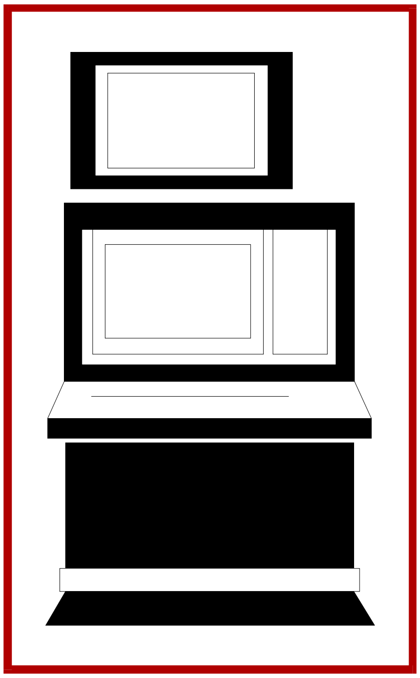
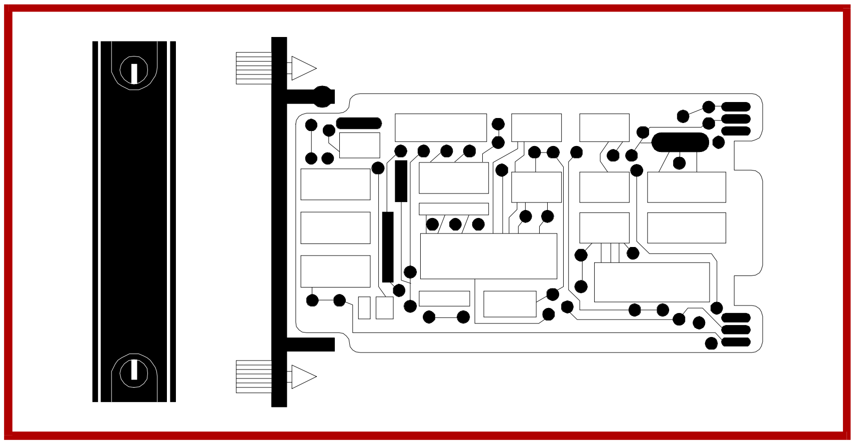
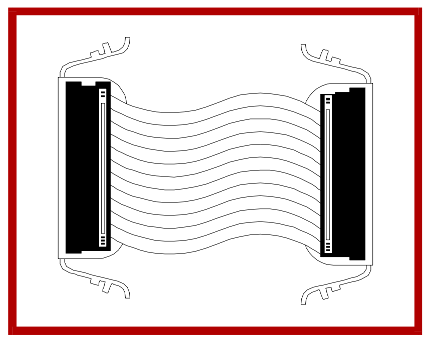
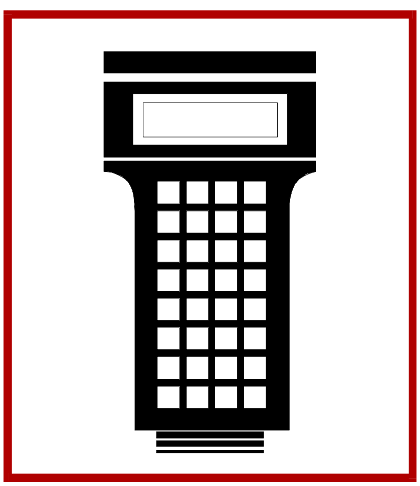
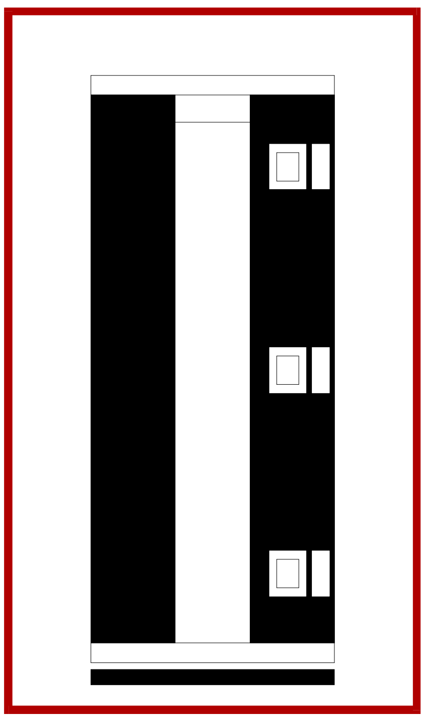
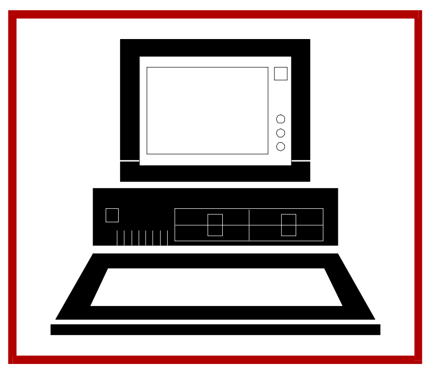
E96-211

Bailey® infi 90®

Instruction

Multi-Function Controller
(IMMFC03)

Bailey® Process Control and Automation Solutions from Elsag Bailey Group

WARNING notices as used in this instruction apply to hazards or unsafe practices that could result in personal injury or death.

CAUTION notices apply to hazards or unsafe practices that could result in property damage.

NOTES highlight procedures and contain information that assists the operator in understanding the information contained in this instruction.

WARNING

INSTRUCTION MANUALS

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

RADIO FREQUENCY INTERFERENCE

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'OPÉRATION

NE PAS METTRE EN PLACE, RÉPARER OU FAIRE FONCTIONNER L'ÉQUIPEMENT SANS AVOIR LU, COMPRIS ET SUIVI LES INSTRUCTIONS RÉGLEMENTAIRES DE **Elsag Bailey**. TOUTE NÉGLIGENCE À CET ÉGARD POURRAIT ÊTRE UNE CAUSE D'ACCIDENT OU DE DÉFAILLANCE DU MATÉRIEL.

PERTURBATIONS PAR FRÉQUENCE RADIO

LA PLUPART DES ÉQUIPEMENTS ÉLECTRONIQUES SONT SENSIBLES AUX PERTURBATIONS PAR FRÉQUENCE RADIO. DES PRÉCAUTIONS DEVRONT ÊTRE PRISES LORS DE L'UTILISATION DU MATÉRIEL DE COMMUNICATION PORTATIF. LA PRUDENCE EXIGE QUE LES PRÉCAUTIONS À PRENDRE DANS CE CAS SOIENT SIGNALÉES AUX ENDROITS VOULUS DANS VOTRE USINE.

PERTURBATIONS DU PROCÉDÉ

L'ENTRETIEN DOIT ÊTRE ASSURÉ PAR UNE PERSONNE QUALIFIÉE EN CONSIDÉRANT L'ASPECT SÉCURITAIRE DES ÉQUIPEMENTS CONTRÔLÉS PAR CE PRODUIT. L'AJUSTEMENT ET/OU L'EXTRACTION DE CE PRODUIT PEUT OCCASIONNER DES À-COUPS AU PROCÉDÉ CONTRÔLE LORSQU'IL EST INSÉRÉ DANS UNE SYSTÈME ACTIF. CES À-COUPS PEUVENT ÉGALEMENT OCCASIONNER DES BLESSURES OU DES DOMMAGES MATÉREILS.

NOTICE

The information contained in this document is subject to change without notice.

Elsag Bailey, its affiliates, employees, and agents, and the authors and contributors to this publication specifically disclaim all liabilities and warranties, express and implied (including warranties of merchantability and fitness for a particular purpose), for the accuracy, currency, completeness, and/or reliability of the information contained herein and/or for the fitness for any particular use and/or for the performance of any material and/or equipment selected in whole or part with the user of/or in reliance upon information contained herein. Selection of materials and/or equipment is at the sole risk of the user of this publication.

Preface

This document explains how to configure, install, operate, and troubleshoot the Multi-Function Controller Module (IMMFC03).

Related hardware such as I/O slave modules, termination units, etc. are also presented. A complete list of hardware documents is listed in Section 1 under the ***Reference Documents*** heading.

Carefully read this document before putting the module into operation.

List of Effective Pages

Total number of pages in this manual is 68, consisting of the following:

Page No.	Change Date
Preface	Original
List of Effective Pages	Original
iii through viii	Original
1-1 through 1-7	Original
2-1 through 2-5	Original
3-1 through 3-7	Original
4-1 through 4-9	Original
5-1 through 5-4	Original
6-1 through 6-5	Original
7-1	Original
8-1	Original
9-1 through 9-3	Original
A-1 through A-9	Original
B-1 through B-3	Original
C-1 through C-3	Original
D-1 through D-3	Original

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

NOTE: On an update page, the changed text or table is indicated by a vertical bar in the outer margin of the page adjacent to the changed area. A changed figure is indicated by a vertical bar in the outer margin next to the figure caption. The date the update was prepared will appear beside the page number.

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.

SPECIFIC WARNINGS	Disconnect power before installing dipshunts for slave modules on the MMU backplane (slave expander bus). Failure to do so could result in severe or fatal shock. (p. 3-7) Strict adherence must be made with regard to the rules set forth in this document. Follow all steps in the sequence given and at no time change configurations or remove the module before the LEDs instruct you to do so. Failure to heed this warning and follow proper procedures could result in unpredictable MFC operation and/or loss of output data. (p. A-2)

Sommaire de Sécurité

AVERTISSEMENTS D'ORDRE GÉNÉRAL	**Environnement de l'équipement** Ne pas soumettre les composants à une atmosphère corrosive lors du transport, de l'entreposage ou l'utilisation. **Possibilité de chocs électriques durant l'entretien** Débrancher l'alimentation ou prendre les précautions pour éviter tout contact avec des composants sous tension durant l'entretien.

AVERTISSEMENTS D'ORDRE SPÉCIFIQUE	Couper l'alimentation avant d'installer les dipshunts sur la plaque arriere du chassis de montage de modules (MMU). Toute negligence a cet egard constitue un risque de choc pouvant entrainer des blessures graves, voire moretlles. (p.3-7) Les procedures decrites dans ce document doivent etre suivies a la lettre. Respecter l'ordre des etapes, et ne jamais apporter de changements a la configuration ou retirer le module du chassis de montage avant que les temoins DEL ne l'autorisent. Tout ecart a la procedure decrite peut mener a un fonctionnement anormal du MFC et/ou entrainer la perte des signaux de sortie. (p. A-2)

Table of Contents

Table of Contents (continued)

Table of Contents (continued)

List of Tables

List of Figures

SECTION 1 - INTRODUCTION

OVERVIEW

The Multi-Function Controller Module (IMMFC03) is a powerful member of the INFI 90 controller family. It runs user designed analog, digital, batch and advanced control strategies, with up to 64 slave modules for inputs/outputs (I/O). Also, the module can run 4,000 lines of BASIC or 5,000 lines of C programs. BASIC programs, C programs and function blocks can be run at the same time. The IMMFC03 is a direct functional replacement for the Network 90 NMFC03. Refer to Figure 1-1 for an application example.

INTENDED USER

This manual is a guide for the system engineer or technician who configures, operates or maintains the MFC in a system. It explains the start-up and service. Follow the steps in this manual closely to maintain and use the MFC properly.

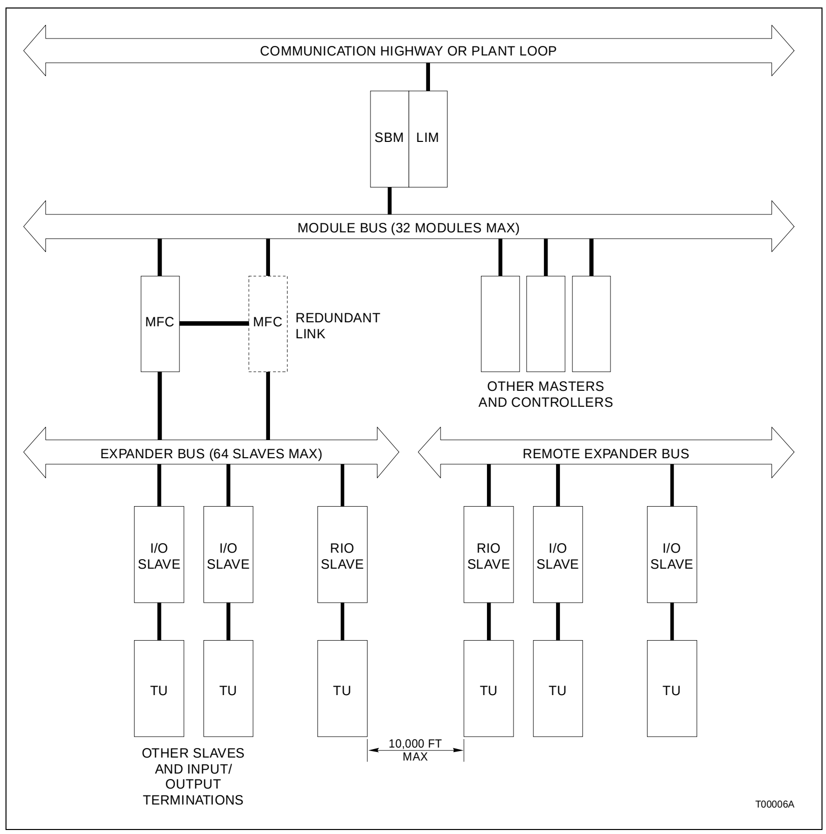


Figure 1-1. IMMFC03 Application Example

MFC DESCRIPTION

The IMMFC03 consists of two printed circuit boards connected by a ribbon cable. The boards are the central processing unit (CPU) board and the memory (MEM) board. The boards attach to a faceplate. Visible through the faceplate are several LEDs. The status LED, on the top left side, shows the operating mode (run, configure, error). A column of eight LEDs, labeled CPU, shows CPU board operating and error status. Two LEDs, labeled MEM, show memory board operating and error status. On board chips include UVROM, dynamic and non-volatile RAM, VLSI and CMOS support circuitry. A 68020 microprocessor controls the module.

The IMMFC03 occupies two slots in the module mounting unit (MMU) of the INFI 90 cabinet. The MMU backplane provides module power, module bus (module to module) communication, and slave expander bus (slave module to MFC communication).

FEATURES

MFC features include executing function codes, BASIC, and C programs in addition to the following.

Redundancy

An IMMFC03, configured the same as the primary, provides backup to the primary module. In a redundant setup, one module is the primary. It performs computations, runs control functions, etc. The other, the backup module, monitors (tracks) the primary. The backup copies the primary controllers outputs, and waits in a hot standby mode. There is constant communication between the primary and the backup module. If the primary module should fail, the backup assumes immediate control. Since the backup copied the primary's outputs, there is no break in control to the process.

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

Switch settings setup redundancy. The Installation section explains these settings.

On-Line Configuration

On-line configuration enables users with backup MFCs to make configuration changes (including changes to BASIC and C programs). On-line configuration changes do not affect the primary module or interrupt the control process. This happens by taking the backup MFC out of the tracking mode, changing the desired functions and putting it back in the tracking mode. When the new configuration in the backup MFC starts up, it uses the present values of process outputs in the primary MFC. This feature permits bumpless transfer of control to the new configuration. The Configuration section explains the steps for on-line configuration.

NOTE: There are constraints to what changes can be made. Refer to the Backup Cycle section of Appendix A for more information.

Inputs/Outputs

Analog and digital slave modules handle the I/O function of the MFC. Refer to the ***NOMENCLATURE*** entry in this section for a list of these modules. Each MFC can support a total of 64 slaves. While high and low power slaves can be mixed, no more than 20 high power slaves can be used. For example, 20 high power and 44 low power slaves can be used.

