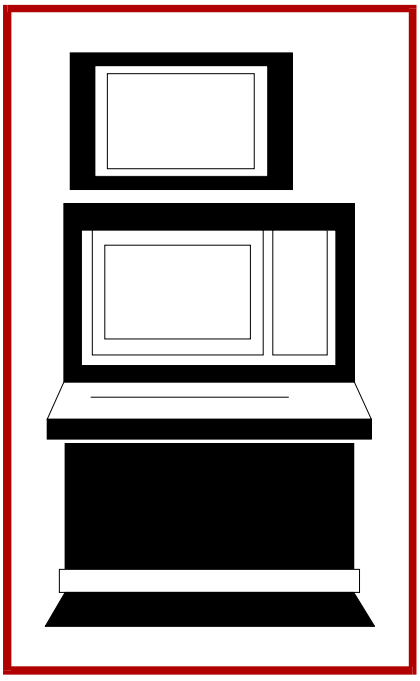
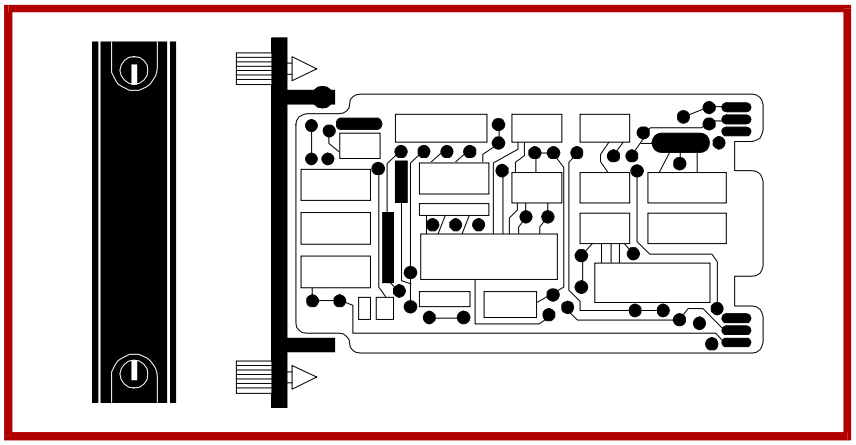
Bailey® infi 90®

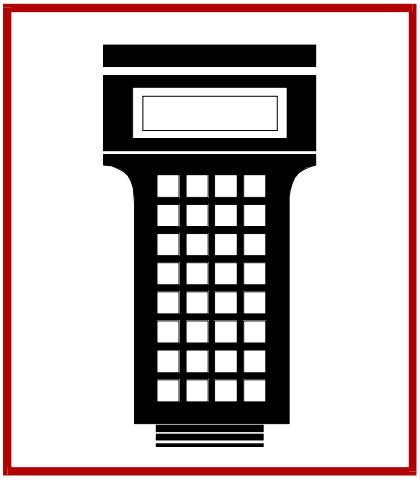
E96-207

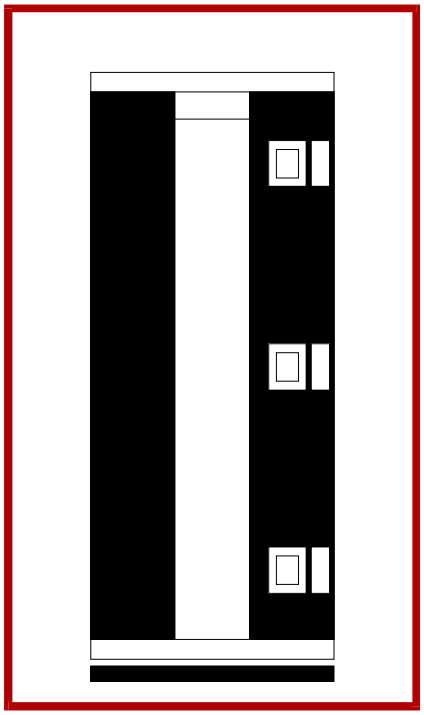
Instruction

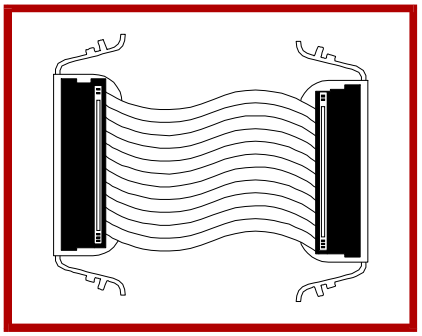
Controller Modules
(IMCOM03 and IMCOM04)

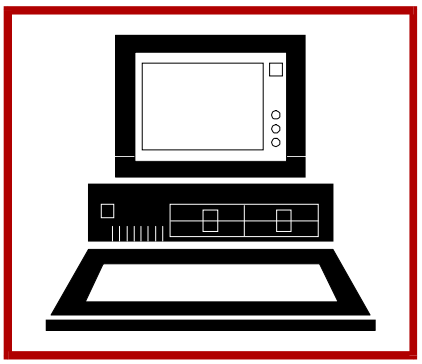












Bailey Process Control and Automation Solutions from Elsag Bailey Group

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.

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Preface

This product instruction provides receiving, installation, operation, service and replacement information for the INFI 90® Controller Module (IMCOM03/04). The INFI 90 Controller Module is a direct replacement for the Network 90® Controller Module (NCOM03/04).

The controller module inputs process field signals, uses them to monitor and control a process, and outputs INFI 90 signals to control the process. This instruction explains the module features, specifications and operation. It details the procedures to follow to set up and install a controller module (COM). It explains troubleshooting, maintenance and module replacement procedures.

The system engineer or technician using the COM should read and understand this instruction before installing and operating the module. In addition, a complete understanding of the INFI 90 system is beneficial.

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List of Effective Pages

Total number of pages in this manual is 74, consisting of the following:

Page No.	Change Date
Preface	Original
List of Effective Pages	Original
iii through ix	Original
1-1 through 1-8	Original
2-1 through 2-12	Original
3-1 through 3-10	Original
4-1 through 4-6	Original
5-1 through 5-2	Original
6-1 through 6-4	Original
7-1	Original
8-1	Original
9-1	Original
A-1 through A-14	Original
B-1 through B-3	Original
C-1 through C-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 ensure that contact with energized parts is avoided when servicing. **Special Handling** This module uses Electrostatic Sensitive Devices (ESD).
SPECIFIC WARNINGS	The module is shipped with the default switches in the open or non-operable state. The module digital outputs are de-energized (off) during start-up, during operator selected RESET, configure mode and for certain failure conditions. (p. 3-2) Analog outputs always hold last value when the module is put into configure mode and go to user-selected values during start-up, during operator selected RESET, and for certain failure conditions. These values must be selected by the end user to prevent personal injury, equipment damage or damage to the product. (p. 3-2) Do not run these tests while a COM is connected to ANY final elements. The test produces analog output triangle waveforms from 0 percent to 100 percent. The digital outputs cycle on and off continuously. (p. 3-6) The module digital outputs are de-energized (off) during start-up, during operator selected RESET, configure mode and for certain failure conditions. Configure the control strategy to prevent personal injury, equipment damage or damage to the product in case digital outputs de-energize. (p. 4-2) Analog outputs always hold last value when the module is put into configure mode and go to user-selected values during start-up, during operator selected RESET, and for certain failure conditions. These values must be selected on the default switch by the end user to prevent personal injury, equipment damage or damage to the product. (p. 4-2)

Safety Summary (continued)

SPECIFIC WARNINGS (continued)	Independent of the user-selected default values, it is possible for the analog or digital outputs to fail in the on state. This is characteristic of solid-state circuits. A solid state-circuit failure in the on state could cause personal injury or significant equipment damage in some applications. Additional interlocks such as overstroke and overlevel limit switches or pressure and temperature limiting valves must be put in the system where operation or maintenance personnel may be working or where there may be serious equipment damage. (p. 4-2) The module analog outputs change to user-selected values during start-up, during operator selected RESET or STOP, and for certain failure conditions. These values must be selected by the end user to prevent personal injury, equipment damage or damage to the product. (p. 4-2)
SPECIFIC CAUTIONS	This equipment contains MOS devices. Use the special handling procedures listed below to avoid damage of MOS devices by static changes (p. 3-1) Do not remove the cable from the module or the termination unit while the INFI 90/Network 90 System is energized. Damage to the module may result. (p. 3-9)

Sommaire de Sécurité

AVERTISSEMENTS D'ORDRE GÉNÉRAL	**Environment de l'equipement** Nes pas soumettre les composantes a une atmosphere corrosive lors du transport, de l'entreposage ou de l'utilisation. **Risques de chocs electriques lor de l'entretien** S'assurer de debrancher l'alimentation ou de prende les precautions necessaires a eviter tout contact avec des composants sours tension lors de l'entretien. **Precautions de Manutention** Ce module contient des composantes sensibles aux decharges electro-statiques.

AVERTISSEMENTS D'ORDRE SPÉCIFIQUE	French translation to be supplied later. (p. 3-2) French translation to be supplied later. (p. 3-6) French translation to be supplied later. (p. 4-2) French translation to be supplied later. (p. 4-2)

ATTENTIONS D'ORDRE SPÉCIFIQUE	Observez les procedures de manipulation prescrites pour eviter les dommages causes par les changes statiques. (p. 3-1) French translation to be supplied later. (p. 3-9)

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SECTION 1 - INTRODUCTION

OVERVIEW

The Controller Module (IMCOM03-Enhanced/04-Advanced) is an INFI 90® plug-in module. Implementation of analog and digital control strategies is the primary purpose of this module. A variety of control functions is available for the user to custom design the control scheme, making the controller module a versatile and powerful element of the INFI 90 system.

The Controller Module (IMCOM03/04) is a stand-alone controller that can be dedicated to one or two loops. It brings four analog and three digital process field signals into the INFI 90/ Network 90® system for processing and monitoring. It outputs four digital and two analog signals for process control. The controller module can control the process and communicate to the communication network. The COM can communicate with the INFI-NET® or plant loop communication networks. The COM performs the control functions and provides the I/O. The INFI 90 Controller Module (IMCOM03/04) is a direct replacement for the Network 90 Controller Module (NCOM03/04).

This manual explains the purpose, operation and maintenance of the controller module. It addresses handling precautions and installation procedures. Figure 1-1 shows the INFI 90 system and the position of the COM module.

INTENDED USER

System engineers and technicians should read this manual before installing and operating the COM module. A module ***SHOULD NOT*** be put into operation until this instruction is read and understood. Refer to the ***Table of Contents*** to find specific information after the module is operating.

MODULE DESCRIPTION

The COM consists of a single printed circuit board (PCB) that occupies one slot in a module mounting unit (MMU). A dipswitch on the PCB configures each of the analog outputs; jumpers configure each of the digital inputs. Each analog input is configured on its Termination Unit (TU) or Termination Module (TM).

Two captive latches on the faceplate secure the module to the MMU. A front panel LED indicates the module status.

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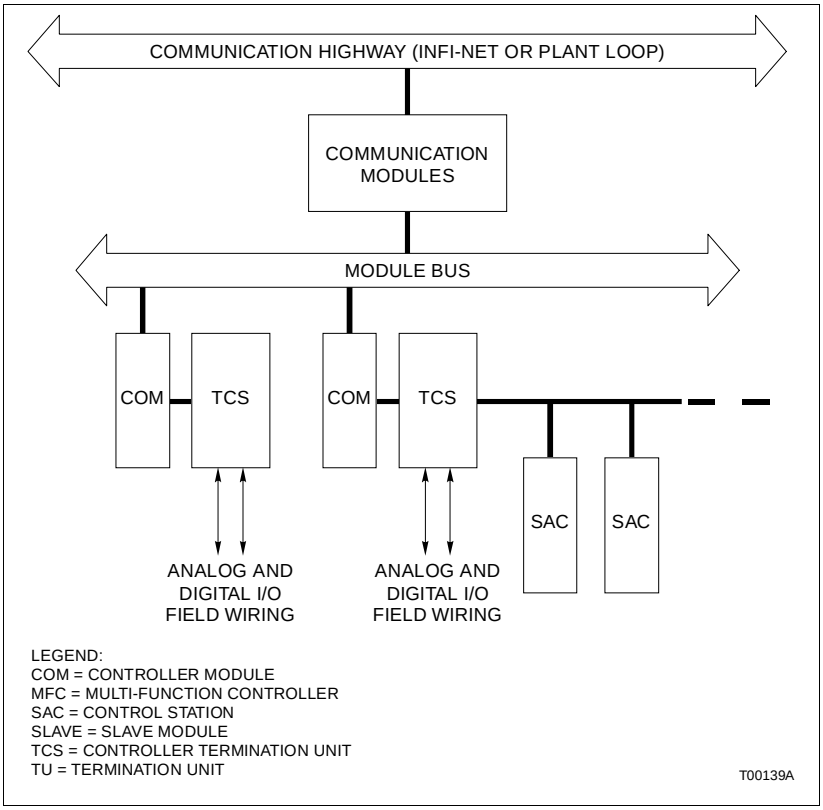


Figure 1-1. INFI 90 Communication Levels

The controller module has two connection points for external signals and power (P1 and P3). P1 connects to logic power that drives the module circuits (refer to the troubleshooting section). Digital and analog signals are input and output through connector P3 using a cable connected to a TU/TM (refer to the troubleshooting section). The terminal blocks (physical connection points) for field wiring are on the TU/TM.

FEATURES

The modular design of the COM, as with all INFI 90 modules, allows for flexibility when you are creating a process management strategy. It brings analog and digital signals into the system and outputs analog and digital signals to the process.

The COM accepts digital signals of 24 VDC to 125 VDC. Individual voltage and response time jumpers on the module configure each input. It accepts analog signals of 1 to 5 VDC, 4-20 mA (single ended or differential). The analog output mode is selectable. A dipswitch selects current or voltage mode for each analog output depending on the process requirements. It outputs 4 to 20 mA or 1 to 5 VDC analog signals and 24 VDC digital signals.

The front panel LED provides a visual indication of the module status to aid in system test and diagnosis. You can remove or install a COM without powering the system down.

INSTRUCTION CONTENT

This manual consists of seven sections.

Introduction — Is an overview of the COM module: Features, description and specifications.

Description and Operation — Explains the module operation, and input and output circuitry.

Installation — Describes precautions to observe when handling COM modules, and setup procedures required before module operation. This section discusses switch and jumper settings, and installation procedures.

Configuration — Explains function blocks and lists the function codes.

Operating Procedures — Explains the front panel indicator and start-up of the slave module.

Troubleshooting — Describes the error indications and corrective actions to take.

Maintenance — Has a maintenance schedule for the slave module.

Repair/Replacement Procedures — Details the procedures to replace a slave module.

Support Services — Provides replacement part ordering information. It explains other areas of support that Bailey Controls provides.

HOW TO USE THIS MANUAL

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

1. Read Section 3 before you connect the COM.
2. Read Section 4 before you power up the COM.
3. Read Section 5 before you use the COM.

HOW TO USE THIS MANUAL *(continued)*

4. Read Appendix A for steps to configure the termination units.

5. Refer to Section 6 for steps to follow to correct error conditions.

6. Refer to Section 2 for more COM theory.

7. Refer to Section 9 for steps to order parts and services.

RELATED EQUIPMENT

Hardware	Nomenclature
Analog Control Station	IISAC01
Control I/O Termination Unit	NTCS02
TCS Cables	
Controller Module to TCS	NKTU01
SAC to TCS	NKCS01
SAC to TCS (daisy chain)	NKCS02, NKDS04
Control I/O Termination Module	NICS01
ICS Cables	
Controller Module to ICS	NKTM01, NKTU02
SAC to ICS	NKTD02
Module Mounting Unit	IEMMU01 IEMMU02 IEMMU04
Station Termination Module	NIDS01
IDS Cables	
ICS to IDS	6634408 (ribbon cable)
SAC to IDS (single station)	NKTD01
SAC to IDS (two stations)	NKDS01
SAC to IDS (daisy chain)	NKDS02, NKDS04

GLOSSARY OF TERMS AND ABBREVIATIONS

Term	Definition
Analog	A continuous time signal with an infinite number of values.
Configuration	A control strategy with function blocks.
Digital	A discrete signal having only two states: on or off.
Dipshunt	Dual in-line package with shorting bars.
Dipswitch	A dual in-line package that contains single pole switches.
EWS	Engineering Work Station; an integrated hardware and software personal computer system for configuring and monitoring INFI 90 modules.
Function Code	An algorithm which defines specific functions. These functions are linked together to form the control strategy.
LED	Light Emitting Diode; the module front panel indicator that shows status and error messages.
LSB	Least Significant Bit; the bit of a binary number that carries the least numerical weight.
Master Module	One of a series of modules designed to direct field processes through a slave module. The multi-function processor is an example.
MCS	Management Command System; integrated operator console with data acquisition and reporting capabilities. It provides a window into the process for control and monitoring.
MMU	Module Mounting Unit; a card cage that provides electrical and communication support for INFI 90 modules.
Module Bus	A peer-to-peer communication path for point data transfer between intelligent modules within a process control unit.
MSB	Most Significant Bit; the bit of a binary number that carries the most numerical weight.
OIS	Operator Interface Station; integrated operator console with data acquisition and reporting capabilities. It provides a window into the process for flexible control and monitoring.
PCU	Process Control Unit; rack type industrial cabinet that contains master, slave and communication modules and their communication paths.

GLOSSARY OF TERMS AND ABBREVIATIONS *(continued)*

Term	Definition
SAC	Station for Analog Control. Provides monitoring and allows manipulation of a single process control loop, and communicates with the MFP. It has front panel LED bar graphs that display set point, process variable and control output values.
Slave Expander Bus	Parallel address/data bus between the master module and the slave.
TM	Termination Module; provides input/output connection between plant equipment and the INFI 90 process modules. The termination module slides into a slot in the termination mounting unit.
TU	Termination Unit; provides input/output connection between plant equipment and the INFI 90 process modules. The termination unit is a flat circuit board for panel mounting.

