

Bridge Controller and Processor Bus Adapter
BRC-100 and PBA-100





The BRC-100 Harmony Bridge Controller is a high-performance, high-capacity process controller. It is a rack controller designed to interface with both Harmony I/O blocks and Harmony rack I/O in the Symphony Enterprise Management and Control System. The Harmony bridge controller is fully compatible with the INFI 90[®] OPEN system in functionality, communication and packaging. The Harmony bridge controller collects process I/O, performs control algorithms and outputs control signals to process level devices. It also imports and exports process data of other controllers and system nodes, and accepts control commands from operators and computers connected to the network.

This instruction provides information about how the Harmony bridge controller works, and how to install, configure, operate and troubleshoot the module.

The Harmony bridge controller is designed for redundancy. This can be achieved while remaining connected to the Hnet, or without, using an optional BRC redundancy kit.



List of Effective Pages

Total number of pages in this instruction is 99, consisting of the following:

Page No.	Change Date
Preface	04 December 2000
List of Effective Pages	04 December 2000
iii through x	04 December 2000
1-1 through 1-8	04 December 2000
2-1 through 2-8	04 December 2000
3-1 through 3-19	04 December 2000
4-1 through 4-5	04 December 2000
5-1 through 5-23	04 December 2000
6-1 through 6-4	04 December 2000
7-1 through 7-3	Original
8-1	04 December 2000
A-1 through A-8	Original
B-1 through B-7	04 December 2000
Index-1 through Index-3	04 December 2000

When an update is received, insert the latest changed pages and dispose of the superseded pages.

NOTE: Changed text or tables are indicated by a vertical bar adjacent to the changed area. Changed figures are indicated by a vertical bar next to the figure caption. The date appears beside the page number.

Table of Contents



Section 1 Introduction	1-1
Overview	1-1
Intended User	1-2
Hardware Description	1-2
Faceplate	1-3
Circuit Board	1-3
Hardware Application.....	1-3
Features	1-3
Instruction Content.....	1-4
How to Use this Instruction.....	1-4
Glossary of Terms and Abbreviations.....	1-5
Reference Documents.....	1-6
Related Nomenclatures	1-6
Specifications.....	1-6
Section 2 Description and Operation	2-1
Introduction.....	2-1
Operation.....	2-1
Circuitry	2-2
Microprocessor.....	2-2
Clock and Real-Time Clock	2-2
Memory.....	2-2
Direct Memory Access	2-3
Controlway.....	2-4
Redundancy Link	2-4
Hnet Communication	2-5
I/O Expander Bus	2-5
I/O Section	2-6
Serial Channels.....	2-6
Station Link	2-6
Power.....	2-7
Section 3 Installation	3-1
Introduction.....	3-1
Special Handling.....	3-2
Unpacking and Inspection.....	3-2
Dipswitches and Jumpers	3-3
Dipswitch SW5 - Module Address	3-4
Dipswitch SW2 - Normal Operating Options.....	3-5
Dipswitch SW2 - Special Operations	3-5
Dipswitch SW3 - Module Options	3-8



Table of Contents (continued)

Section 3 Installation (continued)	
Dipswitch SW4 - Module Options	3-8
Jumpers	3-8
Module Mounting Unit Preparation	3-9
Module Slot Assignments	3-9
Dipshunts	3-10
Controlway Cable.....	3-10
PBA Board Installation.....	3-11
Mounting Bracket	3-11
Cable and Terminator	3-12
Mounting.....	3-13
BRC Redundancy Kit Installation.....	3-16
Module Installation.....	3-18
Pre-Installation Check	3-18
Installation	3-19
<hr/>	
Section 4 Operating Procedures	4-1
Introduction	4-1
Startup.....	4-1
Module LEDs.....	4-2
Front Panel LEDs.....	4-2
Red/Green Status LED	4-3
Stop/Reset Switch.....	4-3
Modes of Operation.....	4-4
<hr/>	
Section 5 Troubleshooting	5-1
Introduction	5-1
Error Codes.....	5-1
Flowcharts	5-5
Diagnostics	5-5
Overview.....	5-5
Diagnostic Test Selection	5-8
LED Display	5-11
Module Status Summary	5-12
Card Edge Connectors	5-17
<hr/>	
Section 6 Maintenance	6-1
Introduction	6-1
Preventive Maintenance Schedule	6-1
Equipment and Tools Required	6-1
Preventive Maintenance Procedures	6-2

Table of Contents (continued)

Section 6 Maintenance (continued)	
Printed Circuit Board Cleaning	6-2
General Cleaning and Washing	6-3
Edge Connector Cleaning.....	6-3
Checking Connections.....	6-4
Section 7 Repair and Replacement	7-1
Introduction.....	7-1
Module Replacement	7-1
PBA Board Replacement.....	7-2
Section 8 Replacement and Spare Parts	8-1
Parts.....	8-1
Appendix A Online Configuration	A-1
Introduction.....	A-1
Setup.....	A-1
Operation.....	A-2
Backup Cycle	A-3
Primary Cycle.....	A-6
Appendix B NTMP01 Termination Unit	B-1
Description	B-1

List of Figures

No.	Title	Page
1-1.	Harmony Bridge Controller Architecture.....	1-2
2-1.	Functional Block Diagram.....	2-3
3-1.	BRC Module Layout	3-3
3-2.	Controlway Cable Installation	3-11
3-3.	PBA Installation	3-14
3-4.	PBA Connector Identification.....	3-15
3-5.	BRC Redundancy Kit Installation	3-17
3-6.	Hood Connector Assembly Connector Identification.....	3-18
4-1.	Front Panel.....	4-2



List of Figures (continued)

No.	Title	Page
5-1.	Troubleshooting Flowchart (Serial Port)	5-6
5-2.	Troubleshooting Flowchart (Status LED)	5-7
5-3.	LEDs - Pass/Fail	5-12
A-1.	Backup Cycle	A-6
A-2.	Primary Cycle	A-8
B-1.	DTE Jumper Configuration (NTMP01)	B-2
B-2.	DCE Jumper Configuration (NTMP01)	B-2
B-3.	Nonhandshake Jumper Configuration (NTMP01)	B-3
B-4.	Loopback Jumper Configuration (NTMP01)	B-3
B-5.	Jumpers J3 through J10 Configuration (NTMP01)	B-4
B-6.	NTMP01 Board Layout	B-5
B-7.	NTMP01 Cable Connections (Redundant BRC Modules/PBA Boards)	B-6
B-8.	Cable Connections (Redundant BRC Modules Using BRC Redundancy Kit)	B-7

List of Tables

No.	Title	Page
1-1.	Glossary of Terms and Abbreviations	1-5
1-2.	Reference Documents	1-6
1-3.	Related Nomenclatures	1-6
1-4.	Specifications	1-7
3-1.	Dipswitch SW5 Settings (Operation)	3-4
3-2.	Dipswitch SW5 Settings (Address)	3-5
3-3.	Dipswitch SW2 Settings (Operating Options)	3-6
3-4.	Dipswitch SW2 Settings (Special Operations)	3-7
3-5.	Dipswitch SW4 Settings (Module Options)	3-8
3-6.	Jumpers Settings (J1 through J4)	3-9
5-1.	Error Codes	5-1
5-2.	Status LED and Other Conditions	5-4
5-3.	DSO and BRC Setup for I/O Expander Bus Test	5-8
5-4.	Diagnostic Dipswitch Settings	5-8
5-5.	Diagnostic Tests	5-9
5-6.	Status Report	5-13
5-7.	Status Report Field Descriptions	5-13
5-8.	P1 Pin Assignments (BRC)	5-17
5-9.	P2 Pin Assignments (BRC)	5-18
5-10.	P3 Pin Assignments (BRC) 1,2	5-18
5-11.	P4 Pin Assignments (BRC)	5-19
5-12.	P1 Pin Assignments (PBA)	5-19

List of Tables (continued)

No.	Title	Page
5-13.	P3 Pin Assignments (PBA)	5-20
5-14.	P4 Pin Assignments (PBA)	5-20
5-15.	P5 Pin Assignments (PBA)	5-21
5-16.	P5 Pin Assignments (Hood Connection Assembly)	5-22
6-1.	Preventive Maintenance Schedule.....	6-2
8-1.	Miscellaneous Nomenclatures	8-1
8-2.	Cable Nomenclatures	8-1
8-3.	Miscellaneous Parts	8-1
A-1.	Legend of Symbols	A-3
A-2.	Backup Cycle	A-3
A-3.	Primary Cycle.....	A-7



Safety Summary

GENERAL WARNINGS

Equipment Environment

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

Electrical Shock Hazard During Maintenance

Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing.

Special Handling

This module uses electrostatic sensitive devices.

SPECIFIC WARNINGS

Disconnect power before installing dipshunts on the module mounting unit backplane. Failure to do so will result in contact with cabinet areas that could cause severe or fatal shock. (p. 3-9)

Disconnect power before installing the processor bus adapter mounting bracket on the module mounting unit backplane. Failure to do so will result in contact with cabinet areas that could cause severe or fatal shock. (p. 3-11)

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 removed from the printed circuit board. (p. 6-1)

SPECIFIC CAUTIONS

Never operate the BRC module with the machine fault timer circuit disabled (jumper pins connected). Unpredictable module outputs and configuration corruption may result. The unpredictable module outputs may damage control equipment connected to the BRC module.

To avoid potential module damage, evaluate your system for compatibility prior to module installation. This module uses connections to the module mounting unit backplane that served other functions in early Network 90 systems. (p. 3-16)

Support Services



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

When ordering parts, use nomenclature or part numbers and part descriptions from equipment manuals. Parts without a description must be ordered from the nearest sales or service office. Recommended spare parts lists, including prices are available through the nearest sales or service office.

ABB has modern training facilities available for training your personnel. On-site training is also available. Contact your nearest ABB sales office for specific information and scheduling.

Additional copies of this instruction, or other instructions, can be obtained from the nearest ABB sales office at a reasonable charge.



Trademarks and Registrations

Registrations and trademarks used in this document include:

- | | |
|--------------|-------------------------------------------------|
| ® INFI 90 | Registered trademark of ABB Process Automation. |
| ® INFI-NET | Registered trademark of ABB Process Automation. |
| ® Network 90 | Registered trademark of ABB Process Automation. |
-



Overview

The BRC-100 Harmony Bridge Controller is a high-performance, high-capacity process controller. It is a rack controller designed to interface with both Harmony I/O blocks and Harmony rack I/O in the Symphony Enterprise Management and Control System. The Harmony bridge controller (BRC) is fully compatible with the INFI 90 OPEN system in functionality, communication, and packaging.

The Harmony bridge controller is a stand-alone controller that can handle specific control and information processing applications in addition to multiple-loop analog, sequential, and batch control. It has the power to execute demanding process control applications that are data intensive, program intensive or both. The Harmony bridge controller supports multiple control languages which include function codes, C, Basic, Batch 90, and Ladder.

The Symphony system uses a variety of analog, control, and digital I/O devices to interface with the process. Control input/output is available from I/O blocks using the Harmony communication network (Hnet) or from Harmony rack I/O modules using the I/O expander bus.

For added reliability, the BRC module has circuitry that supports redundancy. A backup BRC module waits in a standby mode while the primary module executes. If the primary goes offline for any reason, there is a bumpless transfer of control to the backup module. A processor bus adapter (PBA) board is required to support redundant BRC modules and redundant Hnet buses. When no Hnet and termination unit connection is needed, a BRC redundancy kit may be used to support redundant BRC modules.

IISAC01 Analog Control Stations can connect directly to the BRC module via a PBA board and termination unit. The BRC module also supports IISAC01 stations that are connected to a Harmony control I/O block (CIO-100/110) on the Hnet bus or a Harmony control I/O module (IMCIS12, IMQRS12) on the I/O expander bus. The BRC module supports up to 128 SAC sta-



tions communication at a 40-kbaud rate. Figure 1-1 shows the Harmony bridge controller architecture.

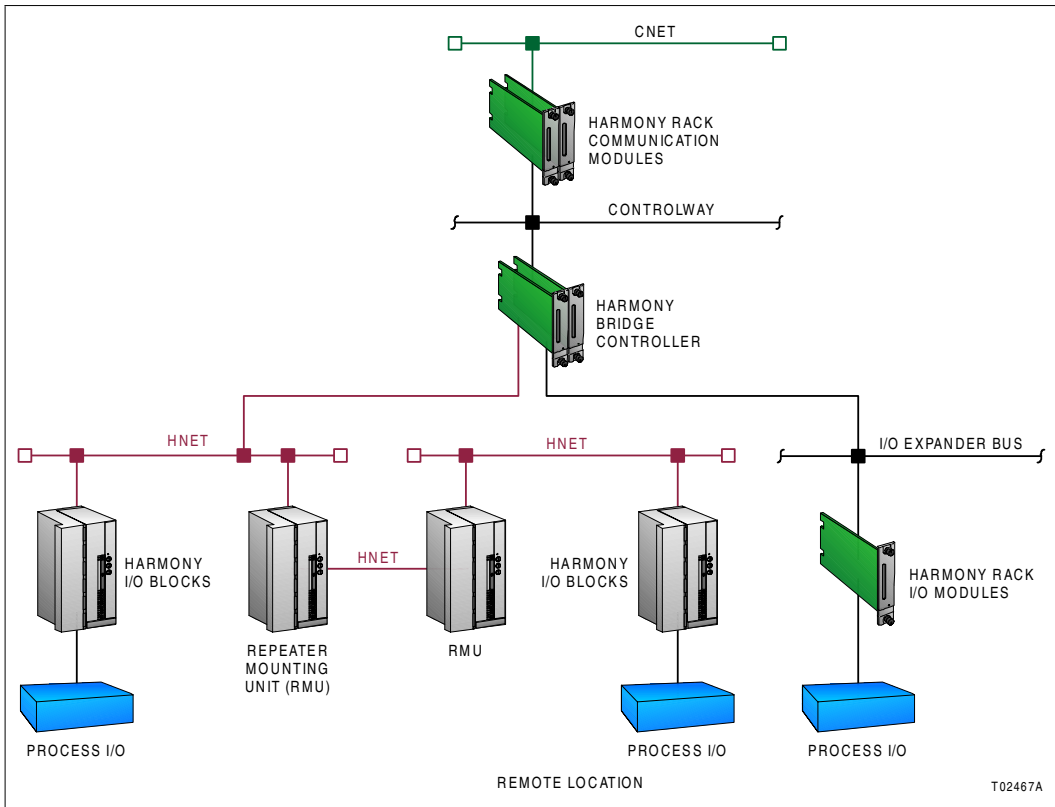


Figure 1-1. Harmony Bridge Controller Architecture

Intended User

Personnel installing, operating or maintaining the BRC module should read this instruction before performing any installation, operation, or maintenance procedures. Installation requires an engineer or technician with experience handling electronic circuitry. Formal training in Symphony system configuration (especially function codes) is helpful when configuring the BRC module.

Hardware Description

The Harmony bridge controller consists of a circuit board and a faceplate.

Faceplate

The BRC faceplate measures 35.56-millimeters wide by 177.80-millimeters high (1.4-inches wide by 7.0-inches high). Two latching screws, one at the top, the other at the bottom, lock the module assembly in a module mounting unit (MMU). A transparent window on the faceplate enables viewing the 16 CPU LEDs and the status LED. These LEDs display operating information. A small hole directly below the window provides access to the combination stop/reset pushbutton. Besides locking the module in place, the faceplate also protects the circuit components and promotes proper air flow within the enclosure.

Circuit Board

The circuit board features state-of-the-art surface mount technology. On the board are nonvolatile random access memory (NVRAM), static random access memory (SRAM), flash memory (ROM), a microprocessor running at 32 megahertz, direct memory access (DMA) circuits, ABB Process Automation custom bus circuits, and various support circuitry. The board attaches to the faceplate with two screws. The module assembly occupies one slot in a module mounting unit.

A processor bus adapter board is required for connection to the Harmony I/O subsystem via Hnet. It also connects to a termination unit for two auxiliary serial I/O ports and IISAC01 stations. Redundant BRC modules and Hnet buses connect through redundant PBA boards.

Hardware Application

Because of the superior performance of the BRC module, applications that formerly required an external mainframe or mini-computer can now be handled in the Harmony control unit. The large memory space and on-board communication ports of the BRC module enable it to meet the sophisticated control



application requirements of supervisory control, optimization routines, performance assessment, and process modeling.

Features

The Harmony bridge controller retains all of the features of the INFI 90 OPEN multifunction processor modules. Additional features of the Harmony bridge controller include:

- Simultaneous Hnet bus and I/O expander bus communication supports both Harmony I/O blocks and Harmony rack I/O modules.
- Redundant Hnet bus.
- Online Hnet communication bus diagnostics and fault isolation.
- Automatic downloading of Harmony I/O block configurations.
- NVRAM battery power monitoring.
- Status output alarm monitoring.
- Two megabytes of on-board SRAM memory.
- Compatible with existing INFI 90 OPEN systems.

Instruction Content

This instruction consists of the following sections:

- Introduction** Provides an overview of the module, a description of the hardware, a glossary of unique terms, and a table of physical, electrical and environmental specifications.
- Description and Operation** Uses block diagrams to explain the function of the key circuits.
- Installation** Explains the handling, inspection, hardware configuration, and installation aspects of the module.
- Operating Procedures** Discusses the front panel indicators and controls, and every-day operation.
- Troubleshooting** Features detailed flowcharts and tables that enable quick diagnosis of error conditions and provides corrective actions.

Maintenance	Covers scheduled module maintenance.
Repair and Replacement	Describes how to repair and replace the module.
Replacement and Spare Parts	Provides a list of part numbers and nomenclatures.
Appendices	Provide quick reference information for NTMP01 hardware configuration and step-by-step instructions for performing online configuration.

How to Use this Instruction

Read this instruction in sequence. To get the best use out of this instruction, read it from cover to cover, then go back to specific sections as required. ABB strongly advises against putting the module into operation until the installation section has been read and performed.

1. Read and perform all steps in the installation section.
2. Thoroughly read the operating procedures section before applying power to the module.
3. Refer to the troubleshooting section if a problem occurs. This section will help to diagnose and correct a problem.
4. Go to the repair and replacement section for replacement part numbers and nomenclatures, and for instructions on how to replace the module.

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
Controlway	High speed, redundant, peer-to-peer communication link. Used to transfer information between intelligent modules within a Harmony control unit.
Hnet	Communications path between Harmony controller and I/O blocks.
Executive block	Fixed function block that determines overall module operating characteristics.



Table 1-1. Glossary of Terms and Abbreviations *(continued)*

Term	Definition
Function block	The occurrence of a function code at a block address of a module.
Function code	An algorithm which manipulates specific functions. These functions are linked together to form the control strategy.
I/O block	Generic name for a processor based Harmony input/output device: AIN-120, AOT-150, CIO-100, DIO-400, etc.; comprised of an I/O module and a base.
I/O module	Houses the I/O block circuitry; part of I/O block.
I/O expander bus	Parallel communication bus between the Harmony rack controller and Harmony rack I/O modules.
MFT	Machine fault timer. Reset by the processor during normal operation. If not reset regularly, the MFT times out and the module stops.
MMU	Module mounting unit. A card cage that provides electrical and communication support for Harmony rack modules.
PBA	Processor bus adapter.
Termination unit	Provides input/output connection between plant equipment and the Harmony rack modules.

Reference Documents

Table 1-2 contains a list of documents referenced in this instruction that provide information on BRC firmware and related hardware.

Table 1-2. Reference Documents

Number	Title
WBPEEU1200502??	Module Mounting Unit (IEMMU11, IEMMU12, IEMMU21, IEMMU22)
WBPEEU1210504??	Function Code Application Manual, Symphony
WBPEEU1230022??	Analog Control Station (IISAC01)
WBPEEU1240751??	Harmony Input/Output System
WBPEEU1240762??	IMDSO14 Digital Output Module
WBPEEU1260039??	NTMP01 Multifunction Processor Termination Unit
WBPEEU1270002??	Primary Interface, Composer
WBPEEU1270003??	Automation Architect, Composer

Related Nomenclatures

Table 1-3 lists nomenclatures related to the BRC module.