INSTRUCTION CONTENT

This manual provides installation, operation, configuration and troubleshooting information. Read and understand this document before putting the module into service. This list is a summary of section content.

Introduction An overview of module capabilities, electronic specifications, glossary of unique terms, and related documents.

Description and Operation Explains data transfer and security functions handled by the hardware and software.

Installation Preparatory steps (switch settings etc.) to complete before putting the module into service. Additional termination information is in the appendices.

Configuration Design of control strategy, function codes such as Invoke C, Allocate C, Segment Control; which are unique to the MFC.

Operation Operating status information conveyed by the various LEDs, the STOP and RESET pushbuttons, what to look for in normal operation.

Troubleshooting Explains error messages and corrective actions.

Maintenance Contains a list of preventive maintenance steps.

Repair/Replacement Procedures Tells how to replace an MFC.

Support Services How to order replacement parts and instruction manuals. This section also contains additional services available.

Appendix A Explains the steps for on-line configuration.

Appendices B to D Have cable connections and dipshunt configurations for termination units.

HOW TO USE THIS MANUAL

Read this manual before using the MFC. Refer to the sections in this list as needed for more information.

1. Read Section 3 before you connect the MFC.
2. Read Section 4 before you power up the MFC.
3. Read Section 5 before you use the MFC.
4. Read Section 4 for steps to follow to do on-line configuration.
5. Refer to Section 6 for steps to follow to correct error conditions.
6. Refer to Section 2 for more MFC theory.
7. Refer to Section 9 for steps to order replacement parts and additional services.

REFERENCE DOCUMENTS

Documents listed below discuss hardware and software related to the MFC. Refer to them as needed.

Number	Document
I-E96-702 I-E96-703 I-E96-710	Batch Language Compiler C Language Compiler User Defined FC Compiler
I-E96-906-6 I-E96-916-16 I-E93-900-20	MFC BASIC Programmer's Reference Manual MFC C Language Implementation Guide Function Code Application Manual
I-E96-117 I-E96-303 I-E96-304	Analog Control Station (IISAC01) Analog Output Station (IMASO01) Analog Slave Input Module (IMASI02)
I-E96-306 I-E96-307 I-E96-308	Control I/O Slave (IMCIS02) Digital Slave Input Module (IMDSI02) Pulse Input Module (IMDSM04)
I-E96-309 I-E96-310 I-E96-313	Digital Slave (IMDSM05) Digital Slave Output Module (IMDSO01/02/03) Digital Slave Output Module (IMDSO04)
I-E96-317 I-E96-413 I-E96-427	Remote I/O Slave Module (IMRIO02) Termination Module/Cables (NIMF01/02, NKTU01) Termination Units/Cables (NTMF01/NKTU02)

GLOSSARY OF TERMS AND ABBREVIATIONS

Term	Definition
Analog	A signal with an infinite number of values as opposed to a digital value that is either 0 or 1.
Checksum	The sum of the bytes in a command except the checksum byte and the command terminator. Software security checks use this sum.
Configuration	Defining module operations (control strategy) with function blocks.
Digital	A value that is either 0 or 1.
Executive Block	Fixed function block that determines module operating characteristics.
Function Block	An area in the MFC's user defined memory containing a function code.
Function Code	Defines operation(s) to be done (AND, OR, PID).
MCS	Management Command System - a CRT-based operator monitor and control console; also used in configuration.
MFT	Machine Fault Timer - reset by the processor during normal operation. If there is an error, the MFT times out and the module stops.
Module Bus	Serial communication link between Multi-Function Controller and other control modules (e.g., Logic Master Module, Controller, etc.).
OIS	Operator Interface Station - a CRT-based operator monitor and control console; also used in configuration.
PCU	Process Control Unit - rack type industrial type cabinet containing control and slave modules.
Primary	The active module in a redundant configuration.
Secondary	The backup module in a redundant configuration.
Slave Expander Bus	Communication link between Multi-Function Controller and slave modules.
TM	Termination module - high density terminator for process wiring.
TU	Termination unit - terminator for process wiring.

NOMENCLATURE

This list contains the nomenclature and functions of the equipment used with the MFC.

Nomenclature of the Control and Slave Modules

Name	Nomenclature	Function
Analog Control Station	IISAC01 (L)	Provides the operator with single loop monitoring and control.
Analog Slave Input	IMASI02 (L)	Supplies 15 analog inputs with a range from +10 to -10 VDC, 1 to 5 VDC, 4-20 mA, Smart Transmitter interface.
Analog Output Station	IMASO01 (L)	Supplies 14 analog outputs, (1-5 VDC, 4-20 mA).
Control I/O Slave Module	IMCIS02 (L)	Supplies 4 analog inputs (4 to 20 mA, 1 to 5 VDC), 3 digital inputs (120 VAC, 125 VDC, or 24 VDC), 2 analog outputs (4 to 20 mA, 1 to 5 VDC), and 4 digital outputs (24 VDC).
Digital Slave Input Module	IMDSI02 (L)	Supplies 16 contact inputs of 24 VDC, 125 VDC, or 120 VAC
Pulse Counter	IMDSM04 (H)	Supplies 8 input channels that determine the count, frequency, or period of pulse or sine wave inputs.
Digital Slave	IMDSM05 (H)	Interfaces the MFC to up to 8 Digital Logic Stations.
Digital Slave Output Module	IMDSO01 (L) IMDSO02 (L) IMDSO03 (L) IMDSO04 (L)	Supplies 8 solid state relay outputs of 24 VAC to 240 VAC. Supplies 8 solid state relay outputs of 4 VDC to 50 VDC. Supplies 8 solid state relay outputs of 5 VDC to 160 VDC. Supplies 16 open collector outputs of 24 VDC.
Remote I/O	IMRIO02 (L)	Acts as the interface between remote slaves located up to 10,000 feet away.

NOTE: (L) denotes low power slave; (H) high power slave. Low power slaves use HCMOS and semi-custom integrated circuits to reduce power consumption.

Nomenclature of the Termination Units

Name	Nomenclature	Function
Termination Unit*	NTMF01	Provides link to Control Stations and redundant MFCs. Provides Serial Ports for Basic, C and sequential event recorder.
Termination Module*	NIMF01 NIMF02	Provides link to Control Stations and redundant MFCs. **NOTE:** Termination modules are high-density versions of the termination units.
Cables	NKTU01 (TU) NKTU02 (TM) NKTM01 (TM) NKMF02 (no TU)	Standard module to termination module cable. Connects primary MFC to redundant MFC.

* Termination units/modules are required if a Control Station is being used for Basic and C programming or for a sequential event recorder. In other cases, only the NKMF02 cable (for redundancy) is required.

SPECIFICATIONS

Microprocessor	68020
Memory	512 Kbytes of RAM 80 Kbytes of Battery Backed RAM (non-volatile) 256 Kbytes of UVROM
Communication Ports	(2) RS-232-C - Serial (2) RS-422 - SAC/DCS Link, MFC to MFC redundancy
Power Consumption	4.5 Amps nominal at +5 VDC (23 Watts) 37 mA nominal at +15 VDC (0.6 Watts) 18 mA nominal at -15 VDC (0.3 Watts)
Power Dissipation	37.68 Watts maximum
Mounting	Occupies two slots in standard Infi 90 Module Mounting Unit (MMU).
Environmental	
Ambient Temperature	0^{o} to 70^{o} C (32^{o} to 158^{o} F)
Relative Humidity	5% to 95% up to 55^{o} C (131^{o} F) (non-condensing) 5% to 45% at 70^{o} C (158^{o} F) (non-condensing)
Atmospheric Pressure	Sea level to 3 km (1.86 miles)
Air Quality	Noncorrosive
Certification	CSA certified for use as process control equipment in an ordinary (nonhazardous) location.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

SECTION 2 - DESCRIPTION AND OPERATION

INTRODUCTION

This section explains the functional blocks that make up the MFC. It also describes data bus communications and security functions of the hardware.

MODULE DESCRIPTION

The IMMFC03 is a series of functional blocks working together. To help you understand how the MFC works, this section shows MFC functionality as a block diagram and then explains each block in the following text. See Figure 2-1.

Microprocessor

The microprocessor, which operates at 8 Megahertz, is responsible for module operation and control. The processor's operating system instructions and the function code library reside in the read only memory (ROM). Since the processor is responsible for overall operation, it communicates with all functional blocks. The processor also does one other critical task. It constantly retriggers the Machine Fault Timer (MFT) circuit. If the processor or software fails and the MFT is not reset, the MFT issues a board-wide reset and the Status LED turns red. This condition is known as a fatal error.

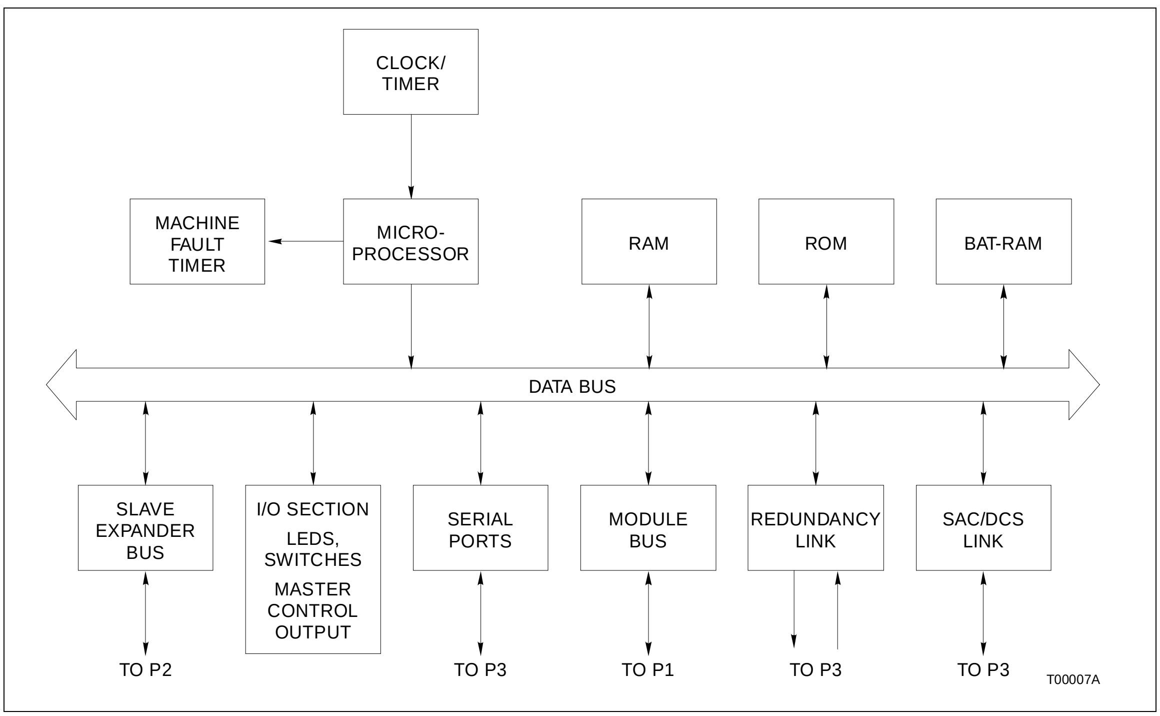


Figure 2-1. IMMFC03 Block Diagram

Clock/Timer

The Clock section provides the clock signals to drive the module at 8 Megahertz. Additionally, it supplies the lower frequency clock signals for the module's system timer for uniform control algorithm execution.

Memory

There is 256 kilobytes of ROM, 512 kilobytes of RAM and 80 kilobytes of battery-backed RAM. The ROM holds the operating system instructions for the processor. The RAM provides temporary storage and a copy of the user's configuration. The battery-backed RAM (BATRAM) holds the user's configuration (control strategy designed with function codes). It is unique in that it retains whatever information it has even when power is lost. This is possible because of the back up batteries that keep the memory active if power is lost.

Slave Expander Bus

The slave expander bus resides on the backplane of the module mounting unit. It is an eight bit parallel bus that provides the communication path for I/O data from slave modules. It is capable of supporting 64 low power slaves (both Network 90 and INFI 90). The bus uses Bailey-designed protocol to ensure data integrity. The bus bandwidth is 500 kilobytes per second.

I/O Section

The I/O Section interface allows the processor to read the switches that tell it how to operate and set its address. The I/O section contains the latches whose outputs connect to the status and error LEDs. An additional function contained in this section is an output that shows that a master is operating as the primary. Upon a failover, this output de-energizes and the backup's output energizes as it takes over. The termination unit or termination module uses this output to show the current master.

Additionally, the I/O section monitors the Stop and Reset pushbuttons. When you press the Stop pushbutton, this section ensures that the module completes any I/O functions before it brings the module to an orderly stop. When you press the Reset pushbutton, the module restarts after the processor and support circuitry is reset.

Serial Channels

There are two independent, general purpose serial channels on the MFC. One is used for language support (C and BASIC). Each channel is capable of supporting standard baud rates up to 19.2 kilobaud. Standard D-type connectors are available on the NTMF01 termination unit or NIMF01 termination module. Note that one channel also can be used as RS-485.

Module Bus

The module bus provides a 83.3 kilobaud peer-to-peer communication link capable of supporting up to 32 drops.

Redundancy Link

The redundancy link is a 25 kilobit serial link between a primary and backup MFC in redundant configurations. As the primary module executes, the backup module waits in hot standby mode and receives a copy of all block outputs over this link. If for any reason, the primary module fails, the backup module takes over immediately without any process interruption.

Station Link

Station link controls the serial communication between the MFC and the panel stations. It provides a 5 kilobaud serial channel for up to eight stations (IISAC01 or NDCS03). This link connects to the termination unit or termination module for control stations via the NTMF01 or NIMF01 and the cable NKSE01.

DATA TRANSFER

The IMMFC03 uses two busses for communication purposes: The module bus and the slave expander bus. Through the module bus, the MFC communicates with other control modules in its process control unit (PCU). The module bus is a serial bus located on the MMU backplane. The slave expander bus is an 8 bit parallel bus located on the MMU backplane. It provides the path for bidirectional communications with slave modules. This bus, through a 12 position dipshunt, can be broken to create separate busses for different masters.

Data transfer between the MFC and its slaves occurs on the slave expander bus. The MFC is able to execute four types of data transfer functions. They are:

- Write a command to a slave.
- Request a slave status.
- Write data to a slave.
- Read data from a slave.

The MFC always initiates the data transfer operation. When a data transaction occurs, the MFC addresses a slave, requests the information, and reads/writes the data.

SECURITY FUNCTIONS

The hardware and software handle a variety of module security functions that detect normal failures.

Hardware Module Security Functions

The hardware performs four security functions: error detection and correction for dynamic RAM, illegal address detection, machine fault timer, and memory management.

The hardware performs error detect and correct on dynamic RAM; detecting and correcting all single bit errors. As these errors are corrected, the MEM 2 LED is lit and remains lit until the RESET is pressed.

If the hardware detects two bit errors, three bit errors or complete memory failure, it causes both MEM LEDs to light and immediately halts the module.

Next, the hardware detects illegal addresses in and above the MFC's allowable address range (16 megabytes). If the processor sources an illegal address, the address decoding hardware detects it and generates a bus error. The front panel LEDs illuminate with the error message.

The third hardware check is the machine fault timer (MFT). The MFC processor periodically resets this timer. If the timer is not reset, it expires. When this happens, the MFC stops immediately and the Status LED turns solid red.

The last security check is the memory manager. The memory manager locks C programs into a pre-defined section of RAM. If a C program attempts to write to an area out of the predefined area, the memory manager forces the processor to abort execution. This security function protects the normal configuration and the user's system from damage due to C program errors.

