Honeywell

TDC 3000X
Advanced Process Manager
Specification and
Technical Data

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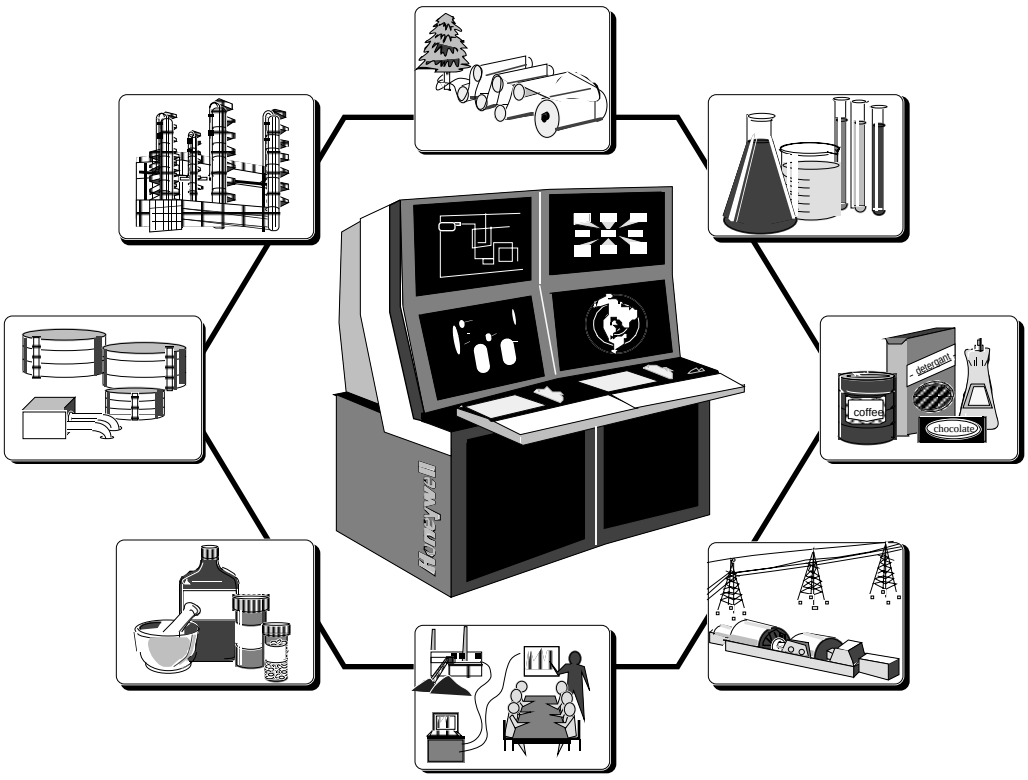

TDC 3000X Advanced Process Manager

Specification and Technical Data

TABLE OF CONTENTS **Page**

PICTURE OF ADVANCED PROCESS MANAGER

6200

Figure 1 — Advanced Process Manager

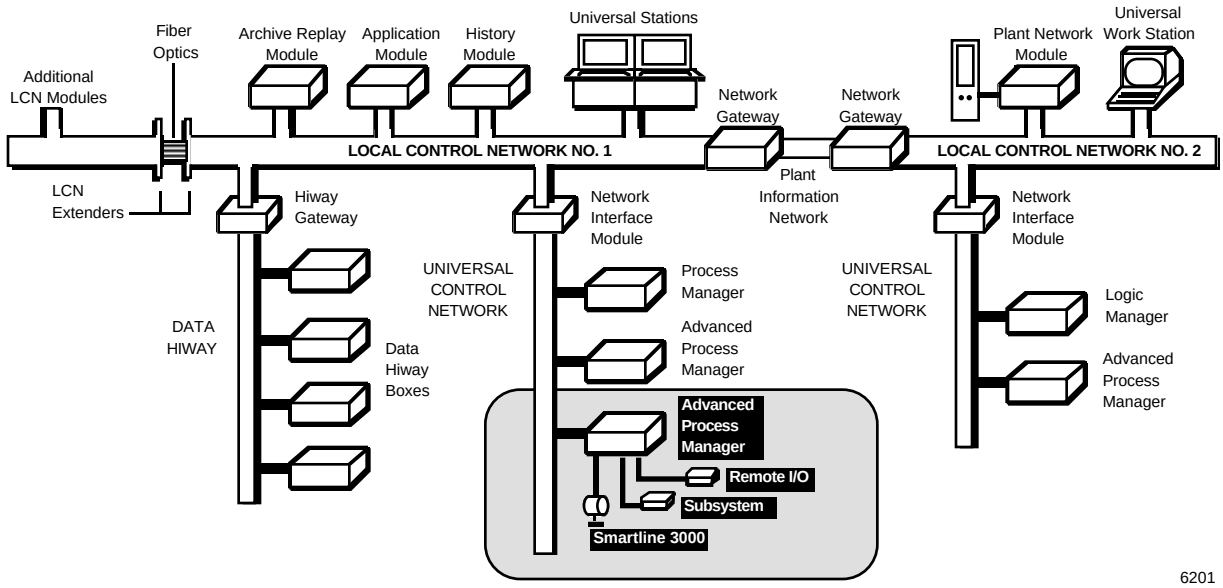

Figure 2 — TDC 3000^X Architecture

Introduction

The Advanced Process Manager (APM) is Honeywell's premier TDC 3000^X data acquisition and control device for industrial process applications.

Like the Process Manager™ (PM), the Advanced Process Manager's new-technology platform offers a range of capabilities that best meet today's and tomorrow's process requirements. The APM offers highly flexible I/O functions for both data monitoring and control. Powerful control functions, including regulatory, logic, and sequencing control are provided for continuous, batch, or hybrid applications.

An optimal toolbox of functions that can be configured and programmed meets the needs of data acquisition and advanced control requirements in a highly secure and performance-intensive manner. Of course, APM's capabilities include peer-to-peer communications and compatibility with industry-standard communications protocols.

As seen in Figure 2, the Advanced Process Manager is a fully integrated member of the TDC 3000^X family. Accordingly, it is capable of:

- Performing data acquisition and control functions, including regulatory, logic, and sequential control functions, as well as peer-to-peer communications with other Universal Control Network-resident devices.
- Providing bidirectional communications to Modbus™ and Allen-Bradley compatible subsystems through a serial interface.
- Fully communicating with operators and engineers at Universal Stations and Universal Work Stations. Procedures and displays are identical or similar to those used with other TDC 3000^X controllers. Plant personnel may already be familiar with them.
- Supporting higher level control strategies available on the Local Control Network through the Application Module and host computers.

Advanced Features

As described above, the APM has the same functionality of the PM plus:

- Digital Input Sequence of Events (DISOE) processing
- Device Control Points
- Array Points for CL Programs
- Foreign device (serial) interface capability
- Larger Memory (over four times larger than the PM)
- String Variables
- Time Variables

Universal Control Network

The communications channel for the Advanced Process Manager is a local area network called the Universal Control Network (UCN). Introduced to TDC 3000^X users in 1988, the UCN is the platform for process I/O connections to the TDC 3000^X.

™ Process Manager, Looptune-II, SP$_Q$C-II, and Logic Manager are trademarks of Honeywell Inc. Modbus is a trademark of AEG Modicon.

The UCN features a 5 megabit per second, carrier band communication system with a token bus network. It is designed to be compatible with IEEE* and ISO** standards. UCN communications are consistent with the growth and direction of evolving international standards, with appropriate Honeywell extensions for secure process control applications.

The UCN uses redundant coaxial cables and can support up to 32 redundant devices. The UCN supports peer-to-peer communication between devices on this network. This feature enables sharing information among Advanced Process Managers, Process Managers, and Logic Managers on the network, thus offering tremendous power and flexibility in implementing advanced, coordinated control strategies.

Network Interface Module

The Network Interface Module (NIM) provides the link between the Local Control Network and the Universal Control Network. Accordingly, it makes the transition from the transmission technique and protocol of the Local Control Network to the transmission technique and protocol of the Universal Control Network. The NIM provides LCN module access to data from UCN-resident devices. It supports program and database loads to the Advanced Process Manager and forwards alarms and messages from the network devices to the LCN. The NIM is also available in a redundant configuration to provide automatic continued operation in the event of a primary failure.

LCN time and UCN time are synchronized by the NIM. The NIM broadcasts LCN time over the UCN. The APM uses it for all alarm (or event) timestamping.

Functional Description

Functional Overview

The Advanced Process Manager is designed to provide flexible and powerful process scanning and control capabilities. To do this, it uses advanced multiprocessor architecture with separate microprocessors dedicated to perform specific tasks. As depicted in Figure 3, the APM consists of the Advanced Process Manager Module (APMM) and the I/O Subsystem.

The Advanced Process Manager Module consists of an Advanced Communication Processor and modem, Advanced I/O Link Interface Processor, and Advanced Control Processor. A redundant APMM can be optionally provided.

The Advanced Communication Processor is optimized to provide high-performance network communications, handling such functions as network data access and peer-to-peer communications. It also supports high-accuracy time stamps.

The Advanced Control Processor is the APM resource dedicated to executing regulatory, logic, and sequence functions, including an excellent user programming facility. Because communication and I/O processing are performed by separate dedicated hardware, the full power of the Advanced Control Processor can be applied to control strategy implementation. The Advanced I/O Link Interface Processor is the APMM interface to its I/O Subsystem.

The I/O Subsystem consists of the redundant I/O Link and up to 40 redundant I/O Processors. These I/O Processors handle all field I/O for both data acquisition and control functions. For example, the I/O Processors provide such functions as engineering unit conversion and alarm limit checking independent of the Advanced Process Manager Module.

The Smart Transmitter Interface processor provides full bidirectional communication to Honeywell smart transmitters, supporting transmitter configuration and improved data accuracy.

All control operations are performed within the Advanced Process Manager Module, with all data acquisition and signal conditioning being performed in I/O Processors. For added control security, the High Level Analog Input, Smart Transmitter Interface, and Analog Output processors can optionally be supplied as redundant devices. The remote I/O option allows I/O Processors to be remote-mounted up to 8 kilometers from the APM file. This option uses redundant fiber optic I/O Link extenders.

The process engineer has complete flexibility of choice in the assignment of point types and control strategies, within the maximum APMM design limits. These selections are implemented using the interactive tools provided by both the TDC 3000^X Universal Station and Universal Work Station.

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* Institute of Electrical and Electronics Engineers

** International Standards Organization

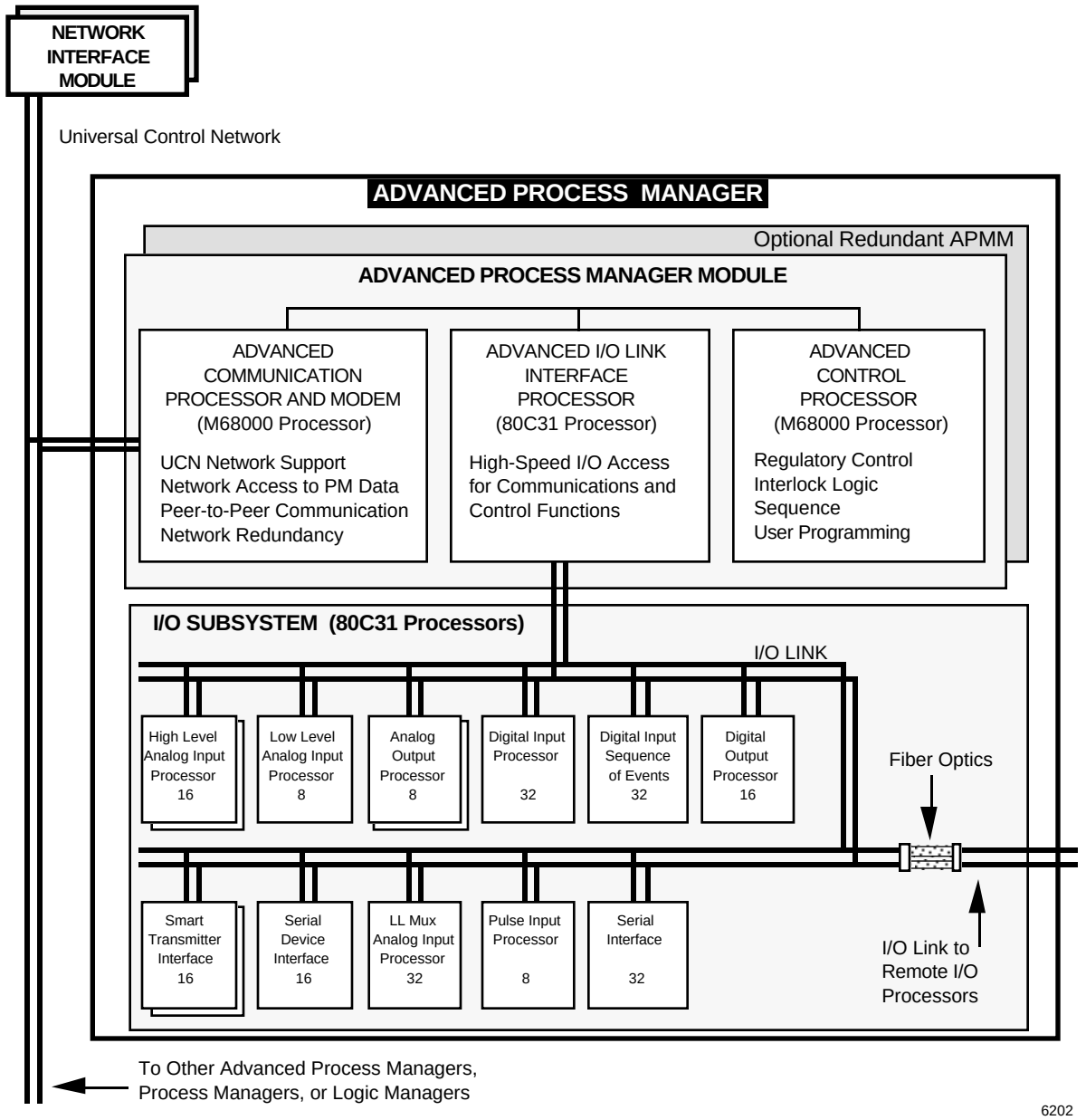

Figure 3 — APM Architecture

Control Functions

The Advanced Process Manager Module (APMM) provides a variety of control tools that can be customized to address a wide range of process automation needs.

