Click **Download Changes** on the design workspace to download the configuration changes to the affected device.

3.3.3 Duplicating Imports and Exports

You can reduce the amount of time spent configuring imports and exports if you have multiple nodes with similar configurations. When you select parameters in the device tree for one device and then select a second device on the design workspace, the system automatically selects the same parameters in the second device.

To duplicate selected import/export parameters for multiple devices:

1. Select the import/export parameters in the device tree for that device.

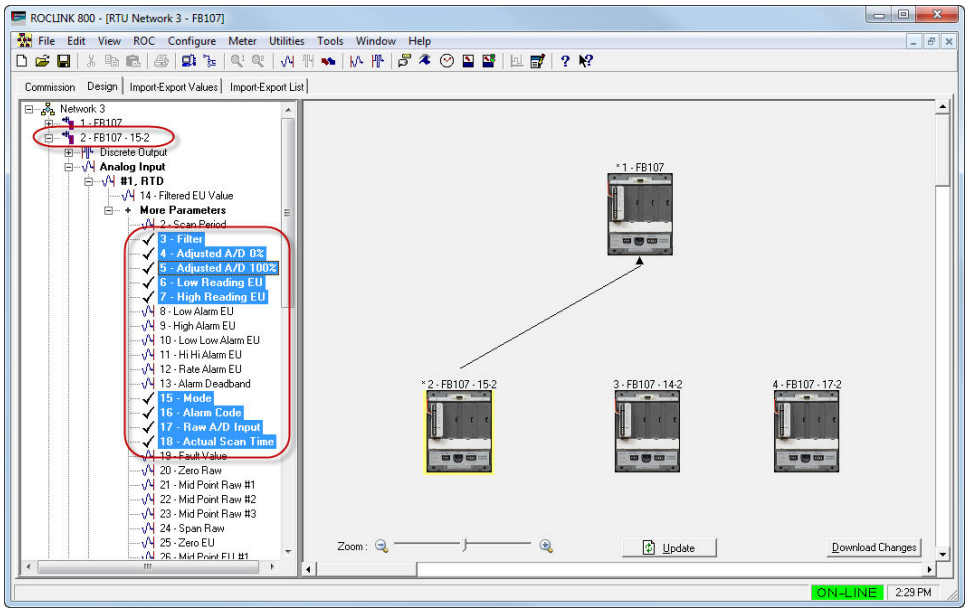


Figure 3-26. Parameters Selected, Device 2

2. Drag the selected parameters from the device tree and place them on top of the target device in the design workspace.
3. Select a new device in the design workspace. Note that all of the parameters selected on the first device are automatically selected on the second device.

Note: **Both** devices **must** have the same parameters in order for this to work.

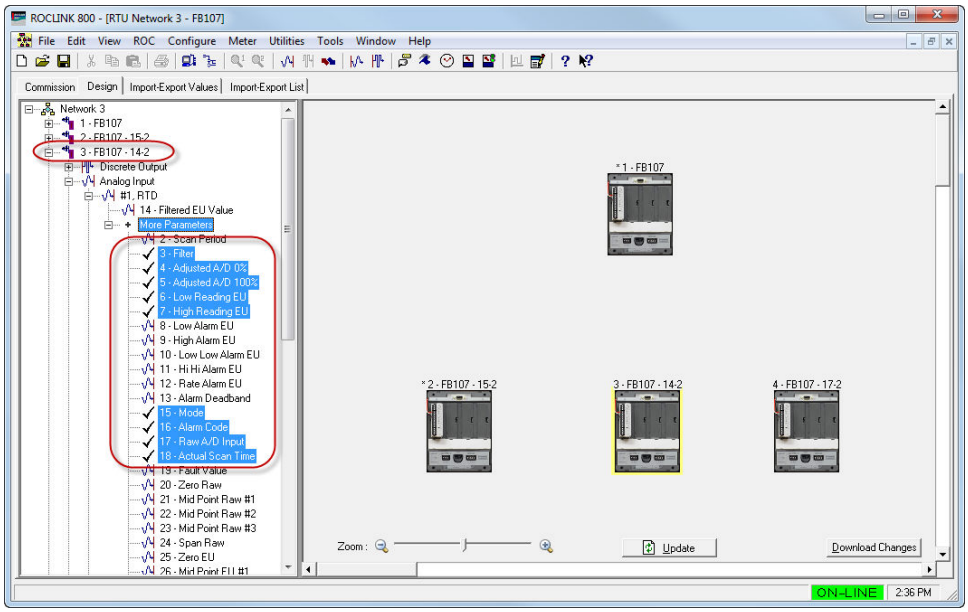


Figure 3-27. Parameters Selected, Device 3

4. Drag the selected parameters to the target device.

5. Repeat steps 3 and 4 to configure any remaining devices with the same import/export parameters.
6. Click **Download Changes** on the design workspace to download the configuration changes to the affected devices.

3.3.4 Deleting Imports and Exports

You may need to delete an import or export from the network. To delete an import or export:

1. Select the Design tab to open the design workspace.

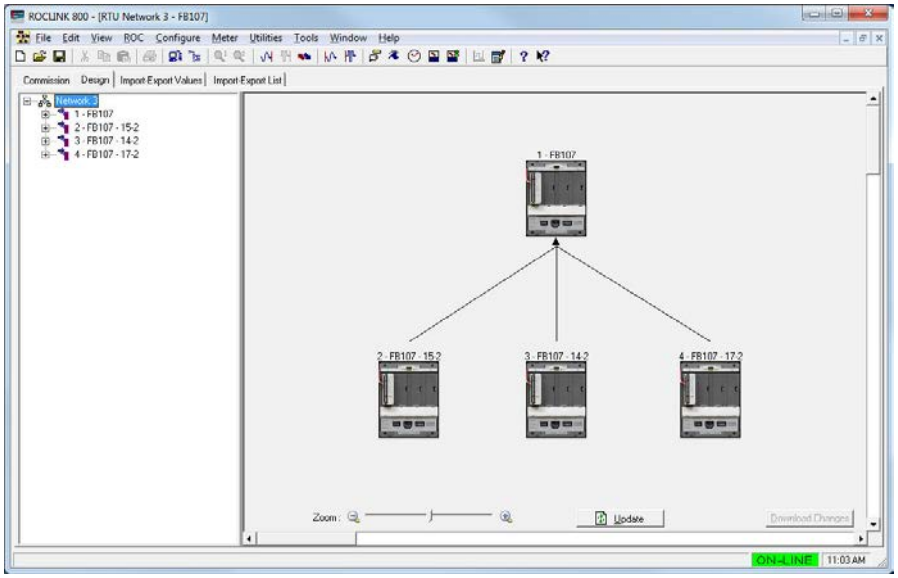


Figure 3-28. Design Workspace

2. Select the device importing or exporting the data.

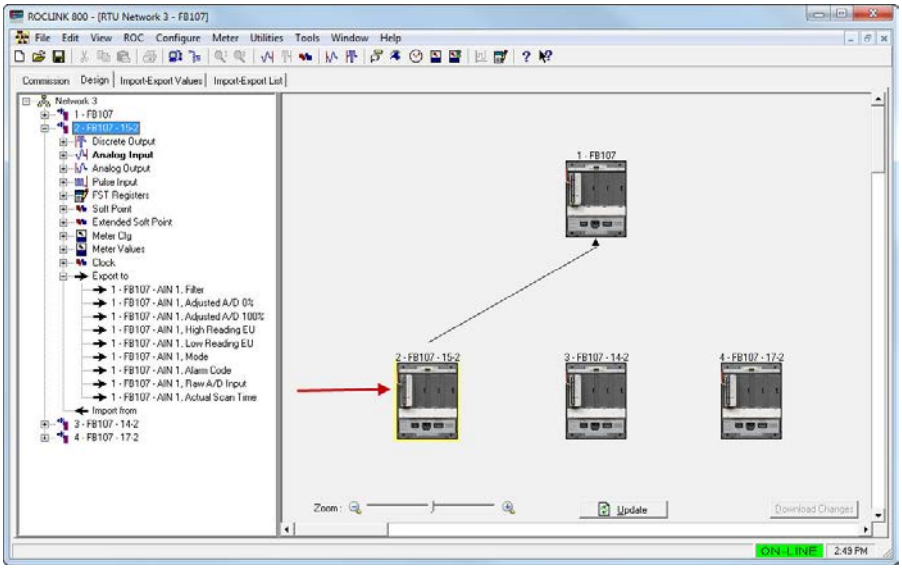


Figure 3-29. Design Workspace (Device Selected)

3. In the device tree, right-click the import/export you want to remove. A pop-up menu displays with a Remove Export from Design option.

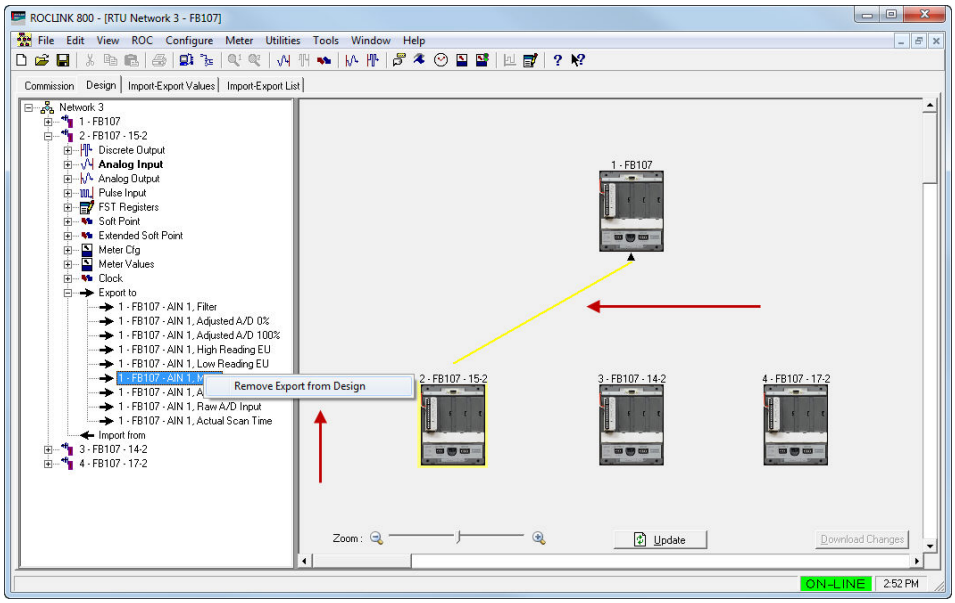
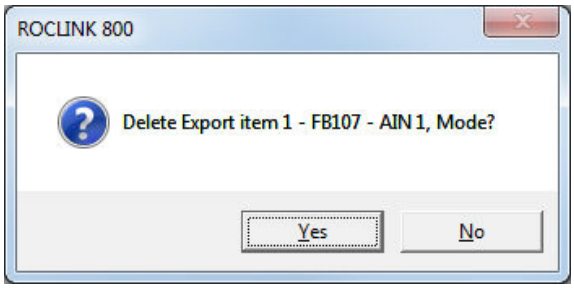


Figure 3-30. Remove Export from Design pop-up

4. Select **Remove Export from Design**. A confirmation message displays.



5. Click **Yes** to remove the import/export from the network design.

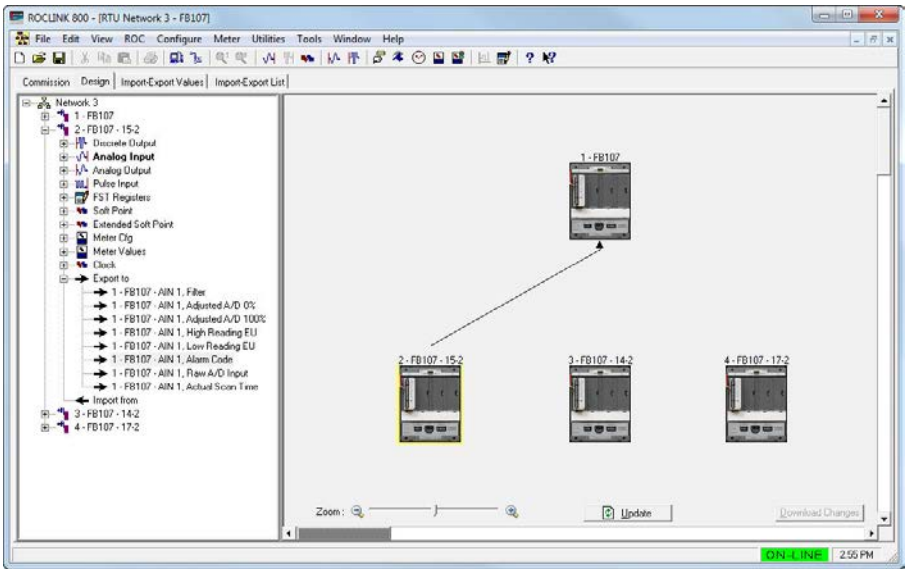


Figure 3-31. Export Removed

6. Click **Download Changes** on the design workspace to download the configuration changes to the affected device.

3.3.5 Color Coding (Design Workspace)

The device name (as shown on the design workspace) is color-coded. This color-coding provides you with visual feedback about the health of the devices, imports, and exports.

