Bailey® network 90®

Remote Input/Output Module (NRIO02)

Bailey®

REMOTE I/O

NRIO02

STOP

A0468

WARNING notices as used in this manual apply to hazards or unsafe practices which could result in severe personal injury or death.

CAUTION notices apply to hazards or unsafe practices which could result in minor personal injury or property damage.

NOTES highlight procedures and contain information which assists the operator in understanding the information contained in this manual.

WARNING

INSTRUCTION MANUALS

DO NOT INSTALL, MAINTAIN OR OPERATE THIS EQUIPMENT WITHOUT READING, UNDERSTANDING AND FOLLOWING THE PROPER **Babcock & Wilcox, Bailey Controls** INSTRUCTIONS AND MANUALS, OTHERWISE INJURY OR DAMAGE MAY RESULT.

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MOST ELECTRONIC EQUIPMENT IS INFLUENCED BY RADIO FREQUENCY INTERFERENCE (RFI). CAUTION SHOULD BE EXERCISED WITH REGARD TO THE USE OF PORTABLE COMMUNICATIONS EQUIPMENT IN THE AREA AROUND SUCH EQUIPMENT. PRUDENT PRACTICE DICTATES THAT SIGNS SHOULD BE POSTED IN THE VICINITY OF THE EQUIPMENT CAUTIONING AGAINST THE USE OF PORTABLE COMMUNICATIONS EQUIPMENT.

POSSIBLE PROCESS UPSETS

MAINTENANCE MUST BE PERFORMED ONLY BY QUALIFIED PERSONNEL AND ONLY AFTER SECURING EQUIPMENT CONTROLLED BY THIS PRODUCT. ADJUSTING OR REMOVING THIS PRODUCT WHILE IT IS IN THE SYSTEM MAY UPSET THE PROCESS BEING CONTROLLED. SOME PROCESS UPSETS MAY CAUSE INJURY OR DAMAGE.

AVERTISSEMENT

MANUELS D'OPERATION

NE PAS METTRE EN PLACE, REPARER OU FAIRE FONTIONNER CE MATERIEL SANS AVIOR LU, COMPRIS ET SUIVI LES INSTRUCTIONS REGLIMENTAIRES DE **Babcock & Wilcox, Bailey Controls** TOUTE NEGLIGENCE A CET EGARD PURRAIT ETRE UNE CAUSE D'ACCIDENT OU DE DEFAILLANCE DU MATERIEL.

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LA PLUPART DES EQUIPEMENTS ELECTRONIQUES SONT SINSIBLES AUX PERTURBATIONS DE LA FREQUENCE RADIO. DES PRECAUTIONS DEVRONT ETRE PRISES LORS DE L'UTILISATION DE MATERIEL DE COMMUNICATION PORTATIF. LA PRUDENCE EXIGE QUE LES PRECAUTIONS A PREDRE DANS CE CAS SOIENT SIGNALEES AUX ENDROITS VOULOUS DANS VOTRE USINE.

PERTES PROCEDE RENVERSEMENTS

L'ENTRETIEN DOIT ETRE ASSURE PAR UN PERSONNEL QUALIFIE ET EN CONSIDERATION DE L'ASPECT SECURITAIRE DES EQUIPEMENTS CONTROLES PAR CE PRODUIT. L'ADJUSTEMENT ET/OU L'EXTRACTION DE CE PRODUIT LORSQUI'IL EST INSERE A UN SYSTEME ACTIF PEUT OCCASIOINNER DES A-COUPS AU PROCEDE CONTROLE. SUR CERTAINS PROCEDES, CES A-COUPS PEUVENT EGALEMENT OCCASIONNER DES DOMMAGES OU BLESSURES.

Preface

This document provides the user with instructions for configuration, installation, operation, and troubleshooting of the NRIO02 Remote I/O Module.

General Information concerning the module, its circuitry, and related equipment is presented here. This document is not intended as an application guide.

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SECTION 1 – INTRODUCTION

GENERAL

The Remote I/O Module (NRIO02) provides the NMFC03/04/05 Multi-Function Controllers with remote process control capability. The RIO allows central control of slave modules up to 10,000 feet (3,000 meters) from the MFC (see Figure 1-1 and 1-2). Limitations on this maximum distance depend on the cable type in the system (refer to Section 3 – Installation). The Remote I/O Module also supplies additional links between the MFC and Digital Control and Digital Indicator Stations.

MANUAL CONTENT

This manual is organized in the following manner: SECTION 1 – INTRODUCTION contains general information, technical specifications, and a glossary; SECTION 2 – THEORY OF OPERATION gives a detailed look at how the module works; SECTION 3 – INSTALLATION is a guide through all the steps that prepare the module for operation; SECTION 4 – OPERATION provides information on day-to-day operation, what the LED codes mean, and what to look for in the event of an error; and SECTION 5 – TROUBLESHOOTING includes corrective actions to possible error situations.