Functions, from I/O scanning through regulatory and logic control to more advanced control, can be easily implemented through the APM. Included are a sophisticated regulatory control package, fully integrated interlock logic functions, and an advanced process engineer-oriented Control Language (CL/APM).

CL/APM is an enhanced version of the Control Language implemented by Honeywell in the Process Manager. This language facility includes the sequence structures needed to handle batch or hybrid applications as well as the computational capability needed for some continuous control tasks. Key to the power of this control capability is the sharing of the data within the APM, and sharing of data from other devices on the Universal Control Network.

All I/O values are converted to engineering units by the I/O Processors and are made available for both communications and further control processing by

the Advanced Process Manager Module (see Figure 4).

Conceptually, the APMM can be thought of as partitioned into "slots" of various types. These slots provide an allocated resource of processing power and memory that can be user-configured, including assignment of a tag name.

A tagged slot is referred to as a *data point* in a TDC 3000^X system. This data point structure is supported by predefined group and detail displays as well as by custom graphics.

Any of the following types of data points can be configured into APMM slots:

- Regulatory PV
- Regulatory Control
- Digital Composite
- Logic
- Device Control
- Process Module
- Array
- Flag
- Numeric
- Timer
- String
- Time

Each of these data point types is discussed in the text that follows.

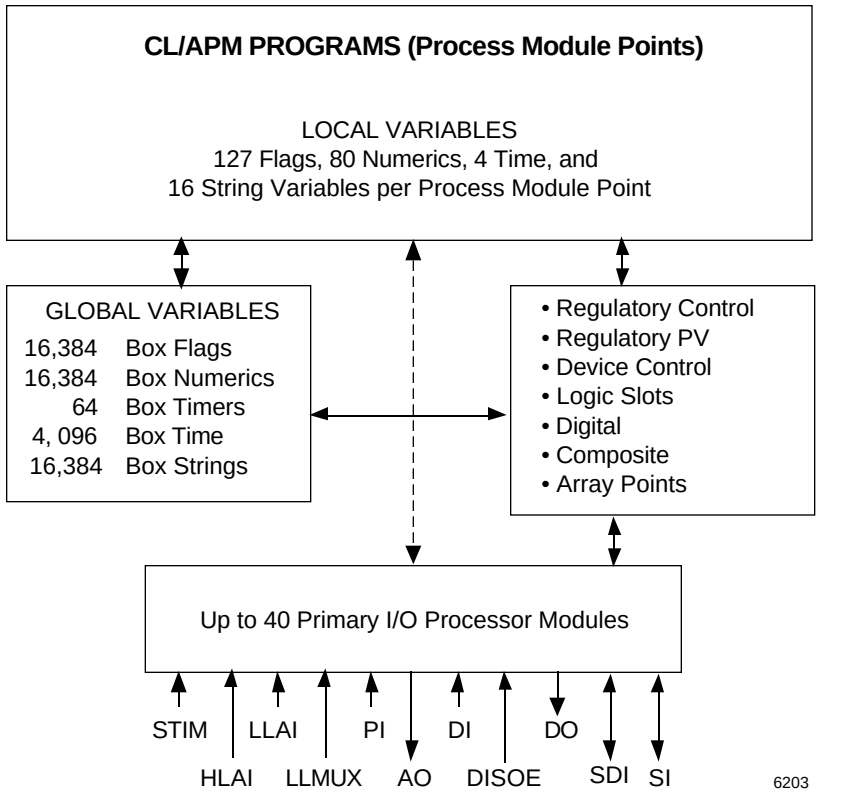

Figure 4 — Advanced Process Manager Functions

Regulatory PV Point

While standard I/O functions such as engineering unit conversion and alarming are handled directly by the I/O Processors, Regulatory PV points provide an easy-to-use configurable approach for implementing Process Variable (PV) calculation and compensation functions. PV processing provides a menu of selectable algorithms such as mass flow, totalization, and variable dead-time compensation. In addition, a full array of selectable functions, including extensive alarm checking and alarm suppression options, signal filtering, and algorithm equation

Table 1 — Regulatory PV Points

Available Algorithms	Supported Functions
Data Acquisition	PV Source (Auto, Manual, Substituted)
Flow Compensation	PV Clamping
Middle-of-3 Selector	EU Conversion and Extended PV Range
High/Low/Average Selector	PV Value Status and Propagation
Summer	PV Filter (Single Lag)
Totalizer	PV Alarming Bad PV PV High/Low PV HiHi/LoLo PV Significant Change PV Rate-of-Change +/-
Variable Dead Time with Lead/Lag	
General Linearization	
Calculator	

Table 2 — Regulatory Control Data Points

Available Algorithms	Supported Functions
PID	Modes (Manual, Auto, Cascade, Backup Cascade)
PID with Feedforward	Mode Attribute (Operator, Program)
PID with External Reset Feedback	Normal Mode
PID with Position Proportional	Remote Cascade, Remote Request, and Remote Configurable Per Slot
Position Proportional	Initialization
Ratio Control	Windup Protection
Ramp Soak	Fixed or Auto Ratio and Bias
Auto/Manual Station	Override Propagation
Incremental Summer	External Mode Switching
Switch	Safety Shutdown
Override Selector	Target Value Processing (Setpoint Ramping)
	Alarms
	Limits (Output, Setpoint, Ratio, Bias)
	PV Source, PV Alarming
	Mode Shed on Bad PV

options are provided. Available algorithms and other supported functions are listed in Table 1.

Regulatory Control Point

Configurable regulatory (or analog) control functions are performed using Regulatory Control points. Regulatory Control points are configured to execute one of the control algorithms listed in Table 2. Each algorithm includes a wide range of configurable options to allow implementation of complex control strategies by a simple menu-selection process. In addition, some functions such as initialization and windup protection are inherently provided. Also, the capability to ramp setpoint (by operator entry of a target value and ramp time) is configurable. Standard and custom graphic displays are available to support these control strategies.

These built-in support functions significantly simplify the implementation and use of sophisticated multiloop control strategies. This ease of APM configuration and operation allows implementation of advanced control strategies at the process-connected level. At the same time, the slot structure for processing and memory resources is designed to ensure that proper control security is built into advanced control strategies. This means that high reliability and integrity are maintained over the entire range of control schemes—from the simplest to the most complex.

Digital Composite Point

Digital Composite points are multi-input/multi-output points that provide an interface to discrete devices, such as motors, pumps, and solenoid valves (see Figure 5).

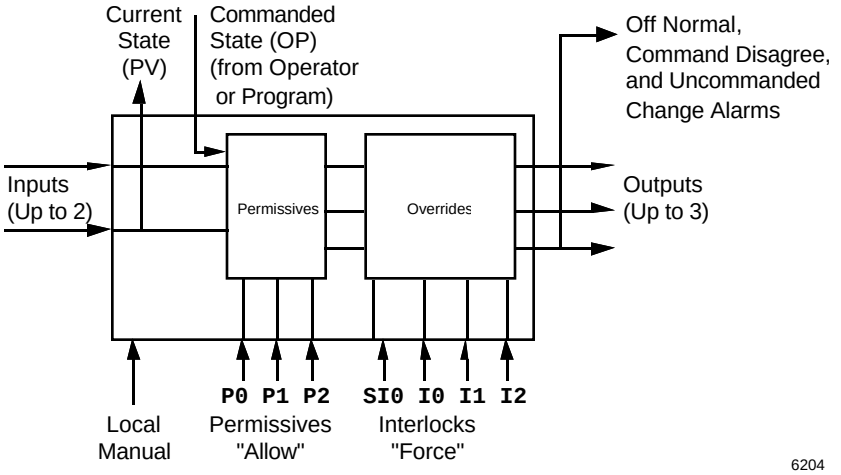

Figure 5 — Structure of Digital Composite Point

This point provides built-in structures for handling interlocks. It supports operator display of interlock conditions in group, detail, and graphic displays.

Displays also contain information needed to trace interlock cause. In addition, provision is made for operation of hand/off/auto switches commonly used for local operation of motorized devices.

The major parameters associated with the Digital Composite point are represented pictorially in Figure 5. Runtime maintenance statistics for the discrete device are also supported.

Logic Point

A Logic point provides a configurable mix of logic capability. Together with a digital composite point, it provides the basis for integrated interlock logic functions. Conceptually, a Logic point can be thought of as the logic processing equivalent to one to two pages of relay ladder logic. A Logic point consists of logic blocks, flags, numerics, input connections, and output connections. Different mixes of inputs, outputs, and logic blocks can be optionally selected. Maximums for each type are shown in Table 3.

In addition to the logic block functions listed in Table 4, the Logic point provides a general-purpose data transfer capability that can be used to read data from input connections and store this data to other database parameters defined by the output connections.

Device Control Point

The Device Control point provides maximum flexibility for controlling discrete devices. It combines the digital composite display and logic control function under a single tag name (see Table 5 and Figure 6).

Table 3 — Maximum Number of Entries for a Logic Point

	Inputs	Logic Blocks	Outputs
Option 1	12	24	4
Option 2	12	16	8
Option 3	12	8	12

Note: Each logic point also provides six status flags and six user flags, plus eight numerics.

Table 4 — Logic Block Algorithms

LOGIC (AND, OR, NOT, NAND, NOR, XOR, QUALIFIED-OR2 QUALIFIED-OR3)
COMPARE REAL (EQ, NE, GT, GE, LT, LE)
DELAY (ON DELAY, OFF DELAY, DELAY)
PULSE (FIXPULSE, MAXPULSE, MINPULSE)
WATCHDOG TIMER
FLIP-FLOP
CHECK for BAD
SWITCH
CHANGE DETECT

Note: AND, OR, NAND, and NOR Gates accept up to three inputs per block, where each input can be optionally inverted.

Table 5 — Device Control Point Algorithms

Gate	Algorithms	Function
Primary Input	Null	Pass Logic Input without change
	Invert	Invert Logic Input
	Arithmetic	Greater than, Greater than or equal, Less than, Less than or equal, Equal to, Not Equal to
	In-Set	Compare a numeric with an array of 10 numerics
Secondary Input	Null	Pass Logic Input without change
	Delay	Delay, On delay, Off delay
	Pulse	Pulse, maximum pulse, minimum pulse
		(Time for delay and pulse ≤ 8000 secs.)
Primary Gate	Logic	AND, OR, NAND, NOR, XOR
	Pulse	PAND, POR, PNAND, PNOR, PXOR
		("P…" outputs are pulsed)
Secondary Gate	Logic	AND, OR, NAND, NOR, XOR
	Pulse	PAND, POR, PNAND, PNOR, PXOR
		("P…" outputs are pulsed)

This provides an enhanced interface for pumps, motors and motor operated valves.

The Device Control point's single tag name enhances the operator interface for motor control points.

