APM/HPM
Serial Interface Options

OP01-501

T⊗tal Plant

Honeywell

Implementation
PM/APM/HPM Optional Devices

APM/HPM
Serial Interface Options

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About This Publication

This publication describes Serial Interface options for the Advanced Process Manager (APM) and the High-Performance Process Manager (HPM). Configuration and operation of the Serial Interface on either platform is essentially the same. This manual is intended for use with Release 500 - 510 systems.

This is a reference manual for process engineers, control-system engineers, and application engineers who design and implement data-acquisition and control strategies for TDC 3000^X systems with Local Control Networks.

The user should be familiar with the system control functions described in *System Control Functions, SW09-501* in the *Implementation/Startup & Reconfiguration - 2* binder before using this publication and the Array Point function described in the *Advanced Process Manager Control Functions and Algorithms* manual, *AP09-500 or the High-Performance Process Manager Control Functions and Algorithms* manual, *HP09-500*.

Detailed descriptions of parameters mentioned in this publication can be found in the *Advanced Process Manager Parameters Reference Dictionary, AP09-540*, or the *High-Performance Process Manager Parameters Reference Dictionary, HP09-540*.

> Change bars are used to indicate paragraphs, tables, or illustrations containing changes that have been made to this manual effective with Release 510. Pages revised only to correct minor typographical errors contain no change bars.

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INTRODUCTION
Section 1

This section introduces the external serial interface options available for the Advanced Process Manager or High-Performance Process Manager Array point. Additional information on the Array point can be found in the Advanced Process Manager Control Functions & Algorithms manual or the High-Performance Process Manager Control Functions & Algorithms manual.

1.1 OVERVIEW

The Advanced Process Manager (APM) and High-Performance Process Manager (HPM) provide a point type known as the Array point. An Array point provides access to two sources of data—

- APM/HPM box global variables
- external data from/to Serial Interface devices

In the first case, an Array point can define a section of the APM or HPM box variables as its own data. This function is described in the *Advanced Process Manager Control Functions and Algorithms* manual and in the *High-Performance Process Manager Control Functions & Algorithms* manual.

In the second case, when the Array point is configured for external I/O operation, data from a Serial Interface (SI) IOP can be scanned, imaged (read), and used as if it were local data to the Array point.

The Serial Interface to external subsystem devices is the focus of this manual.

Once subsystem data is resident in the APM or HPM Array point, it can be used by other APM/HPM points. Thus, serial interface data represents essentially "virtual I/O" to the APM or HPM. Array point data can be accessed by other APM/HPM control points, as well as by CL programs. Data can be communicated peer-to-peer to other UCN nodes.

Each FTA module must have at least one corresponding Array point configured in order to initiate serial communications. Data collected through the SI module is available as local data for use by Digital Composite points, Device Control points, CL programs, etc. Note that, unlike other IOP types, an SI module has no "slots."

Array Point Flags and Numerics are fully supported as I/O connections; however, the Serial Interface is primarily intended as an input vehicle and it can efficiently import large quantities of data.

Additionally, the Serial Interface IOP firmware runs diagnostic routines. It monitors and reports any detected communications time-outs or errors between the IOP and FTAs.

1.2 SERIAL INTERFACE DESCRIPTION

Each Serial Interface IOP connects to one or two FTA assemblies. There are 32 slots per Serial I/O card. Sixteen slots can be configured to FTA-1 and 16 slots can be configured to FTA-2 (see Figure 1-1). Plug-in modules adapt the FTAs for different communications

protocols and applications. Certified applications* include—

Modbus Interface (Modicon Modbus-RTU protocol with extensions for real numbers and string support):

- Modicon 984 programmable logic controller
- Other Honeywell-approved Modbus compatible devices

Allen-Bradley Interface:

- Allen-Bradley PLC-2, 3, and 5 programmable logic controllers

Other standard applications are being developed. Custom applications are also available from Honeywell by request.

APM/HPM

SI IOP

Process Manager Module

(up to 80 SI Array points)

Power Adapter

16 Arrays

FTA 1

16 Arrays

FTA 2

To Field Devices

To Field Devices

Each Array point can contain up to 512 Booleans (Flags), or 16 Reals (Numerics), or 32 Integers (Numerics), or 64 byte-sized Integers (Numerics), or 64 ASCII Characters (Strings)

Figure 1-1 — Serial Interface to an Array Point

12447
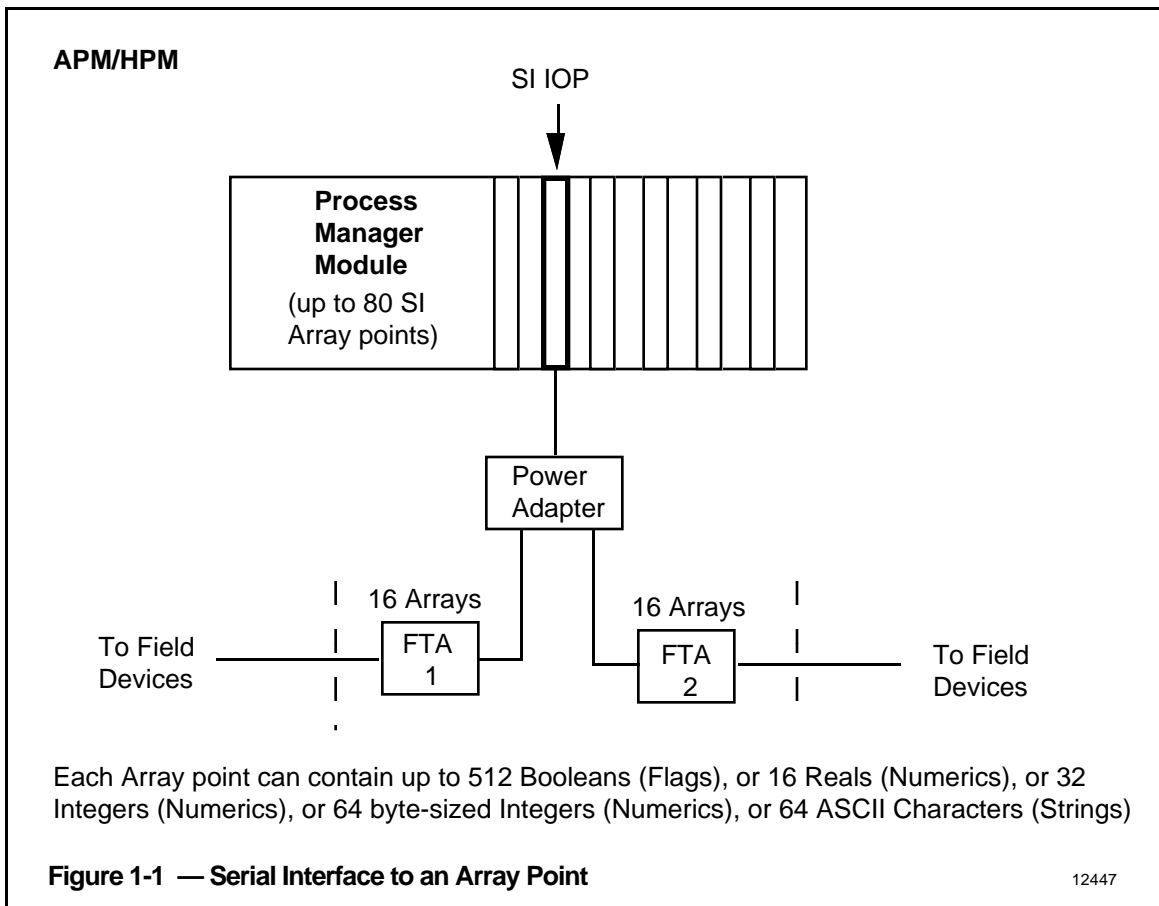
Communications to the field device is by EIA RS-232D or EIA RS-485 standards.** RS-232D communication has a limit of 15 meters (50 feet) and RS-422/485 protocol is supported to 1.2 km (4000 feet). You can extend EIA RS-232D Communications between an FTA and a field device with appropriate MODEMs.

  *Certified Class 2
**Not all signals are supported

1.3 REFERENCES

The following publications contain information related to the functions described in this publication:

- *Advanced Process Manager Parameter Reference Dictionary, AP09-540,* in the *Implementation/Advanced Process Manager - 2* binder.

- *High-Performance Process Manager Parameter Reference Dictionary, HP09-540,* in the *Implementation/High-Performance Process Manager - 2* binder.

- *Engineer's Reference Manual, SW09-505,* in the *Implementation/Startup & Reconfiguration - 2* binder.

- *Control Language/Advanced Process Manager Reference Manual, AP27-510*, in the *Implementation/Advanced Process Manager - 2 binder.*

- *Control Language/High-Performance Process Manager Reference Manual, HP27-510*, in the *Implementation/High-Performance Process Manager - 2 binder.*

- *Advanced Process Manager Implementation Guidelines, AP12-500,* in the *Implementation/Advanced Process Manager - 1* binder.

- *High-Performance Process Manager Implementation Guidelines, HP12-500,* in the *Implementation/High-Performance Process Manager - 1* binder.

- *Advanced Process Manager Control Functions and Algorithms, AP09-500*, in the *Implementation/ Advanced Process Manager -1* binder.

- *High-Performance Process Manager Control Functions and Algorithms, HP09-500*, in the *Implementation/ High-Performance Process Manager - 1* binder.

- *Process Manager I/O Installation*, *PM20-520,* in the *Implementation/ High-Performance Process Manager - 3* binder

- *Process Manager /Advanced Process Manager Service*, *PM13-501*, in the *PM/APM/HPM Service - 1* binder.

- *System Startup Guide–Cartridge Drive*, *SW11-504*, in the *Implementation/ Startup & Reconfiguration - 1* binder**.**

Consult manufacturer's manuals for installation/implementation of the external serial interface devices.

SERIAL INTERFACE INSTALLATION
Section 2

This section covers the installation of the Serial Interface which is comprised of a Serial Interface IOP, Power Adapter, and one or two Serial Interface FTAs.

2.1 SERIAL INTERFACE IOP INSTALLATION

The model MU-PSIM11 Serial Interface IOP can be installed in any available APM or HPM I/O card file slot.

2.2 POWER ADAPTER INSTALLATION

The model MU-TLAP02 Power Adapter is the same size as an A-size (6-inch) FTA and is installed on a standard FTA Mounting Channel. The Power Adapter to IOP connection is made using a model MU-KFTAxx cable (the suffix "xx" references the length of the cable in meters), up to 50 meters (164 feet) in length as shown in Figure 2-1.

2.3 SERIAL INTERFACE FTA INSTALLATION

Up to two Serial Interface FTAs can be connected to a single Serial Interface IOP through the Power Adapter. Any combination of FTAs is allowable. For example, an IOP can support one Allen-Bradley SI FTA (Model MU-TSIA12) and one Modbus SI FTA (Model MU-TSIM12) *or* two of either type.

Each Serial Interface FTA has a single asynchronous serial communications interface that supports standards EIA-232 (RS-232) or EIA-422/485 (RS-422/485), using either a DB-25 or a 5-terminal compression connector, respectively. The Modbus FTA supports either interface type; the Allen-Bradley FTA supports EIA-232 only.

The EIA-232 interface is limited to a distance of 15 meters (50 feet), and the EIA-422/485 interface is limited to a distance of 305 meters (1000 feet) with appropriate interface cable. Consult with your Honeywell representative for the recommended cable if a longer distance is required.

The Serial Interface FTA can be installed in the same APM or HPM cabinet as the Serial Interface IOP using model MU-KLAMxx cable, or remotely using model MU-KSXxxx cable (the suffix "xxx" represents the length of the cable in meters), up to 305 meters (1000 feet) from the Power Adapter. The FTA is an A-size (6-inch) FTA and installs on a standard FTA Mounting Channel.

If the Power Adapter or the Serial Interface FTA is installed remotely to the cabinet, proper grounding and mounting rules must be observed. Refer to the *Process Manager I/O Installation* manual or the *High-Performance Process Manager I/O Installation* manual for the recommended method of mounting and grounding the FTA.

2.4 SERIAL INTERFACE FTA TO POWER ADAPTER CONNECTION

The Serial Interface FTA to the Power Adapter connection is made using Honeywell recommended internal or external cable with stripped wire ends. The cable must have two individually shielded, twisted pair wires. The shield wires are connected to ground at the Power Adapter end only. The wire connections are made using compression terminals in a 6-pin connector at the Power Adapter end and a 4-pin connector at the FTA end as shown in Figure 2-1. The Serial Interface FTA's wiring to the Power Adapter is defined in Table 2-1. A detail of the Serial Interface FTA is shown in Figure 2-2.