Internal Software Security Functions

Two functions are performed by the internal software: module diagnostics and module status check.

Module diagnostics are performed when the MFC is powered up. If a problem is detected, the error is displayed on the front panel LEDs and the module stops immediately.

As a background idle task, the module status check constantly verifies ROM and NVM checksums. If a discrepancy is found in any checksum, the error is displayed on the front panel LEDs and the module stops immediately.

Control Software Security

The control software is responsible for Local I/O problems, remote I/O problems, station problems, and redundancy errors.

Local and remote I/O errors cause the MFC to assign a bad status to the slave signals. Local errors occur when:

- An I/O signal or voltage reference is out of range.
- The MFC is unable to drive analog or digital outputs to correct values.
- The MFC's own status is bad (i.e., the MFC is no longer functioning).
- A slave status is bad.

All I/O points that have any of the preceding errors are tagged by the MFC as bad quality. Bad quality stays with the point no matter where it goes (e.g., in the MFC, on the module bus, or the communication highway.

If you select to run the process using bad quality data, the MFC uses the last valid value it had for the process point before the quality went bad. The MFC then writes the bad quality information to its module status bytes and activates an OIS or MCS alarm.

Station and redundancy failures are also noted in the module's status bytes. Since the status bytes are always available to the communication module (in the same PCU as the MFC), it is also available to the OIS or MCS console. The console operator can be aware of the problem and correct it before a fatal error can occur.

I/O Security

For safety reasons, slave module outputs always go to known states in the event of a failure. Default states (e.g., power up value, hold at current value) are given in the product instructions for the related MFC slave modules. Refer to these documents for specifics.

SECTION 3 - INSTALLATION

INTRODUCTION

Several switches and jumpers must be set and configured before the IMMFC03 is installed. This section explains each switch, what it does, and how to configure it. After all switches and jumpers have been configured, the module can be installed in the module mounting unit. Installation for the MFC ONLY is presented here. Information for connecting the termination units is in Appendix B, C, and D. For complete information concerning cables, termination units (modules), etc., refer to E93-911, Termination Unit Product Instruction.

HANDLING

NOTE: Always use Bailey's Field Static Kit (P/N 1948385A2 - consists of wrist strap, ground cord assembly, alligator clip) when working with modules. The kit is designed to connect a technician and the static dissipative work surface to the same ground point to prevent damage to the modules by electrostatic discharge.

Special Handling

The MFC uses MOS devices. Follow the special handling procedures below:

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

2. Ground the anti-static 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 module.

General Handling

1. Examine the MFC immediately to verify no damage from shipping.

2. Notify the nearest Bailey Controls Sales Office of any such 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 modules.

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

CPU BOARD SWITCH SETTINGS

The CPU Board (Figure 3-1) has three user configured switches: U72 - Options, U73 - Baud Rates, and U75 - Module Address. The following paragraphs explain each switch and their settings.

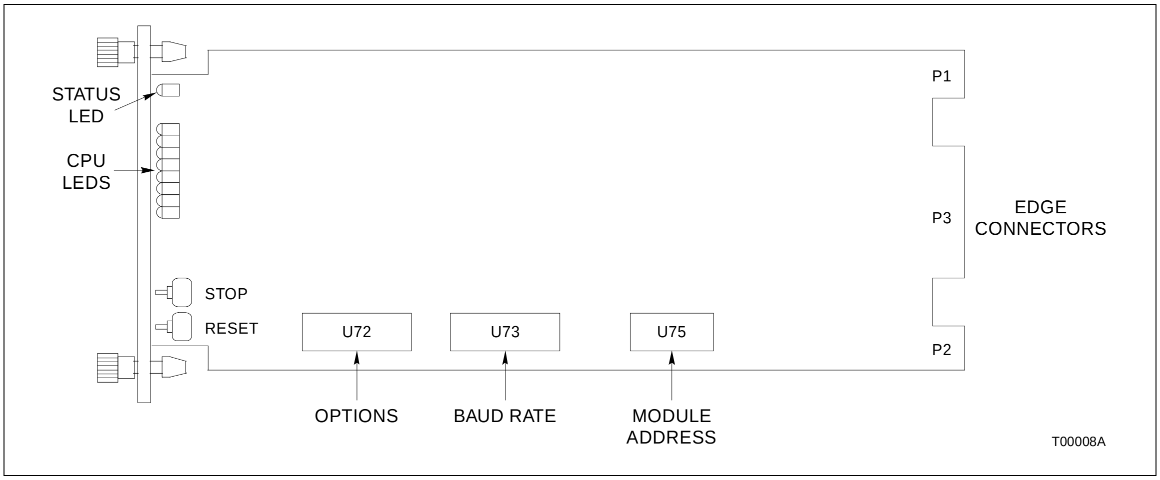


Figure 3-1. CPU Board Component Locations

Switch U72 Options

U72, the Option switch, is used to tell the MFC to perform or not to perform some standard routines. Table 3-1 lists the switch positions and their functions. (Switch closed = logic 0; switch open = logic 1. This applies to all MFC switches.)

NOTES:
1. When redundancy is used, switches 1 through 7 on the redundant MFC are set the same as the primary MFC.
2. Record your settings in the USER SETTINGS column.

Switch U73 Baud Rate

This switch is used to set the baud rates of the two RS-232-C ports of the MFC's Termination Unit (NTMF01) or Termination Module (NIMF01). The termination unit/module provides serial input and output paths for the MFC. Port 0 is the Terminal Port; Port 1 the Printer Port. Table 3-2 lists the baud rates and switch settings. Note that switches 1 through 4 relate to Port 0; 5 through 8 relate to Port 1.

Table 3-1. U72 Switch Settings

User Settings	Switch	Position	Function
	1	0*	Not used.
	2	0*	Disable On-Line Configuration.
		1	Enable On-Line Configuration.
	3	0*	Perform ROM checksum routine.
		1	Inhibit ROM checksum routine.
	4	0*	Not used.
	5	1	Inhibit ROM (CPU Board) check.
		0*	Perform ROM check.
	6	0*	Compact configuration - moves configured blocks to the top of NVM while moving free space to the bottom (this is known as compacting). Leave switch OPEN; insert module into MMU. When front panel LEDs 1, 2, and 4 are ON, remove the module, put the switch in the CLOSED position; reinsert the module. The MFC goes into the CONFIGURE mode and compacts the configuration.
		1	
	7	0*	Initialize NVM (erase configuration). Leave switch OPEN; insert module into MMU. When front panel LEDs 1, 2, and 4 are ON, remove the module, put the switch in the CLOSED position; re-insert the module. The module is now ready to be configured. **NOTE:** This switch remains CLOSED for normal operation.
		1	
	8	0*	Primary MFC.
		1	Redundant MFC.

* Normal switch setting for normal module operation.

Table 3-2. U73 Switch Settings

User Settings	Switch Position Baud Rate	1	2	3	4	5	6	7	8
	50	0	0	0	0	0	0	0	0
	75	1	0	0	0	1	0	0	0
	110	0	1	0	0	1	1	0	0
	134.5	1	1	0	0	1	1	0	0
	150	0	0	1	1	0	0	1	1
	300	1	0	1	0	1	0	1	0
	600	0	1	1	0	0	1	1	0
	1200	1	1	1	0	1	1	1	0
	1800	0	0	0	1	0	0	0	1
	2000	1	0	0	1	1	0	1	1
	2400	0	1	0	1	0	1	0	1
	3600	1	1	0	1	1	1	0	1
	4800	0	0	1	1	0	0	1	1
	7200	1	0	1	1	1	0	1	1
	9600	0	1	1	1	0	1	1	1
	19200	1	1	1	1	1	1	1	1

Switch U75 Module Address

The MFC must have a unique address to enable it to communicate with other modules. Valid ranges are 2 through 31. Switch U75 is used to set the MFC's address. Refer to Table 3-3. Note that switch position 1 has a binary weight of 16, while switch position 5 has a binary weight of 1.

Table 3-3. U75 Switch Settings

Address	Switch Position 1 2 3 4 5	Address	Switch Position 1 2 3 4 5	Address	Switch Position 1 2 3 4 5
2	0 0 0 1 0	12	0 1 1 0 0	22	1 0 1 1 0
3	0 0 0 1 1	13	0 1 1 0 1	23	1 0 1 1 1
4	0 0 1 0 0	14	0 1 1 1 0	24	1 1 0 0 0
5	0 0 1 0 1	15	0 1 1 1 1	25	1 1 0 0 1
6	0 0 1 1 0	16	1 0 0 0 0	26	1 1 0 1 0
7	0 0 1 1 1	17	1 0 0 0 1	27	1 1 0 1 1
8	0 1 0 0 0	18	1 0 0 1 0	28	1 1 1 0 0
9	0 1 0 0 1	19	1 0 0 1 1	29	1 1 1 0 1
10	0 1 0 1 0	20	1 0 1 0 0	30	1 1 1 1 0
11	0 1 0 1 1	21	1 0 1 0 1	31	1 1 1 1 1

MEMORY BOARD JUMPER SETTINGS

Jumpers on the Memory Board (Figure 3-2) determine NVM size. Table 3-4 provides the jumper configurations.

NOTE: These jumpers are set at the factory. Do not change these settings. This table is for information only.

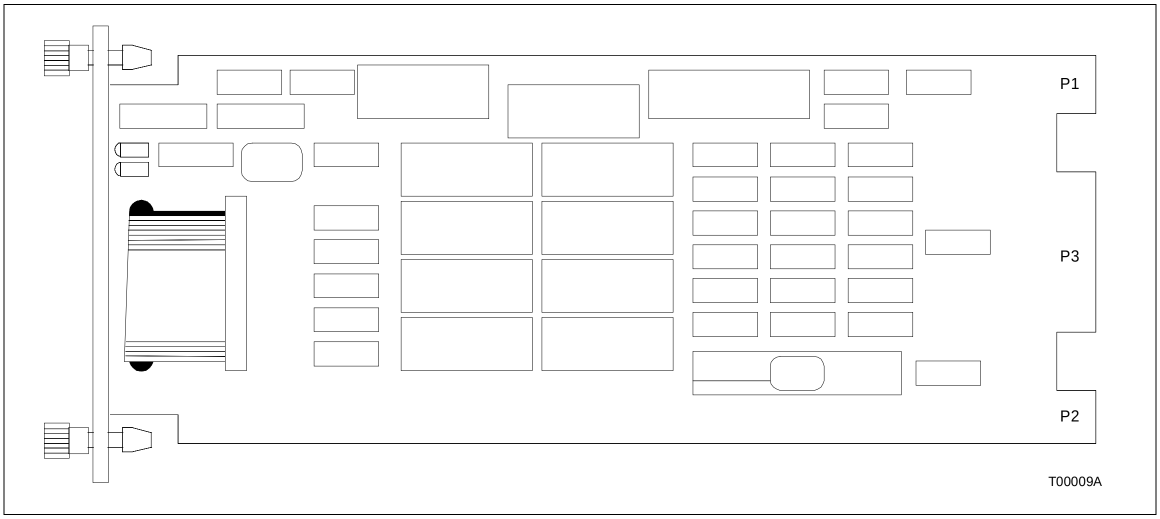


Figure 3-2. Memory Board

Table 3-4. Memory Board Jumpers

Jumper	Configuration	Use
JP1 - JP10	Jumper pins 2 and 3	Selects 8K x 8 NVM
JP11	Removed	Not used - The MFC will NOT function properly with this jumper in place.
P12	Jumper pins 2 and 3	Selects 256K ROM

SETUP FOR COMMUNICATION HIGHWAY ENVIRONMENT

INFI-NET/Superloop

To configure the MFC for use in the INFI-NET/Superloop environment, follow Steps 1 through 4.

1. Set dipswitch U72 poles 1 and 4 in the OFF (open/logic 1). All other poles must be in the ON (closed/logic 0) position. Doing so does not modify the configuration.

2. Reset the module. The Status LED turns red and LEDs 1 through 6 illuminate.

3. Set dipswitch U72 back to its original (or permanent setting).

4. Reset the module.

Plant Loop

To configure the MFC for use in the Plant Loop environment, follow Steps 1 through 5.

1. Set dipswitch U72 with poles 1 and 3 in the OFF (open/logic 1) position to perform a default MFC format operation. All remaining poles must be in the ON (closed/logic 0) position.

   NOTE: This Step deletes the configuration and all files.

2. Reset the module. The Status LED turns red and LEDs 1 through 6 illuminate.

3. Set dipswitch U72 to its original (or permanent setting).

4. Reset the module.

5. Reload plant loop environment configuration.

SPECIAL OPERATIONS

The special operations feature which allows you to configure the MFC to do a one-time special operation rather than entering its normal mode of operation. Steps 1 through 8 explain how to set the MFC for special operations and reset it for normal operation. Table 3-5 shows the switch settings and explains each special operation.

Table 3-5. Switch U72 Special Operations

Pole Value	1 128	2 64	3 32	4 16	5 8	6 4	7 2	8 1	Special Operation	Description
	1	0	0	0	0	0	0	0	0	Reserved. Do not use. If you use this setting your module may not operate properly.
	1	1	0	0	0	0	0	0	1	Reserved for future options. Not used at this time.
	1		1	0	0	0	0	0	2	Initialize NVRAM configuration space.
	1	1	1	0	0	0	0	0	3	Reserved. Do not use. If you use this setting your module may not operate properly.
	1	0	0	1	0	0	0	0	4	INFI-NET protocol enable. This allows the MFC to take advantage of INFI-NET/ Superloop capabilities.
	1	1	0	1	0	0	0	0	5	Permit segment modification (allows change to segment scheme configured with Function Code 82 specification S1).
	1	0	1	1	0	0	0	0	6	Enable time stamping. This operation instructs the MFC to generate time information with point data. It is applicable only to INFI-NET/Superloop systems.

Special operation 2 should be done as the first step of installation. If you are installing the MFC in an INFI-NET or Superloop environment, do special operation 4 next. If you desire time stamping, next do special operation 6.

To reverse INFI-NET protocol or time stamping, do operation 2 again.

1. Set switch U72 pole 1 to the 1 position.

2. Set poles 2 through 6 per Table 3-1.

3. Insert the module in its slot in the module mounting unit (refer to Installing Modules).

4. When the special operation is complete, the Status LED turns red and LEDS 1 through 6 illuminate.

5. Remove the module.

6. Reset pole 1 to the 0 position.

7. Reset poles 2 through 6 per Table 3-1.

8. Insert the module in its slot. It will enter its normal operating mode.

INSERTING THE MFC IN THE MODULE MOUNTING UNIT

After performing the necessary switch configurations, the module is ready to be installed in the module mounting unit (MMU).

To insert the MFC:

1. Verify the slot assignment of the module. Note that the MFC occupies two slots (one for the CPU board; the other for the MEM board).

WARNING	**Disconnect power before installing dipshunts for slave modules on the MMU backplane (slave expander bus). Failure to do so could result in severe or fatal shock.**
AVERTISSEMENT	**Couper l'alimentation avant d'installer les dipshunts sur la plaque arriere du chassis de montage de modules (MMU). Toute negligence a cet egard constitue un risque de choc pouvant entrainer des blessures graves, voire moretlles.**

2. Install the supplied dipshunt between the slots on the MMU backplane.

3. Connect the cable from the NTMF01 Termination Unit (or NIMF01 Termination Module) to the P3 card edge connector of the CPU Board NOT THE MEM BOARD.

4. Slide the module into the slot; push until the rear edge is firmly seated in the backplane connectors. Lock the module in place by turning the two captive screws on faceplate 1/2 turn. The module is in place when the notch on each screw is vertical and the open end is pointing toward the center of the module.

The green Status LED should illuminate. If it does not, refer to Section 6.

The module is now ready to be configured. Follow the steps in Section 4.