Operations are improved because the operator can see the cause of the interlock. An analog feedback signal such as motor control current is displayed.

Implementation effort is also reduced through the use of a simple configuration and standard graphics for troubleshooting.

User Programs— Process Module Point

Today's control strategies frequently need the flexibility of user programs that can be utilized for continuous, batch, or hybrid applications. A Process Module point is a resource for the execution of user-created programs written in Honeywell's Control Language (CL/APM).

The CL language provides an outstanding sequential control and computational tool. CL programs are self-documenting—an important feature when future modification of control strategies is anticipated. The total statement capacity depends on configuration. Typically 10,000 to 20,000 CL/APM statements can be handled by a single APM. Using the Universal Station or Universal Work Station, individual programs can be easily modified and reloaded without affecting execution of regulatory control, logic blocks, and other user programs.

All process module programs can access the Advanced Process Manager database, thereby accessing analog inputs and outputs, digital inputs and outputs, array points, logic block states, alarm states, and failure states, numeric variables, and flags.

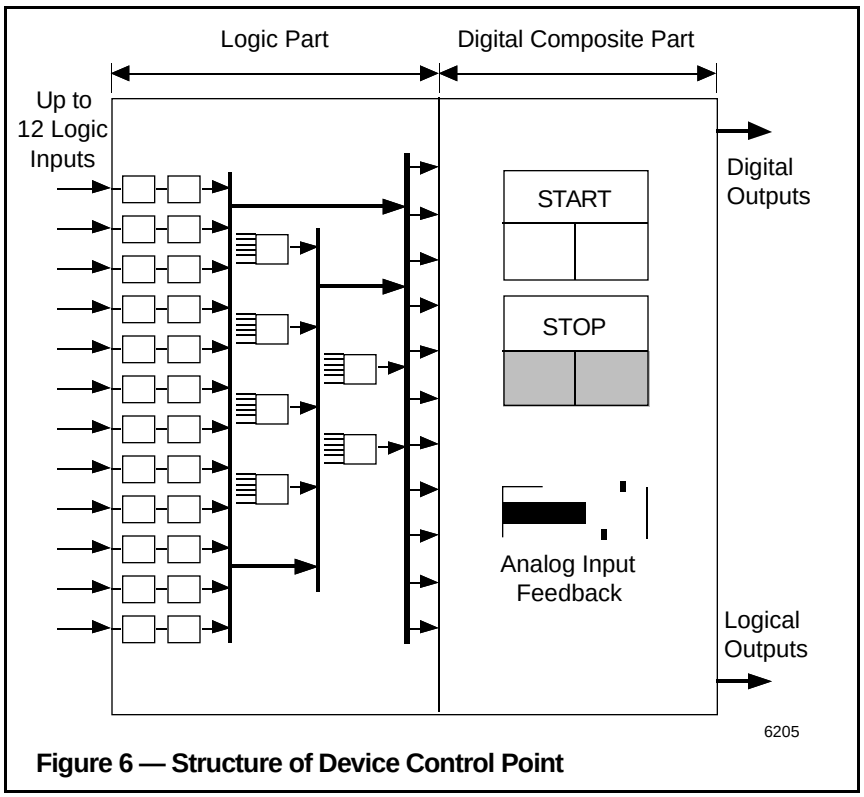

Figure 6 — Structure of Device Control Point

CL/APM programs can also manipulate ASCII values as well as time data. In addition, each process module program supports communication with the operator and can send or receive data from other controllers on the UCN.

Process module points provide a Phase/Step/Statement structure that is well suited for implementing batch process control functions. In addition, a multilevel abnormal handling capability allows user-specified conditions to automatically trigger predefined Hold, Shutdown, or Emergency Shutdown sequences.

Array Point

The Array point provides a more flexible, easy to access point structure for user-defined data. It is especially useful for advanced control or batch sequence programs. For example, an Array point can be used to store calculation variables or batch recipe data. This Array point data is available to the system for local data acquisition and control strategies as well as historization.

Up to 256 Array points can be configured per APM. Each array point is a logical grouping of internal APM box global variables up to

- 1023 Flags (boolean)
- 240 Numeric
- 240 Strings
- 240 Times.

A subset of Array points can be used for Serial Interface (SI) communications. Up to 80 Serial Input Array points can be accessed at a 1 second rate per APM, 40 at a 1/2 second rate, or 20 at a 1/4 second rate.

A single Serial Interface Array point can handle

- 512 Flags (Boolean) or
- 16 Numerics (Reals) or
- 32 Numerics (Integers) or
- 64 Characters of String Data.

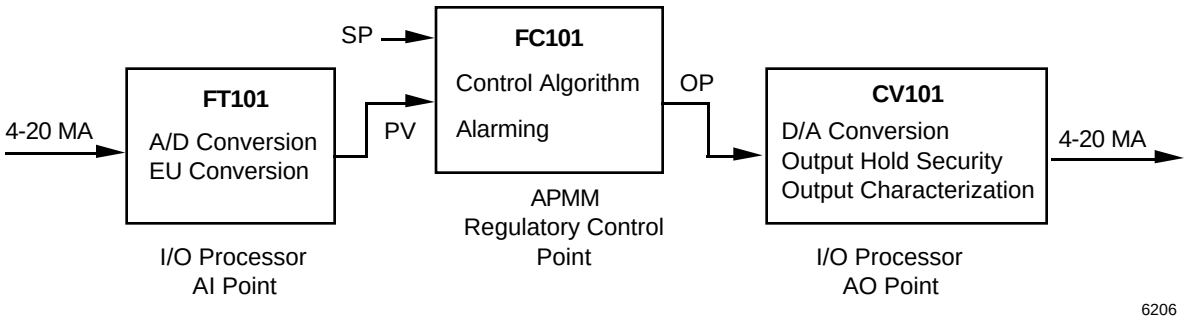

Figure 7 — Typical Regulatory Control Loop

Communication to any Serial Interface Array point is fully bidirectional (read and write). Data from any Serial Interface Array point can be accessed by other APM control and CL functions such as Device Control points. This allows subsystem data to be used for APM data acquisition and control strategies, as well as displayed at the Universal Station.

Flag Point

A Flag point is a two-state (On/Off) point that is used for storing a Boolean value. Flag points are not scheduled and are not processed. Their state is changed from another function, such as by operator input or a user-written program.

Provision is made for up to 16,384 Box Flag points, the first 128 of which can be configured for off-normal alarming.

Numeric Point

Numeric points are used for storage of real numbers. They are used for batch/recipe operations, or as a scratch pad to store the intermediate results of calculations.
12

Like Flag points, they are not scheduled or processed, but are changed as the result of other system activity. There can be up to 16,384 Numeric points.

Timer Point

The Timer point allows for timing of process events by the operator or sequence program. After being started, it provides an indication when the elapsed time has reached a predefined limit. There are 64 timer slots. Each is processed once per second.

String

The string variable adds increased flexibility to both continuous and batch oriented CL control programs. String variables of 8, 16, 32, or 64 characters can be compared and modified by the APM Control Language (CL). Using CL, you can manipulate and store unique messages that pertain to your process. Also, with this serial interface, ASCII data from a subsystem can be imported and used as string variables, as well as written back to the subsystem. Up to 16,384 eight character strings are supported.

Time

The Time variables allow CL programs access to both time and date information. CL programs can use elapsed or actual wall-clock time. Time-dates can be added or subtracted as needed.

Time allows you to schedule CL programs by time-of-day. You can also construct control schemes by allowing a logic slot access to time of day information. Up to 4,096 times are supported.

Control Implementation

A simple control loop can be implemented in an Advanced Process Manager, using an analog input point, a regulatory control point, and an analog output point as illustrated in Figure 7.

Although three data points are used, the primary operator interface is a single tag (FC101) for viewing, alarming, and manipulation in the customary manner through a Group, Detail, or Custom Graphic display.

Table 6 — Control Configuration Examples

Point Type [1]	Example 1				Example 2			
	Frequency (Seconds)	Pt. Qty.	PU/Pt.	Total PUs	Frequency (Seconds)	Pt. Qty.	PU/Pt.	Total PUs
Regulatory Control	1	160	1	160	1	60	1	60
Regulatory PV	—	—	—	—	1	20	1	20
Logic	—	—	—	—	1/4	5	4	20
Digital Composite [2]	—	—	—	—	1/4	50	0.4	20
Device Control	—	—	—	—	1	20	1	20
Process Module	—	—	—	—	1	10/20	2/1 [3]	20
APM Total	—	160	—	160	—	180/190	—	160

1 Array, Flag, Numeric, and Timer points are not listed since they have a PU weight of 0.
2 Logic and DC points must run at execution frequencies equal to, or faster than, the normal scan rate for regulatory points.
3 1 PU for small or infrequently run programs; 2 PU for larger programs.

Control Performance

The Advanced Process Manager is a high-performance device capable of an assured rate of 160 regulatory or discrete control loops per second. Users can customize their control configuration to meet the application requirements.

The parallel processing architecture of the Advanced Process Manager allows the control processing capability of the APM to be totally independent of other APM functions such as the number of I/O points built, data requests for APM data from the Network Interface Module and other UCN devices, and alarming functions. Only two factors must be considered when configuring the control processing—the **type** of control points (slots) desired and their **frequency** of execution, or scheduling interval. The processing power of the Advanced Control Processor is measured in terms of "Processing Units (PUs)." Each Advanced Control Processor has an assured rate of 160 PUs per second. Regulatory, logic, digital composite, and device control points can be configured at different execution frequencies (1/4, 1/2, or 1 second).

A subset of these points can be optionally configured for a 1/4-second rate, with the remainder at a slower rate. Since points use more processing power at faster frequencies, this feature allows the user to implement the greatest possible number of control loops while still assuring high-speed processing where required.

Still another option available for optimizing APM configuration is the selection between two program sizes for Process Module points. Users with sequence programs that process approximately 10 statements per second (or fewer) can implement twice as many such programs (160 instead of 80). This is possible because the smaller programs require less time to run and, therefore, are assigned only half as many Processing Units.

Typically, small programs are used for modular batch applications and large programs for continuous applications.

Any mixture of point types can be used, subject to the following individual maximums:

- 160 Regulatory Control
- 80 Regulatory PV
- 80 Logic
- 512 Digital Composite
- 160 Device Control
- 160 Process Module at 1 PU per APM program
  or
- 80 Process Module at 2 PUs per APM program

Table 6 shows two sample configurations.

I/O Functions

I/O Processors, along with Field Termination Assemblies (FTAs), perform input and output scanning and processing on all field I/O (Figure 8). A redundant I/O Link is standard for added security. Optionally High Level Analog Input, Smart Transmitter Interface, and Analog 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 APM:

- Analog Input–High Level (16 points)
- Analog Input–Low Level (8 points)
- Analog Input–Low Level Multiplexer (32 points)
- Smart Transmitter Interface (16 points) (Multivariable)
- Analog Output (8 points)
- Serial Device Interface (16 points—2 ports)
- Serial Interface (32 arrays, 2 ports)
- Pulse Input (8 points)
- Digital Input (32 points)
- Digital Input SOE (32 points)
- Digital Output (16 points)

Any mix of the above I/O processors can be selected for an APM. This can be any combination of single and/or redundant (HLAI, STI, and AO) 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 configuration, control automatically transfers to the backup I/O processor during board replacement.

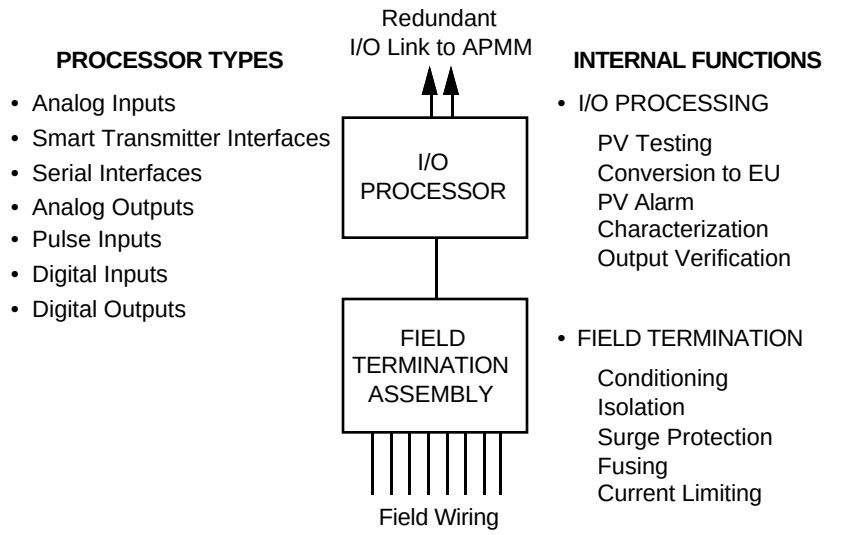

Figure 8 — APM I/O Functions

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

Analog Input

Both the high and low level analog input processors perform signal conversion and conditioning functions:

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

They perform engineering unit conversion, including fifth-order polynomial temperature input characterization, with the high level processor receiving 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 processor provides an even more economical way to bring in a large number of data acquisition signals. Each processor can handle 32 points, using two 16-point FTAs. Each point is scanned once per second with a 1 second scan delay for processing. Open thermocouple detection is performed on a regular basis for all points. Options for either local or remote cold junction reference are available.

