GFK-1322

GE Fanuc Manual Series 90-30

PLC LonWorks Bus Interface Module

I/OPEN™

Programmable Control Products

Series 90™-30 PLC
LONWORKS® Bus Interface Module

User's Manual

GFK-1322A *June 1997*

Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

This manual describes the features and operation of the Series 90™ PLC LONWORKS®® Bus Interface Module (PE693BEM350, 351, and 352). It also provides the configuration and programming information needed to complete the interface between a Series 90-30 programmable logic controller (PLC) and a LONWORKS network.

Content of this Manual

Chapter 1. Module Overview: Provides overviews of the LONWORKS Bus Interface Module (LBIM) and the Echelon® LONWORKS network.

Chapter 2. Operation: Describes the operation of the LBIM.

Chapter 3. Hardware Installation: Explains how to install an LBIM in a Series 90 rack. Provides recommendations for connecting an LBIM node to a LONWORKS network.

Chapter 4. Configuration: Explains how to configure the module network interface and set configuration parameters. Describes network binding.

Chapter 5. Troubleshooting: Lists problem symptoms and corrective actions. Describes the use of Valid bits for network variables.

Appendix A. Specifications: Lists physical specifications and electrical and environmental requirements.

Appendix B: Standard Network Variable Types: Lists the Standard Network Variable Types supported by the LBIM as of the time this manual was published. (Refer to the most recent version of ***The SNVT Master List and Programmer's Guide*** **—** 005-0027-01 **—** for a current listing.)

Appendix C. Configuration File Specifications: Contains reference information pertaining to the files that are created by the configuration software.

Appendix D. Glossary: Provides definitions of acronyms and terminology.

Appendix Q. Quick Start Guide. Describes the steps necessary to get your LBIM up and running quickly. To use this guide, you should have a working knowledge of LONWORKS network technology and GE Fanuc Series 90-30 PLCs.

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Related Publications

For more information about GE Fanuc Series 90 PLCs and related products, refer to the following:

Series 90™-30 Programmable Controller Installation Manual (GFK-0356)

Logicmaster™ 90 Series 90-30/20/Micro Programming Software User's Manual (GFK-0466).

Series 90™-30/20/Micro Programmable Controllers Reference Manual (GFK-0467).

Series 90™-30, 70, PLC Products, Genius ® I/O Products, Field Control™ Distributed I/O & Control Products, GE Fanuc Product Approvals, Standards, General Specifications (GFK-0867B or later)

Information about LONWORKS networks can be found in the following documents, which are available from Echelon Corporation and on the World Wide Web at **www.echelon.com**.

LONWORKS Installation Overview (005-0006-01)

Enhanced Media Access Control with Echelon's LONTALK Protocol (005-0001-01)

LONTALK Response Time Measurements (005-0010-01)

LONTALK Protocol (005-0017-01)

The SNVT Master List and Programmer's Guide and ***The SCPT Master List*** (005-0027-01)

Junction Box and Wiring Guidelines for Twisted Pair LONWORKS Networks (005-0023-01)

Optimizing LONTALK Response Time *(005-0011-01)*

LONMARK Layers 1—6 Interoperability Guidelines (078-0014-01)

LONMARK Application Layer Interoperability Guidelines (078-0120-01)

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Chapter 1 Overview

The Series 90 PLC LONWORKS Bus Interface Module (LBIM) provides an interface between the GE Fanuc Series 90-30 PLC (programmable logic controller) and an Echelon LONWORKS network. The LBIM maps network variables into specific PLC register locations. It can support up to 244 network variables (240 can be configured by the user), and map these network variables into the %I, %Q, %AI, and %AQ PLC memory references. The Module adheres to the *LONMARK Layers 1—6 Interoperability Guidelines* (078-0120-01)for the interface to the LONWORKS network

A LONWORKS network can range in size from two to tens of thousands of devices and can be used in a wide range of control network applications. LONWORKS technology uses peer-to-peer architecture, in which intelligent control devices, called nodes, communicate with each other using the LONTALK® protocol. Each node consists of a physical interface that couples the node microcontroller with the communications medium, and embedded intelligence that implements the protocol and performs control functions. Figure 1-1 illustrates a sample network configuration that uses an LBIM to communicate with a Series 90-30 PLC.

An individual node usually performs a simple task. Devices such as proximity sensors, switches, relays, and motor drives can be nodes on a network. The network controls the interaction of the nodes to perform a complex application, such as controlling a manufacturing line or automating a building.

The LBIM can interface with networks that use twisted pair cabling . The LBIM contains a transceiver that provides a physical communication interface between the module and a LONWORKS network. The type of embedded transceiver determines the network topology supported.

Table 1-1. Bus Interface Module Products

Catalog No.	Embedded Transceiver	Topologies Supported
PE693BEM350	TP/FT-10	Free (Bus, Star, Loop, Others, Combinations)
PE693BEM351	TP/XF-78	Bus/Loop
PE693BEM352	TP/XF-1250	Bus/Loop

The following topics are presented in this chapter:

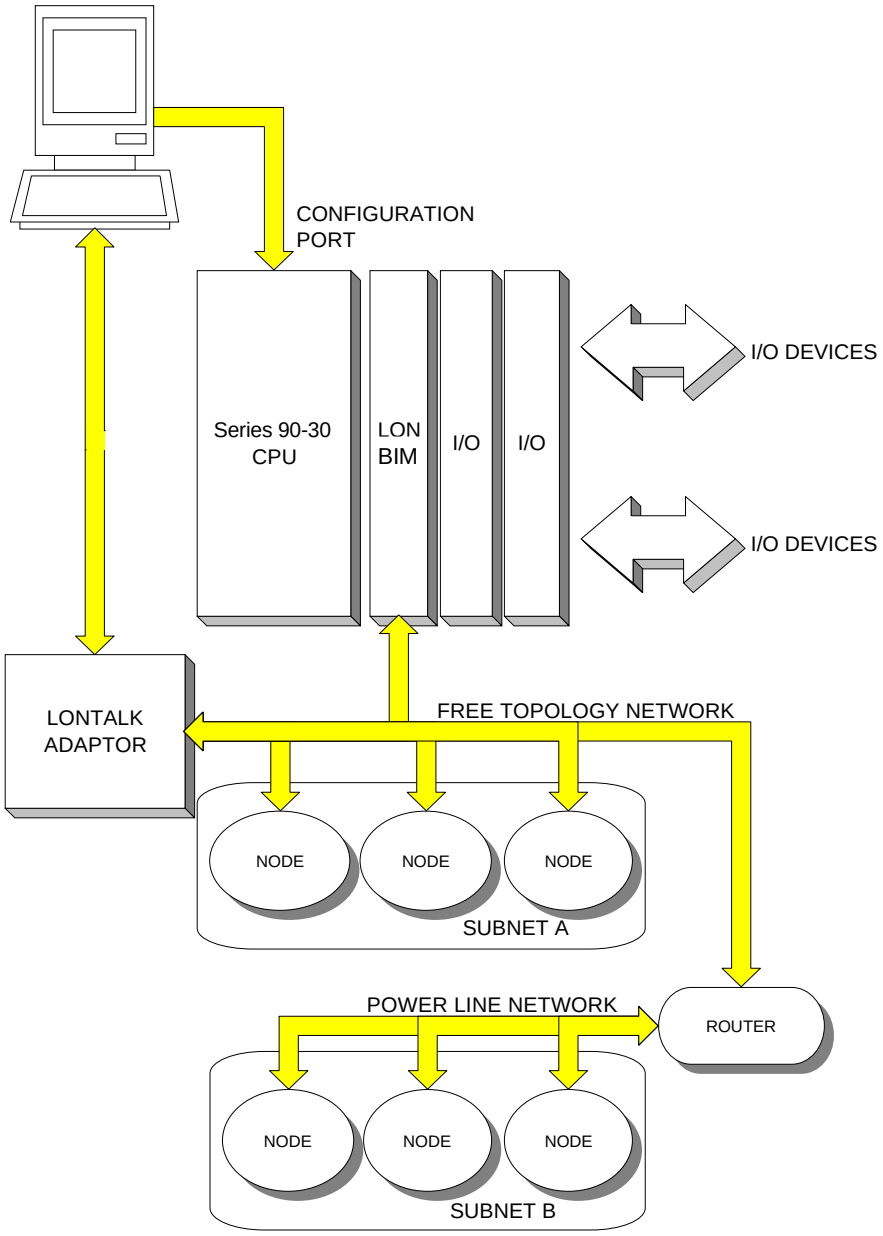


Figure 1-1. Sample LONWORKS Network Configuration

LONWORKS Network Overview

A control network consists of intelligent control devices, called nodes, that communicate using a common protocol. Each node in the network contains embedded intelligence that implements the protocol and performs control functions. In addition, each node includes a physical interface that couples the node's microcontroller with the communications medium.

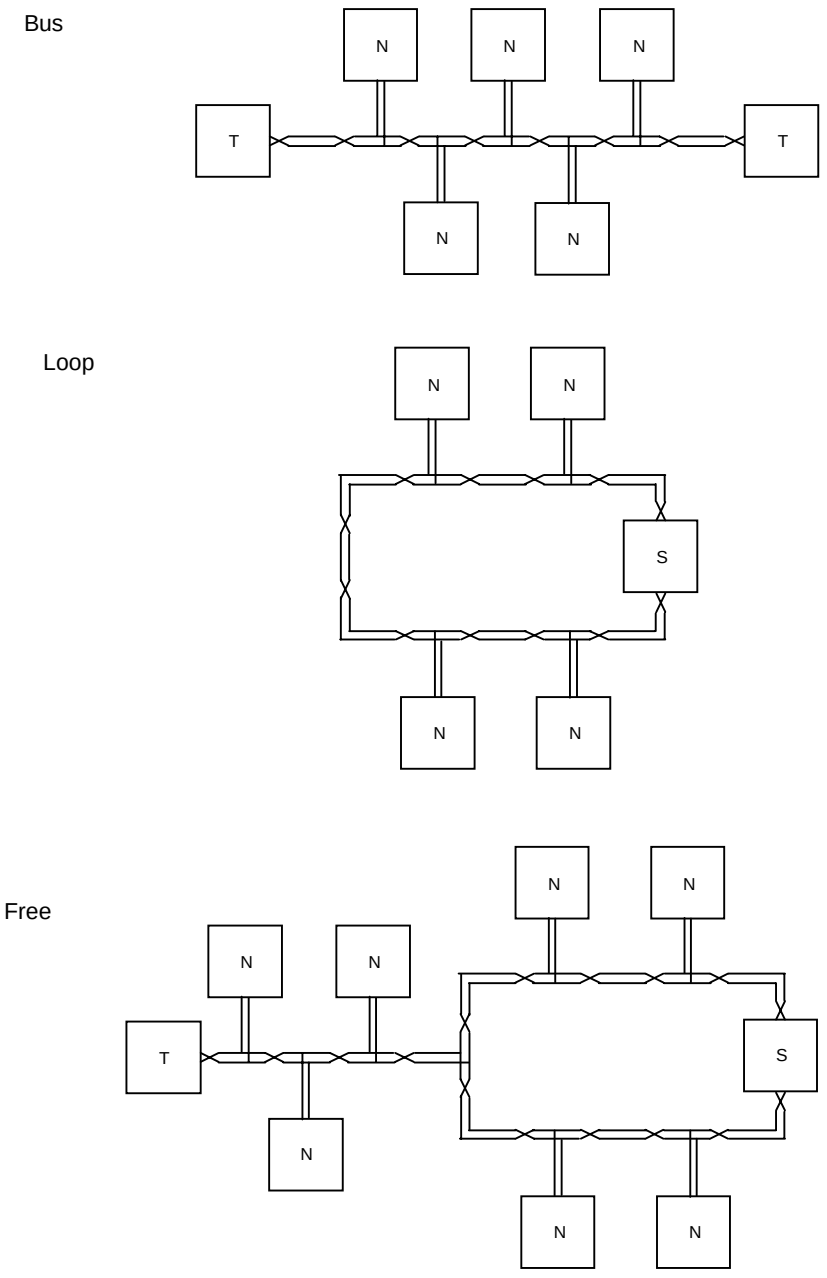
In a LONWORKS network, the nodes communicate over one or more media such as twisted wire pair, power line, fiber optic cable, coaxial cable, RF, or infrared. At the heart of each node is the Neuron® chip which contains the LONTALK protocol, a complete seven-layer communications protocol that ensures that nodes can interoperate using an efficient and reliable communications standard. Because Neuron chips can be connected directly to the sensors and outputs that they supervise, a single Neuron chip will process sensor/output status, execute control algorithms, and communicate with other Neuron chips.

The LONTALK protocol uses I/O points, known as *network variables*, to allow devices from different manufacturers to communicate with each other. Echelon's *Standard Network Variable Types* (SNVTs) provide standard units of measurement for common control quantities, such as pressure, temperature, and volume. The LBIM supports SNVTs that are less than 32 bytes in length, and are defined in *The SNVT Master List and Programmers Guide* (005-0027-01).

The LBIM contains a transceiver that provides a physical communication interface between the module's Neuron chip and a LONWORKS network. The LBIM supports bus and loop topologies, based on the TP/XF-T78 and TP/XF-1250 transceivers, and free topology, based on the TP/FT-10 transceiver. The free topology allows more options for network design. Table 1-2 lists the topologies supported by each type of LBIM. Figure 1-2 illustrates the supported topologies.

Table 1-2. Supported Topologies

Catalog No.	Transceiver	Topology	Network Characteristics
PE693BEM350	TP/FT-10	Free (Bus, Star, Loop, Others, Combinations)	Bit Rate: 78Kbps Distance: 500m free topology, 2,700m with doubly terminated bus. Distance can be multiplied with repeaters. No. of Nodes: up to 64 Other: Transformer-isolated; high impedance when unpowered
PE693BEM351	TP/XF-78	Bus/Loop	Bit Rate: 1.25Mbps Distance: 500m (0.3m stubs) No. of Nodes: up to 64 Other: Transformer-isolated
PE693BEM352	TP/XF-1250	Bus/Loop	Bit Rate: 78Kbps Distance: 2000m (3m stubs) No. of Nodes: up to 64 Other: Transformer-isolated



T Termination Network

N Node

S Switch and Termination Node (closes loop when activated)

Figure 1-2. Topology Examples

Bus Interface Module Overview

The LBIM is a standard, rack-mounted Series 90-30 PLC module. (The table on page 1-10 lists compatible CPUs.) The module plugs easily into the PLC's backplane or into a remote PLC baseplate. The latch on the bottom of the module secures it in position.

There are no DIP switches or jumpers to set on the LBIM. It is configured using the IOPEN.EXE configuration software, provided with the module on floppy disk. Procedures for configuration are provided in Chapter 4.

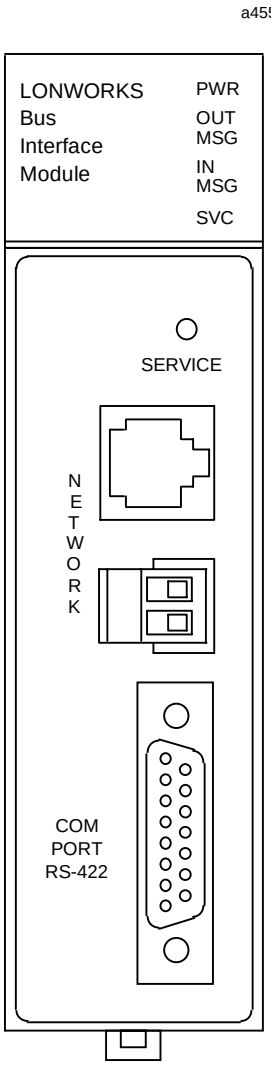


Figure 1-3. Series 90 PLC LONWORKS Bus Interface Module

Controls and Indicators

The only external control is the SERVICE pushbutton. The LEDs on the front of the LBIM indicate its operating status.

Table 1-3. LBIM Controls and Indicators

Switch	Type	Function
SERVICE	Momentary contact pushbutton	When pressed, the LBIM's Neuron chip broadcasts its unique 48-bit Neuron identification code and program identifier to the LONWORKS network. This function is used to facilitate installation of the LBIM in the LONWORKS network.

Indicator	State	Meaning
PWR	Lighted	(Power) +5 VDC primary power is present at the LBIM's logic circuitry.
OUT MSG	Flashes briefly	(Outbound Message) An update message for a bound network variable is sent by the LBIM to the LONWORKS network.
	Lighted briefly	Powerup sequence in process. The configuration parameter value file or the network variable bindings are being saved into the flash memory.
	Flashes alternately with IN MSG LED	A powerup error has occurred. For troubleshooting information, refer to Chapter 5.
	Flashes together with IN MSG LED	LONWORKS wink function implemented. See "Wink Function" in Chapter 5.
IN MSG	Flashes briefly	(Inbound Message) Flashes briefly (10ms) when an update message for a bound network variable is received by the LBIM from the LONWORKS network. Also lighted briefly during powerup sequence.
	Lighted briefly	Powerup sequence in process. The network variable configuration is being saved into the flash memory.
	Flashes alternately with OUT MSG LED	A powerup error has occurred. For troubleshooting information, refer to Chapter 5.
	Flashes together with OUT MSG LED	LONWORKS wink function implemented. See "Wink Function" in Chapter 5.
SVC	Not lighted	Normal operation.
	Flashing	(Service) The LBIM is in a LONWORKS unconfigured state. (The LBIM network variables and PLC mapping are configured and it is waiting for configuration from a network management tool.)
	Lighted	When SERVICE button is pressed.

Connectors

During normal operation, the only external connection to the LBIM is the network connection to the two-pin removable header on the front panel. The RJ-45 connector is reserved for easy connection of network management tools during configuration of the interface and binding of network variables. The RS-422 serial port is used to update LBIM firmware and is not normally needed by the user.

Table 1-4. LBIM Connectors

Connector	Function	Type
NETWORK	Connection of network management tools	RJ-45 NetA, NetB
NETWORK	Provides LONWORKS network field connection (NETA, NETB) using 18-24 AWG (0.86mm^2 to 0.22mm^2) twisted pair wires.	2-pin removable screw terminal
COM PORT RS-422	RS-422 serial port that supports SNP communications (SNP and SNPX). Used to update LBIM firmware. (Does not support Hand-Held Programmer.)	DB-15, female
Series 90-30 backplane	Connection to PLC backplane	24-pin connector

Table 1-5. Pin Assignments for RS-422 Port

Pin	Signal Name
1	Shield
2	No connection
3	No connection
4	No connection
5	No connection
6	RTS (A)
7	OV

Pin	Signal Name
8	CTS (B)
9	RT
10	RD (A)
11	RD (B)
12	SD (A)
13	SD (B)
14	RTS (B)
15	CTS (A)

Functional Characteristics

Most parameters are supported to the limits of the LONTALK Protocol and the LONWORKS node limits.