To IOP

Model MU-TLAP02 Power Adapter

Model MU-KFTAxx
FTA Cable
50 meters (164 feet)
Maximum Length

Model MU-KLAMxx
Part # 51304465
(Internal) Cable
or
Model MU-KSXxx
Part # 51201426
(External) Cable

Trim the
shield short

Serial Interface
FTA

13047
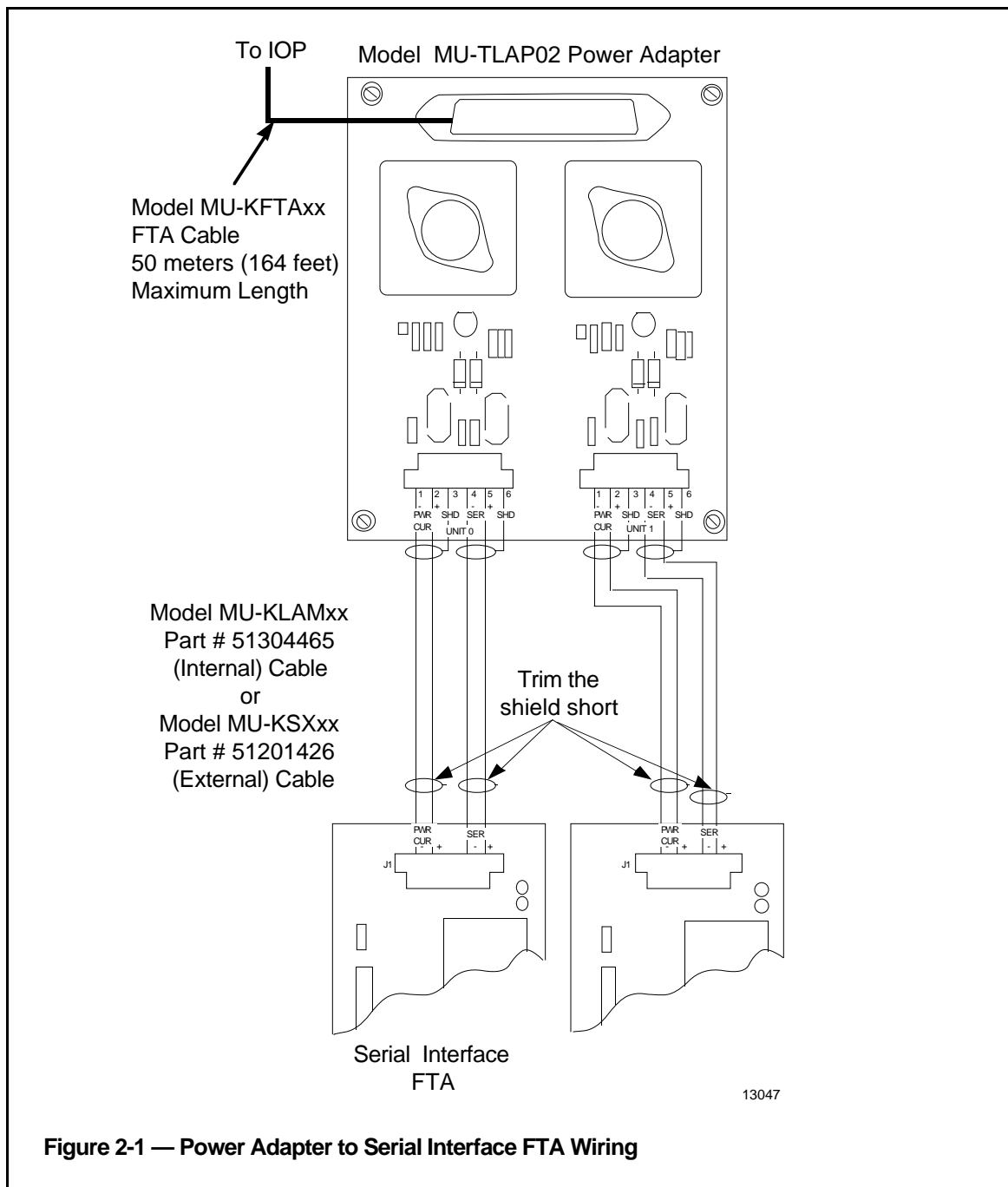
Figure 2-1 — Power Adapter to Serial Interface FTA Wiring

Table 2-1 — J1 – Serial Interface FTA to Power Adapter Interface

Interface Pin	Description
1	Power Current (–)
2	Power Current (+)
3	Serial (–)
4	Serial (+)
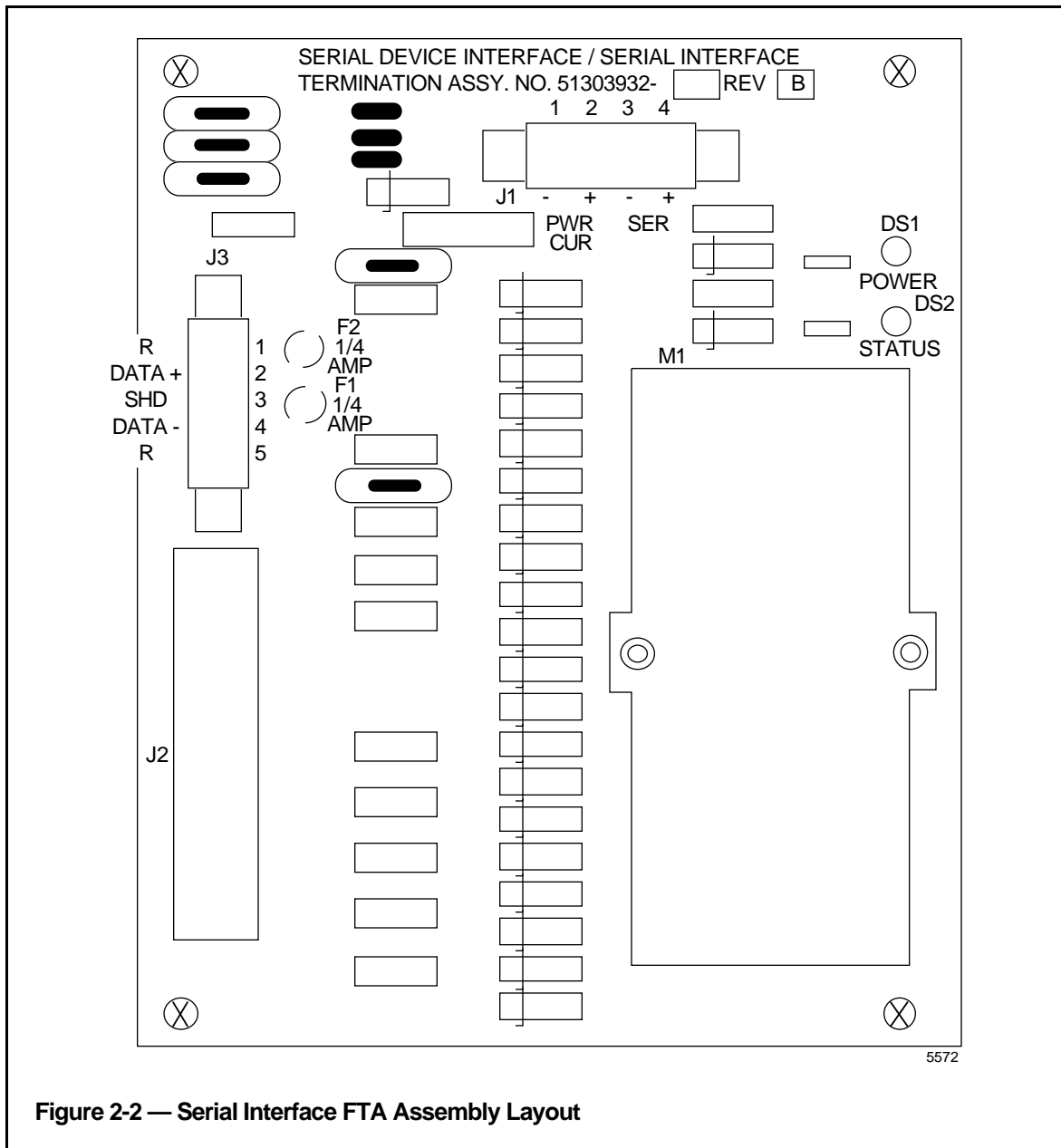
Figure 2-2 — Serial Interface FTA Assembly Layout

2.5 MODBUS SI FTA EIA-232 INTERFACE

The model MU-TSIM12 Modbus Serial Interface FTA, in combination with the model MU-PSIM11 Serial Interface IOP and the model MU-TLAP02 Power Adapter, provides a Modbus RTU EIA-232 (RS-232) *or* EIA-422/485 (RS-422/485) communications interface for peripherals as shown in Figure 2-3.

The EIA-232 interface connection to the device is through the DB-25 type connector, J2, on the FTA (shown in Figure 2-2). Table 2-2 lists the DB-25 pin connections used. Since individual device connection configurations may vary, note to make sure that the FTA Transmit Data pin (2) connects to the Modbus device Receive pin and that the FTA Receive pin (3) connects to the Modbus device Transmit pin.

The EIA-232 interface cable should not exceed 15 meters (50 feet) in length.
The EIA-232 connector on the Serial Interface FTA is a DB-25 socket (female).

Table 2-2 — J2 – Serial Interface FTA EIA-232 Pinout Definitions

Connector Pin	Description
1	Chassis Ground (FG)
2	Transmit Data (TD)
3	Receive Data (RD)
4	Request To Send (RTS)
5	Clear To Send (CTS)
6	Data Set Ready (DSR)
7	Logic Ground (SG)
8	Data Carrier Detect (DCD)
9	Reserved
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	Data Terminal Ready (DTR)
21	
22	
23	
24	
25	

Model MU-PSIM11
Serial Interface
IOP

Card File

Model MU-KFTAxx FTA Cable
50 meters (164 feet) Maximum Length

Model
MU-TLAP02
Power
Adapter

A-size

UNIT 0   UNIT 1

Model MU-KLAMxx Internal Cabinet Cable
or
Model MU-KSXxxx External Cabinet Cable
305 meters (1000 feet) Maximum Length

Model
MU-TSIM12
Serial
Interface
FTA

Model
MU-TSIM12
Serial
Interface
FTA

A-size

EIA-232 (RS-232)
Configured Interface

Modbus
Protocol
Device

Modbus
Protocol
Device
Device 1

Modbus
Protocol
Device
Device 2

EIA-422/485 (RS-422/485)
Configured Interface

Modbus
Protocol
Device
Device 15

6582

Figure 2-3 — Modbus Serial Interface Interconnections

2.6 MODBUS SI FTA EIA-422/485 INTERFACE

The Serial Interface FTA EIA-422/485 (RS-422/485) is provided by a 5-pin compression terminal connector, J3 on the FTA (as shown in Figure 2-2). Signal and ground assignments are listed in Table 2-3. The following guidelines apply for the interface:

- Up to 15 devices can be connected to the EIA-422/485 interface.

- The interface must be no longer than 305 meters (1000 feet). However, the length can be expanded up to 1220 meters (4000 feet) with appropriate cable. Consult with your Honeywell representative for the recommended cable.

- To avoid potential ground loops, the signal cable shield must be connected to the Shield (SHD) pin only at the FTA end of the cable (see Figure 2-4).

- To minimize signal reflections, a 120 ohm 1/2 watt resistor should be connected between pins 1 and 5. The **Data +** and **Data –** signals should be similarly terminated with a 120 ohm resistor on the device at the extreme end of the cable. Figure 2-4 illustrates the method of terminating the EIA-422/485 interface.

- Two 1/4 A fuses, F1 and F2, protect the FTA from excessive current on the data lines. See the Serial Device Interface FTA layout illustration, Figure 2-2.

Table 2-3 — J3 – Serial Interface FTA EIA-422/485 Interface

Connector Pin	Description
1	R (Data +)
2	Data +
3	Shield
4	Data –
5	R (Data –)

NOTE

The EIA-422/485 interface can be configured as a multidrop interface in which several peripheral devices can be connected. Refer to Figure 2-4 for important connection details.