WHO SHOULD READ THIS MANUAL

System engineers and technicians should carefully read and understand this manual before installing and placing the RIO Module into service. Once familiar with the operation of the RIO, the tables and illustrations in this manual provide a concise reference of information.
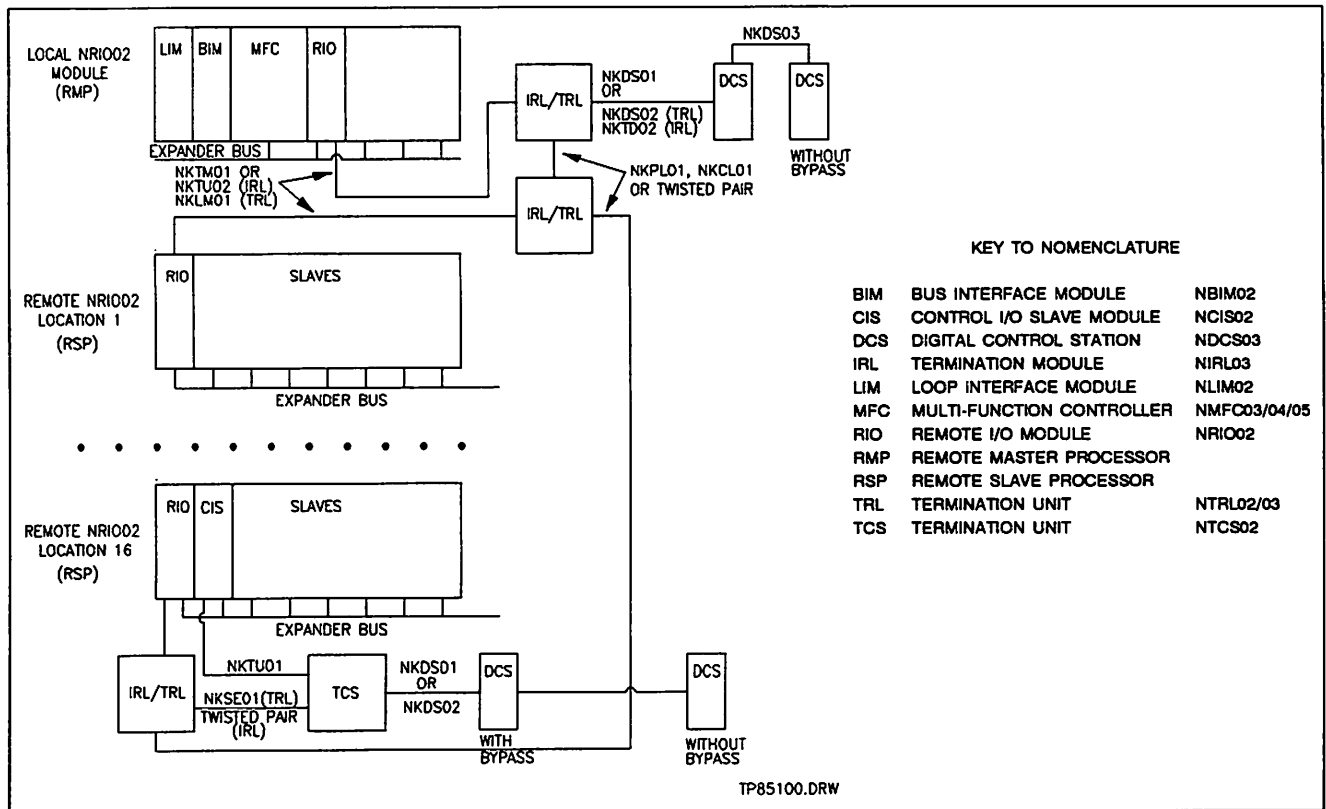
Figure 1-1. Communication Scheme for Remote I/O Modules

SPECIFICATIONS

Power Requirements	
Operating	+5 V dc -- 1.45 amps typ., 1.80 amps max.
	+15 V dc -- 17.5 mA typ., 20.0 mA max.
	-15 V dc -- 80.0 mA typ., 90.0 mA max.
Consumption	+5 V dc -- 7.25 watts typ., 9.00 watts max.
	+15 V dc -- 0.26 watts typ., 0.30 watts max.
	-15 V dc -- 1.20 watts typ., 1.35 watts max.
Data Rates	
Serial Link	1 Mbit/sec
Memory Capacity	
Static RAM	8 kbytes
Static RAM	8 kbytes (shared with MFC)
ROM	32 kbytes
Mounting	Occupies one slot in the NETWORK 90 Module Mounting Unit
Environmental	
Ambient Temperature	0° to 70°C (32° to 158°F)
Humidity	5 to 90% RH (±5%) up to 55°C (131°F) noncondensing
	5 to 40% RH (±5%) at 70°C (158°F) noncondensing
Atmospheric Pressure	Sea level to 3 km (1.86 miles)
Air Quality	Noncorrosive
Certification	CSA certification for ordinary (nonhazardous) locations pending.

Specifications Subject To Change Without Notice

Table 1-1. Edge Connector P1 (Module Power) Pin Assignments

Pin	Signal	Pin	Signal
1	+5 V dc	2	+5 V dc
3	Unused	4	Unused
5	Common	6	Common
7	+15 V dc	8	-15 V dc
9	PFI	10	PFI
11	Module Bus	12	Module Bus

Table 1-2. Edge Connector P2 (Expander Bus) Pin Assignments

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

Table 1-3. Edge Connector P3 (Process Interface) Pin Assignments

Pin	Signal	Pin	Signal
1	Output +	A	Common
2	Output -	B	Unused
3	Common	C	Unused
4	Channel 1 +	D	Unused
5	Channel 1 -	E	Unused
6	Fiber Optic In	F	Unused
7	+5V dc from TM/TU through a resistor	H	+24 V dc Out
8	Common	J	Unused
9	DCS Link +	K	Unused
10	DCS Link -	L	Unused
11	Common	M	Unused
12	Unused	N	Unused
13	+24 V dc In	P	Expander Bus Disable In
14	Common	R	Expander Bus Disable Out
15	Unused	S	Common

RELATED DOCUMENTS

Refer to the following Bailey documents for additional hardware information, when necessary:

E93-900-20	Function Code Application Manual
E93-906-7/12/13	Multi-Function Controller (NMFC03/04/05) Manual
E93-911 Includes:	Termination Units Manual
NTRL02	Fiber Optic Remote Link-Termination Unit
NIRL03	Remote Link Termination Module
NTRL03	Remote Link Termination Unit
NMMU01/02	Module Mounting Unit
NTMU01	Termination Mounting Unit

RELATED HARDWARE

The RIO operates with the following Bailey hardware:

NIRL03	Termination Module, Remote Link
NTCS02	Termination Unit, Controller/Station
NTRL02	Termination Unit, Fiber Optic Remote Link
NTRL03	Termination Unit, Remote Link

¹ REFER TO TABLE 3-4 FOR FIBER OPTIC CABLE SPECIFICATIONS

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KEY TO NOMENCLATURE

BIM	BUS INTERFACE MODULE	NBIM02
CIS	CONTROL I/O SLAVE MODULE	NCIS02
DCS	DIGITAL CONTROL STATION	NDCS03
LIM	LOOP INTERFACE MODULE	NLIM02
MFC	MULTI-FUNCTION CONTROLLER	NMFC03/04/05
RIO	REMOTE I/O MODULE	NRIO02
TRL	TERMINATION UNIT	NTRL02
TCS	TERMINATION UNIT	NTCS02
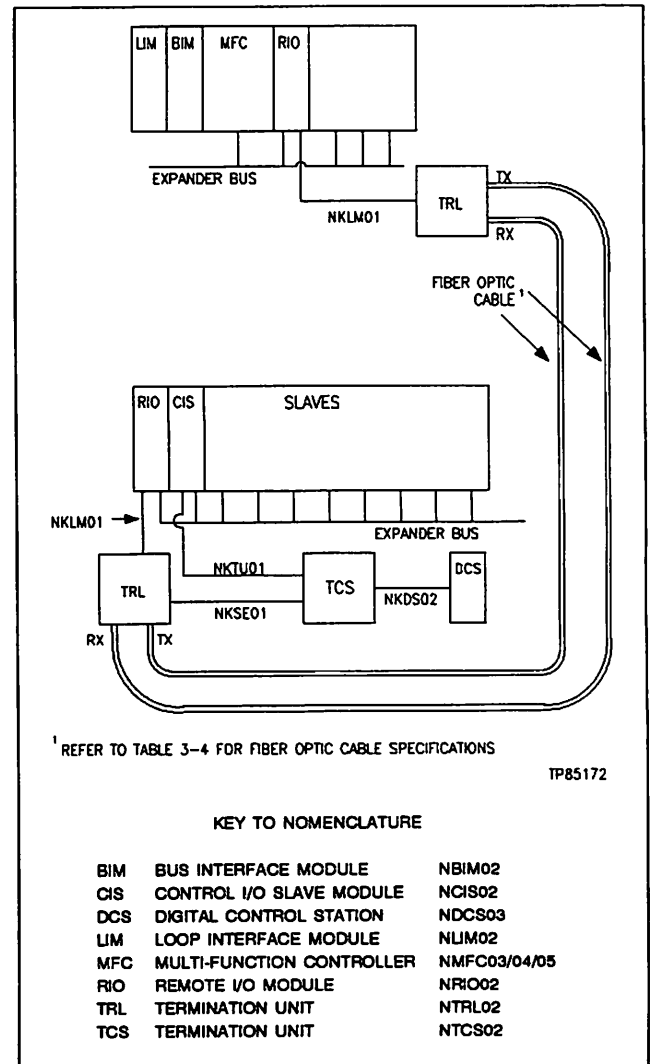
Figure 1-2. Remote I/O Modules Using Fiber Optic Cable

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GLOSSARY

Buffer	A storage device used to compensate for a difference in rate of flow of information, or time between events, when information is transmitted from one computer device to another.
CPU	Central Processing Unit; the hardware and circuitry necessary to interpret and execute control commands.
DCS	Digital Control Station (NDCS03).
Default Latch	A buffer that stores the default values required for fail-safe operation of the system.
Dipshunt	A dual in-line package with shorting bars.
Dipswitch	A dual in-line package with single-pole switches.
Expander Bus	Parallel bus between the master module and the slave, located on the backplane of the MMU.
Latch	A temporary storage buffer that "latches" onto a piece of data until instructed to move it elsewhere.
Master Module	One of the series of controller modules designed to direct field processes through output modules. The MFC is a Master Module; in the remote I/O case, the remote RIO is also a Master Module.
MFC	Multi-Function Controller module (NMFC03/04/05).
MMU	Module Mounting Unit (NMMU01/02); provides electrical and communications support to the modules.
Module Bus	Master Module-to-Master Module (e.g. MFC to MFC) communication link located on the backplane of the MMU.
Node	An active drop on the Plant or Super Loop through which information is passed.
PCU	Process Control Unit; one node on the Plant or Super Loop containing up to 32 active master modules and associated slaves.
Plant Loop/Superloop	The systems which link together NETWORK 90 PCUs and operator consoles.
Register	The computer hardware for storing one machine word.
RIO	Remote I/O Module (NRIO02).
RMP	Remote Master Processor; RIO Module that is a master on the RIO serial communication link (slave to MFC).
RSP	Remote Slave Processor; RIO Module that is a slave on the RIO serial communication link (master on Expander Bus).
TMU	Termination Mounting Unit (NTMU01); provides support to the termination modules.

SECTION 2 – THEORY OF OPERATION

INITIALIZATION

Upon start-up, the Multi-Function Controller downloads the control configuration to the shared memory of the local Remote Master Processor (RMP). The RMP allocates its shared memory accordingly and sends a copy of the configuration to the remotely located Remote Slave Processors (RSPs). The RSPs are master modules on their remote Expander Buses, reading and writing data to their slave modules. They receive data from the RMP and transmit data back upon request. When the communication link is established, the MFC reads and writes data directly to the shared memory of the RMP. The age of the data is proportional to the number of expander bus slaves on the link, and the number of RSPs.

