Harmony Series

Cnet-to-HCU Communication Interface

INNIS21/INNPM22

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Preface

The Cnet-to-HCU interface consists mainly of an INNIS21 Network Interface Module and an INNPM22 Network Processing Module. These modules are Harmony rack modules that in combination provide a Harmony control unit with access to Control Network (Cnet) in the Symphony™ Enterprise Management and Control System.

This instruction explains the Cnet-to-HCU interface features, specifications, and operation. It includes installation, troubleshooting, maintenance, and replacement procedures for the rack modules and terminations that make up the Cnet-to-HCU interface.

NOTE: The INNIS21 and INNPM22 modules are fully compatible with existing INFI 90® OPEN Strategic Enterprise Management Systems using INFI-NET® communication.

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Safety Summary

Electrostatic Sensitive Device
Devices labeled with this symbol require special handling precautions as described in the installation section.

GENERAL WARNINGS

Equipment Environment
All components, whether in transportation, operation or storage, must be in a noncorrosive environment.

Electrical Shock Hazard During Maintenance
Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing.

SPECIFIC WARNINGS

Verify the main power, field power, and power entry panel circuit breakers/switches are turned off before starting installation, retrofit, upgrade, or wiring procedures. Failure to do so could result in severe or fatal shock or equipment damage. Do not turn the power on until the installation, retrofit, upgrade, or wiring procedures are complete. (p. 3-2, PR1-1, PR2-1, PR8-1, PR9-2)

A rack module should not be inserted or removed with power applied when located in a Class I, Division 2 hazardous location unless the area is known to be nonhazardous. (p. 3-2, 7-1, PR3-1, PR11-1)

Verify the main power, field power, and power entry panel circuit breakers/switches are turned off before starting the termination unit removal procedure. Failure to do so could result in severe or fatal shock or equipment damage. Do not turn the power on until the replacement procedure is complete. (p. 7-1, PR10-1)

Wear eye protection whenever working with cleaning solvents. When removing solvents from printed circuit boards using compressed air, injury to the eyes could result from splashing solvent as it is blown off the printed circuit board. (p. PR12-1)

Safety Summary (continued)

SPECIFIC WARNINGS	Turn off all power before attempting the connections check maintenance procedure. Failure to do so could result in severe or fatal shock, or equipment damage. (p. PR13-1)

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ABB will provide assistance in the operation and repair of its products. Requests for sales or application services should be made to your nearest sales or service office. ABB can also provide installation, repair and maintenance contract services.

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® Network 90	Registered trademark of ABB.
™ Symphony	Trademark of ABB.

Introduction

Section 1

Overview

The Cnet-to-HCU interface consists mainly of an INNIS21 Network Interface Module and an INNPM22 Network Processing Module (Fig. 1-1). These modules are Harmony rack modules that in combination provide a Harmony control unit with access to Control Network (Cnet) in the Symphony Enterprise Management and Control System. The Harmony Control Unit (HCU) interface provides access to Cnet for all rack controllers in its node.

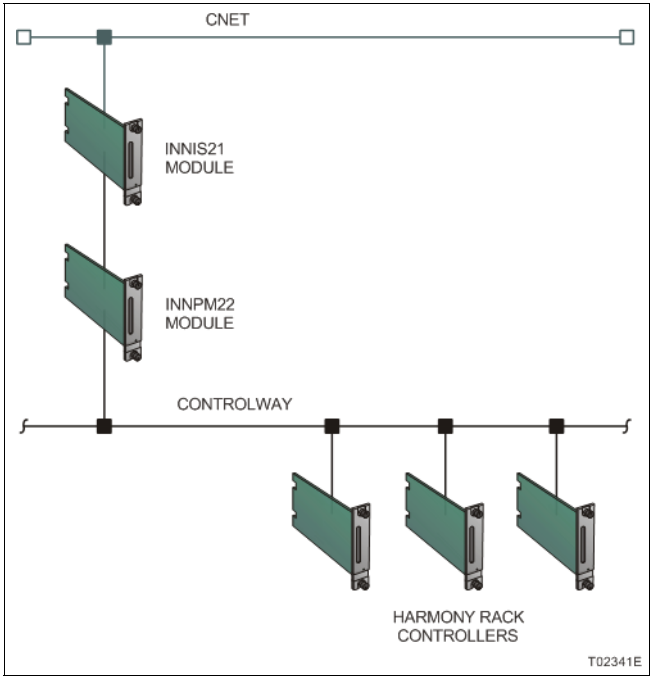

Figure 1-1. Cnet-to-HCU Interface

NOTES:

1. The HCU interface made up of the INNIS21 module and INNPM22 module is fully compatible with existing INFI 90 OPEN Strategic Enterprise Management Systems using INFI-NET communication.

2. The INNPM22 is a functional replacement for the INNPM12 only. The INNPM22 cannot be used in a redundant pair with an INNPM12.

3. The INNIS21 is a direct replacement for the INNIS11. However, the INNPM22 can only be used in combination with an INNIS21 (cannot be used with an INNIS11 or INNIS01).

Control Network

Cnet is a unidirectional, high speed serial data network that operates at a 10-megahertz or two-megahertz communication rate. It supports a central network with up to 250 system node connections. Multiple satellite Cnets can link to the central network. Each satellite network supports up to 250 system node connections. Interfacing a maximum number of satellite networks gives a system capacity of over 62,000 nodes.

On the central network, a node can be a bridge to a satellite network, a human system interface, an HCU, or a computer connected through a Cnet communication interface. On a satellite network, a node can be a bridge to a central network, a human system interface, a HCU cabinet, or a computer. A human system interface is a workstation that runs Conductor or 800xA for Harmony software. A Harmony control unit is comprised of a controller and its I/O devices. A computer can run Composer™ tools, Performer applications, and third-party semAPI applications.

Harmony Control Unit

The Harmony control unit is the fundamental control node of the Symphony system. It connects to Cnet through the Cnet-to-HCU interface. The HCU cabinet contains the Harmony controllers and input/output devices. The actual process control and management takes place at this level. HCU connection to Cnet enables Harmony controllers to:

- Communicate field input values and states for process monitoring and control.
- Receive control instructions from plant personnel through human system interfaces to adjust process field outputs.
- Provide feedback to plant personnel of actual output changes through human system interfaces.

- Communicate controller function block configuration information and parameters. These parameters determine the operation of functions such as process control, data acquisition, alarming, trending, and logging.
- Report status.
- Download firmware.

Data is transferred in messages that contain system data, control, and configuration information and also in exception reports.

Controlway

Controlway is a high speed (one-megabaud), peer-to-peer communication link between Harmony rack controllers and communication modules. It is capable of supporting up to 32 connections. It is strictly used for internal cabinet communication between Harmony rack modules.

Redundancy

The HCU interface supports hardware redundancy (Fig. 1-2). Redundancy requires a full set of duplicate modules (two INNIS21 modules and two INNPM22 modules). The secondary INNPM22 module continuously monitors the primary through a redundancy cable. A failover occurs when the secondary detects a primary module failure. When this happens, the secondary assumes responsibility and the primary is taken offline. Refer to ***Redundancy Failover*** in Section 2 for more information.

NOTE: The INNPM22 can be used redundantly together with ONLY another INNPM22. The INNPM22 cannot be used redundantly together with an INNPM12. The INNPM12 and INNPM22 are NOT compatible for redundancy.

Intended User

Personnel installing, operating, or maintaining the Cnet-to-HCU interface should read this instruction before performing any installation, operation, or maintenance procedures. Installation requires an engineer or technician with

experience handling electronic circuitry and familiarity with communication networks.

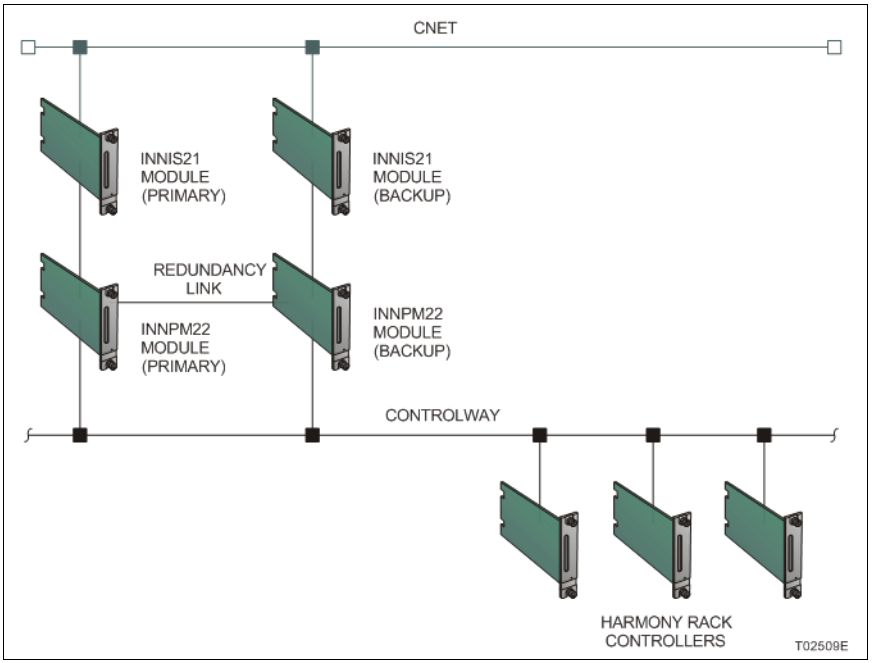

Figure 1-2. Redundant Cnet-to-HCU Interface

Features

The Cnet-to-HCU interface has the following features:

- Cnet provides a plant-wide communication network.
- Cnet provides time-synchronization across the control system plant wide.
- Each node can operate independently of other Cnet nodes.
- HCU interface modules provide localized startup and shutdown on power failure without operator intervention.
- Fast response time. The 10-megahertz communication rate gives timely information exchange.

- The INNPM22 module packages process information for maximum transmission efficiency.
- The HCU interface modules handle four message types: broadcast, time-synchronization, multicast, and NIS poll.
- All messages contain cyclic redundancy check codes (CRC) and checksums to insure data integrity.

Instruction Content

This instruction consists of the following sections:

Introduction Provides an overview of the HCU interface. It also contains features and specifications.

Description and Operation Provides a functional block diagram level description of the HCU interface modules and explains module operating theory.

Installation Covers handling guidelines and describes the HCU interface installation and connection sequence.

Operating Procedures Provides information about normal module operation.

Troubleshooting Explains how to troubleshoot the modules using error codes and lists corrective actions.

Maintenance Contains a maintenance schedule for the HCU interface.

Repair and Replacement Provides replacement procedures for the components that make up the HCU interface.

Replacement and Spare Parts Provides a list of part numbers and nomenclature.

Procedures Individual procedure sections (e.g., PR1, PR6, PR10, etc.) detail installation, maintenance, and replacement actions. A procedure section typically gives the steps for a single task. Installation flowcharts and replacement flowcharts indicate the order in which these procedures are to be performed.

How to Use this Instruction

To use the instruction:

1. Read the introduction section and the description and operation section to gain an understanding of the HCU interface and its functionality.

2. Perform all steps in the installation section. The section provides an installation flowchart.

3. Read the operating procedures section before applying power to the HCU interface.

4. Refer to the troubleshooting section if a problem occurs. This section will help to diagnose and correct common problems.

5. Refer to the maintenance section for scheduled maintenance requirements.

6. Refer to the repair and replacement section for HCU interface replacement procedures. The section provides a replacement flowchart.

Glossary of Terms and Abbreviations

Table 1-1 contains those terms and abbreviations that are unique to ABB or have a definition that is different from standard industry usage.

Table 1-1. Glossary of Terms and Abbreviations

Term	Definition
Cnet	Symphony system advanced data communication highway.
Controlway	High speed, redundant, peer-to-peer communication link. Used to transfer information between intelligent modules within a Harmony control unit.
Exception report	Information update generated when the status or value of a point changes by more than a specified significant amount or after a specified period of time.
HCU	Harmony Control Unit
I/O expander bus	Parallel communication bus between the Harmony rack controllers and rack I/O modules.
Module mounting unit (MMU)	A card cage that provides electrical and communication support for Harmony rack modules.
Termination unit	Provides input/output connection between plant equipment and the Harmony rack modules.

Document Conventions

The ? in a nomenclature or a part number indicates a variable for that position (e.g., IMMFP1?).

Reference Documents

Table 1-2 lists the documents that provide additional information for related hardware and software. Refer to them as needed.

Table 1-2. Reference Documents

Document Number	Title
WBPEEUI210502??	Modular Power System II

Related Nomenclature

Table 1-3 lists nomenclature related to the HCU interface.

Table 1-3. Related Nomenclature

Nomenclature	Description
IEMMU11, EMMU12, IEMMU21, IEMMU22	Module mounting unit
NFTP01	Field termination panel

Specifications

Refer to Table 1-4 for the specifications of the modules that make up the HCU interface.

Table 1-4. Specifications

Property	Characteristic/Value
INNIS21	
Power requirements	+5 VDC at 825 mA; 4.1 W +5 VDC at 1.1 A; 5.5 W
System capability Cnet (INFI-NET):	Over 62,000 nodes in the system; 250 Cnet-to-Cnet interface nodes; 250 nodes on a single network in any combination of Cnet-to-HCU and Cnet-to-computer interfaces
Communication rates	10 Mbaud, 2 Mbaud, or 0.5 Mbaud

Table 1-4. Specifications *(continued)*

Property	Characteristic/Value
INNPM22	
Memory	2 Mbytes ROM; 8 Mbytes RAM
Power requirements	+5 VDC at 2 A; 10 W
Communication rates	1 Mbaud (Controlway); 83.3 kbaud (module bus)
Common	
Mounting	Occupies one slot in a standard module mounting unit
Ambient temperature	0° to 70°C (32° to 158°F)
Relative humidity	20% to 95% up to 55°C (131°F) noncondensing 20% to 45% from 55°C (131°F) to 70°C (158°F) noncondensing
Atmospheric pressure	Sea level to 3 km (1.86 mi)
Air quality	Noncorrosive
Certification	
Canadian Standards Association (CSA) (INNPM22 pending)	Certified for use as process control equipment in an ordinary (nonhazardous) location
Factory Mutual (FM) (INNIS21 and INNMP22 pending)	Approved as nonincendive equipment for use in Class I; Division 2; Groups A, B, C, D; hazardous locations
CE (INNMP22 pending)	CE mark EMC directive

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Introduction

This section explains the functionality of the Cnet-to-HCU interface. Figure 2-1 shows the Harmony components that make up the interface.

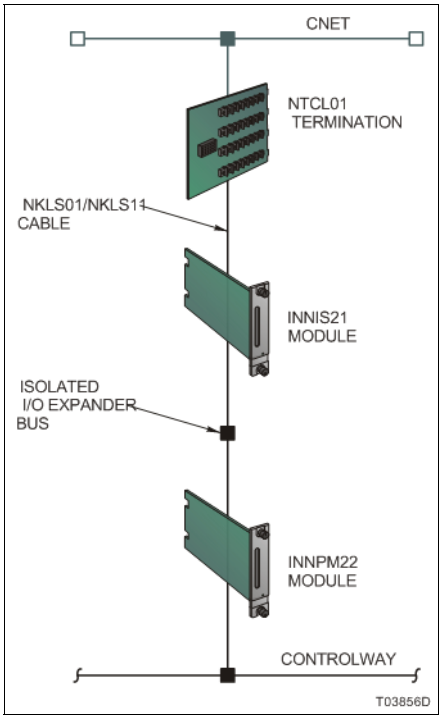

Figure 2-1. Cnet-to-HCU Interface

INNIS21 Network Interface

The INNIS21 Network Interface Module is the front end of every Cnet communication interface. It is the intelligent link between a node and the Cnet. In this case, it works in conjunction with the INNPM22 module. The INNIS21 module allows any node to communicate with any other node within the Symphony system.

The INNIS21 module is a single printed circuit board that occupies one slot in a module mounting unit (MMU). The circuit board contains microprocessor based communication circuitry that enables it to interface with Cnet, and with the INNPM22 module over a dedicated I/O expander bus segment.

Two latching fasteners on the faceplate secure the INNIS21 module to the MMU (Fig. 2-2). There are 16 LEDs on the faceplate that display event or error counts and error codes. There is also one status LED that indicates the operation status of the module. A stop/reset button is also provided.

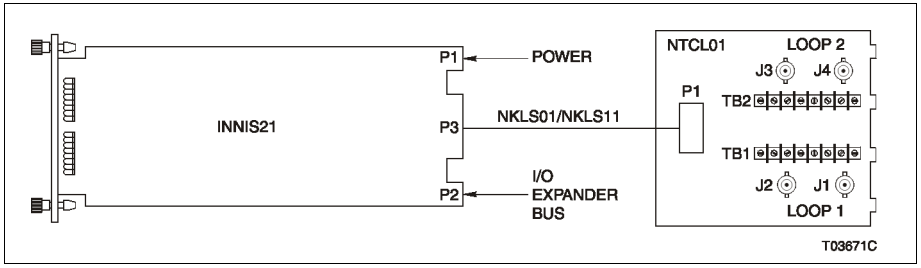

Figure 2-2. INNIS21 Module and NTCL01 Termination Unit

The INNIS21 module has three card edge connectors for external signals and power (P1, P2, and P3). P1 connects to common and +5 VDC power. P2 connects the INNIS21 module to the I/O expander bus to communicate with its INNPM22 module. P3 connects the module to its NTCL01 communication termination unit.

Communication between Cnet nodes is through coaxial or twinaxial cable that connects between the termination units of each node. A NTCL01 unit provides the redundant Cnet connection points for the HCU interface node (coaxial J1 through J4 or twinaxial TB1 and TB2). The INNIS21 module connects to the NTCL01 unit with an NKLS01 or NKLS11 cable attached between its P3 connector and P1 on the termination unit. The termination unit provides isolation circuitry for Cnet.

Block Diagram

Figure 2-3 is a functional block diagram of the INNIS21 module. The module contains a central processing unit (CPU), memory, I/O expander bus interface, and a Cnet interface that supports redundant Cnet (loop one and loop two).

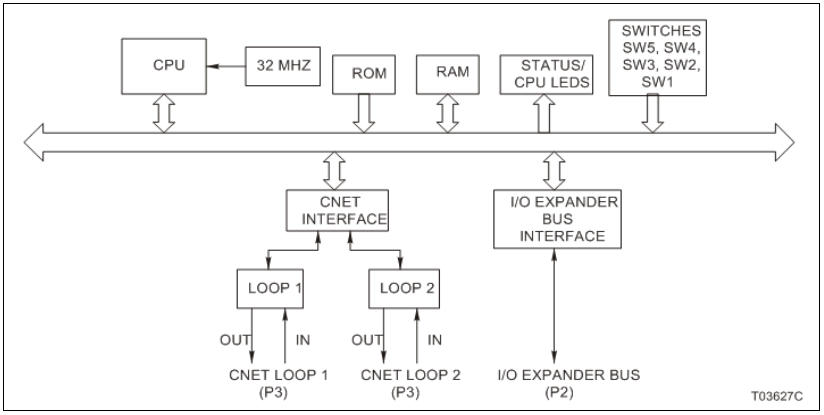

Figure 2-3. INNIS21 Functional Block Diagram

CPU

The CPU contains a 32-bit microprocessor running at 32 megahertz and associated support circuitry (i.e., control logic, address decoder, buffer control, etc.). The CPU interprets and executes instructions to control communication and run diagnostics. Since the microprocessor is responsible for overall module operation, it communicates with all the functional blocks.

