LONWORKS® N2E Bus

Introduction

Application Details

The LONWORKS® N2 Bus is a peer-to-peer network that allows DX-9120 or DX-9121 controllers (Version 3) to communicate with each other and to send event-initiated data to the Network Control Module (NCM350 in North America or NCM361 in Europe). The LONWORKS N2E Bus is different and separate from the Metasys® N2 Bus.

There are also two types of N2E Bus: one has devices with the TP78 transceiver and the other has devices with the FTT10 transceiver. The two types cannot be connected.

The following Metasys controllers can reside on the LONWORKS TP78 N2E Bus:

- DX-9120 controller that features a Neuron® 3150 chip and a TP78 transceiver
- NCM350/361 equipped with a LONWORKS interface card (NU-NET201-0) and a TP78 transceiver

The following Metasys controllers can reside on the LONWORKS FTT10 N2E Bus:

- DX-9121 controller with a Neuron 3150 chip and an FTT10a transceiver
- NCM350/361 equipped with a LONWORKS interface card. (NU-NET202-0) with a FTT10a transceiver

Figure 1 shows an example of a network in which the NCM350/361 uses the LONWORKS N2E Bus.

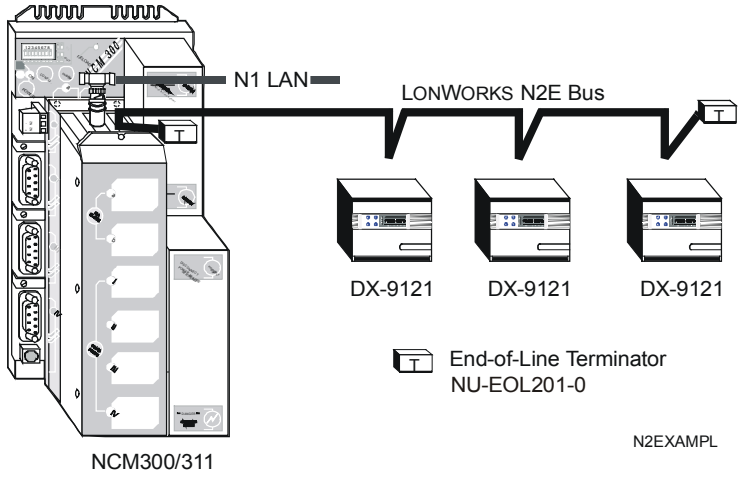


Figure 1: Example of LONWORKS N2E Bus Layout

As with the Metasys N2 Bus, devices over the LONWORKS N2E Bus are wired in a daisy-chained fashion, with multiple devices connected in a series. (However, you can use a short stub length to connect the LONWORKS N2E card. Refer to *Connecting Bus to NCM350/361* in this document for details.) The LONWORKS N2E Bus uses solid or stranded twisted pair wire. You cannot connect coaxial or fiber optic cables directly to these devices.

About LONWORKS Technology

The LONWORKS network is a local operating network that was developed by Echelon® Corporation. The network is built around the Neuron chip, a microprocessor that combines three Central Processing Units (CPUs) into one chip. The Neuron chip is an integral component of the DX-9120 and DX-9121 controller.

Various physical layout media options are available. The LONWORKS N2E Bus uses twisted pair cable and either the TP78 transceiver or the FTT10 transceiver. The DX-9120 controller has a TP78 transceiver, and the DX-9121 uses an FTT10 transceiver.

The LONWORKS network uses the LonTalk™ protocol, a software language for field device communication. This protocol uses the Open Systems Interconnect (OSI) reference model and features all seven communication layers for interoperability among control devices. For more information on LONWORKS technology, contact the Echelon Corporation.

The LONWORKS N2E Bus, NU-NET201-0 and NU-NET202-0 LONWORKS N2E card, and DX-9121 and DX-9120 controller have LONMARK® interoperability certification.

Metasys Implementation

Metasys system implementation of LONWORKS network is:

- peer-to-peer communication, which enables control intelligence to reside at the controller level
- high speed network (78 K baud)
- DX-9120-8454 or DX-9121-8454 controller (Version 3), which contains the Neuron chip
- twisted pair cable as the only media choice (two wire, shielded or unshielded)
- support of a LONWORKS Industry Standard Architecture (ISA) card (NU-NET201-0 or NU-NET202-0) installed into the NCM350/361. (The NCM101/102/401 or NCM200 cannot use this component.)

- support of multiple DX-9120 or DX-9121 controllers per NCM350/361 (See *DX-9100 Extended Digital Controller Technical Bulletin [LIT-6364020]* for details.)
- support of two end-of-line terminators (NU-EOL201-0 or NU-EOL202-0)

The LONWORKS N2E Bus requires Metasys Release 7.01 or later. DX-9120 and DX-9121 devices are defined as N2E Bus devices through Metasys Person-Machine Interface (PMI) or Data Definition Language (DDL). The device type that identifies the DX-9120 and DX-9121 is called "DX91ECH." The LONWORKS N2E is identified by the system as N2E (N2 Echelon LONWORKS).

The Metasys software does not distinguish between the DX-9120 (TP78) and DX-9121 (FTT10) devices, and both are configured in the same way. DX-9120 and DX-9121 controllers cannot reside on the same N2E Bus.

The LONWORKS N2E Bus is wired to the N2 Bus terminal block of each DX-9120 or DX-9121 controller. If you want supervisory communication for downloads, monitoring, and event reporting at the Metasys Operator Workstation (OWS), the NCM350/361 is a required component. Port 2 on the NCM350/361 is defined as N2E, and a LONWORKS ISA card is installed into ISA Slot 2 of the NCM350/361. In this arrangement, the NCM350/361 is a supervisory controller but does not take part in the exchange of data between the controllers or communicate on a peer-to-peer basis.

Theory of Operation

The LONWORKS N2E Bus is a peer-to-peer network operating at 78 K bits per second (78,000 baud).The network enables DX-912x controllers to send and receive data among themselves without a supervisory system. This communication is made possible by the controller's Neuron network processor, which communicates with the other Neuron network processors. Both analog and digital data may be transmitted from one controller to another, and any one piece of data--one analog value or block of 16 digital values--may be sent from one controller to up to 16 other controllers.

Communication Types

The LONWORKS N2E Bus carries all communication between the NCM350/361 and the DX-912x controllers and among the controllers themselves. The types of data that go across the bus include:

- commands from the NCM350/361 to the DX-912x
- automatic reporting of alarms and changes-of-logic states from the DX-912x to the NCM350/361
- responses from the DX-912x to the NCM350/361, including identification and requested data values
- complete databases for the DX-912x controllers
- time synchronization message from the NCM350/361
- analog and binary point data shared among DX-912x controllers

Poll Priorities

Poll priority levels establish how often the NCM350/361 polls a DX-912x controller to determine whether the device is online or offline. The LONWORKS N2E has four priority levels: 0, 1, 2, and 3, where 0 is the highest. For example, a Priority 2 device is polled more often than a Priority 3 device.

