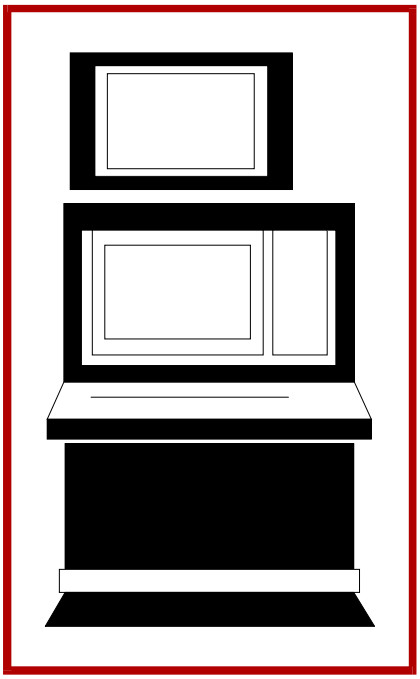
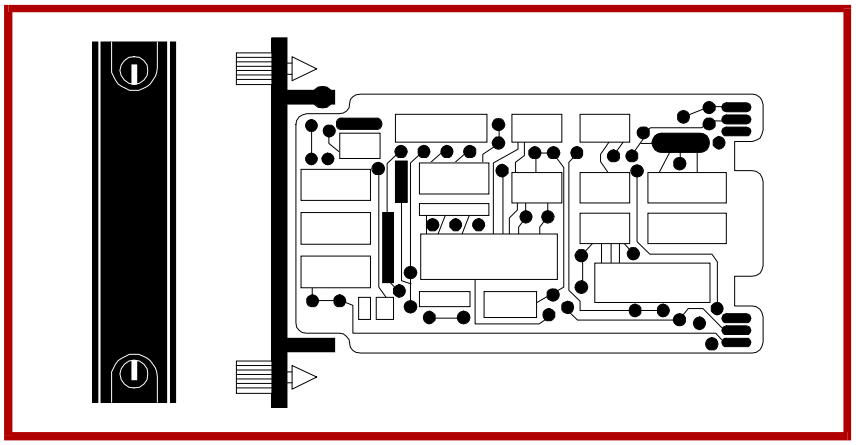
Bailey® infi 90®

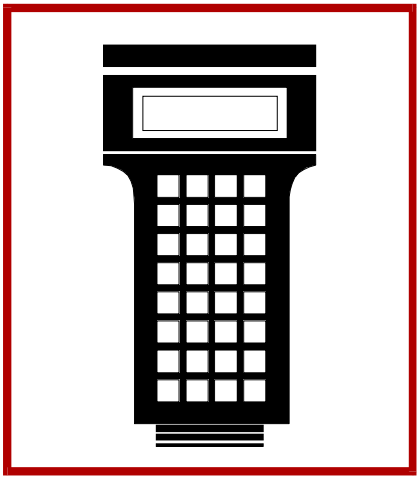
E96-217

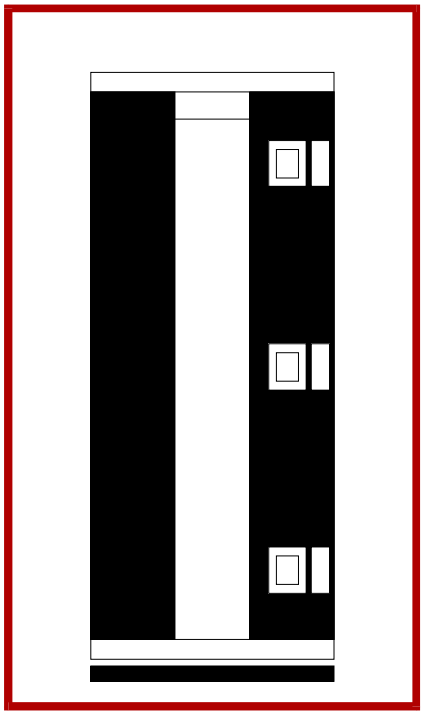
Instruction

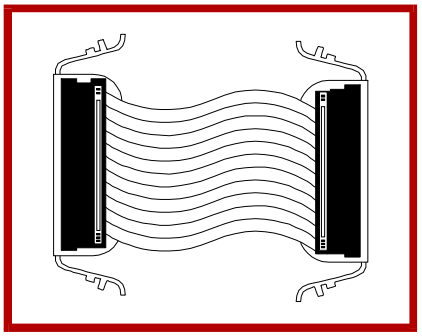
Serial Port Module
(IMSPM01)

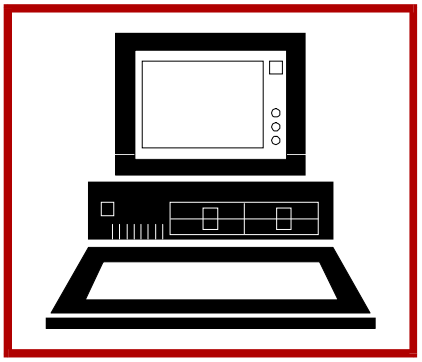












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WARNING notices as used in this instruction apply to hazards or unsafe practices that could result in personal injury or death.

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 Serial Port Module (IMSPM01) is an INFI 90® module that interfaces a computer with modules in a Process Control Unit (PCU). A computer can connect to an SPM directly or through a modem. Built-in Serial Port Module (SPM) functions support Bailey Controls computer or engineering work station software commands. These functions allow a computer to perform tuning and configuration functions, monitor module status and transfer data between it and PCU modules.

This instruction explains the module features, specifications and operation. It details the procedures to follow to set up and install an SPM. It explains troubleshooting, maintenance and module replacement procedures.

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

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List of Effective Pages

Total number of pages in this instruction is 49, consisting of the following:

Page No.	Change Date
Preface	Original
List of Effective Pages	Original
iii through vi	Original
1-1 through 1-8	Original
2-1 through 2-11	Original
3-1 through 3-9	Original
4-1 through 4-3	Original
5-1 through 5-7	Original
6-1	Original
7-1	Original
8-1	Original
A-1 through A-2	Original

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

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

Safety Summary

GENERAL WARNINGS	**Equipment Environment** All components, whether in transportation, operation, or storage must be in a noncorrosive environment. **Electrical Shock Hazard During Maintenance** Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing. **Special Handling** This module uses Electrostatic Sensitive Devices (ESD).

Sommaire de Securite

AVERTISSEMENT D'ORDRE GENERAL	**Environment de l'Equipement** Ne pas soumettre les composants a une atmosphere corrosive lors du transport, de l'entreposage ou de l'utilisation. **Risques de chocs electriques lors de l'entretien** S'assurer de debrancher l'alimentation ou de prendre 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

Table of Contents (continued)

List of Figures

List of Tables

SECTION 1 - INTRODUCTION

OVERVIEW

The Serial Port Module (IMSPM01) is a microprocessor based INFI 90 module that interfaces a computer with INFI 90 modules in a Process Control Unit (PCU). An SPM communicates with other modules over a module bus. Built-in SPM functions support Bailey Controls computer or Engineering Work Station (EWS) software commands. These functions allow computer access to module configuration I/O and status information. An IMSPM01 is a direct functional replacement for the Network 90 NSPM01.

Using an SPM and Bailey Controls software, a computer can perform tuning and configuration functions, monitor module status and transfer data between it and modules (up to 31) connected to the module bus.

The SPM drives two serial ports: port 1 and port 2. The computer can be connected directly or through a modem to port 2 at the faceplate RS-232C connector. This direct connection capability eliminates the need for additional termination hardware and cabling.

An optional Termination Unit (TU) with RS-232C connectors can be installed to connect a diagnostic terminal to port 1 on the SPM. A diagnostic terminal can be used to verify module bus communication, and to perform SPM tests.

When the SPM is installed in a PCU without the optional TU, the computer or modem connects to the faceplate RS-232C connector. Installing the SPM with the optional TU allows computer or modem connection to either the faceplate connector or a TU connector.

Figure 1-1 illustrates the INFI 90 communication levels and the position of the SPM within these levels.

