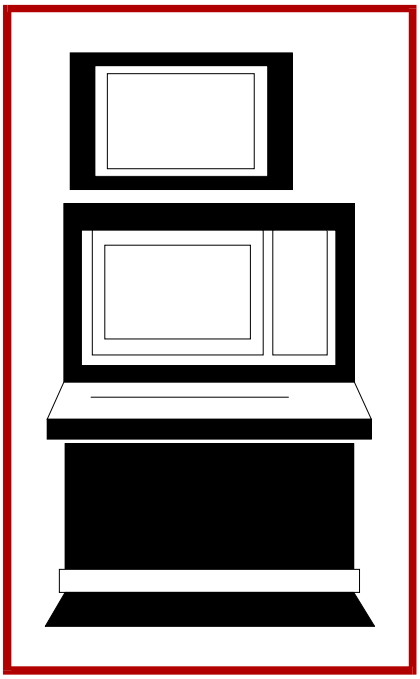
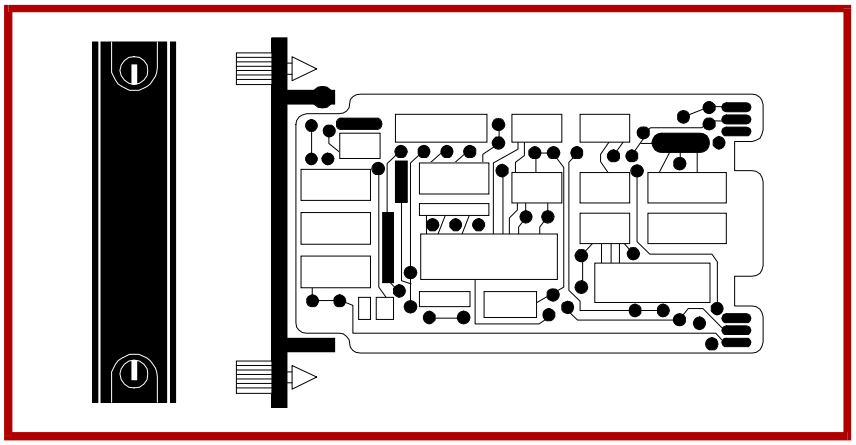
Bailey® infi 90®

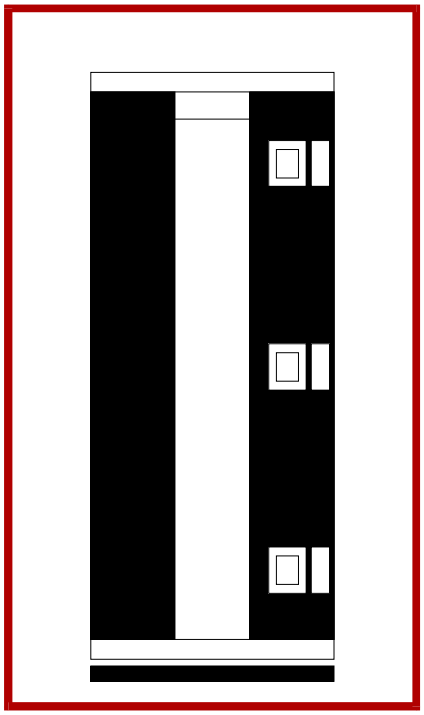
E96-206

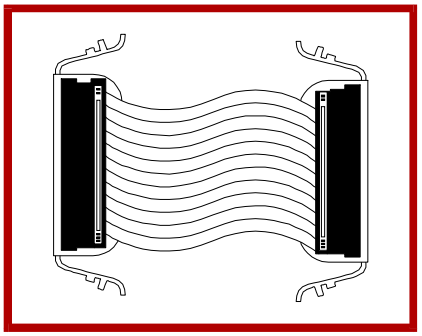
Instruction

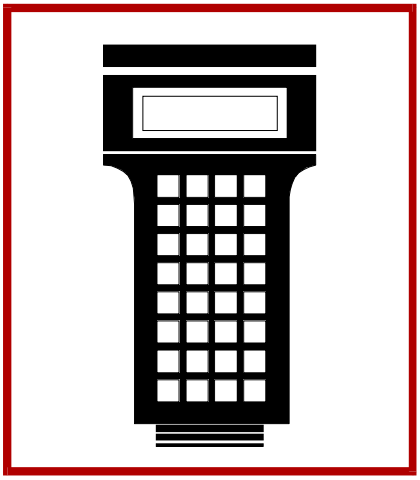
Analog Output Module
(IMAOM01)

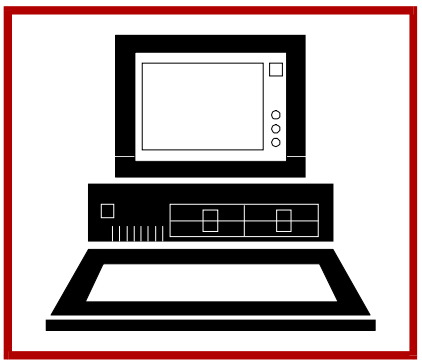












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WARNING notices as used in this instruction apply to hazards or unsafe practices that could result in personal injury or death.

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

The Analog Output Module (IMAOM01) generates eight analog signals, and outputs these signals from the INFI 90 Process Management System to a process. A master module configuration determines the output values. These outputs control process field devices.

This instruction explains the module features, specifications and operation. It details the procedures to follow to set up and install an Analog Output Module (AOM). It explains troubleshooting, maintenance and module replacement procedures.

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

List of Effective Pages

Total number of pages in this instruction is 41, consisting of the following:

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

Sommaire de Securite

AVERTISSEMENT D'ORDRE GENERAL	**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.

Table of Contents

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SECTION 1 - INTRODUCTION

OVERVIEW

The Analog Output Module (IMAOM01) is a microprocessor based INFI 90 module that generates eight individual analog output signals used to control a process. It develops these signals using data received from other INFI 90 devices. Algorithms performed in a master module determine the Analog Output Module (AOM) output signals. The IMAOM01 is a direct functional replacement for the Network 90 NAOM01.

This manual explains the purpose, operation and maintenance of the AOM. It addresses handling precautions and installation procedures. Figure 1-1 illustrates the INFI 90 communication levels and the position of the AOM within these levels.

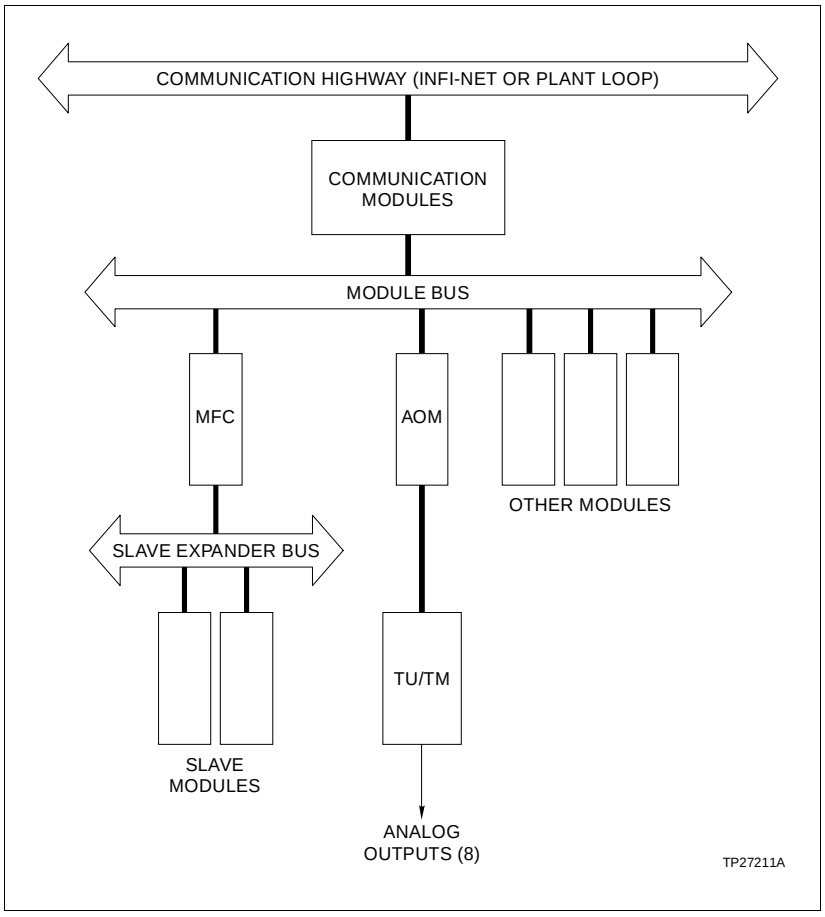


Figure 1-1. INFI 90 Communication Levels

INTENDED USER

System engineers and technicians should read this manual before installing and operating the AOM. 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 AOM is a single printed circuit board (PCB) that occupies one slot in a standard INFI 90 Module Mounting Unit (MMU). Two captive screws on the faceplate secure the module to the MMU. A front panel LED indicates the module status. A module reset switch, accessed through the faceplate, can be used to reset the module circuitry.