Table 1-6. LBIM Functional Characteristics

Microprocessor	Neuron chip running the Microprocessor Interface Program (MIP) with 80C186 host processor.
Maximum number of network variables supported by LBIM	244 (240 of these can be configured by user) The maximum number of network variables depends on the size and type of the variables, limited by the LBIM's PLC register space (2 Kbytes each direction) and the configuration memory budget.
Standard Network Variable Types (SNVTs)	Supports LONWORKS SNVTs as listed in *The SNVT Master List* published by Echelon corporation as of June 1996. Each network variable must be no more than 31 bytes in length.
PLC memory types supported	%I, %Q, %AI, %AQ

Configuration

Configuration of the LBIM consists of defining network variable types and mapping them into the PLC reference space using the IOPEN configuration software. Network Variable types mapped to memory types %I or %Q must be of type SNVT_switch, SNVT_lev_disc, or other bit-represented types. Once the LBIM's network interface has been configured, network configuration and binding can be performed as for any other LONWORKS node. Also, after the LBIM's network interface has been configured, the Series 90-30 backplane CPU must be set up to recognize the LBIM as a foreign smart module with a reference map required to implement the network interface. For details on configuration, refer to Chapter 4.

Diagnostics

The LBIM does not report faults to the PLC. Module errors cause the LBIM to reset. If an acknowledge NV update command fails, it is up to the destination device to assume that a fault has occurred. Configuration errors will cause the LBIM to not be mapped.

For troubleshooting and diagnostics information, refer to Chapter 5.

What You Need to Operate the Bus Interface Module

To configure and operate the LBIM, you need:

- A personal computer or laptop computer that runs Microsoft® Windows® software.
- Series 90-30 backplane with CPU module
  See Table 1-7 for models that can be used with the LBIM.
- Logicmaster 90 software
  Required to configure and program the Series 90-30 PLC. See Table 1-7 for versions that can be used with the LBIM.
- LONWORKS network binding tool
  Many third-party network management software packages that include network binding tools are available. (See Table 1-8 for suggestions.)
- IOPEN network interface configuration software: (for Microsoft Windows) This software is provided on the utility disk supplied with the LBIM.
- A LONTALK adapter and a device driver (See Table 1-9 for the adapter types that can be used by each model of LBIM.)
  This is required to run the network interface configuration software.

® Windows is a registered trademark of Microsoft Corporation.

Table 1-7. Compatible CPU Models and Logicmaster 90 Software Versions

CPU Models IC693CPU___	CPU Firmware	Logicmaster 90 Software IC641SWP___
311S 331T 313H 323H 340B 341K	release 5.0 or later	(release 5.0 or later) 301R 306K 311A
351AA	release 6.0 or later	(release 6.0 or later) 301S 306L 311A
351AB	release 6.02 or later	(release 6.0 or later)

In each case, *later* models or versions can be used.

Table 1-8. Choosing a Network Binding Tool

Third-party network management tools	• LONMAKER from Echelon • ICELAN-G from Intelligent Energy Corporation • MetraVision from Metra Corporation • others
Considerations	• How well it handles nodes that have a large number of network variables • Ability to handle Standard Configuration Parameter Types (SCPT) and load these values using LONTALK File Transfer

Table 1-9. Network Interface Configuration

LBIM Model	LONTALK Adapter and Configuration Utility	Cables
PE693BEM350 (free topology type)	SLTA NodeUtil utility	RS-232
	PCLTA card NodeUtil utility	none
	PCMIA card (PCC-10)	none
PE693BEM351 PE693BEM352 (bus/loop topology types)	SLTA NodeUtil utility	RS-232
	PCLTA card NodeUtil utility	none

Chapter 2 Operation

The following topics are presented in this chapter:

Overview of Operation

The LBIM communicates with other LONWORKS modules through bound network variables. The LBIM communicates with the PLC CPU over the PLC backplane.

Architecture

Figure 2-1 provides an overview of the LBIM's architecture. The LBIM has two processors: an Intel 80186EC processor provides host functions and a 3150 Neuron processor that runs Echelon's Microprocessor Interface Program (MIP) handles the LONWORKS network. The Series 90-30 interface is provided by GE Fanuc Series 90-30 API (application programming interface) software.

When an input network variable is updated, the data associated with it is copied into the corresponding PLC input buffer location. The Store Inputs routine is then called to update the PLC memory during the next PLC scan.

The API (Application Programming Interface) buffers the information for transfer to the PLC during a subsequent scan. When a scan is received from the PLC, the API initiates a callback, in which the LBIM's entire PLC output buffer is copied. Each network variable in the output buffer is then checked to determine whether it differs from the current value of the output buffer. If the values are different, the network variable is updated over the LONWORKS network. If the **Min Send Time** has been configured, the network variable will not be updated until the Min Send Time has expired.

The **Max Send Time** configuration parameter can also drive updating of output network variables if the value does not change. This assures that, even though data in the source is not changing, any newly added users will receive a copy and that users also know that the source is still online. This is how heartbeats are sent across the LONWORKS network.

A separate function determines which network variables need updating and forwards the data to the microprocessor interface program (MIP) through the host interface.

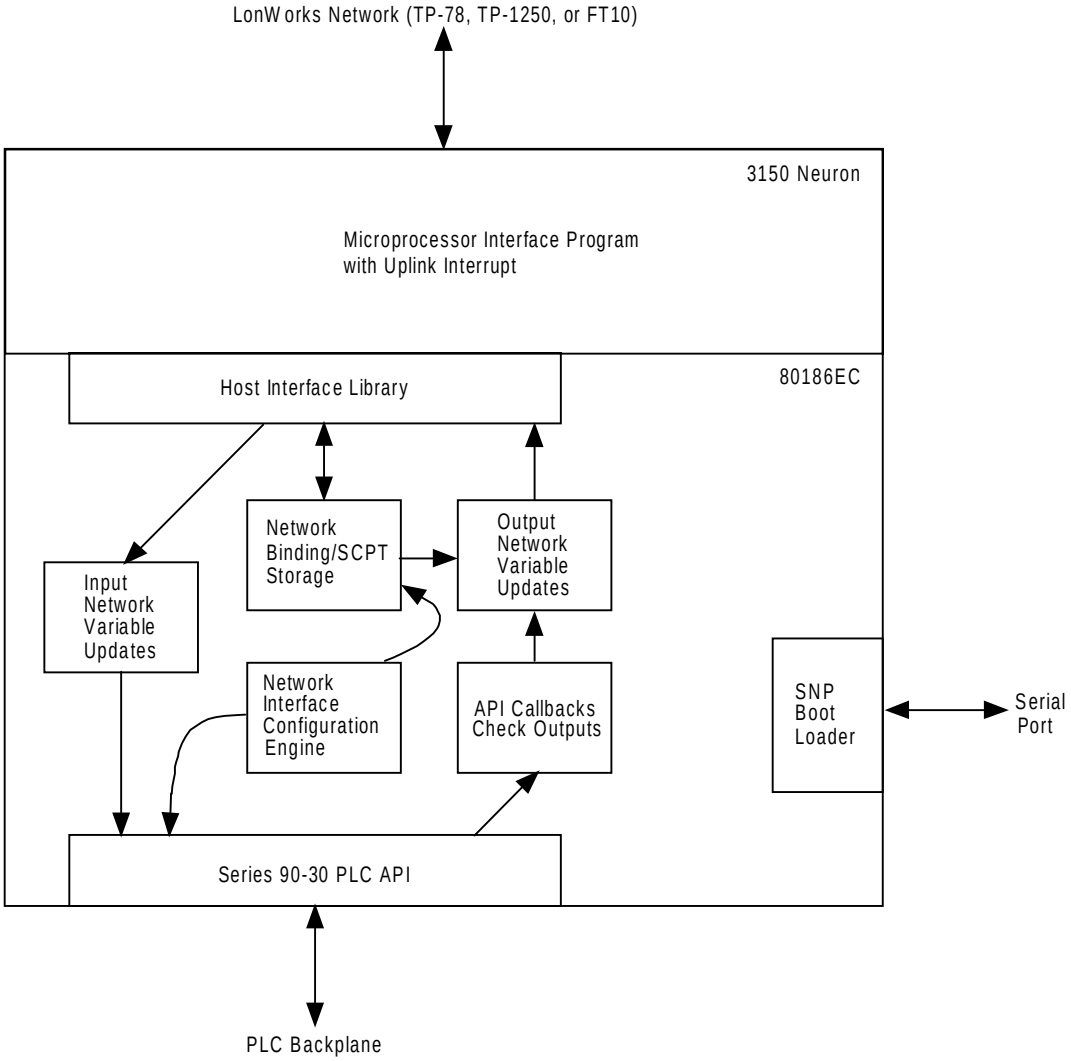


Figure 2-1. Overview of Bus Interface Module Operation

Operating Modes

The LBIM has four modes of operation:

Unconfigured This is how the LBIM is shipped from the factory. Four default network variables are set up to allow the network interface to be configured over the LONWORKS Network. These network variables are part of the LONMARK node object that has the four network variables (index 0—3): SNVT_obj_request, SNVT_obj_status, SNVT_file_req, SNVT_file_status. This mode is also entered if the network interface configuration information is corrupted or if an invalid configuration is loaded to the LBIM.

Unbound This mode exists after the LBIM's network interface has been configured, but before network variables are bound. The LBIM presents self documentation information to the network (in response to queries) and can be configured in the PLC backplane. Network variables are not updated across the network.

Normal Operation If one or more network variables are bound to other LONWORKS nodes, data updated by the PLC will be sent across the network to the other node. Input network variables for the module can also be updated (and the data sent to the PLC) if the network variables are bound.

Software Download If the boot loader is used to update the software, the LBIM does not respond to the network or the PLC interface. The LBIM should be put off-line before downloading new code.

Powerup Sequence

The self-test sequence performed by the LBIM during powerup is illustrated in Figure 2-2.

The default network interface configuration consists of the LonMark node object with four network variables (index 0—3).

- SNVT_obj_request Object request
- SNVT_obj_status Object status
- SNVT_file_req File request
- SNVT_file_status File status

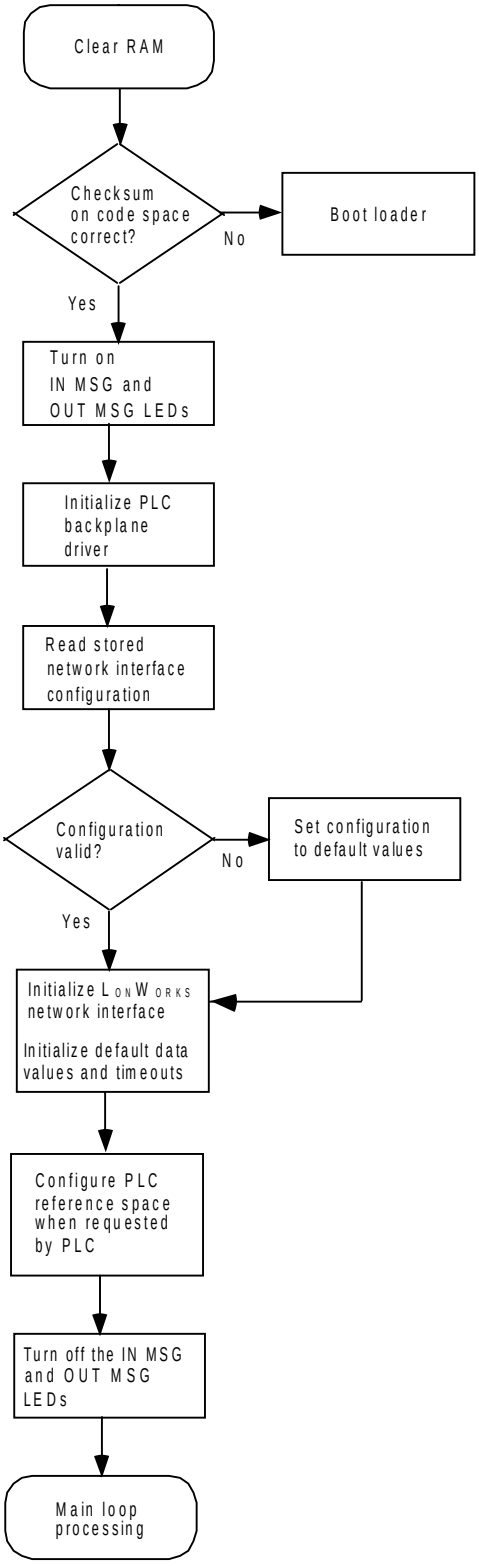


Figure 2-2. Bus Interface Module Powerup Sequence

Sweep Operation

The data flow for information that is sent from the LONWORKS network to the PLC is handled separately from the flow of data from the PLC to the LONWORKS network.

Input data: When an input network variable is updated, the data associated with the network variable is copied into the proper location in a PLC input buffer. The Store Inputs routine is then called to update the data in the PLC at the next scan time.

Output data: When the API callback notifies the LBIM that an output scan has arrived, the data is copied into a holding buffer. This buffer is then scheduled to be checked against the current value of each output network variable. If the data is different, the network variable is updated over the LONWORKS network if the **Min Send Time** for the network variable has expired (only if Min Send Time was configured). This prevents overloading the network with frequently changing data.

If a network variable is configured to be a SNVT_lev_disc or a SNVT_switch and is mapped into the %I or %Q reference area, the data is converted to a bit. This conversion occurs when the data is moved to or from the PLC buffer.

The total sweep time depends on the amount of reference memory used by the LBIM. This is a maximum of 1K words input and 1K words output, and is set when the LBIM's Network Interface is configured.

The I/O response times depend on the following factors:

- number and size of network variables for which the LBIM is configured
- rate at which network variables are updated
- number of network variables that are bound
- service type (ACKD, UNACKD) of each network variable
- network bandwidth
- network traffic
- whether network variables are input or output network variables

Chapter 3 Hardware Installation

This chapter describes:

Rack Location for the Bus Interface Module

The LBIM can be located in any rack in any slot (except for the slots in the main rack that are reserved for the power supply and CPU) in a Series 90-30 PLC. For the most efficient system operation, the main baseplate is preferred.

The following slots are reserved in the PLC main rack:

Models 331, 340, 341, 351, 352 and later: Slot 0 reserved for power supply
Slot 1 reserved for CPU

Models 311 and 313: Slot 0 reserved for power supply (The CPU is built into the baseplate.)

To estimate whether the system you want to design is possible, complete steps 1–3, below.

1. The I/O configuration block uses a base of 90 bytes of user memory. Each smart module uses 257 bytes of user memory for parameter data. Finally, every I/O segment uses an additional 40 bytes of user memory.

   Example of segments:

   A discrete input module has one segment (%I).

2. The total user memory required by a configuration is the sum of all these parts:

   base configuration size (90)
   + number of smart modules *257
   + number of segments *40
   = total user memory required for the configuration

3. The total user memory available for configuration varies with CPU model. If the number derived from the formula above is greater than the number next to the CPU that you are using, the system will not work due to memory limitations.

CPU	Available Memory (bytes)
311	4,720
313	4,720
323	4,720
331	4,656
340/341	8,176
351/352	16,368

Module Installation and Removal

Module Installation

The LBIM is installed and removed in the same manner as all other Series 90-30 modules. **Power must be OFF when installing or removing the module.**

To install the LBIM in the Series 90-30 PLC baseplate

1. Grasp the module with the rear hook facing away from you.
2. Align the module with the desired base slot and connector. Tilt the module upward so that the top rear hook on the module engages the slot on the baseplate.

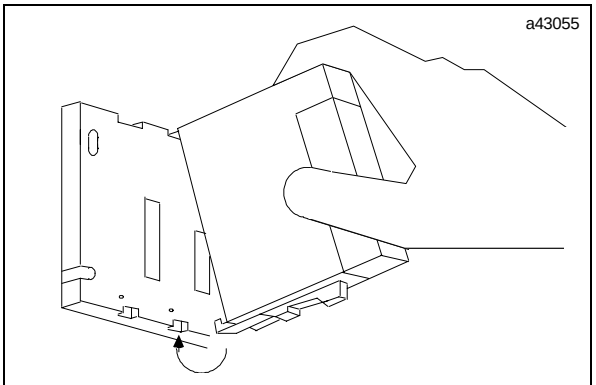


Figure 3-1. Module Installation

3. Swing the module downward until the connectors mate and the locking lever on the bottom of the module snaps into place, engaging the baseplate notch.

Module Removal

Power must be removed from the PLC rack before removing the LBIM from the baseplate. However, it is not necessary to power down the LONWORKS communications bus before removing the module. Do not disconnect the bus cable or any terminating resistor.

If the rest of the bus is powered down, the bus wiring can be removed from the module.

To remove the module:

1. Locate the release lever on the bottom of the module. Firmly press it up toward the module.

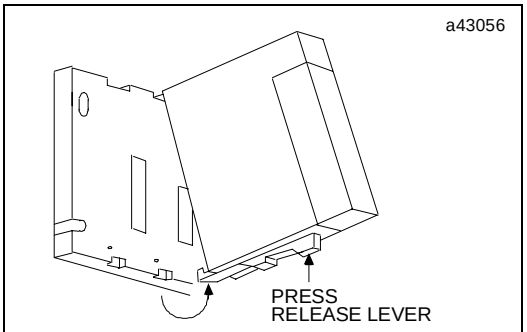


Figure 3-2. Module Removal

2. While holding the module firmly at the top, continue fully depressing the release lever and swing the module upward.
3. Disengage the hook at the top of the module by raising the module up and moving it away from the baseplate.

Network Installation

During normal operation, the network is the only external connection to the LBIM. The network is connected to the Module by means of the two-pin removable header on the front panel.

The LBIM adheres to the *LONMARK Layers 1—6 Interoperability Guidelines* (078-0014-01) for the interface to the LONWORKS network.

Network Wiring Guidelines

Junction Boxes:

A junction box is required to provide an interface between each LONWORKS application node and the twisted pair cable. Depending on the topology, pass-through, stub, and local loop junction boxes can be used. Echelon recommends Weidmüller BLZ (or equivalent) connectors and receptacles for connections to junction boxes.

Cabling:

The network bus wiring should be 22 AWG (0.36 mm^2) twisted pair wiring. The LBIM supports 18-24 AWG wiring with connection through a 5.08mm two-position screw terminal block. Either 22 (0.36$mm^{2)}$ or 24 AWG (0.22mm^2) cabling can be used on the stub between the junction box and the LONWORKS application node. (For an example wiring scheme, refer to Figure 3-3)

Detailed recommendations for network cabling, junction boxes, and connectors can be found in *Junction Box and Wiring Guidelines for Twisted Pair LONWORKS® Networks* (005-0023-01).

Terminating the Network

Network termination is not provided by the LBIM. Termination must be provided by the network as described in the LonWorks Transceiver User's Guide for the transceiver type used or in the *LONMARK Layers 1-6 Interoperability Guidelines* (078-0014-01).