REFERENCE DOCUMENTS

Document Number	Document
I-E96-117	Analog Control Station (IISAC01)
I-E96-506	Module Mounting Unit (IEMMU01/02/04)
I-E96-423	Control I/O Termination Unit (NTCS02)
I-E96-409	Control I/O Termination Module (NICS01)
I-E93-911	Station Termination Module (NIDS01)

NOMENCLATURE

Nomenclature	Hardware
IEMMU01 IEMMU02 IEMMU04	Module Mounting Unit
IISAC01	Analog Control Station
NICS01	Control I/O Termination Module
NIDS01	Station Termination Module
NTCS02	Control I/O Termination Unit

SPECIFICATIONS

Power Requirements	
Operating	+ 5 VDC at 0.75 A (3.75 Watts) maximum + 15 VDC at 89 mA (1.335 Watts) maximum - 15 VDC at 74 mA (1.11 Watts) maximum + 24 VDC at 50 mA (1.2 Watts) maximum
Inputs	4 Analog: 1-5 VDC, 4-20mA 3 Digital; 24/125 VDC (isolated)
Outputs	2 Analog: 1-5 VDC, 4-20 mA 4 Digital; 24 VDC at 150 mA (isolated, open collector)
Surge Protection	Meets IEEE-472-1974 Surge Withstand Capability Test.
General	
Memory	
IMCOM03	32 kbytes of read only memory (ROM) 4 kbytes of random access memory (RAM) 2 kbytes of battery backed RAM (NVRAM)
IMCOM04	48 kbytes of read only memory (ROM) 4 kbytes of random access memory (RAM) 2 kbytes of battery backed RAM (NVRAM)
Execution Rate	User programmable typically 4 times a second
IMCOM03/04	Up to 10 times a second (user specified)
Internal Resolution	16 bit, floating point numbers
Operating	
Digital Inputs	3 Digital Inputs 24 VDC/125 VDC
Logic True Input	10 VDC minimum for 24 VDC input voltage 35.5 VDC minimum for 125 VDC input voltage
Logic False Input	1.7 VDC maximum for 24 VDC input voltage 5.6 VDC maximum for 125 VDC input voltage
Analog Inputs	4 Analog Inputs: 1 to 5 VDC
Linearity	± 0.03% of span
Repeatability	± 0.05% of span
Accuracy (including above)	± 0.1% of span
Resolution	12 bit
Temperature Effect	± 0.004% per ^{o}C
Analog Input Impedance	> 1 Megohm
Crosstalk	- 60 dB
Normal Mode Rejection IMCOM03/04	- 65 dB (60 Hz)
Common Mode Rejection IMCOM03/04	- 58 dB (60 Hz)
Common Mode Voltage	±5 VDC

SPECIFICATIONS (continued)

Operating (continued)	
Digital Outputs	4 Digital Outputs: 24 VDC (Isolated, open-collector type)
Maximum on current	150 mA
Maximum off current	10 µA
Maximum on voltage	1.5 V at 150 mA
Analog Outputs	2 Analog Outputs: 1 to 5 VDC, 4 to 20 mA
Linearity	± 0.1% of span
Repeatability	± 0.05% of span
Accuracy (including above)	± 0.15% of span (voltage mode) ± 0.25% of span (current mode)
Resolution	10 bit
Temperature Effect	± 0.004% of span per ^{o}C
Output Compliance	600 Ohms
Maximum Load Inductance	600 mH
Environmental	
Electromagnetic/ Radio Frequency Interference	Values are not available at this time. Keep cabinet doors closed. Do not use communication equipment any closer than 2 meters from the cabinet.
Ambient Temperature	0^{o} to 70^{o}C (32^{o} to 158^{o}F)
Atmospheric Pressure	Sea level to 3 km (1.86 miles)
Humidity	5% to 90% RH (±5%) up to 55^{o}C (noncondensing) 5% to 40% RH (±5%) at 70^{o}C (noncondensing)
Air Quality	Noncorrosive
Mounting	Each module occupies one slot in the INFI 90 Module Mounting Unit (MMU).
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 inputs, outputs, logic power and connections for the Controller Module (IMCOM03/04). The COM is a process field I/O interface and controller module.

DESCRIPTION

This board contains the reset switch, status LED, module address/test dipswitch, analog output dipswitches, digital input jumpers, the microprocessor unit (MC68B09), read only memory (ROM), and random accessory memory (RAM). Edge connector P1 enables module bus communications and provides module operating power, and edge connector P3 provides the interface for field input/output. Further details of the switches and connectors appear in the installation and troubleshooting sections of this document.

The controller module mounts in one slot of the INFI 90 Module Mounting Unit (IEMMU01/02/04). Two edge connectors provide the IMC0M03/04 with power, communication and process I/O. They receive power and system communication (module bus) through the MMU backplane. Process inputs and optional Analog Control Station (IISAC01) connect to the Control I/O Termination Unit (NTCS02) or module (NICS01). The controller module receives I/O and communicates with the SAC through its cable connection to the termination unit or module. The COM communicates with other master modules on the module bus as shown in Figure 1-1. It references the address set by the address dipswitch (S4). Figure 2-1 is a block diagram of the COM. The controller module can be operated in three modes: EXECUTE, CONFIGURE AND ERROR. Details of the function of these three modes are in the operation section of this document.

The controller module receives and transmits signals by way of the communication highway and the module bus. This allows the module to act as a stand-alone or as part of a larger system.

> **NOTE:** This document covers versions 03 and 04 of the controller module. The difference between these versions is the amount of available configuration memory and the menu of executable control functions.

The main function of the module is control strategy implementation. The circuits on the module also do these functions:

- Store and run the configuration entered into the COM.

- Analog to digital (A/D) conversion. It changes analog inputs to digital values the COM can process.
- Digital to analog (D/A) conversion. It changes the COM digital values to analog voltage or current signals to control process field devices.
- Accepts digital field inputs, and isolates the module circuitry from the process.
- Outputs digital signals to process field devices, and isolates the module circuitry from the process.

The following sections will detail each of these functions.

Microprocessor

The heart of the controller module is a 68B09 microprocessor operating at two MHz. The microprocessor is responsible for memory control, input/output circuitry, serial interfaces, the machine fault timer (MFT) and self-check routines. The processors 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 triggers 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.

Clock/Timer

The eight megahertz clock provides the clock signals for the module. It provides the two megahertz clock for the microprocessor and supplies the clock signals for the module system timer for uniform control algorithm execution.

Status LED Indicator

A front panel module status LED indicator shows the operating state of the COM. Circuits on the COM determine the module status and light the LED. The operation section explains the indications and the troubleshooting section explains corrective actions to take.

Memory

There is 48 kilobytes of ROM, 4 kilobytes of RAM and 2 kilobytes of battery-backed RAM (NVRAM). The ROM holds the operating system instructions for the processor. The RAM provides temporary storage and a copy of the users configuration. The battery-backed RAM (NVRAM) holds the users 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.

The modules memory is divided as follows:

- 48K bytes of Read Only Memory (ROM) - 04 version
- 32K bytes of Read Only Memory (ROM) - 03 version
- 4K bytes of Random Access Memory (RAM)
- 2K bytes of NVRAM

Logic Power

Logic power (+5 VDC and ±15 VDC) drives the COM circuits. It connects through the top 12-pin card edge connector (P1) shown in Figure 2-1. P3 supplies +24 VDC to operate the analog output circuits.

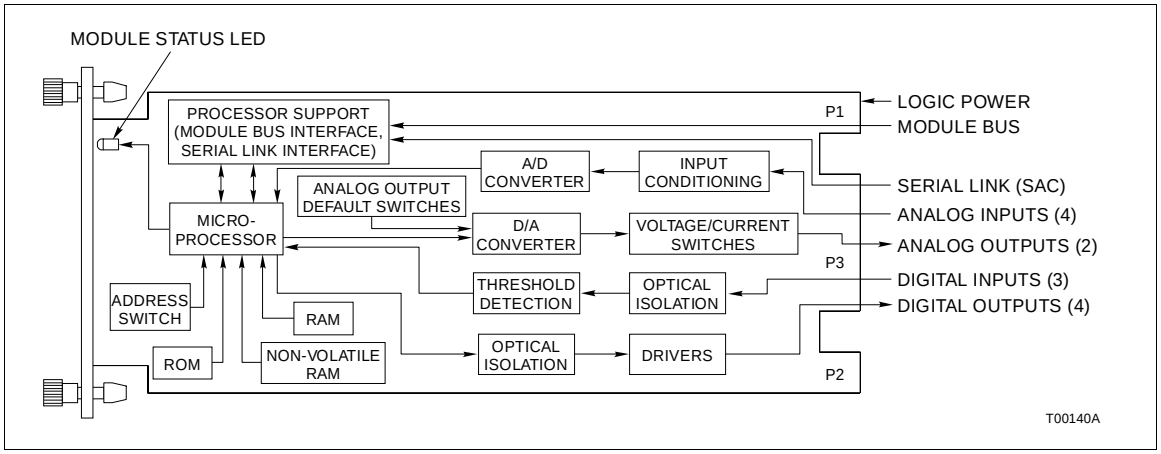


Figure 2-1. Controller Module Block Diagram

I/O SECTION

The I/O section allows the processor to interface with the analog and digital inputs and outputs. The I/O section contains A/D or D/A, default output switch selections. It also contains the analog output mode selection (voltage/current) and the status LED.

The I/O section contains the analog control station interface and module bus interface.

Analog I/O

The COM can input four separate analog signals (1 to 5 VDC), and output two separate analog signals (1 to 5 VDC and 4 to 20 mA). The module accepts analog inputs that are either single ended or differential voltages. The COM output mode is selectable: current or voltage. Figure 2-2 shows typical analog input and output circuits.

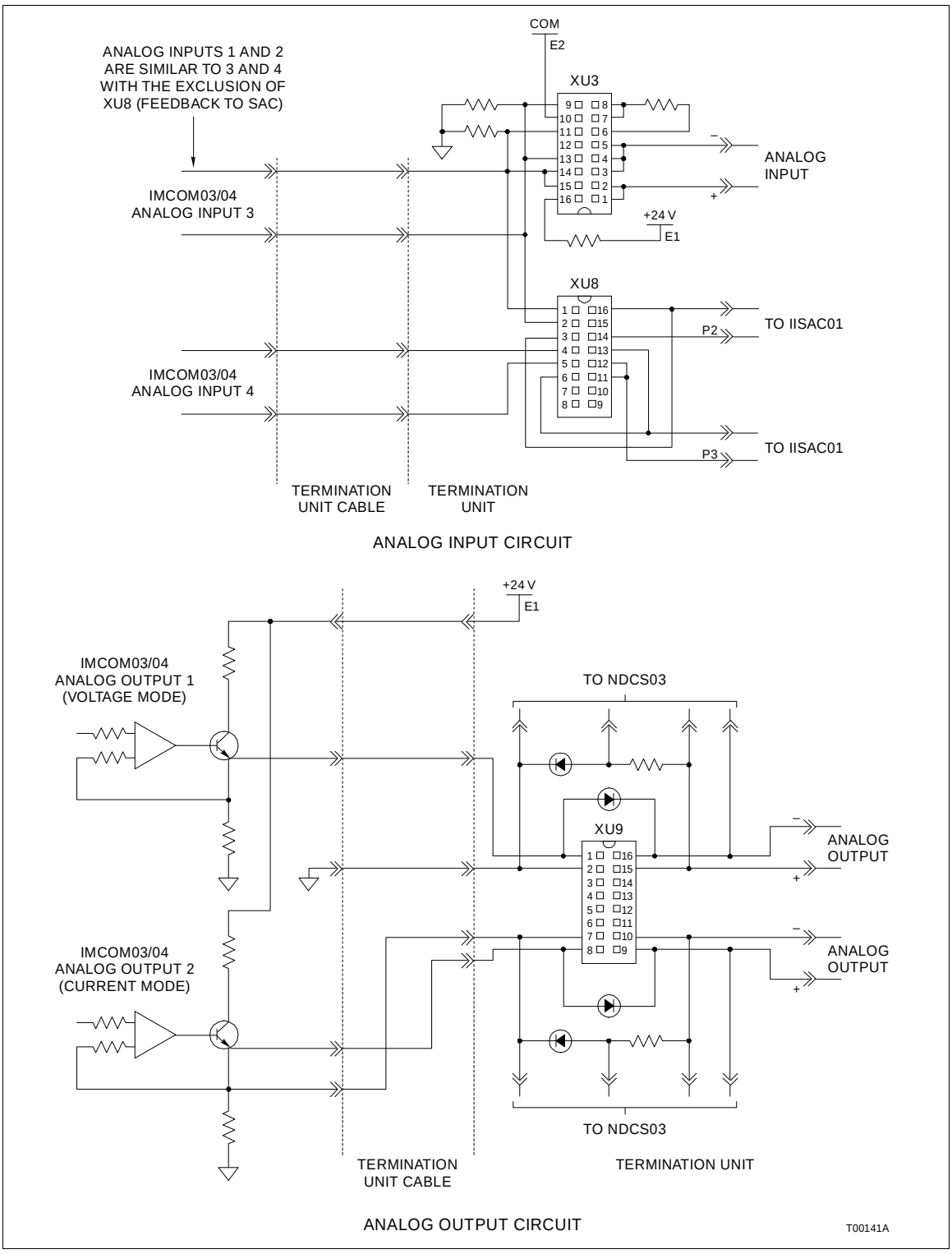


Figure 2-2. MCOM03/04 Analog Input and Output Circuits

Analog Inputs

The input conditioning block consists of two pole input filters that reduce input signal noise. The COM uses analog voltage inputs

only. Its termination unit (TU) or termination module (TM) is configurable for current or voltage inputs; resistors on the TU/TM convert analog current inputs to voltages that are sent to the COM.

The input select block consists of an analog multiplexer and an inverting difference amplifier. The multiplexer selects one of the four inputs or the reference block inputs (calibration voltages). The difference amplifier converts the selected input to a single ended signal.

The A/D converter block circuits change the input signal to a 12-bit digital value. This value is an analog count that corresponds to the input voltage. Nominal input range is 1 to 5 VDC, however, it allows for a 0.75 to 5.25 VDC input range which allows 6.25 percent over or under range of the nominal input range span (4 VDC).

Analog Input Circuit Calibration

A voltage reference generates accurate 1 VDC and 5 VDC signals. The COM does not have potentiometers to adjust zero offset and gain for the A/D converter circuits. Instead, the COM reads the reference voltages once per minute to calibrate the 0 percent (1 VDC) and 100 percent (5 VDC) points; this calibration automatically corrects the measured values. It is performed continuously to correct for drift and temperature variations.

Analog Outputs

The D/A converter block is two separate D/A converters. Each one converts a 10-bit digital value (analog count) from the processor to an analog output (1 to 5 VDC). To check module circuit integrity, the outputs are fed back to the analog input section. The feedback values (analog output digital values) are compared to the values that were sent to the analog output section to test the output quality. This tests for an output circuit failure or an open loop between the master module and field device.

The analog output default switches (S2 and S3) set the output values during system start-up or *time out* (refer to bus fault timer in this section). The analog outputs will go to 0 percent or 100 percent output, or they will hold their current values depending on the setting of S2 and S3.

The analog output mode is also set by switches S2 and S3. S2 and S3 set the type of output, either current or voltage. If current mode is selected, the voltage/current circuits on the COM convert the voltage from the D/A converter to a current output. The installation section explains how to set S2 and S3.

Digital I/O

The COM can input three separate digital signals and output four separate digital signals. Digital inputs are voltages of 24 VDC or 125 VDC. These voltages indicate an energized (ON) field device; a 0 Volt input indicates a de-energized (OFF) field device. The COM digital outputs are 24 VDC at 150 mA. A 24 VDC output energizes (turns on) the field device; a 0 Volt output de-energizes (turns off) the field device. Figure 2-3 shows a typical digital input and output circuit.

Jumpers on the COM select the voltage level for each input. The installation section explains the jumper connections.

Digital Inputs

Current limiters and optocouplers in the isolation block isolate the three field inputs from the module circuitry. The threshold detection block circuits test the input voltage to determine if it is at the proper voltage level to indicate an energized (closed) or de-energized (open) state for the field device. These values are sent to the digital I/O buffer block. Jumpers on the COM select the threshold detection voltage level.

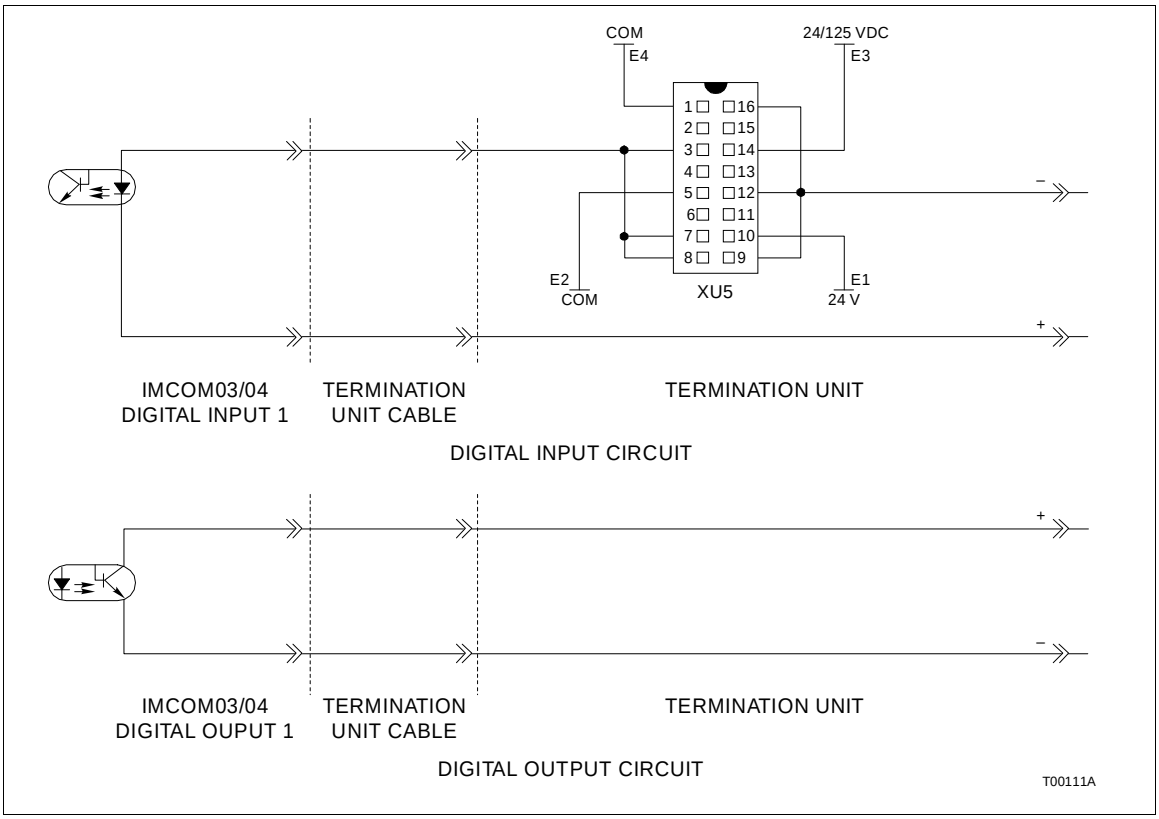


Figure 2-3. IMCOM03/04 Digital Input and Output Circuits

Digital Outputs

The output isolation block consists of optocouplers to isolate the control logic circuits from the process. Four open collector transistors that can sink a 150 mA load make up the driver block.