INTENDED USER

System engineers and technicians should read this manual before installing and operating the SPM. 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 SPM is a single printed circuit board that occupies one slot in a standard INFI 90 Module Mounting Unit (MMU). Two

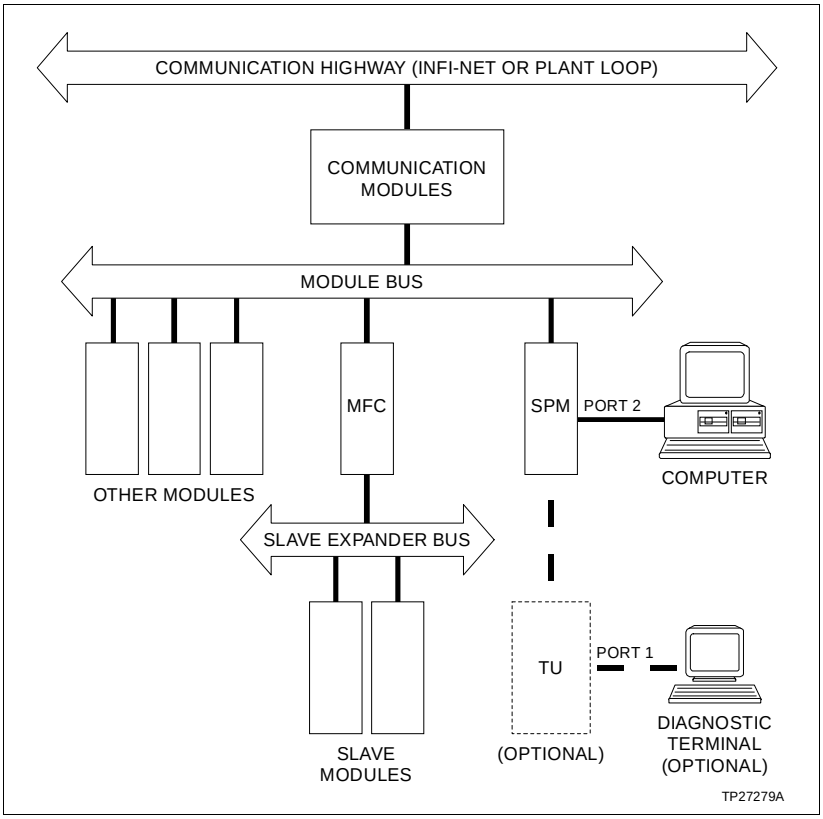


Figure 1-1. INFI 90 Communication Levels

captive screws on the faceplate secure the module to the MMU. Front panel LEDs indicate module status to aid in system test and diagnosis. These include a single module status LED and a group of four status LEDs. A module reset switch (S1), accessed through the faceplate, can be used to reset module circuitry.

A permanent RS-232C D connector (port 2) on the module faceplate provides connection for a computer or modem. A ribbon cable routes signals from this connector to socket XU37 on the PCB. Normally, the faceplate connector provides the computer or modem connection, however, the optional TU can also be used. This optional TU must be installed to connect a diagnostic terminal to the second SPM serial port (port 1).

Three dipswitches mounted on the circuit board set:

- Module address (S2).
- Byte framing and parity for both serial ports (S3).

- Operational options for both serial ports (S4).

Jumpers on the PCB configure the SPM for its intended use. The jumpers:

- JP3 and JP5 configure the Request To Send (RTS) handshaking line.
- JP4 and JP6 configure the Data Terminal Ready (DTR) handshaking line.
- JP11 and JP12 configure the Clear To Send (CTS), Received Line Signal Detect (RLSD) and Data Set Ready (DSR) handshaking lines.
- JP9 and JP10 set the baud rate for port 1 and 2 respectively.

NOTE: JP1 and JP2 are ROM compatibility jumpers. These are factory set and must remain in place for proper SPM operation. DO NOT remove or change them.

Refer to Section 3 for jumper and switch settings.

The SPM has two card edge connectors that provide connection points for external signals and power (P1 and P3). P1 connection provides system power to operate the module circuits, and module bus connection to establish communication between the SPM and other modules (refer to Table 5-3). P3 connects data and handshaking lines between the SPM and a Termination Unit (TU) (refer to Table 5-4). Two RS-232C ports for computer or modem and diagnostic terminal connection are located on the TU.

FEATURES

Modular Design

The modular design of the SPM, as with all INFI 90 modules, allows for flexibility when creating a process management strategy. Configuring the module switches and jumpers, and installing the module in any MMU slot gives the SPM and computer connected to the SPM access to the module bus.

RS-232C Connections

The SPM supports two RS-232C serial ports. A single, permanent RS-232C connector (port 2) is always available at the module faceplate and does not require additional termination hardware. A computer system can communicate with the INFI 90 system modules through this connector. An additional port, used for diagnostic terminal connection, can be accessed by connecting an optional TU with two RS-232C connectors. If desired, the computer can be connected at this TU instead of the faceplate connector.

Diagnostic Terminal Connection

Port 1 can be used to connect a diagnostic terminal to check module bus communication, and to run SPM tests.

Status Indication

The front panel LEDs provide a visual indication of the module status to aid in system test and diagnosis. The SPM performs self tests during initialization or reset. An on-board machine fault timer provides module security and also checks the self test results. Its output determines the module status LED state.

A group of four status LEDs indicate the current on-line test being run and its result. They also indicate the current computer command and SPM reply sequence.

On-Board Tests

In addition to the on-line self tests run during initialization or reset, SPM tests can be run to check the SPM to computer or modem connections, and module bus communication. These tests are selected by positioning the dipswitches mounted on the PCB; a diagnostic terminal is required.

Minor Maintenance

Other than routine maintenance as defined in Section 6, the SPM does not have any special maintenance requirements. An SPM 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 SPM: Features, description and specifications.

Description and Operation

Explains the module operation and 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 SPM.

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 SPM. The manual is organized in sections to enable you to find specific information quickly.

1. Read and do the steps in Section 3.
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
ACIA	Asynchronous Communication Interface Adapter; a device that interfaces RS-232C serial computer, peripheral or modem data. Provides serial/parallel data conversion, handshaking control and data receive and transmission.
Baud Rate	The rate at which data is transmitted over a serial bus. One baud equals one bit per second.
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.
DCE	Data Communication Equipment; equipment that establishes and terminates a communication link between two devices. In RS-232C communication systems, the DCE nomenclature indicates the signals that appear at specified cable connection contacts. A modem is an example of this type of device.
Dipswitch	A dual in-line package that contains single pole switches.
DTE	Data Terminal Equipment; equipment comprising the data source, data sink or both that provides the communication control function. In RS-232C communication systems, the DTE nomenclature indicates the signals that appear at specified cable connection contacts. Terminals and printers are examples of this type of device.

GLOSSARY OF TERMS AND ABBREVIATIONS (continued)

Term	Definition
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.
Handshaking	The procedures and standards used by two computers or a computer and a peripheral device to establish communication.
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.
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.
Parity Bit	An extra bit added to a byte, character or word to ensure that there is always either an even number or odd number of bits, according to the logic of the system. If, through a hardware failure, a bit should be lost in transmission, its loss can be detected by checking the parity.
PCU	Process Control Unit; rack type industrial cabinet that contains master, slave and communication modules, and their communication paths.
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.
ROM	Read Only Memory; a special type of computer memory, permanently programmed with a group of frequently used instructions. It does not lose its program when computer power is removed.
Serial Data	Data transmitted sequentially, one bit at a time.

GLOSSARY OF TERMS AND ABBREVIATIONS (continued)

Term	Definition
Slave Expander Bus	Parallel address/data bus between the master module and the slave that point data and slave status data are exchanged over.
SRAM	Static Random Access Memory; a memory that does not need to be refreshed many times a second, as is required with dynamic RAM; this is volatile memory. Once a device puts a value into a static memory location, the value remains there until power is removed.
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.
UART	Universal Asynchronous Receiver/Transmitter; a device that converts parallel data into serial form for transmission along a serial interface, and vice versa.
UVROM	Ultraviolet Read Only Memory; a special programmable ROM that can be erased using a high-tensity, ultraviolet light, then reprogrammed. This is non-volatile memory; it does not lose its program when power is removed.

REFERENCE DOCUMENTS

Document Number	Document
E93-905-9	Enhanced Computer Interface Unit Programmer's Reference Manual

NOMENCLATURE

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

Nomenclature	Hardware
NTCU01	Termination Unit
NKTU01	Cable, Termination Unit

SPECIFICATIONS

Microprocessor	8 bit processor running at 2 MHZ (16 bit external address line)
Memory	
UVROM	24 Kbyte
SRAM	4 Kbyte
Power Requirements	
Voltage	+5 VDC (±5%) +15 VDC (+5%, –2.5%) –15 VDC (–5%, +2.5%)
Current Consumption (maximum)	1.9 A (+5 VDC) 35 mA (+15 VDC) 28 mA (–15 VDC)
Power Dissipation (maximum)	5.32 watts @ +5 VDC 2.91 watts @ +15 VDC 2.33 watts @ –15 VDC
Framing	
Parity	even, odd or none
Data bits	7 or 8
Stop bits	1 or 2
Baud Rate	
Jumper selectable	300, 1200, 2400, 9600, 19200
Computer Interface	Full duplex serial data EIA standard RS-232C.
Software	Twelve resident I/O functions.
Module Bus Interface	Access to all modules in a single PCU.
Mounting	Occupies one slot in standard INFI 90 Module Mounting Unit.
Environmental	
Ambient Temperature	0° to 70° C (32° to 158° F)
Relative Humidity	0% to 95% up to 55° C (131° F) (noncondensing) 0% to 45% at 70° C (158° F) (noncondensing)
Altitude	Sea Level to 3 Km (1.86 miles)
Air Quality	Noncorrosive
Certification	CSA certified for use as process control equipment in an ordinary (nonhazardous)location.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

SECTION 2 - DESCRIPTION AND OPERATION

INTRODUCTION

This section explains the logic and I/O circuitry, data, logic power and connections for the Serial Port Module (SPM). The SPM is an interface that allows a computer access to INFI 90 modules (e.g., Multi-Function Processor/Controller, Analog Master Module or Controller Modules) in a Process Control Unit (PCU). It gives the ability to manipulate or monitor INFI 90 module activity using an external computer with Bailey Controls software. Using an SPM, a computer can obtain module I/O and status data, change module mode, and configure, modify or monitor module functions (i.e., function blocks).