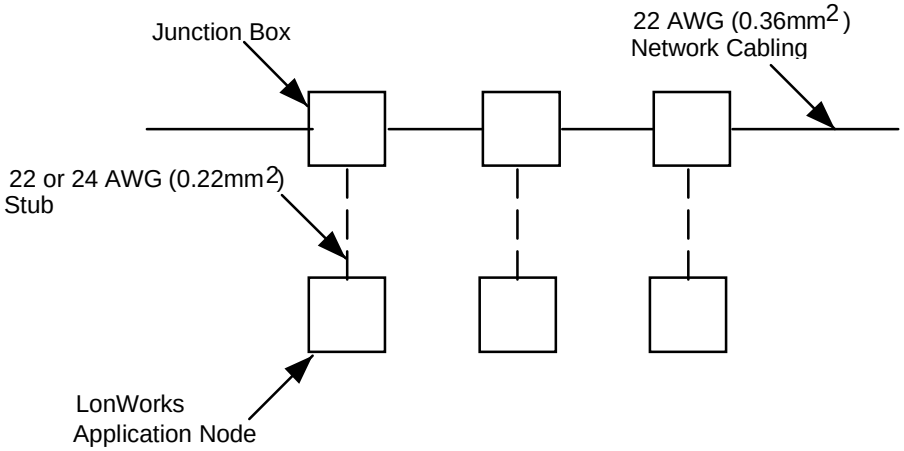


Figure 3-3. Cabling for Bus and Loop Networks

Connecting a Programmer

To configure the LBIM, the computer serial communications port must be connected to the LONWORKS network through a LONTALK adapter (Figure 3-4). In effect, the computer is a node on the network. As shown in Figure 3-5, three types of LONTALK adapters are available:

External SLTA	Can be used with all LBIM models.
PCLTA card	Can be used with all LBIM models.
PCMCIA Interface card (PCC-10), available from Echelon Corporation	Can be used only with PE693BEM350 (free topology) LBIM.
	In all cases, the LONTALK adaptor transceiver type must match that of the LBIM used.

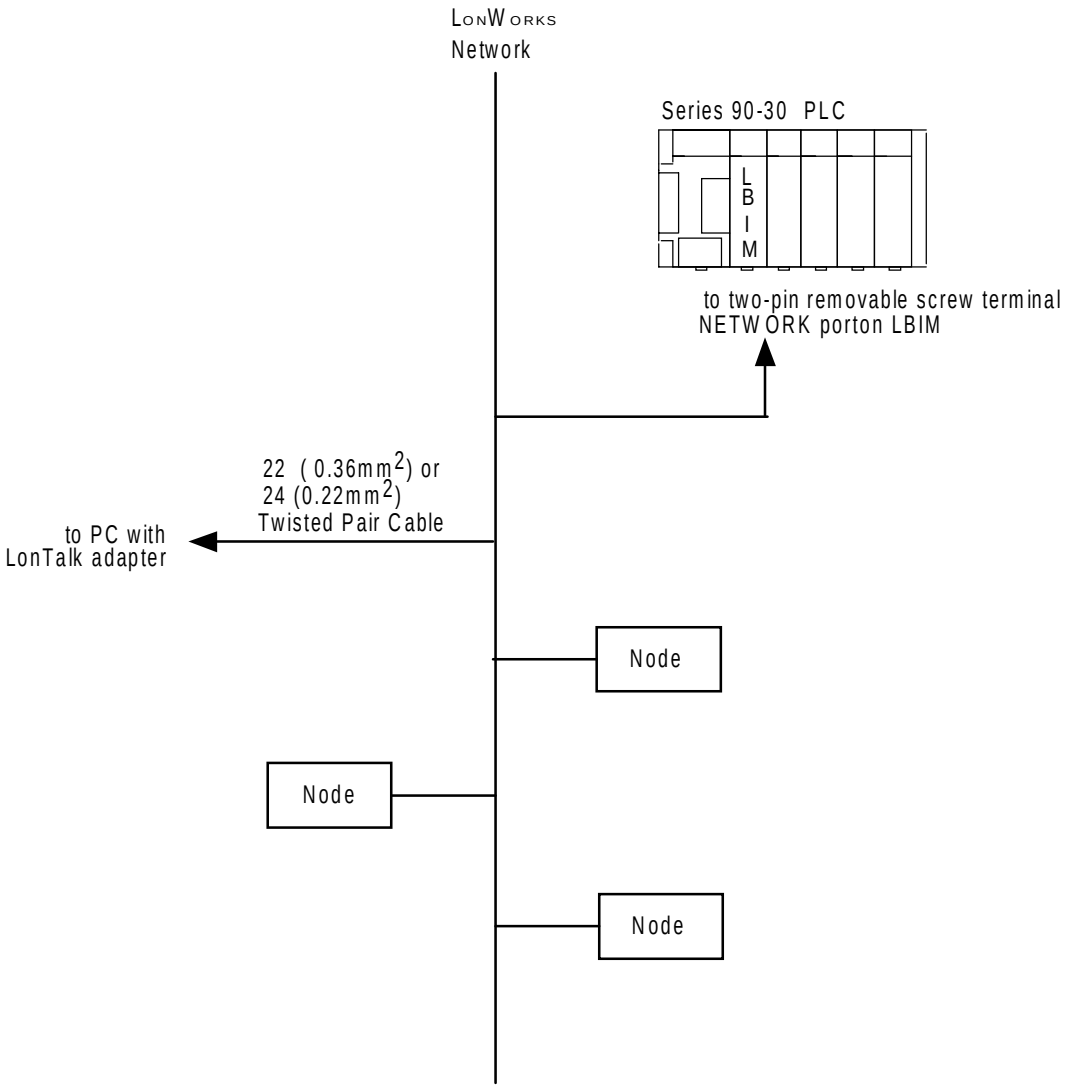
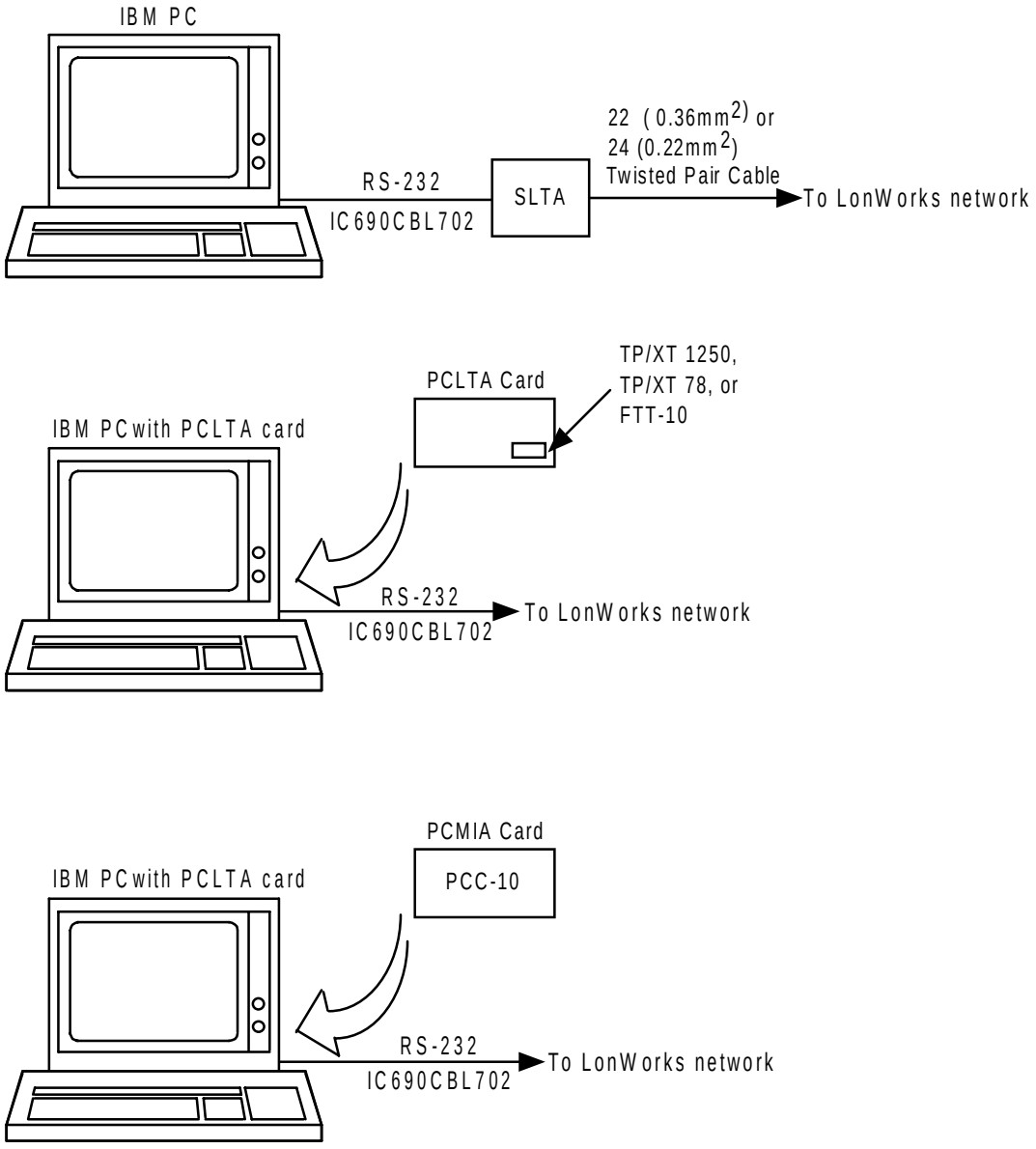


Figure 3-4. Connections for LBIM Configuration



Use with PE693BEM350 (free topology) LBIM only.

Figure 3-5. Computer to LONWORKS Network Connections for LBIM Configuration

Chapter 4 Configuring the LBIM

The following topics are presented in this chapter:

Overview

The LBIM is configured using the I/Open LBIM Configuration program for Microsoft Windows. Using this utility, a configuration file is created. This file is in the external interface file format (.XIF) for LONWORKS devices. The file contains node and network variable information along with the register mapping information needed by the LBIM to configure the interface. The .XIF file is downloaded to the LBIM by the configuration software over the LONWORKS network using LONMARK File Transfer Protocol. The following general procedure is used to configure the LBIM.

Step A. Determine what network variable types will be needed to interface with the PLC.

Example:			
Inputs		**Outputs**	
SNVT_temp	3	SNVT_temp	1
SNVT_count	2	display	1
SNVT_freq_f	1		
SNVT_temp_f	1		

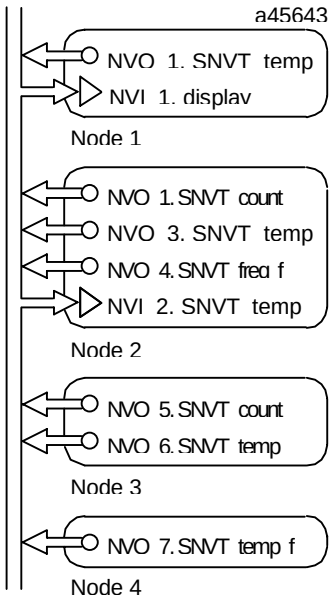


Figure 4-1. Example: Determining What Network Variable Types are Needed

Note

Care should be taken to assure proper orientation or direction of variables defined. An input device such as a temperature sensor will send the value to the network as an output network variable. That network variable would then be declared as an input to the LBIM and be mapped into an input register within the PLC.

Step B. Using the configuration utility software, assign network variable types to the LBIM and the registers in the PLC memory space to which the variable types will map

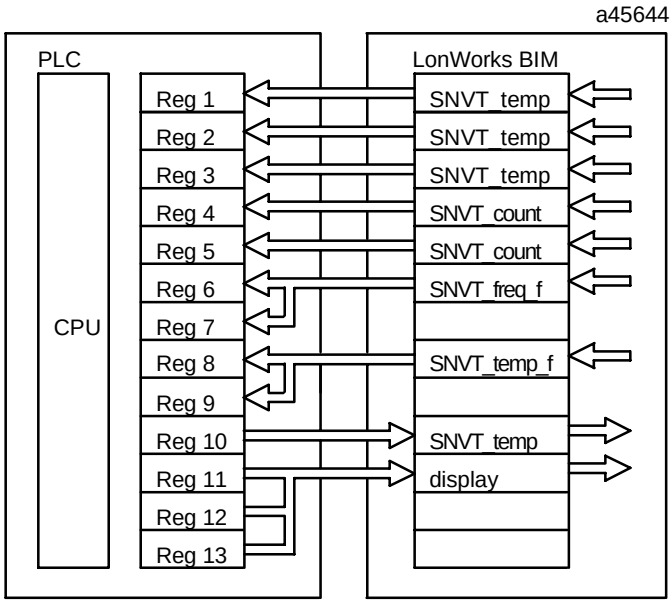


Figure 4-2. Example: Assigning Network Variables Types to the LBIM and PLC Registers

In the example illustrated in Figure 4-2, SNVT_temp and SNVT_count network variable types are one-word values that map directly into a single register address. SNVT_freq_f and SNVT_temp_f are double word values that map into two register locations. The type *display* is a three-word user-defined network variable that maps into three register locations.

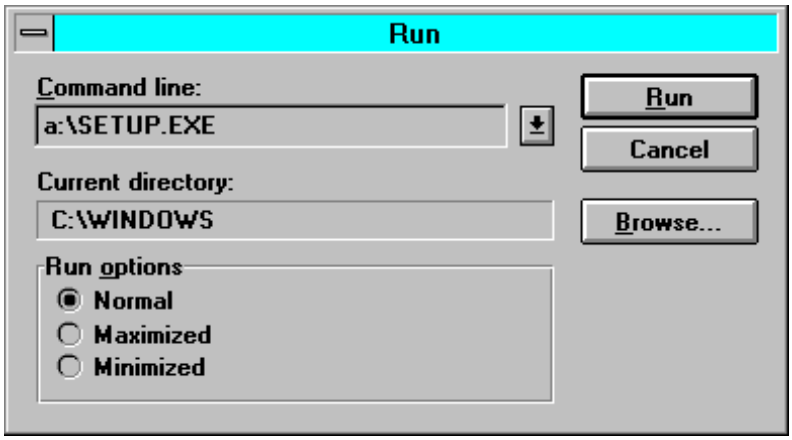
At this point, the module mapping is defined, but the actual network variables are not yet bound to the module and the module is also not configured with the LONWORKS network image. (See "Binding Network Variables.")

Using the LBIM Configuration Software

The Gateway configuration software can be used with Windows 95, or 3.x versions of Windows.

Installation and Startup

Install the Windows LBIM configuration software by inserting the installation disk into the appropriate computer drive. From Windows 95, select RUN from the START menu. From Windows, select RUN from the FILE menu. Modify the command line to run A:\SETUP.EXE. Choose RUN and answer any setup questions while the setup application runs.



The setup program may request that you add “SHARE.EXE” to your CONFIG.SYS PATH statements if it is not already present. Consult a Windows user manual or reference guide for more information.

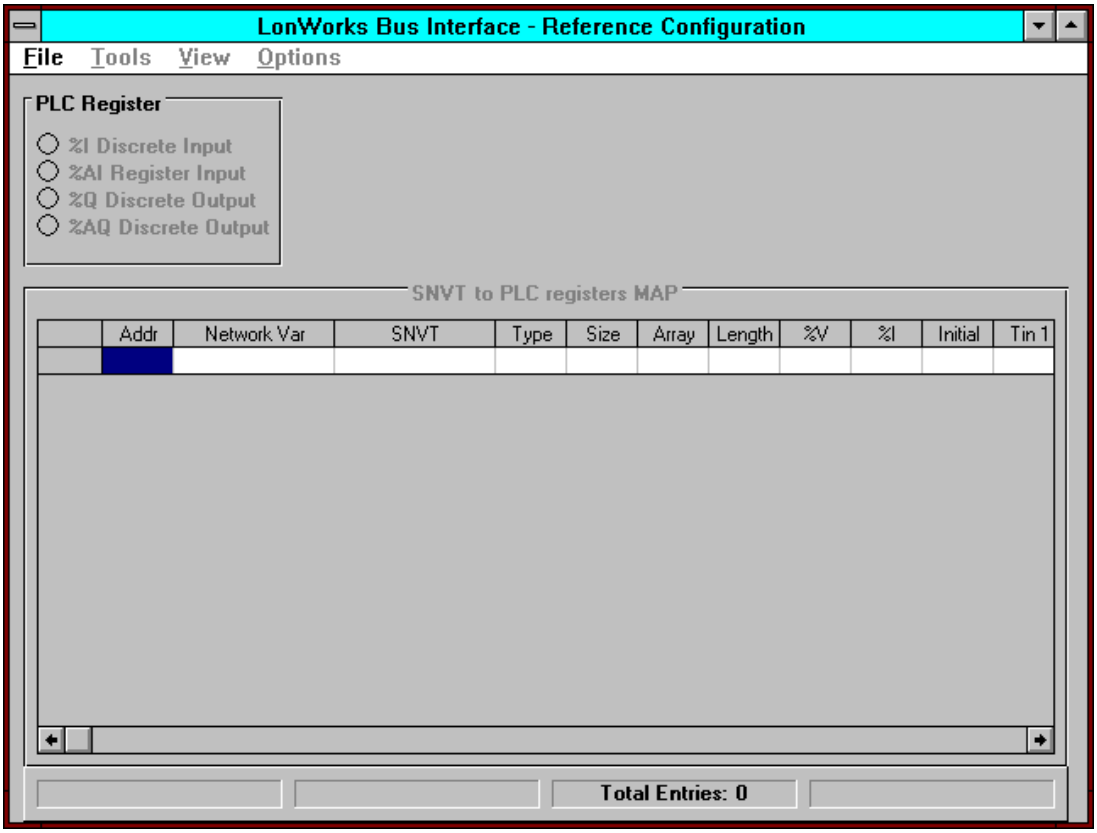
The setup program will create a desktop group window called “I/Open”. Within this group is the LBIM Config icon. To run the program, double click on the icon or select the icon and choose RUN from the FILE menu (START menu in Windows 95).

Editing a Configuration

Note

We recommend a limit for configuration names of a maximum of 7 characters to ensure compatibility with Logicmaster 90 software. (The LBIM configuration software allows names with up to 10 characters.)

