symphony™

Instruction
Harmony Series

Cnet-to-HCU Communication Interface

INNIS01/INNPM12

ABB

Preface

The Cnet-to-HCU interface consists mainly of an INNIS01 Network Interface Module and an INNPM12 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 INNIS01 and INNPM12 modules are fully compatible with existing INFI 90® OPEN Strategic Enterprise Management Systems using INFI-NET® or Plant Loop communication.

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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. 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)

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Introduction

Section 1

Overview

The Cnet-to-HCU interface consists mainly of an INNIS01 Network Interface Module and an INNPM12 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 HCU interface provides access to Cnet for all rack controllers in its node.

NOTES:

1. The HCU interface made up of the INNIS01 module and INNPM12 module is fully compatible with existing INFI 90 OPEN Strategic Enterprise Management Systems using INFI-NET or Plant Loop communication.

2. The INNIS01 module and INNPM12 module operating in Plant Loop mode are replacements for the INLIM03 Loop Interface Module and INBIM02 Bus Interface Module. Refer to the ***Bus Interface Module/Loop Interface Module (INBIM02/INLIM03)*** instruction for a description of Plant Loop operation.

3. An INNIS01 module and an INNPM12 module can operate as half of a redundant pair with an INBIM02 module and INLIM03 module.

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, a Harmony control unit (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 software. A Harmony control unit is comprised of a controller and its I/O devices. A computer can run

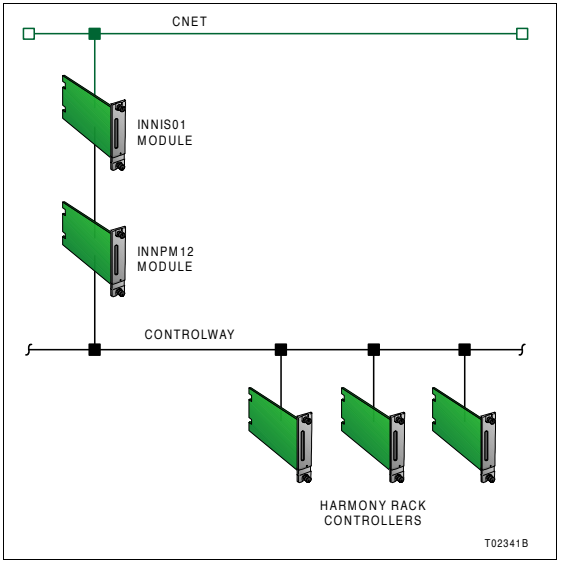

Figure 1-1. Cnet-to-HCU Interface

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 INNIS01 modules and two INNPM12 modules). The secondary INNPM12 module continuously monitors the primary through a direct cable connection. 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.

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.

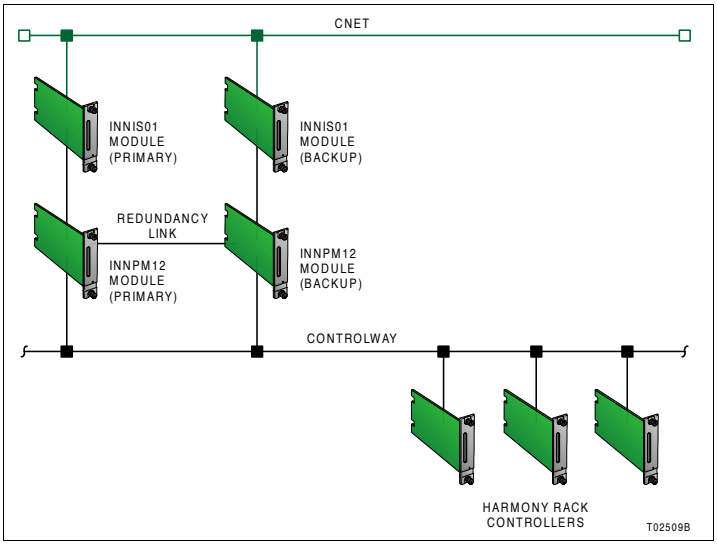

Figure 1-2. Redundant Cnet-to-HCU Interface

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 INNPM12 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 Automation 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.
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
I-E96-605	Bus Interface Module/Loop Interface Module (INBIM02/INLIM03)
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
INNIS01	
Memory	208 kbytes RAM, 32 kbytes ROM
Power requirements	+5 VDC at 900 mA; 4.5 W +15 VDC at 5 mA; 0.1 W -15 VDC at 200 mA; 3.0 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
Plant Loop:	64 nodes

Table 1-4. Specifications *(continued)*

Property	Characteristic/Value
Communication rates Cnet: Plant Loop:	 10 MHz or 2 MHz 500 kHz
INNPM12	
Memory	512 kbytes ROM; 512 kbytes 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	5% to 90% up to 55°C (131°F) noncondensing 5% to 40% above 55°C (131°F) noncondensing
Atmospheric pressure	Sea level to 3 km (1.86 mi)
Air quality	Noncorrosive
Certification Canadian Standards Association (CSA) Factory Mutual (FM)	(Pending for INNPM12) Certified for use as process control equipment in an ordinary (nonhazardous) location Approved as nonincendive equipment for use in Class I; Division 2; Groups A, B, C, D; hazardous locations

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Description and Operation

Section 2

Introduction

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

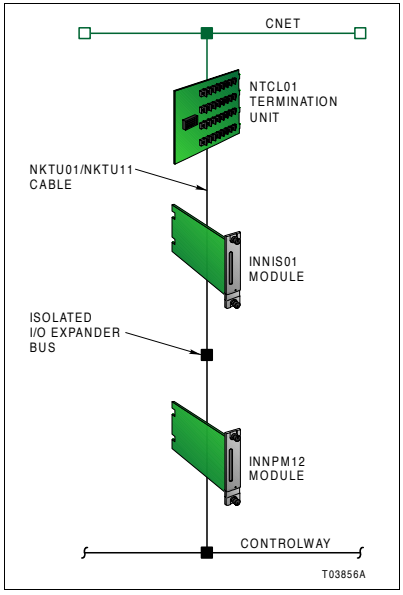

Figure 2-1. Cnet-to-HCU Interface

INNIS01 Network Interface

The INNIS01 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 INNPM12 module. The INNIS01 module allows any node to communicate with any other node within the Symphony system.

The INNIS01 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 INNPM12 module over a dedicated I/O expander bus segment.

Two latching screws on the faceplate secure the INNIS01 module to the MMU (Fig. 2-2). There are 16 LEDs on the faceplate that display event or error counts and error codes.

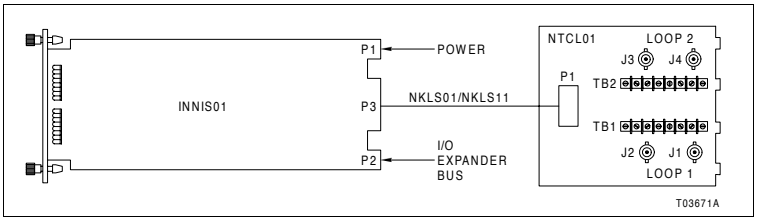

Figure 2-2. INNIS01 Module and NTCL01 Termination Unit

The INNIS01 module has three card edge connectors for external signals and power (P1, P2, and P3). P1 connects to common and +5, +15, and -15 VDC power. P2 connects the INNIS01 module to the I/O expander bus to communicate with its INNPM12 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 INNIS01 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 INNIS01 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).

CPU

The CPU contains a 32-bit microprocessor running at 10 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.

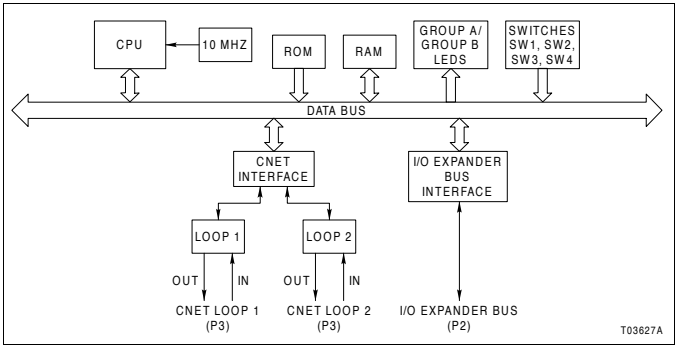

Figure 2-3. INNIS01 Functional Block Diagram

Cnet

The INNIS01 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 INNIS01 module has the ability to isolate itself from Cnet in the event of a component failure or to perform diagnostics.

NOTE: The INNIS01 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 INNIS01 module memory consists of ROM memory and static-RAM (SRAM) memory. The ROM memory holds the operating system instructions for the microprocessor (i.e., firmware). SRAM memory provides temporary storage for the CPU. The Cnet and I/O expander bus interfaces also use a portion of the SRAM 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 INNIS01 module and the INNPM12 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.