Single Cable Ground Connection

Cable Shield

J3

First Unit on Link

R

1

2

Data +

120 Ω

3

Shd

4

Data -

5

R

Note 1

Data +

Data -

Model MU-TSIM12
Serial Interface FTA

Second Unit on Link

Data +

Note 1

Data -

Notes

1. Connect the shield wires together with a crimp connector, Honeywell part number 30755381-001. Ground the cable shield at only one location by connecting the shield wire to J3, pin 3 on the FTA as shown. Insulate the exposed ends of the shield wire.

2. Do not route the cables in the same conduit or tray as AC power.

3. J3, pin 1 is connected to pin 2, and J3, pin 4 is connected to pin 5 internally on the FTA.

4. Up to15 units can be connected to the EIA-422/485 interface. System performance is dependent on several variables such as the number of peripherals, the baud rate, the number of transactions, and the FTA Device Driver firmware.

Last Unit on Link
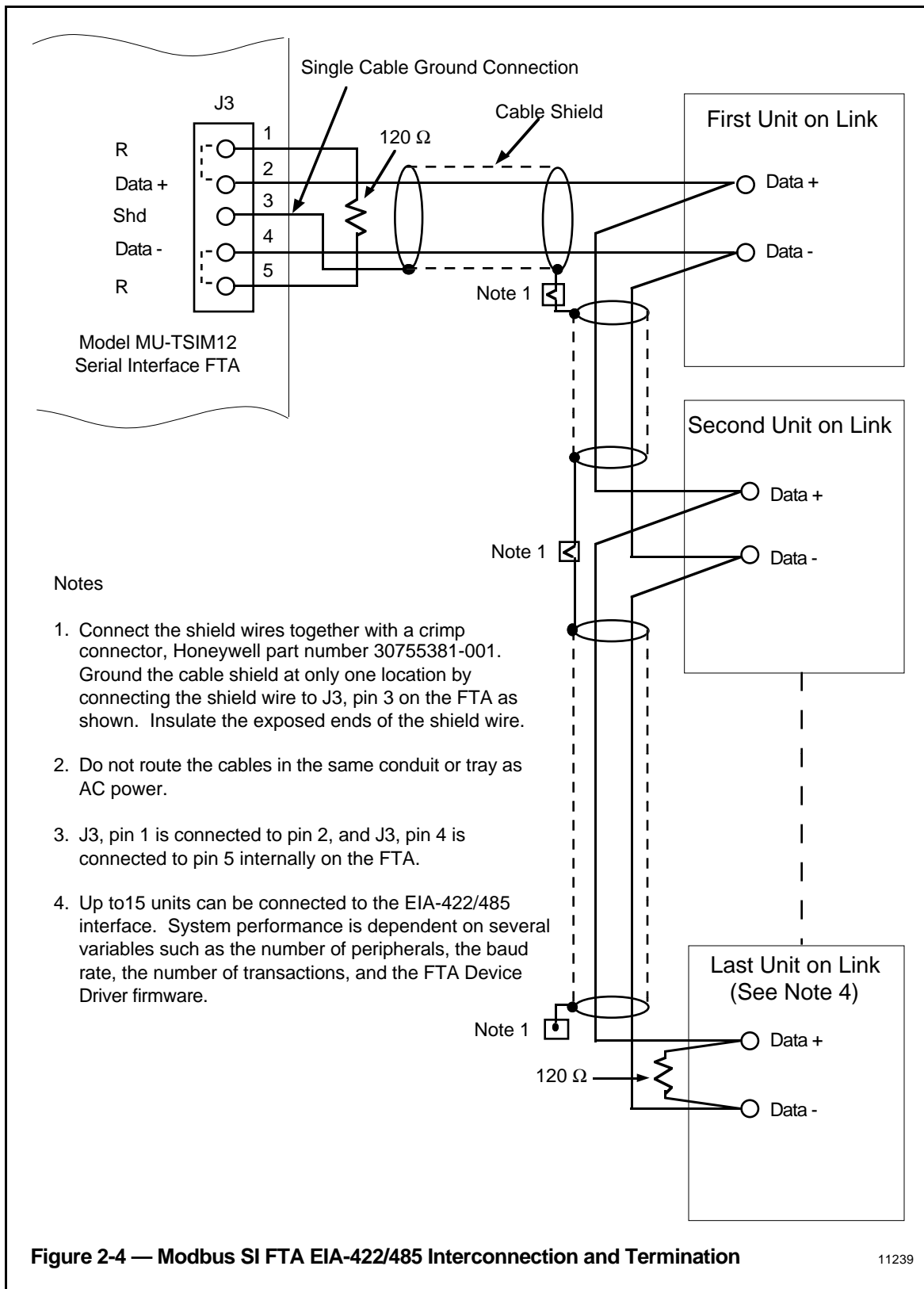(See Note 4)

Note 1

Data +

120 Ω

Data -

Figure 2-4 — Modbus SI FTA EIA-422/485 Interconnection and Termination   11239

2.7 ALLEN-BRADLEY SI FTA EIA-232 INTERFACE

The model MU-TSIA12 Allen-Bradley Serial Interface FTA, in combination with the model MU-PSIM11 Serial Interface IOP and the model MU-TLAP02 Power Adapter, provides an EIA-232 (RS-232) communications interface for the Allen-Bradley PLC-2, PLC-3, or PLC-5 devices with an EIA-232 interface as shown in Figure 2-5 below and in Figure 2-6 (next page).

The interface connection to the device is through the DB-25 type connector, J2, on the FTA (as shown in Figure 2-2). Table 2-2 lists the standard EIA-232 DB-25 pin connections (see also the cable specifications for Allen-Bradley devices in subsection 2.7.1). The EIA-232 interface cable should not exceed 15 meters (50 feet) in length.

NOTE

Connections and options are subject to change by Allen-Bradley without notice to or from Honeywell. Please Contact Allen-Bradley for the latest interface products.

CIM = A-B Communications Interface Module
Protocol = A-B DF1 with embedded responses

14603
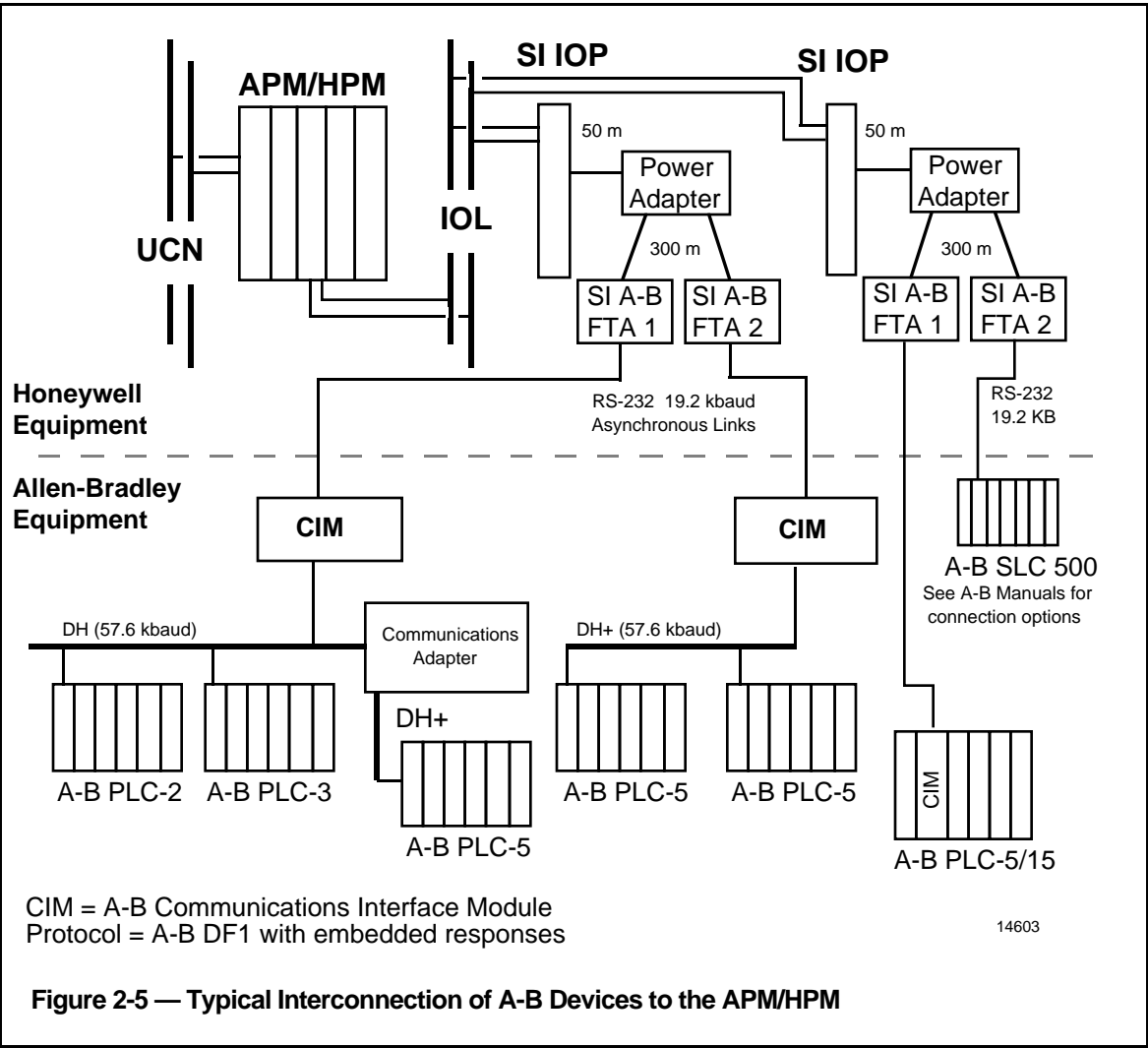
Figure 2-5 — Typical Interconnection of A-B Devices to the APM/HPM

Model MU-PSIM11
Serial Interface IOP

Card File

Model MU-KFTAxx FTA Cable
50 meters (164 feet) Maximum Length

Model
MU-TLAP02
Power
Adapter

A-Size

UNIT 0   UNIT 1

Model MU-KLAMxx Internal Cabinet Cable
or
Model MU-KSXxxx External Cabinet Cable
305 meters (1000 feet) Maximum Length

Model
MU-TSIA12
Serial
Interface
FTA

Model
MU-TSIA12
Serial
Interface
FTA

A-Size

EIA-232 (RS-232) Interface
[Max. Length 15 m (50 ft.)]

Allen-Bradley
PLC-2, PLC-3,
or
PLC-5 Device

Allen-Bradley
PLC-2, PLC-3,
or
PLC-5 Device

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Figure 2-6 — Allen-Bradley Serial Interface FTA EIA-232 Interconnections

2.7.1 Allen-Bradley Serial Interface Cable Specifications

There are a number of Allen-Bradley (A-B) devices to which the Serial Interface FTA can connect. Because pin-out arrangements at the A-B end may vary, no one cable can be recommended. Instead, refer to the pin-out description in the Allen-Bradley device manual and exercise the following cabling guidelines:

- The interconnection is EIA-232, point-to-point, 19.2 kbaud, and the FTA uses only the following connection pins:

        Pin 1   Chassis Ground (FG)
        Pin 2   Transmit Data (TD)
        Pin 3   Receive Data (RD)
        Pin 7   Logic Ground (SG)

Note that:

- The FTA Transmit Pin (2) should connect to the A-B device Receive pin.
- FTA Receive Pin (3) should connect to the A-B device Transmit pin.
- The chassis ground and logic grounds should **not** connect.
- The A-B device may require other pins to be jumpered; refer to the A-B device manual for instructions.
- When connecting to an A-B PLC, usually through a KE or KA module, ensure that the device has the latest firmware available from Allen-Bradley.
- The EIA-232 connector on the Serial Interface FTA is a DB-25 socket (female).

ARRAY POINT IMPLEMENTATION
Section 3

This section describes the Serial Interface Array point in the Advanced Process Manager or the High-Performance Process Manager and tells how it is configured to communicate with external Serial Interface devices. Additional information about the parameters mentioned in this section can be found in the appropriate Parameter Reference Dictionary.

3.1 SERIAL INTERFACE ARRAY POINT DESCRIPTION

The Array point accesses external data from the serial device through its Flag, String, and Numeric parameters. For each Array point, only one type of variable (Strings, Flags, or Numerics) can be used for Serial Interface communications.

3.1.2 Array Parameter Names

Data elements in the Array point are referred to by the Array point tagname, type of variable and index number (i). For example ARR01.FL(9). The complete list follows:

Variable	Parameter Reference
Flags	FL(i)
Numerics	NN(i)
Strings	STRn(i)
Times	TIME(i)

In the case of strings, n refers to the string length, 8, 16, 32, or 64. For example STR32(4).