Smart Transmitter Multivariable Interface

The Smart Transmitter Multivariable (STI-MV) processor is the APM'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
- STT3000
- Smart MagneW™ 3000

These transmitters are used for pressure, temperature, and flow measurement. 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 STI-MV processor also has the ability to accept up to four PVs each from the following multivariable transmitters:

- SCM 3000 Coriolis flowmeter
- Drexelbrook LT level transmitter

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 conversions, 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 processor to the Smart Transmitter are bit-serial, bidirectional, using the Honeywell DE (digital enhanced) protocol.

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

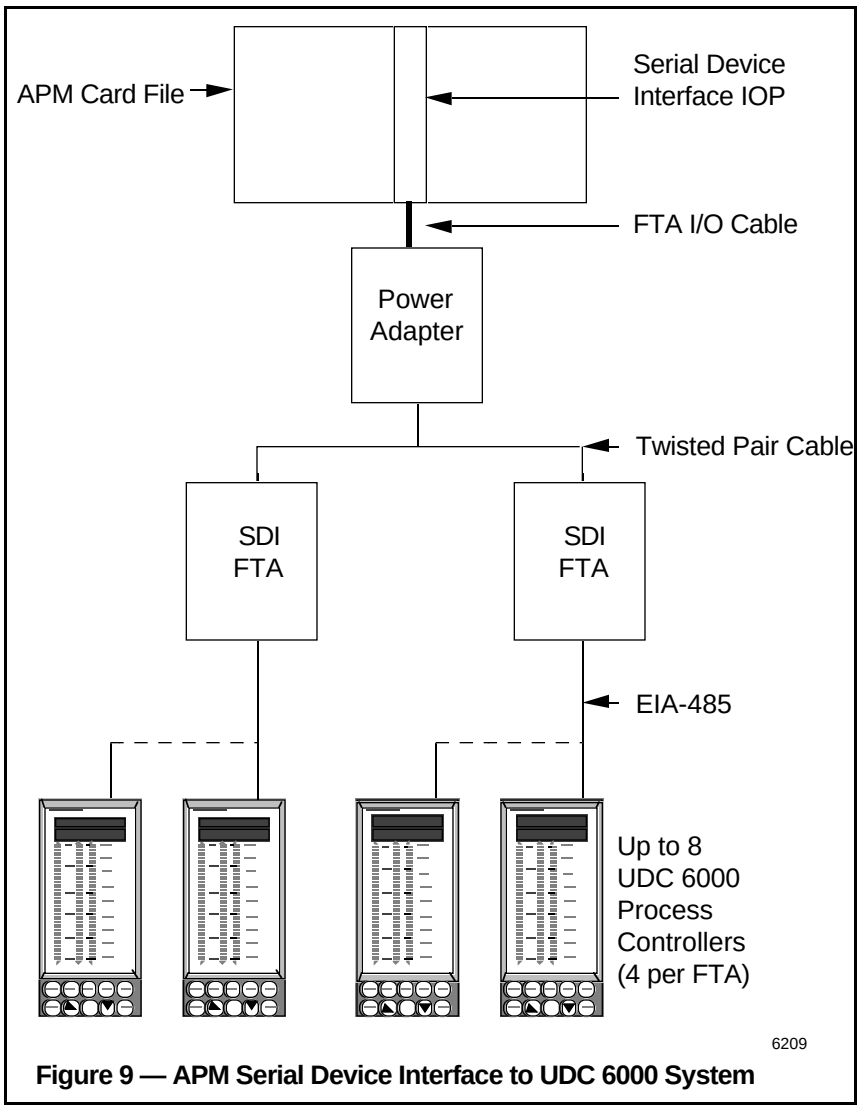

Figure 9 — APM Serial Device Interface to UDC 6000 System

- 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

The Serial Device Interface (SDI) processor provides a cost-effective method to connect 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 by the Advanced Process Manager. The data is available for Universal Station display, advanced control applications, analysis, and reports. Since communication is bidirectional, information such as target value or damping factors can be written to or read from the field device.

™ MagneW is a trademark of Honeywell Inc.

* Electronic Industries Association (formerly RS-232 and RS-485)

Specific serial devices are supported by custom programmable modules.

One such device is the UDC 6000 Process Controller (Figure 9), which provides single-loop remote display and control capability.

Operating as a subsystem of the APM controller, the UDC 6000 displays PV, SP, and OP on front panel bar graphs. When digitally integrated with the APM, the UDC Controller can be configured for the following modes:

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

An interface to Toledo Weigh Cell (T8142), providing weight, setpoint control of feed (fast cutoff) and rate of change alarming, is also supported.

Serial Interface IOP

The serial interface IOP provides a communications interface to Modbus or Allen-Bradley compatible subsystems (see Figure 10). Each serial interface IOP supports up to two FTAs. Each FTA supports one port and up to 16 array points.

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

The serial interface supports direct digital communications to any qualified subsystems. Using this scheme, serial data is then made available for all APM data acquisition and control strategies. Using the 16 available array points, an SI FTA can access up to

- 8192 Flags (boolean) or
- 256 Reals 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 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.

Pulse Input

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. Pulse input provides 24 Vdc transmitter power.

Analog Output

The Analog Output Processor provides 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 analog output processor provides separate D/A converters and power regulator per channel for maximum output security.

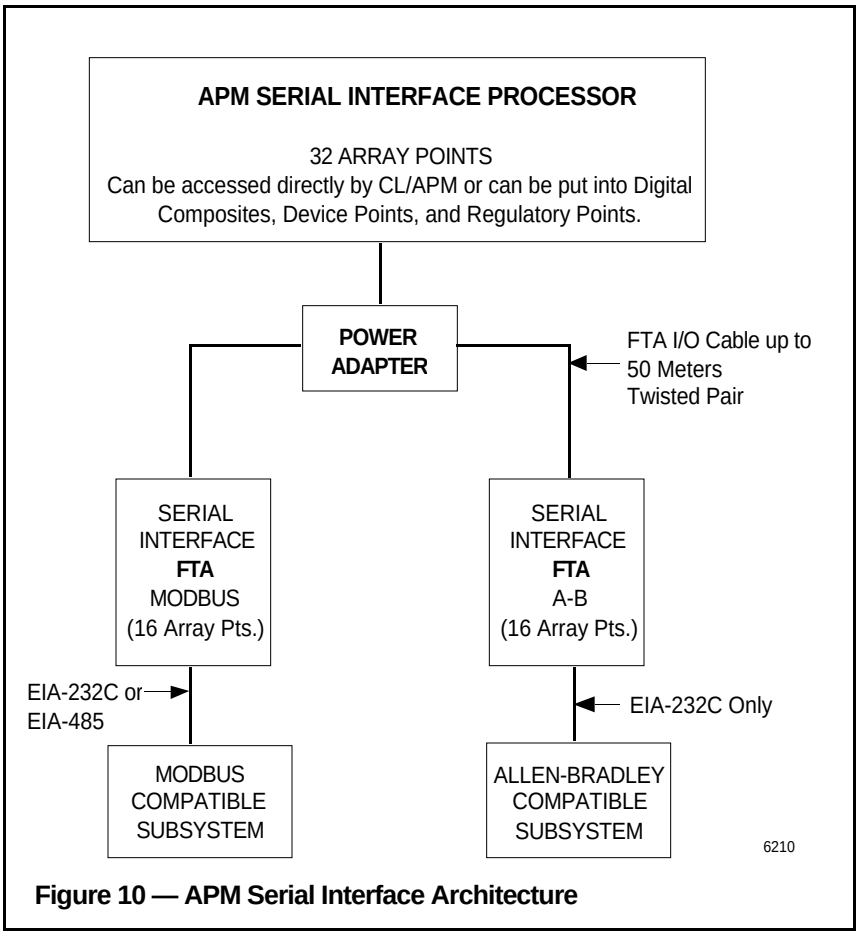

Figure 10 — APM Serial Interface Architecture

As an option, one-on-one Analog Output processor redundancy provides even higher control strategy integrity.

Digital Input

The Digital Input Processor provides the following functions:

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

Digital Input—Sequence of Events

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.

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

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

Digital Output

The Digital Output Processor provides the following functions:

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

For added output security, separate output latches with redundant power regulators are provided for default values.

I/O Simulation Option

An optional I/O Simulator package is available which simulates the functions of the IOPs for the APM. 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 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

- Physical IOPs, FTAs and field wiring not required
- Database (checkpoint) transportable to target system
- Simulation rerun from saved database using PV data
- Full peer-to-peer capability
- I/O functions simulated by Communications processor
- Any I/O configuration can be simulated

The benefits of this package include

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

Alarm System Functions

APM supports the extensive and flexible alarming capabilities of TDC 3000^X. As process alarms occur, they are visually annunciated at the Universal Station through keyboard LEDs and numerous types of displays such as custom graphic displays, group displays, alarm annunciator displays, alarm summaries, and so on. They can also be externally announced through customer-supplied devices activated by contact closures at the Universal Station. Because alarms can be reported on an area or unit basis, operators receive alarm indications that relate to only their specific assignments.

For APM process variables, the following alarms can be configured:

• Hi	• Rate of Change Hi
• HiHi	• Rate of Change Lo
• Lo	• Significant Change
• LoLo	• Deviation Hi/Lo
	• Advisory Deviation

All PV alarms can have a selectable deadband. Alarms can be assigned to both I/O Processors and APMM slots. In general, to provide a single tag for operator interface, when an I/O point is used by an APMM slot, the alarms are configured in the APMM slot.

For digital alarms, these are the types of alarm:

- Uncommanded Change-of-State
- Off-normal alarms
- Command disagree alarms
- Logic input, flag, or gate output alarms
- Alarms forced by CL program
- Command Fail alarm
- User-defined alarms

Off-normal alarms feature a configurable time deadband. Command disagree, command fail, and uncommanded change-of-state are types of alarms that apply to digital composite points.

Alarm priority is individually configured for each alarm type and each Hi or Low trip point for each Advanced Process Manager point. There are five selectable alarm priorities:

- Emergency
- High
- Low
- Journal
- No Action

Contact cutout is another configurable feature provided by the Advanced Process Manager. Contact cutout is used to automatically suppress alarm reporting on a point if certain external conditions occur.

Security

The Advanced Process Manager has a number of security features to provide maximum process availability. Throughout the APM's design, a high-reliability, fault-tolerant approach to both circuitry and overall system architecture has been used. For example, an overall reduction in the number of components increases overall reliability and availability. CMOS technology, including highly heat-tolerant components, provides a high-density design with high reliability. Individual circuitry is used for critical functions, such as D/A converters on the output circuitry. Parallel power paths are employed so that control outputs can be maintained, even in the case of power regulator failure.

Redundancy for communications media, such as the I/O link and the UCN, is provided as a standard feature. Optional APMM redundancy is offered to provide one-on-one backup and auto-switchover for the common electronics. Optional I/O redundancy for HLAI, STI, and AO points can provide added security for critical control loops.

Since redundancy options are designed into the product, automatic switchover from primary to redundant electronics is fully supported. No special user programming is required. Ongoing diagnostics are provided to assure both primary and redundant electronics are functional. This one-on-one redundancy approach enhances coverage to maximize availability. It also simplifies system cabling and configuration.

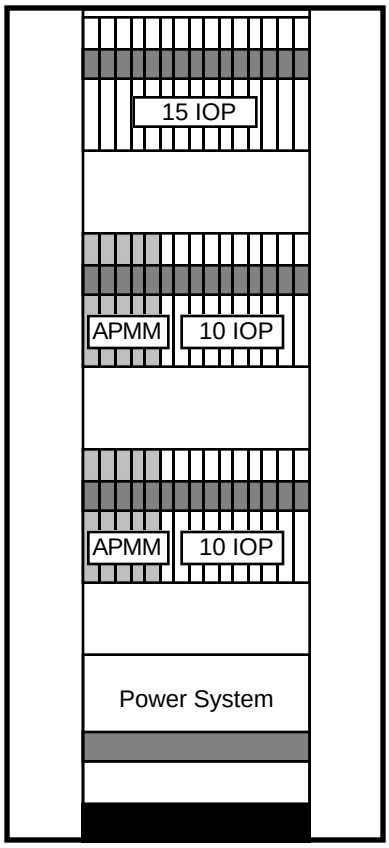

Figure 11 – Cabinet Layout with Redundant APMMs

Optional power redundancy and battery backup can be provided for assured power availability.