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 SW4 through data buffers to determine its operating mode and operating addresses.

Operation

The INNIS01 module is the communication front end for the computer 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 host computer can source exception reports. The INNPM12 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 INNIS01 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 INNIS01 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 INNIS01 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 INNIS01 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 INNIS01 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 INNIS01 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 INNIS01 module can transmit a message independently of any other INNIS01 module on the Cnet. Each INNIS01 module can transmit and receive messages simultaneously. Startup and shutdown is local and requires no interaction with other INNIS01 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 INNIS01 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 INNIS01 module insures data integrity. They are retry logic, node status table, and polling.

Retry Logic. If, on the first transmission of a message, the INNIS01 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 INNIS01 module maintains an internal table of system wide node status such as offline and busy. The INNIS01 module relays node status changes to the INNPM12 module. When the INNIS01 module periodically polls nodes, it updates this table accordingly.

Polling. The INNIS01 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 INNIS01 module updates its table and forwards pertinent information to the INNPM12 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 INNIS01 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 INNIS01 module causes a high level signal on the power system status input, thereby reporting good status.

INNPM12 Network Processing

The INNPM12 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 INNIS01 module. The module is a single printed circuit board that occupies one slot in a module mounting unit. The circuit board contains microprocessor based communication circuitry that enables it to directly communicate with its INNIS01 module over a dedicated I/O expander bus and to interface to Controlway.

Two latching screws on the faceplate secure the INNPM12 module to the module mounting unit (Fig. 2-4). There are nine LEDs on the faceplate and a stop/reset pushbutton.

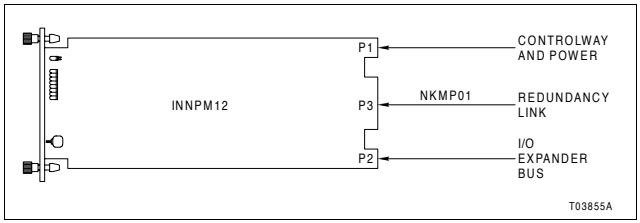

Figure 2-4. INNPM12 Module

The INNPM12 module has three card edge connectors for external signals and power (P1, P2, and P3). Connector P1 connects to common, +5 VDC power, and Controlway. Connector P2 connects the INNPM12 module to the I/O expander bus to communicate with its INNIS01 module. Its P3 connector provides for communication between primary and backup HCU interfaces. A NKMP01 cable attaches between the P3 connectors of the primary and backup INNPM12 modules.

Block Diagram

Figure 2-5 is a functional block diagram of the INNPM12 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.

CPU

The CPU contains a 32-bit microprocessor running at 16 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 INNPM12 module memory consists of ROM memory and SRAM memory. The ROM memory holds the operating system instructions for the microprocessor (i.e., firmware). The SRAM

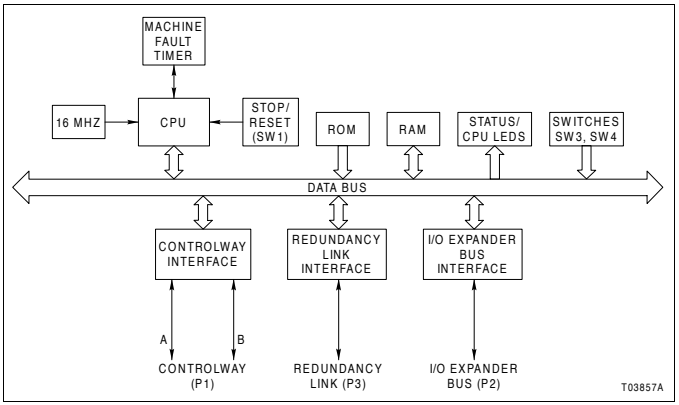

Figure 2-5. INNPM12 Functional Block Diagram

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. The Controlway interface is provided by a custom ABB Automation integrated circuit. It has full DMA capabilities (allowing for quicker operation).

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

The redundancy link is a one-megabaud serial link between a primary INNPM12 module and a backup INNPM12 module in a redundant configuration. A cable connects the redundancy link between the primary and backup modules. The module uses a dual universal asynchronous receiver/transmitter

(DUART) circuit to direct data transfer through the serial link channel. The redundancy link interface also has full DMA capabilities. As the primary module executes, the backup module waits in ready standby mode. If for any reason, the primary module fails, the backup module takes over immediately without any process interruption. Refer to ***Redundancy Failover*** in this section for more information.

NOTE: Firmware revision levels must be the same in both primary and secondary INNPM12 modules. If the firmware revision levels are different and a failover occurs, the modules may operate erratically.

Machine Fault Timer

The machine fault timer (MFT) is a security feature built into the INNPM12 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 (LEDs one through eight) and the status LED. This data includes operating status and error codes. The CPU reads switches SW3 and SW4 through data buffers to determine its operating mode, operating characteristics, and address.

Operation

The INNPM12 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 INNIS01 module on the I/O expander bus. Communication with all Harmony rack controllers is over Controlway.

Exception Reports

The INNPM12 module polls the Harmony rack controllers for exception reports. The poll rate is selected through a switch setting on the INNPM12 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 INNPM12 module and the INNIS01 module. The INNPM12 module always initiates the data transfer. It is responsible for:

- Sending commands to the INNIS01 module.
- Sending data to the INNIS01 module.
- Reading data from the INNIS01 module.
- Requesting INNIS01 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 INNPM12 modules determines which type of failover will occur.

NOTE: Only cold failover occurs when operating in Plant Loop mode.

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 INNPM12 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 INNPM12 module is inserted into the module mounting unit, the two redundant INNPM12 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 link (i.e., NKMP01 cable).

Warm failover requires the primary INNPM12 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 INNPM12 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 INNPM12 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 INNPM12 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 INNPM12 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

INNPM12 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 INNIS01 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 INNPM12 module and the backup INNPM12 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	400	750
50 analog and 100 digital	725	1,475
100 analog and 150 digital	950	2,350
225 analog and 275 digital	1,750	4,400
300 analog and 450 digital	2,550	6,400
400 analog and 600 digital	3,215	8,500
600 analog and 900 digital	4,925	12,325

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 INNPM12 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 Module Mounting Unit 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 module mounting unit 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.

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

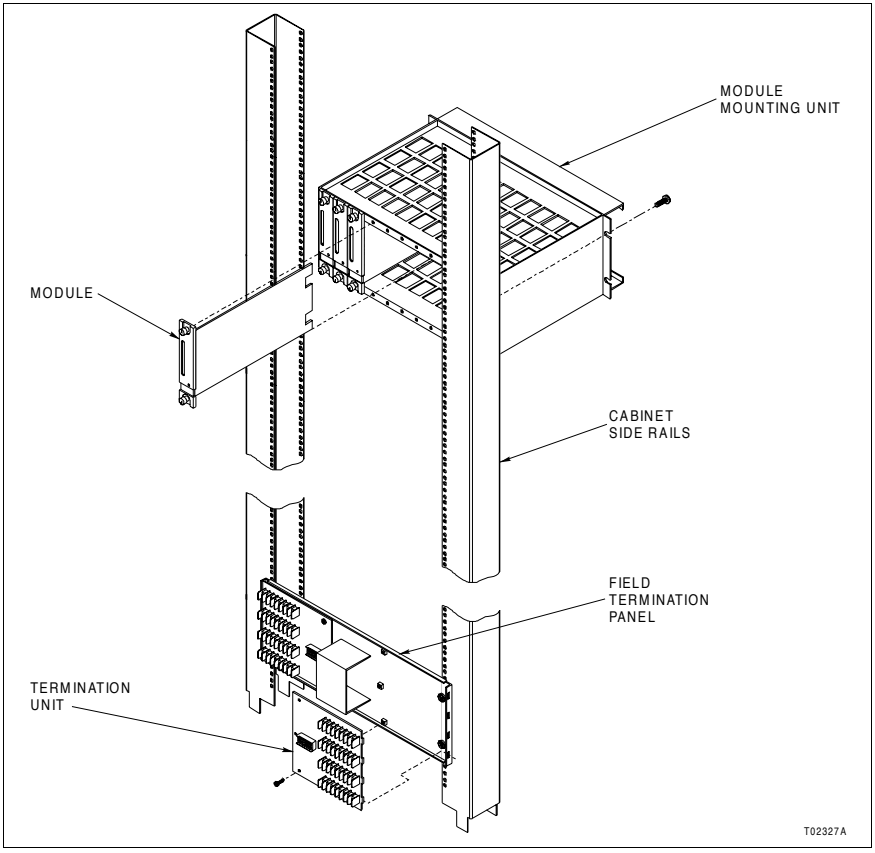

Figure 2-6. Mounting Hardware

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 1948385A1 - 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. 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.