3.1.3 SI Array Point Communication

Figure 3-1 illustrates communications between the Array point and the serial IO subsystem. The plug in FTA module adapts I/O requirements for the specific serial interface.

The SI IOP module has 32 slots available. Up to 16 slots can communicate through FTA number 1, and up to 16 slots can communicate through FTA number 2. An array point automatically communicates through any available slot on the SI IOP connected to the FTA specified during Array point configuration.

Scanning—Figure 3-1 also helps to understand an important concept. At the FTAs, data is scanned in from the serial devices, then sent to the SI IOP as quickly as possible. In the Modbus FTA, data is scanned as fast as possible ("free running") at up to 19.2 kbaud. In the Allen-Bradley FTA, the scan method is individually selected for each array point using one of the following three options: free running, periodic, and report-by-exception (RBE).

That data is then imaged from the SI IOP into the Process Manager Module (PMM) at one of three rates (1/4 second, 1/2 second, or 1 second) which you can configure with the parameter SCANPER. The data is stored in an Image Database and is thereafter immediately available to the PMM.

It is important to understand that even though you might be bringing data into the SI IOP at a 1/4 second rate, the serial subsystem may provide new data at a much slower rate (several seconds for some devices); this may be the limiting factor. A write to the serial subsystem is much faster, but still limited by the subsystem network response time.

APM or HPM
Process Manager Module

Box
Variables

SI
Array
Point

Image
Database

Read

Write

SI IOP

Slots
1–16

Slots
17–32

FTA
1

Serial
Link

FTA
2

Serial
Link

Plug in Module

Scan

Register
Range to
be Scanned

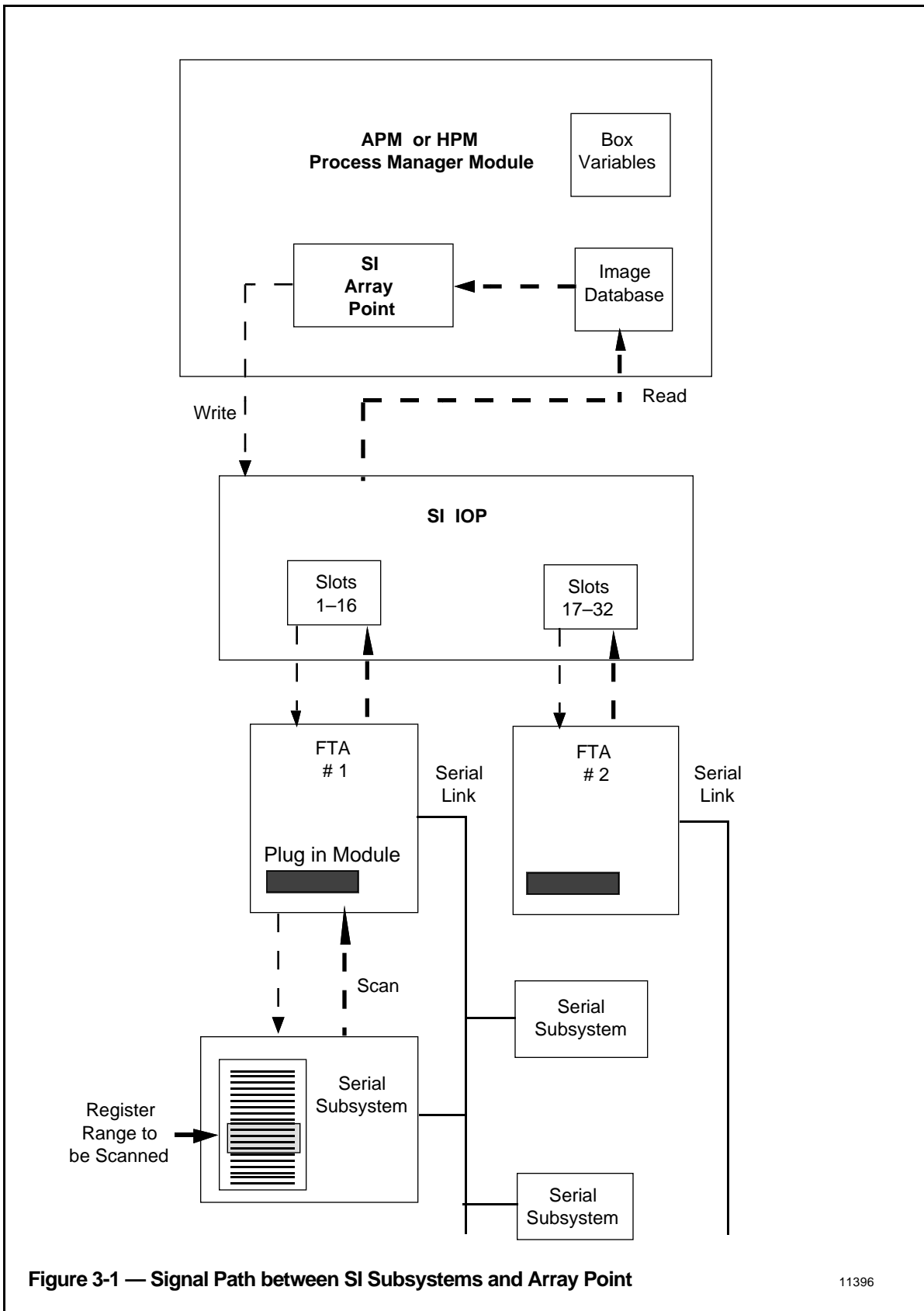Serial
Subsystem

Serial
Subsystem

Serial
Subsystem

Figure 3-1 — Signal Path between SI Subsystems and Array Point

11396

3.2 SERIAL INTERFACE ARRAY POINT CONFIGURATION

There are several parts to configuration. The things you should consider for Serial Interface Array points are described below—

If the APM/HPM node is already configured and running, when adding an SI Array point, you should check the Node Specific Configuration screen for the items described in subsection 3.2.1 and reconfigure the node, if necessary.

If you are initially configuring a system, both the UCN network and the APM/HPM node must be configured. When configuring the node, carefully observe the requirements in subsection 3.2.1.

When the node is configured and running, the array points can be built. Most of this section deals with Array point configuration for the Serial Interface.

Finally, the Serial Interface device(s) will probably need some configuration or preparation. This varies with the manufacturer and is beyond the scope of this publication, so you should refer to the manufacturer's manuals.
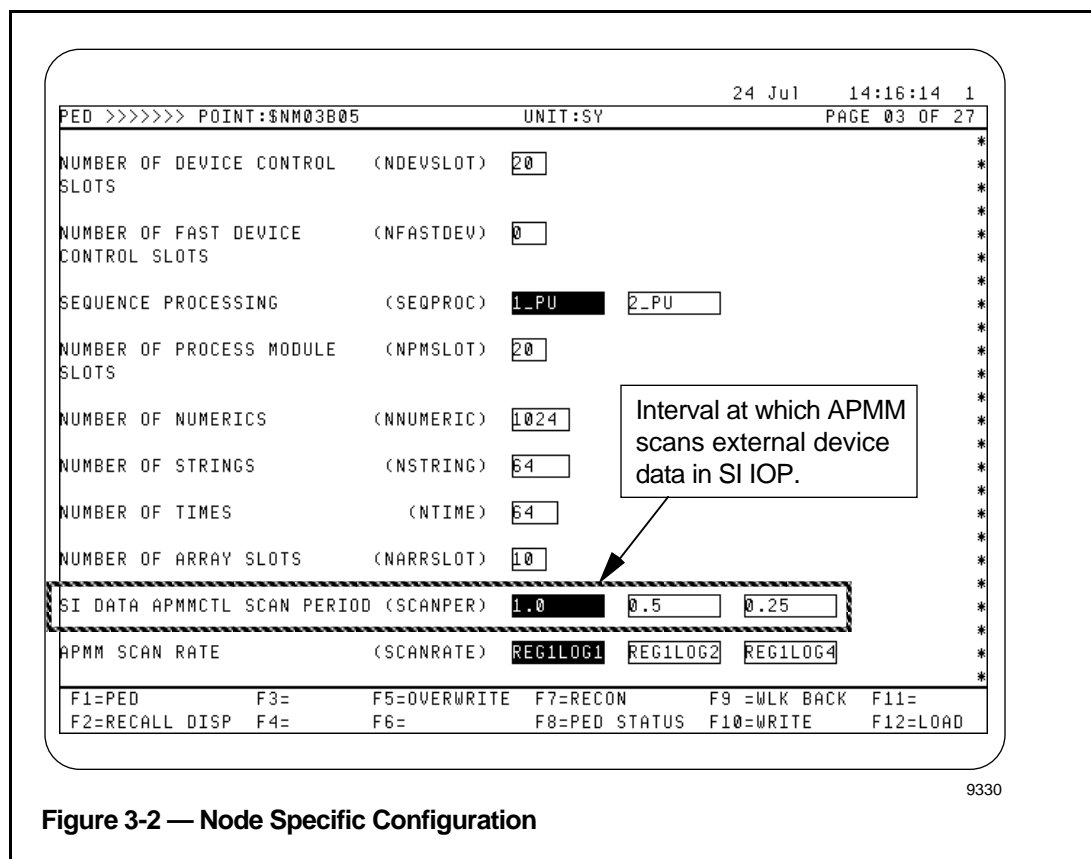
3.2.1 Node Specific Configuration Requirements

APM/HPM Node Specific Configuration is a menu choice after selecting `Network Interface Module` on the Engineering Main Menu. Refer to the System Startup Guide if you are unfamiliar with configuration procedures.

Figure 3-2 illustrates the area of interest for Array point configuration on the Node Specific Configuration screen forms.

The total number of points and data types selected should also include the allocation for global box variable type Array points used for other purposes in the system. Global box variable Array points are described in Section 10 of the *Advanced Process Manager Control Functions and Algorithms* manual or the *High-Performance Process Manager Control Functions and Algorithms* manual.

Also note that 16,384 box flags are always available. The number of variables of each data type available to an Array point is further limited by parameter entries when building each Array point.

You can allocate up to 256 array points through the parameter NARRSLOT (number of array slots). Up to 80 of these can be SI Array points.

```
                                              24 Jul    14:16:14  1
PED >>>>>>> POINT:$NM03B05              UNIT:SY              PAGE 03 OF 27
                                                                         *
NUMBER OF DEVICE CONTROL    (NDEVSLOT)  20                                *
SLOTS                                                                    *
                                                                         *
NUMBER OF FAST DEVICE       (NFASTDEV)  0                                 *
CONTROL SLOTS                                                            *
                                                                         *
SEQUENCE PROCESSING         (SEQPROC)   1_PU       2_PU                  *
                                                                         *
NUMBER OF PROCESS MODULE    (NPMSLOT)   20                               *
SLOTS                                                                    *
                                                                         *
NUMBER OF NUMERICS          (NNUMERIC)  1024    Interval at which APMM   *
                                                scans external device   *
NUMBER OF STRINGS           (NSTRING)   64      data in SI IOP.         *
                                                                         *
NUMBER OF TIMES               (NTIME)   64                               *
                                                                         *
NUMBER OF ARRAY SLOTS       (NARRSLOT)  10                               *
                                                                         *
SI DATA APMMCTL SCAN PERIOD (SCANPER)   1.0        0.5        0.25       *
                                                                         *
APMM SCAN RATE              (SCANRATE)  REG1LOG1  REG1LOG2  REG1LOG4     *
                                                                         *
F1=PED         F3=       F5=OVERWRITE  F7=RECON       F9 =WLK BACK  F11=
F2=RECALL DISP F4=       F6=           F8=PED STATUS  F10=WRITE     F12=LOAD
```

9330

Figure 3-2 — Node Specific Configuration

Other Node Specific Configuration parameters that affect the SI Array point are—

- NNUMERIC - the number of Numerics (in multiples of 16) that you want available.

- NSTRING - the number of Strings that you want available (in multiples of 16).

- NTIME - the number of Times (in multiples of 32) that you want available.