Table 1-3. Related Nomenclatures

Nomenclature	Description
IEMMU11, IEMMU12, IEMMU21, IEMMU22	Module mounting unit
IISAC01	Analog control station
NTMP01	Field termination panel

Specifications

Table 1-4 lists the specifications for the BRC module, process bus adapter board and BRC redundancy kit.

Table 1-4. Specifications

Property	Characteristic/Value														
Microprocessor	32-bit processor running at 32 MHz														
Memory	All memory has 32-bit data path <table border="1" data-bbox="490 899 1063 1008"> <thead> <tr> <th colspan="2">SRAM</th> <th colspan="2">NVRAM</th> <th rowspan="2">Flash ROM Total</th> </tr> <tr> <th>Total</th> <th>Available</th> <th>Total</th> <th>Available</th> </tr> </thead> <tbody> <tr> <td>2 Mb</td> <td>1.57 Mb</td> <td>512 kb</td> <td>441 kb</td> <td>1 Mb</td> </tr> </tbody> </table>	SRAM		NVRAM		Flash ROM Total	Total	Available	Total	Available	2 Mb	1.57 Mb	512 kb	441 kb	1 Mb
SRAM		NVRAM		Flash ROM Total											
Total	Available	Total	Available												
2 Mb	1.57 Mb	512 kb	441 kb	1 Mb											
Power requirements	5 VDC at 2 A; 10 W typical (BRC) 5 VDC at 100 mA; 0.5 W typical (PBA)														
Station support	128 40-kbaud serial stations (IISAC01) or eight 5-kbaud serial stations														
Redundant controller communication link	4 MHz per byte per second (normal operation)														
Programmability	Function codes, C, Basic, Batch, Ladder, user-defined functions														
Dimensions															
BRC	35.56 mm wide, 177.80 mm high, 298.45 mm long (1.40 in. wide, 7.00 in. high, 11.75 in. long)														
PBA	31.60 mm wide, 166.12 mm high, 102.62 mm long (1.24 in. wide, 6.54 in. high, 4.04 in. long)														
Weight															
BRC	0.70 kg (24.69 oz)														
PBA	0.30 kg (10.6 oz)														



Table 1-4. Specifications *(continued)*

Property	Characteristic/Value
Communication ports	2 RS-232-C or 1 RS-232-C and 1 RS-485, 1 SAC channel (128 SACs maximum)
Ambient temperature	0° to 70°C (32° to 158°F)
Relative humidity	0% to 95% relative humidity up to 55°C (131°F) noncondensing 0% to 45% relative humidity at 70°C (158°F) noncondensing
Atmospheric pressure	Sea level to 3 km (1.86 mi)
Certification	CSA certified for use as process control equipment in ordinary (nonhazardous) locations. CE mark compliant for EMC directive and LV directive.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.



Introduction

This section explains the functionality of the Harmony bridge controller (BRC) using block diagrams and text. Block diagrams divide the operation of the Harmony bridge controller.

Operation

The BRC module incorporates the power of a second generation 32-bit microprocessor operating at 32 megahertz. This is coupled with 32-bit wide memory design with an optimized interface. The microprocessor supplies superior performance capable of supplanting the need for external mainframes or minicomputers.

Control input/output is available from I/O blocks using Hnet or from Harmony rack I/O modules using the I/O expander bus. The data within the BRC module may be exported to the Cnet communication network and to existing INFI-NET[®] and Plant Loop communication systems.

In some processes, the effects of a control failure in the system can create dangerous situations or cause economic loss. To reduce the possibility of these problems occurring, redundant modules provide fail-safe control. Redundant BRC modules link directly to each other via the processor bus adapter (PBA) board or the BRC redundancy kit to keep the database in the backup module current. Each module uses a redundant high speed communication channel to accomplish this function. If the primary module fails, the backup module is waiting in standby mode and immediately takes over. The backup module has the same control strategy loaded in its memory as the primary BRC module and is ready to assume control. When operating in Hnet communication mode, the redundant communication channel insures that single point failures will not prevent the backup module from being in a state of readiness to take over.

While the BRC module is controlling a process, it also executes diagnostic routines. It is constantly checking the integrity of its



hardware and firmware during normal operation. If the diagnostic routines discover a module hardware or software problem, it makes that information available to the operator. The operator has access to this information through status LEDs on the module faceplate and through reports received on the human system interface (HSI) in module status bytes.

The BRC module uses a control I/O block (CIO) on Hnet to support a station link that can handle up to 128 IISAC01 stations and is compatible with the Symphony system.

Two auxiliary RS-232-C ports and a serial station link are available through a cable connection via the PBA board to an NTMP01 Multifunction Processor Termination Unit. This station link can handle up to 64 IISAC01 stations at a 40-kilobaud rate or eight stations at a five-kilobaud rate. Various handshake options are available via jumper configurations on the termination unit.

Circuitry

The BRC module has all the needed circuitry to operate as a stand-alone controller. Direct memory access (DMA) operation is supported for the station link. Figure 2-1 shows a block diagram of the BRC circuitry.

Microprocessor

The microprocessor is responsible for module operation and control. The BRC microprocessor is a 32-bit processor that runs from a 32-megahertz clock. The microprocessor executes synchronous access to long word memories and an asynchronous access to all byte ports. Since the microprocessor is responsible for module operation, it communicates with all blocks of the BRC circuitry. The microprocessor operating system instructions and the function code library reside in the read only memory (flash ROM). The microprocessor carries out all control responsibilities as it executes the control strategy set up in its function block configuration.

The microprocessor constantly triggers the machine fault timer (MFT) circuit. If the microprocessor or software fails, the MFT circuit times out, issues a board wide reset, and the status LED turns red. This condition is a fatal module error.

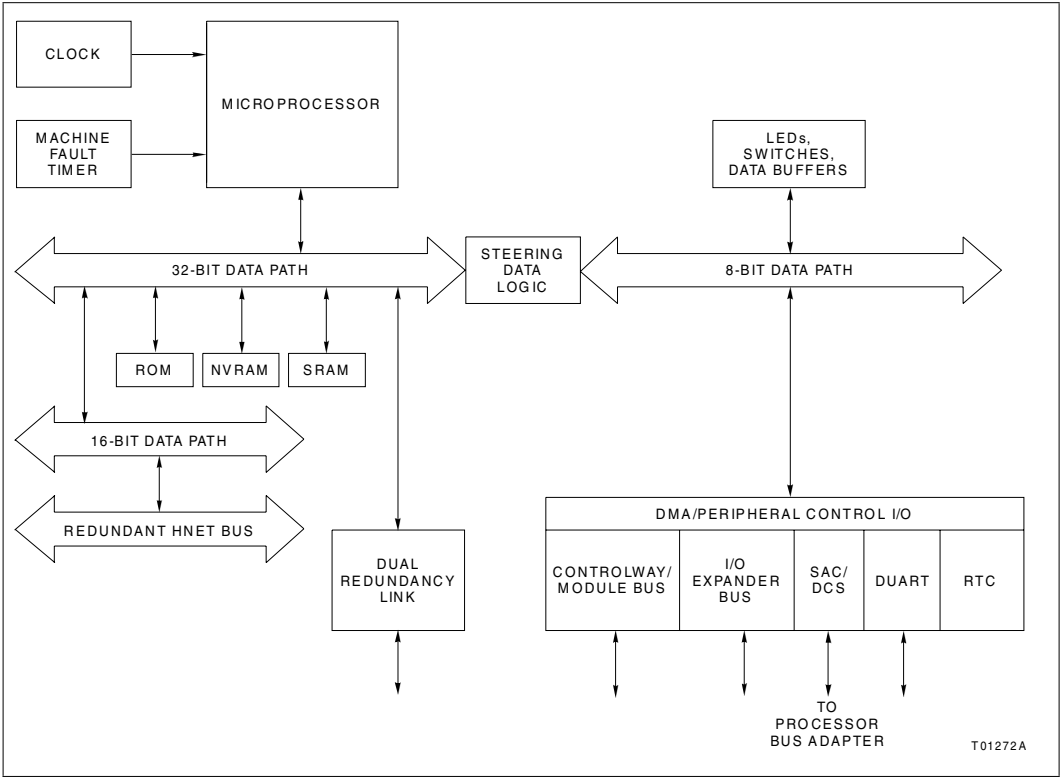


Figure 2-1. Functional Block Diagram

Clock and Real-Time Clock

The clock section provides the clock signals to drive the microprocessor and associated peripheral devices. The clock/timer section also includes a real-time clock (RTC).

Memory

The BRC memory is made up of one megabyte of flash ROM memory, two megabytes of SRAM memory, and 512 kilobytes of NVRAM memory.

The flash ROM memory holds the operating system instructions for the microprocessor. The SRAM memory provides temporary storage and a copy of the system configuration. The NVRAM memory holds the system configuration (control strategy designed with function codes) and files for Batch, Basic, C,



and UDF applications. NVRAM memory retains whatever information it has, even when it loses power.

Direct Memory Access

The DMA section enables the various communication links to do direct data transfers to and from RAM memory without processor intervention. Communication links that support direct memory access are the I/O expander bus, the dual redundancy link, the station serial link, and Controlway. ABB-designed chips control DMA activity.

The DMA process greatly reduces the amount of work the microprocessor needs to do when making data moves. This greatly increases the speed of the BRC module by not overloading the microprocessor with the work associated with data moves. The microprocessor does not have to execute data moves and is free to do other tasks.

Controlway

The Controlway is a high speed communication bus between Harmony rack controllers. The BRC module uses this bus to communicate with other control modules within a Harmony control unit. It provides a one-megabaud, peer-to-peer communication link that can support up to 32 devices. The Controlway interface is provided by a custom integrated circuit that links the BRC module to the Controlway. It has full DMA capabilities (allowing for quicker operation), and two independent, redundant channels.

The redundant Controlway channels run through two paths on the module mounting unit backplane circuit. The BRC module transmits and receives data over both channels simultaneously. By receiving data through two channels, the BRC module can check its integrity. In this way, the Controlway minimizes the potential that a failure on a circuit board or backplane will cause loss of module communication.

The Controlway interface also allows the BRC module to run on module bus by operating in an 83.3-kilobaud mode (switch selectable). The module bus operation option is provided to support existing INFI 90 OPEN and Network 90[®] systems. A jumper allows the BRC module to be installed in systems using early Network 90 modules that require -30 VDC. The jumper

disconnects -30 VDC from pin four of connector P2 on the BRC module.

Redundancy Link

The redundancy link is a dual parallel link between a primary and backup BRC module in redundant configurations. As the primary module executes, the backup module waits in standby mode and receives a copy of block outputs over this link. If for any reason the primary module fails, the backup takes over without any process interruption.

NOTE: Firmware revision levels must be the same in both primary and secondary BRC modules. If the firmware revision level is different and a failover occurs, the redundant BRC module may operate erratically.

Two parallel channels of data and control signals connect by way of a processor bus adapter board. Each BRC module in a redundant configuration connect through PBA boards connected by redundant PBA cables. Both channels have parity protection.

If no Hnet or termination unit communication is needed, the primary and backup BRC modules connect by a BRC redundancy kit. The BRC redundancy kit contains two Harmony I/O hood connection assemblies and a redundant PBA cable. The connection assemblies replace the redundant PBA boards and connect to each other through the redundant PBA cable.

Hnet Communication

An Hnet interface enables communication with Harmony I/O blocks. All communication functions are handled by the Hnet application-specific integrated circuit (ASIC). Hnet is a 16-bit interface that operates via control registers in the I/O section of BRC module memory and a one-megabyte memory space for shared SRAM.

Hnet and I/O expander bus communication can be active simultaneously if enabled, allowing the BRC module to utilize both Harmony I/O blocks and Harmony rack I/O modules to control a process. Function code 90 (S3) controls what combination of I/O interfaces are active. Three selections are available: enable Hnet only, enable Hnet and I/O expander bus, and enable I/O expander bus only.



Physical connection is provided by a direct connection from the BRC module P3 connector to the processor bus adapter board P5 connector. The processor adapter board mounts on the rear of a module mounting unit with the proper adapter brackets installed. It uses cables to connect to the Harmony block mounting columns. The PBA board provides Hnet physical layer functions, termination, isolation relays, and BRC module redundancy link.

I/O Expander Bus

The I/O expander bus interface is implemented using an ABB-designed integrated circuit. The microprocessor can select one of two modes of operation: DMA or auto mode. The BRC software selects the mode of operation. Mode selection is based on optimizing the number of bytes to be transferred. In either mode of operation, the microprocessor does not need to wait for each byte to transfer (as in previous controllers).

The BRC module connects to the I/O expander bus through the P2 connector on the module mounting unit backplane. It is an eight-bit parallel bus that provides the communication path for I/O data from Harmony rack I/O modules. The I/O expander bus supports 64 low power I/O modules.

I/O Section

The I/O section interface allows the microprocessor to read the switches that tell it how to operate and set the module address. This section also contains latches whose outputs connect to the status and error LEDs. This section monitors redundant modules and outputs a signal to the LEDs of the primary module. Upon failover, this output de-energizes and the output of the backup module energizes as it takes over. Additionally, the I/O section monitors the stop/reset pushbutton. When the pushbutton is pressed, the I/O section insures that the module completes any I/O functions before it stops the module.

Serial Channels

Two independent serial channels (RS-485) are available on the BRC module. Both serial channels are dedicated for language support (C or Basic) or sequence of events recording. Clear to send (CTS) and request to send (RTS) handshake signals are supported. A DUART circuit on the processor bus adapter

board supplies the serial channels with handshaking signals. Clock signals for the baud rate generator are derived from an on-board, 7.3728-megahertz oscillator.

The PBA board connects to an NTMP01 Multifunction Processor Termination Unit. Input/output signals enter or leave the PBA board through a cable connection to the termination unit. An NKTU01 or NKTU11 cable connects an NTMP01 termination unit. Standard D-type connectors are available on the termination unit.

To provide better noise immunity, both channels transmit and receive differential serial signals based on the RS-485 standard. These signals are converted to normal RS-232-C voltage levels by the termination unit. Each channel is capable of supporting standard RS-232-C baud rates up to 38.4 kilobaud. The termination unit also provides optical isolation to eliminate the possibility of introducing ground loops into the system from improper cable shield grounding. Channel A (the terminal channel) can be selected to operate without the RS-485/RS-232-C conversion allowing it to be used with differential terminals or programmable logic controllers (PLC).

Station Link

Station communication originates from a DUART circuit on the BRC module. This link controls the serial communication between the BRC module and the control stations. It has two modes of operation: Hnet transactions to a Harmony control I/O block, or direct operation by the BRC module via a termination unit.

The Hnet-to-CIO block mode of operation allows stations to be placed at greater distances from the BRC module because the CIO block contains the physical interface to the station. The BRC module is capable of communicating with a total of 128 IISAC01 stations attached to a total of 64 CIO-100/110 blocks.

NOTES: The system station maximum of 128 stations assumes that only Hnet-to-CIO block communication mode is used.

The BRC module can also directly connect to local IISAC01 stations. Eight stations can be supported at the five-kilobaud rate and up to 64 stations can be supported at the 40-kilobaud rate. The BRC module makes this direct local connection through the PBA board and appropriate termination hardware.



Support for bypass stations requires a Harmony control I/O module (IMCIS12, IMQRS12) configured on the I/O expander bus.

Power

Power requirements are 5 VDC for logic power and for line drivers/receivers. The Hnet interface derives all other power requirements from the 5 VDC logic power. Power for the module is supplied via the module mounting unit connection to the BRC module P1 connector. The PBA board receives 5 VDC logic power via its connection to the BRC module. The PBA board uses this power for Hnet termination, and to power the isolation relays.



Introduction

This section explains how to set up and install the Harmony bridge controller (BRC). Read, understand, and complete the steps in the order they appear before operating the BRC module.

The Harmony bridge controller requires a P-H-BRC-PBA1000 Processor Bus Adapter (PBA) board to support Hnet communication and BRC module redundancy. If no Hnet communication and termination unit is needed, a BRC redundancy kit may be used to support redundancy instead of the PBA boards. This section includes instructions for PBA board, BRC redundancy kit, and related cable installations.

NOTE: This module uses connections to the module mounting unit backplane that served other functions in earlier Network 90 systems. To avoid potential module damage, evaluate your system for compatibility prior to module installation. Earlier Network 90 systems applied -30 VDC to pins three and four of the module connector P1. This voltage is not required for Symphony and INFI 90 OPEN modules. In Symphony and INFI 90 OPEN systems, pin four is used for the Controlway bus.

If the system contains modules that require -30 VDC, set jumper J3 to the 30 VDC position (jumper pins one and two). Doing so allows the installation of the BRC module in a module mounting unit that uses -30 VDC and limits communication to module bus. Refer to Table 3-6 for more information about setting jumper J3.



Special Handling

Observe these steps when handling electronic circuitry:

NOTE: Always use ABB's field static kit (part number 1948385?1 - consisting of two wrist straps, ground cord assembly, alligator clip and static dissipative work surface) when working with the modules. The kit grounds a technician and the static dissipative work surface to the same ground point to prevent damage to the modules by electrostatic discharge.

1. **Use Static Shielding Bag.** Keep the modules in the static shielding bag until you are ready to install them in the system. Save the bag for future use.
2. **Ground Bag Before Opening.** Before opening a bag containing an assembly with semiconductors, touch it to the equipment housing or a 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 modules are properly grounded before using them.
5. **Ground Test Equipment.**
6. **Use an Antistatic Field Service Vacuum.** Remove dust from the module if necessary.
7. **Use a Grounded Wrist Strap.** 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 Dipswitches.** To avoid contamination of dipswitch contacts that can result in unnecessary circuit board malfunction, do not use a lead pencil to set a dipswitch.

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.

Dipswitches and Jumpers

This section explains how to configure and install the BRC module. After installing the module, a function block configuration must be created to define the functions the module will perform.

The BRC module has four configurable dipswitches, and four jumpers. Each dipswitch has eight poles. Figure 3-1 shows the location of the dipswitches and jumpers on the circuit board.

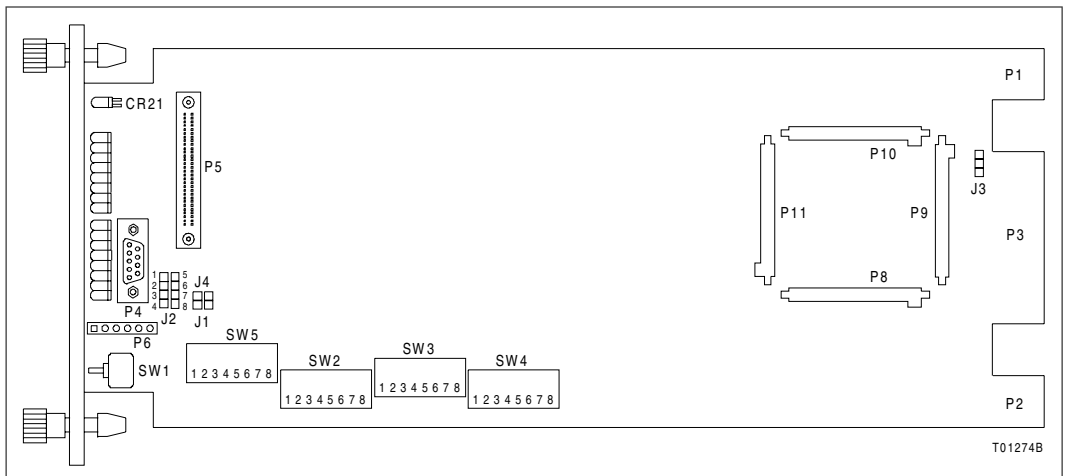


Figure 3-1. BRC Module Layout

Dipswitch SW5 sets the module address, bus speed, and operation mode (normal/diagnostic). Dipswitch SW2 sets module options, enables special operations, and enables diagnostic operations. Dipswitch SW4 sets module mounting unit and memory options. Dipswitch SW3 is not used.