The SPM communicates with INFI 90 devices over a two-line serial module bus as shown in Figure 1-1. Each module on the module bus, including the SPM, has a unique address set by its address dipswitch. Messages are directed to individual modules using this address.

The SPM supports two serial ports: port 1 and port 2. It can be setup in any of the following combinations:

1. A computer or modem connected to the permanent RS-232C connector (port 2) at the module faceplate. A ribbon cable connects this faceplate connector to socket XU37.

2. A computer or modem connected to the permanent, faceplate RS-232C connector, and a diagnostic terminal connected to port 1 through an optional Termination Unit (TU) with RS-232C connectors (NTCU01).

3. A computer or modem connected to one RS-232C connector provided on the TU, and the diagnostic terminal connected at the second RS-232C provided on the TU. A termination cable routes the data and handshaking signals between the TU and SPM.

Normally, the faceplate RS-232C connector provides computer or modem connection. This connector eliminates the need for permanent installation of a TU and cables.

MODULE BLOCK DIAGRAM

An SPM is a stand-alone module. It contains all logic and control circuitry required to:

- Receive and interpret serial computer commands.

- Interface computer or INFI 90 device data.
- Allow a computer to perform configuration loader or module bus monitor functions.

An on-board microprocessor controls all SPM functions using programs residing in ROM. Figure 2-1 is a block diagram of the SPM. An explanation of the functions performed by each block follows.

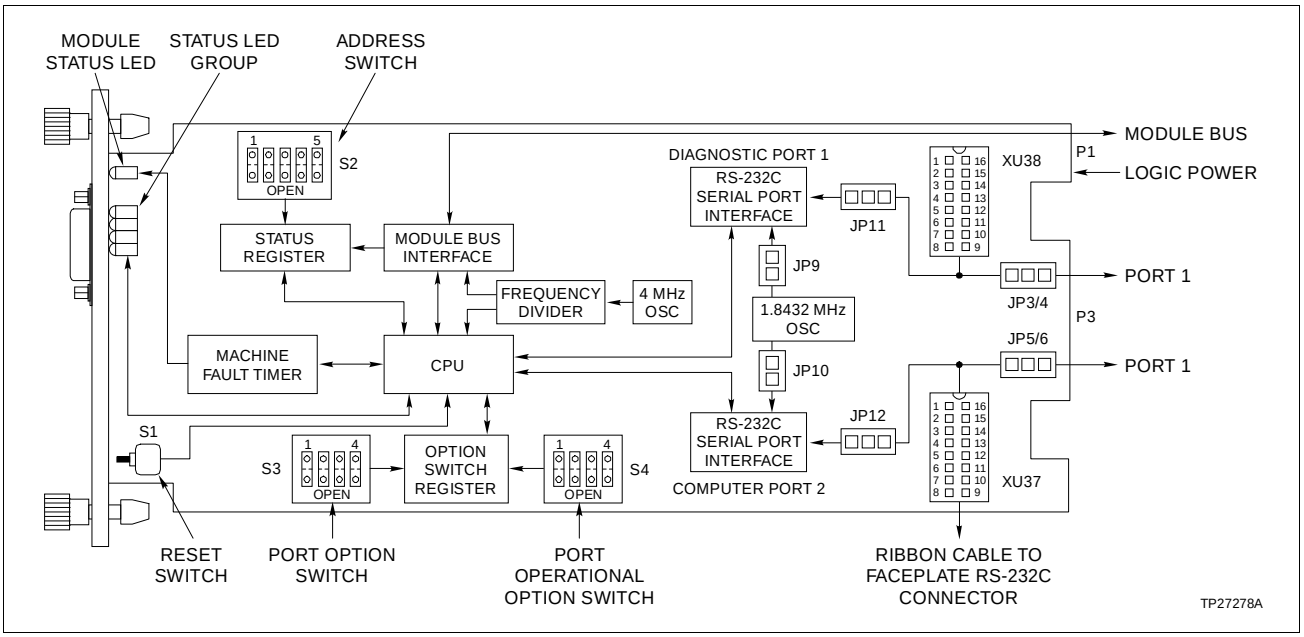


Figure 2-1. Serial Port Module Block Diagram

Control Logic

CPU Block

The Central Processing Unit (CPU) consists of an eight bit microprocessor, microprocessor support circuits and memory. SPM memory is a 24K UVROM and 4K RAM. The microprocessor requires support circuitry to provide its I/O and timing. These circuits include data buffers, decoders, programmable timer and a digital clock. An eight bit bi-directional 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 SPM.

The microprocessor receives computer generated commands, and interprets these instructions to execute programs stored permanently in ROM. Execution of the specified program will generate the necessary module address and instruction codes (i.e., command codes) a module in a PCU requires to accomplish the computer directed function. This data request or command is sent to the module bus interface for transmission.

If the computer specifies a read operation (e.g., read block output, read problem report or read default block), the SPM receives the data from the addressed INFI 90 module and stores it in RAM. The microprocessor can output this data through its serial ports when the computer requests it.

A series of decoder/multiplexer circuits select various circuitry by decoding microprocessor address outputs. The circuits selected include:

- RAM.
- ROM.
- UART data registers (part of module bus interface).
- Control register (part of module bus interface).
- Machine Fault Timer (MFT).
- Port configuration/test switches.
- Status LED group.
- Programmable timer.
- Asynchronous Communication Interface Adapter (ACIA) (part of serial port interface).

During initialization or reset, the CPU conducts self tests to determine operating status of the SPM circuitry. Refer to ***ON-LINE TESTS*** in this section for further explanation.

Status Register

The status register holds the address set on the address switch (S2), and various status bit information relating to module bus interface functions.

Option Switch Register

The option switch register holds the values set on the port option switch (S3) and port operational option switch (S4). The microprocessor reads the contents of this register to determine:

- Byte framing and parity.
- Normal or test options set.
- ASCII or binary mode operation.
- Enable or disable checksum operation.

Frequency Divider Block

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

Machine Fault Timer

A Machine Fault Timer (MFT) generated on the SPM is a security feature common to all microprocessor based INFI 90

modules. The MFT is a one-shot timer that is reset periodically by the CPU. A *time out*:

- Resets the microprocessor.
- Disables the module bus interface circuit.
- Disables the Clear To Send (CTS) handshaking output.

Refer to ***MACHINE FAULT TIMER*** in this section for further explanation of *time out*.

I/O Interface Functions

Commands from a computer are directed to the microprocessor through the RS-232C serial port interface circuits. Module bus data transfer between the SPM and an addressed module is controlled by the module bus interface circuits. The CPU block directs these functions.

Module Bus Interface Block

The module bus interface used by the SPM consists of a bus driver circuit, control register and Universal Asynchronous Receiver/Transmitter (UART). The microprocessor directs the module bus interface functions through the control register. This circuitry allows the SPM to communicate with other INFI 90 modules that have the same basic module bus interface circuitry.

The different data and command messages transmitted serially on the module bus vary in length (i.e., number of bytes). An open collector bus driver circuit is the receive and transmit point for these serial module bus messages entering or leaving the SPM.

A UART performs serial to parallel and parallel to serial conversion on data received or transmitted by the SPM. UART data registers hold this data during a microprocessor initiated transmit or receive sequence. The UART adds the required data format framing bits to messages it transmits, and checks and removes these bits from received messages. The data format (i.e., number of start bits, data bits and stop bits and type of parity) is fixed for module bus messages. The UART uses a clock signal from the frequency divider network to transmit serial data at 83.3 Kbaud, and to synchronize received serial data.

RS-232C Serial Port Interface

The RS-232C serial port interface block consists of two ACIA circuits and related circuitry, and a frequency multiplier circuit. These circuits provide the port interface functions and allow other peripheral equipment having RS-232C port capability to connect and communicate with the SPM.

The two ACIA circuits, one for each port, perform:

- Serial to parallel conversion on data received serially from a computer.
- Parallel to serial conversion on data sent to a computer.
- Byte framing based on the port option switches.
- Parity, overrun and framing error checks.
- Peripheral or modem control (i.e., Clear To Send (CTS), Data Set Ready (DSR) and Data Terminal Ready (DTR)).

Each ACIA has a control register and data transmit/receive register, each register is selectable by the microprocessor. The ACIA receives the values set on the port option switch from the microprocessor. It uses these values to set byte framing and parity: number of bits (seven or eight), number of stop bits (one or two) and type of parity (odd, even or none). The data transmit/receive register holds values being transmitted or received by the SPM. The ACIA automatically removes the start and stop bits from received data.

A frequency multiplier circuit uses the on-board 1.8432 MHZ crystal oscillator to develop clock signals required to provide the jumper selectable baud rates. The SPM can be set to a 300, 1200, 2400, 9600 or 19.2 Kbaud rate using jumper JP9 and JP10. The selected frequency is sent to the ACIAs: JP9 sets port 1 rate and JP10 sets port 2 rate.

Refer to ***SERIAL PORT CONFIGURATION*** in this section for an explanation of handshaking and data signals, and connections for the RS-232C serial ports.

I/O CIRCUIT CONNECTIONS

The two RS-232C serial port interface circuits connect to the 30-pin card edge connector (P3), and XU37 (port 2) and XU38 (port 1). A termination cable routes the I/O signals between P3 of the SPM and a TU. A ribbon cable routes the I/O between XU37 and the faceplate connector. XU38 is not used.

