Honeywell

# FSC Safety Manager
## Control Functions

**for use with the Honeywell FSC System**

**Release 400**

**FS09-500**

TotalPlant®

Honeywell

Implementation
FSC Safety Manager

# *FSC Safety Manager*
## *Control Functions*

**for use with the Honeywell FSC System**
**Release 400**

**FS09-500**
**09/96**

TotalPlant®

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# About This Publication

This publication defines the control functions available for the FSC Safety Manager Module (FSC-SMM) used with the Honeywell FSC system Release 400 and the TotalPlant Solution (TPS) system. It is a reference manual for process engineers, control system engineers and application engineers who design and implement data acquisition and control strategies for TPS systems with Local Control Networks (LCNs).

The user should be familiar with the TPS system control functions described in *System Control Functions* in the *Implementation/Startup & Reconfiguration - 2* binder before using this publication.

Detailed descriptions of the parameters mentioned in this publication can be found in the *FSC Safety Manager Parameter Reference Dictionary* in this binder, and further background information relative to FSC Safety Manager implementation can be found in *FSC Safety Manager Implementation Guidelines* also located in this binder.

This publication supports TotalPlant Solution (TPS) system network Release 520. TPS is the evolution of TDC 3000X.

**All references in this manual to "FSC Safety Manager" or "FSC Safety Manager Module" pertain only for use with the Honeywell FSC system.**

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# Acronyms

AI .......... Analog Input
AM .......... Application Module
AM .......... Application Module
AO .......... Analog Output
APM .......... Advanced Process Manager Module
CL .......... Control Language
CM .......... Computing Module
DC .......... Digital Composite
DI .......... Digital Input
DO .......... Digital Output
EIP .......... Event-Initiated Processing
EPROM .......... Erasable Programmable Read-Only Memory
FLD .......... Functional Logic Diagram
FSC .......... Fail Safe Control
FSC-DS .......... FSC Development System
FSC-SM .......... FSC Safety Manager
FSC-SMM .......... FSC Safety Manager Module
I/O .......... Input/Output
LCN .......... Local Control Network
LED .......... Light-Emitting Diode
LM .......... Logic Manager
NaN .......... Not a Number
NIM .......... Network Interface Module
PM .......... Process Manager
PU .......... Processing Unit
PV .......... Process Variable
RAM .......... Random Access Memory
SM .......... Safety Manager
SMM .......... Safety Manager Module
SP .......... Setpoint
TDC .......... Total Distributed Control
TPS .......... TotalPlant Solution
UCN .......... Universal Control Network
US .......... Universal Station

If the acronym or abbreviation you are searching for does not appear in this list, refer to the following parameter listing.

# Parameters


ALENBST ........ Alarm Enable Status
ALMOPT ........ Alarm Option
BADLPFL ........ Bad Loop Flag
BADPVFL ........ Bad PV Flag
BADPVTXT ........ Bad PV State Descriptor
COMMAND ........ Timer Command
CONTCUT ........ Contact Cut Out
DISRC(1–2) ........ Digital Composite Input Connection Source
DLYTIME ........ Delay Time
DODSTN(1–3) ........ Digital Composite Output Connection Source
EIPPCODE ........ Event Initiated Proceeding Point Identifier
EVTOPT ........ Event Recording Option
FBTIME ........ Feedback Time
FLLSBA ........ Least Significant Source Address
FORCE ........ Force Enable
FORCEFL ........ Force Flag
GENDESC ........ Generic Descriptor
HIGHAL ........ Highest Alarm Detected
HIGHALPR ........ Highest Level Alarm's Priority
INPTDIR ........ Input Direction
L ........ External Output Value
LIBADOPT ........ Logic Bad-Input Handling Option
LOCALMAN ........ Local Manual Flag
LOCUTOFF ........ Low Signal Cut-Off for Flow Inputs
LOENBL(1–12) ........ Logic Output Enable
MODATTR ........ Mode Attribute
MODE ........ Mode
MODEPERM ........ Mode Permissive
MOMSTATE ........ Momentary Output States
MOVPVTXT ........ Moving PV Text Descriptor
NFLAG ........ Number of Flags
NNLSBA ........ Least Significant Alias Address
NNUMERIC ........ Number of Numerics
NODINPTS ........ Number of Digital Inputs
NODOPTS ........ Number of Digital Outputs
NONE_OP(1–3) ........ Value Stored in Output n
NONECONF ........ Add Optional None State
NOSTATES ........ Number of Digital States
OFFNRMFL ........ Off-Normal Alarm Flag
OP ........ Commanded Output State (Digital Output Point)
OP ........ Last Digital Output State Requested (Digital Composite Point)
OP ........ Output in Percent (Analog Output Point)
OPFINAL ........ Final Output State Read Back from the FSC-SRS (Digital Composite Point)
OPFINAL ........ Percent Output at the Control Element Analog Output Point)
OPFINHI ........ Output High Value at Control Element
OPFINLO ........ Output Low Value at Control Element
OPRATRFL ........ Operator Mode Attribute Flag
OPTDIR ........ Analog Output Direct/Reverse Action
PLCADDR ........ FSC-SRS Alias Address
PNTFORM ........ Point Form


*Continued on next page*

# Parameters

PTEXECST .... Point Execution State
PTINAL .... Point in Alarm Indicator
PV .... Process Variable Current State (Digital Composite, Digital Input and Flag)
PV .... Process Variable Current Value (Analog Input, Numeric and Timer Points)
PVALDB .... PV Alarm Dead Band as a Percentage of Full Range
PVAUTO .... Current PV State (Digital Composite and Digital Input Points)
PVCALC .... Calculated PV
PVCHAR .... PV Characterization Option
PVEUHI .... PV High Range in Engineering Units
PVEULO .... PV Low Range In Engineering Units
PVEXEUHI .... PV Extended Engineering Unit Range High
PVEXEULO .... PV Extended Engineering Unit Range Low
PVEXHIFL .... PV Extended High Range Violation
PVEXLOFL .... PV Extended Low Range Violation
PVFL .... PV Flag
PVHIFL .... PV High Alarm Flag
PVHIPR .... PV High Alarm Priority
PVHITP .... PV High Alarm Trip Point
PVLOFL .... PV Low Alarm Flag
PVLOPR .... PV Low Alarm Priority
PVNORMAL .... PV Normal State
PVRAW .... PV Raw Value (Analog Input Point)
PVRAW .... Raw State of Field Contacts (Digital Input Point)
PVSLTSRC .... PV Slot Source
PVSRCOPT .... PV Source Option
REDTAG .... Red Tag State
RV .... Remaining Time
SCANRATE .... Scan Rate
SLOTNUM .... Slot Number
SO .... Status Output (Digital Composite and Digital Output Points)
SO .... Status Output of Timer (Timer point)
SPSLTSRC .... Setpoint Source Address
ST0_OP(1–3) .... State 0 Outputs, 1 through 3
ST1_OP(1–3) .... State 1 Outputs, 1 through 3
ST2_OP(1–3) .... State 2 Outputs, 1 through 3
STATE .... Timer State
STATETXT(0–1) .... State Descriptor Text
TIMEBASE .... Time Base

# References

**For TPS documentation:**

| Publication Title | Publication Number | Binder Title | Binder Number |
|---|---|---|---|
| *FSC Safety Manager Control Functions* | FS09-500 | Implementation FSC Safety Manager | TPS 3076 |
| *FSC Safety Manager Installation Guide* | FS20-500 | Implementation FSC Safety Manager | TPS 3076 |
| *FSC Safety Manager Parameter Reference Dictionary* | FS09-550 | Implementation FSC Safety Manager | TPS 3076 |
| *FSC Safety Manager Configuration Forms* | FS88-500 | Implementation FSC Safety Manager | TPS 3076 |
| *FSC Safety Manager Service Manual* | FS13-500 | Implementation FSC Safety Manager | TPS 3076 |

***For FSC documentation:***

| Publication Title | Publication Number | Version |
|---|---|---|
| *FSC Safety Manual* | PM.MAN.8047 | 400 |
| *FSC Hardware Manual* | PM.MAN.8048 | 400 |
| *FSC Software Manual* | PM.MAN.8025 | 400 |

# Section 1 – Introduction

## 1.1 Section Overview

**About this section**

This section contains an overview of the FSC Safety Manager, its key components and user interfaces. It also provides references to other publications that are useful or necessary during implementation. Topics included in this section are:


| Subsection | Topic | See Page |
|---|---|---|
| 1.1 | Section Overview | 1 |
| 1.2 | FSC Safety Manager Overview | 2 |
| 1.3 | FSC Safety Manager Module | 5 |
| 1.4 | FSC Controller | 8 |
| 1.5 | FSC Development System | 10 |
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## 1.2 FSC Safety Manager Overview

**Background**

The FSC Safety Manager (FSC-SM) is a process-connected device which resides on the Universal Control Network (UCN) of the TotalPlant Solution (TPS) system as a peer to the Process Manager (PM, APM, HPM) and Logic Manager (LM). It provides standard UCN node functionality, and can communicate with the field devices directly or through connected FSCs. The FSC Safety Manager also supports the FSC networking capability. Figure 1-1 illustrates the relationship between FSC-SM and TPS.

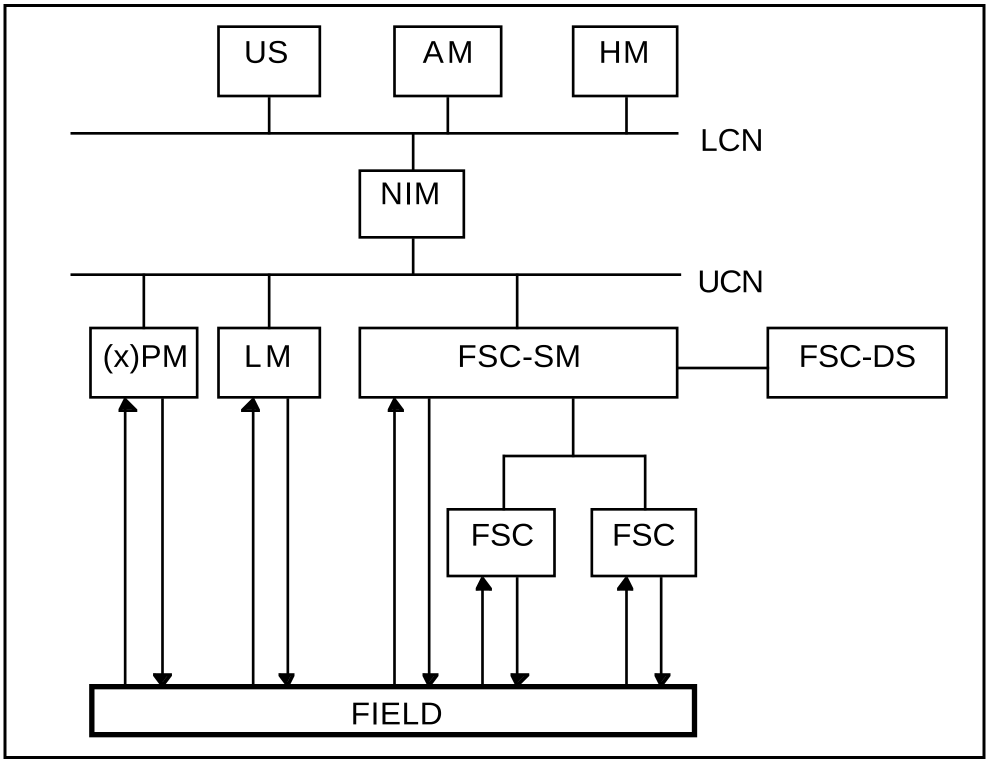


Figure 1-1 – FSC-SM and TPS

*Continued on next page*

**Key components**

As illustrated in Figure 1-2, the FSC Safety Manager (FSC-SM) consists of two key components mounted in one or more standard FSC cabinets:

- FSC,
  a fail safe control system from Honeywell Safety Management Systems, and
- FSC Safety Manager Module (FSC-SMM),
  a Honeywell Safety Management Systems module providing peer-to-peer communications with other process-connected devices residing on the TPS system's Universal Control Network.

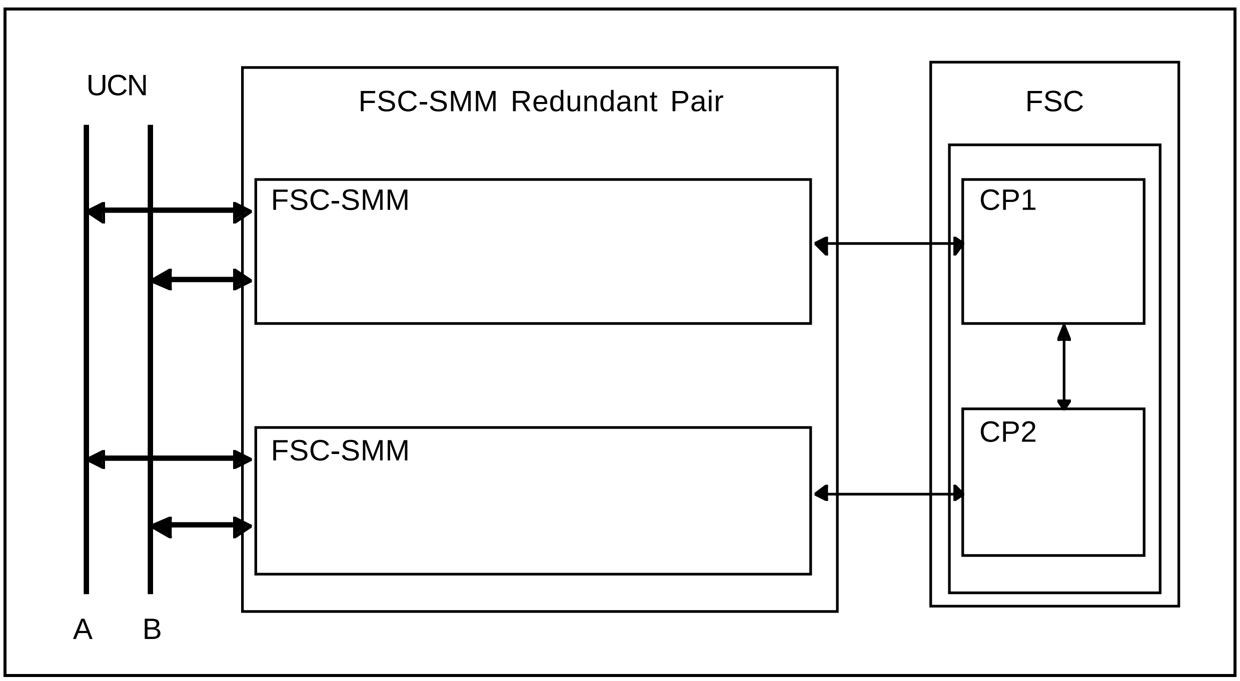


Figure 1-2 – FSC Safety Manager Overview

**Available chassis**

The FSC Safety Manager uses two types of racks to house the various kinds of available plug-in modules. These chassis are:

- Central Part rack,
  housing one or two Central Parts (depending on the FSC configuration), power supplies, communication modules and I/O modules. The configuration of the Central Part rack depends on the FSC configuration rules and the user's choice of modules.
- I/O rack,
  housing I/O modules and the module(s) which provide(s) the interface to the Central Part rack.

*Continued on next page*

**Human interfaces**

As shown in Figure 1-1, two human interfaces are used in conjunction with the FSC Safety Manager:

1) Universal Station (US) and Universal Work Station are two configurations of the TPS-level user interface and can be used to:
   - monitor and control the process, respond to alarms, print reports, and change the equipment status,
   - set up the TPS process database, displays and reports, and load FSC-SMM system software,
   - diagnose and maintain both control room and process-connected equipment.