Jumpers J1, J2, J3, and J4 define module functions and operation. Jumper J1 enables or disables the machine fault timer (MFT). Jumper J2 sets the diagnostic RS-232-C port for operation as data communication equipment (DCE) or data terminal equipment (DTE). Jumper J3 disengages -30 VDC from the module when installing it in a module mounting unit that supplies -30 VDC to other modules. Jumper J4 is reserved for use by ABB engineering.

Dipswitch poles marked not used must be set to the default settings listed in the appropriate table. The BRC module may not operate properly if these dipswitches are improperly set. Since factory settings do not reflect default settings, it is imperative that all dipswitch settings be checked before putting the module into operation.

Dipswitch SW5 - Module Address

Dipswitch SW5 sets the module address, enables module diagnostics, and sets the bus mode. The BRC module can have an address from zero through 31. Table 3-1 explains the functions set by dipswitch poles one through three. Dipswitch poles four through eight set the module address. Table 3-2 shows examples of how to set the address. Record the module address setting in the user setting portion of the table.

NOTES:

1. SW5 provides a module bus option to support existing INFI 90 OPEN and early Network 90 systems. All modules within a process control unit must be set to communicate on the same type of communication bus, either Controlway or module bus.
2. Module addresses of redundant BRC modules must be identical.

Table 3-1. Dipswitch SW5 Settings (Operation)

Pole	Setting	Function	User Setting
1	0	Normal run	
	1	Enable diagnostics using dipswitch SW2	
2	0	Not used - do not change setting	

Table 3-1. Dipswitch SW5 Settings (Operation) *(continued)*

Pole	Setting	Function	User Setting
3 ¹	0	Controlway (1 Mbaud)	
	1	Module bus (83.3 kbaud) or -30 VDC operation	

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

1. The module bus setting is for support of existing INFI 90 OPEN and Network 90 systems.

Dipswitch SW2 - Normal Operating Options

Dipswitch SW2 sets module options that are available when the BRC module is in normal operation. Refer to Table 3-3 for option setting information. The options listed in this table

Table 3-2. Dipswitch SW5 Settings (Address)

Address Example	Dipswitch Pole (Binary Value)				
	4 (16)	5 (8)	6 (4)	7 (2)	8 (1)
7	0	0	1	1	1
15	0	1	1	1	1
User setting					

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

apply to normal operation. Normal operation options are enabled when dipswitch SW2 pole one is set to closed (on). If dipswitch SW2 pole one is set to open (off), special operations are enabled. Refer to ***Dipswitch SW2 - Special Operations*** for a description.

NOTE: Poles one through seven must have the same setting for both modules when using redundant BRC modules.

Dipswitch SW2 - Special Operations

The special operations feature provides a means to configure the BRC module to perform a one-time special operation rather than entering its normal mode of operation. Setting dipswitch SW2 pole one to open (off) enables the special operation mode.



Table 3-3. Dipswitch SW2 Settings (Operating Options)

Pole	Setting	Function	User Setting
1	0	Disable special operations.	
	1	Enable special operations. Refer to <i>Dipswitch SW2 - Special Operations</i> .	
2	0	Disable online configuration.	
	1	Enable online configuration.	
3	0	Perform NVRAM checksum routine.	
	1	Inhibit NVRAM checksum routine. ¹	
4	0	Perform flash ROM checksum routine and file system check.	
	1	Inhibit flash ROM checksum routine and file system check.	
5	0	Enable file system check.	
	1	Disable file system check.	
6	0	Normal operation.	
	1	Compact configuration. The compact configuration function moves configured function blocks to the top of the NVRAM while moving free space to the bottom. To enable this function, open the pole and insert the module into the module mounting unit. After a short time (directly proportional to the configuration size), the module will return to the mode it was in prior to being reset for the compact operation. ²	
7	0	Normal operation.	
	1	Initialize. This operation destroys (erases) the module function block configuration. Initialize NVRAM (erase configuration). Leave pole open; insert module into module mounting unit. When group A LEDs 1, 2 and 4 are on, remove the module, put the pole in the closed position, and insert the module. The module is now ready to be configured. Use special operation two to initialize all NVRAM. NOTE: This pole must remain closed for normal operation.	
8	0	Primary BRC module.	
	1	Redundant BRC module. ³	

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

1. This setting is used by development personnel and should never be used for normal operation. The checksum provides additional module integrity and should be used whenever the module is controlling a process.

2. Leaving this option enabled causes the configuration to be compacted every time the module is reset, thereby increasing the startup time. This increase becomes more substantial as the size of the configuration increases. Therefore, do not leave this option enabled longer than necessary. Disabling this option stops any further compacting operations. It does not uncompact any previously compacted configuration.

3. When redundancy is used, poles one through seven on the redundant BRC module are set the same as the primary BRC module. Pole eight is set to closed (on) for the primary module and to open (off) for the secondary module.

Poles two through eight select the special operation. The following steps explain how to set the BRC module for special operations and reset it for normal operation. Table 3-4 shows the dipswitch settings and explains each special operation.

To use special operations:

1. Set dipswitch SW2 pole one to open (off).
2. Set poles two through eight per Table 3-4. Begin with special operation two.

Table 3-4. Dipswitch SW2 Settings (Special Operations)

Special Operation	Dipswitch Pole	Description
	1 2 3 4 5 6 7 8	
0	1 0 0 0 0 0 0 0	Force the BRC module into configure mode.
2 ¹	1 0 0 0 0 0 1 0	Initialize and format all NVRAM configuration space for Plant Loop protocol.
4	1 0 0 0 0 1 0 0	Cnet or INFI-NET protocol enable. This allows the BRC module to use the Cnet or INFI-NET capabilities.
5	1 0 0 0 0 1 0 1	Permit segment modification (allows change to segment scheme configured with function code 82, specification S1).
6	1 0 0 0 0 1 1 0	Enable time-stamping. This operation instructs the BRC module to generate time information with point data. It is applicable only to Cnet or INFI-NET systems.
9	1 0 0 0 1 0 0 1	Enable simulation mode.

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

1. Special operation two is for support of existing INFI 90 OPEN and Network 90 systems.

3. Insert the BRC module in its slot in the module mounting unit (refer to **Module Installation**).
4. When the special operation is complete, the status LED turns red and LEDs one through six illuminate.
5. Remove the BRC module.
6. Repeat Steps 2 through 8 for any other special operation desired.

NOTE: Do special operation two as the first step of the module installation. If installing the BRC module in a Cnet or INFI-NET environment, do special operation four next. For time-stamping, do special operation six next. To reverse Cnet or INFI-NET protocol or time-stamping, do operation two again.



7. When all special operations are complete, reset pole one on dipswitch SW2 to the closed (on) position.
8. Poles two through eight (module options) should be set for the desired BRC operation per Table 3-4.
9. Insert the BRC module in its slot. It will begin normal operation.

Dipswitch SW3 - Module Options

Dipswitch SW3 is not used. All poles should be set to closed (on).

Dipswitch SW4 - Module Options

Dipswitch SW4 sets additional module options. This dipswitch should be set to the user settings shown in Table 3-5.

Table 3-5. Dipswitch SW4 Settings (Module Options)

Pole	Setting	Function	User Setting
1 - 4	—	Not used	1
5	0	Disable SRAM multiple transfer	1
	1	Enable SRAM multiple transfer	
6	—	Not used	0
7	0	Disable data cache	1
	1	Enable data cache	
8	0	Disable instruction cache	1
	1	Enable instruction cache	

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

Jumpers

There are four jumpers (J1 through J4) on the BRC board. These jumpers are for special hardware applications. They define the RS-232-C diagnostic terminal as data terminal equipment (DTE) or data communication equipment (DCE), enable the machine fault timer and enable the module to oper-

ate in a module mounting unit that uses -30 VDC. Refer to Table 3-6 for an explanation of the functions set by jumpers.

NOTE: Jumper J1 is for ABB development personnel usage only. It is used to disable the machine fault timer circuit. If this function is disabled (jumper pins connected) and a problem develops in the BRC module, the module will not halt, which may result in configuration corruption and unpredictable module outputs.

Table 3-6. Jumpers Settings (J1 through J4)

Jumper	Setting	Function	User Setting
J1	Open	Not used. Must remain open for normal operation.	
J2	Vertical ¹	Sets the RS-232-C diagnostic port to operate as DCE.	
	Horizontal	Sets the RS-232-C diagnostic port to operate as DTE.	
J3	30V	Disconnects Controlway for operation in module mounting units that have -30 VDC (early Network 90).	
	MODB	Allows operation in module mounting units that have Controlway communication. This setting must be used if dipswitch SW5 selects Controlway.	
J4	Open	Not used. Must remain open for normal operation.	

NOTE:

1. Used by ABB service personnel. The J2 setting does not affect the module during normal operation.

Module Mounting Unit Preparation

Preparing the module mounting unit (MMU) consists of identifying the mounting slot, installing the required dipshunts, verifying the Controlway cable is installed, installing the processor bus adaptor (PBA) board, PBA board cables, and Hnet terminator.

Module Slot Assignments

Module placement within the module mounting unit is important. The BRC module requires a processor bus adaptor board to use Hnet and BRC redundancy, or a BRC redundancy kit when no Hnet and termination unit connection is needed. The BRC module connects to the PBA board or the BRC redundancy kit at the rear of the module mounting unit. Redundant BRC modules require mounting in adjacent MMU slots.



Dipshunts

WARNING **Disconnect power before installing dipshunts on the module mounting unit backplane. Failure to do so will result in contact with cabinet areas that could cause severe or fatal shock.**

No dipshunts are required if only Hnet is being used. If Hnet and the I/O expander bus are being used or only the I/O expander bus is being used, dipshunts are required to maintain bus continuity between all BRC modules associated with one I/O expander bus segment. Check to see that dipshunts are in place between all BRC module slots associated with one I/O expander bus. One dipshunt goes between each module slot to maintain bus continuity.

To check a particular BRC module configuration, read specification S3 of Extended Executive (function code 90). Specification S3 indicates if the BRC module is configured to operate in Hnet mode only, Hnet and I/O expander bus mode, or I/O expander bus mode only. Refer to the **Function Code Application Manual** for details on function code 90.

Controlway Cable

NOTE: Because of high speed transaction constraints, a maximum of eight related module mounting units (Controlways linked by cable) can be installed in one enclosure. The number of interconnected module mounting units should be kept to a minimum to avoid crosstalk and interference. Controlways cannot be cable linked from enclosure to enclosure.

Install the Controlway cable in module mounting units as follows:

1. Attach one end of the cable (twisted three-wire) to the bottom three tabs on the lower left of the module mounting unit backplane (facing from behind). Refer to Figure 3-2.
2. Attach (in the same sequence) the other end of the cable to the bottom three tabs on the lower left of the next module mounting unit backplane.

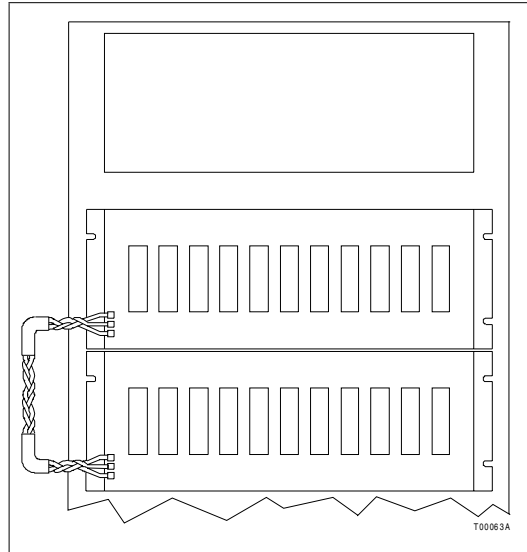


Figure 3-2. Controlway Cable Installation

PBA Board Installation

Hnet is the communication path between a BRC module and Harmony I/O blocks. A PBA board is required to connect a BRC module to Hnet, connect redundant Hnet to redundant BRC modules, and provide a connection point for the NTMP01 termination unit (TU). The termination unit provides a connection for the two auxiliary serial ports and a direct five-kilobaud or 40-kilobaud station link.

Mounting Bracket

A processor bus adapter mounting bracket is required to install the PBA board. The processor bus adapter mounting bracket consists of two mounting brackets and ten 5-40 × ½-inch long, self threading screws, ten spacers, and ten flat washers. Refer to the *Module Mounting Unit (IEMMU11, IEMMU12, IEMMU21, IEMMU22)* instruction for more information on the module mounting unit.

WARNING

Disconnect power before installing the processor bus adapter mounting bracket on the module mounting unit backplane. Failure to do so will result in contact with cabinet areas that could cause severe or fatal shock.



To install the PBA mounting bracket:

1. Turn off power to the cabinet.
2. Install one PBA mounting bracket to the top of the module mounting unit backplane assembly using five screws, flat washers, and spacers. Refer to Figure 3-3.
3. Install the remaining mounting bracket to the bottom of the backplane assembly using five screws, flat washers, and spacers.

Cable and Terminator

There are two cable and terminator installation procedures presented. The first procedure covers redundant installations (two PBA boards), the second procedure covers nonredundant (single PBA board) installations. Refer to Figure 3-4 for PBA board cable connector assignments.

Redundant PBA Boards. To install the PBA board cables for a redundant configuration (two PBA boards):

1. Install the redundant bridge controller link cable (P-MK-HRM-PBA2000A) to both boards. Insert one of the keyed connectors into the P4 connector on each PBA board.
2. Install the redundant processor bus adapter cable (P-MK-HRM-PBA1?00?).
 - a. Position the end socket connector on the PBA assembly bracket M3 studs. Install the two M3 nuts to maintain the position of the connector.
 - b. Install a terminator (P-HA-MS-TER10000) to the male socket connector on the redundant bridge controller link cable.

NOTE: The male socket connector is keyed, but the terminator is not. The terminator can be installed in any direction.

- c. Insert the next keyed connector on the cable into the P1 connector on the PBA board with the terminator mounted to it.
- d. Insert the next keyed connector on the cable into the P1 connector on the other PBA board.

e. Attach the final cable connector to the I/O column after the PBA boards have been mounted. Continue to **Mounting** in this section to mount the redundant PBA boards.

NOTE: Termination unit cables for the direct station link can be installed at any time after the PBA boards are installed. Refer to **Appendix B** for more information.

Single PBA Board. For a single PBA board (nonredundant configuration), install the redundant processor bus adapter cable (P-MK-HRM-PBA1?00?):

1. Position the end socket connector on the PBA assembly bracket M3 studs. Install the two M3 nuts to maintain the position of the connector.
2. Install a terminator (P-HA-MS-TER10000) to the male socket connector on the redundant bridge controller link cable.

NOTE: The male socket connector is keyed, but the terminator is not. The terminator can be installed in any direction.

3. Insert the next keyed connector on the cable into the P1 connector on the PBA board.
4. The next keyed connector on the cable is used only for redundant installations and has no purpose in single PBA board installations. It can be left hanging.
5. Attach the final cable connector to the I/O column after the PBA boards have been mounted. Continue to **Mounting** in this section to mount the PBA board.

NOTE: The termination unit cable for the direct station link can be installed at any time after the PBA board is installed. Refer to **Appendix B** for more information.

Mounting

There are two PBA board mounting procedures presented. The first procedure covers redundant installations (two PBA boards), the second procedure covers nonredundant (single PBA board) installations. Figure 3-3 shows an example of how the PBA board mounts to the PBA mounting bracket.

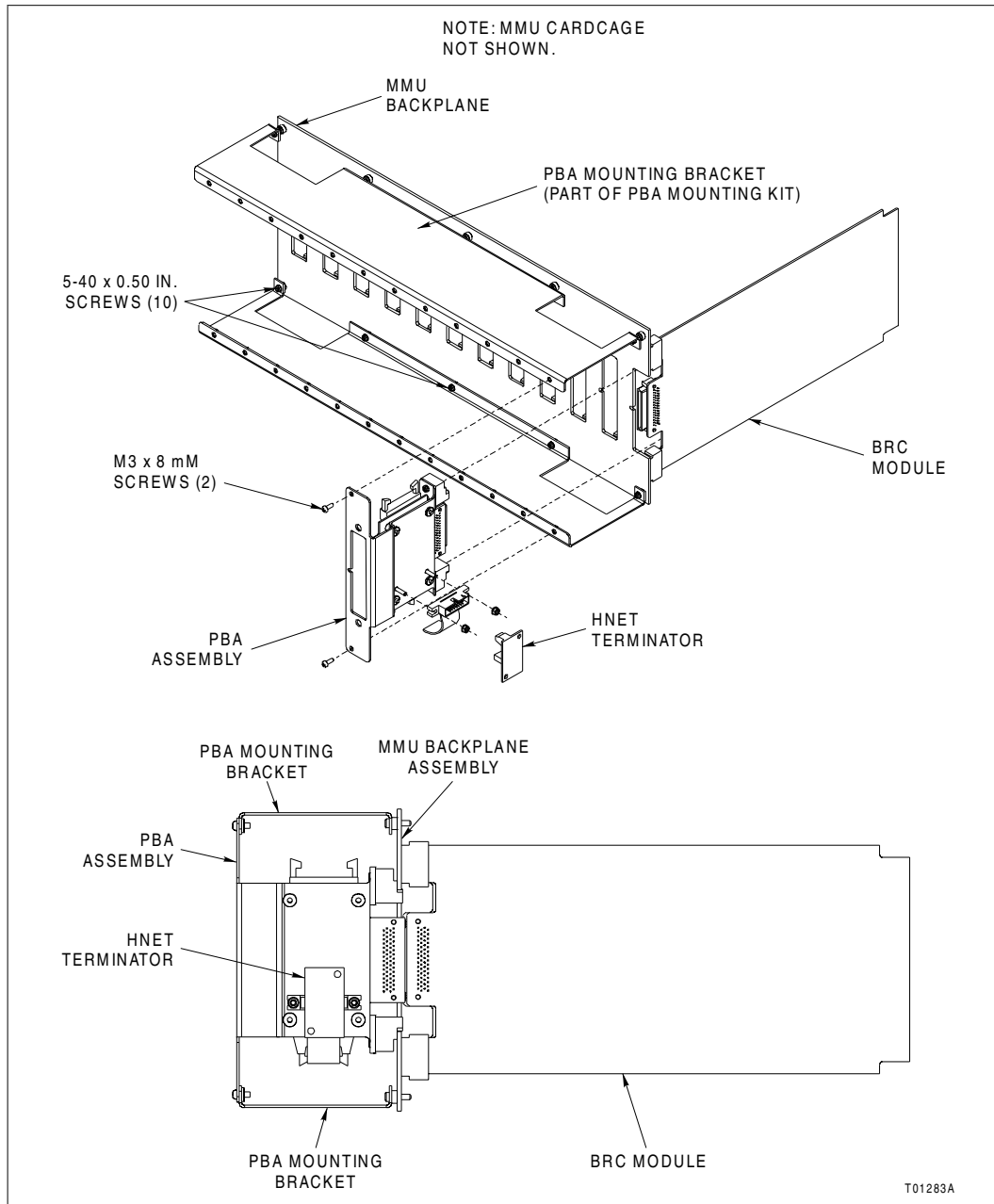


Figure 3-3. PBA Installation

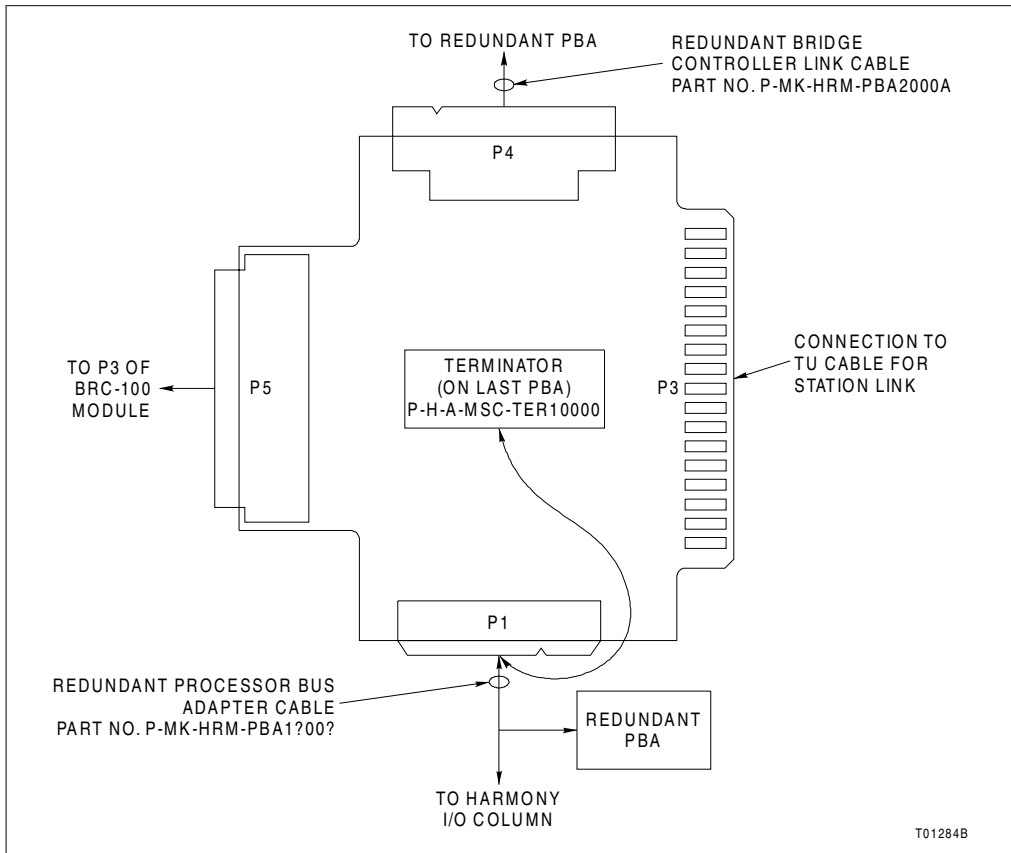


Figure 3-4. PBA Connector Identification

Redundant PBA Boards. To mount redundant PBA boards:

1. Locate and verify the adjacent MMU slots assigned to the redundant BRC modules. Refer to **Module Slot Assignments** in this section for more information.
2. For systems using both Hnet and I/O expander bus, or only I/O expander bus, verify there is a dipshunt installed between the adjacent MMU slots of each BRC module using a particular I/O expander bus. **Do not** install any MMU dipshunts in systems using only Hnet. Refer to **Dipshunts** in this section for information on how to verify a BRC module communication bus configuration.
3. Insert each processor bus adapter assembly into position in the module mounting unit.