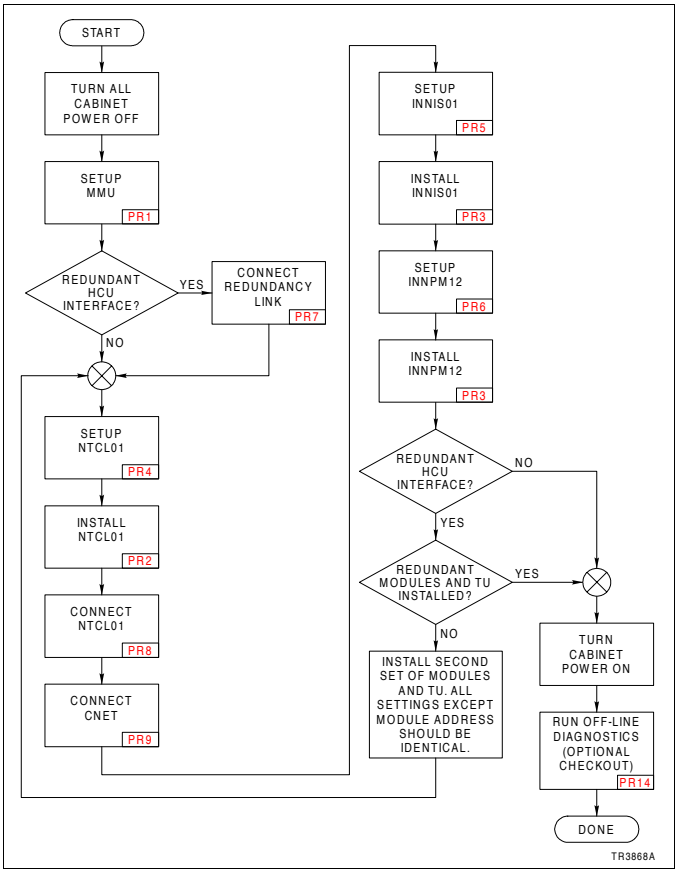

Figure 3-1. Installation and Connection Flowchart

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.

INNIS01 Network Interface

Figure 4-1 shows the INNIS01 module faceplate. On power up, the INNIS01 module microprocessor stays in reset until the INNPM12 module removes the reset and allows the firmware to execute self-diagnostic routines. The INNPM12 module determines when the INNIS01 module will go online. The INNIS01 module comes online in the network mode set by switch SW3, with the type of counter display set by switch SW4.

Group A and B LEDs

Use the faceplate group A and B LEDs to check the INNIS01 module operation. If communication errors occur, the host module sets the INNIS01 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 PR5-5 for a list of event types and their counter addresses.

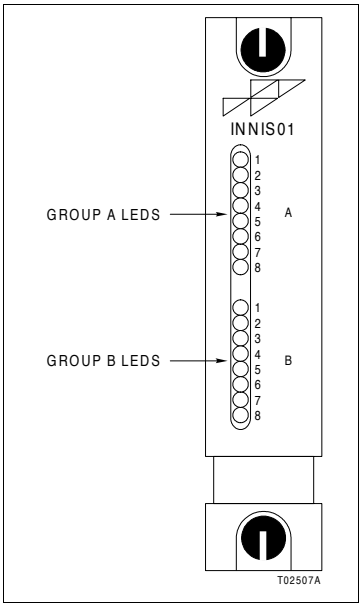

Figure 4-1. INNIS01 Faceplate

Error Counters

Errors such as receive errors, transmit errors, and dumped messages are maintained in internal counters like events are. Refer to Table PR5-6 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 INNIS01 module faceplate LEDs.

INNPM12 Network Processing

Figure 4-2 shows the INNPM12 module faceplate. It has the following features:

- Status LED.
- Eight CPU LEDs.
- Stop/reset button.

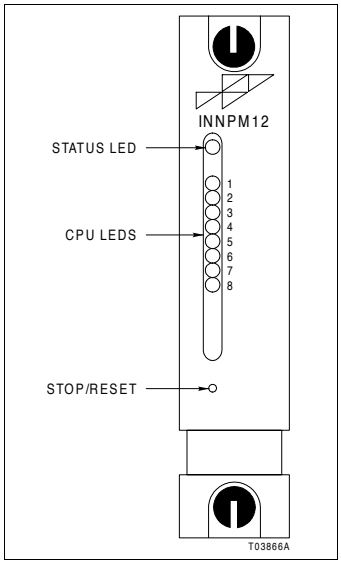

Figure 4-2. INNPM12 Faceplate

Status LED

The status LED displays the operating status of the INNPM12 module. It is a two-color LED that has three possible states described in Table 4-1. Refer to Section 5 for corrective actions if the status LED indicates that an error exists.

Table 4-1. INNPM12 Status LED

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

CPU LEDs

Table 4-2 summarizes the normal operation status LED codes. If an error occurs, these 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 4-2. 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 INNPM12
0	0	0	0	0	0	0	1	Normal operation; backup INNPM12
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 INNPM12 module (or the INNIS01 module) from the module mounting unit.

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 INNPM12 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 INNPM12 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 INNPM12 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 INNPM12 module performs both hardware and software security checks to insure module integrity.

Hardware Checks

The INNPM12 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 INNPM12 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 INNIS01 module has event and error counters that are selectable.

INNIS01

The INNIS01 module error counters total errors in the same manner as the event counters total events. Table PR5-6 lists the types of error counters. The module halts operation if a fatal error condition occurs. 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.

INNPM12

If errors occur while the INNPM12 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 INNPM12 module

Table 5-1. INNIS01 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 INNIS01 module.
16	0 0 0 1 0 1 1 0	Loopback test failure	1. Check cabling and termination unit. 2. Replace INNIS01 module.
31	0 0 1 1 0 0 0 1	Memory or CPU fault	Replace INNIS01 module.
32	0 0 1 1 0 0 1 0	Address or bus error	1. Reset INNPM12 module. 2. Replace INNIS01 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 INNIS01 module	Check switches SW1 through SW4.
3E	0 0 1 1 1 1 1 0	INNIS01/device handshake failure	1. Reset INNPM12 module. 2. Replace INNIS01 or INNPM12 module if error recurs.

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

Table 5-2. INNPM12 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 INNPM12 modules	1. Change the Controlway address set with switch SW3 on a INNPM12 module; refer to Table PR6-1. 2. INNPM12 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	INNIS01 module not responding	1. Replace INNIS01 module. 2. Replace INNPM12 module.
13	0 0 0 1 0 0 1 1	ROM checksum error	1. Reset INNPM12 module. 2. If error persists, replace INNPM12 module.
14	0 0 0 1 0 1 0 0	I/O expander bus message failure	

Table 5-2. INNPM12 Error Codes *(continued)*

Code	LEDs	Condition	Corrective Action
	8 7 6 5 4 3 2 1		
15	0 0 0 1 0 1 0 1	Loopback test failure	1. Check cabling and termination unit. 2. Replace INNIS01 module.
31	0 0 1 1 0 0 0 1	Memory or CPU fault	Replace INNPM12 module.
32	0 0 1 1 0 0 1 0	Address or bus error	1. Reset INNPM12 module. 2. If error persists, replace INNPM12 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 INNIS01/ INNPM12 modules	Check switch settings.
39	0 0 1 1 1 0 0 1	Duplicate node number on loop	1. Change INNIS01 module node address set with switch SW1; refer to Table PR5-1. 2. Check primary and backup INNPM12 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.
3D	0 0 1 1 1 1 0 1	Incompatible INNIS01 firmware	INNPM12 module requires INNIS01 firmware revision E.1 or later.
3F	0 0 1 1 1 1 1 1	Module halted; stop button pressed	Reset INNPM12 module.

NOTE: 0 = LED off, 1 = LED on.
1. Codes are displayed only when the INNPM12 module is halted and the status LED is red.

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 INNPM12 module if this happens. The module has failed if the status LED remains red. Replace the module in this case.

Diagnostics

The firmware of the INNPM12 and INNIS01 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 INNPM12 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 INNPM12 module into diagnostic mode allows it to perform a variety of diagnostic tests but suspends normal operation.

INNPM12 Status Summary

The INNPM12 presents two different status summaries depending on its mode of operation (i.e., Cnet or Plant Loop mode) set with switch SW3 (refer to Table PR6-1). In Cnet mode, INNPM12 has a 16-byte module status record. In Plant Loop mode, INNPM12 has a five-byte module status record. In either case, 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.

Cnet Mode

Table 5-3 lists the fields that make up the INNPM12 module status report when in Cnet mode. Table 5-4 describes each field within the module status record.