- SCANPER - this parameter specifies the period at which the Process Manager Module scans SI data and maps it to the Array points. The PMM can scan SI IOP data at three rates and this determines the maximum number of Array points with SI connections that you can have:

SCANPER (Scan Period)	Maximum Number of SI/Array Points
1 Second	80
0.5 Second	40
0.25 Second	20

Finally, you must select SI as the Module Type on the IO Module Configuration pages for each SI IOP board that you wish to implement. Figure 3-3 illustrates the screen form.
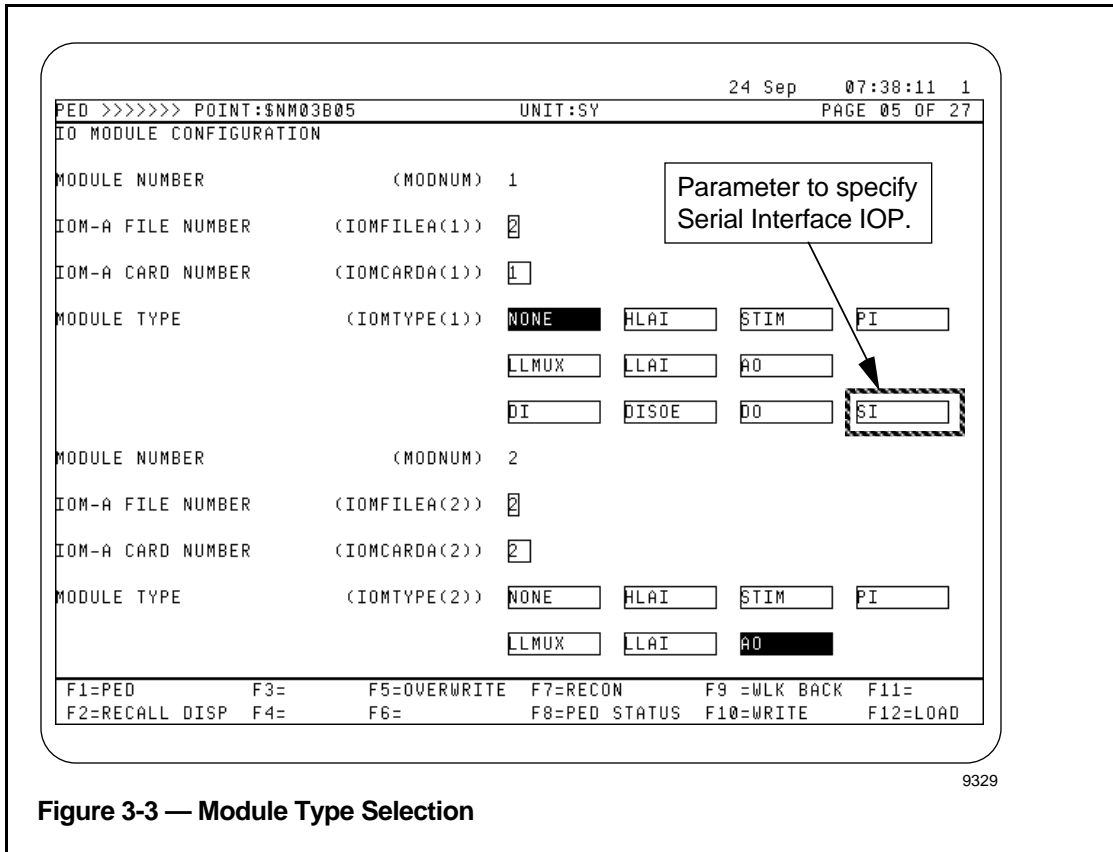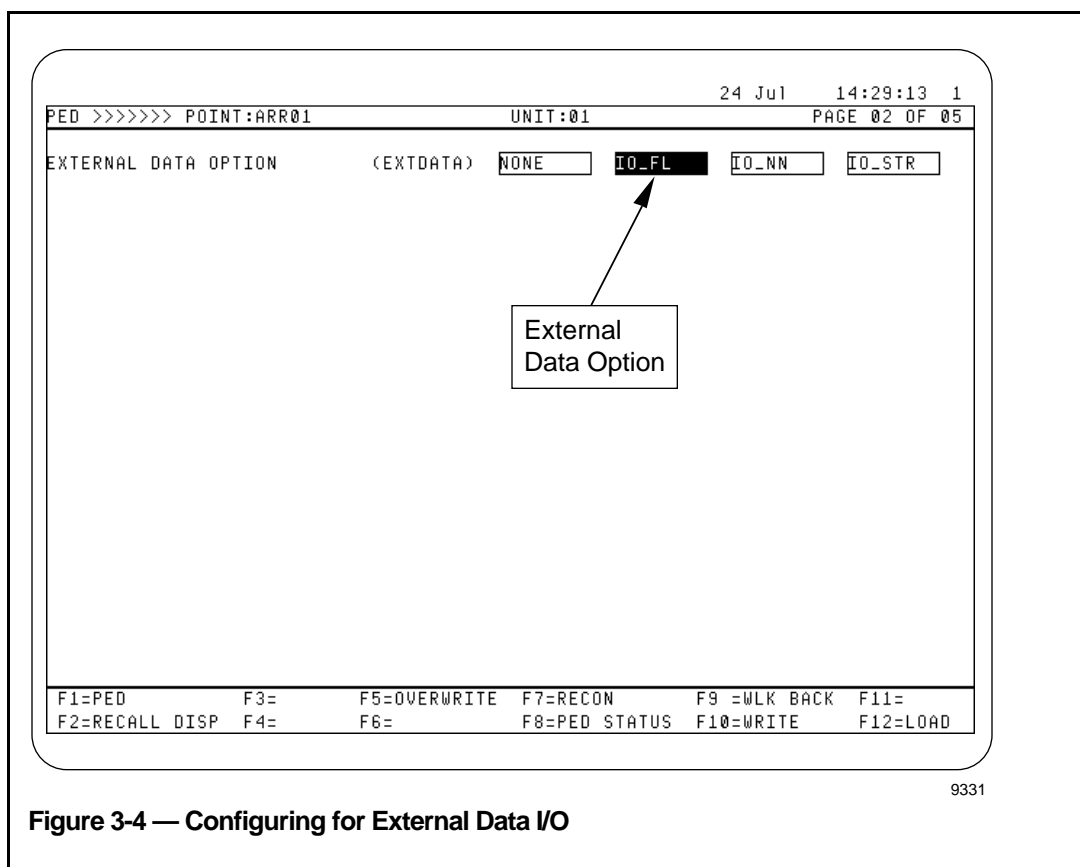
```
                                              24 Sep    07:38:11  1
PED >>>>>> POINT:$NM03B05           UNIT:SY            PAGE 05 OF 27
IO MODULE CONFIGURATION

MODULE NUMBER              (MODNUM)  1
                                             ┌─────────────────────┐
IOM-A FILE NUMBER      (IOMFILEA(1))  2      │ Parameter to specify │
                                             │ Serial Interface IOP.│
IOM-A CARD NUMBER      (IOMCARDA(1))  1      └─────────────────────┘

MODULE TYPE            (IOMTYPE(1))  NONE      HLAI       STIM      PI

                                     LLMUX     LLAI       AO

                                     DI        DISOE      DO        SI

MODULE NUMBER              (MODNUM)  2

IOM-A FILE NUMBER      (IOMFILEA(2))  2

IOM-A CARD NUMBER      (IOMCARDA(2))  2

MODULE TYPE            (IOMTYPE(2))  NONE      HLAI       STIM      PI

                                     LLMUX     LLAI       AO

 F1=PED          F3=      F5=OVERWRITE  F7=RECON       F9 =WLK BACK  F11=
 F2=RECALL DISP  F4=      F6=           F8=PED STATUS  F10=WRITE     F12=LOAD
```

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Figure 3-3 — Module Type Selection

3.3 BUILDING SI ARRAY POINTS

Array point configuration begins by selecting Process Points from the `NIM Build Type Select Menu`. Then select `Array`. The first few screen form entries are for the tagname, unit, etc.

To configure the Array point to obtain input from a serial interface, set EXTDATA = IO_FL, IO_NN, or IO_STR (see Figure 3-4). You can choose Flags, Numerics or Strings, but only one type data can come through the Serial Interface per Array point.

Non-selected parameters still refer to the APM/HPM Box variables. For example, if the EXDATA selection is IO_FL, the number and starting index for flags refers to Serial Interface data through the selected FTA. Numeric, string, and times references from this array point are to the APM/HPM box variables.

```
                                            24 Jul    14:29:13  1
PED >>>>>>> POINT:ARR01               UNIT:01              PAGE 02 OF 05

EXTERNAL DATA OPTION        (EXTDATA)  NONE      IO_FL    IO_NN     IO_STR









                                           External
                                           Data Option













  F1=PED          F3=        F5=OVERWRITE  F7=RECON      F9 =WLK BACK  F11=
  F2=RECALL DISP  F4=        F6=           F8=PED STATUS F10=WRITE     F12=LOAD
```

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Figure 3-4 — Configuring for External Data I/O

When the Array point is configured for external data, additional parameters appear on the configuration screen form. These are:

- the SI IOP module number   IOPNUM
- the FTA number, 1 or 2   FTANUM
- the serial link device address   DEVADDR
- FTA scan priority, low or high   SCANPRI

The screen form is illustrated in Figure 3-5 and the parameters are described in the following paragraphs.

Figure 3-5 — Configuring External SI Array Point Devices

IOPNUM—You must specify the SI IOP module number, but note that SI IOP points do not need to be configured. All configuration is done in the Array point and the Process Manager Module then establishes a connection and loads all necessary configuration data to the SI IOP. The PMM automatically reloads configuration data to the Serial Interface IOP after every IOP startup.

FTANUM—Two FTAs can be connected to each SI IOP. FTANUM specifies which FTA you want to map data through for this Array point.

DEVADDR—is the Serial Link Device Address. This is discussed more later.

SCANPRI—SCANPRI determines the rate at which the FTAs read data from the serial link device(s). Data that changes infrequently can be scanned at low priority to reduce the scanning overhead. This parameter is not used for standard Modbus or Allen-Bradley serial links. Modbus links are scanned as fast as possible, and the Allen-Bradley scan rate is controlled by the AB_DATA4 parameter.

AUX and A-B DATA—These parameters are specific to the type of serial device and are discussed in the Modbus and Allen-Bradley sections.

Refer to the *APM Parameter Reference Dictionary or* the *HPM Parameter Reference Dictionary* for a more detailed explanation of any parameter.

3.3.1 Array Type/Size and Starting Index

Figure 3-6 illustrates the next screen form. Here you can choose the starting index and number of elements for each type of data. Note that parameters not selected for Serial I/O still refer to the APM/HPM Box variables.

For Serial Interface data, the limits are as follows:

Array Type	Array Size	Starting Index Range	Comments
Flag	0 - 512	0 - 99,999	
Numeric (reals)	0 - 16	0 - 99,999	
Numeric (integers)	0 - 32	0 - 99,999	
Numeric (bytes)	0 - 64	0 - 99,999	
Strings	0 - 8	0 - 99,999	Strings may contain 64 characters configured any way from eight, 8-character strings to one, 64-character string.

When used with the Serial Interface, the starting index parameter FLSTIX (Flag), NNSTIX (Numeric), or STRSTIX (String) refer to a register address in the serial device. This register is scanned over the appropriate range as set by the array size. Note that the Starting Index Range may be limited by addressing requirements for the serial device.

Figure 3-6 — Configuring Array Point Starting Index

Access Lock—Parameter SPLOCK determines who has store access to the variables. Configuration choices are Operator, Supervisor, Engineer, or Program.

Descriptors—(Screen form not shown). You can enter 4 descriptors up to 64 characters long, 1 for each type of variable. These descriptors are typically used to describe the array variables. They appear on the Array point Detail Display. Refer to the *Process Operations Manual* for examples.

The SI Array point is designed to communicate with either of the major subsystems described in subsections 3.4 – 3.5 which follow. Continue to the applicable interface description.

3.4   GENERIC MODBUS INTERFACE

Many devices that use the AEG Modicon Modbus RTU protocol can communicate with the APM/HPM through SI Array points. Refer to Modbus documentation for a description of the Modbus protocol.

Some of the Generic Modbus Interface devices approved by Honeywell are—

- AEG Modicon 984
- Triconex Critical Process Controller
- Honeywell 620 Logic Controller
- Rosemount-Micromotion Transmitter

Other devices are being certified. Contact your Honeywell representative for a current list.

3.4.1   Generic Modbus Interface Configuration

The following discussions clarify how to configure an SI Array point for communications with the Generic Modbus.

AUXDATA parameters—The AUXDATA parameters described below all have a default value of NaN (dashes). Note that when the AUXDATA parameters are not being used with a Generic Modbus interface, they should be set to the default value.