You set the priority level when defining the DX-912x. We recommend that you keep the priority levels for all DX-912x controllers at 3, the system default. You may, however, assign higher priorities to a limited number of DX-912xs if your application requires faster online/offline notification for those DX-912x controllers. Realize that the poll priority has a reverse effect on response times. In other words, as you assign more devices to Priority 0, bus traffic increases and Change-of-State (COS) reporting performance decreases.

Components

The components of the LONWORKS N2E Bus are the NCM350/361, LONWORKS N2E card for NCM350/361, DX-912x controllers, end-of-line terminators, ferrite clamp kit, and twisted pair wire.

Note: The LONWORKS N2E Bus does not support the use of repeaters, surge protectors, or fiber optic modems.

NCM350/361

The NCM350/361 (NU-NCM350/361-8) is an optional component but required if you need to download, monitor, or report COSs to a supervisory system. Each NCM350/361 can support one LONWORKS N2E Bus.

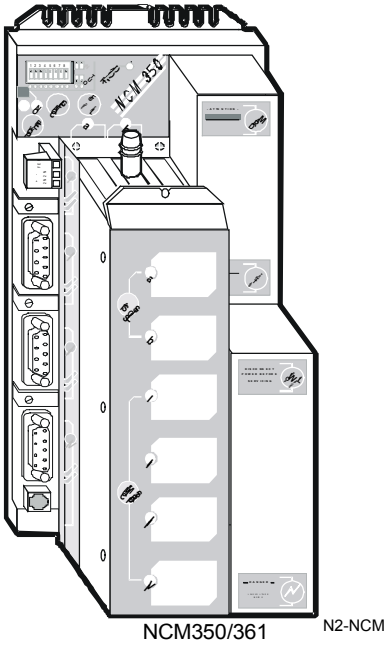


Figure 2: NCM350/361

LONWORKS N2 Card

If you use the NCM350/361 on the bus, a LONWORKS ISA card (NU-NET201-0 or NU-NET202-0) is required. Install this card into Slot 2 (right-hand slot) of the NCM350/361. You may notice a colored button on the top of the card. If you press this service button, the Neuron chip sends out a message over the network with its unique ID code. This has no use with a Metasys system. If you press the button, it does not affect the network or any Metasys component.

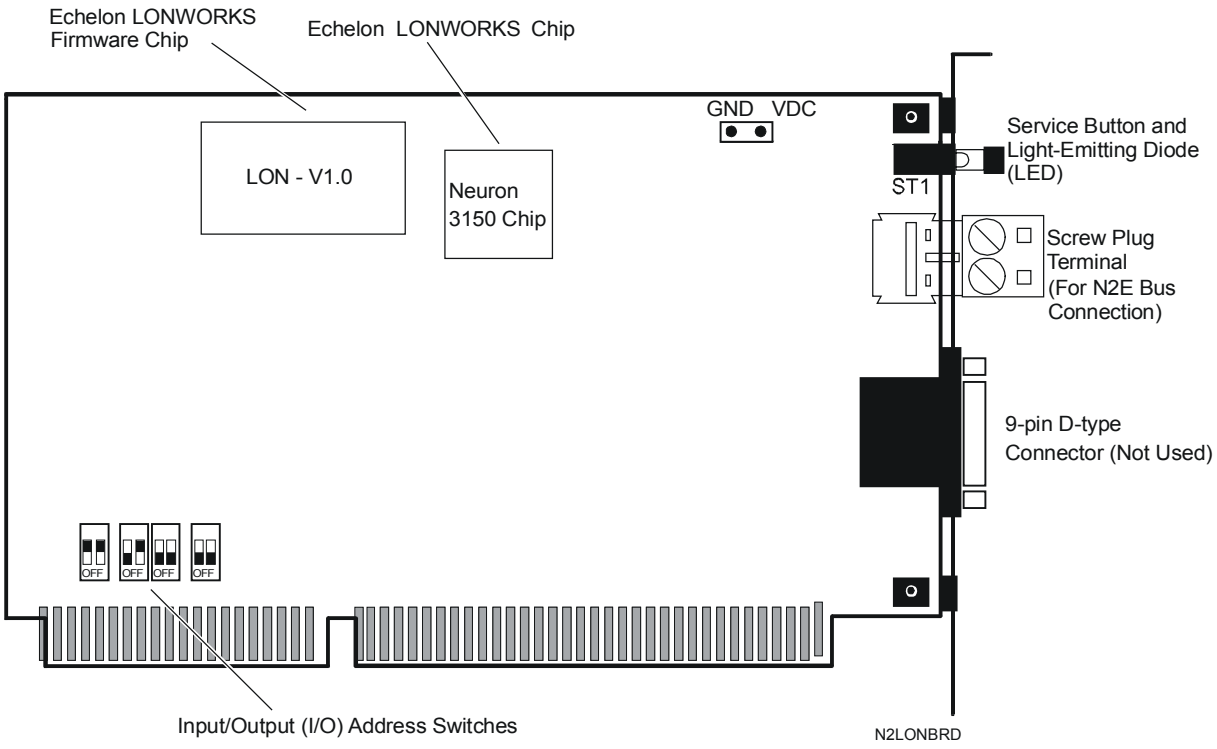


Figure 3: LONWORKS N2E Card

End-of-Line Terminator

You must install End-of-Line (EOL) terminators (NU-EOL201-0 or NU-EOL202-0) at each end of the bus to balance the LONWORKS communications signal. You must attach a small length of 2-wire cable to each terminator for connection to a controller. The unit has screw terminals. The top terminal set is used; the other set is not. You can mount the terminator on DIN rails or next to the controller with double-sided tape or Velcro® fasteners.

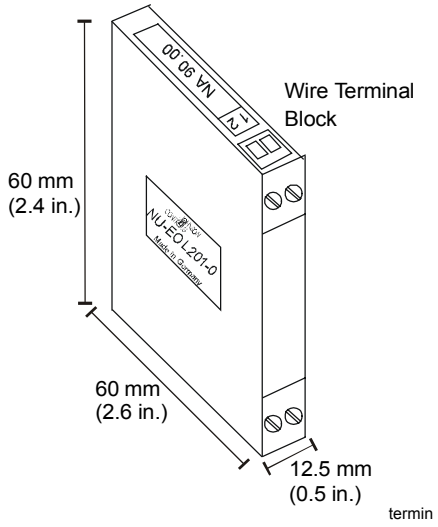


Figure 4: End-of-Line Terminator

Ferrite Clamp Kit

A ferrite clamp kit is included with the LONWORKS N2E card. This kit contains components that you need to install on the LONWORKS N2E Bus wires that connect to the NU-NET201-0 and NU-NET202-0 card. The kit contains two large clamps, two small beads, and two tie wraps. You need to install the kit to meet United States Federal Communications Commission (FCC) and European CE Mark emission requirements.