Digital I/O Buffer

The digital I/O buffer block is a buffer and register that holds the values of the digital inputs and outputs. The digital output interface writes digital data to the register for output by the driver block circuits, and reads the digital input values from the buffer.

I/O Circuit Connections

The I/O signals connect to the 30-pin card edge connector P3 of the COM using a termination cable from a TU/TM. It also supplies +24 VDC power to operate the analog output circuits.

MODULE DATA

COM address switch configuration sets the address on the module bus. It also allows the COM to read input data or status data from master modules, and write output data to them. This data is output by buffer circuits to the module bus interface (see Figure 2-1). Set the module bus address on dipswitch S4.

I/O Data

I/O data is analog input, digital input, and digital and analog output values that the COM reads from the field devices. It is also analog and digital output values that the COM sends to other master modules. The other master modules may use this data to monitor and control a process, and verify COM operation.

Analog input data consists of analog counts from the A/D converter. Analog counts are digital values that correspond to analog signals; the A/D performs the conversion. The signals converted include the four analog inputs, two reference voltages (1 VDC and 5 VDC) and two analog output readback values. The COM reads each of these count values once every execution cycle. Each analog input count value correspond to an analog input voltage. Reference voltage values are read by the COM to verify A/D converter integrity. It reads the two analog output values to adjust the analog outputs and check for output circuit failures.

The COM reads a one byte value that consists of digital output readback values and digital input values. The digital input values indicate the digital input states. Each bit corresponds to one input; the bit value reflects the state of that input, either open (logic 0) or closed (logic 1). Digital output readback data reflects the output states. The COM uses this data to verify that the outputs are correct. Each bit corresponds to one output; a logic 1 indicates an active (ON) output, a logic 0 indicates an inactive (OFF) output.

Status Data

Status data is an eight-bit data value that identifies the controller module and indicates the default values set by the analog output default dipswitch (S2/S3). The COM reads the identification bits (four MSB) to verify the module bus communication integrity and configuration of other master modules. It reads the default bits (four LSB) to determine the default states set for the analog outputs in the event of a *time out*.

Module Bus

The module bus provides an 83.3 kilobaud peer-to-peer serial communication link capable of supporting up to 32 drops. The module bus is the process control unit (PCU) level communication bus. It is the bidirectional communication link for up to 32 controller modules and other modules in the system. Figure 2-4 shows the relationship of the communication highway and module bus.

Communication Highway

The communication highway (Figure 2-4) is used at the system level. It is a unidirectional redundant system of connected process control units (PCUs). A PCU is a group of modules communicating via a module bus. A maximum of 63 PCUs can be on the loop.

Station Link

Station Link controls the serial communication between the COM and the panel stations. It provides a five kilobaud serial channel for up to eight control stations (IISAC01 or NDCS03) and up to four Digital Indicator Stations (NDIS01).

Module Mounting Unit

The Module Mounting Unit (MMU) houses the modules in a process control unit. The controller module can occupy any of the 12 slots. A controller module slides into the MMU on module guides and is secured by two 1/2 turn captive latches. To remove the module, turn both captive latches 1/2 turn until the notches point away from the center of the module faceplate .

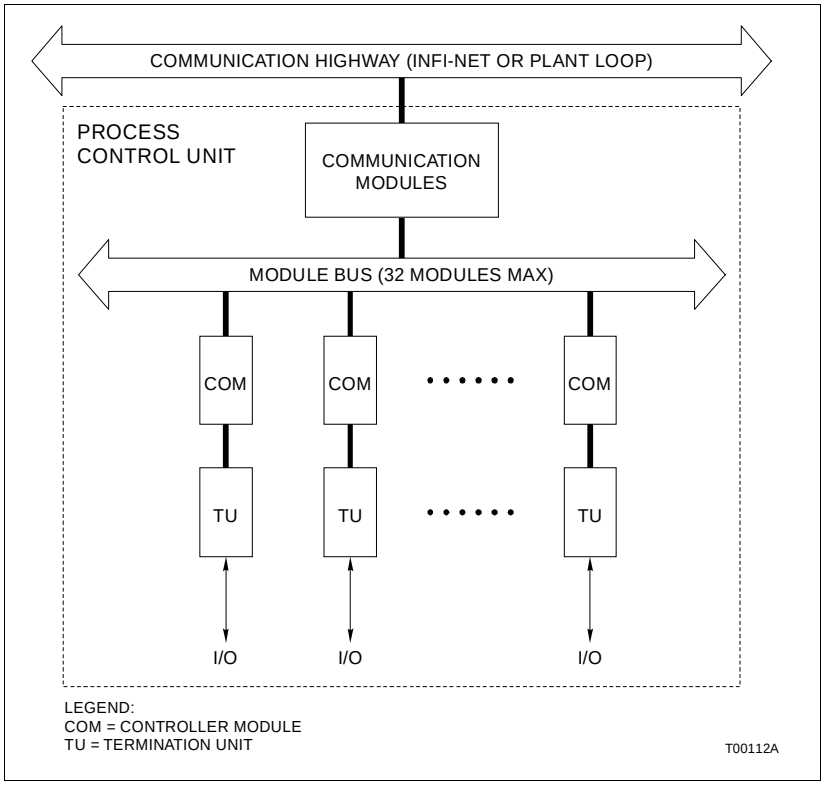


Figure 2-4. Communication Highway/Module Bus Relationship

PROCESS INPUT/OUTPUT INTERFACING

The maximum input/output capability of the controller module from the field (via the termination unit) is four analog inputs, two analog outputs, three digital inputs and four digital outputs. Additional input/output capabilities are provided by the module bus or the communication highway.

Field inputs correspond to terminals on the terminal blocks of the TCS and are conditioned by the user configured dipshunts. The cable (NKTU01), attached to connector P1 of the TCS, carries these inputs to the controller (via card edge P3). The controller modules analog-to-digital (A/D) converter converts field analog signals to digital levels for processing. Digital-to-analog (D/A) conversion circuits convert digital values to analog signals via analog output 1 or analog output 2. The controller configuration dictates how the controller module will process this data.

Another source of inputs is the slave module (analog or digital). The slaves output on the expander bus to their respective master modules. The controller module can request these inputs from the master modules via a module bus transaction.

Valid analog ranges are 1 to 5 VDC or 4 to 20 mA. Values below 0.75 VDC cannot be digitized by the A/D circuits and must be externally conditioned before the controller module can process them.

Both the digital inputs and outputs use optical isolation to separate the module supplies from the field supply, thereby eliminating potential ground loops in the power system.

Analog Control Station Interfacing

Analog Control Stations (IISAC01/NDCS03) allow the user to adjust set point and control output, transfer levels of control and select digital readout. The MANUAL/AUTO transfer station block (function codes 21, 22, and 23) configured in the controller module provides the interface for the SAC.

In the AUTO BYPASS mode, the SAC provides direct manual control of analog outputs in the event of controller failure. In the MANUAL BYPASS mode, the user overrides a normally operating Controller. The controller module is able to support up to eight daisy chained SAC (four from each station port). Only the first SAC in a daisy chain can be used in the MANUAL BYPASS mode. The other SACs in the daisy chain can be used for monitoring outputs.

Module Bus Interfacing

The controller module communicates with other master modules in the processor controller unit (PCU) via the module bus. Each master must have a unique address which is set by a dipswitch on the module. Up to 32 modules can communicate within one PCU. The module bus is physically located on the multibus module unit (MMU) backplane which the modules connect to through the P1 connector on the module.

CONTROL CONFIGURATION

Control configuration is accomplished by assigning function codes to function blocks. The function codes are operations such as multiply, divide, read, compare, etc. The function blocks are addressable memory locations saved in the NVRAM and copied to RAM for execution. Refer to the configuration section for more information on configuring the controller module.

SECURITY FUNCTIONS

Hardware and software security functions help minimize the impact of errors on the controller process. There are two types of security: module security and control input security.

Module Security

Module security is provided by a machine fault timer (MFT). The MFT is reset periodically by the processor. If an error is detected, the MFT is not reset and:

- Execution of algorithms ceases.
- Analog outputs go to their user-selected default states.
- Digital outputs de-energize.
- NVRAM is inhibited (cannot be erased or written).
- Module Bus and Station communications cease.
- The Status LED goes solid RED.

Control Input Security

All input points to the controller module have either a GOOD or BAD quality status. GOOD quality status is the normal operation of the controller module with the parameters of the system. BAD quality status results from an out-of-range signal or a signal not getting through from the module bus or communication highway. The function block TEST QUALITY (function code 31) is used to test the input quality. Depending on the importance of the input, the TEST QUALITY block can be configured to transfer the associated operator manual-auto station to manual, shut down the process, or send a warning to an annunciator.

Internal Software Security Functions

Two functions are performed by the internal software: module diagnostics and module status check. Module diagnostics are performed when the controller is powered up. If a problem is detected the module stops immediately and the status LED turns red. As a background idle task, the module status check constantly verifies ROM and NVRAM checksums. If a discrepancy is found in any checksum the module stops immediately and the status LED turns red.

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 controller to assign a bad status to the input signals. Local errors occur when:

- An I/O signal or voltage reference is out of range.

- The controller is unable to drive analog or digital outputs to correct values.
- The controller's own status is bad (the controller is no longer functioning).
- An input status is bad.

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

If you select to run the process using bad quality data, the controller uses the last valid value it had for the process point before the quality went bad. The controller 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 modules status bytes. Since the status bytes are always available to the communication module (in the same PCU as the controller), 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, the controller module outputs always go to known states in the event of a failure. Default states (for example, power up value, hold at current value) are given in the product instructions for the related controller modules. Refer to these documents for specifics.

SECTION 3 - INSTALLATION

INTRODUCTION

This section explains what you must do before you put the Controller Module (IMCOM03/04) into operation. Do not proceed with operation until you read, understand and do the steps in the order in which they appear.

NOTE: Refer to product instruction I-E93-911 for termination device wiring instructions.

SPECIAL HANDLING

CAUTION	**This equipment contains MOS devices. Use the special handling procedures listed below to avoid damage of MOS Devices by static changes.**
ATTENTION	**Observez les procedures de manipulation prescrites pour eviter les dommages causes par les changes statiques.**

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.

The controller module (COM) uses electrostatic sensitive devices. Follow steps one through four when handling it:

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

2. Ground the antistatic bag before opening.

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

4. Avoid touching the circuitry when handling the module.

UNPACKING AND INSPECTION

1. Examine the hardware immediately to verify that it has not been damaged in transit.

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 hardware.

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

NOTE: Version 03 has one ROM chip (UX3). Version 04 has two ROM chips (UX3,UX4).

SAFETY RELATED INFORMATION

Part of the required installation of the controller is the proper selection of the hardware output default conditions and configuration of output default conditions. Typically, the hardware and configuration default settings will be identical. However, they must be defined separately. The hardware defaults are set through switches on the controller module. The configuration defaults are set through the logic with function codes. These default values must be selected to provide a process condition that is least likely to cause injury or equipment damage.

SETUP/PHYSICAL INSTALLATION

Prior to installation, you must set the module dipswitches and install jumpers to configure the I/O. You must configure the Termination Unit (TU) or Termination Module (TM) to accept the field device signals and output the COM signals to the process.

	The module is shipped with the default switches in the open or non-operable state. The module digital outputs are de-energized (off) during start-up, during operator selected RESET, configure mode and for certain failure conditions.
WARNING	**Analog outputs always hold last value when the module is put into configure mode and go to user-selected values during start-up, during operator selected RESET, and for certain failure conditions. These values must be selected by the end user to prevent personal injury, equipment damage or damage to the product.**
AVERTISEMENT	**French translation to be supplied later.**

SETUP

NOTE: These procedures must be performed before operating the module.

Configure the controller module according to your specific application. Module address, power up voltage levels and time out values for analog outputs, and digital input values are user-configurable, and set by dipswitches S2, S3, S4, and jumpers J1 through J3. Figure 3-1 shows the location of these components.

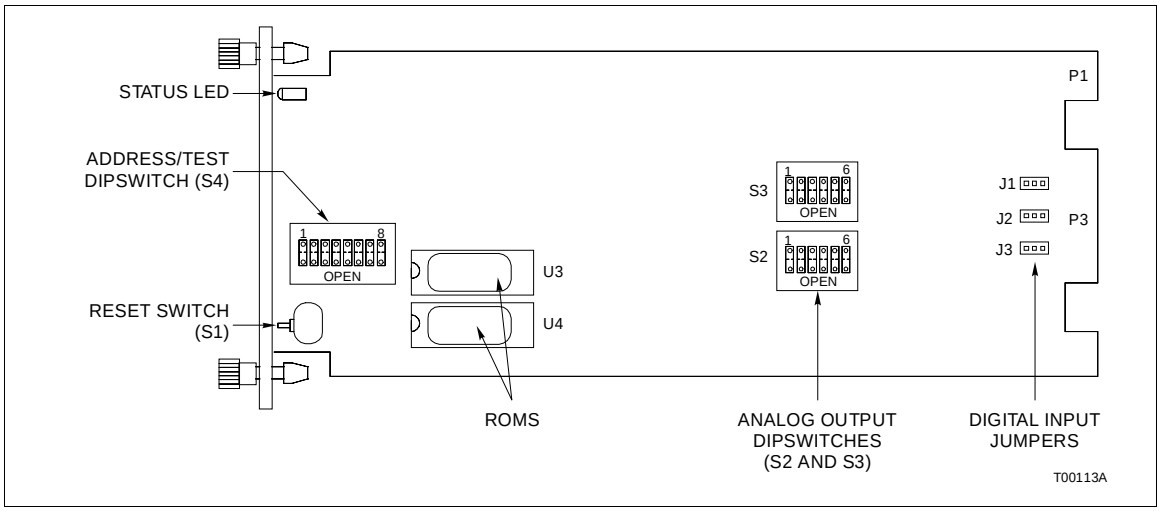


Figure 3-1. Switch and Jumper Locations

Switch Settings

There are four switches on the circuit board. They are S1 (reset switch), S2 (analog output number 1), S3 (analog output number 2), and S4 (module address and self-test routines).

Refer to Table 3-1 and Figure 3-2 for the settings of S2 and S3. Refer to Table 3-2 and 3-3 and Figure 3-3 for the settings of S4.

NOTE: Digital outputs are zero during start-up and during operator selected RESET or STOP.

Table 3-1. Switch S2/S3 Analog Output Settings

Analog Output Number 1 Switch S2			
Switch Position	**Open (1 - off)**	**Closed (0 - on)**	**Function**
1	X		Yields 5.25 VDC output for power up.
		X	Yields 0.75 VDC output for power up.
2	X		Holds last analog output value on time out.
3		X	

Table 3-1. Switch S2/S3 Analog Output Settings (continued)

Analog Output Number 1 Switch S2			
Switch Position	**Open (1 - off)**	**Closed (0 - on)**	**Function**
2		X	Goes to power up value set by SW2-1 on time out.
3	X		
4, 6		X	Yields voltage output.
5	X		
4, 6	X		Yields current output.
5		X	
Analog Output Number 2 Switch S3			
Switch Position	**Open (1 - off)**	**Closed (0 - on)**	**Function**
1	X		Yields 5.25 VDC output for power up.
		X	Yields 0.75 VDC output for power up.
2	X		Holds last analog output value on time out.
3		X	
2		X	Goes to power up value set by SW3-1 on time out.
3	X		
4, 6		X	Yields voltage output.
5	X		
4,6	X		Yields current output.
5		X	

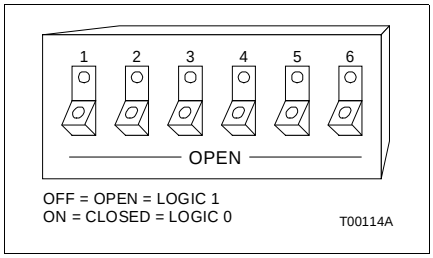


Figure 3-2. Switch S2/S3 Analog Output Switch

Table 3-2. Switch S4 Module Address Switch Settings

Position					Address	
4	5	6	7	8	Binary	Decimal
Closed	Closed	Closed	Closed	Closed	00000	0[1]
Closed	Closed	Closed	Closed	Open	00001	1[1]
Closed	Closed	Closed	Open	Closed	00010	2
Closed	Closed	Closed	Open	Open	00011	3
Closed	Closed	Open	Closed	Closed	00100	4
Closed	Closed	Open	Closed	Open	00101	5
Closed	Closed	Open	Open	Closed	00110	6
Closed	Closed	Open	Open	Open	00111	7
Closed	Open	Open	Closed	Closed	01000	8
Closed	Open	Closed	Closed	Open	01001	9
Closed	Open	Closed	Open	Closed	01010	10
Closed	Open	Closed	Open	Open	01011	11
Closed	Open	Open	Closed	Closed	01100	12
Closed	Open	Open	Closed	Open	01101	13
Closed	Open	Open	Open	Closed	01110	14
Closed	Open	Open	Open	Open	01111	15
Open	Closed	Closed	Closed	Closed	10000	16
Open	Closed	Closed	Closed	Open	10001	17
Open	Closed	Closed	Open	Closed	10010	18
Open	Closed	Closed	Open	Open	10011	19
Open	Closed	Open	Closed	Closed	10100	20
Open	Closed	Open	Closed	Open	10101	21
Open	Closed	Open	Open	Closed	10110	22
Open	Closed	Open	Open	Open	10111	23
Open	Open	Closed	Closed	Closed	11000	24
Open	Open	Closed	Closed	Open	11001	25
Open	Open	Closed	Open	Closed	11010	26
Open	Open	Closed	Open	Open	11011	27
Open	Open	Open	Closed	Closed	11100	28
Open	Open	Open	Closed	Open	11101	29
Open	Open	Open	Open	Closed	11110	30
Open	Open	Open	Open	Open	11111	31[2]

1. Reserved for communication modules.
2. Recommended module for Configuration and Tuning Module (CTM).

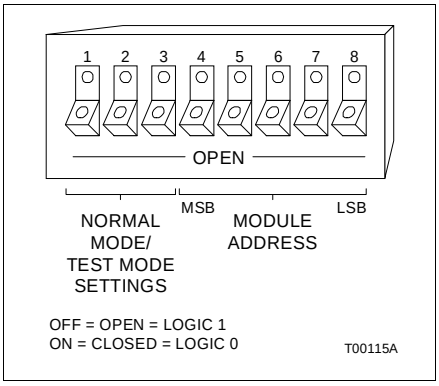


Figure 3-3. Switch S4 Module Address and Self-Test SW (S4)

Table 3-3. Switch S4 Normal Mode/Test Mode Settings

Position	Open (1 - off)	Closed (0 - on)	Function
NORMAL MODE-Switch Position 1 is CLOSED			
2	X		NVRAM initialize.
3	X		Configuration lockout.
DIAGNOSTIC MODE-Switch Position 1 is OPEN			
2-8		X	Group Test
2-7		X	Switch/LED Test
8	X		
2-6,8		X	ROM 2 Test
7	X		
2-6		X	ROM 1 Test
7	X		
2-5,7&8		X	RAM Test
6	X		
2-5,7		X	Clock Test
6,8	X		
2-5,8		X	Hardware Timer Test
6,7	X		
2-5		X	Analog Output Test[1]
6-8	X		
2-4,6-8		X	Digital Output Test[1]
5	X		
2-4,6&7		X	Machine Fault Timer (MFT) Test
5-8	X		

NOTE: Red LED will light if test fails.