  AUXDATA1—AUXDATA1 specifies the Keep Alive Address of a Modbus coil. This feature indicates to the Modbus device that the APM/HPM subsystem is functioning. It can be configured separately on each Array point, but no two Array points should write to the same coil. The coil address must be within the range 00001 to 09999.

  When AUXDATA1 = NaN (dashes), the Keep Alive function is inactive. If you want to check the Keep Alive coil, you must program the Modbus device to do so.

  AUXDATA2— AUXDATA2 specifies the time interval in seconds to wait before attempting a message retry. The range is .25 to 5 seconds or NaN. If NaN is specified, the default time-out is 1.5 seconds. A timeout value can be configured separately for each Array point. If a valid response is not received after three tries (original plus two retries), a MSGTMOUT error results.

AUXDATA3/4—The first valid Array point loaded to the FTA with values in AUXDATA3 and AUXDATA4 sets the mode and baud rate for FTA communications. Therefore, AUXDATA3 and AUXDATA4 must contain the same value for all points configured through the same FTA. If Array points loaded thereafter to that FTA have different AUXDATA3 or AUXDATA4 values, an AUXMATCH error results.

AUXDATA3 specifies the signaling protocol and modem control in an integer/decimal format:

$$\underline{mmm}.\underline{n}$$

signaling   ⌐   ⌐   modem control
protocol   0 = OFF; 1 = ON

For example, 232.1 indicates EIA-232 with modem control on. The other choices are 232.0 and 485.0. EIA-232 permits use of an external modem. The modem control feature switches the following signals: RTS, CTS, DSR, DTR, and DCD. When AUXDATA3 = NaN (the default value) protocol is EIA-232 and modem control is off.

AUXDATA4 specifies the baud rate and parity in an integer/decimal format:

$$\underline{bbbbb}.\underline{n}$$

baud rate   ⌐   ⌐   parity: 0 = none, 1 = Odd, 2 = even

Legal baud rates are 19200, 9600, 4800, 2400, and 1200. NaN (dashes) results in a default value of 19200 baud with odd parity.

AB DATA parameters—The AB_DATA parameters are for use with the Allen-Bradley interface (described later in this section). They should be set to NaN (dashes) when communicating with a Modbus. Likewise, when the Allen-Bradley interface is being used, the AUXDATA parameters should be set to NaN.

3.4.2 Modbus Address Map

The value entered in the Array point Start Index parameter FLSTIX (Flag), NNSTIX (Numeric), or STRSTIX (String) determines the Modbus Start Index and function. Only one type of external data can be accessed per Array point.

Table 3-1 illustrates Modbus functions and their relationship to the Array Start Index. This table is generally familiar to Modbus users. The following paragraphs explain key items.

Array Start Index Ranges—the most significant digit in this column is used to look up the Modbus function (for example, read coil status). The lower four digits define the starting address to access data for that Modbus function.

Data Type, External Data Option, and Data Format—this column specifies the data type for each Modbus range. The Array point External Data Option parameter (IO_FL, IO_NN, or IO_STR) must agree with the Modbus data type for the address range specified.

Note that—

- APM/HPM numeric data mapped to an integer register in a Modbus device is truncated to whole numbers.

- Floating point format data for the address range 20001 to 29999 is returned in standard IEEE floating point format except that the low and high words are swapped. This format is appropriate for the Modicon 984 Programmable Logic Controller (PLC).

- Floating point format data for the address range 70001 to 79999 is returned in standard IEEE floating point format. This format is appropriate for the Triconex Critical Process Controller.

- Floating point format data for the address range 80002 to 89999 is returned in standard IEEE address - 1 floating point format. This format is appropriate for the Honeywell 620 LCS.

For Modbus compatible devices other than those listed above, floating point formats may vary. Honeywell's multivendor interface certification program determines which format (if any) is appropriate. Contact your Honeywell representative for further information.

Maximum Number of Elements—the number in this column specifies the maximum number of array elements configurable for each range. The number of flags, numerics, or strings specified in the Array point parameter NFLAG, NNUMERIC, or NSTRING cannot exceed this number. All of the specified elements are read in a single transaction.

Table 3-1 — Modbus Address Map

Start Index Ranges	Modbus Function	Read FC / Write FC	Data Type, External Data Option, and Data Format	Data Range	Max. No. Elem.
00001-09999	Read Coil Status ———————— Force Single Coil	01 ———— 05	FLAGS, IO_FL Read/Write Bit Flags	ON/OFF	512
10001-19999	Read Input Status ———————— N/A	02 ———— N/A	FLAGS, IO_FL Read Only Bit Flags	ON/OFF	512
20001-29999*	Read Holding Registers ———————— Preset Multiple Registers	03 ———— 16**	NUMERICS, IO_NN Word Swapped IEEE Fl.Pt Read/Write	-34E38 to 34E38	16
30001-39999	Read Input Registers ———————— N/A	04 ———— N/A	NUMERICS, IO_NN Signed Integer Words Read Only	-32768 to 32767	32
40001-49999	Read Holding Registers ———————— Preset Single Register	03 ———— 06	NUMERICS, IO_NN Signed Integer Words Read/Write	-32768 to 32767	32
50001-59999*	Read Holding Registers ———————— Preset Multiple Registers	03 ———— 16**	STRINGS, IO_STR ASCII Encoded Bytes Read/Write	Printable Characters	8 of 8 4 of 16 2 of 32 1 of 64
60000*	Loopback Diagnostic ———————— N/A	08 ———— N/A	STRINGS, IO_STR Loopback Test	None	1 of 64
70001-79999*	Read Holding Registers ———————— Preset Multiple Registers	03 ———— 16**	NUMERICS, IO_NN IEEE Floating Point Read/Write	-34E38 to 34E38	16
80002-89999*	Read Holding Registers ———————— Preset Multiple Registers	03 ———— 16**	NUMERICS, IO_NN IEEE Fl. Pt in Addr-1 Read/Write	-34E38 to 34E38	16
90001-99999	Read Holding Registers ———————— Preset Single Register	03 ———— 06	NUMERICS, IO_NN Unsigned Integer Words Read/Write	0 to 65535	32

*These ranges are extensions to the Modbus protocol specification to support certain Modbus devices.

**Function Code 16 is used to write a multiword data type in one transaction.

3.4.3 Modbus Loopback Diagnostic

The loopback test consists of sending a test message to the Modbus device and waiting for the proper response. The procedure is—

- build an Array point with the external data parameter EXT_DATA = IO_STR
- configure for a single, 64-character string at address 60000 (Loopback Test address) (NSTRING = 1, STRLEN = 64, and STRSTIX = 60000).

When the point is active, the Detail display should contain the message:

```
Loopback Test: Attempted - xxxxx   Pass - xxxxx,
```

where xxxxx is a pass/failure count.

Note that the loopback test can run along with other Array point scans, but doing so adversely affects performance.

3.4.4 Performance Considerations

All configured array points scan the Modbus devices in a circular sequence as quickly as possible with read data requests. When a write data request occurs, it preempts the read requests. The number of consecutive write data requests is limited to 16, after which, one array point read request is issued.

Lab testing on a Modicon 984-385 indicates that, in general, up to 30 write requests per second can be serviced (with no ladder logic running) before read response is significantly affected. Because of the time ladder logic takes to execute, the maximum number of write requests per second to a Modbus device running ladder logic should be limited further.

3.5 ALLEN-BRADLEY SUBSYSTEM COMMUNICATIONS

This section describes the configuration procedures necessary for an Array point to communicate with Allen-Bradley Programmable Logic Controllers (PLC) through the Serial Interface (SI). Refer to the *Process Manager /Advanced Process Manager I/O Installation* manual or the *High-Performance Process Manager I/O Installation* manual for the standard FTA hardware clip and switch settings.

The Serial Interface FTA communicates with the Allen-Bradley KE/KF Computer Interface Module (CIM) using EIA-232-D protocol at 19.2 Kbaud. The KE/KF module communicates with PLCs on an Allen-Bradley Data Highway or Data Highway Plus using DF1 protocol with embedded responses. Refer to Allen-Bradley Data Highway protocol manuals for details.

The Allen-Bradley families supported are PLC-2, PLC-3, or PLC-5. For the purpose of this document, the PLC-5 family consists of the 5/10, 5/15, 5/25, 5/40, and 5/60 models.

3.5.1 Allen-Bradley Interface Configuration

The parameters described on the following pages are discussed in the order that they appear in the APM/HPM Array point configuration display and some are described further in the *APM* or *HPM Parameter Reference Dictionary*.

3.5.1.1 Device Address

DEVADDR, the device address parameter, must contain the PLC Node Address. The entry must specify the Allen-Bradley node address in octal, but do not convert the address to decimal. For example, if the node address is 75_8, enter 75. Conversion is done automatically by the FTA firmware. The range is $0_8 - 376_8$. More than one Array point can have the same device address.

3.5.1.2 Start Index

The start index specification varies for the different family types. When the requirement is for an octal address, the numbers are typed in from the Universal Station as if they were octal. Any nonoctal digit causes a STARTIDX error. The following paragraphs describe the entry for each Allen-Bradley family.

PLC-2 Array Start Index—for PLC-2, NNSTIX (the numeric start index) or FLSTIX (the flag start index), or STRSTIX (the string start index), specifies an octal address within the PLC-2 data table. For example, if the octal address is 176_8, enter 176.

PLC-3 Array Start Index—for PLC-3, the start index (NNSTIX, FLSTIX, or STRSTIX) specifies either the word part of the PLC-3 address or the structure value for floating point data. For all data types except I/O, the range is $0 - 9999_{10}$. For input and output, the value is entered as if it was an octal number and can range from $0_8 - 377_8$ for actual I/O and $400_8 - 7777_8$ for storage locations.

The PLC-3 Context and External Data Tables are only supported to the extent that Context is fixed = 1 (current context) and the External Data Table always = E3.

PLC-5 Array Start Index—for PLC-5, the file start index is specified by NNSTIX, FLSTIX, or STRSTIX (numerics, flags, or strings, respectively) depending on the type of data.

For flag data, the start index represents the word address within the file.

There is one special case. For the input or output file (when AB_DATA3 = 0 or 1), the value entered for the flag start index (FLSTIX) represents an octal number in the range 000_8 - 177_8. File size ranges from $000_8 – 177_8.$ A nonoctal digit or an out-of-range value causes a STARTIDX error.

All other PLC-5 start index values are specified as integers, including the flag starting index (except for the input or output file). File size is not checked by the Serial Interface.

3.5.1.3 Number of Elements

The Array point parameters NNUMERIC, NFLAG, or NSTRING specify the number of file or data table elements (numerics, flags, or strings, respectively) mapped to an Array point. The number of strings depends on the string length. The maximum number of elements for each type are:

Data Type	Max. No. Elements
Numeric Floating Point	16
Numeric Integers	32
Flags	512
String-8	8
String-16	4
String-32	2
String-64	1

3.5.1.4 AB_DATA Parameters

The AB_DATA1, 2, 3, and 4 parameters described in the following paragraphs are one of the most important considerations when configuring an Allen-Bradley PLC through an SI Array point.

The following table is only a general overview of the AB_Data parameters. Each is discussed in detail and there are many variations depending on the PLC family.

Parameter	Purpose
ABDATA_1	Specifies PLC Family
ABDATA_2	Specifies PLC File Number
ABDATA_3	Specifies Data type
ABDATA_4	Specifies Scan Rate

AB_DATA1 Specifies the Allen-Bradley PLC family type:

- 2.0 = PLC-2
- 3.0 = PLC-3
- 5.0 = PLC-5

Note that —

- Different PLC families can be accessed through the same FTA by using multiple SI Array points with the desired family specified in each array point's AB_DATA1 parameter.

- PLC-3 or PLC-5 controllers can be accessed using PLC-2 emulation by setting AB_DATA1 = 2.0.

- For diagnostic related array points, other values are used (for example, 0, NaN, ...). See subsection 3.5.4 for more detail.

AB_DATA2 Specifies the Allen-Bradley PLC File Number from which data is imaged into the Array point for PLC-3 or PLC-5 controllers. The range is 0 – 999.

For a PLC-2 controller, AB_DATA2 must be set to NaN. AB_DATA2 can have other values when used for diagnostics. Refer to subsection 3.3.5.5.

AB_DATA3 Specifies the data type for Allen-Bradley PLC-2 or PLC-5 controllers or the section ID for PLC-3 controllers.