Jumpers on the PCB configure the analog outputs: 4 to 20 mA, 1 to 5 VDC or 0 to 10 VDC. Each output can be either a current or voltage signal depending on the configuration of its respective mode jumper (E6 thru E13). Jumper E3 selects the voltage range for all outputs.

The AOM has two card edge connectors that provide connection points for external signals and power (P1 and P3). P1 connection provides logic power to operate the module logic circuits, and connects the module bus to establish communication between it and other modules (refer to Table 5-3). The analog signals are output through connector P3 using a cable connected to a Termination Unit (TU) or Termination Module (TM) (refer to Table 5-4). P3 also connects +24 VDC required to operate the analog output circuits from a TU/TM to the module. The terminal blocks (physical connection points) for field wiring are on the TU/TM.

FEATURES

Modular Design

The modular design of the AOM, as with all INFI 90 modules, allows for flexibility when creating a process management strategy. It outputs eight separate analog signals used to control a process. The AOM receives its output values from INFI 90 master modules.

Adaptable

The AOM analog outputs can be 1 to 5 VDC, 0 to 10 VDC or 4 to 20 mA. Individual jumpers configure the mode (current or voltage) for each output, and a single jumper selects the voltage range. This capability allows the INFI 90 system to match the process requirements.

Status Indication

The front panel LED provides a visual indication of the module status to aid in system test and diagnosis. The AOM performs self tests during initialization or reset and lights the status LED accordingly. An on board machine fault timer provides module security.

Minor Maintenance

Other than routine maintenance as defined in Section 6, the AOM does not have any special maintenance requirements. An AOM module can be removed or installed without powering the system down.

INSTRUCTION CONTENT

This manual consists of eight sections:

Introduction

Is an overview of the AOM: Features, description and specifications.

Description and Operation

Explains the module operation and output circuitry.

Installation

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

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 module and other INFI 90 assemblies.

Repair/Replacement Procedures

Details the procedures to replace an AOM.

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 through in sequence. It is important to become familiar with the entire contents of this manual before using the AOM. The manual is organized in sections to enable you to find specific information quickly.

1. Read and do the steps in Section 1.
2. Read Section 4 before putting the module into operation.
3. Refer to Section 5 if a problem occurs.
4. Refer to Section 6 for scheduled maintenance requirements.
5. Use Section 8 when ordering replacement parts.

GLOSSARY OF TERMS AND ABBREVIATIONS

Term	Definition
Analog	A continuous time signal with an infinite number of values.
CTT	Configuration and Tuning Terminal; hand held module that provides a local means for system configuration, tuning and diagnostics.
Checksum	The sum of all bytes in memory. Software security checks use this to verify software and hardware integrity.
Configuration	A control strategy with function blocks.
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 Block	A function code located in the user defined memory of a multi-function processor.
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 controller modules designed to direct field processes through a slave module. The multi-function processor is an example.
MFP	Multi-Function Processor Module; a multiple loop controller with data acquisition and information processing capabilities.
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 status and 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
PROM	Programmable Read Only Memory; a memory that can be programmed by electrical pulses. Once programmed, it is read-only.
RAM	Random Access Memory; processor memory that has both read and write capability. This memory is volatile; its contents are lost when power is removed.
Slave Expander Bus	Parallel address/data bus between the master module and the slave that point data and slave status data are exchanged over.
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-E96-201	Multi-Function Processor (IMMFP01)
I-E96-202	Multi-Function Processor (IMMFP02)
I-E96-211	Multi Function Controller (IMMFC03)
I-E96-212	Multi Function Controller (IMMFC04)
I-E96-213	Multi Function Controller (IMMFC05)
I-E96-207	Controller Module (IMCOM03/04)
I-E93-911	Termination Unit Manual
I-E96-100	Operator Interface Station
I-E93-916	Engineering Work Station
I-E92-501-2	Configuration and Tuning Terminal
I-E93-900-20	Function Code Application Manual

SPECIFICATIONS

MICROPROCESSOR	
Processor	8 bit processor running at 1 MHZ (16 bit external address line)
MEMORY	
PROM	4 Kbyte
RAM	1 Kbyte
POWER REQUIREMENTS	
Voltage	
Logic Circuits	+5 VDC
Output Circuits	+24 VDC (from termination unit/termination module)
Current Consumption (maximum)	
Logic Circuits	1.4 A (+5 VDC)
Output Circuits	290 mA (+24 VDC)
Dissipation (maximum)	7.35 watts @ +5 VDC 7.00 watts @ +24 VDC
ANALOG OUTPUTS	
Output	8 independent channels
Options	4-20 mA, 1-5 VDC or 0-10 VDC
4-20 mA	Individually jumper selected for each output
1-5 VDC	Individually jumper selected for each output
0-10 VDC	Jumper selected for ALL outputs
Output Impedance	
Current (minimum)	200 Kohm
Voltage (maximum)	0.7 ohm
Output Load	
Current (maximum)	600 ohm
Voltage (minimum)	> 1 Kohm
Short Circuit Protection	75 mA (maximum)
D/A Resolution	10 bits
MOUNTING	
Occupies one slot in standard INFI 90 Module Mounting Unit.	
ENVIRONMENTAL	
Ambient Temperature	0^{o} to 70^{o} C (32^{o} to 158^{o} F)
Relative Humidity	0% to 95% up to 55^{o} C (131^{o} F)(non-condensing) 0% to 45% at 70^{o} C (158^{o} F)(non-condensing)
Altitude	Sea Level to 3 Km (1.86 miles)
Air Quality	Non-corrosive
CERTIFICATION	
CSA certified for use as process control equipment in an ordinary (non-hazardous) location.	

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

NOMENCLATURE

The following modules and equipment can be used with a AOM:

Nomenclature	Hardware
IMMFP01/02	Multi-Function Processor Module
IMMFP03/04/05	Multi-Function Processor Module
IMCOM03/04	Controller Module
NTAO01	Termination Unit
NIAO01	Termination Module
NKTU01	Cable, Termination Unit
NKTU02	Cable, Termination Module
NKTM01	Cable, Termination Module

SECTION 2 - DESCRIPTION AND OPERATION

INTRODUCTION

This section explains the output circuitry, logic, data, logic power and connections for the Analog Output Module (AOM). The AOM generates analog output signals from values determined by a Multi-Function Processor, Multi-Function Controller or Controller Module. These INFI 90 devices communicate with the AOM over a two-line serial module bus as shown in Figure 1-1. Each module on the module bus has a unique address set by its address dipswitch.

Analog outputs from the AOM can be 1 to 5 VDC, 0 to 10 VDC or 4 to 20 mA. Jumpers select the type of output. The process requirements determine the output mode (current or voltage) and voltage range to use. These signals, steered by a master module configuration, are sent to the process to control field devices.

MODULE BLOCK DIAGRAM

An AOM operates in conjunction with master modules. It contains all control circuitry required to receive and interpret data from other INFI 90 devices, generate eight separate analog outputs and relay operating status when requested. All AOM functions are controlled by an on-board microprocessor. Figure 2-1 is a block diagram of the AOM that illustrates signal flow through the module. An explanation of the functions performed by each block follows.