Table 5-3. INNPM12 Status Byte Description (Cnet Mode)

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. INNPM12 Status Bit Descriptions (Cnet Mode)

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
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

Table 5-4. INNPM12 Status Bit Descriptions (Cnet Mode) *(continued)*

Byte	Field	Field Size or Value	Description
4 *(cont.)*	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 = INNPM12
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: 0x01 = INNPM12
15	—	FF	Revision letter (in ASCII code). For example, 0x41 = A
16	—	FF	Revision number (in ASCII code). For example, 0x30 = 0

Plant Loop Mode

Table 5-5 lists the fields that make up the INNPM12 module status report when in Plant Loop mode. Table 5-6 describes each field within the module status record.

Table 5-5. INNPM12 Status Byte Description (Plant Loop Mode)

Byte	Bit							
	7	6	5	4	3	2	1	0
1	ES	MODE		TYPE				
2	Reserved							
3	CSP	MOV	NSF	BKCFG	BKSTS			PSI
4		LR1	LR2	LT1	LT2			
5	Reserved							

Table 5-6. INNPM12 Status Bit Descriptions (Plant Loop Mode)

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: 0x08 = INNPM12 (Plant Loop mode)
2	—	00	Reserved
3	CSP	80	Communication status problem: 0 = no, 1 = yes
	MOV	40	Memory overflow: 0 = good, 1 = bad
	NSF	20	Node environment status flag: 0 = good, 1 = bad
	BKCFG	10	Redundant configuration: 0 = no, 1 = yes
	BKSTS	08	Backup failed: 0 = no, 1 = yes
	PSI	01	Primary/backup indicator: 0 = primary, 1 = backup
4	LR1	40	Plant Loop 1 receive error: 0 = no, 1 = yes
	LR2	20	Plant Loop 2 receive error; 0 = no, 1 = yes
	LT1	10	Plant Loop 1 transmit error: 0 = no, 1 = yes
	LT2	08	Plant Loop 2 transmit error: 0 = no, 1 = yes
5	—	00	Reserved

INNIS01 Edge Connectors

Tables 5-7, 5-8, and 5-9 list the INNIS01 module edge connector pin assignments.

Table 5-7. P1 Pin Assignments (INNIS01)

Pin	Signal	Pin	Signal
1	+5 VDC	2	+5 VDC
3	Unused	4	Unused
5	Common	6	Common
7	+15 VDC	8	-15 VDC
9	Power fail interrupt	10	Unused
11	Unused	12	Unused

Table 5-8. P2 Pin Assignments (INNIS01)

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 5-9. P3 Pin Assignments (INNIS01)

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 (-)

INNPM12 Edge Connectors

Tables 5-10, 5-11, and 5-12 list the INNPM12 module edge connector pin assignments.

Table 5-10. P1 Pin Assignment (INNPM12)

Pin	Signal	Pin	Signal
1	+5 VDC	2	+5 VDC
3	Unused	4	Controlway B

Table 5-10. P1 Pin Assignment (INNPM12) *(continued)*

Pin	Signal	Pin	Signal
5	Common	6	Common
7	Unused	8	Unused
9	Power fail interrupt	10	Unused
11	Controlway A/module bus	12	Unused

Table 5-11. P2 Pin Assignments (INNPM12)

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 5-12. P3 Pin Assignments (INNPM12)

Pin	Signal	Pin	Signal
1	Unused	16	Unused
2	Unused	17	Unused
3	Redundancy transmit (-)	18	Redundancy transmit (+)
4	Redundancy transmit clock (-)	19	Redundancy transmit clock (+)
5	Redundancy receive (-)	20	Redundancy receive (+)
6	Redundancy receive clock (-)	21	Redundancy receive clock (+)
7	Receive data A (-)	22	Receive data A (+)
8	Receive data B (-)	23	Receive data B (+)
9	Clear to send A (-)	24	Clear to send A (+)
10	Clear to send B (-)	25	Clear to send B (+)
11	Transmit data A (-)	26	Transmit data A (+)
12	Transmit data B (-)	27	Transmit data B (+)
13	Request to send A (-)	28	Request to send A (+)
14	Request to send B (-)	29	Request to send B (+)
15	Unused	30	Unused

NOTE: A = port 0; B = port 1.

Maintenance

Section 6

Introduction

The reliability of any stand-alone 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, non-flammable, 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. 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. 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

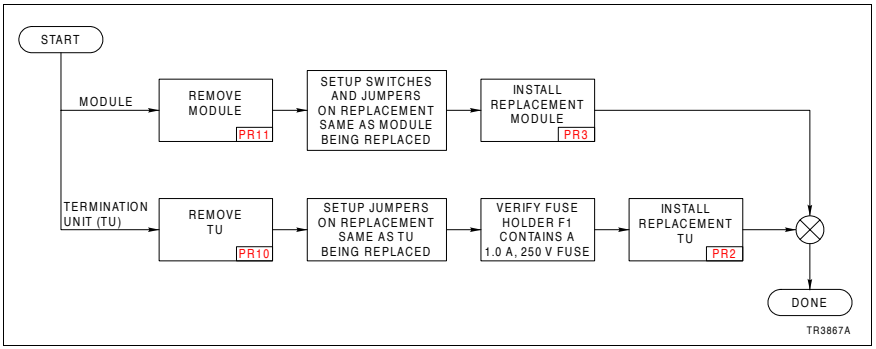

Figure 7-1. Replacement Flowchart

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

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 through 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**	**0**	**1**	**Network Interface Module**
I	**N**	**N**	**P**	**M**	**1**	**2**	**Network Processing Module**
N	**T**	**C**	**L**	**0**	**1**		**Communication Termination Unit**

Table 8-2. Cable Nomenclature

1	2	3	4	5	6	7	8	9	10	
N	**K**	**L**	**S**	**0**	**1**	**-**	**1**	**0**		**INNIS01 to NTCL01 Termination Unit Cable (PVC)**
N	**K**	**L**	**S**	**1**	**1**	**-**	**1**	**0**		**INNIS01 to NTCL01 Termination Unit Cable**
N	**K**	**M**	**P**	**0**	**1**	**-**	**2**			**Redundancy Link Cable (PVC) -** 0.6 m (2 ft)
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)

Table 8-3. Miscellaneous Parts

Part Number	Description
1946715A12	Dipshunt (12-position, 24-pin)
1946715A8	Dipshunt (8-position, 16-pin)
1946984A1	Jumper
194776A11001	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, lockwasher

Module Mounting Unit Setup

PR1

Purpose/Scope

10 min.

This procedure describes the steps required to properly set up the IEMMU11, IEMMU12, EMMU21, or IEMMU22 Module Mounting Unit for the HCU interface.

Prerequisites

- Module mounting unit installed.

Parts

Number	Qty	Description
1946715A12	1	Dipshunt (12-position, 24-pin)

Tools

None.

Safety Considerations

WARNING

1. 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. 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 INNIS01 and INNPM12 modules. Two slots are required for a nonredundant interface; four slots are required for a redundant interface. The INNIS01 and INNPM12 module pair mount in adjacent MMU slots.

☐ 

2. From the front of the module mounting unit 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 INNIS01 module and the slot to be used by the INNPM12 module.

☐ 3. Remove any 24-pin dipshunts from the I/O expander bus sockets that would connect the INNIS01 and INNPM12 modules to any other modules including the redundant modules.

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

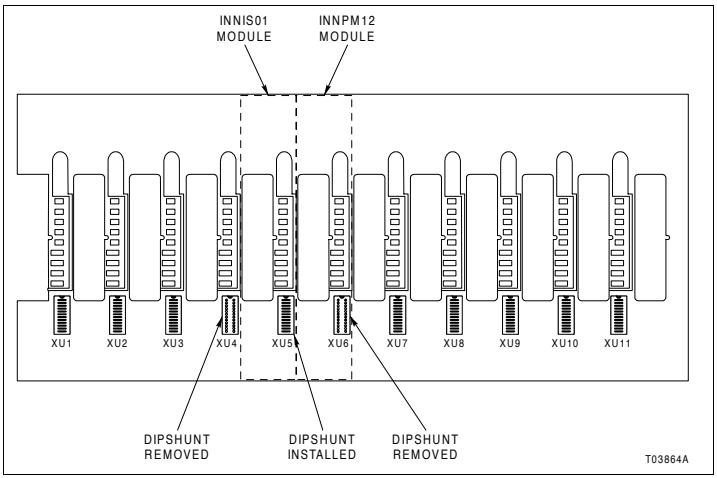

Figure PR1-1. Nonredundant Interface Example MMU Configuration (Front View)

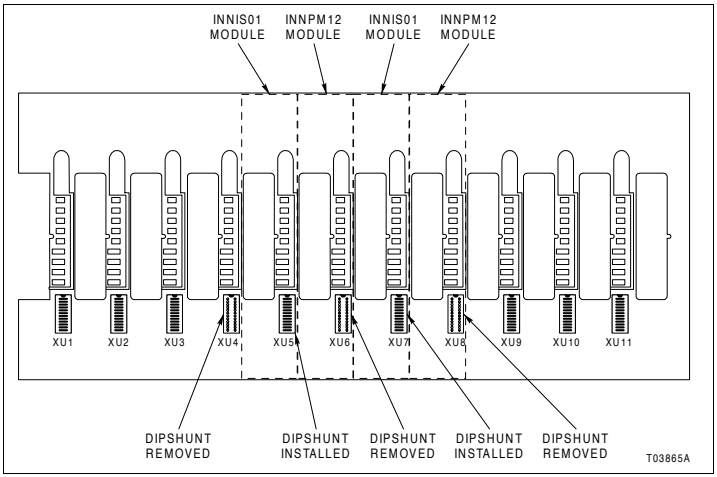

Figure PR1-2. Redundant Interface Example MMU Configuration (Front View)

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

1. 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. 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 lockwasher in the location shown in Figure PR2-2.

