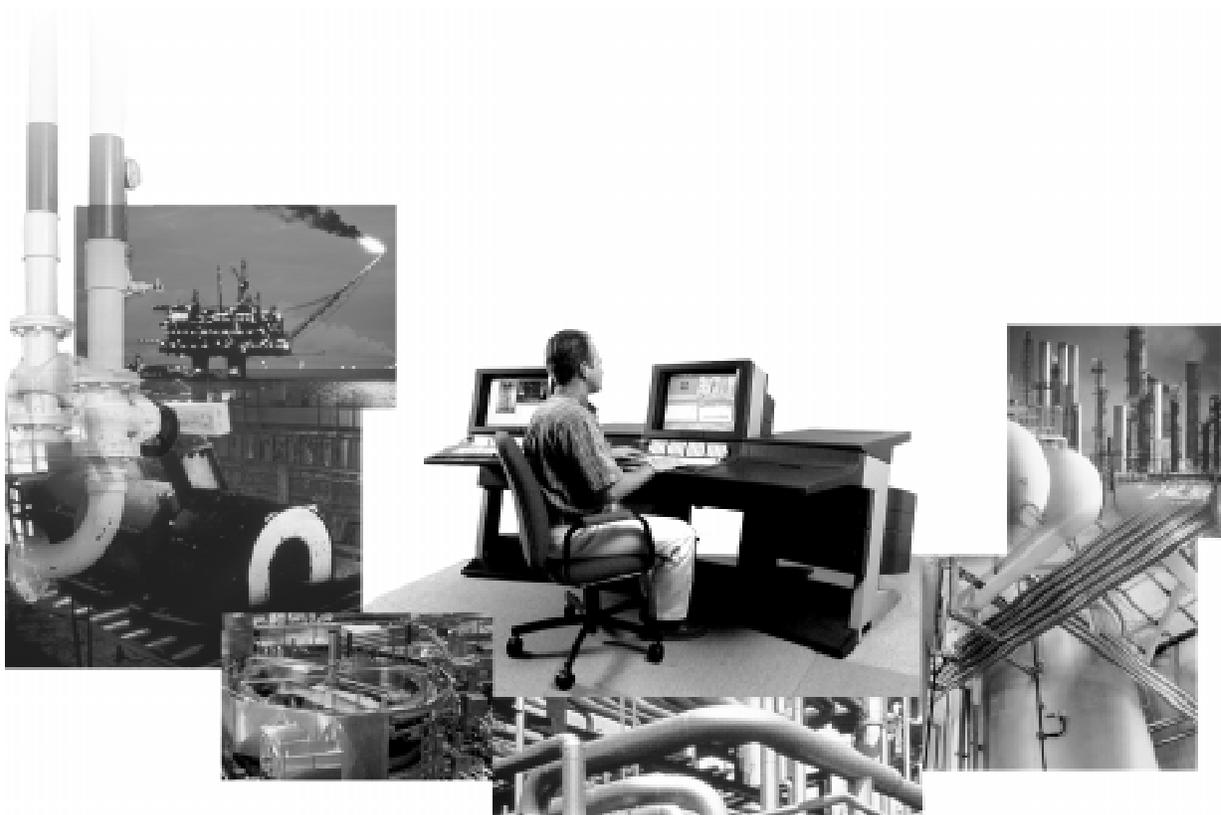


# **TPS Process Manager I/O Specification and Technical Data**

**IO03-500  
Release 500  
11/97**



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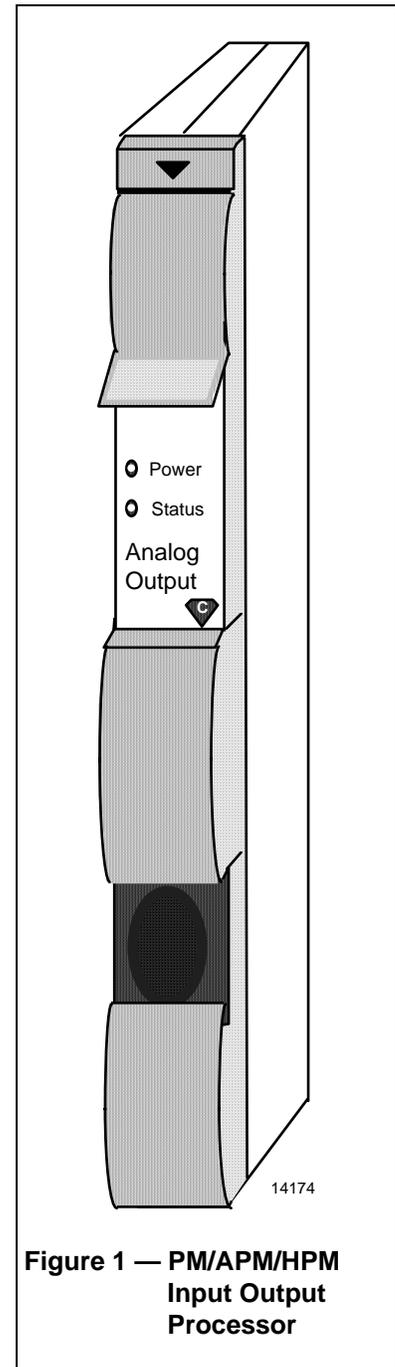
## Introduction

The Process Manager (PM), Advanced Process Manager (APM) and High Performance Process Manager (HPM) are Honeywell's leading **TotalPlant** Solution (TPS) system control and data acquisition devices for industrial process applications. They represent a powerful combination of cost-effective Honeywell controllers which can be applied to solve a broad range of industrial process control problems.

The PM, APM, and HPM offer highly flexible I/O (input/output) functions for both data monitoring and control. One of the unique features of this family of controllers is its common set of Input/Output Processors (IOPs) and Field Termination Assemblies (FTAs). All IOPs and FTAs are usable by all three controllers (with only minor exceptions).

This specification and technical data sheet provides information on PM, APM, and HPM IOPs and FTAs. Please refer to the following specification and technical data sheets for information about each controller:

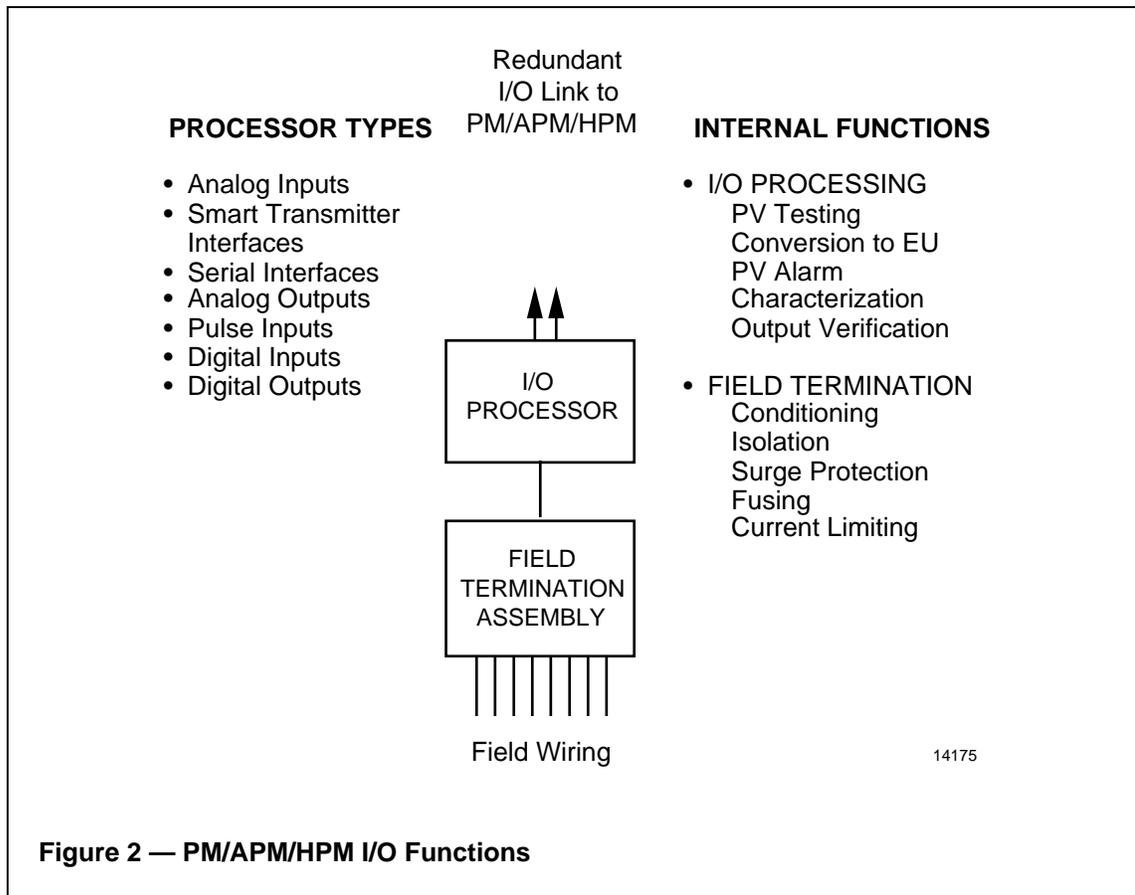
- **PM03-400** - Process Manager Specification and Technical Data
- **AP03-500** - Advanced Process Manager Specification and Technical Data
- **HP03-500** - High Performance Process Manager Specification and Technical Data



## Functional Description

### Functional Overview

I/O Processors, along with Field Termination Assemblies (FTAs), perform input and output scanning and processing on all field PM/APM/HPM I/O (Figure 2).



A redundant I/O Link is standard for maximum security. Optionally, High Level Analog Input, Smart Transmitter Interface, Analog Output, Digital Input and Digital Output processors can be redundant. I/O processing is performed separately from control processing functions so that I/O scan rates are completely independent of I/O quantity, controller loading, processing, and alarming. This partitioning of functions allows more efficient use of advanced Control Processor capability and provides for future I/O expansion.

A variety of I/O processors are available for the PM controllers:

- Analog Input–High Level (16 points)
- Analog Input–Low Level (8 points)
- Analog Input–Low Level Multiplexer (32 points)
- Smart Transmitter Multivariable Interface (16 points)
- Analog Output (8 points)
- Analog Output (16 points)
- Serial Device Interface (16 points—2 ports)
- Serial Interface (32 arrays, 2 ports)\*
- Pulse Input (8 points)
- Digital Input (32 points)
- Digital Input 24 Vdc (32 points)
- Digital Input Sequence of Events (DISOE) (32 points)\*
- Digital Output (16 points)
- Digital Output (32 points)

\* *APM and HPM only*

Any mix of the above I/O processors can be selected for a PM/APM/HPM controller. This can be any combination of single and/or redundant (HLAI, STI, AO, DI and DO) pairs, up to a total of 40. Even with the maximum complement of 80 physical IOPs, there is no impact on control or communication performance. In a redundant IOP configuration, control automatically transfers to the backup I/O processor during board replacement or failure.

While a separate FTA of a given type is required to handle varying field wiring signal levels, identical I/O Processors can usually be used. This I/O approach simplifies system hardware selection and minimizes spare parts requirements. For example, one Digital Input Processor can handle 24 Vdc, 120 Vac, 125 Vdc or 240 Vac, depending on the FTA selected.

### *Analog Input*

**High and low level analog input** (HLAI + LLAI - 8) processors both perform signal conversion and conditioning functions:

- PV Source (Auto, Manual, Substituted)
- PV Clamping
- EU Conversion
- PV Value Status
- PV Filter (Single Lag)
- Bad PV
- PV Hi/Lo
- PV HiHi/LoLo
- PV Rate-of-Change +/-
- Software Calibration
- Low PV Cutoff

They perform engineering unit conversion, including fifth-order polynomial temperature input characterization, if the high level processor receives these inputs from mV/I converters. Through use of a dual processor design and custom integrated circuits, the low level analog input processor supports software configuration per channel for different thermocouples or RTD types with excellent resolution and accuracy. Open thermocouple detection is performed once per scan so that no bad data is propagated for control processing.

The **Low Level Multiplexer (LLMUX)** processor provides an economical way to bring in a large number of data acquisition signals. Each processor can handle 32 points, using two 16-point FTAs. Every point is scanned once per second with a one second scan delay for processing. Open thermocouple detection is performed every 30 seconds for all points. Options for either local or remote cold junction reference are available.

The **Remote Hardened Multiplexer (RHMUX)** processor provides functionality similar to that of the LLMUX, but the two 16-input FTAs may be mounted up to 2 km away from the xPM cabinet. Each FTA is mounted in its own NEMA-4 or -4X enclosure, providing protection against precipitation, hosedown, and windblown dust. The FTA itself is conformally coated, and is capable of operation in a GX “Severe” corrosive environment and in the presence of condensing humidity.

Power for the RHMUX’s remote FTAs is provided by one of two power adapters, which provide power limiting, serial data interfaces, and galvanic isolation. The power adapter mounts in the FTA tray in the xPM cabinet, and provides the interface between the IOP and the two remote FTAs. The Intrinsically Safe Power Adapter (ISPA) allows the FTAs to be placed in Division 1 or Zone 0 environments. The Non-Incendive Power Adapter (NIPA) provides an economical means to allow the remote FTAs to be placed in Division 2 or Zone 1 environments.

Every point is scanned once per 4 seconds. Data is made available at the end of each scan; there is no additional processing latency. Open-thermocouple detection (OTD) is optionally performed on every measurement. If enabled, the OTD test is performed immediately after the A/D conversion. If the test indicates an open thermocouple, data from the just-completed conversion will not be propagated.

To prevent spurious ground paths from affecting readings, two levels of ground-fault detection are performed: a low-sensitivity check on every measurement, and a high-sensitivity check once per 4-second scan cycle.

All RHMUX remote FTAs are equipped with a local cold junction reference.

The RHMUX IOP is configured into the TPS PM system as a standard LLMUX. This permits using the RHMUX in Release 300 and greater systems.

FM, CSA, KEMA, and EC approvals are pending for the RHMUX.

### *Smart Transmitter Multi-Variable Interface (STI-MV)*

The Smart Transmitter Multivariable processor is the PM/APM/HPM's digital interface to Honeywell's advanced series of smart transmitters.

Each STI-MV processor can communicate bidirectionally with up to 16 smart transmitters, including:

- ST3000 Pressure Transmitters
- STT3000 Temperature Transmitters
- MagneW 3000 Magnetic Flowmeters

These transmitters are used for pressure, temperature, and flow measurement.

Each STI-MV processor also has the ability to accept up to four PVs each from the following multivariable transmitters:

- SCM 3000 Coriolis flowmeter
- Drexelbrook SLT level transmitter
- SMV3000 Multivariable Pressure Transmitter
- SGC3000 Gas Chromatograph

Multivariable transmitters provide the high accuracy of a digital interface while reducing wiring costs because multiple PVs are available over a single pair of wires.

Each IOP can accommodate DE inputs to a maximum of:

- 16 single PV inputs from Smartline transmitters
- Four multivariable field devices with up to four PVs each, or
- A mix of single and multivariable field devices that equals up to 16 inputs per IOP (some restrictions apply)

The STI-MV Interface supports the functions for PV processing, EU conversion, and alarming supported by the other analog input processors (see above). It also provides Bad PV and Bad Database protection for added security.

All communications from the STI-MV processors to the Smart Transmitter are bit-serial, bi-directional, using the Honeywell DE (digital enhanced) protocol.

An individual at a Universal Station can perform any of the following functions:

- Display primary and secondary Process Variables
- Display/Modify/Configure the transmitter database
- Re-range the transmitter
- Save/Restore the database
- Support calibration commands
- Display detailed transmitter status information
- Display the transmitter scratch pad, serial number, and revision level.

Enhanced digital accuracy is provided for all signals, resulting in accuracy that typically is three times better than that of analog.

### *Serial Device Interface (SDI)*

The Serial Device Interface processor provides connection to field devices that use serial communications (EIA-232 or EIA-485). Inputs from these devices are mapped into the I/O database and can be used directly for calculations and control. Since communication is bi-directional, information such as target value or damping factors can be written to or read from the field device. Specific serial devices are supported by custom programmable modules.

One such device is the UDC 6000 Process Controller, which provides single-loop remote display and control capability. Operating as a subsystem of the PM/APM/HPM controller, the UDC 6000 displays PV, SP, and OP on front panel bar graphs. When digitally integrated with the PM/APM/HPM, the UDC Controller can be configured for the following modes:

- Manual/Auto (M/A) Station where all control resides in the PM, APM, or HPM.
- M/A Station with emergency backup control.
- Stand-alone control with the PM/APM/HPM as supervisor.
- Stand-alone control with remote SP from the PM, APM, or HPM.

Another device is the Toledo Weigh Cell (T8142), providing weight, setpoint control of feed (fast cutoff) and rate of change alarming.