The primary function of the RIO is to allow the MFC to interface with remote slave modules. Its secondary function is to provide the MFC with extra Digital Control Station (DCS) links. The RIO also supports remote DCS links. The MFC communicates with the RMP over the Expander Bus. The RMP communicates with the RSPs over a serial link at a rate of 1 Mbit/second and uses Cyclic Redundancy Check (CRC) error checking.

SECURITY

Module security is provided by a Machine Fault Timer (MFT) and a Bus Fault Timer (BFT). The MFT is reset regularly by the microprocessor under normal operation. If the MFT expires, all critical parts of the module will be reset.

The BFT is usually reset by the bus clock and has 2 modes of operation.

1. **Remote Master Processor.** When the RIO is used at the local end, it is a slave to the MFC. The BFT will expire if the bus clock stops for more than 10 ms. The RSPs are informed and in turn put their slaves in a "Fail Safe Mode". In this mode, the modules hold their current configurations until the bus clock is restarted. Since the link has been shut down, the RMP has to be reconfigured by the MFC in order to restart.

2. **Remote Slave Processor.** At the remote end, the BFT is used only for redundancy. If the active RSP module fails, no bus clock, the BFT of the backup RSP expires after 1 ms. This causes the backup RSP to become active and restart the clock, preventing the slaves from shutting down.

REDUNDANCY

Two completely independent RIO module sets, termination units and serial links are used for redundancy. The MFC determines the primary (active) link. The primary link is started first and then the backup link is downloaded. The backup link remains in standby until the MFC commands it to take control.

A red LED, visible through the RIO front plate, is used to indicate the active link. The RMP and all RSPs on the active link will have their red LEDs turned on. The red LEDs of all RIO Modules on the standby link will be turned off.

A failover occurs when a RMP or RSP error is detected on the primary link and no errors exist on the backup link.

The two RMPs must have unique expander bus addresses for the MFC to manage both links independently. Each RSP pair must be configured with the same serial link node address.

HARDWARE DESCRIPTION

The RIO Module circuitry is comprised of the following seven blocks (see Figure 2-1):

1. Expander Bus Slave Interface
2. Expander Bus Master Interface
3. Shared RAM
4. Memory
5. CPU Support
6. Serial – CPU Interface
7. Serial Link Interface

An explanation of these blocks follows.

Expander Bus Slave Interface
This interface contains the circuitry necessary to provide communication between the MFC and the RIO. A custom integrated circuit enables the interface to recognize messages sent from the MFC to the RIO across the Expander Bus.

Expander Bus Master Interface
This interface enables the RIO to act as a master module on a remote Expander Bus.

Shared RAM
This block contains 8 kbytes of RAM and the necessary logic to allow the MFC and CPU to access it. The shared RAM is a buffer that stores slave information until the MFC can access it. It also enables the MFC to write data to the slave modules.

Additional Memory
The RIO Module also contains the following general purpose memory:

• 8 Kbytes of static RAM.

• 32 Kbytes of ROM.

CPU Support
The RIO contains two custom integrated circuits that provide support for the CPU.
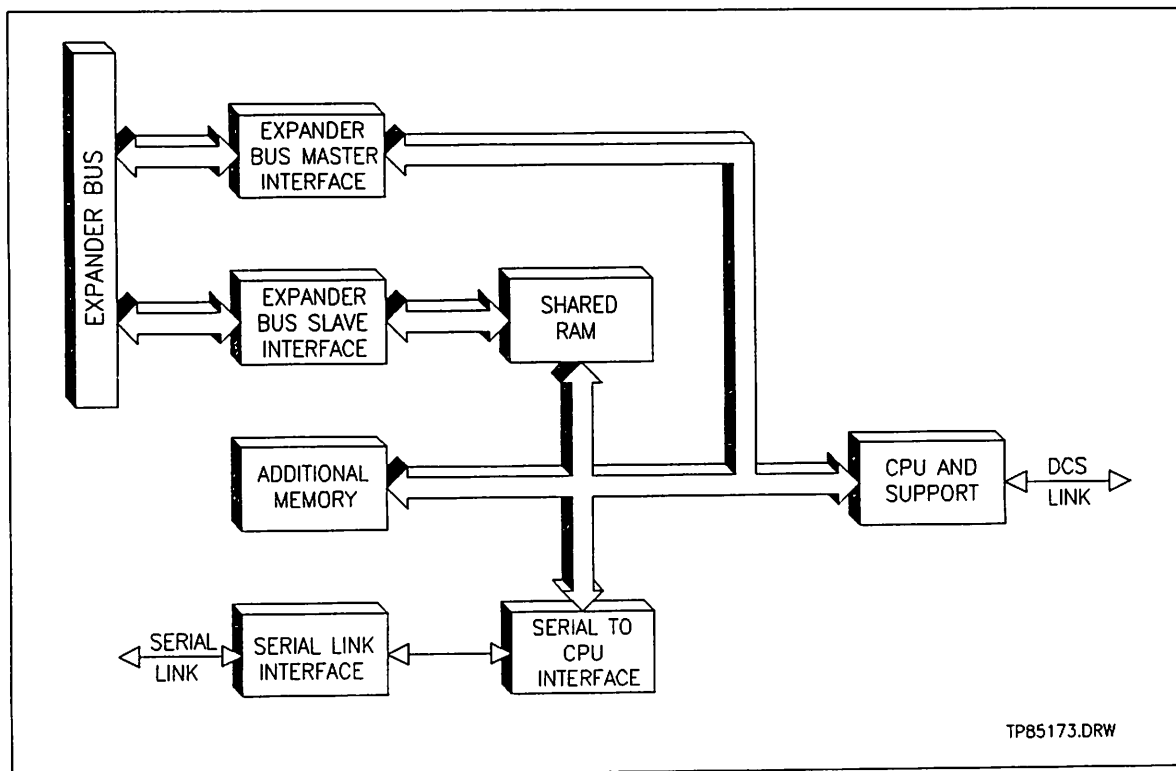
Figure 2-1. Functional Block Diagram

Machine Fault Timer (MFT)

The MFT circuit is periodically retriggered by the CPU under normal conditions.