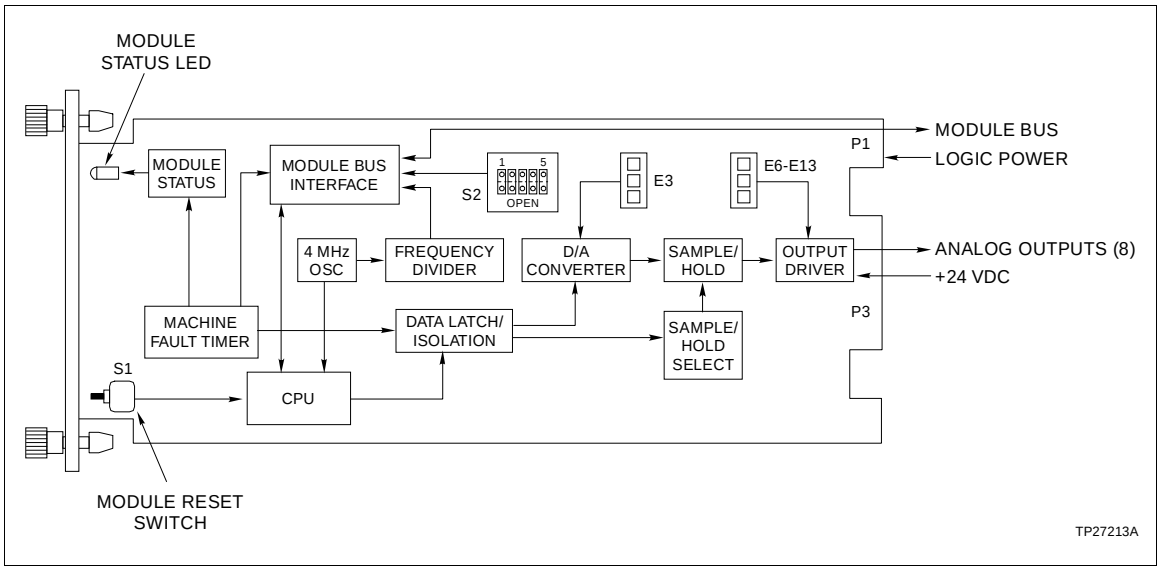


Figure 2-1. Analog Output Module Block Diagram

Control Logic

CPU Block

The Central Processing Unit (CPU) consists of an eight bit microprocessor, 4K PROM, 1K RAM, data buffer, address decoders, programmable timer and digital clock. An eight bit bidirectional data bus and 16 bit address bus connect the different components. A variety of control signals direct the operation of these circuits. This is the heart of the module. It directs all functions performed by the AOM.

During initialization or reset, the CPU conducts self tests to determine AOM operating status.

Output Logic

The AOM receives its output values in an analog output message received on the module bus. It interprets this message and drives the output channel defined in the message with the output data.

Function Code (FC) 28 in a master module configuration defines the data values. It defines only one output channel. Eight separate function blocks must be created to define all eight outputs.

> **NOTE:** To obtain the 0 VDC output, a -25 percent value must be sent to the AOM using FC 28. The input to FC 28 is converted to a percentage using the equation:
>
> $$OUTPUT = 100 \times \frac{\langle S3 \rangle - (S4)}{(S5)}$$
>
> Refer to the Function Code Application Manual I-E93-900-20 for further explanation.

Module Bus Interface Block

The module bus interface used by the AOM consists of a bus driver, status and control registers and Universal Asynchronous Receiver/Transmitter (UART).

The bus driver is the receive and transmit point for serial module bus data messages. Any data entering or leaving the AOM is driven by the bus driver circuit. The AOM receives process data and responds to messages but does not initiate messages.

A UART performs serial to parallel data conversion for data received serially on the module bus. And conversely parallel to serial data conversion for AOM data sent on the module bus.

The status register holds the module address set on switch S2 and module operating status information. After receiving a status request, the CPU reads the values from the register and sends a status message on the module bus to the requesting INFI 90 device.

Frequency Divider Block

A frequency divider network uses the 4 MHZ crystal oscillator on board the AOM to develop the various clock signals for module bus interface functions, and microprocessor and timer circuit requirements.

D/A Block

The Digital to Analog (D/A) converter block consists of a voltage reference circuit, 10 bit D/A converter and buffer amplifiers. The CPU converts received REAL-2/3 values to 10 bit digital data integer values and sends this data serially to the D/A converter block.

> **NOTE:** REAL values are floating decimal point numbers that can be whole numbers or decimal fractions. A REAL-2 value type is a positive or negative number within a range of 1.0 E-3 to 4.0 E 6 and can be processed with a resolution of 0.1 percent. A REAL-3 value type is a positive or negative number within a range of 2.7 E-20 to 9.2 E 18 and can be processed with a resolution of 0.0015 percent.

The D/A converter is a serial data input, constant current output device. It changes a digital value to an analog signal that it sends to one of eight S/H blocks.

A buffer amplifier changes the current output from the D/A to a voltage. A second buffer amplifier provides high and low gain selection. A jumper selects either the high gain position (0 to 10 VDC) or the low gain position (1 to 5 VDC). Refer to ***Output Voltage Option*** in Section 3 for jumper settings.

Isolation Circuit

Data Latch/Isolation Block

The data latch/isolation consists of a data latch and six opto-isolators. These circuits effectively isolate the module logic circuits from the output circuits. The data latch passes information from the CPU block through the opto-isolators to the output section.

Output Circuits

Each analog output channel has an associated Sample/Hold (S/H) and output driver circuit. This circuitry develops and outputs the signals required to control process field devices.

S/H Select Block

A decoder in the S/H select block selects one of the eight S/H circuits. This S/H receives an analog output voltage from the D/A block. Using data from the CPU, it selects the circuit that corresponds to the current output channel. Output point data received in an analog output message determines the output channel and S/H circuit selection.

S/H Block

S/H circuits are analog voltage storage circuits. Each circuit, when selected, samples a voltage from the D/A block to set its output level. A capacitor holds this voltage level while the CPU

sequences through the rest of the channels. Voltages from the S/H circuits drive the output circuits.

The CPU cycles through each S/H circuit in sequence to refresh each corresponding output channel. It uses stored data to maintain the output levels or new data to change the outputs. Only one output channel and its corresponding S/H circuit are selected at a time. During normal operation, this sequence repeats continuously for each of the output channels.

Output Driver Block

The output driver block is eight separate analog output circuits. Each of these output circuits has a voltage buffer/current converter to produce the final analog output signal. Figure 2-2 shows the analog output circuit. These circuits adjust the outputs as compared to the S/H output demand. Jumpers determine whether the operational amplifier will act as a voltage buffer or a current converter. All outputs automatically go to zero (0 VDC or 0 mA) at start-up or reset.

The AOM has three output signal configurations. Output mode (current or voltage) is selectable for each output channel. Jumpers E6 through E13 select the mode for channels 1 through 8 respectively. Jumper E3 selects the output voltage range, 1 to 5 VDC or 0 to 10 VDC, for ALL output channels. Refer to Section 3 for jumper settings.

> **NOTE:** E3 selects the voltage range for ALL output channels. If the 0 to 10 VDC option is selected, ALL outputs must be configured in voltage mode.

A current limiter in each output circuit provides short circuit protection. For a short condition, it limits the output current to 75 mA.