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 SPM performs the interface functions for a computer. The P1 card edge connector of the SPM 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 BUS DATA

An SPM receives and interprets commands from a computer. From these commands, it generates and sends command messages to an INFI 90 module. Programs permanently stored in ROM are run to accomplish SPM functions. Execution of a specified program generates the module address and instruction code (i.e., command code) an INFI 90 module requires to accomplish the computer directed function. Table 2-1 is a list of functions that can be performed using the SPM.

Table 2-1. SPM Resident Functions

Command	Function
SPM RESTART	Reset.
DEMAND MODULE STATUS	Read the status of any module in the PCU.
READ PROBLEM REPORT	Read a module problem report of any module.
READ BLOCK OUTPUT	Access the output of any function block.
MODULE OPERATION	Change a module operating mode.
READ BLOCK	Read a function block in any module.
READ NEXT BLOCK	Read the next defined function block.
READ DEFAULT BLOCK	Read the function block default parameters.
WRITE BLOCK	Configure a block in a PCU.
TUNE BLOCK	Change the tuning parameters in a block.
DELETE BLOCK	Remove a block from a module.

The SPM resident functions are a subset of the INFI-NET to Computer Interface (INICI01) and Plantloop to Computer Interface (INPCI01/02) unit functions. Refer to the Enhanced Computer Interface Unit Programmer's Reference Manual I-E93-905-9 for an explanation of these functions and their use.

The SPM generates a module bus message and directs this message to a module on the module bus. The message contains:

- Destination address (0 to 31).
- Source module address (SPM address).
- Message code (function to perform).
- Data (dependent on the type of command).
- Checksum (generated by module bus interface function).

The message code (i.e., command code) determines the function the receiving module is to perform. After receiving and interpreting a message, a module responds with a reply message. This message contains a data field with either an acknowledge or the requested data. The SPM stores the received data in RAM until the computer is ready for it.

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

POWER

Standard INFI 90 power (+5 VDC, ±15 VDC) drives the SPM circuitry. It connects through the top 12-pin card edge connector (P1) shown in Figure 2-1. The +5 VDC supply is for the logic circuitry, the ±15 VDC for the RS-232C interface. In addition to the power, the module bus and Power Fail Interrupt (PFI) connect through P1.

MACHINE FAULT TIMER

A Machine Fault Timer (MFT) generated on the SPM is a security feature common to all microprocessor based INFI 90 modules. The timer is reset periodically by the microprocessor (approximately once every 2.2 seconds). If it is not reset within this time, the timer expires 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 the SPM will no longer communicate with the INFI 90 system or computer.

A MFT status signal is also used to develop the Clear To Send (CTS) output to verify for the computer that the module is capable of receiving data transmission.

ON-LINE TESTS

When the SPM 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 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.

ROM Test A ROM test computes a checksum of ROM 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 SPM initializes all RAM memory locations and begins to execute computer commands. 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 SPM 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 SPM that causes the microprocessor to fail or operate incorrectly, the MFT will not be reset resulting in a *time out*.

STATUS LED INDICATOR

A single front panel module status LED indicator shows the operating state of the SPM (i.e., normal operation or *time out*). The MFT circuits on the SPM determine the module status and light the LED accordingly. It lights green to indicate normal operation; red for a *time out*.

A group of four status LEDs also indicate module operating status. The microprocessor sets the LEDs to indicate the current on-line test being run and its result, and the sequence of computer commands and SPM replies.

Section 4 explains the LED indications and Section 5 explains corrective actions to take.

SERIAL PORT CONFIGURATION

Access to both SPM serial ports, port 1 and port 2, is available at the P3 edge connector or at sockets XU37 and XU38. The faceplate connector provides connection to port 2 only through a ribbon cable connected to XU37. Refer to Table 5-2 and 5-3 for pin outs of P3, XU37 and XU38.

Figure 2-2 shows the pin numbering for the front panel, NTCU01 and RS-232C cables. An explanation of the signals at each wired pin follows. Refer to Section 3 for an explanation of proper cable wiring and connections between the SPM and Data Terminal Equipment (DTE) or Data Communication Equipment (DCE).

The front panel and NTCU01 connectors are arranged according to Electronics Industries Association (EIA) RS-232C standards. This standard identifies various interchange signals, signal levels and pin connections that are available for serial data transmission. The SPM can monitor or output the signals required for data exchange between it and a DTE or DCE device. An example of a DCE device is a modem; an example of

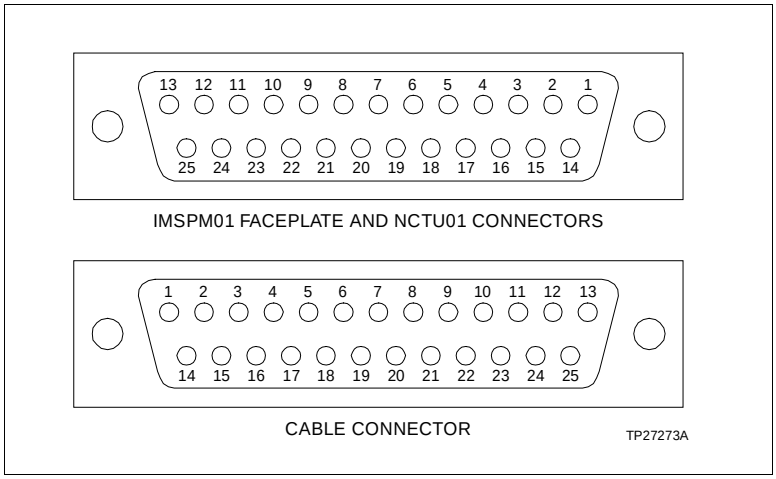


Figure 2-2. Serial Port Connector Pin Numbers

a DTE device is a computer or terminal. The SPM functions with a DCE device through a type Z interchange.

The handshaking signals can be configured using jumpers on the SPM. This allows the SPM to match the handshaking signal requirements of the device connected to it.

A description of each SPM signal line follows. The RS-232C pin names and functions are defined with respect to the DTE device. For example, the RX DATA (RECEIVED DATA) line is input or received by the DTE (e.g., computer) and output or transmitted from a DCE (e.g., SPM). The pin numbers given refer to the SPM and NTCU01 RS-232C connectors shown in Figure 2-2.

Pin 1 PROTECTIVE GROUND (PROT GND) - This is a protective ground line electrically connected to the equipment frame.

Pin 2 TRANSMITTED DATA (TX DATA) - Serial data line that is a serial data output from the DTE to a DCE.

For the SPM, this is the serial data input line.

Pin 3 RECEIVED DATA (RX DATA) - Serial data line that is a serial data input to the DTE from a DCE.

For the SPM, this is the serial data output line.

Pin 4 REQUEST TO SEND (RTS) - DTE output signal line that it uses to signal a DCE to begin transfer of data.

For the SPM, this signal is NOT used by SPM software. When connecting Bailey Controls equipment, jumpers (JP3 and JP5) tie this line active high to continuously enable the serial interface circuits (i.e., ACIAs). This line can be enabled with the

jumpers if using software that requires the SPM to monitor the RTS signal.

> **NOTE:** In the continuous enable position, the RTS line is not physically disconnected from the faceplate connector, but is disconnected from P3. When connecting equipment to the faceplate connector, these lines must not be grounded or forced to other voltage levels.

Pin 5 CLEAR TO SEND (CTS) - DTE input signal line that a DCE uses to signal a DTE in response to a received RTS signal.

Since the SPM does not use the RTS signal, it generates the CTS signal while the MFT is in its normal state and the ACIA is initialized. For Bailey Controls software, this line must be continuously enabled. Jumpers (JP11 and JP12) tie the line to +15 VDC to continuously enable the output. The jumpers can also be set to provide a logic 1 output if required.

Pin 6 DATA SET READY (DSR) - DTE input signal line that a DCE uses to signal the DTE that the requested data is ready to be sent.

For the SPM, this signal is synonymous with the CTS signal because of an overlap in SPM signal definition. Both signals are generated at a common point. The Bailey Controls software requirements are the same as for the CTS signal.

Pin 7 SIGNAL GROUND (SIG GND) - This is a common line for all signals.

Pin 8 RECEIVED LINE SIGNAL DETECT (RLSD) - DTE input signal line that indicates that a valid communication link has been established between the DTE and DCE.

For the SPM, this signal indicates when access to the module bus is possible. The communication link is valid if the ACIA is enabled and the MFT is in its normal state. This signal is synonymous with the CTS and DSR signals. All three are generated from a common point. It is generated to allow interfacing with other data equipment. The Bailey Controls software requirements are the same as for the CTS signal.

Pin 20 DATA TERMINAL READY (DTR) - DTE output signal line that the DCE uses to confirm that the DTE is present, and the communication link is to be maintained.

This signal has the same purpose for the SPM. If the DTE device does not generate this signal, jumpers on the SPM can be set to continuously enable the input by tying the line to +15 VDC.

> **NOTE:** In the continuous enable position, the DTR line is not physically disconnected from the faceplate connector but is disconnected from P3. When connecting equipment to the faceplate connector, these lines must not be grounded or forced to other voltage levels.