Cnet

The INNIS21 module handles all Cnet communication for the HCU interface. This includes transmitting Cnet messages originated from the node, receiving messages intended for the node, and forwarding Cnet messages destined for other Cnet nodes. The Cnet interface contains a transceiver, loop one and loop two transmit drivers, and loop one and loop two receivers. The INNIS21 module has the ability to isolate itself from Cnet in the event of a component failure or to perform diagnostics.

NOTE: The INNIS21 module supports INFI-NET communication in existing INFI 90 OPEN systems.

Receive

On the receive side, the module has two independent channels with separate memory for each channel to temporarily store incoming messages. Messages are received on both channels simultaneously and stored. The data is automatically checked for integrity and various data protocol errors. If a message is

intended for the node, it is stored. If a message is intended for another Cnet node, it is passed to the transmit side.

Transmit

On the transmit side the module has one transmitter but two independent transmit driver circuits. Messages originated by the node and forwarded messages are transmitted on both channels. Messages are first checked and formatted by the CPU before they are transmitted. Messages are transmitted using a transmit/acknowledge sequence.

Memory

The INNIS21 module memory consists of ROM memory and RAM memory. The ROM memory holds the operating system instructions for the microprocessor (i.e., firmware). RAM memory provides temporary storage for the CPU. The Cnet and I/O expander bus interfaces also use a portion of the RAM memory to store received messages and messages to be transmitted.

I/O Expander Bus

The I/O expander bus is an eight-bit parallel bus that provides the communication path for data between the INNIS21 module and the INNPM22 module. The I/O expander bus interface is implemented using a custom integrated circuit utilizing an ABB Automation designed communications protocol. This interface provides the following functions:

- Address comparison and detection.
- Read strobe generation.
- Data line filtering of bus signals.
- On-board bus drivers.

The I/O expander bus used by the HCU interface is isolated from any other rack modules.

NOTE: I/O expander bus is strictly used for internal cabinet communication.

Stop/Reset

Control logic determines the stop/reset pushbutton operation. The pushbutton is used to halt the module operation and to reset the module. It is accessible through a small hole in the front panel. Pressing the pushbutton once causes the module to perform an orderly shutdown. Pressing the pushbutton a second time resets the module.

Switches and LEDs

The CPU reads one of several internal event and error counters and writes count data to data latches to control the front panel LEDs. It reads switches SW1 through SW5 through data buffers to determine its operating mode and operating addresses. A status LED is located near the top of the faceplate.

Operation

The INNIS21 module is the communication front end for the HCU interface. This section provides an overview of its operating theory.

Exception Reports

Exception reported data is available to all Cnet nodes. Once configured, Harmony nodes exception report data on Cnet automatically. A controller, for example, generates an exception report periodically to update data, after a process point reaches a defined alarm limit or changes state, or after a significant change in value occurs. An exception reporting route must be established, however, for the node to begin acquiring the exception reported data. The data typically appears as dynamic values, alarms, and state changes on displays and in reports generated by human system interfaces and other system nodes.

Exception reports can have data values in the following formats: digital, analog, and status. Exception reports are time-stamped to reflect their processing sequence. Some examples of information contained in exception report parameters include:

- Alarm level.
- Alarm state.
- Analog process value.
- Deviation (rate of change).
- Digital process state.
- Quality.

A function block address is included in each exception report to identify the source of the report. The address is a loop, node, module, and block number.

Maximum and minimum report time parameters insure that an exception report is generated for static data and limit reports for rapidly changing data. The minimum report time parameter controls the quantity of exception reports a single rapidly changing point generates. The maximum report time parameter generates a periodic report of data items that do not change.

The controller is the source exception reports. The INNPM22 module packages together exception reports having a common node destination. Packing places all exception reports for a destination (or multiple destinations) into one message. The INNIS21 module then sends them to other Cnet nodes as a single message. This process reduces the number of transmissions required, and adjusts the message size for maximum Cnet efficiency.

NOTE: If a point goes into or out of alarm, the time parameters are ignored and the value is reported immediately. Minimum and maximum exception report times are set through FC 82.

Messages

The INNIS21 module processes four different message types. They are broadcast, time-synchronization, multicast, and NIS poll.

Broadcast. A node generates a broadcast message when sending information to all system nodes. Typically, these messages announce changes in node status. Broadcast messages include:

- Node online.
- Node offline.
- Node restart.
- Node busy.

Time-Synchronization. The time-synchronization message is a high priority broadcast type of message. The INNIS21 module services this message type immediately. Time-synchronization provides a common system time base to be used for sequencing exception reports, accessing trend data, and display on a human system interface such as a workstation running Conductor software.

Multicast. A message that contains data for multiple destinations is a multicast message. This message can have from one to 64 destinations.

NIS Poll. The NIS poll message is a single destination message. The INNIS21 module uses this message type to request the operational status of another node.

Message Format. Messages exist as frames of information. Each frame consists of a message control field that follows an information field. The information field contains the message data. It can consist of multiple messages and vary in size to a maximum of 1,500 bytes. The control field contains time of origination, sequence number, source node address, size, circulation count, message type, destinations, and checksum.

The INNIS21 module increments the circulation count field of all incoming messages. When a message count field exceeds 255, the message is discarded. This is useful in keeping retry and spurious message traffic to a minimum. The INNIS21 module uses the message type to determine how to process the message. The checksum and cyclic redundancy check code fields verify data integrity.

Message Transmission. Any INNIS21 module can transmit a message independently of any other INNIS21 module on the Cnet. Each INNIS21 module can transmit and receive messages simultaneously. Startup and shutdown is local and requires no interaction with other INNIS21 modules on the network. Each module receives all incoming messages and transmits a new stream of messages in a store and forward fashion to the next node. When there are no messages for the INNIS21 module to transmit, the module transmits flag characters (null packets) as the loop synchronizing condition to keep the receivers in lock.

Data Integrity

There are three methods by which the INNIS21 module insures data integrity. They are retry logic, node status table, and polling.

Retry Logic. If, on the first transmission of a message, the INNIS21 module does not receive positive acknowledgment from the destination node, it retransmits the message 11

times. If after this series of retries there is still no response, the destination node is marked offline.

Node Status Table. The INNIS21 module maintains an internal table of system wide node status such as offline and busy. The INNIS21 module relays node status changes to the INNPM22 module. When the INNIS21 module periodically polls nodes, it updates this table accordingly.

Polling. The INNIS21 module uses the information in its status table for polling purposes. As it scans the status table, it picks out destinations targeted for multicast messages that have been marked offline or busy. After polling the destination, the INNIS21 module updates its table and forwards pertinent information to the INNPM22 module.

Power System Status

The communication system provides a means to monitor the status of the power system of each node. This status information can be displayed on a human system interface. Electronics within the power entry panel monitor the power system status. A single status output is made available to the communication system. To use this feature, wire the status output to the terminal block on the NTCL01 termination unit labeled PSS1 or PSS2. Two sets of terminals are available on the termination unit for interconnecting the power system status output.

This power system status signal is fed through the termination unit cable to the P3 connector on the INNIS21 module. The power system status input is a TTL-compatible signal. A high voltage level (5 VDC) on power system status indicates good status. A low voltage level (0 VDC) indicates bad status. When no connection is made to either of the power system status inputs, a pull-up resistor on the INNIS21 module causes a high level signal on the power system status input, thereby reporting good status.

INNPM22 Network Processing

The INNPM22 Network Processing Module acts as a gateway between Cnet and Controlway. The module holds the HCU database and directs the communication process between the modules residing on Controlway and the INNIS21 module. The

module is a single printed circuit board that occupies one slot in a MMU. The circuit board contains microprocessor based communication circuitry that enables it to directly communicate with its INNIS21 module over a dedicated I/O expander bus and to interface to Controlway.

Two latching fasteners on the faceplate secure the INNPM22 module to the MMU (Fig. 2-4). There are 16 LEDs on the faceplate (8 red and 8 green), a status LED, and a stop/reset pushbutton.

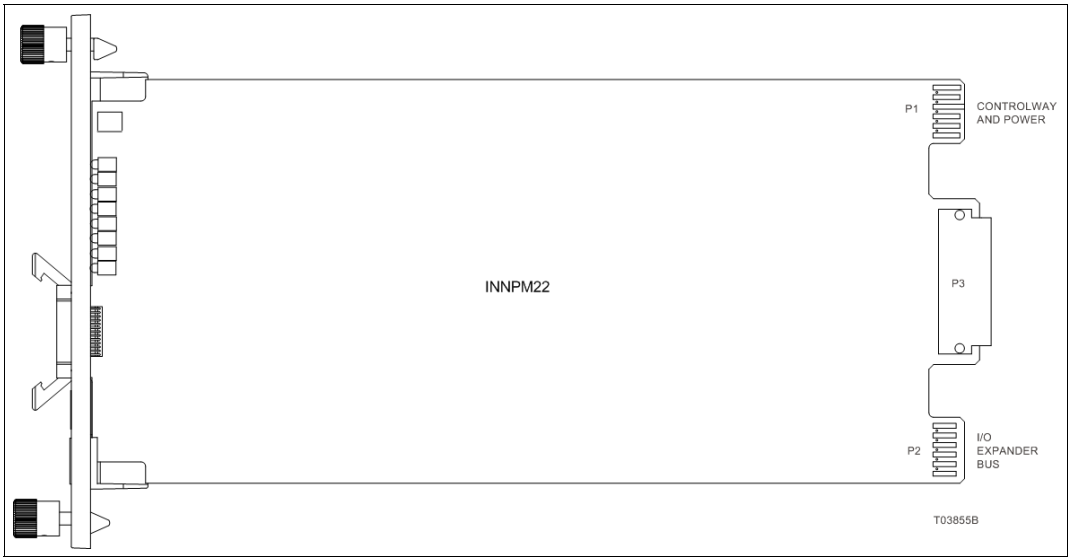

Figure 2-4. INNPM22 Module

The INNPM22 module has two card edge connectors for external signals and power (P1 and P2). Connector P1 connects to common, +5 VDC power, and Controlway. Connector P2 connects the INNPM22 module to the I/O expander bus to communicate with its INNIS21 module.

Block Diagram

Figure 2-5 is a functional block diagram of the INNPM22 module. The module primarily contains a central processing unit (CPU), memory, and I/O expander bus and RS-232-C serial channel interfaces. Refer to ***I/O Expander Bus*** for an explanation of the I/O expander bus interface.

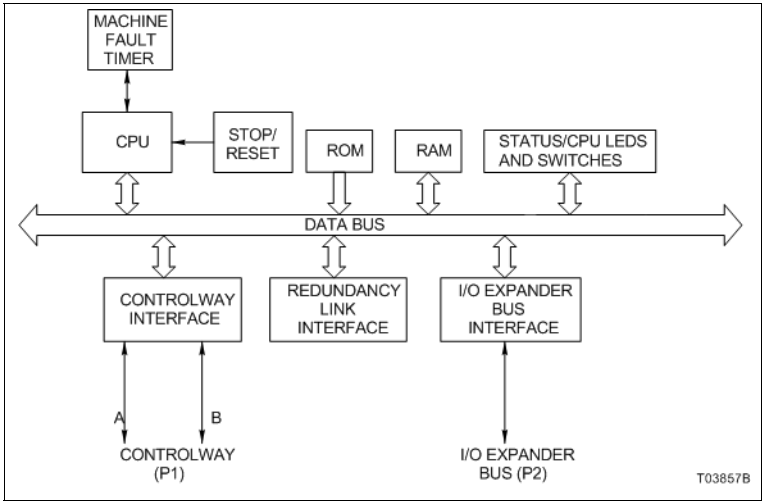

Figure 2-5. INNPM22 Functional Block Diagram

CPU

The CPU contains a 32-bit microprocessor running at 160 megahertz and associated support circuitry (i.e., control logic, address decoder, interrupt interface, system timer, etc.). The CPU interprets and executes instructions to perform its computer interface functions, control communication, and run diagnostics. Since the microprocessor is responsible for overall module operation, it communicates with all the functional blocks.

Memory

The INNPM22 module memory consists of ROM memory and RAM memory. The ROM memory holds the operating system instructions for the microprocessor (i.e., firmware). The RAM memory provides temporary storage and a copy of the exception report route database records.

Controlway

Controlway provides a one-megabaud, peer-to-peer communication link capable of supporting up to 32 connections.

There are two separate communication paths on the MMU backplane for Controlway communications. Data is transmitted over both channels simultaneously and received in sepa-

rate receivers where it is checked for integrity. In this way, the Controlway minimizes the chances that a failure on a circuit board or the backplane will cause loss of module communication. As point data between intelligent modules travels on the bus, the module performs a bit-by-bit comparison.

Redundancy Link

Redundancy is accomplished via a redundancy cable (refer to ***Replacement and Spare Parts*** for the part number) connecting from the faceplate of the primary INNMP22 module to the faceplate of the redundant INNPM22 module.

As the primary INNPM22 module executes, the redundant INNPM22 module waits in standby mode and receives a copy of route records over this link. If for any reason the primary INNPM22 module fails, the redundant INNPM22 module takes over without any process interruption. Refer to ***Redundancy Failover*** in this section for more information.

NOTES:

1. Firmware revision levels must be the same in both primary and secondary INNPM22 modules. If the firmware revision levels are different and a failover occurs, the modules may operate erratically.

2. Installing or removing a redundant INNPM22 module during a firmware download at either the source or destination end of the transfer may prevent the firmware download from completing successfully.

Machine Fault Timer

The machine fault timer (MFT) is a security feature built into the INNPM22 module. The timer is a one-shot timer that must be periodically reset by the CPU to prevent it from timing out. If an error condition exists that causes the module to fail or operate incorrectly, the timer will not be reset and will cause a time-out condition. A time-out condition triggers a reset signal to shut down the module.

The module performs a series of online diagnostics to verify circuit integrity. A detected failure may trigger a reset signal to shut down the module. If the cause of the problem is not a hardware failure, the module and timer can be reset by the stop/reset pushbutton accessed through the front panel.

Stop/Reset

Control logic determines the stop/reset pushbutton (SW1) operation. The pushbutton is used to halt the module operation and to reset the module. It is accessible through a small hole in the front panel. Pressing the pushbutton once causes the module to perform an orderly shutdown. Pressing the pushbutton a second time resets the module.

Switches and LEDs

To control the front panel, the CPU writes data to latches connected to the CPU LEDs (Group A (red) LEDs and Group B (green) LEDs) and the status LED. This data includes operating status and error codes. The CPU reads switches SW2 and SW5 through data buffers to determine its operating mode, operating characteristics, and address.

Operation

The INNPM22 module holds the exception report route database records and directs the operation of the HCU interface. It acts as a gateway between Cnet and Controlway. It communicates directly with the INNIS21 module on the I/O expander bus. Communication with all Harmony rack controllers is over Controlway.

Exception Reports

The INNPM22 module polls the Harmony rack controllers for exception reports. The poll rate is selected through a switch setting on the INNPM22 circuit board. The module has standard poll rates of one, two, four, or eight polls per second. A poll rate multiplier switch setting can be used to increase this to 64 polls per second.

Exception reporting for a controller is automatic. The controller generates an exception report:

- Periodically to update values.
- After a process point reaches a defined alarm limit or changes state.
- After a significant change in value occurs.

There are several alarm indicators that can be communicated in an exception report message.

Data Transfer

Data transfer occurs between the INNPM22 module and the INNIS21 module. The INNPM22 module always initiates the data transfer. It is responsible for:

- Sending commands to the INNIS21 module.
- Sending data to the INNIS21 module.
- Reading data from the INNIS21 module.
- Requesting INNIS21 module status.

Redundancy Failover

In a redundant HCU interface configuration (Fig. 1-2), two types of failover from primary interface to backup interface can occur: cold failover and warm failover. The current state of the exception report route database in the primary and backup INNPM22 modules determines which type of failover will occur.

Warm failover causes less interruption in exception reporting as compared to a cold failover. A cold failover requires all exception report routes to be reestablished. The time it takes to complete the cold failover depends on the number of exception report routes that need to be reestablished. The interruption can exceed one minute for an HCU interface with a large configuration. In contrast, a warm failover does not require all of the exception reporting routes to be reestablished, but can only occur if the database in the primary INNPM22 module has been stable for a certain period of time.

During cold failover, all other nodes that import points from the failed HCU interface mark the imported points with bad quality. They remain in bad quality until new good quality exception reports are received. During a warm failover, points configured in the HCU interface that has failed are not marked as being in bad quality. Warm failover allows other nodes to maintain good quality briefly during the failover.

Operation

During power up or whenever a backup INNPM22 module is inserted into the MMU, the two redundant INNPM22 modules

arbitrate for primary and backup roles. This arbitration takes place over Controlway. When the primary and backup roles are established, the backup module requests an image of the switch settings of the primary module. This image is transferred over the Controlway. All further redundancy communication takes place over the redundancy cable (refer to ***Replacement and Spare Parts*** for more information).

Warm failover requires the primary INNPM22 module to transfer a copy of its database records to the backup module. On warm failover, the new primary module broadcasts a warm failover node restart broadcast message on the loop and immediately obtains new exception reports from controllers in its node. These exception reports are sent to all nodes that have established exception report routes to the former primary module. Other nodes that recognize the warm failover restart broadcast message will send the new primary module updated exception reports for all points that the former primary module requested. In this way the new primary module transfers updated exception reports out of and into its node without taking time to reestablish exception report routes.

The backup INNPM22 module must receive a copy of the primary exception report route database (not exception report data) over the redundancy link before it is ready for warm failover. The database in the primary module must be stable for 15 seconds before it can be transferred to the backup module. After 15 seconds with no changes, the primary module transfers (one record at a time) a complete copy of its database to the backup module. It takes about three minutes to completely transfer a large database.

If the primary INNPM22 module database changes before the transfer is complete, the transfer is aborted and will be restarted after 15 seconds without database changes. Once the entire database has been transferred, the backup module is ready for warm failover.

If the primary INNPM22 module database changes after the backup module is ready for warm failover, the changes are transferred to the backup module in one of two ways. If only a few database records have changed, the changes are immediately transferred to the backup module. If more than a few database record changes occur in a short time period, the

primary module resets the backup module causing the entire database to be transferred to the backup module.

The CPU LEDs on the backup INNPM22 module faceplate indicate the current state of readiness for warm failover. When the backup module is initially powered up, LED seven is on. This state indicates that the backup module is not ready for warm failover. When the backup module is ready for warm failover, LED seven goes out and LED eight turns on. If the primary module fails before the backup module is ready for warm failover, a cold failover will take place. As discussed previously, cold failover protocol requires that all exception report routes must be reestablished and points imported from the failed INNPM22 module must be marked with bad quality until new good quality exception reports are received.

NOTE: The NTCL01 termination unit has an online LED (CR3) which indicates if its associated INNIS21 module is active. In a redundant configuration, this LED will be on for the primary (active) module and off for the backup (standby) module.

Performance

Performance of the warm failover feature is measured in the elapsed time between failure of the primary INNPM22 module and the backup INNPM22 module assuming control. Table 2-1 lists the results of warm failover testing between a redundant HCU interface node and a nonredundant HCU interface node. The primary module of the redundant interface node was stopped to simulate failure. The nonredundant interface node imports exception reports from and exports exception reports to the redundant interface node. The time values listed in Table 2-1 indicate the time required for the backup module to recognize a primary module failure, assume the primary role, and to import and export various numbers of exception reports.