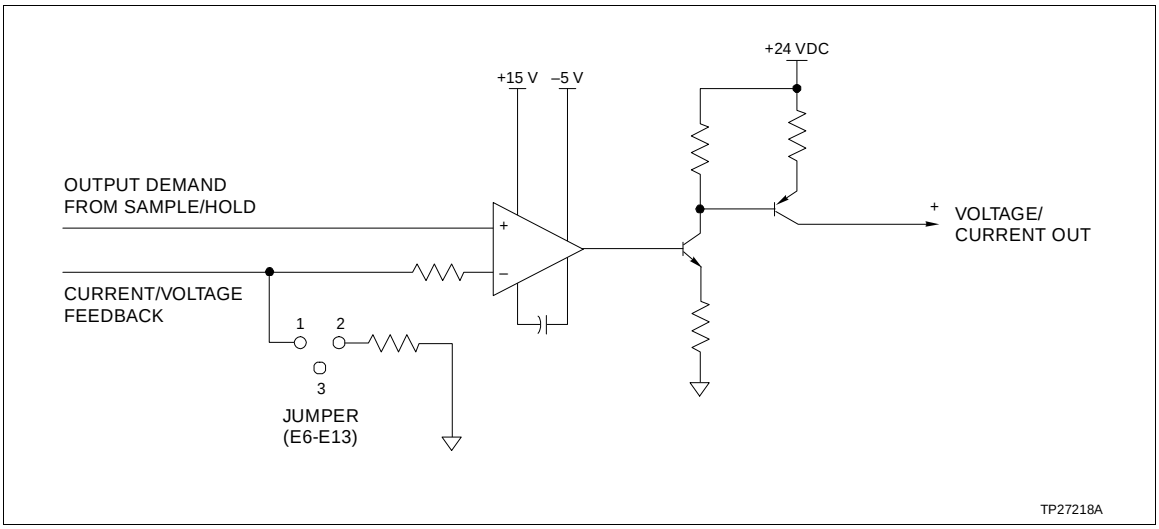


Figure 2-2. Analog Output Circuit

OUTPUT CIRCUIT CONNECTIONS

The output circuits connect to the 30-pin card edge connector P3. The outputs are routed to a TU/TM using a termination cable. P3 also supplies +24 VDC power from the TU/TM to the AOM. This voltage drives the analog output circuits.

MODULE BUS

The INFI 90 module bus is a peer-to-peer serial communication bus. It provides a communication path between modules connected to it. An AOM performs the output functions for a master module. The P1 card edge connector of the AOM connects to the module bus.

The module bus is a serial signal line located on the Module Mounting Unit (MMU) backplane. It provides a communication connection point for up to 32 separate modules, each with a unique address (0 to 31).

MODULE DATA MESSAGES

An AOM receives messages from several INFI 90 devices: master modules, operator interfaces or communication modules. These messages, sent to an AOM, contain output values and data requests. The AOM receives process data and responds to messages but does not initiate messages.

Before performing an operation, the AOM performs consistency checks to determine if a message is valid. The type of message and number of bytes must conform to standard transaction formats.

Point (output) data can be sent to an AOM by using a write analog output command message. Module status and point values can be read from an AOM with read status and read point command messages. The AOM responds to several other messages including:

- Module active poll.
- Module reset command.
- Module problem report.
- Exception report messages.
- System troubleshooting messages.
- DEBUG messages.

Write Analog Output

A master module sends analog output data to an AOM by generating a write analog output message. This message contains the destination module address (AOM address), block number (output channel number) and point data value (in percentage)

for only one output channel. The AOM converts a 24 bit percentage value (REAL-2/3) to generate an analog output.

The value in a write point message from a master module is dependent on FC 28 in the master module configuration. An output point (channel number) must be defined in a FC 28 block to output a control signal for that point.

> **NOTE:** A value received by the AOM must be within its input range. If it is not, the AOM will drive the corresponding output to either a maximum or minimum level. This does not cause an error to occur, but does cause the AOM to output incorrect signals. To avoid this, the values sent to the AOM must be within the 0 to 100 percent range when using the 1 to 5 VDC or 4 to 20 mA range, or -25 to 100 percent when using the 0 to 10 VDC range.

The AOM sends a reply message to acknowledge receipt of a write point message.

Read Point

A master module or operator interface (e.g., Configuration and Tuning Terminal) can read an analog point value from the AOM by generating a read point message (i.e., monitor function). This message contains the destination module address (AOM address) and block number (output channel number) to read. After receiving the message, the AOM responds with a reply message that contains the requested data.

Read Status

A communication module (i.e., Bus Interface Module (BIM) or Network Processing Module (NPM)) or operator interface can acquire the AOM operating status by generating a read status message. After receiving this message, the AOM responds with a reply message containing status information. When status is requested from an AOM, it is mainly to determine if the AOM is on-line.

An AOM also sends a module status message in response to an exception report poll from a BIM/NPM.

LOGIC POWER

Logic power (+5 VDC) drives the AOM logic 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.

MACHINE FAULT TIMER

A Machine Fault Timer (MFT) generated on board the AOM is a security feature common to all microprocessor based INFI 90 modules. The timer is reset periodically by the microprocessor. If it is not reset within a set time, the timer times out causing the module to shut down (*time out*). It is reset on power up or by the manual reset switch accessed through the module faceplate.

If a *time out* occurs, the front panel module status LED lights red and all outputs go to zero (0 mA or 0 VDC).

NOTE: Pressing the reset switch causes the outputs to go to zero.

ON-LINE TESTS

When the AOM is first installed or after a reset, it conducts on-line self tests to verify that its logic circuitry is operating properly.

RAM Test A RAM test consists of writing data to the RAM, and then comparing the data in RAM to the data that was written. If this test fails, the microprocessor stops resetting the MFT causing a *time out* to shut the module down.

PROM Test A PROM test computes a checksum of the PROM memory contents. It then compares this checksum to the known checksum. If they do not match, the microprocessor stops resetting the MFT causing a *time out* to occur.

If all tests pass, the AOM initializes all RAM memory locations and begins to drive the outputs to the demanded position (i.e., sample/hold demand). It also sets the front panel LED to solid green to indicate that the module is on-line and operating correctly.

Other problems within the AOM can cause a *time out* to occur. The microprocessor periodically resets the MFT preventing it from ever timing out. If a condition exists for the AOM that causes the microprocessor to fail or operate incorrectly, the MFT will not be reset resulting in a *time out*.

STATUS LED INDICATOR

A front panel module status LED indicator shows the operating state of the AOM. Circuits on the AOM determine the module status and light the LED accordingly. It lights green to indicate normal operation. Section 4 explains the indications and Section 5 explains corrective actions to take.

SECTION 3 - INSTALLATION

INTRODUCTION

This section explains what you must do before you put the Analog Output Module (AOM) 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

> **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 AOM uses electrostatic sensitive devices. Follow Steps 1 through 4 when handling:

1. Keep the module in its 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.

UNPACKING AND INSPECTION

1. Examine the hardware immediately to verify 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.

SETUP/PHYSICAL INSTALLATION

The address dipswitch (S2) must be set, and the analog output jumpers (E3, E6 thru E13) configured ***BEFORE*** installing or operating the AOM. Its respective Termination Unit (TU) or Termination Module (TM) must be configured to develop the correct analog signals from the AOM.

NOTES:

1. Jumpers E1 and E2 are factory installed and must NOT be changed or removed. The type of PROM used determines the jumper settings. Removing or changing the jumpers will cause the module to operate incorrectly.

2. R25 is set during factory calibration of the module; DO NOT adjust it. Adjusting R25 will cause incorrect voltage or current outputs.

Address Switch (S2) Setting

The AOM can have one of 32 addresses (0 to 31) on the module bus. This address uniquely identifies the AOM to a master module or operator interface. Function Code (FC) 28 specification 1 in a master module configuration must be the same as the address on S2 of an AOM to direct output signal values to that AOM.

NOTE: The address must be a unique address within a PCU. Normally, addresses 0 and 1 are not used for an AOM since these are reserved for communication modules.

The module address is set by positioning the five dipswitches on S2; Figure 3-1 shows the location. Table 3-1 is a binary address conversion table for setting S2.