### Serial Interface (SI) (APM and HPM only)

The **Serial Interface** IOP provides a communications interface to Modbus or Allen-Bradley compatible subsystems (see Figure 3). Each serial interface IOP, by way of a Power Adapter, supports any combination of up to two FTAs. Note that the SI IOP is supported by the APM and HPM *only*. Each FTA supports one port and up to 16 array points.

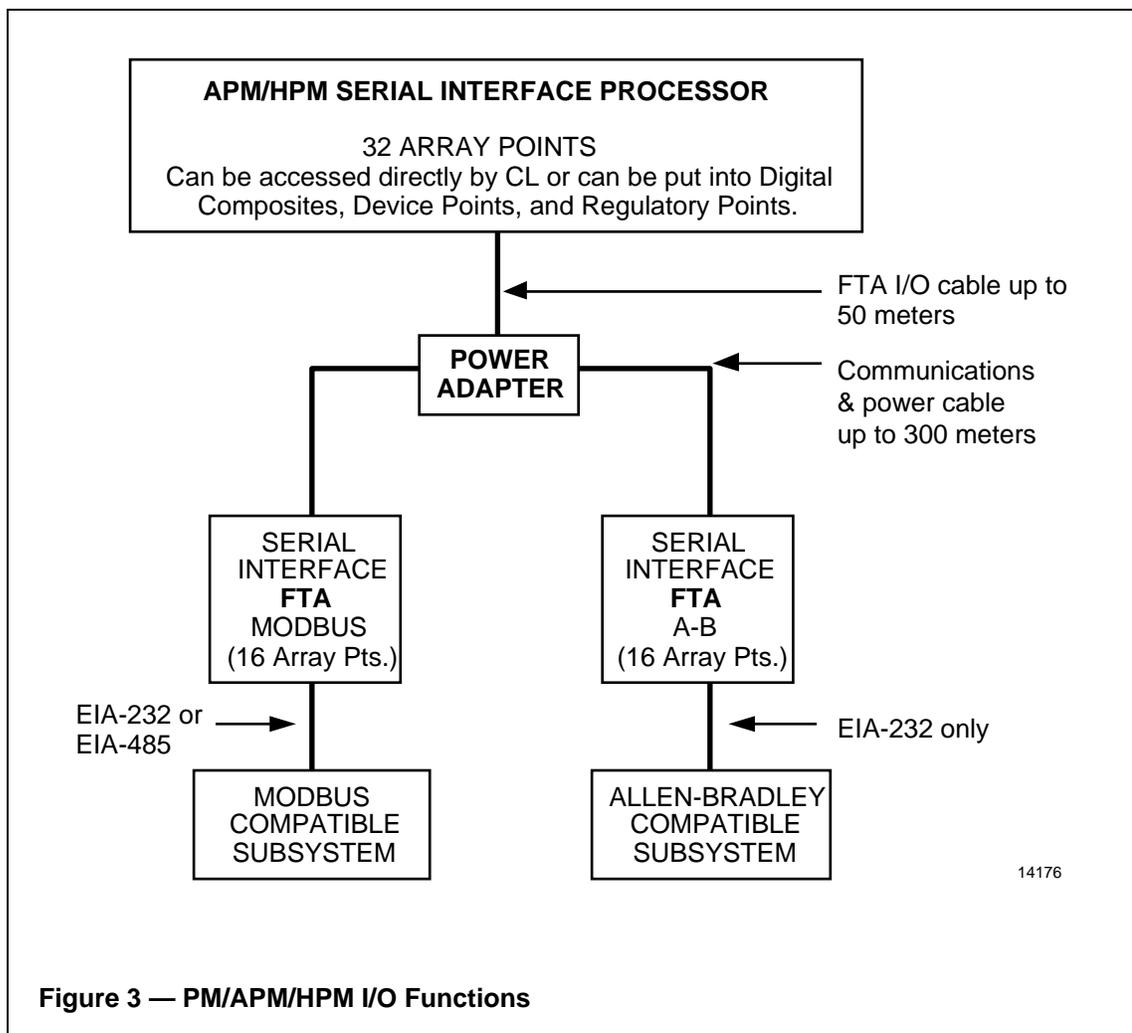


Figure 3 — PM/APM/HPM I/O Functions

The Modbus SI FTA supports Modbus RTU protocol and uses either EIA-232 or EIA-422/485 communications, including multidrop configurations. The Allen-Bradley FTA supports DF-1 protocol and uses only EIA-232 communication.

The serial interface supports direct digital communications to any qualified, compatible subsystem. Using this scheme, serial data is then made available for all APM and HPM data acquisition and control strategies. Using the 16 available array points, an SI FTA has a nominal capacity of up to:

- 8192 Flags (Boolean) or
- 256 Reals (Floating Point) or
- 512 Integers or
- 1024 Characters.

The array point values can be displayed at the Universal Station or used as part of advanced control strategies. These values can be configured into APM and HPM control strategies using Digital Composites, Device Points, and Regulatory Points as well as CL programs. Both reads and writes of subsystem data are supported.

To assure smooth field integration of a variety of subsystems, subsystem devices with the serial interface are qualified as part of Honeywell's Multi-Vendor Interface Program.

In addition, custom interfaces can be designed to meet your specific interfacing requirements. Contact your account manager for more information.

## **Pulse Input (PI)**

Precise control using high-accuracy pulsing-type sensing devices is possible with the Pulse Input processor. The result is improved product quality and reduced material waste. Pulse rates up to 20 kHz can be handled. Conversion to engineering units is performed, along with alarm checking, filtering, and data validity checking. 24 Vdc transmitter power is provided.

## Analog Output

Two versions of the Analog Output IOP are available: one with 8 outputs and one with 16 outputs.

Both processors provide the following functions:

- Readback check of actual output current
- Output characterization (5 segment)
- Output default action on failure (hold or unpowered)
- Modes and associated functions to support Manual loader and DDC control
- Software calibration

The 8-pt. analog output processor provides separate D/A converters and power regulator per channel for maximum output security. As an option, one-on-one Analog Output processor redundancy (available for both versions) provides even higher control strategy integrity.

### *Digital Input*

Two Digital Input IOP models are available, both with 32 inputs. The Digital Input Processor provides the following functions:

- Event counting (accumulation) (maximum pulse rate = 15 Hz)
- Push-button and status type inputs (minimum on-time = 40 ms)
- Time deadband on alarms for status inputs
- Input direct/reverse
- PV source selection
- State or change of state alarming for status inputs
- Sequence of events resolution of 20 ms

Several voltage types are handled through a selection of FTAs. As an option, one-on-one Digital Input processor redundancy is available.

---

## Digital Input Sequence of Events (APM and HPM only)

This specialized digital input processor (DISOE) provides all the functions of the conventional Digital Input except accumulation. Inputs from the board can be used for control strategies just like any other digital input. Note that the DISOE IOP is supported by the APM and HPM *only*.

In addition, this DISOE processor provides high-resolution sequence of events monitoring. Using the DISOE processor, SOE time stamp resolution within 1 ms is assured.

The DISOE processor provides optimum resolution when used with the standard 24 Vdc Digital Input FTA.

Optional one-on-one redundancy is available for higher availability.

### *Digital Output*

Two versions of the Digital Output IOP are available: one with 16 outputs and one with 32 outputs. Both processors provide the following functions:

- Output types (configurable per output)
  - Latched
  - Pulsed
  - Pulse-width modulated
- Output default action on failure (hold or unpowered)
- Output readback checking

The 16-point digital output processor provides separate output latches with redundant power regulators for added output security. As an option, one-on-one Digital Output processor redundancy is available for the 32-output IOP.

## **I/O Simulation Option**

### ***(APM/HPM only)***

The optional I/O Simulator package simulates the functions of the IOPs for the APM and HPM. It is a low cost, high fidelity simulation approach for control strategy checkout or for operator training support. A unique feature of this optional package is complete database transportability between the Simulation personality and the APM or HPM On-Process (normal operating) personality. This is especially useful for configuring the system before the physical I/O is available or connected. Features of the package include:

- “Bumpless” pause/resume interruption/restart
- Physical IOPs, FTAs and field wiring not required
- Simulation status indicated and journaled
- Database (checkpoint) transportable to target system
- Simulation rerun from saved data base using PV data
- Full peer-to-peer capability
- I/O functions simulated by Communications processor
- Almost any I/O configuration can be simulated
- Simulation load and status supported on system network
- Fault response testing and I/O redundancy simulation

The benefits of this package include:

- The ability to perform high fidelity simulation
- Control strategy checkout
- Operator training
- Project cost savings

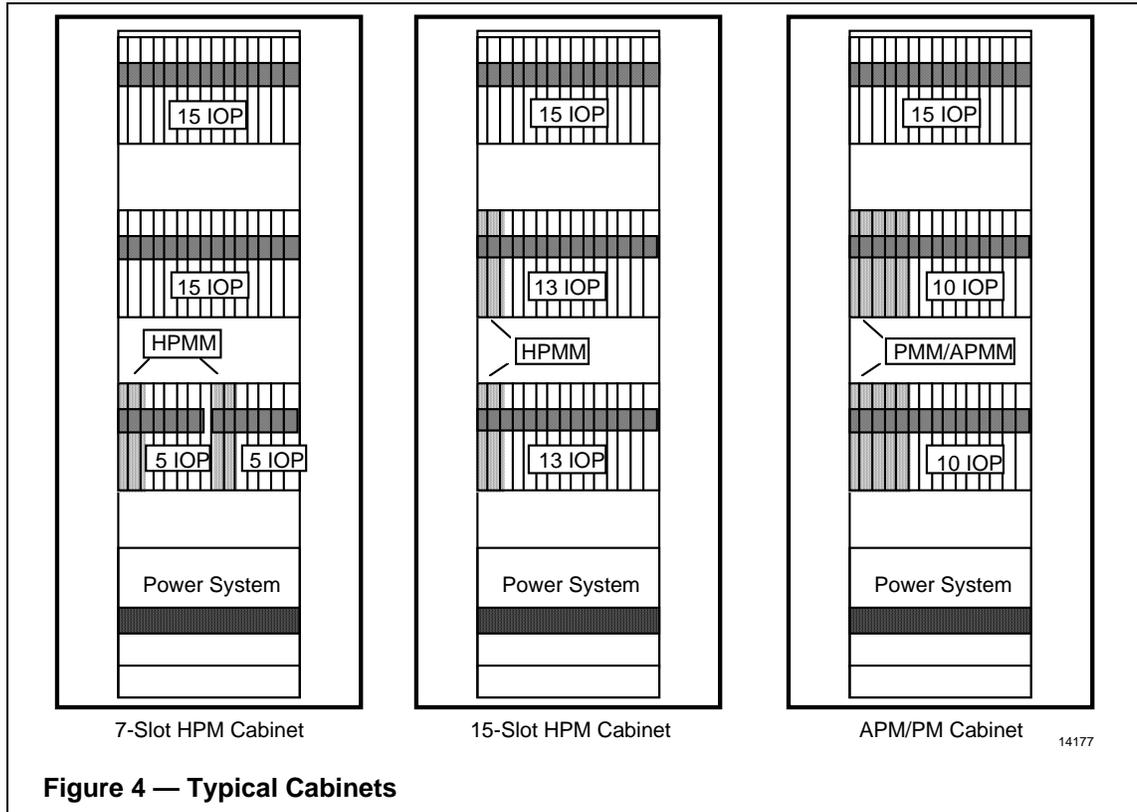
**Card File Assemblies**

A maximum of 40 logical IOPs can be configured per PM, APM, and HPM. A “logical” IOP consists of either a single IOP or a redundant IOP pair). Typical PM, APM, and HPM configurations may vary, but they generally consist of up to three cardfiles plus a power supply system. Each cardfile row may contain up to 15 module slots. (Refer to Figure 4.)

When options such as I/O redundancy and/or remote I/O are used, configurations with up to 8 “logical” card files can be provided.

One or two card files contain the PM, APM, or HPM Module(s). All remaining card file slots can be filled with any combination of I/O Processors. Note that 7-slot files which are used for the HPM (i.e., not for PM or APM) *can* also be filled with IOPs. This "IOP only" configuration can be used to provide I/O for PMs and APMs as well.

With 7-slot HPM files, a single cabinet side can hold up to 40 I/O Processors along with redundant High-Performance Process Manager Modules. Figure 4 shows typical cabinet layouts with redundant HPMs, APMs, and PMs.



## Field Termination Assemblies

All connections to and from the process are made to Field Termination Assemblies (FTAs). Compression-type termination blocks (that can accept wire sizes as large as 14 AWG or ~1.6 mm) are available for all FTAs. Screw-type termination's can also be provided for most FTAs as shown in Table 1 in the "Specifications" section. The FTAs are connected to the I/O processors by cables that can be up to 50 meters in length. Three sizes of FTAs are used as shown in this table. Twenty-four Vdc transmitter and digital inputs sense power connections are provided through the standard FTA cable.

## Options

### I/O Redundancy

A one-on-one I/O redundancy option is also available for critical high level analog inputs, smart transmitter interface connections, analog outputs, digital inputs and digital outputs. This option offers significantly increased availability of automatic control by providing continuous operation through failure and replacement of I/O Processors, FTA cables, backplanes, and AO switching hardware. Up to 40 I/O Processors can be supported in a redundant or non-redundant PM, APM, or HPM, and the user can selectively apply redundancy to some or all IOPs, for a maximum of 40 IOP pairs. The one-on-one design approach offers maximum coverage and fast switchover times. Integrity of the backup database and of the switching functions is provided through the extensive diagnostic coverage made possible by the processing capability of the smart I/O Processors.

### *Galvanically Isolated/ Intrinsicly Safe FTAs*

These FTAs are available for applications requiring a direct interface to either FM or CSA Class 1, Div 1, or CENELEC Zone 0 hazardous areas. Wiring and installation are simplified because integral galvanically isolated intrinsic safety isolators are part of the FTA. See GA03-100, Galvanic Isolation/ Intrinsic Safety Specification and Technical Data for further information.

### *Standby Manual*

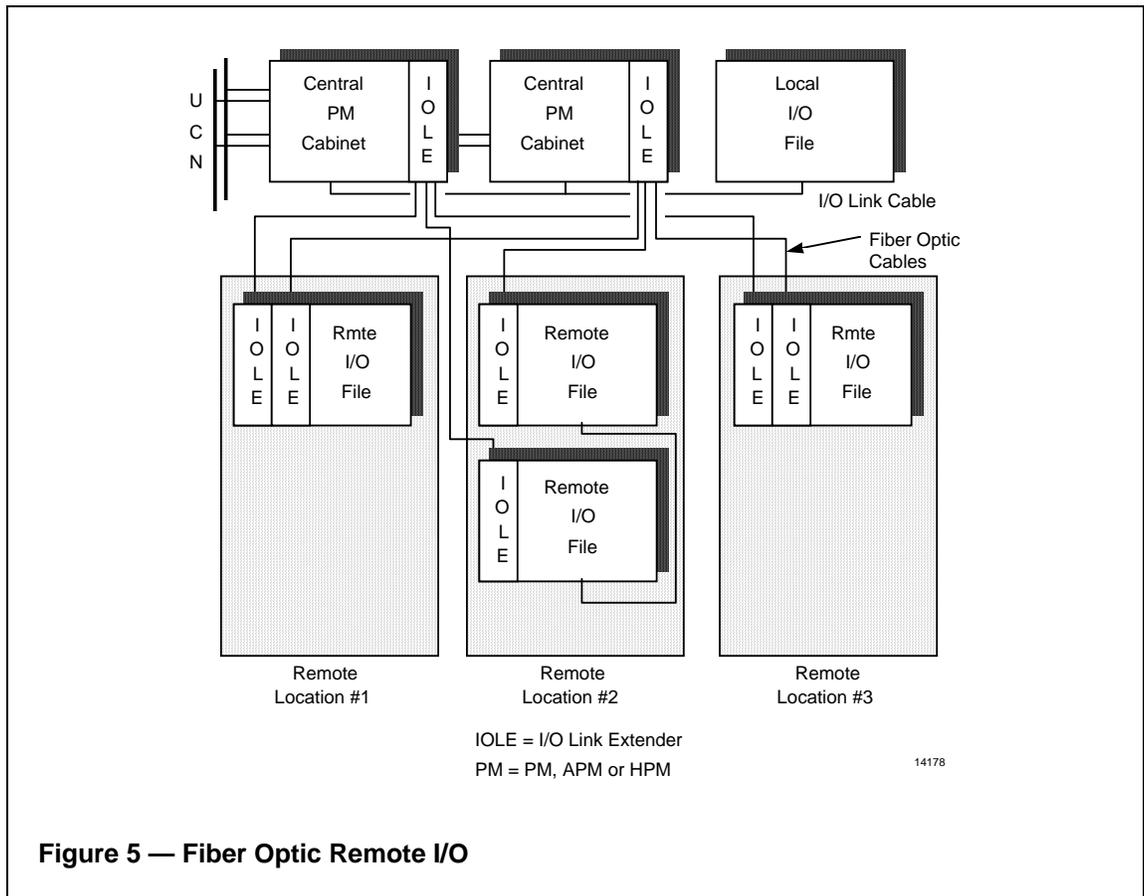
The 16-point digital output FTA and both analog output FTAs (8-point and 16-point) support connection to a standby manual unit. This option allows outputs to be maintained during I/O Processor replacement.