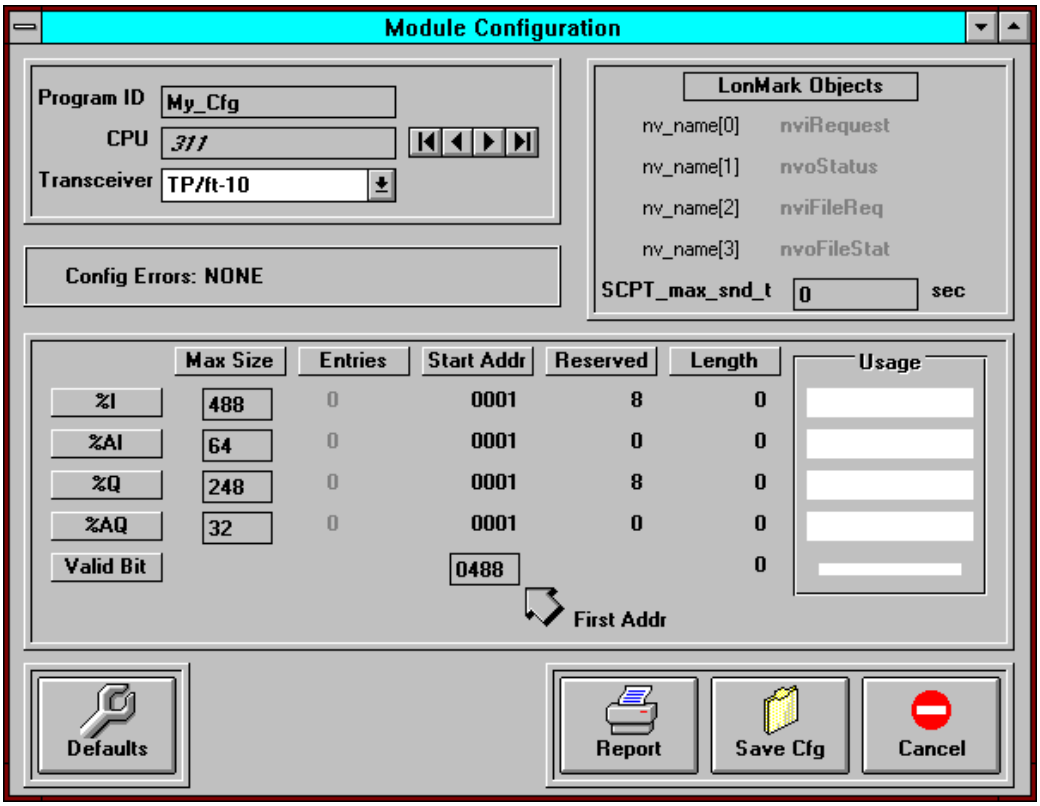
When you run the LBIM Config program you will see a blank main screen.



To Edit an existing configuration, choose OPEN from the FILE menu and choose the file name of the configuration desired. To open a new configuration, choose NEW from the FILE menu. Choosing NEW will open a module configuration screen used to set the configuration name and overall module parameters.

Module Configuration

When choosing to open a new configuration, the program will call the module configuration screen. It will be necessary to define the general parameters of the module before defining network variables. The module configuration information can be edited after network variable assignments have been made by choosing Configuration under the View menu in the Reference Configuration screen.



Program ID:

The program ID assignment serves two functions. The first is the filename by which this configuration is saved. For this reason, the program ID name must conform to DOS file naming conventions and contain no more than 8 characters. The other function served by the program ID is to provide the LONTALK external interface file identification for the LONWORKS network. The program ID can be accessed by network management tools to identify a particular configuration in a LBIM during network commissioning.

CPU type

This field allows the user to choose the type of CPU to be used in the system. The choice of CPU may affect the maximum number of network variables that can be assigned to each of the registers. While the number of variables that can be assigned will depend on a number of issues, in some cases the size of the particular register is less than the number of allowed variables. In this case, the program will default to a maximum size that corresponds with the register size for the CPU model chosen. If there is doubt as to which CPU model will be used, choose the smaller (lower model number) of the available CPUs to assure compatibility. If the number of variables needed exceeds the capacity of a particular CPU, a larger CPU should be chosen. Keep in mind that there are limits to the number of I/O references that can be used by any one module on the backplane. The limit for analog references is 64 inputs and 64 outputs (%AI and %AQ) for all CPUs. The limit for each discrete register is 1024 for the 351 CPU and 512 for all other CPUs. Some versions of LogicMaster will not allow assignment of more than 16 analog inputs or outputs to a single module.

Transceiver

Using a pull-down menu, the program allows the user to choose a particular transceiver type for the configuration. This is necessary to assure that the proper communications parameters are specified in the external interface file created by the program. If the wrong transceiver type is configured, the module will not communicate properly. The LBIM comes factory equipped with one of three transceiver types as listed below. Be sure to choose the transceiver type of the module to be used.

Module Number	Transceiver	Description
PE693BEM350	TP/FT-10	Free topology twisted pair @ 78K bps
PE693BEM351	TP/XF-78	Isolated twisted pair @ 78K bps
PE693BEM352	TP/XF-1250	Isolated twisted pair @ 1.25M bps

LONMARK Objects

For information on LONMARK Interoperability guidelines and LONMARK objects, please see the LONMARK Application Layer Interoperability Guidelines (Version 1.3 or greater) published by Echelon Corporation.

SCPT_max_send_t

This field allows the user to set a maximum send time configuration parameter. This parameter determines the maximum elapsed time between network transactions. If a network variable update has not been sent when this time has expired, an update will be transmitted. Sending an update will reset the timer. This feature is usually used for two purposes. The first is to establish a “heartbeat” so that remote network members will know if the LBIM node is offline if an update has not been received within a specified time period. The other is to update variables on the network so that new network members will receive current data within a specified period after being put on the network. Setting this value to 0 (default) disables this feature.

Register Configuration

The area in the center of the Module Configuration screen is used to configure and monitor the register definitions for the module. During the initial module definition phase the only parameters that need attention are the maximum sizes and the start addresses. The other fields will be automatically updated as network variables are defined.

The maximum sizes begin as default values based on the choice of CPU type (see above). The default register size defaults to the maximum register size for the chosen CPU or the maximum size based on the network variable capacity of the LBIM. The LBIM can use up to 240 network variables, so the maximum for the discrete registers would be 240 discrete locations for network variables. Additionally, the %I register is where the valid bits for all network variables are stored. For a configuration using 240 %I references, there are 240 bits plus 240 valid bits plus 8 reserved bits for a total of 488 possible %I references.

The maximum size definition is only for configuration error checking purposes and can be changed later if necessary. Defaults for the various CPU types can be changed by the user (see Default Button command below).

The Start Addr fields allow the user to define any valid beginning reference value for the individual registers. This start definition is relative to the configured start address as defined for the module in the PLC backplane. This allows two or modules to use identical module configurations and be configured into the same PLC backplane with differing address ranges. For example, if two modules had identical configurations with %I starting at address 1 with length 100, they could be configured into the same backplane using Logicmaster software as foreign modules with start addresses in %I of 1 and 101 respectively. The PLC program then addresses the variables in the two modules using references that are offset by 100 from each other.

The Entries field is for monitoring only and shows the number of variables currently defined for that particular register. The Length field is for monitoring only and shows the total length of the defined register space. This value includes gaps left between variables as the register configuration must be contiguous. The graphical usage display shows a bar graph representation of the defined variable space versus the maximum defined space.

Note

The configured length of each register must match EXACTLY the length defined in the 90-30 backplane configuration for the module.

Valid Bit End Address

Valid bits are automatically assigned by the program and begin at the highest defined %I location and grow down in the %I space. Setting the valid bit end address determines where the program begins assigning the valid bits. For example, if a configuration will be using 50 %I references and 64 total valid bits, the valid bit end address should be defined at or above 50 + 64 + 8 (reserved) = %I0122. The first defined variable will have a valid bit assigned to %I0122, the next will be assigned to %I00121, and so on. Valid bit referencing can be altered after variables are defined.

Button Commands

1. *Defaults*

Click on this button to set the default maximum sizes and start addresses for CPU types. Clicking the button activates an edit screen. After changing the desired values, click the default button again to save the changes and return to the module configuration screen.

2. *Modules Report*

Click this button to print a report that contains the current configuration values.

3. *Save Cfg*

Click on this button to save the current configuration to disk. This action does not save the configuration to the LBIM module.

4. *Cancel*

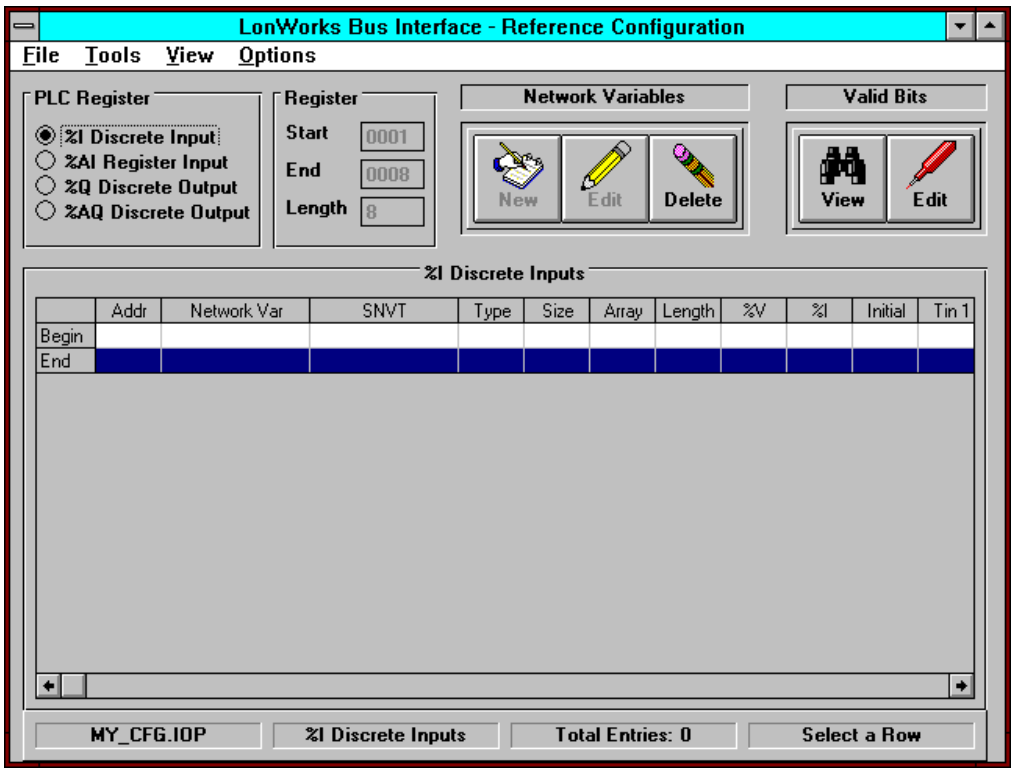
Click on the cancel command button to leave this screen without saving the configuration to disk. All changes since the last save will be lost.

Table 4-1. Configuration Editor Fields

Field	Description
Program ID	LONWORKS Program ID. Same as the Configuration Name. To change, type up to 8 characters in the field (7 characters maximum recommended) and press **ENTER.**
CPU	PLC CPU Model Number. To change, click on arrows to scroll through choices.
Transceiver	Transceiver Type. Use pull down menu to view choices.
Max Size (4 fields)	Maximum number of register references allowed in this configuration.
Entries	Number of Variable entries defined for the reference space. This is a display-only field.
Start Addr	Beginning reference for the register. To change, highlight the current value and type in a new reference address.
Reserved	Number of reserved reference locations. The reserved locations will occupy the lowest address locations.
Length	Length or number of references currently configured.
Usage	Graphical representation of the configured portion of the reference space as a portion of the maximum allowed space.
Valid Bit End Addr	Reference address of the beginning of the valid bit space. Valid bits are stored in the %I space and are assigned automatically beginning at this address and grow down as more are defined. Change this field by highlighting the current value and entering a new value. Note that the current valid bit configuration may need to updated manually to affect this change.
Defaults	Default size parameters. Activating this command allows the user to set default values for the maximum sizes allowed for the various CPU choices.
Module Rep	Print Module Report. Activating this command prints a report to the system printer showing the configuration details.
Save Cfg	Save configuration. Activating this command saves the current configuration to the file.
Cancel	Cancel. Activating this command returns control to the register configuration screen without saving any changes since the last save.
Node Object Network Variable Names The LBIM implements a standard Node Object as specified in the LONMARK Interoperability Guidelines. You can configure the names of the standard network variables for this object.	
nviObjRequest	The name of the Object Request (SNVT_obj_request, index 0) network variable.
nvoObjStatus	The name of the Object Status (SNVT_obj_status, index 1) network variable.
nviFileRequest	The name of the File Request (SNVT_file_req, index 2) network variable.
nvoFileStatus	The name of the File Status (SNVT_file_status, index 3) network variable.
SCPT_max_snd_t	Configuration parameter for Maximum Send Time. Set value by Selecting current value and type in new value.

Reference Configuration

After setting the module parameters for a new configuration, the Reference Configuration screen will appear as below. This screen is used to view the configuration of the individual registers. Only one register is displayed at a time. From this screen the user can go to variable editing, valid bit editing, module configuration, exporting and downloading interface files, and environment setup.



Field Definitions

PLC Register Box

In the upper left corner of the screen is the PLC Register list. To choose a particular register to become active in the display, simply click in the proper radio button next to the desired register label. This will cause the chosen register to be displayed in the main register listing and the Register parameters to be displayed.

Register Parameters.

The Start, End, and Length parameters for the active register are displayed in the Register box at the top of the screen just left of center. This display contains information about the current defined state of that register. The length parameter includes any reserved addresses and includes the valid bit area in the %I register display.

Register Configuration Box

The main list on this screen contains information on the current definition of the active reference space.

Addr	Network Var	SNVT	Type	Size	Array	Length	%I	%V	Initial	Tin 1	Tout1	Tout2	Bytemap

Addr This value is the reference address of the variable within the active register space.

Network Var The name of the network variable.

SNVT Network variable type description.

Type Network variable type number.

Size Number of register locations required for this variable

Array Number of elements in an array

Length Total length of the variable or array.

%V The number designation of the valid bit associated with this variable.

%I The location within the %I space where the valid bit is stored.

Initial Initial state of the variable on power-up (Hold or zero).

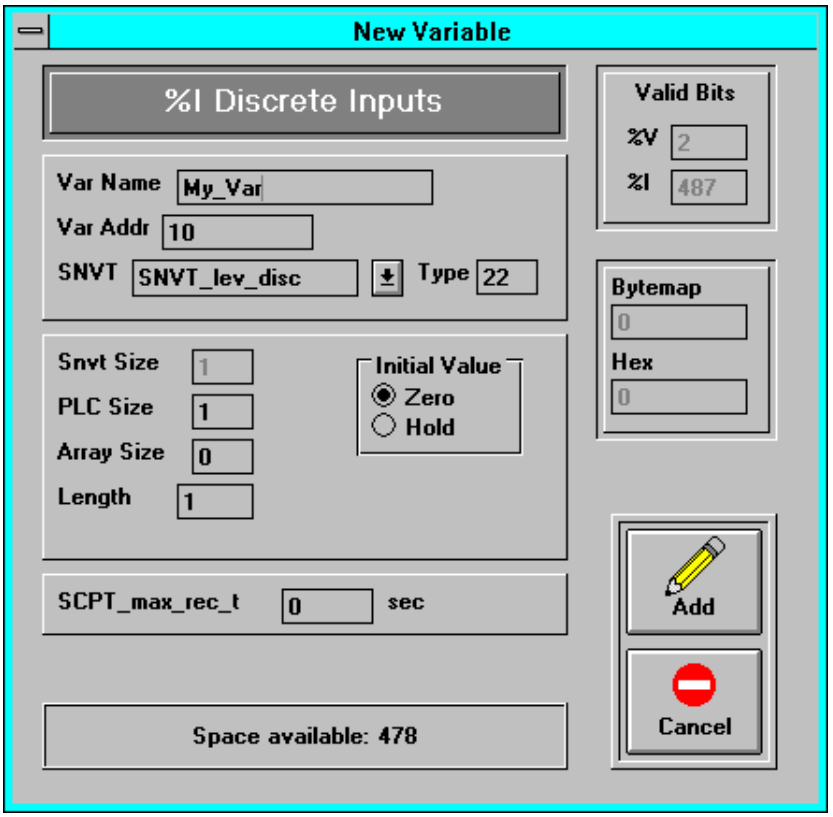
Tin 1 The value of the configuration parameter max_rec_time in seconds. This parameter has meaning for input variables only and will appear as zero for outputs or if not defined for the input variable.

Tout 1 The value of the configuration parameter max_send_time in seconds. This parameter has meaning for output variables only and will appear as zero for inputs or if not defined for output variables.

Tout 2 The value of the configuration parameter min_send_time in seconds. This parameter has meaning for output variables only and will appear as zero for inputs or if not defined for output variables.

Defining Variables

To add a new variable From the Reference Configuration screen, select a location by clicking on either an existing variable or the “begin” address line and then click in the “NEW” command button. This will add a variable that will be placed in the next available location after the highlighted address. The Edit Variable screen will then appear.



Field Definitions

Var Name Network variable name. The name must follow LONTALK variable naming conventions

Var Addr

Reference address with the active register space.

SNVT

Description of the network variable’s type. Chosen with pull-down list or entered as a user-defined type.

Type

The network variable type number.

SNVT Size

Size of the network variable in 8-bit bytes. This is the variable size as viewed from the LONWORKS network.

PLC Size

Number of PLC register addresses needed to hold this variable or a single element if the variable is an array. In the case of discrete registers (%I and %Q) this number represents the number of bits required. For analog registers (%AI and %AQ) this is the number of 16-bit register locations needed for this variable.

Array Size

Array size is the number of array elements defined for the variable. To change, highlight the value and type new value over the old. The program will recalculate the variable length. An array of size zero represents a single normal variable with no array indexing. An array of size one is treated as a single variable, but includes array indexing.

Variable	Array Size	Resulting Names
NVI_MyVar	0	NVI_MyVar
NVI_MyVar	1	NVI_MyVar[0]
NVI_MyVar	2	NVI_MyVar[0] NVI_MyVar[1]
NVI_MyVar	i	NVI_MyVar[0] NVI_MyVar[1] ..... NVI_MyVar[i-1]

Length

Length is the total number of register locations used by the currently defined variable. It includes all elements of an array.

SCPTs

Depending on the direction of the current variable, one of the following configuration parameters can be edited from this screen. If the variable is an input, the maximum receive time parameter is displayed. The maximum send time and minimum send time parameters apply to output variables. SCPTs are NOT defined in the .XIF file created for the module configuration. SCPTs are contained in the Value File which must be downloaded to the module in a separate download operation.

SCPT_max_rec_t

The configuration parameter SCPT_max_recv_time can be set by entering a value into this field. The maximum receive time can be set in whole increments of one second. This value is the maximum time period between updates of an input variable before a fault is recognized. If the variable is set to 10 seconds and 11 second elapse since the last update of the variable, then a fault is generated meaning that the sending node is presumed to be off-line. The fault is signified by the setting of the valid bit associated with the particular variable. To download this to the module, be sure to download the "Value File" with the Download tool.