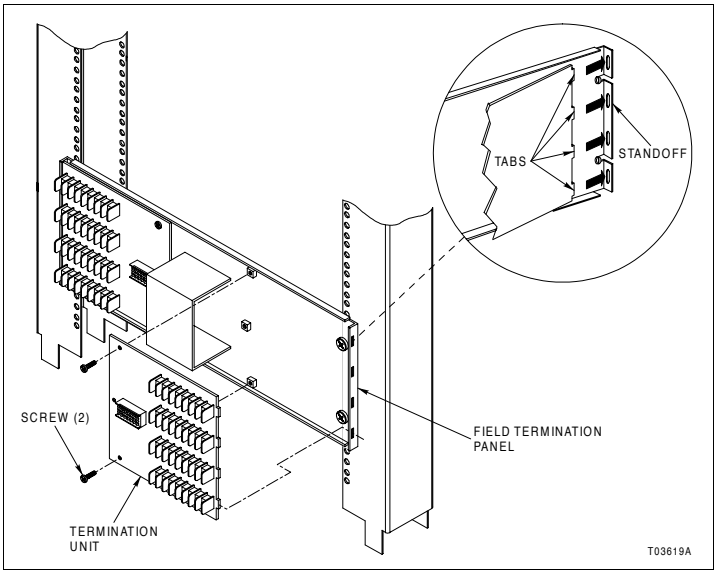

Figure PR2-1. Termination Unit Attachment

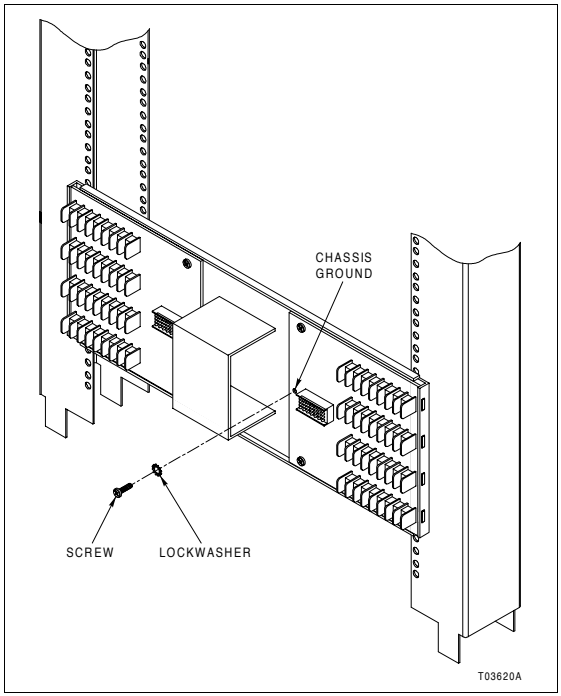

Figure PR2-2. Chassis Ground Connection

Module Installation

PR3

Purpose/Scope

1 min.

This procedure describes the steps required to install an INNIS01 or INNPM12 module into the module mounting unit (MMU). A rack module can be installed with power on.

Parts None.

Tools None.

Safety Considerations

WARNING	**1. 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 module mounting unit (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 screws ½-turn to lock the module in place. The slot on both latching screws should face the center of the module faceplate.

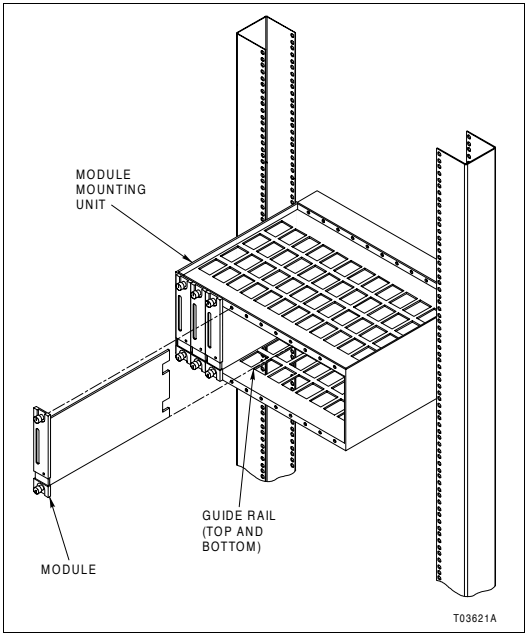

Figure PR3-1. Module Installation

NTCL01 Setup

PR4

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).

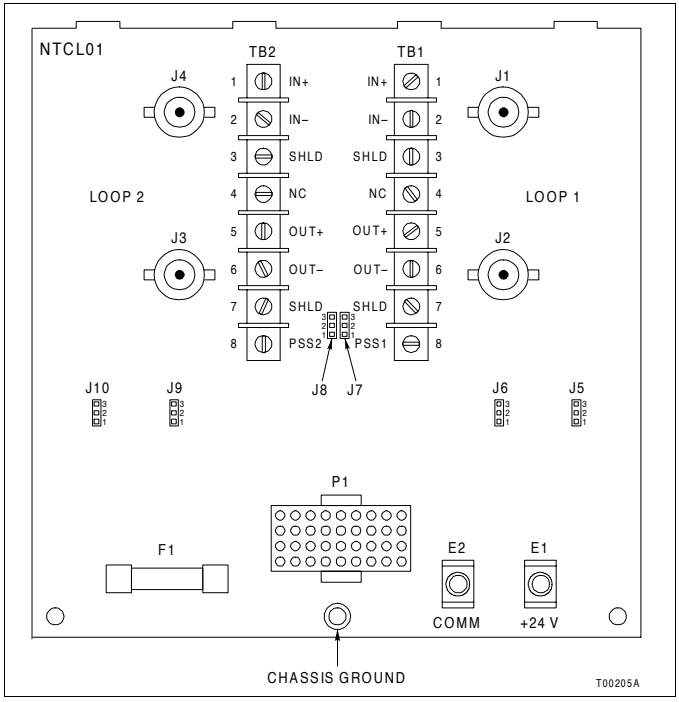

Figure PR4-1. NTCL01 Layout

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	3 2 1	3 2 1
Coaxial	3 2 1	3 2 1

☐ 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 INNIS01 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).

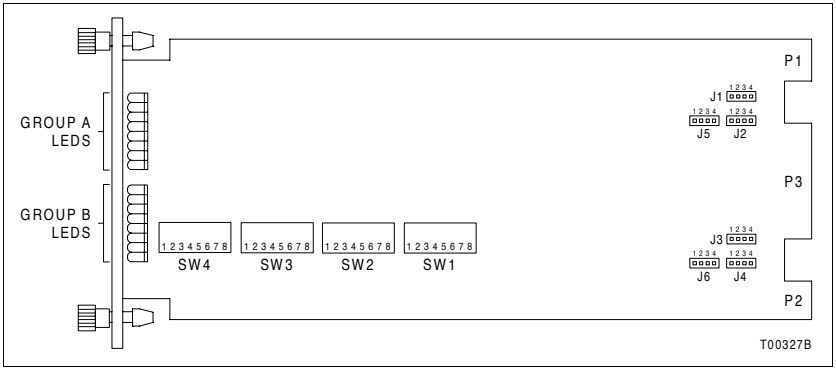

Figure PR5-1. INNIS01 Layout

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.

NOTE: When operating in Plant Loop mode, valid node addresses are from one to 63.

Table PR5-1. INNIS01 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.

NOTE: When operating in Plant Loop mode, set the loop number to one.

Table PR5-2. INNIS01 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. INNIS01 Switch SW3 - Operating Mode

Pole	Setting	Function
1	0	Normal operation. Cnet-to-HCU interface mode.
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[1]	0	Disable test mode; normal operation.
	1[2]	Enable test mode: no time-out for handshake failure.
4[1]	0	Disable test mode; normal operation.
	1[2]	Enable test mode: all loop messages return a busy negative acknowledgment.