2) FSC Development System (FSC-DS), which is used to interface with the FSC to:
   - configure FSC hardware and variables,
   - create and load the FSC control program,
   - diagnose FSC system faults,
   - force variables for loop check-out and maintenance of field devices,
   - view FSC control program execution,
   - print engineering documentation,
   - log FSC sequence of events (SOE),
   - verify the configuration and control program of the FSC component.

# 1.3 FSC Safety Manager Module

**Introduction**

The FSC Safety Manager consists of two key components mounted in one or more standard TPS cabinets:

- FSC,
  a fail safe control system from Honeywell Safety Management Systems, and
- FSC Safety Manager Module (FSC-SMM),
  a Honeywell optional module to FSC providing peer-to-peer communications with other process-connected devices residing on the TPS system's Universal Control Network.

This subsection provides an overview of the FSC Safety Manager Module component of the FSC Safety Manager.

For more information on FSC redundancy concepts refer to the *FSC Software Manual* and the *FSC Safety Manual*.

**Frontplate features**

As illustrated in Figure 1-3, the FSC-SMM frontplate includes the following major features:

- Diagnostic and operation LED indicators, which indicate:
  - the result of self-test diagnostics ('STATUS' LED),
  - the UCN transmit status ('Tx' LED),
  - the primary (On) or secondary (Off) ('P' LED),
  - the UCN cable that is currently carrying message traffic ('A' LED / 'B' LED).
- F-style connectors, which provide a link to the redundant Universal Control Network (A and B) via drop cables.

*Continued on next page*

**Frontplate features,** continued

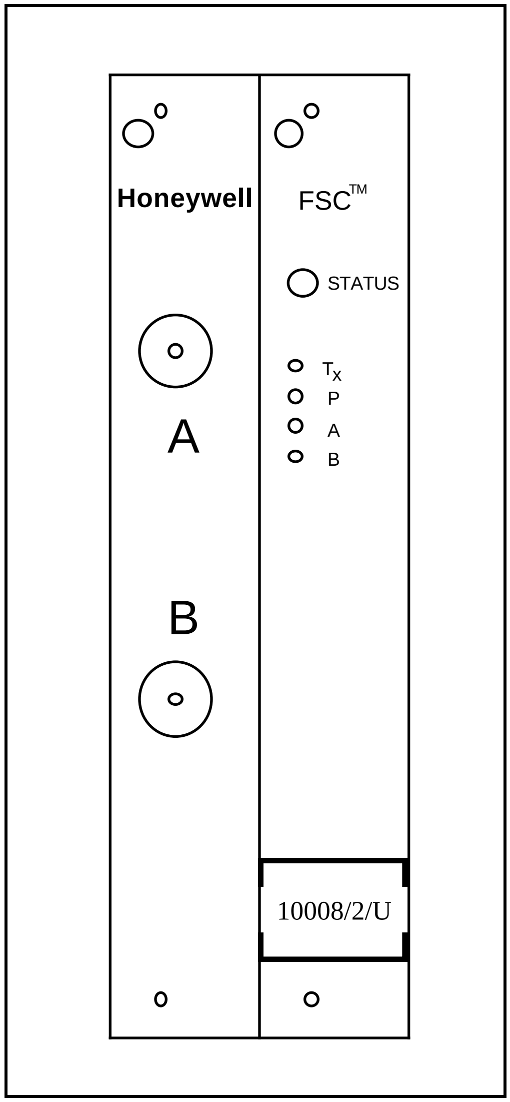


Figure 1-3 – FSC-SMM Frontplate

*Continued on next page*

**Function**

The FSC Safety Manager Module (FSC-SMM) serves as the communications interface between FSC and the Universal Control Network. The UCN communication channel is redundant. The basic functions of the FSC-SMM are the following (as illustrated in Figure 1-4):

- exchange data between its own tables and the tables of the FSC Control Processor,
- collect and process information from the FSC and its control program:
    - convert the information to TPS data types,
    - perform engineering unit conversions, alarm handling, diagnostic status reporting, peer-to-peer communications, and other UCN functions,
    - pass the converted information to the appropriate devices on the UCN, and
- collect and process information received over the UCN:
    - convert the information to the appropriate formats,
    - pass the converted information to the FSC.

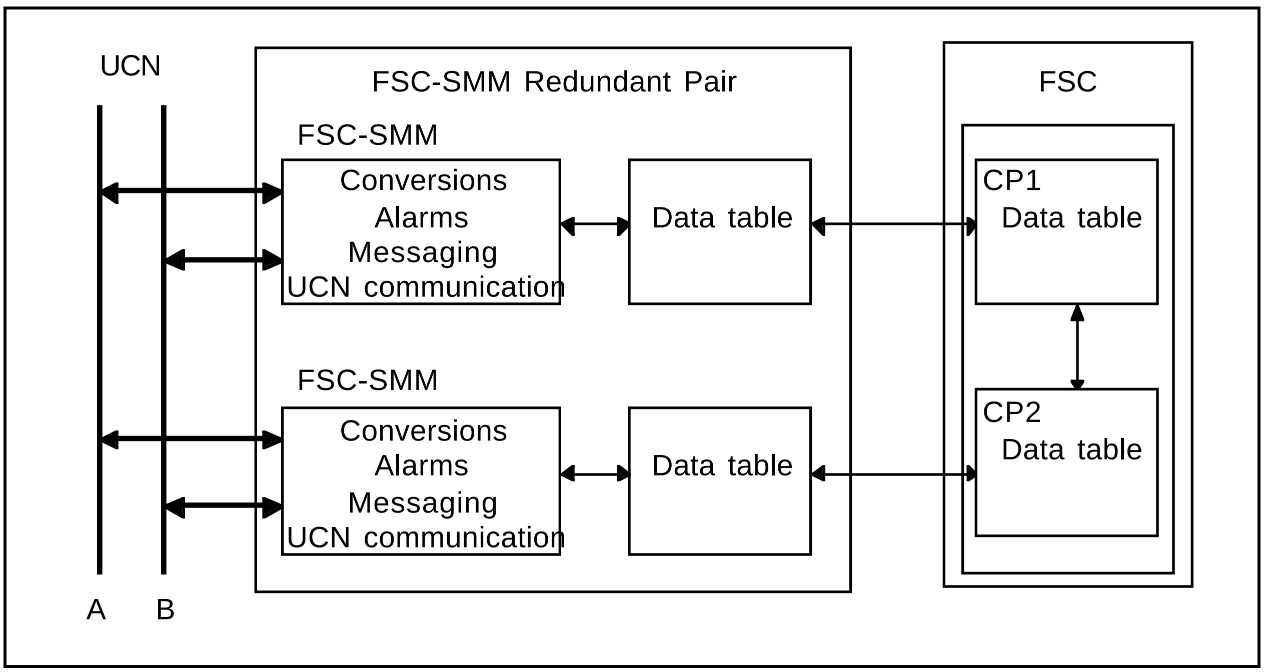


Figure 1-4 – FSC Safety Manager Functions

## 1.4 FSC Controller

**Introduction**

The FSC Safety Manager consists of two key components mounted in one or more standard FSC cabinets:

- FSC,
  a fail safe control system from Honeywell Safety Management Systems, and
- FSC Safety Manager Module (FSC-SMM),
  a Honeywell Safety Management Systems module providing peer-to-peer communications with other process-connected devices residing on the TPS system's Universal Control Network.

For detailed information regarding the concepts and functions described in this section refer to the FSC documentation.

**FSC configuration**

The configuration of an FSC system depends on the required safety class.

For detailed information regarding the FSC configurations and safety classes refer to the *FSC Safety Manual*.

**FSC modules**

For detailed information regarding the FSC hardware modules refer to the *FSC Hardware Manual*.

**FSC rack configuration**

For detailed information regarding the FSC rack configuration refer to the *FSC Software Manual*.

*Continued on next page*

## 1.4 FSC Controller, Continued

**Networks of FSCs**

For detailed information regarding the FSC networks refer to the *FSC Software Manual*.

## 1.5 FSC Development System

**Functions**

The FSC component of the FSC Safety Manager is programmed, configured and diagnosed using a personal computer-based human interface known as the FSC Development System (FSC-DS). The FSC-DS can be used by process engineers and maintenance personnel to:

- define the hardware configuration of the FSC,
- define FSC control program variable tagnames,
- develop, test and document the FSC control program, and
- diagnose system faults within the FSC.

For additional information regarding the functions, features and use of FSC-DS refer to the *FSC Software Manual* provided with your FSC Safety Manager.

## 1.6 Universal Station

**Background**

The Universal Station (US) is the TPS-level user interface to:

- monitor and control the process, respond to alarms, print reports, and change the equipment status,
- set up the TPS process database, displays and reports, and load system software,
- diagnose and maintain both control room and process connected equipment.

**FSC-SM standard displays**

The standard suite of node status displays associated with the FSC Safety Manager and its data points are consistent with similar displays provided for the Logic Manager and Process Manager family of UCN devices.

**Display access scenarios**

As illustrated in Figure 1-5, access to the US displays associated with FSC Safety Manager status is typical of any other UCN device.

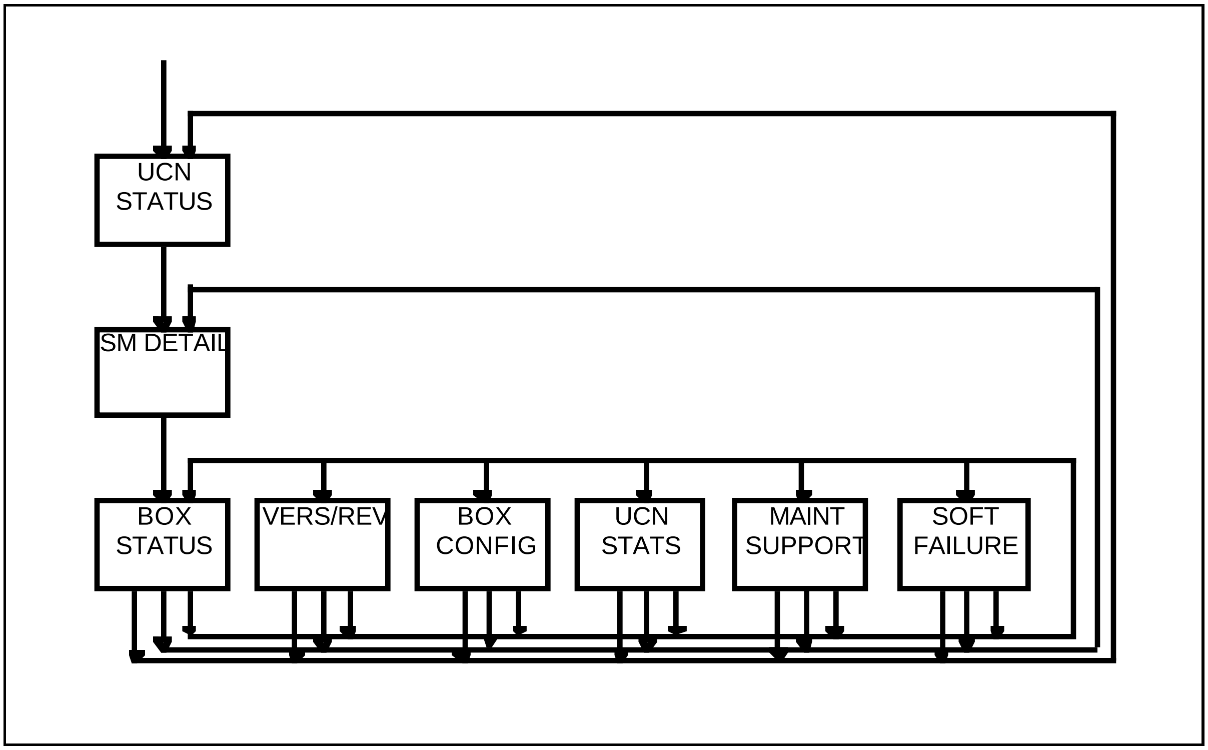


Figure 1-5 – Display Access Scenario

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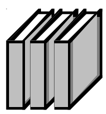
# Section 2 – FSC Operation Overview

## 2.1 Section Overview

**About this section**

This section provides an overview of the operation of the FSC component of the FSC Safety Manager system. The information presented here provides an overview of the FSC's general operating characteristics. It does not discuss this device's operation in detail. Topics included in this section are:


| Subsection | Topic | See Page |
|---|---|---|
| 2.1 | Section Overview | 13 |
| 2.2 | Operational States | 14 |
| 2.3 | FSC Control Program | 16 |
| 2.4 | Communication between FSC-SMM and the FSC Control Processor | 17 |
| 2.5 | Functional Logic Diagrams | 20 |

For additional and detailed information regarding operating characteristics of the FSC component of the FSC Safety Manager system, refer to the *FSC Software Manual*.

## 2.2 Operational States

**Introduction**

The FSC can be in one of five operational states. The FSC state can be retrieved via the Box Status display, or via the box parameter PLCMODE(1). Figure 2-1 shows the possible transitions from one state to another.

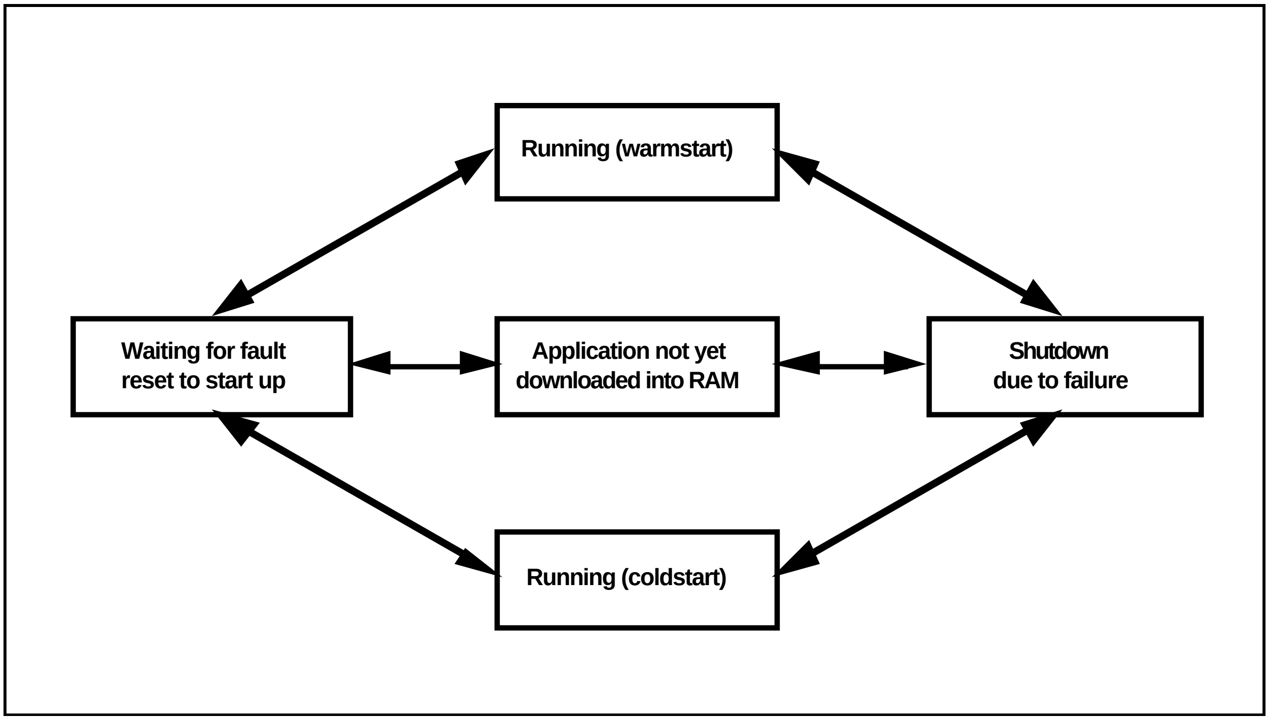



Figure 2-1 – FSC State Transitions

**Description of states**

As illustrated in Figure 1-2, the FSC Safety Manager (FSC-SM) consists of two key components mounted in one or more standard FSC cabinets:

- FSC,
  a fail safe control system from Honeywell Safety Management Systems, and
- FSC Safety Manager Module (FSC-SMM),
  a Honeywell Safety Management Systems module providing peer-to-peer communications with other process-connected devices residing on the Universal Control Network of the TotalPlant Solution (TPS) system.