SCPT max_send_t

The configuration parameter SCPT_max_send_time can be set by entering a value into this field. The maximum send time can be set in whole increments of one second. This value is the maximum time period between updates of an output variable. If the variable has not been sent to the network due to a change in value over the max_send_time period, the variable is sent to the network even if the it has not changed since the last update. This will allow other devices on the network to assure that the value they have is current and that the LBIM is still online. Setting this parameter to zero (default) disables the operation of this feature. To download this to the module, be sure to download the "Value File" with the Download tool.

SCPT min_send_t

The configuration parameter SCPT_min_send_time can be set by entering a value into this field. The minimum send time can be set in whole increments of one second. This value is the minimum time period between updates of an output variable. If more than one network update is requested for the variable within this time period, transmission is inhibited until the time expires. This sets a minimum time between output transmissions to avoid loading the network with rapidly changing data. Setting this parameter to zero (default) disables the operation of this feature. To download this to the module, be sure to download the "Value File" with the Download tool.

Note

Caution should be used in assigning the max send time. Setting many variables to have short max send times can cause network performance problems. This would cause many variables to be sent to the network rapidly and may overload the network. Max_send_time should only be used when necessary for the application and should be set to the highest period allowed by the application.

Initial Value

This choice allows the user to set the state of the variable upon reset or power-up. When using hold, the last known value is retained through power-down or reset and this value is used as the initial state. When the initial state is set to zero, the variable is set to zero on power-up or reset until changed by normal operation. Use the radio button control to choose the appropriate initial value.

Bytemap

The bytemap determines the ordering of message bytes when being mapped into register locations. For standard network variable types the bytemap is predefined and is not changeable by the user. When defining custom variables, the bytemap will need to be created in order to assure that the message is placed in the register space in the desired manner. Please see the section of this manual on defining custom variables.

Saving a Variable Definition

Use the pointer to click on the OK command button in the lower right of the screen to accept the current variable definition. Clicking OK makes a copy of the definition in the proper register configuration while the edit copy remains. To continue adding variables to the current register, simply change the variable name and any of the other fields that require modification. When finished adding variables to the current register, click on the cancel command button to return to the register configuration screen. Be sure to save the current variable definition before leaving the screen.

Message Field

The narrow frame in the bottom left of the screen is a message field. In most cases the message will show information about the number of register locations available at the current entry point. For instance, if a variable is being defined with the starting location 0010 and there is a variable defined in location 0015, the space available for the current variable would be 5. Errors in the definition will cause error messages to appear in this area.

Table 4-2. Network Variable Fields in the Network Variable Editor

Field	Description
Name	The name of the network variable as seen from LONWORKS. Enter a name to create a new network variable.
Reference Type	To change this field, click the scroll bar. Discrete — type %I or %Q, depending on direction Register — type %AI or %AQ, depending on direction *Only network variables of type SNVT_switch or SNVT_lev-disc can use the discrete reference type.*
Network Variable Direction	To change this field, click the scroll bar. The choices are: Input — from LONWORKS to the PLC Output — from the PLC to LONWORKS
Array Size	Used to create network variable arrays. Arrays are mapped to subsequent PLC references. For example, an array of 12 discrete, input, SNVT_switch network variables starting at reference %I9 would be mapped to %I9 through %I20. For network variables that are mapped to registers, the network variable data is packed into the subsequent registers.
Reference Address	The reference address specified must be within the PLC reference type blocks configured for the LBIM. Also, the address cannot be the same as other network variables.
Valid Bit Address	The address of the %I reference type that will be the valid bit for the network variable.
Default	Specifies the default value the PLC will assume for the network variable if a network error occurs. To change this field, click the scroll bar. The choices are: Hold — maintain the last value when an error occurs Zero — set the value to zero when an error occurs
Type	Specifies the network variable data type. To change this field, click the scroll bar. The choices are: Standard Network Variable Types — choose from the list of SNVTs user_defined — allows custom network variables (This is the final choice on the list of SNVTs.)
Size	The number of bytes used by the network variable. You can modify this field only if the network variable type is user_defined.
Length	The total length, in bytes, of the network variable or network variable array. You cannot modify this field.

Menu Commands

There are four command menus available in the Reference Configuration screen. They are File, Tools, View, and Options. The File menu includes the commands Open New File, Open Existing File, Save Current File, Save current file under a different name, and Exit. The Tools menu contains the commands to edit transceiver type, form the .XIF file, download the .XIF file to the module, and rebuilding the valid bit table. The View menu allows the user to choose either the reference configuration or the valid bit table. The Options menu allows the user to edit screen colors.

Defining Custom Variables

The user has the ability to create custom or user-defined variable types to be used with the LBIM. These variable types are limited to 31 Bytes or less. LONWORKS messages are processed in 8-bit words. The PLC registers are configured for 16-bit words. In order to form the 16-bit words from the 8Bit data, the interface needs instructions on how to place the data into the registers in the desired order. This is accomplished using the bytemap information.

Bytemapping

To control mapping of data, a Bytemap is required for each network variable. The bytemap is a 32-bit (8 hex digits) value. The first 31 bits (bit0-bit30) represent each of the 31 possible bytes in a network variable. The most significant bit (bit 31) determines whether all the bytes in the network variable are packed into the PLC register locations.

Network variables can be organized as nearly any combinations of bits, 8-bit bytes, and 16-bit words up to 31 bytes total. The PLC %AI and %AQ registers are 16-bits wide. If an 8-bit network variable is mapped to a %AI register, it would normally be placed into the lower 8-bits with the upper 8 bits left empty. The next reference would be stored in the low byte of the next register. To conserve memory space or to affect logical association of byte-wide data, the data can be “packed” such that a byte can be stored in the lower byte of the register and the next byte value stored in the upper byte of the same register. The bytemap configuration value controls this process.

To pack data, the most significant bit of the bytemap is set to 0. With the remaining 31 bits associated with the possible 31 bytes of the network variable, a 0 means the byte at that location is to be handled as an individual byte. A 1 means the byte is part of a larger word. Since a 1 signifies that the byte is combined with the next higher byte, a 0 in that next location would be meaningless since that byte cannot be an individual (it is joined with the next lower byte). In this case, a 0 means that this byte completes the data word, while a 1 means that these two bytes form the lower word of a double-word value. In this case, the remaining two bits for the double word bytes should be set to 0 (see example below).

Example:

		Bytemap = 0x800001A4	Bytemap = 0x000001A4
bit	**data**	**unpacked**	**packed**
0 (LSB)	byte1	low byte register 1	low byte register 1
0	byte2	low byte register 2	high byte register 1
1	byte3 word1	register 3	register 2
0	byte4		
0	byte5	low byte register 4	low byte register 3
1	byte6 word2	register 5	register 4
0	byte7		
1	byte8 double word 1	register 6	register 5
1	byte9		
0	byte10	register 7	register 6
0	byte11		
0	byte12	low byte register 8	low byte register 7
0	byte13	low byte register 9	high byte register 7

Resulting Register Map

Unpacked

LOW BYTE	HIGH BYTE
Byte1	
Byte2	
Byte3	Byte4
Byte5	
Byte6	Byte7
Byte8	Byte9
Byte10	Byte11
Byte12	
Byte13	

Register 1	
Register 2	
Register 3	
Register 4	
Register 5	
Register 6	
Register 7	
Register 8	
Register 9	

Packed

LOW BYTE	HIGH BYTE
Byte1	Byte2
Byte3	Byte4
Byte5	
Byte6	Byte7
Byte8	Byte9
Byte10	Byte11
Byte12	Byte13

File Menu

New

Choose this command to open a new configuration file. If there is already a configuration open, be sure to save it before opening a new file or changes may be lost.

Open

Choose this command to open an existing file. The program will prompt the user for a file name with a browser window. If there is already a configuration open, be sure to save it before opening another file or changes may be lost.

Save

Choose this command to save changes to the file. The file will be saved under the current filename.

Save As...

Use this command to save the configuration file under a different name. This feature can be used to begin a configuration from a previous version, make changes and save as a new configuration.

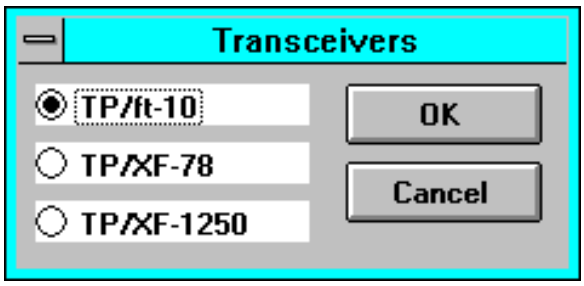
Exit

Choose this command to exit the configuration program and return to windows.

Tools Menu

Transceivers

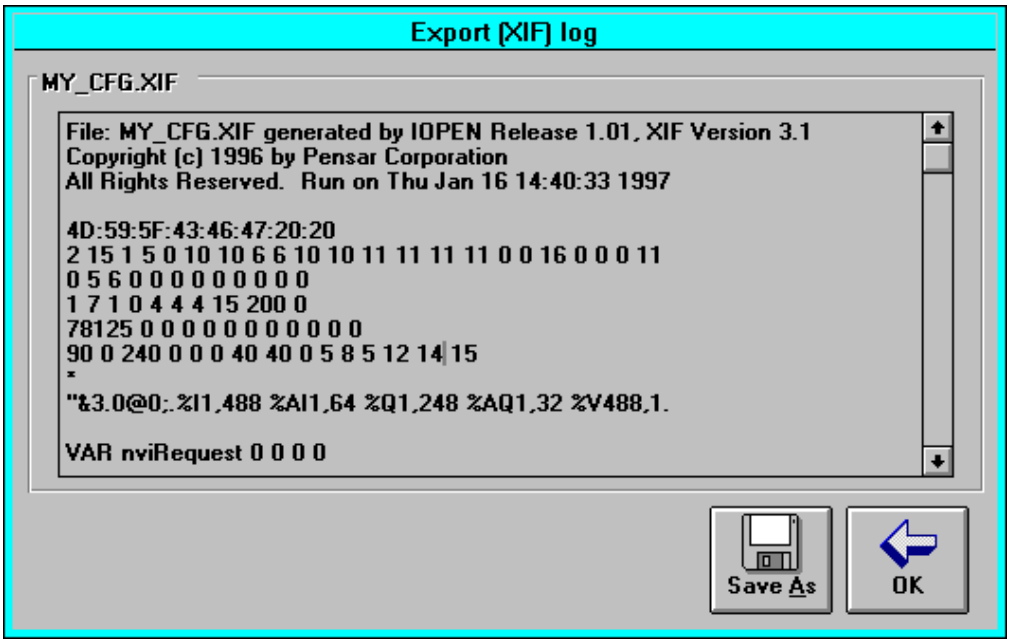
Use this command to call a dialog box that will allow the user to choose a transceiver type for the current configuration.



To choose a transceiver, click on the radio button of the choice and then click on the OK button. Transceiver type can also be changed from the Module Configuration screen.

Export

Choose the Export command to create the LonWorks External Interface File (file extension .XIF) from the current module configuration file (file extension .IOP). After the .XIF file is created and saved using the configuration filename with a .XIF extension. The created file will then appear in a view screen.



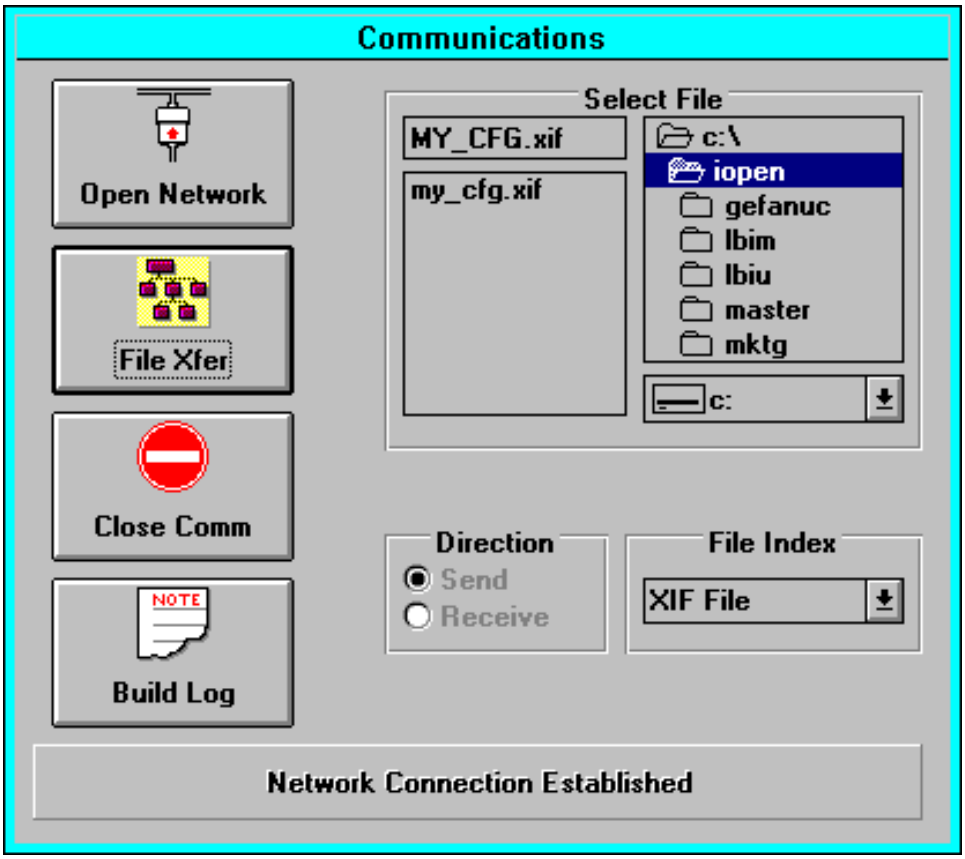
This screen is to used for viewing and editing the output file. Normally, no changes need to be made to this file. However, if modifications are desired, they can be added to this screen. The SaveAs command button will not appear until the file has been edited. Be sure to save any changes made to this file. Modifications can also be made to the file with most text editing applications as the file is saved in an ASCII text format.

note

The interface file (.XIF) is downloaded to the module using LonMark “file Transfer Protocol”. The I/Open configuration software MUST be used for this operation. LonBuilder and other network management tools use a different method of loading an interface file and will not work with the LBIM.

Download

Choosing download activates a utility screen that will allow the downloading of configuration or value data to the LBIM module. Before invoking the download function, check to see that the LONWORKS network interface is connected and functioning properly. The .XIF file is downloaded to the module through a LONWORKS network interface such as a Serial LONTALK Adapter (SLTA) to the module via the network interface connection. When the downloader is invoked, the program will open the network interface drivers. If the interface is not properly responding, error messages will be displayed.



On entering this screen, if the network interface failed to open, attempts to open it can be made by clicking on the open network command button. The status of the network connection will be displayed in the message field at the bottom of the display.

Use the 'Select File' browser display to choose the file to download. The default will select the current configuration interface file. Once the interface is established and the proper file is selected, clicking on the download command button will initiate the download function. If the module to be configured is installed in a PLC backplane, Be sure the CPU is NOT running a logic program and the LBIM module is powered and properly connected to the network.

To download a value file to a module, chose "Value File" in the File Index pull-down list. The value file contains configuration parameter data such as MaxSendTime. If the application makes use of Valid bits and definitions of MaxSendTime, MinRecTime, or Min SendTime have been made, the value file must be downloaded to the module to set the configuration parameters.

To Upload a LONMARK Configuration Paratmeter Template File (.LNM) from the module, choose "Template File" in the File Index box. Notice that the direction indication changes to Receive. For information on template files, see the "LONMARK Application Layer Interoperability Guidlines" published by the LONMARK Interoperability Association (doc 078-0120-01C).

Binding Network Variables

The addressing, configuration, and establishment of connections (binding) among LONWORKS nodes is referred to as installation, and is supported by a collection of network management services built into the Neuron chip.

The Network Binding and Configuration Parameter Value files are created by the network binding software tool. (For a list of network management software packages, refer to "What You Need to Operate the LBIM" in Chapter 1.) The individual network variable configuration parameters are set through the Parameter Value File. Configurable network image parameters are listed in Table 4-5. For more information, refer to the documentation provided with your network binding software tool.

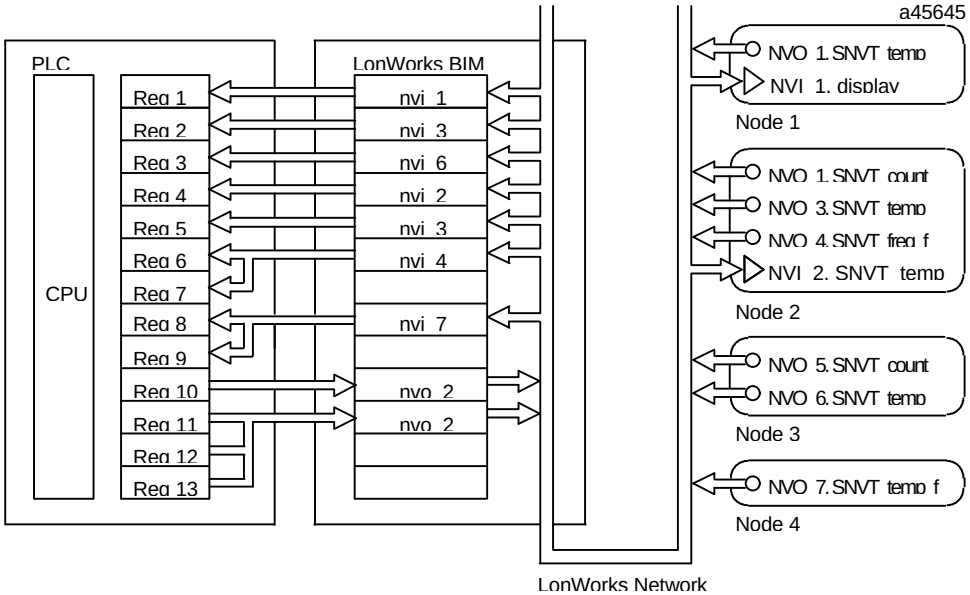


Figure 4-3. Example: Installing the LBIM in the Network and Binding the Variables

This step binds the individual variables from the network into the type slots defined as described in "Configuring the LBIM." When these variables are updated, the new values are passed into the proper PLC register locations. When the PLC updates a register value, the new value is transferred to the network. In this example, a change in the value of the input on Node 4 will cause its network variable to update on the network. This value is acquired in the LBIM and forwarded to registers 6 and 7 in the PLC.