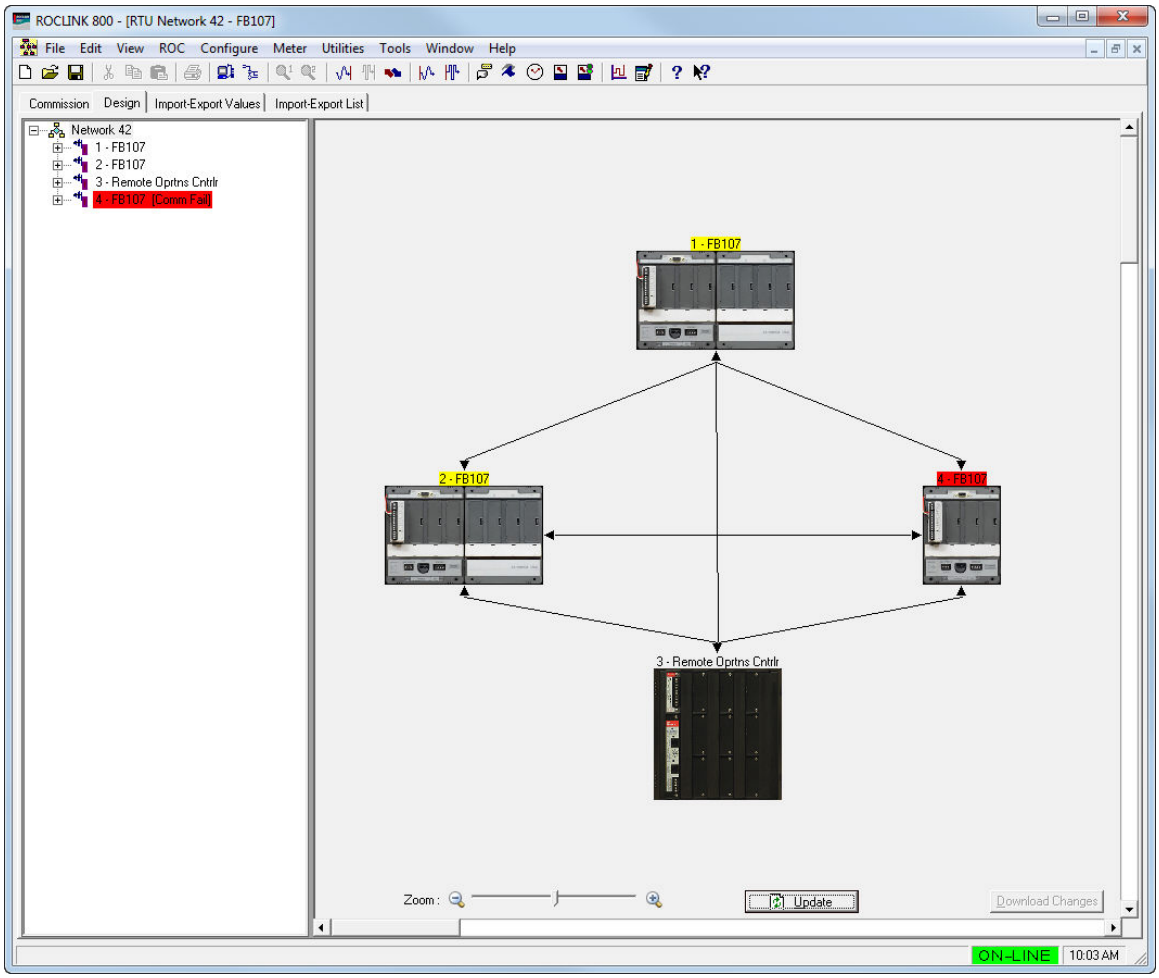


Figure 3-32. Device Color Coding

Colors, their meaning, and possible solutions include:

Color	Description
Yellow (No Update)	One or more of the import values has not been updated in the last 10 seconds. Double-click on the device in the design workspace to open up the Import-Export Values tab. On the Import-Export Values tab, you can find out which device is causing the error by looking at the Status column of the Imports table.
Red (Communication Failure)	A communication failure occurs when a device fails to communicate with the network for one minute.

3.3.6 Pop-up Menus

The device tree and design workspace support several menus you can access to streamline work.

Device Tree Menu

If you right-click a network label in the device tree, the system displays the following pop-up menu:

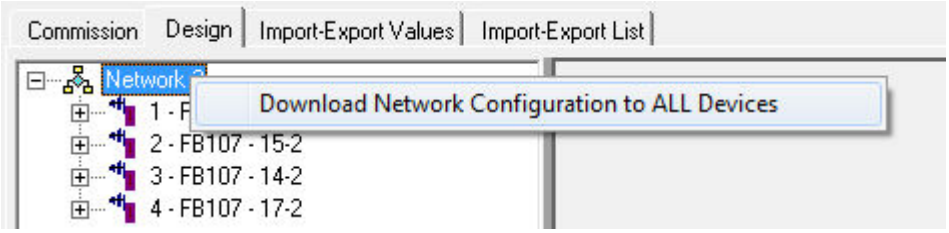
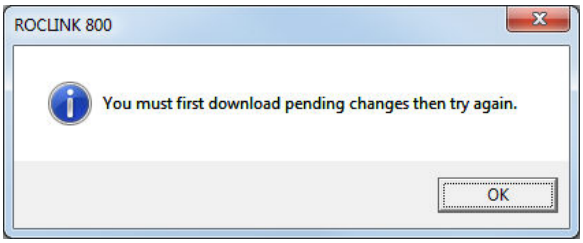


Figure 3-33. Pop-up Menu: Network Label

Use this menu to:

Menu Option	Description
Download Network Configuration to ALL Devices	Clears the imports and exports currently defined for the entire network, downloads the imports and exports defined in the network configuration to each device, and performs a warm start on all devices. When you select this option, the system displays a warning dialog:  You must click **Yes** to proceed. **Note**: If a device label on the design workspace contains an asterisk (*), ROCLINK 800 does not allow you to perform this action and displays a warning dialog:  Click **OK** to close this dialog. Then either select **Download Changes** to save any pending changes to the affected devices (this action saves any changes you have made to the network and updates the network configuration) or close the RTU Network screen completely before retrying the download. (This action discards any changes and preserves your current network configuration.)

Device Label Menu

If you right-click a device label in the device tree, the system displays the following pop-up menu:

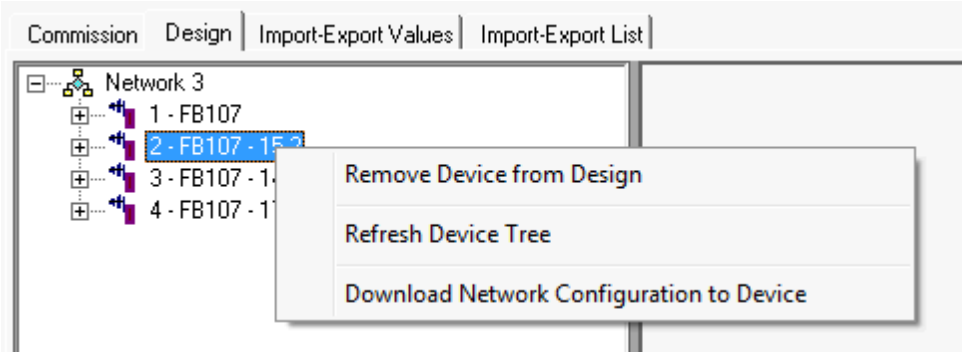
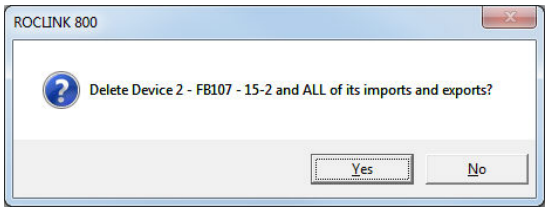
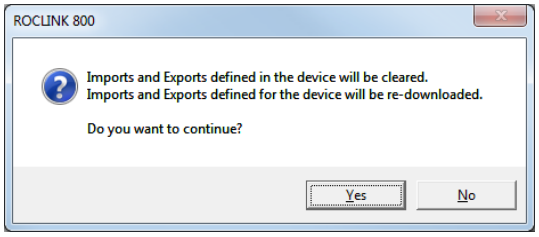
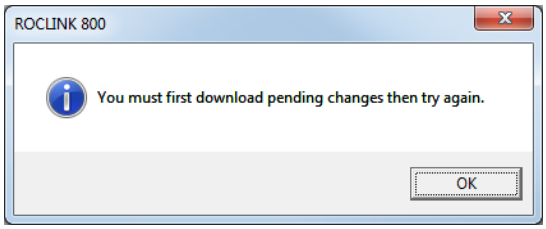


Figure 3-34. Pop-up Menu: Device Label

Use this menu to:

Menu Option	Description
Remove Device from Design	Removes the selected device from the design workspace. To prevent accidental removals and to alert you of the interconnection of a device in the network, the system displays a warning dialog:  You must click **Yes** to proceed.
Refresh Device Tree	Refreshes the content and available parameters of the selected device. This is useful if you make any changes to a device, such as installing new modules or user programs.
Download Network Configuration to Device	Clears the imports and exports currently defined for the device, downloads the imports and exports configuration defined in the network configuration, and performs a warm start on the updated devices. This is useful when replacing a device on the network. When you select this option, the system displays a warning dialog.  You must answer **Yes** to continue. After “refreshing” the device’s configuration, the system warm starts the device.

Menu Option	Description
	Note: If a device label on the design workspace contains an asterisk, ROCLINK 800 does not allow you to perform this action and displays a warning dialog:  Click **OK** to close this dialog. Then either select **Download Changes** to save any pending changes to the affected devices (this action saves any changes you have made to the network and updates the network configuration) **or** close the RTU Network screen completely before retrying the download (this action discards any changes and preserves your current network configuration).

Design Workspace Menu

If you right-click a device in the design workspace, the system displays the following pop-up menu:

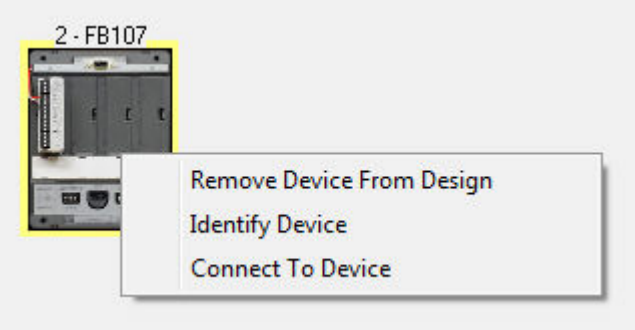
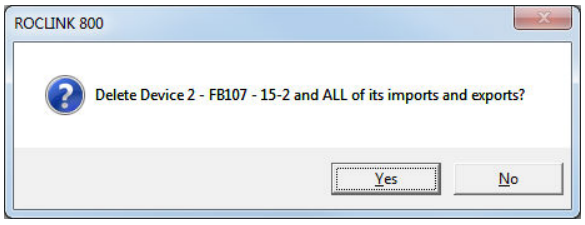


Figure 3-35. Pop-up Menu: Design Workspace

Use these menu options on the design workspace to remotely initiate a ROCLINK connection with a node, identify which device is associated with a label on the workspace, or remove a device from the network design.

Menu Option	Description
Remove Device from Design	Removes the selected device from the design workspace. To prevent accidental removals and to alert you of the interconnection of a device in the network, the system displays a warning dialog:

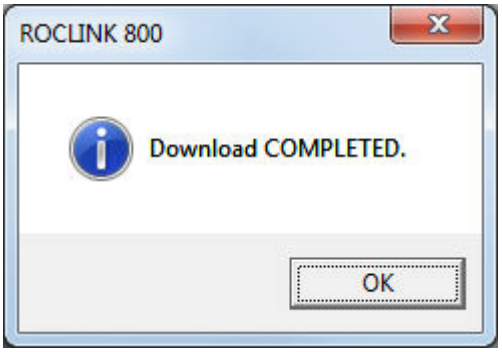
Menu Option	Description
	 Click **Yes** to proceed.
Identify Device/ Stop Identifying	Flashes all LEDs on the NRM. This helps you to quickly identify a particular NRM on the network. You must select **Stop Identifying** to perform any other function with this NRM. **Note**: This option is available only for nodes.
Connect to Device	Starts a ROCLINK session that connects directly to the selected node. This enables you to modify configuration details in the selected node. To enable this option, you **must enable pass-through messaging** for the selected device using the Commission tab. **Note**: Do not download firmware, program, or display updates to devices over the RTU network.

3.3.7 Saving a Network Configuration

As you design your network, you should periodically save it by clicking the **Download Changes** button. When you click **Download Changes**, ROCLINK 800 downloads the import/export configurations and warm starts all devices.

To save the network configuration:

1. Select **Download Changes** when you have made changes to import/export values for one or more devices and you want to save those changes to the network configuration file **and** download those modifications to the device. The system saves the changes to the configuration file, applies those changes to the device(s), and performs a warm start for device(s) with changes. When the process completes, the system displays a dialog:



2. Click **OK**. The system removes the asterisks from the labels, indicating the changes have been saved and downloaded to the devices.

Note: It is a good idea to save your device configuration file using **File > Save Configuration**. When saving the device configuration for a NAP, the system saves a copy of the network configuration along with the device data.

3.3.8 Downloading a Network Configuration

Use this menu option to **clear all** defined import and export values for all devices in the entire network, download the import and export configurations currently defined in the network configuration, and perform a warm start to all devices. This option is useful if you have a catastrophic failure of numerous network components, and want to quickly restore the configuration of an entire network.