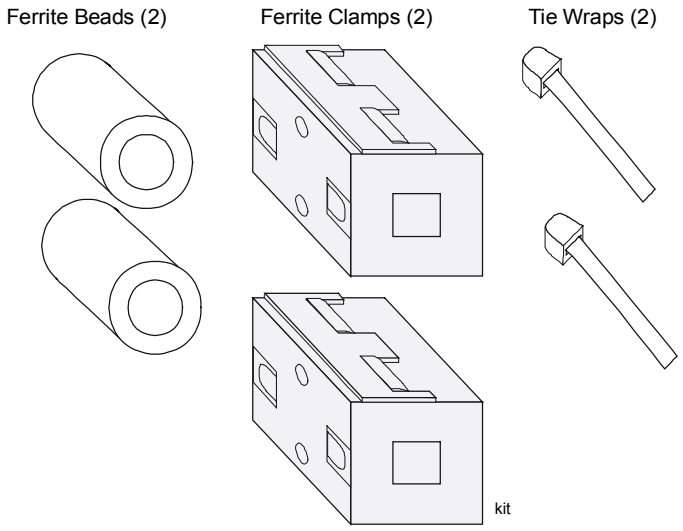


Figure 5: Ferrite Clamp Kit

Cable

A balanced 120 ohm twisted pair cable is required. Use 22 AWG solid or stranded wire. As an option, you can use shielded cable. Refer to Table 4 for a list of recommended wire.

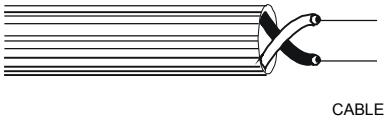


Figure 6: Cable

Design Considerations

The LONWORKS N2E Bus provides exceptional performance over an equivalent N2 Bus configuration for alarm reporting and intercontroller communication if you take full advantage of the peer-to-peer communication capability of the DX-912x. However, if the bus is heavily polled by a Network Control Module (NCM), the bus can become overloaded, resulting in decreased bus performance. You may notice this performance problem when displaying system summaries and graphics.

The LONWORKS Bus is ideal for many devices where a COS is rarely reported. The LONWORKS Bus can become a bottleneck if COSs are sent at a rate of more than one per second for an extended time. Use the *Appendix A: LONWORKS N2E Bus Poll Estimation Worksheet* in this document to help you configure N2E Bus installations. The worksheet allows you to calculate the message rate generated by a particular NCM configuration.

The N2E Bus must be engineered differently from the N2 Bus in order to match the performance of an N2 Bus. Follow these guidelines to ensure adequate response time.

- Avoid using Binary Data (BD) and Analog Data (AD) objects mapped to Control System (CS) Object attributes. Instead, map critical points to Logic Result Status (LRS) or unused Analog Outputs (AOs), which can be direct mapped to Binary Input (BI) and Analog Output Setpoint (AOS) objects.
- Map all XT/XTM expansion points to Metasys objects directly.
- Avoid using Metasys Trend and Point History features.
- Do not put alarm warnings on Analog Input (AI) objects.
- Split systems so there are only 15 to 20 analog values in each.
- Use DX program module capabilities rather than Graphic Programming Language (GPL) for analog calculations or data sharing.
- Avoid polling (see the *LONWORKS N2E Bus Poll Estimation Worksheet* in this document).
- Use peer-to-peer network variables to move data from one DX to another.
- Map only binary items that do not contain bits with rapid COS. Avoid this situation by either:
  - transferring a slow DI1 to an LRS logic variable in the Programmable Logic Controller (PLC) module and then mapping the LRS to a BI object in the NCM
  - **or**
  - moving rapid COS type bits (a pulse counter input, for example) to an XT/XP module

    Note: The additional cost of an XP module or extra configuration may well reduce overall costs by improving system performance.

    For a complete listing of item groups, see the *DX-9100 Configuration Guide (LIT-6364030), XTM905 Extension Module, XPx-xxx Expansion Modules Technical Bulletin (LIT-6364210),* and *XT-9100 Configuration Guide (LIT-6364050).*

Cable Type

The LONWORKS N2E Bus requires a balanced 120 ohm twisted pair cable with two wires. You can also use shielded cable.

Number of Devices

The address range of DX-912x controllers is 1 to 255, and up to 30 DX-912xs can be physically connected to one NCM over the LONWORKS N2E Bus. For acceptable performance on installations with high communication traffic, the number of controllers is normally fewer than 10 per N2E Bus. You can connect multiple NCMs through the N1 LAN (Local Area Network) with each NCM having its own LONWORKS N2E Bus, which means that a system can have several LONWORKS N2E Buses.

For additional details, refer to *DX-9100 Extended Digital Controller Technical Bulletin (LIT-6364020).*

Bus Length

A maximum of 1200 meters (4000 feet) of daisy-chained cable is allowed from the NCM350/361 to the farthest DX controller, including any stub lengths. We do not support repeaters to extend the distance of the bus length.

Metasys N2 Bus Support

The NCM350/361 supports one Metasys N2 Bus in addition to the LONWORKS N2E Bus (Figure 1). The Metasys N2 Bus supports all existing Metasys Application Specific Controllers and System 91 controllers except the LONWORKS DX-9120 and DX-9121.

When defining the NCM in the Global file in DDL, configure the LONWORKS N2E Bus as Port 2 (physically Port 6 of the NCM350/361) and the Metasys N2 Bus as Port 1. When defining DCDR devices in the NCM File in DDL, the Metasys N2 Bus is Trunk 1 and the LONWORKS N2E Bus is Trunk 2.

We **do not** recommend use of the N2 Bus and the N2E Bus on one NCM except for very small installations where performance is not critical or the communication load is light (for example, small extensions to existing installations that provide acceptable performance). If in doubt, install separate NCMs for N2 Bus and N2E Bus devices.

For any communication required between a device on a Metasys N2 Bus and a device on a LONWORKS Bus, use the standard peer communication provide by the N1 LAN and the NCMs.

IMPORTANT: The Design Considerations section of the *Dual N2 Bus Application Note (LIT-6363145)* is not applicable to the Metasys N2 Bus of an NCM that also has a LONWORKS N2E Bus.

Upgrading Metasys N2 Bus to LONWORKS N2E Bus

If you want to use peer-to-peer communication for an existing network, the LONWORKS N2E Bus can replace a single Metasys N2 Bus installation. However, these rules must be applied:

- If the cable of an existing Metasys N2 Bus is the correct type, you can reconfigure the N2 Bus as a LONWORKS N2E Bus. However, only the NCM350/361 and DX-9120 or DX-9121controllers can reside on the LONWORKS N2E. Any Metasys controllers other than DX-912xs that currently reside on the bus, such as the DX-9100 and Variable Air Volume (VAV) controllers, must be removed. Also, because the LONWORKS N2E does not use the REF wire, tape back the REF wire at each device that is being replaced with a DX-912x.
- The LONWORKS N2E Bus is designed to take advantage of the peer-to-peer communication capabilities of the DX-9120 or DX-9121. Make sure that communication with the NCM and Operator Workstation is provided only for monitoring and internetwork functions and does not involve continuous data transfer between controllers and the NCM.
- To reduce communication between DX-912x controllers and the NCM, use the Metasys AI and BI object mapping capabilities of the DX-912x, and avoid the use of BD and AD objects for alarm monitoring via CS objects.