If any of the following conditions are detected by the CPU, it does not retrigger the MFT:

- Failure of ROM checksum (an error-detecting procedure).

- Failure of diagnostics at reset/power up time.

- Failure of diagnostics in diagnostic mode with HALT ON ERROR enabled.

When the MFT expires, the CPU is halted and the red/green LED becomes red.

Serial to CPU Interface

This block contains circuitry for the serial communications link, along with FIFO (First In, First Out) buffers. The CPU receives and transmits messages through the FIFO buffers. The CPU transmits a message and waits for a reply. The CPU can read the Serial Link Information Buffer for information about interrupt sources and the current status of the link.

Serial Link Interface

This block contains the driver and receiver circuits for the serial link interface. The receiver circuits reshape the analog waveform, and a custom integrated circuit converts this signal back to digital data. This digital data is then stored in the Receive FIFO buffer.

SECTION 3 – INSTALLATION

The steps in this section **must be** performed before the NRIO02 Remote I/O Module is put into operation.

> NOTE: This section explains module installation only. For information about installing process wiring and termination units, refer to Product Instruction E93-911.

HANDLING

Special Handling
The NRIO02 uses Electrostatic Sensitive (ESD) devices. Follow these handling procedures:

1. Keep the module in the special antistatic bag until you are ready to install it in the system. Save the bag for future use.

2. Ground the antistatic bag before opening.

3. Verify that all devices connected to the module are properly grounded before using them.

4. Avoid touching the circuitry when handling the modules.

> NOTE: Grounding straps (field static kits) must be used when installing or removing modules to configure or change switch settings.

General Handling
1. Examine the module immediately to verify that no damage has occurred in transit.

2. Notify the nearest Bailey Controls Sales/Service 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/or container to store the module.

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

GENERAL

The RIO occupies one slot in the Module Mounting Unit. The module front plate has a built-in latch that catches on the MMU to hold the module securely in place. The RIO may be mounted in any slot provided connection to the Expander Bus. Twelve position dipshunts insert in the 24 pin sockets at the interior bottom of the MMU backplane between adjacent modules. This provides Expander Bus communication between Master Modules and their slaves.

OPTIONS

The RIO has four dipswitches as shown in Figure 3-1. Switch S1 has two functions depending on the use of the RIO.

LOCAL MODE (RMP)

In local mode, S1 sets the slave address on the Expander Bus. Valid addresses range between 0 and 63 (refer to Appendix A for switch settings corresponding to these addresses).

The slave address must be unique for redundant RIOs on the MFC Expander Bus.

REMOTE MODE (RSP)

In remote mode, S1 sets the node address. Valid addresses range between 0 and 63 (refer to Appendix A for switch settings corresponding to these addresses).

The node address must be identical for redundant RIOs in the same remote node.

The maximum number of slaves on the Expander Bus is 64 and the maximum number of drops on the serial link is 16.
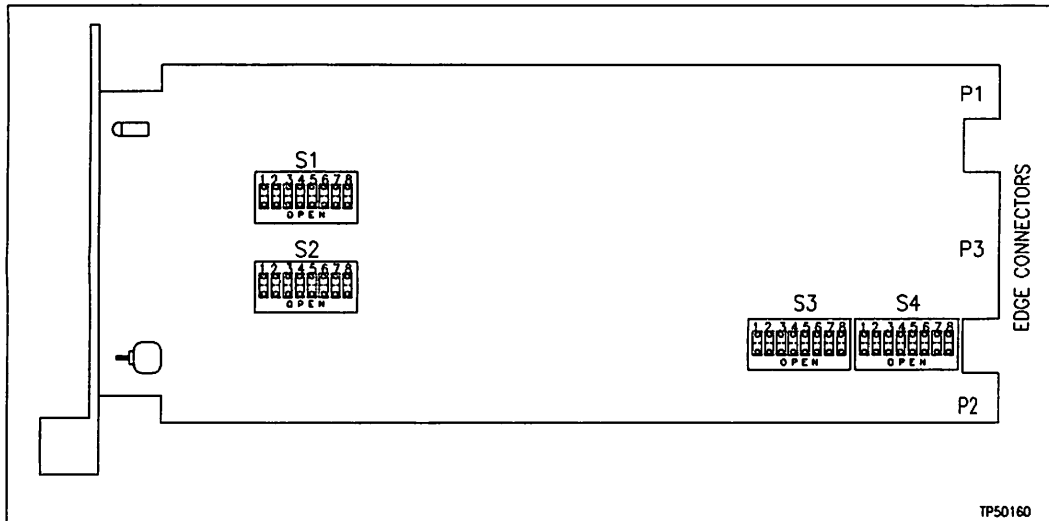
Figure 3-1. NRIO02 Switch and Connector Locations

DIPSWITCH S1

RSP – Node Address

Switch Positions
1 2 3 4 5 6 7 8
0 0 ⌐————————⌐
     └———— Remote Node (RSP);
             Node address

RMP – Expander Bus Address

Switch Positions
1 2 3 4 5 6 7 8
0 0 ⌐————————⌐
     └———— Local Node (RMP);
             Expander Bus address

DIPSWITCH S2

S2 provides no user options and must be set as shown below.