**Remote I/O**

Remote I/O options are available to enable IOPs and FTAs to be distributed at up to six remote sites (see Figure 5). Using redundant fiber-optic cables to extend the I/O Link, remote I/O installation benefits from inherent immunity against ground potential differences and EMI/RFI. In addition, remote installation of IOPs and FTAs can significantly reduce signal wire runs.

Two options are available. The Remote I/O option supports remote sites up to 1 kilometer from the main PM/APM/HPM electronics, while the Long Distance I/O option provides for separation of up to 8 kilometers. Either option requires an I/O link Extender pair (IOLE) at both ends. The 1-km option supports up to three remote sites for each IOLE, while the 8-km option requires one IOLE per remote site.

FTAs at the remote site may be located an additional 50 meters from the I/O Processors. LLAI Mux, Serial Device, or Serial Interface FTAs may be located an additional 300 meters away. The RHMUX FTA may be located an additional 2 km away.



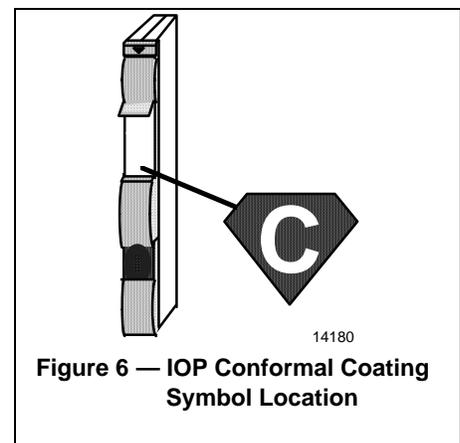
**Figure 5 — Fiber Optic Remote I/O**

### *Corrosion Protection Option*

As electronic board layouts have become more compact, sensitivity to corrosion has increased. In addition, a trend toward locating I/Os closer to the process to save installation costs has generated a requirement for environmentally hardened products. To provide extra corrosion protection when PM/APM/HPM equipment cannot be located in a mild (G1) environment, board sets are conformally coated as a standard feature. These boards are completely covered with a thin plastic film resistant to the corrosive effects of humidity and certain gases, and are thus suitable for placement in a harsh (G3) atmosphere. Coating is optional for most PM/APM/HPM system components, such as IOPs, FTAs, power supplies and backplanes. Many components are coated as a standard, such as the HLAI IOP, AO IOP, and HPM controller board set.

All coated products are denoted by a "C" in the second character of their model number. Uncoated boards maintain the standard MU-xxxxxx style numbers; therefore, all products for which conformal coating is available have two model numbers. For example, the uncoated DI IOP model number is MU-PDIX02, and the coated version is MC-PDIX02. In order to easily identify coated IOPs in the field, they are labeled with a distinctive symbol located on their faceplate (see Figure 6). The "C" surrounded by a solid diamond (the universal symbol of hardness) represents the protection this conformal coating process provides.

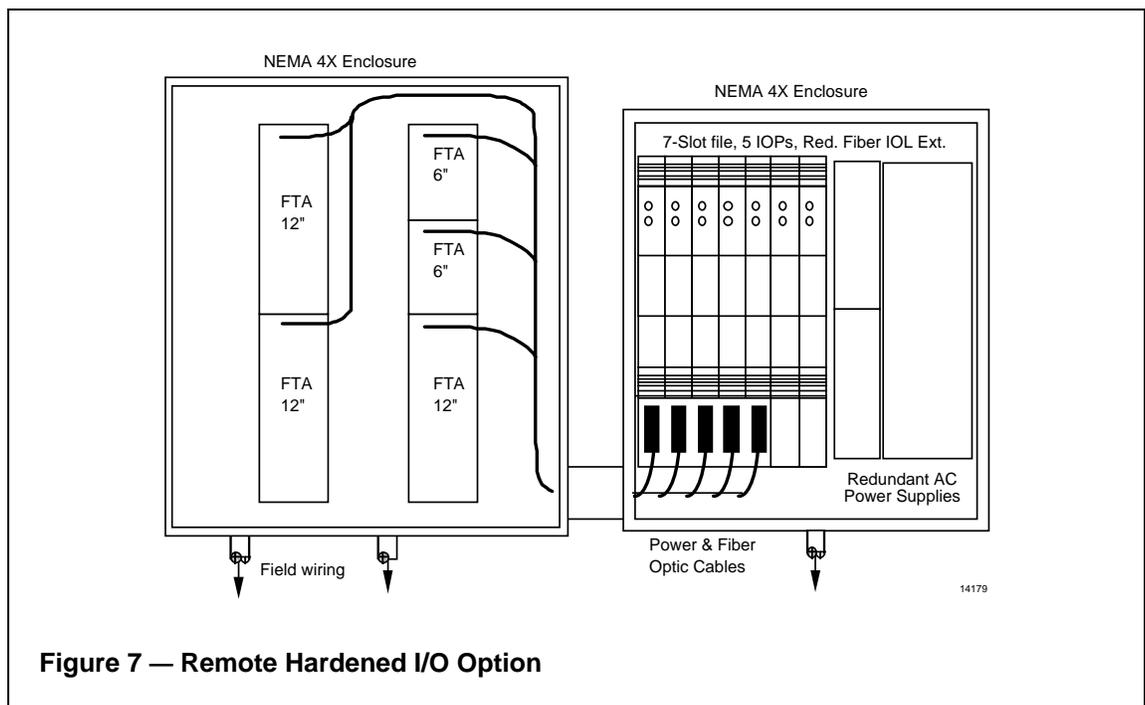
**Note:** Boards installed and maintained in a G1 (mild) control room environment (defined by the ISA Environmental Severity Classification) do not need this added protection.



## Harsh Environment Option

To help reduce wiring and installation costs, as well as free up valuable control room space, a Remote Hardened I/O (RHIO) NEMA4X sealed cabinet option is available for remotely mounting PM/APM/HPM I/O (see Figure 7). Backplanes and power supplies included with RHIO are conformally coated. When populated with conformally coated IOPs, FTAs, and Fiber Optic Extenders, the RHIO option provides a GX “Severe” environment product rating against corrosion due to humidity and corrosive gases in remote locations.

The IOP cabinet accommodates a 7-slot file and a redundant 8-amp power supply and is available as a standard product; the FTA cabinet must be custom ordered due to the many variations of FTA sizes and layouts.



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## European Community (EC) Compliance

The APM and HPM are available in compliance with European Community (EC) directive requirements, denoted by the "CE mark" (Communauté Européenne). The PM is not covered. This compliance extends to the APMM/HPMM, cardfiles, power supplies, IOPs and FTAs, as well as to Rittal cabinets. Since January 1, 1996, all goods imported into the European community or moving between member countries must be compliant with the new EC directives.

For APMM/HPMM, customers must indicate whether or not CE compliance is required. APMMs, HPMMs, IOPs, and power supplies are only available CE-compliant. For cardfiles and some FTAs, both compliant and non-compliant versions are available. Only Rittal cabinets are CE-compliant. Please refer to Table 1 for IOP/FTA more information. Note that the system must be mounted in a standard Rittal cabinet per Honeywell specifications, use only standard Honeywell/Rittal mounting hardware, and be installed according to Honeywell instructions.

## Specifications

Specifications apply to the PM/APM/HPM I/O modules mounted in a standard cabinets. See PM/APM/HPM Specification and Data Sheets for more information.

### I/O Link Extender (Remote I/O)

Parameter	Specification	
	Remote I/O Link Extender	Long Distance I/O Link Extender
Fiber Link Length	1.2 km	8 km
Fiber Size	62.5/125 $\mu$ m	62.5/125 $\mu$ m
Wave Length	820 nanometers	1300 nanometers
Fiber Power Budget Over-Temperature Range	5.5 dB	10.0 dB
Note: Fiber optic cables are supplied by outside vendors in accordance with Honeywell specifications. For additional information, see the <i>PM/APM Process Manager Planning</i> manual, PM02-501, Section 9.		

### European Community Compliance (CE-Mark)

<b>CE Conformity (Europe)</b>	This product is in conformity with the protection requirements of the following European Council Directives: 73/23/EEC, the Low Voltage Directive, and 89/336/EEC, the EMC Directive. Conformity of this product with any other "CE Mark" Directive(s) shall not be assumed.  <i>Deviation from the prescribed procedures and conditions specified in the installation manuals may invalidate this product's conformity with the Low Voltage and EMC Directives. See Table 1 for IOP and FTA model information.</i>
<b>Product Classification</b>	Class I: Permanently mounted, permanently connected Industrial Control Equipment with protective earthing (grounding). (EN 61010-1-1993)
<b>Installation Category</b>	Category II: Energy-consuming equipment supplied from the fixed installation. Local Level Appliances and Industrial Control Equipment. (EN 61010-1-1993)
<b>Pollution Degree</b>	Pollution Degree 2: Normally non-conductive pollution with occasional conductivity caused by condensation. (IEC 664-1-1992)
<b>EMC Classification</b>	Group 1, Class A, Industrial, Scientific and Medical (ISM) Equipment. (EN55011-1991; Emissions)
<b>Method of Assessment</b>	EMC: Technical Construction File (TCF) LVD: Technical File (TF)

High Level Analog Input Processor - 16 Inputs

MC-PAIH03

Parameter	Specification
FTA Models	MU-TAIH02, TAIH12, TAIH52, TAIH03, TAIH13, TAIH23, TAIH53, TAIH22, TAIH62
Input Type	Voltage, current (2-wire or self-powered transmitters)
Input Channels	16 differential input channels
Common Mode Rejection Ratio, dc to 60 Hz (500 $\Omega$ source imbalance)	70 dB
Common Mode Voltage, dc to 60 Hz <sup>(1)</sup>	-6 to +5 V peak
A/D Converter Resolution	16 bits (14 bits used)
Input Range	0 to 5 V 1 to 5 V 0.4 to 2 V 4-20 mA (through 250 $\Omega$ )
Normal Mode Rejection Ratio, at 60 Hz	32 dB
Normal Mode Filter Response	Single-pole RC, -3 dB @ 1 Hz
Maximum Normal Mode Input (differential inputs, no damage)	$\pm 30$ Volts
Crosstalk, dc to 60 Hz (channel-to-channel)	60 dB
Input Impedance (Voltage Inputs)	> 10 M $\Omega$ powered
Maximum Input Voltage (any input referenced to common, no damage)	$\pm 30$ Volts
Input Scan Rate	4 samples per second per channel. All channels sampled within a 250 ms window.
Hardware Accuracy (@ CMV = 0 V)	$\pm 0.075\%$ full-scale (23.5 $\pm 2^\circ\text{C}$ ) $\pm 0.15\%$ full-scale (0 to 50 $^\circ\text{C}$ )
Transmitter Power Conditioning MU-TAIH02, TAIH52, TAIH12, TAIH03, TAIH13, TAIH53	Resistor Current Limited, 145 $\Omega$ (not fused) for Class 1, Div 2 interfacing
MU-TAIH22, TAIH23, & TAIH62	Individually Protected Current Limiting Circuits for Class 1, Div 2 interfacing  Maximum current: 30 ma Minimum voltage 23 V
Surge withstand capability (Common mode)	ANSI/IEEE C37.90.1-1978
(1) The low-side input connection is normally connected to system common by a wire jumper on the FTA. This can be removed by the user, subject to operating within the CMV specification.	

**High Level Analog Input Processor Redundancy Option**MU-TAIH12, TAIH52, TAIH13,  
TAIH53, TAIH22, TAIH23, TAIH62

Parameter	Specification
Input Scan Cycles Missed or Delayed During Swap or Failover	No cycles missed or delayed
Hardware Accuracy Effect of Failure	No effect nominally $\pm 2\%$ of FS maximum (at 0 V Common Mode)

**Low Level Analog Input Processor - 8 Inputs**

MU-PAIL02

Data Conversion Performance	
Parameter	Specification
<b>FTA Model</b>	<b>MU-TAIL02, TAIL03</b>
Input Type	Thermocouple, RTD, Voltage, & Current (2-wire transmitters require separate power source)
Input Channels	8 galvanically isolated
A/D Converter Resolution	15 bits
Input Range	See table on following page
CMV, dc to 60 Hz	250 Vac rms or $\pm 250$ Vdc
Dielectric Strength	1500 Vac rms or $\pm 1500$ Vdc Channel-to-channel, and channel-to-PM/APM/HPM common
CMRR, dc to 60 Hz	120 dB min. w/1k lead imbalance
NMRR, at line frequency	60 dB min.
Normal Mode Filter Response	-3 dB point: Typical 10.6 Hz; min. 9.6 Hz; max. 11.9 Hz
Crosstalk, dc to 60 Hz	120 dB
Input Impedance	5 k $\Omega$ min. @ 0-5 Vdc (unpowered)
Input Impedance	10 M $\Omega$ min. @ 0-5 Vdc (powered)
Maximum Normal Mode Input (no damage)	-20 mV to 5.5 Volt
Input Scan Rate	8 samples per second per channel. All channels sample simultaneously. 4 samples per second per channel for thermocouple input if open thermocouple detection enabled.
Line Frequency Synchronization Type Frequency Range	Running Average 50/60 Hz +3%, -6%
Hardware (only) Accuracy (0-100 mV, 0-5 V)	$\pm 0.05\%$ of full scale, or $\pm 0.075\%$ of reading at 23.5° $\pm 2^\circ\text{C}$ (whichever is larger)

(Continued)

Low Level Analog Input Processor - 8 Inputs (continued)

MU-PAIL02

Data Conversion Performance	
Parameter	Specification
FTA Model	MU-TAIL02, TAIL03
Software (only) Accuracy <sup>(1)</sup>	±0.1°C typical, ±0.5°C maximum at 23.5° ±2°C
Hardware Reference Junction Accuracy	±0.9°C maximum at 23.5° ±2°C (in cabinet)
Temperature Stability Voltage Input, current input, thermocouple input (except reference junction) RTD Input	45 ppm/°C RSS 70 ppm/°C maximum 50 ppm/°C RSS 85 ppm/°C maximum
Surge withstand capability (common mode)	ANSI/IEEE C37.90.1-1978
(1) Software EU conversion error including software reference junction compensation. The temperature conversion by software meets or exceeds the accuracy tolerances for fifth order polynomials as specified in the National Institute of Standards and Technology (NIST) Monograph 125 (IPTS-68).	

Signal Types and Ranges		
Signal Type	Normal Signal Range	Extended Signal Range
ANSI J	-100 to 750°C	-200 to 1200°C
ANSI K	0 to 1100°C	-200 to 1370°C
ANSI E	-150 to 500°C	-200 to 1000°C
ANSI T	-200 to 300°C	-230 to 400°C
ANSI B	+600 to 1650°C	+100 to 1820°C
ANSI S	+550 to 1500°C	0 to 1700°C
ANSI R	+550 to 1500°C	0 to 1700°C
JAPAN Type R	+550 to 1500°C	0 to 1700°C
RTD (3 Wire)		
Pt: 100 Ω DIN (4376)	-200 to 850°C	N/A
Pt: 100 Ω JIS (C-1604)	-200 to 650°C	N/A
Ni: 120 Ω Ed #7	-45 to 315°C	N/A
Cu: 10 Ω	-20 to 250°C	N/A
Voltage Input		
	0-100 mV	N/A
	0-5 V	N/A

## Low Level Analog Input Multiplexer Processor - 32 Inputs

MU-PLAM02

Data Conversion Performance (General Specifications)	
Parameter	Specification
<b>FTA Models</b>	<b>MU-TAMR03, TAMT03, TAMT13</b>
Input Type	Thermocouple, RTD, and linear millivolts
Input Channels	32 galvanically isolated
A/D Converter Resolution	14 bits TC types J, K, E, T, B, S, R, RP: 10 $\mu$ V per bit 100 $\Omega$ and 120 $\Omega$ RTDs: 64 m $\Omega$ per bit 10 $\Omega$ RTD: 8 m $\Omega$ per bit Linear mV sensors: 20 $\mu$ V per bit
CMV, dc to 60 Hz	250 Vac Peak or $\pm$ 250 Vdc
Dielectric Strength	1500 Vac rms or $\pm$ 1500 Vdc channel-to-channel (operating), and channel-to-PM/APM/HPM common (not operating)
Crosstalk, dc to 60 Hz	120 dB
Input Impedance	2 M $\Omega$ min. @ 100 mV
Maximum Normal Mode Continuous Input (No damage)	-1 V to 10 V
Input Scan Rate	32 samples per second (each channel once per second)
Line Frequency Synchronization	Configurable to 50 or 60 Hz
Hardware (only) Accuracy	$\pm$ 40 $\mu$ V, or $\pm$ 160 m $\Omega$ 23.5° $\pm$ 2°C
Software (only) Accuracy <sup>(1)</sup>	$\pm$ 0.1°C typical, $\pm$ 0.5°C maximum at 23.5° $\pm$ 2°C
Surge withstand capability (common mode)	ANSI/IEEE C37.90.1-1978
(1) Software EU conversion error including software reference junction compensation, at reference temperature. The temperature conversion by software meets or exceeds the accuracy tolerances for fifth order polynomials as specified in the National Institute of Standards and Technology (NIST) Monograph 125 (IPTS-68).	
<b>NOTE:</b> Mercury-Wetted Relays are used in this product.	