The supported data types for each Allen-Bradley family, the corresponding AB_DATA3 entry, and Array type are shown in the following tables:

PLC-2 Data Type	AB–DATA3	Array Type
Output	0	Flag
Input	1	Flag
Status	2	Flag
Bit	3	Flag
Integer	4,5	Numeric (unsigned 16 bit)
Floating Point	6	Numeric (VAX F Format)
Integer	7	Numeric (signed 16 bit)
Floating Point	8	Numeric (IEEE Single Precision)
ASCII	9	String

Note that the PLC-2 only recognizes status or integer data types. The interface handles other data types by requesting single or multiple elements of integer data according to the AB_DATA3 entry.

AB–DATA3 Continued—

PLC-3 Data Type	AB–DATA3	Array Type
Output	1	Flag
Input	2	Flag
Integer	5	Numeric (16-bit signed)
Floating Point	6	Numeric (VAX F Single Precision)
Binary	8	Flag
ASCII	9	String
Status	13	Flag

Note that—

• The number entered for AB_DATA3 corresponds to the PLC-3 Section Identifier.

• Data types not supported for PLC-3 are timers, counters, decimal, high order (two word) integers and pointers.

• The APM/HPM converts the VAX F format into IEEE floating point numbers, and when writing, it converts from IEEE floating point numbers to VAX F format.

PLC-5 Data Type	AB–DATA3	Array Type
Output	0	Flag
Input	1	Flag
Status	2	Flag
Bit	3	Flag
Integer	*4,5	Numeric (unsigned 16 bit)
Integer	7	Numeric (signed 16 bit)
Floating Point	8	Numeric (IEEE Single Precision)
ASCII	9	String
*These Allen-Bradley file types are read only and writes to these file types are ignored.		

Note that—

• The number entered for AB_DATA3 corresponds to the PLC-5 file types except for string data where 9 is assigned.

• Timers/counters require three words per timer/counter. Presets and accumulated values are read only; they can only be modified in ladder logic.

The following restrictions also apply for PLC-5:

If the AB_DATA2 file no. = 0, AB_DATA3 must be set to 0 (output data).
If the AB_DATA2 file no. = 1, AB_DATA3 must be set to 1 (input data).
If the AB_DATA2 file no. = 2, AB_DATA3 must be set to 2 (status).

Data Range—The data range for each type of Array point data is given in the following table:

APM/HPM Array Type	Data Range
Flag	ON/OFF
Numeric (signed integer)	-32768 to +32767
Numeric (unsigned integer)	0 to 65535
Numeric (floating point)	-34E38 to +34E38
String	Printable Characters

AB_DATA4 Specifies the Allen-Bradley PLC scan rate. Each SI Array point can have a different scan rate. The Allen-Bradley interface supports either polling or Report by Exception (RBE) independent of the scan rate. Scan rates are configured according to the following table:

AB–DATA4	Point Scan Rate
0	Scan the point as fast as possible
1 - 255	Scan the point once every 1 to 255 seconds
256	Scan the point once after configuration or after link or device failure recovery (then only Report by Exception)

Note that—

- you should use higher priority scanning for time-critical data, and slower scanning or report-by-exception for lower priority points where data changes infrequently.

- if all points are set to very fast scan (0 - 2 seconds), actual performance may be less than one update per second especially when writes are used.

- entering a scan frequency greater than 256 causes a "POL FREQ" error.

- if more than one SI Array point is configured to map the same PLC memory area, only one of the array points will be updated with report by exception data.

- when AB_DATA4 = 256, after the first scan, Array data is updated when RBE data is received for that point or after any communications error (but not after configuration errors).

- the Report by Exception (RBE) feature is independent of scan rate. See 3.3.5.5 for RBE requirements.

AUXDATA Parameters—The AUXDATA1-4 parameters are for use with the Generic Modbus interface (described earlier in this section). They should be set to NaN (dashes) when communicating with an Allen-Bradley PLC. Likewise, when the Modbus interface is being used, the AB_DATA parameters should be set to NaN.

3.5.2 Report by Exception Requirements

Before an FTA will accept RBE data, the following conditions must be true:

- The corresponding array point must be configured.

- The point must have been scanned at least once.

- The sending device's source address (SRC) must match the Array point's Device Address (DEVADD) parameter.

- The quantity of the data received by the FTA in an RBE request must match the quantity of the data configured for the destination array point.

- The command code (CMD) and function number (FNC) in the Allen-Bradley communication messages must be as specified in Table 3-2.

- An RBE_FULL error results if even one RBE message is rejected without indication back to the device that generated the message.

- RBE data is rejected by any SI Array point configured to map diagnostic counter data, or run a diagnostic loop, or by any PLC-5 configured for Timer/Counter data.

- For PLC-5, the Type/Data parameter must match the file type configured for the destination array point.

Note that if you configure more than one array point that maps the same PLC memory area, only one of the array points is updated with RBE data.

Table 3-2 — Allen-Bradley Request Response Table

FUNCTION	PLC-2	PLC-3	PLC-5
Data Read by SI from PLC (All data types)	Basic Command Set: "Unprotected Read" CMD: 01 FNC: NA	PLC-3 Specific command "Word Range Read" CMD: 0F FNC: 01	PLC-5 Specific command "Word Range Read" CMD: 0F FNC: 01
Data Write by SI to PLC (Flag Data Type)	Basic Command Set: "Unprotected Bit Write" CMD: 05 FNC: NA	PLC-3 Specific command "Bit Write" CMD: 0F FNC: 02	PLC-5 Specific command "Read-Modify-Write CMD: 0F FNC: 26
Data Write by SI to PLC Other Data Types	Basic Command Set: "Unprotected Write" CMD: 08 FNC: NA	PLC-3 Specific command "Word Range Write" CMD: 0F FNC: 00	PLC-5 Specific command "Word Range Write" CMD: 0F FNC: 00
Data Write by PLC to SI (RBE) (All Data Types)	Basic Command Set: "Unprotected Write" CMD: 08 FNC: NA	PLC-3 Specific command "Word Range Write"* CMD: 0F FNC: 00	PLC-5 Specific command "Typed Write" * CMD: 0F FNC: 67

*These functions must use the Logical Binary Addressing format or the RBE message is rejected by the Serial Interface. Other formats including PLC-3 Symbolic and PLC-5 Logical ASCII will be rejected.

3.5.3 Performance Considerations

All configured array points scan the Allen-Bradley PLC devices in a circular sequence at the specified scan rate with read data requests. A write data request preempts the read requests (and/or response to any RBE requests). The number of consecutive write data requests is limited to eight, after which a Report By Exception request or scan read request is serviced. If outputs, Report By Exception requests, and scan read requests are stacked continuously, the Report By Exception requests and scan read requests are alternately serviced after every eight outputs. This slows data acquisition considerably.

Points with a scan frequency of 3 to 255 seconds are scanned once upon point build and then at the configured scan rate. RBE messages reset the scan interval timer, therefore frequent RBE messages can prevent unnecessary scanning.

There is a limit to the number of write requests per second that can be serviced before read response is significantly affected. Because of the time ladder logic takes to execute, the maximum number of write requests per second to a PLC running ladder logic should be limited even further. Your Honeywell representative can provide test data and reports on PLC modules certified to date.

3.5.4 Diagnostic Procedures and Data

Diagnostic data is stored as single or double bytes of information in the Allen-Bradley Highway module. The various PLC modules hold diagnostic information in different forms and in different RAM locations. This data is referred to as the Diagnostic Counters.

The Allen-Bradley diagnostic commands supported by the procedures that follow are:

- Diagnostic Status
- Diagnostic Read
- Diagnostic Counters Reset

Only modules whose diagnostic information address is returned as a reply to a Diagnostic Status Command in the 7th and 8th bytes are supported (PLC-5 returns 0). This address is added to the value specified in NNSTIX as an offset, and a Diagnostic Read collects data into the APM or HPM. Therefore, you do not need to know the starting address for diagnostic data.

Because of the differences between modules, you must be familiar with the equipment to properly configure an SI Array point for diagnostic purposes. It is also up to you to interpret the diagnostic data returned. The software automatically reformats data from diagnostic counters for easier interpretation.

You can cause a Diagnostic Counters Reset by executing a write to any element of the diagnostic array counters. Note that a write to any one diagnostic counter resets all the diagnostic counters in the module.

3.5.4.1 Diagnostic Data from the Computer Interface Module

One or more array points can be configured to acquire diagnostic information from the Allen-Bradley KE/KF Computer Interface Module (CIM). Numeric data is used for diagnostic counters. The required configuration parameters are—

Parameter	Entry for Diagnostic Data
DEVADDR	the module address (specified in octal)
AB_DATA1	0 (indicates CIM)
AB_DATA2	-1 (indicates diagnostic counter)

AB_DATA3	enter—
	    11 for up to 32 values of 2-byte data
	    7 for up to 32 values of 2-byte data
	    20 for up to 64 values of single-byte data

AB_DATA4	scan frequency
NNSTIX	offset into Allen-Bradley Diagnostic Table*
NNUMERIC	number of diagnostic words/bytes
* You must know which CIM is used because each model can have different meanings for its offset values.	

3.5.4.2 Diagnostic Data from the PLC

To obtain diagnostic data from an Allen-Bradley PLC, configure the SI Array point as usual, except for the following parameters which must be set up according to the table. Numeric data is used.

Parameter	Entry for Diagnostic Data
DEVADDR	the module address (specified in octal)
AB_DATA1	2, 3, or 5 (indicates PLC type)
AB_DATA2	-1

AB_DATA3	Enter—
	    11 for up to 32 values of 2-byte data
	    7 for up to 32 values of 2-byte data
	    20 for up to 64 values of single-byte data

AB_DATA4	scan frequency
NNSTIX	offset into Allen-Bradley Diagnostic Table*
NNUMERIC	number of diagnostic words/bytes
* You must know which PLC model is being used because each model can have different meanings for its offset values.	

3.5.4.3 The Diagnostic Loop

A repetitive diagnostic loop can be set up to check the integrity of transmissions over the communication link. It works by transmitting a message of a certain length from the FTA which causes the Allen-Bradley device to reply by transmitting the same data back to the FTA. In this case, string data is used.

To create a Diagnostic Loop, configure an SI Array point as usual except set up the following parameters according to the table:

Parameter	Entry
DEVADDR	PLC Station address in Octal
EXTDTA	IO_STR
STRELN	64 characters
NSTRING	1
AB_DATA1	NaN
AB_DATA2	-3
AB_DATA3	NaN
AB_DATA4	scan frequency (but $\neq$ 256)

Counters check the attempted/successful transactions and when the point is active, the Detail display should contain the message:

```
Loopback Test: Attempted - xxxxx   Pass - xxxxx,
```

where xxxxx is a pass/failure count.

Any communication errors are displayed, but BADPVFL is not set for a diagnostic loop.

Note that the loopback test can run along with other Array point scans, but doing so adversely affects performance.

3.5.4.4 Time-Out Gate Configuration

The time-out gate feature checks for communication between the FTA and the Allen-Bradley interface. The purpose of a time-out gate is to confirm to the PLC that the Serial Interface is working.

By configuring an array point for a periodic write (such as every 10, 20, or 30 seconds), the PLC issues a Report by Exception message. This causes the FTA to return a status message which the ladder logic can monitor and react to.

If the FTA fails, the PLC receives a status code 20_{16} and/or a timeout occurs indicating to the PLC that the host is not communicating. When the FTA recovers, the condition clears and the normal 00 status (message was successful) returns.

3.6 SERIAL INTERFACE ARRAY OPERATION

3.6.1 Checkpointing and Startup

Checkpointing—SI slot data is not checkpointed, but SI configuration is contained in the Array point checkpoint.   Configuration of related Array points is saved.

Startup—SI slot configuration data is automatically reloaded on every startup. When reloaded, the SI IOP Database Valid parameter is automatically set to Valid.

3.6.2 Accessing SI Array Data

Serial Interface IOP data mapped to an Array point is accessed through the Array point Numeric(NN(i)), Flag (FL(i)), and String (STRn(i)) parameters.

Because the APM or HPM Process Manager Module regularly scans data from the Serial Interface, read access to SI Array data does not require an IOL prefetch cycle (that is, CL programs are not delayed while data is being fetched).

When writing to a serial device, data is not stored in the Array point, SI IOP, or SI FTA databases on the way to the external device. Write access to the SI Array data does cause an IOL poststore. A write to the SI Array data is successfully completed when the Array point enters the write request in a queue for the I/O link.

CAUTION

Do not configure a situation that causes constant writes to the Serial Interface (for example, a logic output). Doing so can overload the system and degrade performance.