Table PR5-3. INNIS01 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[2]	Enable diagnostics mode.
7/8	0/0	10-MHz network mode (Cnet).
	0/1	2-MHz network mode (Cnet).
	1/0	Not used.
	1/1	500-kHz network mode (Plant Loop[3]).

NOTE: 1 = open or off, 0 = closed or on.
1. Pole four in conjunction with pole three makes the node appear to be busy to other nodes. This setting is used by ABB personnel only.
2. Testing modes interfere with normal operation.
3. Plant Loop mode is for compatibility with existing INFI 90 OPEN and Network 90® systems.

☐ 4. Set the I/O expander bus address to zero with poles one through three of switch SW4 (Table PR5-4).

Table PR5-4. INNIS01 Switch SW4 - I/O Expander Bus Address

Address	Switch Pole (Binary Value)		
	1 (4)	2 (2)	3 (1)
0	0	0	0

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

☐ 5. 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 INNIS01 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 PR5-5 lists the event counter addresses. Table PR5-6 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 (on), 5 = closed (off), 6 = closed (off), 7 = closed (off), and 8 = closed (off).

Table PR5-5. INNIS01 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.
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 INNIS01 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 INNIS01 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 PR5-6. INNIS01 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.
0	1	0	0	0	0x08	Number of messages attempted with source-sequence mismatch.

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

☐ 6. Set the communication rate of the receiver analog circuit with jumpers J1 through J6 (Table PR5-7). 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 PR5-7. INNIS01 Jumpers J1 to J6 - Loop Mode

Option	J1 - J6
10 Mhz (Cnet)	1 2 [3 4]
2 MHz (Cnet)	1 [2 3] 4
500 kHz (Plant Loop[1])	[1 2] 3 4

NOTE:
1. Plant Loop mode is for compatibility with existing INFI 90 OPEN and Network 90 systems.

Purpose/Scope

10 min.

This procedure describes the steps required to set up the INNPM12 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).

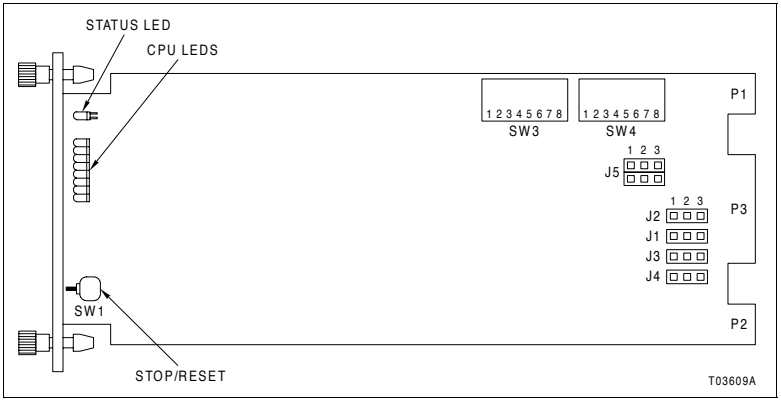

Figure PR6-1. INNPM12 Layout

Procedure

☐ 1. Set the module operating mode with switch SW3 (Table PR6-1).

Table PR6-1. INNPM12 Switch SW3 - Operating Mode

Pole	Setting	Function
1	0	Disable offline hardware diagnostics; normal operation.
	1	Enable offline hardware diagnostics.

Table PR6-1. INNPM12 Switch SW3 - Operating Mode *(continued)*

Pole	Setting	Function
2	0	Cnet (INFI-NET) mode; normal operation.
	1	Plant Loop mode[1].
3	0	Controlway mode (1 Mbaud); normal operation.
	1	Module bus mode (83.3 kbaud)[2].
4/5[3]	0/0	Diagnostic port: 1,200 baud.
	0/1	Diagnostic port: 2,400 baud.
	1/0	Diagnostic port: 9,600 baud.
	1/1	Diagnostic port: 19,200 baud.
6/7	0/0	Not used; must be set as shown.
8[4]	0	Controlway or module bus address 0.
	1	Controlway or module bus address 1.

NOTE: 1 = open or off, 0 = closed or on.
1. Plant Loop communication mode is for compatibility with existing INFI 90 OPEN and Network 90 systems. When selected, set pole 3 to module bus mode and set the module address with pole 8.
2. Module bus mode is for compatibility with existing INFI 90 OPEN and Network 90 systems. When in Plant Loop mode set with pole 2, the module must be set to module bus mode with pole 3.
3. For ABB service personnel only.
4. In a redundant HCU interface, each INNPM12 module must have a unique address.

☐ 2. Set additional module operating options with switch SW4. Refer to Table PR6-2 if operating in Cnet mode (set with SW3, pole two). Refer to Table PR6-3 if operating in Plant Loop mode.

Table PR6-2. INNPM12 Switch SW4 - Operating Options (Cnet Mode)

Pole	Setting	Function
1	0	Enable ROM checksums; normal operation. It is recommended to leave checksums enabled to take full advantage of the on-board diagnostics.
	1	Disable ROM checksums.
2	0	Not used.
3	0	Disable redundancy.
	1	Enable redundancy; redundant INNPM12 module expected.
4	0	Disable Cnet diagnostics; normal operation.
	1	Enable Cnet diagnostics; for ABB use only.

Table PR6-2. INNPM12 Switch SW4 - Operating Options (Cnet Mode) *(continued)*

Pole	Setting	Function
5/6	0/0	Exception report poll rate: 1 poll per second.
	0/1	Exception report poll rate: 2 polls per second.
	1/0	Exception report poll rate: 4 polls per second; normal operation.
	1/1	Exception report poll rate: 8 polls per second.
7	0	Disable test mode; normal operation.
	1	Enable test mode; for ABB use only.
8	0	Enable time-stamp filter; time-stamped data received from an external source is adjusted to INNPM12 time if the time varies from the INNPM12 time by more than ±5 seconds.
	1	Disable time-stamp filter; externally sourced time-stamp is used.

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

Table PR6-3. INNPM12 Switch SW4 - Operating Options (Plant Loop Mode)

Pole	Setting	Function
1/2	0	Not used.
3	0	Disable redundancy.
	1	Enable redundancy; redundant INNPM12 module expected.
4	0	Not used.
5/6	0/0	Exception report poll rate: 1 poll per second.
	0/1	Not valid; do not use.
	1/0	Not valid; do not use.
	1/1	Exception report poll rate: 4 polls per second; normal operation.
7/8	0	Not used.

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

☐ 3. Jumpers J1 through J4 are factory set. Verify they are set as shown in Table PR6-4.

Table PR6-4. INNPM12 Jumpers J1 to J4

Jumper	Setting
J1, J2, J3, J4	

☐ 4. Jumper J5 is for compatibility with older systems (Table PR6-5).

Table PR6-5. INNPM12 Jumper J5

Option	J5
Normal Controlway operation.	1 [2 3] 4 5 6
Disconnects Controlway channel B. This setting allows the module to function in early Network 90 systems that supplied -30 VDC to modules.	[1 2] 3 4 5 6

Redundancy Link Connection

PR7

Purpose/Scope

5 min.

This procedure gives the steps required to connect the redundancy link between redundant INNPM12 modules. The redundancy link connects between the P3 connectors of each module.

Parts

Number	Qty	Description
NKMP01	1	Redundancy link cable

Tools None.

Procedure

☐ 1. From the back of the module mounting unit (MMU) attach the NKMP01 cable to the MMU backplane slot assigned to one of the redundant INNPM12 modules.

☐ 2. Connect the other end of the NKMP01 cable to the MMU backplane slot assigned to the other redundant INNPM12 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 INNIS01 module and requires 24 VDC power connection.

Parts

Number	Qty	Description
NKLS01	1	INNIS01 to NTCL01 cable
NKLS11		

Tools Modular Power System II instruction.

Safety Considerations

WARNING

1. 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. 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 INNIS01 module.

☐ W1 2. From the back of the module mounting unit (MMU) attach the hooded end of the NKLS01 or NKLS11 cable to the MMU backplane slot assigned to the INNIS01 module.

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

☐ 4. Attach a 2.1 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 2.1 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 0.83 to 2.1 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.