[1]WARNING	**Do not run these tests while a COM is connected to ANY final elements. The test produces analog output triangle waveforms from 0 percent to 100 percent. The digital outputs cycle on and off continuously.**
AVERTISSEMENT	**French translation to be supplied later.**

ANALOG OUTPUTS (S2 AND S3)

Analog output number 1 and number 2 set the output for a logic 1 or 0 at power up, the default value for output in case of module failure, and the outputs for either voltage or current output.

MODULE BUS ADDRESS SELECTION/SELF-TEST SWITCH (S4)

In order to communicate with the system, each module must have a unique address. Switch S4 positions four through eight are used to set the module address and are listed in Table 3-2.

The COM can have one of 32 addresses (address 0 to 31) on the module bus. This address uniquely identifies the controller module (COM) and must be the same as the address set in the configuration.

The address is set by the eight position address dipswitch (S1) shown in Figure 3-1. The five right switch positions (4 through 8) of S4 set the six bit COM address. Positions 1,2 and 3 are not used and must remain in the closed position (see Figure 3-2). Table 3-2 is a binary address conversion table for setting S1.

DIGITAL INPUT JUMPER SETTINGS

Three jumpers are used to condition the Digital Inputs for either 24 VDC or 125 VDC. They are J1 for Digital Input Number 1, J2 for Digital Input Number 2, and J3 for Digital Input Number 3. Figure 3-4 shows how to set these jumpers for the desired digital input.

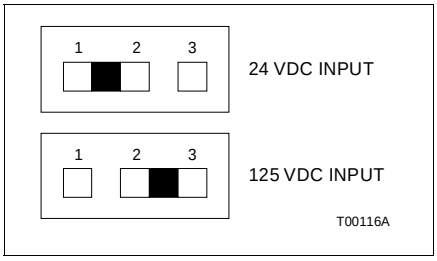


Figure 3-4. Digital Input Jumper Settings

EDGE CONNECTORS

P1 - Receives and applies power to the module and enables interfacing with the module bus.

P2 - Not used.

P3 - Receives inputs from, and outputs to, the field via the NKTU01 cable, and provides interfacing to the analog control stations.

CONFIGURING NVRAM

The NVRAM (battery backed memory) holds the configuration data (Function Blocks). This type of memory is used because it

will retain data in the event of a power failure. Use the following sequence for a new unconfigured module.

1. Remove module from the module mounting unit (MMU) rack.

2. Verify that position 1 of switch S4 is CLOSED (Refer to Figure 3-1 for switch locations).

3. Set position 2 of S4 to OPEN position.

4. Re-insert module into MMU rack.

5. Allow module to initialize (the LED starts blinking green). Leave in the rack for approximately 60 seconds.

6. Remove module from MMU rack.

7. Set position 2 of S4 to CLOSED position.

8. Reinsert the module to MMU rack.

9. Use the configuration and tuning module or other operator interface device to enter configuration data. Refer to Appendix A for configuration information.

TERMINATION MODULE CONFIGURATION

A termination module (TM) connects the field device wiring to the INFI 90 system. The terminal blocks (connection points) are located on the TM.

You must configure the TM to accept the field inputs that are sent to the COM, and to output the COM signals that are sent to the process field device. Refer to the appendices to determine the configuration for your application.

PHYSICAL INSTALLATION

> **NOTE:** The installation section provides instructions pertaining to the physical installation of the COM only. For complete cable and TU/TM information, refer to ***Station Termination Module I-E93-911***.

The Controller Module (IMCOM03/04) inserts into a standard INFI 90 module mounting unit (MMU) and occupies one slot. To install:

1. Verify the slot assignment of the module.

2. Connect the hooded end of the termination cable from the TU/TM to the MMU backplane. To do this, insert the connector

into the backplane slot in the same slot as the one assigned to the module. The latches should snap securely into place.

3. Align the module with the guide rails in the MMU; gently slide the module in until the front panel is flush with the top and bottom of the MMU frame.

4. Push and turn the two captive retaining latches on the module faceplate one half turn to the latched position. It is latched when the slots on the latches are vertical and the open ends face the center of the module. (To remove the module, turn the module retaining latches to the unlatched position and gently slide it out).

WIRING CONNECTIONS AND CABLING

CAUTION	**Do not remove the cable from the module or the termination unit while the INFI 90/Network 90 System is energized. Damage to the module may result.**
ATTENTION	**French translation to be supplied later.**

NOTE: Modules may be removed from the Module Mounting Unit while the system is energized.

The COM has two card edge connectors to supply logic power and provide I/O (P1 and P3 respectively).

Wiring

Installing the module in the MMU connects the controller to the logic power, necessary to drive the circuitry, at P1. It will also connect P3 to the I/O for communication with the field devices. P1 and P3 connection require no additional wiring or cabling.

Cable Connections

The IMCOM03/04 use either an NTCS02 or NICS01 for termination. Connect the controller module to the controller termination unit (TCS) with the NKTU01 cable. The J1 end of the cable attaches to connector P1 on the TCS. The J2 end of the cable attaches to the P3 card edge connector of the controller module. See Figure 3-5 to determine the cables to use with the termination unit or module you are using.

PREOPERATING ADJUSTMENTS

You do not have to make any adjustments to the COM prior to operating.

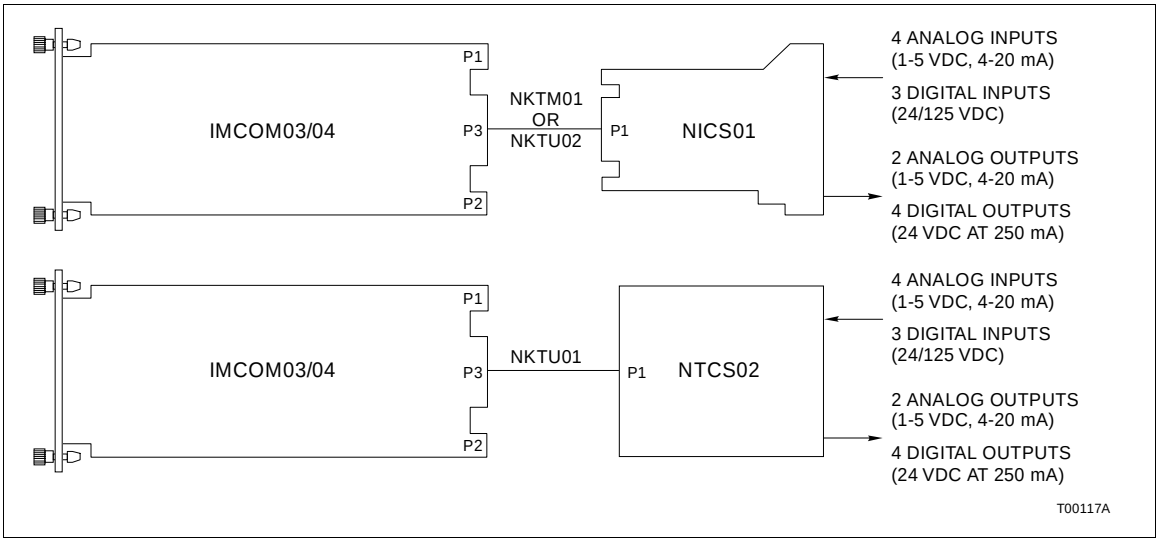


Figure 3-5. IMCOM03/04 Cable Connections and Termination

SECTION 4 - CONFIGURATION

INTRODUCTION

This section lists the function codes used by the controller module to control the process. (For complete information about COM function codes, refer to ***I-E93-900-20***, ***Function Code Application Manual***).

A variety of control and math functions reside in the module's firmware. These are known as function codes. These codes, when assigned to addresses in NVM, become function blocks. Link these function blocks sequentially to perform the control strategy. Figure 4-1 shows an example of a ratio control loop configuration

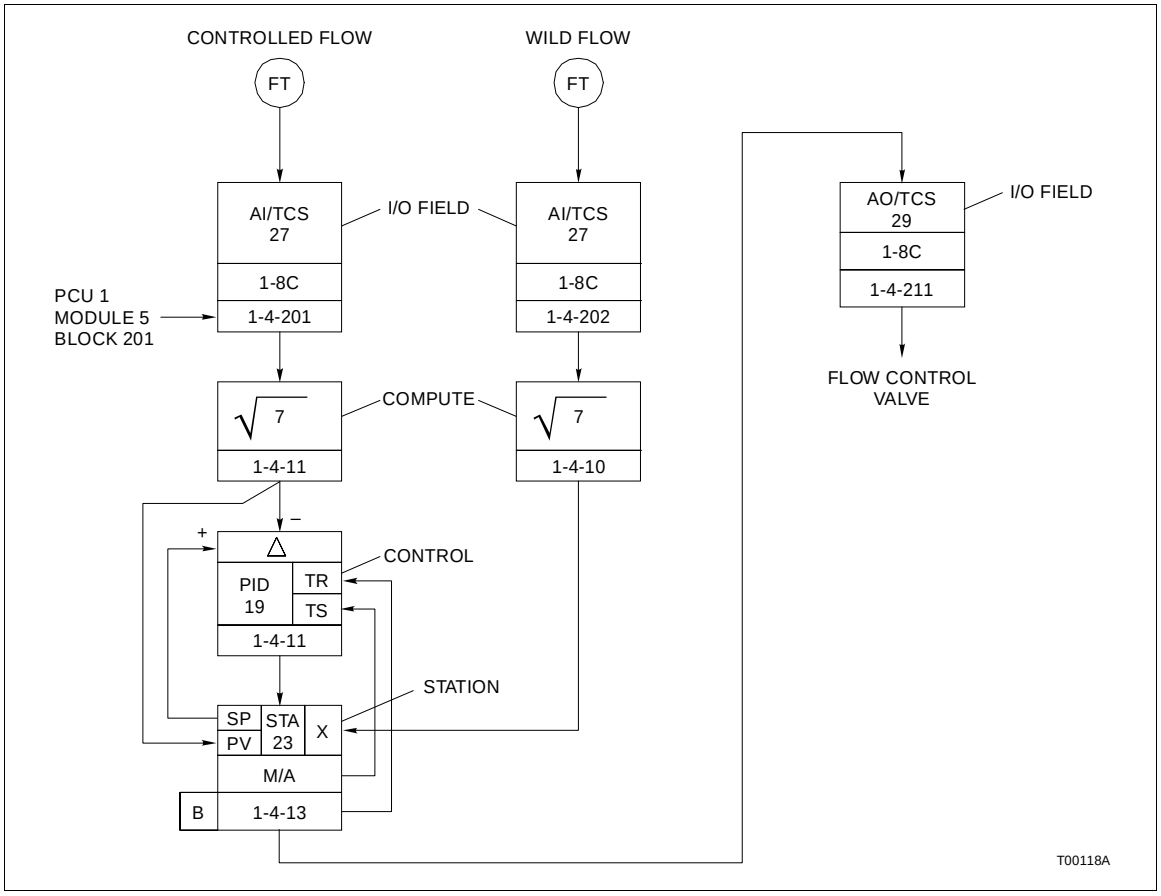


Figure 4-1. Sample Flow Ratio Control Loop Configuration

CONFIGURATION

WARNING	**The module digital outputs are de-energized (off) during start-up, during operator selected RESET, configure mode and for certain failure conditions. Configure the control strategy to prevent personal injury, equipment damage or damage to the product in case digital outputs de-energize.** **Analog outputs always hold last value when the module is put into configure mode and go to user-selected values during start-up, during operator selected RESET, and for certain failure conditions. These values must be selected on the default switch by the end user to prevent personal injury, equipment damage or damage to the product.**
AVERTISEMENT	**French translation to be supplied later.**

WARNING	**Independent of the user-selected default values, it is possible for the analog or digital outputs to fail in the on state. This is characteristic of solid-state circuits. A solid state-circuit failure in the on state could cause personal injury or significant equipment damage in some applications. Additional interlocks such as overstroke and overlevel limit switches or pressure and temperature limiting valves must be put in the system where operation or maintenance personnel may be working or where there may be serious equipment damage.** **The module analog outputs change to user-selected values during start-up, during operator selected RESET or STOP, and for certain failure conditions. These values must be selected by the end user to prevent personal injury, equipment damage or damage to the product.**
AVERTISEMENT	**French translation to be supplied later.**

FUNCTION BLOCKS

The IMCOM03/04 has 240 function blocks available for user configuration. Of these, blocks 0 through 9 are fixed (their values are preassigned; you can not alter them), and block 240 is reserved.

> **NOTE:** The total number of blocks actually configurable for user selected functions depends on several critical factors: Execution time, memory utilization, degree of complexity, etc. Refer to the ***Function Code Application Manual***, ***I-E93-900-20*** for utilization factors for each function code.

The following example uses three function blocks. The steps below determine how to calculate the memory and CPU utilization.

1. Identify memory utilization and execution time:

Function Code 7 Square Root	0.7% memory 12,500 microseconds execution rate.
Function Code 19 PID	2.5% memory 20,100 microseconds execution rate.
Function Code 53 Executive Block	0.0% memory 600 microseconds execution rate.

2. Specify the number of blocks. In this example, 15 Square Root blocks, 15 PID blocks and 1 Executive Block are configured.

3. Calculate the amount of memory the configuration uses:

   a. Multiply 15 PID blocks by 2.5% per block = 37.5% used.

   b. Multiply 15 Square Root blocks by 0.7% per block = 10.5% of used.

   c. Note that the Executive Block uses 0.0% used.

   d. Add products: 37.5%
10.5%
47.0%

   There is 53.0% of memory remaining.

4. Calculate the amount of CPU time the configuration requires to run.

   a. Multiply 15 PID blocks by 20.100 milliseconds.

b. Multiply 15 Square Root blocks by 12.500 milliseconds.

c. Multiply 1 Executive Block by .000,60 milliseconds.

d. Add products: 301.500
000.060
+187.500
489.06 milliseconds of CPU time

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

FUNCTION CODES

Control configuration is accomplished by assigning function codes to function blocks. The function codes are operations such as multiply, divide, read, compare, etc. The function blocks are addressee memory locations saved in the NVRAM and copied to RAM for execution. Configuration requires defining the block address, function code and the code specifications. Refer to product instruction I-E93-900-20, Function Code Reference Manual, for details.

Block Address

Block 0 through 9 are fixed blocks (constants) on all controller modules and have the following values:

0	0 logic
1	1 logic
2	0.0
3	- 100.0
4	- 1.0
5	0.0
6	+ 1.0
7	+ 100.0
8	-9.2×10^{18} (minimum negative value)
9	$+9.2 \times 10^{18}$ (maximum positive value)

Blocks 10 through 199 are user-definable. The total number of blocks that can be defined within this range is dependent on the function codes required. This total is the same for 03 and 04 versions. The 04 version has the same functions of the 03 version and also includes a set of advanced functions.

Refer to Tables 4-1 and 4-2 for a list of the functions. Refer to product instruction I-E93-900-20, Function Code Reference Manual, for details.

Code Specifications

The user defines the block address and assigns a function code to it. The output of the block can be referenced as an input to another block. Blocks are executed in sequential order. Each function code has a list of specifications. These specifications apply to input/output coordinates time constants and gains, and have default values. The user can accept the default values or substitute his own values.

Each function code has a utilization factor associated with it. The factor represents the amount of memory occupied by the function. When planning control strategy it is important to note the utilization factor associated with the functions used, so not to exceed 100. Appendix E, controller module reference I-E93-900-20, Function Code Reference Manual, lists the utilization percentage.

The CONFIGURE mode of operation allows the user to either configuration data using the configuration and tuning mode or the operator interface unit.

Table 4-1 lists the basic control functions of the controller module COM03/04. Table 4-2 lists the advanced control functions of the controller module (COM04 only).

Table 4-1. Basic Control Functions

No.	Function Code Definition	No.	Function Code Definition
	Station		**Miscellaneous**
20	Indicator Station	66	Analog Trend
21	Basic Station	86	Elapsed Timer
22	Cascade Station	51	Manual Set Constant
23	Ratio Station	50	Manual Set Switch
24	Adapt	68	Remote Manual Constant
	Control	95	Module Status Monitor
4	Pulse Positioner	32	Trip
18	PID Control/Deviation	53	Executive Block
19	PID Control (PV and SP)	52	Manual Set Integer
		61	Blink
		62	Remote Control Memory

Table 4-1. Basic Control Functions (continued)

No.	Function Code Definition	No.	Function Code Definition
Compute		**Logic**	
1	Function Generation	33	Not
3	Lead/Lag	34	Remote Control Memory
5	Pulse Rate	35	Time Delay, Digital
6	High/Low Limit	36	Qualified OR (8 input)
7	Square Root	37	AND - 2 Inputs
8	Rate Limit	38	AND - 4 Inputs
13	Integer Transfer	39	OR - 2 Inputs
14	Sum - 4 Inputs	40	OR - 4 Inputs
15	Sum - 2 Inputs	85	Up/Down Counter
16	Multiply	**Signal Status**	
17	Divide	12	High Alarm/Low Alarm
58	Time Delay, Analog	31	Test Quality
65	4 Input Digital Sum with Gain	69	Test Alarm
Signal Select		**I/O - Module Bus**	
9	Transfer, Analog	25	Analog Input/Bus
10	High Select	28	Analog Output/Bus
11	Low Select	41	Digital Input/Bus
13	Transfer, Integer	63	Analog Input List/Bus
59	Transfer, Digital	64	Digital Input List/Bus
I/O - Field		**I/O - Communication Highway**	
27	Analog Input/TCS	26	Analog Input/Loop
29	Analog Output/TCS	30	Analog Output/Loop (Exception Report)
43	Digital Input/TCS	42	Digital Input/Loop
44	Digital Output/TCS	45	Digital Output/Loop

Basic functions apply to the IMCOM03 and IMCOM04.