4. Align the two holes on each PBA mounting bracket with the matching holes in the MMU backplane assembly mounting bracket. Install two M3 × 8-mm long, Phillips pan head screws and tighten to secure each PBA assembly to the PBA mounting brackets on the MMU backplane assembly.

Single PBA Board. To mount a single PBA board:

1. Locate and verify the MMU slots assigned to the BRC modules. Refer to **Module Slot Assignments** in this section for more information.
2. Insert the processor bus adapter assembly into position in the module mounting unit.
3. Align the two holes on the PBA mounting bracket with the matching holes in the MMU backplane assembly mounting bracket. Install two M3 × 8-mm long, Phillips pan head screws and tighten to secure the PBA assembly to the PBA mounting brackets on the MMU backplane assembly.

BRC Redundancy Kit Installation

When no Hnet communication and no termination unit is needed, the BRC redundancy kit (P-MK-HRM-BRC1000A) may be used to provide a redundant connection between a primary and backup BRC module.

To install the BRC redundancy kit:

1. Verify that the two BRC modules to be linked are mounted adjacent to each other in the MMU, and are properly configured.
2. Insert one Harmony I/O hood connector to the P3 connector of each BRC module. Refer to Figure 3-5.

NOTE: The ends of the redundant PBA cable are keyed. When installing, make sure that the slots between the hood connector and the redundant PBA cable are properly aligned.

3. Link the two hood connectors using the redundant PBA cable by firmly pressing the cable ends into the hood connector sockets. When the cable ends are in place, the hood connector brackets will snap into place. Refer to Figure 3-6.

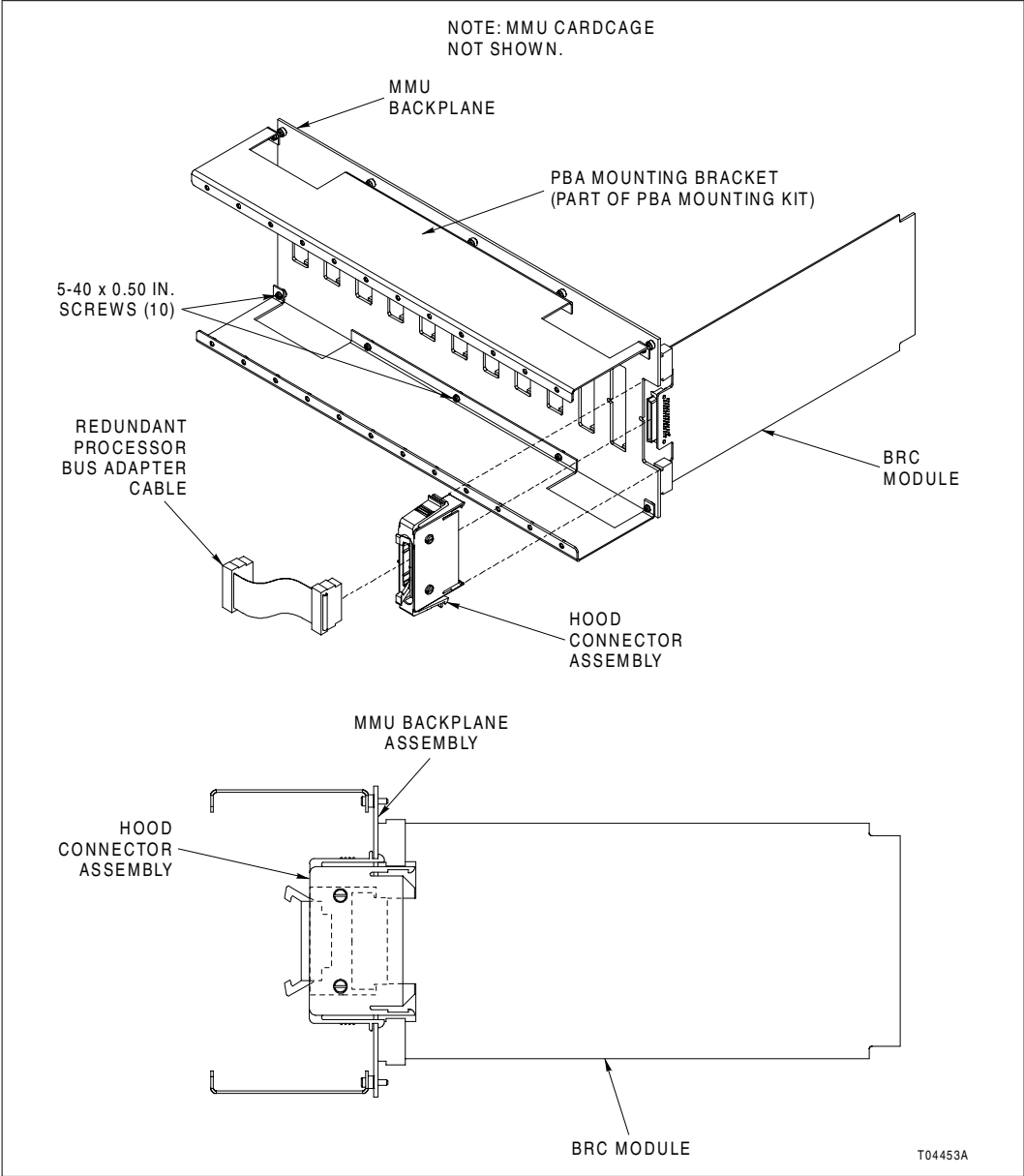


Figure 3-5. BRC Redundancy Kit Installation

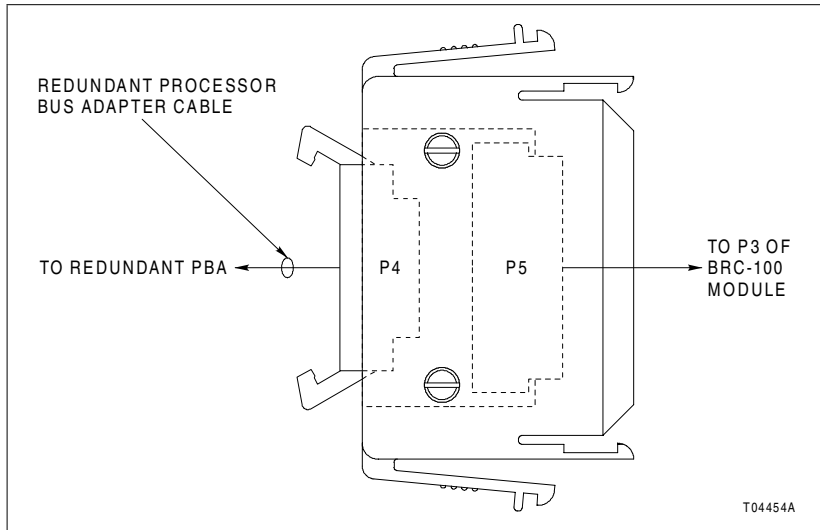


Figure 3-6. Hood Connector Assembly Connector Identification

Module Installation

CAUTION

Never operate the BRC module with the machine fault timer circuit disabled (jumper pins connected). Unpredictable module outputs and configuration corruption may result. The unpredictable module outputs may damage control equipment connected to the BRC module.

To avoid potential module damage, evaluate your system for compatibility prior to module installation. This module uses connections to the module mounting unit backplane that served other functions in early Network 90 systems.

Pre-Installation Check

To determine if the module mounting unit uses -30 VDC:

1. Locate the -30 VDC faston. It is the second faston from the top when viewing the module mounting unit from the rear.
2. Check for -30 VDC with respect to system common at the -30 VDC faston.

3. If -30 VDC is present, set jumper J3 and dipswitch SW5 to the appropriate positions.

Installation

Before installing BRC modules:

1. Check all module dipswitch, and jumper settings (normal and special operation).
2. Verify that the PBA board is attached to the proper slot on the module mounting unit backplane.
3. Modules can be installed and removed under power. When doing so, the status LED will turn red momentarily and then turn green. If it does not, refer to [Section 5](#) for troubleshooting information.

To install the BRC module:

1. Slide the BRC module into its mounting slot while guiding the top and bottom edges of the module along the top and bottom rails of its assigned slots in the module mounting unit.
2. Push on the faceplate until the rear edge of the module is firmly seated in the P5 connector of PBA board.

NOTE: If installing the BRC module under power, verify the status LED momentarily lights red and then remains green. If this does not occur, refer to the troubleshooting section for corrective action.

3. Turn the two latching screws $\frac{1}{2}$ -turn to lock the module in place. The module is locked into place when the open end of the slot on each latching screw faces the center of the faceplate.





Introduction

The first part of this section explains Harmony bridge controller (BRC) startup, LED indications, and stop/reset. The last part explains the three modes of operation.

Startup

When power is applied to the BRC module, it does an internal check, checks its configuration, and builds the necessary databases.

During startup of the primary BRC module, the front panel LEDs will go through the following sequence:

1. All front panel LEDs will illuminate red.
2. The status LED will change from red to green.
3. Group A LEDs one through six will go out.
4. Group B LEDs one through eight will go out.

During startup of the secondary BRC module, the front panel LEDs will go through the following sequence:

1. All front panel LEDs will illuminate red.
2. The status LED will change from red to green.
3. All LEDs will go out.
4. Group A LED seven will illuminate red and then go out.
5. Group A LED eight will illuminate red.

If the appropriate LEDs do not illuminate, refer to [Section 5](#) for more details.



Module LEDs

There are 17 LEDs visible through the faceplate window. Eight group A and eight group B LEDs relate to processor status, and one is the module status LED (Fig. 4-1).

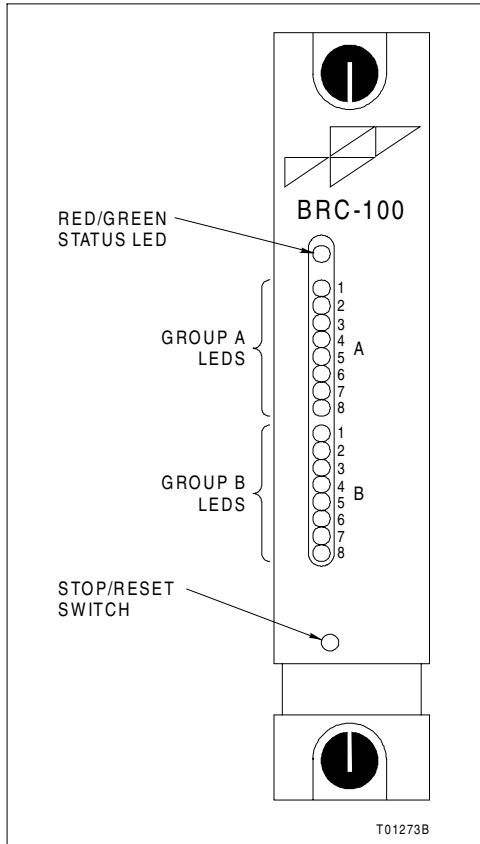


Figure 4-1. Front Panel

Front Panel LEDs

Group A LEDs display codes if a BRC module error occurs during normal operation. Additionally, in redundant configurations, they show which module is the primary and which is the secondary. Group B LEDs display the pass and fail counts when the module is in diagnostic mode. Group A LEDs seven and eight are on if the module is primary; group A LED eight is on if the module is secondary. If an error occurs, the status

LED turns red and the group A LEDs light up to display the error code (Table 5-1).

NOTE: Both groups of LEDs one through eight are on when the system is first coming up. This is normal. It means that the BRC module is not yet online.

Red/Green Status LED

The status LED is a red/green LED. It shows BRC operating condition. There are four possible states.

- Off No power to the BRC module, or the module is powered and jumper J4 is installed. Jumper J4 must remain open for normal operation. The status LED momentarily goes off when the microprocessor initializes on startup.
- Solid Green The BRC module is in execute mode.
- Flashing Green The BRC module is in execute mode but there is an NVRAM checksum error, or the module is in the configure or error mode.
- Solid Red The BRC module diagnostics have detected a hardware failure, configuration problem, etc., and stopped the module. Additionally, the group A LEDs will illuminate in a certain sequence to display the error code.

Stop/Reset Switch

NOTES:

1. Do not remove an operational BRC module under power unless the stop/reset switch has been depressed once and the module has halted (status LED is red and group A LEDs one through six are on). This procedure must be followed when removing a BRC module from a redundant configuration. An operational module must halt operation before control passes to the secondary module.
2. Firmware revision levels must be the same in both primary and secondary BRC modules. If the firmware revision levels are different and a failover occurs, the secondary BRC modules may operate erratically.

The stop/reset switch is a two-hit switch. It stops the BRC module in an orderly manner, preventing glitches on the bus. The switch is accessible through the opening on the faceplate (Fig. 4-1). Since the opening is small, pressing the switch requires a thin round object. Pressing the switch once stops



operation. Always stop the BRC module before removing it from the module mounting unit. Stopping the BRC module this way causes it to:

- Save and lock the BRC module configuration.
- Complete any nonvolatile memory write operations in progress.
- Deactivate all communication links.
- Transfer control from the primary BRC module to the secondary module in redundant configurations.
- Change the status LED color to red.

Once the BRC module is stopped, pressing the switch again resets the module. Use the reset mode to:

- Reset the default values to the power-up values.
- Recover from a BRC module time-out or operator-initiated stop.

NOTE: Pressing and holding the stop/reset switch provides no additional functionality over pressing and releasing the switch. It will only stop the BRC module. To stop the module, press and release the stop/reset switch. To reset the module, press the stop/reset switch a second time. If the BRC module halts due to an error (causing the status LED to turn red), a single push of the stop/reset switch resets the module.

Modes of Operation

The BRC module has three operating modes: execute, configure, and error.

- Execute The execute mode is the normal mode of operation. In this mode, the BRC module communicates with I/O blocks, rack I/O modules, and other control modules. It executes control configurations, reads inputs, and updates outputs. The BRC module also processes exception reports, and configuration and control messages.

Configure Use the configure mode to enter control strategies. The BRC module receives configuration commands over Controlway and changes the data in the NVRAM memory.

NOTE: The process of configuring the BRC module requires information from at least two documents. The *Function Code Application Manual* contains all of the information needed to design a control strategy. The instruction for the particular configuration tool being used (e.g., Composer) explains the steps required to download control strategies into module memory.

Error The BRC module goes into error mode whenever the built-in system diagnostics detect a hardware or configuration error. If a hardware error is detected, the module halts and displays the error code using group A LEDs one through eight. If an NVRAM error is detected, the status LED flashes, but the module continues to operate. This is possible because a copy of the configuration is held in SRAM and executed from there. The next time the module is reset it will not start up, but will fail with an NVRAM error.





Introduction

This section contains Harmony bridge controller (BRC) troubleshooting information. Included is information on module error codes, troubleshooting flowcharts, diagnostic routines, and the module status summary.

Error codes provide specific module fault information and appropriate corrective action. Troubleshooting flowcharts provide a quick look at hardware associated problems that may occur during module installation and startup. Diagnostic tests help determine if there is a problem with module components or circuitry. They are useful for testing the module when the system is down or there is some other means of controlling the process. For example, use the backup module (if redundant modules are installed) to control the process while testing the primary module. The module status summary is a 16-byte module status record that provides summary flags for error conditions, module type, and firmware revision level.

Error Codes

BRC module error codes are listed in Table 5-1. The module displays error codes on group A LEDs. Table 5-2 lists status LED states and other conditions that are indicated by LEDs.

Table 5-1. Error Codes

Code ¹	LED	Condition	Corrective Action
	8 7 6 5 4 3 2 1		
01	0 0 0 0 0 0 0 1	NVRAM checksum error	Initialize NVRAM. If error recurs call ABB field service.
02	0 0 0 0 0 0 1 0	Analog input calibration	Check I/O module error.
03	0 0 0 0 0 0 1 1	I/O module status bad	Check module status and I/O modules.
05	0 0 0 0 0 1 0 1	Configuration error (undefined block)	Check module status undefined block (modules referenced).



Table 5-1. Error Codes (continued)

Code ¹	LED	Condition	Corrective Action
	8 7 6 5 4 3 2 1		
06	0 0 0 0 0 1 1 0	Configuration error (data type mismatch)	Check module status (data type) modules.
08	0 0 0 0 1 0 0 0	Trip block activated	Check module status.
0A	0 0 0 0 1 0 1 0	Software programming error	Internal error. If error recurs, call ABB field service.
0B	0 0 0 0 1 0 1 1	NVRAM initialized	Confirm that NVRAM is initialized; no action is required.
0C	0 0 0 0 1 1 0 0	NVRAM opened for write	Initialize NVRAM. If error recurs, call ABB field service.
0D	0 0 0 0 1 1 0 1	Intermodule link error	Check the cable connection between primary and secondary BRC modules at the PBA board.
0E	0 0 0 0 1 1 1 0	Redundancy IDs the same	Put position 8 of SW2 in the opposite position of the primary module SW2 position 8.
0F	0 0 0 0 1 1 1 1	Primary failed, backup cannot take over, configuration not current	Check configuration. Correct any faulty values. Execute the configuration.
10	0 0 0 1 0 0 0 0	Primary failed, backup cannot take over, data not check pointed	Check configuration. Correct any faulty values. Execute the configuration.
11	0 0 0 1 0 0 0 1	Error during write to nonvolatile memory	
12	0 0 0 1 0 0 1 0	Backup and primary module addresses are different	Set addresses the same.
13	0 0 0 1 0 0 1 1	ROM checksum error	Contact ABB field service.
14	0 0 0 1 0 1 0 0	BRC set for INFI-NET/Superloop but in a Plant Loop environment	Reformat BRC module.
17	0 0 0 1 0 1 1 1	Duplicate Controlway address detected	Set address to unique value in PCU.
1D	0 0 0 1 1 1 0 1	Hnet failure	Check Hnet cabling and connections to PBA board, terminations, and Harmony I/O blocks. Replace the BRC module if Hnet cabling and connections check out.
20	0 0 1 0 0 0 0 0	C program format error	Repeat configuration download.
21	0 0 1 0 0 0 0 1	File system error	Check file directory, replace bad file.