In summary, an N2 Bus configuration with complete dependence on the master-subordinate communication between the NCM and the DX-9100 controllers does not provide equal performance when transferred directly to the LONWORKS N2E Bus with the DX-912x. However, a LONWORKS N2E Bus, when correctly configured, provides superior performance over an equivalent N2 Bus configuration for alarm reporting and intercontroller communications.

Upgrading LONWORKS N2E Bus from TP78 to FTT10

When extending a small installation of DX-9120 controllers, you may want to replace the DX-9120 controllers with DX-9121 controllers. The FTT10 transceiver used in the DX-9121 is now preferred within the building controls industry for the LONWORKS field bus. The DX-9120 was discontinued except as a repair part in March 2001.

The overall performance of the DX controller on the N2E Bus is the same with TP78 or FTT10 transceivers. (FTT10 transceivers offer the advantage of a free topology network structure and a line power option in non-proprietary, open LONWORKS networks.)

To upgrade an N2E Bus from TP78 to FTT10, change the following components:

- DX controllers
- mounting bases
- LONWORKS N2E card in the NCM 350/361
- end-of-line terminators

Refer to the *Ordering Instructions* section of this document for the component ordering codes. When upgrading, you **do not** have to change the following:

- field wiring, sensors and actuators
- Metasys software and database configuration
- DX controller configuration in the GX Software Configuration Tool

Calculating Timing Between Peer-to-Peer Devices

It is possible to calculate how long it takes for a network point on the DX-912x to broadcast a change in state or value to all other DX-912xs. Doing so helps you determine how many points to share across controllers. To make this calculation, use the following equation:

```
(Number of Peer-to-Peer Modules * 0.5 sec) +
(Number of Destination Connections of the Changed
Module * 0.1 sec) + 0.4 sec
```

Example

One Network Analog Output (NAO) point shared with five DX-912xs
Number of Peer-to-Peer Modules = 1 (NAO)
Number of Destination Connections = 5 (DX-912xs)

Transmit time for one network point change to be broadcast to all controllers:

```
(1 module * 0.5 sec) + (5 connections * 0.1 sec) +
0.4 sec = 1.4 seconds
```

Note: This calculation assumes that all nodes are online and communicating. If one or more nodes are offline, the transmission time required is greater.

Specifications

Table 1: Specification

Category	Specification
Product Name	LONWORKS N2E Communications Bus
Network Bus Polarity	Polarity insensitive
Supply Voltage	5 VDC ±10%
Typical Supply Current	10 mA
Bus Wiring	UL Level 4, 22 AWG (0.65 mm) twisted pair (solid or stranded)
Address Range of Devices	1 to 255
Nodes per Bus	30 per NCM350/361
Transmission Speed	78,000 bits per second (78 K baud)
Termination Method	Terminators at both ends
Physical Configuration	Daisy-chained (maximum stub length 3m [10 feet])
Total Line Length	Up to 4,000 feet (1200 meters)
Standard Components	NCM350/361 LONWORKS N2E card DX-912x Controllers End-of-Line Terminators 60 x 12.5 x 60 mm (2.4 H x 0.5 W x 2.4 D in.) Cable

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

Installation Procedures

Preliminary Information

When installing LONWORKS N2E Bus wiring throughout a building, be aware of the following:

- Follow all National Electrical Code (NEC) and local code restrictions.
- Do not exceed the device maximums given in this document.
- Do not run bus cables close to transformers or high frequency generating equipment.
- Run low voltage bus cables separately from line voltage and power cables.
- Do not connect any bus wire to the COM terminal on the DX-9100-8990/6/7 or DX-9121-8996/7 terminal board. The LONWORKS N2E Bus does not use these terminals.
- If shielded cable is used, ground the shield at one location only (normally at the NCM350/361).
- Use solid or stranded 22 AWG (0.65 mm) diameter cable. Do not use thinner gauge wire (24 AWG or greater), because it can break easily and limits the total bus length to less than the specified maximum length.

Acceptable Bus Layouts

The following are examples of acceptable layouts for the LONWORKS N2E Bus. The NCM can be at either end of the bus or in the middle with controllers on both ends. As shown, an end-of-line terminator is required at the end of each bus segment.

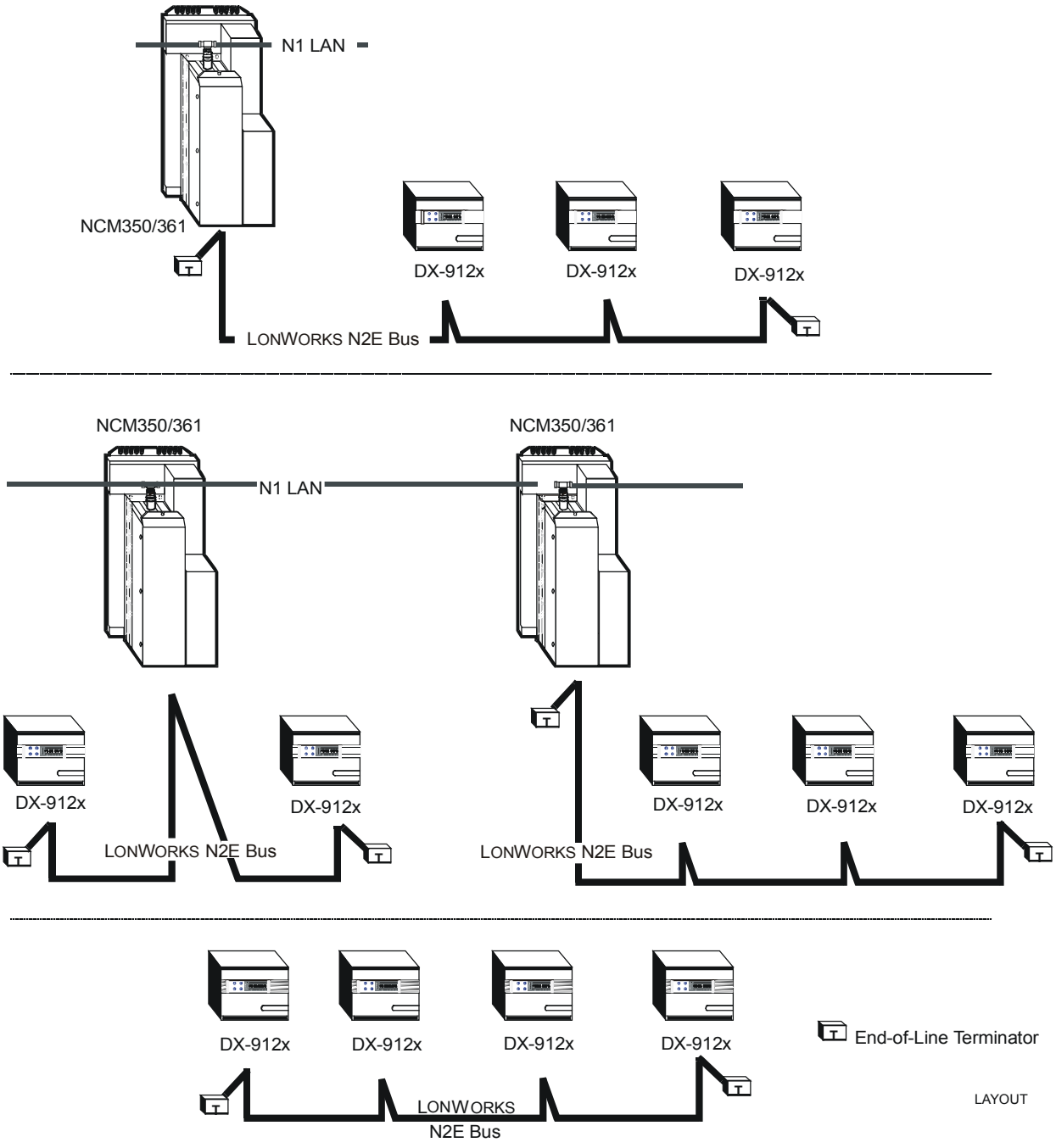
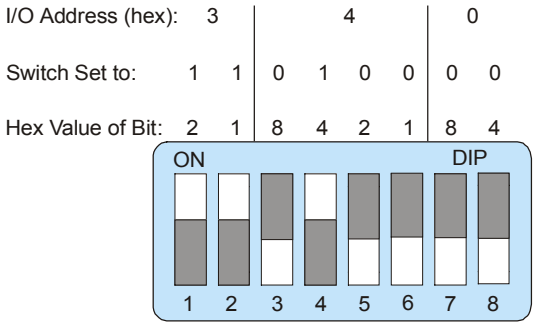