Table 4-2. Advanced Control Functions

No.	Function Code Definition	No.	Function Code Definition
152	Model Parameter Estimator	166	Integrator
153	ISC Parameter Converter	167	Polynomial Equation1
154	Adaptive Parameter Controller	168	2 Dimensional Interpolation Integrator
156	Advanced PID Controller	169	3 x 3 Matrix Add
157	General Digital Controller	170	Multiply Sequence Generator (3X#3 Matrix Multiply)
160	Smith Predictor	171	Trigonometric Functions
161	Sequence Generator	172	Y^X, e^X (Exponential)
162	Segment Buffer/Digital	173	Power
163	Segment Buffer/Analog	174	Ln x, log x (Logarithm)
164	Segment Control Block		
165	Moving Average		

Advanced functions apply to the IMCOM04.

SECTION 5 - OPERATING PROCEDURES

INTRODUCTION

This section explains the front panel indicator and start-up procedures for the Controller Module (IMCOM03/04).

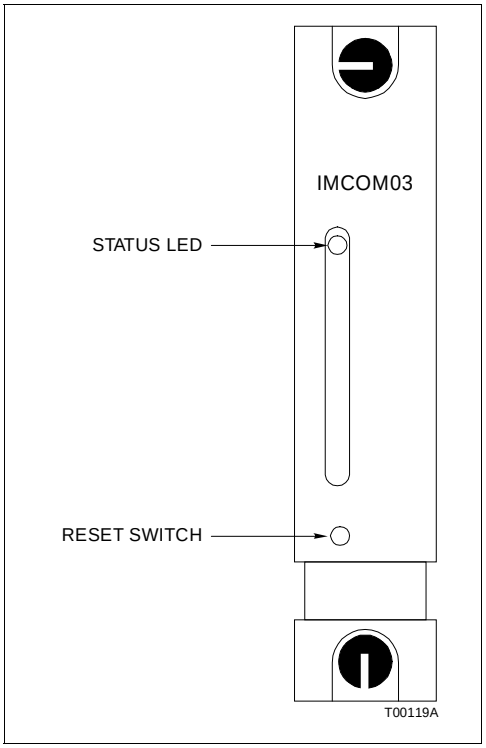


Figure 5-1. IMCOM03/03 Front Panel

MODULE STATUS INDICATOR

The controller module has a front panel module status LED indicator to aid in system test and diagnosis. The location of the indicator is shown in Figure 5-1. Table 5-1 explains the three states of the status LED indicator (refer to the trouble-shooting section to determine corrective actions).

Table 5-1. IMCOM03/04 Status LED Indicator

LED	Indication
Solid Green	Enabled and communicating
Off	No power or not enabled
Solid Red	Bus error

START-UP PROCEDURES

The controller starts up automatically. The front panel LED (solid green) verifies that the module is enabled and communicating.

MODES OF OPERATION

The controller module has three modes of operation: execute, configure and error.

Execute

The execute mode is the normal mode of operation for the controller module. The status LED is solid green. The controller reads the configuration, monitors and updates outputs, computes the algorithms, and performs self-diagnostic routines. The configuration cannot be changed but parameters such as gains and time constants may be tuned, and block outputs can be monitored.

Configure

The configure mode is used to enter new configuration data, and delete or modify an existing configuration. The status LED is blinking green. When this mode is entered, the analog outputs are held at their present value, the digital outputs are de-energized, and the algorithms are not computed. Existing parameters can be modified, and blocks can be deleted or added, and tunable parameters can be adjusted with an operator interface device.

Error

If the MFT is not reset, an error exists. The following are some examples of errors that will cause the MFT to time out and the status LED to go red:

- Reference out of acceptable tolerance.
- Excessive analog output gain/offset.
- Power failure/reset during EEPROM write operation.
- Trip Block activated.

SECTION 6 - TROUBLESHOOTING

INTRODUCTION

This section explains the error indications and corrective actions for the Controller Module (IMCOM03/04).

ERROR INDICATIONS AND CORRECTIVE ACTION

Obtain the status of the COM through an INFI 90 operator interface (e.g. Operator Interface Station, Engineering Work Station, Configuration and Tuning Terminal) or the front panel module status LED indicator.

Status LED

The front panel status LED has three states to indicate normal operation and error conditions. Table 6-1 lists the symptom and recovery procedures for execute errors.

Controller Module Errors

The controller module performs its own status checks. An error will appear in the report function of an operator interface. Refer to the product instruction for the operator interface you are using for an explanation of these reports.

NOTE: Refer to the product instruction for your configuration device when referring to this table.

Table 6-1. Status LED Indications and Corrective Actions

Symptom	Problem	User Action
Flashing green LED when COM is in the EXECUTE mode.	An error (non-fatal one that does not immediately affect the execution) exists.	Use a non-conductive pointed instrument to press the RESET switch through the COM faceplate.
	The COM is not in ERROR mode.	Use the CTM to obtain the status word for the type of error.
		Put the COM in CONFIGURE[1] mode to correct the error.
Solid red LED when the COM is in the EXECUTE mode.	A fatal error (one that immediately affects the execution) exists.	Remove COM and replace with a known good one. Follow the instructions in Appendix A to configure the replacement).

NOTE: If the status word indicates an NVRAM error, PUTTING THE COM IN THE CONFIGURE MODE WILL ERASE ANY EXISTING CONFIGURATION. You will need to re-configure the mode using your configuration chart. Or you can remove the COM and insert replacement configured COM.

If the status word indicates an error other than NVRAM the existing configuration will not be erased when the COM is put in the CONFIGURE mode. You can now modify, add, delete, or tune the configuration.

NOTE: Make sure that your analog control station (SAC) is in the AUTO BYPASS mode so that you have manual control of the process.

STATUS WORD DISPLAYS

Table 6-2 lists the module status words. Table 6-3 contains the status byte descriptions. These words provide detailed information on COM 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	0
1	ES	MODE		TYPE				
2	FTX	—	RIO	LIO	SEG	EAF	EAI	DLS
3								
4								
5								

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 (05=COM)
Byte 2		
FTX	80	First Time in Execute (0-No, 1-Yes)
RIO	20	Summary Remote I/O Status (0-OK, 1-Bad)
LIO	10	Summary Local I/O Status (0-OK, 1-Bad)
SEG	08	Summary Segment Alarm Status (0-No, 1-Yes)
EAF	04	Summary NVRAM Failure State (0-OK, 1-Yes)
EAI	02	Summary NVRAM Initialized State (0-No, 1-Yes)
DLS	01	Digital Control Station Status (0-OK, 1-Bad)

Table 6-3. Status Byte Descriptions

Field	Value			Description
Bytes	**3**	**4**	**5**	
	01	01 02 03 FF	— — — —	NVRAM Error: Write Failure Checksum Failure Bad Data Reset During Write
	02	00	04 05	Analog Input Reference Error: 1 Volt Ref. Analog Input Reference Error: 5 Volt Ref.
	03	00	—	Missing I/O Expander Board
	05	(1)	(2)	Configuration Error - Undefined Block (1) = Block making reference (2) = Block being referenced
	06	(1)	(2)	Configuration Error - input data type is incorrect (1) = Block number making reference (2) = Block number being referenced
	08	(1)	—	Trip block activated (1) = Block number of Trip block
	09	(1)	(2)	Function Not Allowed in Segment (1) = Segment block number (2) = Block number in error
	0A	—	—	Too Many Segment Control Blocks
	0B	(1)	(2)	Segment Control Block Priority Violation (1) = Block number of first segment (2) = Block number of segment in error

NOTE: 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.

MODULE PIN CONNECTIONS

The controller module has two connection points for external signals and power (P1 and P3). Table 6-4 shows the module pin connections.

Table 6-4. P1 Power Pin Connections (COM03/04)

Pin (P1)	Connection	Pin (P1)	Connection
1	+5 VDC	7	+15 VDC
2	+5 VDC	8	-15 VDC
3	NC	9	PFI
4	NC	10	PFI
5	Common	11	NC
6	Common	12	NC

NOTES:
NC = Not Connected
PFI = Power Fail Interrupt

TERMINATION UNIT CONNECTIONS

Table 6-5 lists the P3 connections on the controller module (P1 connections on the termination Unit).

Table 6-5. P1 Pin Connections (NTCS02)

Cable Connections	
1. Digital Output 1- 3. Digital Output 2- 5. Digital Output 3- 7. Digital Output 4-	2. Digital Output 1+ 4. Digital Output 2+ 6. Digital Output 3+ 8. Digital Output 4+
13. Serial Link - 17. Digital Input 1- 19. Digital Input 2- 21. Digital Input 3-	16. Serial Link + 18. Digital Input 1+ 20. Digital Input 2+ 22. Digital Input 3+
23. +24 VDC 25. Analog Output 1- 27. Analog Output 2- 29. Analog Input 1-	24. No Connection 26. Analog Output 1+ 28. Analog Output 2+ 30. Analog Input 1+
31. Analog Input 2- 33. Analog Input 3- 35. Analog Input 4-	32. Analog Input 2+ 34. Analog Input 3+ 36. Analog Input 4+

NOTE: 14 is the TU Cable Shield.

Table 6-6. Terminal Block Assignments

TB1-10	AI 1+	TB3-10	AI 3-
TB1-9	AI 1-	TB3-9	AI 3-
TB1-8	AO 1+	TB3-8	DO 3+
TB1-7	AO 1-	TB3-7	DO 3-
TB1-6	M/A 1 COMMON	TB3-6	DO 4+
TB1-5	M/A 1 SELECT	TB3-5	DO 4-
TB1-4	M/A 1 POWER	TB3-4	DI 3+
TB1-3	LOWER 1	TB3-3	DI 3-
TB1-2	R/L 1 COMMON	TB3-2	+24 VDC (fused)
TB1-1	RAISE 1	TB3-1	COMMON
TB2-10	AI 2+	TB4-10	AI 4+
TB2-9	AI 2-	TB4-9	AI 4-
TB2-8	DO 1+	TB4-8	AO 2+
TB2-7	DO 1-	TB4-7	AO 2-
TB2-6	DO 2+	TB4-6	M/A 2 COMMON
TB2-5	DO 2-	TB4-5	M/A 2 SELECT
TB2-4	DI 1+	TB4-4	M/A 2 POWER
TB2-3	DI 1-	TB4-3	LOWER 2
TB2-2	DI 2+	TB4-2	R/L 2 COMMON
TB2-1	DI 2-	TB4-1	RAISE 2

Legend:

DI-Digital Input
R/L-Raise/Lower
AI-Analog Input
DO-Digital Output
AO-Analog Output
M/A-Manual/Auto (Final Device Drive Status)
A-Analog or Pulse Input
M-Raise Lower Contact Input

SECTION 7 - MAINTENANCE

INTRODUCTION

The controller module 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 PROCEDURES

INTRODUCTION

This section explains the replacement procedures for a controller module. There are no special tools required to replace a controller module.

MODULE REPAIR/REPLACEMENT PROCEDURES

If you determine the controller module is faulty, replace it with a new one. ***DO NOT*** try to repair the module; replacing components may affect the module performance. You can remove the module while system power is supplied. To replace a module:

1. Push and turn the two front panel captive retaining screws one half turn to unlatch the module. It is unlatched when the slots on the screws are vertical and the open end of the slots face away from the module.

2. Gently slide the module out of the MMU.

3. Configure the replacement module switch and jumper settings. Ensure they are set the same as the original module.

4. In the same slot assignment as the original module, align the replacement module with the guide rails in the MMU; gently slide it in until the front panel is flush with the top and bottom of the MMU frame.

5. Push and turn the two captive retaining screws on the module faceplate one half turn to the latched position. It is latched when the slots on the screws are vertical and the open ends face the center of the module.

6. Return to normal operation.

SECTION 9 - SUPPORT SERVICES

INTRODUCTION

Bailey Controls is ready to help in the use, application and repair of its products. Contact your nearest sales office to make requests for sales, applications, installation, repair, and maintenance contract services.

REPLACEMENT PARTS AND ORDERING INFORMATION

When making repairs at your facility, order replacement parts from a Bailey Controls sales office. Please provide this information:

1. Part description, part number and quantity.

2. Model and serial numbers (if applicable).

3. Bailey Controls instruction manual number, page number and reference figure that identifies the part.

When ordering standard parts from Bailey Controls, use part numbers and descriptions from the product instruction manual. Order parts without commercial descriptions from the nearest Bailey Controls sales office.

TRAINING

Bailey Controls has a modern training facility that provides service and repair instruction. This facility is available for in-plant training. Contact a Bailey Controls sales office for specific information and scheduling.

TECHNICAL DOCUMENTATION

Obtain additional copies of this manual from the nearest Bailey Controls sales office at a reasonable charge.

APPENDIX A - TERMINATION UNIT CONFIGURATION (NTCS02)

INTRODUCTION

The IMCOM03/04 uses an NTCS02 for termination. It handles four analog inputs, two analog outputs, three digital inputs and four digital outputs. Dipshunts on the Termination Unit (NTCS02) configure the I/O.

> **NOTE:** There is no dipshunt socket to configure for the digital outputs on the NTCS02.

The Controller Termination Unit (NTCS02) and Cable (NKTU01) provide the interface from the field connections to the controller module. The TCS consists of four terminal blocks, nine dipshunts and sockets, fuses and limiting resistors (see Figure A-1). The terminal blocks correspond to fixed function blocks (analog input/outputs and digital inputs/outputs). The dipshunts are configured to match the field input type, current or voltage.

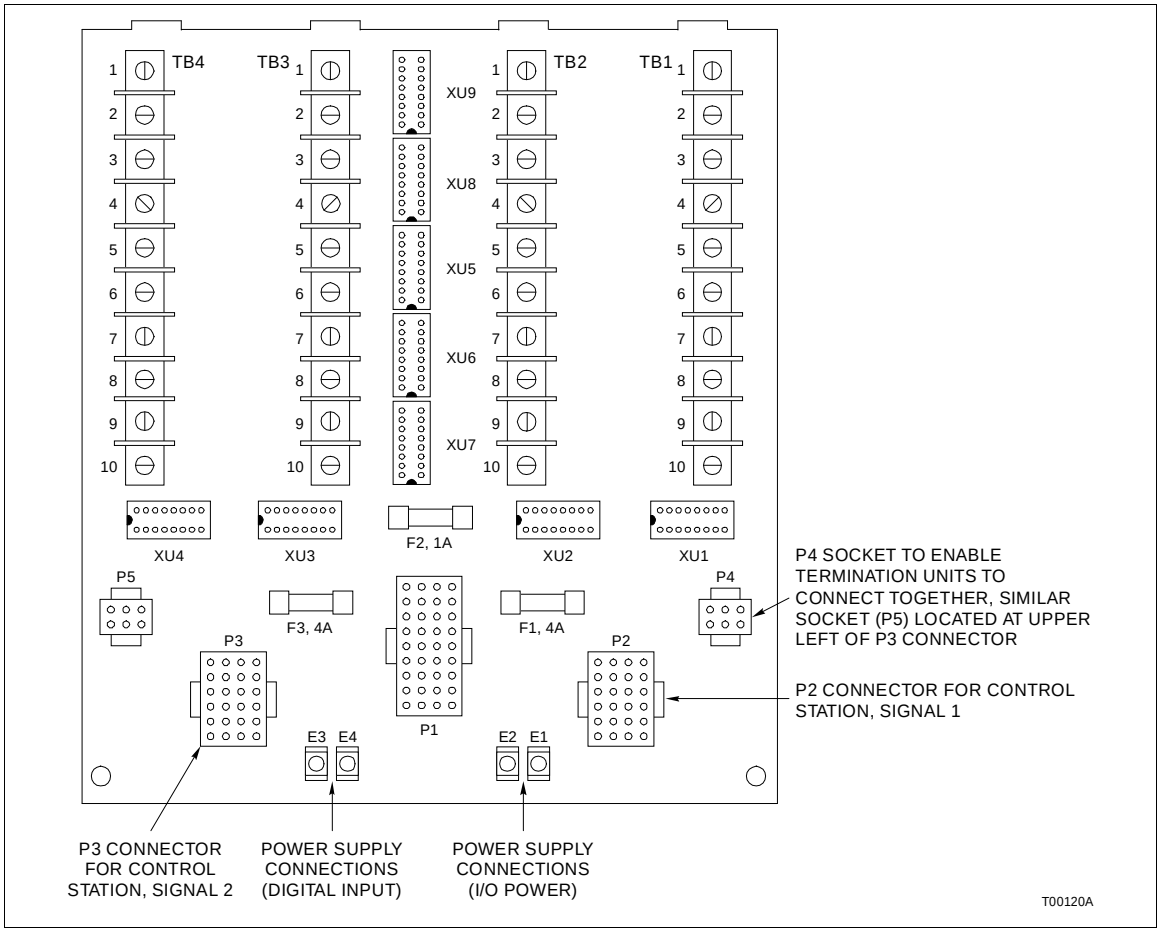


Figure A-1. NTCS02 Termination Unit

For example, analog input number 1 field wiring is attached to screw terminals 9 (-) and 10 (+) of terminal block number 1. Dipshunt XU1 conditions analog input number 1. If analog input number 1 is a powered 4-20 mA input, XU1 is configured as follows: straps 2, 4, and 5 are cut, straps 1, 3, 6, 7 and 8 are left intact. The dipshunt is now configured for a power 4-10 mA input and it matches the input from the field wiring. Module configurations for other types of inputs are given in the figures and tables in this section.

Mounting

The TCS mounts on the field termination panel (FTP) in the INFI 90/Network 90 cabinet by two screws in the panel mounting slots. Since it can be mounted on either the left or right side, it is VERY IMPORTANT to observe the orientation of the dipshunts and sockets for the location of pin number 1.

Figure A-1 shows the Termination Unit (NTCS02). Table A-1 lists the dipshunt configurations and Table A-2 lists the terminal block assignments.

Configuring Dipshunts

There are two methods for breaking desired dipshunt straps:

1. With dipshunt in socket: use an Amp, Inc. Tool P/N 435862-1 or equivalent and push down in the middle of the strap.

2. With dipshunt out of socket, turn it over with its leads up and break the desired strap as in step 1. Or lay it on a piece of 1/4 in. square key stock or similar material to support the dipshunt while breaking straps.

Use either method, but always ensure that the strap is completely broken and that shorts to adjacent straps have not occurred.

Dipshunt Assignments

NOTES:

1. Analog output mode (current or voltage) is dependent on the COM configuration. The outputs can be both voltage, both current, or one voltage and one current. Refer to Table A-1 for the configurations.