RSP	RMP
Switch Positions 1 2 3 4 5 6 7 8 0 0 0 0 0 0 0 0	Switch Positions 1 2 3 4 5 6 7 8 0 1 0 0 0 0 0 0
0 represents a closed switch (on). 1 represents an open switch (off).	

DIPSWITCHES S3 and S4

When used at the local end, dipswitches S3 and S4 disconnect the Expander Bus signals that go to the driver section. Position 4 of S3 must be set to match the cable type in your system. The choices are either electrical (standard NETWORK 90 cable) or fiber optic cable. The switches are set as follows:

RSP	
S3[1] 1 2 3 4 5 6 7 8 x x x[2] 1 0 0 0	S4 1 2 3 4 5 6 7 8 0 0 0 0 0 0 0 0

RMP	
S3[1] 1 2 3 4 5 6 7 8 x x x[2] 0 1 1 1	S4 1 2 3 4 5 6 7 8 1 1 1 1 1 1 1 1

[1] x - switch position may be open or closed.
[2] For electrical cables, this switch should be 0 (closed).
   For fiber optic cables, this switch should be 1 (open).

INSERTING THE RIO INTO THE MMU

After setting the switches, the RIO is ready to be placed in the MMU. The MMU provides slots for up to twelve modules.

To insert the RIO:

1. Verify the slot assignment of the module.

2. Connect the NKTM01 or NKTU02 cable from the NIRL03 Termination Module, or the NKLM01 cable from the NTRL02/03 Termination Unit, to the rear of the MMU backplane.

3. Slide the RIO into the slot; push until the rear edge connector (P3) is firmly seated in the cable plug, and the module latch snaps into place on the bottom frame of the MMU.

> NOTE: RIO Modules can be inserted while the NETWORK 90 System is operating. When the RMP is inserted, the MFC reads, initializes, and brings the RMP on-line without loss of system performance. Similarly, an RSP begins normal start-up routines upon insertion, and waits for the RMP to bring it on-line.

WARNING

The RIO Module MUST be stopped before removal. The output status of slaves may incorrectly change if an active RIO is removed before being properly stopped.

ATTENTION

Le module RIO doit etre place en mode arret avant d'etre retire du chassis. L'etat des sorties des modules asservis pourrait changer de facon erronee si un module RIO actif est retire avant d'etre place en mode arret.

To halt the RIO Module, press the Stop switch on the faceplate. Wait until the red/green Status LED becomes red. The stop is now complete, and the module may be removed. Once stopped, the RIO Module must be removed and reinserted to restart.

REMOTE LINK TERMINATION MODULE/UNIT

There are three termination devices currently available to interface the RIO to the field inputs.

Termination Unit - NTRL03
This Termination Unit is a seven square inch circuit board which mounts to a Field Termination Panel. An NKLM01 cable connects the RIO to the NTRL03.

Termination Module - NIRL03
The NIRL03 is a modular version of the NTRL03 and occupies one slot in a Termination Mounting Unit. Either an NKTU02 or NKTM01 cable joins the RIO and the NIRL03.

Fiber Optic Termination Unit - NTRL02
The NTRL02 allows for fiber optic cable connection to a second NTRL02.

The NKLM01 cable connects the RIO to the NTRL02.

CABLE TERMINATION

Due to transmission line effects, the cables must be terminated at each end with the characteristic impedance. The J3 jumper setting on the NTRL03 or NIRL03 must match the node position (see Figure 3-2) and the system cable type. Table 3-1 illustrates the necessary jumper settings.

Table 3-1. J3 Jumper Settings

Application	Jumper Position
Coax cable (end nodes only)	▨ ▨ ■ ■
Coax or Twinax cable (middle nodes only)	■ ▨ ▨ ■
Twinax cable (end nodes only)	■ ■ ▨ ▨

NOTE: Jumper positions for twisted wire pairs are the same as those for Twinax cable.
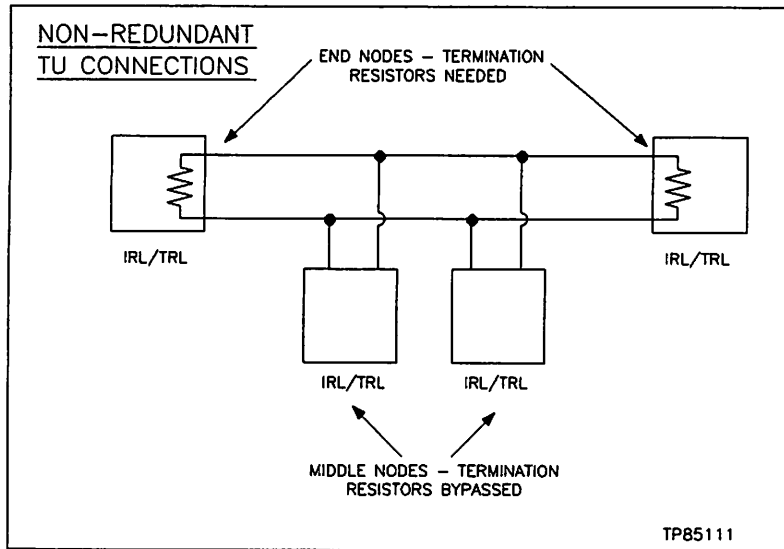
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Figure 3-2. Node Positions for Non-Redundant TM/TU Connections

REDUNDANCY

The termination units/modules require additional connections when used with redundant RIO serial links (see Figure 3-3). If Digital Control Stations (DCS) are used, then the DCS links must be connected between TUs at each location (local/remote) that has them.