*Continued on next page*

**Description of states,** continued

The following states can occur:

- *Application not yet downloaded into RAM.* The control program in the FSC can be loaded either into RAM or into EPROM. If the program is loaded into EPROM, this state does not occur. If the program is loaded into RAM, and the program is not yet loaded, the FSC waits for download of its program from the FSC-DS.
- *Waiting for fault reset to start up.* The program has been loaded, and the configuration and program are correct.
- *Running (warmstart).* The program is running. If the FSC is switched off, and then on again, the program restarts with the last values.
- *Running (coldstart).* The program is running. If the FSC is switched off, and then on again, the program restarts with the initial power-on values as defined by the user.
- *Shutdown due to failure.* This state is entered if a failure has been detected which demands shutdown of the FSC.

# 2.3 FSC Control Program

**Introduction**

The application control program runs in the FSC system and is used for data acquisition, local process/Boolean control algorithms, data transmission to the field, data exchange with other FSCs and data exchange with the FSC-DS. The FSC control program is developed using the FSC-DS.

**ATTENTION** The FSC's control program should not be confused with control and data acquisition operations performed at the TPS level. The FSC Safety Manager Module (FSC-SMM) is the interface between the FSC and the TPS system so that data and control operations at the FSC level can be closely integrated with data acquisition and control operations at the TPS level.

**FSC Development System**

With regard to the FSC control program, the FSC Development System (FSC-DS) is used to:

- define the hardware configuration of the FSC,
- define the FSC control program variable tagnumbers,
- develop the functional logic diagrams (FLDs).

**Hardware configuration**

The FSC-DS "Configure FSC System" program is used to define the physical location and identification of the hardware in the FSC, including the FSC-SMM. This information becomes part of the FSC control program and is downloaded to the FSC. Upon downloading, the location and identification of the system hardware is checked against the FSC control program's configuration definition. Any mismatches are immediately reported.

**Tagnumbers**

It is not necessary to assign numerical addresses to the FSC control program variables. Instead, the FSC-DS "Configure FSC system" or "Design Functional Logic Diagrams" program is used to define all program variables using alphanumeric variable names (tagnumbers). A variable is uniquely defined by its type and tagnumber.

For additional and detailed information regarding attributes of variable types refer to the *FSC Software Manual*.

**ATTENTION** The variables of an FSC control program should not be confused with the Points configured for the FSC-SMM.

## 2.4 Communication between FSC-SMM and the FSC Control Processor

**FSC-SMM – FSC Control Processor memory map**

In the FSC-SMM, there are entities called Points. In the FSC Control Processor, there are entities called Variables. If communication between Points and Variables is required, they are linked to each other. This is accomplished by giving them both an address.

In the FSC-SMM, each Point has an address called PLCADDR. In the FSC, each variable can have an address known as a DCS address. If the PLCADDR of a Point is equal to the DCS address of a Variable, the Point and the Variable are linked, and exchange their value.

FSC-SMM points that require more than one signal to be transferred, have more than one PLC address, with different names. The DCS address of an FSC variable can have any value in the interval [1..65535].

FSC-SMM Flag points and FSC-SMM Numeric points have a PLC address defined by their slot number (SLOTNUM) and by the start address (FLLSBA and NNLSBA, respectively). The PLC address of a Flag is FLLSBA + SLOTNUM - 1, the PLC address of a Numeric is NNLSBA + SLOTNUM - 1. The maximum SLOTNUM that can be assigned to a Flag is NFLAG, the maximum SLOTNUM that can be assigned to a Numeric is NNUMERIC.

**ATTENTION** The control program within the FSC has primary control over the processing of data which is read into, and written from, its memory. As a consequence, configuration of the FSC-SMM data points must be coordinated with the FSC control program if unexpected results are to be avoided.

**Communication mechanism**

Both the FSC-SMM and the FSC Control Processor have memory tables where the database of process information is stored and accessed. Figure 2-2 illustrates the communication between these tables.

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# 2.4 Communication between FSC-SMM and the FSC Control Processor, Continued

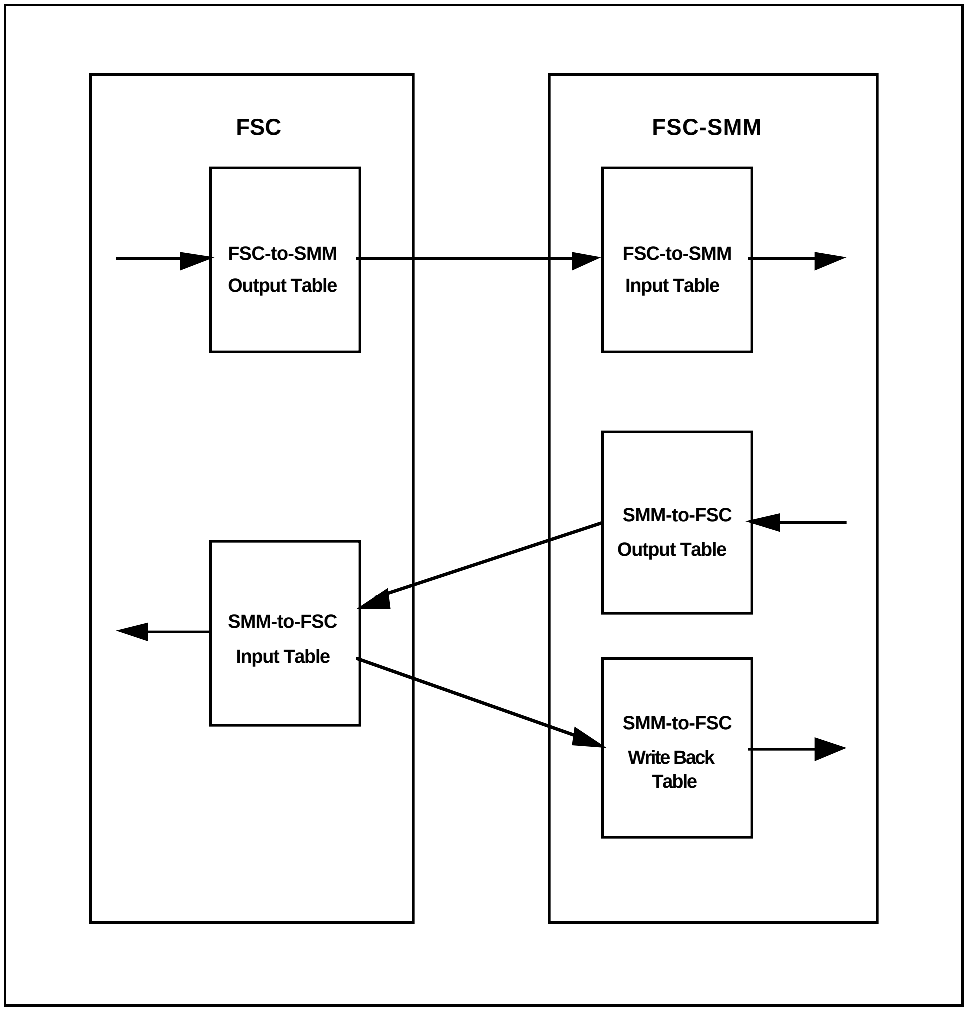



Figure 2-2 – Communication between FSC-SMM and the FSC Control Processor

**Communication mechanism,** continued

Data that is to be transferred from the FSC to the FSC-SMM is copied by the FSC each FSC cycle from the FSC-to-SMM Output Table to the FSC-to-SMM Input Table. This data can be: field inputs, field outputs, variables in another FSC, or variables from another device which communicates with the FSC.

In addition, during the same FSC cycle, the FSC writes the data back to the SMM-to-FSC Write Back Table. In this way, the FSC-SMM can verify that the data has correctly arrived in the FSC.

*Continued on next page*

**Communication mechanism,** continued

**ATTENTION** Please note the following:

- FSC-SMM outputs cannot be directly mapped to the FSC field outputs. FSC-SMM outputs are mapped to the SMM-to-FSC Output Table. The control program, running in the FSC, is responsible for reading these FSC-SMM output states from memory, processing them, and actuating any field output. This limitation is essential to maintaining the integrity of the safety shutdown system.
- The effect of Write Back is indicated for AO, DC, and DO points. The value returned from the FSC is stored in a parameter. For the AO point, it is OPFINAL (value from FSC controller, after OPFINHI/OPFINLO range calculation) and OP (OPFINAL after OPTDIR calculation). For the DC point, OPFINAL is the state representation of the field outputs. The actual values of the field outputs is not available in any parameters. For the DO point, it is OP (self-defining enumeration) and SO (Boolean).

**Channel status**

Each FSC variable has a channel status. The channel status indicates whether the FSC part of the loop is Healthy or Faulty. If the channel status is Faulty, the value of the variable cannot be trusted. In that case the BADPVFL parameter of the point corresponding to the variable is set.

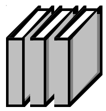
**Loop status**

Each FSC variable has a loop status. The loop status indicates whether the field part of the loop is Healthy or Faulty. The loop status is always Healthy when the input or output channel to which the variable is allocated does not have loop monitoring. In case the channel does have loop monitoring, the loop status of the allocated variable is either Healthy or Faulty. If the loop status is Faulty, the value of the variable cannot be trusted. In that case the BADLPFL parameter of the point corresponding to the variable is set.

## 2.5 Functional Logic Diagrams

**Introduction**

The FSC control program is made up of functional logic diagrams (FLDs), which are created using the FSC Development System (FSC-DS) software.



For additional and detailed information regarding functional logic diagrams of the FSC control program, refer to the *FSC Software Manual*.

# Section 3 – FSC-SMM Data Point Overview

## 3.1 Section Overview

**About this section**

This section contains an overview of the data point types available in the FSC Safety Manager Module (FSC-SMM) component of the FSC Safety Manager (FSC-SM) system. Topics included in this section are:


| Subsection | Topic | See Page |
|---|---|---|
| 3.1 | Section Overview | 21 |
| 3.2 | Summary of FSC-SM Data Point Types | 22 |
| 3.3 | Data Point Mix | 24 |
| 3.4 | Execution States | 28 |
| 3.5 | Point Loading and Checkpointing | 29 |
| 3.6 | Point Form | 30 |
| 3.7 | Alarming | 31 |
| 3.8 | Red Tagging | 32 |
| 3.9 | Forcing | 33 |

## 3.2 Summary of FSC-SM Data Point Types

**Introduction**

Table 3-1 lists and describes the various TPS data point types available in the FSC Safety Manager Module (FSC-SMM).

Table 3-1 – FSC Safety Manager Module Data Point Types

| Point Type | Description |
|---|---|
| Digital Input (DI) | Binary input from FSC. |
| Digital Output (DO) | Binary output to FSC.<br>- a memory location for use by the FSC control program. |
| Digital Composite (DC) | Multiple digital I/O point.<br>- can have 0–2 inputs and 0–3 outputs, and<br>- is typically used for motor or valve control. |
| Analog Input (AI) | Real value from the FSC — may originate from the FSC as:<br>- raw process input from an analog input module, or<br>- a value supplied by the FSC control program. |
| Analog Output (AO) | Real value output to FSC.<br>- a memory location for use by the FSC control program. |
| Logic | Transfers data between the UCN and FSC connections.<br>- supports peer-to-peer communications, and<br>- is known as a Linkage Point in the Logic Manager (LM). |
| Flag | A two-state point for storing a Boolean value. |
| Numeric | A point for storing a real value. |
| Timer | Provides timekeeping functions through an interface with an FSC Timer variable. |

**Data point processing**

Data points are executed in the following order:

1. analog input (AI) points,
2. digital input (DI) points,
3. digital composite (DC) points,
4. logic points,
5. timer points,
6. flag points (SLOTNUM ≤ 512 only),
7. analog output (AO) points, and
8. digital output (DO) points.

Within one type, the points are executed in ascending SLOTNUM order.

*Continued on next page*

**Data point processing,** continued

**ATTENTION** Please note the following characteristics regarding data point processing:

- The order of point processing cannot be configured or altered.
- Do not confuse the FSC-SMM scan with the FSC control program scan, as these two processes are completely independent and run asynchronously to each other.

All UCN and FSC-SMM input information is prefetched prior to their respective processing scan cycles. Output information is poststored after the processing scan cycles. In case of an overrun, all point processing is completed, all end of cycle operations are completed (that includes poststores), and during the next scan, only parameter access is performed until the next cycle comes around (i.e. point process is skipped for one cycle). An excessive number of such scan cycle "slips" will result in an error message.

**Point capacity**

As part of configuring the FSC-SMM, the required number of points of each type is selected. Each point type has an absolute maximum number per FSC-SMM as shown in Table 3-2. The FSC-SMM point mix must be configured while the FSC-SMM is in the Idle state, and must comply with the performance calculation algorithms as described in the following subsections.

Table 3-2 – Maximum Number of Data Points per Type

| Point Type | Maximum Number of Points |
|---|---|
| Digital Input (DI) | 2000 |
| Digital Output (DO) | 2000 |
| Digital Composite (DC) | 1000 |
| Analog Input (AI) | 1000 |
| Analog Output (AO) | 1000 |
| Logic Slot | 30 |
| Flag | 2000 |
| Numeric | 1000 |
| Timer | 1500 |

## 3.3 Data Point Mix

**Determining point mix**

Typically, a mix of different types of points will be configured. To ensure that scanning of all configured points is achieved within the scheduled scan cycle, a per-point weighting system has been established.
Each FSC-SMM data point type has been assigned a weight, or point processing unit value. These weights are listed in Table 3-3.

Table 3-3 – Processing Load per Data Point

| Point Type | Scan Type | Processing Units per point for 0.5 s scan period | Processing Units per point for 1 s scan period |
|---|---|---|---|
| Digital Input (DI) | digital | 3.3 | 1.65 |
| Digital Output (DO) | digital | 1.8 | 0.9 |
| Digital Composite (DC) | digital | 13.5 | 6.75 |
| Analog Input (AI) | analog | 17.6 | 8.8 |
| Analog Output (AO) | analog | 4.4 | 2.2 |
| Logic Slot | digital | 300 | 150 |
| Flag (SLOTNUM ≤ 512) | digital | 0 | 0 |
| Flag (SLOTNUM > 512) | none | 0 | 0 |
| Numeric | none | 0 | 0 |
| Timer | digital | 2.6 | 1.3 |

The processing load of a point depends on its scan period. The scan period can be configured independently for digital and analog points. The scan type for each point type is indicated in Table 3-3. Note that the Logic Slot has scan type Digital, even when all inputs of the Logic Slot are analog values.

The scan period can be configured by means of the SCANRATE parameter as shown in Table 3-4.

*Continued on next page*

Table 3-4 – Scan rates

| SCANRATE | Analog Scan Frequency | Digital Scan Frequency |
|---|---|---|
| AR1DT1 | 1 per second | 1 per second |
| AR1DT2 | 1 per second | 2 per second |
| AR2DT2 | 2 per second | 2 per second |

**Validity of point mix**

To determine the validity of the intended point mix, follow the procedure described in Table 3-5.

Flag and numeric points use a fixed amount of processing overhead, and therefore are not required to be calculated into the point mix determination.