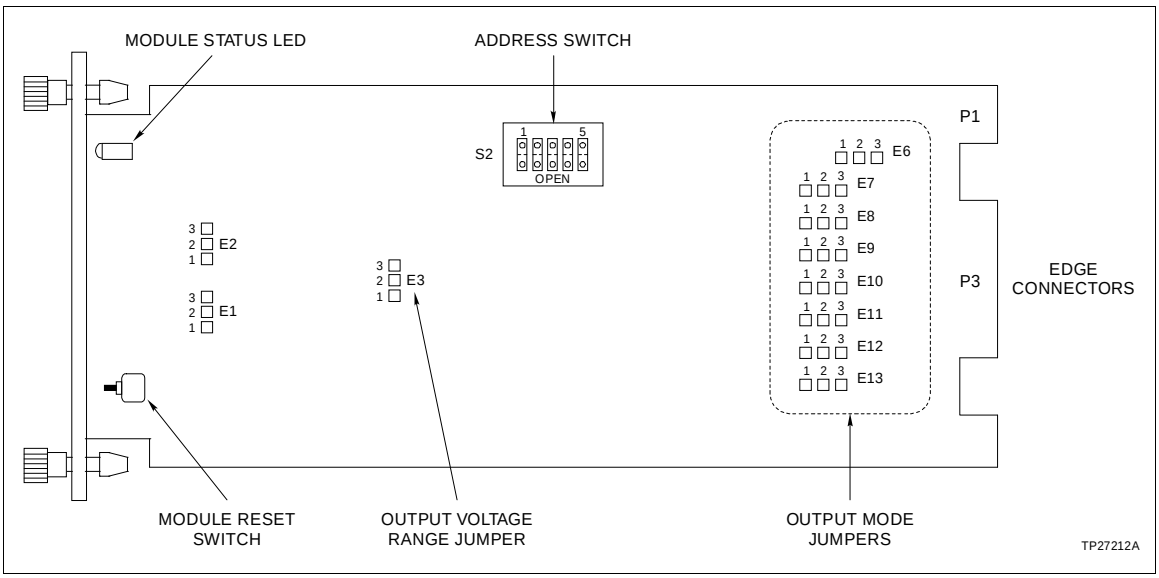


Figure 3-1. Analog Slave Output Module

Determine the address for the AOM, and set S2 dipswitches to the corresponding address positions shown in Table 3-1.

Table 3-1. Address Switch Settings (S2)

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

NOTE: 1=OPEN; 0=CLOSED

Output Voltage Option

Jumper E3 sets the output voltage range for ALL AOM outputs. It can be set to either a 1 to 5 VDC or 0 to 10 VDC range. Figure 3-1 shows the location of this jumper.

Install a jumper across pins 1 and 2 of E3 to select the 1 to 5 VDC range or across pins 2 and 3 to select the 0 to 10 VDC range.

> **NOTE:** E3 must be configured for the 1 to 5 VDC range to use the 4 to 20 mA mode option.

Output Mode Options

Jumpers E6 through E13 configure the analog output mode (current or voltage) for outputs 1 through 8 respectively. Current mode is 4 to 20 mA. Figure 3-1 shows the location of the jumpers on the AOM. To configure the outputs:

> **NOTE:** When E3 is configured for 0 to 10 VDC, ALL outputs must be configured for a voltage output.

1. Determine the output mode requirement of each analog output channel for the AOM's intended application.

2. Refer to Table 3-2 to cross reference jumper to output point.

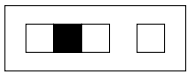
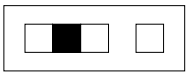
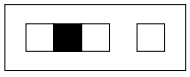
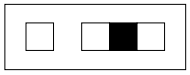
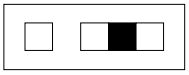
3. Install a jumper across pins 1 and 2 for a current output or pins 2 and 3 for a voltage output at the point currently being configured.

Table 3-2. Analog Output Point to Jumper

Analog Output	Jumper	Analog Output	Jumper
1	E13	5	E9
2	E12	6	E8
3	E11	7	E7
4	E10	8	E6

Table 3-3 shows the jumper settings required to produce each of the three output signal options. Refer to this table when configuring the AOM.

Table 3-3. Output Option Jumper Configuration

Signal	Jumper	Jumpers E6 - E13
4 - 20 mA		
1 - 5 VDC		
0 - 10 VDC		 TP27224A

Termination Unit/Module Configuration

A TU/TM connects the process field device wiring to the INFI 90 system. It also provides +24 VDC to operate the AOM output circuits. The terminal blocks (connection points) are located on the TU/TM. A TU/TM must be configured to output the AOM signals to process field devices. Refer to the appendices to determine the configuration for your application.

Physical Installation

NOTE: Section 3 provides instructions pertaining to the physical installation of the AOM only. For complete cable and TU/TM installation information, refer to Termination Unit Manual I-E93-911.

The AOM inserts into a standard INFI 90 Module Mounting Unit (MMU) and occupies one slot. To install:

NOTE: Configure the AOM ***BEFORE*** installing.

1. Verify the slot assignment of the module.

2. Connect the hooded end of a termination cable to the MMU backplane. To do this, insert the connector into the backplane slot in the same slot as the one assigned to the AOM. 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 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. (To remove the module, turn the module retaining screws to the unlatched position and gently slide it out).

WIRING CONNECTIONS AND CABLING

The AOM has two card edge connectors, P1 and P3, to provide power to the AOM circuitry, establish communication with modules on the module bus and cable connection to a TU/TM for the output signals.

Wiring

Installing the AOM in the MMU connects P1 of the module to logic power (+5 VDC) necessary to operate the logic circuitry. It also connects to the module bus for communication with other modules. P1 connection requires no additional wiring or cabling.

Cable Connections

The IMAOM01 uses either a NTAO01 or NIAO01 for termination. A cable routes the analog outputs from the AOM to the TU/TM. It also routes +24 VDC to the AOM to operate the output circuitry. See Figure 3-2 to determine the cables to use with the TU/TM being used.

FUSING

The AOM does not have any on board fusing requirements.

PRE-OPERATING ADJUSTMENTS

There are no adjustments to be performed prior to operating the AOM.

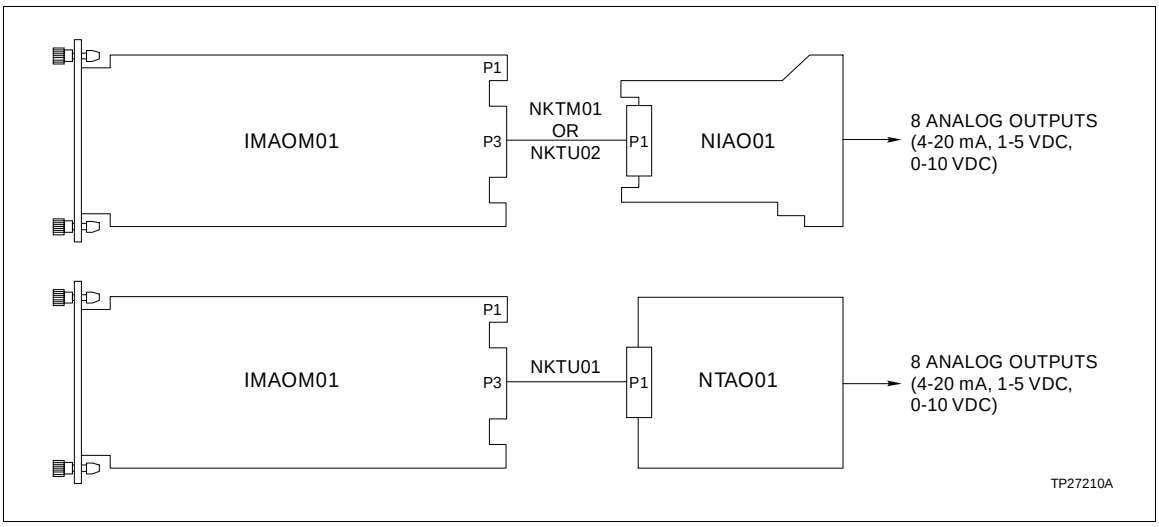


Figure 3-2. IMAOM01 Cable Connections and Termination

SECTION 4 - OPERATING PROCEDURES

INTRODUCTION

This section explains the front panel indicator and start-up procedures for the Analog Output Module (AOM).

MODULE STATUS INDICATOR

The AOM has a front panel module status LED indicator to aid in system test and diagnosis. The location of the indicator is shown in Figure 4-1. Table 4-1 explains the three states of the status LED indicator (refer to Section 5 to determine corrective actions).