1. Right-click the network label in the device tree. The system displays this menu:

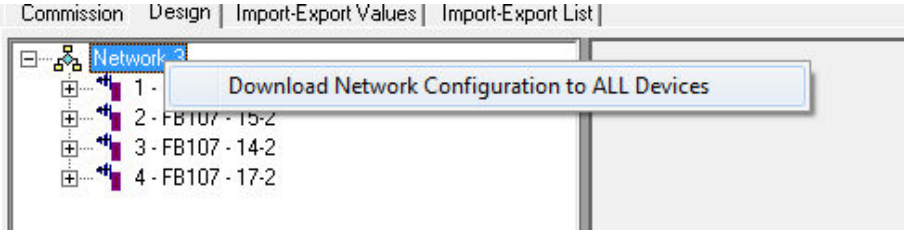
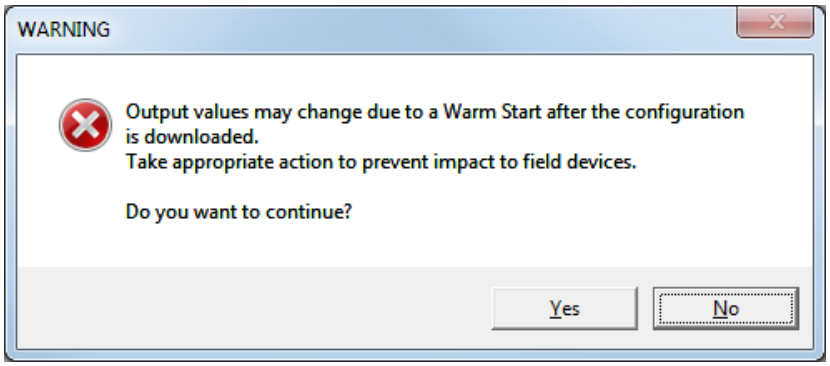


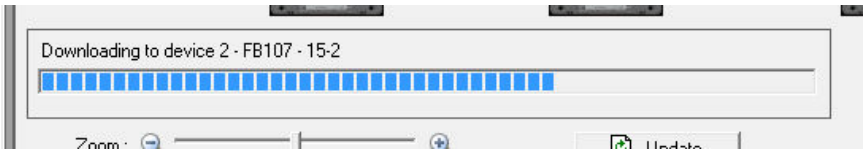
Figure 3-36. Pop-up Menu: Network Label

2. Select this option. The system displays a warning dialog:

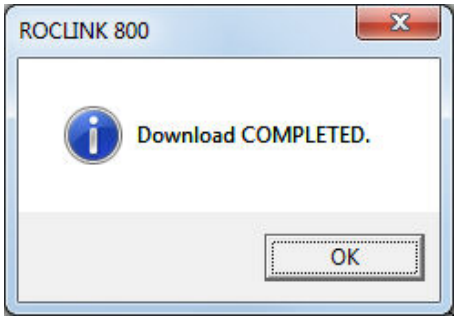
3. Click **Yes** to continue. The system displays a warning dialog:



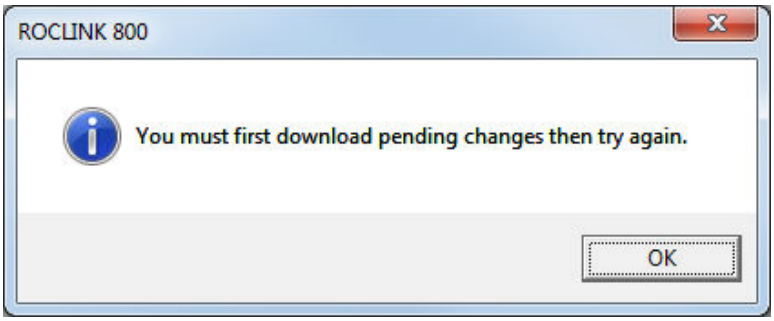
4. Click **Yes** to continue. The system displays a progress indicator at the bottom of the design workspace as it restores values to each device.



5. After downloading values to all devices, the system warm-starts all devices and then displays a completion dialog:



Note: If a device label on the design workspace contains an asterisk, ROCLINK 800 does not allow you to perform this action and displays a warning dialog:



Click **OK** to close this dialog. Then either select **Download Changes** to save any pending changes to the affected devices (this action saves any changes you have made to the network) **or** close the RTU Network screen completely before retrying the download (this action discards any changes and preserves your current configuration).

3.3.9 Creating a Network Configuration Template (Offline)

One of the design features the Distributed RTU Network provides is the ability to create a network configuration template when you are not connected to a device. This is useful when you have one or more standard network configurations you commonly install.

For example, your organization routinely installs either an 8-node or a 20-node network, depending on the size of the field and the number of wellheads. To streamline the installation process, your installation technician can use offline configuration to build a standard **template** for the 8-node and the 20-node network and store those templates on the laptop used for installation.

Notes:

- Remember that network configuration template resides on the **laptop** used to configure the network, and not on the NAP or any component node.
- The template network and the network you are creating must use the same device (ROC800 or FB107) as the NAP. You cannot copy a ROC800-based network to a FB107-based network (or vice versa).

When the need occurs for a new 8-node network, the technician bench-configures the network nodes and network access point. After installing the nodes and network access point in the field, he re-connects to the NAP and, when prompted, selects the 8-node template as the model for the new network. He directs the program to discover the eight new nodes, commissions them by dragging them onto the pre-defined 8-node network, and then verifies (or modifies) the import and export values.

To create an offline configuration template:

Start a ROCLINK 800 session, but **do not** log onto a device.

1. Open (**File** > **Open**) a previously saved .800 configuration file for a network access point.
2. Select the NRM module.

   Note: If your NAP is a FB107, you must click Configure to access the Design tab. If your NAP is a ROC800, the RTU Network screen opens to the Design tab.

3. Select the **Commission** tab.

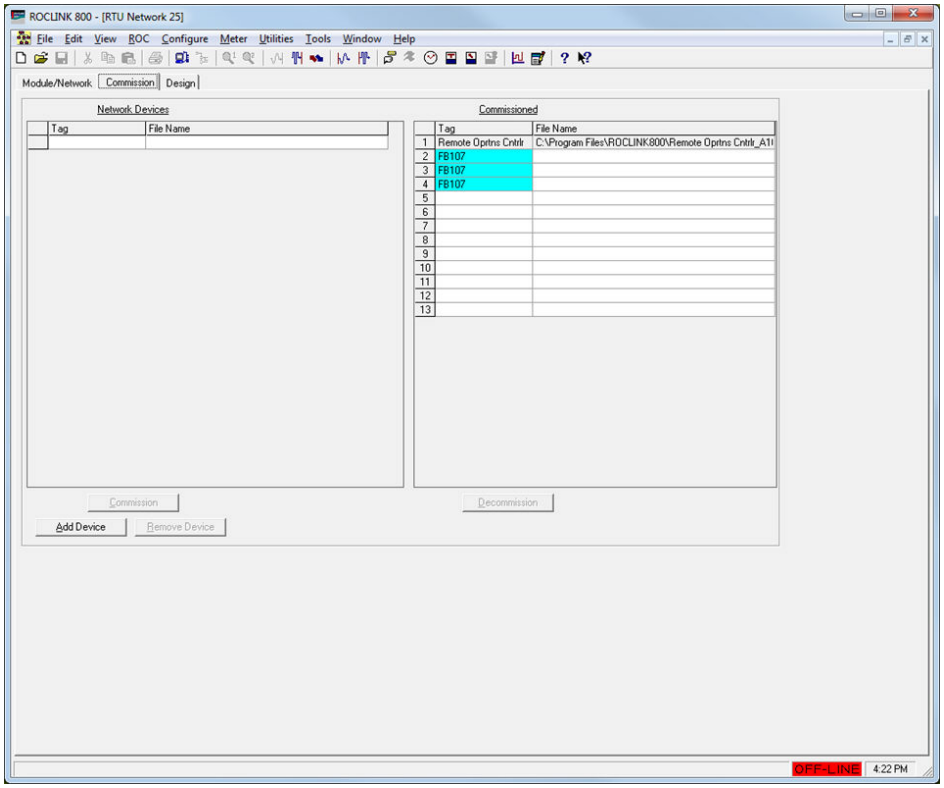


Figure 3-37. Commission Tab (Offline Configuration)

Because you are offline, the program changes the names of certain screen components. The name of the left-hand column is now **Network Devices**. Additionally, the buttons under the Network Devices column are labeled **Add Device** and **Remove Device** (instead of **Discover**). Finally, the Commissioned column does not have **Auto Sca**n or **Update** buttons.

4. Click **Add Device**. The program opens a Select Configuration Files window.
5. Double-click the configuration file (.800) for a node. The program closes the Select Configuration Files window and adds the configuration file to the list of Network Devices.

6. Repeat the selection process for each node you want to add to the configuration.

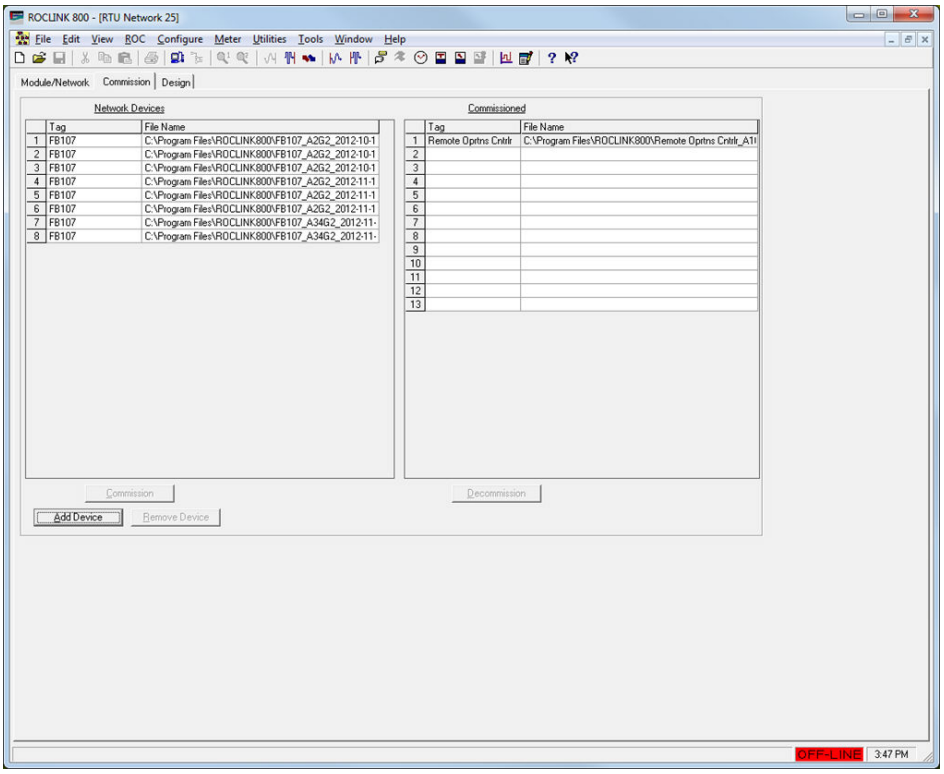


Figure 3-38. Added Devices (Offline Configuration)

Note: In our example above, the NAP originally defined only three nodes. For our 8-node network template, we add five more nodes. We define the imports and exports for our template network later.

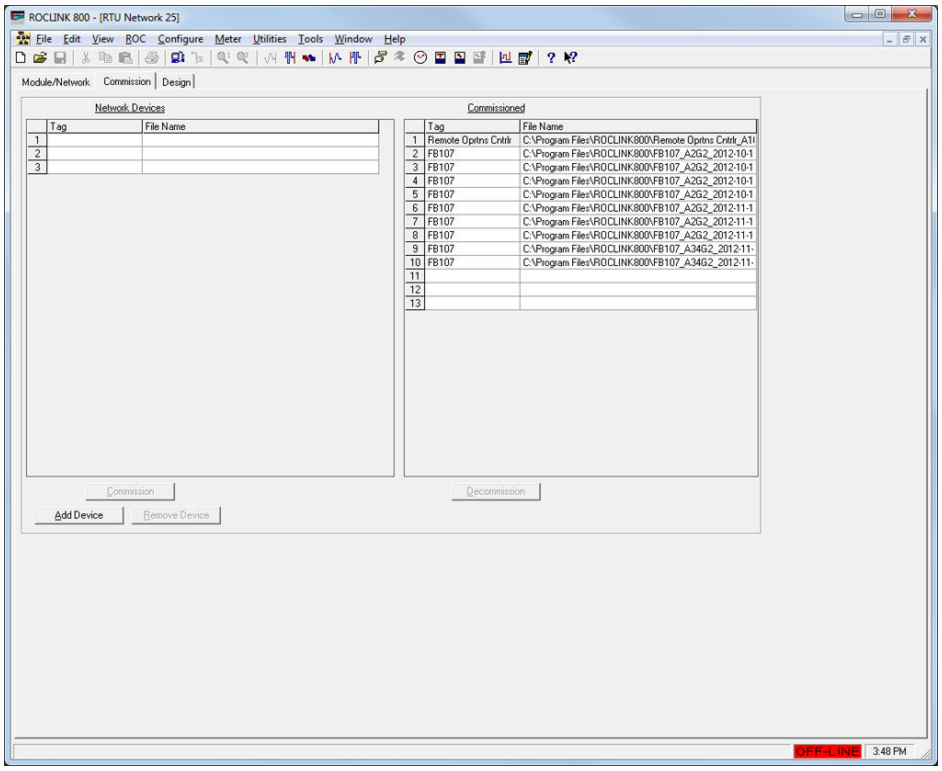
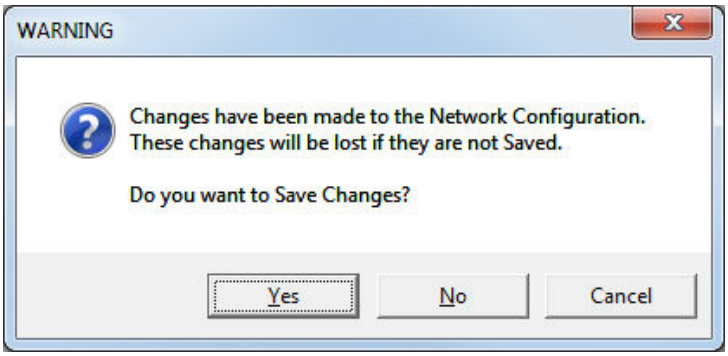


Figure 3-39. Commissioned Devices (Offline Configuration)

7. Select the **Design** tab.
8. Drag the added nodes onto the design workspace and define the exports and imports for each network component.
9. Close the RTU Network screen. A warning displays:



10. Click **Yes** to save the changes. The system saves the network template with a .NCF file extension in the ROCLINK800 subfolder on your computer. Network configuration file names are based on the Network ID and NAP device type. For example, "N58D-V-Remote Oprtns Cntrlr.ncf" is the configuration file for a network configured to use Network ID 58 with a ROC800 as the NAP, and "N42D-V-FB107.ncf" is for a network configured to use Network ID 42 with a FB107 as the NAP.

Note: To help identify this template for later use, you might want to uniquely re-label it (such as ***N25D-V-ROC-8NodeTemplate.ncf***).

3.3.10 Copying a Network Configuration (Online)

If you need to install several RTU networks that are fundamentally the same (that is, they use same controller as a NAP and approximately the same number of nodes), you can speed the creation process by using an existing network configuration as a template. I

Note: The template network and the network you are creating must have the same device (ROC800 or FB107) as the NAP. You cannot copy a ROC800-based network to a FB107-based network (or vice versa).

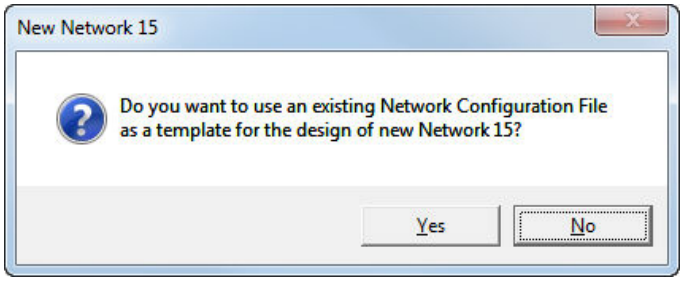
1. Save the configuration of the network you want to use as a template.