All other RS-232C pin connections are not required, and are not connected on the SPM. Their presence or absence does not effect the SPM operation.

SECTION 3 - INSTALLATION

INTRODUCTION

This section explains what you must do before you put the Serial Port Module (SPM) into operation. ***DO NOT*** proceed with operation until you read, understand and do the steps in the order in which they appear.

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 SPM 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

Several steps must be performed prior to operating the SPM. These steps include:

> **NOTE:** For INFI 90 switches, OPEN and OFF have the same meaning; CLOSED and ON have the same meaning.

1. Setting the address switch (S2).
2. Setting the port option switch (S3).
3. Setting the port operational option switch (S4).
4. Connecting the Request To Send (RTS) handshaking line jumpers (JP3 and JP5).
5. Connecting the Data Terminal Ready (DTR) handshaking line jumpers (JP4 and JP6).
6. Connecting the Clear To Send (CTS) handshaking line jumpers (JP11 and JP12).
7. Connecting baud rate jumpers (JP9 and JP10).
8. Installing the SPM in the Module Mounting Unit (MMU), and connecting termination cable if applicable.
9. Installing optional termination unit if applicable.
10. Connecting RS-232 cables.

> **NOTE:** Jumpers JP1 and JP2 are factory installed ROM compatibility jumpers; DO NOT change or remove them. Removing or changing the jumpers will cause the module to operate incorrectly. A jumper should be installed across pins 2 and 3 of JP1 and pins 2 and 4 of JP2.

After the SPM is installed, the serial port checkout (i.e., echo test) and module bus checkout test can be run to verify SPM operation. Refer to Section 5 for the procedures to run these tests; a diagnostic terminal (dumb terminal) is required.

Address Switch (S2) Settings

The SPM can have one of 32 addresses (0 to 31) on the module bus. This address uniquely identifies the SPM.

> **NOTE:** The address must be a unique address within a PCU. Normally, addresses 0 and 1 are not used for an SPM 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 of S2. Table 3-1 is a binary address conversion table for setting S2.

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

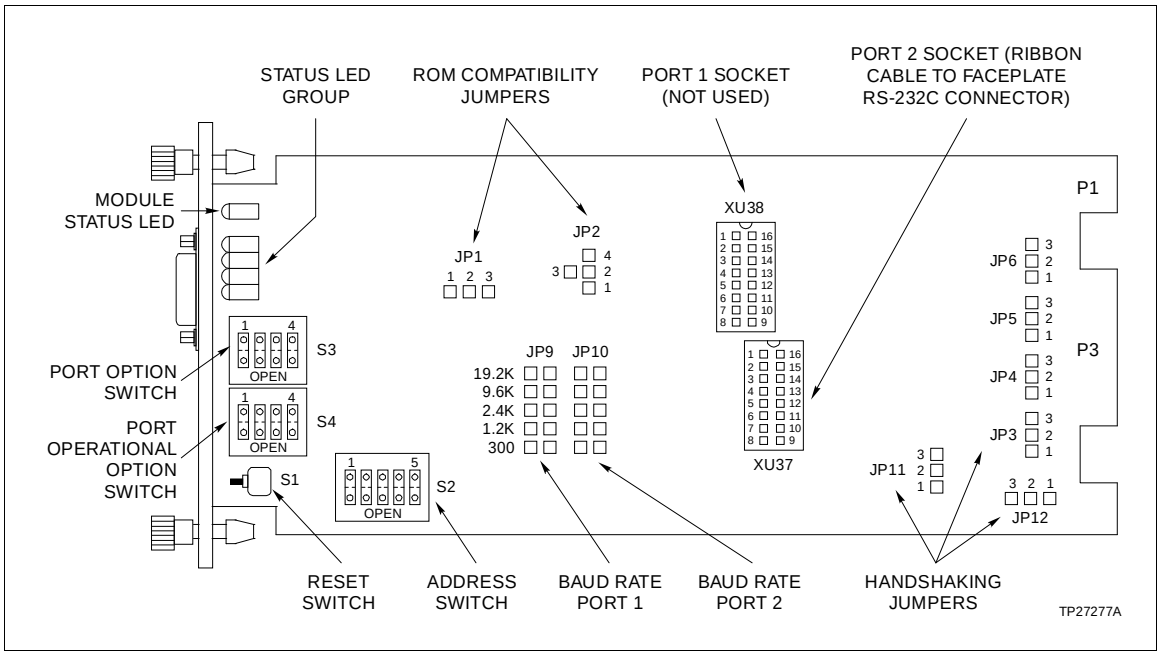


Figure 3-1. Serial Port Module Component Locations

Table 3-1. Address Switch (S2) Settings

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 (OFF); 0=CLOSED (ON)

Port Option Switch (S3) Settings

The port option switch (S3) sets the byte framing and parity for both serial ports. Byte framing can be set to seven or eight data bits and one or two stop bits. Parity can be set to odd, even or none. Table 3-2 shows the port options and the corresponding switch settings. Figure 3-1 shows the location of this switch.

Determine the byte framing and parity requirements for your application and set dipswitch positions 2 thru 4 to the corresponding position defined in Table 3-2.

S3 dipswitch position 1 determines whether port 1 (i.e., diagnostic port) uses the byte framing and parity set on S3 or predefined values. Set dipswitch position 1 to CLOSED (ON) to use the values set on S3 for both port 1 and port 2. Set dipswitch position 1 to OPEN (OFF) to use the values set on S3 for port 2 (i.e., computer port), and to set port 1 to eight data bits, one stop bit and even parity.

Table 3-2. Port Option Switch (S3) Settings

Dipswitch			Data Bits	Stop Bits	Type Parity
2	3	4			
ON	ON	ON	7	2	EVEN
ON	ON	OFF	7	2	ODD
ON	OFF	ON	7	1	EVEN
ON	OFF	OFF	7	1	ODD
OFF	ON	ON	8	2	NONE
OFF	ON	OFF	8	1	NONE
OFF	OFF	ON	8	1	EVEN
OFF	OFF	OFF	8	1	ODD

NOTE: ON = CLOSED, OFF = OPEN

Port Operational Option Switch (S4) Settings

The port operational option switch (S4) sets normal operational options and test mode options for both serial ports. When operating with Bailey Controls software and equipment, the normal position for the four S4 dipswitch positions is CLOSED (ON). Table 3-3 lists the options that can be set with S4. Figure 3-1 shows the location of S4.

Determine the requirements for your application and set each dipswitch position to the corresponding position defined in Table 3-3. The echo check setting is used when testing the SPM. Section 5 explains the use of this setting.

Table 3-3. Port Operational Option Switch (S4) Settings

Dipswitch Position	Closed (on)[1]	Open (off)
1	Binary code	ASCII code
2	ROM self test during normal operation	Not allowed
3	Normal operation	Echo check
4	Command and reply checksums used	Command and reply checksums not used

1. All dipswitch positions are normally CLOSED (ON) when SPM is operating with Bailey Controls equipment.

Jumper Configuration

Jumpers on the SPM set up the module handshaking signals and baud rate. The SPM is designed to conform to the Electronics Industries Association (EIA) RS-232C standard. This standard identifies various interchange signals, signal levels and pin connections that are available for serial data transmission. The SPM can monitor or output the signals required for data exchange between it and Data Communication Equipment (DCE) (e.g., modem) and Data Terminal Equipment (DTE) (e.g., computer). The SPM functions with a DCE device through a type Z interchange.

For the SPM, the required interchange signals (i.e., handshaking) can be continuously enabled or disabled with on-board jumpers. This allows setting the SPM to match the DTE device requirements. The jumper settings depend on the equipment being used with the SPM. For an explanation of the handshaking signals, or further explanation about the serial port configuration, refer to ***SERIAL PORT CONFIGURATION*** in Section 2.

NOTE: This instruction identifies ALL RS-232C handshaking signals with respect to the DTE device.

JUMPERS JP3/JP5

Jumpers JP3 and JP5 are for the Request To Send (RTS) handshaking lines of the RS-232C serial ports: JP3 for port 1 and JP5 for port 2. These are input lines to the SPM that signal a request from a DTE device to transfer data. When the SPM is connected to equipment that does not support the RTS lines, place a jumper across pins 2 and 3 of JP3 and JP5. This causes each serial port interface circuit (i.e., ACIA) to be continuously enabled. For applications requiring the SPM to monitor the RTS signal, these lines can be enabled by placing

jumpers across pins 1 and 2 of JP3 and JP5. Figure 3-1 shows the location of JP3 and JP5.

NOTE: When JP3 and JP5 are configured to provide a continuous enable signal to their respective ACIAs (i.e., jumpers across pins 2 and 3), +15 volts is taken through a resistor to provide the proper logic state to enable the ACIA. With the jumpers in this position, the RTS input lines are physically disconnected from P3. They are NOT, however, disconnected from the faceplate connector. When connecting equipment to the faceplate connector, these lines must NOT be grounded or forced to other voltage levels that would change the logic state and disable the ACIA.

JUMPERS JP4/JP6

Jumpers JP4 and JP6 are for the Data Terminal Ready (DTR) handshaking lines of the RS-232C serial ports: JP4 for port 1 and JP6 for port 2. These are inputs to the SPM. It uses this signal to verify that a DTE device is connected and that a communication link is to be maintained. The jumper connections depend on whether the equipment being connected to a port provides the DTR handshaking signal or not.