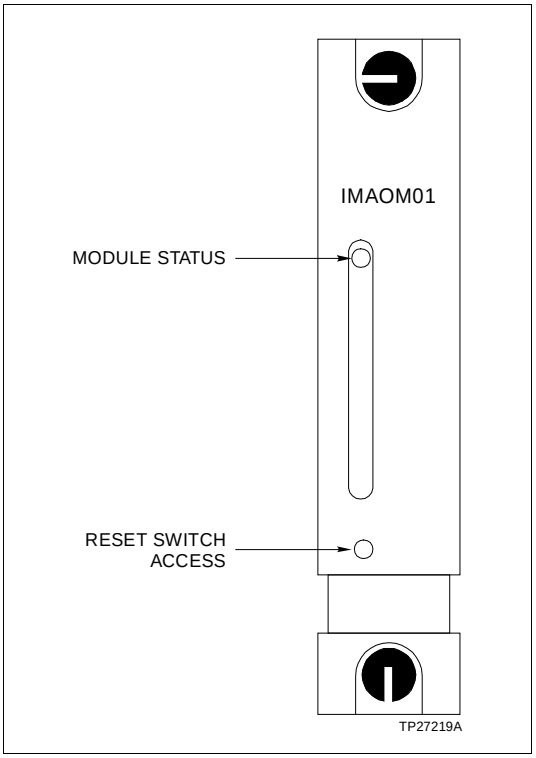


Figure 4-1. IMAOM01 Front Panel

Table 4-1. IMAOM01 Status LED Indicator

LED	Indication
Solid Green	Powered up and operating properly
Off	No power
Solid Red	Machine fault timer error (*time out*)

START-UP PROCEDURES

Start-up of the AOM is fully automatic. Its jumpers and address dipswitch must be configured before installing the module. If the status LED is not solid green after installing the module, refer to Section 5 for corrective actions.

SECTION 5 - TROUBLESHOOTING

INTRODUCTION

This section explains the error indications and corrective actions for the Analog Output Module (AOM).

NOTE: If the corrective actions in this section do not correct a problem with the AOM, replace it or contact your nearest Bailey Controls representative. Refer to Section 7 for procedures to replace an AOM.

ERROR INDICATIONS AND CORRECTIVE ACTION

After power up or reset, the AOM conducts self tests on its logic circuits to determine its operating status. These tests are performed on the logic section (i.e., microprocessor and related circuitry) only. The status can be obtained through an INFI 90 operator interface or the front panel module status LED indicator.

NOTE: If you determine the AOM is faulty, replace it with a new one. DO NOT try to repair the module; replacing components may affect the module performance.

Status LED

The front panel status LED has three states to indicate normal operation and error conditions. Table 5-1 lists AOM status LED states, indications, probable causes and corrective actions.

NOTE: If the status LED is indicating an error condition (time out), press the module reset switch to attempt to reset the error. It can be accessed through the faceplate.

Table 5-1. Status LED Indications and Corrective Actions

LED State	Indication	Probable Cause	Corrective Action
Green	AOM powered up and operating normally, ALL self tests passed	Normal operation	No action required
Off	No power to AOM	Module not completely inserted in MMU	Verify module is completely inserted in MMU: faceplate flush with MMU and captive retaining screws latched
	+5 VDC logic power failure (on board AOM)	AOM circuit failure	Replace module or contact nearest Bailey Controls representative
Red	Machine fault timer error (*time out*)	Microprocessor or related hardware failure	Press reset switch to attempt to clear the error If this does not reset the error, replace module or contact nearest Bailey Controls representative

Refer to Section 2 for an explanation of the Machine Fault Timer.

Operator Interface

A module status report can be obtained through an operator interface (e.g., Operator Interface Station, Engineering Work Station, Configuration and Tuning Terminal). The current output point values can be read from an AOM using an operator interface. Refer to the Product Instruction for the operator interface you are using for an explanation of procedures.

Output Errors

If the status LED is green, but the outputs from the module are not correct or not present, a problem may exist in a master module configuration or in the output circuitry.

MASTER MODULE CONFIGURATION

Function Code (FC) 28 in a master module configuration determines the output values sent to the AOM (refer to Table 5-2). If this FC is not configured properly for an output, the output will not be correct. This FC defines only one output channel.

NOTE: FC 31 can be included in your configuration to test the quality of the outputs. Refer to I-E93-900-20 Function Code Application Manual for further explanation.

Table 5-2. Function Code 28

OUTPUTS		
Block Number	**Data Type**	**Description**
N	REAL	Value to be transmitted over the module bus with quality. Quality: 0=good 1=bad

SPECIFICATIONS						
Spec No.	**Tune**	**Default Value**	**Data Type**	**Range Min.**	**Range Max.**	**Description**
S1	NO	0	INT	0	31	Destination module address (AOM)
S2	NO	0	INT	1	8	Destination block address (output)
S3	NO	5	INT	0	255/2046	Block address of input
S4	NO	0.000	REAL	FULL		Input zero in E.U.
S5	NO	100.000	REAL	FULL		Input span in E.U.

Incorrect Address

Verify that FC 28 in a master module directing an AOM output is correct. Specification 1 (S1) of this FC is the AOM address. Make sure that it is the same as the address set on the AOM address switch. If not:

1. Remove the module and change the setting of the address switch to correspond with the master module configuration (refer to Section 3 for the procedures to set an address and to install the module).

OR

2. Modify the address in the master module configuration (FC 28 S1) to correspond with the address set on the address switch. Use an INFI 90 operator interface to modify the configuration (for procedures on how to modify a function code specification, refer to the Product Instruction for the operator interface you are using).

Incorrect Block Number

Each FC 28 defines only one output. To output a signal from an output channel, specification 2 (S2) must be set to that output channel number (1 to 8). If an output signal is not present at a channel that should have an output, verify that a FC is configured with that output channel specified in S2.

OUTPUT CIRCUIT ERROR

If all inputs to an AOM are correct and the outputs are still not correct, this may indicate a module output circuit failure. Replace the AOM or contact your nearest Bailey Controls representative.

MODULE PIN OUT

The module has two connection points for external signals and power (P1 and P3). Tables 5-3 and 5-4 show the pin connections.

Table 5-3. P1 Pin Connections

Pin	Connection	Pin	Connection
1	+5 VDC	7	NC
2	+5 VDC	8	NC
3	NC	9	PFI
4	NC	10	PFI
5	Common	11	Module bus
6	Common	12	Module bus

PFI=Power Fail Interrupt
NC=Not Connected

Table 5-4. P3 Pin Connections

Pin	Signal	Pin	Signal
A	AO8 I (-)/FB	1	AO8 V/I (+)
B	AO7 V (-)	2	AO8 V (-)
C	AO7 I (-)/FB	3	AO7 V/I (+)
D	AO6 I (-)/FB	4	AO6 V/I (+)
E	AO5 V (-)	5	AO6 V (-)
F	AO5 I (-)/FB	6	AO5 V/I (+)
H	AO4 I (-)/FB	7	AO4 V/I (+)
J	AO3 V (-)	8	AO4 V (-)
K	AO3 I (-)/FB	9	AO3 V/I (+)
L	AO2 I (-)/FB	10	AO2 V/I (+)
M	AO1 V (-)	11	AO2 V (-)
N	AO1 I (-)/FB	12	AO1 V/I (+)
P	+24 VDC COM	13	+24 VDC
S	+24 VDC COM	14	+24 VDC COM
R	+24 VDC COM	15	+24 VDC

AO=Analog Output; I=Current; V=Voltage; COM=Common; FB=Feedback

SECTION 6 - MAINTENANCE

INTRODUCTION

The Analog Output Module (AOM) requires limited maintenance. This section contains a maintenance schedule.

MAINTENANCE SCHEDULE

Perform the tasks in Table 6-1 at the specified intervals.

Table 6-1. 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 Termination Units/Modules	Every 6 months or during plant shutdown, whichever occurs first

SECTION 7 - REPAIR/REPLACEMENT PROCEDURES

INTRODUCTION

This section explains the replacement procedures for an Analog Output Module (AOM). There are no special tools required to replace an AOM.