SECTION 4 - CONFIGURATION

INTRODUCTION

The variety of control and math functions residing in IMMFC03 firmware enables the module to perform analog and digital control, computations, and advanced control schemes. Functions from the library are user selected and serially linked by function blocks. The process of defining the functions, the function block address, and storing them in the nonvolatile memory is known as configuration. This section explains how to establish, define and enter the configuration.

ENTERING CONFIGURATION

The MFC can be configured with any of the following INFI 90 operator interface devices: Management Command System (MCS), Operator Interface Station (OIS), Computer Interface Unit (CIU), Engineering Work Station (with applicable software), or Configuration Tuning Terminal (CTT). Refer to the product instruction for your specific interface device for complete configuration details.

FUNCTION BLOCKS

The valid range of function block addresses is 0 to 9,998. However, block addresses 0 through 29 are fixed (meaning that you cannot assign function codes to them). These blocks contain executive functions and system constants. Blocks 30 through 9,998, are available for assignments.

NOTE: The total number of blocks available for user selected functions depends on several critical factors inherent to INFI 90 function codes: execution time, bytes of nonvolatile memory (NVM) and RAM, complexity such as resolution, etc. Refer to the Function Code Application Manual for these values.

The following text provides an example of how to calculate memory usage:

For example purposes, two function blocks are used: Square Root and PID.

1. Define NVM and execution times:

Function Code 7 Square Root:

12 Bytes NVM
44 Bytes RAM
190 microseconds execution rate

Function Code 19 PID:

36 Bytes NVM
116 Bytes RAM
690 microseconds execution rate

Function Code 82 Segment Control:

60 Bytes NVM
256 Bytes RAM

NOTE: In this example, execution time for this function is negligible.

2. Specify the number of blocks for both types. In this example, 205 square root blocks, 205 PID blocks, and 2 segment control blocks are configured.

3. Assign priorities to segments of these function blocks. Give the segment of blocks controlling the most critical functions the highest priority. The execution rates are listed in Table 4-1.

Table 4-1. Function Block Execution Rates

Control Type	Rate of Execution	PID Block	Square Root Block
Critical Control	20 times/second	5	5
Normal Priority Control Loops	4 times/second	100	100
Low Priority Control Loops	1 time/2 seconds	100	100

4. Calculate the amount of NVM the configuration uses:

a. Multiply 205 PID blocks by 36 bytes per block = 7,380 bytes of NVM.

b. Multiply 205 Square Root blocks by 12 bytes per block = 2,460 bytes of NVM.

c. Multiply 2 Segment Control blocks by 60 bytes per block = 120 bytes of NVM.

d. Add products:

```
  7,380
  2,460
+   120
-------
  9,960 bytes of NVM
```

There are 79,042 bytes available at the beginning. There are 69,082 bytes of NVM remaining.

5. Calculate the amount of RAM the configuration uses:

   a. PID blocks use 116 bytes. Therefore, multiply 205 PID blocks by 116 = 23,780 bytes RAM.

   b. Square Root blocks use 44 bytes. Therefore, multiply 205 Square Root blocks by 44 = 9,020 bytes RAM.

   c. Segment Control blocks use 256 bytes. Therefore, multiply 2 Segment Control blocks by 256 = 512 bytes RAM

   d. Add products:

```
  23,780
   9,020
+    512
  33,312 bytes of RAM
```

   There are 327,152 bytes available at the beginning. There are 293,840 bytes of RAM remaining.

6. Calculate the amount of CPU time the configuration requires to run. First, calculate the maximum amount of CPU time. Next, calculate how much CPU time the low priority loops require.

   a. Multiply 100 PID blocks by 690 microseconds = 0.069 seconds

   b. Multiply 100 Square Root blocks by 190 microseconds = 0.019 seconds

   c. Add products:

```
  0.069
+ 0.019
  0.088 seconds of CPU time
```

   The result of this calculation gives the amount of CPU time that the low priority control functions use during execution.

7. Calculate the amount of CPU time used by normal priority loops of control functions:

   a. Determine the number of times the normal priority loops run during the amount of CPU time specified. In this example, multiply 4 times/second by 2 seconds. The normal priority function blocks are executed 8 times.

b. Calculate the amount of CPU time that is used each time the normal priority function blocks are executed.

100 PID blocks x 690 microseconds =	0.069 seconds
100 Square Root blocks x 190 microseconds =	+0.019 seconds
	0.088 seconds

c. Calculate the total time used by the normal priority function blocks during the available 2 seconds:

Normal priority blocks = 0.088 seconds used each time they are executed.

Executed 8 times during the 2 second interval.

Therefore 8 x 0.088 = 0.704 CPU seconds used by the normal priority tasks.

8. Calculate the amount of time required for high priority function blocks to execute.

a. Multiply 5 PID blocks by 690 microseconds = 0.00345 seconds

b. Multiply 5 Square Root blocks by 190 microseconds = 0.00095 seconds.

c. Add products:

0.00345
+ 0.00095
0.00440 seconds

The above sum represents CPU time used by one pass of the high priority loop.

d. Multiply 20 times per second by 2 seconds = 40 times in 2 seconds (number of times the high priority loops are run within maximum CPU time allotted).

e. Multiply 0.00440 by 40 = 0.176 seconds (the amount of CPU time the high priority loops use within the 2 second maximum).

9. Add the final products.

0.088 (CPU seconds used by low priority loops)
0.704 (CPU seconds used by normal priority loops)
+0.176 (CPU seconds used by high priority loops)
0.968 seconds = total CPU time used by this configuration

10. Subtract the total CPU time from the maximum amount of CPU time specified.

2.000 seconds available
-0.968 seconds used by the control blocks
1.032 seconds of CPU time still available.

The results of the previous calculations determine that the example will run.

FUNCTION CODES

NOTE: Only function codes that are unique to the MFC are provided in this section. For complete Function Code information, refer to the Function Code Application Manual (E93-900-20).

Function Code 81 - Executive

The Executive Function Code occupies blocks 0 through 14. Within these blocks are constant values that can be used as block inputs anywhere in the configuration. Additionally, this function is used to select the outputs of the front panel status LEDs. Table 4-2 lists the specifications. Table 4-3 lists the system constants.

Table 4-2. Function Code 81 Specifications

Spec No.	Tune*	Default Value	Data Type	Range Min. Max.	Description
S1	Yes	0.000	Int(2)	0 1	Front panel LED display mode 0 = normal (MFC status) 1 = display memory
S2	Yes	0.000	Real(3)	Full	Memory display address (most significant byte of address)
S3	Yes	0.000	Real(3)	Full	Memory display address (middle byte of address)
S4	Yes	0.000	Real(3)	Full	Memory display address (least significant byte of address)

*Tune - a yes indicates that these specifications can be altered during execution.

Table 4-3. Function Code 81 Block Outputs (System Constraints)

Block Number	Data Type	Description
0 1 2	Boolean Boolean Boolean	Logic 0 Logic 1 0 or Real 0.0
3 4 5	Real Real Real	-100.0 -1.0 0.0
6 7 8	Real Real Real	1.0 100.0 -9.2E18 (maximum negative value)
9 10 11	Real Boolean Real	+9.2E18 (maximum positive value) Start-up in progress flag (0 = no; 1 = yes) Memory Display Value
12 13 14	Real Real Real	System free time in percent Revision Level (hardware and firmware) Reserved

Function Code 82 - Segment Control

Function Code 82, Segment Control, is permanently assigned to block 15 and occupies the next four consecutive blocks. The Segment Control block is used to divide the set of function blocks into subsets (or segments), and specify the operating parameters for each segment individually. The Segment Block has 5 outputs that can be used as inputs to other blocks. The MFC supports a maximum of eight Segment Control Blocks. The seven other Segment Control blocks can be placed in any user configurable block. Refer to Tables 4-4 and 4-5.

Table 4-4. Function Code 82 Specifications

Spec. No.	Tune*	Default Value	Data Type	Range Min. Max.	Description
S1	No	1	Int(2)	1 to 2	Segment Attributes Tune Lock and Time Units Tune Lock 0X = Tuning allowed 1X = Tuning not allowed Time Units X1 = Seconds X2 = Minutes
S2	Yes	.250	Real(3)	Full	Target period (seconds/minutes)
S3	No	0	Int(2)	0 to 32,767	Segment priority (0 = lowest)
S4	No	1	Int(2)	0 to 32,767	Checkpoint period (number of cycles per checkpoint)
S5	No	0	Int(1)	0 to 1	PID reset mode 0 = normal 1 = external
S6	No	10.000	Real(3)	Full	PID maximum derivative gain

Table 4-4. Function Code 82 Specifications (continued)

Spec. No.	Tune*	Default Value	Data Type	Range Min. Max.	Description
S7	No	1.000	Real(3)	0.0 to 9.2E18	Minimum report time for all exception reports in this segment (in seconds)
S8	No	60.000	Real(3)	0.0 to 9.2E18	Maximum report time for all exception reports in this segment (in seconds)
S9	No	2.000	Real(3)	0.0 to 9.2E18	Significant change parameter for all loop (i.e., Station) exception reports in this segment (in % of span)
S10	No	1.000	Real(3)	0.0 to 9.2E18	Alarm deadband for all high/low alarm reports in this segment (in % of span)
S11	No	1.000	Real(3)	0.0 to 9.2E18	Alarm deadband for all deviation alarm reports in this segment (in % of span)
S12	No	0.0	Real(3)	Full	Reserved
S13	No	1.000	Real(3)	0.0 to 9.2E18	Module bus I/O period for this period (in seconds). This should be a multiple of the Extended MFC Executive Block 20, specification S2.
S14	Yes	9.2E18	Real(3)	0.0 to 9.2E18	Segment cycle time alarm limit (in seconds)
S15	No	0	Int(2)	0 to 1	Auto sequencing 0 = Off 1 = On

Table 4-5. Function Code 82 Block Outputs

Block Number	Description
N	Elapsed time of the previous execution cycle in S1 units, including any segment idle time. If the time required to run the block is less than the requested cycle time, the remainder is idle time spent waiting before starting the next cycle. Any idle time is available for lower priority segments. This output is used to verify that the cycle time specified by S2 is being met.
N+1	Elapsed time of the current execution cycle in S1 units, not including any segment idle time. It is a measure of the actual runtime of the blocks within the segment, plus the block runtime of all higher priority segments. This output is used to verify that the segment is running. A continual upward ramp indicates that the segment is not running. This occurs when higher priority segments consume all the processor time, or when a BASIC program is waiting for operator input, in an infinite loop, or aborted because of some error condition.
N+2	Processor utilization in percent.

Table 4-5. Function Code 82 Block Outputs (continued)

Block Number	Description
N+3	Checkpoint overrun count number. The number of cycles executed over that specified by S4. This output is used to verify that the checkpoint period is being met. A continual upward ramp indicates that the segment is never getting the link for dynamic data transfer. A cyclic ramp indicates that dynamic data transfer is occurring, but not at the requested rate. Depending on the overrun, this may be an acceptable situation. If not, then the checkpoint period of the segment or the next highest priority segment must be increased until no overrun occurs.
N+4	Cycle time overrun in units specified by S1. If cycle time exceeds that set by S14, the overrun is output from this block. This output enables you to program logic to take specific action based on a given cycle time alarm limit being exceeded.

Function Code 90 - Extended Executive

Function Code 90, Extended Executive, resides at block 20 and occupies the next nine consecutive blocks. It is used in conjunction with Functions 81 and 82. This code defines a number of variables affecting overall module operation. Refer to Tables 4-6 and 4-7.

Table 4-6. Function Code 90 Specifications

Spec. No.	Tune*	Default Value	Data Type	Range Min. Max.	Description
S1	No	0	Int(2)	0 to 9998	Block address of configure mode lockout flag 0 = configure mode allowed 1 = configure mode locked out
S2	No	.250	Real(3)	0 to 9.2E18	Base module bus I/O period for MFC (in seconds)
S3	Yes	0	Int(2)	0 to 1	Redundant MFC configuration flag 0 = no redundancy 1 = redundancy
S4	Yes	15.000	Real(3)	0.0	Module start-up time (in seconds)
S5	No	.250	Real(3)	0.0	Logic Station poll rate (in seconds)
S6	No	0	Int(1)	0 to 1	SOE monitor time sync flag 0 = inhibit sync of SOE monitor to time of day 1 = sync of SOE monitor to time of day

Table 4-7. Function Code 90 Block Outputs

Block Number	Data Type	Description
20 21 22	Real Real Real	Time of day, hours Time of day, minutes Time of day, seconds
23	Boolean	Time/date synchronization flag 0 = time/date invalid 1 = valid
24 25 26	Real Real Real	Calendar year (0 - 99) Calendar month (1 - 12) Calendar day (1 - 31)
27	Real	Calendar day of week 1 = Sunday, 2 = Monday, etc.
28 29	Real Real	Reserved Reserved

BASIC LANGUAGE FUNCTION CODES

Function Codes 91 and 92 are used only if a BASIC program is part of your configuration. Refer to the Function Code Application Manual (E93-900-20) for specifications.

C Language Function Codes

Function Codes 143 and 144 are used only if a C language program is part of your configuration. Refer to the Function Code Application Manual for specifications.

Complete instructions for programming in BASIC or C can be found in the programmer's reference manuals.

SECTION 5 - OPERATION

INTRODUCTION

This section explains the indicators, controls, and operating modes of the IMMFC03.

INDICATORS AND CONTROLS

The MFC front panel (Figure 5-1) has the following: Status LED, eight CPU LEDs, two Memory Status LEDs, and Stop and Reset pushbuttons.

Status LEDs

The Status LED is a red/green LED that indicates MFC operating condition. It has four possible states:

Off Indicates that the MFC is not powered.

Solid Green Indicates that the MFC is in the Execute mode.

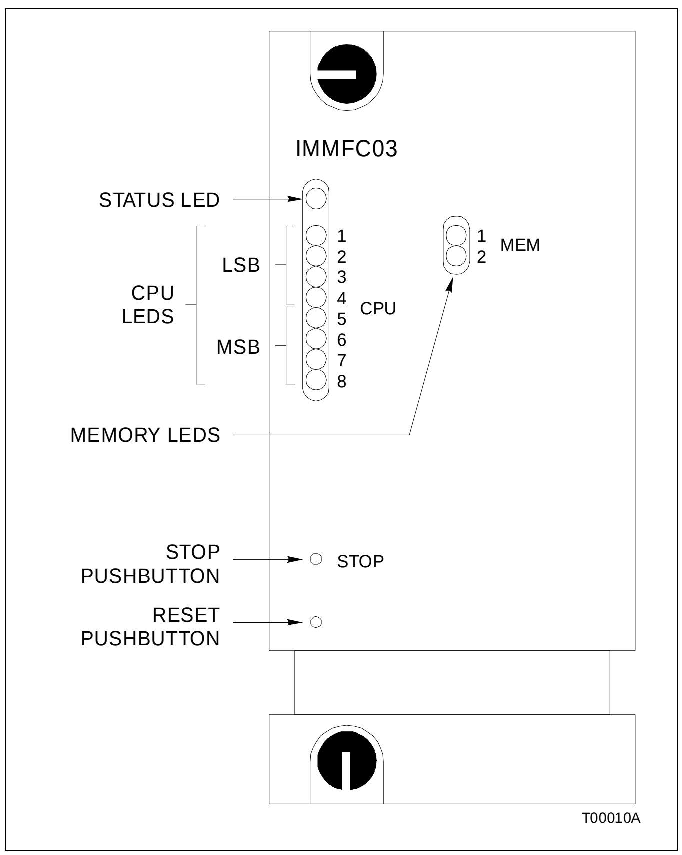


Figure 5-1. Front Panel LED Indicators and Controls

Flashing Green Indicates the MFC is in the Configure mode or a non executable mode (e.g., non fatal error detected).

