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

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

Control Network

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

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

Harmony Control Unit

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

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

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

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

Controlway

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

Redundancy

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

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

Intended User

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

experience handling electronic circuitry and familiarity with communication networks.

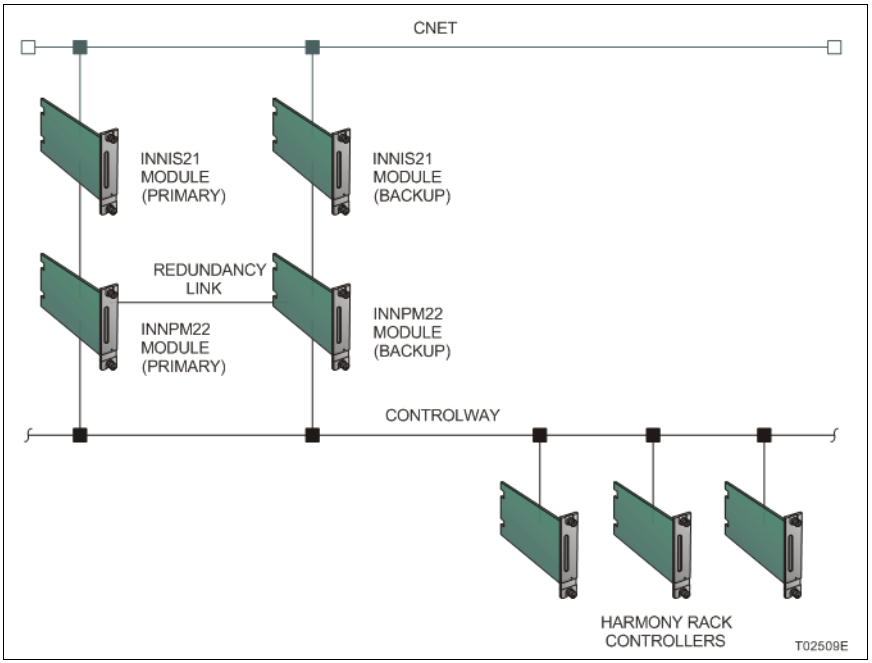

Figure 1-2. Redundant Cnet-to-HCU Interface

Features

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

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

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

Instruction Content

This instruction consists of the following sections:

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

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

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

Operating Procedures Provides information about normal module operation.

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

Maintenance Contains a maintenance schedule for the HCU interface.

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

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

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

How to Use this Instruction

To use the instruction:

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

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

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

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

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

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

Glossary of Terms and Abbreviations

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

Table 1-1. Glossary of Terms and Abbreviations

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

Document Conventions

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

Reference Documents

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

Table 1-2. Reference Documents

Document Number	Title
WBPEEUI210502??	Modular Power System II

Related Nomenclature

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

Table 1-3. Related Nomenclature

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

Specifications

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

Table 1-4. Specifications

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

Table 1-4. Specifications *(continued)*

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

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Introduction

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

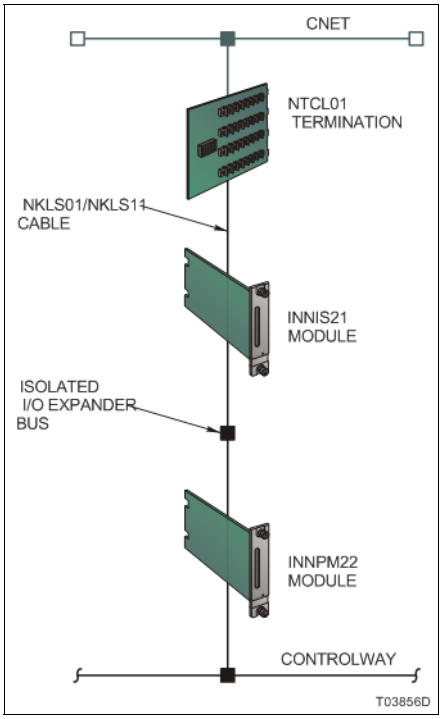

Figure 2-1. Cnet-to-HCU Interface

INNIS21 Network Interface

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

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

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

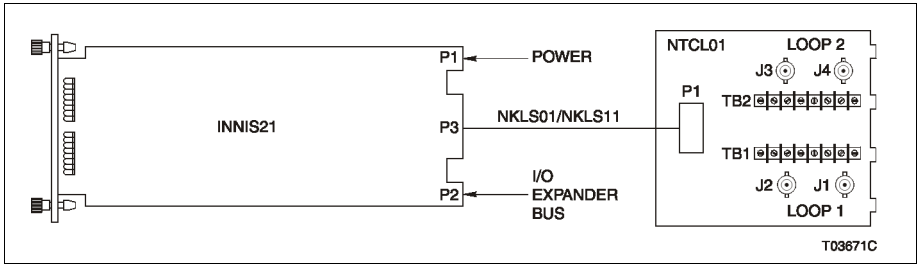

Figure 2-2. INNIS21 Module and NTCL01 Termination Unit

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

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

Block Diagram

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

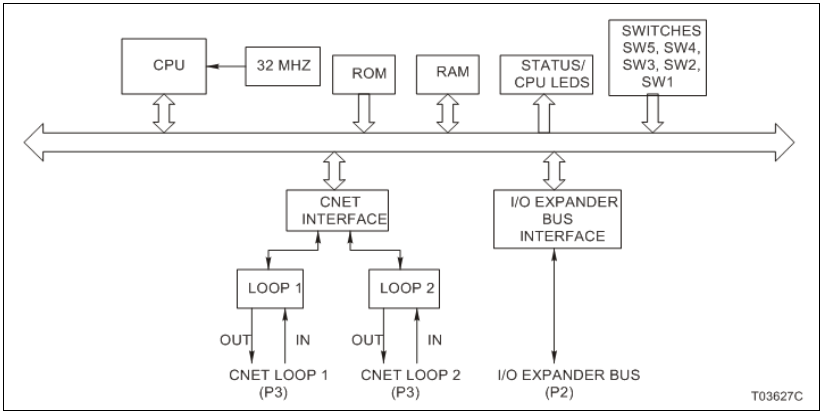

Figure 2-3. INNIS21 Functional Block Diagram

CPU

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

Cnet

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

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

Receive

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

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

Transmit

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

Memory

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

I/O Expander Bus

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

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

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

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

Stop/Reset

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

Switches and LEDs

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

Operation

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

Exception Reports

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

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

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

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

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

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

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

Messages

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

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

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

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

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

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

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

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

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

Data Integrity

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

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

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

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

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

Power System Status

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

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

INNPM22 Network Processing

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