(Continued)

Low Level Analog Input Multiplexer Processor - 32 Inputs (continued)

MU-PLAM02

Data Conversion Performance --Thermocouple (TC) and Voltage Input			
Parameter	Specification		
	Normal Signal Range		Extended Signal Range
Thermocouple Device Range			
ANSI J	-100 to	750° C	-200 to 1200° C
ANSI K	0 to	1100° C	-200 to 1370° C
ANSI E	-150 to	500° C	-200 to 1000° C
ANSI T	-200 to	300° C	-230 to 400° C
ANSI B	+600 to	1650° C	+100 to 1820° C
ANSI S	+550 to	1500° C	0 to 1700° C
ANSI R	+550 to	1500° C	0 to 1700° C
JAPAN Type R	+550 to	1500° C	0 to 1700° C
Voltage Input Signal Range	0 to 100 mV		
CMRR, dc to 60 Hz (0-100 mV)	120 dB min. with 500Ω lead imbalance		
NMRR, at line frequency (50 or 60 Hz)	60 dB min.		
NMRR, at other than line frequency (1-15 mV)	$\text{NMRR} = -20 \times \log_{10} \left( \frac{\sin(\pi^x f^x t)}{(\pi^x f^x t)} \right) - 20 \times \log_{10} \left( \frac{1}{K^x f} \right)$ <p>Where:  <math>\pi = 3.14159</math>  <math>f =</math> Noise Frequency  <math>t =</math> Integration Time (20 ms @ 50 Hz, 16.66ms @ 60 Hz)  <math>K = 0.20878</math> (a constant)</p>		
Normal Mode Filter Response (TC & mV)	-3 dB point: Typical 5.1 Hz; min. 4.3 Hz; max. 6.4 Hz		
Hardware Reference Junction Accuracy	±1.0°C maximum at 23.5° ±2°C (in cabinet)		
Temperature Stability Voltage Input, current input, thermocouple input (except reference junction)	20 ppm/°C RSS 30 ppm/°C maximum		
TC Max Length, 250 V Peak/dc Common Mode 16 Gauge TC Wire 18 Gauge TC Wire 20 Gauge TC Wire	3,500 ft. 2,250 ft. 1,250 ft.		
CMRR = Common Mode Rejection Ratio. NMRR = Normal Mode Rejection Ratio.			

(Continued)

## Low Level Analog Input Multiplexer Processor - 32 Inputs (continued)

MU-PLAM02

Data Conversion Performance--Resistive Temperature Device (RTD)	
Parameter	Specification
RTD (3 Wire) Input Signal Range Pt: 100 Ω DIN (4376) Pt: 100 Ω JIS (C-1604) Ni: 120 Ω Ed #7 Cu: 10 Ω	-200 to 850°C -200 to 650°C -45 to 315°C -20 to 250°C
CMRR, dc to 60 Hz (0-100 mV)	10Ω RTD: 120 dB min. 100Ω RTD: 110 dB min.
NMRR, at line frequency (50 or 60 Hz)	10Ω RTD: 60 dB min. (for 50/60 Hz noise of 0-15 mV) 100Ω RTD: 60 dB min. (for 50/60 Hz noise of 0-75 mV)
NMRR, at other than line frequency 10Ω RTD: (0-15 mV) 100Ω RTD: (0-75 mV)	$\text{NMRR} = -20 \times \log_{10} \left( \frac{\sin(\pi \times f \times t)}{(\pi \times f \times t)} \right) \text{ Where:}$ <p> <math>\pi = 3.14159</math>  <math>f = \text{Noise Frequency}</math>  <math>t = \text{Integration Time (20 ms @ 50 Hz, 16.66ms @ 60 Hz)}</math> </p>
Hardware Reference Junction Accuracy	±1.0°C maximum at 23.5° ±2°C (in cabinet)
Temperature Stability RTD Input	30 ppm/°C RSS 40 ppm/°C maximum
RTD Max Lead Resistance	15 Ω
CMRR = Common Mode Rejection Ratio. NMRR = Normal Mode Rejection Ratio.	

Remote Hardened Multiplexer Processor - 32 Inputs

MU-PRHM01

Data Conversion Performance (General Specifications)	
Parameter	Specification
FTA Model	MC-GRMT01
Input Type	Thermocouple and linear millivolts
Input Channels	32 galvanically isolated (16 per remote FTA)
A/D Converter resolution	15 bits 100 mV range: LSB = 8 $\mu$ V Type J, K, or E thermocouples: LSB = 8 $\mu$ V Type T, B, S, R, or R' thermocouples: LSB = 2 $\mu$ V
Common Mode Voltage, dc to 60 Hz	$\pm$ 30 VRMS Continuous (max, no damage) $\pm$ 200 V Intermittent (max, no damage)
Crosstalk, dc to 60 Hz	120 dB min
Input Impedance	10 Megohms Min
Maximum Normal Mode Continuous Input (no damage)	$\pm$ 30 VRMS Continuous, one channel at a time
Input Scan Rate	Each channel once per 4 seconds
Line Frequency Noise Cancellation	Configurable to 50 or 60 Hz
Hardware (only) accuracy	0.075% of Full Scale (mV or T/C range)
Software (only) accuracy <sup>(1)</sup>	0.1°C typical, 0.5°C maximum at 20°C
Surge withstand capability	ANSI/IEEE C37.90.1-1978
Data Conversion Performance (Thermocouple and Voltage Input)	
Parameter	Specification
Thermocouple Device Range	
ANSI J	-200 to + 1200°C
ANSI K	-100 to + 1370°C
ANSI E	-200 to + 1000°C
ANSI T	-230 to + 400°C
ANSI B	+100 to + 1820°C
ANSI S	0 to + 1700°C
ANSI R	0 to + 1700°C
Japan Type R	0 to + 1700°C

(Continued)

## Remote Hardened Multiplexer Processor - 32 Inputs (continued)

MU-PRHM01

Data Conversion Performance (Thermocouple and Voltage Input)	
Parameter	Specification
Voltage Input Signal Range	0 to 100 mV
CMRR <sup>(2)</sup> , dc to 60 Hz	90 dB min, 1000Ω lead resistance, DC or line frequency 120 dB min, 0Ω lead resistance, DC or line frequency
Hardware Reference Junction Accuracy	±1°C max error in 20 to 25°C static environment
Calibration Stability: Voltage input or thermocouple input (except reference junction)	±50 ppm per °C max
Open Thermocouple Detection	Performed on every conversion ≤1000Ω good, ≥1200Ω PV = NAN
T/C Max loop resistance	1000Ω total loop resistance
Environmental Specifications	
Parameter	Specification
Operating Temperature	-40 to +85°C at Remote FTA 0 to +50°C cabinet ambient for IOP and power adapters
Operating Humidity	10 to 100% condensing, Remote FTA 10 to 90% non-condensing, IOP and power adapters
Corrosives	Gx, Remote FTA G1 or G3 for IOP and power adapters, depending on corrosion option
Notes:	
(1) Software EU conversion error including software reference junction compensation, at reference temperature. The temperature conversion by software meets or exceeds the accuracy tolerances for fifth-order polynomials as specified in the National Institute of Standards and Technology (NIST) monograph 125 (IPTS-68).	
(2) CMRR = Common Mode Rejection Ratio	

**Smart Transmitter Interface Processor\***

**MU-PSTX03**

<b>Parameter</b>	<b>Specification</b>
<b>FTA Models</b>	<b>MU-TAIH02, TAIH12, TAIH22, TAIH52, TAIH62, TSTX03, TSTX13, TSTX53</b>
Input Type	Honeywell DE (digital enhanced) protocol (bidirectional)
Input Channels	16 digital input channel PVs
Resolution	The resolution of the connected field instrument is passed through without degradation.
Maximum Input Voltage (any input referenced to common, no damage)	-10 V to +30 V
Transmitter broadcast frequency (PV)	2.4-3.6 PVs per second per channel (configuration dependent).
Accuracy	The accuracy of the connected field instrument is passed through without degradation.
Surge withstand capability (Common mode)	ANSI/IEEE C37.90.1-1978
Transmitter Power Conditioning	
MU-TAIH02, MU-TAIH52, MU-TAIH12, MU-TSTX03,	Resistor Current Limited, 145 $\Omega$ (not fused) for Class 1, Div 2 interfacing
MU-TSTX13, MU-TSTX53 MU-TAIH22 & TAIH62	Individual Protected Current Limiting Circuits for Class 1, Div 2 interfacing  Maximum current: 30 ma Minimum voltage 23 V

**Smart Transmitter Interface Processor\* Redundancy Option**

**MU-TAIH12, TAIH52,  
TSTX13, TSTX53**

<b>Parameter</b>	<b>Specification</b>
Input Scan Cycles Missed or Delayed During Swap or Failover	No cycles missed or delayed
Hardware Accuracy Effect of Failure	No effect nominally. The resolution of the connected field instrument is passed through without degradation.

\* Smart Transmitter Interface Processor (MU-PSTX03) supports both single and multivariable transmitter types.

**Serial Device Interface (General Specifications)****MU-PSDX02**

Parameter	Specification
<b>FTA Models</b>	<b>MU-TSDM02, TSDT02, TSDU02</b>
Input Channels	1 galvanically isolated serial channel per FTA
Interface Type	EIA-232, EIA-422 or EIA-485
Points per FTA (Maximum of two FTAs per IOP)	1-8
Points per IOP	1-16
Common Mode Voltage, dc to 60 Hz	250 Vac rms or $\pm 250$ Vdc
Dielectric Strength	1500 Vac rms or $\pm 1500$ Vdc (channel to PM/APM/HPM)
Surge withstand capability	ANSI/IEEE C37.90.1-1978

**Serial Device Interface - Toledo Weigh Cell****MU -TSDT02**

Parameter	Specification
Physical Interface	EIA-232 using DB-25 female connector
Device Supported	Toledo Weigh Cell Model Number 8142-2089
Lines Supported (EIA-232)	Transmit Data, Receive Data, Request To Send, Clear To Send, Data Set Ready, Data Terminal Ready, Data Carrier Detect, Logic Ground, Protective Ground
Full Modem Support	No
Distance, Power Adapter to FTA	<ul style="list-style-type: none"> <li>Internal cable within PM/APM/HPM cabinet or</li> <li>External cable 300 m (1000 ft.) maximum</li> </ul>
EIA-232 Cable Length, FTA to Device	15 m (2500 pF cable capacity maximum)*
Surge withstand capability	ANSI/IEEE C37.90.1-1978
ESD Protection	IEC 801.2
Number of Toledo Weigh Cells	<ul style="list-style-type: none"> <li>2 FTAs per SDI IOP</li> <li>1 Toledo Weigh Cell per FTA</li> </ul>
Baud Rate	9600 bps fixed rate
Data Transfer	Bidirectional, Half-Duplex
Message Validity	<ul style="list-style-type: none"> <li>Single-bit character parity</li> <li>Message block checksum</li> </ul>

\* Consult factory for longer lengths.

**Serial Device Interface - Manual/Auto Station****MU-TSDM02**

<b>Parameter</b>	<b>Specification</b>
Physical Interface	EIA-485 Multidrop using 5-terminal compression connector
Device Supported	Honeywell Manual/Auto Station
Lines Supported (EIA-485)	R (Data+), Data+, Shield, Data-, R (Data-)
Full Modem Support	No, Multidrop is not a modem interface
Distance, Power Adapter to FTA	<ul style="list-style-type: none"> <li>• Internal cable within PM/APM/HPM cabinet or</li> <li>• External cable 300 m (1000 ft.) maximum</li> </ul>
EIA-485 Cable Length, FTA to Device	1.2 km (4000 ft.) with appropriate cable*
Surge withstand capability	ANSI/IEEE C37.90.1-1978
ESD Protection	IEC 801.2
Number of Manual/Auto Stations	<ul style="list-style-type: none"> <li>• 2 FTAs per SDI IOP</li> <li>• 4 Manual/Auto Stations per FTA</li> </ul>
Baud Rate	19.2 Kbps
Transmission Mode	Asynchronous, Bit Serial
Data Transfer	Bidirectional, Half-Duplex
Message Validity	<ul style="list-style-type: none"> <li>• Single-bit character parity</li> <li>• Message block checksum</li> </ul>
Tag ID Downloaded	8 Characters
PV Range	EUHI and EULO downloaded
Input Scan Rate	Four updates per second per point

\* Refer to PM I/O Installation manual (PM20-520).

**Serial Device Interface - UDC 6000 Process Controller****MU-TSDU02**

<b>Parameter</b>	<b>Specification</b>
Physical Interface	EIA-485 Multidrop using 5-terminal compression connector
Device Supported	Honeywell UDC 6000 with Modbus Communication Option
Lines Supported (EIA-485)	R (Data+), Data+, Shield, Data-, R (Data-)
Full Modem Support	No—Multidrop is not a modem interface
Distance, Power Adapter to FTA	<ul style="list-style-type: none"> <li>• Internal cable within APM cabinet or</li> <li>• External cable 300 m (1000 ft.) maximum</li> </ul>
EIA-485 Cable Length, FTA to Device	1.2 km (4000 ft.) with appropriate cable*
Surge withstand capability	ANSI/IEEE C37.90.1-1978
ESD Protection	IEC 801.2
Number of UDC 6000s	<ul style="list-style-type: none"> <li>• 2 FTAs per SDI IOP</li> <li>• 4 UDC 6000s per FTA</li> </ul>
Baud Rate	19.2 Kbps
Transmission Mode	Asynchronous, Bit Serial
Data Transfer	Bidirectional, Half-Duplex
Communication Protocol	Modbus Remote Terminal Unit (RTU) protocol
Message Validity	<ul style="list-style-type: none"> <li>• Single-bit character parity</li> <li>• Message block checksum</li> </ul>

\* Refer to PM I/O Installation manual (PM20-520).

Serial Interface I/O Processor/FTA - Modbus

MU-TSIM12

Parameters	Specification
Physical Interface	EIA-232 or EIA-485
Devices Supported	Multivendor Qualified Modbus Compatible Devices
Distance, Power Adapter to FTA	<ul style="list-style-type: none"> <li>• Internal cable within APM/HPM cabinet or</li> <li>• External cable 300 m (1000 ft.) maximum</li> </ul>
Surge withstand capability	ANSI/IEEE C37.90.1-1978
ESD Protection	IEC 801.2
Number of Devices per SI	<ul style="list-style-type: none"> <li>• 2 FTAs per SI</li> <li>• Up to 15 devices per FTA</li> </ul>
Data Quantity per IOP	16 Points per serial channel (organized as Arrays in the APMM/HPMM) Each point can access <i>one</i> of the following: 512 Booleans into FLAGS 16 Reals or 32 Integers into NUMERICS 64 NUMERICS (Diagnostic Counter Data Only) 1 STRING of 64 Characters 2 STRINGS of 32 Characters 4 STRINGS of 16 Characters 8 STRINGS of 8 Characters
Serial Data Format	8 data bits with programmable 9th bit
EIA RS232 Support Transmission Mode: Lines Supported: Distance, FTA to Device:	Serial asynchronous, bidirectional TXD, RXD, RTS, CTS, DSR, DTR, DCD, Logic GND, Protective GND 15 m (2500 pf cable capacity maximum)
EIA-RS485 Support Transmission Mode: Lines Supported: Common Mode Operation: Number of drops: Distance, FTA to Device:	Serial asynchronous, bidirectional, half duplex only Two wire, differential pair: Data+(B), Data-(A), Protective GND (shield) 250 Vac rms (continuous) 15 drops maximum 1.2 Km (4000 ft.) maximum
Modbus Interface Specification Protocol: Serial Line Mode: Selectable Baud Rates: Selectable Parity: Number of Stop Bits: Modem Control Support: Keep Alive Cell Write Message Response Timeout: Exception Errors Reported: Data Formats Supported: Intermessage stall time: Function Codes Supported:	(Default parameters are shown in <b>bold.</b> ) Modbus, Remote Terminal Unit (RTU) <b>RS232</b> or RS485 1200, 2400, 4800, 9600, <b>19200</b> bps None, <b>odd</b> , or even 1 Selectable ON/ <b>OFF</b> Configurable address/ <b>NONE</b> Configurable timeout/ <b>1.5 seconds</b> All Boolean, Real, ASCII Strings, Signed Integers 3.5 character time minimum 01, 02, 03, 04, 05, 06, 08, 16