Figure 7: Acceptable Bus Layouts (Note: All controllers on one N2E Bus must be the same model [DX-9120 or DX-9121].)

Installing LONWORKS N2 Card into NCM350/361

In order for the NCM350/361 to be connected to and communicate over the LONWORKS N2E Bus, a LONWORKS ISA card is required. As part of installation, the card's I/O address factory setting is verified and the card installed into the second ISA slot (right-hand slot) of the NCM350/361.

1. Turn power off at the NCM350/361.
2. Verify that the I/O Address on the card is set to the factory default of 0340h (Figure 8). The address is set with Switches S1, S2, and S3.



Note: The position of each of the eight slide switches is shown by the white area. A switch is set to 1 when it is pushed towards the ON side as indicated on the switch assembly.

switch

Figure 8: LONWORKS ISA Card I/O Address Switch Settings

3. Install the card into Slot 2 of the NCM350/361 (right-hand slot), referring to Figure 9. In order to insert the card, you must temporarily remove the colored screw plug terminal.

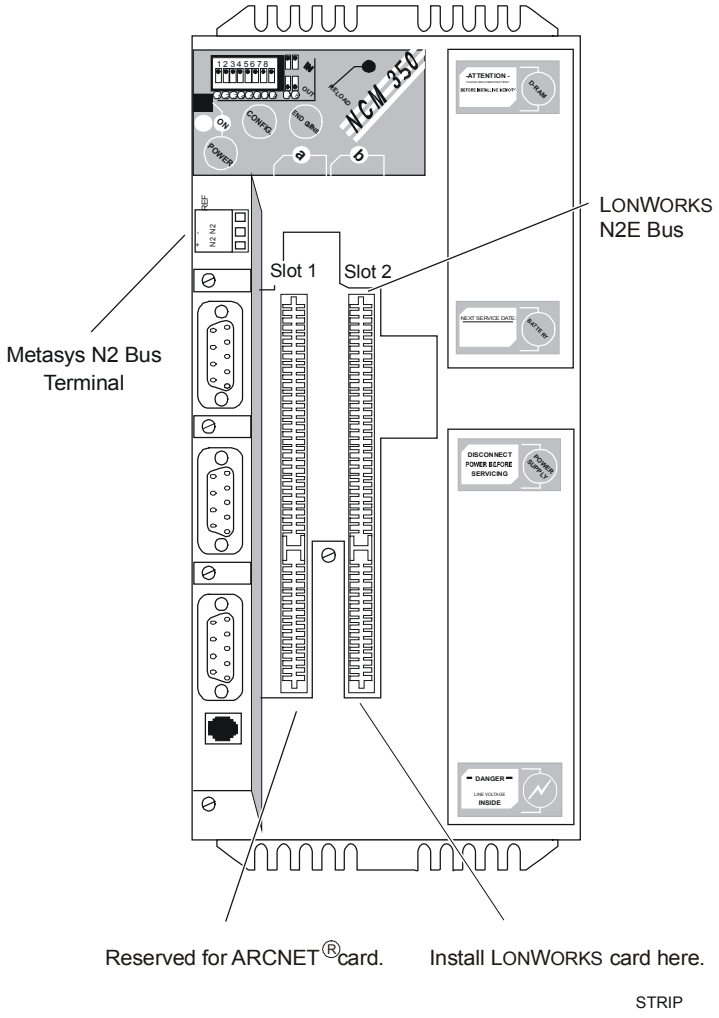


Figure 9: LONWORKS Card Installs into Slot 2 of NCM350/361

4. Return power to the NCM350/361.

Connecting Bus to NCM350/361

The LONWORKS N2E Bus is connected to the NCM350/361 at its LONWORKS N2E card. A ferrite clamp kit is provided with the card. This kit contains two clamps, two beads, and two tie wraps that must be properly installed onto the N2 Bus wire to meet FCC and CE Mark emission requirements. Refer to Figure 10 and Figure 11.

1. Cut a small piece of N2 Bus wire about 15 cm (6 inches). Use this wire as a stub length.

   Note: If a longer stub length is required, up to 3 meters (10 feet) is allowed. Also, if the NCM350/361 you are connecting is at the end-of-line, a stub length is not needed. See Figure 11.

2. Remove the N2E Bus screw plug terminal from the LONWORKS N2E card. It is labeled on the card as ST1.

3. Referring to Figure 10, install the ferrite clamps, beads, and tie wraps to the stub length. Note that each wire is looped once around the small beads before it is connected to the screw plug terminal. The tie wraps keep the two large ferrite clamps from slipping off the wire. Cut off the excess length of tie wrap.