   Note: ROCLINK automatically places a copy of the saved network configuration into the ROCLINK800 folder on your computer. This copy uses the file extension .NCF.

2. Connect to each device on the new network and configure its Network ID, Channel, and Radio Transmit Power values.

   Note: Configure the NAP last.

3. Close the ROCLINK 800 session, and reconnect to the NAP. When you access the NAP, the program displays a dialog:



   Note: Click No **only** if you want to totally recreate the network.

4. Click **Yes**. The program displays a Select Template File screen:

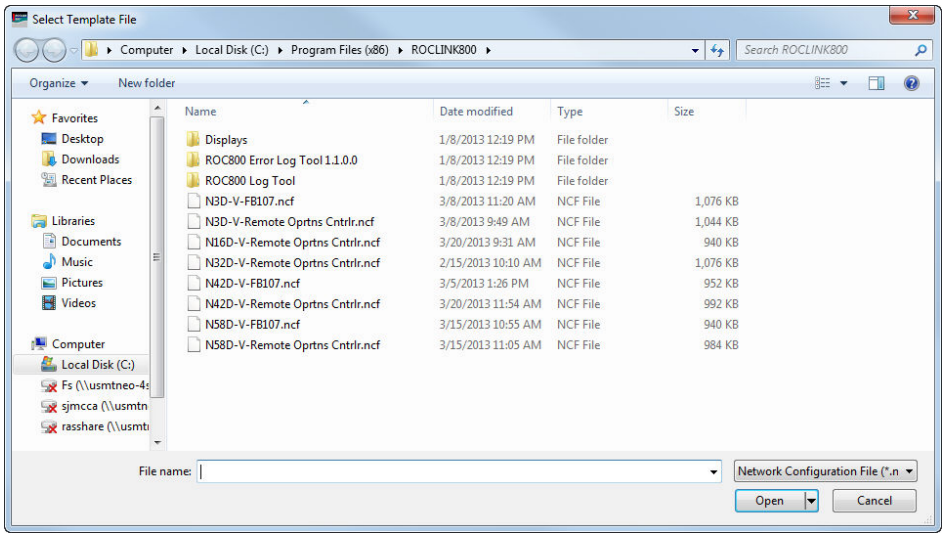


Figure 3-40. Select Template File screen

This screen lists all copies of network configurations (.NCFs) defined in the ROCLINK800 folder (the default location for these files).

Note: The system names copies of a network configuration based on the Network ID and NAP device type. For example, "N58D-V-Remote Oprtns Cntrlr.ncf" is the configuration file for a network configured to use Network ID 58 with a ROC800 as the NAP, and "N42D-V-FB107.ncf" is for a network configured to use Network ID 42 with a FB107 as the NAP.

Select a network configuration file and click **Open**. Remember that the type of controller (FB107 or ROC800) **must** match the controller in the new network. The program displays the RTU Network screen, showing the Module/Network tab.

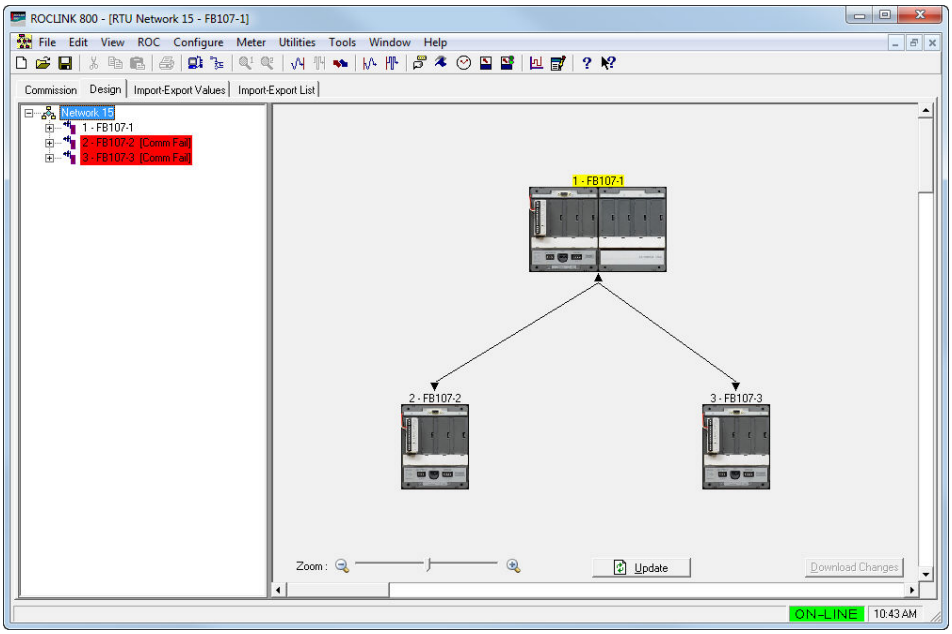


Figure 3-41. Design tab

5. Select the **Commission** tab.

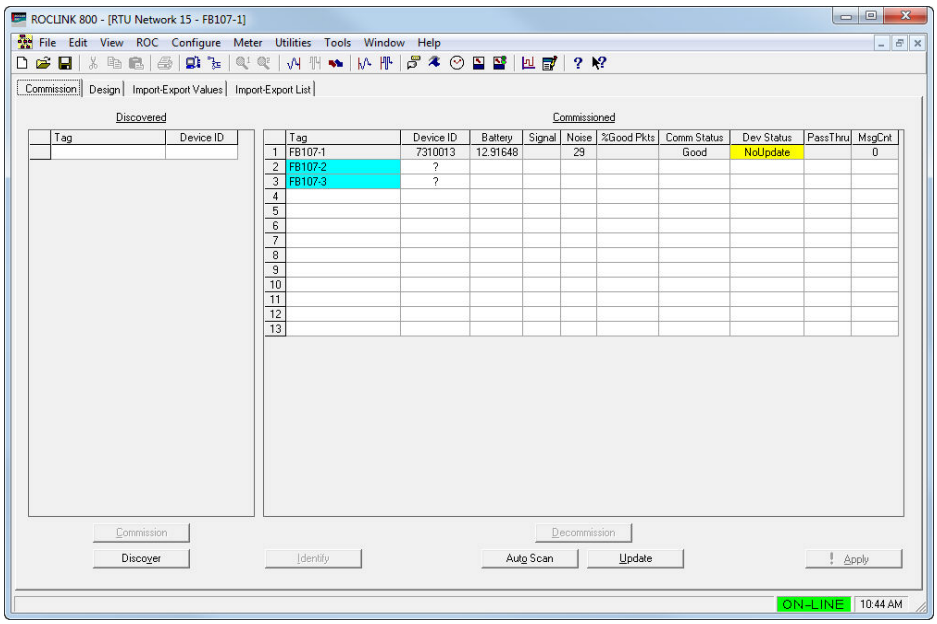


Figure 3-42. Commission screen

Notice in the Commissioned list that the three FB107 nodes are highlighted in blue **and** that the Device ID for each device is a question mark (?). This indicates that the program has used another network's template but the definitions for those nodes are no longer valid.

6. Click **Discover**. Once the program locates all the nodes associated with your new network, click **Stop Discovery**.

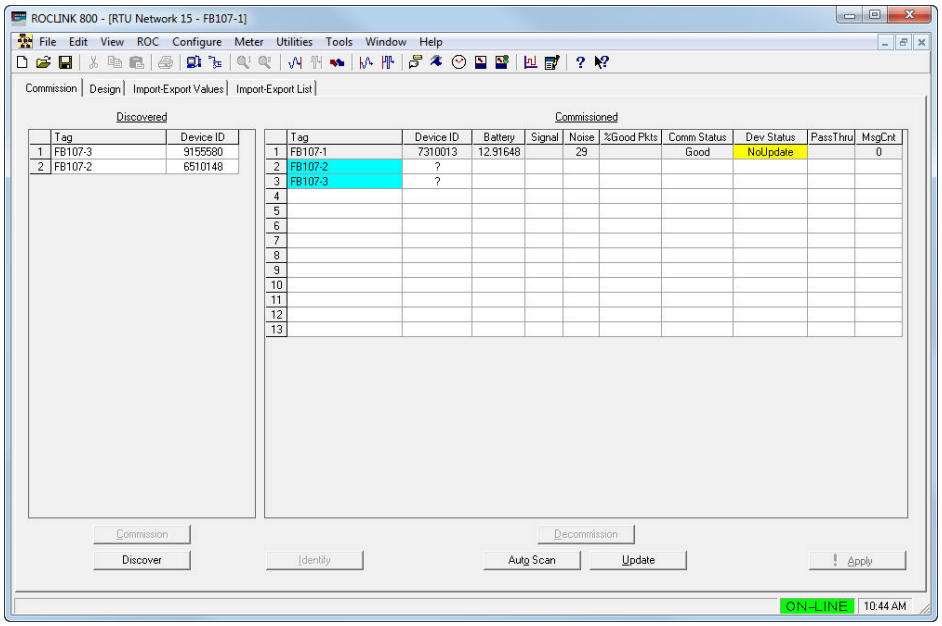


Figure 3-43. Commission screen (with Devices)

7. Click and drag the first node in the Discovered list on top of the first node in the Commissioned list. The program displays a dialog:

8. Click **Yes**. This enables the new node to assume the **same export and import values** you defined for the original network. (You can always change these values later.) When the node is commissioned, the screen removes the blue highlighting **and** provides the node's device ID:

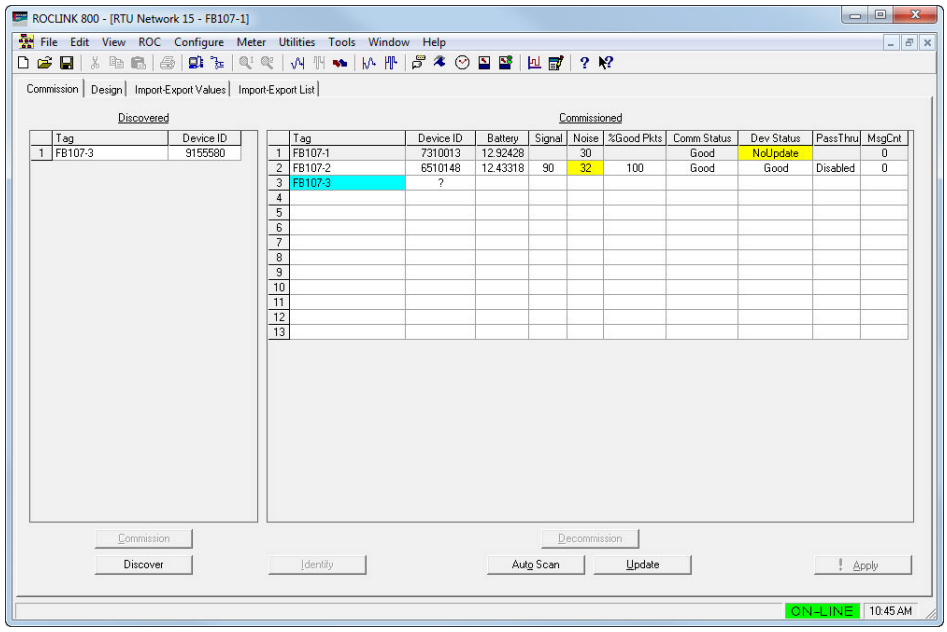


Figure 3-44. Commission Device screen (1)

Note: You must repeat the drag-and-drop for **each** device. Because of the import and export definitions, the program does not allow a “mass” drag-and-drop.

9. Repeat the drag-and-drop for each device. Because of the import and export definitions, the program does not allow a “mass” drag-and-drop. When you are finished, the highlighting is gone and each node has a device ID:

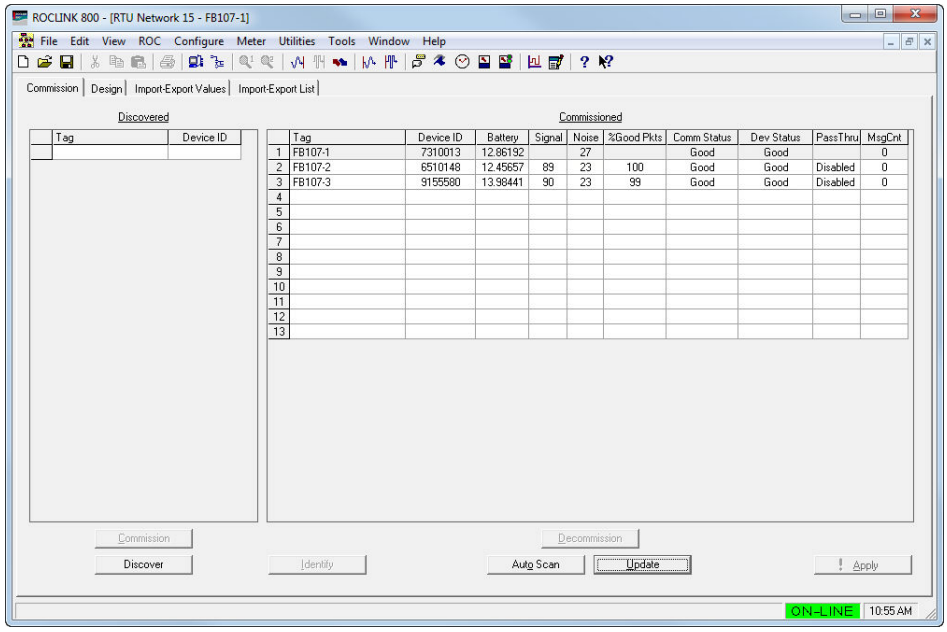


Figure 3-45. Commission Device screen (2)

10. Select the **Design** tab, which displays the design workspace and shows the imports and exports defined for your new network.