When the SPM is connected to equipment that does not support the DTR lines, place a jumper across pins 2 and 3 of JP4 and JP6. This causes each ACIA circuit to be continuously enabled. For special applications, these lines can be enabled by placing jumpers across pins 1 and 2 of JP4 and JP6.

If port 1 (diagnostic port) is not used, a jumper is not required for JP4. Figure 3-1 shows the location of JP4 and JP6.

NOTE: When JP4 and JP6 are configured to provide a continuous enable signal to their respective ACIAs (i.e., jumpers across pins 2 and 3), +15 volts is taken through a resistor to provide the proper logic state to enable the ACIA. With the jumpers in this position, the DTR input lines are physically disconnected from P3. They are NOT, however, disconnected from the faceplate connector. When connecting equipment to the faceplate connector, these lines must NOT be grounded or forced to other voltage levels that would change the logic state and disable the ACIA.

JUMPER JP11/JP12

Jumpers JP11 and JP12 are for the Clear To Send (CTS), Data Set Ready (DSR) and Received Line Signal Detect (RLSD) handshaking lines of the RS-232C serial ports: JP11 for port 1 and JP12 for port 2. These are outputs from the SPM to the DTE.

Normally, the CTS signal is output in response to receiving a RTS. Since the SPM assumes a true RTS at all times, the CTS signal is active when the Machine Fault Timer (MFT) is normal and the software initializes the ACIA. For the SPM, the DSR and RLSD signals are synonymous with the CTS signal

because of an overlap in SPM signal definition. All three signals are generated at a common point.

Bailey Controls software does NOT provide these signals. When the SPM is connected to Bailey Controls equipment, place a jumper across pins 2 and 3 of JP11 and JP12. This sets the output lines at +15 VDC.

For applications requiring this output, place the jumpers across pins 1 and 2 of JP11 or JP12. This causes the SPM to output a logic 1 when the MFT is normal and the ACIA is initialized.

JUMPERS JP9/JP10

Jumpers JP9 and JP10 set the RS-232C serial port output baud rate: JP9 for port 1 and JP10 for port 2. To select a baud rate, place a jumper across the pins next to the desired rate for each port. Figure 3-1 shows the location of jumpers JP9 and JP10, and provides a cross reference for jumper to baud rate selection. When the SPM is used with a Bailey Controls work station, set the baud rate at 9.6 Kbaud. Refer to the product instruction for the computer system you are using for the required baud rate setting.

Physical Installation

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

> **NOTE:** Configure the SPM jumpers and switches BEFORE installing.

1. Verify the slot assignment of the module.

2. If a TU is used to connect a diagnostic terminal, connect the hooded end of a termination cable (NKTU01) to the MMU backplane. To do this, insert the connector into the backplane slot in the same slot as the one assigned to the SPM. The latches should snap securely into place. If the optional TU is not used, continue with next step.

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).

Termination Unit Installation

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

An optional TU can be installed to provide connection for a diagnostic terminal to port 1, and an alternate connection point for a DTE and DCE device to port 2. This TU has two RS-232C D connectors that a termination cable connects to P3 of the SPM. Normally, a computer or modem connects to the RS-232C connector provided at the SPM faceplate. Refer to Appendix A for more information.

WIRING CONNECTIONS AND CABLING

The SPM has two card edge connectors, P1 and P3, to provide power to the SPM circuitry, establish communication with INFI 90 modules and cable connection to an optional TU.

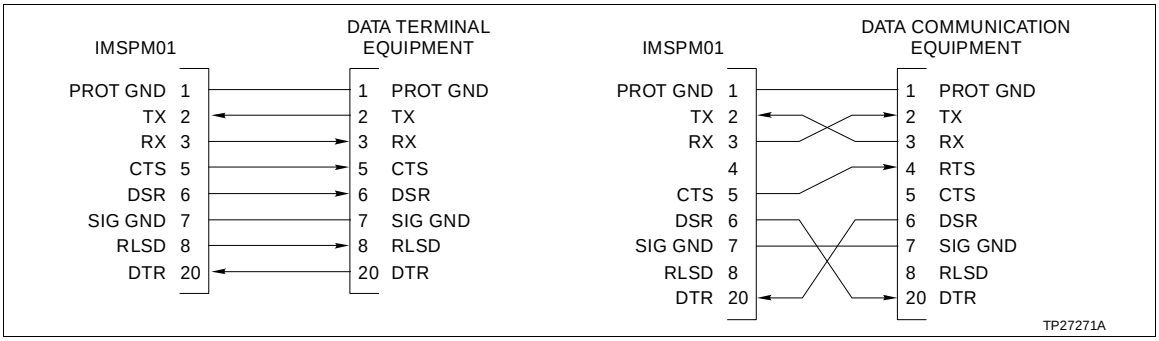
Wiring

Installing the SPM in the MMU connects P1 of the module to logic power (+5 VDC and ±15 VDC) necessary to operate its circuitry. It also connects to the module bus for communication with other modules. P1 connection requires no additional wiring or cabling.

Cable Connections

Faceplate RS-232C Cable Connection

An RS-232C cable connects a DTE (e.g., computer) or DCE (e.g., modem) device to the SPM faceplate connector. This cable routes the handshaking signals and data transferred between DTE or DCE devices and the SPM. Refer to Figure 3-2 for the RS-232C cable wiring requirements for use with DTE or DCE devices.



NOTE:
PROT GND - Protective ground.
TX - Transmitted data.
RX - Received data.
CTS - Clear to send.
DSR - Data set ready.
SIG GND - Signal ground.
RLSD - Received line signal detect.
DTR - Data terminal ready.

Figure 3-2. RS-232C Compatible Cable Wiring Requirements

To install the RS-232C cable:

> **NOTE:** Make sure power for the DCE or DTE device being connected is OFF before installing the RS-232C cable.

1. Connect one end of the RS-232C cable to the SPM faceplate serial port.

2. Connect the other end of the cable to the DTE or DCE device serial port.

If a diagnostic terminal is not being used, installation is complete. If it is being used, refer to Appendix A for cable connections.

FUSING

The SPM does not have any on-board fusing requirements.

PRE-OPERATING ADJUSTMENTS

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

SECTION 4 - OPERATING PROCEDURES

INTRODUCTION

This section explains the front panel indicators and start-up procedures for the Serial Port Module (SPM).

MODULE STATUS INDICATOR

The SPM has a single front panel module status LED indicator and a group of four status LEDs. These LEDs are visible through the SPM faceplate. Figure 4-1 shows the location of these indicators and the faceplate RS-232C connector.

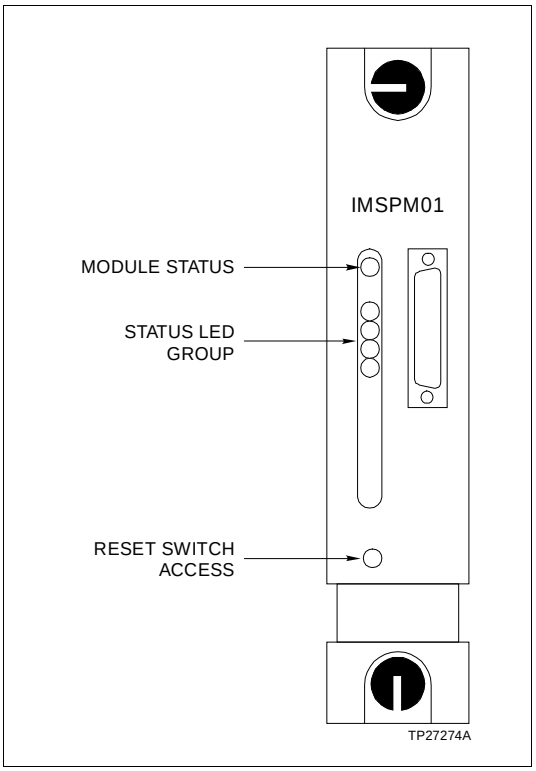


Figure 4-1. IMSPM01 Front Panel

Module Status LED

Table 4-1 explains the three states of the module status LED indicator (refer to Section 5 to determine corrective actions).

Table 4-1. MSPM01 Module Status LED Indicator

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

Status LED Group

The status LED group indicates start-up and normal operation conditions. During start-up, these LEDs can be observed to determine the current on-line test (i.e., ROM or RAM) being run and its result. During normal operation, these LEDS indicate the current command and reply sequence between the computer and SPM.

Start-Up LED Sequence

Figure 4-2 illustrates the LED sequence during start-up or reset. When the SPM first starts up, the LEDs light and extinguish one at a time sequentially (i.e., LED test). When this test is complete and all four LEDs are extinguished, the ROM test runs. The top LED in the group lights indicating the completion of the ROM test and start of the RAM test. Then, all four LEDs light to indicate completion of the RAM test and that the SPM is ready and waiting for the first computer initiated command.

NOTE: A failure of either test results in a *time out*, which lights the module status LED red.

Normal Operation LED Sequence

After the start-up is complete, the LEDs maintain a binary count of the computer command and SPM reply sequence.