Table 3-5 – Point Mix Validity Test Procedure

| Step | Action | Result |
|---|---|---|
| 1 | Multiply the number of each type of data point in a system by its point processing unit value. | Produces the weighted value of each point type. |
| 2 | Add the products produced in Step 1. | Produces the total weighted value of all point types. |
| 3 | Test the validity of the point mix. | If the point processing total is less than or equal to 6000, then the total number of data points is valid. |

**Point mix worksheet**

Use Table 3-6 to determine the validity of the intended point mix. Follow the procedure described in Table 3-5 to complete this worksheet.

*Continued on next page*

**Point mix worksheet, continued**

Table 3-6 – Point Mix Worksheet

| Point Type | Maximum Allowable Point Count | Processing Unit Value Per Point | X | Number or Points Desired | = | Total Point Processing Units |
|---|---|---|---|---|---|---|
| *Digital Input*<br>0.5 sec. digital scan | 2000 | 3.3 | X | _______ | = | __________ |
| 1.0 sec. digital scan | | 1.65 | X | _______ | = | __________ |
| *Digital Output*<br>0.5 sec. digital scan | 2000 | 1.8 | X | _______ | = | __________ |
| 1.0 sec. digital scan | | 0.9 | X | _______ | = | __________ |
| *Digital Composite*<br>0.5 sec. digital scan | 1000 | 13.5 | X | _______ | = | __________ |
| 1.0 sec. digital scan | | 6.75 | X | _______ | = | __________ |
| *Analog Input*<br>0.5 sec. analog scan | 1000 | 17.6 | X | _______ | = | __________ |
| 1.0 sec. analog scan | | 8.8 | X | _______ | = | __________ |
| *Analog Output*<br>0.5-sec. analog scan | 1000 | 4.4 | X | _______ | = | __________ |
| 1.0 sec. analog scan | | 2.2 | X | _______ | = | __________ |
| *Logic*<br>0.5 sec. digital scan | 30 | 300 | X | _______ | = | __________ |
| 1.0 sec. digital scan | | 150 | X | _______ | = | __________ |
| *Timer*<br>0.5 sec. digital scan | 1500 | 2.6 | X | _______ | = | __________ |
| 1.0 sec. digital scan | | 1.3 | X | _______ | = | __________ |
| | | | | **POINT PROCESSING TOTAL** | | __________ |

*This page may be reproduced for use as a configuration worksheet.*

*Continued on next page*

**Data point mix considerations**

The following considerations apply when determining the data point mix:

- Point processing total must be 6000 or less to be valid.
- The maximum total number of connections between FSC-SMM points and FSC variables is 2000, excluding connections made via flag and numeric points.
- The FSC application cycle time is less than 0.5 second.
- The maximum number of Logic Slots is also limited by the requirement of maximum 50 connections. If all connections of the Logic Slots are used, the maximum number of Logic Slots is four.
- The maximum number of points per Network Interface Module (NIM) is 8000.
- A timer has four FSC addresses: PLCADDR (dual address), PVSLTSRC and SPSLTSRC. If each timer has individual addresses, the maximum number of timers is 500.
- The maximum number of timers with TIMEBASE = Minutes is 446.
- The maximum frequency with which other TPS modules can read parameters from the FSC-SMM is 800 per second..
- The maximum frequency with which other TPS modules can write parameters to the FSC-SMM is 100 per second.
- The maximum number of parameter changes that can be communicated from the FSC-SMM to the FSC is 50 per FSC cycle. As a result, there can be a maximum of 50 AO points which receive their value from a continuous controller.
- The maximum rate of continuous events before event overflow occurs is 16 per second.
- The maximum rate of burst events before event overflow occurs is 512 per 10 seconds.

The considerations mentioned above can occur simultaneously. Thus 800 reads per second, 100 writes per second and 50 parameter changes per FSC cycle may take place simultaneously.

## 3.4 Execution States

**Introduction**

A loaded data point is in one of two execution states: Active or Inactive.

**Active state**

When in the Active state, the point is being processed by the FSC-SMM.

**Inactive state**

When in the Inactive state, the point is not being processed. Please note the following:

- A new or changed point will initially be placed in the Inactive state when being loaded into the FSC-SMM database.
- A point must be placed in this state before changes to its configuration can be made.
- A point may be set to this state when the FSC application is changed during on-line modification (only applicable for redundant FSC configurations). The point is set to Inactive when the PLC address of the point no longer exists in the new FSC application or the data type is no longer compatible.

**Displaying execution states**

The Universal Station's Group and Detail displays indicate the state of a point. From the Detail display, the user can also change the point's state by selecting the PTEXECST parameter (Point Execution Status).

# 3.5 Point Loading and Checkpointing

**Point loading and checkpointing**

The FSC-SMM database, like those for most other TPS devices, consists of two basic sets of data:

- program instructions (fixed for each release of software), and
- variable configuration data
  - box-related data (applies to entire device), and
  - point data.

Whenever a Safety Manager (or other device) is activated – for the first time or after being powered down for any reason – its FSC-SMM program instructions must be loaded from the History Module or removable media. A simple operating procedure is provided for this purpose. Once loaded, the configuration remains intact unless a failure or power-down occurs.

Device or point data is unique for each device or point. Some of these data types can change or be changed by the user at any time. For this reason, a provision is made to automatically save, or checkpoint, the data on a periodic basis. A manual save can also be requested by the user at any time. If the data is then lost from device memory due to a failure, it can be restored from the checkpointed database.

Parameters associated with the FSC-SMM data points are maintained in tables within the FSC-SMM or within the NIM. The *FSC Safety Manager Parameter Reference Dictionary* indicates for each parameter in which box its value is kept.

For additional details regarding point loading and checkpointing, refer to the *FSC Safety Manager Implementation Guidelines.*

## 3.6 Point Form

**Introduction**

Within the TPS system, certain process-related information is grouped together and given a name for purposes of identification. For example, all data pertinent to an input from the process (value, limits, engineering units, etc.) is stored in a database file and assigned a unique point tagname. This enables the system to access all or part of that point's data whenever required.

**Point form purposes**

To implement many control strategies using Logic Managers (LMs), Process Managers (PMs) or Safety Managers (SMs), the data from several data points must be linked together during the point configuration process. For example, a regulatory control loop might consist of an analog input from the Safety Manager, a sophisticated calculation accomplished by an Application Module (AM), and an output through the Safety Manager. The operator, however, needs only one interface to this control loop, not three. To provide for this situation, the Safety Manager, like the Logic and Process Managers, supplies a configurable parameter called PNTFORM (point form), which defines which points are to be used as the primary operator interface for point data. The PNTFORM parameter provides the user with two choices for point form: Full and Component.

**Full point form**

Points used for the primary operator interface are configured as having full point form, which includes alarm-related parameters.

**Component point form**

Points that do not require alarm-related parameters are configured as having component point form. Alarm-related parameters are nonexistent for component points. The component point form should be used for points that:

- provide inputs to the full point,
- handle the outputs from the full point.

## 3.7 Alarming

**Introduction**

As with other UCN-based devices, common alarming functions can be configured for FSC-SMM points. Alarm detection and reporting for a point can be configured only if the full point form is specified (PNTFORM = Full).

**Priorities**

For each point, a separate alarm priority can be specified for each alarm (for example, PV low alarm can be low priority but PV high alarm can be emergency priority). Alarm priority configuration information is maintained by the NIM. The following alarm priorities are supported for FSC-SMM points:

ï Noaction,
ï Journal,
ï Low,
ï High,
ï Emergency,
ï Printer,
ï Jnlprint.

**Enable status**

Alarm enable status is applicable to full point forms, and allows enabling, disabling and inhibition of alarms. This function is accomplished through the ALENBST parameter. The alarm enable status function is resident in the NIM.

**Contact cutout**

The main purpose of the contact cutout function is to prevent a proliferation of alarms from being reported to the operator. This function can be used to cut out alarms on a point when they are generated because of alarm conditions that have already been detected at other points. Contact cutout is provided for all the point types in the SM and is implemented through the CONTCUT parameter. When the contact cutout state is On, the alarms at the point are cut out; any new alarm detected is not reported on the Alarm Summary display of the Universal Station. The alarms continue to be reported to the journals and to the AM or CM for event-initiated processing (EIP).

## 3.8 Red Tagging

**Introduction**

A point can be red tagged to indicate that it requires maintenance.

**Red tagging**

This is accomplished by setting the REDTAG parameter to On. Typically, the operator sets the output of the point to a desired safe value before the red tag is put on. Once red tagged,

- the point's mode, mode attribute, external mode switching state, and output cannot be changed, and
- the point cannot be reconfigured or deleted if the red tag is On.

Red tagging is supported for the digital output (DO), analog output (AO), and digital composite (DC) point types. A point must be configured for the full point form in order to be red tagged.

**Conditions for red tagging**

Before a point can be red tagged, the point's

- MODE must be changed to Man,
- MODATTR must be changed to Operator.

**ATTENTION** To red tag a digital composite point, the output of the point may not be configured for the momentary state.

## 3.9 Forcing

**Forcing**

Using the FSC-DS it is possible to force variables which have been configured with the FORCE ALLOWED attribute to Yes. Forcing is only possible after the FORCE ENABLE key-switch is in the Enable position. Now the value of the variable can be forced to a user-specified value. The FORCE STATUS attribute of a forced variable is On, for a unforced variable this attribute has the value Off.

If the FSC variable has the force option configured as On, the corresponding FSC-SMM point has the FORCE parameter On. If the FSC variable is configured with the force option Off, the corresponding FSC-SMM point has the FORCE parameter Off. If the value is actually forced, the FORCEFL is On. If the value is actually unforced, the FORCEFL is Off.

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# Section 4 – Data Point Detailed Description

## 4.1 Section Overview

**About this section**

This section describes in detail each of the operator-displayable data point types, including their major parameters, and how the points relate to the FSC variable database. Topics included in this section are:


| Subsection | Topic | See Page |
|---|---|---|
| 4.1 | Section Overview | 35 |
| 4.2 | Digital Input Point | 36 |
| 4.3 | Digital Output Point | 41 |
| 4.4 | Digital Composite Point | 42 |
| 4.5 | Analog Input Point | 59 |
| 4.6 | Analog Output Point | 64 |
| 4.7 | Logic Point | 66 |
| 4.8 | Flag Point | 69 |
| 4.9 | Numeric Point | 71 |
| 4.10 | Timer Point | 72 |

# 4.2 Digital Input Point

**Background**

A digital input point converts raw FSC Boolean I/O status into UCN-compatible Boolean formats and performs off-normal alarming. It represents any single FSC Boolean I/O status variable.
The Boolean I/O status variables can be:

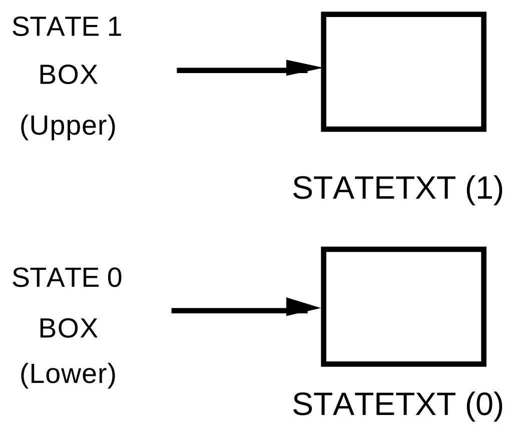
ï field inputs (signal from field, converted by the FSC, but not changed by the FSC program),
ï field outputs (copy of signal to the field),
ï inputs from the FSC-SMM or other devices (signal from another FSC-SMM, not changed by the FSC program),
ï outputs to the FSC-SMM or other devices (copy of signal to another FSC-SMM),
ï inputs from other FSCs (signal from other FSC, not changed by the FSC program),
ï outputs to other FSCs (copy of signal to another FSC),
ï local FSC variables.

*Continued on next page*

## 4.2 Digital Input Point, Continued

**Status representation**

The current state of the PV input is represented on the Universal Station Group and Detail displays as two boxes, as shown in Figure 4-1. The boxes are lit or extinguished depending on the current state of PVRAW and the input direction as configured through the INPTDIR parameter, as shown in Figure 4-1.




| PVRAW | INPTDIR = Direct | INPTDIR = Reverse |
|---|---|---|
| On | PV = State 1<br>State 1 Box is lit<br>State 0 Box is extinguished | PV = State 0<br>State 0 Box is lit<br>State 1 Box is extinguished |
| Off | PV = State 0<br>State 0 Box is lit<br>State 1 Box is extinguished | PV = State 1<br>State 1 Box is lit<br>State 0 Box is extinguished |

Figure 4-1 – DI Point US Status Representation

*Continued on next page*

**Point processing**

Processing performed on a digital input point is illustrated in Figure 4-2. The PVAUTO value represents the state of the input signal after the direct/reverse conversion is performed. The digital input point can be configured for PV source selection, detection of off-normal alarms, and for reporting any PV state changes to the system.

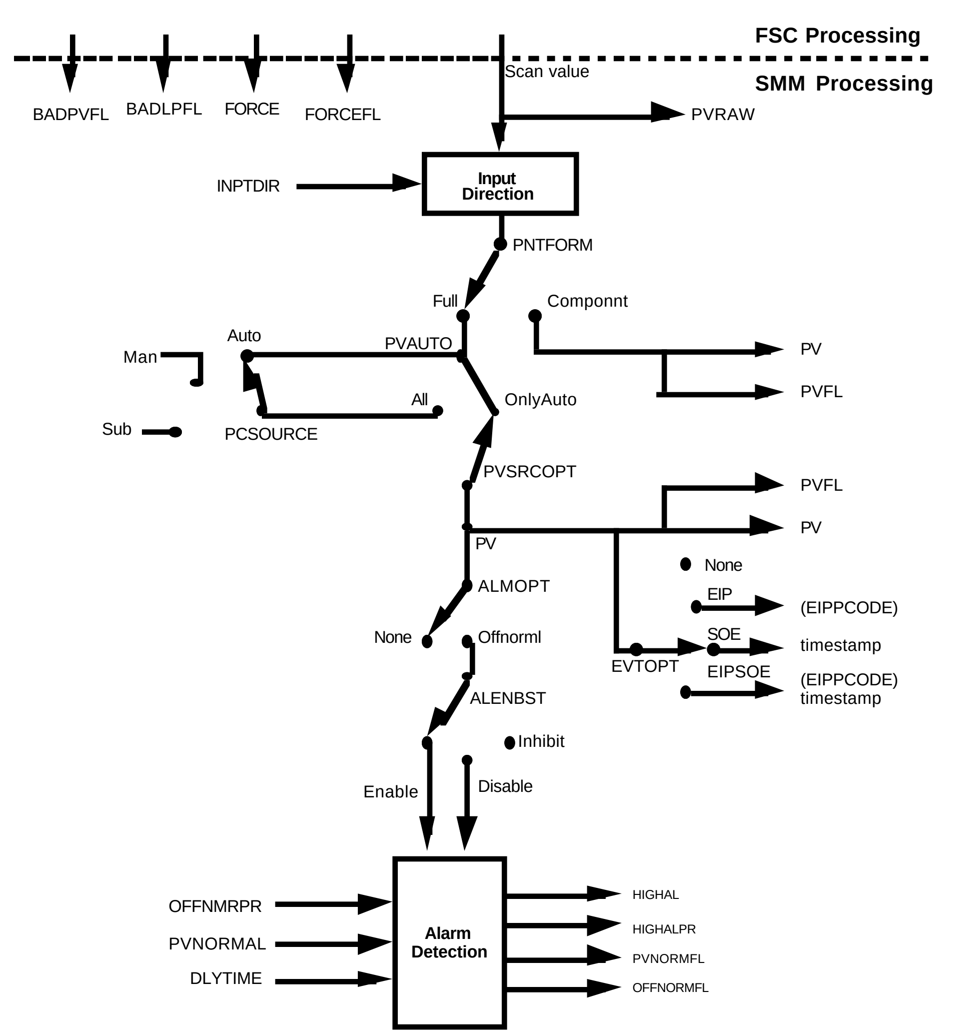



Figure 4-2 – DI Point Processing, Functional Diagram

*Continued on next page*

**PV source selection**

The PV source parameter (PVSOURCE) determines the source of the PV for a digital input point, depending on the PV source option (PVSRCOPT). If the PVSOURCE option is All, the source can be the PV input from the FSC (Auto), the PV state entered by the operator (Man), or it can be supplied by a user program (Sub). If PVSOURCE is Auto, PV tracks PVRAW. If the PV source option (PVSRCOPT) is OnlyAuto, PV tracks PVRAW.