Table 5-1. Error Codes (continued)

Code ¹	LED 8 7 6 5 4 3 2 1	Condition	Corrective Action
22	0 0 1 0 0 0 1 0	Invoke C error	Check C program and invoke C blocks, correct and rerun.
23	0 0 1 0 0 0 1 1	User write violation	Check C program, correct and rerun.
24	0 0 1 0 0 1 0 0	C program stack overflow	
25	0 0 1 0 0 1 0 1	Configureable Logic Interface Function Code incompatible with firmware	Check firmware revision level. Verify that it supports the revision the CLIF was compiled for.
28	0 0 1 0 1 0 0 0	User defined function (UDF) block number reference invalid	Check configuration. Fix block configuration. Fix block reference.
29	0 0 1 0 1 0 0 1	UDF function block cannot read program	Check configuration. Fix UDF block file.
2A	0 0 1 0 1 0 1 0	Not enough memory for UDF	Revise configuration.
2B	0 0 1 0 1 0 1 1	Missing UDF declaration	Add function code 190 to configuration.
2C	0 0 1 0 1 1 0 0	Wrong UDF type	Put correct UDF type in configuration.
2D	0 0 1 0 1 1 0 1	Missing UDF auxiliary	Put function code 198 in block configuration.
2E	0 0 1 0 1 1 1 0	UDF compiler and firmware incompatible	Check firmware revision level. Verify that it supports UDF.
2F	0 0 1 0 1 1 1 1	Basic program error	Check Basic program, correct and rerun.
30	0 0 1 1 0 0 0 0	Primary active during failover attempt	Replace primary and/or backup to determine faulty module.
31	0 0 1 1 0 0 0 1	Memory or CPU fault	Replace BRC module. If error recurs, call ABB field service.
32	0 0 1 1 0 0 1 0	Address or bus error	Reset BRC module. If error recurs, replace BRC module.
33	0 0 1 1 0 0 1 1	Illegal instruction	
34	0 0 1 1 0 1 0 0	Internal error - trace/privilege violation	
35	0 0 1 1 0 1 0 1	Internal error - spurious/unassigned exception	Reset BRC module. If error recurs, replace BRC module.
36	0 0 1 1 0 1 1 0	Internal error - divide by 0 or check instruction	
37	0 0 1 1 0 1 1 1	Internal error - undefined trap	Restart BRC module. If error recurs, replace BRC module.
38	0 0 1 1 1 0 0 0	Board level hardware error	Contact ABB field service.



Table 5-1. Error Codes *(continued)*

Code¹	LED 8 7 6 5 4 3 2 1	Condition	Corrective Action
3F	0 0 1 1 1 1 1 1	Normal stop	None.
40	0 1 0 0 0 0 0 0	Backup - cold takeover ready	
80	1 0 0 0 0 0 0 0	Backup - hot takeover ready	
C0	1 1 0 0 0 0 0 0	Primary - operating	
XX ²	—	Unknown	Contact ABB field service.

NOTES:

1. Code numbers are hexadecimal digits.
2. This symbol represents any LED combination not specifically addressed in this table.

Table 5-2. Status LED and Other Conditions

LED	Condition	Corrective Action
Status	Off	Check power.
		Check module seating.
		Check jumper J4. Remove if installed.
		If power and seating are okay, remove the module and replace with identically configured module.
	Red	Press reset button. If LED remains red, remove the module and replace with identically configured module.
Green	None - normal.	
Group A 6/7/8	Off	Check power.
		Check module seating.
		If power and seating are okay, remove the module and replace with identically configured module.
	Red	None - indicates primary module is in simulation mode.
Group A 7/8	Off	Check power.
		Check module seating.
		If power and seating are okay, remove the module and replace with identically configured module.
Red	None - indicates primary module.	

Table 5-2. Status LED and Other Conditions *(continued)*

LED	Condition	Corrective Action
Group A 8	Off	Check power.
		Check module seating.
		If power and seating are okay, remove the module and replace with identically configured module.
	Red	None - indicates backup module in redundant configuration.

Flowcharts

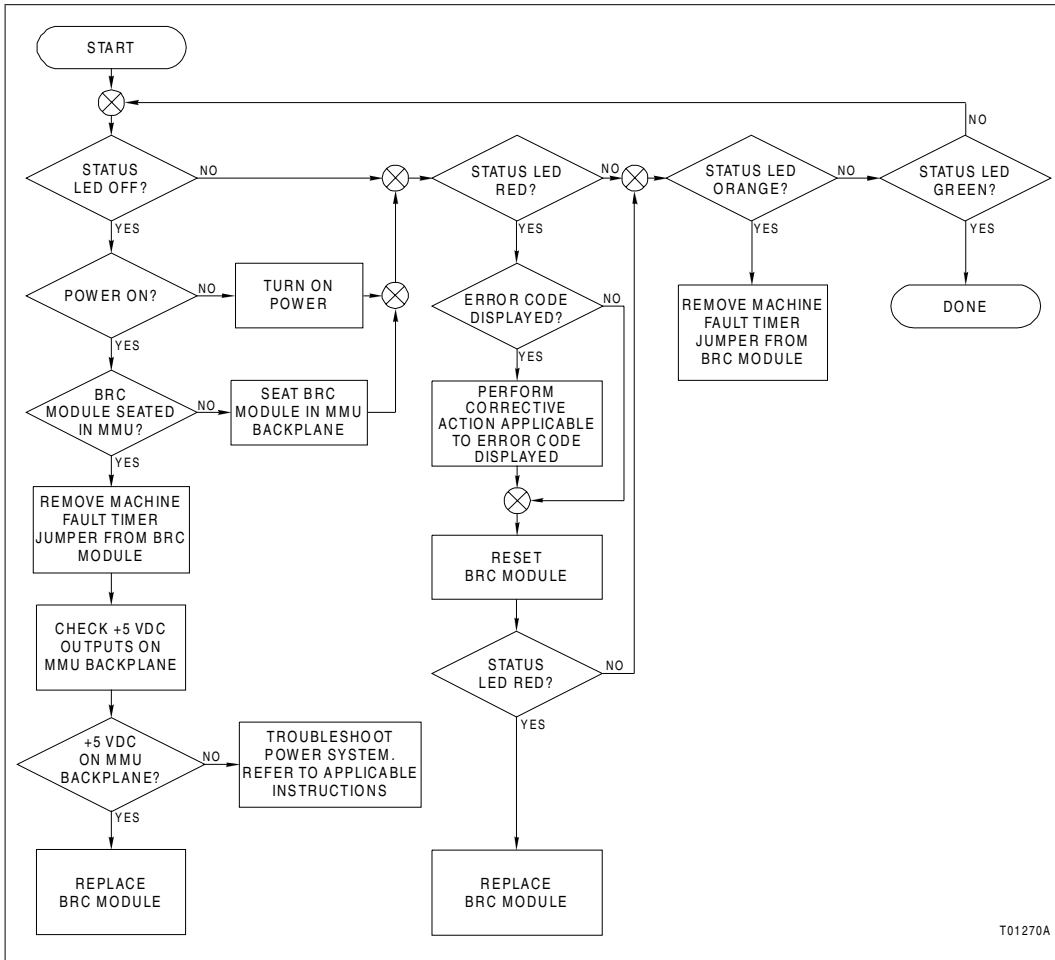
The flowcharts in Figures 5-1 and 5-2 provide a quick look at hardware related problems that may occur during module installation and startup. Use the flowcharts to troubleshoot problems that may have occurred because of improper hardware installation.

Diagnostics

The BRC firmware contains diagnostic routines that can be invoked during module power up. These routines verify the proper operation of the module components and circuitry. Putting the BRC module in the diagnostic mode allows the module to perform a variety of diagnostic tests but suspends normal operation. Therefore, use it during installation to check module integrity, when the system is down, or transfer system control to a backup BRC module to check a currently operating module. Refer to **Diagnostic Test Selection** in this section for information on how to use the diagnostic routines. Table 5-5 lists each test routine and gives a brief description.

Overview

Use the BRC dipswitches to select the required diagnostic routine. Diagnostic test results display on the BRC module front panel LEDs. Both group and individual tests can be executed. The typical procedure is to select a diagnostic routine to execute, set the module dipswitches accordingly, reset the module, and observe the results on the faceplate LEDs. If the halt on error feature is disabled, the selected test runs repeatedly until the module is reset and another test is selected. If halt on



T01270A

Figure 5-1. Troubleshooting Flowchart (Serial Port)

error feature is enabled, the test stops and the LEDs display the failure.

An additional module is required for I/O expander bus communication tests. To test I/O expander bus communications:

1. Set the dipswitches on the IMDSO14 (DSO) module and the BRC module to the settings in Table 5-3.
2. Insert the DSO module in the same module mounting unit (MMU) as the BRC module.

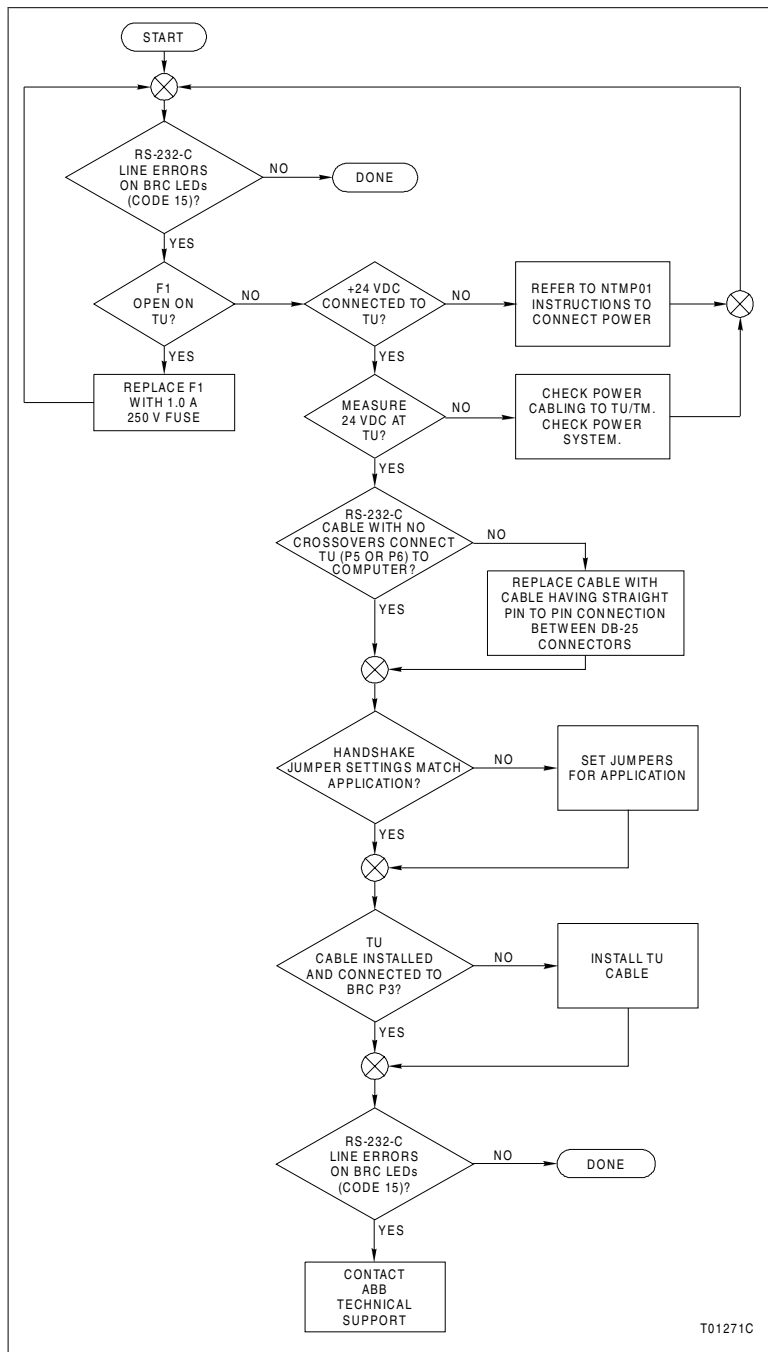


Figure 5-2. Troubleshooting Flowchart (Status LED)


Table 5-3. DSO and BRC Setup for I/O Expander Bus Test

Module	Address Dipswitch	Pole							
		1	2	3	4	5	6	7	8
IMDSO14	S1	0	0	0	0	1	1	1	1
BRC-100	SW3	0	0	0	0	1	1	1	1

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

3. There must be continuity between the DSO and BRC modules on the I/O expander bus (i.e., I/O expander bus dipshunts inserted with straps intact between the DSO and BRC modules). The modules do not need to be in adjacent slots.

An additional NTMP01 termination unit (TU) is required for redundancy link and SAC link tests.

Diagnostic Test Selection

Pole one of dipswitch SW5 must be set to the open (off) position to put the module into the diagnostic mode. The remaining poles on dipswitch SW5 are used to select the module address and communication bus mode. They should remain in their normal operating position. Use dipswitch SW2 to select diagnostic tests. Table 5-4 defines the function of each pole of dipswitches SW2 and SW5.

Table 5-4. Diagnostic Dipswitch Settings

Dipswitch	Pole	Setting	Function
SW5	1	1	Diagnostics mode. Test selected with SW2.
	2	0	Not used.
	3	0	Controlway mode.
		1	Module bus mode.
	4 - 8	0 - 31 (dec)	Module address. Refer to Table 3-1.
SW2	1	0	Special operations disabled.
	2	0	Not used.
	3 - 8	0 - 2B (hex)	Test number (ID). Refer to Table 5-5.

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

On dipswitch SW2, poles three through eight select the diagnostic test. Pole eight is the least significant bit (binary weight one); pole three is the most significant bit (binary weight 32). Refer to Table 5-5 for test ID values. Pole one selects a special operations feature. When enabled, the BRC module will halt test execution whenever the selected test detects an error. The number of the failing test is displayed on the group A LEDs (Fig. 5-3). The group B LEDs display the pass/fail count. Refer to Table 5-5 for a description of each diagnostic test.

Table 5-5. Diagnostic Tests

Test Name	Test-ID	Description
Switches and LEDs	00	Byte value of all dipswitches are exclusive ORed together. Results are displayed on LEDs. Status LED is off for even or on for odd total.
CPU	01	Verifies CPU instruction set is operational.
ROM	02	Calculates checksum of ROM and compares it to value stored in ROM during programming.
RAM	03	Performs walking one test. Clears, verifies, sets and verifies all RAM. Test includes byte, word and long word accesses.
NVRAM	04	Verifies read and write function of NVRAM.
Timer	05	Initializes DUART timer for 1-msec interrupts and then waits for it to time-out.
Real-time clock	06	Verifies real-time clock is functioning.
I/O expander bus stall	07	Sets a latch enabling a level seven interrupt to occur.
Controlway	08	Sends series of bytes to Controlway verifying timing and transfer status.
Dispatcher IRQ2	09	Issues software dispatcher request and waits for interrupt to occur.
DUART 0	0A	Tests (in local loopback mode) both serial channels of DUART circuitry that supports the RS-232-C/RS-485 serial ports.
DUART 1	0B	Tests (in local loopback mode) both serial channels of DUART circuitry that supports station link and debug port.
Immediate INT	0C	Sets and resets all interrupt levels verifying proper operation.
Hnet (local loop back)	0D	Test Hnet interface in local loop back mode. Checks Hnet ASIC operation including both channel A and B, shared RAM, timers, time-sync, registers, etc.
ID ROM	0E	Reads CRC code from ID-ROM.
Unused	0F	—
Group test 1	10	Executes tests 01 through 0F.



Table 5-5. Diagnostic Tests (continued)

Test Name	Test-ID	Description
I/O expander bus test ¹	11	BRC module performs status read and verifies the IMDSO14 (address 15) responds over I/O expander bus. IMDSO14 LEDs count successful tests.
Unused	12	—
SAC link controller/station	13/23	Test station link (IISAC01) communication between a BRC module acting as a controller and another BRC module acting as a station. Checks the ability to perform direct memory accessed data transfers across the RS-485 station link at 40-kilobaud rate. Requires two BRC modules (redundant) and the appropriate PBA and redundancy cabling. The master BRC module will provide pass/fail indication; the station BRC module will display data received and transmitted.
Redundancy link primary/backup	14/24	Tests communications between redundant BRC modules. Checks the ability to perform direct memory accessed data transfers across both redundancy link channels. Requires two BRC modules (redundant) and the appropriate PBA and redundancy cabling or BRC redundancy kit. Set one module to test 14 (primary); the other to test 24 (backup). The primary BRC module will provide pass/fail indication; the backup BRC module will display data received and transmitted.
Hnet	16/21	Tests Hnet communication between a BRC module acting as a master and another BRC module acting as an I/O device. Checks the ability to both transmit and receive Hnet messages. Requires two BRC modules (redundant or nonredundant) and the appropriate PBA, Hnet cabling, and termination hardware. Set one BRC module to test 16 (master); the other to test 21. Both BRC modules provide pass/fail indication. NOTE: A Harmony I/O block set at test 21 can also serve as the I/O device. This is the recommended setup for testing Hnet.
Unused	15-1F	—
Group test 2	20	Executes tests 01 through 1F.
SAC station and redundancy link backup	22	Displays running count of bytes received by backup BRC module when primary BRC is executing test 20. Provides the common functionality of both tests 23 and 24.
I/O expander bus fault time halt ²	25	Arms the fault timer and allows the I/O expander bus clock to stall. This checks the BRC module ability to disengage from the I/O expander bus in the event it can no longer drive the expander bus clock. This test passes if module halts with a 0x55 pattern displayed on the LEDs. Fails if module continues to operate with any other pattern displayed on the LEDs.

Table 5-5. Diagnostic Tests (continued)

Test Name	Test-ID	Description
NVRAM retention - data storage ²	26	Stores a known data pattern in NVRAM for testing by the NVRAM retention - data check test 27. Halts with LED pattern 0x55 if test has completed writing data. NOTE: Remove power from module prior to running the NVRAM retention - data check test. If practical leave module unpowered for one hour prior to running the data check test.
NVRAM retention - data check	27	Verifies NVRAM holds data pattern stored in test 26. Provides normal pass/fail indication.
Unused	28	—
Stop pushbutton ²	29	Verifies proper pushbutton operation. Passes if after pressing the stop pushbutton once, LED display changes from 0x29 to 0x55 with the red/green LED red.
Memory management unit ²	2A	Verifies the ability of the memory management unit hardware to detect legal and illegal accesses to the BRC module memory address space. Passes if the module halts with the LED pattern 0x23 (user write violation halt code). Fails if the module continues to operate or halts with any other LED pattern.
Station link	2B	Tests the BRC module ability to communicate with a single IISAC01 station set at a 40-kilobaud rate and station address seven. Passes if the bar graphs of the station ramp up and no E01 error occurs.

NOTES:

1. Requires the IMDSO14 module (Table 5-3).
2. Test is not continuous. The BRC module halts and displays a nonstandard pass/fail indication.

LED Display

The front panel LEDs (Fig. 5-3) are used during diagnostic mode operation to display test results.

On module reset, all front panel LEDs turn on. Next, the BRC module reads the dipswitches, executes the selected test, and displays the result on the group A and B LEDs. Group A LEDs display the test number on LEDs one through six. If LED eight is on, the test failed. The display is latched on for $\frac{1}{4}$ -second for viewing ease, then the LEDs blank out for about $\frac{1}{8}$ -second, and the test is repeated. Group B LEDs display a running tally of successes and failures. LEDs one through four tally the passes; LEDs five through eight tally the failures.