Extensive self-diagnostics are employed to diagnose APM operation and identify any failure. Failures are characterized as hard failure (HF) or soft failure (SF). APM status is indicated both locally through LEDs and at the standard status displays at the Universal Station.

Repairs to the APM can be made easily by replacing boards while power is on. Analog and Digital Standby Manual Units are available to maintain process outputs during board replacement. Overall, the APM provides superb control capabilities with excellent process control availability and security.

Physical Characteristics

The Advanced Process Manager consists of single or redundant Advanced Process Manager Modules, I/O Processors, associated card files, Field Termination Assemblies, and a single or redundant power assembly mounted in a cabinet. Either top or bottom field wire entry is available.

Because CMOS technology is used, power requirements and heat dissipation are extremely low. The Advanced Process Manager is also highly space efficient because of flexible I/O architecture, low power use, and high-density terminations.

The APM has been approved by Factory Mutual for mounting in, or interfacing to, devices in a Class 1, Division 2 area for the following signal types: Low Level Analog

Input, High Level Analog Input, STI, Analog Output, Pulse Input, and 24 Vdc Digital Input.

Power Systems

The Advanced Process Manager has significantly lower power requirements than traditional designs because it uses low-power CMOS technology. Two power systems are available to meet different system requirements.

The standard APM power system provides an integrated system battery backup option. The power system can also be easily upgraded to redundancy in the field.

The AC-Only power system is intended for use with UPS systems and does not have provision for system battery backup. It can provide more cost-effective power for a small, remote I/O installation where a UPS is available.

Both power systems provide 24 Vdc power to the Advanced Process Manager Module and I/O Subsystem, and 24 Vdc transmitter power is provided through standard FTA connections. Both power systems support single or redundant power supplies in a highly compact space.

Both power systems provide 50-hour memory backup; the standard system includes rechargeable batteries with a charger, while the AC-Only power system uses alkaline batteries.

Each power supply on both systems provide a relay with a Form-A contact output that de-energizes (contact opens) in the event of power loss.

A single LED on each power module of the AC-Only system annunciates power loss, while the standard system has separate LED indicators for

- Loss of ac power
- Loss of dc power
- Improper charging of backup battery
- Failure or disconnection of battery
- High temperature

The standard APM power system delivers 20 amps. Two power supply sizes are available for the AC-Only power system—8 amp and 16 amp.

Table 7 — FTA Sizes

FTA Type	Compr'n Terminals	Screw Terminals	Circuits	Size(1)
High Level Analog Input/STI	√		16	A
High Level Analog Input/STI		√	16	B
HL Analog Input/STI (Redundant)	√	√	16	B
Low Level Analog Input	√		8	B
Low Level Analog Input Multiplexer (2)	√		16	B
Serial Device Interface (2)			1	A
Serial Interface (2)			1	A
Power Adapter				A
Analog Output	√		8	A
Analog Output		√	8	B
Analog Output (Redundant)	√	√	8	B
Digital Input—24 Vdc	√	√	32	C
Digital Input—120 Vac	√	√	32	C
Digital Input—240 Vac	√	√	32	C
Power Distribution FTA	√		12	A
Pulse Input	√	√	8	B
Digital Output—24 Vdc, Nonisolated Solid State	√	√	16	B
Digital Output—3-30 Vdc Solid State	√	√	16	B
Digital Output—31-200 Vdc Solid State	√	√	16	B
Digital Output—120/240 Vac Solid State	√	√	16	B
Digital Output—120 Vac/125 Vdc Relay	√	√	16	B
Digital Output—240 Vac/125 Vdc Relay	√	√	16	B
I.S. Galvanic Isolation—HLAI/STI FTA	√		16	B
I.S. Galvanic Isolation—AO FTA	√		16	B
I.S. Galvanic Isolation—DI FTA	√		16	B
I.S. Galvanic Isolation—DOFTA	√		16	B
I.S. Galvanic Isolation—Marshalling Panel		√	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 I.S. Galvanic Isolation) = 12.065 cm/4.75 in.
(all I.S. Galvanic Isolation FTAs) = 12.446 cm/4.90 in.

(2) Requires Power Adapter FTA (see Figures 9 and 10).

Card File Assemblies

A typical base APM configuration consists of up to three card files, as illustrated in Figure 11. When options such as I/O redundancy and/or remote I/O are used, configurations with up to eight card files can be provided. One or two card files contain the Advanced Process Manager Module(s). All remaining card file slots can be filled with any combination of I/O Processors. A single cabinet holds up to 35 I/O Processors along with redundant Advanced Process Manager Modules. Alternatively, it holds up to 40 I/O Processors with a single Advanced Process Manager Module. Figure 11

shows the cabinet layout with redundant APMMs.

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) are available for all FTAs. Screw-type terminations can also be provided for most FTAs as shown in Table 7.

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 (Table 7). FTAs can be mounted in cabinets, or remotely, using Termination Mounting Channels. Digital input sense and 24 Vdc transmitter power are provided through standard FTA connections.

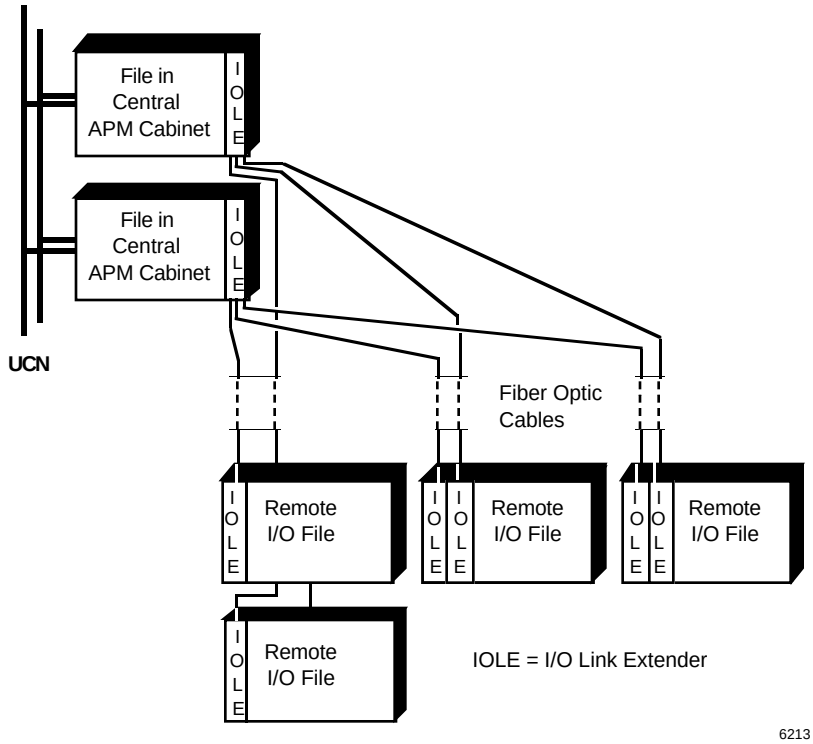

Figure 12 — Fiber Optic Remote I/O—1 Kilometer

Options

Advanced Process Manager Module Redundancy

In addition to the Universal Control Network, the I/O Link, and dc power cabling, which are always redundant, the Advanced Process Manager Module has a one-on-one redundancy option. In order to minimize the impact of a single failure, the database and functions within the backup APMM are kept up-to-date with the primary. If failure of the primary is detected by diagnostics that are continually being executed, the backup APMM automatically takes over from the primary and the operator is notified by a system alarm. The primary and secondary APMM can be located in separate card files to maximize control function availability.

I/O Redundancy

A one-on-one I/O redundancy option is also available for critical high level analog inputs, smart transmitter interface connections, and analog 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 Advanced Process Manager, 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.

Power System Redundancy

Both standard and AC-Only power systems include the option for a redundant 24 Vdc power supply. In both cases, two different ac feeds can be used for the power system. No rearrangement of devices within a cabinet is necessary and, with the standard power system, the second power supply may be added at a future date.

Battery Backup

An option to the standard APM power system is a backup battery capable of providing regulated 24 Vdc power in the event of the loss of ac input power. The battery is a compact set of gel cells that is mounted within the cabinet's power system enclosure.

A fully charged battery provides a minimum of 20 minutes of backup for a fully loaded Advanced Process Manager.

Diagnostic and alarm capabilities inform the operator of the existing state of readiness of the battery and charger.

Because the backup batteries provide input to the power supplies, rather than powering

the load directly, voltage regulation is equally as good when operating from either batteries or line power. If line power fails, load power is not interrupted during switchover.

For the AC-Only power system, line power backup is typically achieved by connecting a UPS to one of the two ac feeds.

Galvanically Isolated FTAs

These FTAs are available for applications requiring FM Class 1, CSA Class 1, or CENELEC Zone 0 protection. Wiring and installation are simplified because integral galvanically isolated intrinsic safety barriers are part of the FTA. See GA03-100, *Galvanic Isolation/ Intrinsic Safety Specification and Technical Data* for further information.

Remote I/O

Two Remote I/O options are available. Both enable distribution of I/O Processors and FTAs at up to six remote sites. One option supports remote sites up to 1 kilometer from the main APM electronics (see Figure 12), while the second option provides for separation of up to 8 kilometers.

FTAs at the remote locations can be located an additional 50 meters from the processors, and LLAI Mux, Serial Device or Serial Interface FTAs can be placed an additional 300 meters further.

The result can be a significant reduction of signal wire runs. Since redundant fiber optic cables are used, remote I/O installation benefits from inherent immunity to ground potential differences, and EMI/RFI interference. The redundant links each require an I/O Link Extender Pair (IOLE) at both ends. The Remote I/O (1 km) option (shown in Figure 12) supports up to three remote sites for each IOLE at the APM end, while the Long Distance I/O (8 km) option requires one APM IOLE per site.

Standby Manual

Each of the termination assemblies associated with output type processors (analog and digital outputs) includes provision to connect a standby manual unit. This option allows outputs to be maintained during I/O Processor replacement.

User-Preference Options

In addition to the options described above, several other options are available to better serve differing application requirements. Included are

- Two types of cabinets
- Two types of termination connections for most FTAs; compression or screw-type
- Three widths of FTA trays; 4", 8", and 10"
- Two types of power systems; battery backup and AC only.

Specifications

Specifications apply to the APM modules mounted in a standard APM cabinet.

Advanced Process Manager Environmental Conditions

Parameter	Reference Band	Normal Limits	Operative and Storage Limits	Transportation Band
Ambient Temperature(1, 2) Range Rate of Change	25 ± 1°C None	0–50°C ≤0.25°C/min.	0–50°C(2) ≤1°C/min.	-40 to 80°C(3) ≤5°C/min.
Relative Humidity(4)	15–55%	15–70%	10–90% (no condensation)	5–95%
Vibration (3 major axes) Frequency Acceleration Displacement	None	10–60 Hz 0.1 g maximum 0.03 inches	10–60 Hz 0.5 g maximum 0.1 inches	0–60 Hz 1 g maximum 0.1 inches
Mechanical Shock Acceleration Duration	None	1 g maximum 30 ms maximum	5 g maximum 30 ms maximum	20 g maximum 30 ms maximum
Barometric Pressure Altitude	Sea Level	+3000 m/-300 m	+3000 m/-300 m	any
Corrosives(1)	—	Class G1	Class G1	Class G1
Electromagnetic Interference(1)	—	15 V/M	15 V/M	—
Electrostatic Discharge(1)	—	IEC 801-2 15 kV 20x once/5 seconds	IEC 801-2 15 kV 20x once/5 seconds	—

(1) External to standard APM cabinet with doors closed.

(2) APM boards are nominally rated 0-70°C. This is the potential temperature inside a cabinet when external temperature is 0-50°C.

(3) Battery backup option must be transported and stored at temperatures -40 to +65°C.

(4) The maximum relative humidity specification applies up to 40°C. For 50°C, the RH specification is derated to 55% to maintain constant moisture content.

(5) The ESD rating is applicable when ESD is applied to the APM cabinet, APM customer interfaces (cable connectors input/output wiring terminals), and whatever a customer can touch without using a tool (excluding backplane traces and PWA circuitry). ESD testing and pass/fail criteria are covered in Honeywell documents 51109386, 5519389, and 51109764.