**Off-normal alarming**

*Enabling, Disabling, and Inhibiting Off-Normal Alarms*
The ALENBST parameter can be used to enable (permit), disable or inhibit the off-normal alarm. Disabling the alarm still allows the alarm to be listed on the Alarm Summary display. Inhibiting the alarm prevents the current PV state from being compared to the configured normal state.

*Off-Normal Alarming and PV Change Reporting*
Off-normal alarming can be selected for the digital input point through the ALMOPT parameter. An off-normal alarm is generated when the input PV state is different from the configured normal (desired) state for the point, as specified by the PVNORMAL parameter. The priority of the off-normal alarm is determined through the OFFNRMPR parameter.
In addition, any PV state change can be historized as determined by HM volume configuration.

*Alarm Delay*
When off-normal alarming has been configured and an off-normal alarm is detected, the event is reported to the system. Further off-normal alarms for the same data point are not reported until the time delay (0 to 60 seconds as specified by the DLYTIME parameter) expires. When the time delay expires, the time delay function is disabled and the off-normal alarm for the data point can again be reported.

*Continued on next page*

**Event reporting**

The EVTOPT parameter for the digital input allows the user to:

- optionally specify the tagname (EIPPCODE) of a data point in the system that is to be notified when the PV changes state, and/or
- specify that a time stamp be added to the reported PV state change.

For a status input point, EVTOPT has four possible entries: None, EIP, SOE, and EIPSOE. EIP specifies that the user supply the tagname of the data point in the system that is to receive the PV state change, while SOE specifies that a timestamp is added to the PV state change to establish a sequence of events. EIPSOE is the combination of EIP and SOE.

**Suppression of reporting of rapid events**

If the EVTOPT parameter is configured as SOE or EIPSOE, reporting of rapid PV changes can be suppressed.

When the PV changes, this is immediately reported. Subsequently nothing is reported during the time specified in PVCHGDLY. After this time has elapsed, the PV is evaluated. When the PV is the same as immediately after the first event, nothing is reported. When the PV is different from the value immediately after the first event, the event immediately following the first one is reported; this report has the timestamp corresponding to the event, not the timestamp corresponding to the report. In both cases, all other possible events are ignored.

# 4.3 Digital Output Point

**Background**

The digital output (DO) point value is copied by the FSC from the SMM-to-FSC output table to the SMM-to-FSC input table.

**Connections**

Depending on the output connection, the DO can be controlled from:
ï a DC point output,
ï a Logic slot output,
ï a CL program, or
ï the operator.
Figure 4-3 shows these connections.

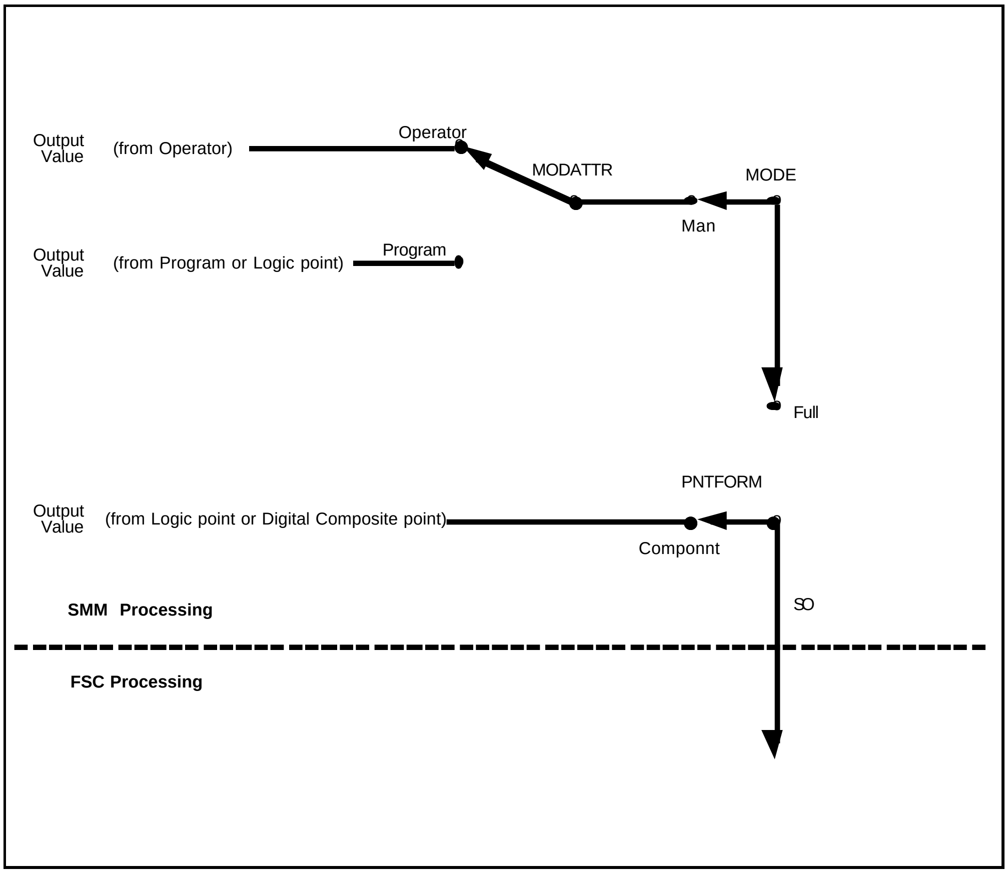



Figure 4-3 – DO Point Processing, Functional Diagram

**Output latch functions**

The output latch function is obtained by linking a DC point or a Logic slot output connection to the SO parameter of the DO point.

*Continued on next page*

## 4.4 Digital Composite Point

**Background**

The digital composite (DC) point is a multi-input/multi-output point which provides an interface to a control algorithm in the FSC. The FSC, in turn, actuates a field device, such as a motor or a valve. The FSC Safety Manager interface allows the operator at a Universal Station to monitor and make inputs to the control scheme through Group, Detail, and Graphic displays.

**CAUTION** The appropriate algorithm must be programmed into the FSC for the DC point to function. The FSC-SMM uses the FSC variables required to make the DC point's multiple input/output display available to the operator.

Functions performed by the DC point include:

ï Commanded states, provided by the operator or a program, pass to the point's outputs for use by the FSC. A Logic slot cannot set the commanded state of a DC point.
ï Interlock overrides reflect an override operation built into the FSC control program.
ï Because the FSC can alter the state of the outputs to the field device so that it differs from the commanded state, the output of the FSC is read back into the Digital Composite (DC) point so that the operator or the CL program can be aware that the actual output state is not the same as the commanded state.
ï FSC variables, local digital inputs, or flags are monitored through feedback inputs. The resulting inputs are checked against the commanded state for Off Normal, Command Disagree, or Uncommanded Change, and alarmed as necessary.
ï The status of a local/manual (LOCALMAN) input from the FSC is monitored. No alarming or control is provided. It will prevent writes to the DC point (OP) if the input is on.

**Status representation**

Figure 4-4 illustrates how DC points are depicted in a Universal Station's Group display. In the display, each state is represented by a separate box. The State 0 box is the middle box (STOP), the State 1 box is the upper box (FORWARD), and State 2 box is the lower box (REVERSE). The State 2 box only appears if the point has been configured for three states (NOSTATES = 3).

*Continued on next page*

**Status representation,** continued

**ATTENTION** State changes are read back from the FSC, and their indications on the Group or Detail displays may take a few moments after the command to change is issued. This delay can be attributed to:

ï any normal lag time required for the actuated field device to change state,
ï the scan time for the FSC's logic control program to read the change from the field, and
ï the communications time required for transferring data from the FSC, through the FSC-SMM, UCN, NIM, LCN and the US.

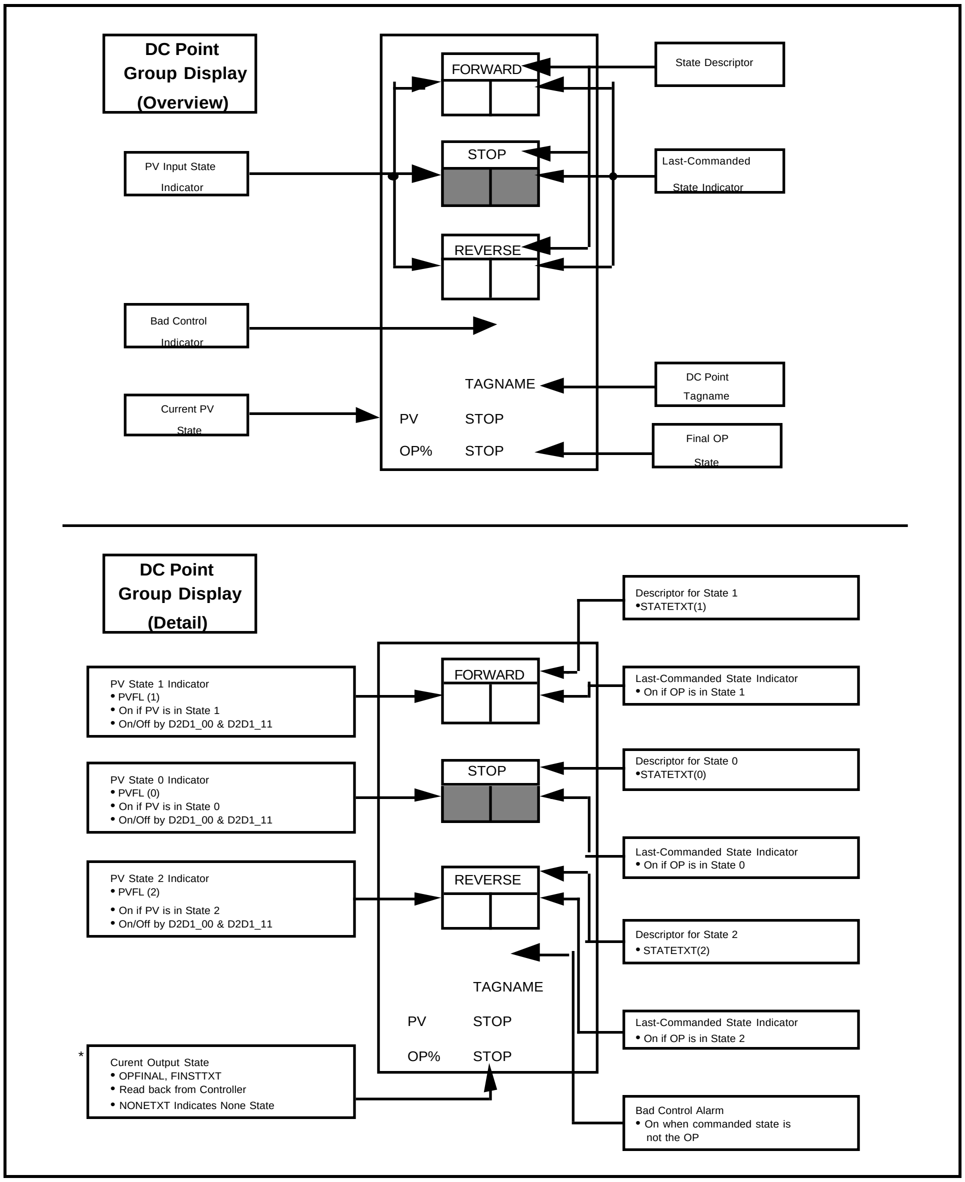



Figure 4-4 – DC Point Group Display

*Continued on next page*

**Point states**

*Normal States*
DC points can have two or three normal states which allow the data point to interface with devices that have two or three operational states. The normal states of a DC point are defined in Table 4-1.

Table 4-1 – Normal Digital Composite Point State Definitions

| State | Definition |
|---|---|
| 1 | First active state |
| 0 | Inactive (middle) state |
| 2 | Second active state |

**ATTENTION** The second active state is only applicable if the entry for the NOSTATES parameter is 3, signifying that the data point has three states.

*Momentary States*
DC points can be configured as being momentary by using the MOMSTATE parameter. In the momentary state the point acts like a doorbell (state remains active as long as a button is pressed). The momentary states of a DC point are defined in Table 4-2.

Table 4-2 – Momentary Digital Composite Point State Definitions

| MOMSTATE | Definition |
|---|---|
| None | No momentary states. |
| Mom_1 | State 1 is momentary.<br>- When released from this state, it jumps back to State 0. |
| Mom_0 | State 0 is momentary.<br>- When released from this state, it jumps back to State 1.<br>- Mom_0 can be selected only if the parameter NOSTATES = 2. |
| Mom_2 | State 2 is momentary.<br>- When released from this state, it jumps back to State 0.<br>- Mom_2 can be selected only if the parameter NOSTATES = 3. |
| Mom_1_2 | States 1 and 2 are momentary.<br>- When released from any one of these states, it jumps back to State 0.<br>- Mom_1_2 can be selected only if the parameter NOSTATES = 3. |

*Continued on next page*

**Point states,** continued

*Moving/Bad States*
The digital composite data point has two states which represent the conditions when the current state of the device is "bad" (indeterminate) or the current state is "moving" (from one state to another). The moving/bad state descriptor is located below the State 2 box on the display.

- The Bad State (BADPVTXT parameter) can result when the PV input signals from the process are in an inconsistent state.
  - For example, limit switches on a valve indicating open and closed are both simultaneously on.
- The Moving State (MOVPVTXT) is encountered when the device is in transition from one state to another.
  - For example, a slow moving valve is changing from the open state to the closed state.

The BADPVTXT and MOVPVTXT parameter descriptors are configured once for each FSC-SMM box data point and then are used for all digital composite points in the same FSC-SMM.

*None State*
The user can create an optional None state for a DC point by configuring On in parameter NONECONF. The None state operates as follows:

NONECONF cannot be configured when NODOPTS = 1, because of the following reason. When there is only one output, it can only be one of two states (one each for the two or three states of the DC point). No other possibilities exist that can be a None (or none of the above) state, as opposed to two outputs (four possibilities) or three outputs (eight possibilities).

If the state read back from the FSC does not match the commanded state in OP or the None state (if configured), then a bad control alarm is not generated.

Users can specify an output state (or a pattern of states if there is more than one output) which does not generate a bad control alarm, even though it differs from the commanded state.

*OPFINAL*
OPFINAL represents the current state of the actual outputs as described in Table 4-3. The output values are first written by the FSC and then compared to the STx_OPy parameters for a match.

*Continued on next page*

**Point states,** continued

Table 4-3 – Digital Composite Point OPFINAL operation

| If the field outputs match the ... | Then OPFINAL ... |
|---|---|
| STx_OPy for the current state in OPFINAL (assuming OPFINAL is not Bad) | does not change |
| ST0_OPy | is set to State 0 |
| ST1_OPy | is set to State 1 |
| ST2_OPy | is set to State 2 |
| NONE_OPy and NONECONF is On | is set to None state |
| otherwise | is set to Bad state |

The outputs are first compared to that of the current state, because more then one state may have the same output values, and OPFINAL should not change to a different state that happens to have the same output value configuration.