Solid Red Indicates that the MFC diagnostics have detected a hardware failure, configuration problem, etc. and the module is halted. Additionally, the eight CPU LEDs illuminate to display the error code (refer to the Troubleshooting section).

NOTE: DO NOT put the IMMFC03 into operation until ALL preliminary Installation and Configuration tasks have been performed.

CPU LEDs

The eight CPU LEDs provide operating and error information. The information provided by these LEDs is provided in the Troubleshooting section.

NOTE: When contacting Bailey personnel about problems with your IMMFC03, it is important to indicate the error codes shown on the CPU LEDs.

Memory LEDs

There are two Memory LEDs. MEM LED 2 illuminates only when single bit errors are being corrected. Both LEDs illuminate when two bit errors, three bit errors or complete memory failure occur.

Stop Pushbutton

The Stop pushbutton performs the following:

- Forces the MFC to finish all Nonvolatile memory write operations.
- Completes data transfers over the slave expander and module busses.
- Halts the primary module and forces control from the primary to the secondary MFC in redundant configurations.

The Stop pushbutton should be used:

- To force control from a primary to a backup MFC in redundant configurations.
- Before removing the MFC from the module mounting unit. (Wait until the Status LED turns RED, then remove the module.)

Reset Pushbutton

The Reset pushbutton is used to:

- Reset the MFC to power up (default) status after a stop.
- Recover from a user initiated stop or module timeout.

OPERATING MODES

The MFC has three modes of operation. They are: Execute, Configure, and Error.

Execute Mode

The Execute Mode is the normal mode of operation. When the MFC is in Execute mode, it computes algorithms, performs functions, updates outputs, and communicates with the module and slave expander busses. While in this mode, certain user configured function block parameters can be tuned (adjusted), but configurations cannot be modified. The status LED is solid green indicating normal operation. However, in certain nonfatal error conditions, the LED flashes green but the MFC continues to operate.

Configure Mode

The Configure Mode is used to enter or modify the configuration that makes up the user's control strategy. In this mode, function blocks can be added, modified, or deleted by using any of the standard INFI 90 operator interface devices (MCS, OIS, etc.).

When the MFC is in the Configure Mode:

- Slave outputs (analog) will hold their current values.
- Slave outputs (digital) are de-energized or hold last value (refer to the specific slave instructions for details).
- Function algorithms are not computed.
- The module responds only to CONFIGURE messages.
- The Status LED blinks green.

Error Mode

Enter the Error Mode:

- When a configuration error is detected when going from the Configure to Execute mode.
- After resetting due to a red light condition as a result of a hardware problem (e.g., NVM or ROM checksum error).
- When the MFC is unable to communicate with other modules (non fatal).

Depending on your configuration, the MFC does one of the following when an error occurs:

Stops execution; the Status LED turns red. The slave outputs hold their present value or go to user selected default state.

-OR-

Continues to execute, but marks the I/O data of the failed slave as Bad Quality. When the MFC's status is read by the user's interface device, the slave failure is detected. When the operator inquires, he is advised of a slave failure and can take corrective action.

Any fatal error results in the MFC halting execution and the Status LED turning red. When this situation occurs, put the MFC in the Configure Mode to exit from the Error Mode, then correct the problem.

SECTION 6 - TROUBLESHOOTING

INTRODUCTION

This section contains the CPU LED displays, the status words for communication and non critical errors and the signals on the IMMFC03 edge connectors.

Table 6-1 provides the defined CPU LED displays, what they mean, and what corrective action(s) to take.

Table 6-1. CPU LED Error Codes

LED (Binary) 8 7 6 5 4 3 2 1	Hex	Meaning	Action
1 1 0 0 0 0 0 0	C0	Primary MFC (normal operation)	None.
0 0 0 0 0 0 0 0	00	Backup MFC configuration is not initialized.	Check contact 7 (U72). Should be closed.
0 1 0 0 0 0 0 0	40	Backup configuration is okay, however dynamic data is not initialized.	Check contact 7 (U72).
1 0 0 0 0 0 0 0	80	The backup module has copied the primary configuration and is ready.	None.
0 0 0 0 0 0 0 1	01	NVM checksum error.	Reset U72 contact 7 or replace NVM.
0 0 0 0 0 0 1 0	02	Analog input calibration error.	Check IMCIS02 slave switch settings. Check dipshunt configurations on NTCS02 T.U. Also, check specifications of applicable function codes.
0 0 0 0 0 0 1 1	03	Slave status error; wrong type or not responding.	Check switch settings on slave modules. Check dipshunt configuration on NIMF01. Also, check specifications of applicable function codes.
0 0 0 0 0 1 0 1	05	Configuration error (undefined block).	Check configuration. Add appropriate function codes/blocks.
0 0 0 0 0 1 1 0	06	Configuration error (data type error).	Check function code specifications in the configuration. Correct if needed.
0 0 0 0 1 0 1 1	0B	Initialize NVM switch is set.	Reset U72 contacts 6 and 7. Remove and re-insert the module.
0 0 0 0 1 1 0 0	0C	Nonvolatile memory write in progress.	Initialize configuration.
0 0 0 0 1 1 0 1	0D	Communication error between primary and redundant MFCs.	Check the NTMF01 cable between the primary and secondary MFCs. Also, check the NKTU01 cable to the termination module or termination unit.
0 0 0 0 1 1 1 0	0E	Backup MFC ID switch is same as primary's ID.	Contact 8 of U72 on backup should be toggled.
0 0 0 0 1 1 1 1	0F	Primary failed; backup configuration not current.	Reconfigure the primary MFC.

Table 6-1. CPU LED Error Codes *(continued)*

LED (Binary) 8 7 6 5 4 3 2 1	Hex	Meaning	Action
0 0 0 1 0 0 0 0	10	Primary failed; backup dynamic data is not current.	Reconfigure the primary MFC.
0 0 0 1 0 0 0 1	11	Error during write to Nonvolatile Memory.	Check configuration. Correct any faulty values. Re-execute configuration.
0 0 0 1 0 0 1 0	12	Backup MFC module bus address is not same as primary.	Set module bus switch same as primary's.
0 0 0 1 0 0 1 1	13	Bad UVROM.	Contact Bailey Field Service.
0 0 0 1 0 1 0 0	14	Inconsistent module/loop setup. (i.e., module configured for Plant Loop is on INFI-NET/Superloop)	Refer to ***SETUP FOR COMMUNICATION HIGHWAY ENVIRONMENT*** in Section 3.
0 0 1 0 0 0 0 0	20	Inconsistent FORMAT TABLE data caused by a configuration restore operation.	Put MFC in Configure mode and retry the Restore operation.
0 0 1 0 0 0 0 1	21	File system error.	Put MFC in Configure mode, check module's file directory for the file in error.
0 0 1 0 0 0 1 0	22	Invoke C error. Function Code is configured, but program files are missing, or Invoke is configured in the wrong function block segment.	Check Invoke C configuration, check module's file directory for program files.
0 0 1 0 0 0 1 1	23	User write violation. Program attempted to write outside the allowable user address space.	Check the C program for writes to null pointers, etc.
0 0 1 0 0 1 0 0	24	Stack overflow detected. C program wrote past the end of the stack.	Check the C program for unbounded stack growth.
0 0 1 0 1 1 1 1	2F	BASIC error.	Check BASIC program for errors.
0 0 1 1 0 0 0 0	30	Primary active during fail over attempt.	Replace primary with new module.
0 0 1 1 0 0 0 1	31	Memory/CPU fault.	Replace the MFC with a known good MFC.
0 0 1 1 0 0 1 0	32	Address/bus error.	Reset module; if error recurs, replace it.
0 0 1 1 0 0 1 1	33	Illegal instruction.	Reset module; if error recurs, replace it.
0 0 1 1 0 1 0 0	34	Trace/privilege violation.	Reset module; if error recurs, replace it.
0 0 1 1 0 1 0 1	35	Spurious exception.	Reset module; if error recurs, replace it.
0 0 1 1 0 1 1 0	36	Divide by 0/CHK instruction.	Reset module; if error recurs, replace it.
0 0 1 1 0 1 1 1	37	A Trap instruction was entered in the configuration.	Reset module; if error recurs, replace it.
0 0 1 1 1 1 1 1	3F	STOP pushbutton used to halt CPU normally.	None.

STATUS WORD DISPLAYS

Communication and other noncritical error types are detailed in Table 6-2 and Table 6-3. These Status Words provide detailed information on MFC error conditions.

Any of the INFI 90 operator interface devices can be used to access these words. Refer to the product instruction for your specific interface device for details.

Table 6-2. Status Bytes

Byte	Bit							
	7	6	5	4	3	2	1	
1	ES	MODE		TYPE				
2	FTX	BAC	RIO	LIO	N/A	NVI	CFG	N/A
3	PCU	MEM	NEF	N/A	N/A	N/A	N/A	N/A
4	LIE	LRE	LRE	LTE	LTE	N/A	N/A	N/A
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 6-3. Status Byte Descriptions

Field	Value			Description
Byte 1				
ES		80		Error Summary (0 - OK, 1 - Error)
MODE		60		Module Mode (00 - Config, 01 - Error, 11 - Exec)
TYPE		1F		Module Type Code (0B = MFC)
Byte 2				
FTX		80		First Time in Execute (0 - No, 1 - Yes)
BAC		40		Backup MFC Status (0 - OK, 1 - Bad)
RIO		20		Summary Remote I/O Status (0 - OK, 1 - Bad)
LIO		10		Summary Local I/O Status (0 - OK, 1 - Bad)
CFG		08		On-line configuration changes being made (0 - No, 1 - Yes)
NVF		04		NVM Checksum Error (0 - OK, 1 - Bad)
NVI		02		NVM default Configuration (0 - No, 1 - Yes)
DSS		01		Digital Station Status (0 - OK, 1 - Bad)
Bytes 3 - 5	**3**	**4**	**5**	
	01	01	---	NVM Error: Write Failure
		02	---	Checksum Failure
		03	---	Bad Data
		FF	---	Reset During Write
	02	(1)	(2)	Analog Input Reference Error (1), (2) = Block number* of Control Interface Slave block
	03	(1)	(2)	Missing Slave Module or Slave Expander Board (1), (2) = Block number* of slave module or Digital Station
	05	(1)	(2)	Configuration Error - undefined block (1), (2) = Block* making reference
	06	(1)	(2)	Configuration Error - input data type is incorrect (1), (2) = Block* making reference
	08	(1)	(2)	Trip block activated (1), (2) = Block number* of Trip block
	0F	---	---	The primary MFC failed and the redundant MFC configuration is not current.
	10	---	---	The primary MFC failed and the dynamic RAM data in the redundant MFC is not current.

* All block numbers are encoded in BCD (binary coded decimal) with (1) = MSB (most significant byte) and (2) = LSB (least significant byte)

Example: Block Number 1024 — (1) = 10, (2) = 24.

EDGE CONNECTOR PIN OUTS

Tables 6-4, 6-5 and 6-6 list signals on the IMMFC03 edge connectors.

Table 6-4. Edge Connector P1 Pin Outs

Pin No.	Signal	Pin No.	Signal
1	+ 5 VDC	2	- 5 VDC
3	N/C	4	N/C
5	Common	6	Common
7	+ 15 VDC	8	- 15 VDC
9	Power Fail Interrupt	10	Power Fail Interrupt
11	Module Bus	12	Module Bus

Table 6-5. Edge Connector P2 Pin Outs

Pin No.	Signal	Pin No.	Signal
1	Data Bit D1 (low true)	2	Data Bit D0 (low true)
3	Data Bit D3 (low true)	4	Data Bit D2 (low true)
5	Data Bit D5 (low true)	6	Data Bit D4 (low true)
7	Data Bit D7 (low true)	8	Data Bit D6 (low true)
9	Clock	10	Sync
11	N/C	12	N/C

Table 6-6. Edge Connector P3 Pin Outs

Pin No.	Signal	Pin No.	Signal
1	SAC/DCS Link (+)	A	SAC/DCS Link (-)
2	Redundancy Link Transmit Data (+)	B	Redundancy Link Transmit Data (-)
3	Redundancy Link Receive Data (-)	C	Redundancy Link Receive Data (+)
4	Terminal Port Transmit Data	D	Terminal Port Receive Data
5	Terminal Port Request to Send	E	Terminal Port Clear to Send
6	Terminal Port Data Carrier Detect	F	N/A
7	Printer Port Transmit Data	G	Printer Port Receive Data
8	Printer Port Request to Send	H	Printer Port Clear to Send
9	Printer Port Data Carrier Detect	I	N/A
10	Digital Output 1 (+)	J	Digital Output 1 (-)
11	Digital Output 2 (+)	K	Digital Output 2 (-)
12	N/A	L	N/A
13	N/A	M	N/A
14	N/A	N	N/A
15	N/A	O	N/A

NOTE: Refer to Figure ? for Edge Connector locations.

SECTION 7 - MAINTENANCE

INTRODUCTION

The Multi-Function Controller (IMMFC03) requires limited maintenance. This section contains a maintenance schedule.

MAINTENANCE SCHEDULE

Perform the tasks in Table 7-1 at the specified intervals.

Table 7-1. Maintenance Schedule

Task	Interval
Clean and tighten all power and grounding connections.	Every 6 months or during plant shutdown, whichever occurs first.
Use a static safe vacuum cleaner to remove dust from: Modules Module Mounting Unit Fan Assembly Power Entry Panel	Every 6 months or during plant shutdown, whichever occurs first.

SECTION 8 - REPAIR/REPLACEMENT

INTRODUCTION

Repair procedures are limited to module replacement. If the MFC module fails, remove and replace it with another. Verify that firmware revision levels match and that replacement switch settings are the same as the failed module. Refer to Table 8-1 for a list of recommended spare parts.

MODULE REPLACEMENT

Follow Steps 1 through 5 to replace the MFC Module.

1. Turn the two concentric screws one-half turn either way to release them. The notches on the screws point away from the middle of the module when they are unlocked.

2. Grasp the screws and slide out the module.

3. Set the switches on the replacement to match the settings of the MFC you have just removed.

4. Hold the module by the faceplate and slide it into the slot; push until the rear edges are firmly seated in the backplane connectors.

5. Turn the two concentric screws one-half turn clockwise to lock the module into the Module Mounting Unit. The module is locked when the notches on the front of the knobs are pointing toward the middle of the module.

Table 8-1. Recommended Spare Parts List

Description	Part Number	Quantity
Module, Multi-Function Controller	IMMFC03	1 (2 if redundancy is used)
Termination Module, Multi-Function Controller Module	NIMF01	1
Termination Module, Multi-Function Controller Module	NIMF02	1 (if redundancy is used)
Termination Unit, Multi-Function Controller Module	NTMF01	1
Cable, MFC to Termination Unit	NKTU01	1 (2 if redundancy is used)
Cable, MFC to Termination Module	NLTM02 OR NKTU02	1 (2 if redundancy is used)
Cable, Termination Module to Termination Module	6634408	1 (for each redundant pair)

SECTION 9 - SUPPORT SERVICES

INTRODUCTION

Bailey Controls is always ready to assist you with the operation and repair of its products. Requests for sales and/or application services along with installation, repair, overhaul and/or maintenance contract services should be directed to your nearest Bailey Controls sales/service office.