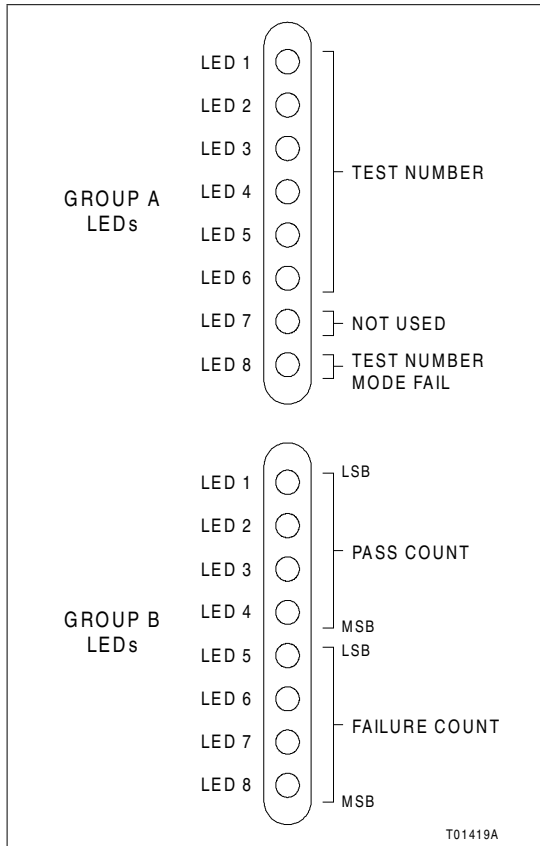


Figure 5-3. LEDs - Pass/Fail

If a test fails with the special operations feature selected (dipswitch SW2, pole one on), the status LED turns red. The test number that failed is displayed on the group A LEDs.

For group tests (10, 20), each test is run in numerical order. On a failure, group A LED eight flashes and LEDs one through six display the test number that failed. When all tests in the group are done, the error count is incremented and displayed on the group B LEDs.

Module Status Summary

The BRC module has a 16-byte module status record that provides summary flags for error conditions, module type, and firmware revision level. Table 5-6 shows the fields of the BRC

status report. Table 5-7 lists the definition of each field within the module status report. Refer to the appropriate human system interface (HSI) instruction for an explanation of how to access the module status report.

Table 5-6. Status Report

Byte	Bit							
	7	6	5	4	3	2	1	0
1	ES	Mode		Type				
2	FTX	BAC	RIO	LIO	CFG	NVF	NVI	DSS
3	Error code							
4	Error code descriptor (1)							
5	Error code descriptor (2)							
6	ETYPE							
7	CWA	CWB	R1F	R2F	PF	Unused	HnetA	HnetB
8	SIME	SIMR	SIMT	Unused				
9	RA	RB	Unused					
10	PRI	CFC	Unused	CHK	RID	RDEXP	OCE	RDEET
11	Unused	Unused	Unused	SOA	RNO	Unused	Unused	Unused
12-13	Unused							
14	Module nomenclature							
15	Revision letter (ASCII)							
16	Revision number (ASCII)							

Table 5-7. Status Report Field Descriptions

Byte	Field	Field Size or Value	Description
1	ES	80	Error summary: 0 = good, 1 = errors.
	Mode	60	Module mode: 00 = configure, 10 = error, 11 = execute.
	Type	1F	Module type code: (15) ₁₆ = Enhanced status.
2	FTX	80	First time in execute: 0 = no, 1 = yes.
	BAC	40	Backup status: 0 = good, 1 = bad.
	RIO	20	Summary remote input status: 0 = good, 1 = bad.
	LIO	10	Summary local input status: 0 = good, 1 = bad.
	CFG	08	Online configuration changes being made.
	NVF	04	Summary NVRAM failure status: 0 = good, 1 = fail.



Table 5-7. Status Report Field Descriptions *(continued)*

Byte	Field	Field Size or Value	Description
2 <i>(continued)</i>	NVI	02	Summary NVRAM initialized state: 0 = no, 1 = yes.
	DSS	01	Digital station status: 0 = good, 1 = bad.
3 - 5 Byte 3 is displayed on the front panel LEDs when the module is in ERROR mode.	Error code	3 4 5	
		01 01 —	NVRAM error: Write failure Checksum failure Bad data Reset during write.
		02 —	
		03 —	
		FF —	
		02 (1) (2)	Analog input reference error: (1), (2) = block number of control I/O module block.
		03 (1) (2)	Missing I/O module or expander board: (1), (2) = block number of I/O module or station.
		05 (1) (2)	Configuration error – undefined block: (1), (2) = block number making reference.
		06 (1) (2)	Configuration error – input data type is incorrect: (1), (2) = block number making reference.
		08 (1) (2)	Trip block activated: (1), (2) = block number of trip block.
		0F — —	Primary module has failed and the redundant module configuration is not current.
		10 — —	Primary module has failed and the dynamic RAM data in the redundant module is not current.
		11 — —	NVRAM write failure error.
		20 — —	Program format error - inconsistent format table.
		21 (1) (2)	File system error: (1), (2) = file number.
		22 (1) (2)	Invoke C error: (1), (2) = block number making reference.
24 (1) (2)	C program stack overflow: (1), (2) = block number making reference.		
28 (1) (2)	User defined function (UDF) reference is invalid: (1), (2) = block number making reference.		
29 (1) (2)	UDF block cannot read program file: (1), (2) = block number making reference.		
2A (1) (2)	Not enough memory for UDF: (1), (2) = block number making reference.		

Table 5-7. Status Report Field Descriptions (continued)

Byte	Field	Field Size or Value	Description
3-5 (continued)	Error code	2B (1) (2)	Missing UDF declaration: (1), (2) = block number making reference.
		2C (1) (2)	Wrong UDF type: (1), (2) = block number making reference.
		2D (1) (2)	Missing UDF auxiliary block: (1), (2) = block number making reference.
		2E (1) (2)	UDF compiler and firmware are incompatible: (1), (2) = block number making reference.
		2F (1) (2)	Basic program error: (1), (2) = line number of error.
6	ETYPE	1F	Enhanced module type = $(24)_{16}$ = BRC.
7	CWA	80	Controlway bus A failure: 0 = good, 1 = fail.
	CWB	40	Controlway bus B failure: 0 = good, 1 = fail.
	R1F	20	Redundancy link channel 1 failure: 0 = good, 1 = fail.
	R2F	10	Redundancy link channel 2 failure: 0 = good, 1 = fail.
	—	—	Unused.
	—	—	Unused.
	HnetA	02	Hnet channel A failure: 0 = good, 1 = fail.
HnetB	01	Hnet channel B failure: 0 = good, 1 = fail.	
8	SIME	80	Simulation enabled: 0 = normal operation, 1 = simulation active.
	SIMR	40	Simulation running/frozen: 0 = simulation frozen, 1 = simulation running.
	SIMT	20	Simulation time rate: 0 = real-time, 1 = slow/fast time.
	—	—	Unused.
	—	—	Unused.
	—	—	Unused.
	—	—	Unused.
	—	—	Unused.
9	RA	80	Hnet channel A relay fault: 0 = good, 1 = fail.
	RB	40	Hnet channel B relay fault: 0 = good, 1 = fail.
	—	—	Unused.
	—	—	Unused.
	—	—	Unused.



Table 5-7. Status Report Field Descriptions *(continued)*

Byte	Field	Field Size or Value	Description
9 <i>(continued)</i>	—	—	Unused.
	—	—	Unused.
	—	—	Unused.
10	PRI	80	Module is primary versus backup; set to 1 in the primary module.
	CFC	40	Configuration current (latched until backup is reset). Set when LED 7 is enabled (1 = on or blinking) on the backup module.
	—	—	Unused.
	CHK	10	Backup has completed checkpointing (latched until backup is reset). Always set to 0 on the primary module. Follows LED 8 (1 = on or blinking) on the backup module.
	RID	08	Redundancy ID. Follows setting of redundancy ID pole on the dipswitch.
	RDEXP	04	Redundancy expected. Always set to 1 on the backup module. Follows state of function code 90, specification S3, ones digit on the primary module.
	OCE	02	Online configuration is enabled. Follows setting of online configuration enable pole on dipswitch.
	RDDDET	01	Redundancy detected (latched until module is reset or it changes from backup to primary or primary to backup). Set to 1 when a properly configured redundant module is detected.
11	—	—	Unused.
	—	—	Unused.
	—	—	Unused.
	SOA	10	Status output alarm. Indicates the status of the system +24 volt power and the I/O block power (logic and field power for a single cabinet). 0 = OK, 1 = alarm.
	RNO	08	Redundancy NVRAM overrun (latched indication). Set to 1 in primary module if NVRAM checkpoint overruns have occurred. NVRAM checkpoint overruns cause the primary module to reset the backup module.
	—	—	Unused.
	—	—	Unused.
	—	—	Unused.
12-13	—	00	Unused.

Table 5-7. Status Report Field Descriptions (continued)

Byte	Field	Field Size or Value	Description
14	—	FF	Module nomenclature: $(05)_{16} = \text{BRC}$.
15	—	FF	Revision letter (in ASCII code), for example, $(46)_{16} = \text{F}$, $(47)_{16} = \text{G}$.
16	—	FF	Revision number (in ASCII code), for example, $(30)_{16} = 0$.

Card Edge Connectors

The BRC module has two card edge connectors and one high density connector that provide it with power and I/O channels. Tables 5-8 through 5-11 list the BRC card edge connector pin assignments. The PBA board has four connectors. Tables 5-12 through 5-15 list the PBA board connector pin assignments.

NOTE: The pin assignments for the PBA board connector P5 are identical to the pin assignments for the BRC module connector P3 listed in Table 5-10.

Table 5-8. P1 Pin Assignments (BRC)

Pin	Signal	Pin	Signal
1	5 VDC	2	5 VDC
3	Unused	4 ¹	-30 VDC or Controlway/module bus B
5	Common	6	Common
7	Unused	8	Unused
9	Power fail interrupt	10	Unused
11	Controlway/module bus A	12	Unused

NOTE:

1. This pin connects the BRC module to -30 VDC when it is used in -30 VDC Network 90 systems. When the BRC module is used in newer Network 90, INFI 90 OPEN, and Symphony systems, this pin connects the module to the redundant Controlway channel.

**Table 5-9. P2 Pin Assignments (BRC)**

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	Bus clock - BCLK	10	Sync
11	Unused	12	Unused

NOTE: All data bits are true low.

Table 5-10. P3 Pin Assignments (BRC)^{1,2}

Pin	Signal	Pin	Signal
1	Common	31	Receive data A (+) ⁴
2	Digital output 1 ³	32	Receive data B (-) ⁴
3	Red1 data7	33	Receive data B (+) ⁴
4	Red1 data6	34	Clear to send A (-) ⁴
5	Red1 data5	35	Clear to send A (+) ⁴
6	Red1 data4	36	Clear to send B (-) ⁴
7	Red1 data3	37	Clear to send B (+) ⁴
8	Red1 data2	38	Transmit data A (-) ⁴
9	Red1 data1	39	Transmit data A (+) ⁴
10	Red1 data0	40	Transmit data B (-) ⁴
11	Red1 parity ³	41	Transmit data B (+) ⁴
12	Red1 BCLK ³	42	Request to send A (-) ⁴
13	Red1 busy ³	43	Request to send A (+) ⁴
14	Red2 data7	44	Request to send B (-) ⁴
15	Red2 data6	45	Request to send B (+) ⁴
16	Red2 data5	46	SOA ³
17	Red2 data4	47	5 VDC
18	Red2 data3	48	Hnet transmit data A
19	Red2 data2	49	Hnet receive data A
20	Red2 data1	50	Hnet transmit clock A
21	Red2 data0	51	Hnet receive clock A
22	Red2 parity ³	52	Hnet transmit data B
23	Red2 BCLK ³	53	Hnet receive data B

Table 5-10. P3 Pin Assignments (BRC)^{1,2} *(continued)*

Pin	Signal	Pin	Signal
24	Red2 busy ³	54	Hnet transmit clock B
25	5 VDC	55	Hnet receive clock B
26	DCS/SAC link A (-)	56	Hnet transmit enable A ³
27	DCS/SAC link A (+)	57	Hnet transmit enable B ³
28	DCS/SAC link B (-)	58	PBA/Hnet relay A
29	DCS/SAC link B (+)	59	PBA/Hnet relay B
30	Receive data A (-)	60	Common

NOTES:

1. PBA adaptor connector P5 pin assignments listed in Table 5-15 are identical to the pin assignments listed in this table.
2. Harmony I/O Hood Connector P5 pin assignments listed in Table 5-16 are identical to the pin assignments listed in this table.
3. Data bit or signal is true low.
4. Serial signal from the RS-232-C DUART.

Table 5-11. P4 Pin Assignments (BRC)

Pin	Signal	
	DTE	DCE
2	Receive data	Transmit data
3	Transmit data	Receive data
7	Request to send	Clear to send
8	Clear to send	Request to send
9	Ground	Ground

Table 5-12. P1 Pin Assignments (PBA)

Pin	Signal	Pin	Signal
1	Common	2	Hnet channel 1C
3	5 VDC	4	Hnet channel 1D
5	5 VDC	6	Status output alarm 1
7	Common	8	Common
9	Status output alarm 2	10	5 VDC
11	Hnet channel 2D	12	5 VDC
13	Hnet channel 2C	14	Common

NOTE: All signals are true low.

**Table 5-13. P3 Pin Assignments (PBA)**

Pin	Signal	Pin	Signal
1	SAC/DCS link A (-)	16	SAC/DCS link A (+)
2	SAC/DCS link B (-)	17	SAC/DCS link B (+)
3 - 6	NC	18 - 21	NC
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	Digital output 1 (-)	30	Digital output 1 (+)

Table 5-14. P4 Pin Assignments (PBA)

Pin	Signal	Pin	Signal
1	Common	21	Red1 parity ¹
2	Red2 busy ¹	22	Common
3	Common	23	Red1 data0
4	Red2 BCLK ¹	24	Red1 data1
5	Common	25	Red1 data2
6	Red2 parity ¹	26	Red1 data3
7	Common	27	Red1 data4
8	Red2 data0	28	Red1 data5
9	Red2 data1	29	Red1 data6
10	Red2 data2	30	Red1 data7
11	Red2 data3	31	Common
12	Red2 data4	32	NC
13	Red2 data5	33	NC
14	Red2 data6	34	NC
15	Red2 data7	35	NC
16	Common	36	NC
17	Red1 busy ¹	37	NC
18	Common	38	NC

Table 5-14. P4 Pin Assignments (PBA) *(continued)*

Pin	Signal	Pin	Signal
19	Red1 BCLK ¹	39	NC
20	Common	40	NC

NOTE:

1. Data bit or signal is true low.

Table 5-15. P5 Pin Assignments (PBA)

Pin	Signal	Pin	Signal
1	Common	31	Receive data A (+) ²
2	Digital output 1 ¹	32	Receive data B (-) ²
3	Red1 data7	33	Receive data B (+) ²
4	Red1 data6	34	Clear to send A (-) ²
5	Red1 data5	35	Clear to send A (+) ²
6	Red1 data4	36	Clear to send B (-) ²
7	Red1 data3	37	Clear to send B (+) ²
8	Red1 data2	38	Transmit data A (-) ²
9	Red1 data1	39	Transmit data A (+) ²
10	Red1 data0	40	Transmit data B (-) ²
11	Red1 parity ¹	41	Transmit data B (+) ²
12	Red1 BCLK ¹	42	Request to send A (-) ²
13	Red1 busy ¹	43	Request to send A (+) ²
14	Red2 data7	44	Request to send B (-) ²
15	Red2 data6	45	Request to send B (+) ²
16	Red2 data5	46	SOA ¹
17	Red2 data4	47	5 VDC
18	Red2 data3	48	Hnet transmit data A
19	Red2 data2	49	Hnet receive data A
20	Red2 data1	50	Hnet transmit clock A
21	Red2 data0	51	Hnet receive clock A
22	Red2 parity ¹	52	Hnet transmit data B
23	Red2 BCLK ¹	53	Hnet receive data B
24	Red2 busy ¹	54	Hnet transmit clock B
25	5 VDC	55	Hnet receive clock B
26	DCS/SAC link A (-)	56 ¹	Hnet transmit enable A
27	DCS/SAC link A (+)	57 ¹	Hnet transmit enable B

**Table 5-15. P5 Pin Assignments (PBA)** *(continued)*

Pin	Signal	Pin	Signal
28	DCS/SAC link B (-)	58	PBA/Hnet relay A
29	DCS/SAC link B (+)	59	PBA/Hnet relay B
30	Receive data A (-)	60	Common

NOTES:

1. Data bit or signal is true low.
2. Serial signal from the RS-232-C DUART.

Table 5-16. P5 Pin Assignments (Hood Connection Assembly)

Pin	Signal	Pin	Signal
1	Common	31	Receive data A (+) ²
2	Digital output 1 ¹	32	Receive data B (-) ²
3	Red1 data7	33	Receive data B (+) ²
4	Red1 data6	34	Clear to send A (-) ²
5	Red1 data5	35	Clear to send A (+) ²
6	Red1 data4	36	Clear to send B (-) ²
7	Red1 data3	37	Clear to send B (+) ²
8	Red1 data2	38	Transmit data A (-) ²
9	Red1 data1	39	Transmit data A (+) ²
10	Red1 data0	40	Transmit data B (-) ²
11	Red1 parity ¹	41	Transmit data B (+) ²
12	Red1 BCLK ¹	42	Request to send A (-) ²
13	Red1 busy ¹	43	Request to send A (+) ²
14	Red2 data7	44	Request to send B (-) ²
15	Red2 data6	45	Request to send B (+) ²
16	Red2 data5	46	SOA ¹
17	Red2 data4	47	5 VDC
18	Red2 data3	48	Hnet transmit data A
19	Red2 data2	49	Hnet receive data A
20	Red2 data1	50	Hnet transmit clock A
21	Red2 data0	51	Hnet receive clock A
22	Red2 parity ¹	52	Hnet transmit data B
23	Red2 BCLK ¹	53	Hnet receive data B

Table 5-16. P5 Pin Assignments (Hood Connection Assembly)

24	Red2 busy ¹	54	Hnet transmit clock B
25	5 VDC	55	Hnet receive clock B
26	DCS/SAC link A (-)	56 ¹	Hnet transmit enable A
27	DCS/SAC link A (+)	57 ¹	Hnet transmit enable B
28	DCS/SAC link B (-)	58	PBA/Hnet relay A
29	DCS/SAC link B (+)	59	PBA/Hnet relay B
30	Receive data A (-)	60	Common
NOTES: 1. Data bit or signal is true low. 2. Serial signal from the RS-232-C DUART.			





Introduction

The reliability of any stand-alone product or control system is affected by the maintenance of the equipment. ABB 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 you in establishing good preventive maintenance practices. Select the minimum steps required to meet the cleaning needs of your system.

Personnel performing preventive maintenance should meet the following qualifications:

- Should be qualified electrical technicians or engineers that know the proper use of test equipment.
- Should be familiar with the Harmony bridge controller (BRC), 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 BRC module. The table lists the preventive maintenance tasks in groups according to their specified maintenance interval. Some tasks in Table 6-1 are self-explanatory. Instructions for tasks that require further explanation are covered under **Preventive Maintenance Procedures**.

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

Equipment and Tools Required

Listed are the tools and equipment required for maintenance:



- Antistatic vacuum.
- Clean, lint-free cloth.
- Compressed air.
- Non-abrasive eraser.
- Fiberglass or nylon burnishing brush.
- Foam tipped swab.
- Bladed screwdriver suitable for terminal blocks.
- Isopropyl alcohol (99.5 percent electronic grade).
- Natural bristle brush.

Table 6-1. Preventive Maintenance Schedule

Task	Frequency
Check cabinet air filters. Clean or replace them as necessary. Check the air filter more frequently in excessively dirty environments.	3 months
Check cabinet and BRC module and PBA board for dust. Clean as necessary using an antistatic vacuum.	
Check all BRC module and PBA board signal, power and ground connections within the cabinet. Verify that they are secure. See procedure.	
Check BRC and PBA circuit board, giving special attention to power contacts and edge connectors. Clean as necessary. See procedure.	12 months
Check BRC and BRC redundancy kit edge connectors (where applicable). Clean as necessary. See procedure.	12 months
Complete all tasks in this table.	Shutdown

Preventive Maintenance Procedures

Tasks from Table 7-1 that require further explanation include:

- Cleaning printed circuit boards.
- Checking signal, power and ground connections.