MODULE REPAIR/REPLACEMENT PROCEDURES

If you determine the AOM is faulty, replace it with a new one. ***DO NOT*** try to repair the module; replacing components may affect the module performance.

The module can be removed 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.

NOTE: The outputs initialize to zero values (0 mA or 0 VDC) at power up.

SECTION 8 - 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, overhaul and maintenance contract services.

REPLACEMENT PARTS AND ORDERING INFORMATION

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

1. Part description, part number and quantity.

2. Model and serial numbers (if applicable).

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

Order parts without commercial descriptions from the nearest Bailey Controls sales office.

Table 8-1. Parts List

Description	Part No.
Jumper	1946984A1

TRAINING

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

TECHNICAL DOCUMENTATION

Additional copies of this manual, or other Bailey Controls manuals, can be obtained from the nearest Bailey sales office at a reasonable charge.

APPENDIX A - TERMINATION UNIT CONFIGURATION (NTAO01)

INTRODUCTION

The IMAOM01 uses an NTAO01 termination unit to terminate its output signals. Dipshunts on the termination unit (TU) configure the analog outputs that are sent to the process. The Analog Output Module (AOM) output signals are 4 to 20 mA, 1 to 5 VDC or 0 to 10 VDC depending on the AOM configuration.

Figures A-1 and A-2 show a configured NTAO01 dipshunt, and the analog signal path from the AOM to a field device for a TU application. Table A-1 also shows the dipshunt strapping for the two options available: current or voltage mode.

NOTE: Make sure that the NTAO01 dipshunt configuration matches the AOM output configuration.

Figure A-3 shows the terminal assignments for the analog output signals and +24 VDC auxiliary power connections. Refer to this figure when connecting field wiring to the NTAO01.

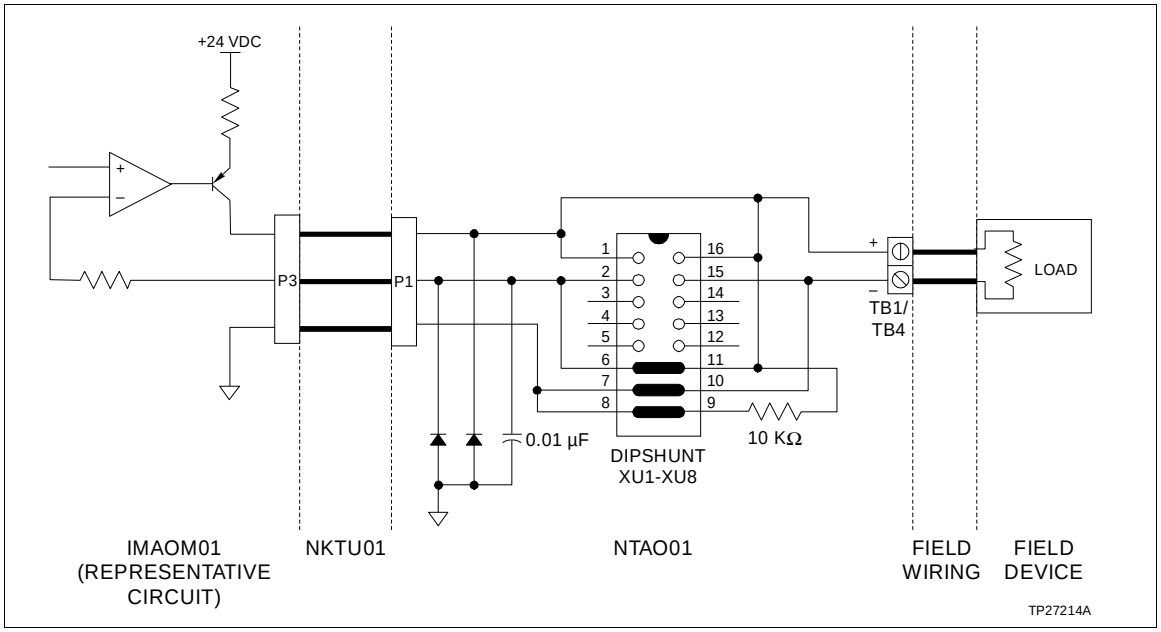


Figure A-1. NTAO01 Circuit Diagram (Voltage Mode)

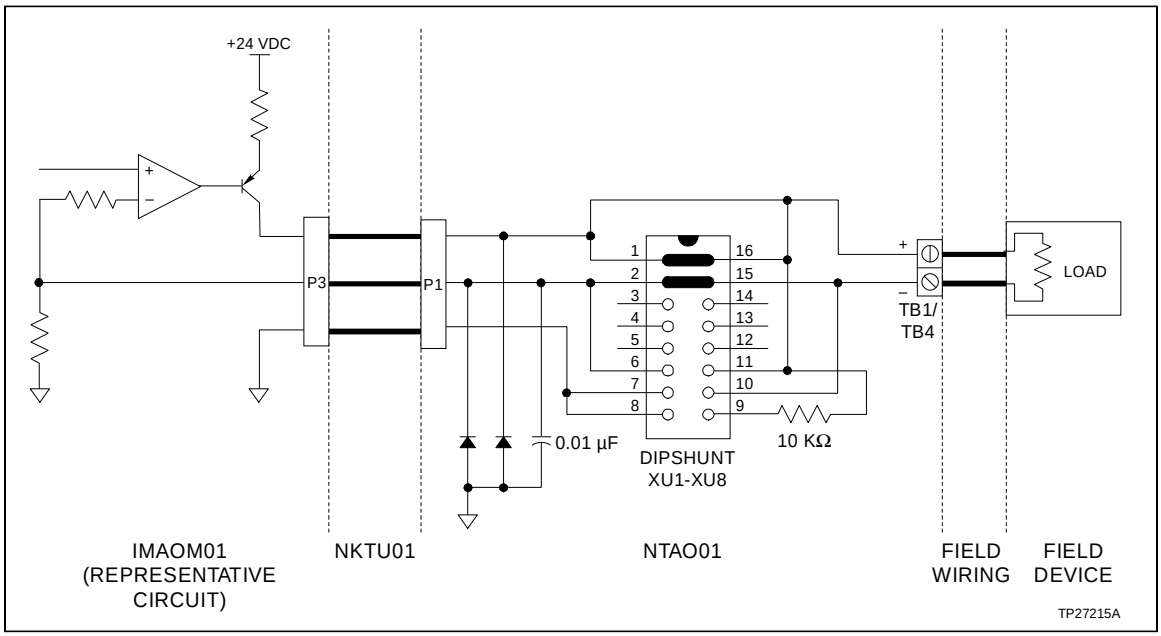
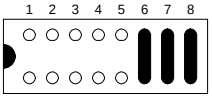
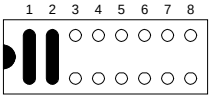


Figure A-2. NTAO01 Circuit Diagram (Current Mode)

Table A-1. NTAO01 Dipshunt Configuration

Application/Signal Type	Dipshunt XU1 - XU8 Configuration
VOLTAGE OUTPUT (1 - 5 VDC, 0 - 10 VDC)	
CURRENT OUTPUT (4 - 20 mA)	 TP27221A

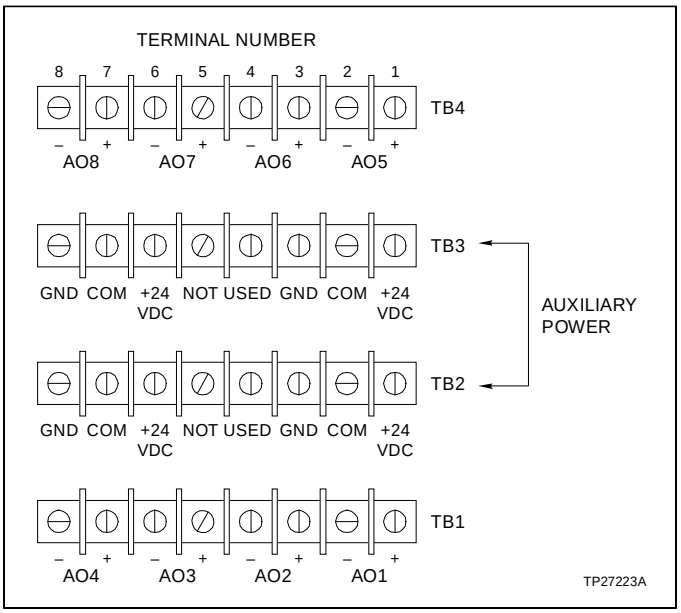


Figure A-3. NTAO01 Terminal Assignments

APPENDIX B - TERMINATION MODULE CONFIGURATION (NIAO01)

INTRODUCTION

The IMAOM01 uses an NIAO01 termination module to terminate its output signals. Dipswitches on the termination module (TM) configure the analog outputs that are sent to the process. The Analog Output Module (AOM) output signals are 4 to 20 mA, 1 to 5 VDC or 0 to 10 VDC depending on the AOM configuration.