REPLACEMENT PARTS AND ORDERING INSTRUCTIONS

To make repairs at your facility, order replacement parts through a Bailey sales/service office. We request that the following information be provided when ordering parts:

1. Part description, part number, and quantity.

2. Model and serial (if applicable) number(s) and ratings of the assembly for which the part has been ordered.

3. Bailey publication number and reference used in identifying the part.

When ordering parts from Bailey, we request that part numbers and part descriptions from Renewal Parts sections of pertinent equipment manuals be used. Parts which do not have a commercial description provided must be ordered from your nearest Bailey sales/service office. Recommended spare parts lists, including prices, on standard assemblies are also available through your nearest Bailey sales/service office.

When ordering a Multi-Function Controller Module as a replacement for your system in a redundant configuration, your Bailey representative needs to know the revision of the firmware presently in your MFC. The firmware is the integrated circuit in the MFC which controls and guides the module. These integrated circuits are ROM (Read Only Memory) chips which contain Bailey operation codes.

Bailey changes the operation codes to create the best module efficiency possible. With new functions and enhancements, system integrity is improved. All MFC modules should have the same firmware revision level to ensure consistent operation with the rest of the system.

Figure 9-1 shows the location of the firmware revision level that the MFC is presently operating with. The ROM chip(s) have a white tab on them. On this tab is a letter and number(s) that designate the current firmware revision. The ROM chips are located in sockets XU16, XU28, XU40, and XU49.

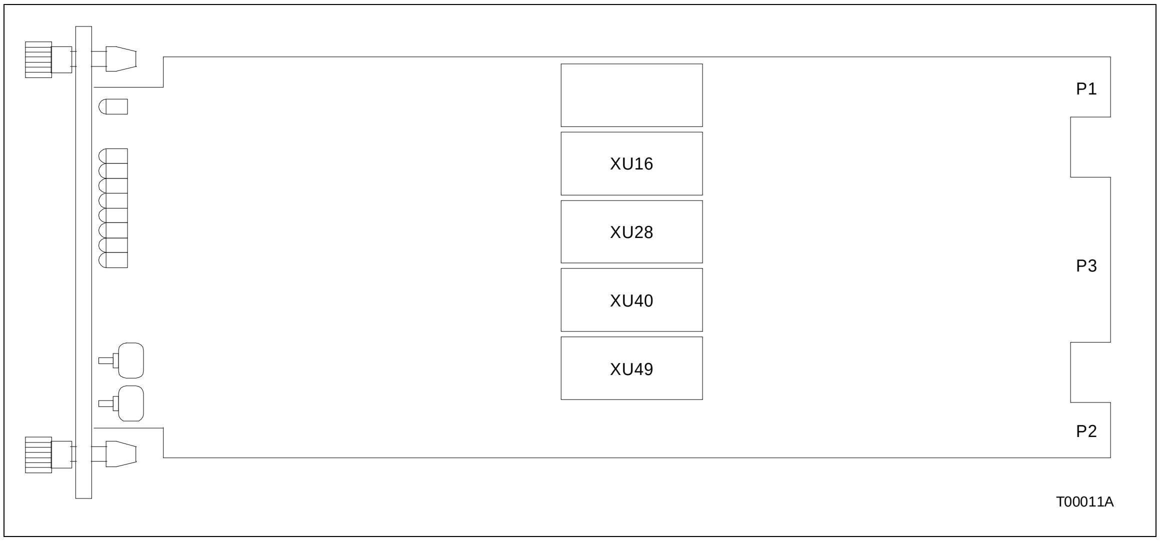
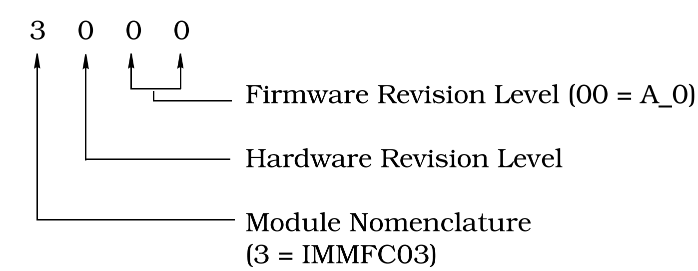


Figure 9-1. IMMFC03 Firmware Revision Level Location

Ordering Firmware

To order new firmware, first you must know which revision you have. There are two ways to find the revision level of your firmware. Read the revision number from the label shown in Figure 9-1. Or you can use a Configuration/Tuning Module, Engineering Workstation, etc. to read the output of Block 13. The output is the current firmware revision level you have. An example of Block 13 output is shown:



Call your Bailey Sales Representative with this information; tell him you want the latest version.

TRAINING

Bailey Controls has a modern training center, equipped to provide service and repair instruction, which is available for in-plant training of customer personnel. Specific information regarding course content and scheduling can be obtained from your nearest Bailey sales/service representative.

TECHNICAL DOCUMENTATION

Price and delivery of additional copies of this publication can be obtained through your nearest Bailey sales/service office.

If any questions arise on the ordering procedure, please contact your Bailey representative. Our Global Technical Support Department is also available to answer your technical questions at 1-800-4-BAILEY.

APPENDIX A - ON-LINE CONFIGURATION

INTRODUCTION

This section provides a basic procedure for on-line configuration, and shows both the state of LEDs 7 and 8 as well as the contents of the second module status byte (specifically bits 7, 6, 3 and 1). On-line configuration, used with redundant Multi-Function Controllers (MFC), enables you to make configuration changes without affecting the primary MFC or interrupting the control process.

In redundant MFC configurations, the primary MFC executes the process control logic while the backup MFC tracks the configuration of the primary. On-line configuration allows the user to remove the backup MFC from the tracking mode and make configuration changes, without interrupting the process control operation of the primary MFC. Normal off-line changes are supported by on-line configuration. When the backup MFC is reconfigured, it can assume control with the new configuration while the original primary MFC takes the backup role.

During start-up of the new configuration in the backup MFC, the present values of all process outputs in the primary MFC are used. This feature permits bumpless transfer of control to the new configuration.

SETUP

On-line configuration of redundant MFCs requires two consecutive module bus addresses to be reserved. In normal operation each member of the redundant pair has the same module bus address. (If the module bus address of the redundant pair is at 4 during normal operation, then automatically the module bus address of the backup MFC is at 5 during on-line configuration).

Set Switch 2 on Dipswitch SW4 (see Figure 3-1 in Section 3) of the backup and the primary MFC to the open position. Doing so enables the use of on-line configuration.

OPERATION

The following procedure shows how to perform on-line configuration. These standard INFI 90 configuration tools can be used to do on-line configuration: Configuration and Tuning Module (CTM), Configuration Tuning Terminal (CTT), Operator Interface Station (OIS), Management Command System (MCS), and

Engineering Workstation (EWS) with PC-90 Ladder Software or CAD/TEXT.

NOTE: Be careful when using either PC-90 Ladder Software or CAD/TEXT to avoid deleting blocks and/or adding blocks in the middle of existing ones. Refer to the note preceding Step 3 of the backup cycle for a further explanation.

See Figure 5-1 in Section 5 for the front panel LED positions. The status of LEDs 7 and 8 is indicated for each step of the backup and primary cycles. Refer to Table 6-1 for LED error codes.

WARNING	**Strict adherence must be made with regard to the rules set forth in this document. Follow all steps in the sequence given and at no time change configurations or remove the module before the LEDs instruct you to do so. Failure to heed this warning and follow proper procedures could result in unpredictable MFC operation and/or loss of output data.**
ATTENTION	**Les procedures decrites dans ce document doivent etre suivies a la lettre. Respecter l'ordre des etapes, et ne jamais apporter de changements a la configuration ou retirer le module du chassis de montage avant que les temoins DEL ne l'autorisent. Tout ecart a la procedure decrite peut mener a un fonctionnement anormal du MFC et/ou entrainer la perte des signaux de sortie.**

For example, do not reset an MFC before its CPU LED 7 lights. When lit, this LED tells the user that a successful copy of the configuration has been made. Resetting the MFC before this copy is complete could result in unpredictable MFC operation and/or loss of output data.

NOTES:

1. In some applications, you may not be able to see the LEDs of remote MFCs. In these applications, use the data from the second module status byte.

2. The value of bit 7 depends on the communication module residing in the same module bus as the MFC.

The specific interface device determines how module status is acquired. For example: using an operator interface station (OIS), the status is polled by selecting the module in the PCU status display selected from the system status display. With an EWS using CAD/TEXT software, the problem report option must be selected. Note that this option does not continuously poll for module status. The EWS operator may have to poll the status several times until the final module status condition arises for the step of the on-line configuration cycle. The problem report option is available in the modify mode menu of the CAD/TEXT software.

NOTE: The LED displays show the CPU operating state. Errors may occur during on-line configuration that are not exactly described by the LED displays listed in this section. The LED displays indicating these errors are written in the MFC Product Instruction manual.

Legend		
	Primary	**Backup**
Module Address	n	n+1
Second Module Status Byte**	Bit* 7 6 5 4 3 2 1 0 0 1 x x 0 x 0 x	Bit 7 6 5 4 3 2 1 0 1 0 x x 1 x 0 x
LEDs 7 and 8		
ON	●	●
OFF	○	○
Blinking	☼	☼
* bit 7 = First time in Execute (Most Significant Bit (MSB)) bit 6 = Backup MFC status bad. bit 3 = On-line configuration changes being made. bit 1 = NVM default configuration. ** x = Don't care.		

Figure A-1. LED Legend

Figures A-2 and A-3 illustrate the backup and primary cycles. For clarity, the term ***backup MFC*** will always refer to the original backup MFC and the term ***primary MFC*** will always refer to the original primary MFC. When the roles are reversed for either unit, their status will be carefully noted.

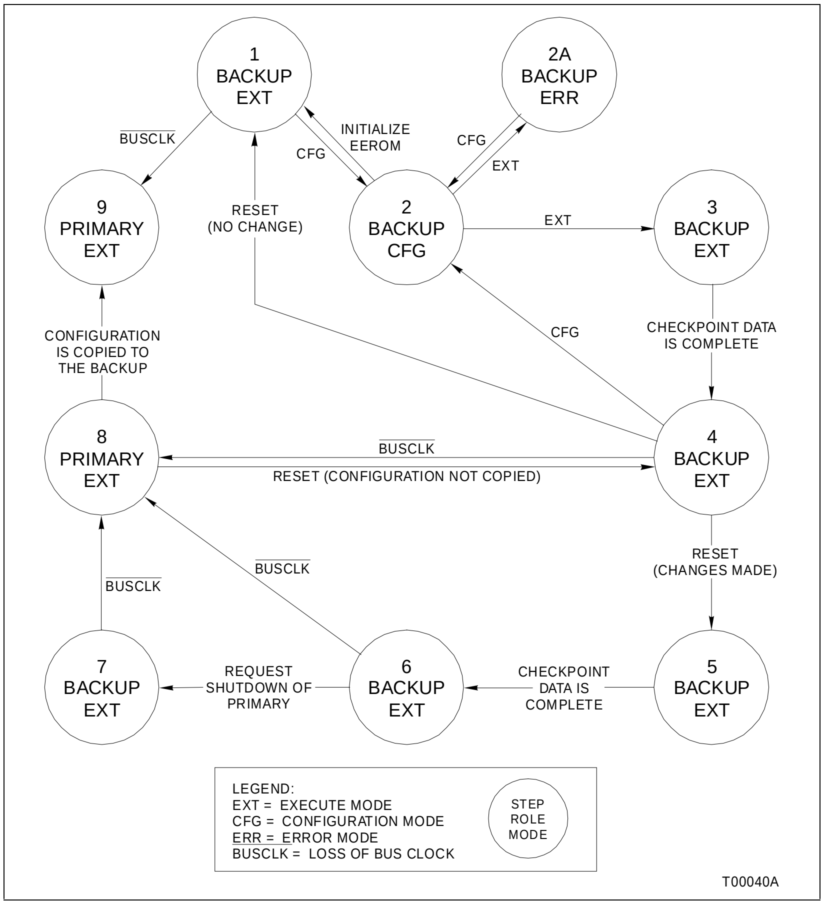


Figure A-2. Backup MFC Operation Cycle

Backup Cycle

The step numbers in this cycle correspond to the states of Figure A-2. The state of the LEDs and the contents of the second module status byte are indicated in the left margin.

NOTE: When resetting the module with the Reset pushbutton, always halt the module first by pressing the Stop pushbutton. Wait for the status light to turn red before you press the Reset pushbutton.

Primary n	Backup n+1
00xx0x0x	10xx0x0x
●	○
●	●

1. Save a copy of the old configuration. This enables it to be easily restored if necessary.

Primary	Backup
n	n+1
01xx0x0x	00xx0x0x
●	○
●	●

2. Place the backup MFC in CONFIGURE mode. The green LED of the backup MFC will blink indicating CONFIGURE mode. Configuration Commands to the backup MFC are sent to the address of the primary MFC plus one. The primary MFC now indicates that the backup MFC is not available for automatic failover.

To return to Step 1 without making any changes, place the backup MFC in EXECUTE mode; stop and reset it after LED 8 illuminates. Resetting an MFC causes all the LEDs on it to light momentarily before returning to normal status.

Primary	Backup
n	n+1
01xx0x0x	00xx1x0x
●	☼
●	○

When changes are being made to the backup MFC, LED 7 blinks indicating that the configurations of the backup and primary MFCs do not match.

If these changes to the configuration are incorrect, return to Step 1 by initializing NVM. Wait for LED 8 on the backup MFC to light before continuing.

NOTE: When configuring the backup MFC, the following rules are strictly enforced by the module:

1. Blocks can only be added in the block space at the end of a segment.

2. A block existing in the primary MFC cannot be deleted.

3. A specification change cannot be made to a block already existing in the primary MFC, if that change effects the module utilization factor (change memory requirements).

4. Do not attempt to change segment control block priority.

5. Complete every on-line configuration sequence. Do not abort a partly completed sequence. For example, do not transfer the backup MFC to the configure mode and then bring it back to the execute mode until the on-line configuration sequence is complete.

An attempt to bypass rules 1 through 3 will cause an error message. An attempt to bypass rules 4 and 5 will not cause an error message.

Primary	Backup
n	n+1
01xx0x0x	00xx1x0x
●	☼
●	○

3. When an error exists in the new configuration, the backup MFC enters ERROR mode before going to EXECUTE mode. The user must return to CONFIGURE mode to fix the error. The green LED of the backup MFC blinks to indicate it is in the ERROR or CONFIGURE mode. Group A LED 7 of the backup MFC blinks to indicate that configuration differences exist between the primary and backup.

Primary	Backup
n	n+1
01xx0x0x	00xx1x0x
●	☼
●	○

4. The backup MFC can now be placed in EXECUTE mode provided no errors remain in the new configuration.

Additional configuration changes can be made by entering CONFIGURE mode (Step 2). If no changes have been made at this point, a stop and reset returns the backup MFC to Step 1.

Primary	Backup
n	n+1
01xx0x0x	10xx1x0x
●	○
●	☼

5. When the checkpoint data for the old configuration is received from the primary MFC, the reconfigured backup MFC can assume the role of the primary MFC if a failure is detected in the old configuration (refer to Step 9). However, the primary MFC 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 at this point, a stop and reset returns the backup MFC to Step 1.

Primary	Backup
n	n+1
01xx0x0x	00xx1x0x
●	○
●	○

6. A stop and reset at this step, changes having been made, is used to tell the reconfigured backup MFC to assume the role of the primary MFC. The backup MFC enters EXECUTE mode with the configuration marked as valid.

Primary	Backup
n	n+1
01xx0x0x	10xx1x0x
●	☼
●	○

Primary	Backup
n	n+1
01xx0x0x	10xx1x0x
●	○
●	☼

7. After the checkpoint data is updated, the backup MFC is ready to take over the duties of the primary MFC.

Primary n	Backup n+1
01xx0x0x	11xx1x0x
○	☼
●	☼

8. The backup MFC requests the primary MFC to shutdown and assume the role of a hot backup. The backup MFC waits to act as the primary MFC. (A hot backup is a backup which remains on-line and ready to assume control if an error is detected in the new configuration).