Table 4-3. Configurable Network Image Parameters

Parameter	When Initialized	Basis for Configuration	Changeable when node is installed?	Compile-time option to prevent field-override of initial setting?
Channel Bit rate	compilation or installation	node	yes	no
Domain ID	installation	domain	yes	no
Subnet/Node Address	installation	domain	yes	no
Group Address(es)	installation	node	yes	no
Neuron ID	manufacture	node	no	no
Acknowledged Service-Explicit Messages	compilation	network variable or explicit message	no	no
Acknowledged Service-Network Variables	compilation or installation	network variable or explicit message	yes	yes
Retry Count	installation	network variable or explicit message	yes	no
Authenticated Service-Explicit Messages	compilation	network variable or explicit message	no	no
Authenticated Service-Network Variables	compilation or installation	network variable or explicit message	yes	yes
Parameter	when/where initialized	basis for configuration	changeable when node is installed	compile-time option to prevent field-override of initial setting
Authentication Key	compilation or installation	domain	yes	no
Number of Priority Slots	installation	node	yes	no
Priority Service-Explicit Messages	compilation	network variable or explicit message	no	no
Priority Service-Explicit Network Variables	compilation or installation	network variable or explicit message	yes	yes
Network Variable Types	compilation	network variable or explicit message	no	yes

Chapter 5 Troubleshooting

This chapter describes the tools available for troubleshooting problems with the LBIM and its configuration.

The LBIM does not report faults. Module errors cause the LBIM to reset. If an acknowledged network variable (NV) update fails, it is up to the destination device to assume a default value. Configuration errors prevent the LBIM from being mapped on the PLC backplane.

The following topics are discussed in this chapter:

Startup and Configuration

The following table lists symptoms, causes and corrective actions for problems that could occur while the LBIM is being powered up or during configuration.

Table 5-1. Troubleshooting

Symptom	Cause	Corrective Action
SVC indicator flashing.	The LBIM is in a LONWORKS unconfigured state.	Complete the LBIM configuration. (For configuration procedures, see Chapter 4.)
IN MSG and OUT MSG indicators flashing alternately every second	EEPROM checksum error Incorrect PLC backplane initialization Errors during initialization of the LONWORKS network interface	Power cycle the LBIM.
	Incorrect network interface configuration	Check for overlaps in the network variable mapping and correct the mapping if necessary. Download the configuration again and power cycle the LBIM.
IN MSG and OUT MSG indicators flashing together	LONWORKS wink function implemented. This feature is used to facilitate installation of the LBIM on the LONWORKS network.	None. This does not indicate a problem.
When you attempt to download the configuration .XIF file, the following message appears: `Error opening network driver:...`	Network driver not installed.	Install network driver.
Module continuously transmits network traffic.	Max_Send_Time set too low.	Change Max_Send_Time to a larger value for all but critical variables.
Data does not transfer to CPU and/or PLC I/O Fault tables show LOSS/ADD Faults.	Configuration mismatch	Change backplane configuration to match that of the module exactly. Be sure to account for reserved space and valid bits. (See Chapter 4)

Valid Bits

Each network variable is assigned a valid bit in the %I reference area associated with each module. For input variables, a '1' in the valid bit location signifies valid data. The bit will be cleared to '0' if the data were not updated and the Max Receive Time (if configured to be non-zero) has expired. Thus the PLC logic can determine whether any data is not updated within a specified time period of time. This can be useful for setting up a "heartbeat" to sense network integrity. On power up, the input valid bits are all set to zero until the first update is received.

For output network variables, the bit will be cleared if the variable was bound using acknowledged service and a message is sent that does not receive acknowledgment. By monitoring the state of this bit, the PLC logic can determine whether an output was reliably transmitted.

The Valid bits are included in the total length configured in the %I reference area.

Note

An input network variable (a node input) is an output from the LBIM. An output network variable (a node output) is an input to the LBIM.

Input network variables:

If the bit is 1: Normal operation.

If the bit is 0: The NV has not been updated *and* the Max Receive Time (if configured to a non-zero value) has expired. This indicates that an input heartbeat has not been received.

Output network variables:

If the bit is 1: Normal operation.

If the bit is 0: The NV has been bound using acknowledged service, the NV was updated, *and* an Update Failed condition was detected (ACK not received.)

Or, The first update has not been sent. (Normal operation during powerup.)

Wink Function

The LONTALK wink function is used during network installation to identify unconfigured nodes. If there is more than one unconfigured node on the network, LONTALK wink network management messages can be used to differentiate the nodes.

When the LBIM receives a wink message, it responds by flashing the IN MSG and OUT MSG LEDs together five times.

Appendix A Specifications

This chapter provides the following information:

Module Specifications

Power Requirements

Input Power	+5 VDC ±5% from 90-30 backplane
Power consumption	300mA typical, 400mA maximum

Environmental Requirements

Operating Temperature Range	0°C to 55°C
Storage Temperature Range	-45°C to 85°C
Operating Humidity Range	5% to 95% non-condensing
Ventilation	Convection
Vibration	IEC68-2-6, JISC0911 1G at 40—50 Hz, 0.012p-p at 10—40 Hz
Shock	IEC68-2-27, JISC0912 15G, 11ms
Flammability	PCB material UL-94VO Components UL recognized
ESD Immunity	IEC801-2, 8KV air discharge, 4.4KV contact discharge.
RF Susceptibility	IEC801-3 10V/meter
Fast Transient Susceptibility	IEC801-4, 1 KV specification
Electrical Surge Susceptibility	ANSI/IEEE C37.90 or IEC801-5 ANSI 37.90a IEC801.5

Agency Approvals

CSA 22.2 213-M1987 Hazardous Location
UL 1604 with C-UL Hazardous Location
CSA 22.2 142-M1987 Process Control
UL 508 Industrial Control Equipment
CISPR11, EN55011, Class A
FCC Part 15, Subpart J Class A limits

Microprocessor Configuration

Network interface processor	Neuron 3150, 10 Mhz
Network interface program	Echelon MIP/P50
Neuron program memory	32 Kbytes EPROM (32-pin PLCC socket)
Neuron data memory External Internal	 8 Kbytes RAM 2 Kbytes RAM
Network configuration memory	internal 512 bytes EEPROM 10,000 erase/write cycles
Neuron-Host configuration	MIP/P50, type “B” with either Uplink Interrupt or Polled I/O
Host processor	Intel 80C186EC, 20 Mhz
Host program memory	128 Kbytes flash
Host data memory	64 Kbytes RAM

Interface Specifications

Serial Communications Protocol

Port	Firmware download port only
Electrical interface	EIA RS-422 compliant
Baud rate	9600 BPS
Data word length	8 bits
Stop bits	1
Parity	none
Transfer handshake	RTS/CTS
Hand-Held Programmer	Not supported in firmware. The HHP Present pin is supported in hardware.

Network Communications

LONWORKS Transceivers	Transformer Isolated Twisted Pair TP/XF-1250 Twisted Pair Transceiver TP/XF-78 Twisted Pair Transceiver TP/FT-10 Free Topology Twisted Pair Transceiver
Termination	external
SNVTs	Supports SNVTs 31 bytes or less in length

Series 90-30 Backplane Interface

Backplane processor	GE Fanuc SI-30 ASIC (application specific integrated circuit)
Direct Memory Access	16-bit DMA transfer mode
Host application processor interface	API for Series 90-30 Smart Modules

Appendix B Standard Network Variable Types

The LBIM supports SNVTs that are 31 bytes or less in length. This appendix provides a listing of SNVTs defined as of the publication date of this manual. For a current listing of SNVTs, refer to the most recent version *The SNVT Master List and Programmer's Guide* (005-0027-01). Further explanation of SNVTs can be found in the following documents, which are available from Echelon Corporation:

The SNVT Master List and Programmer's Guide (005-0027-01)

Neuron C Programmer's Guide

LonMark Application Layer Interoperability Guidelines (078-0120-01)

Table B-1. SNVTs Supported by the Bus Interface Module

Measurement	Name	SNVT #
Alarm state	SNVT_alarm	88
Angular velocity	SNVT_angle_vel	4
	SNVT_angle_vel_f	50
	SNVT_rpm[3]	102
Area	SNVT_area[3]	110
Character	SNVT_char_ascii	7
Char string	SNVT_str_as	36
	SNVT_str_int	37
Color	SNVT_color	70
Concentration	SNVT_ppm	29
	SNVT_ppm_f	58
Count, event	SNVT_count	8
	SNVT_count_f	51
Count, incremental	SNVT_count_inc	9
	SNVT_count_inc_f	52
Currency	SNVT_currency	89
Current	SNVT_amp	1
	SNVT_amp_f	48
	SNVT_amp_mil	2

Table B-1. - Continued

Measurement	Name	SNVT #
Date	SNVT_date_cal	10
Day of week	SNVT_date_day	11
Density	SNVT_density	100
	SNVT_density_f	101
Emergency mode, HVAC	SNVT_hvac_emerg	103
Energy, elec	SNVT_elec_kwh	13
	SNVT_elec_whr	14
	SNVT_elec_whr_f	68
Energy, thermal	SNVT_btu_f	67
	SNVT_btu_kilo	5
	SNVT_btu_mega	6
File position	SNVT_file_pos	90
File request	SNVT_file_req	73
File status	SNVT_file_status	74
Flow	SNVT_flow[3]	15
	SNVT_flow_f	53
	SNVT_flow_mil	16
Frequency	SNVT_freq_f	75
	SNVT_freq_hz	76
	SNVT_freq_kilohz	77
	SNVT_freq_milhz	78
Gain	SNVT_muldiv	91
Grammage	SNVT_grammage	71
	SNVT_grammage_f	72
HVAC mode	SNVT_hvac_mode[2]	108
HVAC override	SNVT_hvac_overid[2]	111
HVAC status	SNVT_hvac_status[2]	112
Humidity	SNVT_lev_percent	8
Illumination	SNVT_lux	79
Installation source	SNVT_config_src	69
Length	SNVT_length	17
	SNVT_length_f	54
	SNVT_length_kilo	18
	SNVT_length_micr	19
	SNVT_length_mil	20
Level, continuous	SNVT_lev_cont	21
	SNVT_lev_cont_f	55
Level, discrete	SNVT_lev_disc	22
Level, percent	SNVT_lev_percent[4]	81

Table B-1. - Continued

Measurement	Name	SNVT #
Magnetic cards	SNVT_magcard	86
	SNVT_ISO_7811	80
Mass	SNVT_mass	23
	SNVT_mass_f	56
	SNVT_mass_kilo	24
	SNVT_mass_mega	25
	SNVT_mass_mil	26
Multiplier	SNVT_multiplier	82
Object request	SNVT_obj_request	92
Object status	SNVT_obj_status	93
Occupancy	SNVT_occupancy	10
Override	SNVT_override	97
Phase/rotation	SNVT_angle	3
	SNVT_angle_deg	104
	SNVT_angle_f	49
Phone state	SNVT_telcom	38
Power	SNVT_power	27
	SNVT_power_f	57
	SNVT_power_kilo	28
Power factor	SNVT_pwr_fact	98
	SNVT_pwr_fact_f	99
Preset	SNVT_preset	94
Pressure - gauge	SNVT_press	30
Pressure - absolute	SNVT_press_f	59
Pressure - gauge	SNVT_press_p	113
Resistance	SNVT_res	31
	SNVT_res_f	60
	SNVT_res_kilo	32
Sound level	SNVT_sound_db	33
	SNVT_sound_db_f	61
Speed	SNVT_speed	34
	SNVT_speed_f	62
	SNVT_speed_mil	35
State	SNVT_state	83
Switch	SNVT_switch	95

Table B-1. - Continued

Measurement	Name	SNVT #
Temperature	SNVT_temp	39
	SNVT_temp_p	105
	SNVT_temp_f	63
Temperature setpts	SNVT_temp_setpt	106
Time of day	SNVT_date_time	12
Time - elapsed	SNVT_time_f	64
	SNVT_elapsed_tm	87
	SNVT_time_sec	107
	SNVT_time_passed	40
Time stamp	SNVT_time_stamp	84
Translation table	SNVT_trans_table	96
Volume	SNVT_vol	41
	SNVT_vol_f	65
	SNVT_vol_kilo	42
	SNVT_vol_mil	43
Voltage	SNVT_volt	44
	SNVT_volt_dbmv	45
	SNVT_volt_f	66
	SNVT_volt_kilo	46
	SNVT_volt_mil	47
Zero and Span	SNVT_zerospan	85

Notes

1. SNVT_temp represents tenths of a degree Celsius above -274°C. To get SNVT_temp units, define a constant: C_to_K equal to 2740 which is added to temperature expressed in tenths of degrees C.
2. To be used for heating, ventilation and air conditioning applications.
3. The value 0xFFFF represents invalid data.
4. The value 0x7FFF represents invalid data.

Appendix C Configuration File Specifications

The following topics are presented in this chapter.

Network Interface and PLC Mapping

The Network Interface Configuration file is created using the configuration utility provided with the LBIM. Table C-1 lists the specifications for the Network Variable Definition file, which defines the network variables at the node.

Table C-1. Network Variable Definition File

File Mode	Write Only
File Format	ASCII, External Interface File (.XIF) version 3
Index	2
.XIF Lines/Fields supported:	Line 5: Program ID. Line 6, Field 4: Number of NVs. Node Self-Identification String Network Variable Entries (all lines).

Network Variable Parameter Configuration

For additional information about the Configuration Parameter Value File, refer to the LONMARK Application Layer Interoperability Guidelines (078-0120-01).

Table C-2. Configuration Parameter Value File

File Mode	Read/Write
File Format	Binary
Index	1

Table C-3. Configuration Parameter Template File

File Mode	Read Only
File Format	ASCII
Index	0
SCPTs supported	Max Send Time for Node Object
	Min Send Time for all NV's (output only)
	Max Send Time for all NV's (output only)
	Max Receive Time for all NV's (input only)
	Note - Timeouts will have 1 second minimum time (resolution).

Standard Table C-4. Configuration Memory Budget

Resources used in calculating the budget:	Flash EPROM, RAM, the LBIM's PLC register space and the number of NVs.
Non-volatile (flash)	24 Kbytes
RAM	24 Kbytes
PLC I/O table space	1K 16-bit words each direction
Network Variable Configuration file size	64K bytes
Configuration Files	All configuration is performed using three configuration files.
File Transfer Methods	LonMark File Transfer Protocol

Table C-5. PLC I/O Table Configuration

PLC I/O Table Mapping Method	Defined using Parameter 0.
Reference Parameters	1 - The parameter 0 register setup will be used. In addition, an enumerated text parameter will be used as parameter 1. The text will contain: "Last Parameter"
Module Input/Output Offsets in PLC CPU I/O Tables	Specified in the custom area of the self documentation string for the node. This will consist of: . %I start, len %AI start, len %Q start, len %AQ start, len %V start, len. where: "." is the start/end of the address description "start" is the starting CPU I/O table offset for each memory type (max. 5 digits). "len" is the number of memory locations used by this module. %V specifies the start and length of the valid bit block in the %I I/O table.
PLC I/O Table to NV Mapping	Specified in the custom area of the self documentation string for each network variable. This will consist of: .%mType start, len, valid, default. where: "." is the start / end of the map desc. "mType" is I, Q, AI, or AQ "start" is the starting CPU I/O table offset for the memory type (max. 5 digits). "len" is the number of I/O table locations used by this NV. "valid" is the %I CPU I/O table offset of the valid bit for the network variable. "default" is either H or 0. This is used when the LBIM detects the network interface is down, where: H - Leave value sent to the PLC as is. 0 - Set the value to the PLC to zero. Default only applies to input network variables.
PLC Register to NV Array Mapping	An NV array has one declaration in the .XIF file and therefore has only one mapping description in the self-documentation string. The size of the IO Table data will be the size of the NV element times the number of NV array elements.
Data Coherency	The PLC must update all memory locations for a network variable in a single sweep to stop intermittent values from propagating over the network. Data Coherency must be maintained over each network variable.
Fast updates	If the PLC updates memory locations faster than the LBIM can update the NV or the network can propagate the NV, will result in those transitions being lost.
Valid Bit	Each network variable is configured to have a valid bit in the %I I/O table. For input NVs, the bit will be set if the NV has been updated and the Max Receive Time (if set) has not expired. For output NVs, the bit will be set if the NV has been propagated and a failure not been detected (must use acknowledged service).
Module Control %I locations	8 bits of %I registers (mapped to first location). Bit 1: LONWORKS interface running. Bit 2: Network variable mapping configured. Bits 3-8: reserved for future use

Table C-5. - Continued

Module Control %Q locations	8 bits of %Q register (mapped to first location). Bit 1: Reset Module (hardware reset) Bit 2: Send Service Pin Message Bits 3-8: reserved for future use.
Parameter 0 definition	Created from Network Variable Definition File (.XIF) file.
Config File/Init File definition	Created from Network Variable Definition File (.XIF) file.
Hand Held Programmer	By setting the maximum parameter to 1, and parameter 1 to the text "Last Parameter", the API will handle all commands from the Hand Held Programmer attached to the PLC CPU
Dependent parameters	None (API skip table not used).
Configuration Freeze	Not Used
Packing of Discrete NVs into %I, %Q	SNVT_lev_disc, SNVT_switch supported.

Configuration Parameter Types

Standard Configuration Parameter Types (SCPTs) are used to transfer node configuration information via the LONTALK File Transfer protocol. SCPTs provide a means of handling large amounts of configuration information on a node. SCPTs do not use network variable resources and are downloaded and uploaded to a node via the LONTALK file transfer protocol.

Appendix D Glossary

This appendix contains a concise, alphabetized listing of conventional communications terms and (where applicable) their associated acronyms. Most of these terms (but not necessarily all) are used in this manual.