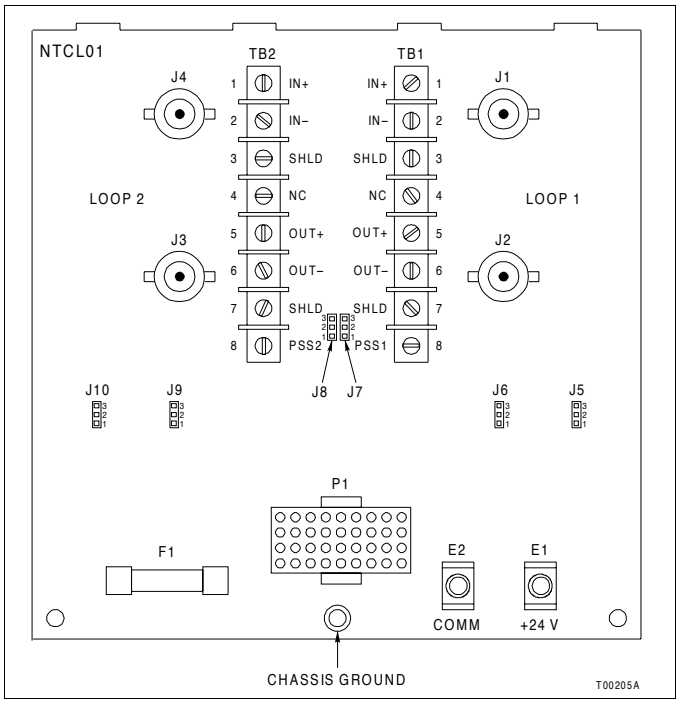

Figure PR8-1. NTCL01 Layout

Cnet Connection

PR9

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
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
			2,000 m (6,562 ft), Plant Loop
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
			2,000 m (6,562 ft), Plant Loop

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

Nomenclature	Application	Connector	Maximum Length
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

1. 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. 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.

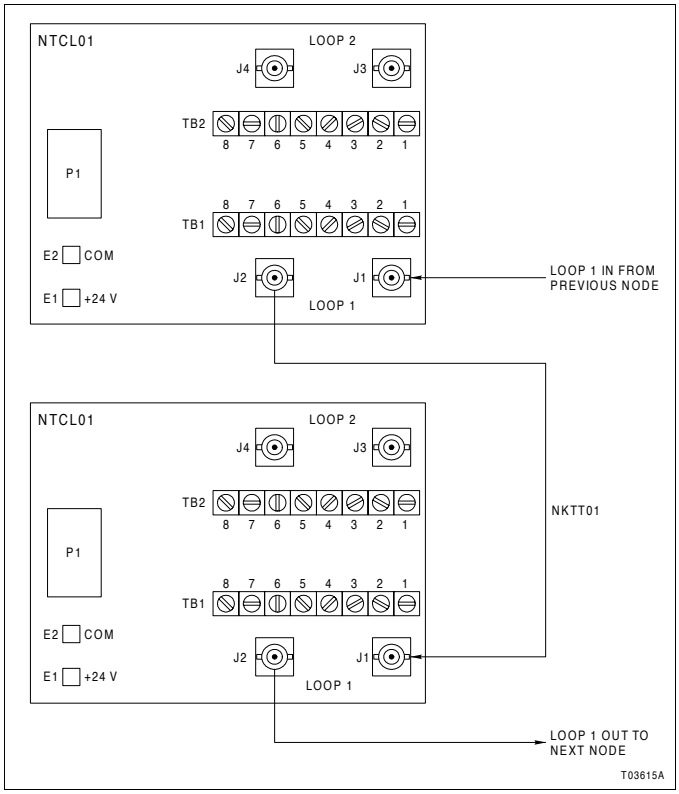

Figure PR9-1. Intracabinet Coaxial Cnet Cable Connection

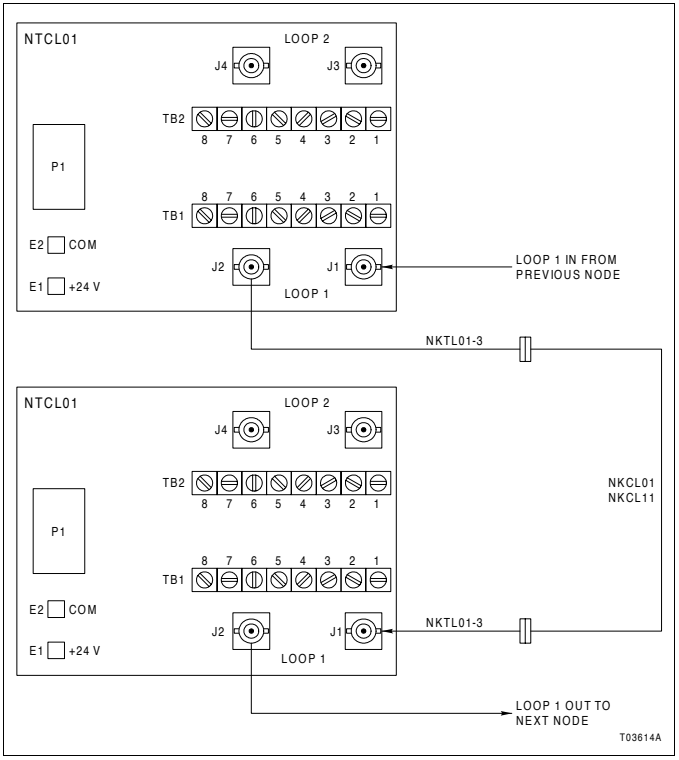

Figure PR9-2. Intercabinet Coaxial Cnet Cable Connection

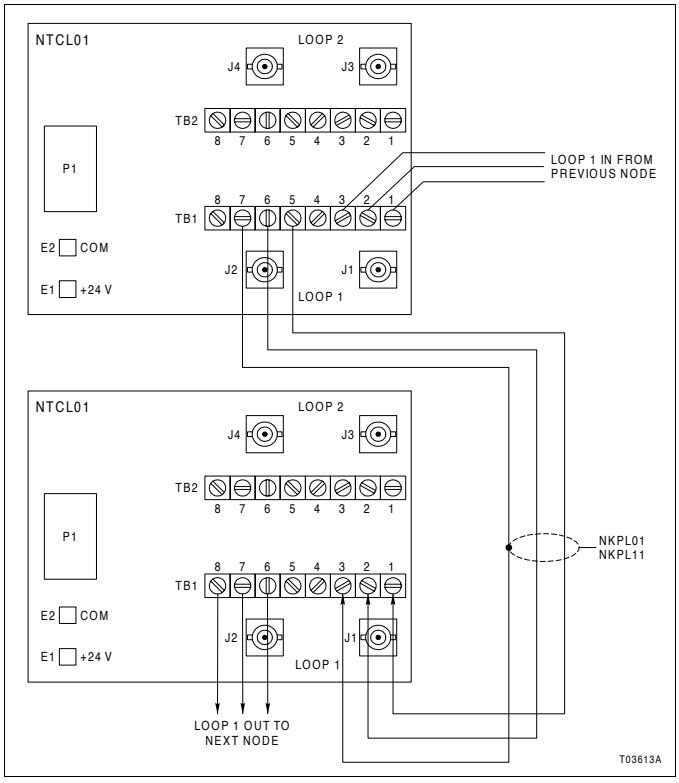

Figure PR9-3. Twinaxial Cnet Cable Connection

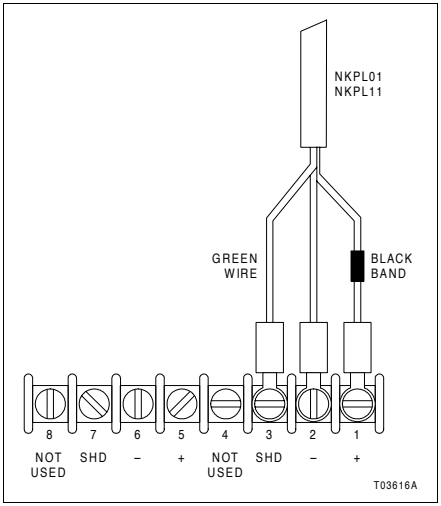

Figure PR9-4. Twinaxial Cable Terminal Block Connections

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	**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. 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 lockwasher (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.