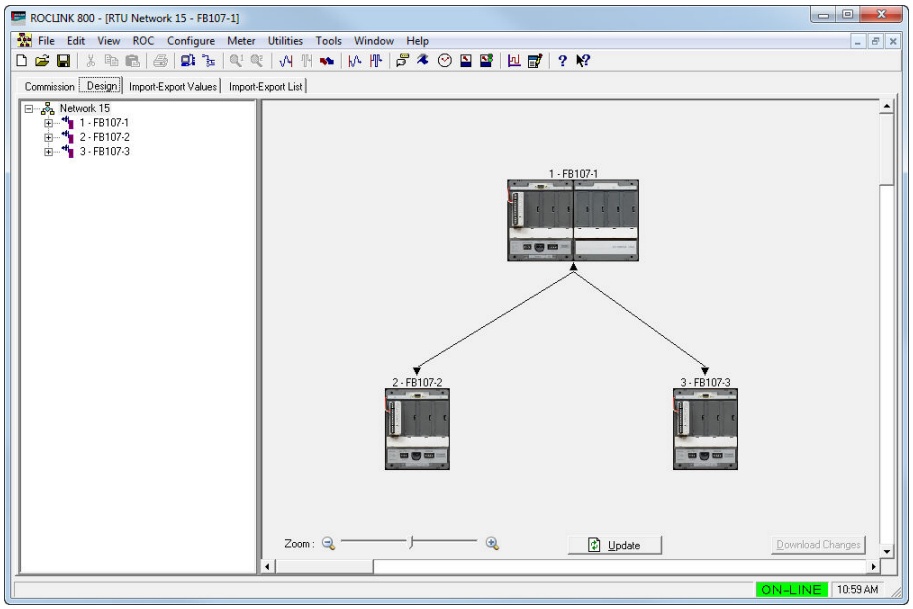


Figure 3-46. Design Workspace

11. Click **Download Changes** to save the new network configuration and download the import/export definitions into the NAP and nodes.

Note: At this point you can review the defined imports/exports and make any adjustments necessary for this particular network. Remember that you can click the **Import-Export Values** tab to quickly review these values for each device.

Repeat this process as necessary to create the networks you need.

3.3.11 Restoring a Single Device Configuration

You can restore the input and output configurations for a single device on your network. This is useful if a device experiences a hardware failure or you completely replace the device.

To restore the configuration of a single device:

1. Verify the device being restored is configured with the correct Network ID and channel.
2. Connect to the NAP using ROCLINK 800.
3. Open the RTU Network screen and select the Design tab.
4. Right-click the device label in the device tree of the device you wish to restore. The system displays the following menu:

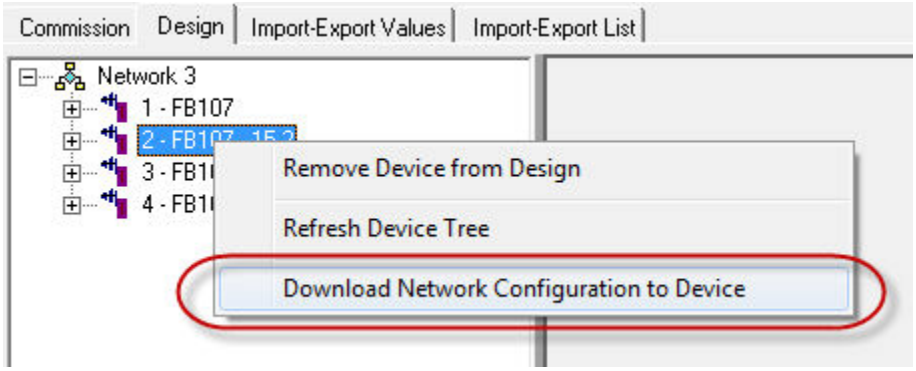
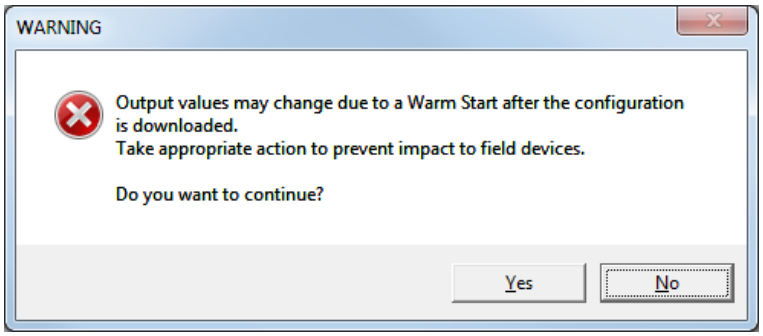


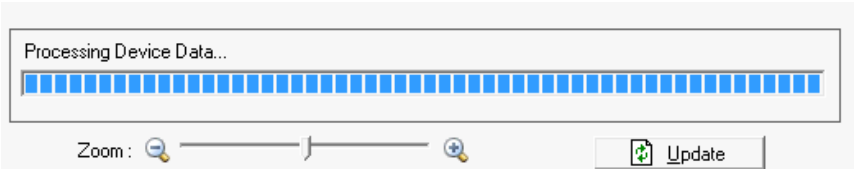
Figure 3-47. Pop-up Menu: Device Tree

5. Select **Download Network Configuration to Device**. The system displays a warning dialog:

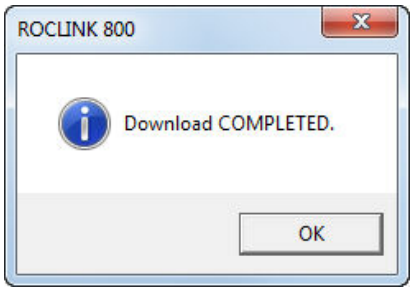
6. Click **Yes** to continue, The system displays a warning dialog:



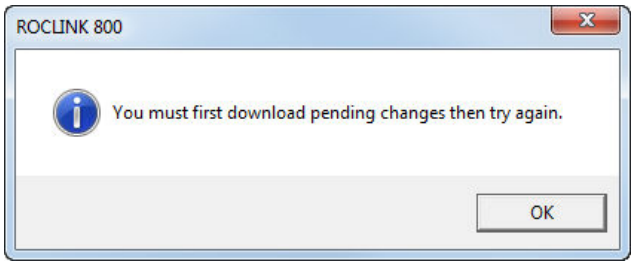
7. Click **Yes** to continue. The system displays a progress indicator at the bottom of the design workspace as it restores values to each device.



8. After downloading values to all devices, the system warm starts all devices and then displays a completion dialog:



Note: If a device label on the design workspace contains an asterisk, ROCLINK 800 does not allow you to perform this action, and displays a warning dialog:



Click **OK** to close this dialog. Then either select **Download Changes** to save any pending changes to the affected devices (this action saves any changes you have made to the network) or close the RTU Network screen completely before retrying the download (this action discards any changes and preserves your current configuration).

3.3.12 Restoring an Entire Network Configuration

You can restore the entire network to a previously saved state. The system saves the network configuration file as part of the device configuration file (.800) when you save the configuration of the NAP (**File>Save Configuration**). You can use this file to restore all input/output configurations for all devices on the network.

1. Connect to each node using ROCLINK 800 and verify all devices are configured with the correct Network ID and channel.
2. Connect to the NAP using ROCLINK 800.
3. Select **File>Download** to load the previously saved configuration file (.800) that contains the correct network configuration.
4. Click **Select All** to select all points in the configuration file to be downloaded.
5. Click **Download** to begin downloading the configuration to the device.
6. Select **Close** when the download completes.

7. Select the NRM module and click **Configure**. The RTU Network displays showing the Design tab.
8. Right-click the network label in the device tree. The system displays the following menu:

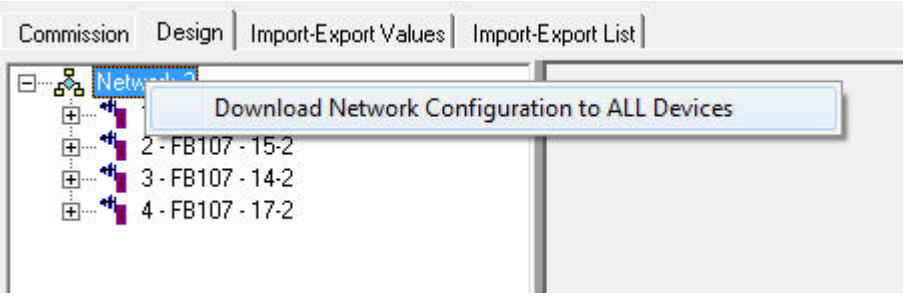
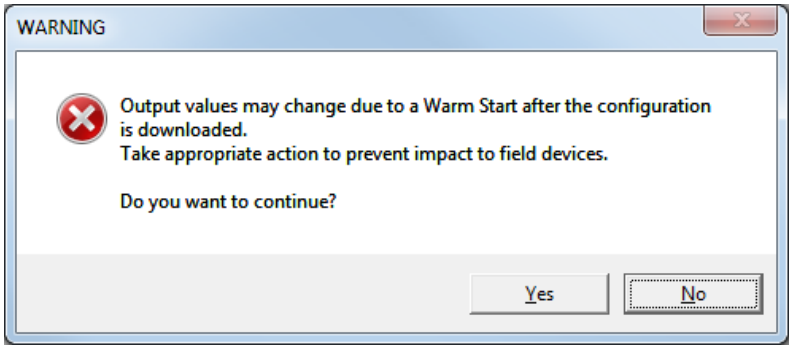


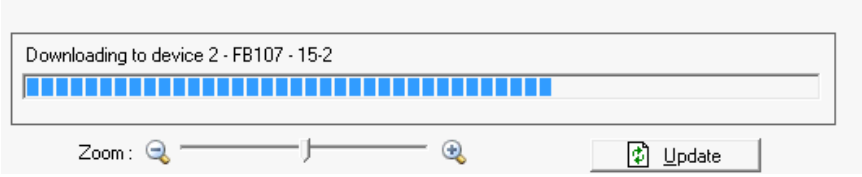
Figure 3-48. Pop-up Menu: Network

9. Select this option. The system displays a warning dialog:

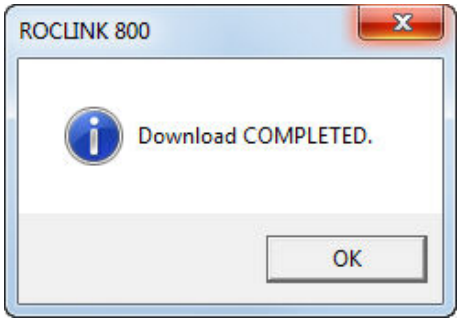
10. Click **Yes** to continue. The system displays a warning dialog:



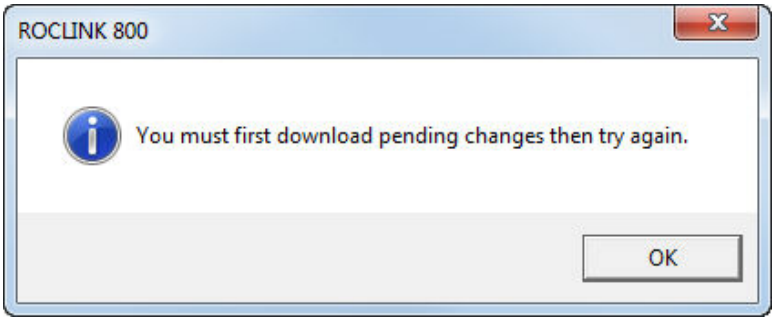
11. -Click **Yes** to continue. The system displays a progress indicator at the bottom of the design workspace as it restores values to each device.



12. After downloading values to all devices, the system warm starts all devices and then displays a completion dialog:



Note: If a device label on the design workspace contains an asterisk, ROCLINK 800 does not allow you to perform this action, and displays a warning dialog:



Click **OK** to close this dialog. Then either select **Download Changes** to save any pending changes to the affected devices (this action saves any changes you have made to the network) or close the RTU Network screen completely before retrying the download (this action discards any changes and preserves your current configuration).

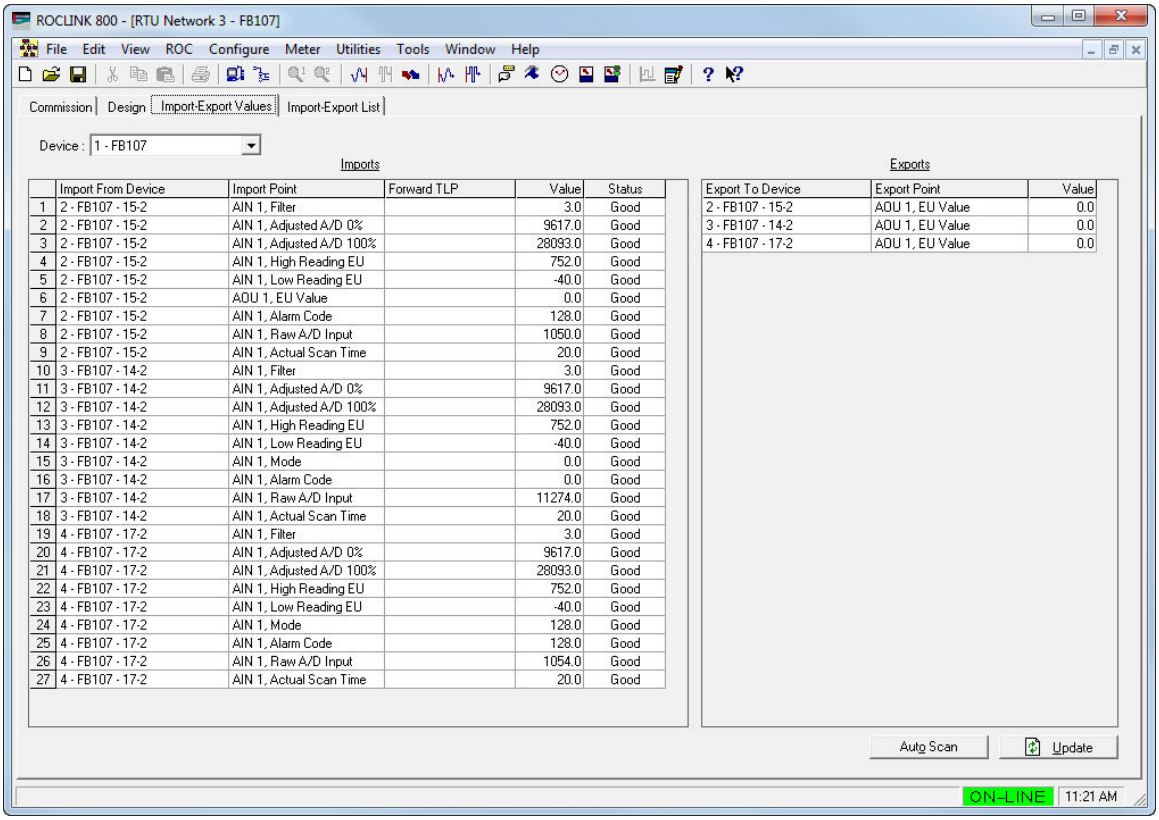
3.4 Import-Export Values Tab

Note: If your network access point is a FB107, click **Configure** and then select the **Import-Export Values** tab to access this screen. If your network access point is a ROC800, select the **Import-Export Values** tab.