(6) The surge rating is applicable when the surge (per ANSI/IEEE specification C37.90.1-1989) is applied to any signal/cable entering or leaving the APM cabinet (see spec for test conditions and pass/fail criteria).

APM Certifications(1)

For:	Certifying Agency
General Purpose Area	FM, CSA
Class 1, Division 2 Mounting (1)	FM
Class 1, Division 2 Interfacing, without barriers (1, 2)	FM

(1) Received and Pending — For further details, see the *APM Site Planning Manual,* Section 13.

(2) With HLAI, LLAI, LLAI Mux, STI, AO, Pulse Input, and 24 Vdc DI FTAs mounted in standard APM cabinet.

Manual/Auto Station Environmental Conditions

The Manual/Auto Station can be mounted in a cabinet or on a panel.

Parameter	Reference Band	Normal Limits	Operative and Storage Limits	Transportation Band
Ambient Temperature Range Rate of Change	 25 ± 3°C None	 0–50°C ≤0.25°C/min.	 0–60°C 1°C/min.	 -40 to 80°C ≤5°C/min.
Relative Humidity*	10–55%	10–90%	5–90% (no condensation)	5–95%
Vibration (3 major axes) Frequency Acceleration Displacement	 None	 0-70 Hz 0.1 g maximum 0.03 inches	 0–200 Hz 0.2 g maximum 0.1 inches	 0–200 Hz 0.5 g maximum 0.1 inches
Electrostatic Discharge	—	IEC 801-2 10 kV 20x once/5 sec.	IEC 801-2 10 kV 20x once/5 sec.	—

*The maximum relative humidity specification applies up to 40°C. For 50°C, the RH specification is derated to 55% to maintain constant moisture content.

Advanced Process Manager Standard Power Systems

Electrical Specifications			
Parameter	**Reference**	**Normal Band**	**Operating Limits**
Vac Input			
Voltage (Vac rms)	120 or 240	100-264	100-264
Current (amps)			
– Maximum Inrush (peak)	35	—	—
– Running (rms)	9	—	—
– Crest Factor	1.1 max.	—	—
Frequency	50/60	47-63	47-63
Total Harmonic Distortion	0	0-8%	0-8%
DC Output			
Voltage (Vdc) powered from ac	25.5	25-26	25-26
Current (amps)	20	0-20	0-20
Voltage (Vdc) powered from batteries	24.5	24-25	24-25
Hold-Up Time (any supply voltage)	20 ms (nominal line and full load—without batteries)		
Efficiency (any supply)	65% minimum		

System Battery Backup Specifications	
Parameter	**Specification**
Environment	See Environmental Conditions
Battery Type	48 Vdc (bulk), 12 amp-hours (sealed gel-cell)
Battery Life	5 years at 20°C ambient in an operating system
Switchover, Switchback Time	Instantaneous—diode switching

CMOS Memory Backup Specifications	
Parameter	**Specification**
Environment	See Environmental Conditions
Battery Type	Three 1.2 Vdc, size AA nickel-cadmium cells
Battery Life	5 years
Switchover, Switchback Time	Instantaneous—diode switching

Advanced Process Manager AC-Only Power Systems

Electrical Specifications			
Parameter	**Reference**	**Normal Band**	**Operating Limits**
120 Vac Input(1)			
Voltage (Vac rms)	120	100-132	100-132
Current (amps)			
– Maximum Inrush (Peak)	30	—	—
– Running (rms) for 8 amp PS	3.5 max.	—	—
– Running (rms) for 16 amp PS	6.5 max.	—	—
– Crest Factor	2.8 max.	—	—
Frequency	50/60	47-63	47-63
Total Harmonic Distortion	0	0-8%	0-8%
240 Vac Input(1)			
Voltage (Vac rms)	240	200-264	200-264
Current (amps)			
– Maximum Inrush (Peak)	30	—	—
– Running (rms) for 8 amp PS	2.0 max.	—	—
– Running (rms) for 16 amp PS	3.3 max.	—	—
– Crest Factor	2.8 max.	—	—
Frequency	50/60	47-63	47-63
Total Harmonic Distortion	0	0-8%	0-8%
DC Output			
Voltage (Vdc) powered from ac	25	24.5-25.5	24.5-25.5
Current (amps) for 8 amp PS (2)	8	0-8	0-8
Current (amps) for 16 amp PS (2)	16	0-16	0-16
Hold-Up Time (any supply voltage)	20 ms (nominal line and full load)		
Efficiency (any supply)	75% minimum		

CMOS Memory Backup Specifications	
Parameter	**Specification**
Environment	See Environmental Conditions
Battery Type	Three size AA alkaline cells
Battery Recharge	Not rechargeable, replace after any use
Battery Life	One year if not used—50 hours when used
Switchover, Switchback Time	Instantaneous—diode switched

(1) Input voltage is factory set—cannot be changed in the field.
(2) Output current and redundancy are factory configured. They cannot be changed in the field.

APMM Redundancy Option

Parameter	Specification
Control Hold Due to Swap or Failover Typical Maximum	 1.5 seconds 3.0 seconds

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 µm	62.5/125 µm
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 *Advanced Process Manager Site Planning* Manual, Section 17.		

High Level Analog Input Processor **MU-PAIH03**

Parameter	Specification
FTA Models	MU-TAIH02, TAIH12, TAIH52
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 Ω source imbalance)	70 db
Common Mode Voltage, dc to 60 Hz(1)	-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 Ω)
Normal Mode Rejection Ratio, at 60 Hz	32 db
Normal Mode Filter Response	Single-pole RC, 3 db down @ 1 Hz
Maximum Normal Mode Input (differential inputs, no damage)	+/- 30 volts
Crosstalk, dc to 60 Hz (channel-to-channel)	60 db
Input Impedance (voltage inputs)	> 10 MΩ powered
Maximum Input Voltage (any input referenced to common, no damage)	+/- 30 volts
Input Scan Rate	4 samples per second per channel. All channels sampled within a 250 ms window.
Hardware Accuracy (@ CMV = 0 V)	+/- 0.075% full-scale (23.5° ±2°C) +/- 0.15% full-scale (0 to 50°C)
Transmitter Power Conditioning	Resistor Current Limited, 145 Ω (not fused)
Surge Protection (Common mode)	IEEE SWC 472-1974

(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**

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 ±2% of FS maximum (at 0 V Common Mode)

Low Level Analog Input Processor — 8 Inputs **MU-PAIL02**

Data Conversion Performance	
Parameter	**Specification**
FTA Models	MU-TAIL02
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 ±250 Vdc
Dielectric Strength	1500 Vac rms or ±1500 Vdc Channel-to-channel, and channel-to-APM 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 3.4 Hz; min. 2.2 Hz; max. 5.7 Hz
Crosstalk, dc to 60 Hz	120 db
Input Impedance	5 kΩ min. @ 100 mV (unpowered)
Input Impedance	10 MΩ min. @ 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)	±0.05% of full scale, or ± 0.075% of reading at 23.5° ±2°C (whichever is larger)
Software (only) Accuracy (1)	±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 Protection (common mode)	IEEE SWC 472-1974
(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).	

(Continued)

Low Level Analog Input Processor — 8 Inputs (continued) **MU-PAIL02**

Signal Types and Ranges		
Signal Type	**Normal Signal Range**	**Extended Signal Range**
Thermocouple		
ANSI J	-100 to 750°C	-200 to 1200°C
ANSI K	0 to 1100°C	-100 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)	-180 to 800°C	N/A
Pt: 100 Ω JIS (C-1604)	-180 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**
FTA Models	MU-TAMR02, TAMT02, TAMT12
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 μV per bit 100 Ω and 120 Ω RTDs: 64 mΩ per bit 10 Ω RTD: 8 mΩ per bit Linear mV sensors: 20 μV per bit
CMV, dc to 60 Hz	250 Vac Peak or ±250 Vdc
Dielectric Strength	1500 Vac rms or ±1500 Vdc channel-to-channel (operating), and channel-to-APM common (not operating)
Crosstalk, dc to 60 Hz	120 db
Input Impedance	2 MΩ 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 Type Frequency Range	 Fixed by software 50/60 Hz
Hardware (only) Accuracy	±40 μV, or ± 160 mΩ 23.5° ±2°C
Software (only) Accuracy(1)	±0.1°C typical, ±0.5°C maximum at 23.5° ±2°C
Surge Protection (common mode)	IEEE SWC 472-1974
(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).	
NOTE: 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**	
Thermocouple Device Range	Normal Signal Range	Extended Signal Range
ANSI J	-100 to 750° C	-200 to 1200° C
ANSI K	0 to 1100° C	-100 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 1550° C	0 to 1700° C
ANSI R	+550 to 1550° C	0 to 1700° C
JAPAN Type R	+550 to 1550° 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 50Ω lead	
NMRR, at line frequency (50 or 60 Hz)	60 db min.	
NMRR, at other than line frequency (1-15 mV)	$NMRR = 20 \log_{10}\left(\frac{\sin(\quad)}{(\quad)}\right) \log_{10}\left(\frac{1}{(\quad)}\right)$ Where 1.41 Frequency Integration Time (20 ms @ 50 Hz, 16.66ms @ 60 Hz) 20 (constant)	
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) **MP-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	 -180 to 800° C -180 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 noise of 0-15 mV) 100Ω RTD: 60 db min. for noise of 0-75 mV)
NMRR, at other than line frequency 10Ω RTD: (0-15 mV) 100Ω RTD: (0-75 mV)	$NMRR = 20 \log_{10}\left(\frac{\sin(\quad)}{(\quad)}\right)$ Where 1415 Noise Frequency = Integration Time (20 ms @ 50 Hz, 16.66ms @ 60 Hz)
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.	

Smart Transmitter Interface* Processor **MU-PSTX03**

Parameter	Specification
FTA Models	MU-TAIH02, TAIH12, TAIH52
Input Type	Honeywell DE (digital enhanced) protocol (bidirectional)
Input Channels	16 digital input channels
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 Protection (Common mode)	IEEE SWC 472-1974

Smart Transmitter Interface Processor* Redundancy Option

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 ±2% of FS maximum (at 0 V Common Mode)

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

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

Parameter	Specification
Input Channels	1 galvanically isolated serial channel per FTA
Interface Type	EIA-232-D, 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 ±250 Vdc
Dielectric Strength	1500 Vac rms or ±1500 Vdc (channel to APM)
Surge Protection	IEEE SWC 472-1974

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

Parameter	Specification
Physical Interface	EIA-232 using DB-25 connector
Device Supported	Toledo Weigh Cell Model Number 8142
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	• Internal cable within APM cabinet or • External cable 300 m (1000 ft.) maximum
EIA-232 Cable Length—FTA to Device	15 m (2500 pf cable capacity maximum)*
Surge Protection	IEEE SWC 472-1974
ESD Protection	IEC 801.2
Number of Toledo Weigh Cells	• 2 FTAs per SDI IOP • 1 Toledo Weigh Cell per FTA
Baud Rate	9600 bps fixed rate
Data Transfer	Bidirectional, Half-Duplex
Message Validity	• Single-bit character parity • Message block checksum

*Consult factory for longer lengths.

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

Parameter	Specification
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	• Internal cable within APM cabinet or • External cable 300 m (1000 ft.) maximum
EIA-485 Cable Length—FTA to Device	300 m (1000 ft.)*
Surge Protection	IEEE SWC 472-1974
ESD Protection	IEC 801.2
Number of Manual/Auto Stations	• 2 FTAs per SDI IOP • 4 Manual/Auto Stations per FTA
Baud Rate	19.2 Kbps
Transmission Mode	Asynchronous, Bit Serial
Data Transfer	Bidirectional, Half-Duplex
Message Validity	• Single-bit character parity • Message block checksum
Tag ID Downloaded	8 Characters
PV Range	EUHI and EULO downloaded
Input Scan Rate	Four updates per second per point

*Consult factory for longer lengths.

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

Parameter	Specification
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	• Internal cable within APM cabinet or • External cable 300 m (1000 ft.) maximum
EIA-485 Cable Length—FTA to Device	300 m (1000 ft.)*
Surge Protection	IEEE SWC 472-1974
ESD Protection	IEC 801.2
Number of UDC 6000s	• 2 FTAs per SDI IOP • 4 UDC 6000s per FTA
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	• Single-bit character parity • Message block checksum

*Consult factory for longer lengths.