2. For schematic configurations refer to Figures A-3, A-4, A-5 and A-6.

3. XU8 provides a position feedback for electric control drives. Analog input 3 provides the feedback to the bypass SAC cabled to P2 on the TCS. Analog input 4 provides the feedback to the bypass SAC cabled to P3 on the TCS.

4. The feedback signals are used only for electric control drives and should not be connected if signals other than drive position are used on these inputs. The signal settings on the SAC must match the setup of dipshunt XU8.

Table A-1. Input/Output Dipshunt Configuration

Application	Dipshunts	Configuration 1 2 3 4 5 6 7 8
ANALOG INPUTS 1 through 4	XU1-XU4	
Powered 4-20 mA Input		1 0 1 0 0 1 1 1
Unpowered 4-20 mA Input		0 1 0 1 0 1 0 1
Single-Edged Voltage Input		0 1 0 1 0 0 1 1
Differential Voltage Input		0 1 0 1 1 0 0 0
ANALOG OUTPUTS	XU9	
Both Outputs in Voltage Mode		1 1 0 0 0 0 1 1
Analog Output 1 = Voltage		1 1 0 0 0 0 0 0
Analog Output 2 = Current		
Analog Output 1 = Current		
Analog Output 2 = Voltage		0 0 0 0 0 0 1 1
Both Outputs in Current Mode		0 0 0 0 0 0 0 0
DIGITAL INPUTS 1 through 3	XU5-XU7	
+24 VDC I/O Supply in Series		0 0 0 0 1 0 1 0
Separate 24 VDC/125 VDC		1 0 1 0 0 0 0 0
Supply in Series		
Field Powered Input (External)		0 0 0 0 0 0 0 1
ANALOG INPUT FEEDBACK	XU8	
Both Digital Stations		1 1 0 1 1 0 0 0
Digital Station 1		1 1 0 0 0 1 0 0
Digital Station 2		0 0 1 1 1 0 0 0
DIGITAL OUTPUTS	NONE	N/A

NOTE: 0 - Cut strap, 1 - Strap intact

Table A-2. Dipshunt Assignments

DipShunt	Assignment	Fixed Block*	Terminal Block (TB)	Terminal Position +	Terminal Position -
XU1 XU2 XU3	Analog Input 1 Analog Input 2 Analog Input 3	201 202 203	1 2 3	10 10 10	9 9 9
XU4 XU5 XU6	Analog Input 4 Digital Input 1 Digital Input 2	204 221 222	4 2 2	10 4 2	9 3 1
XU7 XU8	Digital Input 3 Electric Drive SAC (Analog Control Station) Position Feedback	223	3	4	3
XU9	Analog Output 1 Analog Output 2	211 212	1 4	8 8	7 7

* Refer to Product Information E93-900-20, Function Code Reference Manual, for block details.

Terminal Assignments

Figure A-2 shows the termination assignment for the termination unit (TCS).

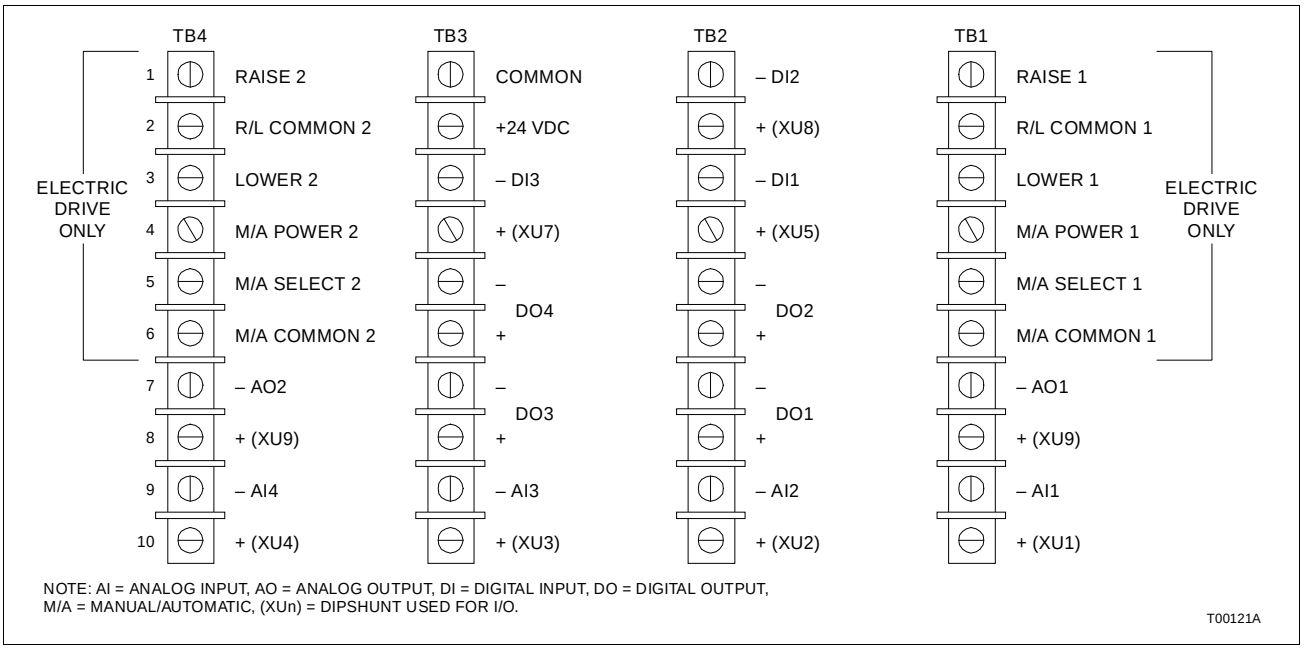


Figure A-2. NTCS02 Terminal Assignments

Table A-1 lists the TCS analog output dipshunts. Figures A-3, A-4, A-5 and A-6 show the TCS dipshunts, and the I/O signal path from the field device to the controller module for a termination unit application. Refer to Table A-1 to determine the dipshunt strapping to configure your application. Figure A-2 shows the terminal assignments for the digital and analog I/O signals. Refer to this figure when connecting field wiring to the TCS.

Figure A-7 and Figure A-8 show COM to TCS cable connections.

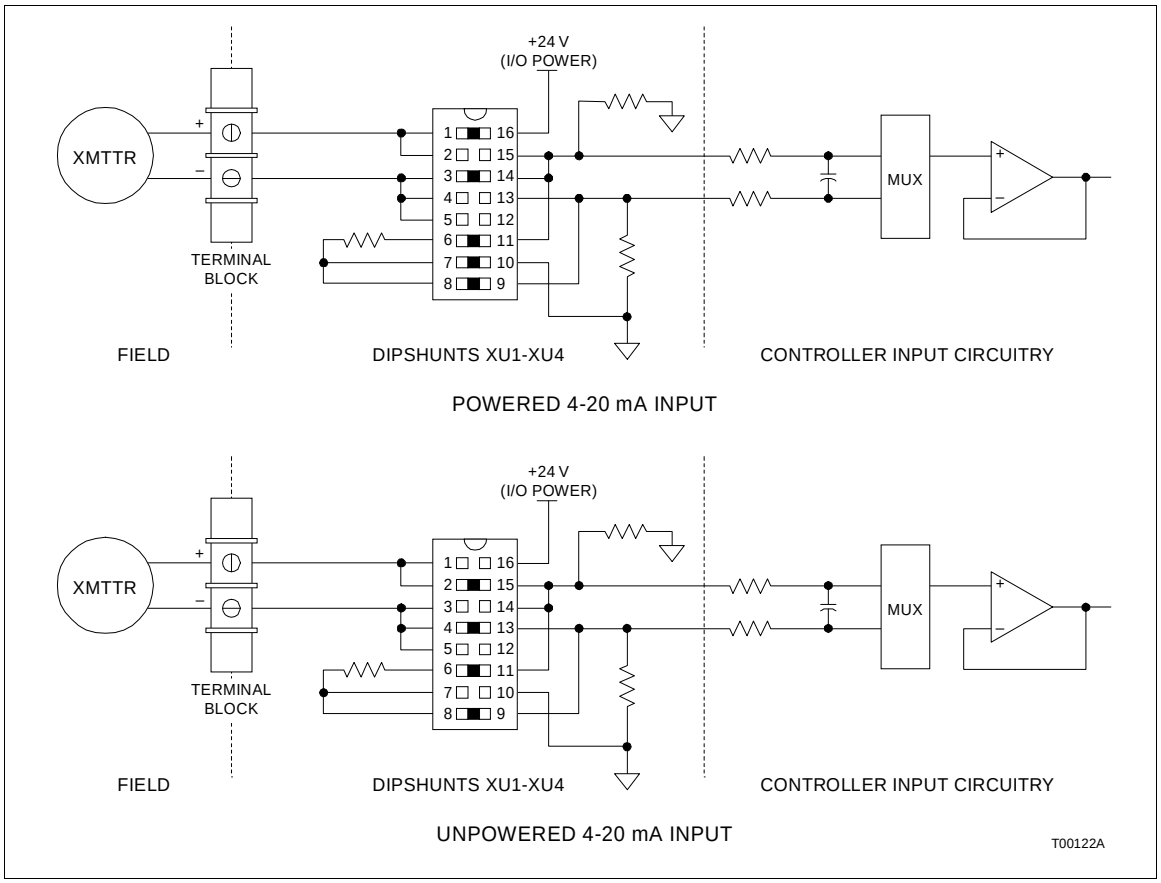


Figure A-3. Analog Input Dipshunt Configurations

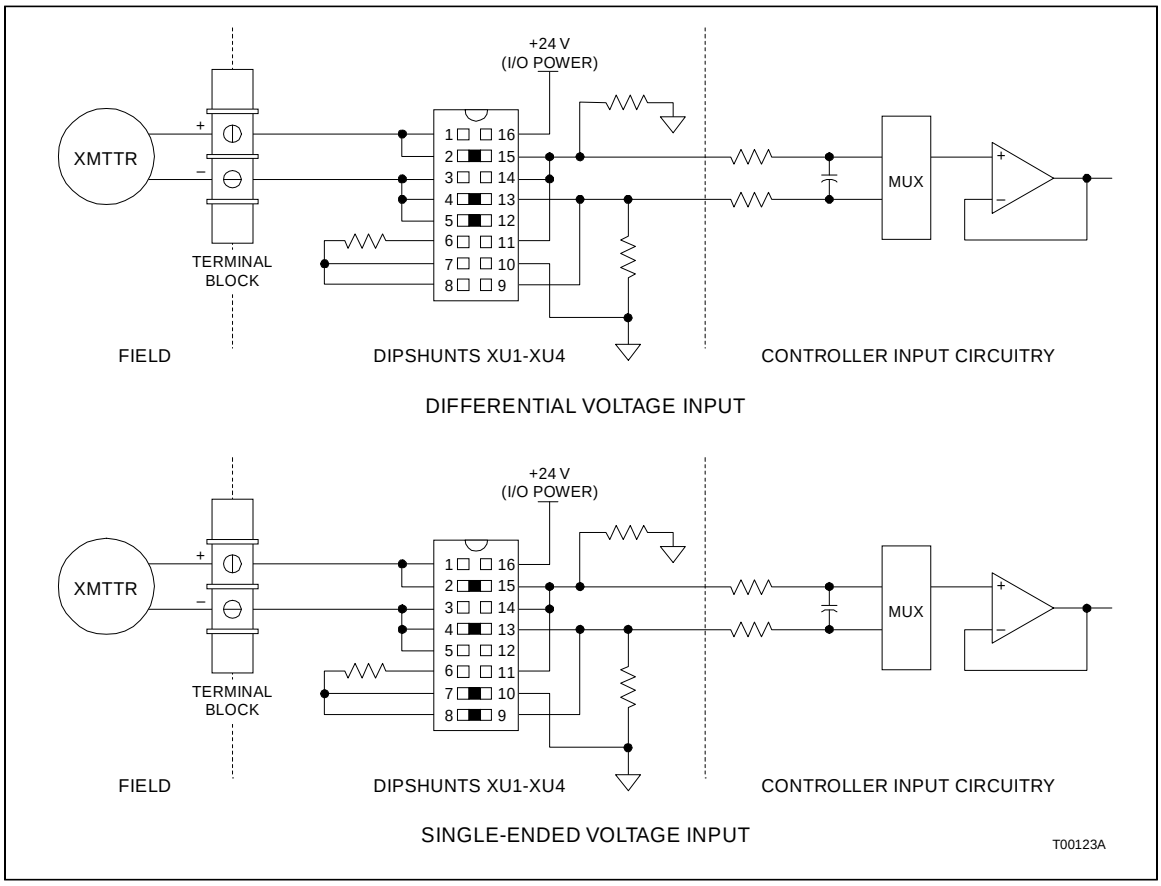


Figure A-3. Analog Input Dipshunt Configurations (continued)

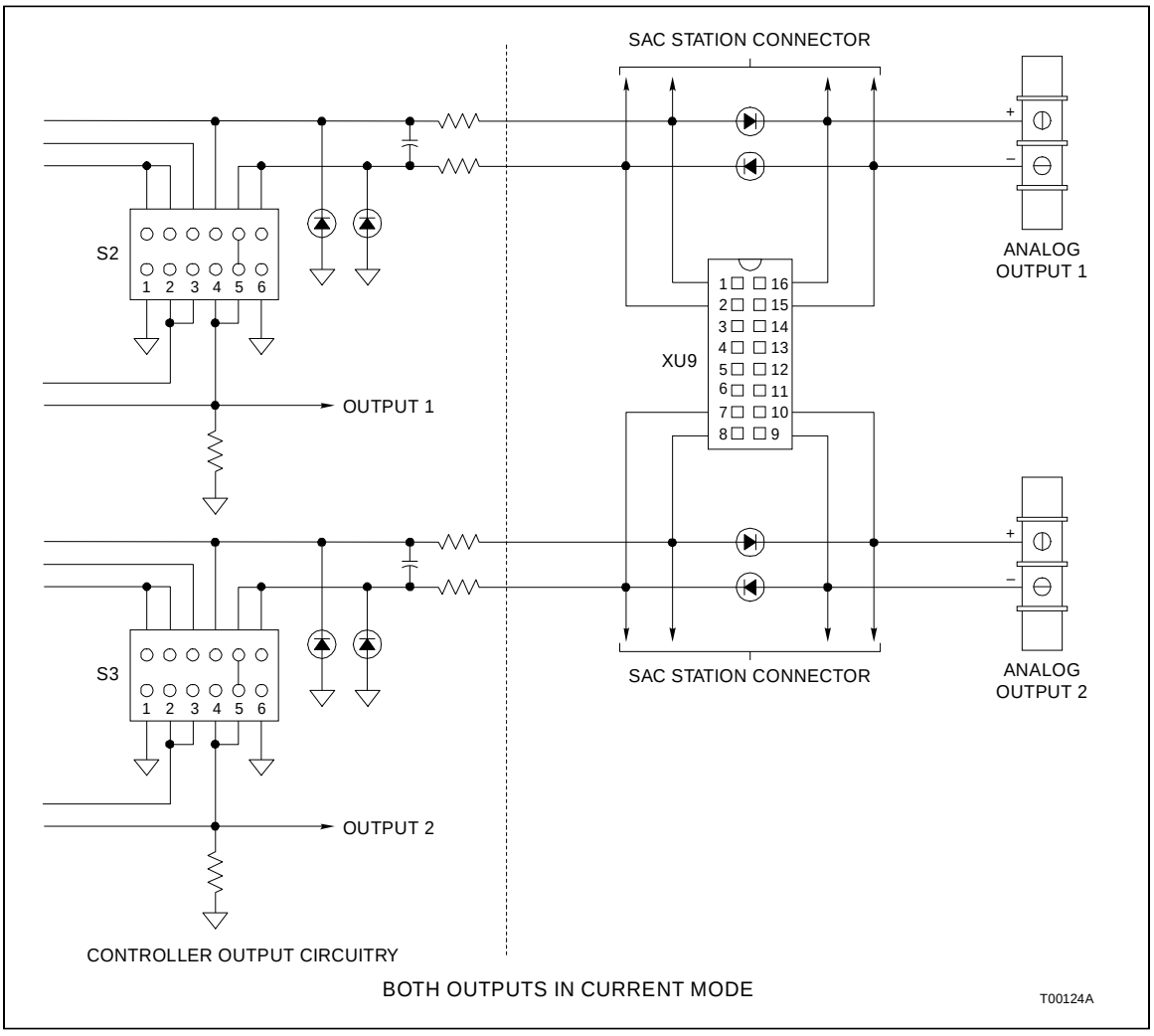


Figure A-4. Analog Output Dipshunt Configurations

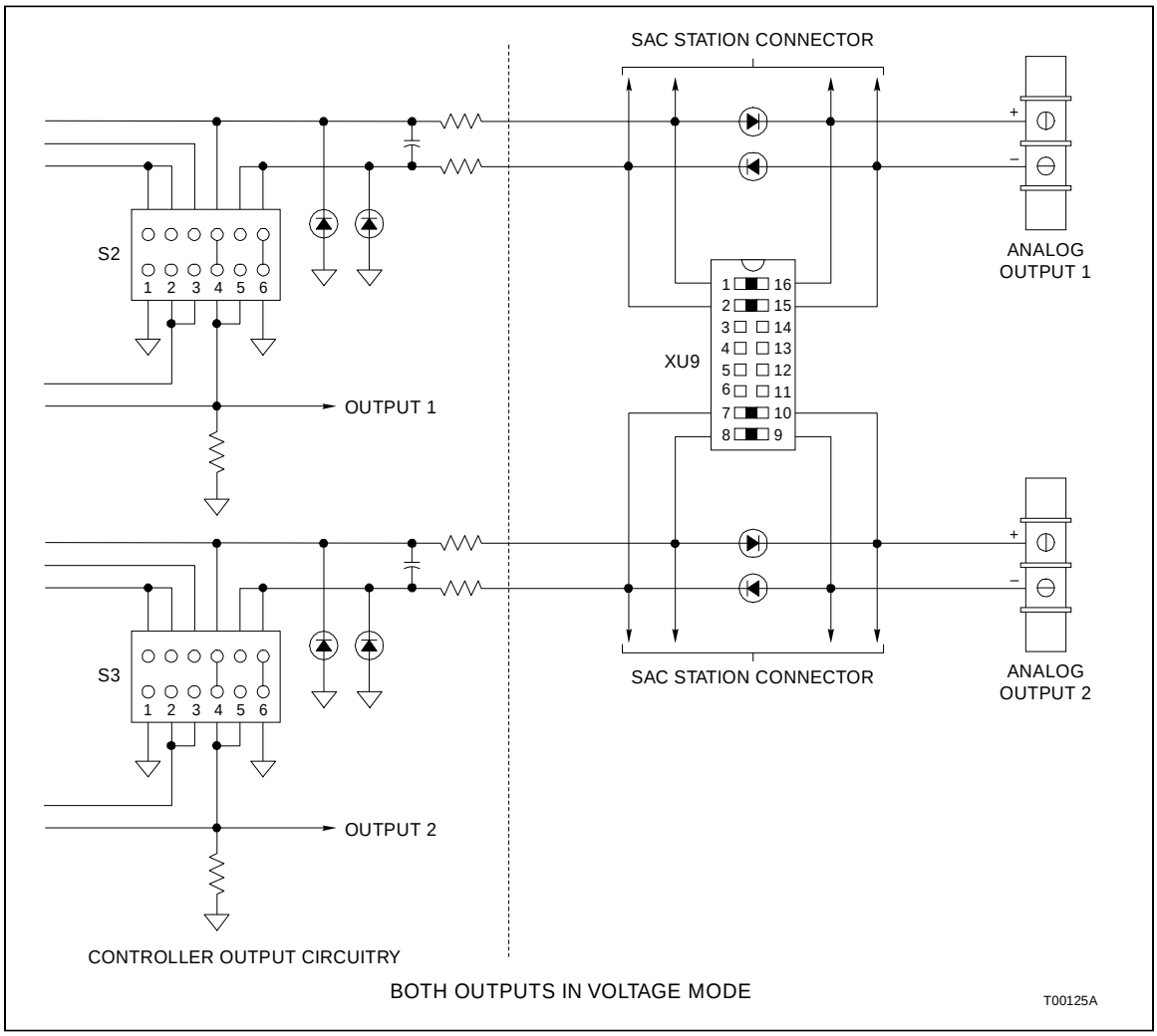


Figure A-4. Analog Output Dipshunt Configurations (continued)