Figures B-1 and B-2 show a configured NIAO01 dipswitch and the analog signal path from the AOM to a field device for a TM application. Table B-1 also shows the dipswitch settings for the two options available: current or voltage mode.

> **NOTE:** Make sure that the NIAO01 dipswitch configuration matches the AOM output configuration.

Figure B-3 shows the terminal assignments for the analog output signals and +24 VDC auxiliary power connections. Refer to this figure when connecting field wiring to the NIAO01.

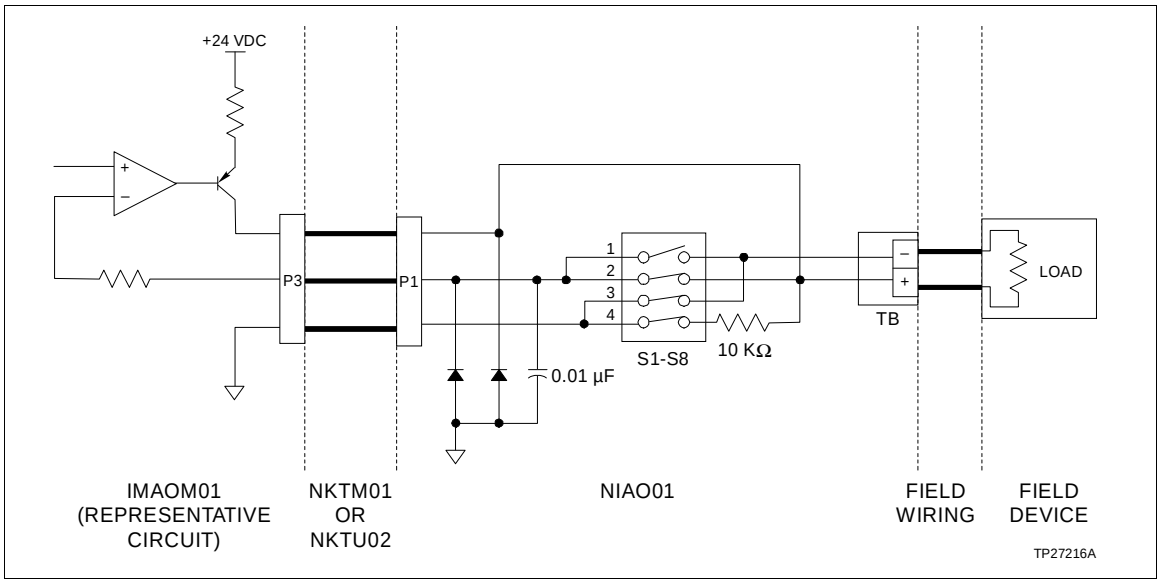


Figure B-1. NIAO01 Circuit Diagram (Voltage Mode)

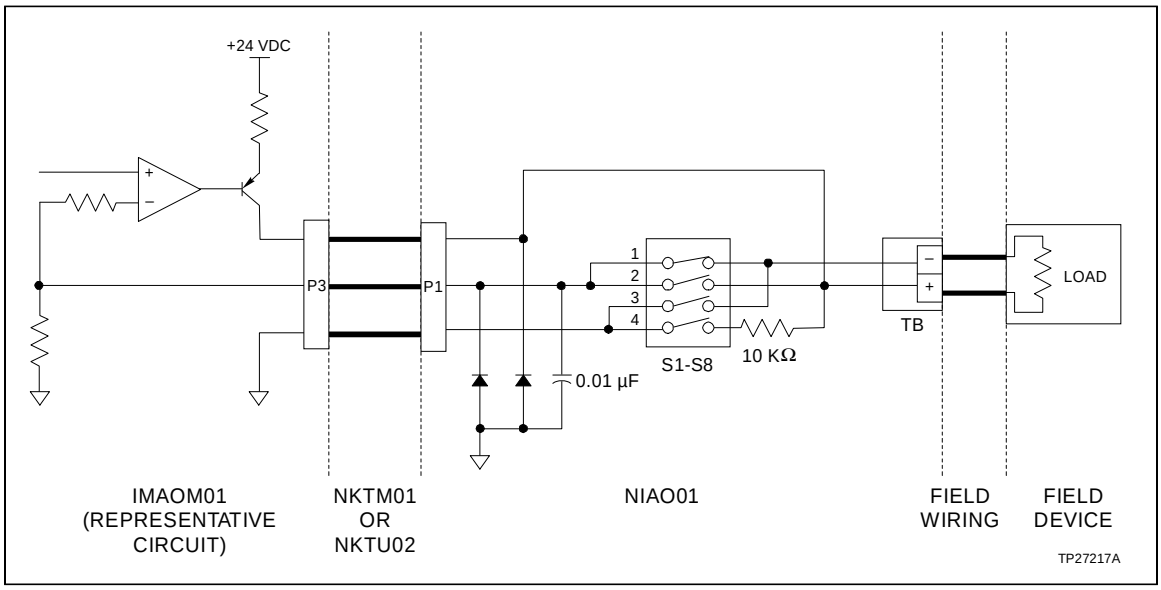
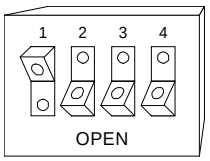
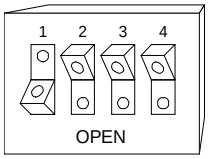


Figure B-2. NIAO01 Circuit Diagram (Current Mode)

Table B-1. NIAO01 Dipswitch Configuration

Application/Signal Type	Dipswitch S1-S8 Configuration
VOLTAGE OUTPUT (1 - 5 VDC, 0 - 10 VDC)	
CURRENT OUTPUT (4 - 20 mA)	

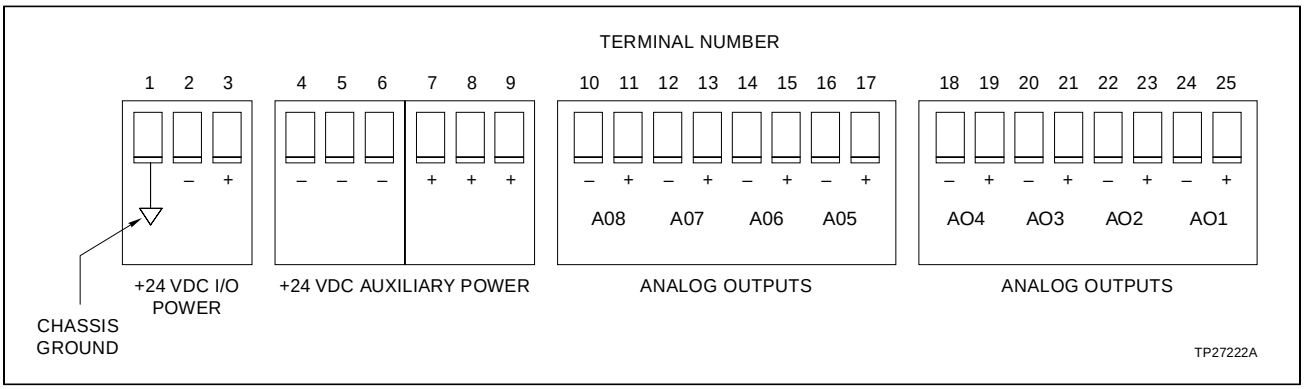


Figure B-3. NIAO01 Terminal Assignments

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