## Serial Interface I/O Processor/FTA - Allen-Bradley

MU-TSIA12

Parameters	Specification
<b>General</b>  Interface Type: Number of Channels per IOP: Distance, Power Adapter to FTA: Baud Rate: Serial Data Format with parity bit: Common Mode Operation:	EIA-RS232 2 300 m (1000 ft.) 19.2 k bps 8 data bits 250 V rms (continuous)
<b>EIA-RS232 Support</b>  Interface Type: Lines Supported: Distance, FTA to Device:	Serial asynchronous TXD, RXD, Logic GND, Protective GND 15 meters (cable cap. = 2500 pF max.)
<b>SI A-B Specific Interface Specifications</b>  Protocol: Transmission Mode: Serial Line Mode: Parity: No. Stop Bits: Modem Control Support: ACK Timeout: FTA Message Response Timeout: Data Formats Supported: CIM Communication Options:	Full Duplex Allen-Bradley DF1 with embedded responses Character oriented RS232 even 1 Off 3.2 sec. 4.0 sec. Booleans, Reals, Signed/Unsigned Integers, ASCII Strings Pass-through diagnostic Accept duplicate message BCC error check
<b>Allen-Bradley Family Types Supported:</b>	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)

**Pulse Input Processor/FTA**

**MU-PPIX02**

Parameters	Specification
<b>FTA Models</b>	<b>MU-TPIX12, TPIX52</b>
Sensor Inputs	Self-powered 2-wire PM/APM/HPM-powered (with automatic current limiting) 3-wire Pulse voltage or contact input
Input Type	Rectangular or sine waves
Input Channels	8
Input Impedance	10 k $\Omega$ minimum
Input Frequency <sup>(1)</sup> 50% Duty Cycle Square Wave Sine Waves	1 Hz to 20 kHz (all channels same amplitude) 1 Hz to 20 kHz
Pulse Levels Low High	-0.5 V to +1.9 V +3.5 V to +24 V (Hysteresis prevents change between 1.9 V and 3.5 V)
Pulse Width (On/Off Dwell) High and Low	25 $\mu$ s minimum at 20 kHz (with IOP filter jumper in storage position) 50 $\mu$ s minimum at 10 kHz (with IOP filter jumper in H position) 500 $\mu$ s minimum at 1 kHz (with IOP filter jumper in L position)
Contact Current Low (0, Field contact closed) High (1, Field contact open)	23 mA maximum (with FTA Pullup) <sup>(2)</sup> 20 mA maximum (with FTA Pullup) <sup>(2)</sup>
Contact Resistance Low (0, Field contact closed) High (1, Field contact open)	82 $\Omega$ maximum (with FTA Pullup) <sup>(2)</sup> 175 $\Omega$ minimum (with FTA Pullup) <sup>(2)</sup>
Field Input Scan Rate	20 ms
AV Update Rate (Used for Totalizer Algorithm)	20 ms
PV Update Rate	500 ms for 8 channels
Rate Accuracy	$\pm$ 0.01% of input frequency, $\pm$ 0.4 Hz (whichever is larger)
Rate Resolution	$\pm$ 0.4 Hz
Input Range (No Damage)	$\pm$ 30 V maximum
Transmitter Power Conditioning (for 3-wire connection) Open Circuit Voltage Full Load Short Circuit Current	23-25 Vdc 21 V @ 115 mA 150 mA maximum
<p>(1) Sine waves must not be intermixed with square waves or contacts on the same FTA.                      50 M FTA cables with mixed signal amplitudes: frequency is 9 kHz maximum (55 <math>\mu</math>s minimum pulse width)                      30 M FTA cables: frequency is 13 kHz maximum (38 <math>\mu</math>s minimum pulse width)                      20 M FTA cables: frequency is 15 kHz maximum (33 <math>\mu</math>s minimum pulse width)                      10 M FTA cables: frequency is 18 kHz maximum (28 <math>\mu</math>s minimum pulse width)                      5 M FTA cables: frequency is 20 kHz maximum (25 <math>\mu</math>s minimum pulse width)</p> <p>(2) 1 k<math>\Omega</math> to 24 Vdc.</p>	

**Analog Output 8-Point Processor/FTA****MC-PAOX03**

Parameter	Specification
FTA Models	<b>MU-TAOX02, TAOX12, TAOX52</b>
Output Type	4-20 mA
Output Channels	8
Output Ripple	100 mV peak-to-peak at power line frequency, across 250 $\Omega$ load
Output Temperature Stability	0.02% Full Scale/ $^{\circ}$ C
Resolution	$\pm$ 0.05%
Calibrated Accuracy	$\pm$ 0.35% (25 $^{\circ}$ C) including linearity
Output Readback Checking Accuracy	$\pm$ 4%
Humidity	10 - 90% non-condensing
Directly Accessible Output Current Range	0.1-21.4 mA
Maximum Current Output	26 mA
Maximum Resistive Load	750 $\Omega$ @ 22 mA
Output Settling Time (digital input code to 98% of final output value)	4 ms
Surge withstand capability	ANSI/IEEE C37.90.1-1978

**Analog Output 8-Point Processor Redundancy Option****MU-TAOX12, TAOX52**

Parameter	Specification
Output Signal Perturbation During Swap	1 ms nominal 4 ms maximum
Output Signal Perturbation During Failover	30 ms nominal 125 ms maximum
FTA Switching Hardware Diagnostic Frequency	Once per minute

**Analog Output 16-Point Processor/FTA**

**MU-PAOY22**

Parameter	Specification
FTA Models	<b>MU-TAOY22, TAOY23, TAOY52, TAOY53</b>
Output Type	4-20 mA
Output Channels	16
Output Ripple	100 mV peak-to-peak at power line frequency, across 250 $\Omega$ load
Output Temperature Stability	$\pm 0.02\%$ Full Scale/ $^{\circ}\text{C}$
Output Readback Accuracy	$\pm 4\%$
Humidity	$\pm 0.1\%$ full scale (50% RH $\pm 40\%$ RH)
Output Current Linearity	$\pm 0.05\%$ nominal
Resolution	$\pm 0.05\%$
Calibrated Accuracy	$\pm 0.35\%$ (25 $^{\circ}\text{C}$ ) including linearity
Directly Settable Output Current Range	0 mA, 2.9 mA to 21.1 mA
Absolute Max Current Output for AO Value Digital Input Code	24 mA
Maximum Resistive Load (24 V supply = 20 V)	750 $\Omega$ @ 20 mA
Maximum Output Compliant Voltage (24 V supply = 20 V)	15 V
Output Settling Time (digital input code to 98% of final output value)	4 ms
Surge Withstand Capability	ANSI/IEEE C37.90.1-1978

**Analog Output 16-Point Processor Redundancy Option MU-TAOY22, TAOY23, TAOY52, TAOY53**

Parameter	Specification
Gap (0 mA) of Output to Field on Failover	20 ms maximum
Switching Hardware Diagnostic Frequency	Once per minute

## Digital Input Processor and Digital Input Sequence of Events Processor MU-PDIX02/MU-PDIS12

FTAs with Removable Plug-In Isolators			
Parameter	Specification		
	24 Vdc FTA	120 Vac FTA 125 Vdc FTA	240 Vac FTA
FTA Models	MU-TDID12, TDID52	MU-TDIA12, TDIA52	MU-TDIA22, TDIA62
Input Channels	32	32	32
Accumulated Input Frequency	dc - 15 Hz	NA	NA
Galvanic Isolation (field to PM/APM/HPM)	1500 Vac rms or $\pm 1500$ Vdc <sup>(2)</sup>	1500 Vac rms or $\pm 1500$ Vdc	1500 Vac rms or $\pm 1500$ Vdc
Isolation Technique	Optical	Optical	Optical
Digital Input Pwr. Range <sup>(1)</sup>	20-30 Vdc	90-132 Vac rms	180-264 Vac rms
Sense Current (ON condition)	4.5 mA minimum	3.5 mA minimum	2.2 mA minimum
Sense Current (OFF condition)	2.8 mA maximum	1.5 mA maximum	1.0 mA maximum
Pick Up Voltage (ON condition)	20 Vdc minimum <sup>(3)</sup>	90 Vac rms minimum <sup>(4)</sup>	180 Vac rms minimum <sup>(4)</sup>
Drop Out Voltage (OFF condition)	10 Vdc maximum <sup>(3)</sup>	25 Vac rms maximum <sup>(4)</sup>	50 Vac rms maximum <sup>(4)</sup>
Absolute Delay Across Input Filter and Isolation (Bounceless Input to PM/APM/HPM logic level change)	2.0 ms maximum	25 ms maximum	25 ms maximum
Frequency Range	dc	47-63 Hz	47-63 Hz
Surge withstand capability	ANSI/IEEE C37.90.1-1978	ANSI/IEEE C37.90.1-1978	ANSI/IEEE C37.90.1-1978
<p>(1) These dc voltage limits include an ac component that has a peak value of 5% of the nominal dc range value.</p> <p>(2) Not applicable if system power is used to power field inputs.</p> <p>(3) This voltage present from '-' terminal to ground.</p> <p>(4) The voltage present across input terminals.</p>			

(Continued)

Digital Input Processor and Digital Input SOE Processor (continued)

MU-PDIX02/ MU-PDIS12

Packaged FTAs without Plug-In Isolators		
Parameter	Specification	
	24 Vdc FTA	120 Vac FTA
FTA Model Numbers	<b>MU-TDID72</b>	<b>MU-TDIA72</b>
Input Channels	32	32
Accumulated Input Frequency	dc - 15 Hz	NA
Galvanic Isolation (field to APM)	1500 Vac rms or $\pm 1500$ Vdc <sup>(5)</sup>	1500 Vac rms or $\pm 1500$ Vdc
Isolation Technique	Optical	Optical
Digital Input Pwr. Range <sup>(1)</sup>	18-30 Vdc	90-132 Vac rms
Sense Current (ON condition)	12 mA minimum	5.2 mA minimum
Sense Current (OFF condition)	4.3 mA maximum	1.47 mA maximum
Absolute Delay Across Input Filter and Isolation (Bounceless Input to PM/APM/HPM logic level change)	3.6 ms maximum	25 ms maximum
Field Resistance for Guaranteed ON condition <sup>(2, 3)</sup>	100 $\Omega$ maximum	100 $\Omega$ maximum
Field Resistance for Guaranteed OFF condition <sup>(2, 3)</sup>	45 k $\Omega$ minimum <sup>(4)</sup>	71 k $\Omega$ minimum
Frequency Range	dc	47-63 Hz
Surge withstand capability	ANSI/IEEE C37.90.1-1978	ANSI/IEEE C37.90.1-1978
<p>(1) These dc voltage limits include an ac component that has a peak value of 5% of the nominal dc range value.</p> <p>(2) This resistance is present between the two legs of a DI current sense circuit.</p> <p>(3) For field wiring distance guidelines, see the appropriate <i>Site Planning</i> manual.</p> <p>(4) Reduce to 37.4 k<math>\Omega</math> if digital input power range is limited to 18-25 Vdc.</p> <p>(5) Not applicable if system power is used to power field inputs.</p>		

Digital Input Processor Redundancy Option (MU-PDIS12 Only)

Parameter	Specification
Input Scan Cycles Missed or Delayed During Swap or Failover	No cycles missed or delayed (all FTA types)

**Digital Input 24 Vdc Processor****MU-PDIY22**

<b>Parameter</b>	<b>Specification</b>
FTA Models	<b>MU-TDIY22, MU-TDIY62</b>
No. Points per IOP/FTA	32
Galvanic Isolation (any input terminal voltage referenced to common)	30 Vac, $\pm 42.4$ Vdc (max)
Isolation Technique	Optical (in IOP)
DI Power Voltage Range	15 to 30 Vdc
Input Signal Direction	Source/Sink
ON Sense Voltage/Current OFF Sense Voltage/Current	13 Vdc (min) or 3 mA (min) 5 Vdc (max) or 1.2 mA (max)
Input Impedance	4.2 K $\Omega$
Absolute Delay Across Input Filter and Isolation	5 ms $\pm$ 20%
Field Resistance for Guaranteed ON Condition	300 $\Omega$ max @ 15 Vdc
Field Resistance for Guaranteed OFF Condition	30 K $\Omega$ min @ 30 Vdc
Surge Withstand Capability	ANSI/IEEE C37.90.1-1978

Digital Output 16-Point Processor

MU-PDOX02

Parameter	Solid State		
	Specification		
	3-30 Vdc FTA	120/240 Vac FTA	31-200 Vdc FTA
FTA Model Numbers	MU-TDOD13, 53, 14, 54	MU-TDOA13, MU-TDOA53	MU-TDOD23, MU-TDOD63
Output Channels	16 (Outputs are independent from each other and can use independent load power supplies.)	16 (Outputs are independent from each other and can use independent load power supplies.)	16 (Outputs are independent from each other and can use independent load power supplies.)
Output Type	Normally open power transistor switch per output (emitter and collector terminals are both available to the user.)	Normally open triac switch per output (both triac terminals are available to the user)	Normally open power transistor switch per output (emitter and collector terminals are both available to the user.)
Load Voltage Range	13, 53 3-30 Vdc 14, 54 5-30 Vdc	120/240 Vac	31-200 Vdc
FTA Max Continuous Load Current	1.25 Adc per output <sup>(2)</sup>	1.25 Adc per output <sup>(2)</sup>	0.5 Adc per output <sup>(2)</sup>
Load Fuse Rating <sup>(5)</sup>	2.5 A 125 V slow blow (5x20 mm) fuse per output (readily replaceable in fuseholders)	2.5 A 125 V slow blow (5x20 mm) fuse per output (readily replaceable in fuseholders)	1 A 125 V slow blow (5x20 mm) fuse per output (readily replaceable in fuseholders)
Fuse Type (BUSS)	GDC-2.5 A	GDC-2.5 A	GDC-1 A
Load Power Factor	N/A	Must be 0.5 or greater <sup>(1)</sup>	N/A
Min. Load Current <sup>(3)</sup>	10 mAdc	50 mA (rms)	10 mAdc
Isolation	1500 V (rms) (field terminals to system power supply common)	1500 V (rms) (field terminals to system power supply common)	1500 V (rms) (field terminals to system power supply common)
On-State Voltage Drop	(@ max. load current) 13, 53 1.6 V max. 14, 54 3.0 V max.	1.6 V max. (@ max. load current)	3.0 V max. (@ max. load current)
Off-State Leakage Max.	13, 53 10 µAdc max. 14, 54 100 µAdc max.	5 mA rms	100 µAdc max.
Turn-on/Turn-off Time	1 ms max.	Next zero voltage/next zero current <sup>(4)</sup>	1 ms max.
Contact Suppression (Shunt)	Diode clamp	Resistor/capacitor snubber plus varistor per output	Diode clamp
Surge withstand capability	ANSI/IEEE C37.90.1-1978	ANSI/IEEE C37.90.1-1978	ANSI/IEEE C37.90.1-1978

- (1) Load power factors less than 0.5 can damage the triac switches. Additional resistor/capacitor snubbing must be added across the triac as discussed in the appropriate *Installation* manual for load power factors less than 0.5; otherwise a load with power factor 0.5, or greater, must be used.
- (2) Individual output rated at maximum 2 Adc, provided that total current for two adjacent channels does not exceed 2.5 amps.
- (3) Surge current rating of solid-state switch at 20°C non-repeating.
- (4) As much as 0.5 line cycle (8.33 ms for 60 Hz line) for power factor <1.0.
- (5) Actual fuse rating is slightly greater than the maximum FTA output allowed. "Use the FTA Max Continuous Load Current" section for maximum FTA output rating.