Table 2-1. Warm Failover Performance Data

Points Imported and Exported	Time (msec)	
	Local	Remote
50 analog	250	750
50 analog and 100 digital	300	900
100 analog and 150 digital	350	1,200

Table 2-1. Warm Failover Performance Data *(continued)*

Points Imported and Exported	Time (msec)	
	Local	Remote
225 analog and 275 digital	450	1,500
300 analog and 450 digital	600	2,000
400 analog and 600 digital	700	2,250
600 analog and 900 digital	1,000	3,000

All test configurations are balanced in that both nodes import and export the same numbers and types of exception reports. ***Local*** time values represent the time required by the backup INNPM22 module in a redundant interface node to recognize a primary module failure, assume the primary role, and send the indicated number of exception reports to the nonredundant interface node. ***Remote*** time values represent the time required by the nonredundant module to transmit all exception reports to the redundant module following a primary module failure.

Mounting Hardware

Harmony rack modules and termination units mount in standard ABB Automation enclosures (CAB-01, CAB-04, CAB-12). The number of modules that can be mounted in a single cabinet varies.

An IEMMU11, IEMMU12, IEMMU21, or IEMMU22 MMU and a NFTP01 Field Termination Panel (FTP) are used for module and termination unit mounting respectively (Fig. 2-6). The mounting unit and termination panel both attach to the side rails in standard 483-millimeter (19-inch) enclosures. Front mount and rear mount MMU versions are available to provide flexibility in enclosure mounting.

A MMU is required to mount and provide power to rack modules. The unit is for mounting controllers, I/O modules, and communication interface modules. The MMU backplane connects and routes:

- Controlway.
- I/O expander bus.
- Logic power to control, I/O, and interface modules.

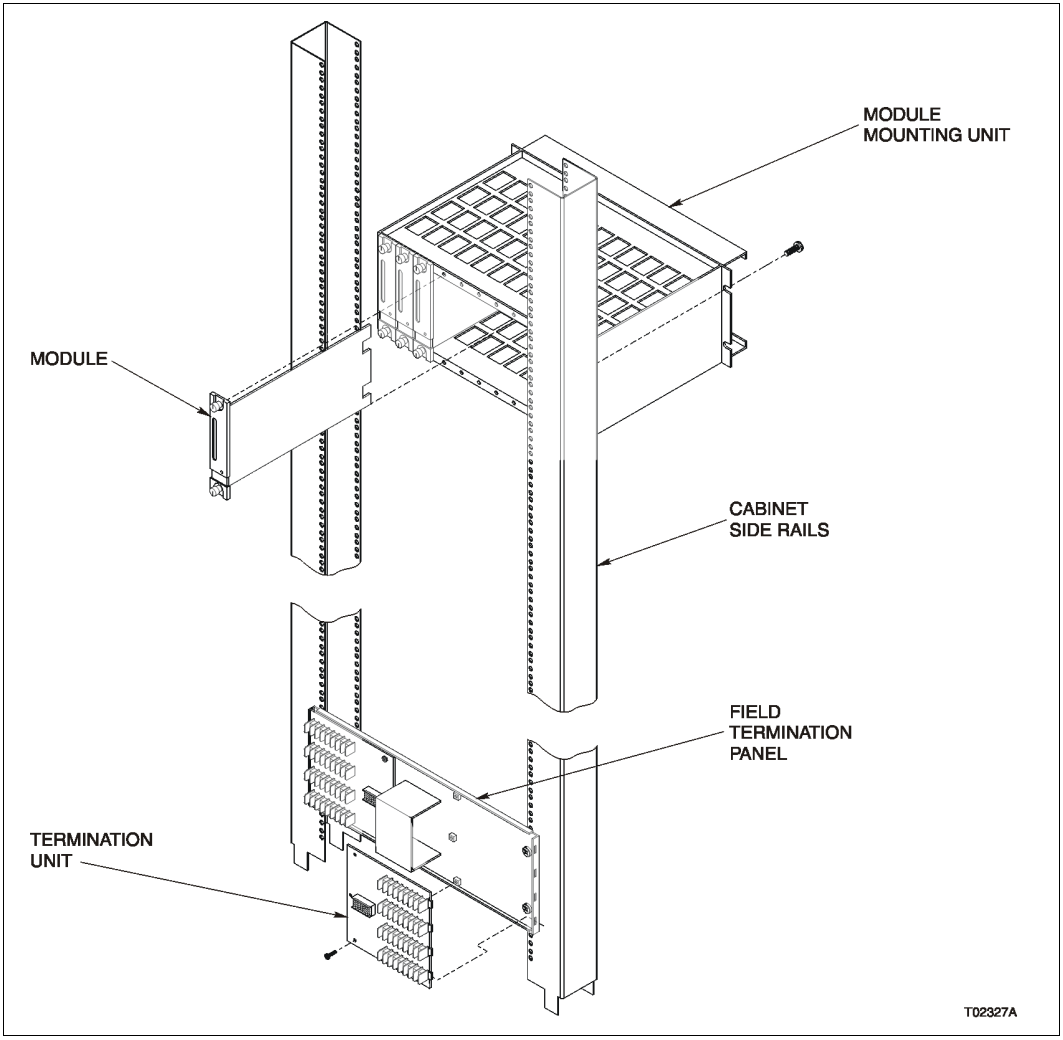

Figure 2-6. Mounting Hardware

The Controlway and I/O expander bus are internal cabinet, communication buses. Communication between rack controllers and communication interface modules is over Controlway.

Installation

Section 3

Introduction

This section explains the steps necessary to install a HCU interface. This instruction discusses only HCU interface installation requirements. The instruction does not provide any planning information, and assumes all components have already been purchased and are ready to be installed.

Special Handling

Observe these steps when handling electronic circuitry:

1. ***Use Static Shielding Bag.*** Keep an assembly in its static shielding bag until ready to install it in the system. Save the bag for future use.

2. ***Ground Bags before Opening.*** Before opening a bag containing an assembly with static sensitive devices, touch it to the equipment housing or ground to equalize charges.

3. ***Avoid Touching Circuitry.*** Handle assemblies by the edges; avoid touching the circuitry.

4. ***Avoid Partial Connection of Semiconductors***. Verify that all devices connected to the module are properly grounded before using them.

5. ***Ground Test Equipment***.

6. ***Use an Antistatic Field Service Vacuum***. Remove dust from assemblies if necessary.

7. ***Use a Grounded Wrist Strap***. Use ABB Automation field static kit (part number 1948385?1 - consisting of two wrist straps, ground cord assembly, alligator clip, and static dissipative work surface) when working with modules. The kit grounds a technician and the static dissipative work surface to the same ground point to prevent damage to the circuitry by electrostatic discharge. Connect the wrist strap to the appropriate grounding plug on the power entry panel. The

grounding plug must be effectively connected to the earth grounding electrode system through the AC safety ground.

8. ***Do Not Use Lead Pencils to Set Switches***. To avoid contamination of switch contacts that can result in unnecessary circuit board malfunction, do not use a lead pencil to set a switch.

Unpacking and Inspection

1. Examine the hardware immediately to verify that it has not been damaged in transit.

2. Notify the nearest ABB sales office of any damage.

3. File a claim for any damage with the transportation company that handled the shipment.

4. Use the original packing material and container to store the hardware.

5. Store the hardware in an environment of good air quality, free from temperature and moisture extremes and corrosives.

Installation and Connection Sequence

WARNING	**Verify the main power, field power, and power entry panel circuit breakers/switches are turned off before starting installation, retrofit, upgrade, or wiring procedures. Failure to do so could result in severe or fatal shock or equipment damage. Do not turn the power on until the installation, retrofit, upgrade, or wiring procedures are complete.** **A rack module should not be inserted or removed with power applied when located in a Class I, Division 2 hazardous location unless the area is known to be nonhazardous.**

NOTE: Always follow the instructions given in ***Special Handling*** in this section when handling the modules.

Figure 3-1 is the HCU interface installation and connection flowchart. This flowchart applies whether installing the interface in a new system or in an existing system.

In the flowchart, each flowchart block represents a single task. The PR code in the flowchart block identifies the procedure section that describes the steps to complete the indicated task. For example, turn to section PR3 to read about module installation. Some steps are self-explanatory and have no related procedure section. Complete all steps given in a procedure section before continuing to the next flowchart block. The procedure sections are located towards the back of the instruction.

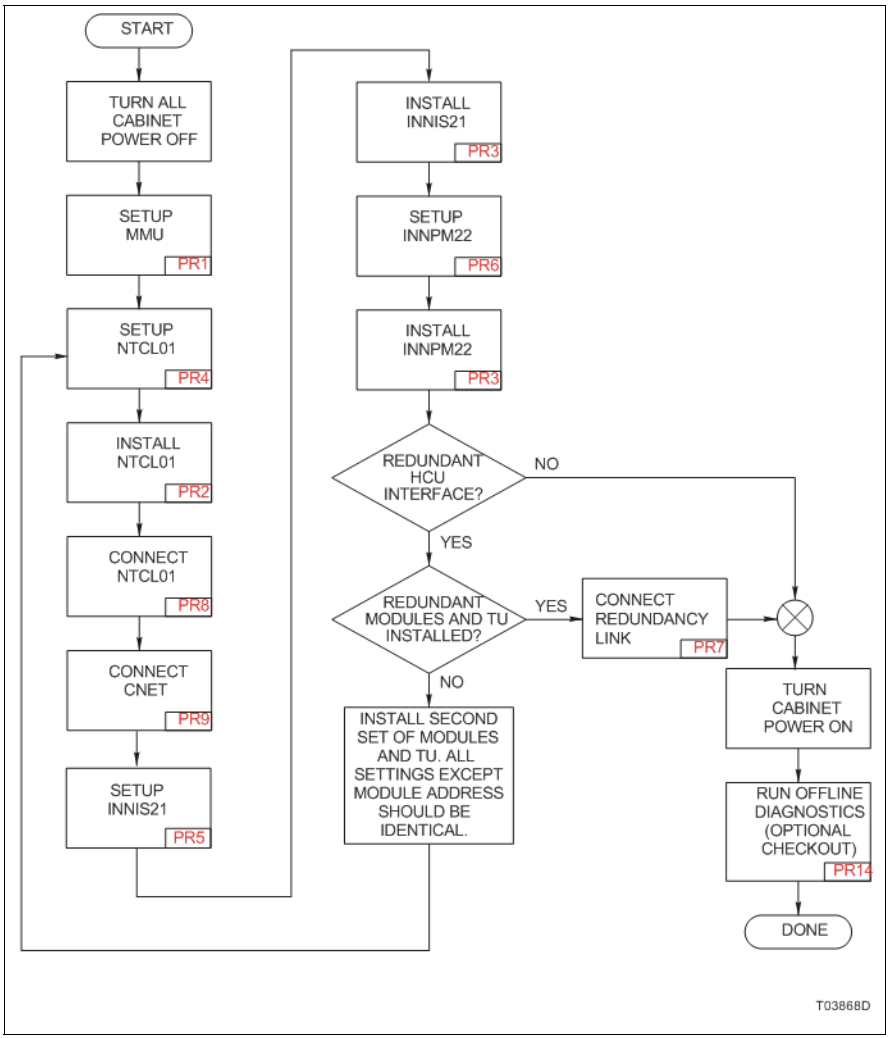

Figure 3-1. Installation and Connection Flowchart

Operating Procedures

Section 4

Introduction

After completing the steps detailed in the installation section, the modules of the HCU interface are ready to be put into operation. This section provides the necessary information for daily operation of the modules.

INNIS21 Network Interface

Figure 4-1 shows the INNIS21 module faceplate. On power up, the INNIS21 module microprocessor stays in reset until the INNPM22 module removes the reset and allows the firmware to execute self-diagnostic routines. The INNPM22 module determines when the INNIS21 module will go online. The INNIS21 module comes online in the network mode set by switch SW3, with the type of counter display set by switch SW4.

Status LED

The status LED is a two-color LED (red and green) that displays the operating status of the INNIS21 module. It has two possible states. Table 4-1 lists the meaning of the status LED states.

Table 4-1. Status LED States (INNIS21)

LED State	Description
Solid green	Module is online and operational.
Solid red	NPM has not yet taken NIS module out of reset - or - NPM or NIS module has been reset - or - Diagnostics detected a hardware failure or configuration problem. Group A and B LEDs display an error code when the status LED is red.

Group A and B LEDs

Use the faceplate group A and B LEDs to check the INNIS21 module operation. If communication errors occur, the host module sets the INNIS21 module communication status bits in the module status. View the module status by using a human system interface such as a workstation running Conductor software.

Event Counters

Internal counters maintain a count of events such as the number of messages transmitted, retries, and number of messages lost. The group A and B LEDs on the module faceplate display a binary value of the event counter selected with switch SW4. LED B8 is the most significant bit; LED A1 is the least significant bit. Refer to Table PR5-6 for a list of event types and their counter addresses.

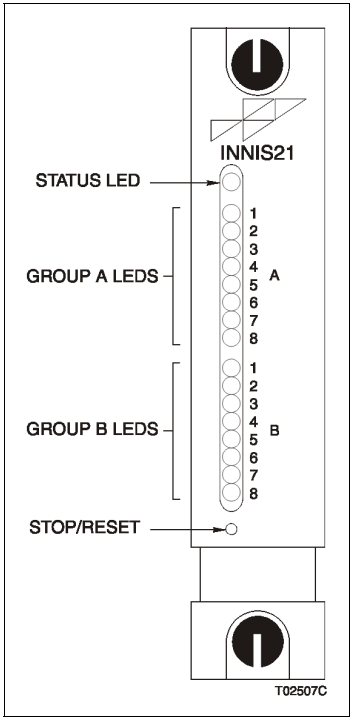

Figure 4-1. INNIS21 Faceplate

Error Counters and Codes

Errors such as receive errors, transmit errors, and dumped messages are maintained in internal counters like events are. Refer to Table PR5-7 for a list of error types and their counter addresses. Table 5-1 lists the error codes and corrective actions for errors that can display on the INNIS21 module faceplate LEDs after the NIS module detects a critical error and stops operation.

Stop/Reset

Push the stop/reset pushbutton once and wait for the status LED to turn red before removing an INNIS21 module from the MMU. Pressing the stop/reset pushbutton again causes the restoration of the INNIS21 module to power up values after a halt. It is also used to recover from an operator-initiated stop or a module time-out.

INNPM22 Network Processing

Figure 4-2 shows the INNPM22 module faceplate. It has a status LED, 16 CPU LEDs (group A and B), and a Stop/reset button.

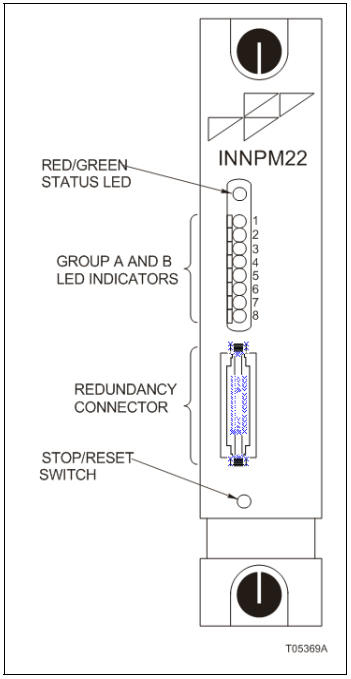

Figure 4-2. INNPM22 Faceplate

Status LED

The status LED displays the operating status of the INNPM22 module. It is a two-color LED that has three possible states described in Table 4-2. Refer to Section 5 for corrective actions if the status LED indicates that an error exists.

Table 4-2. INNPM22 Status LED

LED State	Description
Off	No power.
Solid green	Online and executing.
Solid red	NPM module is in reset or diagnostics detected a hardware failure or configuration problem. CPU LEDs display an error code when the status LED is red.

CPU LEDs

Table 4-3 summarizes the normal operation status LED codes. If an error occurs, red colored LEDs display an error code and

the status LED turns red. Refer to Table 5-2 for a list of CPU LED error codes and associated corrective actions.

Table 4-3. Normal Operation Status Codes

Status LEDs								Condition
1	2	3	4	5	6	7	8	
0	0	0	0	0	0	1	1	Normal operation; primary INNPM22
0	0	0	0	0	0	0	1	Normal operation; backup INNPM22
1	1	1	1	1	1	0	0	Normal stop; stop button pressed.

NOTE: 0 = LED off, 1 = LED on.

Stop/Reset

The stop/reset button is used to interrupt module execution and to initiate a hardware reset. The button is accessed through the small opening on the faceplate. Some type of thin rod, preferably nonmetallic, is required to press the button.

First Press Stop

Press the button once to halt operation. The electronics conduct an orderly shutdown after stop is initiated then turns the status LED on red. Wait for the status LED to turn red before removing the INNPM22 module (or the INNIS21 module) from the MMU.

Second Press Reset

Press the button a second time to initiate a hardware reset. A hardware reset is required to recover from a module time-out or a manual stop (single press). This also restores the module to power up values.

NOTE: If the module has already stopped due to an error (i.e., status LED on red), a single press resets the module.

Operating Modes

The INNPM22 module has two modes of operation: execute and error.

Execute

Execute mode is the normal mode of operation. In this mode the Cnet and Harmony control unit modules interact through the HCU interface. The INNPM22 module can request exception reports, collect exception reports, allow the operator to

adjust tunable module specifications, and configure modules within a node residing on Cnet.

Error

The INNPM22 module enters error mode if the internal system diagnostic routines detect a hardware or execution error. If the module detects an error, the module halts and displays an error code on the CPU LEDs. Refer to Section 5 for corrective actions.

Module Integrity

All communication modules have normal Symphony system security functions that insure module integrity. The INNPM22 module performs both hardware and software security checks to insure module integrity.

Hardware Checks

The INNPM22 module performs the following hardware checks:

Illegal Address Detection — Detecting an illegal address generates a bus error and the module halts operation. It also displays an error code on the faceplate LEDs.

Machine Fault Timer — The microprocessor updates the machine fault timer. If the microprocessor fails to reset the MFT timer, it expires. When a time-out occurs, the module stops and the status LED turns red.

Software Checks

The INNPM22 module performs the following software checks:

Module Diagnostics — The module diagnostic routines execute automatically on system power up. If the diagnostic tests fail, the faceplate LEDs display error conditions, the status LED turns on red, and the module operation halts.

ROM Checksum — The ROM checksum test verifies checksums of the ROM memory. Discrepancies cause the module status LED to go solid red and the module operation halts.

Troubleshooting

Section 5

Introduction

This section provides troubleshooting information necessary to isolate HCU interface errors. It is not meant to be all inclusive. If a problem exists that cannot be corrected using the information provided in this instruction, contact a local ABB service office for assistance.

Troubleshooting Procedures

Troubleshooting the HCU interface is limited to deciphering module LED error codes and viewing the contents of the error counters and the module status report from any human system interface (HSI). Refer to the instruction for the specific HSI workstation being used for information on module status reports.

Error Codes

All Cnet communication modules have faceplate LEDs that serve as error code displays. The INNIS21 module has event and error counters that are selectable.

INNIS21

The INNIS21 module error counters total errors in the same manner as the event counters total events. Table PR5-7 lists the types of error counters. If a critical error occurs while the INNIS21 module is operating, the status LED turns red and the module halts operation. Group A LEDs on the module faceplate display error codes. Group B LEDs are off when group A LEDs are displaying any error code. Refer to Table 5-1 for a list of error codes and associated corrective actions. A code that is not listed may appear if a machine fault time-out occurs. Reset the module if this happens. The module has failed if the status LED remains red. Replace the module in this case.