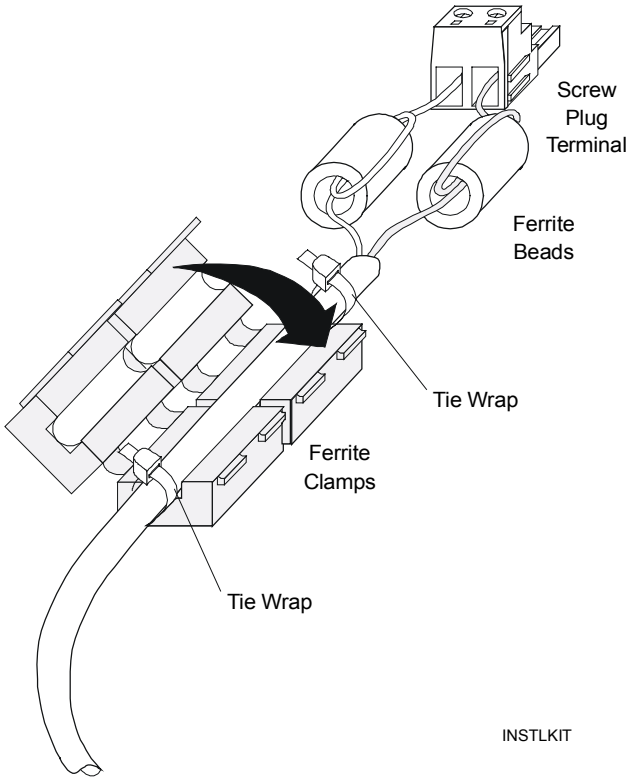


Figure 10: Ferrite Clamp Installation

4. Connect the stub length to the screw plug terminal, stripping back enough wire to make the connection. **There are no + or - terminals because this network is not polarity sensitive.**
5. Using standard wire screws or nuts, connect the free end of the stub length to the N2E Bus wires that lead to the other controllers (Figure 11).

Note: If the NCM is at the end of the bus segment, install an end-of-line terminator to the screw plug terminal. (You need to install a small section of N2E Bus wire to the terminator in order to connect it to the screw plug.) You need a terminator only if the NCM is at the end of the bus.

6. Reconnect the ST1 screw plug terminal to the card.

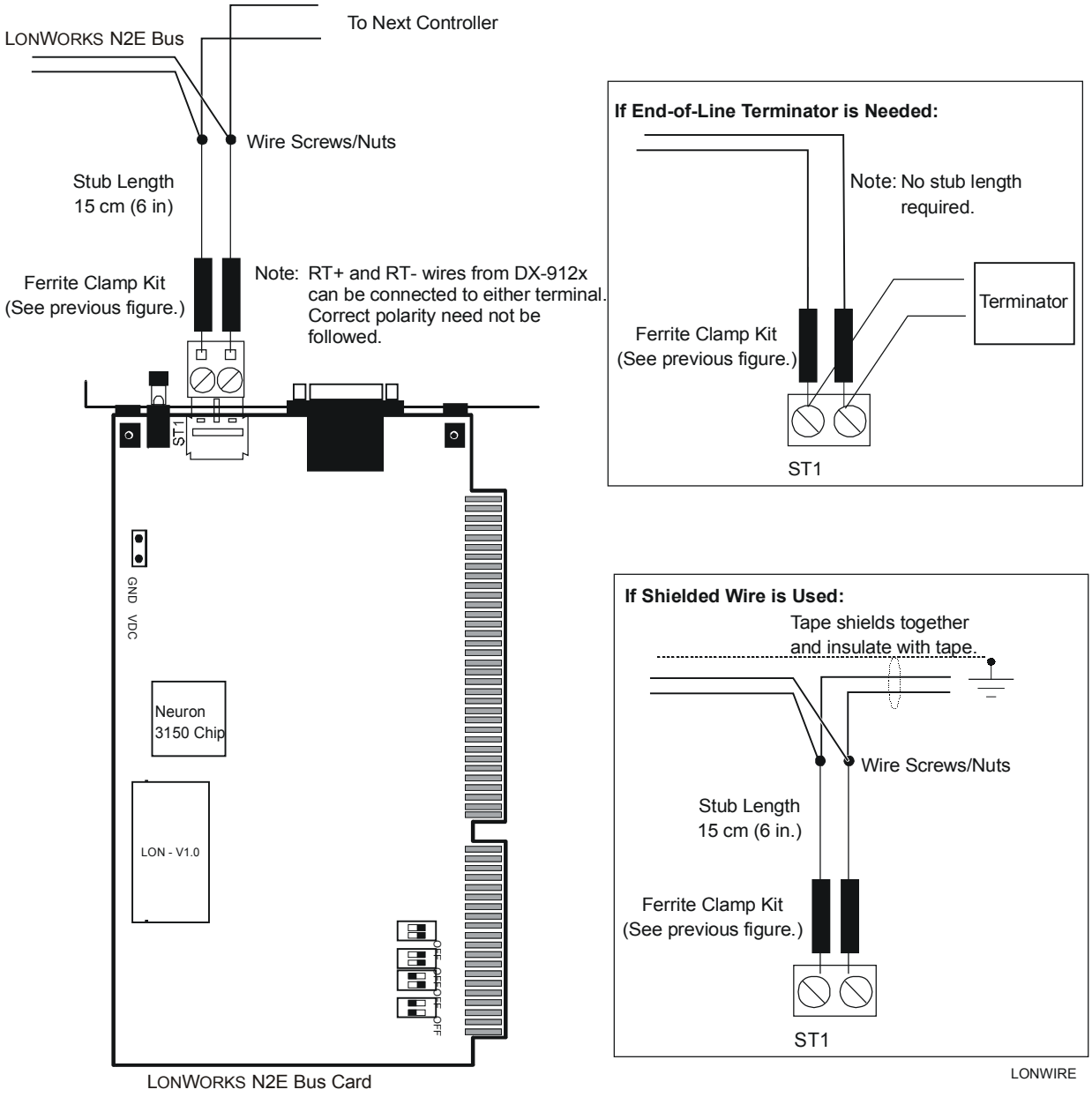


Figure 11: Connecting the NCM350/361 to the Bus

When the NCM350/361 with a LONWORKS N2E card first receives power, two Light-Emitting Diodes (LEDs) blink while startup diagnostics is running:

- DS5 LED on the NCM350/361 motherboard
- Service LED on the LONWORKS N2E card

After startup diagnostics finishes normally and the LONWORKS N2E Bus is defined, the Service LED on the LONWORKS N2E card remains off, but the DS5 LED on the NCM350/361 remains lit. This is normal operation, even though a lit DS5 LED on an NCM350/361 without the LONWORKS interface would indicate a problem.

Connecting Bus to DX-912x Controllers

Follow these steps, referring to Figure 1:

Note: A ferrite clamp kit is not needed for terminating the LONWORKS N2E Bus to the DX-912x controller.

1. Connect each DX-912x controller to the LONWORKS N2E Bus as shown in Figure 12. Two wire cable is used. You may use shielded wire. If you do, twist shields together and insulate with tape. **When wiring the bus, you do not need to consider the polarity of the connections.**
2. If this DX-912x is the last device on the bus segment, install an end-of-line terminator at the bus terminals with a small section of wire.