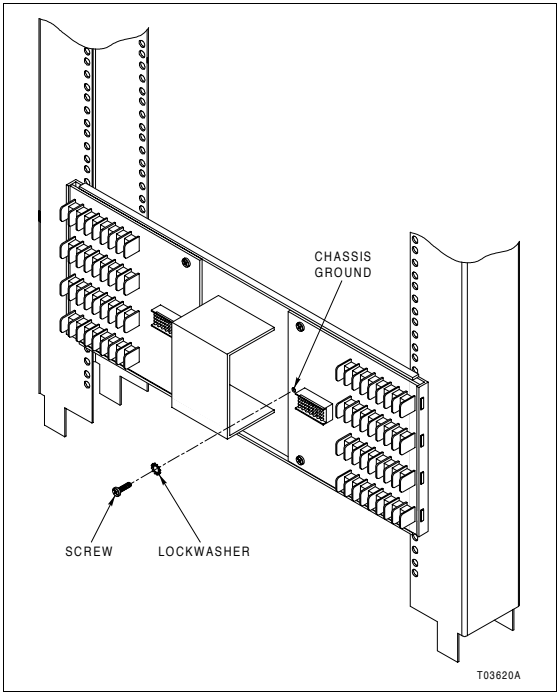

Figure PR10-1. Chassis Ground Connection

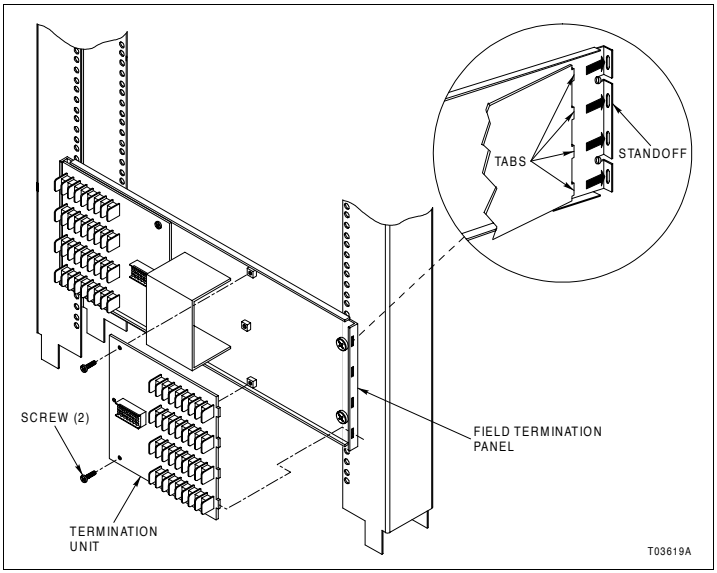

Figure PR10-2. Termination Unit Removal

Module Removal

PR11

Purpose/Scope

1 min.

This procedure describes the steps required to remove either the INNIS01 or INNPM12 module from the module mounting unit (MMU). A module can be removed with power on.

Parts None.

Tools
- Thin rod for reset button, preferably nonmetallic.

Safety Considerations

WARNING	**1. 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 INNPM12 module once to halt operation if not already halted. This should be done when removing either or both modules.

☐ 

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

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

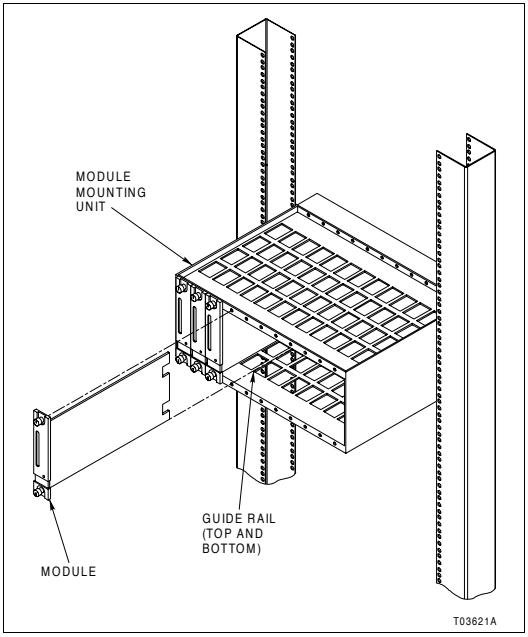

Figure PR11-1. Module Removal

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	**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.**

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	**1. 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 INNPM12 module.

Parts None.

Tools None.

Procedure

☐ 1. Verify the system is offline or run the diagnostics with the INNPM12 module in a test enclosure.

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

☐ 3. Enable diagnostic mode by setting switch SW3 as shown in Table PR14-1. Putting the INNPM12 module into diagnostic mode allows the module to perform a variety of diagnostic tests but suspends normal operation.

Table PR14-1. INNPM12 Switch SW3 - Diagnostic Mode

Pole	Description
1	1 = diagnostic mode.
2 - 8	x = setting ignored in diagnostic mode.

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

☐ 4. Select the test options with poles one and two of switch SW4 as shown in Table PR14-2.

Table PR14-2. INNPM12 Switch SW4 - Diagnostic Options

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

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

☐ 5. Select the desired test by setting switch SW4 as shown in Table PR14-3.

☐ 6. Insert the module into the module mounting unit. 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.

Table PR14-3. INNPM12 Switch SW4 - Diagnostic Tests

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	MMU
04	0	0	0	1	0	0	RAM
05	-	-	-	-	-	-	Unused
06	0	0	0	1	1	0	PLD
07	0	0	0	1	1	1	Password
08	0	0	1	0	0	0	I/O expander bus stall
09	0	0	1	0	0	1	Controlway/module bus
0A	0	0	1	0	1	0	Timer IRQ5 (DUART)

Table PR14-3. INNPM12 Switch SW4 - Diagnostic Tests *(continued)*

Test ID	Pole						Test
	3	4	5	6	7	8	
0B	0	0	1	0	1	1	Dispatcher IRQ2
0C	-	-	-	-	-	-	Unused
0D	0	0	1	1	0	1	Redundancy link (local)
0E - 0F	-	-	-	-	-	-	Unused
10	0	1	0	0	0	0	Group 1 test - 01 to 0F
11	0	1	0	0	0	1	I/O expander bus (external)
12	0	1	0	0	1	0	I/O expander bus IRQ3
13	-	-	-	-	-	-	Unused
14	0	1	0	1	0	0	Redundancy link (primary)
15 - 1F	-	-	-	-	-	-	Unused
20	1	0	0	0	0	0	Group 2 test - 01 to 1F
21 - 23	-	-	-	-	-	-	Unused
24	1	0	0	1	1	0	Redundancy link (backup)
25 - 28	-	-	-	-	-	-	Unused
29	1	0	1	0	0	1	Stop/reset button[1]

NOTES: 1 = off or open; 0 = on or closed.
1. Test is not continuous.

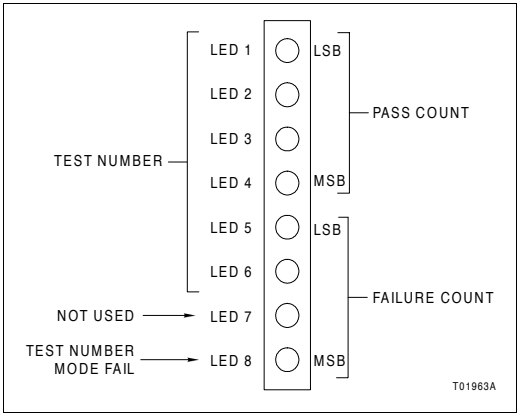

Figure PR14-1. Diagnostic Test LED Indications

Display Mode

Test Number The test number display mode uses LEDs one through six 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, LEDs one through six display the diagnostic test number and LED eight remains off. If a diagnostic test is not successful, LEDs one through six 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 LEDs one through eight 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. Depending on the display mode, the status indicators will identify the test being run or will display a test count (Fig. PR14-1).

Enabled If halt on error is enabled, the test stops if an error is encountered. Depending on the display mode, the status indicators will identify the test that failed or will display a test 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

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.

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

Test ID		Description
03	MMU	Test the onboard memory management unit.
04	RAM	Clears and verifies then sets and verifies all RAM memory. Test includes byte, word, and long word accesses.
06	PLD	Loads programmable logic devices. Verifies proper loading and operation.
07	Password	Verifies PAL password against a stored value.
08	I/O expander bus stall	Tests the I/O expander bus stall detection and IRQ7 interrupt handling.
09	Controlway/ module bus	Sends a series of bytes to Controlway or module bus to verify timing and transfer status.
0A	Timer IRQ5 (DUART)	Tests IRQ5 interrupt handling. Initializes DUART timer for 1-msec interrupt and then waits for it to time-out.
0B	Dispatcher IRQ2	Tests IRQ2 interrupt handling. Issues software dispatcher request and waits for interrupt to occur.
0D	Redundancy link (local)	Tests the DUART serial channels used for the redundancy link in local loopback mode.
10	Group 1 test	Executes tests 01 to 0F.
11	I/O expander bus	Tests I/O expander bus communication with another module. Requires an IMDSO14 module set to module address 15. IMDSO14 LEDs count successful tests. Verify MMU backplane connection between INNPM12 and IMDSO14 modules before starting test.
12	I/O expander bus IRQ3	Tests IRQ3 interrupt handling. Enables an interrupt level 3 and then writes a value to the I/O expander bus to initiate an interrupt.
14/ 24	Redundancy link	Test communication link between redundant INNPM12 modules. Checks ability to pass information and handshaking. Two INNPM12 modules connected with an NKMP01 cable at P3 are required. Set one INNPM12 module to test 14 (primary); the other to test 24 (backup). Primary will provide pass/fail indication.
20	Group 2 test	Executes tests 01 to 1F.
29	Stop/reset button	Tests pushbutton operation. Displays code 0x55 on LEDs if successful.

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