WARNING

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

Printed Circuit Board Cleaning

There are several circuit board cleaning procedures in this section. These procedures cover circuit board cleaning and

washing, cleaning edge connectors and circuit board laminate between edge connectors. Use the procedures that meet the needs of each circuit board. Remove all dust, dirt, oil, corrosion or any other contaminant from the circuit board.

Do all cleaning and handling of the printed circuit boards at static safe work stations. Observe the steps listed in **Special Handling** in Section 3 when handling printed circuit boards.

General Cleaning and Washing

If the printed circuit board needs minor cleaning, remove dust and residue from the printed circuit board surface using clean, dry, filtered compressed air or an antistatic field service vacuum cleaner. Another method of washing the printed circuit board is:

1. Clean the printed circuit board by spraying it with isopropyl alcohol (99.5% electronic grade) or wiping the board with a foam tipped swab wetted in isopropyl alcohol.
2. When the circuit board is clean, remove excess solvent by using compressed air to blow it free of the circuit board.

Edge Connector Cleaning

To clean edge connector contacts:

1. Use a solvent mixture of 80% isopropyl alcohol (99.5% electronic grade) and 20% distilled water.
2. Soak a lint-free cloth with the solvent mixture.
3. Work the cloth back and forth parallel to the edge connector contacts.
4. Repeat with a clean cloth soaked with the solvent mixture.
5. Dry the edge connector contact area by wiping with a clean lint-free cloth.

To clean tarnished or deeply stained edge connector contacts:

1. Use a non-abrasive eraser to remove tarnish or stains. Fiberglass or nylon burnishing brushes may also be used.
2. Minimize electrostatic discharge by using the 80/20 isopropyl alcohol/water solution during burnishing.



3. 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.

Checking Connections

Check all signal wiring, power and ground connections within the cabinet to verify their integrity. 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 must not be any motion done to loosen the connection.

NOTE: Power to the cabinet must be off while performing this task.

Verify that all cable connections are secure.



Introduction

Repair procedures are limited to module replacement. If the Harmony bridge controller (BRC) module or processor bus adapter (PBA) board fails, remove and replace it with another. Verify that firmware revision levels match and that the replacement module switch and jumper settings are the same as those of the failed module.

Module Replacement

Observe the steps under **Special Handling** in Section 3 when handling BRC modules.

NOTE: Do not remove a BRC module or PBA board under power unless the stop/reset switch on the BRC module has been depressed once and the module has halted (status LED is red and group B LEDs one through six are on). This procedure must be followed when removing a BRC module or PBA board from a redundant configuration. An operational primary BRC module/PBA board must halt operation before control passes to the secondary BRC module/PBA board.

To replace the BRC module:

1. Turn the two latching screws on the BRC module faceplate $\frac{1}{2}$ -turn either way to release it.
2. Grasp the screws and pull out the module from the module mounting unit (MMU).
3. Set all dipswitches and jumpers on the replacement BRC module to match the settings of the removed BRC module.

NOTE: Dipswitch SW3 is not used. Set all poles on dipswitch SW3 to closed (on).

4. Hold the module by the faceplate and slide it into its assigned MMU slot. Push until the rear edge of the module is firmly seated in the PBA board connector (for BRC modules controlling Harmony I/O blocks via Hnet) or the backplane



connector (for BRC modules controlling rack I/O modules via the I/O expander bus).

5. Turn the two latching screws on both modules $\frac{1}{2}$ -turn to lock the module in place. The module is locked into the module mounting unit when the open end of the slots on the latching screws faces the center of the module faceplate.

PBA Board Replacement

Observe the steps under **Special Handling** in Section 3 when handling a PBA board.

NOTE: Do not remove a BRC module or PBA board under power unless the stop/reset switch on the BRC module has been depressed once and the module has halted (status LED is red and group B LEDs one through six are on). This procedure must be followed when removing a BRC module or PBA board from a redundant configuration. An operational primary BRC module/PBA board must halt operation before control passes to the secondary BRC module/PBA board.

To replace the PBA board:

1. Turn the two latching screws on the BRC module faceplate $\frac{1}{2}$ -turn either way to release it.
2. Grasp the screws and pull the module from its P5 connection on the PBA board. It is not necessary to completely remove the BRC module from the module mounting unit.
3. Disconnect the redundant PBA ribbon cable from the P4 connector on the PBA board. Figure 3-4 identifies the PBA connectors.
4. Disconnect the processor bus adapter to Harmony mounting column cable from the P1 connector on the PBA board.
5. If the auxiliary serial channels or analog control stations are being used, disconnect the termination unit cable from the P3 connector on the PBA board.
6. To remove the PBA assembly, remove the two M3 \times 8-mm long, Phillips pan head screws that secure the PBA assembly to the PBA mounting brackets on the MMU backplane assembly.
7. If the PBA board being replaced has a terminator, remove the terminator from the existing PBA board and install it on the

replacement PBA board. The terminator must stay attached to the cable. Figure 3-3 shows the location of the terminator. A terminator should be installed on the last PBA board in a redundant configuration.

8. Insert the replacement processor adapter assembly (circuit board and mounting bracket) into position on the module mounting unit.

9. Align the two holes in the PBA mounting bracket with the matching holes in the MMU backplane assembly mounting bracket. Install two M3 × 8-mm long, Phillips pan head screws and tighten to secure the PBA assembly to the PBA mounting brackets on the MMU backplane assembly.

10. Connect the redundant PBA ribbon cable to the P4 connector on the replacement PBA board.

11. Connect the redundant processor bus adapter to Harmony mounting column cable to the P1 connector on the PBA board.

12. If the auxiliary serial channels or analog control stations are being used, connect the termination unit cable to the P3 connector on the replacement PBA board.





Parts

Order parts without commercial descriptions from the nearest ABB sales office. Contact ABB for help determining the quantity of spare parts to keep on hand for your particular system. Tables 8-1 through 8-3 list Harmony bridge controller (BRC) related parts.

Table 8-1. Miscellaneous Nomenclatures

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
N	T	M	P	0	1	-	-	-	-	-	-	-	-	-	-	-	Multifunction processor termination unit
P	-	H	A	-	M	S	C	-	P	B	A	0	0	0	0	0	PBA mounting kit
P	-	H	A	-	M	S	C	-	T	E	R	1	0	0	0	0	Hnet terminator
P	-	H	C	-	B	R	C	-	1	0	0	0	0	0	0	0	Harmony bridge controller
P	-	H	C	-	B	R	C	-	P	B	A	1	0	0	0	0	Processor bus adapter
P	-	M	K	-	H	R	M	-	B	R	C	1	0	0	0	A	BRC redundancy kit

Table 8-2. Cable Nomenclatures

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
N	K	S	E	0	1	-	-	-	-	-	-	-	-	-	-	-	Serial extension cable (PVC)
N	K	S	E	1	1	-	-	-	-	-	-	-	-	-	-	-	Serial extension cable (non-PVC)
N	K	T	U	0	1	-	-	-	-	-	-	-	-	-	-	-	Termination unit cable (PVC)
N	K	T	U	1	1	-	-	-	-	-	-	-	-	-	-	-	Termination unit cable (non-PVC)
P	-	M	K	-	H	R	M	-	P	B	A	1	0	0	0	-	Redundant processor bus adapter to single mounting column cable Cable length: x 1 to 4 for 1.0 to 4.0 m (3.3 to 13 ft) – end mounted PBA connectors
P	-	M	K	-	H	R	M	-	P	B	A	1	T	0	0	-	Redundant processor bus adapter to two mounting columns cable Cable length: x 2 to 4 for 2.0 to 4.0 m (6.6 to 13 ft) – center mounted PBA connectors
P	-	M	K	-	H	R	M	-	P	B	A	2	0	0	0	A	Redundant bridge controller link cable – 0.5 m (1.6 ft)

Table 8-3. Miscellaneous Parts

Description	Part Number
Jumper	1946984?1





Introduction

Using online configuration in conjunction with redundant Harmony bridge controller (BRC) modules enables making configuration changes without affecting the primary BRC module or interrupting the control process.

Composer provides functions to guide the user through the online configuration process. These functions use the enhanced status information contained in byte ten of the module status report. Using Composer for online configuration is the preferred method. The information in this appendix explains how to manually perform online configuration.

In redundant BRC module configurations, the primary BRC module executes the process control logic while the backup BRC module tracks the configuration of the primary. Online configuration allows removing the backup (or secondary) module from the tracking mode and making configuration changes, without interrupting the process control operation of the primary module. It also supports conventional offline changes. When the backup module has been reconfigured, it can assume control with the new configuration while the original primary module assumes the backup role.

During startup of the new configuration in the backup module, it uses the current values of all process outputs in the primary module. This feature permits bumpless transfer of control to the new configuration.

Setup

Online configuration of redundant BRC modules requires two consecutive Controlway addresses to be reserved (n and $n+1$ where n is the primary address, $n+1$ is the backup). In normal operation, each member of the redundant pair has the same address as determined by the address dipswitch (SW5) settings. (If the Controlway address of the redundant pair is at four during normal operation, then automatically the address



of the backup BRC module is at five during online configuration.)

Set position two on the options dipswitch (SW2) of the backup and primary BRC modules to the open position to enable online configuration.

Operation

This appendix provides a step-by-step procedure for performing online configuration. Use a human system interface (HSI) with appropriate ABB configuration software to accomplish online configuration.

NOTE: Care must be exercised to avoid deleting blocks or adding blocks between existing ones. (Refer to the notes at the end of Step 2 in Table A-2 for further explanation).

In some user applications, BRC modules are remotely located and the operator is unable to view the group A LEDs. In these applications, the data from the second module status byte must be used. This appendix provides an outline procedure for online configuration, and shows both the state of LEDs seven and eight as well as the contents of the second module status byte (specifically bits seven, six, three and one). For each step of the online configuration process, both the contents of the status byte as well as the state of group A LEDs seven and eight (Fig. 4-1) are indicated in the margin.




A workstation running Conductor software and a computer running Conductor software are examples of HSI platforms that can be used to acquire module status reports. Refer to the instruction for the interface being used for the procedures to call up status reports.

Do not reset a BRC module before the LEDs or module status byte indicate that the module is available. Resetting a BRC module prematurely could result in unpredictable operation or loss of output data.

Table A-1 shows the symbols used in this section. Table A-2 and Figure A-1 illustrate the backup cycle. Table A-3 and Figure A-2 illustrate the primary cycle. For clarity, the term backup BRC module always refers to the original backup BRC module and the term primary BRC module always refers to the

original primary BRC module. When the roles are reversed for either unit, their status is carefully noted.

Table A-1. Legend of Symbols

Description	Primary	Backup
Module address	n	n+1
Second module status byte	Bit ¹ 7 6 5 4 3 2 1 0 0 1 x x 0 x 0 x	Bit ¹ 7 6 5 4 3 2 1 0 1 0 x x 1 x 0 x
LEDs 7 and 8. In the following tables, LED 7 is on top, LED 8 is on bottom.	 on  off  blinking	

NOTE: x = don't care, 1 = bit set, 0 = bit not set.
 bit 7 = first time in execute (most significant bit (MSB))
 bit 6 = backup BRC module status bad
 bit 3 = online configuration changes being made
 bit 1 = NVRAM default configuration

Backup Cycle

Step numbers correspond to the status of Figure A-1.

Table A-2. Backup Cycle









Primary	Backup	Procedure
n 00xx0x0x  	n+1 10xx0x0x  	1. Save a copy of the current configuration. This enables it to be easily restored if needed.
n 01xx0x0x  	n+1 00xx0x0x  	2. Place the backup BRC module in configure mode. The green LED of the backup BRC module blinks indicating configure mode. The module status also indicates configure mode. Configuration commands to the backup module are sent to the address of the primary BRC module plus one (n+1). The primary module now indicates that the backup module is not available for automatic failover. Bit 6 indicates this condition. To return to Step 1 without making any changes, place the backup module in execute mode and reset it after LED 8 illuminates or the primary status indicates 00xx0x0x. Resetting a BRC module causes all the LEDs on it to light momentarily before returning to normal status.



Table A-2. Backup Cycle (continued)

Primary	Backup	Procedure
<p>n 01xx0x0x</p>	<p>n+1 00xx1x0x</p>	<p>2. (continued)</p> <p>When changes are being made to the backup module, LED 7 blinks and bit 3 of the backup module is set indicating that the configurations of the backup and primary modules do not match. If these changes to the configuration are incorrect, return to Step 1 by an initialize of the backup module NVRAM while it is in configure mode.</p> <p>NOTE: When configuring the backup module, the following rules are strictly enforced by the module:</p> <ol style="list-style-type: none"> 1. Blocks can only be added in the block space at segment end. 2. A block existing in the primary module cannot be deleted. 3. A specification change cannot be made to a block already existing in the primary module if that change will affect the module RAM utilization factor (change memory requirements). <p>Any attempt to circumvent these rules will result in an appropriate error message.</p>
<p>n 01xx0x0x</p>	<p>n+1 00xx1x0x</p>	<p>3. When an error exists in the new configuration, the backup module enters error mode when initiating a transfer to execute mode command. Return to configure mode to fix the error. The green LED of the backup module blinks to indicate it is in the error or configure mode. The first byte of the module status also indicates the mode. Backup module LED 7 blinks and bit 3 of the module status is set to indicate that configuration differences exist between the primary and backup.</p>
<p>n 01xxxx0x</p>	<p>—</p>	<p>During steps 2, 3 and 4 of online configuration, the backup module is not capable of taking over as primary module because of the incomplete configuration or incomplete checkpoint data. If there is a complete failure of the primary module, the online configured backup will takeover as the primary module, but will be in error mode. All Harmony I/O blocks and I/O expander bus modules will enter their configured stall states.</p>
<p>n 01xx0x0x</p>	<p>n+1 00xx1x0x</p>	<p>4. The backup module can now be placed in execute mode provided no errors remain in the new configuration.</p> <p>Additional configuration changes can be made by entering configure mode (Step 2). If no changes have been made, a backup module reset returns the backup to the state of Step 1. If changes have been made, the backup must be put into configure mode and initialized to get to the state of Step 1.</p> <p>NOTE: The backup cycle step transition 3 to 4 occurs automatically after a successful Step 3 backup module execute. The transaction completion time depends on the BRC configuration.</p>

Table A-2. Backup Cycle (continued)

Primary	Backup	Procedure
n 01xx0x0x ● ●	n+1 10xx1x0x ○ ☀	5. When the checkpoint data for the old configuration is received from the primary module, the reconfigured backup module can assume the role of the primary module if a failure is detected in the old configuration (Step 8). However, the primary module still indicates that no backup is available when the configuration is different. Additional configuration changes can be made by entering configure mode (Step 2). If no changes have been made, a backup module reset returns the backup to the state of Step 1. If changes have been made, the backup must be put into configure mode and initialized to get to the state of Step 1.
n 01xx0x0x ● ●	n+1 00xx1x0x ○ ○	6. After the changes have been made, tell the reconfigured backup module to assume the role of the primary module by pressing and releasing the stop/release button on the backup module 2 times. The first time stops the module; the second time resets the module. The backup module comes up in execute mode with the configuration marked as valid.
n 01xx0x0x ● ●	n+1 10xx1x0x ☀ ○	7. Backup cycle step transitions 5 to 6 to 7 to 8 occur automatically after the Step 5 backup module reset. The time it takes to complete these transitions depends on BRC configuration. The status indicated in cycles 5, 6 and 7 may not be seen depending on the actual step transition times. The important status to wait on is indicated by Step 8. After the checkpoint data is updated, the backup module is ready to take over the duties of the primary module.
n 01xx0x0x ● ●	n+1 11xx1x0x ○ ☀	8. The backup module requests the primary module to shut down and assume the role of a hot backup (n+1). The backup module waits to act as the primary module (n). A hot backup retains the old configuration and control data and is ready to assume control if an error is detected in the new configuration.
n+1 01xx0x0x ○ ●	n 01xx1x0x ☀ ☀	9. The primary module has removed the bus clock (BUSCLK) and acts as a hot backup (n+1). The reconfigured backup module is now serving as the primary module (n). Before proceeding to the following commands, insure that LED/module status is as shown in Step 8. To return to Step 4, reset the backup module (n). This allows correcting a bad configuration. The primary module (n+1) must be reset at this point for the online configuration cycle to complete. Resetting the primary module (n+1), currently acting as the hot backup, tells it to get a copy of the new configuration.
n+1 10xx0x0x ○ ●	n 00xx0x0x ● ●	10. After the backup module copies the new configuration into the primary module, the cycle is complete. The backup module is now serving as the primary module (n) while the primary handles the backup role (n+1). The LED combination and module status is the opposite of Step 1, indicating the role reversal.

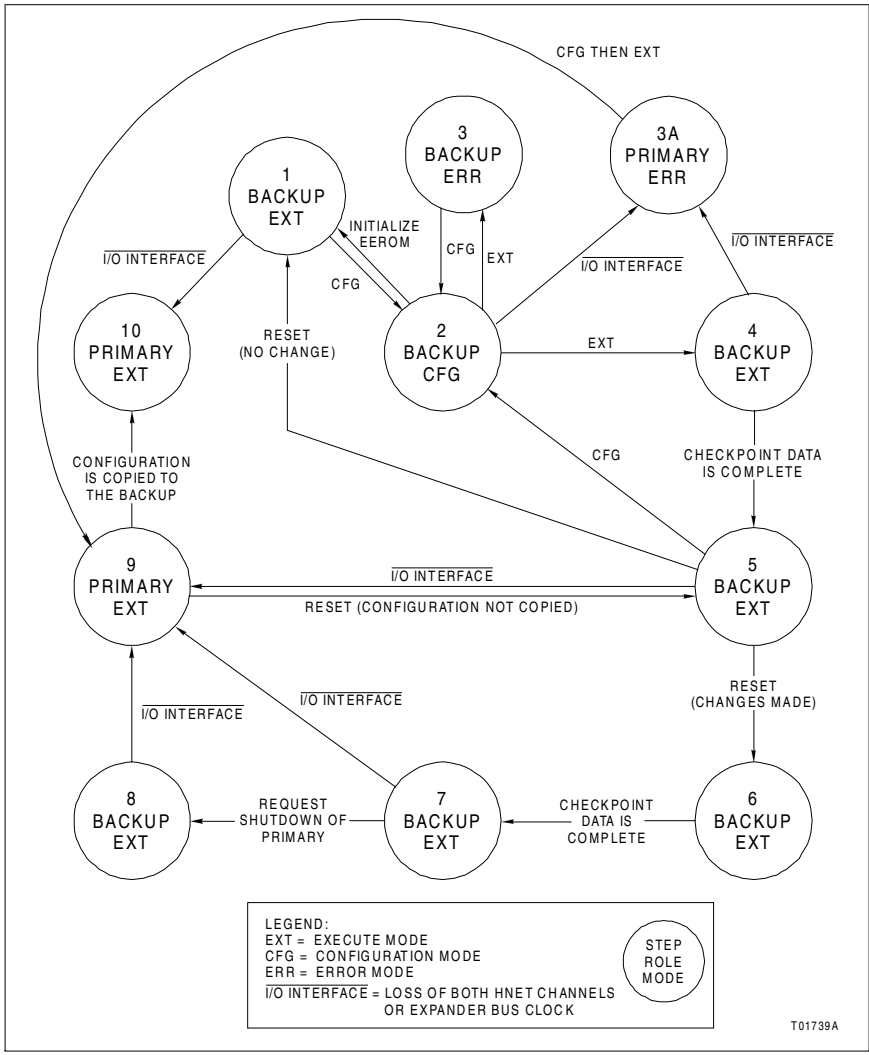


Figure A-1. Backup Cycle

Primary Cycle

Refer to Table A-3 for the primary cycle procedure. The step numbers in this cycle correspond to the states of Figure B-2. This information is provided for status purposes. Follow the backup cycle procedures to perform online configuration.