CABLE OPTIONS

Cable selection determines the maximum distance possible between RIO Modules and between RIOs and TMs/TUs. Tables 3-2 and 3-3 give the available choices of cable types and corresponding distances allowed. Refer to Table 3-4 for fiber optic cable specifications.
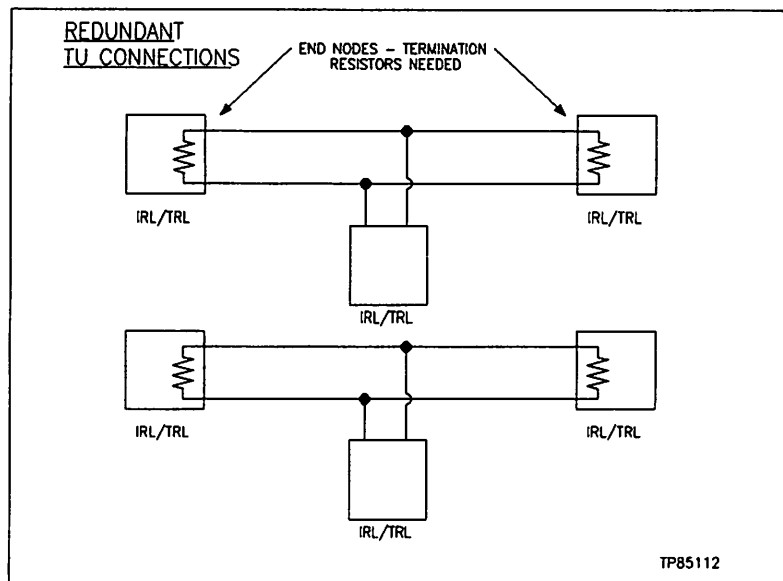

Figure 3-3. Node Positions for Redundant TM/TU Connections

Table 3-2. Remote I/O Application Guide

Type	Nomenclature	Maximum Length Between RIOs
Coax	NKCL01/NKTL01	10,000 feet (3000 m)
Twinax	NKPL01	4,500 feet (1371 m)
Twisted Pair[1]	------	1,500 feet (457 m)

[1]The twisted pair is 22 AWG with 36 AWG shield drain wire. Each wire of the twisted pair is seven strands of 30 AWG wire.

Table 3-3. Termination Unit Cable Application Guide

Type	Nomenclature	Maximum Length Between RIOs and TMs/TUs
Flat Cable	NKTM01	20 feet
Twisted Pair	NKTU02	20 feet
Twisted Pair	NKLM01	45 feet

Table 3-4. Fiber Optic Cable Specifications

Fiber Size	62.5/125 micrometer
Fiber Attenuation	-3.3 decibels/kilometer
Index	Graded
Wavelength	850 nanometers
Bandwidth	100 megahertz/kilometer
Connector Type	Amphenol 905/906 SMArt series
Minimum Power Budget	15 decibels
Maximum Supported Link Distance	3 kilometers (10,000 feet)

SECTION 4 – OPERATION

GENERAL

This section provides information for day-to-day operation of the RIO Module. Observe the front panel LED indicator to verify that the module is operating properly.

START-UP

RIO Module start-up is fully automatic. The following operations are performed before the RIO comes on line:

1. The MFC downloads the configuration into the shared memory of the RIO.

2. The green LED blinks during configuration and turns solid green when the configuration is complete.

If the module fails to operate properly, refer to Table 5-1 in the Troubleshooting Section for corrective action.

STATUS LED

The front panel has a red/green LED that indicates the states shown in Table 4-1 (see Figure 4-1).

Table 4-1. Status LED Display

LED Status	Comment
Off	No power or no communication with MFC
Blinking green	Any error or non-executing state except as above
Solid green	Normal execute mode
Solid red	Machine Fault Timer has timed out

REDUNDANCY LED

The front panel also has a red LED which, when lit, indicates the active module of a redundant pair (see Figure 4-1).
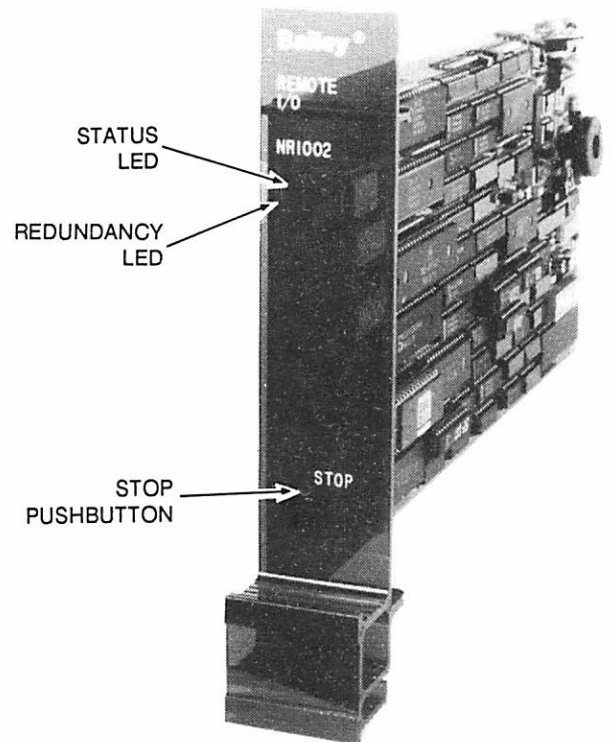
Figure 4-1. NRIO02 LED and Switch Locations

SECTION 5 – TROUBLESHOOTING

GENERAL

While RIO modules are dependable, error situations can occur. This section provides a troubleshooting table with step-by-step procedures to follow should an error situation arise.