(Continued)

## Digital Output 16-Point Processor (continued)

## MU-PDOX02

Solid State (continued)	
Parameter	Specification
	<b>24 Vdc Nonisolated FTA</b>
FTA Models	<b>MU-TDON12, MU-TDON52</b>
Output Channels	16 (outputs referenced to power supply common)
Output Type	Open-collector (current-sinking) NPN transistors
Output Volt. States <sup>(1)</sup>	ON-state: 0-2 Vdc (maximum) OFF-state: "Ref +" terminal voltage (24 Vdc nominal)
Maximum Load Current	100 mA per output <sup>(2)</sup>
Minimum Load Current	1 mA per output
Output Isolation	None (any screw terminal to common)
On-State Voltage Drop	2 V max. @ max. load current
Off-State Leak. Current	100 $\mu$ A max. @ max. output voltage
Turn-on/Turn-off Time	10 $\mu$ s
Contact Suppression (Shunt)	Diode per output to "Ref +" terminal <sup>(3)</sup>
Output Transient Protection	(See Contact Suppression)
<p>(1) Because of the open-collector transistor configuration of the outputs, the nominal off-state output voltage is the load power supply ("Ref +") voltage, nominally +24 Vdc, minus any voltage across the load caused by off-state leakage current.</p> <p>(2) All outputs ON (100% duty cycle) at maximum operating temperature.</p> <p>(3) User must diode-suppress any inductive loads (such as relay coils) as close as possible to the load.</p>	

(Continued)

Digital Output 16-Point Processor (continued)

MU-PDOX02

Electro-Mechanical Relay--120 Vac FTA, 125 Vdc FTA															
Parameter	Specification														
FTA Models	<b>MU-TDOR12, MU-TDOR52</b>														
Outputs	16 isolated Form A (SPST/NO) or Form B (SPST/NC) contacts (jumper selectable per output)														
Contact Type	Silver alloy														
Maximum Load Voltage	140 Vac (rms)/140 Vdc														
Maximum Steady-State Load Current	5 A rms @ 120 Vac (resistive) per output 2 A @ 30 Vdc (resistive) per output 0.5 A @ 125 Vdc (resistive) per output 1/8 horsepower per output														
Minimum Load Current <sup>(1)</sup>	100 mA														
Load Surge Current <sup>(2)</sup>	Overload and Endurance per UL 508														
Isolation	1500 Vac rms or ±1500 Vdc Channel-to-channel, and channel-to-PM/APM/HPM common														
Turn-on Time	10 ms typical, 15 ms maximum														
Turn-off Time	10 ms typical, 15 ms maximum														
Maximum Repetition Rate	360 cycles per hour at rated load														
Contact Life <sup>(3)</sup>	<table border="0"> <thead> <tr> <th><u>Operations</u></th> <th><u>% of Max. Load</u></th> </tr> </thead> <tbody> <tr> <td>350,000</td> <td>100</td> </tr> <tr> <td>450,000</td> <td>80</td> </tr> <tr> <td>750,000</td> <td>60</td> </tr> <tr> <td>1,000,000</td> <td>40</td> </tr> <tr> <td>1,300,000</td> <td>20</td> </tr> <tr> <td>20,000,000</td> <td>0 (Mechanical Life)</td> </tr> </tbody> </table>	<u>Operations</u>	<u>% of Max. Load</u>	350,000	100	450,000	80	750,000	60	1,000,000	40	1,300,000	20	20,000,000	0 (Mechanical Life)
<u>Operations</u>	<u>% of Max. Load</u>														
350,000	100														
450,000	80														
750,000	60														
1,000,000	40														
1,300,000	20														
20,000,000	0 (Mechanical Life)														
Contact Suppression (Shunt)	22 Ω/0.1 μF resistor/capacitor snubber across each contact														
Load Fusing on Termination Assembly	6 A 125 V slow-blow (5x20 mm) fuse per output														
Surge withstand capability	ANSI/IEEE C37.90.1-1978														
<p>(1) The power contacts in these relays are not suitable for load currents less than 100 mA.</p> <p>(2) Contact surge rating is limited by fuse opening time. Fuse opening time is 0.5 sec @ 18 A, 1 sec. @ 15 A, 5 sec @ 10 A</p> <p>(3) For resistive loads (power factor = 1.0); derate linearly by 5% at 0.9 load power factor to 50% at 0.1 load power factor.</p>															

(Continued)

## Digital Output 16-Point Processor (continued)

MU-PDOX02

Electro-Mechanical Relay--240 Vac FTA, 125 Vdc FTA															
Parameter	Specification														
FTA Models	MU-TDOR22, MU-TDOR62														
Outputs	16 isolated Form A (SPST/NO) or Form B (SPST/NC) contacts (jumper selectable per output)														
Contact Type	Silver alloy														
Maximum Load Voltage	265 Vac (rms)/140 Vdc														
Maximum Steady-State Load Current	2.5 A (rms) @ 240 Vac (resistive) per output 2 A @ 30 Vdc (resistive) per output 0.5 A @ 125 Vdc (resistive) per output 1/8 horsepower per output														
Minimum Load Current <sup>(1)</sup>	100 mA														
Load Surge Current <sup>(2)</sup>	Overload and Endurance per UL 508														
Isolation	1500 Vac rms or $\pm 1500$ Vdc Channel-to-channel, and channel-to-PM/APM/HPM common														
Turn-on Time	10 ms typical, 15 ms maximum														
Turn-off Time	10 ms typical, 15 ms maximum														
Maximum Repetition Rate	360 cycles per hour at rated load														
Contact Life <sup>(3)</sup>	<table border="0"> <thead> <tr> <th>Operations</th> <th>% of Max. Load</th> </tr> </thead> <tbody> <tr> <td>350,000</td> <td>100</td> </tr> <tr> <td>450,000</td> <td>80</td> </tr> <tr> <td>750,000</td> <td>60</td> </tr> <tr> <td>1,000,000</td> <td>40</td> </tr> <tr> <td>1,300,000</td> <td>20</td> </tr> <tr> <td>20,000,000</td> <td>0 (Mechanical Life)</td> </tr> </tbody> </table>	Operations	% of Max. Load	350,000	100	450,000	80	750,000	60	1,000,000	40	1,300,000	20	20,000,000	0 (Mechanical Life)
Operations	% of Max. Load														
350,000	100														
450,000	80														
750,000	60														
1,000,000	40														
1,300,000	20														
20,000,000	0 (Mechanical Life)														
Contact Suppression (Shunt)	51 $\Omega$ /0.022 $\mu$ F resistor/capacitor snubber across each contact														
Load Fusing on Termination Assembly	3 A 250 V slow-blow (5x20 mm) fuse per output														
Surge withstand capability	ANSI/IEEE C37.90.1-1978														
<p>(1) The power contacts in these relays are not suitable for load currents less than 100 mA.</p> <p>(2) Contact surge rating is limited by fuse opening time. Fuse opening time is 0.5 sec @ 10 A, 1 sec. @ 8 A, 5 sec @ 6 A.</p> <p>(3) For resistive loads (power factor = 1.0); derate linearly by 5% at 0.9 load power factor to 50% at 0.1 load power factor.</p>															

## Digital Output 32-Point Processor

## MU-PDOY22

24 Vdc FTA	
Parameter	Specification
FTA Model Numbers	<b>MU-TDOY22, MU-TDOY62</b>
Output Channels	32
Output Type	Open-collector (current sinking) NPN transistors
Load Voltage Range	15-30 Vdc
Load Current	MU-TDOY22 0.5 A (max) per pts. 1.0 A (max) per 2 pts. 5 A (max) per 32 pts.  MU-TDOY62 0.5 A (max) per pts. 1.2 A (max) per 8 pts. 5 A (max) per 32 pts.
Isolation	Galvanic Isolation (photo coupler) 30 Vac, $\pm 42.4$ Vdc max. (Any output voltage referenced to common)
On-State Voltage	0.5 V (max), load current @ 0.5A
Off-State Voltage	30 Vdc (max)
Off-State Leak Current	0.5 $\mu$ A (max)
Turn-On/Turn-Off Time	200 msec (max)
Surge withstand capability	ANSI/IEEE C37.90.1-1978
Load Fuse Rating	MU-TDOY22 -- 1 fuse/2 pts. (compression)* MU-TDOY62 -- 1 fuse/8 pts. (screw terminal)*  * Fuse - 1.6 A 125 V (5.5 x 17.2 MM)

(Continued)

## Digital Output 32-Point Processor (continued)

MU-PDOY22

120/240 Vac Relay FTA																							
Parameter	Specification																						
FTA Model Numbers	<b>MU-TDOY23, MU-TDOY63</b>																						
Output Channels	32 (16 per FTA) 16 isolated Form A (SPST/NO) or Form B (SPST/NC) contacts (jumper selectable per output)																						
Contact Type	Gold-clad silver nickel																						
Maximum Load Voltage	250 Vac (RMS)/125 Vdc																						
Maximum Steady State Load Current per Output	<table> <thead> <tr> <th>Current</th> <th>Voltage</th> </tr> </thead> <tbody> <tr> <td>3 A</td> <td>250 Vac(resistive)</td> </tr> <tr> <td>3 A</td> <td>125 Vac (resistive)</td> </tr> <tr> <td>3 A</td> <td>30 Vdc (resistive)</td> </tr> <tr> <td>1 A</td> <td>48 Vdc (resistive)</td> </tr> <tr> <td>0.4 A</td> <td>125 Vdc (resistive)</td> </tr> <tr> <td>2 A</td> <td>250 Vac (inductive = 0.4 power factor)</td> </tr> <tr> <td>2 A</td> <td>125 Vac (inductive = 0.4 power factor)</td> </tr> <tr> <td>1 A</td> <td>30 Vac (inductive L/R = 100 ms)</td> </tr> <tr> <td>0.3 A</td> <td>48 Vac (inductive L/R = 100 ms)</td> </tr> <tr> <td>0.1 A</td> <td>125 Vac (inductive L/R = 100 ms)</td> </tr> </tbody> </table>	Current	Voltage	3 A	250 Vac(resistive)	3 A	125 Vac (resistive)	3 A	30 Vdc (resistive)	1 A	48 Vdc (resistive)	0.4 A	125 Vdc (resistive)	2 A	250 Vac (inductive = 0.4 power factor)	2 A	125 Vac (inductive = 0.4 power factor)	1 A	30 Vac (inductive L/R = 100 ms)	0.3 A	48 Vac (inductive L/R = 100 ms)	0.1 A	125 Vac (inductive L/R = 100 ms)
Current	Voltage																						
3 A	250 Vac(resistive)																						
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0.4 A	125 Vdc (resistive)																						
2 A	250 Vac (inductive = 0.4 power factor)																						
2 A	125 Vac (inductive = 0.4 power factor)																						
1 A	30 Vac (inductive L/R = 100 ms)																						
0.3 A	48 Vac (inductive L/R = 100 ms)																						
0.1 A	125 Vac (inductive L/R = 100 ms)																						
Minimum Load Voltage	5 Vdc																						
Minimum Load Current	10 mA																						
Isolation	1500 Vac rms or $\pm 1500$ Vdc Channel-to-channel, and channel-to-PM/APM/HPM common																						
Turn-On Time	10 ms maximum																						
Turn-Off Time	10 ms maximum																						
Maximum Repetition Rate																							
Contact Life	<table> <thead> <tr> <th>Operations</th> <th>% of Max Load</th> </tr> </thead> <tbody> <tr> <td>10,000,000</td> <td>0 (Mechanical Life)</td> </tr> <tr> <td>200,000 @ 3 A</td> <td>(100%)</td> </tr> </tbody> </table>	Operations	% of Max Load	10,000,000	0 (Mechanical Life)	200,000 @ 3 A	(100%)																
Operations	% of Max Load																						
10,000,000	0 (Mechanical Life)																						
200,000 @ 3 A	(100%)																						
FTA +24 Vdc Current	12.5 mA for each energized relay (coil resistance = 2 K $\Omega$ )																						
Surge Absorber for Coil	120 $\Omega$ + 0.03 $\mu$ F for each channel																						
Serviceability	No fuse for FTA																						
Surge withstand capability	ANSI/IEEE C37.90.1-1978																						
NOTE: One FTA supports up to 16 circuits. When 17-32 circuits are used, 2 FTAs are required. Bridge cable MU-KBFT01 or MU-KBFT02 is required to connect the two FTAs.																							

**Analog Input IOP Comparison**

Product	LLAI 8	LLMUX	RHMUX
IOP Configuration <sup>(1)</sup>	LLAI	LLMUX	LLMUX
Channels	8	32	32
T/C inputs	Yes	Yes (MU-TAMT03/13)	Yes
RTD inputs	Yes	Yes (MU-TAMR03)	No
Linear Voltage	0 - 100 mV 0 - 5 V	0 - 100 mV	0 - 100 mV
CJR	Local	Local (MU-TAMT03) Remote (MU-TAMT13)	Local (on mux FTA)
A/D Converter Resolution	15 bits	14 bits	15 bits
Max distance	50 meters	300 meters	2000 meters
Scans/Second	8 (without OTD) 4 (with OTD)	1	0.25 <sup>(2)</sup>
OTD Detection	Every Sample	Every 30 Seconds	Every Sample
Ground Fault Detect	No	No	Yes
Multiplexer Switch Type	N/A	Mercury-Wetted Relays	Solid-State Relays
Temperature Range	0 to 50°C	0 to 50°C	-40 to +85°C (FTA only)
Humidity Range	10-90% noncondensing	10-90% noncondensing	10-100% condensing (FTA only)
Mounting	FTA Tray	FTA Tray	Remote Enclosure <sup>(3)</sup>
Corrosion Resistance	G1 or G3 <sup>(4)</sup>	G1 or G3 <sup>(4)</sup>	GX
<p>(1) The RHMUX is configured into the TPS PM system as a standard LLMUX, and may be used in systems with Release 300 or greater.</p> <p>(2) The IOP scans one or both remote FTAs every 4 seconds.</p> <p>(3) The RHMUX remote multiplexer FTA is designed to mount in a NEMA-4 or NEMA-4X enclosure to withstand harsh environmental conditions.</p> <p>(4) Depending on corrosion option.</p>			

**Analog Output IOP Comparison**

Function IOP Models	AO (8 points) MC-PAOX03	AO (16 points) MU-PAOY22
IOP Configuration	AO	AO_16
Number of Channels	8	16
Smallest ORU <sup>(1)</sup>	IOP	IOP
Redundancy <sup>(2)</sup>	Yes	Yes
Redundancy Method	Outputs Electrically Isolated via Field Replaceable Relay Switch Module on FTA	Parallel Outputs -- Solid-State Switch in IOPs
Redundancy Bias <sup>(3)</sup>	Yes	No
Output Condition on IOP failure <sup>(4)</sup>	Configurable	Unpowered
Output Condition on PMM failure <sup>(5)</sup>	Configurable	Configurable
Single Channel Failure Robustness <sup>(6)</sup>	High	Medium
External Connection Check <sup>(7)</sup>	Yes	Yes
Standby Manual <sup>(8)</sup>	Yes	Yes
<p>(1) The Optimal Replaceable Unit (ORU) is the object that can be replaced on a failure that minimally impacts the operation of the system. The ORU is generally an item that can be replaced in the field using a minimum number of tools. In many cases the item is plug replaceable such as the IOP.</p> <p>(2) Failure detection coverage for the redundancy option is equivalent.</p> <p>(3) In a redundant configuration, the primary is a "preferred" primary. System availability is slightly increased when the primary IOP is the "preferred" Primary. Servicing of the FTA switching module can be performed without disturbing the process when the IOP is the "preferred" primary.</p> <p>(4) The output state upon failure of the AO8 IOP is configurable to either <b>Hold</b> or <b>Unpower</b> the output. AO16 outputs are always set to <b>Unpowered</b> upon failure of the IOP.</p> <p>(5) The output state upon failure of the PMM for both AO8 and AO16 IOPs is configurable to either <b>Hold</b> or <b>Unpower</b> the output.</p> <p>(6) Channel robustness is different in the two module types. The AO8 provides individual channel output circuitry including individual output power systems and individual DAC output circuits. The AO16 provides one power supply and one DAC per IOP. Individual AO16 outputs are controlled using sample and hold circuitry.</p> <p>(7) Point level failures are detected by both AO8 and AO16 IOPs. Both IOPs can detect if the output is being correctly propagated to the field (i.e., wires are connected).</p> <p>(8) The Standby Manual is an optional unit which handles 8 outputs. The AO16 provides a Standby manual function by using two AO8 standby manual units connected into the AO16 FTA.</p>		

**Digital Input IOP Comparison**

Function IOP Models	DI (32 points) MU-PDIX02	DI (32 points) MU-PDIY22	DI SOE (32 points) MU-PDIS12
Number of Channels	32	32	32
IOP Configuration <sup>(1)</sup>	DI	DI	DISOE
Maximum Input Voltage @ FTA	250 V ac/dc	30 Vdc	250 V ac/dc
Smallest ORU <sup>(2)</sup>	2 Channels	IOP	2 Channels
Redundancy	No	Yes	Yes
<p>(1) The DI24V is configured into the TPS PM system as a standard DI IOP. This permits using the DI24 V IOP in systems on releases prior to R500. Any PM system requiring only 24 Volt Digital Inputs can use the DI24 V IOP.</p> <p>(2) The Optimal Replaceable Unit (ORU) is the object that can be replaced on a failure that minimally impacts the operation of the system. The ORU is generally an item that can be replaced in the field using a minimum number of tools. In many cases the item is plug replaceable such as the IOP.</p>			