Primary n	Backup n+1
01xx0x0x	01xx1x0x
○	☼
●	☼

9. The primary MFC has removed the bus clock (BUSCLK) and acts as a hot backup. The reconfigured backup MFC is now serving as the primary MFC.

To return to Step 5, stop and reset the backup MFC. This allows the user to correct a bad configuration.

10. Resetting the primary MFC, currently acting as the hot backup, tells it to get a copy of the new configuration. The primary MFC must be stopped and reset at this point in order for the cycle to complete.

Primary n	Backup n+1
10xx0x0x	00xx0x0x
○	●
●	●

11. After the backup MFC copies the new configuration into the primary MFC, this cycle is complete. The backup MFC is now serving as the primary MFC while the primary handles the backup role. (Notice that the LED combination is the opposite of Step 1 indicating the role reversal).

Primary Cycle

The step numbers in this cycle correspond to the states of Figure A-3. The state of the LEDs and the contents of the second module status byte are indicated in the left margin.

Primary n	Backup n+1
01xx0x0x	10xx1x0x
●	○
●	☼

1. The primary MFC is actively controlling the process. (This represents the same juncture as Step 5 of the backup cycle).

Primary	Backup
n+1	n
01xx0x0x	11xx1x0x
○	☼
●	☼

2. When the shutdown request is received from the backup MFC (Step 8 of the backup cycle), the primary MFC stops executing and removes the bus clock.

Primary	Backup
n+1	n
01xx0x0x	01xx1x0x
○	☼
●	☼

3. The primary MFC is now acting as the hot backup. All the 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 MFC, currently acting as the hot backup, can take control using the old configuration and block output information (returns to Step 1).

Primary	Backup
n+1	n
00xx0x0x	00xx1x0x
○	☼
○	☼

4. Stopping and resetting the primary MFC, currently acting as the hot backup, tells it to get a copy of the new configuration (Step 9 of the backup cycle).

Primary	Backup
n+1	n
10xx0x0x	00xx0x0x
●	●
○	●

5. When the new configuration has been copied, the backup MFC has completed its cycle, and is now serving as the primary MFC.

Primary	Backup
n+1	n
10xx0x0x	00xx0x0x
○	●
●	●

6. After the checkpoint data is complete, the primary MFC is now serving as the backup MFC and is ready to take over the control process. The primary cycle is complete. (This represents the same juncture as Step 11 of the backup cycle).

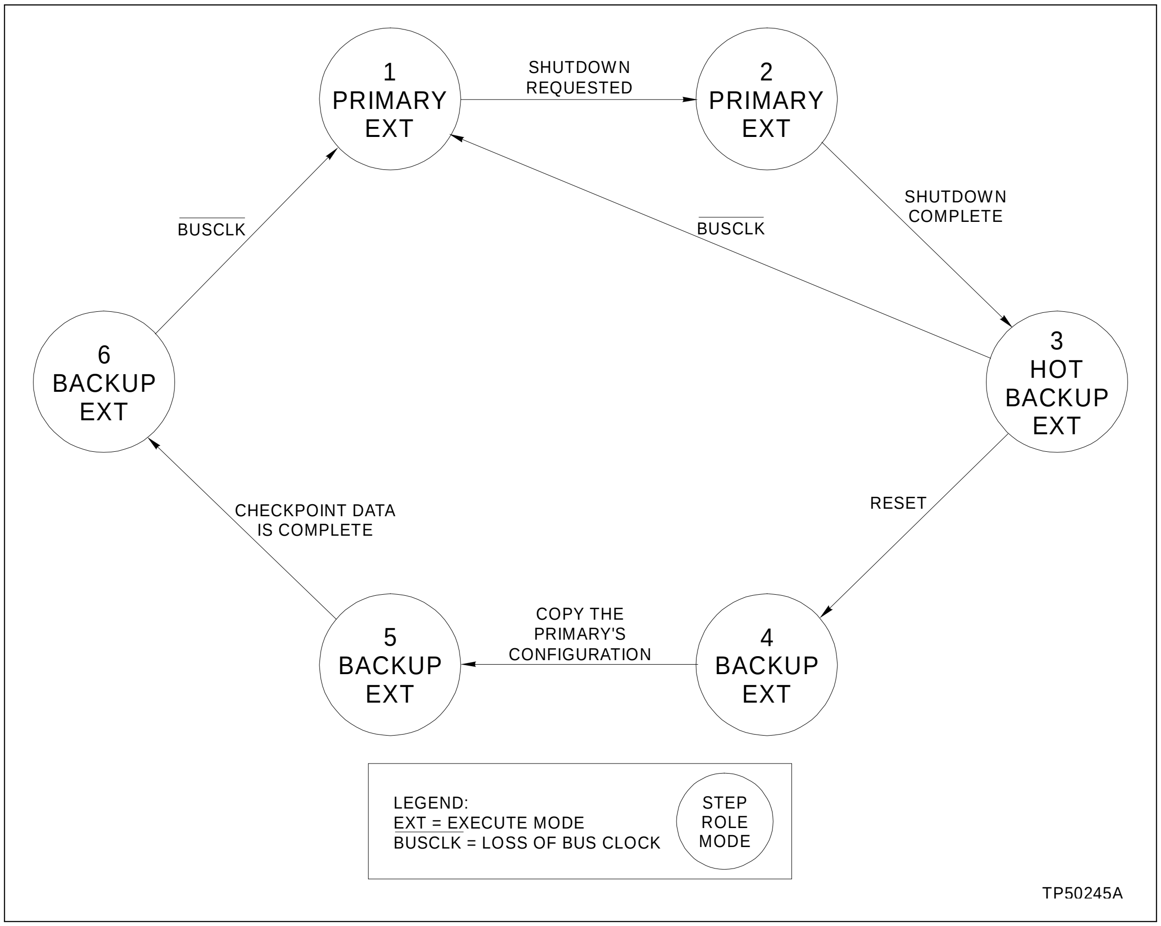


Figure A-3. Primary MFC Operation Cycle

APPENDIX B - NTMF01 TERMINATION UNIT CONFIGURATION

INTRODUCTION

The Multi-Function Controller module (IMMFC03) uses an NTMF01 to connect with its output devices. Dipshunts on the termination unit configure the outputs.

Figure B-1 shows the input connectors, dipshunts and output ports on the termination unit.

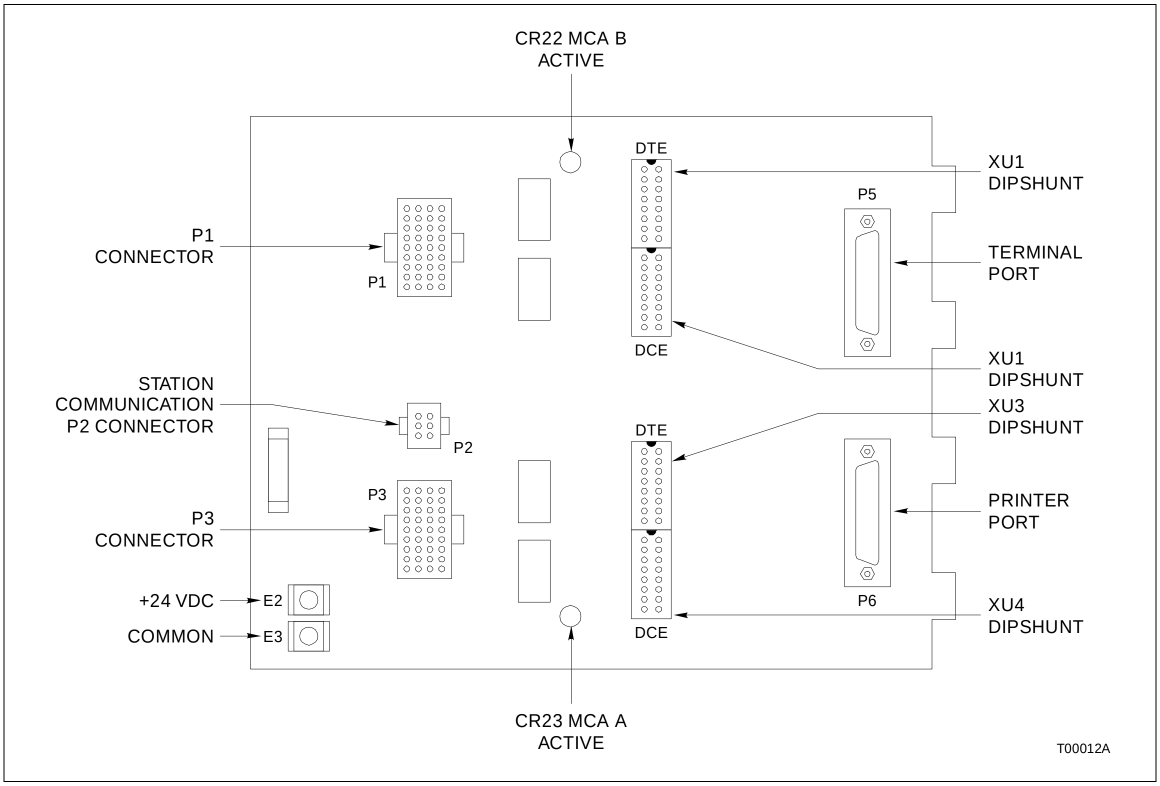
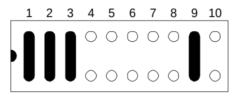
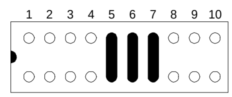
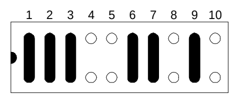
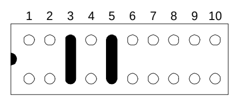
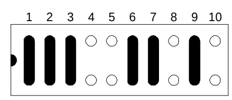
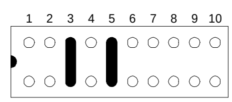


Figure B-1. NTMF01 Termination Unit

CONFIGURING NTMF01

Figure B-2 shows the possible configurations for the dipshunts on the termination unit. It has 4 sockets numbered XU1 through XU4. The dipshunts control the output circuits for the terminal port and printer port.

Interfaces To	Connecting Cable	Application/ Signal Type	Dipshunt Configuration
Multi-Function Controller Module IMMFC03/04/05	NKTU01	Sequential Events Recorder	DIPSHUNTS XU1, XU2 NOT USED  XU3  XU4
		IBM® PC COMPAQ® & Compatible Computers	 XU1/XU3  XU2/XU4
		Terminals VT1XX, ADM3, VISUAL 50, WYSE (WY50), TELEVIDEO	 XU1/XU3  XU2/XU4 T00013A

IBM® Registered trademark of International Business Machines Corporation.
COMPAQ® Registered trademark of COMPAQ Computer Corporation.

Figure B-2. NTMF01 Dipshunt Configurations

CABLE CONNECTIONS

Figure B-3 shows the cable connections from the NTMF01 to the MFC and the output devices. The output devices are the monitor, printer and Control Station Termination Unit (NTCS02).

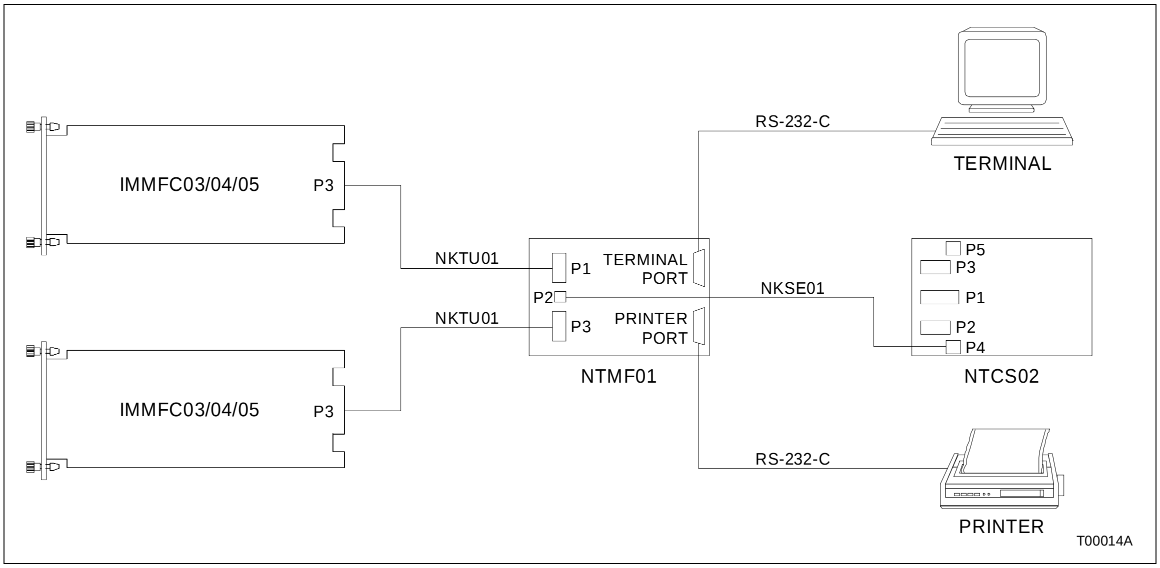


Figure B-3. NTMF01 Cable Connections

APPENDIX C - NIMF01 TERMINATION MODULE CONFIGURATION

INTRODUCTION

The Multi-Function Controller module (IMMFC03) uses an NIMF01 to connect with output devices. Dipshunts on the termination module configure the inputs. For redundant systems, the MFC module uses both an NIMF01 and NIMF02 to connect with output devices (refer to Appendix D). Dipshunts on the termination module configure the outputs.

Figure C-1 shows the dipshunts, input connectors and output ports on the termination module.