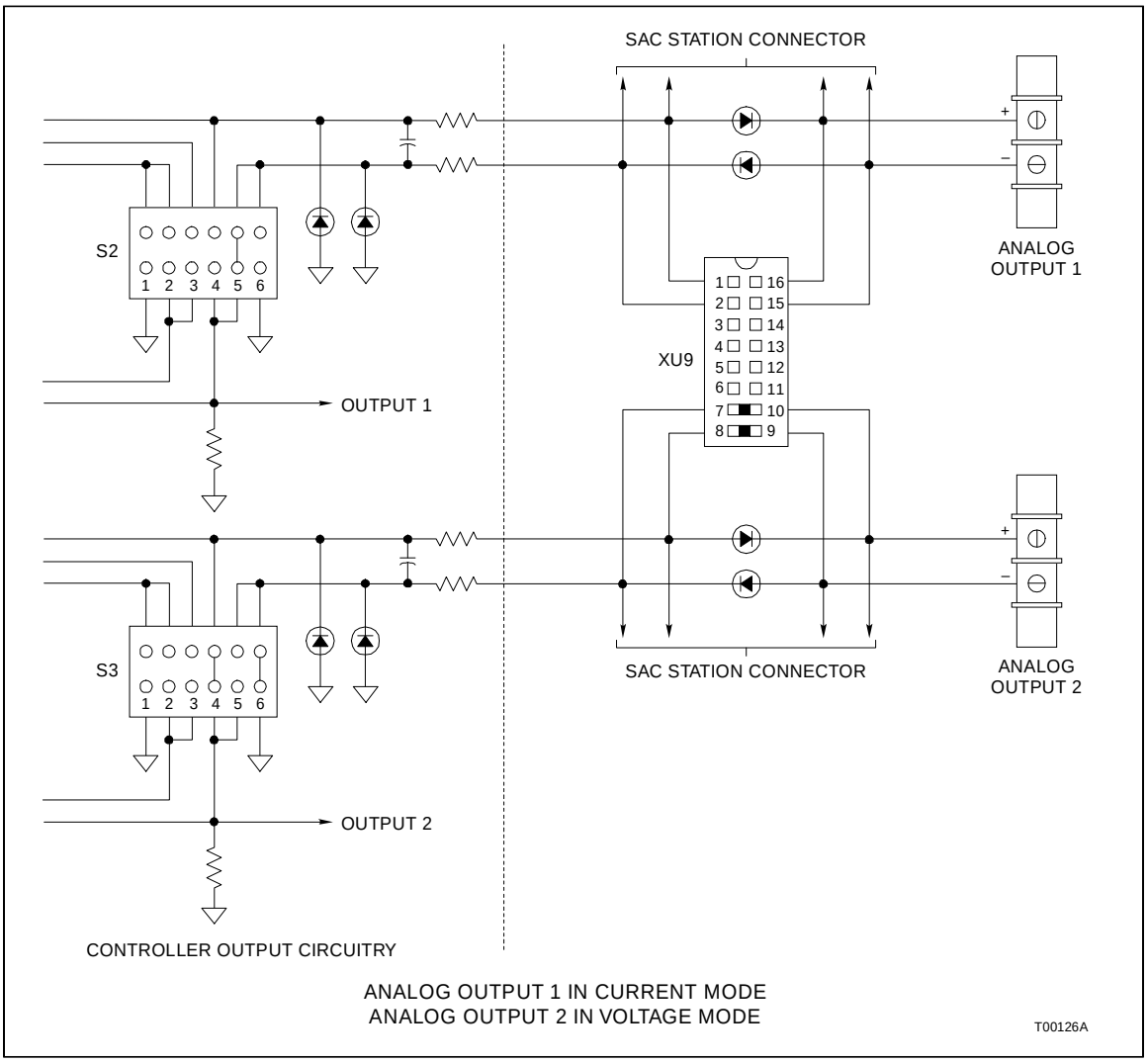


Figure A-4. Analog Output Dipshunt Configurations (continued)

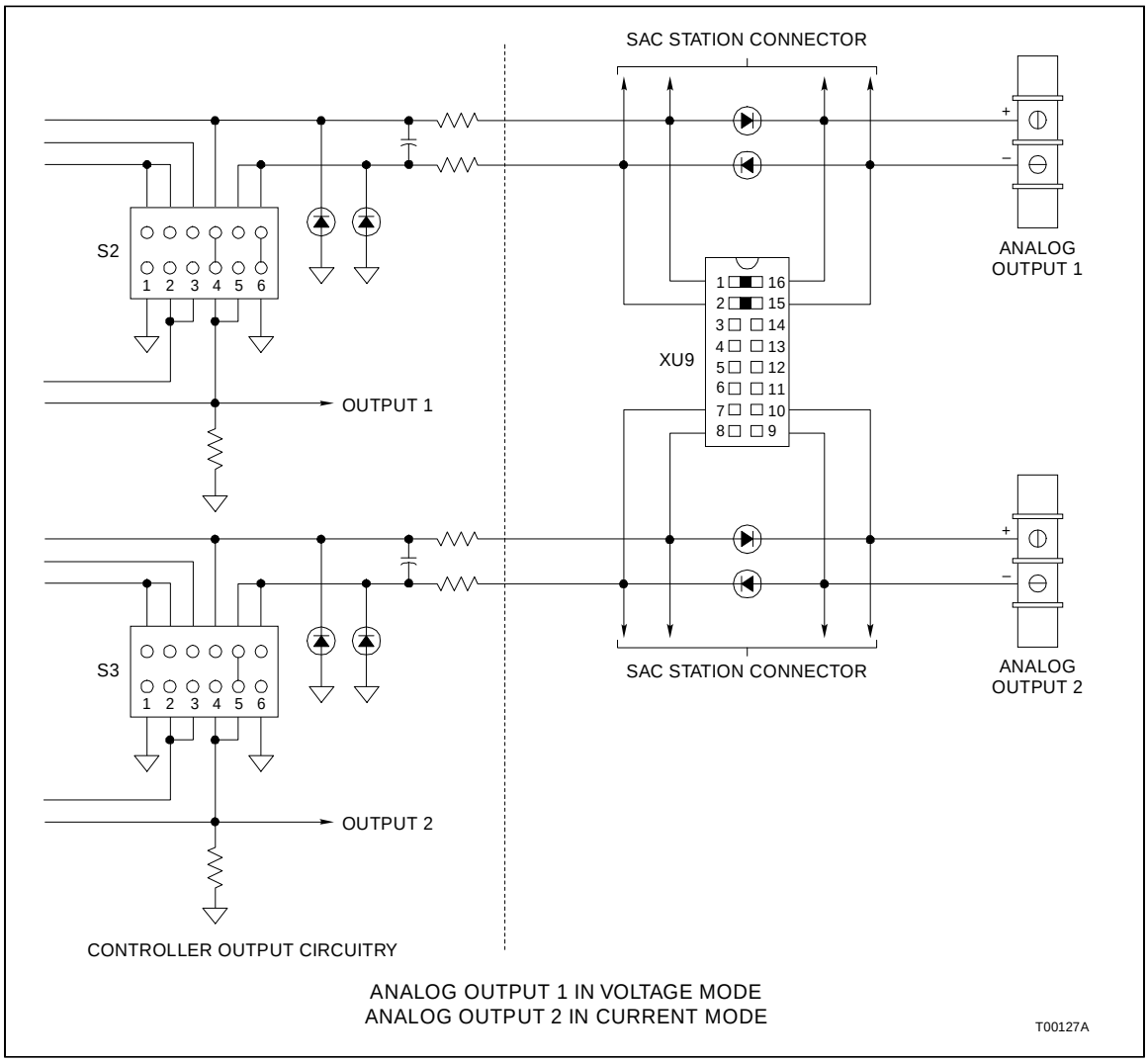


Figure A-4. Analog Output Dipshunt Configurations (continued)

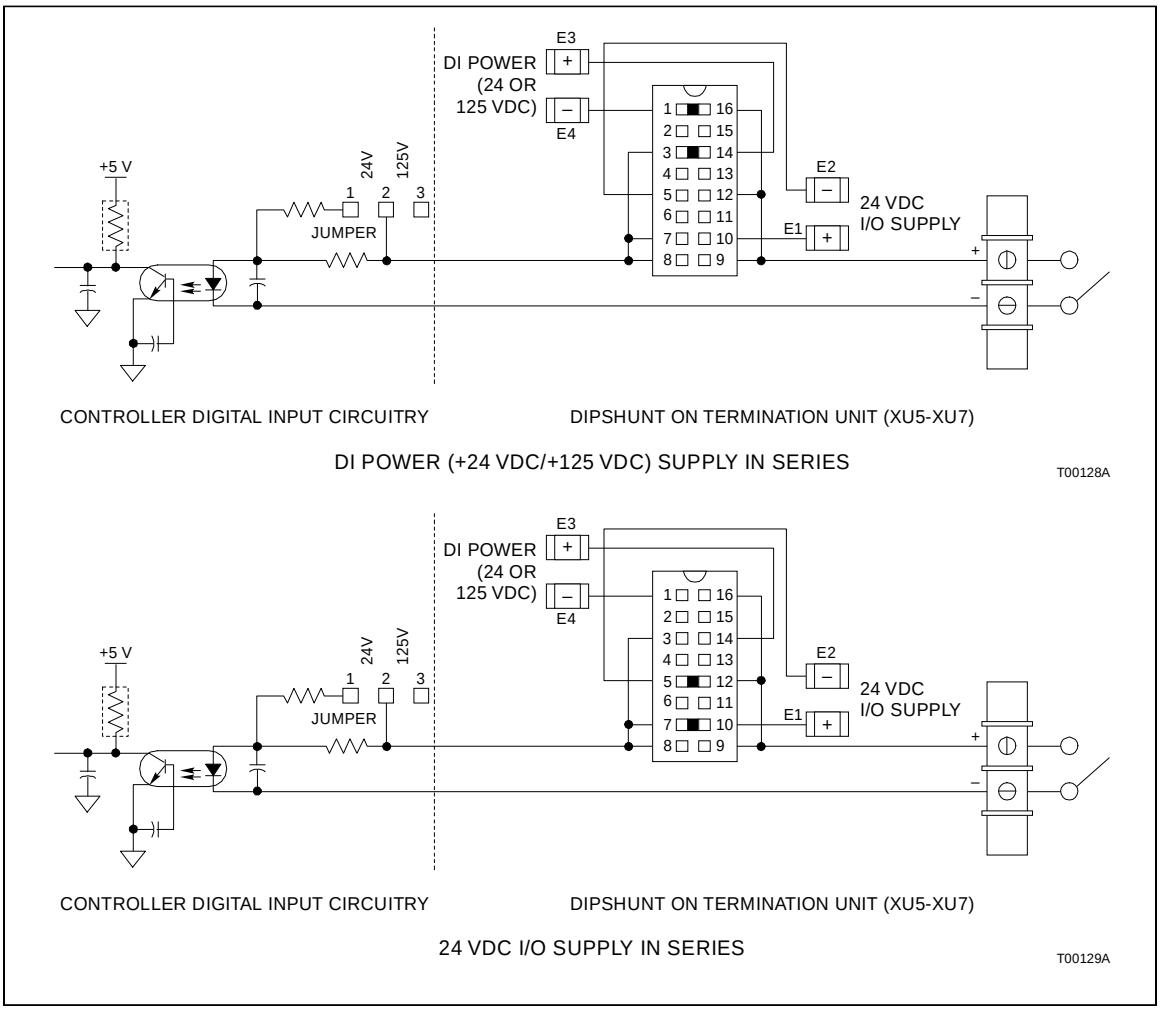


Figure A-5. Digital Input Dipshunt Configurations

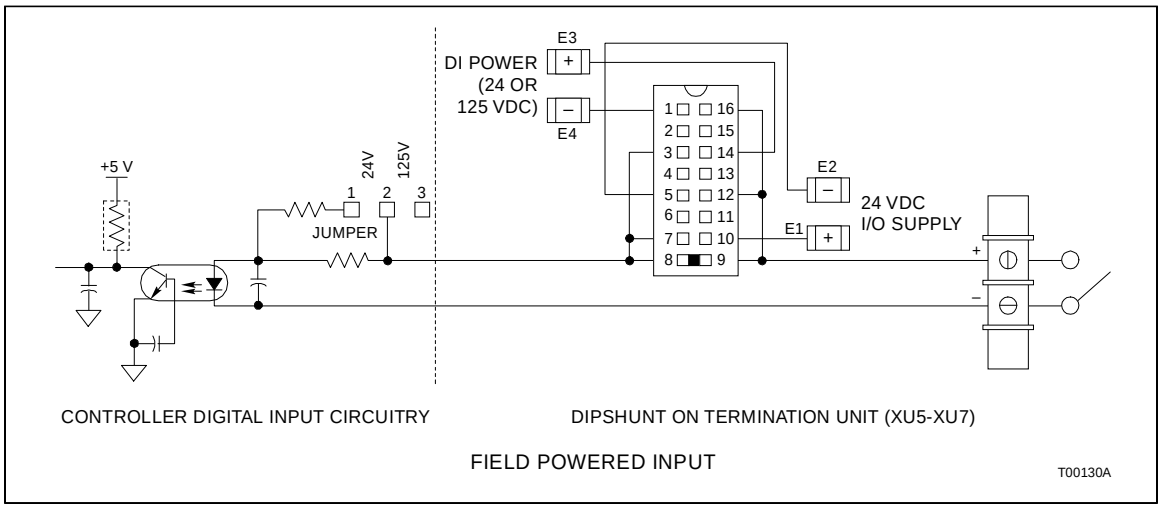


Figure A-5. Digital Input Dipshunt Configurations (continued)