This screen provides a **read-only** table that lists the current import and export values for a selected device (either node or NAP). The system updates these real-time values whenever you display this screen.

Notes:

- If the connected device is **configured as a node**, the Device drop-down list only contains the currently connected device. If the connected device is **configured as a NAP**, the Device drop-down list contains every device on the network.\
- All Import/Export configuration is done on the design tab. You **cannot** change the values on this tab.



	Import From Device	Import Point	Forward TLP	Value	Status
1	2 - FB107 - 15-2	AIN 1, Filter		3.0	Good
2	2 - FB107 - 15-2	AIN 1, Adjusted A/D 0%		9617.0	Good
3	2 - FB107 - 15-2	AIN 1, Adjusted A/D 100%		28093.0	Good
4	2 - FB107 - 15-2	AIN 1, High Reading EU		752.0	Good
5	2 - FB107 - 15-2	AIN 1, Low Reading EU		-40.0	Good
6	2 - FB107 - 15-2	AOU 1, EU Value		0.0	Good
7	2 - FB107 - 15-2	AIN 1, Alarm Code		128.0	Good
8	2 - FB107 - 15-2	AIN 1, Raw A/D Input		1050.0	Good
9	2 - FB107 - 15-2	AIN 1, Actual Scan Time		20.0	Good
10	3 - FB107 - 14-2	AIN 1, Filter		3.0	Good
11	3 - FB107 - 14-2	AIN 1, Adjusted A/D 0%		9617.0	Good
12	3 - FB107 - 14-2	AIN 1, Adjusted A/D 100%		28093.0	Good
13	3 - FB107 - 14-2	AIN 1, High Reading EU		752.0	Good
14	3 - FB107 - 14-2	AIN 1, Low Reading EU		-40.0	Good
15	3 - FB107 - 14-2	AIN 1, Mode		0.0	Good
16	3 - FB107 - 14-2	AIN 1, Alarm Code		0.0	Good
17	3 - FB107 - 14-2	AIN 1, Raw A/D Input		11274.0	Good
18	3 - FB107 - 14-2	AIN 1, Actual Scan Time		20.0	Good
19	4 - FB107 - 17-2	AIN 1, Filter		3.0	Good
20	4 - FB107 - 17-2	AIN 1, Adjusted A/D 0%		9617.0	Good
21	4 - FB107 - 17-2	AIN 1, Adjusted A/D 100%		28093.0	Good
22	4 - FB107 - 17-2	AIN 1, High Reading EU		752.0	Good
23	4 - FB107 - 17-2	AIN 1, Low Reading EU		-40.0	Good
24	4 - FB107 - 17-2	AIN 1, Mode		128.0	Good
25	4 - FB107 - 17-2	AIN 1, Alarm Code		128.0	Good
26	4 - FB107 - 17-2	AIN 1, Raw A/D Input		1054.0	Good
27	4 - FB107 - 17-2	AIN 1, Actual Scan Time		20.0	Good

Export To Device	Export Point	Value
2 - FB107 - 15-2	AOU 1, EU Value	0.0
3 - FB107 - 14-2	AOU 1, EU Value	0.0
4 - FB107 - 17-2	AOU 1, EU Value	0.0

Figure 3-49. Import-Export Values screen

If you have selected a device on the design workspace, this screen opens displaying the values for that device. If you have not selected a device on the design workspace, this screen opens displaying the values for the NAP.

Note: You can also access this screen by double-clicking on a device on the design workspace.

Field	Description		
Device	Click ▼ to select a device on your network and display all import and export configurations for the selected device.		
Imports	This **read-only** table shows all data points being imported to the selected device. The table includes:		
	Import From Device	Shows the device description from which the import data is originating. The description is comprised of a number (the device location in the table on the Commission tab) and the device tag.	
	Import Point	Shows the data point in the source device that is being imported to the selected device.	
	Forward TLP	Shows the TLP to which the imported data is being forwarded.	
	Value	Shows the current value of the import data point.	
	Status	Shows the current condition of the import data point. Valid values are:	
		Good	The import data point condition is good.
		No Update	The selected device has failed to return a value for the import during the previous 10 seconds.
		Point Alarm	The data point is currently reporting an active alarm (for example, an analog input is reporting a low alarm).
		Point Fail	The hardware of the source device is reporting a malfunction.
Exports	This **read-only** table shows all data points being exported from the selected device. The table includes:		
	Export to Device	Shows the device description for to which the export is being sent. The description consists of a number (the device location in the table on the Commission tab)	

Field	Description	
		and the device tag.
	Export Point	Shows the data point being exported to the selected device.
	Value	Shows the current value of the export data point.
Auto Scan	Click to begin a real-time once-per-second continual update of the displayed values. The update continues until you click **Stop Scan**. During Auto Scan you cannot select another device.	
Update	Click to immediately update the display to the values obtained in the last once-per-period system scan.	

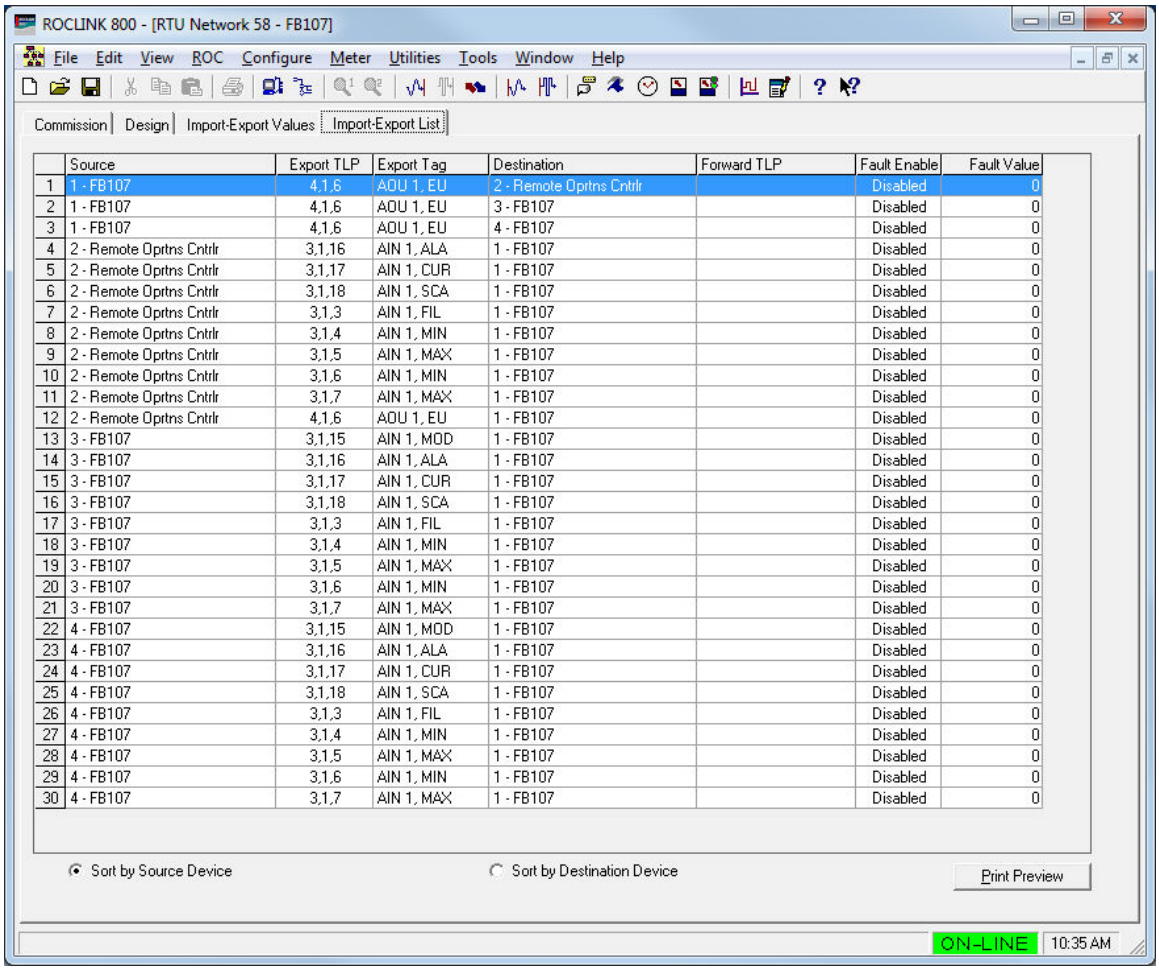
3.5 Import-Export List Tab

Note: If your network access point is a FB107, click **Configure** and then select the **Import-Export List** tab to access this screen. If your network access point is a ROC800, select the **Import-Export List** tab.

This screen is a table that lists the assigned import and export values for **all** devices in the network (either node or NAP). You **cannot** change these values.

Notes:

- This tab is **only** available through the Network Access Point.
- All Import/Export configuration is done on the Design tab. You **cannot** change the values on this tab.



	Source	Export TLP	Export Tag	Destination	Forward TLP	Fault Enable	Fault Value
1	1 - FB107	4,1,6	AOU 1, EU	2 - Remote Oprtns Cntrlr		Disabled	0
2	1 - FB107	4,1,6	AOU 1, EU	3 - FB107		Disabled	0
3	1 - FB107	4,1,6	AOU 1, EU	4 - FB107		Disabled	0
4	2 - Remote Oprtns Cntrlr	3,1,16	AIN 1, ALA	1 - FB107		Disabled	0
5	2 - Remote Oprtns Cntrlr	3,1,17	AIN 1, CUR	1 - FB107		Disabled	0
6	2 - Remote Oprtns Cntrlr	3,1,18	AIN 1, SCA	1 - FB107		Disabled	0
7	2 - Remote Oprtns Cntrlr	3,1,3	AIN 1, FIL	1 - FB107		Disabled	0
8	2 - Remote Oprtns Cntrlr	3,1,4	AIN 1, MIN	1 - FB107		Disabled	0
9	2 - Remote Oprtns Cntrlr	3,1,5	AIN 1, MAX	1 - FB107		Disabled	0
10	2 - Remote Oprtns Cntrlr	3,1,6	AIN 1, MIN	1 - FB107		Disabled	0
11	2 - Remote Oprtns Cntrlr	3,1,7	AIN 1, MAX	1 - FB107		Disabled	0
12	2 - Remote Oprtns Cntrlr	4,1,6	AOU 1, EU	1 - FB107		Disabled	0
13	3 - FB107	3,1,15	AIN 1, MOD	1 - FB107		Disabled	0
14	3 - FB107	3,1,16	AIN 1, ALA	1 - FB107		Disabled	0
15	3 - FB107	3,1,17	AIN 1, CUR	1 - FB107		Disabled	0
16	3 - FB107	3,1,18	AIN 1, SCA	1 - FB107		Disabled	0
17	3 - FB107	3,1,3	AIN 1, FIL	1 - FB107		Disabled	0
18	3 - FB107	3,1,4	AIN 1, MIN	1 - FB107		Disabled	0
19	3 - FB107	3,1,5	AIN 1, MAX	1 - FB107		Disabled	0
20	3 - FB107	3,1,6	AIN 1, MIN	1 - FB107		Disabled	0
21	3 - FB107	3,1,7	AIN 1, MAX	1 - FB107		Disabled	0
22	4 - FB107	3,1,15	AIN 1, MOD	1 - FB107		Disabled	0
23	4 - FB107	3,1,16	AIN 1, ALA	1 - FB107		Disabled	0
24	4 - FB107	3,1,17	AIN 1, CUR	1 - FB107		Disabled	0
25	4 - FB107	3,1,18	AIN 1, SCA	1 - FB107		Disabled	0
26	4 - FB107	3,1,3	AIN 1, FIL	1 - FB107		Disabled	0
27	4 - FB107	3,1,4	AIN 1, MIN	1 - FB107		Disabled	0
28	4 - FB107	3,1,5	AIN 1, MAX	1 - FB107		Disabled	0
29	4 - FB107	3,1,6	AIN 1, MIN	1 - FB107		Disabled	0
30	4 - FB107	3,1,7	AIN 1, MAX	1 - FB107		Disabled	0

Figure 3-50. Import-Export List Tab

Field	Description
Source	This **read-only** field shows the device originating the import data. The description consists of a

Field	Description
	number (the device location in the table on the Commission tab) and the device tag.
Export TLP	This **read-only** field shows the data point of the import in the originating device.
Export Tag	This **read-only** field shows the name associated with the data point of the import in the originating device.
Destination	This **read-only** field shows to which device the import data is being sent. The description contains a number (the location of the device in the table on the Commission tab) and the device tag.
Forward TLP	This **read-only** field shows the TLP to which the import data is sent.
Fault Enable	This **read-only** field shows if a fault value has been enabled for the selected export. If enabled and a point failure occurs, the system uses this value set in the Fault Value field for the selected export value.
Fault Value	This **read-only** field shows the user-entered value for the selected export.
Sort by Source Device	Select to sort the table according to the source device of the exported data.
Source by Destination Device	Select to sort the table according to the destination device of the exported data.
Print Preview	Click to print the list or export it to a file. When the Print Preview screen appears, click **Print** to send the list to a printer. You may also set the PDF, Excel, Txt, HTML or RTF buttons to export the list as a file in those formats.
Auto Scan	Click to begin a real-time once-per-second continual update of the displayed values. The update continues until you click Stop Scan. During Auto Scan you cannot select another device.
Update	Click to immediately update the display to the values obtained in the last once-per-second system scan.

Creating this template allows the technician to quickly configure a network based on a standardized format. Of course, the technician can remove or add imports and exports based on the specific requirements for the individual network, but using a network template speeds the initial installation process.