Analog Output Processor/FTA **MU-PAOX03**

Parameter	Specification
FTA Models	MU-TAOX02, TAOX12, TAOX52
Output Type	4-20 mA
Output Channels	8
Output Ripple	100 mV peak-to-peak at power line frequency, across 250 Ω load
Output Temperature Stability	0.02% Full Scale/°C
Resolution	± 0.05%
Calibrated Accuracy	± 0.35% (25°C) including linearity
Output Readback Checking Accuracy Diagnostic Frequency	 ±4% 8 checks per second
Humidity	No effect
Directly Accessible Output Current Range	0.1-21.4 mA
Maximum Current Output	26 mA
Maximum Resistive Load	750 Ω @ 22 mA
Output Settling Time (digital input code to 98% of final output value)	4 ms
Surge Protection	IEEE SWC 472-1974

Analog Output Processor Redundancy Option

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

Digital Input Processor and Digital Input Sequence of Events Processor **MU-PDIX02 /MU-PDISI1**

FTAs with Removable Plug-In Isolators			
Parameter	**Specification**		
	24 Vdc FTA	**120 Vac FTA**	**240 Vac FTA**
FTA Model Numbers	MU-TDID12, TDID52	MU-TDIA12, TD1A52	MU-TDIA22, TDIA62
Input Channels	32	32	32
Galvanic Isolation (field to APM)	1500 Vac rms or ±1500 Vdc	1500 Vac rms or ±1500 Vdc	1500 Vac rms or ±1500 Vdc
Isolation Technique	Optical	Optical	Optical
Digital Input Pwr. Range(1)	18-30 Vdc	90-132 Vac rms	180-264 Vac rms
Sense Current (ON condition)	12 mA minimum	5.2 mA minimum	3.3 mA minimum
Sense Current (OFF condition)	0.62 mA maximum	1.47 mA maximum	0.74 mA maximum
Absolute Delay Across Input Filter and Isolation (Bounceless Input to APM logic level change)	1.0 ms maximum	25 ms maximum	25 ms maximum
Field Resistance for Guaranteed ON condition(2, 3)	100 Ω maximum	100 Ω maximum	100 Ω maximum
Field Resistance for Guaranteed OFF condition(2, 3)	45 kΩ minimum(4)	71 kΩ minimum	287 kΩ minimum
Frequency Range	dc	47-63 Hz	47-63 Hz
Surge Protection	IEEE SWC 472-1974	IEEE SWC 472-1974	IEEE SWC 472-1974

(1) These dc voltage limits include an ac component that has a peak value of 5% of the nominal dc range value.

(2) This resistance is present between the two legs of a DI current sense circuit.

(3) For field wiring distance guidelines, see the *Advanced Process Manager Site Planning* manual.

(4) Reduce to 37.4 kΩ if digital input power range is limited to 18-25 Vdc.

(Continued)

Digital Input Processor and Digital Input Sequence of Events Processor (continued)

Packaged FTAs without Plug-In Isolators		
Parameter	**Specification**	
	24 Vdc FTA	**120 Vac FTA**
FTA Model Numbers	MU-TD1D72	MU-TDIA72
Input Channels	32	32
Galvanic Isolation (field to APM)	1500 Vac rms or ±1500 Vdc	1500 Vac rms or ±1500 Vdc
Isolation Technique	Optical	Optical
Digital Input Pwr. Range(1)	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 APM logic level change)	3.6 ms maximum	25 ms maximum
Field Resistance for Guaranteed ON condition(2, 3)	100 Ω maximum	100 Ω maximum
Field Resistance for Guaranteed OFF condition(2, 3)	45 kΩ minimum(4)	71 kΩ minimum
Frequency Range	dc	47-63 Hz
Surge Protection	IEEE SWC 472-1974	IEEE SWC 472-1974

(1) These dc voltage limits include an ac component that has a peak value of 5% of the nominal dc range value.

(2) This resistance is present between the two legs of a DI current sense circuit.

(3) For field wiring distance guidelines, see the *Advanced Process Manager Site Planning* manual.

(4) Reduce to 37.4 kΩ if digital input power range is limited to 18-25 Vdc.

Digital Output Processor **MU-PDOX02**

Solid State			
Parameter	**Specification**		
	3-30 Vdc FTA	**120/240 Vac FTA**	**5-200 Vdc FTA**
FTA Model Numbers	MU-TDOD13, TDOD53	MU-TDOA13, TDOA53	MU-TDOD22, TDOD32
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	3-30 Vdc	120/240 Vac	5-200 Vdc
FTA Max Continuous Load Current	1.25 Adc per output (2)	1.25 Adc per output (2)	0.5 Adc per output (2)
Load Fusing	2.5 A 125 V SB (5x20 mm) fuse per output (readily replaceable in fuseholders)	2.5 A 250 V SB (5x20 mm) fuse per output (readily replaceable in fuseholders)	1 A 250 V SB (5x20 mm) fuse per output (readily replaceable in fuseholders)
Load Power Factor	N/A	Must be 0.5 or greater(1)	N/A
Min. Load Current(3)	10 mAdc	50 mA (rms)	10 mAdc
Isolation	1500 V (rms) (field terminals to APM system power supply common)	1500 V (rms) (field terminals to APM system power supply common)	1500 V (rms) (field terminals to APM system power supply common)
On-State Voltage Drop	1.6 V max. (@ max. load current)	1.6 V max. (@ max. load current)	1.6 V max. (@ max. load current)
Off-State Leak. Max.	10 µA DC	5 mA rms	2 mAdc max.
Turn-on/Turn-off Time	1 ms max.	Next zero voltage/next zero current(4)	1 ms max.
Contact Suppression (Shunt)	Diode clamp	Resistor/capacitor snubber plus varistor per output	Diode clamp
Fuse Type (BUSS)	GDC-2.5A	GDC- 2.5A	GDC-1A
Surge Protection	IEEE SWC 472-1974	IEEE SWC 472-1974	IEEE SWC 472-1974

(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 *Advanced Process Manager 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 nonrepeating.

(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 Processor (continued)

Solid State (continued)	
Parameter	**Specification**
	24 Vdc Nonisolated FTA
FTA Model Numbers	MU-TDON12, TDON52
Output Channels	16 (outputs referenced to Advanced Process Manager power supply common)
Output Type	Open-collector (current-sinking) NPN transistors
Output Volt. States(1)	ON-state: 0-2 Vdc (maximum) OFF-state: "Ref +" terminal voltage (24 Vdc nominal)
Maximum Load Current	100 mA per output(2)
Minimum Load Current	1 mA per output
Output Isolation	None (any screw terminal to APM common)
On-State Voltage Drop	2 V max. @ max. load current
Off-State Leak. Current	100 μA max. @ max. output voltage
Turn-on/Turn-off Time	10 μs
Contact Suppression (Shunt)	Diode per output to "Ref +" terminal(3)
Output Transient Protection	(See Contact Suppression)

(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.

(2) All outputs ON (100% duty cycle) at maximum operating temperature.

(3) User must diode-suppress any inductive loads (such as relay coils) as close as possible to the load.

(Continued)

Digital Output Processor (continued)

Electro-Mechanical Relay—120 Vac FTA, 125 Vdc FTA	
Parameter	**Specification**
FTA Model Numbers	MU-TDOR12, TDOR52
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(1)	100 mA
Load Surge Current(2)	Overload and Endurance per UL 508
Isolation	1500 V (rms) (field terminals to APM system power supply common)
Turn-on Time	10 ms typical, 15 ms maximum
Turn-off Time	10 ms typical, 15 ms maximum
Maximum Repetition Rate	1,000 cycles per hour at rated load
Contact Life(3)	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)	20 Ω/0.1 μF resistor/capacitor snubber and varistor across each contact
Load Fusing on Termination Assembly	6 A 125 V slow-blow (5x20 mm) fuse per output
Surge Protection	IEEE SWC 472-1974

(1) The “power contacts” in these relays are not suitable for load currents less than 100 mA.

(2) Rating of relay contact, not fuse. Load surge (inrush) currents greater than maximum steady-state load currents, shown above, further reduce contact life beyond deratings; for example, 2x surge = 150,000 operations, 3x surge = 50,000 operations.

(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.

(Continued)

Digital Output Processor (continued)

Electro-Mechanical Relay—240 Vac FTA, 125 Vdc FTA	
Parameter	**Specification**
FTA Model Numbers	MU-TDOR22, 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) @ 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(1)	100 mA
Load Surge Current(2)	Overload and Endurance per UL 508
Isolation	1500 V (rms) (field terminals to APM system power supply common)
Turn-on Time	10 ms typical, 15 ms maximum
Turn-off Time	10 ms typical, 15 ms maximum
Maximum Repetition Rate	1,000 cycles per hour at rated load
Contact Life(3)	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 Ω/0.22 µF resistor/capacitor snubber and varistor across each contact
Load Fusing on Termination Assembly	3 A 250 V slow-blow (5x20 mm) fuse per output
Surge Protection	IEEE SWC 472-1974

(1) The “power contacts” in these relays are not suitable for load currents less than 100 mA.

(2) Rating of relay contact, not fuse. Load surge (inrush) currents greater than maximum steady-state load currents, shown above, further reduce contact life beyond deratings; for example, 2x surge = 150,000 operations, 3x surge = 50,000 operations.

(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.

Pulse Input Processor/FTA **MU-PRIX02**

Parameters	Specification
FTA Model Numbers	MU-TLPA02, TPIX52
Sensor Inputs	Self-powered 2-wire APM-powered (with automatic current limiting) 3-wire Pulse voltage or contact input
Input Type	Rectangular or sine waves
Input Channels	8
Input Impedance	10 kΩ minimum
Input Frequency (1) 50% Duty Cycle Square Wave Sine Waves	 1 to 20 kHz (all channels same amplitude) 1 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 µs minimum at 20 kHz (with IOP filter jumper in storage position) 50 µs minimum at 10 kHz (with IOP filter jumper in H position) 500 µs 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) (2) 20 mA maximum (with FTA Pullup) (2)
Contact Resistance Low (0, field contact closed) High (1, field contact open)	 82 Ω maximum (with FTA Pullup) (2) 175 Ω minimum (with FTA Pullup) (2)
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	±0.01% of input frequency, ±0.4 Hz
Rate Resolution	±0.4 Hz
Input Range (no damage)	±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

(1) Sine waves must not be intermixed with square waves or contacts on the same FTA.
50 M cables with mixed signal amplitudes — frequency is 9 kHz maximum (55 µs minimum pulse width)
30 M cables — frequency is 13 kHz maximum (38 µs minimum pulse width)
20 M cables — frequency is 15 kHz maximum (33 µs minimum pulse width)
10 M cables — frequency is 18 kHz maximum (28 µs minimum pulse width)
5 M cables — frequency is 20 kHz maximum (25 µs minimum pulse width)
(2) 1 kΩ to 24 Vdc.