Table 5-1. INNIS21 Error Codes

Code	LEDs	Condition	Corrective Action
	8 7 6 5 4 3 2 1		
13	0 0 0 1 0 0 1 1	ROM checksum error	Replace INNIS21 module.
16	0 0 0 1 0 1 1 0	Loopback test failure	1. Check cabling and termination unit. 2. Replace INNIS21 module.
1F	0 0 0 1 1 1 1 1	Expander bus failure	1. Reset INNPM22 module. 2. Replace INNIS21 or INNPM22 module if error recurs.
31	0 0 1 1 0 0 0 1	Memory or CPU fault	Replace INNIS21 module.
32	0 0 1 1 0 0 1 0	Address or bus error	1. Reset INNPM22 module. 2. Replace INNIS21 module if error recurs.
33	0 0 1 1 0 0 1 1	Illegal instruction	
34	0 0 1 1 0 1 0 0	Trace/privilege violation	
35	0 0 1 1 0 1 0 1	Spurious/unassigned exception	
36	0 0 1 1 0 1 1 0	Divide by 0/checksum/format error	
37	0 0 1 1 0 1 1 1	Trap instruction	
38	0 0 1 1 1 0 0 0	Invalid switch settings on INNIS21 module	Check switches SW1 through SW5.
3C	0 0 1 1 1 1 0 0	Loop termination unit failure	1. Replace fuse on termination unit. 2. Replace INNIS21 module. 3. Replace termination unit.
3E	0 0 1 1 1 1 1 0	INNIS21/device handshake failure	1. Reset INNPM22 module. 2. Replace INNIS21 or INNPM22 module if error recurs.

NOTE: 0 = LED off, 1 = LED on.

INNPM22

If errors occur while the INNPM22 module is operating, the status LED turns on red and the CPU LEDs on the module faceplate display error codes. Table 5-2 lists the INNPM22 module error codes and associated corrective actions. The module displays error codes only when it is halted.

A code that is not on the list may appear if a machine fault time-out occurs. Reset the INNPM22 module if this happens. The module has failed if the status LED remains red. Replace the module in this case.

Table 5-2. INNPM22 Error Codes

Code	LEDs	Condition	Corrective Action
	8 7 6 5 4 3 2 1		
0D	0 0 0 0 1 1 0 1	I/O expander bus errors	Check I/O expander bus for connections to other modules.
0E	0 0 0 0 1 1 1 0	Controlway address set the same on redundant INNPM22 modules	1. Change the Controlway address set with switch SW3 on a INNPM22 module; refer to Table PR6-3. 2. INNPM22 modules use address 0 or 1; check for another rack module with a Controlway address set the same.
12	0 0 0 1 0 0 1 0	INNIS21 module not responding	1. Replace INNIS21 module. 2. Replace INNPM22 module.
13	0 0 0 1 0 0 1 1	ROM checksum error	1. Reset INNPM22 module. 2. If error persists, replace INNPM22 module.
14	0 0 0 1 0 1 0 0	I/O expander bus message failure	
15	0 0 0 1 0 1 0 1	Loopback test failure	1. Check cabling and termination unit. 2. Replace INNIS21 module.
31	0 0 1 1 0 0 0 1	Memory or CPU fault	Replace INNPM22 module.
32	0 0 1 1 0 0 1 0	Address or bus error	1. Reset INNPM22 module. 2. If error persists, replace INNPM22 module.
33	0 0 1 1 0 0 1 1	Illegal instruction	
34	0 0 1 1 0 1 0 0	Trace/privilege violation	
35	0 0 1 1 0 1 0 1	Spurious/unassigned exception	
36	0 0 1 1 0 1 1 0	Divide by zero/checksum/format error	
38	0 0 1 1 1 0 0 0	Switch settings different between primary and backup INNIS21/ INNPM22 modules	Check switch settings.
39	0 0 1 1 1 0 0 1	Duplicate node number on loop	1. Change INNIS21 module loop address (switch SW2) or node address (switch SW1); refer to Table PR5-1. 2. Check primary and backup INNPM22 configuration (i.e., NKMP01/NKMP11 cable installed).
3C	0 01 1 1 1 0 0	Relay or fuse failure on termination unit or power supply failure	1. Check fuse. 2. Check power supply. 3. If error persists, replace termination unit.

Table 5-2. INNPM22 Error Codes *(continued)*

Code	LEDs	Condition	Corrective Action
	8 7 6 5 4 3 2 1		
3D	0 0 1 1 1 1 0 1	Incompatible INNIS21 firmware	INNPM22 module requires INNIS21 firmware revision F.7 or later.
3F	0 0 1 1 1 1 1 1	Module halted; stop button pressed	Reset INNPM22 module.

NOTE: 0 = LED off, 1 = LED on.
1. Codes are displayed only when the INNPM22 module is halted and the status LED is red.

Diagnostics

The firmware of the INNPM22 and INNIS21 modules contain various diagnostic routines used to verify proper operation of components and circuitry. Some are run automatically during startup and normal operation (online), and others can be invoked manually (offline). If any of the online checks detect a hardware problem, the module will provide error status code indications (if possible) and will halt. Refer to Tables 5-1 and 5-2 to decipher the status codes.

Offline tests can be run to verify operation of suspect INNPM22 modules or to check module integrity before putting it into operation. Offline diagnostics should only be run during installation or when a system is down. Refer to procedure section PR14 for the steps to run offline diagnostics. Putting the INNPM22 module into diagnostic mode allows it to perform a variety of diagnostic tests but suspends normal operation.

INNPM22 Status Summary (Cnet)

The INNPM22 has a 16-byte module status record. The status report provides summary flags for error conditions, module type, and firmware revision level.

The status report can be viewed from a human system interface. To interpret the status bytes:

1. Convert each hexadecimal byte to its binary equivalent. For example (Cnet mode):

Byte 1 0x75 = 01110101

Refer to Tables 5-3 and 5-4 for an explanation of each byte and data bit.

Bit 7	0 = no errors.
Bit 6/5	11 = execute mode.
Bit 4-0	10101 = enhanced node type; reference byte 6 (ETYPE) for actual type.

Table 5-3 lists the fields that make up the INNPM22 module status report. Table 5-4 describes each field within the module status record.

Table 5-3. INNPM22 Status Byte Description

Byte	Bit							
	7	6	5	4	3	2	1	0
1	ES	MODE		TYPE				
2	Reserved							
3	CSP	MOV		BKCFG	BKSTS			PSI
4	NSF	LR1	LR2	LT1	LT2	RI1	RI2	RCF
5	Reserved							
6	ETYPE							
7	CWA	CWB						
8	Reserved							
9	NDT1	NDT2			NCD1	NCD2		
10 - 13	Reserved							
14	Module nomenclature							
15	Revision letter (ASCII)							
16	Revision number (ASCII)							

Table 5-4. INNPM22 Status Bit Descriptions

Byte	Field	Field Size or Value	Description
1	ES	80	Error summary: 0 = good, 1 = errors
	MODE	60	Module mode: 10 = error, 11 = execute
	TYPE	1F	Module type: 0x15 = enhanced status (ETYPE)
2	—	00	Reserved

Table 5-4. INNPM22 Status Bit Descriptions *(continued)*

Byte	Field	Field Size or Value	Description
3	CSP	80	Communication status problem: 0 = no, 1 = yes
	MOV	40	Memory overflow: 0 = good, 1 = bad
	BKCFG	10	Redundant configuration: 0 = no, 1 = yes
	BKSTS	08	Backup failed: 0 = no, 1 = yes
	PSI	00	Primary/backup indicator: 0 = primary, 1 = backup
4	NSF	80	Node environment status flag: 0 = good, 1 = bad
	LR1	40	Cnet 1 receive error: 0 = no, 1 = yes
	LR2	20	Cnet 2 receive error: 0 = no, 1 = yes
	LT1	10	Cnet 1 transmit error: 0 = no, 1 = yes
	LT2	08	Cnet 2 transmit error: 0 = no, 1 = yes
	RI1	04	Receiver idle on channel 1: 0 = no, 1 = yes
	RI2	02	Receiver idle on channel 2: 0 = no, 1 = yes
	RCF	01	Loop communication failure: 0 = no, 1 = yes
5	—	00	Reserved
6	ETYPE	20	Enhanced module type: 0x25 = INNPM22
7	CWA	80	Controlway channel A failure: 0 = no, 1 = yes
	CWB	40	Controlway channel B failure: 0 = no, 1 = yes
8	—	00	Reserved
9	NDT1	80	NIS loop relay drive transistor 1 failure: 0 = no, 1 = yes
	NDT2	40	NIS loop relay drive transistor 2 failure: 0 = no, 1 = yes
	NCD1	08	NIS receive channel 1 disable: 0 = no, 1 = yes
	NCD2	04	NIS receive channel 2 disable: 0 = no, 1 = yes
10 - 13	—	—	Reserved
14	—	FF	Module nomenclature: 0x22 = INNPM22
15	—	FF	Revision letter (in ASCII code). For example, 0x41 = A
16	—	FF	Revision number (in ASCII code). For example, 0x30 = 0

INNIS21 Edge Connectors

Tables 5-5, 5-6, and 5-7 list the INNIS21 module edge connector pin assignments.

Table 5-5. P1 Pin Assignments (INNIS21)

Pin	Signal	Pin	Signal
1	+5 VDC	2	+5 VDC
3	Unused	4	Unused
5	Common	6	Common
7	Unused	8	Unused
9	Power fail interrupt	10	Unused
11	Unused	12	Unused

Table 5-6. P2 Pin Assignments (INNIS21)

Pin	Signal	Pin	Signal
1	Data bit 1	2	Data bit 0
3	Data bit 3	4	Data bit 2
5	Data bit 5	6	Data bit 4
7	Data bit 7	8	Data bit 6
9	Clock	10	Sync
11	Unused	12	Unused

Table 5-7. P3 Pin Assignments (INNIS21)

Pin	Signal	Pin	Signal
1	Receive 1 (-)	A	Receive 1 (+)
2	Ground	B	Ground
3	Ground	C	Ground
4	Bypass control (-)	D	Bypass control (+)
5	Ground	E	Ground
6	Transmit 1 (-) (phase 2)	F	Transmit 1 (+) (phase 2)
7	Transmit 1 (+) (phase 1)	H	Transmit 1 (-) (phase 1)
8	Ground	J	Ground
9	Transmit 2 (-) (phase 1)	K	Transmit 2 (+) (phase 1)
10	Transmit 2 (+) (phase 2)	L	Transmit 2 (-) (phase 2)
11	Ground	M	Ground
12	Power system status 2	N	Power system status 1
13	Ground	P	Ground
14	Ground	R	Ground
15	Receive 2 (+)	S	Receive 2 (-)

INNPM22 Edge Connectors

Tables 5-8 and 5-9 list the INNPM22 module edge connector pin assignments.

Table 5-8. P1 Pin Assignment (INNPM22)

Pin	Signal	Pin	Signal
1	+5 VDC	2	+5 VDC
3	Unused	4	Controlway B
5	Common	6	Common
7	Unused	8	Unused
9	Power fail interrupt	10	Unused
11	Controlway A/module bus	12	Unused

Table 5-9. P2 Pin Assignments (INNPM22)

Pin	Signal	Pin	Signal
1	Data bit 1	2	Data bit 0
3	Data bit 3	4	Data bit 2
5	Data bit 5	6	Data bit 4
7	Data bit 7	8	Data bit 6
9	Clock	10	Sync
11	Unused	12	Unused

Maintenance

Section 6

Introduction

The reliability of any standalone product or control system is affected by the maintenance of the equipment. ABB Automation recommends that all equipment users practice a preventive maintenance program that will keep the equipment operating at an optimum level.

This section presents procedures that can be performed on-site. These preventive maintenance procedures should be used as guidelines to assist in establishing good preventive maintenance practices. Select the minimum steps required to meet the cleaning needs of your system.

Personnel responsible for maintenance should be familiar with the Harmony rack modules, have experience working with process control systems, and know what precautions to take when working on live AC systems.

Preventive Maintenance Schedule

Table 6-1 is the preventive maintenance schedule for the HCU interface. The table lists the preventive maintenance tasks in groups according to their specified maintenance interval. Some tasks in Table 6-1 are intuitive or self explanatory. Instructions for tasks that require further explanation are covered in the indicated procedure section.

NOTE: The preventive maintenance schedule is for general purposes only. Your application may require special attention.

Table 6-1. Preventive Maintenance Schedule

Task	Procedure	Frequency
General cleaning. Use a lint-free cloth and mild, all-purpose, nonflammable, commercial spray cleaner to remove dirt, fingerprints, and grease from the module. Spray the cleaner on the cloth and not directly on the equipment.	N/A	As required
Check and clean modules and termination units.	PR12	
Check module for dust. Clean as necessary using an antistatic vacuum. Insure air vents are free of dust and lint.	N/A	3 months
Check all signal, power, ground, and cable connections associated with the modules; verify they are secure.	PR13	
Complete all tasks in this table.	N/A	Shutdown

Repair and Replacement

Section 7

Introduction

This section explains repair and replacement procedures for the HCU interface.

Repair

HCU interface repair is limited to assembly replacement. If a module or termination unit fails, remove and replace it with another provided by ABB or another authorized ABB sales representative. Do ***not*** attempt to replace discrete components in any Harmony device.

Replacement

WARNING	**Verify the main power, field power, and power entry panel circuit breakers/switches are turned off before starting the termination unit removal procedure. Failure to do so could result in severe or fatal shock or equipment damage. Do not turn the power on until the replacement procedure is complete.** **A rack module should not be inserted or removed with power applied when located in a Class I, Division 2 hazardous location unless the area is known to be nonhazardous.**

NOTE: Always follow the instructions given in ***Special Handling*** in Section 3 when handling the modules.

The replacement procedures for most parts and assemblies are intuitive. Figure 7-1 is the HCU interface replacement flowchart, which contains replacement procedures for those parts and assemblies that need explanation.

In the flowchart, each flowchart block represents a single task. The PR code in the flowchart block identifies the procedure section that describes the steps to complete the indicated task. Some steps are self-explanatory and have no related procedure section. Complete all steps given in a procedure section before

continuing to the next flowchart block. The procedure sections are located towards the back of the instruction.

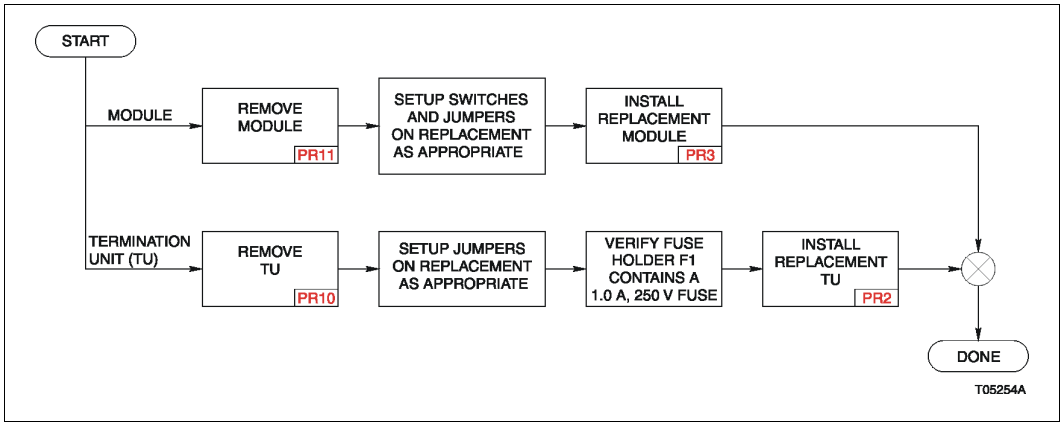

Figure 7-1. Replacement Flowchart

Parts

Order parts without commercial descriptions from the nearest ABB sales office. Contact ABB Automation for help determining the quantity of spare parts to keep on hand for your particular system. Tables 8-1, 8-2, and 8-3 list HCU interface related parts.

Table 8-1. Module and Termination Unit Nomenclature

1	2	3	4	5	6	7	
I	**N**	**N**	**I**	**S**	**2**	**1**	**Network Interface Module**
I	**N**	**N**	**P**	**M**	**2**	**2**	**Network Processing Module**
N	**T**	**C**	**L**	**0**	**1**		**Communication Termination Unit**

Table 8-2. Cable Nomenclatures

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
N	**K**	**L**	**S**	**0**	**1**	**-**	**1**	**0**									**INNIS21 to NTCL01 Termination Unit Cable (PVC)**
N	**K**	**L**	**S**	**1**	**1**	**-**	**1**	**0**									**INNIS21 to NTCL01 Termination Unit Cable**
N	**K**	**T**	**L**	**0**	**1**	**-**	**3**										**Cnet Termination Cable -** 0.9 m (3 ft)
N	**K**	**T**	**T**	**0**	**1**	**-**	–	–	–								**Node to Node Cnet Termination Cable**
																	Cable Length
							x	x	x								1 to 500 for 0.3 to 152.4 m (1 to 500 ft)
P	**-**	**M**	**K**	**-**	**H**	**R**	**M**	**-**	**B**	**R**	**C**	**3**	**0**	**0**	**0**	**A**	**Redundancy cable for two INNPM22 modules, one MMU (horizontal)**
P	**-**	**M**	**K**	**-**	**H**	**R**	**M**	**-**	**B**	**R**	**C**	**3**	**0**	**0**	**0**	**B**	**Redundancy cable for two INNPM22 modules, two MMUs (vertical)**

Table 8-3. Miscellaneous Parts

Part Number	Description
1946715?12	Dipshunt (12-position, 24-pin)
1946715?8	Dipshunt (8-position, 16-pin)
1946984?1	Jumper
194776?11001	1.0 A, 250 V, normal fuse
NFWAB17010	0.19-16 (no. 10) × 5/8 in., Phillips-head, thread-forming screw
NTLAC19000	0.19 in. (no. 10), external tooth, lock washer

MMU Setup

PR1

Purpose/Scope

10 min.

This procedure describes the steps required to properly set up the IEMMU11, IEMMU12, IEMMU21, or IEMMU22 MMU for the HCU interface.

Prerequisites

- MMU installed.

Parts

Number	Qty	Description
1946715?12	1	Dipshunt (12-position, 24-pin)

Tools

None.

Safety Considerations

WARNING

Verify the main power, field power, and power entry panel circuit breakers/switches are turned off before starting installation, retrofit, upgrade, or wiring procedures. Failure to do so could result in severe or fatal shock or equipment damage. Do not turn the power on until the installation, retrofit, upgrade, or wiring procedures are complete.

Procedure

☐ 1. Verify the MMU slot assignments for the INNIS21 and INNPM22 modules. Two slots are required for a nonredundant interface; four slots are required for a redundant interface.

☐ 

2. From the front of the MMU insert a 24-pin dipshunt with all pins intact in the I/O expander bus socket (XU1 to XU11) between the MMU slot to be used by the INNIS21 module and the slot to be used by the INNPM22 module.

☐ 3. Remove any 24-pin dipshunts from the I/O expander bus sockets that would connect the INNIS21 and INNPM22 modules to any other modules including the redundant modules.

Figures PR1-1 and PR1-2 show example MMU configurations (horizontal): nonredundant interface and redundant interface respectively.