Appendix A – Glossary

Note: This is a generalized glossary of terms. Not all the terms may necessarily correspond to the particular device or software described in this manual. For that reason, the term "ROC" is used to identify all varieties of Remote Operations Controllers (including ROC800-Series, ROC800L, DL8000, FloBoss™ 107, and FloBoss™ 100-Series). Refer to *Measurement Units, Symbols, and Abbreviations* (Form A6302) for additional information.

A

A/D	Analog to Digital signal conversion.
ABS	Acrylonitrile Butadiene Styrene.
ADC	Analog to Digital Converter. Used to convert analog inputs (AI) to a format the flow computer can use.
AGA	American Gas Association. A professional organization that oversees the AGA3 (orifice), AGA5 (heating value), AGA7 (turbine), AGA8 (compressibility), and AGA11 (ultrasonic) gas flow calculation standards. See http://www.aga.org.
AWG	American Wire Gauge.
AI	Analog Input.
AO	Analog Output.
Analog	Analog data is represented by a continuous variable, such as an electrical current signal.
AP	Absolute Pressure.
API	American Petroleum Institute. See http://www.api.org.
Area	A user-defined grouping of database entities.
ASCII	American (National) Standard Code for Information Interchange.
Attribute	A parameter that provides information about an aspect of a database point. For example, the alarm attribute is an attribute that uniquely identifies the configured value of an alarm.

B

BMV	Base Multiplier Value, used in AGA7 (turbine) calculations.
BPS	Bits Per Second, associated with baud rate.
BTU	British Thermal Unit, a measure of heat energy.
Built-in I/O	I/O channels that are fabricated into the ROC and do not require a separate option. Also called "on-board" I/O.

C

C1D2	Class 1, Division 2 hazardous area
CMOS	Complementary Metal Oxide Semiconductor, a type of microprocessor used in a ROC.
Coil	Digital output, a bit to be cleared or set.
COL	Ethernet Packet Collision.
COM	Communications port on a personal computer (PC).

C (continued)

COMM	Communications port on a ROC used for host communications. . **Note**: On FloBoss 500-Series and FloBoss 407s, COMM1 is built-in for RS-232 serial communications.
Comm Module	Module that plugs into a ROC to provide a channel for communications via a specified communications protocol, such as EIA-422 (RS-422) or HART.
CF	Compare Flag; stores the Signal Value Discrete (SVD).
Configuration	Refers either to the process of setting up the software for a given system or the result of performing this process. The configuration activity includes editing the database, building schematic displays and reports, and defining user calculations. Typically, the software setup of a device that can often be defined and changed. Can also mean the hardware assembly scheme.
Configuration Tree	In ROCLINK 800, the graphical display that appears when a configuration file opens. It is a hierarchical branching ("tree-style") method for navigating within the configuration screens.
CPU	Central Processing Unit.
CRC	Cyclical Redundancy Check error checking.
Crosstalk	The amount of signal that crosses over between the receive and transmit pairs, and signal attenuation, which is the amount of signal loss encountered on the Ethernet segment.
CSA	Canadian Standards Association. See http://www.csa.ca.
CSMA/CD	Carrier Sense Multiple Access with Collision Detection.
CTS	Clear to Send modem communications signal.

D

D/A	Digital to Analog signal conversion.
DB	Database.
dB	Decibel. A unit for expressing the ratio of the magnitudes of two electric signals on a logarithmic scale.
dBm	Power ratio in decibels (dB), referenced to one milliwatt (mW), also known as dBmW.
DCD	**Data Carrier Detect** modem communications signal. In addition, **Discrete Control Device** – A discrete control device energizes a set of discrete outputs for a given setpoint and matches the desired result against a set of discrete inputs (DI).
DCE	Data Communication Equipment.
Deadband	A value that is an inactive zone above the low limits and below the high limits. The purpose of the deadband is to prevent a value (such as an alarm) from being set and cleared continuously when the input value is oscillating around the specified limit. This also prevents the logs or data storage location from being over-filled with data.
Device Directory	In ROCLINK 800, the graphical display that allows navigation through the PC Comm Ports and ROC Comm Ports setup screen.
DI	Discrete Input.
Discrete	Input or output that is non-continuous, typically representing two levels (such as on/off).
DMM	Digital multimeter.
DO	Discrete Output.
Download	The process of sending data, a file, or a program from a PC to a ROC.
DP	Differential Pressure.
DRN	Distributed RTU Network, in which two or more remotely distributed RTU devices (RRTUs) are wirelessly connected in a peer-to-peer network to share data.

D (continued)

DRTU	A primary component of the Distributed RTU Network, consisting of a FB107 chassis housing a focused functionality CPU and a Network Radio module (NRM). The DRTU collects process variables from one or more wellheads and transmits the signals throughout the designed network.
DSR	Data Set Ready modem communications signal.
DTE	Data Terminal Equipment.
DTR	Data Terminal Ready modem communications signal.
Duty Cycle	Proportion of time during a cycle that a device is activated. A short duty cycle conserves power for I/O channels, radios, and so on.
DVM	Digital voltmeter.
DVS	Dual-Variable Sensor. A device that provides static and differential pressure inputs to a ROC.

E

EDS	Electronic Static Discharge.
EEPROM	Electrically Erasable Programmable Read-Only Memory, a form of permanent memory on a ROC.
EFM	Electronic Flow Metering or Measurement.
EIA-232 (RS-232)	Serial Communications Protocol using three or more signal lines, intended for short distances. Concerning RS232D and RS232C, the letters C or D refer to the physical connector type. D specifies the RJ-11 connector where a C specifies a DB25 type connector.
EIA-422 (RS-422)	Serial Communications Protocol using four signal lines.
EIA-485 (RS-485)	Serial Communications Protocol requiring only two signal lines. Can allow up to 32 devices to be connected together in a daisy-chained fashion.
EMF	Electro-Motive Force.
EMI	Electro-Magnetic Interference.
ESD	Electro-Static Discharge.
EU	Engineering Units. Units of measure, such as MCF/DAY.

F

FCC	Federal Communications Commission. See http://www.fcc.gov.
Firmware	Internal software that is factory-loaded into a form of ROM. In a ROC, the firmware supplies the software used for gathering input data, converting raw input data values, storing values, and providing control signals.
FlashPAC module	ROM and RAM module for a ROC300-Series unit that contains the operating system, applications firmware, and communications protocol.
Flash ROM	A type of read-only memory that can be electrically re-programmed. It is a form of permanent memory (requires no backup power). Also called Flash memory.
FloBoss	A microprocess-based device that provides flow calculations, remote monitoring, and remote control. A FloBoss is a type of ROC.
FM	Factory Mutual.
Force	Write an ON/OFF, True/False, or 1/0 value to a coil.
FOUNDATION™ Fieldbus	An open architecture for information integration, managed by the Fieldbus Foundation (www.fieldbus.org).
FPV	Compressibility Factor.

F (continued)

FSK	Frequency Shift Keypad.
FST	Function Sequence Table, a type of user-written program in a high-level language designed by Emerson Process Management's Flow Computer Division.
Ft	Foot or feet.

G

GFA	Ground Fault Analysis.
GHz	Gigahertz, 10^9 cycles per second
GND	Electrical ground, such as used by the ROC's power supply.
GP	Gauge Pressure.

H

H1	A Foundation Fieldbus protocol operating at 31.25 kbit/s that interconnects field devices (such as sensors or I/O devices).
HART	Highway Addressable Remote Transducer.
Holding Register	Analog output number value to be read.
HSE Protocol	High Speed Ethernet protocol; a communications protocol operating at 100 Mbit/s used to integrate high-speed controllers (or servers) connected via Ethernet.
Hw	Differential pressure.
Hz	Hertz.

I, J

IC	Integrated Circuit. Also, Industry Canada (more recently known as Measurement Canada), an organization that grants custody transfer approvals on certain ROC units.
ID	Identification.
IEC	Industrial Electrical Code or International Electrotechnical Commission. See http://www.iec.ch.
IEEE	Institute of Electrical and Electronic Engineers. A professional organization that, in conjunction with the International Standards Organization (ISO), establishes and maintains the Open System Interconnection (OSI) reference model and an international standard for the organization of local area networks (LANs). Refer to http://www.ieee.org.
IMV	Integral Multiplier Value, used in AGA3 (orifice) calculations.
Input	Digital input, a bit to be read.
Input Register	Input numeric value to be read.
Local Port	Also LOI; the serial EIA-232 (RS-232) port on the ROC through which local communications are established, typically for configuration software running on a PC.
I/O	Input/Output.
I/O Module	Module that plugs into an I/O slot on a ROC to provide an I/O channel.
IRQ	Interrupt Request. Hardware address oriented.
ISO	International Standards Organization. See http://www.iso.ch.
IV	Integral Value.

K

KB	Kilobytes.
kHz	KiloHertz.

L

LCD	Liquid Crystal Display.
LDP	Local Display Panel, a display-only device that plugs into ROC300-Series units (via a parallel interface cable) used to access information stored in the ROC.
LED	Light-Emitting Diode.
Logical Number	The point number the ROC and ROC Plus protocols use for I/O point types are based on a physical input or output with a terminal location; the point numbers for all other point types are “logical” and are simply numbered in sequence.
LNK	Ethernet has linked.
LOI	Local Operator Interface (or Local Port). Refers to the serial EAI-232 (RS-232) port on the ROC through which local communications are established, typically for configuration software running on a PC.
LPM	Lightning Protection Module; a device that provides lightning and power surge protection for ROCs.
LRC	Longitudinal Redundancy Checking error checking.

M

m	Meter.
mA	Milliamp(s); one thousandth of an ampere.
MAC Address	Media Access Control Address; a hardware address that uniquely identifies each node of a network.
Manual mode	For a ROC, indicates that the I/O scanning has been disabled.
MAU	Medium Attachment Unit.
MCU	Master Controller Unit.
Modbus	A popular device communications protocol developed by Gould-Modicon.
MPU	Micro-Processor Unit.
mm	Millimeter.
MMBTU	Million British Thermal Units.
msec	Millisecond, or 0.001 second.
MVS	Multi-Variable Sensor. A device that provides differential pressure, static pressure, and temperature inputs to a ROC for orifice flow calculations.
mV	Millivolts, or 0.001 volt.
mW	Milliwatts, or 0.001 watt.

N

NAP	Network Access Point; the point in the distributed RTU network at which ROCLINK 800
NEC	National Electrical Code.
NEMA	National Electrical Manufacturer’s Association. See *http://www.nema.org*.

N (continued)

Node A basic structural component of the Distributed RTU Network. A node (usually a FB107 chassis housing a focused-functionality CPU and a Network Radio module) provides a data collection point that wirelessly transmits data throughout the designed network.

NRM Network Radio module; a module used in both the FloBoss 107 and ROC00-Series based devices to wirelessly transmit information throughout the distributed RTU network.

O

OH Off-Hook modem communications signal.

Off-line Accomplished while the target device is not connected (by a communications link). For example, “off-line configuration” refers to configuring an electronic file that is later loaded into a ROC.

Ohms Units of electrical resistance.

On-line Accomplished while connected (by a communications link) to the target device. For example, “on-line configuration” refers to configuring a ROC800-Series unit while connected to it, so that you can view the current parameter values and immediately load new values.

Opcode Type of message protocol the ROC uses to communicate with the configuration software, as well as host computers with ROC driver software.

Operator Interface Also LOI or Local Port; the serial EIA-232 (RS-232) port on the ROC through which local communications are established, typically for configuration software running on a PC.

Orifice meter A meter that records the flow rate of gas through a pipeline. The flow rate is calculated from the pressure differential created by the fluid passing through an orifice of a particular size and other parameters.

P, Q

Parameter A property of a point that typically can be configured or set. For example, the Point Tag ID is a parameter of an Analog Input point. Parameters are normally edited by using configuration software running on a PC.

PC Personal Computer.

Pf Flowing pressure.

P/DP Pressure/Differential Pressure.

PI Pulse Input.

PID Proportional, Integral, and Derivative control feedback action.

PIT Periodic Timer Interrupt.

PLC Programmable Logic Controller.

Point Software-oriented term for an I/O channel or some other function, such as a flow calculation. Points are defined by a collection of parameters.

Point Number The physical location of an I/O point (module slot and channel) as installed in the ROC.

Point Type Defines the database point to be a specific type of point available to the system. The point type determines the basic functions of a point.

Preset Number value previously determined for a register.

PRI Primary PID control loop.

Protocol A set of standards that enables communication or file transfers between two computers. Protocol parameters include baud rate, parity, data bits, stop bit, and the

	type of duplex.
PSTN	Public Switched Telephone Network.
PT	Process Temperature.
PTT	Push-to-Talk signal.
Pulse	Transient variation of a signal whose value is normally constant.
Pulse Interface module	A module that provides line pressure, auxiliary pressure, and pulse counts to a ROC.
PV	Process Variable or Process Value.

R

Rack	A row of slots on a ROC into which I/O modules can be plugged. Racks are given a letter to physically identify the location of an I/O channel (such as “A” for the first rack). Built-in I/O channels are assigned a rack identifier of “A” while diagnostic I/O channels are considered to be in “E” rack.
RAM	Random Access Memory. RAM is used to store history, data, most user programs, and additional configuration data.
RBX	Report-by-exception. RBX always refers to Spontaneous RBX in which the ROC contacts the host to report an alarm condition.
RR	Results Register; stores the Signal Value Analog (SVA).
RFI	Radio Frequency Interference.
RI	Ring Indicator modem communications signal.
ROC	Remote Operations Controller microprocessor-based unit that provides remote monitoring and control.
ROCLINK 800	Microsoft® Windows®-based software used to configure functionality in ROC units.
ROM	Read-only memory. Typically used to store firmware. Flash memory.
Rotary Meter	A positive displacement meter used to measure flow rate, also known as a Roots meter.
RTC	Real-Time Clock.
RTD	Resistance Temperature Detector.
RTS	Ready to Send modem communications signal.
RTU	Remote Terminal Unit.
RTV	Room Temperature Vulcanizing, typically a sealant or caulk such as silicon rubber.
RS-232	Serial Communications Protocol using three or more signal lines, intended for short distances. Also referred to as the EIA-232 standard.
RS-422	Serial Communications Protocol using four signal lines. Also referred to as the EIA-422 standard.
RS-485	Serial Communications Protocol requiring only two signal lines. Can allow up to 32 devices to be connected together in a daisy-chained fashion. Also referred to as the EIA-485 standard.
RX or RXD	Received Data communications signal.