MODULE REMOVAL

When an RIO must be removed from the MMU, press the Stop switch and wait until the Status LED becomes red. Squeeze the plastic clip on the front panel of the RIO, releasing it from the lower flange on the MMU. Carefully, pull the RIO straight out with minimum disturbance to adjacent modules. The module should slide out easily; do not force it.

> **WARNING**
>
> The RIO Module MUST be stopped before removal. The output status of slaves may incorrectly change if an active RIO is removed before being properly stopped.
>
> **ATTENTION**
>
> Le module RIO doit etre place en mode arret avant d'etre retire du chassis. L'etat des sorties des modules asservis pourrait changer de facon erronee si un module RIO actif est retire avant d'etre place en mode arret.

Table 5-1. Troubleshooting the RIO

Problem	Suggested Action
Status LED remains off after start-up	**Local RIO:** 1. Check the MFC configuration to verify the RIO address assignment. 2. Check the RIO address switch. It must match the address configured in the MFC. 3. Check the status of other slaves on the local Expander Bus. If their status is okay, then a probable defect exists in the RIO, or its connection to the local Expander Bus. 4. Check S2 dipswitch to ensure it is set for local operation.
	Remote RIO: 1. Check the local RIO to verify it is operating. 2. Check the MFC configuration to verify the RIO address assignment. 3. Check the RIO address switch. It must match the address configured in the MFC. 4. Check S2 dipswitch to ensure it is set for remote operation. 5. Check all cable connections between the local and the remote node.
Status LED remains red after start-up	1. Replace the RIO.

One of the following situations occurs when the RIO is removed from the MMU:

1. When the RIO is located on the local expander bus, all remote modules go to a default setting.

OR

2. When the RIO is located on a remote expander bus, the remote node is marked off-line. All associated remote slave modules go to the default setting.

MAINTENANCE

The RIO module requires no routine maintenance. If the module fails, it must be replaced.

SERVICE

Module replacement and company services are available. Contact your nearest Bailey Sales/Service Office for prompt attention.

APPENDIX A - ADDRESS SWITCH SETTINGS

Table A gives the switch settings that select module or node addresses. The maximum expander bus and node address permitted is 63. A switch position of 1 represents an open switch; a switch position of 0 represents a closed switch.

Address	Switch Numbers 1 2 3 4 5 6 7 8	Address	Switch Numbers 1 2 3 4 5 6 7 8	Address	Switch Numbers 1 2 3 4 5 6 7 8
0	0 0 0 0 0 0 0 0	22	0 0 0 1 0 1 1 0	44	0 0 1 0 1 1 0 0
1	0 0 0 0 0 0 0 1	23	0 0 0 1 0 1 1 1	45	0 0 1 0 1 1 0 1
2	0 0 0 0 0 0 1 0	24	0 0 0 1 1 0 0 0	46	0 0 1 0 1 1 1 0
3	0 0 0 0 0 0 1 1	25	0 0 0 1 1 0 0 1	47	0 0 1 0 1 1 1 1
4	0 0 0 0 0 1 0 0	26	0 0 0 1 1 0 1 0	48	0 0 1 1 0 0 0 0
5	0 0 0 0 0 1 0 1	27	0 0 0 1 1 0 1 1	49	0 0 1 1 0 0 0 1
6	0 0 0 0 0 1 1 0	28	0 0 0 1 1 1 0 0	50	0 0 1 1 0 0 1 0
7	0 0 0 0 0 1 1 1	29	0 0 0 1 1 1 0 1	51	0 0 1 1 0 0 1 1
8	0 0 0 0 1 0 0 0	30	0 0 0 1 1 1 1 0	52	0 0 1 1 0 1 0 0
9	0 0 0 0 1 0 0 1	31	0 0 0 1 1 1 1 1	53	0 0 1 1 0 1 0 1
10	0 0 0 0 1 0 1 0	32	0 0 1 0 0 0 0 0	54	0 0 1 1 0 1 1 0
11	0 0 0 0 1 0 1 1	33	0 0 1 0 0 0 0 1	55	0 0 1 1 0 1 1 1
12	0 0 0 0 1 1 0 0	34	0 0 1 0 0 0 1 0	56	0 0 1 1 1 0 0 0
13	0 0 0 0 1 1 0 1	35	0 0 1 0 0 0 1 1	57	0 0 1 1 1 0 0 1
14	0 0 0 0 1 1 1 0	36	0 0 1 0 0 1 0 0	58	0 0 1 1 1 0 1 0
15	0 0 0 0 1 1 1 1	37	0 0 1 0 0 1 0 1	59	0 0 1 1 1 0 1 1
16	0 0 0 1 0 0 0 0	38	0 0 1 0 0 1 1 0	60	0 0 1 1 1 1 0 0
17	0 0 0 1 0 0 0 1	39	0 0 1 0 0 1 1 1	61	0 0 1 1 1 1 0 1
18	0 0 0 1 0 0 1 0	40	0 0 1 0 1 0 0 0	62	0 0 1 1 1 1 1 0
19	0 0 0 1 0 0 1 1	41	0 0 1 0 1 0 0 1	63	0 0 1 1 1 1 1 1
20	0 0 0 1 0 1 0 0	42	0 0 1 0 1 0 1 0		
21	0 0 0 1 0 1 0 1	43	0 0 1 0 1 0 1 1		