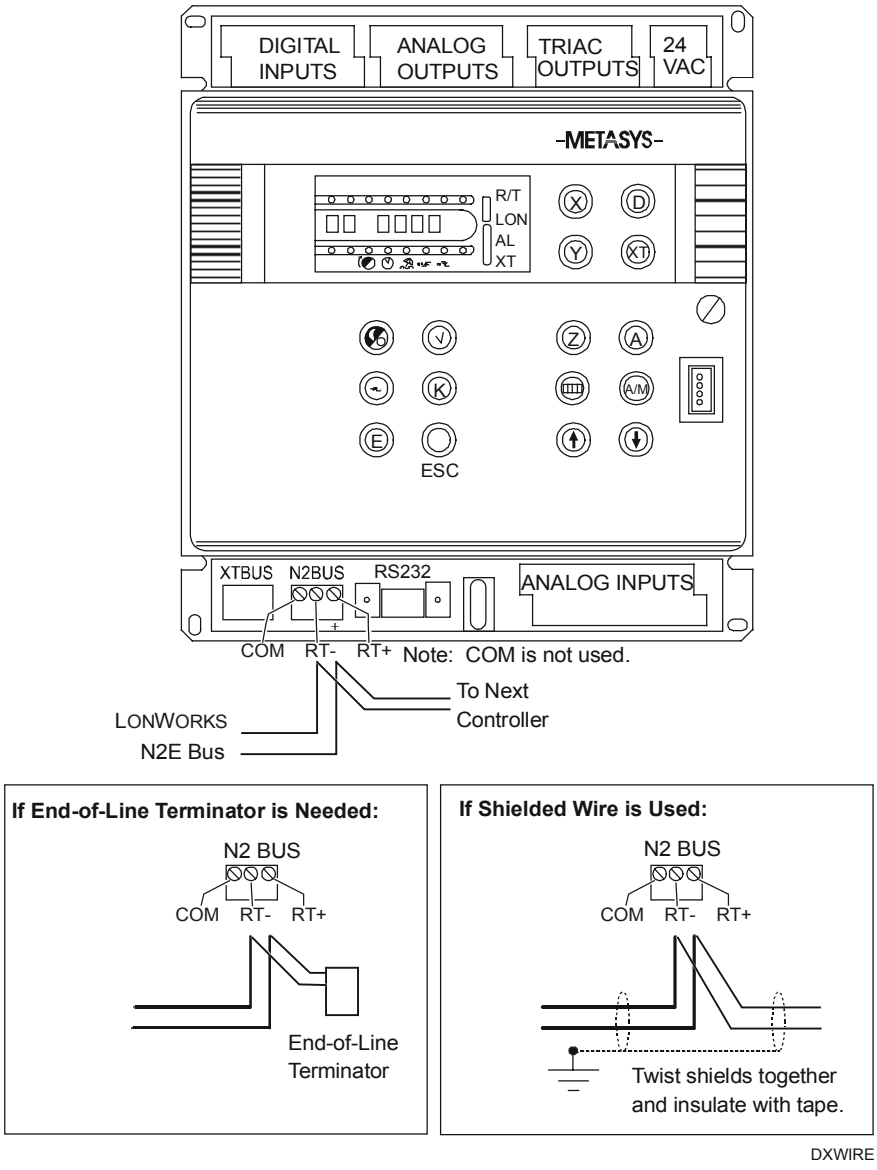


Figure 12: Connecting the DX-912x Controller to the Bus

Commissioning Procedures

Overview

This section covers commissioning steps for the LONWORKS N2E Bus. Commissioning the bus includes checking and, when necessary, modifying the wiring between the NCM350/361 and DX-912x controllers.

Checking Bus Installation

Checking the bus installation involves verifying the:

- bus has been installed according to the rules described in the *Installation Procedures* section
- bus wiring for all devices has been completed

Modifying Bus Installation

Modifying the N2E Bus includes adding, deleting, or relocating an NCM350/361 or DX-912x controller. Before making any modifications:

- make sure that any control processes that rely on bus communication are switched off or set to a nonoperating status
- be careful not to short bus wires during modification

Adding a Controller

An NCM350/361 or DX-912x controller can be added between two other controllers or at the end of the bus. Follow these steps:

1. Define the new controller in the system software. (Refer to the *Defining an Object* in the *Defining Objects* chapter of the *Operator Workstation User's Manual*.)
2. Wire the bus to the designated N2 Bus terminals to add a controller to the LONWORKS N2E Bus.

Deleting a Controller

Follow these steps to delete a controller:

1. Delete the controller from system software. (Refer to the *Deleting an Object* in the *Defining Objects* chapter of the *Operator Workstation User's Manual*.)
2. To delete a controller located somewhere in the middle of the bus, disconnect the two sets of N2E wiring and tie together.

   To delete a controller located at the end of line, disconnect the N2E wiring from the device and disconnect only the N2E OUT wiring from the upstream device. Move the end-of-line terminator to the upstream device.

Relocating a Controller

An NCM350/361 or DX-912x can be moved to a different location on the N2 Bus. Follow these steps:

1. Disconnect the N2E Bus wiring from the controller.
2. Install the DX-912x in its new position, following all termination rules.

Troubleshooting Procedures

Overview

The LONWORKS N2E Bus is a reliable communications bus. However, there are situations in which communication problems may occur. Under most circumstances, a problem is indicated by lights on the NCM350/361 motherboard and LONWORKS N2E card. A communication problem exists if the:

- DS5 LED (LED 3) on the NCM350/361 **is not** on steadily. If this LED stays off, the NCM does not communicate with the N2E card. In this case, make sure you have:
  - defined an N2E trunk
  - downloaded the NC
  - defined at least one N2E device

  If the LED stays off, possible causes include:
  - faulty NCM motherboard
  - wrong/faulty N2E card

  Note: LED off is not a problem related to the network or bus.
- Service Button LED on the LONWORKS ISA card **is on or flashing**

If one or both of these lights are behaving in this way, the bus is not working properly. You may also refer to the N2 Bus Statistics window under NC Diagnostics at the Operator Workstation (examine the Number of Retries figure). The last column of the N2 Bus Statistics under NC Diagnostics, labeled N2E-COS, contains the number of received COS messages for every Echelon device. From this information, you can determine which devices are causing an N2E Bus overload with their COS reporting.

The most likely problems with a malfunctioning LONWORKS N2E Bus are:

- broken or frayed wire
- improper bus termination
- missing or improperly installed EOL terminator
- defective DX-912x
- too many DX-912xs defined
- bus is too long

- bus has “T” or “Y” connections installed
- ground loop present on bus

Checking for Good Wire Runs

The wire used for the bus must be free of broken or frayed sections. If either of the two signal lines is broken or frayed, the devices that are located after the break reports offline. To determine which part of the cable is defective, start at the device that physically precedes the first offline device. The problem is likely in the cable between the last online device and the first offline device.

Checking for Proper Termination

To verify proper cable termination, examine all bus wiring. There must not be any breaks in the two signal lines, and the wires must be connected to their proper terminals. Lightly tug on each wire to ensure that it is secure. For the LONWORKS N2E Bus, polarity **does not** need to be checked.

Checking End-of-Line Terminations

For every LONWORKS N2E Bus segment, you must have an EOL terminator installed at each device that is at the end of the bus (total of two per segment). In most installations, the terminators are located at the NCM350/361 and the last DX-912x. If these terminators are not installed, or they are installed at incorrect locations, signal reflections may interfere with communication. If you install too many terminators, the bus may be loaded down, reducing the total number of devices that can be connected. Verify that the location and number of terminators are correct.