**Mode attributes**

DC points support only the manual (Man) mode with mode attributes (specified by parameter MODATTR) of Operator and Program. Table 4-4 defines how the commanded state is provided.

Table 4-4 – Digital Composite Point Mode Attribute Operation

| If MODATTR is | Then ... |
|---|---|
| **Operator** | only the Universal Station operator can provide the commanded output state. |
| **Program** | only user programs (continuous or discontinuous) can provide the commanded output state. |

The operator mode attribute flag (OPRATRFL) is also provided for potential use by the interlocking logic.
The MODEPERM parameter is provided to optionally prevent the operator (as opposed to the supervisor or engineer) at the Universal Station from changing the mode attribute.

**Interlocks**

Two kinds of interlocks, permissives and overrides, can be programmed in the FSC control program for controlling the DC points associated real-world FSC output(s). When they are so programmed, their positions (On, Off) are communicated to the FSC-SMM. Table 4-5 defines to what state the commanded state is forced.

*Continued on next page*

**Interlocks,** continued

***Permissive interlocks***

The permissive interlock parameters P0, P1 and P2 determine whether the operator and user programs are allowed to change the output of a DC point to a specific state. A permissive interlock can be provided for each of the three states. Permissive interlocks themselves never cause the OP to change.

For the commanded output to be changed to the desired state, the corresponding permissive interlock parameter must be set to On. The permissive interlock parameters P0, P1, and P2 are normally set to On, thereby allowing permission for all states. These parameters must be individually set to Off by the FSC control program to prevent access to the corresponding commanded output state.

***Override interlocks***

The override interlock parameters I0, I1 and I2 force the commanded output (OP) to a specific state regardless of the condition of the permissive interlocks. The operator and user programs cannot change the output state when any override interlock is On. An override interlock can be provided for each of the three output states. Note that the actual outputs to the process are supplied only by command from the FSC control program.

Table 4-5 – Digital Composite Point Override Interlock Operation

| If override interlock ... | Then ... |
|---|---|
| I0 is set to On by the FSC control program | the commanded output is forced to State 0 (regardless of the condition of parameters I1 and I2) |
| I0 is set to Off and I1 is set to On by the FSC control program | the commanded output is forced to State 1 (regardless of the condition of parameter I2) |
| I0 and I1 are set to Off and I2 is set to On by the FSC control program | the commanded output is forced to State 2 |
| I0, I1, and I2 are all set to Off by the FSC control program | the last value of the commanded output is maintained until changed by the operator, program or another override interlock |

*Continued on next page*

**Interlocks,** continued

Override interlock parameters I0, I1 and I2 are normally set to Off, disabling all the override interlocks. They must be set to On (by the FSC control program) to force OP only (not the field outputs) to go to any specific state.

**ATTENTION**

- On the FSC Safety Manager, the override interlocks only change OP, not the field outputs. (The relation between OP and field outputs is created in the FSC control program.)
- A Logic Slot cannot set the values of the interlock parameters Px and Ix, even when the parameters PISRC(x) and OISRC(x) have the value 0 (= not configured). If PISRC(x) has the value 0, the corresponding permissive interlock Px is On. If OISRC(x) has the value 0, the corresponding override interlock Ix is Off.

**Digital inputs**

When configuring digital inputs of the DC data point, the user can specify
ï the input connections,
ï PV states,
ï PV source and options,
ï alarming, and
ï change-of-state events.
The input portion of a DC point can be configured only if the user has entered 1 or 2 for the NODINPTS parameter (Number of Digital Inputs).

***Current input state (PV)***
The DC point allows the user the flexibility to assign the states of the PV for each possible combination of digital inputs, so that the states correspond to the different applications in which this point type can be used. The PV parameter represents the current state of the interfaced device and is derived from inputs D1 and D2 that can be feedback signals from the process. Separate parameters are used to configure a single-input point and a dual-input point.

*Continued on next page*

**Digital inputs,** continued

Table 4-6 describes the characteristics associated with single-point and dual-point input parameters.

Table 4-6 – DC Point Single and Dual Digital Input Parameter Characteristics

| Point Use | Comment | Assigned Conditions |
|---|---|---|
| Single Input | • One input parameter (D1)<br>• Two possible PV states:<br>  • Pvstate0<br>  • Pvstate1<br>• Assigned to either one of two input conditions | • D1 is On; parameter D1_1<br>• D1 is Off; parameter D1_0 |
| Dual Input | • Two input parameters (D2 and D1)<br>• Four possible combinations of input conditions<br>• User can assign any one of five PV states:<br>  • Pvstate1<br>  • Pvstate0<br>  • Pvstate2<br>  • Movpv<br>  • Badpv | • D2 is Off, D1 is Off; parameter D2D1_00<br>• D2 is Off, D1 is On; parameter D2D1_01<br>• D2 is On, D1 is Off; parameter D2D1_10<br>• D2 is On, D1 is On; parameter D2D1_11 |

Single Point: Only Pvstate0 or Pvstate1 need to be assigned to parameter D1_1; the system automatically assigns the remaining PV state to parameter D1_0.

Dual Point: Pvstate1, Pvstate0 and Pvstate2 cause the PV indicator to be lit in the respective state box on the Group display when the assigned D2D1 input conditions are satisfied. The Movpv and Badpv states cause the respective MOVPVTXT or BADPVTXT descriptor to appear below the state boxes on the Group display.

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**Digital inputs,** continued

Inputs to a digital composite point are usually the PVs from digital input points. When the Digital Input point is configured as component point, its input direction is direct, and the direct/reverse action can be configured by assigning the appropriate PV state parameters of the Digital Component point. If the Digital Input point is configured as full point, its input direction can be configured with the INPTDIR parameter, and the direct/reverse action can also be configured by assigning the appropriate PV state parameters of the Digital Component point.

***PV source***
The PV source parameter (PVSOURCE) determines the source of the current PV state for the digital input portion of the digital composite data point. Table 4-7 lists the possible sources of the current PV state.

Table 4-7 – Current PV Source States

| Source | Description |
|---|---|
| Man (manual) | Current PV state is provided by the operator from the Universal Station |
| Auto (automatic) | Current PV state is derived from Input 1 (D1) and Input 2 (D2) |
| Track | Current PV state is the commanded output state |
| Sub (substituted) | Current PV state is provided by a user program |

By configuration, the user can specify the PV sources to be used for this data point. Parameter PVSRCOPT allows the user to select the PV source as being only Auto, or to select all the PV sources in the above listing as allowable sources of the PV.

***Input Connections***
The inputs to a DC point are specified by the user through digital input-source parameters DISRC(1)-DISRC(2). The status of Input 1 is represented by parameter D1; input 2 is represented by parameter D2. Input 2 can be configured only when the entry for the number-of-digital-inputs parameter (NODINPTS) is 2. These inputs are designated as Input 1 and Input 2, and can be obtained from:
ï FSC connection,
ï SO parameter of a digital output point within the same FSC-SMM,
ï PVFL parameter of a local digital input,
ï PVFL parameter of a local flag point, and
ï FSC-SMM box flag PV.
The input sources must be in the same FSC-SMM box as the DC point.

*Continued on next page*

**Digital inputs,** continued

Table 4-8 describes the procedures for assigning DC input point connections.

Table 4-8 – Digital Composite Point Input Connections

| To assign ... | Then ... |
|---|---|
| an FSC connection | enter the following information for the respective DISRC(n) input connection parameter ...<br><br>**!LCxxxxx**<br><br>where **!LCxxxxx** is the address of the variable as programmed in the FSC. |
| a local DI point | enter the following information for the respective DISRC(n) output connection parameter ...<br><br>**Tagname.PVFL**<br><br>where the **tagname** is the name assigned to the logic slot providing the output and **PVFL** signifies the PV flag. |
| a local DO point | enter the following information for the respective DODSTN(n) output connection parameter ...<br><br>**Tagname.SO**<br><br>where the **tagname** is the name assigned to the data point through the NAME parameter and **SO** signifies the writeable status command of the digital output point. |
| an FSC-SMM box flag in the same FSC-SMM | enter the following information for the respective DISRC(n) output connection parameter ...<br><br>**Tagname.PVFL**<br><br>or<br><br>**!BOX.FL(nnnn)**<br><br>or<br><br>**$NMhhBxx.FL(nnnn)**<br><br>where the **Tagname** is the name assigned to the box PV flag, **PVFL** signifies the PV flag, **!BOX** specifies the same SM device where the DC point resides, **nnnn** is the flag's slot number, **hh** is the SM's UCN network number, and **xx** is the SM's UCN address. |

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**Digital inputs,** continued

*DC Input Point Processing*

Figure 4-5 provides a functional diagram illustrating the processing of a DC input point.

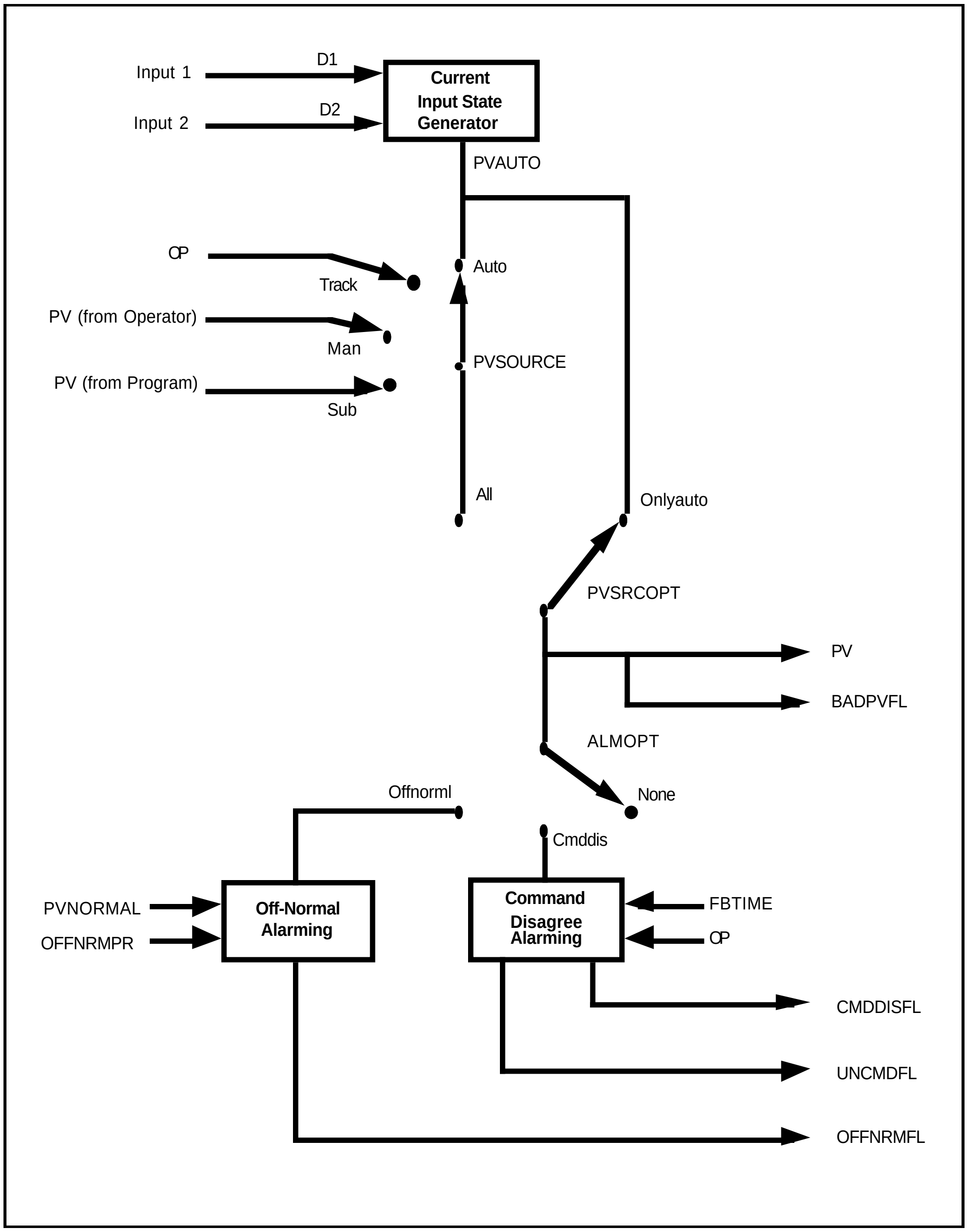


Figure 4-5 – DC Input Point Processing, Functional Diagram

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**Digital outputs**

Digital outputs for the digital composite (DC) point can be configured as either latched or momentary. Momentary outputs use the MOMSTATE parameter.

***Commanded state (OP)***
The command to go to a specific state normally results in the output to the field device going to the commanded state. (The FSC can alter output state to the field device.) The OP parameter in the DC point contains the descriptor for the commanded state. The descriptor is configured in parameters STATETXT(0) through STATETXT(2). The OP parameter is available for configuration only if the number of digital output connections (NODOPTS) is configured to be greater than 0.
Up to nine Boolean parameters of the form STx_OPy (where x = 0, 1, or 2 for the state number and y = 1, 2, or 3 for the output number) allow the user to specify the normal state values that are to be stored by the output connections. For each of the 3 commanded states per output connection, the user must define the value (On or Off) of the state.
For the None state, the output values for the 3 possible outputs are configured in parameters NONE_OP1, NONE_OP2 and NONE_OP3.

SO(0), SO(1) and SO(2) represent the State Output of the DC point. They are another way of representing OP, but with Boolean values instead of a self-defining enumeration. SO(0) will be On (the others Off) if OP is State 0, SO(1) will be On (the others Off) if OP is State 1, and SO(2) will be On (the others Off) if OP is State 2. Also, for example, writing to SO(1) to On is the same as writing OP to State 1.

***Output connections***
The destinations of the outputs (and the output types) from a DC point are specified by the user through the DODSTN(1) - DODSTN(3) parameters. Destinations that can be specified are:
ï FSC connection,
ï SO parameter of a digital output point within the same FSC-SMM,
ï PVFL parameter of a local flag point, and
ï FSC-SMM box flag.
The output destinations must be in the same FSC-SMM box as the DC point.

*Continued on next page*

**Digital outputs,** continued

Table 4-9 describes the possibilities for assigning DC output point connections.

Table 4-9 – Digital Composite Point Output Connections

| To assign DC output point to ... | Then ... |
|---|---|
| an FSC connection | enter the following information for the respective DODSTN(n) output connection parameter ...<br><br>**!LCxxxxx**<br><br>where **!LCxxxxx** is the address of the variable as programmed in the FSC. |
| a local digital output point | enter the following information for the respective DODSTN(n) output connection parameter ...<br><br>**Tagname.SO**<br><br>where the **tagname** is the name assigned to the data point through the NAME parameter and **SO** signifies the writeable status command of the digital output point. |
| a local flag point | enter the following information for the respective DODSTN(n) output connection parameter ...<br><br>**Tagname.PVFL**<br><br>where the **tagname** is the name assigned to the data point through the NAME parameter and **PVFL** signifies the PV flag. |
| an FSC-SMM box flag in the same FSC-SMM | enter the following information for the respective DODSTN(n) output connection parameter ...<br><br>**!BOX.FL(nnnn)**<br><br>or<br><br>**$NMhhBxx.FL(nnnn)**<br><br>where **!BOX** specifies the same SM device where the DC point resides, **nnnn** is the flag's slot number, **hh** is the SM's UCN network number, and **xx** is the SM's UCN address. |

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**Digital outputs,** continued

***DC Output Point Processing***

Figure 4-6 provides a functional diagram of the processing of a DC output point.