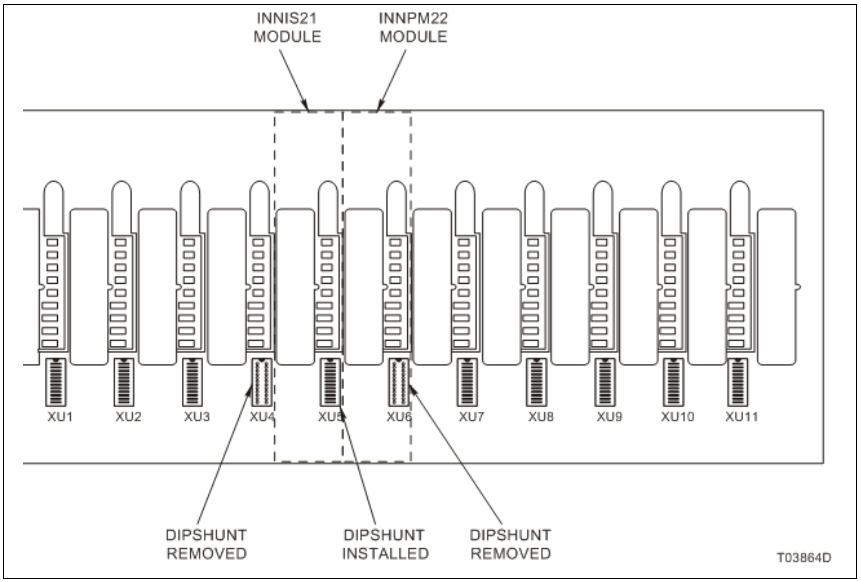

Figure PR1-1. Nonredundant Interface Example MMU Configuration (Front View)

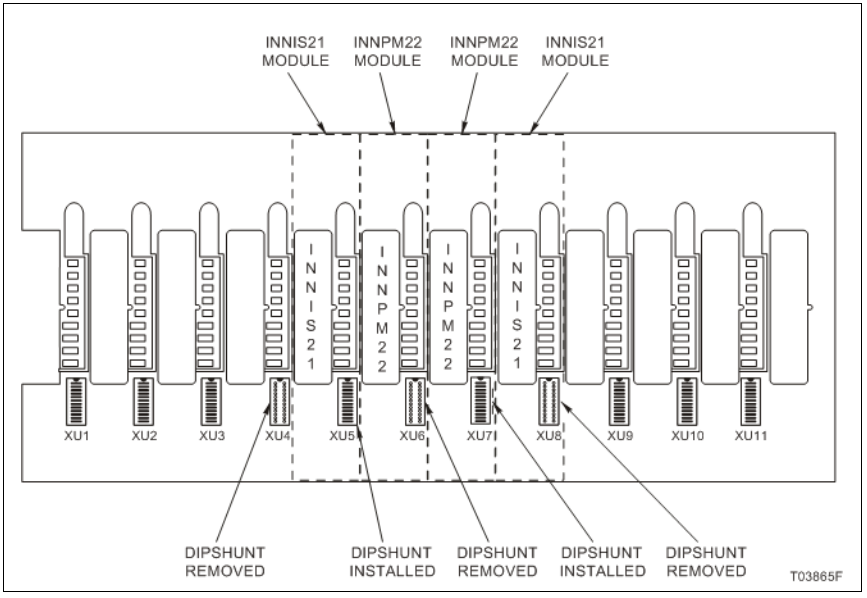

Figure PR1-2. Redundant Interface Example MMU Configuration (Front View)

Figure PR1-3 shows redundant INNPM22 modules mounted in two separate MMUs. The INNPM22 modules must be mounted directly above or below each other as shown (vertical). A special redundancy cable must be used to connect redundant INNPM22 modules when used in different MMUs. Refer to ***Redundancy Cable Connection*** for more information.

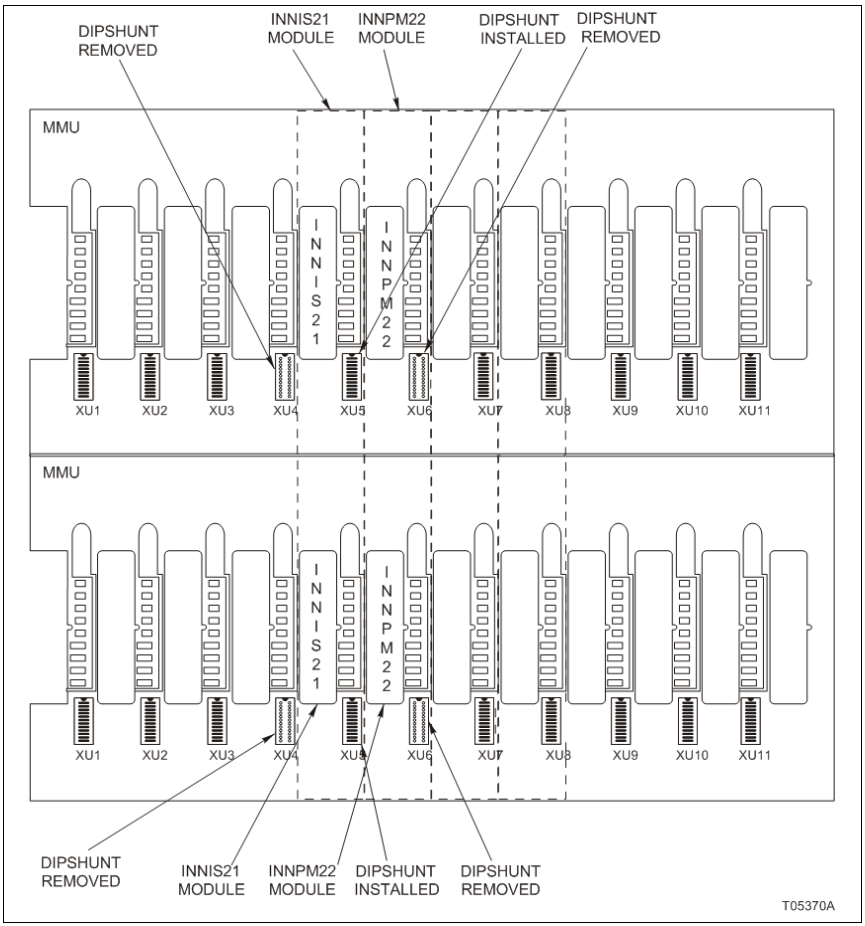

Figure PR1-3. Multiple MMU Configuration

Termination Unit Installation

PR2

Purpose/Scope

5 min.

This procedure describes the steps required to mount a NTCL01 termination unit on the NFTP01 Field Termination Panel.

Prerequisites

- NTFP01 panel installed.

Parts

Number	Qty	Description
NFWAB17010	3	0.19-16 (no. 10) × 5/8 in., Phillips-head, thread-forming screw
NTLAC19000	1	0.19 in. (no. 10), external tooth, lockwasher

Tools

- Phillips screwdriver.

Safety Considerations

WARNING

Verify the main power, field power, and power entry panel circuit breakers/switches are turned off before starting installation, retrofit, upgrade, or wiring procedures. Failure to do so could result in severe or fatal shock or equipment damage. Do not turn the power on until the installation, retrofit, upgrade, or wiring procedures are complete.

Procedure

☐ 

1. Position the termination unit on the NTFP01 panel. Insert the tabs of the termination unit into the slots of the panel standoff as shown in Figure PR2-1.

☐ 2. Attach the termination unit to the panel using two screws.

☐ 3. Connect chassis ground to the termination unit by installing a screw with lock washer in the location shown in Figure PR2-2.

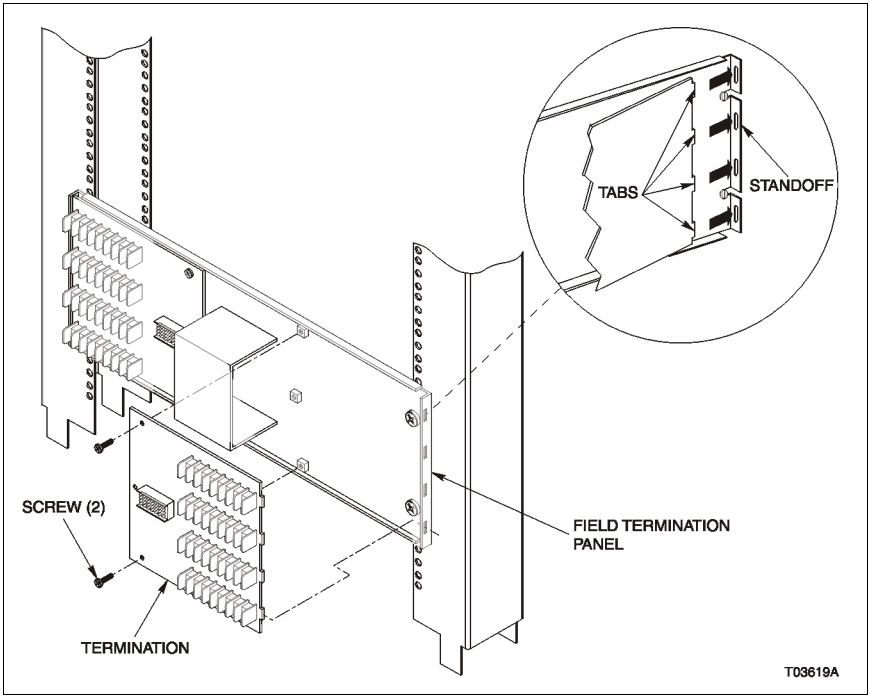

Figure PR2-1. Termination Unit Attachment

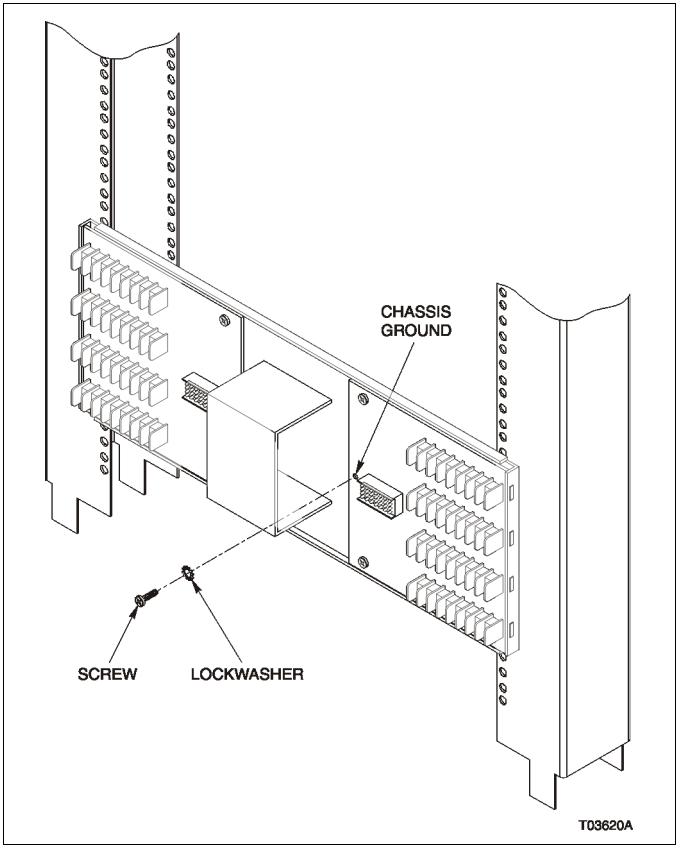

Figure PR2-2. Chassis Ground Connection

Module Installation

PR3

Purpose/Scope

1 min.

This procedure describes the steps required to install an INNIS21 or INNPM22 module into the MMU. A rack module can be installed with power on.

Parts None.

Tools None.

Safety Considerations

WARNING	**A rack module should not be inserted or removed with power applied when located in a Class I, Division 2 hazardous location unless the area is known to be nonhazardous.**

Procedure

☐ 1. Verify the MMU slot assignment for the module.

☐ 

2. Align the module with the top and bottom guide rails, then slide the module into the MMU (Fig. PR3-1).

☐ 3. Push on the faceplate until the module is firmly seated into the MMU backplane connectors. The module faceplate should be flush with the MMU frame.

☐ 4. Turn the two latching fasteners ½-turn to lock the module in place. The slot on both latching fasteners should face the center of the module faceplate.

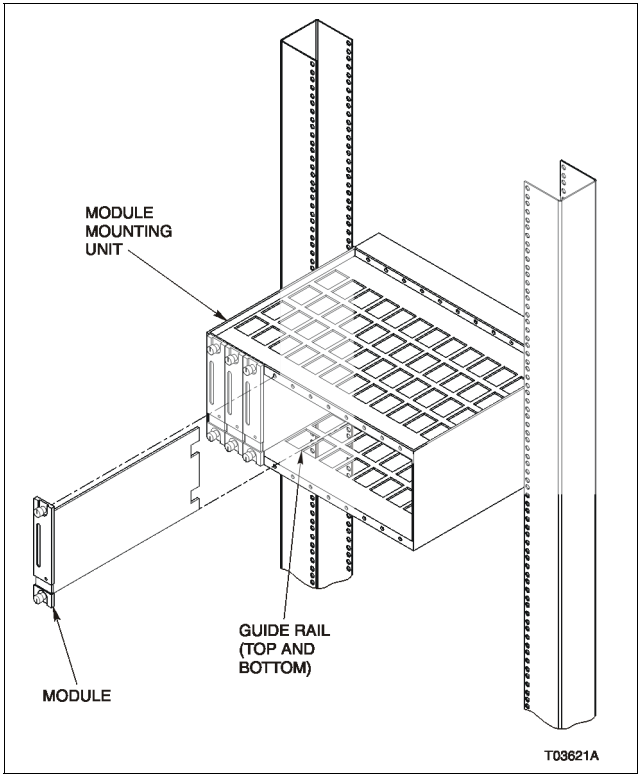

Figure PR3-1. Module Installation

Purpose/Scope

2 min.

This procedure describes the steps required to set up the NTCL01 termination unit for use with the HCU interface (Fig. PR4-1).

Parts None.

Tools
- Needlenose pliers (optional).

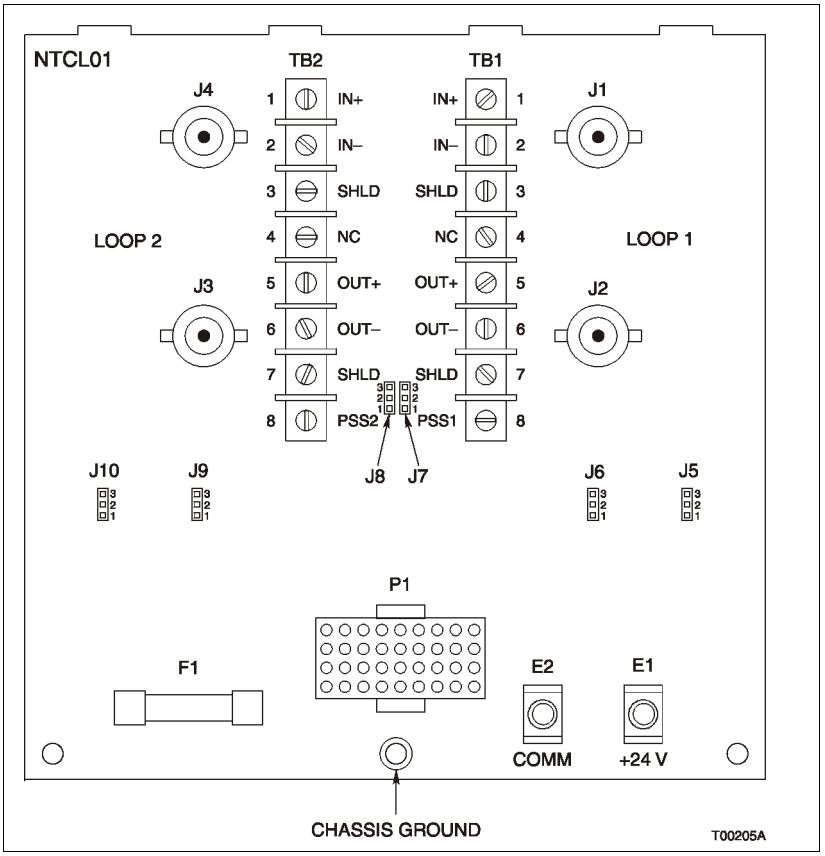

Figure PR4-1. NTCL01 Layout

Procedure

☐ 1. Set jumpers J5 through J10 according to the type of Cnet cable being used (Table PR4-1). J5, J6, and J7 are for loop one and J8, J9, and J10 are for loop two.

Table PR4-1. NTCL01 Jumpers J5 to J10

Cable Type	J5 - J7 (Loop 1)	J8 - J10 (Loop 2)
Twinaxial		
Coaxial		

☐ 2. Verify there is a 1.0 A, 250 V fuse in the F1 fuse holder.

Purpose/Scope

10 min.

This procedure describes the steps required to set up the INNIS21 module of the HCU interface (Fig. PR5-1). Both switches and jumpers must be set before putting the module into operation.

Parts None.

Tools Needlenose pliers (optional).

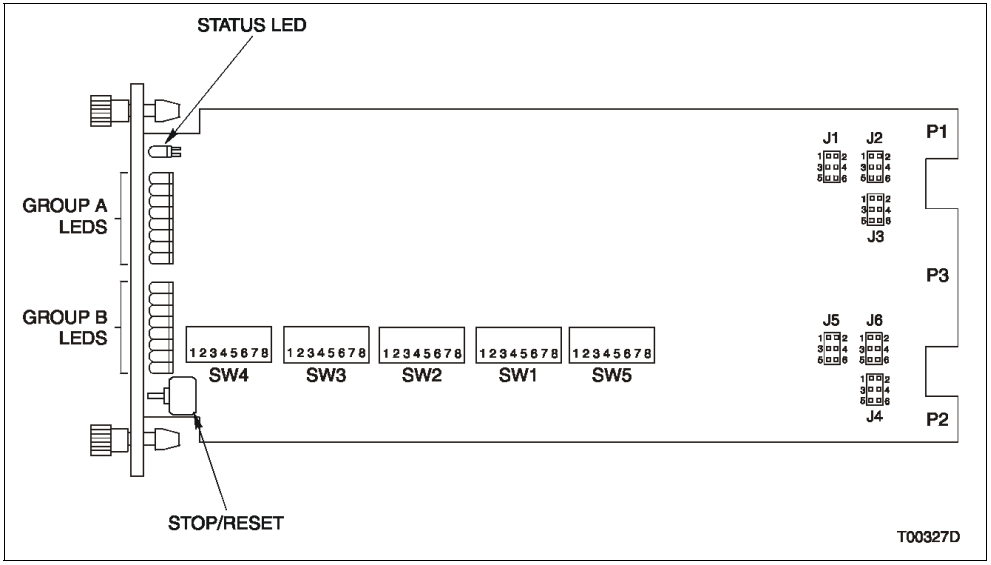

Figure PR5-1. INNIS21 Layout

Procedure

☐ 1. Set the node address with switch SW1 (Fig. PR5-1). The address must be unique. Valid node addresses are from one to 250. Table PR5-1 lists some example node address settings.

Table PR5-1. INNIS21 Switch SW1 - Node Address

Address Example	Switch Pole (Binary Value)							
	1 (128)	2 (64)	3 (32)	4 (16)	5 (8)	6 (4)	7 (2)	8 (1)
1	0	0	0	0	0	0	0	1
63	0	0	1	1	1	1	1	1
250	1	1	1	1	1	0	1	0

NOTE: 1 = open or off, 0 = closed or on.

☐ 2. Set the Cnet loop number on which the interface resides with switch SW2. All nodes on a loop must be set to the same loop number. Valid loop numbers are from one to 250. Table PR5-2 provides some example loop number settings.

Table PR5-2. INNIS21 Switch SW2 - Loop Number

Address Example	Switch Pole (Binary Value)							
	1 (128)	2 (64)	3 (32)	4 (16)	5 (8)	6 (4)	7 (2)	8 (1)
1	0	0	0	0	0	0	0	1
63	0	0	1	1	1	1	1	1
250	1	1	1	1	1	0	1	0

NOTE: 1 = open or off, 0 = closed or on.

☐ 3. Set the module operating mode with switch SW3 (Table PR5-3).