The SI IOP's Detail Status display shows the protocol, baud rate, and parity type configured for each FTA. If a fault exists, the configuration information is replaced with a failure message by using parameter IOPSTR1(n) or IOPSTR2(n).

3.6.3 CL Notes

All Array point data (flags, numerics, etc.) can be accessed by a CL program (without impacting IOL prefetch limitations). Refer to the *Control Language/Advanced Process Manager Reference Manual* or *Control Language/High-Performance Process Manager Reference Manual* for additional information.

The CL compiler issues a warning when external Array point data (data read from a Serial Interface) is used in a LOCAL declaration. This is done because the data is not truly local, but resides in the external device connected to the Serial Interface IOP.

3.6.4 Status and Error Checking

Several Array point parameters provide status reporting. Error information appears on the Array Point Detail displays and the SI IOP Detail Status display, or can be tested with CL. The following parameters should be checked periodically:

- BADPVFL provides an overall database status (ON = bad). The overall status is bad when there are communication problems or the SI module is in Idle. CL programs should check BADPVFL or INITREQ before using SI data.

- INITREQ, when set to ON, indicates that the write to the SI module cannot be completed.

- ERRCODE provides an 8-character error string. Refer to the *Advanced Process Manager Parameter Reference Dictionary* for complete information.

Note that BADPVFL and INITREQ are always OFF if not using SI data (EXTDATA = None).

3.6.4.1 Read-Back Check

To verify that a write was successful in reaching the external device, simply read back a just written parameter and compare it with the value written to guarantee that data was successfully stored all the way to the serial device. Feedback time varies due to device performance.

3.6.4.2 FTA Lamps

Refer to Figure 2-2 in subsection 2 for the lamp locations on the Serial Interface FTA.

The power lamp DS1 should be on whenever power is being supplied to the FTA.

The status indicator DS2 uses several blink patterns to indicate errors. The error codes are:

- Slow Blink (symmetrical 1 second on/off)—the FTA has not received a Time Out Gate refresh from the SI-IOP within 10 seconds. This indicates that the host (the Serial Interface) has a problem and will not communicate.

- Fast Blink (symmetrical .5 second on/off)—one or more Array points configured to this FTA have a communication error.

- Odd Blink (asymmetrical 1/.25 second on/off)—one or more Array points configured to this FTA are incorrectly configured.

- Steady On (both DS1 and DS2)—no errors were detected by the FTA.

- Steady Off (both DS1 and DS2)—the FTA has no power or is in a hardfail condition.

3.6.4.2 Error Messages

Tables 3-3 through 3-5 provide error messages for the Serial Interface and devices. You may also need to refer to Modbus documentation and Allen-Bradley documentation for error messages specific to those devices.

Table 3-3 — Serial Interface Error Messages

Error Message	Description
# ELEMNT	Number of elements is out of range for data type selected.
ARR INIT	The point is configured, but no valid data has been received.
AUXMATCH	UART mode settings in AUXDATA3 and AUXDATA4 do not match the other points in the FTA. All points must agree.
BAUD/PAR	The Baud Rate/Parity setting in AUXDATA4 is not a valid setting.
CONFIG	General configuration error. Check configuration carefully.
DATATYPE	Data type/file type is not supported or out of range for this device.
DEV ADDR	Device address is out of range.
FAC TEST	Factory test diagnostic mode in progress.
FILE NUM	PLC file number is not supported or out of range for this PLC.
KPA ADDR	Keep Alive coil address is out of range.
MAX CONF	"Catch all" configuration error.
NO CONF	No Configuration (slot is not viewable at the operator Station).
PLC TYPE	PLC type is not supported.
POL FREQ	Polling frequency is out of range.
SIG/MOD	The signal mode/modem control setting in AUXDATA3 is not a valid setting.
STARTIDX	Start Index/file word address is out of range.
STR LEN	Illegal string length for diagnostic loop point type.
TMOT VAL	Message timeout value is out of range.
DATA COND	Unsupported data type for current Serial Interface version.

The error messages in Tables 3-4 and 3-5 appear on the IOP Detail Status displays.

Note that when any configured array point detects a Communication error, the FTA re-scans **all** configured points in its database regardless of the scan frequency specified for the points.

Table 3-4— Modbus Communication Error Messages

Error Message	Description
CHECKSUM	Incorrect checksum (CRC) received.
EX - nn	Modbus device error codes (Hex) Refer to device documentation.
INV RESP	Invalid response received from the Modbus device.
MSGTMOUT	Timeout on message response from the Modbus device.
NO CTS	Modem did not respond with Clear To Send within the message timeout time.
NO DSR	Modem is not asserting Data Set Ready as expected.
PARITY	Incorrect character parity received.
RX OVFLO	A receive buffer overflow occurred on a message response received from the Modbus device.

Table 3-5 — Allen-Bradley Communication Error Messages

Error Message	Description
ABEXT_mm	Allen-Bradley remote station specific EXT STS error (refer to Allen-Bradley documentation).
ABSTS_nn	Allen-Bradley local/remote station specific STS error (refer to Allen-Bradley documentation).
ACKTMOUT	Timed out waiting for ACK from CIM device.
ARR INIT	Point configured, but no valid data received yet.
CHECKSUM	Incorrect BCC detected on the last received message.
CIM_NAK	Received a NAK from the CIM device.
INV RESP	Invalid response received from the Allen-Bradley device.
MAXMSGST	"Catch all" Serial Interface error.
MSGTMOUT	Timeout waiting for the Allen-Bradley device to reply to the last request.
OK_POLL	No errors exist against the array point whose poll rate is within 0 - 255.
OK_RBE	No errors exist against the array point whose poll rate is 256.
PARITY	Incorrect parity on at least one character in the last received message.
RBE_FULL	RBE buffer full due to too many Report by Exception requests from the PLC devices.

SPECIFICATIONS
Section 4

This section defines the I/O specifications for external serial interface devices that connect to the A PM or HPM Array Point's Serial Device Interface.

4.1 SERIAL INTERFACE ARRAY POINT

APM/HPM SI Array point capacity:　80 SI Array Points/APM/HPM @ 1 second rate
(40 @ 1/2 sec; 20 @ 1/4 sec)

FTA point capacity:　Up to 16 Array Points per SI FTA
IOP point capacity:　Up to 32 Array Points per SI IOP (2 FTAs)

Data capacity per Array point:　512 Flags (Booleans/coils), or

(contiguous data in PLC)
64 Numerics (8-bit integers), or
32 Numerics (Integers), or
16 Numerics (Reals), or
1 String of 64 characters, or
2 String of 32 characters, or
4 String of 16 characters, or
8 String of 8 characters

Performance Guidelines:
Read and write performance is sensitive to a number of variables, including: the PLC type, scan time, message response time, PLC network configuration and traffic, amount of data access from other devices, and the overall health of the PLC network. For best results, a direct PLC connection is recommended.

Reads per Port*:
Up to 2048 Booleans/second, or
up to 128 Integers/second, or
up to 64 Reals/second, or
up to 4, 64-character strings; or
weighted combinations of the above

Writes per Port*:
10 points/second

NOTE

***These are guidelines only, and <u>do not</u> represent best performance figures. Read performance degrades with increased writes.**

4.2 MODBUS SERIAL INTERFACE

4.2.1 MODBUS Serial Interface Model Numbers

SI FTA Model Number:	MU-TSIM12
SI IOP Model Number:	MU-PSIM11
Power Adapter FTA Model Number:	MU-TLPA02

4.2.2 MODBUS Serial Interface Specifications

Interface Type:	EIA-232-D or EIA-485
Number of Serial Channels:	2 per IOP, 1 per FTA
Distance – Power Adapter to FTA:	300 m
Protocol:	Modbus
Transmission Mode:	RTU
Serial Line Mode:	RS232 or RS485
Selectable Baud Rates:	1200, 2400, 4800, 9600,19,200 bps
Serial Data Format:	8 data bits with programmable 9th bit (parity)
Selectable Parity:	None, odd, or even
Common Mode Operation:	250 V rms (continuous)
Surge Protection:	IEEE SWC 472-1974
ESD Protection:	IEEE 801.2
Number of Stop Bits:	1
Modem Control Support:	Selectable On/Off
Keep Alive Cell Write:	Configurable address
Message Response Timeout Time:	Configurable timeout
Exception Errors Reported:	Keep Alive, Message Response Timeout, Signaling Mode/Modem Support, Baud Rate, Parity
Data Formats Supported:	Boolean, Real, ASCII Strings, Signed Integers, Unsigned Integers
Inter-Message Stall Time:	3.5 Character Time minimum

EIA-232-D SUPPORT

Interface Type:	Serial asynchronous
Lines Supported:	TXD, RXD, RTS, CTS, DSR, DTR, Logic GND, Protective GND (Compatible with CCIT V.24; CCIT V.28)
Distance – FTA to Device:	15 meters (cable cap. = 2500 pF max.)

EIA-485 SUPPORT

Interface Type:	Serial asynchronous Half Duplex only
Lines Supported:	Two wire, differential pair: DATA+, DATA-, Protective GND (shield)
Number of Transceivers:	15 drops maximum
Distance – FTA to Device:	1.2 Km (4000 ft) max.

4.3 ALLEN-BRADLEY SERIAL INTERFACE

4.3.1 Allen-Bradley Serial Interface Model Numbers

A-B SI FTA Model Number:	MU-TSIA12
SI IOP Model Number:	MU-PSIM11
Power Adapter FTA Model Number:	MU-TLPA02

4.3.2 Allen-Bradley Serial Interface Specifications

GENERAL

Interface Type:	EIA-RS232-D
Number of Serial Channels:	2 per IOP, 1 per FTA
Distance – Power Adapter to FTA:	300 m
Baud Rate:	19.2 k bps
Serial Data Format:	8 data bits with parity bit
Common Mode Operation:	250 V rms (continuous)
ESD Protection:	IEEE SWC 472-1974

EIA-RS232-D SUPPORT

Interface Type:	Serial asynchronous
Lines Supported:	TXD, RXD, Logic GND, Protective GND (Compatible with CCIT V.24; CCIT V.28)
Distance – FTA to Device:	15 meters (cable cap. = 2500 pF max.)

4.3.3 SI Allen-Bradley Specific Interface Specifications

Protocol:	Full Duplex Allen-Bradley DF1 with embedded responses
Transmission Mode:	Character oriented
Serial Line Mode:	RS232
Parity:	even
No. Stop Bits:	1
Modem Control Support:	Off
ACK Timeout:	3.2 sec.
FTA Message Response Timeout:	4.0 sec.
Data Formats Supported:	Booleans, Reals, Signed/Unsigned Integers, ASCII Strings
CIM Communication Options:	Pass-through diagnostic requests Ignore handshaking Accept duplicate message BCC error check

4.3.4 Allen-Bradley Devices/Data Types Supported

Allen-Bradley Family Types Supported: PLC-2
                                             PLC-3 (Native Mode and PLC-2 Mode)
                                             PLC-5, except PLC-5/250
                                             (Native Mode and PLC-2 Mode)

Allen-Bradley File Types:

APM/HPM Array Point Types	PLC-5 File Types	PLC-3 Files Types
Flag	Output (O), Input (I), Status (S)	Output (O), Input (I), Status (S)
Flag	Bit (B)	Binary (B)
Numeric (16-bit Signed Integer)	Integer (N)	Integer (N)
Numeric (IEEE Single Precision)	Float (F) (IEEE Format)	Float (F) (VAX F Format)
Numeric (16-bit Unsigned Integer)	Timer (T), Counter (C) (READ ONLY)	
String	ASCII (A)	ASCII (A)

4.3.5 Allen-Bradley Scan Features

Three methods of updates:

- Data for each Array point is read at the user-configured scan frequency: 1 to 255 seconds.
- Independent of scan frequency, any point will accept Unsolicited requests (RBE).
- Any point may be configured to rely strictly on Unsolicited requests.

Independent of scan frequency, writes are pushed to the target Allen-Bradley device as high priority traffic.

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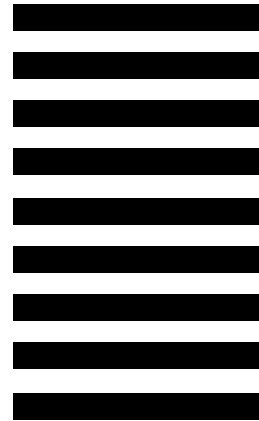2820 West Kelton Lane
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