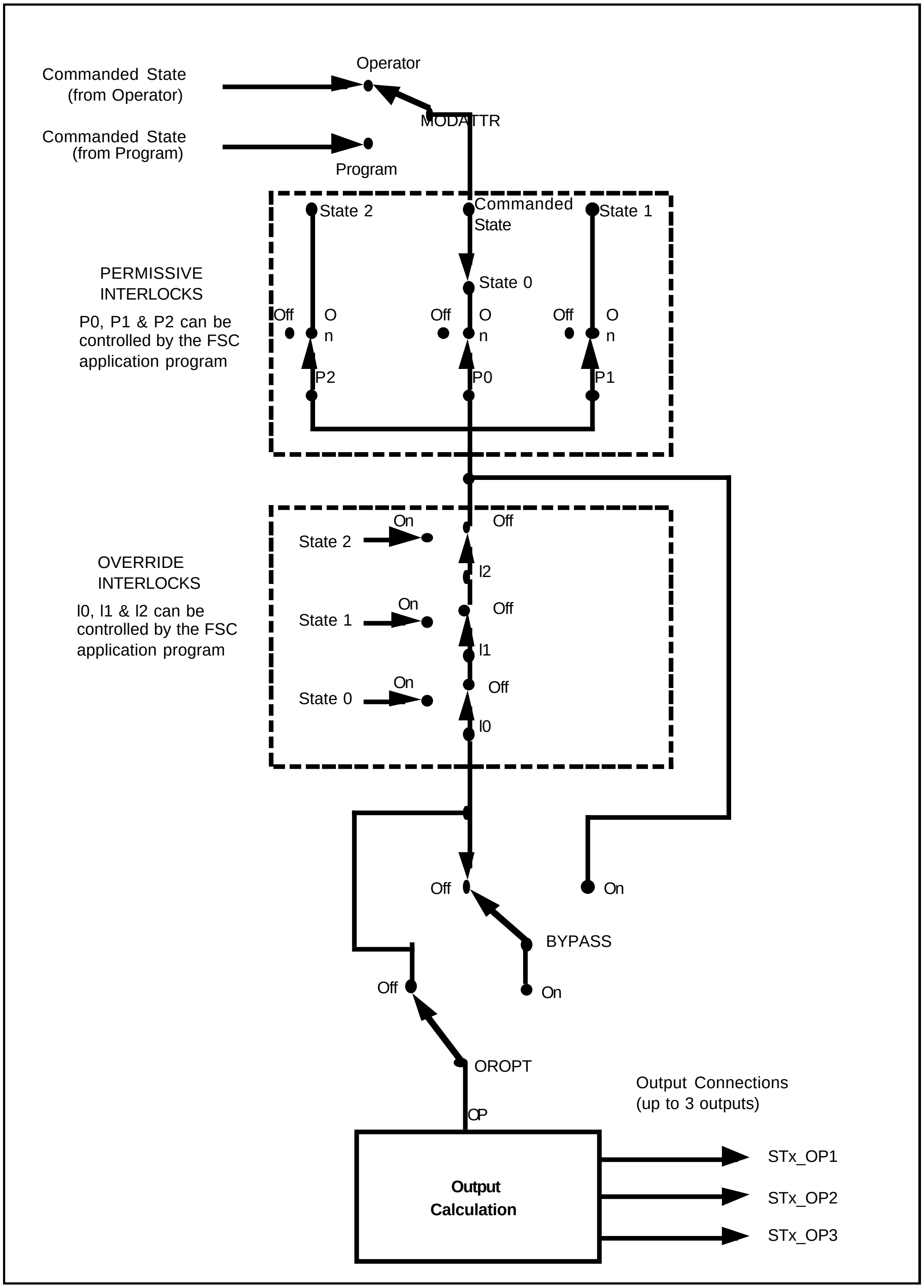


Figure 4-6 – DC Output Processing, Functional Diagram

**Digital outputs,** continued

The three arrows originating from the lower box in Figure 4-6 are not output connections. What the diagram is trying to show is that the DC point uses the configured parameters STx_OPy to determine what values should be written to the output connections.

**ATTENTION** The following statements apply:

- When override interlocks change, only OP is changed, not the field outputs. (The relation between OP and field outputs is created in the FSC control program.)
- When a commanded state from outside comes in, the override interlock values are checked to verify that the state can be changed. (All override interlocks must be Off.)
- There is no feedback loop from override interlocks to the outputs.

***Multiple Output Processing***

Parameter NODOPTS can be configured to specify one, two or three FSC-SMM outputs from a DC point, all of which reflect the commanded output state in OP. These outputs can be connected to several destinations, including destinations in the FSC. Where there is more than one FSC output, the SMM compares each read-back output with OP, and reports the first match in OPFINAL. If no match is found, a bad control alarm is generated.

**Alarming**

A DC point can be configured to detect and report command disagree, uncommanded change, or off-normal alarms through the use of the ALMOPT parameter. Also provided is the option of specifying no alarming for the data point. These alarm options can be configured only if the digital composite point is configured to have inputs, or inputs and outputs.

***Command Disagree and Uncommanded Change***

This type of alarming is selected by entering Cmddis for the ALMOPT parameter. When the commanded-output state is changed and the actual input PV state does not change accordingly within a predefined feedback time, a command disagree alarm is generated. The feedback time is specified by the FBTIME parameter. This alarm condition returns to normal when the input PV state and the commanded-output state are the same.

*Continued on next page*

**Alarming,** continued

If the commanded state is momentary, no alarm is generated. For example, a motor may have two PV states (Run and Stop), but there may be three commanded output states (Run, Stop, and Jog) where Jog is defined as a momentary state. Command disagree alarming is performed for only the Run and Stop commanded output states.

If a change does not occur in the commanded output state but the input PV state changes (and the PV is not bad), an uncommanded-change alarm is generated. This alarm condition returns to normal when the input PV state and the commanded state are the same. If the point state has been configured as being momentary, this type of alarm is not applicable.

***Off-normal***
Detection of off-normal alarms is configured by entering Offnorml for the ALMOPT parameter. The normal state of the PV input is defined by the user through the PVNORMAL parameter. When the PV input state is different from the state specified by the PVNORMAL parameter, the off-normal alarm is generated. The alarm condition returns to normal when the PV input state and the specified PV normal state are the same.

***Change-of-State Events***
Any transitions in the PV input state can be reported as events for journalizing and for causing the event-initiated processing of points in the Application Module (AM). It is configured by entering EIP for the Event-Report-Option parameter EVTOPT. The user must enter the tag name of the AM or CM point using the EIPPCODE parameter. If only journalizing is required, the EIPPCODE parameter can be set to a null tagname.

***Bad Control Alarm***
A bad control alarm indicates that the FSC output state does not match the commanded state in the OP parameter. After a change in the output is commanded by an operator at a Universal Station or by a user-written program, the FSC-SMM defers the calculation of the read back status from the FSC for one FSC control program scan to allow the FSC to update its output to the field. The FSC-SMM compares each of the outputs (1, 2 or 3) with OP, and reports the first match in OPFINAL. A Bad Control alarm (BADCTLFL = On) is generated if no match is found on any output. This causes the bad control indicator (see Figure 4-4) to appear on the Group or Detail display for the point.

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**Local manual indication**

Field devices that are interfaced by a DC point often have a local Hand/Off/Auto switch (often called Hand/Off/Remote). Unless this switch is in the Auto position, the SM may not have any control over that device. The user can optionally feedback the switch position into the SM to obtain some display indication for the Universal Station operator. This indication is provided by the word LOCALMAN appearing at the bottom of the DC point on a Group display.

When in local manual, any changes to the output by the operator, user programs or override interlocks are typically prohibited (assuming the FSC is programmed accordingly). The override interlocks should be programmed to take effect as soon as the local manual condition is cleared. To support Hand/Off/Auto switches, a Boolean flag called LOCALMAN is provided for connection to the FSC. The On state indicates that the switch is not in Auto position.

**CAUTION** Be aware of the importance of assuring compatibility of the FSC control program with the connections established for the FSC-SMM DC point.

# 4.5 Analog Input Point

**Background**

The analog input (AI) point converts raw FSC numbers into engineering units for use by the rest of the TDC 3000 system.

**Data flow**

Analog input values from the field can be collected from the FSC via its logic control program.

The FSC:

ï collects the analog input value from the specified I/O address, and
ï stores the collected value in its data storage area (memory), and
ï transfers the most recently collected value of the desired analog input from the FSC-to-SMM output table to the FSC-to-SMM input table.

The FSC-SMM:

ï accesses the specified location where the desired analog input value has been stored.

**Point processing**

Upon receiving the raw AI value from the FSC, the FSC-SMM performs:

ï PV characterization,
ï range checking and PV filtering,
ï PV source selection, and
ï alarm detection.

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**Point processing,** continued

Figure 4-7 illustrates the processing functions and associated parameters.

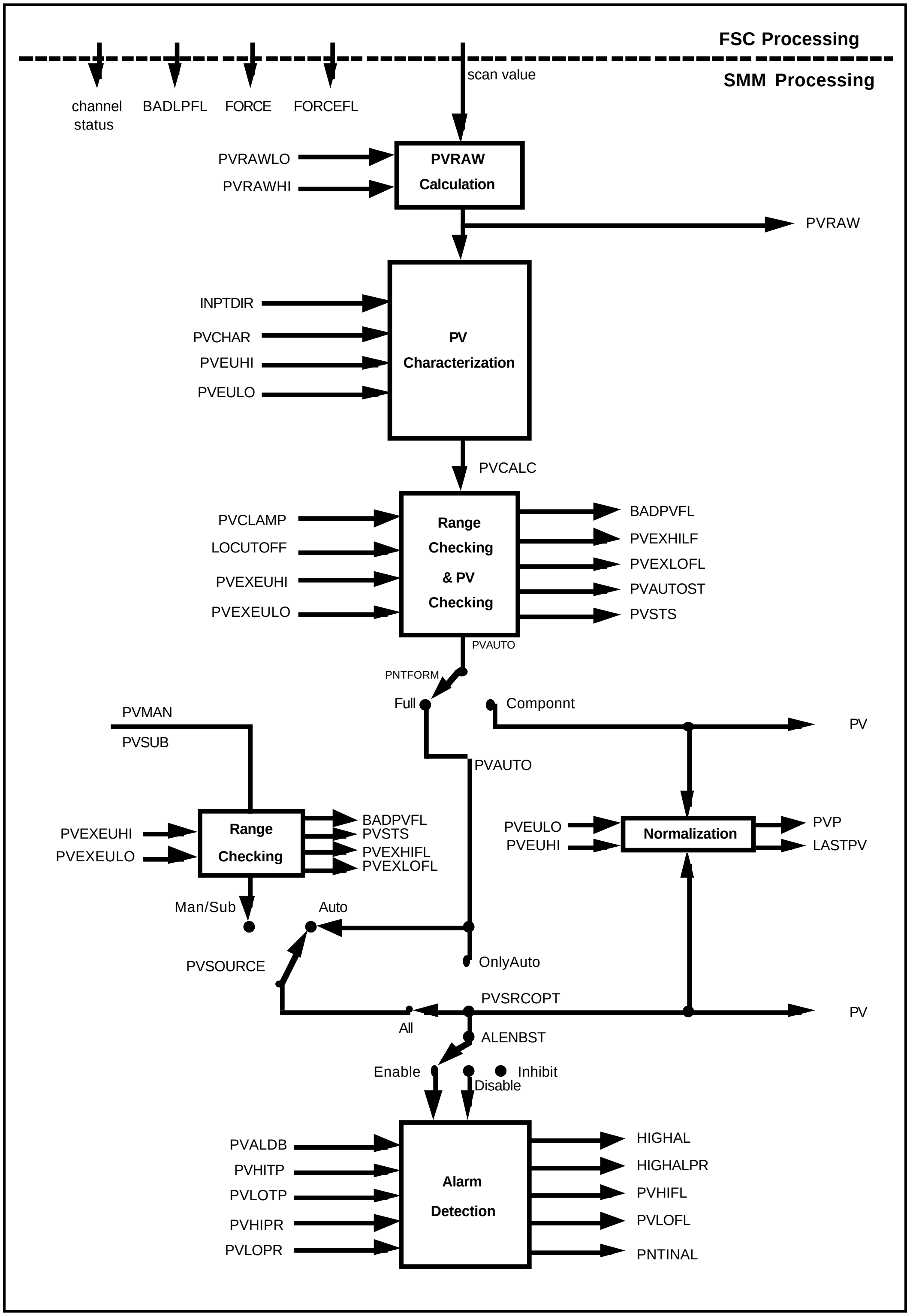


Figure 4-7 – AI Point Processing, Functional Diagram

**Raw PV processing**

The value written by the FSC is converted to percent (0 to 100%) using the following equation:

$$PVRAW = 100 * \frac{scan\ value - PVRAWLO}{PVRAWHI - PVRAWLO}$$

**PV characterization**

The PVRAW signal received from the FSC is a percentage of the source range. It is characterized based on the entries made for the PVCHAR and INPTDIR parameters. This value is converted to engineering units.

PVCHAR can be Linear or Sqroot. The intermediate variable pvint is calculated as follows:

Table 4-10 – PV Characterization Effect on Characterization Equations

| PVCHAR | pvint |
|---|---|
| Linear | PVRAW |
| Sqroot | $100 * \sqrt{\frac{PVRAW}{100}}$ |

The output value of the characterization is PVCALC. The value of the input direction parameter (INPTDIR) is taken into consideration during the calculation of PVCALC as described in Table 4-11, where pvint is the intermediate variable calculated as shown above.

Table 4-11 – Input Direction Effect on Characterization Equations

| INPTDIR | PVCALC |
|---|---|
| Direct | $\left(\frac{pvint}{100} * (PVEUHI - PVEULO)\right) + PVEULO$ |
| Reverse | $PVEUHI - \left(\frac{pvint}{100} * (PVEUHI - PVEULO)\right)$ |

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**PV range checking**

PV range checking ensures that the PVCALC output of the PV characterization is within the limits defined by the parameters PVEXEULO and PVEXEUHI. PV range checking (limits defined by parameters PVEUHI and PVEULO) characteristics to consider with the analog input point include the following.

ï If either of the PVEXEULO or PVEXEUHI limits is violated and clamping has not been specified, PVAUTO is set to NaN (not a number) and the BADPVFL is set to On.

ï If either of the PVEXEULO or PVEXEUHI limits is violated and clamping has been specified, PVAUTO is clamped to PVEXEULO or PVEXEUHI.

ï If the range-checked value is less than the value specified by the user-configured LOCUTOFF parameter, PVAUTO is forced to PVEULO.

The BADPVFL is also set to On if the channel status is not Healthy.

**PV source selection**

The PVSOURCE parameter allows the user to select the source of the PV for this data point. The PV can be provided by the range checking circuit (when PVSOURCE is Auto). In addition, the PV source option parameter (PVSRCOPT) determines whether it is permissible to change the PV source to a source other than Auto. PVSRCOPT has two states: OnlyAuto and All. The All state allows the PVSOURCE to be set to Man (operator can enter value) or Sub (program can enter value).

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# 4.5 Analog Input Point, Continued

**Alarming**

The analog input data point compares the PV to threshold values and records the alarms in the database of the data point. The alarms are then reported by the FSC-SMM. Table 4-12 lists the parameters that are associated with alarming in the analog input point.