Table PR5-3. INNIS21 Switch SW3 - Operating Mode

Pole	Setting	Function
1[1]	0	Module is part of Cnet-to-HCU interface (or Cnet-to-computer interface).
	1	Module is part of Cnet-to-Cnet interface.
2	0	Disable ROM checksums.
	1	Enable ROM checksums; normal operation. It is recommended to leave checksums enabled to take full advantage of the on-board diagnostics.
3[2]	0	Disable test mode; normal operation.
	1[3]	Enable test mode: no time-out for handshake failure.
4[2]	0	Disable test mode; normal operation.
	1[3]	Enable test mode: all loop messages return a busy negative acknowledgment.

Table PR5-3. INNIS21 Switch SW3 - Operating Mode *(continued)*

Pole	Setting	Function
5	0	Disable loop idle condition display. LED display as defined by switch SW4.
	1	Enable loop idle condition display. Group A LEDs will toggle on and off if loop 1 is idle or shorted. Group B LEDs will toggle on and off if loop 2 is idle or shorted. Normal display otherwise.
6	0	Disable diagnostics mode; normal operation.
	1[3]	Enable diagnostics mode.
7/8	0/0	10 Mbaud network mode.
	0/1	2 Mbaud network mode.
	1/0	Unused
	1/1	0.5 Mbaud network mode.

NOTES: 1 = open or off, 0 = closed or on.

1. Dipswitch SW3 pole one must be set to 0.
2. Pole four in conjunction with pole three makes the node appear to be busy to other nodes. This setting is used only by ABB.
3. Diagnostic modes interfere with normal operation.The diagnostic modes selected by SW4 poles four through eight are run when diagnostics mode is enabled by SW3 pole six.

☐ 4. Enable or disable the offline module termination unit test being run on the backup INNIS21 module using pole 1 of switch SW4. Refer to Table PR5-4 for more information.

Table PR5-4. Offline Module Termination Unit Test Setting SW4 (INNIS21)

Pole	Setting	Function	User Setting
1	1	Briefly energizes the relay on the backup loop termination unit and verifies the presence of loop traffic. This diagnostic test is scheduled to run 24 hours after the INNIS21 module is connected to a backup INNPM22 module. This test is executed and is rescheduled to be executed the same time every day. Testing is halted when the INNPM22 module goes online. When the INNPM22 module goes offline, testing is resumed on the original schedule. If the connection between the INNPM22 and INNIS21 modules is broken (if the INNIS21 module is reset), the testing schedule is deleted and the INNIS21 module behaves as though it was never connected to the INNPM22 module. When the connection is restored, the INNIS21 module behaves as though it was connected for the first time.	
	0	Disables the backup module termination unit test.	

NOTE: 1 = open or off, 0 = closed or on.

NOTE: Enabling this test may slightly degrade loop performance.

☐ 5. Set the I/O expander bus address to zero with poles two and three of switch SW4 (Table PR5-5).

Table PR5-5. INNIS21 Switch SW4 - I/O Expander Bus Address

Address	Switch Pole (Binary Value)	
	2 (2)	3 (1)
0	0	0

NOTE: 1 = open or off, 0 = closed or on.

☐ 6. Set the faceplate LED display option with poles four through eight of switch SW4. The poles select the address of an on-board event and error counter that the INNIS21 module is to display using the group A and B faceplate LEDs. LED B8 is the most significant bit. LED A1 is the least significant bit. Table PR5-6 lists the event counter addresses. Table PR5-7 lists the error counter addresses.

Example of Counter Usage

A counter setting with the hexadecimal value of 0x10 keeps track of the number of messages transmitted or the total loop traffic. To display this counter on the front panel LEDs, set dipswitch SW4 as follows: position 4 = open (off), 5 = closed (on), 6 = closed (on), 7 = closed (on), and 8 = closed (on).

Table PR5-6. INNIS21 Switch SW4 - Event Counter Address

Switch Pole (Binary Value)					Value	Description
4 (16)	5 (8)	6 (4)	7 (2)	8 (1)		
0	0	0	0	0	0x00	Number of timer interrupts.
0	1	0	0	1	0x09	Number of multicast messages received (excluding originated messages).
0	1	0	1	0	0x0A	Number of multicast destinations received.
0	1	0	1	1	0x0B	Number of time-sync messages received (excluding originated messages).
0	1	1	0	0	0x0C	Number of broadcast messages received (excluding originated messages).
0	1	1	0	1	0x0D	Number of NIS poll messages received (excluding originated messages).
0	1	1	1	0	0x0E	Number of poll messages acknowledged by this node.
0	1	1	1	1	0x0F	Number of poll messages busy negative acknowledged by this node.

Table PR5-6. INNIS21 Switch SW4 - Event Counter Address *(continued)*

Switch Pole (Binary Value)					Value	Description
4 (16)	5 (8)	6 (4)	7 (2)	8 (1)		
1	0	0	0	0	0x10	Number of messages transmitted (total loop traffic); ***normal operation***.
1	0	0	0	1	0x11	Number of loop messages received and forwarded by this node.
1	0	0	1	0	0x12	Number of messages originated by this node (including retries).
1	0	0	1	1	0x13	Number of message retries originated by this node.
1	0	1	0	0	0x14	Number of transmitted message watchdog expirations.
1	0	1	0	1	0x15	Number of messages put into the receive buffer and retained.
1	0	1	1	0	0x16	Number of bytes originated by this node (including retries).
1	0	1	1	1	0x17	Number of bytes received and forwarded by this node.
1	1	0	0	0	0x18	Number of I/O expander bus to INNIS21 handshakes.
1	1	0	0	1	0x19	Number of I/O expander bus to transmit buffer signals.
1	1	0	1	0	0x1A	Number of I/O expander bus HCU status requests.
1	1	0	1	1	0x1B	Number of I/O expander bus INNIS21 status requests.
1	1	1	0	0	0x1C	Number of I/O expander bus interrupts with invalid status.
1	1	1	0	1	0x1D	Number of transmit buffer realignments due to invalid contents.
1	1	1	1	0	0x1E	Number of receive buffer realignments.
1	1	1	1	1	0x1F	Number of status buffer realignments.

NOTES: 1 = open or off, 0 = closed or on.

Table PR5-7. INNIS21 Switch SW4 - Error Counter Address

Switch Pole (Binary Value)					Value	Description
4 (16)	5 (8)	6 (4)	7 (2)	8 (1)		
0	0	0	0	1	0x01	Number of receive errors on channel 1.
0	0	0	1	0	0x02	Number of receive errors on channel 2.
0	0	0	1	1	0x03	Number of transmit errors for this node.
0	0	1	0	0	0x04	Number of messages lost to receive queue overflow.
0	0	1	0	1	0x05	Number of messages discarded with circulation count errors.
0	0	1	1	0	0x06	Number of messages discarded with destination count or message-type errors.
0	0	1	1	1	0x07	Number of messages discarded with source-state errors.

Table PR5-7. INNIS21 Switch SW4 - Error Counter Address *(continued)*

Switch Pole (Binary Value)					Value	Description
4 (16)	5 (8)	6 (4)	7 (2)	8 (1)		
0	1	0	0	0	0x08	Number of messages attempted with source-sequence mismatch.

NOTE: 1 = open or off, 0 = closed or on.

Poles four through eight of dipswitch SW4 also select a diagnostic test when pole 6 of dipswitch SW3 is set to 1. Table PR5-8 lists the available diagnostic tests. Utilizing the diagnostic features controlled by dipswitch SW5 disables these diagnostic tests.

Table PR5-8. Communication Diagnostic Tests (INNIS21)

Dipswitch Pole (Binary Value)					Hex Value	Description
4 (16)	5 (8)	6 (4)	7 (2)	8 (1)		
0	0	0	0	0	00	Toggle address test
0	0	0	0	1	01	Test switches and LEDs
0	0	0	1	0	02	Test channel 1 buffer RAM memory
0	0	0	1	1	03	Test channel 2 buffer RAM memory
0	0	1	0	0	04	Test transmit buffer RAM memory
0	0	1	0	1	05	Test receive buffer RAM memory
0	0	1	1	0	06	Test status buffer RAM memory
0	0	1	1	1	07	Test interrupts
0	1	0	0	0	08	Test Transmit/receive good message, good checksum
0	1	0	0	1	09	Test Transmit/receive good message, bad checksum
0	1	0	1	0	0A	Test Transmit/receive good message, bad checksum, checksum disabled
0	1	0	1	1	0B	Pulse LEDs - allow expander bus tests to run
						User setting

NOTE: 1 = open or off, 0 = closed or on.

☐ 7. Set the diagnostic mode with poles 3 through 8 of switch SW5. Dipswitch SW5 (poles 1 and 2) determine if the module is in normal operating mode, operate from RAM memory mode, or diagnostic mode. Table PR5-9 lists the required settings for

each mode. When in diagnostic mode, poles three through eight select the diagnostic test. Table PR5-10 lists the available diagnostic tests.

Table PR5-9. Dipswitch SW5 (INNIS21)

Pole	Setting	Function	User Setting
1	1	Diagnostic mode.	
	0	Normal operating mode.	
2	1	Run module from RAM memory.	
	0	Normal operating and diagnostic modes.	
3	1	Unused in normal operating mode. Diagnostic select when in diagnostic mode.	
	0		
4	1	Unused in normal operating mode. Diagnostic select when in diagnostic mode.	
	0		
5	1	Unused in normal operating mode. Diagnostic select when in diagnostic mode.	
	0		
6	1	Branch cache enabled. Diagnostic select when in diagnostic mode.	
	0	Normal operating mode. Branch cache disabled. Diagnostic select when in diagnostic mode.	
7	1	Data cache enabled. Diagnostic select when in diagnostic mode.	
	0	Normal operating mode. Data cache disabled. Diagnostic select when in diagnostic mode.	
8	1	Instruction cache enabled. Diagnostic select when in diagnostic mode.	
	0	Normal operating mode. Instruction cache disabled. Diagnostic select when in diagnostic mode.	

NOTE: 1 = open or off, 0 = closed or on.

☐ 8. Set the communication rate of the receiver analog circuit with jumpers J1 through J6 (Table PR5-11). All six jumpers must be set in the same position. The jumper setting must match the communication rate set on switch SW3 (refer to Table PR5-3).

Table PR5-10. Processor and Memory Diagnostic Tests SW5 (INNIS21)

Dipswitch Pole (Binary Value)						Hex Value	Description
3 (32)	4 (16)	5 (8)	6 (4)	7 (2)	8 (1)		
0	0	0	0	0	0	00	Byte value of all dipswitches are exclusive ORed together. Results are displayed on LEDs. Status LED is off for even or on for odd total.
0	0	0	0	0	1	01	Verifies CPU instruction set is operational.
0	0	0	0	1	0	02	Calculates checksum of ROM and compares it to value stored in ROM during programming.
0	0	0	0	1	1	03	Performs walking one test. Clears, verifies, sets and verifies all RAM. Test includes byte, word, and long word accesses.
0	0	0	1	0	1	05	Initializes DUART timer for 1-msec interrupts and then waits for it to time out.
0	0	1	0	1	1	0B	Tests (in local loopback mode) both serial channels of DUART circuitry.
1	0	1	1	0	1	2D	Load ROM from serial port.
							User setting

NOTE: 1 = open or off, 0 = closed or on.

Table PR5-11. INNIS21 Jumpers J1 to J6 - Loop Mode

Option	J1 - J6
10 Mbaud	
2 Mbaud	
0.5 Mbaud	

Purpose/Scope

10 min.

This procedure describes the steps required to set up the INNPM22 module of the HCU interface (Fig. PR6-1). Switches must be set and jumper settings verified before putting the module into operation.

Parts None.

Tools Needlenose pliers (optional).

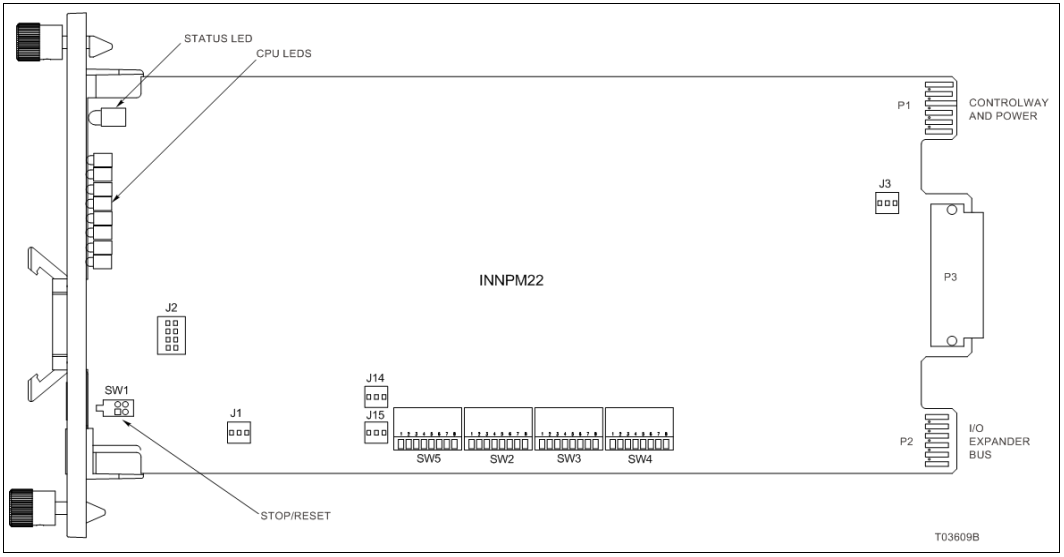

Figure PR6-1. INNPM22 Layout

Procedure

☐ 1. Set switch SW5 (Table PR6-1).

Table PR6-1. INNPM22 Switch SW5

Pole	Setting	Function
1	0	Normal run mode
	1	Hardware diagnostic mode

Table PR6-1. INNPM22 Switch SW5 *(continued)*

Pole	Setting	Function
2	0	Reserved. Must be set to 0.
3	0	Controlway mode (1M bit rate).
	1	Module Bus mode (83K bit rate).
4	—	Not used.
5	—	Not used.
6/7	—	Exception poll rate multiplier: 0 = 1x
		Exception poll rate multiplier: 1 = 2x
		Exception poll rate multiplier: 2 = 4x
		Exception poll rate multiplier: 3 = 8x
8	0 or 1	Controlway address.

NOTE: 1 = open or off, 0 = closed or on.

☐ 2. Set switch SW2 (Table PR6-2).

Table PR6-2. INNPM22 Switch SW2

Pole	Setting	Function	
		Normal Run Mode	Hardware Diagnostic Mode
1	0	ROM checksumming enabled.	Failure action continue running.
	1	ROM checksumming disabled.	Failure action halt on failure.
2	—	Not used.	Bit 6 of test select.
3	0	Redundancy expected: no.	Bit 5 of test select.
	1	Redundancy expected: yes.	
4	0	Local/remote diagnostics support: no.	Bit 4 of test select.
	1	Local/remote diagnostics support: yes. [1]	
5/6	—	Exception pole rate: 0 = 1 per sec.	Bits 2 and 3 of test select.
		Exception pole rate: 1 = 2 per sec.	
		Exception pole rate: 2 = 4 per sec.	
		Exception pole rate: 3 = 8 per sec.	

Table PR6-2. INNPM22 Switch SW2 *(continued)*

Pole	Setting	Function	
		Normal Run Mode	Hardware Diagnostic Mode
7	0	INNIS21 test mode: no.	Bit 1 of test select.
	1	INNIS21 test mode: yes.	
8	0	Timestamp correction on.	Bit 0 of test select.
	1	Timestamp correction off.	

NOTE: 1 = open or off, 0 = closed or on.
1. When this is set to 1, it enables INNPM22 diagnostics use of the serial port (DB-9 connector behind the front panel).

☐ 3. Set switch SW3 (Table PR6-3).

Table PR6-3. INNPM22 Switch SW3

Pole	Setting	Function
1	0	Emulator (BDM mode) - Flash (normal run) -
	1	Emulator (BDM mode) - RAM (emulator only).
2	0	Controller serial port bit rate setting: Auto baud.
	1	Controller serial port bit rate setting: Fixed rate.
3	0	NVM crash dump inhibit: enabled
	1	NVM crash dump inhibit: disabled
4	0	Serial port application: diagnostics.
	1	Serial port application: CPM.
5	0	Communication CPM command checksumming: no.
	1	Communication CPM command checksumming: yes. [1]
6/7/8[2]	0/0/0	Communication CPM/diagnostics port baud rate: 1,200
	0/0/1	Communication CPM/diagnostics port baud rate: 2,400
	0/1/0	Communication CPM/diagnostics port baud rate: 4,800
	0/1/1	Communication CPM/diagnostics port baud rate: 9,600
	1/0/0	Communication CPM/diagnostics port baud rate: 19.2K
	1/0/1	Communication CPM/diagnostics port baud rate: 38.4K
	1/1/0	Communication CPM/diagnostics port baud rate: 57.6K
	1/1/1	Communication CPM/diagnostics port baud rate: 119.2K

NOTE: 1 = open or off, 0 = closed or on.
1. When this is set to 1, it enables the INNPM 22 modules CPM mode functionality use of the serial port (DB-9 connector behind the front panel). For communication module diagnostics use of this port, it must be set to 0 and SW2 pole 4 must be set to 0. Enter ~ and then **!** to bring up the diagnostics.
2. For pole 8, this is set to 1 when running Firmware Copy (test 2C) to identify the target module for the firmware copy.

☐ 4. Set switch SW4 (Table PR6-4).

Table PR6-4. INNPM22 Switch SW4

Pole	Setting	Function
1	0	INNPM22 diagnostic mode: normal.
	1	INNPM22 diagnostic mode: INNIS21 diagnostics enabled.
2	0	Controlway test: normal.
	1	Controlway test: test mode enabled.
3	0	Reserved. Must be set to 0.
4	—	Not used.
5	0	MMU disabled.
	1	MMU enabled.
6[1]	0	Cache burst disabled.
	1	Cache burst enabled.
7[1]	0	Data cache disabled.
	1	Data cache enabled.
8[1]	0	Instruction cache disabled.
	1	Instruction cache enabled.

NOTE: 1 = open or off, 0 = closed or on.
1. This pole must be set to 1 (cache enabled) at all times.

☐ 5. Jumpers J1 through J3, J14, and J15 are factory set. Verify they are set as shown in Table PR6-5.

Table PR6-5. INNPM22 Jumpers J1 through J3, J14, and J15

Jumper	Setting	Function
J1	No jumpers	Not used
J2	All four jumpers in vertical position[1]	Sets the RS232-C diagnostic port as DCE
		Setting the jumpers horizontal sets DTE
J3	2 - 3[2]	Allows operation in MMUs that have Controlway communication
J14	1 - 2	Not used
J15	1 - 2	Must remain in positions 1 - 2

1. Used by ABB service personnel. The J2 setting does not affect the module during normal operation.
2. Setting J3 jumper 1-2 disconnects Control way for operation in MMUs that have -30VDC (early Network 90).

Redundancy Cable Connection

PR7

Purpose/Scope

5 min.

This procedure gives the steps required to connect the redundancy cable between redundant INNPM22 modules. The redundancy cable connects from the faceplate of the primary INNPM22 module to the faceplate of the redundant INNPM22 module.

Parts

Number	Qty	Description
P-MK-HRM-BRC3000A	1	Redundancy cable for two INNPM22 modules, one MMU (horizontal).
P-MK-HRM-BRC3000B	1	Redundancy cable for two INNPM22 modules, two MMUs (vertical).

Tools None.

Procedure

☐ 1. Install the primary and redundant INNPM22 modules.