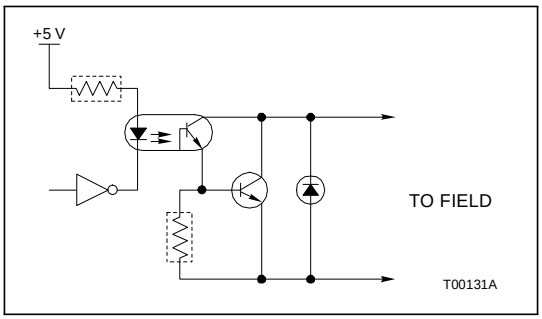


Figure A-6. Digital Output Circuitry

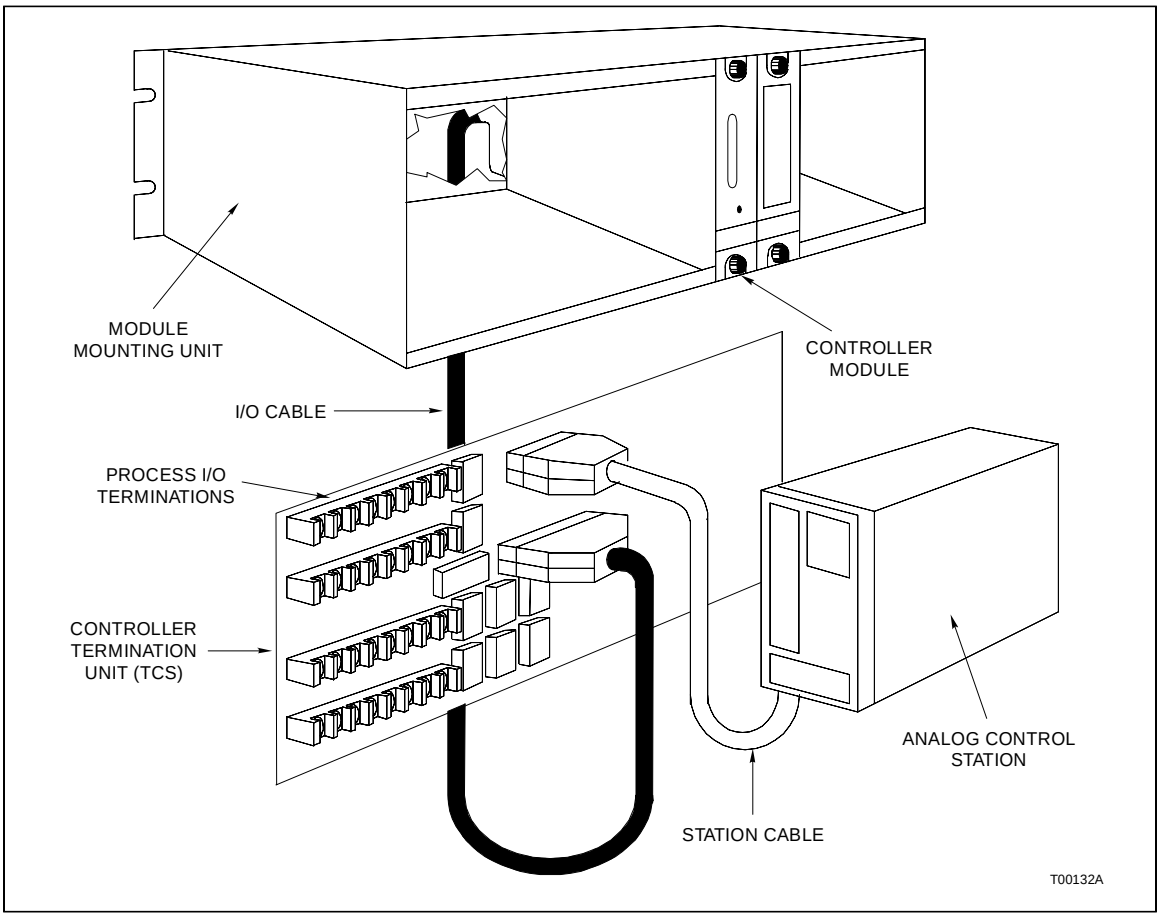


Figure A-7. COM/TCS Cable Connections

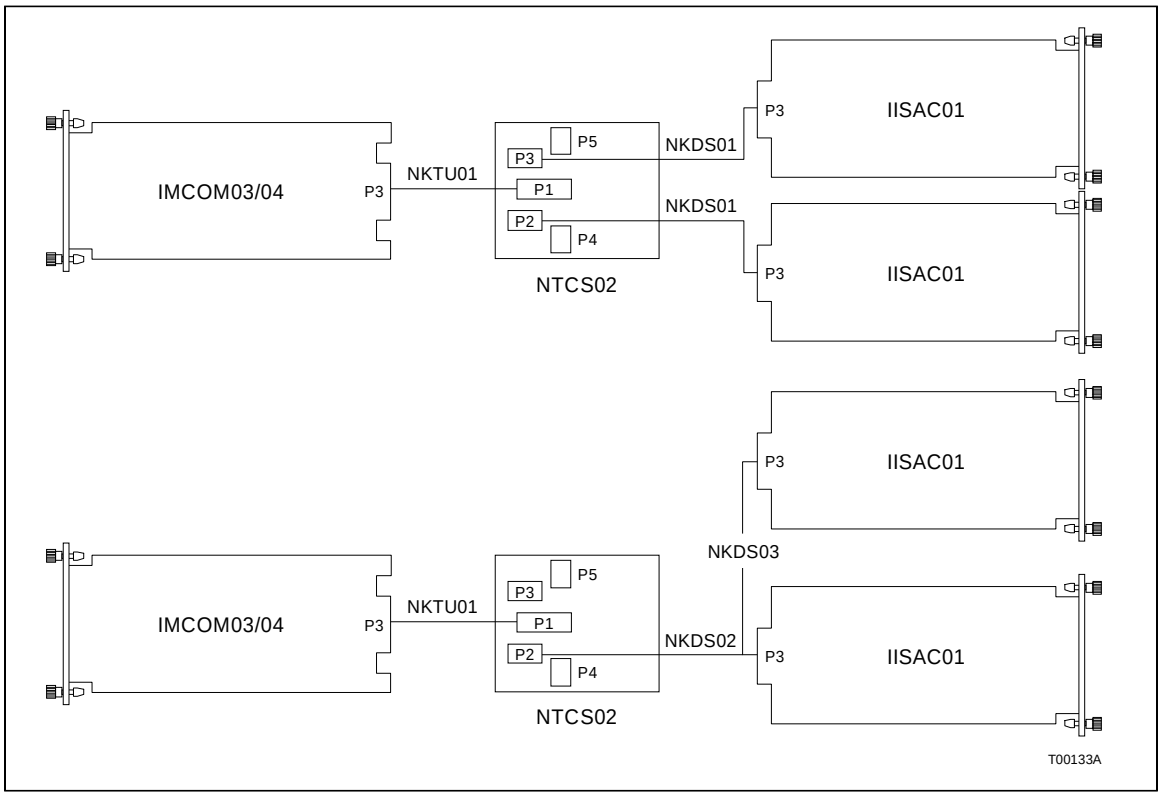


Figure A-8. COM/TCS Cabling Diagram

APPENDIX B - TERMINATION MODULE CONFIGURATION (NICS01)

INTRODUCTION

The IMCOM03/04 uses a Termination Module (NICS01) for termination. The termination module handles 4 analog inputs, 2 analog outputs, 3 digital inputs and 4 digital outputs. Dipswitches on the termination module configure the I/O. Figure B-1 shows the termination module.

Refer to Table B-1 to determine the dipswitch settings to configure your application. Figure B-2 shows the terminal assignments for the digital and analog I/O signals. See Figure B-2 when connecting field wiring to the termination module. Figure B-3 shows the cabling from the termination module to the controller module.

Refer to Appendix A for examples of input/output circuits for digital and analog signals.

NOTE: There are no dipswitches to configure for the digital I/O on the termination module.

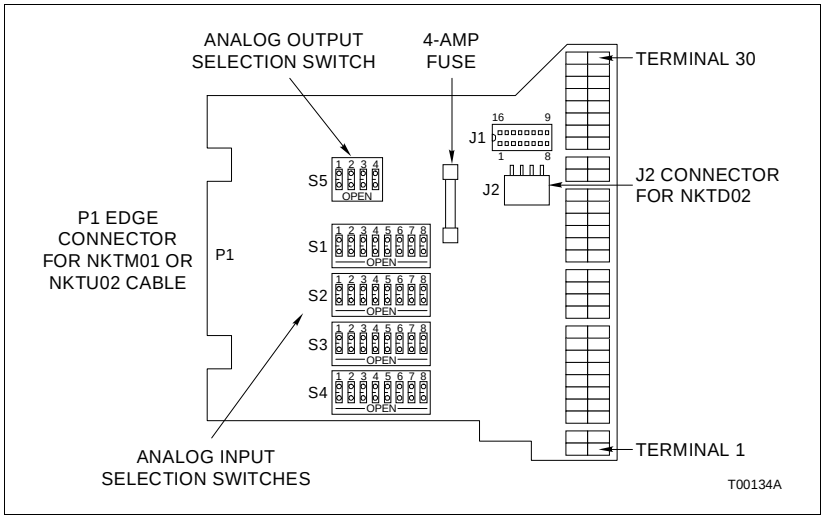
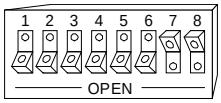
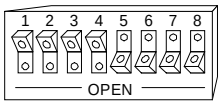
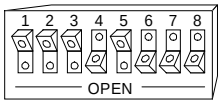
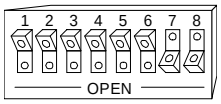
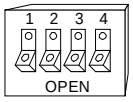
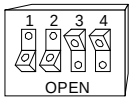
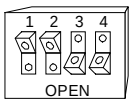
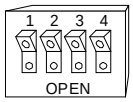


Figure B-1. NICS01 Termination Module

Table B-1. NICS01 Dipswitch Configuration

Analog Input	
Application/Signal Type	**Dipswitch Configuration S1-S4**
System powered 4-20 mA	
Externally powered 4-20 mA	
Single ended voltage	
Differential voltage	
Analog Output	
Application/Signal Type	**Dipswitch Configuration S5**
Both outputs in voltage mode	
Output 1 in voltage mode, output 2 in current mode	
Output 1 in current mode, output 2 in voltage mode	
Both outputs in current mode	 T00192A

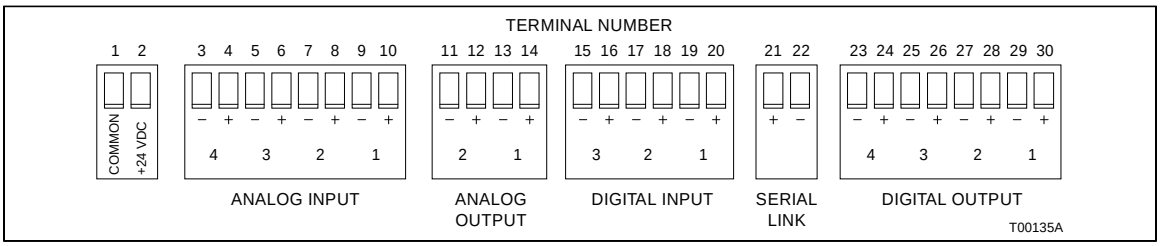


Figure B-2. NICS01 Terminal Assignments

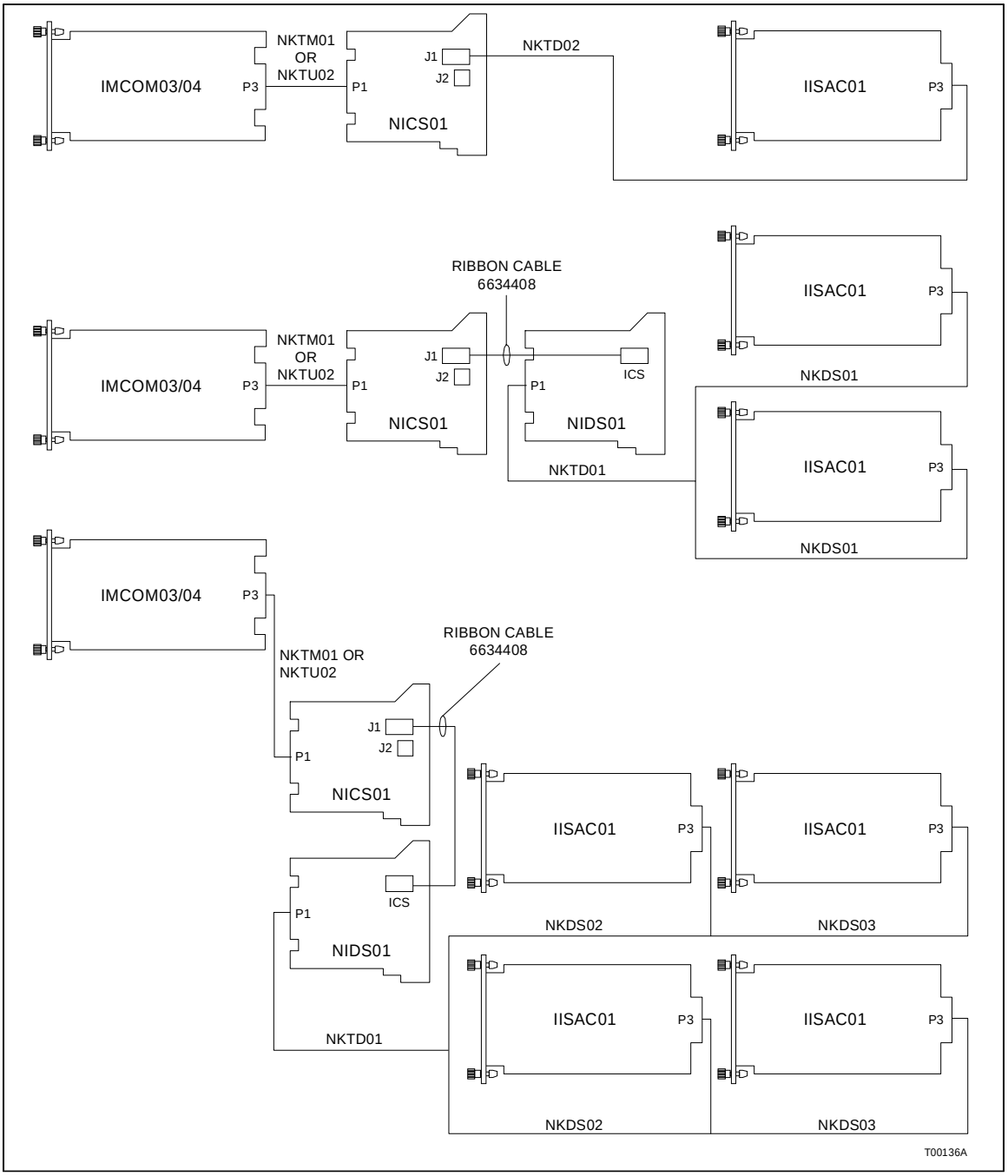


Figure B-3. NICS01 Cabling Diagrams

APPENDIX C - TERMINATION MODULE CONFIGURATION (NIDS01)

INTRODUCTION

The IMCOM03/04 uses a Termination Module (NIDS01) for termination. The termination module connects the NICS01 termination module to a Digital Control Station (NDCS03), Digital Indicator Station (NDIS01), or Analog Control Station (IISAC01). Figure C-1 shows the termination module.

Refer to Table C-1 to determine the applications for the IDS. Table C-2 shows the terminal assignments for the termination module. Refer to Table C-2 when connecting field wiring to the termination module. Figure C-2 shows the cabling from the termination module to the control station or indicator station.

NOTE: There are no dipswitches to configure on the termination module.

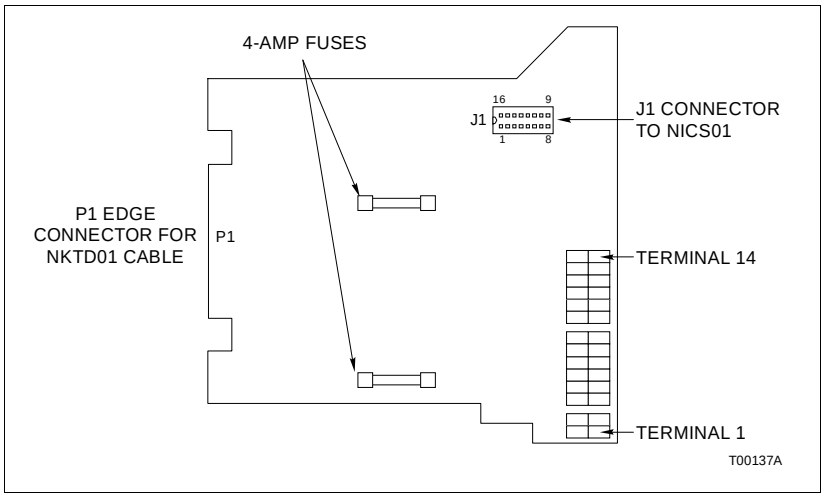


Figure C-1. NIDS01 Termination Module

Table C-1. NIDS01 Application Summary

Interfaces To	Connecting Cable	Application Signal Type
Control Station NDCS03 or IISAC01	NKTD01	24 VDC provides communication between a control module and a control station.
Digital Indicator Station NDIS01	NKTD01	
Termination Module NICS01	6634408 ribbon cable	

Table C-2. NIDS01 Terminal Assignments

Terminal Number	Assignment
1	Common
2	+24 VDC
3	Manual/Auto 2 Select
4	Lower 2
5	Raise/Lower 2 Common
6	Raise 2
7	Manual/Auto 2 Power
8	Manual/Auto 2 Common
9	Manual/Auto 1 Select
10	Lower 1
11	Raise/Lower 1 Common
12	Raise 1
13	Manual/Auto 1 Power
14	Manual/Auto 1 Common

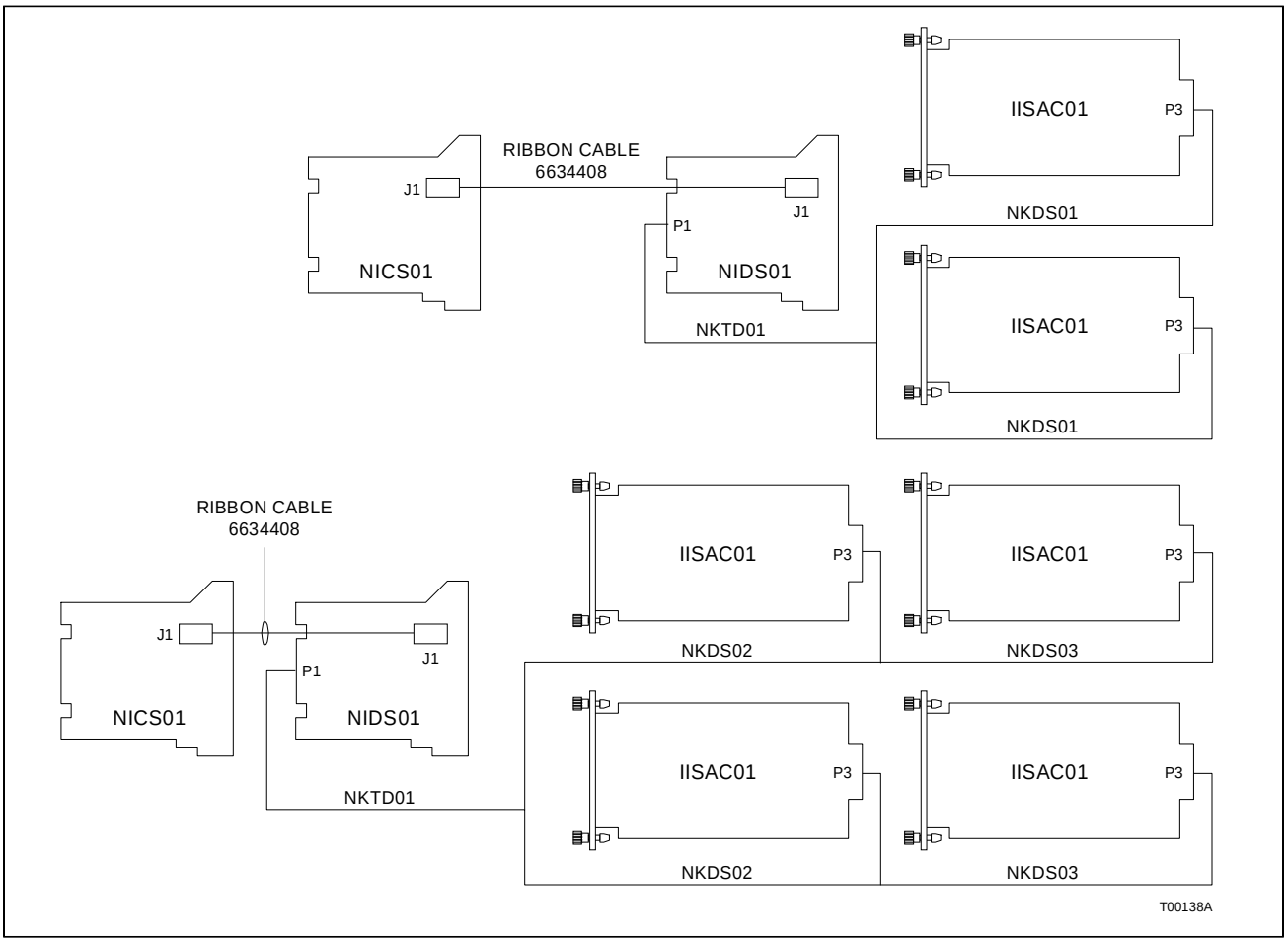


Figure C-2. NIDS01 Cabling Diagram

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