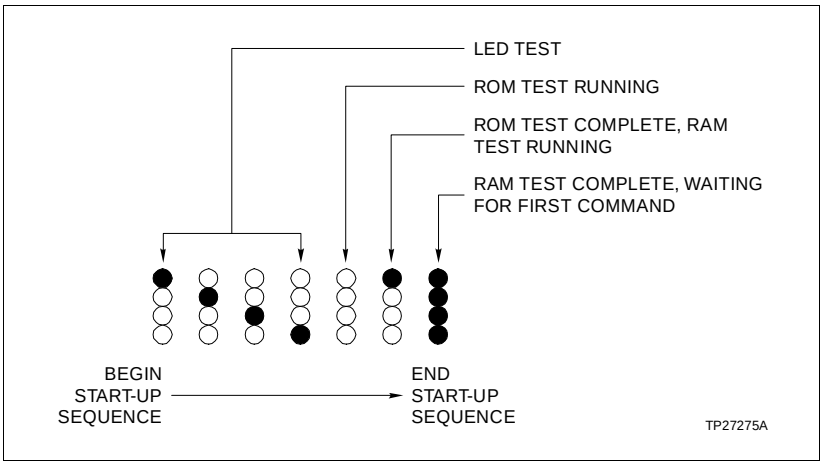


Figure 4-2. Status LED Group Sequence During Start-Up

Figure 4-3 illustrates the LED sequence during normal operation.

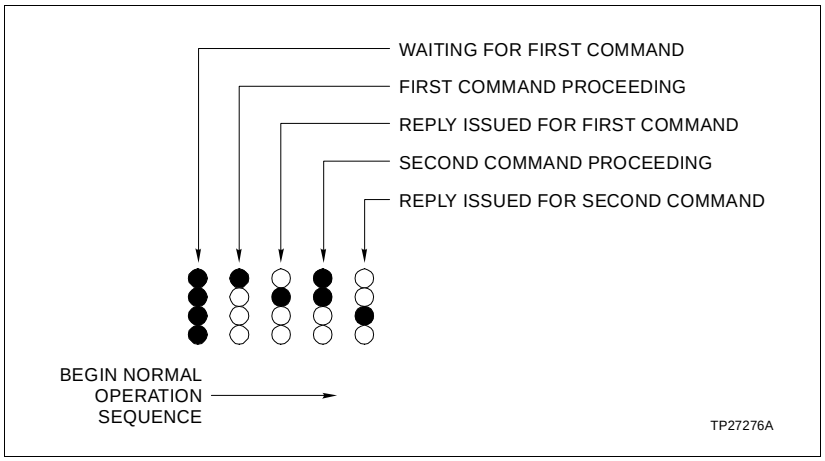


Figure 4-3. Status LED Group Sequence During Normal Operation

START-UP PROCEDURES

Start-up of the SPM is fully automatic. Its jumpers and dipswitches must be configured before installing the module. The module automatically runs on-line self tests to determine the status of its circuitry and lights the status LEDs accordingly. If the module status LED is not solid green after installation and the start-up sequence (i.e, on-line tests), refer to Section 5 for corrective actions. Once the module is on-line and operating, observe the status LED group to determine the sequence of operations currently being performed by the SPM.

SECTION 5 - TROUBLESHOOTING

INTRODUCTION

This section explains the error indications and corrective actions for the Serial Port Module (SPM). It also contains procedures to run a serial port checkout and module bus checkout test.

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

ERROR INDICATIONS AND CORRECTIVE ACTION

After power up or reset, the SPM conducts self tests to determine its operating status. A failure of these tests causes a module *time out*. The status can be obtained through the front panel module status LED indicator.

The status LED group can be observed during start-up to determine the current on-line test being run. It can also be observed during normal operation to determine the current computer command and SPM reply sequence. Refer to Section 4 to interpret the start-up indications.

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

MODULE STATUS LED

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

> **NOTES:**
> 1. 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.
>
> 2. Module status cannot be read for this module.

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

Table 5-1. Status LED Indications and Corrective Actions

LED State	Indication	Probable Cause	Corrective Action
Green	SPM powered up and operating normally, ALL self tests passed.	Normal operation.	No action required.
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.
Off	No power to SPM.	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 SPM). LED or LED driver failure.	SPM circuit failure.	Replace module or contact nearest Bailey Controls representative.

SERIAL PORT AND MODULE BUS CHECKOUT

Tests can be run to check the SPM serial ports and module bus communication. The serial port checkout (i.e., echo test) can be done to check either of the SPM serial ports. The module bus checkout procedure checks the communication between the SPM and modules on the module bus. Both tests require a diagnostic terminal (i.e., dumb terminal).

These tests can be run as a troubleshooting procedure or after SPM installation to verify module operation and connections. An explanation of the procedures follows.

Serial Port Checkout Procedures

The echo test can be run to test each RS-232C serial port. In the echo test mode, the SPM receives a character code (i.e., keyboard character) typed at a diagnostic terminal and returns that code to the terminal for display. The terminal monitor will immediately display the letter that was typed if the SPM serial port the diagnostic terminal is connected to operates properly.

The echo test checks the SPM receive and send operations. It also checks the connections between the SPM and the terminal.

To run the test:

1. Set S4 dipswitch position 3 on the SPM to OPEN (OFF) to initiate the echo test. Take note of the byte framing and parity

set by the SPM jumpers. Refer to Section 3 to interpret the jumper settings.

2. Install the module in the Module Mounting Unit (MMU) following the procedures outlined in ***Physical Installation*** in Section 3. Observe the module LEDs to verify proper start-up. If the module status LED does not light green, refer to Table 5-1 to interpret indications and determine corrective actions.

3. Set the diagnostic terminal byte framing and parity to match the SPM.

> **NOTE:** Make sure the diagnostic terminal power is OFF before connecting or disconnecting the RS-232C cable.

4. Connect a RS-232C cable to the faceplate connector to test port 2, or to the RS-232C connector on the optional Termination Unit (TU) to test port 1. Refer to Appendix A for TU connections. The cable should be wired for DTE to SPM connection shown in Figure 3-2.

5. Connect the other end of the RS-232C cable to the diagnostic terminal, and turn the diagnostic terminal ON.

6. Type any character on the terminal keyboard. The SPM status LED group should increment each time a character is typed, and the terminal monitor should display the typed character.

7. If the terminal or SPM does not respond, check the cable connection and verify that the byte framing and parity is set the same for the SPM and terminal. If the test works properly, continue to next step.

> **NOTE:** Make sure the diagnostic terminal power is OFF before connecting or disconnecting the RS-232C cable.

8. If both ports are to be tested, change the RS-232C cable to serial port connection. Remove the RS-232C cable from the port it was connected to in step 4 and connect it to the opposite port (i.e., if connected to port 2, change it to port 1). Reset the SPM and repeat steps 6 and 7. If the second port is not being tested, continue to step 9.

9. Remove the SPM and set S4 dipswitch position 3 to CLOSED (ON).

10. Disconnect the diagnostic terminal and connect the SPM for normal operation.

Module Bus Checkout Procedures

The module bus checkout tests the SPM module bus communication. A diagnostic terminal is required to run this check. By entering command codes at a diagnostic terminal connected to the SPM, the communication between the SPM and modules on the module bus can be checked.

A fault exists if the SPM does not respond with a reply code that displays on the terminal monitor. The SPM front panel status LED group can be observed while running this test to verify that commands are being received by the SPM. The LEDs increment each time a command and reply sequence initiates.

To run the test:

1. Set S4 dipswitch position 1 on the SPM to OPEN (OFF) to enter ASCII mode. Take note of the byte framing and parity set by the SPM jumpers. Refer to Section 3 to interpret the jumper settings.

2. Install the module in the MMU following the procedures outlined in ***Physical Installation*** in Section 3. Observe the module LEDs to verify proper start-up. If the module status LED does not light green, refer to Table 5-1 to interpret indications and determine corrective actions.

3. Set the diagnostic terminal byte framing and parity to match the SPM.

> **NOTE:** Make sure the diagnostic terminal power is OFF before connecting the RS-232C cable.

4. Connect a RS-232C cable to port 1 (i.e., computer port) at the faceplate connector or the TU. Refer to Appendix A for TU connections. The cable should be wired for DTE to SPM connection shown in Figure 3-2.

5. Connect the other end of the RS-232C cable to the diagnostic terminal, and turn the diagnostic terminal ON.

6. Press Enter on the terminal keyboard. The terminal monitor should display *002.* The *002* is a reply code that indicates that an incorrect command has been entered.

> **NOTE:** Refer to the Computer Interface Unit Programmer's Reference Manual I-E93-905-9 for a complete list of reply codes.

7. Type **AU000000002** Enter. This is the full restart command. The SPM should reply with *000,* which overwrites the *AU0.*

> **NOTE:** The typed characters DO NOT display on the terminal monitor.

8. Read a module status to verify that total communication between the SPM and the modules in a PCU works properly. To do this, type **BC00000000XXXXX** Enter, where XXXXX is the five digit module address. These numbers are decimal and not hexadecimal.

> **NOTE:** For example, **BC0000000000022** Enter reads the status of the module with address 22.

A proper reply for a working module consists of 18 digits. The first three digits being a *000* reply code to indicate no errors followed by five, three-digit, decimal status byte values.