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	• Internal cable within APM cabinet or • External cable 300 m (1000 ft.) maximum
Surge Protection	IEEE SWC 472-1974
ESD Protection	IEC 801.2
Number of Devices per SI	• 2 FTAs per SI • Up to 15 devices per FTA
Data Quantity per IOP	16 Points per serial channel (organized as Arrays in the APMM) Each point can access one of the following: 512 Booleans into FLAGS 16 Reals or 32 Integers into NUMERICS 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-D Support Transmission Mode: Lines Supported: Distance—FTA to Device:	 Serial asynchronous, bidirectional TXD, RXD, RTS, CTS, DSR, DTR, Logic GND, Protective GND 15 m (2500 pf cable capacity maximum)
EIA RS485 Support Transmission Mode: Lines Supported: Common Mode Operation: Number of : Distance—FTA to Device:	 Serial asynchronous, bidirectional, half duplex only Two wire, differential pair: DATA+, DATA-, 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 **bold**.) Modbus, Remote Terminal Unit (RTU) **RS232** or RS485 1200, 2400, 4800, 9600, **19200** bps None, **odd**, or even 1 Selectable ON/**OFF** Configurable address/**NONE** Configurable timeout/**1.5 seconds** 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 **MP-TSIA12**

Parameters	Specification
General	
Interface Type:	EIA-RS232-D
Number of Channels per IOP:	2
Distance—Power Adapter to FTA:	300 m
Baud Rate:	19.2 k bps
Serial Data Format with parity bit:	8 data bits
Common Mode Operation:	250 V rms (continuous)
ESD Protection:	IEEE SWC 472-1974
EIA-RS232-D Support	
Interface Type:	Serial asynchronous
Lines Supported:	TXD, RXD, Logic GND, Protective GND (Compatible with CCIT V.24; CCIT V.28)
Distance—FTA to Device:	15 meters (cable cap. = 2500 pF max)
SI A-B Specific Interface Specifications	
Protocol:	Full Duplex Allen-Bradley DF1 with embedded responses
Transmission Mode:	Character oriented
Serial Line Mode:	RS232
Parity:	even
No. Stop Bits:	1
Modem Control Support:	Off
ACK Timeout:	3.2 sec.
FTA Message Response Timeout:	4.0 sec.
Data Formats Supported:	Booleans, Reals, Signed/Unsigned Integers, ASCII Strings
CIM Communication Options:	Pass-through diagnostic requests Ignore handshaking Accept duplicate message BCC error check
Allen-Bradley Family Types Supported:	PLC-2 PLC-3 (Native Mode and PCL-2 Mode) PLC-5, except PLC-5/250 (Native Mode and PLC-2 Mode)

Allen-Bradley File Types

APM Array Point Types	PCL-5 File Types	PLC-3 File 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)

Model Numbers

Description	Model Number
Advanced Process Manager Module Board Sets	
Advanced Process Manager Module Board Set — Redundant	MU-APMR01
Advanced Process Manager Module Board Set — Single	MU-APMS01
APMM Redundancy Upgrade Kit (APMS01 to APMR01)	MU-ZAMR01
APMM Blank Filler Plates for 5 Slots	MU-APME01
PM to APM Upgrade Kit (Single)	MU-ZAPS01
PM to APM Upgrade Kit (Redundant)	MU-ZAPR01
Card Files (Telephone Connector* Version)	
APMM/PMM File (Empty, 10 I/O Slots)	MU-PMFX02
APMM/PMM File (Empty) Side-by-Side Redundant (5 I/O Slots)	MU-PMFR02
I/O Processor File (Empty, 15 I/O Slots)	MU-IOFX02
I/O Processors	
High Level Analog Input Processor (16 Inputs)	MU-PAIH03
Smart Transmitter Interface Processor (16 Inputs)	MU-PSTX03
Serial Device Interface Processor (16 Points/Port)	MU-PSDX02
Serial Interface Processor (16 Points/Port)	MU-PSIM11
Low Level Analog Input Processor (8 Inputs)	MU-PAIL02
Low Level Analog Input Multiplexer Processor (32 Inputs)	MU-PLAM03
Analog Output Processor (8 Outputs)	MU-PAOX03
Pulse Input Processor (8 Inputs)	MU-PPIX02
Digital Input Processor (32 Inputs)	MU-PDIX02
Digital Input Processor for Sequence of Events (32 Inputs)	MU-PDIS11
Digital Output Processor (16 Outputs)	MU-PDOX02
Blank Filler Plate for I/O Slot	MU-PFPX01
I/O Link Extender Pair—Main Location	MU-IOLM02
I/O Link Extender Pair—Remote Location	MU-IOLX02
Long Distance I/O Link Extender Pair	MU-ILDX02
FTA I/O Cables (Telephone Connector* Version)	
FTA I/O Cable (Local Cabinet Use)	MU-KFTA00
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
LLAI Mux or Serial Device Interface Serial I/F Twisted Pair Cables	
Twisted Pair Cable with shield (Local Cabinet Use)	MU-KLAM00
Twisted Pair Cable with shield—18 gauge (76 m/250 ft.)	MU-KLX076
Twisted Pair Cable with shield—18 gauge (152 m/500 ft.)	MU-KLX152
Twisted Pair Cable with shield—18 gauge (305 m/1000 ft.)	MU-KLX305

* For DIN-style FTAs, Cables, and File Options, see the *Site Planning* manual.

Model Numbers (continued)

Description	Model Number
Field Termination Assemblies (Phone Connector Style* — Compression Terminals)	
High Level Analog Input/STI FTA (16 Inputs)	MU-TAIH02
High Level Analog Input/STI FTA for Redundancy (16 Inputs)	MU-TAIH12
Low Level Analog Input FTA (8 Inputs)	MU-TAIL02
Low Level Analog Input Multiplexer RTD FTA (16 Inputs)	MU-TAMR02
Low Level Analog Input Multiplexer TC FTA (16 Inputs)	MU-TAMT02
Low Level Analog Input Multiplexer TC FTA with Remote CJR (16 Inputs)	MU-TAMT12
Power Adapter FTA	MU-TLPA02
Pulse Input FTA (8 Inputs)	MU-TPIX12
Analog Output FTA (8 Outputs)	MU-TAOX02
Analog Output FTA for Redundancy (8 Outputs)	MU-TAOX12
Digital Input Isolated 120 Vac FTA (32 Inputs)	MU-TDIA12
Digital Input Isolated 240 Vac FTA (32 Inputs)	MU-TDIA22
Digital Input 24 Vdc FTA (32 Inputs)	MU-TDID12
Digital Output 120/240 Vac Solid-State FTA (16 Outputs)	MU-TDOA13
Digital Output 3-30 Vdc Solid-State FTA (16 Outputs)	MU-TDOD13
Digital Output 5-200 Vdc Solid State (16 Outputs)	MU-TDOD22
Digital Output 24 Vdc, 100ma Nonisolated FTA (16 Outputs)	MU-TDON12
Digital Output 120 Vac/125Vdc Relay FTA (16 Outputs)	MU-TDOR12
Digital Output 240 Vac/125Vdc Relay FTA (16 Outputs)	MU-TDOR22
Field Termination Assemblies (Phone Connector* Style with Screw Terminals)	
High Level Analog Input/STI FTA (16 Inputs)**	MU-TAIH52
Pulse Input FTA (8 Inputs)	MU-TPIX52
Analog Output FTA (8 Outputs)**	MU-TAOX52
Digital Input Isolated 120 Vac FTA (32 Inputs)	MU-TDIA52
Digital Input Isolated 120 Vac FTA —Packaged (32 Inputs)	MU-TDIA72
Digital Input Isolated 240 Vac FTA (32 Inputs)	MU-TDIA62
Digital Input 24 Vdc FTA (32 Inputs)	MU-TDID52
Digital Input 24 Vdc FTA —Packaged, without plug-in isolators (32 Inputs)	MU-TDID72
Digital Output 120/240 Vac Solid-State FTA (16 Outputs)	MU-TDOA53
Digital Output 3-30 Vdc Solid-State FTA (16 Outputs)	MU-TDOD53
Digital Output 5-200 Vdc Solid State (16 Outputs)	MU-TDOD62
Digital Output 24 Vdc, 100ma Nonisolated FTA (16 Outputs)	MU-TDON52
Digital Output 120 Vac/125 Vdc Relay FTA (16 Outputs)	MU-TDOR52
Digital Output 240 Vac/125 Vdc Relay FTA (16 Outputs)	MU-TDOR62
Field Termination Assemblies for Serial Device Interface and Serial Interface	
Serial Device Interface FTA for Toledo Scale (8142)	MU-TSDT02
Serial Device Interface FTA for Manual/Auto Station	MU-TSDM02
Serial Device Interface FTA for UDC 6000	MU-TSDU02
Serial Interface FTA for Modbus	MU-TSIM12
Serial Interface FTA for Allen-Bradley	MU-STIA12

* For DIN-style FTAs, Cables, and File Options, see the *Site Planning* manual.
** These FTAs can be used for single or redundant applications.

Model Numbers (continued)

Description	Model Number
Display Units	
Manual/Auto Station	MU-MASX02
EIA - 485 Cables	
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
Standby Manual Units (Phone Connector* Style)	
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
Cabinets and Cabinet Components (Markhon Style)	
NEMA 1 Cabinet — Dual Access (.8 W x .8 D x 2.1 H [meters])	MU-CBDM01
NEMA 1 Cabinet — Single Access (.8 W x 5.5 D x 2.1 H [meters])	MU-CBSM01
NEMA 1 Cabinet Lifting Eyebolts (4)	MU-CLBM01
NEMA 1 Cabinet (Dual Access) Forklift Base	MU-CFDM01
NEMA 1 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
Cabinets and Cabinet Components (Rittal Style)	
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
Cabinet Fan Assemblies (All Styles)	
Cabinet Fan Assembly (240 Vac-50/60 Hz)	MU-FAN501
Cabinet Fan Assembly with Alarm (240 Vac-50/60 Hz)	MU-FAN511
Cabinet Fan Assembly (120 Vac-50/60 Hz)	MU-FAN601
Cabinet Fan Assembly with Alarm (120 Vac-50/60 Hz)	MU-FAN611

* For DIN-style FTAs, Cables, and File Options, see the *Site Planning* manual.
** These FTAs can be used for single or redundant applications.

Model Numbers (continued)

Description	Model Number
Power Systems Including, or Upgradable to, System Battery Backup	
PM/APM Redundant Power System with Mounting (20 A)	MU-PSRX03
PM/APM Single Power System with Mounting (20 A)	MU-PSSX03
PM/APM Redundant Power System with System Battery Backup Mounting (20 A)	MU-PSRB03
AC-Only Power Systems	
AC-Only Redundant Power Supply 120 Vac (8 A)	MU-PAR111
AC-Only Redundant Power Supply 240 Vac (8 A)	MU-PAR211
AC-Only Single Power Supply 120 Vac (8 A)	MU-PAS111
AC-Only Single Power Supply 240 Vac (8 A)	MU-PAS211
AC-Only Redundant Power Supply 120 Vac (16 A)	MU-PAR121
AC-Only Redundant Power Supply 240 Vac (16 A)	MU-PAR221
AC-Only Single Power Supply 120 Vac (16 A)	MU-PAS121
AC-Only Single Power Supply 240 Vac (16 A)	MU-PAS221
AC-Only Power System Cover Plate	MU-PACP01
24 Vdc Power Distribution	
Power Distribution FTA (24 Vdc)	MU-TDPR02
Digital Sense Power Cables	
Power Distribution (24 Vdc) (In Cabinet)	MU-KDPR00
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) (45 m)	MU-KDPR45
Power Distribution (24 Vdc) (50 m)	MU-KDPR50

Model Numbers (continued)

Description	Model Number
UCN Cables (Indoor Use)	
UCN RG-6 Drop Cable Pair (In Cabinet)	MU-NKD000
UCN RG-6 Drop Cable Pair (2 m)	MU-NKD002
UCN RG-6 Drop Cable Pair (5 m)	MU-NKD005
UCN RG-6 Drop Cable Pair (10 m)	MU-NKD010
UCN RG-6 Drop Cable Pair (20 m)	MU-NKD020
UCN RG-6 Drop Cable Pair (30 m)	MU-NKD030
UCN RG-6 Drop Cable Pair (40 m)	MU-NKD040
UCN RG-6 Drop Cable Pair (50 m)	MU-NKD050
UCN RG-6 Drop Connectors Kit (24 Connectors)	MU-NKDK01
UCN RG-6 Trunk Cable Crimp Tool	MU-NKDT01
UCN RG-11 Trunk Cable Pair (2.5 m)	MU-NKT002
UCN RG-11 Trunk Cable Pair (5 m)	MU-NKT005
UCN RG-11 Trunk Cable Pair (10 m)	MU-NKT010
UCN RG-11 Trunk Cable Pair (20 m)	MU-NKT020
UCN RG-11 Trunk Cable Pair (30 m)	MU-NKT030
UCN RG-11 Trunk Cable Pair (50 m)	MU-NKT050
UCN RG-11 Trunk Cable Pair (100 m)	MU-NKT100
UCN RG-11 Trunk Cable Pair (200 m)	MU-NKT200
UCN RG-11 Trunk Cable Pair (400 m)	MU-NKT400
UCN RG-11 Trunk Cable Pair (600 m)	MU-NKT600
UCN RG-11 Trunk Connectors Kit (24 Connectors)	MU-NKTK01
UCN RG-11 Trunk Cable Crimp Tool	MU-NKTT01
UCN RG-11 Trunk Cable Splice Kit (10 in a Package)	MU-NCSK01
UCN RG-11 Raw Cable (152 m)	51190899-152
UCN RG-11 Raw Cable (305 m)	51190899-305
UCN RG-11 Raw Cable (762 m)	51190899-762
UCN Cables (Outdoor Use)	
UCN RG-11 Raw Cable (152 m)	51191607-152
UCN RG-11 Raw Cable (305 m)	51191607-305
UCN RG-11 Raw Cable (762 m)	51191607-762
UCN Taps	
UCN Tap Pair with 2 Drops per Tap (with Brackets)	MU-NTAP02
UCN Tap Pair with 4 Drops per Tap (with Brackets)	MU-NTAP04
UCN Tap Pair with 8 Drops per Tap (with Brackets)	MU-NTAP08
UCN Tap Torque Tool Kit	MU-NKTQ01