## Digital Output IOP Comparison

Function IOP Models	DO (16 points) MU-PDOX02	DO (32 points) MU-PDOY22
IOP Configuration	DO	DO_32
Number of Channels	16	32
Smallest ORU <sup>(1)</sup>	1 Channel	IOP
Redundancy <sup>(2)</sup>	No	Yes
Redundancy Method	Solid-state switch in IOP	Solid-state switch in IOP
Relay Minimum Load current Relay FTA)	100 ma	10 ma
Standby Manual Supported	Yes	No
Output Overload Protection <sup>(3)</sup>	Fuses on FTA per channel	<ul style="list-style-type: none"> <li>• Fuses on 24 Vdc FTA</li> <li>• No fuse on relay FTA</li> </ul>
Contact Bounce Suppression-Relay FTA	Always Installed	Configurable via Jumper
Galvanic Output Isolation - Relay FTA <sup>(4)</sup>	per Channel	per Channel
Galvanic Output Isolation - SS FTA <sup>(4)</sup>	per Channel	no per channel isolation
Galvanic Output Isolation <sup>(4)</sup>	per Channel	per 16 Channels
Output Condition on IOP Failure <sup>(5)</sup>	Configurable	Unpowered
Output Condition on PMM Failure <sup>(6)</sup>	Configurable	Configurable
Output Readback Check <sup>(7)</sup>	Yes	Yes
Number of FTAs Supported <sup>(8)</sup>	5 (See Below)	2 (Direct & Relay)
<p>(1) The Optimal Replaceable Unit (ORU) is the object that can be replaced on a failure that minimally impacts the operation of the system. The ORU is generally an item that can be replaced in the field using a minimum number of tools. In many cases the item is plug replaceable such as the IOP.</p> <p>(2) Readback check coverage for the redundancy option is not equivalent. See Output Readback Check.</p> <p>(3) Compression-type relay FTA for DO-32 has 1 fuse per 2 points. Screw-type relay FTA for DO-32 has 1 fuse per 8 points. Current overload protection for the DO16 is provided on a per channel basis based on the particular FTA used.</p> <p>(4) All Outputs are galvanically isolated from system common.</p> <p>(5) The output state upon failure of both the DO16 and DO32 IOP is configurable to either <b>Hold</b> or <b>Unpower</b> the output. The DO32 outputs are set to <b>Unpowered</b> when the on-board power regulator (5 V) has failed.</p> <p>(6) The output state upon failure of the PMM (or APMM or HPMM) for both DO16 and DO32 IOPs is configurable to either <b>Hold</b> or <b>Unpower</b> the output.</p> <p>(7) The DO32 performs register readback check on the IOP. The DO16 performs actual output readback check including the FTA and FTA cable.</p> <p>(8) DO16 FTA types are: 120 Vac Electro-Mechanical Relay; 240 Vac Electro-Mechanical Relay; 24 Vdc @100 ma Non-Isolated; 20-200 Vdc Solid State; 3-30 Vdc Solid State; 120/240 Vac Solid State; 31-200 Vdc Solid State.</p>		

**IOP/FTA Compatibility Matrix**

IOP Model Number	FTA Model Number	Description	Red	CE Mark	Term Type <sup>(6)</sup>	Circuits	Size <sup>(1)</sup>
<b>MC-PAIH03</b>		<b>High Level Analog Input</b>	√	√		16	
	MU-TAIH02	HLAI/STI			C	16	A
	MU-TAIH12	HLAI /STI Redundant	√		C	16	B
	MU-TAIH52	HLAI/STI Redundant	√		S	16	B
	MU-TAIH03	HLAI		√	C	16	A
	MU-TAIH13	HLAI Redundant	√	√	C	16	B
	MU-TAIH53	HLAI Redundant	√	√	S	16	B
	MU-TAIH22	Enhanced Power HLAI /STI	√		C	16	B
	MU-TAIH23	Enhanced Power HLAI	√	√	C	16	B
	MU-TAIH62	Enhanced Power HLAI /STI	√		S	16	B
	MU-GAIH13	GI/IS - Aux. Out (4041B)	√	√	C <sup>(3)</sup>	16	B
	MU-GAIH83	GI/IS - Aux. Out (4041B)	√	√	CP <sup>(3)</sup>	16	B
	MU-GAIH14	GI/IS - Aux. & Hi V Out (4041P)	√	√	C <sup>(3)</sup>	16	B
	MU-GAIH84	GI/IS - Aux. & Hi V Out (4041P)	√	√	CP <sup>(3)</sup>	16	B
	MU-GAIH22	GI/IS - Aux. Current Out (4041B)	√	√	C <sup>(3)</sup>	16	B
	MU-GAIH92	GI/IS - Aux. Current Out (4041B)	√	√	CP <sup>(3)</sup>	16	B
<b>MU-PSTX03</b>		<b>Smart Xmtr Int. - Multi-Var.</b>	√	√		16	
	MU-TAIH02	HLAI /STI			C	16	A
	MU-TAIH12	HLAI/STI Redundant	√		C	16	B
	MU-TAIH52	HLAI/STI Redundant	√		S	16	B
	MU-TAIH22	Enhanced Power HLAI/STI	√		C	16	B
	MU-TAIH62	Enhanced Power HLAI/STI	√		S	16	B
	MU-TSTX03	STI		√	C	16	A
	MU-TSTX13	STI Redundant	√	√	C	16	B
	MU-TSTX53	STI Redundant	√	√	S	16	B
	MU-GAIH13	GI/IS - Aux. Out (4041B)	√	√	C <sup>(3)</sup>	16	B

**NOTE:** The footnotes are located at the end of the table.

(Continued)

## IOP / FTA Compatibility Matrix (continued)

IOP Model Number	FTA Model Number	Description	Red	CE Mark	Term Type <sup>(6)</sup>	Circuits	Size <sup>(1)</sup>
<b>MU-PSTX03</b> (cont'd)	MU-GAIH83	GI/IS - Aux. Out (4041B)	√	√	CP <sup>(3)</sup>	16	B
	MU-GAIH14	GI/IS - Aux. & Hi V Out (4041P)	√	√	C <sup>(3)</sup>	16	B
	MU-GAIH84	GI/IS - Aux. & Hi V Out (4041P)	√	√	CP <sup>(3)</sup>	16	B
	MU-GAIH22	GI/IS - Aux. Current Out (4041B)	√	√	C <sup>(3)</sup>	16	B
	MU-GAIH92	GI/IS - Aux. Current Out (4041B)	√	√	CP <sup>(3)</sup>	16	B
<b>MU-PAIL02</b>		<b>Low Level Analog Input</b>		√		8	
	MU-TAIL02	Low Level Analog Input			C	8	B
	MU-TAIL03	Low Level Analog Input		√	C	8	B
<b>MU-PLAM02</b>		<b>Low Level Analog Input Mux.</b>		√		32	
	MU-TAMR03	LLMUX FTA RTD <sup>(2)</sup>		√	C	16	B
	MU-TAMT03	LLMUX FTA RTD <sup>(2)</sup>		√	C	16	B
	MU-TAMT13	LLMUX FTA TC w/ Remote CJR <sup>(2)</sup>		√	C	16	B
<b>MU-PRHM01</b>		<b>Remote Hardened Mux.</b>		√		32	
	MU-GRPA01	Intrinsically Safe Power Adapter <sup>(7)</sup>		√	C <sup>(3)</sup>	16	A
	MU-TRPA01	Non-Incendive Power Adapter <sup>(7)</sup>		√	C	16	B
	MC-GRMT01	Remote FTA <sup>(7)</sup>		√	C	16	12.5 x 12.5 in.
<b>MU-PSDX02</b>		<b>Serial Device Interface</b>		√		16 <sup>(5)</sup>	
	MU-TSDM02	SDI - Manual / Auto Station IF <sup>(2)</sup>		√	C	1	A
	MU-TSDT02	SDI - Toledo Weigh Cell IF <sup>(2)</sup>		√	DB25	1	A
	MU-TSDU02	SDI - UDC6000 IF <sup>(2)</sup>		√	C	1	A

(Continued)

IOP / FTA Compatibility Matrix (continued)

IOP Model Number	FTA Model Number	Description	Red	CE Mark	Term Type <sup>(6)</sup>	Circuits	Size <sup>(1)</sup>
<b>MU-PSIM11</b>		<b>Serial Interface</b>		√		32 <sup>(5)</sup>	
	MU-TSIA12	SI - Allen Bradley PLC-2/3/5 IF <sup>(2)</sup>		√	DB25	1	A
	MU-TSIM12	SI - Modbus IF <sup>(2)</sup>		√	DB25 or C	1	A
<b>MC-PAOX03</b>		<b>Analog Output (8 Outputs)</b>	√	√		8	
	MU-TAOX02	AO		√	C	8	A
	MU-TAOX12	AO Redundant	√	√	C	8	B
	MU-TAOX52	AO Redundant	√	√	S	8	B
	MU-GAOX02	GI/IS - AO (4045C)		√	C <sup>(3)</sup>	8	B
	MU-GAOX72	GI/IS - AO (4045C)		√	CP <sup>(3)</sup>	8	B
	MU-GAOX12	GI/IS - AO Redundant (4045C)	√	√	C <sup>(3)</sup>	8	B
	MU-GAOX82	GI/IS - AO Redundant (4045C)	√	√	CP <sup>(3)</sup>	8	B
<b>MU-PAOY22</b>		<b>Analog Output (16 Outputs)</b>	√	√		16	
	MU-TAOY22	AO16 Redundant w/ Stby Man.	√	√	C	16	B
	MU-TAOY52	AO16 Redundant w/ Stby Man.	√	√	S	16	B
	MU-TAOY23	AO16 Redundant w/o Stby Man.	√		C	16	B
	MU-TAOY53	AO16 Redundant w/o Stby Man.	√		S	16	B
<b>MU-PDIX02</b>		<b>Digital Input</b>		√		32	
<b>MU-PDIS12</b>		<b>Digital Input SOE</b>	√	√		32	
	MU-TDID12	DI 24 Vdc	√	√	C	32	C
	MU-TDID52	DI 24 Vdc	√	√	S	32	C
	MU-TDID72	DI Packaged 24 Vdc			RS	32	C
	MU-TDIA12	DI Isolated 120 Vac	√	√	C	32	C
	MU-TDIA52	DI Isolated 120 Vac	√	√	S	32	C
	MU-TDIA72	DI Pckgd. Isolated 120 Vac			RS	32	C
	MU-TDIA22	DI 240 Vac	√	√	C	32	C
	MU-TDIA62	DI 240 Vac	√	√	S	32	C

(Continued)

## IOP / FTA Compatibility Matrix (continued)

IOP Model Number	FTA Model Number	Description	Red	CE Mark	Term Type <sup>(6)</sup>	Circuits	Size <sup>(1)</sup>
<b>MU-PDIS12</b> (cont'd)	MU-GDID12	GI/IS - DI (4016)	√	√	C <sup>(3)</sup>	32	B
	MU-GDID82	GI/IS - DI (4016)	√	√	CP <sup>(3)</sup>	32	B
	MU-GDID13	GI/IS - DI Solid-State Relays (4013)	√	√	C <sup>(3)</sup>	32	B
	MU-GDID83	GI/IS - DI Solid-State Relays (4013)	√	√	CP <sup>(3)</sup>	32	B
<b>MU-PDIY22</b>		<b>Digital Input 24 V Only</b>	√	√		32	
	MU-TDIY22	DI 24 Vdc Only	√	√	C	32	B
	MU-TDIY62	DI 24 Vdc Only	√	√	S	32	B
<b>MU-PPIX02</b>		<b>Pulse Input</b>		√		8	
	MU-TPIX12	Pulse Input		√	C	8	B
	MU-TPIX52	Pulse Input		√	S	8	B
<b>MU-PDOX02</b>		<b>Digital Output (16 Outputs)</b>		√		16	
	MU-TDON12	DO 24 Vdc, Nonisolated			C	16	B
	MU-TDON52	DO 24 Vdc, Nonisolated			S	16	B
	MU-TDOD13	DO 3-30 Vdc, Solid State			C	16	B
	MU-TDOD53	DO 3-30 Vdc, Solid State		√	S	16	B
	MU-TDOD14	DO 3-30 Vdc, Solid State		√	C	16	B
	MU-TDOD54	DO 3-30 Vdc, Solid State		√	S	16	B
	MU-TDOD23	DO 31-200 Vdc, Solid State		√	C	16	B
	MU-TDOD63	DO 31-200 Vdc, Solid State		√	S	16	B
	MU-TDOA13	DO 120/240 Vac, Solid State		√	C	16	B
	MU-TDOA53	DO 120/240 Vac, Solid State		√	S	16	B
	MU-TDOR12	DO120 Vac/125 Vdc Relay		√	C	16	B
	MU-TDOR52	DO120 Vac/125 Vdc Relay		√	S	16	B
	MU-TDOR22	DO 240 Vac/125 Vdc Relay		√	C	16	B
	MU-TDOR62	DO 240 Vac/125 Vdc Relay		√	S	16	B

(Continued)

IOP / FTA Compatibility Matrix (continued)

IOP Model Number	FTA Model Number	Description	Red	CE Mark	Term Type <sup>(6)</sup>	Circuits	Size <sup>(1)</sup>
<b>MU-PDOX02 (cont'd)</b>	MU-GDOL12	GI/IS - DO w/ line fault dect.(4023)		√	C <sup>(3)</sup>	16	B
	MU-GDOL82	GI/IS - DO w/ line fault dect.(4023)		√	CP <sup>(3)</sup>	16	B
	MU-GDOD12	GI/IS - DO (4021)		√	C <sup>(3)</sup>	16	B
	MU-GDOD82	GI/IS - DO (4021)		√	CP <sup>(3)</sup>	16	B
	MU-GLFD02	GI/IS DO Combiner Panel		√	N/A	32	A
<b>MU-PDOY22</b>		<b>Digital Output (32 Outputs)</b>	√	√		32	
	MU-TDOY22	Digital Output 32, 24 Vdc	√	√	C	32	B
	MU-TDOY62	Digital Output 32, 24 Vdc	√	√	S	32	B
	MU-TDOY23	Digital Output 32, Relay <sup>(4)</sup>	√	√	C	16	B
	MU-TDOY63	Digital Output 32, Relay <sup>(4)</sup>	√	√	S	16	B
		<b>Misc. / Multiple Use FTAs</b>					
	MU-TLPA02	LLMUX, SI, SDI Power Adapter		√	C	2	A
	MU-TDPR02	DI Power Distribution FTA		√	S	12	A
	MU-GPRD02	GI/IS Power Distribution FTA		√	N/A	12	A
	MU-GMAR52	GI/IS — Marshalling Panel		√	S	16	B

- (1) Length: A = 15.24 cm/6.0 in.  
B = 30.73 cm/12.1 in.  
C = 46.228 cm/18.2 in.
- (1) Width: All FTAs except GI/IS FTAs = 12.065 cm/4.75 in.  
All GI/IS FTAs = 12.446 cm/4.90 in.  
MU/MC-TAIL03 = 13.335 cm/5.25 in.
- (2) Requires Power Adapter FTA.
- (3) Terminals are on top of the GI/IS modules.
- (4) One FTA supports up to 16 circuits. When 17-32 circuits are used, 2 FTAs are required. Bridge cable MU-KBFT01 or MU-KBFT02 is required to connect the two FTAs.
- (5) Number of Circuits denotes number of logical connections.
- (6) For nongalvanically isolated FTAs, the terminal connector types are compression (C), nonremovable screw (S), and removable screw (RS). For galvanic isolation type FTAs, the terminal connector types are compression (C), and crimp pin (CP). The Marshalling Panel has nonremovable screw (S) terminals.
- (7) The MC-GRMT01 is a remotely mountable Field Termination for Thermocouple inputs. Two of these FTAs can be connected to a single Power Adapter (MU-GRPA01 or MU-TRPA01) depending on the hazardous environment. The Power Adapter is, in turn, connected to the IOP (MU-PRHM01).

**Model Numbers**

Description	Uncoated Model Number	Coated Model Number (see note)
<b>I/O Processors</b>		
High Level Analog Input Processor (16 Inputs)	n/a	MC-PAIH03
Smart Transmitter Interface (Multivariable) Processor (16 Inputs)	MU-PSTX03	MC-PSTX03
Serial Device Interface Processor (16 Points/Port)	MU-PSDX02	MC-PSDX02
Serial Interface Processor (16 Points/Port)	MU-PSIM11	MC-PSIM11
Low Level Analog Input Processor (8 Inputs)	MU-PAIL02	MC-PAIL02
Low Level Analog Input Multiplexer Processor (32 Inputs)	MU-PLAM02	MC-PLAM02
Remote Hardened Multiplexer IOP (32-Points)	MU-PRHM01	MC-PRHM01
Pulse Input Processor (8 Inputs)	MU-PPIX02	MC-PPIX02
Analog Output Processor (8 Outputs)	n/a	MC-PAOX03
Analog Output 16 Processor (16 Outputs)	n/a	MC-PAOY22
Digital Input Processor (32 Inputs)	MU-PDIX02	MC-PDIX02
Digital Input Processor for Sequence of Events (32 Inputs)	MU-PDIS12	MC-PDIS12
Digital Input 24 Vdc Processor (32 Inputs)	MU-PDIY22	MC-PDIY22
Digital Output Processor (16 Outputs)	MU-PDOX02	MC-PDOX02
Digital Output 32 Processor (32 Outputs)	MU-PDOY22	MC-PDOY22
Blank Filler Plate for I/O Slot	MU-PFPX01	n/a
I/O Link Extender Pair–Main Location	MU-IOLM02	MC-IOLM02
I/O Link Extender Pair–Remote Location	MU-IOLX02	MC-IOLX02
Long Distance I/O Link Extender Pair	MU-ILDX03	MC-ILDX03
I/O Link Extender Shroud (EC)	MU-ILES01	n/a
<b>NOTE:</b> MC model numbers indicate conformally coated boards. All IOPs are available conformally coated (MC models).		