Table A-3. Primary Cycle

Primary	Backup	Procedure
n 01xx0x0x ● ●	n+1 10xx1x0x ○ ☀	1. The primary module is actively controlling the process. This represents the same juncture as Step 4 of the backup cycle.
n+1 01xx0x0x ○ ●	n 11xx1x0x ☀ ☀	2. When the shutdown request is received from the backup module (Step 7 of the backup cycle), the primary module stops executing and removes the bus clock (BUSCLK).
n+1 01xx0x0x ○ ●	n 01xx1x0x ☀ ☀	3. The primary module is now acting as the hot backup (n+1). All old configuration and block output information remains intact from when it is shut down in Step 2. If the new configuration is not operating as expected, the primary module, currently acting as the hot backup (n+1), can take control using the old configuration and block output information (returns to Step 1).
n+1 00xx0x0x ○ ○	n 00xx1x0x ☀ ☀	4. Resetting the primary module (n+1), currently acting as the hot backup, directs it to get a copy of the new configuration (Step 8 of the backup cycle).
n+1 10xx0x0x ● ○	n 00xx0x0x ● ●	5. When the new configuration has been copied, the backup module has completed its cycle and is now serving as the primary module.
n+1 10xx0x0x ○ ●	n 00xx0x0x ● ●	6. After the checkpoint data is complete, the primary module is now serving as the backup module and is ready to take over the control process with the updated configuration. The primary cycle is complete. This represents the same juncture as Step 10 of the backup cycle.

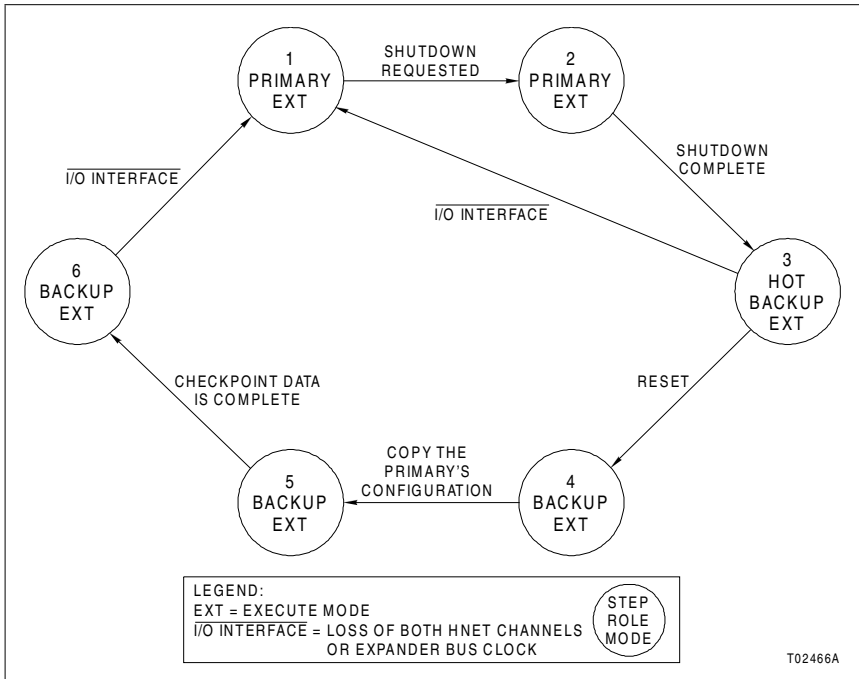


Figure A-2. Primary Cycle



Description

The Harmony bridge controller (BRC) and processor bus adapter (PBA) combination uses an NTMP01 termination unit to connect two auxiliary serial I/O ports and IISAC01 Analog Control Stations. Jumpers on the NTMP01 termination unit configure the two RS-232-C ports for data terminal equipment (DTE) or data communication equipment (DCE). One of the RS-232-C ports can be configured as an RS-485 port. Refer to the NTMP01 instruction for complete information on applications.

Figures B-1 through B-4 show the jumper configurations for jumpers J1 and J2. Figure B-5 shows the jumper configurations for jumpers J3 through J10. Figure B-6 shows the NTMP01 connector assignments and jumper locations. Figure B-7 shows how to connect redundant BRC modules and PBA boards.

Jumpers J11 and J12 are storage posts for extra jumpers. Jumper J13 is normally set with pins one and two connected. This connects the cable shielding pin of connector P7 to chassis ground. Jumper J18 configures the terminal serial port for RS-485 operation when pins two and three are connected and connector P7 is used instead of connector P5.

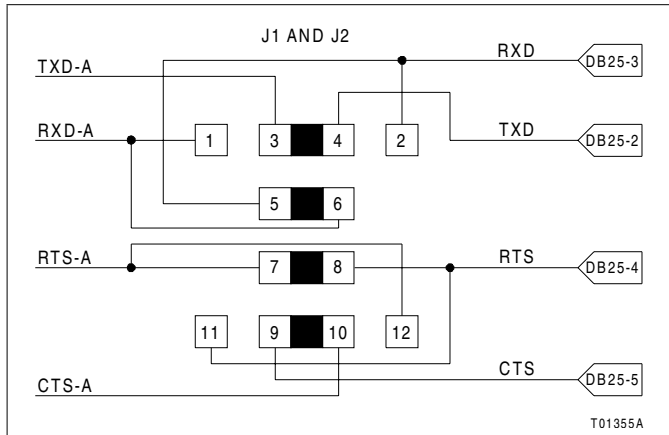


Figure B-1. DTE Jumper Configuration (NTMP01)

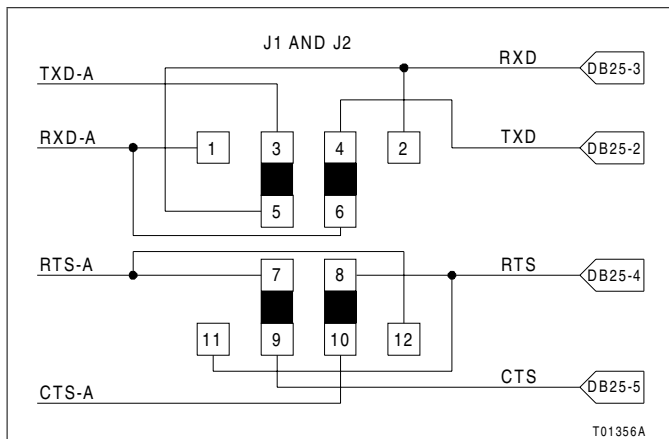


Figure B-2. DCE Jumper Configuration (NTMP01)

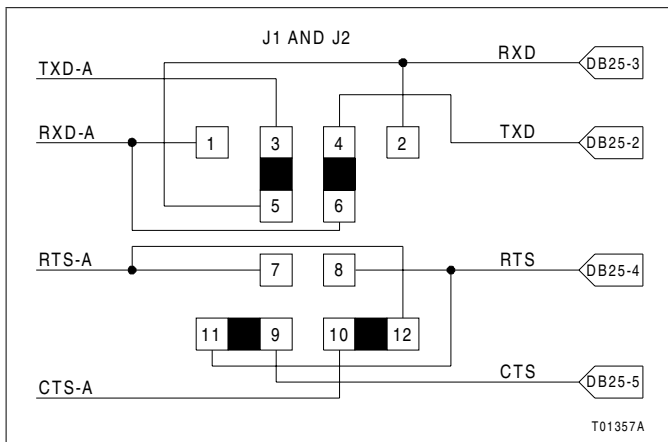


Figure B-3. Nonhandshake Jumper Configuration (NTMP01)

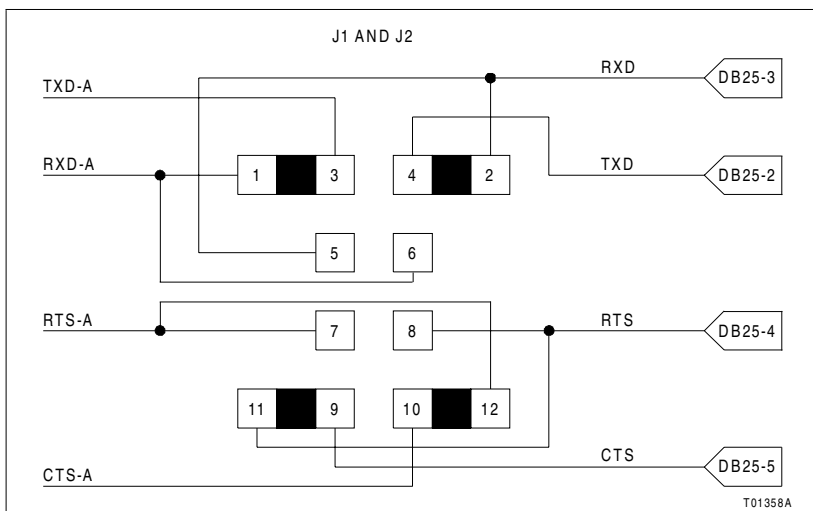


Figure B-4. Loopback Jumper Configuration (NTMP01)

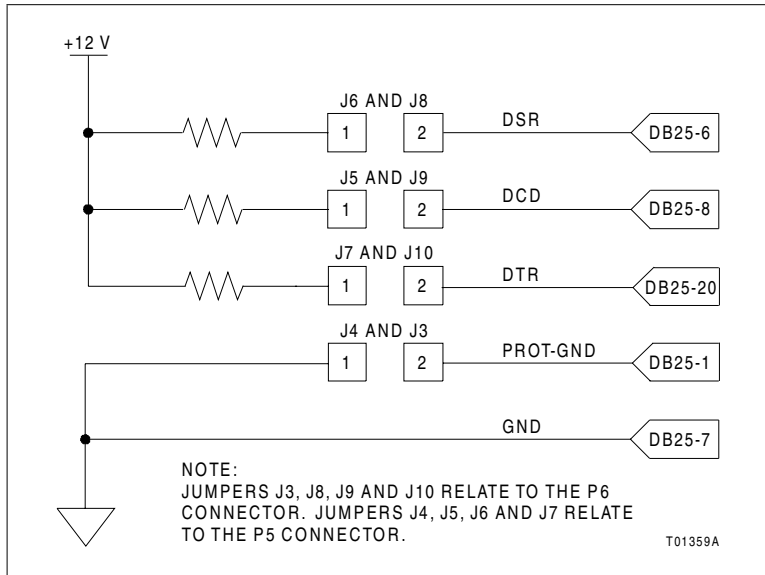
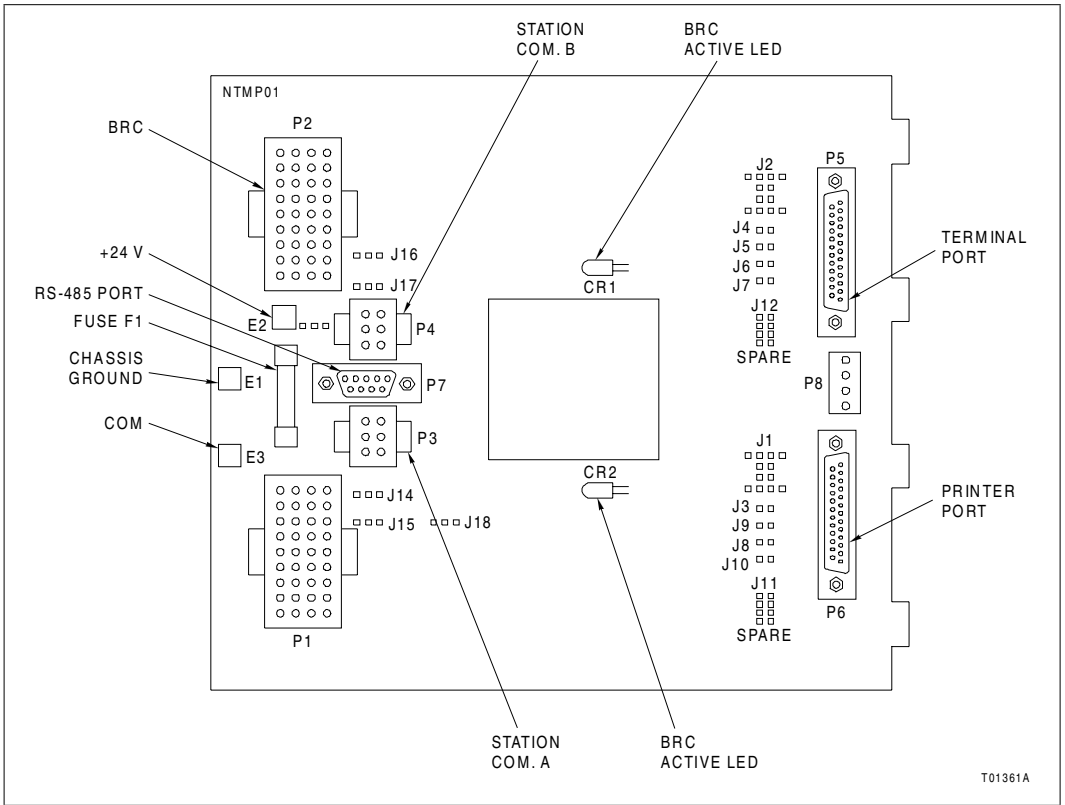


Figure B-5. Jumpers J3 through J10 Configuration (NTMP01)



T01361A

Figure B-6. NTMP01 Board Layout

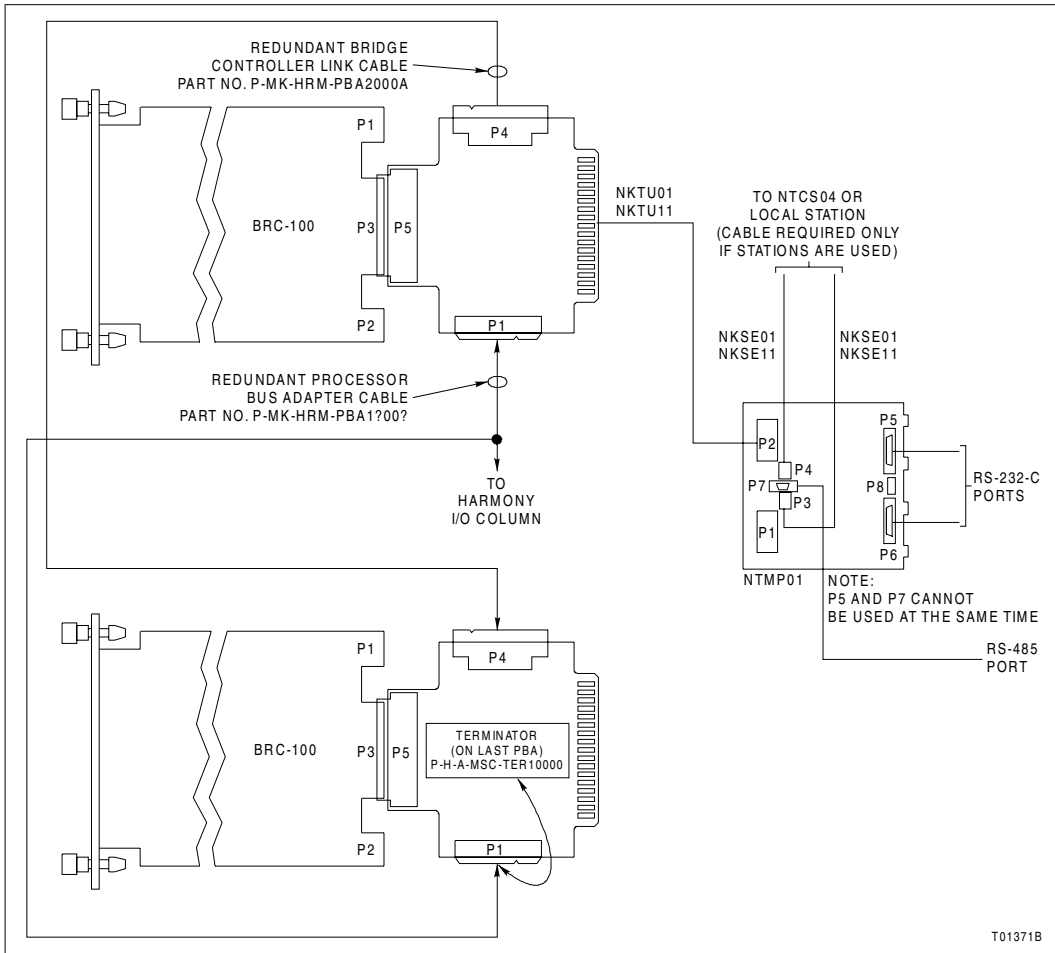


Figure B-7. NTMP01 Cable Connections (Redundant BRC Modules/PBA Boards)

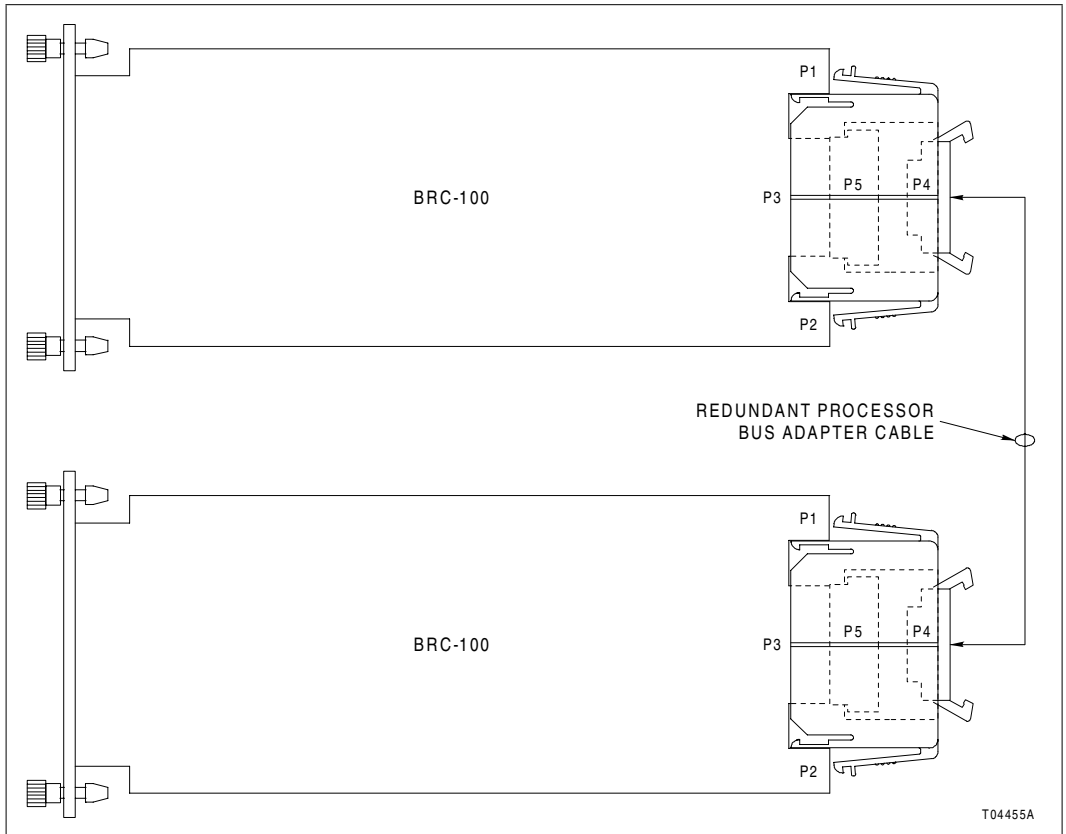


Figure B-8. Cable Connections (Redundant BRC Modules Using BRC Redundancy Kit)



For the latest information on ABB visit us on the World Wide Web at <http://www.abb.com>

Our worldwide staff of professionals is ready to meet *your* needs for process automation.
For the location nearest you, please contact the appropriate regional office.

Americas

29801 Euclid Avenue
Wickliffe, Ohio USA 44092
Telephone 1-440-585-8500
Telefax 1-440-585-8756

Asia/Pacific

539 Yishun Industrial Park A
Singapore 768740
Telephone 65-756-7655
Telefax 65-756-7309

Germany

Industriestrasse 28
D-65760 Eschborn
Germany
Telephone 49-6196-800-0
Telefax 49-6196-800-1119

Europe, Africa, Middle East

Via Puccini 2
16154 Genoa, Italy
Telephone 39-010-6584-943
Telefax 39-010-6584-941