Checking DX-912x Controllers

The DX-912x, if internally shorted, can bring down the bus. However, this situation is rare. If you suspect this problem, you need to disconnect each DX-912x, one at a time, and observe when the bus comes back online. What is more common is for a DX-912x to report offline. The most common reason is an incorrect address setting. The address must match what is set in software. Also, be aware that DX-912x on the LONWORKS N2E Bus with a poll priority of 3 is polled approximately once every 30 seconds. Allow enough time for any DX-912x to come online before performing any troubleshooting steps.

Checking Number of Defined Controllers

If you have too many devices defined and connected to the bus, the LONWORKS N2E Bus may not communicate. The maximum number of DX-912x controllers recommended on the bus is 30. However, depending on how you use these devices, the actual maximum may be lower. When you reach the maximum number, you need to connect the remaining devices to a different LONWORKS N2E Bus on a different NCM.

Checking Bus Length

The LONWORKS N2E Bus may not communicate because the length of the bus is too long. The recommended maximum is 1200 meters (4000 feet) between the devices farthest apart.

Checking for "T" or "Y" Connections

The LONWORKS N2E Bus must be wired to the DX-912xs in a daisy-chained fashion. For example, you cannot cut the bus between two DX-912xs, add a T or Y connection, and then connect another DX-912x from the connection. If you do this, signal reflections result, disturbing normal N2E communication. Make sure no such connections exist.

Note: A short stub length is used to connect the NCM350/361 to the LONWORKS N2E Bus using the LONWORKS N2E card. Refer to *Connecting Bus to NCM350/361* in this document for details.

Checking for a Ground Loop

A shielded LONWORKS N2E Bus must be properly grounded at only one location, preferably at the NCM. If grounded at two or more locations, a ground loop is introduced, disrupting normal N2E communications.

Improving System Performance

Use these guidelines to reconfigure the system for corrections to improve performance. Review the *LONWORKS N2E Bus Poll Estimation Worksheet* in *Appendix A: LONWORKS N2E Bus Poll Estimation Worksheet* and change the software to reduce the messages to 1.5 per second or fewer for the N2E trunk. To check an already engineered and installed system, go to the NCM diagnostics screen on the Metasys OWS as instructed in this section. The current readings may change and not reflect the true permanent messages. Run the test at a high traffic time of day. Follow these steps:

1. Go to NC diagnostics, N2/L2.St statistics, both trunks.
2. Select Action Clear statistics.
3. Wait one minute.
4. Select Action Reread statistics.
5. Add all numbers corresponding to all columns on Trunk two except Err Resp/N2E COS.
6. Divide the total by 60 to calculate messages per second.

Ordering Instructions

Johnson Controls Code Numbers

Table 2: Code Numbers for N2E Bus with DX-9120 (TP78) Controllers

Description	Product Code Number
LONWORKS N2E Card (TP78) for NCM350/361	NU-NET201-0
End-of-Line Terminator (TP78)	NU-EOL201-0
LONWORKS Extended Digital Controller, Version 3, TP78	DX-9121-8454
Panel Mounting Base for DX-9120 Controller, with Terminal Covers	DX-9100-8997 (available in Europe only)
Panel Mounting Base for DX-9120 Controller, without Terminal Covers	DX-9100-8990F for UL 864 applications (available in North America only)
Cabinet Door Mounting Frame for DX-9120 Controller	DX-9100-8996

Note: The DX-9120-8454 controller was discontinued for new project and product sales in October 2000. The DX-9121 controller replaced the DX-9120.

Table 3: Code Numbers for N2E Bus with DX-9121 (FTT10) Controllers

Description	Product Code Number
LONWORKS N2E Card (FTT10) for NCM350/361	NU-NET202-0
End-of-Line Terminator (FTT10)	NU-EOL202-0
LONWORKS Extended Digital Controller, Version 3, FTT10	DX-9121-8454
Panel Mounting Base for DX-9121 Controller, with Terminal Covers	DX-9121-8997 (also for UL 864 application)
Cabinet Door Mounting Frame for DX-9121 Controller	DX-9121-8996

Vendor Parts

Table 4: Vendor Parts

Description	Manufacturer	Type
LONWORKS N2E Cable	Connect-Air International 4240 B Street NW Auburn, WA 98002 (253) 813-5599	22 AWG, unshielded, one pair stranded, PVC
		22 AWG, shielded, one pair stranded, PVC
		22 AWG, unshielded, one pair stranded, plenum
		22 AWG, shielded, one pair stranded, plenum
	Anixter 4711 Golf Rd. Skokie, IL 60076 (847) 677-2600	22 AWG, unshielded, one pair solid, PVC
		22 AWG, shielded, one pair solid, PVC
		22 AWG, unshielded, one pair solid, plenum
		22 AWG, shielded, one pair solid, plenum
Ferrite Clamp Kit	Supplied with NU-NET201-0 and NU-NET202-0 LONWORKS N2E Card.	

Appendix A: LONWORKS N2E Bus Poll Estimation Worksheet

To ensure performance of a LONWORKS N2E Bus is not adversely affected by NCM polling activity, define the database and/or feature software in an NCM such that the message rate (polls) does not exceed 1.5 messages per second. Follow these guidelines to maintain a screen refresh rate of approximately 20 seconds.

Use the *LONWORKS N2E Bus Poll Estimation Worksheet* to calculate the message rate generated by a particular NCM configuration.

LONWORKS N2E Bus Poll Estimation Worksheet

Number of DXs (poll priority should be set to 3 for N2E applications) *93 msg/h =_____

Number of AIs with warning limits defined *120 msg/h =_____

Number of ADs mapped to CS attributes *120 msg/h =_____

Number of BDs mapped to CS attributes *900 msg/h =_____

Number of AIs with point history *2 msg/h =_____

Number of AOs with local control and point history *2 msg/h =_____

Number of Annunciator Control Modules (ACMs) *60 msg/h =_____

Total number of displayed CS attributes, AIs and AOs with local control typically displayed on all OWS/OT/NTU (average):

Number of OWS/OT/NTU _____ * number of points _____ *180 msg/hr =_____

Number of objects mapped to network port objects_____ *# of points *360 =_____

(If the number of points is greater than 15, enter 5400 msg/hr)

Number of AI alarm events per hour =_____

Number of attributes read by JC-BASIC/GPL processes or Metalink per hour =_____

Average number of scheduled commands per hour =_____

Average number of MCO commands per hour =_____

Number of trend samples per hour =_____

Sum of all messages per hour =_____

÷ 3600

Sum of all messages per second =_____

(The message rate should **not** exceed 1.5 msg/sec.)

The message rate of 180 messages per hour for AI and AO objects with local control must be adjusted if the refresh time parameters SummaryUpdate and GraphicsUpdate are changed from a default of 20 in the METASYS.INI file.

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