(Continued)

**Model Numbers** (continued)

<b>FTA I/O Cables (Telephone Connector* Version)</b>		
FTA I/O Cable (5 m)		MU-KFTA05
FTA I/O Cable (10 m)		MU-KFTA10
FTA I/O Cable (15 m)		MU-KFTA15
FTA I/O Cable (20 m)		MU-KFTA20
FTA I/O Cable (25 m)		MU-KFTA25
FTA I/O Cable (30 m)		MU-KFTA30
FTA I/O Cable (35 m)		MU-KFTA35
FTA I/O Cable (40 m)		MU-KFTA40
FTA I/O Cable (45 m)		MU-KFTA45
FTA I/O Cable (50 m)		MU-KFTA50
Shielded FTA I/O Cables (lengths, xx, same as MU-KFTAxx)		MU-KFTSxx
FTA I/O Bridge Cable, 0.5 meter	To combine two 16 pt. MU-TDOY63 relay	MU-KBFT01
FTA I/O Bridge Cable, 2.0 meter	FTAs for 32-pt. MU-PDOY22 DO IOP	MU-KBFT02
<b>LLAI MUX, Serial Device Interface, or Serial I/F Twisted Pair Cables</b>		
Twisted Pair Cable with Shield (Local Cabinet Use)		MU-KLAM00
Four-Conductor Cable with Shield - 18 gauge (76 m/250 ft.)		MU-KLX076
Four-Conductor Cable with Shield- 18 gauge (152 m/500 ft.)		MU-KLX152
Four-Conductor Cable with Shield - 18 gauge (305 m/1000 ft.)		MU-KLX305
Four-Conductor Outdoor Cable with Armor and Shield - 12 gauge (305 m/1000 ft.)		MU-KLO305
LLMUX (TC) Remote CJR Cable (45 m/150 ft.)		MU-KRCJ00
* For DIN-style FTAs, Cables, and File Options, see the <i>Site Planning</i> manual.		

**Model Numbers** (continued)

Description	Uncoated Model Number	Coated Model Number
<b>Field Termination Assemblies (Phone Connector Style* - Compression Terminals)</b>		
High Level Analog Input/STI FTA (16 Inputs)	MU-TAIH02	MC-TAIH02
High Level Analog Input/STI FTA for Redundancy (16 Inputs) **	MU-TAIH12	MC-TAIH12
High Level Analog Input FTA (16 Inputs) (CE Mark)	MU-TAIH03	MC-TAIH03
High Level Analog Input FTA for Redundancy (16 Inputs) (CE Mark) **	MU-TAIH13	MC-TAIH13
Smart Transmitter Interface FTA (16 Inputs) (CE Mark)	MU-TSTX03	MC-TSTX03
Smart Transmitter Interface FTA for Redundancy (16 Inputs) (CE Mark) **	MU-TSTX13	MC-TSTX13
Enhanced Power High Level /STI Analog Input FTA (16 Inputs) **	MU-TAIH22	MC-TAIH22
Enhanced Power High Level Analog Input FTA (16 Inputs) (CE Mark)**	MU-TAIH23	MC-TAIH23
Low Level Analog Input FTA (8 Inputs)	MU-TAIL02	MC-TAIL02
Low Level Analog Input FTA (8 Inputs) (CE Mark)	MU-TAIL03	MC-TAIL03
Low Level Analog Input Multiplexer RTD FTA (16 Inputs)	MU-TAMR03	MC-TAMR03
Low Level Analog Input Multiplexer TC FTA (16 Inputs)	MU-TAMT03	MC-TAMT03
Low Level Analog Input Multiplexer TC FTA with Remote CJR (16 Inputs)	MU-TAMT13	MC-TAMT13
RHMUX Remote FTA		MC-GRMT01
RHMUX GI/IS Power Adapter	MU-GRPA01	MC-GRPA01
RHMUX GI/NI Power Adapter	MU-TRPA01	MC-TRPA01
RHMUX NEMA 4 Enclosure (Painted Carbon Steel)	MU-CMSC03	
RHMUX NEMA 4X Enclosure (Stainless Steel)	MU-CMSS03	
LLMUX, SDI, SI Power Adapter	MU-TLPA02	MC-TLPA02
Pulse Input FTA (8 Inputs)	MU-TPIX12	MC-TPIX12
Analog Output FTA (8 Outputs)	MU-TAOX02	MC-TAOX02
Analog Output FTA for Redundancy (8 Outputs) **	MU-TAOX12	MC-TAOX12
Analog Output 16 FTA (16 Outputs), w/StbyMan (use ONLY w/ MU-PAOY22)**	MU-TAOY22	MC-TAOY22
Analog Output 16 FTA (16 Outputs), w/o StbyMan (use ONLY w/ MU-PAOY22)**	MU-TAOY23	MC-TAOY23
Digital Input Isolated 120 Vac FTA (32 Inputs)	MU-TDIA12	MC-TDIA12
Digital Input Isolated 240 Vac FTA (32 Inputs)	MU-TDIA22	MC-TDIA22
Digital Input 24 Vdc FTA (32 Inputs)	MU-TDID12	MC-TDID12
Digital Input 24 Vdc FTA (32 Inputs) (use ONLY w/ MU-PDIY22)**	MU-TDIY22	MC-TDIY22
Digital Output 120/240 Vac Solid-State FTA (16 Outputs)	MU-TDOA13	MC-TDOA13
Digital Output 3-30 Vdc Solid-State FTA (16 Outputs)	MU-TDOD13	MC-TDOD13
Digital Output 3-30 Vdc Solid-State FTA (16 Outputs) (CE Mark)	MU-TDOD14	MC-TDOD14
Digital Output 31-200 Vdc Solid-State (16 Outputs)	MU-TDOD23	MC-TDOD23
Digital Output 24 Vdc, 100 ma Nonisolated FTA (16 Outputs)	MU-TDON12	MC-TDON12
Digital Output 120 Vac/125 Vdc Relay FTA (16 Outputs)	MU-TDOR12	MC-TDOR12
Digital Output 240 Vac/125 Vdc Relay FTA (16 Outputs)	MU-TDOR22	MC-TDOR22
Digital Output 24 Vdc FTA (32 Outputs) (use ONLY w/ MU-PDOY22)**	MU-TDOY22	MC-TDOY22
Digital Output Relay FTA (16 Outputs) (use two w/ MU-PDOY22)**	MU-TDOY23	MC-TDOY23
* For DIN-style FTAs, Cables and File Options, See the <i>Site Planning</i> manual.		
** These FTAs can be used for single or redundant applications.		
All FTAs are available conformally coated (MC-models).		

Model Numbers (continued)

Description	Uncoated Model Number	Coated Model Number
<b>Field Termination Assemblies (Phone Connector* Style with Screw Terminals)</b>		
High Level Analog Input/STI FTA (16 Inputs)**	MU-TAIH52	MC-TAIH52
High Level Analog Input FTA (16 Inputs) (CE Mark)**	MU-TAIH53	MC-TAIH53
Smart Transmitter Interface FTA for Redundancy (16 Inputs) (CE Mark)**	MU-TSTX53	MC-TSTX53
Enhanced Power High Level Analog Input/STI FTA (16 Inputs)**	MU-TAIH62	MC-TAIH62
Pulse Input FTA (8 Inputs)	MU-TPIX52	MC-TPIX52
Analog Output FTA (8 Outputs)**	MU-TAOX52	MC-TAOX52
(use ONLY w/ MU-PAOY22)**	MU-TAOY52	MC-TAOY52
Analog Output 16 FTA (16 Outputs), w/o StbyMan	MU-TAOY53	MC-TAOY53
(use ONLY w/ MU-PAOY22)**		
Digital Input Isolated 120 Vac FTA (32 Inputs)	MU-TDIA52	MC-TDIA52
Digital Input Isolated 120 Vac FTA -Packaged (32 Inputs)	MU-TDIA72	MC-TDIA72
Digital Input Isolated 240 Vac FTA (32 Inputs)	MU-TDIA62	MC-TDIA62
Digital Input 24 Vdc FTA (32 Inputs)	MU-TDID52	MC-TDID52
Digital Input 24 Vdc FTA -Packaged, without plug-in isolators (32 Inputs)	MU-TDID72	MC-TDID72
Digital Input 24 Vdc FTA (32 Inputs) (use ONLY w/ MU-PDIY22)**	MU-TDIY62	MC-TDIY62
Digital Output 120/240 Vac Solid-State FTA (16 Outputs)	MU-TDOA53	MC-TDOA53
Digital Output 3-30 Vdc Solid-State FTA (16 Outputs)	MU-TDOD53	MC-TDOD53
Digital Output 3-30 Vdc Solid-State FTA (16 Outputs) (CE Mark)	MU-TDOD54	MC-TDOD54
Digital Output 31-200 Vdc Solid-State (16 Outputs)	MU-TDOD63	MC-TDOD63
Digital Output 5-200 Vdc Solid State (16 Outputs)	MU-TDOD62	MC-TDOD62
Digital Output 24 Vdc, 100 ma Nonisolated FTA (16 Outputs)	MU-TDON52	MC-TDON52
Digital Output 120 Vac/125 Vdc Relay FTA (16 Outputs)	MU-TDOR52	MC-TDOR52
Digital Output 240 Vac/125 Vdc Relay FTA (16 Outputs)	MU-TDOR62	MC-TDOR62
Digital Output 24 Vdc FTA (32 Outputs) (use ONLY w/ MU-PDOY22)**	MU-TDOY62	MC-TDOY62
Digital Output Relay FTA (16 Outputs) (use two w/ MU-PDOY22)**	MU-TDOY63	MC-TDOY63
<b>Field Termination Assemblies for Serial Device Interface and Serial Interface</b>		
Serial Device Interface FTA for Toledo Scale (8142)	MU-TSDT02	MC-TSDT02
Serial Device Interface FTA for Manual/Auto Station	MU-TSDM02	MC-TSDM02
Serial Device Interface FTA for UDC 6000	MU-TSDU02	MC-TSDU02
Serial Interface FTA for Modbus	MU-TSIM12	MC-TSIM12
Serial Interface FTA for Allen-Bradley	MU-TSIA12	MC-TSIA12
<p>* For DIN-style FTAs, Cables and File Options, See the <i>Site Planning</i> manual.</p> <p>** These FTAs can be used for single or redundant applications.</p> <p>All FTAs are available conformally coated (MC- models).</p>		

**Model Numbers** (continued)

Description	Model Number
<b>Display Units</b>	
Manual/Auto Station	MU-MASX02
<b>EIA - 485 Cables</b>	
SDI/SI FTA EIA - 485 Cable (30.5 m/100 ft.)	MU-KSX030
SDI/SI FTA EIA - 485 Cable (152.4 m/500 ft.)	MU-KSX152
SDI/SI FTA EIA - 485 Cable (304.8 m/1000 ft.)	MU-KSX305
<b>Standby Manual Units (Phone Connector* Style)</b>	
Analog Output Standby Manual (8 Outputs) with Case and 3 Meter Cable	MU-SMAC02
Digital Output Standby Manual (16 Outputs) with Case and 3 Meter Cable	MU-SMDC02
Digital Output Standby Manual (16 Outputs - mounts similar to FTA) with Cable	MU-SMDX02
<b>Cabinets and Cabinet Components (Markhon Style)</b>	
Cabinet - Dual Access (.8 W x .8 D x 2.1 H [meters])	MU-CBDM01
Cabinet - Single Access (.8 W x 5.5 D x 2.1 H [meters])	MU-CBSM01
Cabinet Lifting Eyebolts (4)	MU-CLBM01
Cabinet (Dual Access) Forklift Base	MU-CFDM01
Cabinet (Single Access) Forklift Base	MU-CFSM01
Cabinet Trim File Filler Panel	MU-CTFP11
Vertical Trim Panel Set - Full Height	MU-CTVF11
Vertical Trim Panel Set - Half Height	MU-CTVH11
FTA Mounting Channel - Narrow	MU-TMCN11
FTA Mounting Channel with Shield Ground Bar - Narrow	MU-TMCN12
FTA Mounting Channel - Wide	MU-TMCW11
FTA Mounting Channel with Shield Ground Bar - Wide	MU-TMCW12
<b>Cabinets and Cabinet Components (Rittal Style)</b>	
Cabinet - Dual Access (.8 W x .8 D x 2 H [meters])	MU-CBDX01
Cabinet - Single Access (.8 W x .5 D x 2 H [meters])	MU-CBSX01
Cabinet Trim File Filler Panel	MU-CTFP01
Vertical Trim Panel Set - Full Height	MU-CTVF01
Vertical Trim Panel Set - Half Height	MU-CTVH01
FTA Mounting Channel - Narrow	MU-TMCN01
FTA Mounting Channel with Shield Ground Bar - Narrow	MU-TMCN02
FTA Mounting Channel - Wide	MU-TMCW01
FTA Mounting Channel with Shield Ground Bar - Wide	MU-TMCW02

<b>Cabinet Fan Assemblies (All Styles)</b>	<b>Uncoated Model</b>	<b>Coated Model</b>
	<b>Numbers</b>	<b>Numbers</b>
Cabinet Fan Assembly (240 Vac-50/60 Hz)	MU-FAN501	n/a
Cabinet Fan Assembly with Alarm (240 Vac-50/60 Hz)	MU-FAN511	MC-FAN511
Cabinet Fan Assembly (120 Vac-50/60 Hz)	MU-FAN601	n/a
Cabinet Fan Assembly with Alarm (120 Vac-50/60 Hz)	MU-FAN611	MC-FAN611
* For DIN-style FTAs, Cables and File Options, See the <i>Site Planning</i> manual. ** These FTAs can be used for single or redundant applications.		

**Model Numbers** (continued)

Description	Uncoated Model Numbers	Coated Model Number
<b>Power Systems Including, or Upgradeable to, System Battery Backup</b>		
Redundant Power System with Mounting (20 A)	MU-PSRX04	MC-PSRX04
Single Power System with Mounting (20 A)	MU-PSSX04	MC-PSSX04
Redundant Power System with System Battery Backup Mounting (20 A)	MU-PSRB04	MC-PSRB04
HPM Power System (20 A) Upgrade Kit (upgrade from MU/MC-PSxx03 only)	MU-ZPSR04	MC-ZPSR04
<b>Harsh Environment Option</b>		
Remote Hardened I/O Encl, 110 Vac, Left (1-7) <sup>(1)</sup>	MU-CBSS01	
Remote Hardened I/O Encl, 110 Vac, Right (9-15) <sup>(1)</sup>	MU-CBSS02	
Remote Hardened I/O Encl, Left (1-7), No Power Supply	MU-CBSS11	
Remote Hardened I/O Encl, Right (9-15), No Power Supply	MU-CBSS12	
Remote Hardened I/O Encl, 220 Vac, Left (1-7) <sup>(1)</sup>	MU-CBSS21	
Remote Hardened I/O Encl, 220 Vac, Right (9-15) <sup>(1)</sup>	MU-CBSS22	
<b>AC-Only Power Systems</b>		
AC-Only Redundant Power Supply 120 Vac (8 A)	MU-PAR111	MC-PAR111
AC-Only Redundant Power Supply 240 Vac (8 A)	MU-PAR211	MC-PAR211
AC-Only Single Power Supply 120 Vac (8 A)	MU-PAS111	MC-PAS111
AC-Only Single Power Supply 240 Vac (8 A)	MU-PAS211	MC-PAS211
AC-Only Redundant Power Supply 120 Vac (16 A)	MU-PAR121	MC-PAR121
AC-Only Redundant Power Supply 240 Vac (16 A)	MU-PAR221	MC-PAR221
AC-Only Single Power Supply 120 Vac (16 A)	MU-PAS121	MC-PAS121
AC-Only Single Power Supply 240 Vac (16 A)	MU-PAS221	MC-PAS221
AC-Only Power System Cover Plate	MU-PACP01	
<b>24 Vdc Power Distribution</b>		
Power Distribution FTA (24 Vdc)	MU-TDPR02	MC-TDPR02
(1) Includes enclosure, power distribution panel, backplane, and 8 A, redundant power supplies.		

<b>Digital Sense Power Cables</b>	<b>Model Number</b>
Power Distribution (24 Vdc) (5 m)	MU-KDPR05
Power Distribution (24 Vdc) (10 m)	MU-KDPR10
Power Distribution (24 Vdc) (15 m)	MU-KDPR15
Power Distribution (24 Vdc) (20 m)	MU-KDPR20
Power Distribution (24 Vdc) (25 m)	MU-KDPR25
Power Distribution (24 Vdc) (30 m)	MU-KDPR30
Power Distribution (24 Vdc) (35 m)	MU-KDPR35
Power Distribution (24 Vdc) (40 m)	MU-KDPR40
Power Distribution (24 Vdc) (50 m)	MU-KDPR50
CE-Mark Power Distribution (24 Vdc) (lengths, xx, same as MU-KDPRxx)	MU-KSPRxx

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