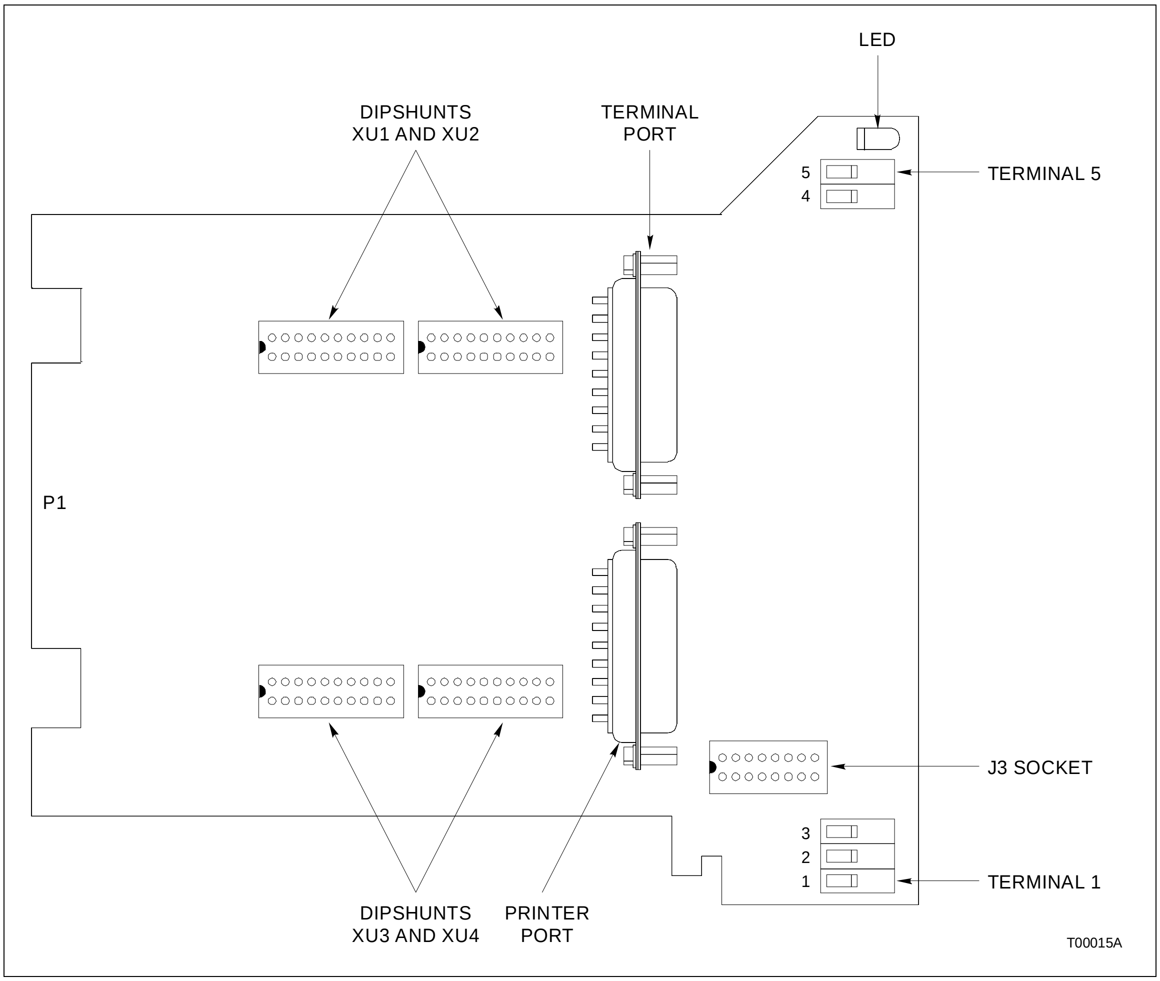
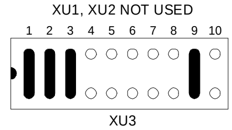
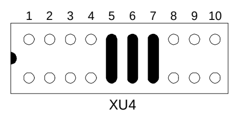
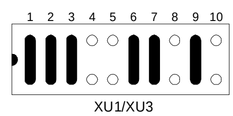
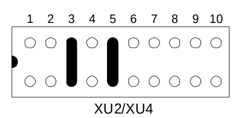
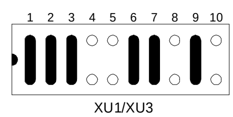
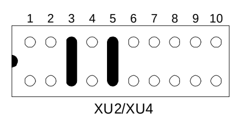


Figure C-1. NIMF01 Termination Module

CONFIGURING NIMF01

Figure C-2 shows the dipshunts on the termination module. It has 4 sockets numbered XU1 through XU4. The dipshunts control the I/O circuits for the terminal port and printer port.

Figure C-3 shows the shows the terminal assignments for NIMF01.

Interfaces To	Connecting Cable	Application/ Signal Type	Dipshunt Configuration
Multi-Function Controller Module IMMFC03/04/05	NKTU02 or NKTM01	Sequential Events Recorder	DIPSHUNTS XU1, XU2 NOT USED  
		IBM® PC COMPAQ® & Compatible Computers	 
		Terminals VT1XX, ADM3, VISUAL 50, WYSE (WY50), TELEVIDEO	  T00013A

IBM® Registered trademark of International Business Machines Corporation.
COMPAQ® Registered trademark of COMPAQ Computer Corporation.

Figure C-2. NIMF01 Dipshunt Configurations

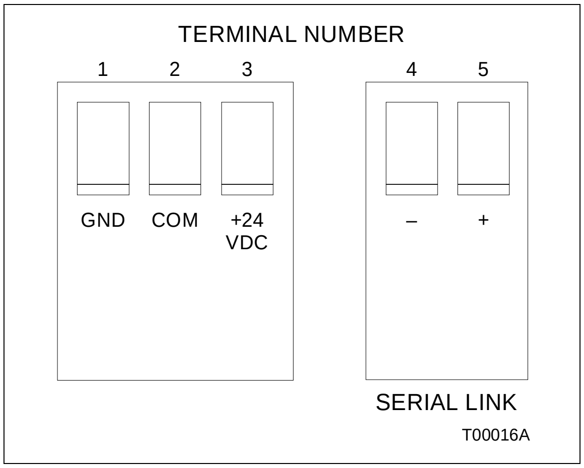


Figure C-3. NIMF01 Terminal Assignments

CABLE CONNECTIONS

Figure C-4 shows the cable connections from the NIMF01 to the MFC and the output devices. The output devices are the monitor, printer and control station termination module (NICS01).

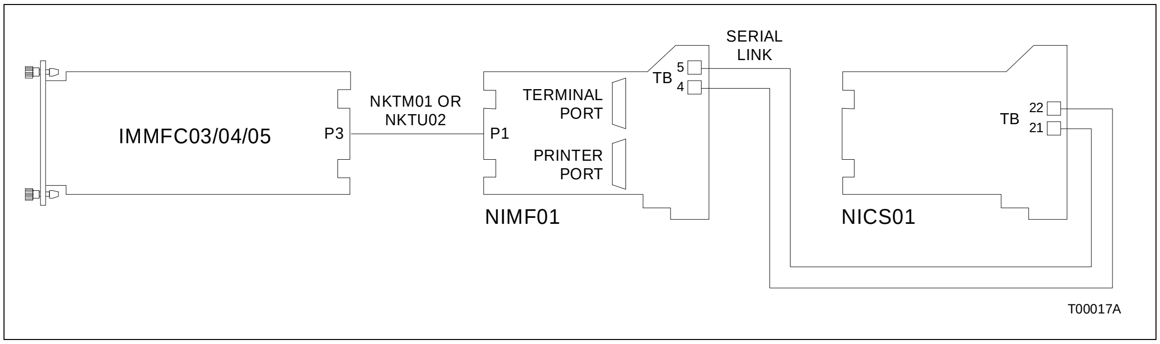


Figure C-4. NIMF01 Cable Connections

APPENDIX D - NIMF02 TERMINATION MODULE CONFIGURATION

INTRODUCTION

The redundant Multi-Function Controller module (IMMFC03) uses an NIMF02 to connect with output devices. Note that the NIMF02 is used only to connect the redundant MFC. In redundant systems, the primary MFC module uses an NIMF01 and the redundant MFC uses the NIMF02 to connect output devices. Dipshunts on each termination module configure the outputs. The green LED lights on the active termination module.

Figure D-1 shows the dipshunts, input connectors and output ports on the termination module.

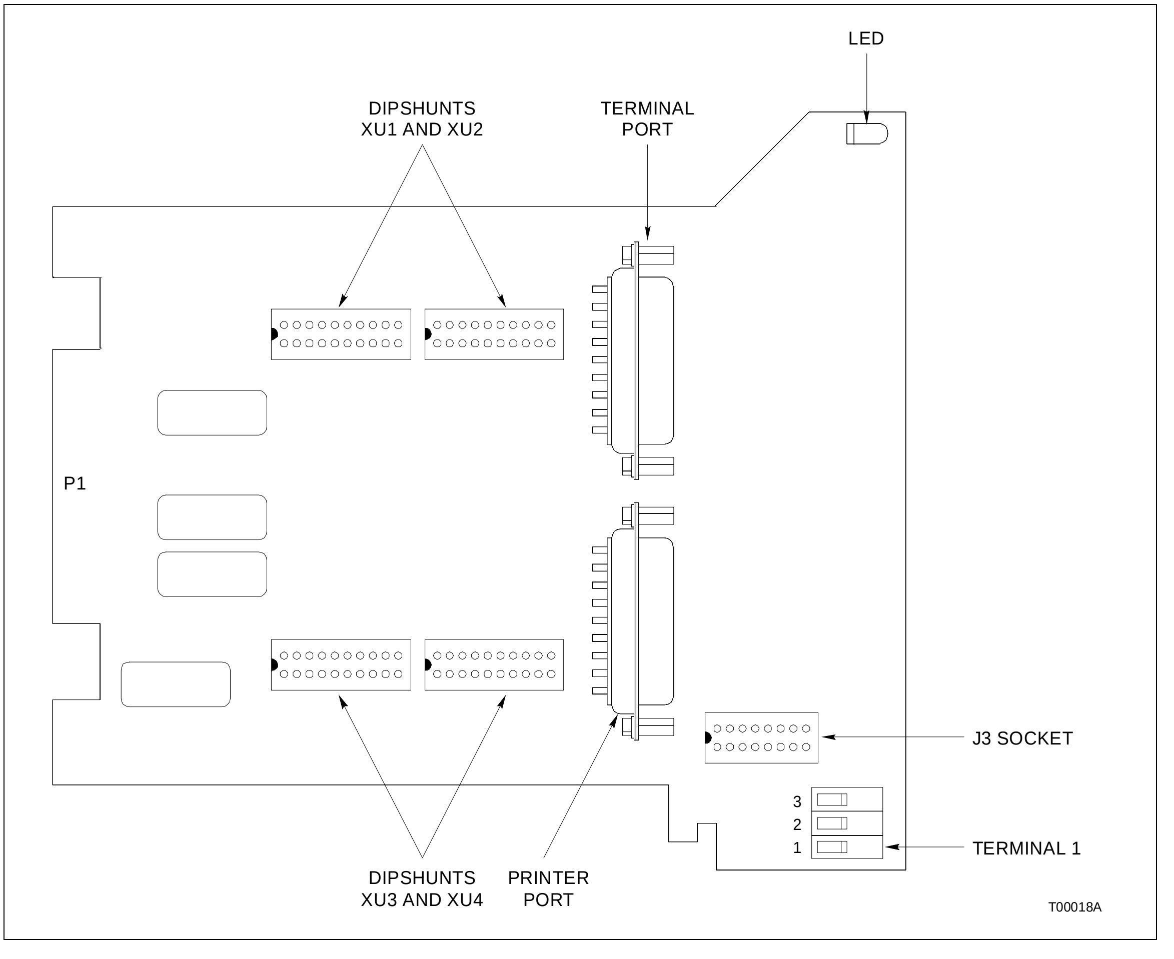


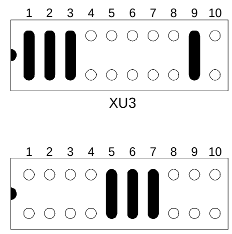
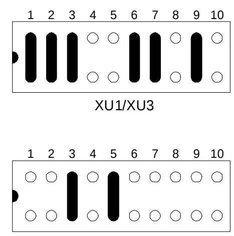
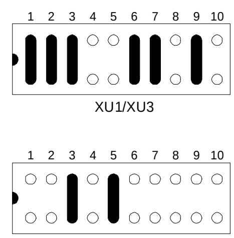
Figure D-1. NIMF02 Termination Module

CONFIGURING NIMF02

Figure D-2 shows the dipshunts on the termination module. It has 4 sockets numbered XU1 through XU4. The dipshunts control the I/O circuits for the terminal port and printer port.

NOTE: For redundant systems, be sure dipshunts are the same on both termination modules.

Figure D-3 shows the shows the terminal assignments for NIMF02.

Interfaces To	Connecting Cable	Application/ Signal Type	Dipshunt Configuration
Multi-Function Controller Module IMMFC03/04/05	NKTU02 or NKTM01	Sequential Events Recorder	DIPSHUNTS XU1, XU2 NOT USED 
		IBM® PC COMPAQ® & Compatible Computers	
		Terminals VT1XX, ADM3, VISUAL 50, WYSE (WY50), TELEVIDEO	

T00013A

IBM® Registered trademark of International Business Machines Corporation.
COMPAQ® Registered trademark of COMPAQ Computer Corporation.

Figure D-2. NIMF02 Dipshunt Configurations

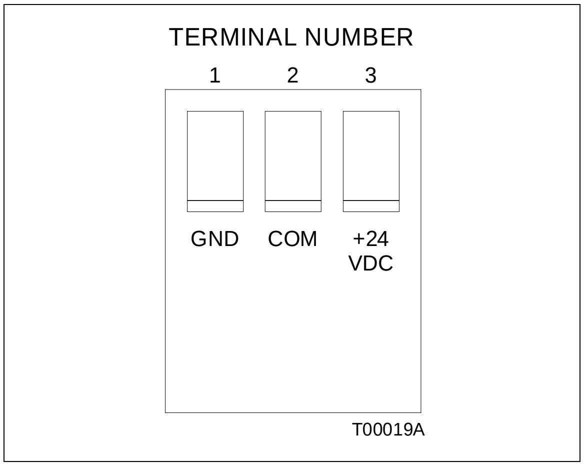


Figure D-3. NIMF02 Terminal Assignments

CABLE CONNECTIONS

Figure D-4 shows the cable connections from the NIMF02 to the MFC and the output devices. The output devices are the monitor, printer and control station termination module (NICS01). For redundant MFP systems, NIMF01 connects to NIMF02 through a ribbon cable. Relays on the NIMF02 provide switching between the two termination modules. NIMF02 connects to an NICS01 through a twisted-pair between the serial termination blocks on each module. This provides a communication link between a multi-function controller and a control station.

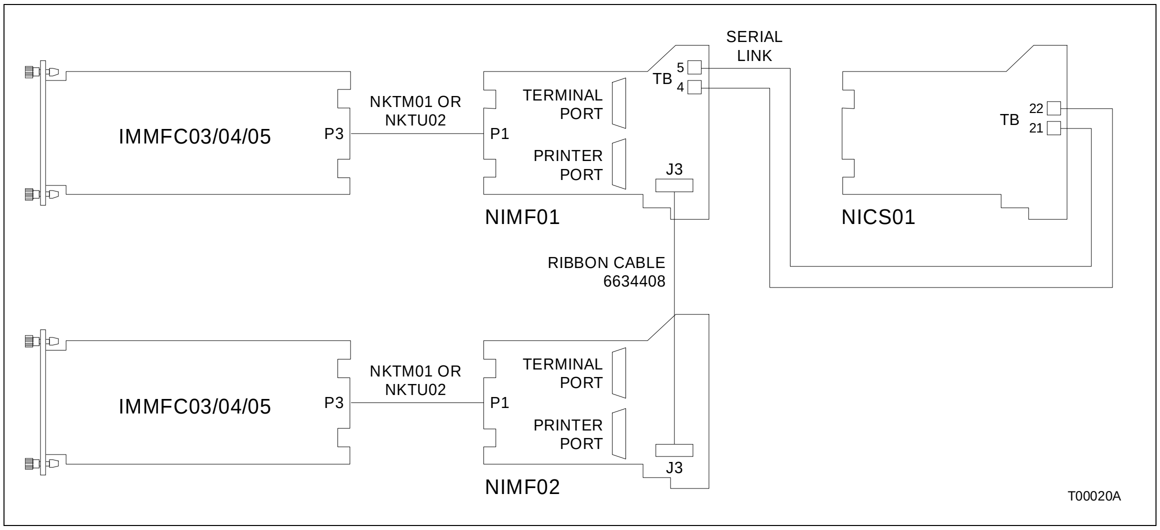


Figure D-4. NIMF02 Cable Connections

AMERICAS
29801 Euclid Avenue
Wickliffe, Ohio USA 44092
Telephone 1-216-585-8500
Telefax 1-216-585-8756

ASIA/PACIFIC
152 Beach Road
Gateway East #20-04
Singapore 189721
Telephone 65-391-0800
Telefax 65-292-9011

EUROPE, AFRICA, MIDDLE EAST
Via Puccini 2
16154 Genoa, Italy
Telephone 39-10-6582-943
Telefax 39-10-6582-941

GERMANY
Graefstrasse 97
D-60487 Frankfurt Main
Germany
Telephone 49-69-799-0
Telefax 49-69-799-2406

Form I-E96-211A Litho in U.S.A. 1190