Commonly Used Acronyms and Abbreviations

API ..... Application Programming Interface

AUI..... Attachment Unit Interface

ARP ..... Address Resolution Protocol

ASCII ..... American National Standard Code for Information Interchange

ASIC..... Application Specific Integrated Circuit

BOOTP..... Boot Strap Protocol

BPS..... Bits Per Second

CPU ..... Central Processing Unit

CSMA/CD . Carrier Sense Multiple Access with Collision Detection

DCE..... Data Communications Equipment

DCS ..... Detailed Channel Status

DDP..... Distributed Directory Protocol

DHCP ..... Dynamic Host Configuration Protocol

DIB..... Directory Information Base

DNS..... Domain Name System

DTE..... Data Terminal Equipment

GSM ..... GEnet System Manager

ICMP ..... Internet Control Message Protocol

IEEE ..... Institute of Electrical and Electronics Engineers

IP ..... Internet Protocol

KB ..... Kilobyte (1024 bytes)

LAN..... Local Area Network

LED ..... Light Emitting Diode

LISW..... LAN Interface Status Word

LLC..... Logical Link Control

LON ..... Local Operating Network

LSAP..... Link Layer Service Access Point

MAC ..... Medium Access Control

MAU ..... Medium Attachment Unit

MB ..... Megabyte (1,048,576 bytes)

MIP ..... Microprocessor Interface Program

PC ..... Personal Computer, IBM compatible

PCLTA..... PC LONTALK adapter

PCMCIA ... Portable Computer Memory Card International Association

PDU ..... Protocol Data Unit

PLC..... Programmable Logic Controller

SCPT..... Standard Configuration Parameter Types

SLTA ..... Serial LONTALK Adapter

SNP..... Series 90 Protocol

SNVT..... Standard Network Variable Type

SQE..... Signal Quality Error

SRTP..... Service Request Transfer Protocol

TCP..... Transmission Control Protocol

TCP/IP ..... Transmission Control Protocol/Internet Protocol

UDP ..... User Datagram Protocol

Glossary of Terms

AUI Port	The connector on the network interface.
AUI Cable	The cable between the AUI port and the transceiver (some transceivers plug directly into the AUI port, thus requiring no separate AUI cable).
Address Administration	The assignment of LAN addresses locally or on a universal basis.
Address Field	The part of a Protocol Data Unit (PDU) that contains an address.
Address Resolution Protocol	The Internet Protocol that binds dynamically a high-level Internet Address to a low-level physical hardware address such as a MAC address.
ASCII Code	The American Standard Code for Information Interchange is an information code standard by which digits, letters, symbols and control characters can be encoded as numbers.
Attachment Unit Interface (AUI)	In a network node on a Local Area Network, the interface between the medium attachment unit (MAU) and the data terminal equipment. Often called “transceiver cable”.
Bit	Contraction of Binary Digit. The smallest unit of memory. Can be used to store one piece of information that has only two possible states or values (e.g., One/Zero, On/Off, Yes/No). Data that requires more than two states or values (e.g., numerical values) requires multiple bits (see Word).
BOOTP	BOOTP is a bootstrap protocol that allows a TCP/IP network node (such as a Series 90 PLC with Ethernet Interface) to discover its own IP address, the address of a file server host, and the name of a file to be loaded into memory and executed. Information is supplied from a BOOTP Server device on the network.
Broadcast Address	A LAN group address that identifies the set of all nodes on a Local Area Network.
Bridge	A functional unit that interconnects two Local Area Networks (LANs) that use the same logical link control protocol, but may use different medium access control protocols.
Broadcast	Sending of a frame that is intended to be accepted by all other nodes on the same Local Area Network.
Bus Network	A Local Area Network in which there is only one path between any two network nodes and in which data transmitted by any node is available to all other nodes connected to the same transmission medium. NOTE: A bus network may be linear, star, or tree topology.
Byte	A group of bits, typically 8 bits, operated on as a single unit. A single ASCII character typically occupies one byte. (See Octet).
Carrier Sense	In a Local Area Network, an ongoing activity of a network node to detect whether another node is transmitting.
Carrier Sense Multiple Access with Collision Detection (CSMA/CD)	A bus network in which the medium access control protocol requires carrier sense and in which exception conditions caused by collision are resolved by retransmission.
Channel	A channel is an abstract term used to describe a connection between a client PLC and a server PLC and the periodic transfer of data between the two devices.

Channel Status Bits	The Channel Status bits comprise bits 17–80 (64 bits) of the status indication area. These bits consist of an *error* bit and a *data transfer* bit for each of the channels that can be established
Client	A node that requests network services from a server. A client PLC initiates a communications request. (See also Server.)
Collision	A condition that results from concurrent transmissions by two or more nodes on the transmission medium.
Collision Domain	A single CSMA/CD network. If two or more nodes are within the same collision domain and both transmit at the same time, a collision will occur. Nodes separated by a repeater are within the same collision domain. Nodes separated by a bridge are within different collision domains.
Command Dictionary	Provides an alphabetical listing of the LAN Interface commands.
Command Field	That part of a protocol data unit (PDU) that contains commands, as opposed to the address field and information field.
Communications Window	A part of the PLC scan that provides an opportunity for the LAN Interface to read and write PLC memory. The window is executed automatically once per PLC scan.
Connection	A logical communication link established between two end points and used to transfer information.
CSMA/CD	See Carrier Sense Multiple Access with Collision Detection.
Data Communications Equipment (DCE)	Examples: Modems and transceivers. Distinct from DTE, Data Terminal Equipment.
Data Link Layer	In Open Systems Interconnection architecture, the layer (Layer 2) that provides services to transfer data over a physical link between open systems. Consists of the LLC and MAC sublayers.
Data Terminal Equipment	Examples: computers, terminals, printers. Distinct from DCE, Data Communications Equipment.
DCS Words	See Detailed Channel Status Words.
Detailed Channel Status Words	Two status words containing detailed information on a single Series 90 channel. The DCS words are retrieved using the Retrieve Detailed Channel Status Command.
Device Name	A character string that identifies a particular communication destination at a given network adapter (for example, the PLC CPU or an SNP gateway).
Directory Information Base (DIB)	A collection of information used for directory services (like name resolution). In this document DIB refers to the DDP database which is actually distributed among all DDP devices instead of in a single name server. (See also Distributed Directory Protocol (DDP).
Distributed Directory Protocol (DDP)	The GE Fanuc proprietary protocol used to provide distributed name service on a TCP/IP Ethernet network. The distributed nature of DDP means that there is no name server.
Domain Name System (DNS)	The predominant name service protocol used by the Internet. DNS is primarily used to resolve a name into an IP address.
Dotted Decimal	The notation for IP, gateway, and name server addresses as well as the subnet mask. It consists of 4 decimal numbers (0–255) separated by periods. Example IP address: 3.0.0.1
Dynamic Host Configuration Protocol (DHCP)	A superset of the BOOTP protocol (see BOOTP).

Ethernet Interface	The general term used in this manual to identify the GEnet hardware module, with or without software, that connects a PLC (or CNC) to a network. It may also appear in the shortened form, “Interface”. (See also LAN Interface.)
Flash Memory	A type of read-only memory that can be erased and reprogrammed under local software control. It is used to store data that must be preserved when power is off..
Frame	A data structure that consists of fields, predetermined by a protocol, for the transmission of user data and control data.
Gateway	A special purpose, dedicated computer that attaches to two or more networks and routes packets from one to the other. In particular, an Internet gateway routes IP datagrams among the networks to which it connects. Gateways route packets to other gateways until they can be delivered to the final destination directly across the physical network. (Also sometimes referred to as a router.)
Global Address Administration	Address administration in which all LAN individual addresses are unique within the same or other Local Area Networks. (See also Local Address Administration.)
Group Address	An LLC address that identifies a group of network nodes on a Local Area Network.
Host	A computer or workstation that communicates with stations such as PLCs or CNCs across a network, especially one that performs supervisory or control functions. Note that this same term is widely used in TCP/IP literature to refer to any network node that can be a source or destination for network messages. (See also Hostid.)
Hostid	The hostid is the part of the IP address identifying the host on the network. (See also Netid.)
IEEE 802	The IEEE 802 LAN series of standards are as follows:
IEEE 802.1	Overview and Architecture.
IEEE 802.2	The Logical Link Control (LLC) sublayer of OSI Data Link Layer common above all IEEE 802 Medium Access Control (MAC) sublayers.
IEEE 802.3	CSMA/CD (Ethernet) MAC and Physical Layer standard.
IEEE 802.4	Token Bus (MAP LANs) MAC and Physical Layer standard.
IEEE 802.5	Token Ring (IBM) MAC and Physical Layer standard.
Information Field	That part of a protocol data unit (PDU) that contains data, as opposed to the address field and command field.
Initiating Station	The station from which an instance of communication (a transaction) originates. Also referred to as “client.”
Interface	Shortened form for “Ethernet Interface”. The general term used in this manual to identify the GEnet hardware module, with or without software, that connects a PLC (or CNC) to a network. (See also LAN Interface.)
Internet	Any collection of networks and gateways that use the TCP/IP protocols and function as a single, cooperative virtual network, specifically, the world-wide *Connected Internet.*
Internet Address	A unique Internet address identifies each node on an IP network (or system of connected networks). The Internet address is assigned to the node by the user. (Also known as an IP address.) (See also Physical Address.)

Internet Control Message Protocol (ICMP)	The Internet Protocol that handles error and control messages.
Internet Protocol (IP)	The Internet standard protocol that defines the Internet datagram and provides the basis for the Internet packet delivery service. See also Transmission Control Protocol (TCP).
Inter Repeater Link (IRL)	A mechanism for interconnecting two and only two repeater units.
IP Address	See Internet Address.
Jabber	A transmission by a network node beyond the time interval allowed by the protocol.
LAN Interface	A term used in this manual to identify the GEnet hardware module, with or without software, that connects a PLC or CNC to a network.
LAN Interface Status Bits (LIS Bits)	The LIS bits comprise bits 1–16 of an 80-bit status bit area. The location of this 80-bit status area is assigned using the Logicmaster 90 Configuration Package in the “Status Address” field. The LIS bits contain information on the status of the Local Area Network (LAN) and the Ethernet Interface itself.
Linear Topology	A network topology in which nodes are each connected at a point along a common continuous cable which has no loops and only two endpoints.
Link Service Access Point (LSAP)	A Data Link layer SAP. A single byte that identifies the routing of data received by the network node.
LIS Bits	See LAN Interface Status Bits.
Local Address Administration	Address administration in which all LAN individual addresses are unique within the same Local Area Network. (See also, Global Address Administration.)
Local Area Network (LAN)	A computer network located on a user’s premises within a limited geographical area.
Local Station	The station at your immediate location, i.e., “here”. (See also “Remote Station”).
Log Events	Events recorded in the system exception log for the LAN Interface. The maximum number of events in the exception log is 16.
Logical Link Control (LLC) Protocol	In a Local Area Network, the protocol that governs the exchange of frames between network nodes independently of how the transmission medium is shared.
MAC Address	The Medium Access Control (MAC) address is a 12-digit hexadecimal number that identifies a node on a local network. Each Ethernet Interface has its own unique MAC address.
Medium Access Control (MAC)	In a local area network (LAN), the part of the protocol that governs access to the transmission medium independently of the physical characteristics of the medium, but taking into account the topological aspects of the network, in order to enable the exchange of data between network nodes.
Medium Access Control Protocol	In a Local Area Network, the protocol that governs access to the transmission medium, taking into account the topological aspects of the network, to enable the exchange of data between network nodes.
Medium Attachment Unit (MAU)	In a network node on a Local Area Network, a device used to couple the data terminal equipment (DTE) to the transmission medium. Often called “transceiver”. The MAU may be built into the DTE or it may be a separate unit that attaches to the DTE through an AUI.
Multicast Address	A LAN group address that identifies a subset of the network nodes on a Local Area Network.

Name	Usually, this refers to the Network Address Name. For Distributed Directory Protocol operation, this can sometimes refer to a Long-Form name, which is a combination of a Network Address Name and a specific Device Name at that network adapter.
Netid	The netid is the part of the IP address identifying the network on which the node resides. (See also Hostid.)
Network	An arrangement of nodes and interconnecting branches.
Network Adapter	The device, such as the Ethernet Interface, providing communications services for a particular network.
Network Address Name	A character string that is used in lieu of an actual IP address. The client device uses Name Resolution to resolve this symbolic name into the actual IP address. This name represents the address on the network of a particular network adapter.
Node	The physical module that connects a node to the network. The Ethernet Interface is an example of a node. It connects a station (PLC or CNC) to a network (Factory LAN). A station may contain more than one Ethernet Interface and therefore contain more than one node.
Octet	A group of 8 bits operated on as a single unit. (See also Byte.)
One-Way Propagation Time	See Transmission Path Delay.
Path	The sequence of segments and repeaters providing the connectivity between two DTEs. In CSMA/CD networks, there is one and only one path between any two DTEs.
Peer	Another entity at the same level (layer) in the communication hierarchy.
Peer-Peer	Communication between nodes at the same level or layer in the hierarchy.
Physical Address	The unique physical layer address associated with a particular node on the Local Area Network (LAN). Ethernet physical addresses are typically assigned by the manufacturer. (See for comparison, Internet Address.)
Protocol	A set of rules for exchanging messages between two communicating processes.
Protocol Data Unit (PDU)	Information that is delivered as a unit between peer entities of a local area network (LAN) and that contains control information, address information, and may contain data.
Remote Station	Station located elsewhere on the network. (See also “Local Station”)
Repeater	In a Local Area Network, a device that amplifies and regenerates signals to extend the range of transmission between network nodes or to interconnect two or more segments.
Responding Station	A station which generates a message in response to a command that was directed to the station.
Round-Trip Propagation Time	Twice the time required for a bit to travel between the two most distant nodes in a bus network. NOTE: In a network using carrier sense, each frame must be long enough so that a collision or jam signal may be detected by the transmitting node while this frame is being transmitted. Its minimum length is therefore determined by the round-trip propagation time.
Router	A device similar to a bridge that allows access to multiple LANs. (Also known as a gateway in Internet terminology.)

Server EXAMPLE: File server, print server, mail server.	A network node that provides specific services to other network nodes (clients). (See also Client.)
Service Request Transfer Protocol (SRTP)	A proprietary protocol that encodes Series 90 “Service Requests”, the native language of the Series 90 PLC CPUs, to provide general purpose communications with a Series 90 PLC. SRTP is presently available over 802.3/Ethernet networks. SRTP is also used by Logicmaster 90 to communicate over an Ethernet network.
Signal Quality Error (SQE)	An indication from the MAU (transceiver) to the Ethernet Interface to indicate any of three conditions: 1) improper signals received from the medium, 2) collision detected, or 3) SQE message test.
Slot Time (in a CSMA/CD network)	Minimum bitrate-dependent unit of time which, in case of collision, is used to determine the delay after which network nodes may attempt to retransmit. [Slot time for all IEEE 802.3 10 Mbps implementations is 51.2 μsec (512 bit times)].
Soft Switches	Basic system information set up by the Logicmaster 90 Configurator and transferred to the LAN Interface upon powerup or restart.
Station	A computer, PLC, or other device that connects to one or more networks. (See also Node.)
Station Address	Each node on an Ethernet network must have a unique MAC address which is different from all other nodes on the network. This is a 12-hexadecimal digit MAC address. (See also MAC Address.)
Station Manager	A part of the basic Ethernet Interface communications software that executes as a background activity on the Ethernet Interface. The Station Manager provides interactive supervisory access to the Ethernet Interface. The Station Manager may be accessed locally via the serial port, or remotely over the LAN.
Tally	Counters kept by the LAN Interface to indicate load and performance information.
Topology	The pattern formed by the physical medium interconnecting the nodes of a network.
Transceiver	See Medium Attachment Unit (MAU).
Transceiver Cable	See Attachment Unit Interface (AUI).
Transmission Path Delay	The time required for a bit to travel between the two most distant network nodes in a bus network.
Transmission Control Protocol (TCP)	The Internet standard connection-oriented transport level protocol. See also Internet Protocol (IP).
Universal Address Administration	See Global Address Administration.
Word	A measurement of memory length, usually 4, 8, 16, or 32 bits long. In the Series 90 PLC, a word is always 16 bits.

Appendix Q Quick Start Guide

This Quick Start Guide describes the steps necessary to get your Series 90™ PLC LONWORKS® Bus Interface Module (PE693BEM350, 351, and 352) up and running quickly. It assumes that you have a working knowledge of LONWORKS network technology and GE Fanuc Series 90-30 PLCs.

If you are unfamiliar with LONWORKS networks or with Series 90-30 PLCs, please refer to the detailed instructions in the appropriate chapters in this manual and in the related documentation.

This chapter covers the following topics:

Related Documentation

Series 90™-30 Programmable Controller Installation Manual (GFK-0356)

Logicmaster™ 90 Series 90-30/20/Micro Programming Software User's Manual (GFK-0466).

LONWORKS Installation Overview (005-0006-01)

For references to additional publications that may be helpful, refer to the Preface in this manual.

Module Description

The Series 90 PLC LONWORKS Bus Interface Module (LBIM) provides an interface between the GE Fanuc Series 90-30 PLC and an Echelon LONWORKS network (Figure Q-1). The LBIM can interface with networks that use twisted pair cabling in bus, loop, or free-topology configurations. The LBIM can support up to 244 network variables (four of which are reserved as configuration variables) and map these network variables (NVs) into the %I, %Q, %AI, and %AQ PLC memory references. The Module adheres to the LONMARK Layers 1-6 Interoperability Guidelines for the interface to the LONWORKS network.

The LBIM can be located in any rack in any slot (except for the slots in the main rack that are reserved for the power supply and CPU) in a Series 90-30 PLC. For the most efficient system operation, the main baseplate is preferred.

The following slots are reserved in the PLC main rack:

Models 331, 340, 341, 351, 352 and later:	Slot 0 reserved for power supply Slot 1 reserved for CPU
Models 311 and 313:	Slot 0 reserved for power supply (The CPU is built into the baseplate.)

Functional Characteristics

Most parameters are supported to the limits of the LONTALK protocol and those of the LONWORKS node. The module supports up to 240 user NVs. The actual maximum number of NVs depends on the size and type of the NVs, the PLC available memory space (2kbytes each direction), and the configuration memory budget. The module supports all Standard Network Variable Types (SNVTs) as listed in the SNVT Master List published by Echelon Corporation as of June 1996. Each NV must be no more than 31 Bytes in length. NVs can be mapped into PLC memory types %I, %Q, %AI, or %AQ. NVs mapped to memory types %I or %Q must be of type SNVT_lev_disc, SNVT_switch, or other bit-represented types.

When an input NV is updated, the data associated with it are copied into the proper PLC input buffer location. The Store Inputs routine is then called to update the PLC memory during the next PLC scan. When the API callback notifies the module that an output scan update has arrived, the data are copied into a holding buffer. This buffer is then scheduled to be checked against the current value of each NV output. If the data are different, the NV is updated over the LONWORKS network if the Min Send Time has expired (only if Min Send Time was configured).

The LBIM has four LED indicators that show the module's operating status. The Service and Wink functions provided by LONWORKS are implemented in the LBIM (for details, see "Controls and Indicators").