☐ 2. After the redundant INNPM22 is installed, connect the redundancy cable between the faceplates of the two modules. The cable is keyed and only inserts in one orientation.

NOTE: If the redundant INPM22 modules redlights during the installation of the redundancy cable, reset the module.

NTCL01 Connection

PR8

Purpose/Scope

10 min.

This procedure gives the steps required to properly connect the NTCL01 termination unit (Fig. PR8-1). The termination unit cable connects to its associated INNIS21 module and requires 24 VDC power connection.

Parts

Number	Qty	Description
NKLS01	1	INNIS21 to NTCL01 cable
NKLS11		

Tools Modular Power System II instruction.

Safety Considerations

WARNING **Verify the main power, field power, and power entry panel circuit breakers/switches are turned off before starting installation, retrofit, upgrade, or wiring procedures. Failure to do so could result in severe or fatal shock or equipment damage. Do not turn the power on until the installation, retrofit, upgrade, or wiring procedures are complete.**

Procedure

☐ 1. Verify the MMU slot assignment for the INNIS21 module.

☐ 

2. From the back of the MMU attach the hooded end of the NKLS01 or NKLS11 cable to the MMU backplane slot assigned to the INNIS21 module.

☐ 3. Insert the socket connector end of the cable into P1 of the NTCL01 unit (Fig. PR8-1).

☐ 4. Attach a 2.5 square millimeter (14 AWG) wire terminated with a Faston connector from a +24 VDC source within the enclosure to the E1 terminal.

☐ 5. Attach a 2.5 square millimeter (14 AWG) wire terminated with a Faston connector from system common within the enclosure to the E2 terminal.

☐ 6. To monitor the power system status, use 1.0 to 2.5 square millimeter (18 to 14 AWG) wire to connect the status output (TB3, OUT) on the power module chassis backplane to the TB1-8 (PSS1) or TB2-8 (PSS2) terminal on the NTCL01 unit.

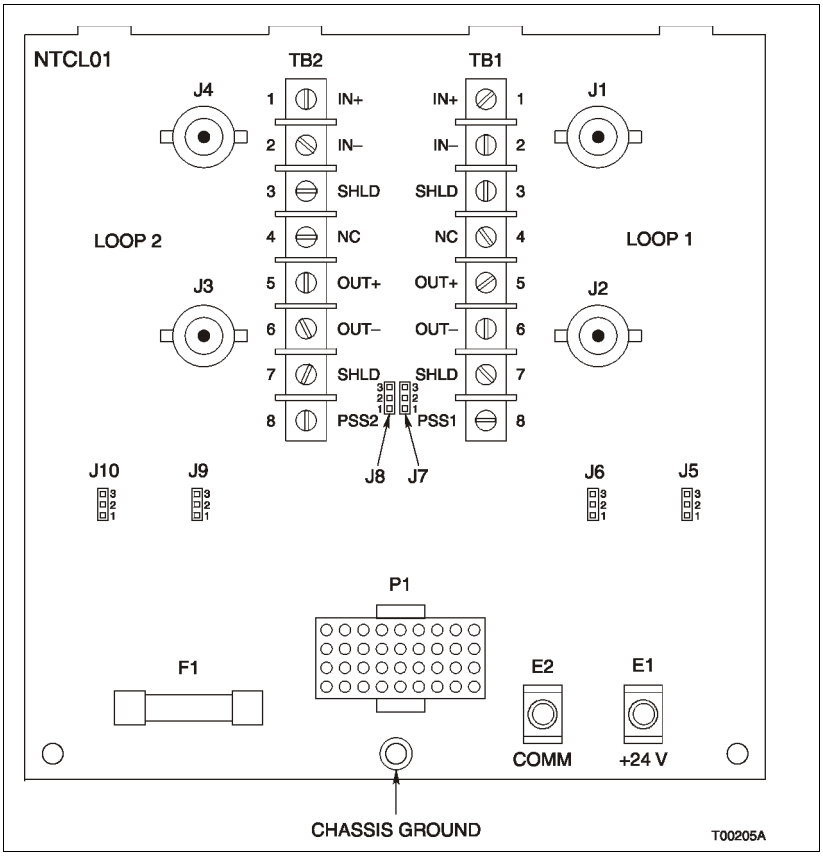

Figure PR8-1. NTCL01 Layout

Purpose/Scope

10 min.

This procedure describes Cnet connection to the NTCL01 termination unit. It includes the connections between:

- Nodes located within the same enclosure (intracabinet).
- Nodes located in different enclosures (intercabinet).

Parts

Number	Qty	Description
NKTL01-3	System dependent	Cnet termination cable
NKTT01	System dependent	Node to node Cnet termination cable

Tools None.

Cnet is isolated through transformers and operates at 5 VDC. The BNC housing is not grounded.

NOTE: All figures in this section show nonredundant loop one connection only. Connect both loop one and loop two in the same way for redundant communication.

Table PR9-1 lists the communication cables, their application, connector assignments, and maximum lengths.

Table PR9-1. Communication Cable Applications

Nomenclature	Application	Connector	Maximum Length[1]
NKCL01 NKCL11	Coaxial node to node connection (intercabinet)	Connects to NKTL01 coaxial adapter cable at each end	2,000 m (6,562 ft), 10 MHz Cnet
			4,000 m (13,120 ft), 2 MHz Cnet
NKPL01 NKPL11	Twinaxial node to node connection (intercabinet or intracabinet)	TB1 for loop 1 TB2 for loop 2	1,000 m (3,281 ft), 10 MHz Cnet
			2,000 m (6,562 ft), 2 MHz Cnet

1. The length difference between Loop1 and Loop2 must be less than 600m for coaxial or 400m for twinaxial.

Table PR9-1. Communication Cable Applications *(continued)*

Nomenclature	Application	Connector	Maximum Length[1]
NKTL01-3	Coaxial adapter cable; connects between NKCL01 or NKCL11 and NTCL01	J1 and J2 for loop 1 J3 and J4 for loop 2	1 m (3 ft)
NKTT01	Coaxial node to node connection (intracabinet)	J1 to J2 for loop 1 J3 to J4 for loop 2	152 m (500 ft)

Safety Considerations

WARNING	**Verify the main power, field power, and power entry panel circuit breakers/switches are turned off before starting installation, retrofit, upgrade, or wiring procedures. Failure to do so could result in severe or fatal shock or equipment damage. Do not turn the power on until the installation, retrofit, upgrade, or wiring procedures are complete.**

Coaxial Connection Procedure

☐ W1 Use a NKTT01 cable to make coaxial connections between NTCL01 units that are located within the same enclosure (Fig. PR9-1).

-***or***-

Use an NKTL01-3 cable to make coaxial connections to the NTCL01 unit when the:

- NKCL01 or NKCL11 cable enters from another node in another enclosure.
- NKCL01 or NKCL11 cable leaves the enclosure to connect to a node in another enclosure.

Refer to Figure PR9-2.

Twinaxial Connection Procedure

☐ W1 Connect the cables directly to TB1 and TB2 of the NTCL01 unit when using NKPL01 or NKPL11 twinaxial cable (Fig. PR9-3). This method can be used for both intercabinet and

intracabinet connections. Figure PR9-4 shows the terminal block connections.

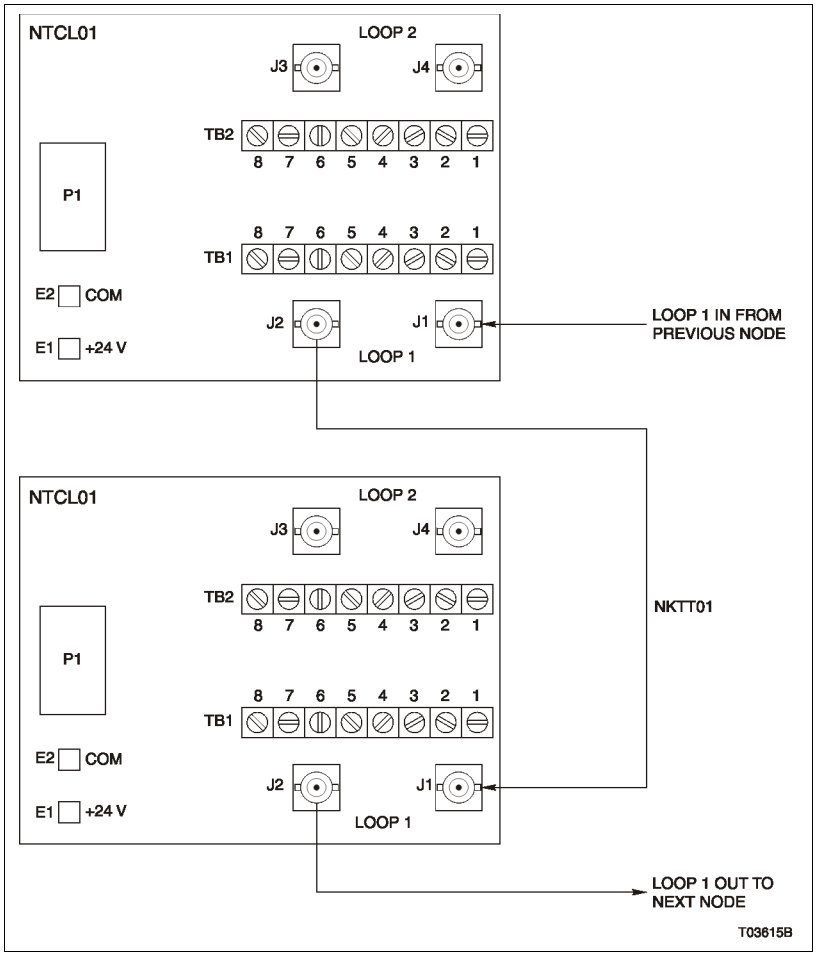

Figure PR9-1. Intracabinet Coaxial Cnet Cable Connection

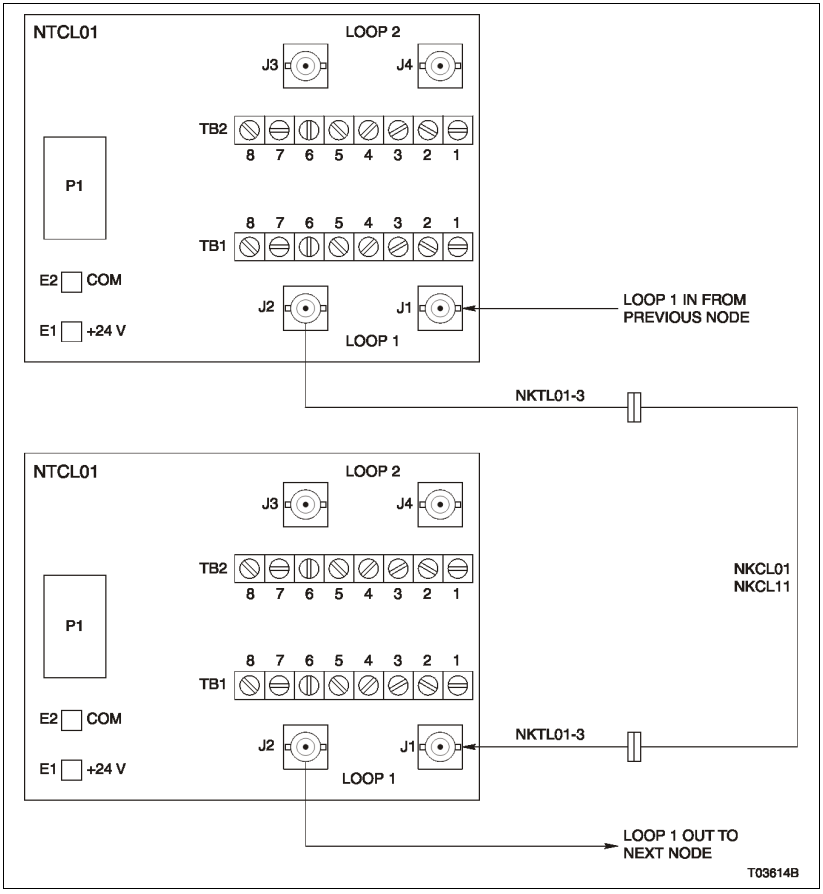

Figure PR9-2. Intercabinet Coaxial Cnet Cable Connection

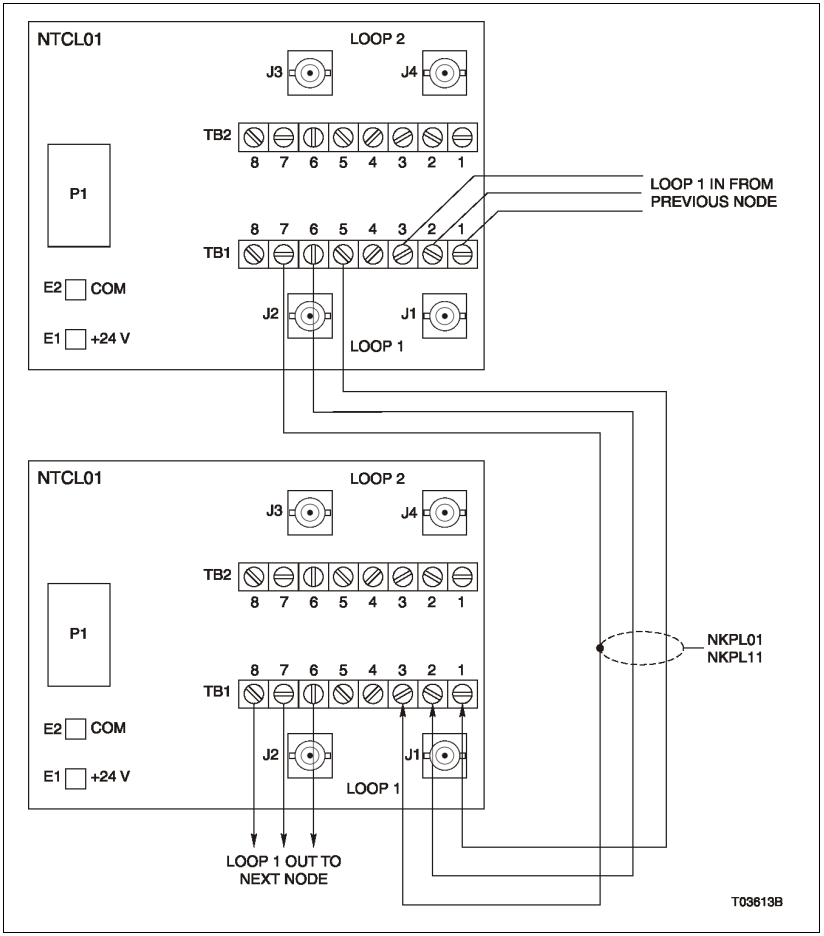

Figure PR9-3. Twinaxial Cnet Cable Connection

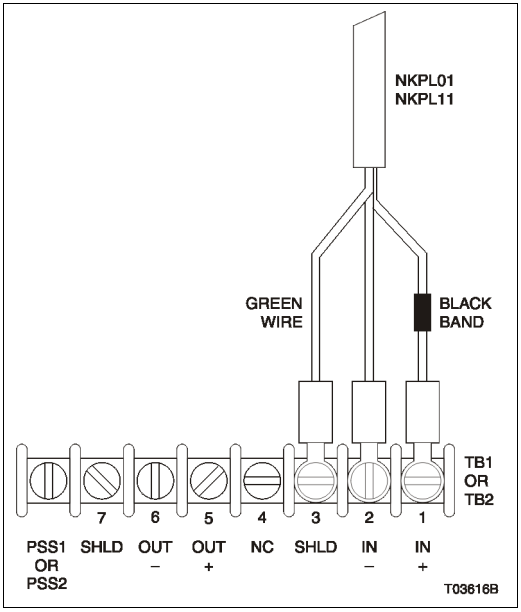

Figure PR9-4. Twinaxial Cable Terminal Block Connections

Termination Unit Removal

PR10

Purpose/Scope

5 min.

This procedure describes the steps required to remove a termination unit.

Parts None.

Tools
- Phillips screwdriver.

Safety Considerations

WARNING	**Verify the main power, field power, and power entry panel circuit breakers/switches are turned off before starting the termination unit removal procedure or equipment damage. Failure to do so could result in severe or fatal shock. Do not turn the power on until the replacement procedure is complete.**

Procedure

☐ 1. Record any wiring and cabling information necessary so it can be easily reconnected.

☐ 

2. Disconnect any cables.

☐ 3. Disconnect the +24 VDC power and common from the Faston connectors.

☐ 4. Remove the chassis ground screw and lock washer (Fig. PR10-1).

☐ 5. Remove the two screws that attach the termination unit to the NTFP01 Field Termination Panel (Fig. PR10-2).

☐ 6. Slide the termination unit tabs out of the slots of the panel standoff.

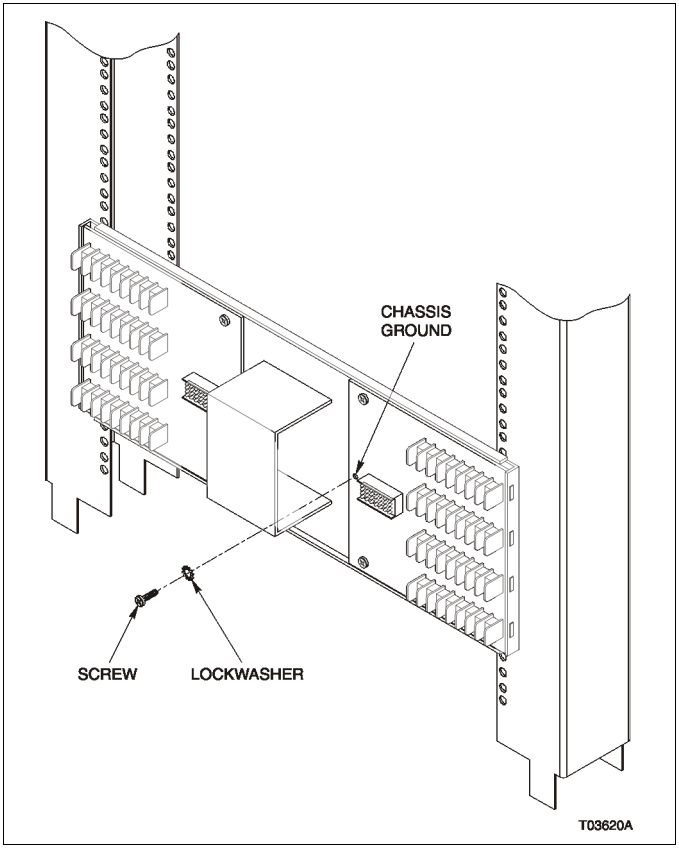

Figure PR10-1. Chassis Ground Connection

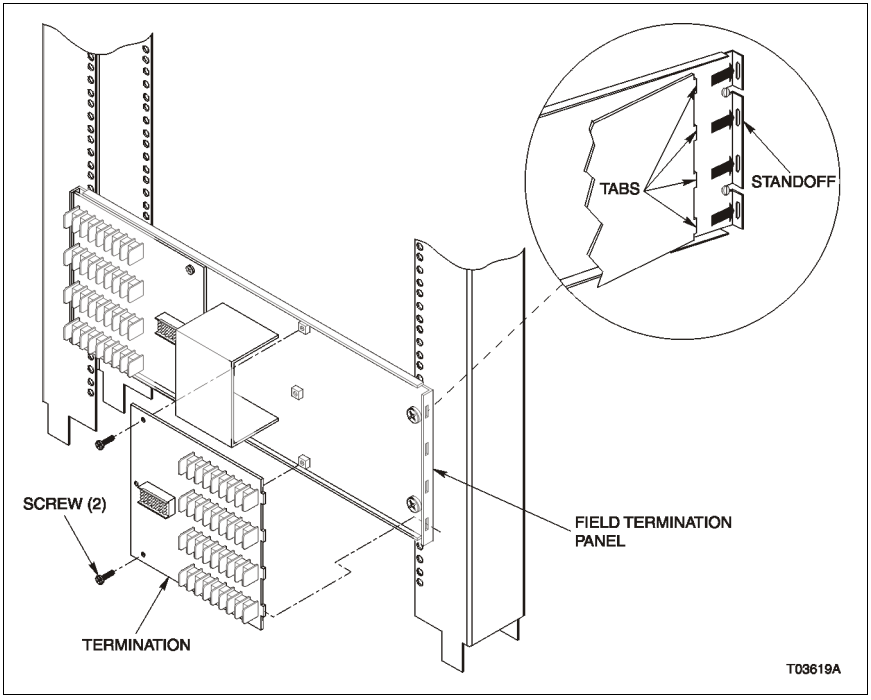

Figure PR10-2. Termination Unit Removal

Module Removal

PR11

Purpose/Scope

1 min.