> **NOTE:** For example, *000101000000000000* is returned by an executing COM module. The decimal 101 translates to a hexadecimal 65. This is the first status byte that indicates no errors and EXECUTE mode for a COM module. Refer to the Computer Interface Unit Programmer's Reference Manual I-E93-905-9 or the product instruction for the module being checked to interpret status bytes.

9. If S4 dipswitch position 1 was changed in Step 1, remove the module and return the dipswitch to its original position. If not, connect the SPM for operation. Refer to Section 3.

MODULE PIN OUT

Table 5-2 shows the pin connections for edge connector P1.

Table 5-2. P1 Pin Connections

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

PFI = Power Fail Interrupt
NC = Not Connected

Table 5-3 shows the serial port pin connections to edge connector P3 and XU37/XU38. Table 5-4 lists the RS-232C faceplate connector pin connections. All signals are defined with respect to the DTE device (e.g., computer) connected to the SPM. For example RECEIVE DATA (RX DATA) is serial data received by the computer and transmitted by the SPM.

Table 5-3. Port 1 and Port 2 Pin Connections

PORT 1		
P3 Pin	**XU38**	**Signal**
1-5	1-6	NC[1]
6	14	RECEIVE DATA (RX DATA)
7	10	SIGNAL GROUND (SIG GND)
8	15	TRANSMIT DATA (TX DATA)
9	10	SIGNAL GROUND (SIG GND)
10	9/11/12	CLEAR TO SEND (CTS)[2]
11	10	SIGNAL GROUND (SIG GND)
12	13	REQUEST TO SEND (RTS)
13	10	SIGNAL GROUND (SIG GND)
14	7	DATA TERMINAL READY (DTR)
15	10	SIGNAL GROUND (SIG GND)

PORT 2		
P3 Pin	**XU37**	**Signal**
A-E	1-6	NC[1]
F	10	SIGNAL GROUND (SIG GND)
H	14	RECEIVE DATA (RX DATA)
J	10	SIGNAL GROUND (SIG GND)
K	15	TRANSMIT DATA (TX DATA)
L	10	SIGNAL GROUND (SIG GND)
M	9/11/12	CLEAR TO SEND (CTS)[2]
N	10	SIGNAL GROUND (SIG GND)
P	13	REQUEST TO SEND (RTS)
S	7	DATA TERMINAL READY (DTR)
R	10	SIGNAL GROUND (SIG GND)

NOTES:
1. NC = Not Connected
2. For the SPM, the Data Set Ready (DSR) and ReceivedLine Signal Detect (RSLD) signals are synonymous with the Clear To Send (CTS) signal of the SPM. These signals are generated at a common point on the SPM.

Table 5-4. SPM Faceplate RS-232C Connector Pinout

Pin	Signal
1	PROTECTIVE GROUND (PROT GND)
2	TRANSMITTED DATA (TX DATA)
3	RECEIVED DATA (RX DATA)
4	REQUEST TO SEND (RTS)
5	CLEAR TO SEND (CTS)
6	DATA SET READY (DSR)
7	SIGNAL GROUND (SIG GND)
8	RECEIVED LINE SIGNAL DETECT (RLSD)
20	DATA TERMINAL READY (DTR)

Refer to ***SERIAL PORT CONFIGURATION*** in Section 2 for an explanation of these handshaking signals, and how they relate to the SPM.

SECTION 6 - MAINTENANCE

INTRODUCTION

The Serial Port Module (SPM) requires limited maintenance. This section contains a maintenance schedule for the SPM and other INFI 90 assemblies.

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 shut-down, 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 shut-down, whichever occurs first.

SECTION 7 - REPAIR/REPLACEMENT PROCEDURES

INTRODUCTION

This section explains the replacement procedures for a Serial Port Module (SPM).

MODULE REPAIR/REPLACEMENT PROCEDURES

If you determine the SPM 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:

> **NOTE:** Turn the computer or modem power OFF before disconnecting the RS-232C cable.

1. If connected, disconnect the RS-232C cable from the serial port connector located on the module faceplate.

2. 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.

3. Gently slide the module out of the MMU.

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

5. 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.

6. 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.

7. If a RS-232C cable was removed in Step 1, reconnect the cable.

8. Return to normal operation.

> **NOTE:** The module runs on-line self tests during start-up. If an error occurs after installing the module (i.e., module status LED red), refer to Section 5.

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. Spare 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 (NTCU01)

INTRODUCTION

NOTE: This instruction provides information pertaining to the physical installation of the SPM only. For complete termination cable and Termination Unit (TU) installation procedures, refer to Termination Unit Manual I-E93-911.

The Serial Port Module (SPM) can use an optional NTCU01 to provide connection for a diagnostic terminal to serial port 1. A second RS-232C connector on this TU can also be used to connect a computer or modem to port 2 instead of using the SPM faceplate connector.

A NKTU01 termination cable connects the SPM to the TU. This cable connects the handshaking signal and data lines between the SPM and TU.

The same RS-232C cable wiring requirements shown in Figure 3-2 apply when connecting Data Terminal Equipment (DTE) (e.g., computer or diagnostic terminal) or Data Communication Equipment (DCE) (e.g., modem) to the RS-232C connectors on the NTCU01.

To determine TU signal routing, refer to Figure A-1. This figure is a schematic diagram of the NTCU01. Refer to Figure A-2 for

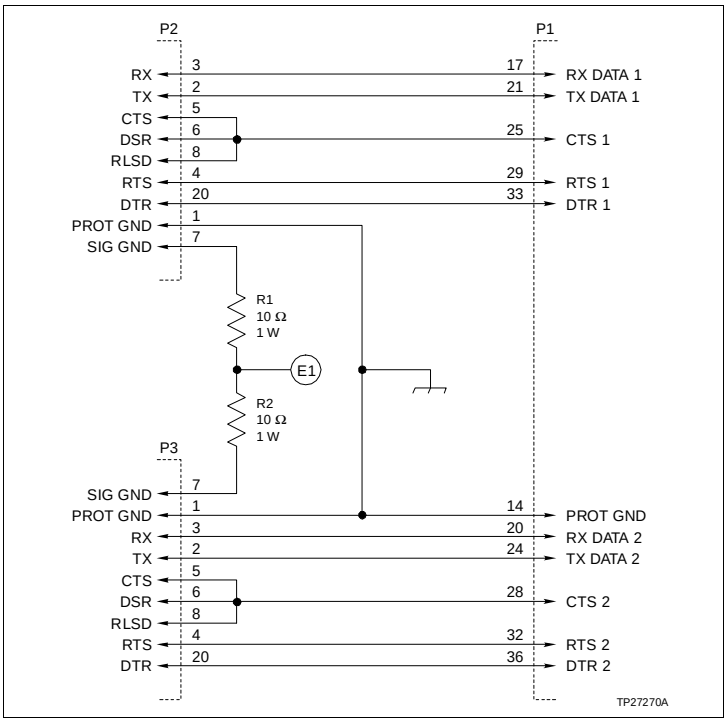


Figure A-1. NTCU01 Schematic Diagram

the cable connections required when installing the optional NTCU01.

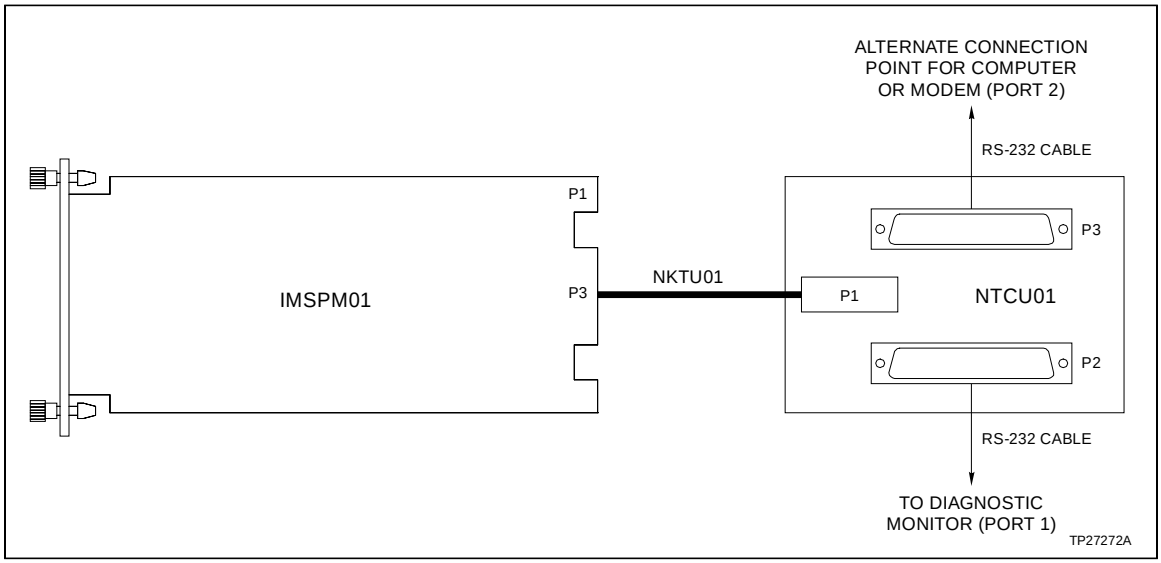


Figure A-2. SPM to Optional Termination Unit Cable Connections

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