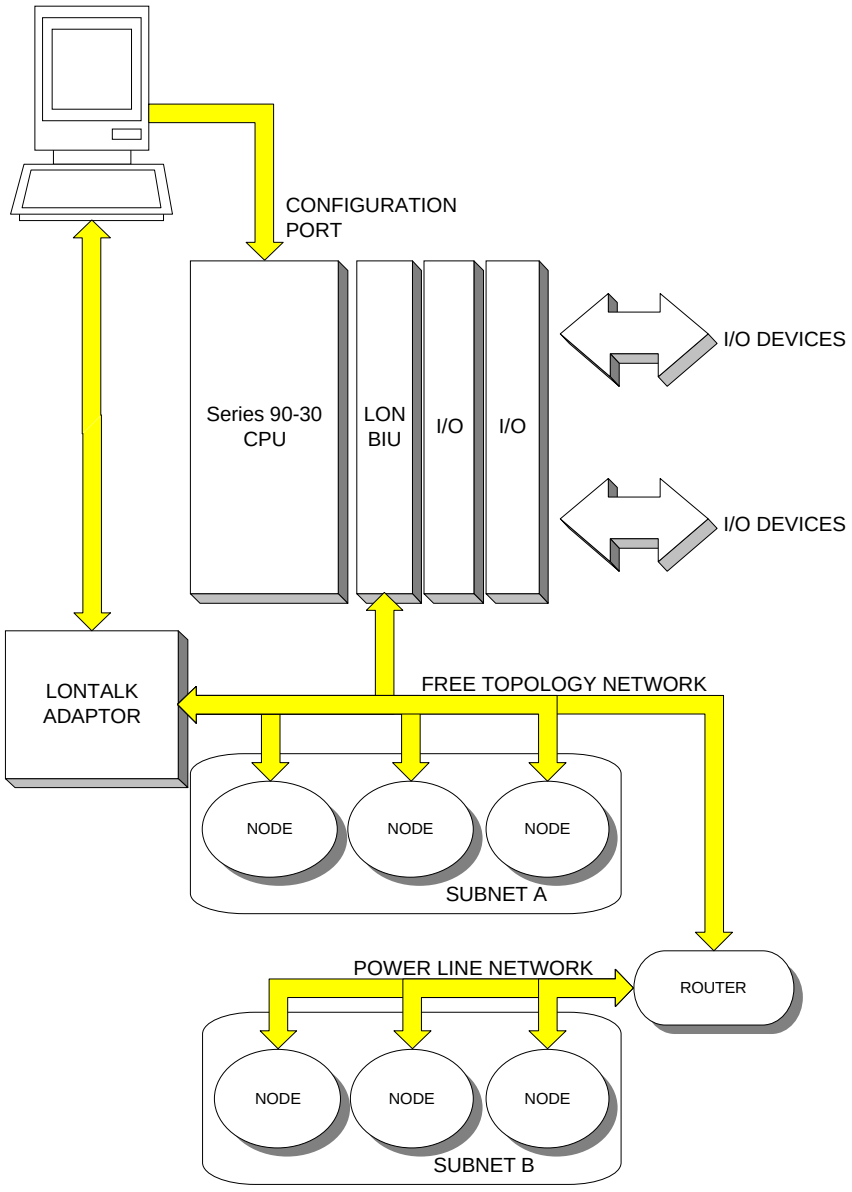


Figure Q-1. Sample Network Configuration

Controls and Indicators

Switch	Type	Function
SERVICE	Momentary contact pushbutton	When pressed, the module's Neuron chip broadcasts its unique 48-bit Neuron identification code and program identifier to the LONWORKS network. This function is used to facilitate installation of the Module in the LONWORKS network.

Indicator	State	Meaning
PWR	Lighted	(Power) +5 VDC primary power is present at the Module logic circuitry.
OUT MSG	Flashes briefly	(Outbound Message) An update message for a bound NV is sent by the Module to the LONWORKS network.
	Lighted briefly	Powerup sequence in process. The configuration parameter value file or the NV bindings are being saved into the flash memory.
	Flashes alternately with IN MSG LED	A powerup error has occurred. For troubleshooting information, refer to Chapter 5.
	Flashes together with IN MSG LED	LONWORKS wink function implemented. See "Wink Function" in Chapter 5.
IN MSG	Flashes briefly	(Inbound Message) Flashes briefly (10ms) when an update message for a bound NV is received by the Module from the LONWORKS network. Also lighted briefly during powerup sequence.
	Lighted briefly	Powerup sequence in process. The NV configuration is being saved into the flash memory.
	Flashes alternately with OUT MSG LED	A powerup error has occurred. For troubleshooting information, refer to Chapter 5.
	Flashes together with OUT MSG LED	LONWORKS wink function implemented. See "Wink Function" in Chapter 5.
SVC	Not lighted	Normal operation.
	Flashing	(Service) The Module is in a LONWORKS unconfigured state. (The Module NVs and PLC mapping are configured and it is waiting for configuration from a network management tool.)
	Lighted	When SERVICE button is pressed.

Connectors

The Module has three connectors on the front panel in addition to the backplane connector on the module base.

Connector	Function	Type
NETWORK	Connection of network management tools	RJ-45 NetA, NetB
NETWORK	Provides LONWORKS network field connection (NETA, NETB) using 18-24 AWG (0.86mm^2 to 0.22mm^2) twisted pair wires.	2-pin removable screw terminal
COM PORT RS-422	RS-422 serial port that supports SNP communications (SNP and SNPX). Used to update module firmware. (Does not support Hand-Held Programmer.)	DB-15, female
Series 90-30 backplane	Connection to PLC backplane	24-pin connector

Diagnostics

The LBIM does not report faults to the PLC. Module errors cause the module to reset. If an acknowledge NV update command fails, it is up to the destination device to assume that a fault has occurred. Configuration errors will cause the module to not be mapped.

For troubleshooting and diagnostics information, refer to Chapter 5.

What You Need to Operate the Bus Interface Module

- Series 90-30 backplane with CPU module
  See Table Q-1 for models that can be used with the LBIM.
- A PC or laptop that runs Microsoft Windows with either a Serial LONTALK Adapter (SLTA) or PC LONTALK Adapter (PCLTA)
  This is required to run the network interface configuration software provided with the LBIM.
- Logicmaster 90 software
  See Table Q-1 for versions that can be used with the LBIM.
- LONWORKS network binding tool
  No network binding tool is included with the product. However, many third-party network management software packages that include network binding tools are available. (See Table Q-2 for suggestions.)
- Network interface configuration software: (for Microsoft Windows) IOPEN.EXE
  This is provided with the LBIM.

Table Q-1. Compatible CPU Models and Logicmaster 90 Software Versions

CPU Models IC693CPU___	CPU Firmware	Logicmaster 90 Software IC641SWP___
311S 331T 313H 323H 340B 341K	release 5.0 or later	(release 5.0 or later) 301R 306K 311A
351AA	release 6.0 or later	(release 6.0 or later) 301S 306L 311A
351AB	release 6.02 or later	(release 6.0 or later)

In each case, *later* models or versions can be used.

Table Q-2. Choosing a Network Binding Tool

Third-party network management tools	• LONMAKER from Echelon • ICELAN-G from IEC • MetraVision from Metra Corporation • others
Considerations	• How well it handles nodes that have a large number of NVs • Ability to handle Standard Configuration Parameter Types (SCPT) and load these values using LONTALK File Transfer

Hardware Installation and Powerup

The LBIM can be installed in any rack, in any slot except slot 0, which is reserved for the CPU module.

Caution

Power to the PLC rack must be off before installing or removing the module.

1. Grasp the module with the rear hook facing away from you.
2. Align the module with the desired base slot and connector. Tilt the module upward so that the top rear hook on the module engages the slot on the baseplate.
3. Swing the module downward until the connectors mate and the locking lever on the bottom of the module snaps into place, engaging the baseplate notch.

When power is applied to the LBIM, the following sequence of events should occur:

- PWR indicator lights
- LBIM performs self-test, during which IN MSG and OUT MSG indicators will light briefly
- When powerup is complete, the PWR indicator will remain lighted and the SVC indicator will be flashing to indicate Module is unconfigured.

If the IN MSG and OUT MSG indicators flash alternately (indicates possible EEPROM checksum error, incorrect backplane initialization, or errors during initialization of the network interface) power cycle the module. (For troubleshooting information, refer to Chapter 5.)

Module Configuration/Network Installation

Configuration of the LBIM consists of defining NV types and mapping them into the PLC reference space using the LBIM configuration software. When the module's network interface has been configured, network configuration and binding can be performed as for any other LONWORKS node. Also, the Series 90-30 backplane CPU must be set up to recognize the module as a foreign smart module with the reference map necessary to implement the network interface (see "PLC Configuration").

1. Determine which NV types will be needed to interface with the PLC.

Note

You must classify the variable direction from the LBIM to the LONWORKS network. If a NV is an output of a node, it will be an input to the LBIM.

Example:

Inputs		Outputs	
Type	**Quantity**	**Type**	**Quantity**
SNVT_temp	3	SNVT_temp	1
SNVT_count	2	display	1
SNVT_freq_f	1		
SNVT_temp_f	1		

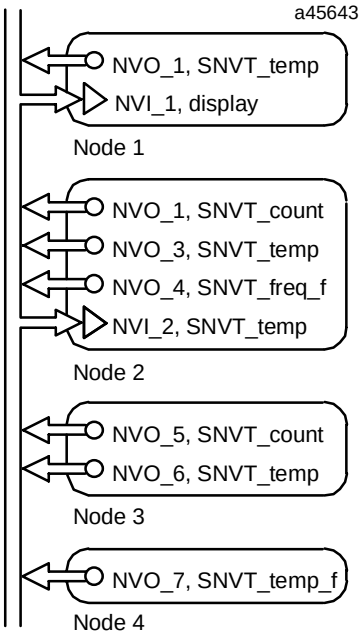


Figure Q-2. Example: Identifying the Network Variables Needed to Interface with the PLC

2. Using the LBIM configuration utility, assign NV types to the module and the registers in the PLC memory space to which the variable types will map.

Note

We recommend that you limit configuration names to a maximum of 7 characters to ensure compatibility with Logicmaster 90 software. (The LBIM configuration software allows up to 10 characters.)

Example: SNVT_temp and SNVT_count variable types are one-word values that map directly into a single register address (Figure Q-3). SNVT_freq_f and SNVT_temp_f are double word values that map into two register locations. The type *display* is a three-word, user-defined NV that maps into three locations.

At this point, the module mapping is defined, but the actual NVs are not yet bound to the module and the module is also not configured with the LONWORKS network image.

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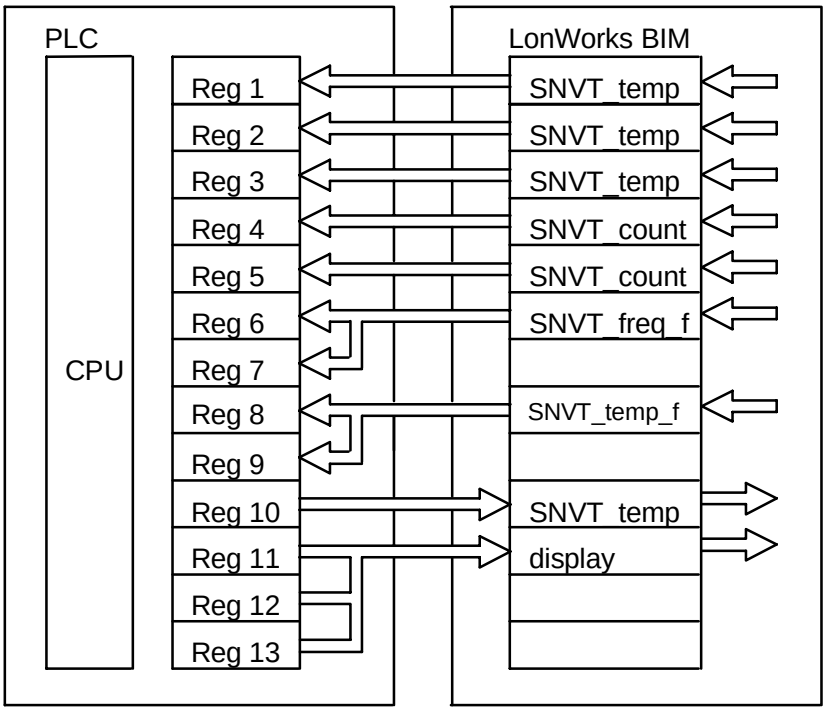


Figure Q-3. Example: Assigning Network Variables to the Module and the PLC Registers

3. Using a LONWORKS network installation tool, install the module in the network and bind the variables.

   This step binds the individual variables from the network into the type slots defined previously. When these variables are updated, the new values are passed into the proper PLC register locations. When the PLC updates a register value , the new value is transferred to the network.

Example: In the example illustrated in Figure Q-4, a change in the value of the input on Node 4 will cause its network variable to update on the network. This value is acquired in the LBIM and forwarded to registers 6 and 7 in the PLC.

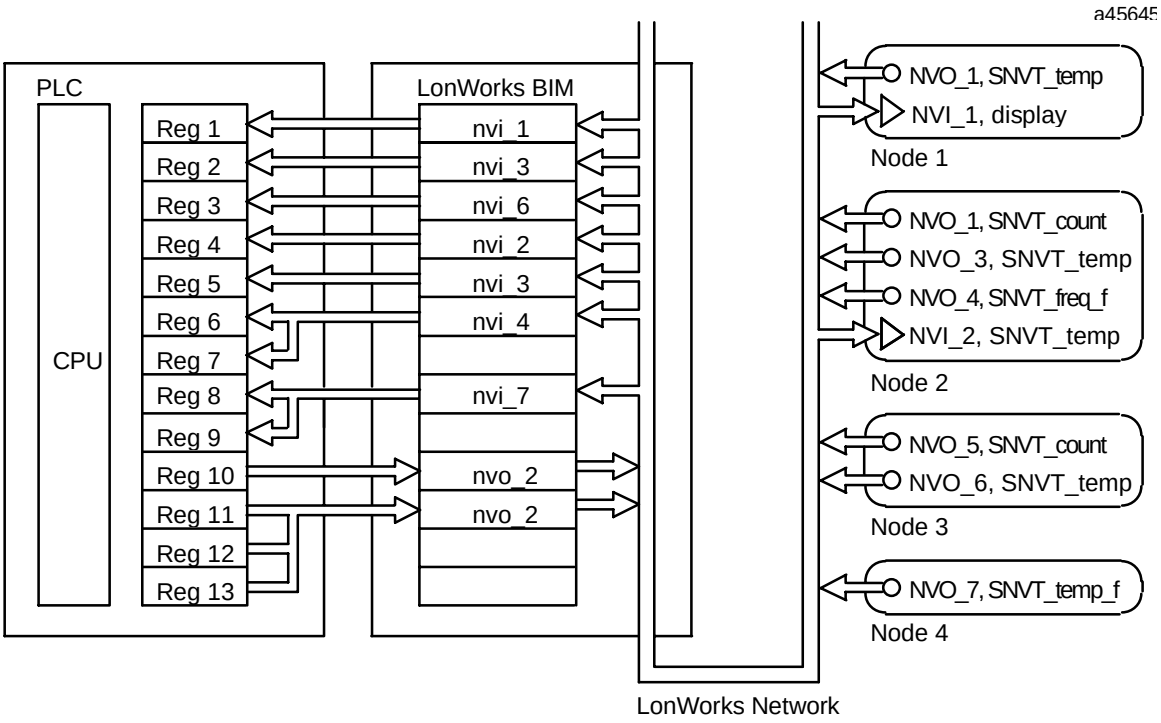


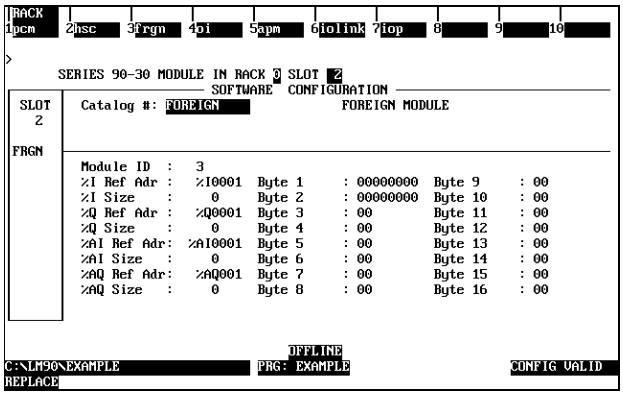
Figure Q-4. Example: Installing the Module in the Network and Binding the Variables

PLC Configuration

The Series 90-30 PLC must be configured to recognize the module as a foreign smart module with the reference map necessary to implement the network interface. The PLC is configured using Logicmaster Series 90-30/20/Micro software. (For detailed information, see "Configuring a Third-Party Module" in the *Logicmaster™ 90 Series 90™-30/20/Micro Programming Software User's Manual* (GFK-0466).

To configure the LBIM in the Series 90 PLC:

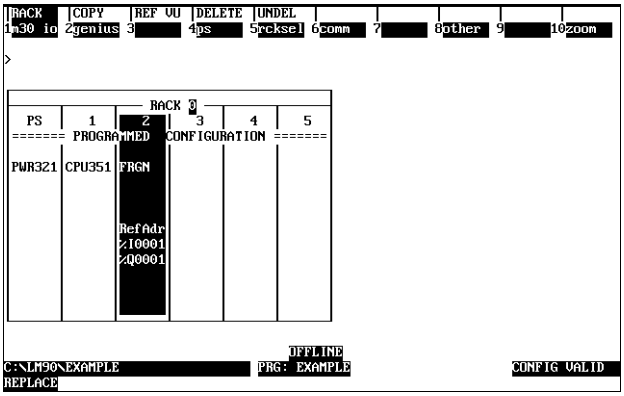
1. Start Logicmaster 90-30/20/Micro software. From the Main menu, select the Configuration package (**F2**). The Configuration Software menu will appear.
2. From the Configuration menu, press **F1** (I/O Configuration). An I/O Configuration Rack screen is displayed. Use the arrow keys to select the rack and slot in which the LBIM is to be configured.
3. To configure a foreign module, press **F8** (other). A detail screen for the slot will appear. Press **F3** (frgn). A Software Configuration screen for a Foreign Module will appear.
4. Press the **ENTER** key to display the detail screen for the Foreign Module configuration. This is the point where the reference map for the LBIM is configured.



5. Use the arrow keys to move from field to field. To edit the field contents, type in the desired value or press the **TAB** or **SHIFT**+**TAB** keys to scroll the values.

Parameter	Description
Module ID	A 1, 2, or 3-digit signed integer value (0—256) representing a vendor module designation. A range of valid vendor module IDs is used to allow validation.
Reference Data	Enter the starting address and length for each of the %I, %Q, %AI, and %AQ references. The reference address parameters default to the next highest reference address. The size parameters default to zero and are validated to be within the configuration memory limits and the configured CPU for the respective reference types.
Soft Switch Data (Byte 1—Byte 16)	Not used with LBIM

6. When you have finished configuring the reference map, press **ESC** to return to the Rack Configuration view, which will now contain the Foreign Module. (If you want to return to the detail screen shown in step 4, press **F10** — zoom).



7. To save the configuration and return to the Configuration Software menu, press **ESC**.

Summary

After the LBIM configuration, network installation, and PLC configuration have been completed, you are ready to check the configuration. To do this, power cycle the PLC. When the PLC powers up, you should observe the following sequence of events:

- The PWR indicator on the LBIM lights and remains on.
- LBIM performs a self-test, during which IN MSG and OUT MSG indicators will light briefly.
- When powerup is complete the SVC indicator should *not* be flashing. (The SVC indicator flashes when the LBIM is in an unconfigured state.)

If the IN MSG and OUT MSG indicators flash alternately, perform the following procedure:

1. Check for overlaps in the network variable mapping and correct the mapping if necessary.
2. Download the LBIM configuration again.
3. Power cycle the module.

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