S

SAMA	Scientific Apparatus Maker’s Association.
SCADA	Supervisory control and data acquisition; referring to a computer system that monitors and controls oil and gas pipeline systems.

S (continued)

Script	An uncompiled text file (such as keystrokes for a macro) that a program interprets in order to perform certain functions. Typically, the end user can easily create or edit scripts to customize the software.
Soft Points	A type of ROC point with generic parameters that can be configured to hold data as desired by the user.
SP	Setpoint, or Static Pressure.
SPI	Slow Pulse Input.
SPK	Speaker.
SRAM	Static Random Access Memory. Stores data as long as power is applied; typically backed up by a lithium battery or supercapacitor.
SRBX	Spontaneous Report-By-Exception. SRBX always refers to Spontaneous RBX in which the ROC contacts the host to report an alarm condition.
SVA	Signal Value Analog. Stored in the Results Register, it is the analog value that is passed between functions in an FST.
SVD	Signal Value Discrete. Stored in the Compare Flag, it is the discrete value that is passed down the sequence of functions in an FST.
System Variables	Configured parameters that describe the ROC; set using ROCLINK software.

T

T/C	Thermocouple Input.
TCP/IP	Transmission Control Protocol/Internet Protocol.
TDI	Time Duration Input.
TDO	Time Duration Output.
Tf	Flowing temperature.
TLP	Type (of point), Logical (or point) number, and Parameter number.
TX or TXD	Transmitted Data communications signal.
Turbine meter	A device used to measure flow rate and other parameters.

U

Upload	Send data, a file, or a program from the ROC to a PC or other host.
USB	Universal Serial Bus, a serial bus standard used to connect devices.

V-Z

V	Volts.

Appendix B – Optimizing Wireless Communications

The success of your distributed network of RTUs depends on a number of factors, none more important than how you manage the ability of the RTUs to effectively communicate with each other. This appendix provides general principles on how to optimize wireless communications.

Note: This information is focused on wireless communications. For specific information on installing the components of your Distributed RTU™ Network (DRN), refer to *Chapter 2* of this manual. For information on configuring and commissioning the DRN components, refer to *Chapter 3*.

In This Chapter

B.1 Wireless Basics

The radio installed in the Network Radio module (NRM) is particularly suited to the kind of terrain you might encounter when setting up your network nodes on remotely located wellpads. With a line-of-sight (LOS) range of 20 km (12.4 miles), a wide range of operating temperatures, a low power requirement, a high noise immunity, and use of spread spectrum transmission (rather than narrow band transmission), the GXM radio operates more consistently and reliably in a unfriendly environment.

Note: For detailed specifications on the NRM, refer to the product data sheets *FloBoss™ 107 Network Radio Module* (Form FB107:NRM) or the *ROC800-Series Network Radio Module* (Form ROC800:NRM), both available on the Remote Automation Solutions website.

B.1.1 Line-of-Sight

Assessing line-of-sight is essential as you place your nodes. Be aware of objects (mountains, buildings, trees, or infrastructures such as high-power lines) which could block or otherwise impede a clear signal. Consider as well the earth's curvature, which begins to affect line-of-sight between 5-7 miles.

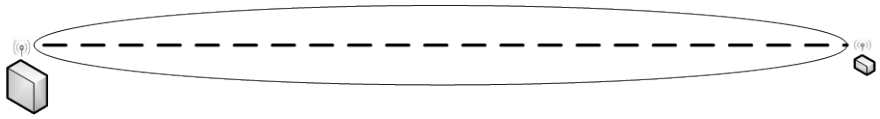


Figure B-1. Line of Sight

Figure B-1 shows a line-of sight between a network node (on the right) and a network access point (on the left). Visually there may be no blockage to the signal, but anything that obstructs up to 40% of the oval area (called a “Fresnel zone”) around that line of sight can obstruct the full radio signal.

Pole-mounted antennas move the Fresnel zone up and out of potential obstructions and are an effective way to address line-of-sight concerns.

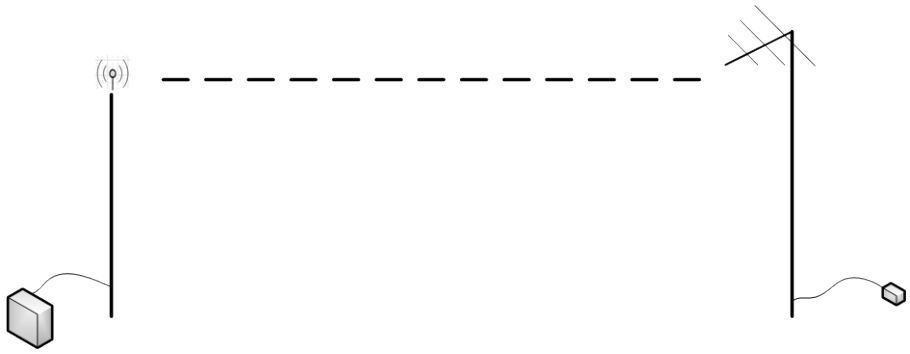


Figure B-2. Resolving LOS Issues with Pole-mounted Antennas

B.1.2 Antennas

Antennas are designed to efficiently radiate and receive radiated electromagnetic waves. When you select an antenna, consider the following characteristics:

- Antenna type and radiation patterns
- Power gain
- Directivity
- Polarization

Radio applications most commonly use omnidirectional and Yagi antennas. Additionally, since a node may need a directional antenna mounted to an enclosure, ensure that the directional antenna is pointed toward the omnidirectional antenna (typically located on the network access point).

Antenna Types

Radio antennas have two basic categories: omnidirectional or directional. Omnidirectional antennas have a 360 degree horizontal antenna pattern and a certain amount of vertical pattern. Directional antennas (primarily based on the designs from its inventors, Drs. Yagi and Uda) can include parabolic dishes and directed devices.

Directional antennas tend to have a narrower antenna pattern (beam-width) and a higher gain or “push” to the signal.

Cable Length

Because the antenna is mounted to the exterior of an enclosure, to minimize line loss, keep the coaxial cable that connects the module to the external antenna **as short as possible**. Guidelines for the kind of coaxial cable based on distances:

- Up to 15 meters (50 feet): LMR-400
- Up to 30 meters (100 feet): LMR-600
- Up to 45 meters (150 feet): LMR-900
- Up to 76 meters (250 feet): LMR-1200

Antenna Gain

Most simply, this is the value the signal increases (or “gains”), expressed as dBi, by the addition of an antenna.

Mounting

Mount antennas outside of metal enclosures, and ensure that antennas have at least 3 m (10 ft) of vertical separation from any other antenna.

Recommended Antennas

Remote Automation Solutions recommends the following 2.4Ghz omnidirectional, directional, and small mobile antennas.

High Performance Omnidirectional Antennas (from PCTEL)

- 4 dBi Gain, Model Number MHO24004NM
- 6 dBi Gain, Model Number MHO24006NM
- 8 dBi Gain, Model Number MHO24008NM

Mast-mount Omnidirectional Antenna (from PCTEL)

- 5.5 dBi Gain, Model Number MM024005PT36RPC

Professional Grade Yagi (from Wavelink)

- 4 dBi Gain, Model Number PRO2400-4

Heavy-duty Flexible Small Whip Mobile Antenna (from PCTEL)

- 5 dBi Gain, Model Number PCTP2425

Small Omnidirectional blade-style Antenna (from PCTEL)

- 2.14 dBi Gain, Model Number NPAMB24495804

Transmitter Power Out

The Federal Communications Commission (FCC) has established rules (Section 15.247) for the amount of power a transmitter may emit. For the frequency bandwidth the radio on the NRM uses (2400-2483 MHz), the maximum power allowed is +36 dBm (or 4 Watts) Equivalent Isotropically Radiated Power.

You can calculate EIRP by taking the transmitter power (the FB107 RTU supports a maximum of +27 dBm or 500 mW), subtracting the loss due to coaxial cable, and then adding that result to the antenna gain. For example, +27 minus 3db (loss due to 39 ft. of LMR-400 Times wire coaxial cable) added to 15 dBi gain for a Yagi directional antenna (+24-3+15) = 39 dBm, which is 3 dBm more than the FCC allowable limit.

To resolve this, you can either add another 39 ft. of LMR-400 cable **or** reduce the transmitter power by 3dB from +27 dBm to +24dBm (250mW). Either of these solutions lowers the dBm to the maximum legal EIRP value of 36 dBm or 4 Watts.

B.1.3 Antenna Installations

Depending on your geographical conditions, pole-mounted antennas may be required. Most antennas are packaged as kits, containing weatherproofing materials, mounting brackets and hardware; you must determine the appropriate pole materials and pole height.

Because of their 360-degree signal transmission and reception patterns, omnidirectional antennas are most usually connected to the network access point (NAP) of the Distributed RTU™ Network. For network nodes, use directional antennas aimed toward the omnidirectional antenna.

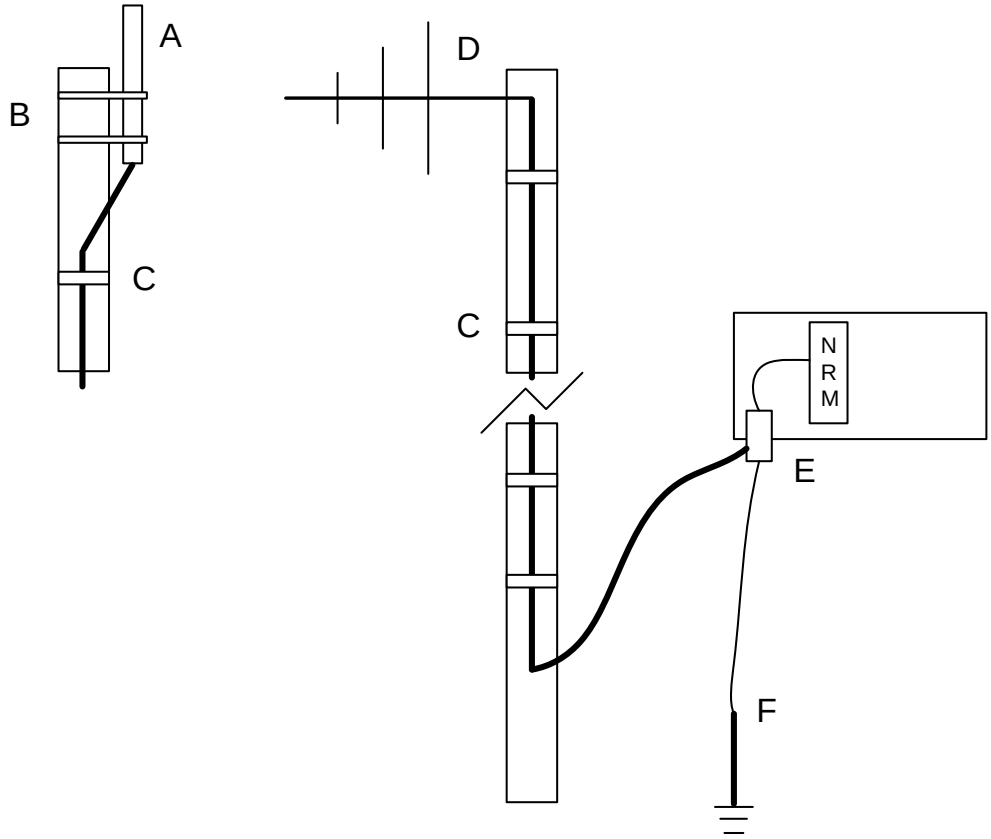
Harsh weather conditions require that you use external-quality antenna cabling. To reduce signal loss, limit the antenna cable to 9 meters (30 feet). Typically, each end of the external antenna cable has a male Type N connector.

Enclosures and Lightning Arrestors

The network access point and the nodes require protective weatherproof enclosures. The external antenna cabling connects into the housing through a lightning arrestor, which is wired to a grounding rod.

The internal antenna cable is typically 15-30 cm (6-12 inches) in length with a male Type N connector at one end and a male Type TNC connector at the other. It attaches to the lightning arrestor and connects the external antenna cable to the Network Radio module.

The lightning arrestor typically has two female Type N connectors and a connector for the grounding wire. A grounding wire connects the lightning arrestor to the grounding rod. See *Figure B-3*.



A Pole-mounted omnidirectional antenna (connected to network access point) provides 360 degrees of signal transmission and reception
B Pole mounting brackets and hardware provided with antenna
C Plastic cable ties secure external antenna cable to mast
D Mast-mounted directional antenna (connected to network node) provides a directed pattern of signal transmission and reception. Directional antenna must be aimed at omnidirectional antenna.
E Protective housing for node or network access point with installed lightning arrestor connected to grounding rod.
F Grounding rod for lightning arrestor.

Figure B-3. Antenna Installation (Omnidirectional and Directional)

Waterproofing Waterproof **all** cable connections. Water in a cable can cause high VSRW/antenna reflection powers.

B.1.4 Frequency Hopping

"Frequency hopping" means that the carrier signal moves quickly from one frequency to another. The signal can move as many as 170 times per second, based on the signal's "packet size" (the size of the encapsulated information being transmitted) and the "dwell time" (how long you want the signal to remain on one frequency).

Frequency hopping is particularly useful in situations of high electronic "noise" that might result from one or more competing local radio networks or infrastructure challenges (such as high power transmission lines). You can modify the hopping pattern the module's radio uses to avoid noise and produce a clearer signal. Additionally, frequency

hopping is difficult to jam (either intentionally or accidentally) and ensures the privacy of the signal.

You can change the hopping pattern by changing the channel that a network uses (see *Section 2.2, Configuring Nodes*).

Note: All devices on a specific network must use the **same** channel.

B.1.5 Narrowband vs. Spread Spectrum Transmission

Radio frequency signals transmit in two major ways: narrowband and spread spectrum. Narrowband uses – as the name implies – less bandwidth but typically requires higher power. This can be an issue in remote situations where battery or solar power is the only power source. Spread spectrum transmission uses more bandwidth to spread the signal and requires less power (??). Additionally, spread spectrum transmission is more resistant to natural interference, noise from competing radio networks, and accidental or intentional jamming.

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