This procedure describes the steps required to remove either the INNIS21 or INNPM22 module from the MMU. A module can be removed with power on.

Parts None.

Tools
- Thin rod for reset button, preferably nonmetallic.

Safety Considerations

WARNING	**A rack module should not be inserted or removed with power applied when located in a Class I, Division 2 hazardous location unless the area is known to be nonhazardous.**

Procedure

☐ 1. Depress the stop/reset button on the INNPM22 module once to halt operation if not already halted. This should be done when removing either or both modules.

☐ 

2. Turn the two latching fasteners ½-turn to unlock the module. The slot on both latching fasteners should face away from the center of the module faceplate.

☐ 3. Slide the module out of the MMU (Fig. PR11-1).

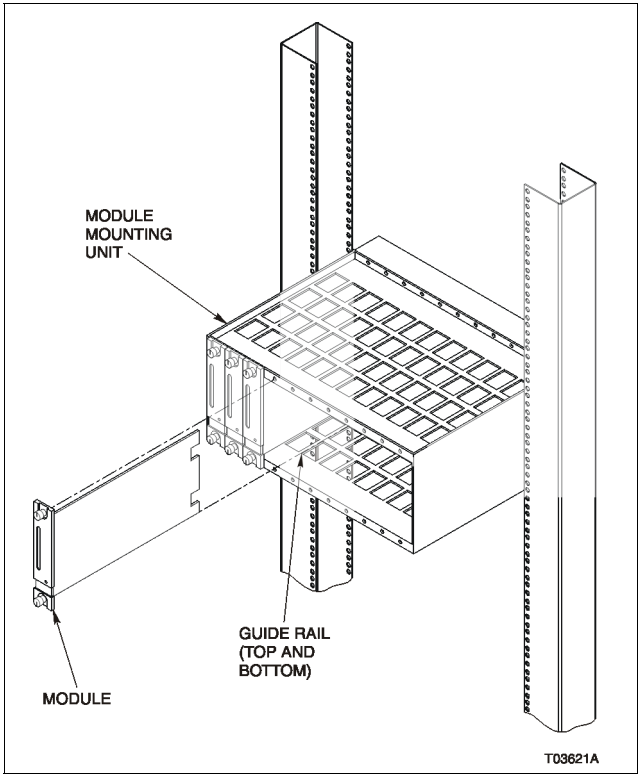

Figure PR11-1. Module Removal

Printed Circuit Board Cleaning

PR12

Purpose/Scope

30 min.

This procedure explains how to clean the printed circuit boards (i.e., module and termination unit boards).

Parts None.

Tools
- Clean, dry, filtered compressed air.
- Antistatic vacuum.
- Isopropyl alcohol (99.5 percent electronic grade).
- Foam-tipped swab.
- Distilled water.
- Nonabrasive eraser.
- Fiberglass or nylon burnishing brush.
- Piece of scrap printed circuit board.
- Soft lint-free cloths.

There are several cleaning procedures described. Use the procedures that meet the needs of the particular printed circuit board to remove all dust, dirt, oil, corrosion, or any other contaminants from the board.

Perform all cleaning and handling of the printed circuit boards at static safe workstations. Always observe electrostatic sensitive device handling precautions when handling printed circuit boards.

Safety Considerations

WARNING	**Wear eye protection whenever working with cleaning solvents. When removing solvents from printed circuit boards using compressed air, injury to the eyes could result from splashing solvent as it is blown off the printed circuit board.**

General Cleaning and Washing

☐ 1. Remove dust and residue from the printed circuit board surface using clean, dry, filtered compressed air or an anti-static field service vacuum.

- or -

☐ 

1. Spray or wipe the printed circuit board with isopropyl alcohol (99.5% electronic grade).

☐ 2. Use a foam-tipped swab to wipe the printed circuit board.

☐ 3. When the printed circuit board is clean, remove excess solvent using clean, dry, filtered compressed air.

Edge Connector Cleaning

☐ 

1. Make a solution of 80% isopropyl alcohol (99.5% electronic grade) and 20% distilled water.

☐ 2. Soak a soft lint-free cloth in the solvent mixture.

☐ 3. Work the soft lint-free cloth in a back and forth motion parallel to the edge connector contacts.

☐ 4. If necessary use the nonabrasive eraser to remove tarnish or stains. A fiberglass or nylon burnishing brush may also be used.

NOTES:

1. Minimize electrostatic discharge by using the 80% to 20% isopropyl alcohol to distilled water solution during burnishing.

2. Do not use excessive force while burnishing. Use only enough force to shine the contact surface. Inspect the edge connector after cleaning to assure no loss of contact surface.

☐ 5. Wipe any residual from the contacts with a clean soft lint-free cloth.

☐ 6. Dry the edge connector contact area by wiping with a clean soft lint-free cloth.

Connections Check

PR13

Purpose/Scope

30 min.

This procedure describes the connections check maintenance procedure. Check all signal wiring, power, ground, and cable connections within the enclosure to verify their integrity.

Parts None.

Tools
- Flat-blade screwdriver.
- Phillips screwdriver.

Safety Considerations

WARNING	**Turn off all power before attempting the connections check maintenance procedure. Failure to do so could result in severe or fatal shock, or equipment damage.**

Procedure

When checking connections, always turn a screw, nut, or other fastening device in the direction to tighten only. If the connection is loose, it will be tightened. If the connection is tight, the tightening action will verify that it is secure. There should ***not*** be any motion done to loosen the connection.

NOTE: ABB Automation recommends this preventive maintenance task be performed during power supply preventive maintenance while the power to the enclosure is off.

☐ 

1. Verify that power is removed before checking any connections for tightness.

☐ 2. Verify that all power wiring connections are secure.

☐ 3. Check all cable connections.

Offline Diagnostics

PR14

Purpose/Scope

45 min.

This procedure gives the steps necessary to run offline diagnostics. The diagnostics run in the INNPM22 module.

Parts None.

Tools None.

Procedure

☐ 1. Verify the system is offline or run the diagnostics with the INNPM22 module in a test enclosure.

☐ 2. Remove the module being tested from the MMU. Refer to procedure section PR11 if necessary.

☐ 3. Enable diagnostic mode by setting switch SW5 as shown in Table PR14-1. Putting the INNPM22 module into diagnostic mode allows the module to perform a variety of diagnostic tests but suspends normal operation.

Table PR14-1. INNPM22 Switch SW5 - Hardware Diagnostic Mode

Pole	Description
1	1 = diagnostic mode.
2 - 8	When pole on of SW5 is set to 1 (diagnostic mode) refer to SW2.

NOTE: 1 = off or open; 0 = on or closed.

☐ 4. Select the test options with poles one and two of switch SW2 as shown in Table PR14-2.

Table PR14-2. INNPM22 Switch SW2 - Diagnostic Options

Pole	Setting	Option	Description
1	0	Display mode: pass/fail count	Refer to ***Display Mode*** in this section.
	1	Display mode: current test number	
2	0	Halt on error: no	Refer to ***Halt On Error*** in this section.
	1	Halt on error: yes	

NOTE: 1 = off or open; 0 = on or closed.

☐ 5. Select the desired test by setting switch SW2 as shown in Table PR14-3.

Table PR14-3. INNPM22 Switch SW2 - Hardware Diagnostic Mode

Test ID	Pole						Test
	3	4	5	6	7	8	
00	0	0	0	0	0	0	LEDs and switches[1]
01	0	0	0	0	0	1	CPU
02	0	0	0	0	1	0	ROM
03	0	0	0	0	1	1	RAM
04	0	0	0	1	0	0	NVM
05	0	0	0	1	0	1	TIMER - 5307 system TIC
06	0	0	0	1	1	0	Real Time Clock
07	0	0	0	1	1	1	XBus Stall
08	0	0	1	0	0	0	Module BUS
09	0	0	1	0	0	1	Dispatcher
0A	0	0	1	0	1	0	RS-232 (local loopback)
0B	0	0	1	0	1	1	Debug & DCS link local
0D	0	0	1	1	0	1	DBUS (local loopback)
0E	0	0	1	1	1	0	IDROM
10	0	1	0	0	0	0	Group 1 test - 01 to 0E

Table PR14-3. INNPM22 Switch SW2 - Hardware Diagnostic Mode *(continued)*

Test ID	Pole						Test
	3	4	5	6	7	8	
12	0	1	0	0	1	0	Exbus INNIS21
14	0	1	0	1	0	0	Redundancy
16	0	1	0	1	1	0	DBUS MASTER
20	1	0	0	0	0	0	Group 2 test - 01 to 16
21	1	0	0	0	0	1	DBUS SLAVE (for MASTER)
22	1	0	0	0	1	0	DCS & Redundancy (Backup)
23	1	0	0	0	1	1	DCS (Backup role)
24	1	0	0	1	0	0	Redundancy (Backup role)
25	1	0	0	1	0	1	XBus Assassin
26	1	0	0	1	1	0	NVM retention, data store
27	1	0	0	1	1	1	NVM retention, data check
28	1	0	1	0	0	0	Redundancy break
29	1	0	1	0	0	1	STOP push button
2A	1	0	1	0	1	0	MMU
2C	1	0	1	1	0	0	Copy image to ROM
2D	1	0	1	0	1	1	LOAD image from RS-232 port to ROM

NOTES: 1 = off or open; 0 = on or closed.

1. Test is not continuous.

☐ 6. Insert the module into the MMU. Refer to procedure section PR3 if necessary.

☐ 7. Observe the front panel status indicators to determine if the test passed or failed (Fig. PR14-1). In general if a diagnostic test fails, replace the module. Table PR14-4 describes each test.

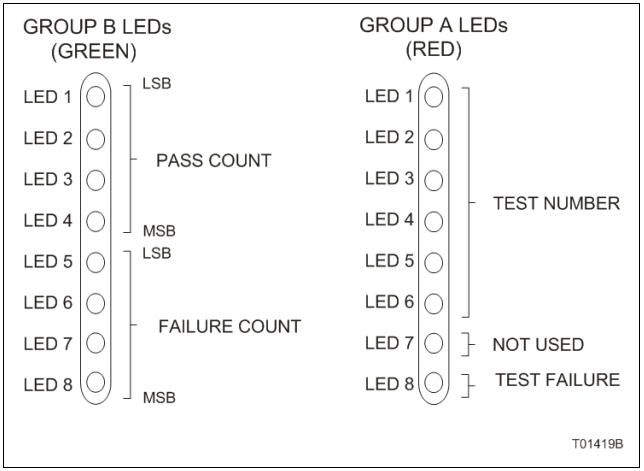

Figure PR14-1. Diagnostic Test LED Indications

Display Mode

Test Number

The test number display mode uses Group A (red) LEDs to display the diagnostic test number and LED eight to display whether the test passed or failed (Fig. PR14-1). If a diagnostic test is successful, Group A (red) LEDs display the diagnostic test number and LED eight remains off. If a diagnostic test is not successful, Group A (red) LEDs still display the diagnostic test number but LED eight will turn on. LED seven is not used in test number display mode.

Pass/Fail Count

The pass/fail display mode uses Group B (green) LEDs to display a combination of incrementing pass and fail counters (Fig. PR14-1). LEDs one through four display a binary count of the number of passed tests and LEDs five through eight display the number of failed tests.

Halt On Error

Disabled

If halt on error is disabled, the selected test runs repeatedly until the module is removed. Group A (red) LEDs displays the test number and Group B (green) LEDs displays the pass count and failure count (Fig. PR14-1).

Enabled

If halt on error is enabled, the test stops if an error is encountered. Group A (red) LEDs display the test number and Group B (green) LEDs displays the pass count and failure

count. The test continues to run, however, if no error is detected.

Diagnostic Tests

Table PR14-4 describes the diagnostic tests.

Table PR14-4. Diagnostic Tests (SW2)

Test ID		Description
00	LEDs and switches	Performs walking one test on the LEDs, then the byte value of SW3 and SW4 are exclusive ORed together. Results are displayed on LEDs. The status LED is off for even or on for odd total.
01	CPU	Verifies CPU and CPU instruction set operation.
02	ROM	Calculates checksum of ROM and compares it to an expected value. If the test fails: 1. Download firmware to the module. 2. Replace the module.
03	RAM	Clears and verifies then sets and verifies all RAM memory. Test includes byte, word, and long word accesses.
04	NVM	Verifies read and write function of NVRAM.
05	TIMER - 5407 system TIC	Initializes DUART timer for 1-msec interrupts and then waits for it to time-out.
06	Real Time Clock	Verifies real-time clock is functioning.
07	XBus Stall	Sets a latch enabling a level seven interrupt to occur.
08	Module Bus	Sends series of bytes to Controlway verifying timing and transfer status.
09	Dispatcher	Issues software dispatcher request and waits for interrupt to occur.
0A	RS-232 (local loopback)	Tests both serial channels of DUART circuitry that supports the RS-232-C/RS-485 serial ports.
0B	Debug & DCS link local	Test both serial channels of DUART circuitry that supports station link and debug port.
0D	Hnet (local loopback)	Test Hnet interface in local loop back mode. Checks Hnet ASIC operation including both channel A and B, shared RAM, timers, time-sync, registers, etc.
0E	IDROM	Reads CRC code from ID-ROM.
10	Group 1 test	Executes tests 01 to 0E.

Table PR14-4. Diagnostic Tests (SW2) *(continued)*

Test ID		Description
12	XBus INNIS21	Exercises the XBus communications to and from the INNIS21. Requires an INNIS21 to be installed on the same XBus segment as the INNPM22, and the INNIS21 must simultaneously be running test 11 (hex).
14/ 24	Redundancy	Test communication link between redundant INNPM22 modules. Checks ability to pass information and hand-shaking. Set one INNPM22 module to test 14 (primary); the other to test 24 (backup). Primary will provide pass/fail indication.
16/ 21	DBUS MASTER/DBUS SLAVE (for MASTER)	Tests Hnet communications between a controller acting as a master and another controller acting as a slave. Checks the ability to both transmit and receive Hnet messages. Requires two INNPM22 modules (redundant or non-redundant) with Process Bus Adapters and Hnet cabling connected between the two INNPM22s. Set one controller to test ID 16 (master); the other to test ID 21.
20	Group 2 test	Executes tests 01 to 16.
22	IISAC01 station and redundancy link redundant	Displays running count of bytes received by backup module when primary module is executing test 20. Provides the common functionality of both tests 23 & 24.
25	I/O expander bus fault time halt	Arms the fault timer and allows the I/O expander bus clock to stall. This checks the modules ability to disengage from the I/O expander bus in the event it can no longer drive the expander bus clock. This test passes if module halts with a 0x55 pattern is displayed on the leds. Fails if module continues to operate with any other pattern displayed on the leds.
26	NVM retention, data store	Stores a known data pattern in NVRAM for testing by the NVRAM retention - data check test. Halts with led pattern 0x55 if test has completed writing data. Note: Remove power from module prior to running the NVRAM retention - data check test. If practical leave module un-powered for one hour prior to running the data check test.
27	NVM retention, data check	Verifies NVRAM holds data pattern stored in test 26. Provides normal pass/fail indication.
28	Redundancy break	Tests redundancy links ability to generate and detect a break in the transmission. An intentionally generated break is sent. The receiver detects the break and in response sends a break back. Requires to modules and the appropriate redundancy cable.

Table PR14-4. Diagnostic Tests (SW2) *(continued)*

Test ID		Description
29	Stop push button	Tests pushbutton operation. Displays code 0x55 on LEDs if successful.
2A	MMU	Test the onboard memory management unit.
2C	Copy image to ROM	This operation allows firmware to be copied from INNPM22 module to another. Refer to ***INNPM22 Firmware*** for more information.
2D	LOAD image from RS-232 port to ROM	This operation allows for a firmware download to be accomplished via the Debug RS-232 serial port using the XMODEM protocol.

INNPM22 Firmware

PR15

Purpose/Scope

15 min.

The INNPM22 firmware must be loaded with a direct serial (RS-232) connection to a computer with terminal emulator software.

Parts None.

Tools None.

Procedure

☐ 1. Set SW5 pole 1 to Open on the INNPM22 module.

☐ 2. Set SW2 poles 3, 5, 6, and 8 to Open on the INNPM22 module.

☐ 3. Connect an RS-232 cable to the DB9 connector just behind the INNPM22 front panel.

NOTE: A flat ribbon cable with DB9 connectors is required if there is no space between modules in the MMU. The other end of the cable goes to PC COM port.

☐ 4. Using Hyperterminal, configure the COM port to 38, N, 8, and 1 (38K baud, no parity, 8 data bits, and 1 stop bit). Also, select no flow control.

☐ 5. Insert the INNPM22 module in the MMU and wait for the following prompt to appear:

Hello, enter "~" and "!" to start XMODEM download

☐ 6. Using Hyperterminal, select **Transfer > Send**.

☐ 7. Select the download file and XModem protocol.

☐ 8. Copy (CTRL+C) the file name and path.

☐ 9. Close the Send File dialog box.

☐ 10. Enter **~!** and the following message appears:

You have 10 sec to start XMODEM download of binary file

☐ 11. Using Hyperterminal, select **Transfer > Send**.

☐ 12. Paste (CTRL+V) the file name and path in the Transfer File dialog box.

☐ 13. Enter **Return** to start the transfer and wait for the following prompt to appear:

Hello, enter "~" and "!" to start XMODEM download

NOTE: Do not remove the INNPM22 module until after this message has appeared.

☐ 14. Remove the INNPM22 module and set SW5 pole 1 and all SW2 poles to Closed.

☐ 15. Optional - Change the baud rate settings and enable the Local/remote diagnostics. The banner displayed on the serial port should show the NPM22 revision.

Redundancy Link

This procedure copies the firmware image of the source INNPM22 over the redundancy cable to the destination INNPM22 module. To update the firmware of the redundant INNPM22 module, perform the following procedure:

☐ 1. Set SW5 pole 1 to Open on both source and destination modules.

☐ 2. Set SW2 poles 3, 5, and 6 to Open on both source and destination modules.

☐ 3. For the destination module only, set SW3 pole 8 to Open.

☐ 4. Insert the destination module.

☐ 5. Insert the source module.

☐ 6. Stop the source module by pressing the Stop/Reset button on the faceplate.

☐ 7. Connect the redundancy cable (refer to ***Redundancy Cable Connection*** for more information).

☐ 8. Start the source module by pressing the Stop/Reset button on the faceplate.

The LEDs will flash on and off on both modules. The destination module has completed flash to ROM when all LEDs are off and the status LED turns Red.

NOTE: The status LED remains green throughout this operation.

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