Table 4-12 – Analog Input Point Associated Alarm Parameters

| Parameter | Definition |
|---|---|
| ALENBST | Alarm Enable Status |
| BADPVFL | Bad PV Flag |
| BADPVPR | Bad PV Alarm Priority |
| CONTCUT | Contact Cutout |
| EIPPCODE | Event-Initiated Processing Point Identifier |
| HIGHAL | Highest Alarm Detected |
| HIGHALPR | Highest Level Alarm's Priority |
| PTINAL | Point in Alarm Indicator |
| PVALDB | PV Alarm Deadband as a Percent of Full Range |
| PVEXHIFL | PV Extended High Range Violation |
| PVEXLOFL | PV Extended Low Range Violation |
| PVHIFL | PV High Alarm Flag |
| PVHIPR | PV High Alarm Priority |
| PVHITP | PV High Alarm Trip Point |
| PVLOFL | PV Low Alarm Flag |
| PVLOPR | PV Low Alarm Priority |
| PVLOTP | PV Low Alarm Trip Point |

Refer to the *FSC Safety Manager Parameter Reference Dictionary* for detailed definitions of these parameters.

# 4.6 Analog Output Point

**Background**

The analog output (AO) point value is copied by the FSC from the SMM-to-FSC output table to the SMM-to-FSC input table.

**Point processing**

Figure 4-8 illustrates the FSC-SMM processing functions that are associated with an analog output point, and can be configured via parameters.

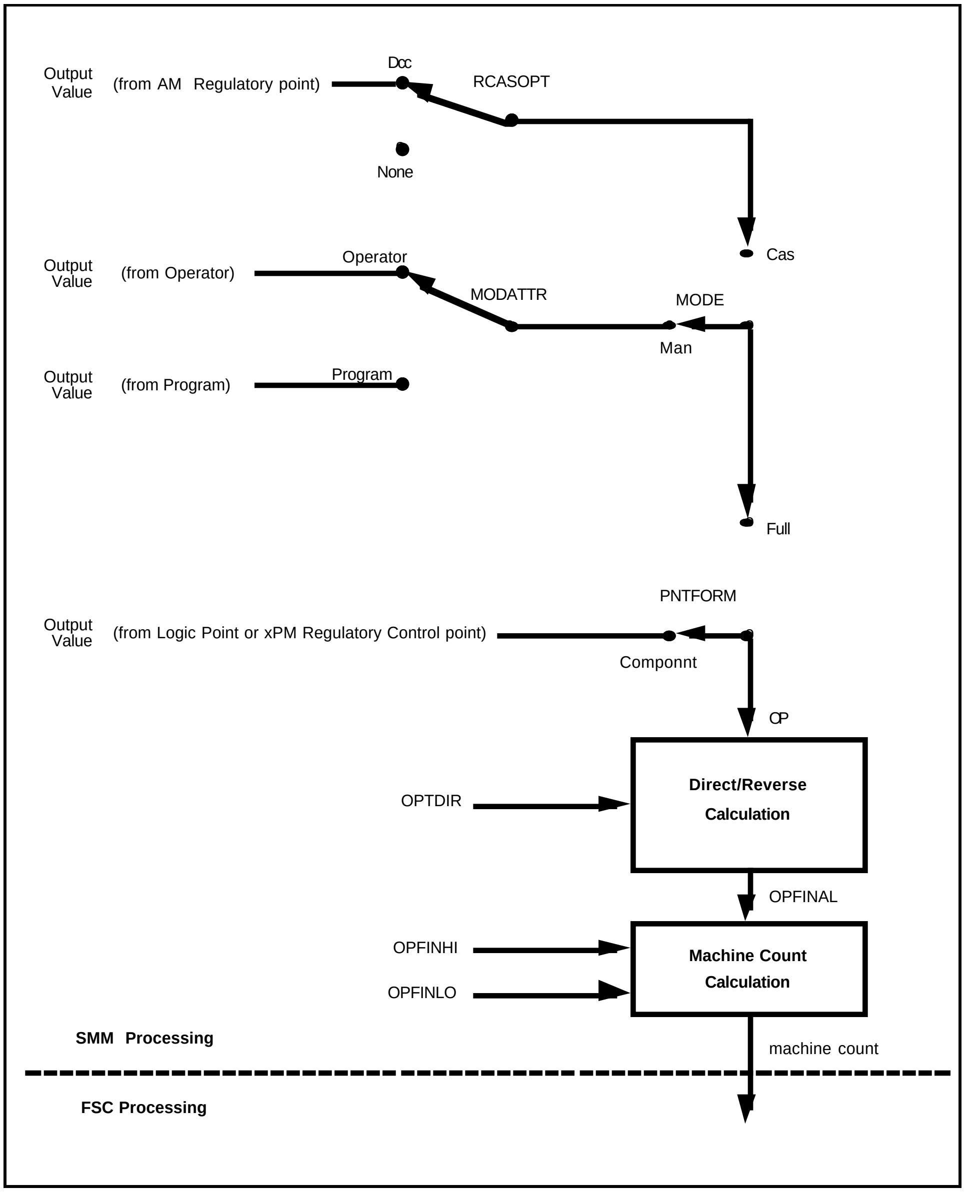


Figure 4-8 – AO Point Processing, Functional Diagram

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**Output direction**

The OPTDIR parameter specifies whether the output of the data point is direct or reverse directed:

Table 4-13 – Output Direct Effect

| OPTDIR | OPFINAL |
|---|---|
| **Direct** | OP |
| **Reverse** | 100 - OP |

**Final value processing**

The value read by the FSC is calculated using the following equation:

$$\text{machine count} = \left(\frac{\text{OPFINAL}}{100} * (\text{OPFINHI} - \text{OPFINLO})\right) + \text{OPFINLO}$$

# 4.7 Logic Point

**Background**

The function of the logic point is limited to the transfer of data between points in modules on the same UCN. The logic point has, therefore, in the LM been referred to as the "linkage point", and is the basis for the FSC-SMM's application-level support of peer-to-peer communications. Data types can be Boolean or Real.

**Configuration**

Each logic point accommodates 12 input connections and 12 output connections, with a total maximum of 50 connections scheduled for processing during any single FSC-SMM scan cycle.

**Input connections**

Inputs to the logic point are assigned during configuration by using logic input connections. Up to 12 inputs can be assigned to logic-slot inputs L(1) to L(12), as shown in Figure 4-9. The logic input connections are specified through the LISRC parameter.
The inputs to the logic slot can be obtained from:

ï any Boolean, integer, unsigned integer, enumeration, self-defining enumeration, or real parameter within this FSC-SMM, or in another node on the same UCN, using the "Tagname.Parameter" format.

**ATTENTION** Integer, unsigned integer, enumeration or self-defining enumeration parameters are automatically converted to real values.

ï an address (!LCxxxxx) in the FSC.

**ATTENTION** Logic point input and output must be of the same type, i.e. you can connect Flag1.PV to a Flag2.PV (enum → enum), but not a Flag1.PV to a Flag2.PVFL (enum → boolean).

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**Input connections,** continued

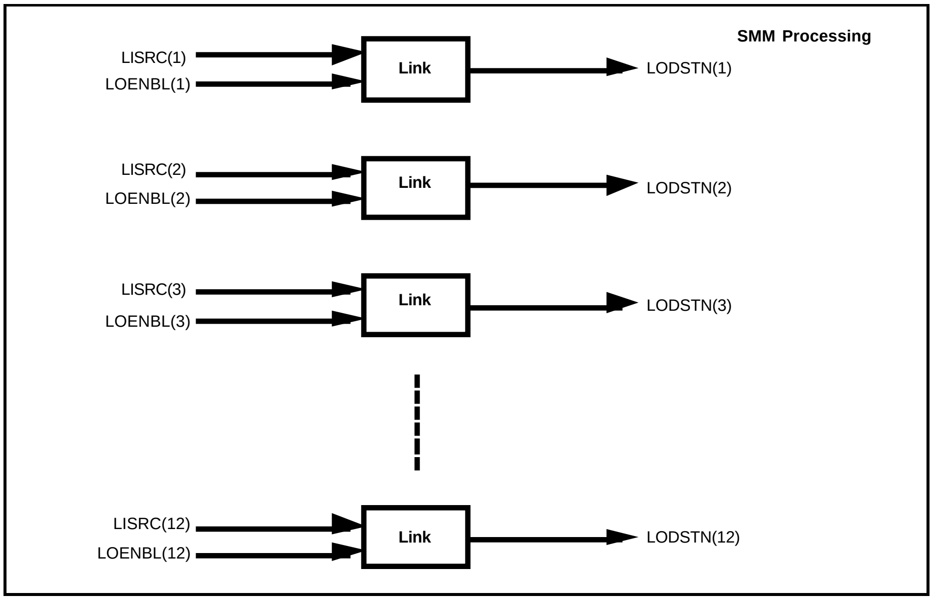


Figure 4-9 – Logic Point Input Connections

**Input errors**

Three types of errors can occur with regard to logic point inputs.

- A communication error occurs as the result of a failed device.
- The point has been deleted.
- A configuration error occurs when the point mix in that module has been changed such that the specified point no longer exists.

In order for the routine to be able to continue in spite of a configuration error, the following special features are provided:

- Bad Boolean inputs - If a Boolean input is not successfully fetched, its value is defaulted, based on the logic-input-bad-handling-option parameter (LIBADOPT) as listed in Table 4-14.
- Bad real inputs - If a real input cannot be successfully fetched, its value is defaulted to NaN (Not a Number) and no value is set to the output. This means that the destination keeps its last good value.

Table 4-14 – Logic Input Point Bad Handling Option Parameters

| LIBADOPT | Action |
|---|---|
| On | The On state is substituted for the unsuccessful input. |
| Off | The Off state is substituted for the unsuccessful input. |
| Hold | The previous value (the last successfully fetched value) is substituted for the unsuccessful input. On start-up, the previous value is defaulted to the Off state. |

*Continued on next page*

**Output connections**

Logic output connections are used to write the values of local parameters of a logic slot to the configured destinations. Up to 12 output connections can be configured for each logic slot. The destinations are specified by the LODSTN parameter by using the "Tagname.Parameter" format, the UCN hardware reference address format, or the FSC address. Each destination address is tied to the input bearing the same number (LODSTN(1) to L1, LODSTN(2) to L2, etc.).
The logic output connection can write the selected local parameters of a logic slot to

- any Boolean or real parameter in this FSC-SMM, or another node on the same UCN,
- an address in the FSC of which the corresponding variable has an DCS address.

Associated with each output connection is a logic output enable flag, LOENBL(n), which is always an FSC address (!LCxxxxx). The FSC variable pointed to by LOENBL(n) must be On for the corresponding output connection to write to the specified destination. The default value of 0 represents the On state.

**Generic descriptors**

Up to twelve user-defined generic descriptors are provided with each logic slot for identifying external inputs (L1, L2, etc.) with custom names to be shown on Universal Station displays. The actual number of descriptors used is determined by the NODESC parameter for this logic slot. The corresponding eight-character descriptor is defined by GENDESC(n).

# 4.8 Flag Point

**Background**

A flag data point is a two-state (On and Off) point that is used for storing a Boolean value.

**Data flow**

A Flag is not just a Boolean value in the FSC-SMM. The value of each Flag is copied to the FSC every FSC cycle, using the mechanism illustrated in Figure 2-2.
The Flag point's state can change whenever it is accessed by other system functions, such as an operator, a continuous point or a user-written program.

The point's state can be supplied by
ï the operator,
ï an output connection from another FSC-SMM point (DC or LS),
ï another box (SM, PM, LM, etc.) on the same UCN,
ï a node on the LCN (AM etc.).
The FSC cannot write the value of the flag.

**Point processing**

The flag point has the parameters PVFL and PV. PVFL has a Boolean value, whereas PV has the value equal to either STATETXT(0) or STATETXT(1).
PVFL will also light the Pvstate1 and Pvstate0 boxes on the Universal Station displays, depending on its state. If PVFL is On, the Pvstate1 (upper) box will be lit; if PVFL is Off, the Pvstate0 (lower) box will be lit.
Flag points can be configured as full or component points as determined through the PNTFORM parameter.

Figure 4-10 illustrates the FSC-SMM processing associated with the flag point.

*Continued on next page*

**Point processing,** continued

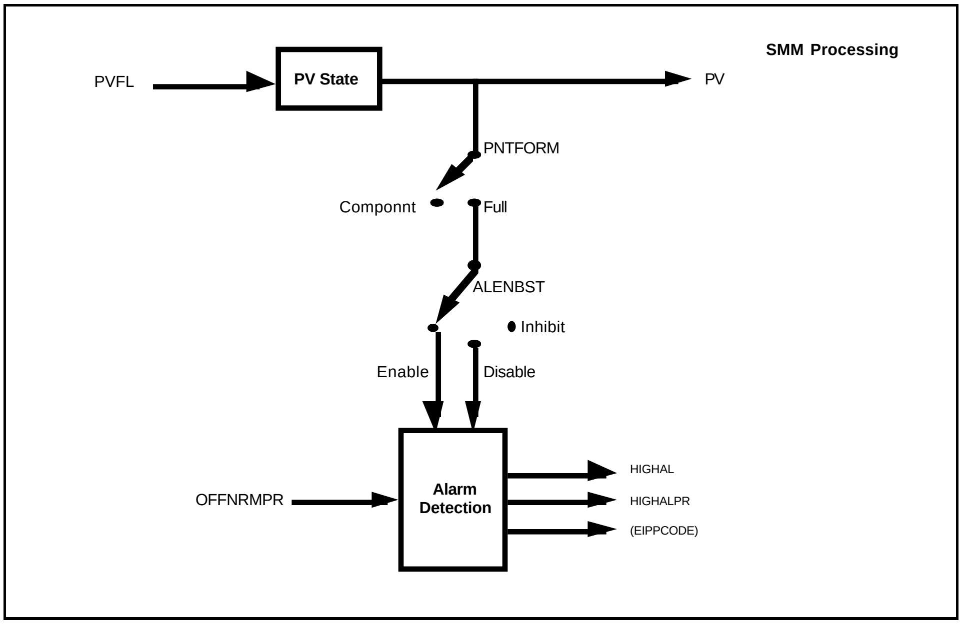


Figure 4-10 – Flag Point Processing, Functional Diagram

**Alarming**

Flags with SLOTNUM ≤ 512 can be configured for off-normal alarming. An alarm is generated when the PV of the flag point is changed from Pvstate0 (PVFL = Off) to Pvstate1 (PVFL = On).
Alarming is available only if the flag point has been configured as a full point.

## 4.9 Numeric Point

**Background**

Numeric data points are used to store real values, such as
ï operator entries,
ï accumulations, or
ï intermediate results of program calculations.

**Data flow**

A Numeric is not just a real value in the FSC-SMM. The value of each Numeric is copied to the FSC every FSC cycle, using the mechanism illustrated in Figure 2-2.
The Numeric point's state can change whenever it is accessed by other system functions, such as an operator, a continuous point, or a user-written program.

The point's value can be supplied by:
ï the operator,
ï an output connection from another FSC-SMM point (LS),
ï another box (SM, PM, LM, etc.) on the same UCN,
ï a node on the LCN (AM etc.).
The FSC cannot write the value of the numeric.

# 4.10 Timer Point

**Background**

The timer data point provides timekeeping in the FSC Safety Manager. This type of data point keeps track of the elapsed time after the timer has been started (by the operator or by a program), and provides an indication when the elapsed time has reached the predefined limit.

**Point processing**

Timer points can be configured as either full or component points. They are accessible to routines in:

- the same SM,
- any other box (SM, PM, APM, etc.) on the same UCN,
- the FSC, or
- any node on the LCN.

The preset length of time that the timer point is to run – in units of tenths of a second, seconds or minutes – is determined by the value recorded in the SP parameter. The SP parameter is set to the preset time value by the operator at a Universal Station, or by a program.

This value is frozen for one FSC-SMM cycle (0.5 second) to assure transfer to the FSC. Once the preset value is entered, the timer can be started by setting the COMMAND parameter to Start. The operator has also the option to reset the timer through the COMMAND parameter.

The time value in PV starts at 0 and increments toward the preset time value. The RV parameter indicates the time remaining until the timer reaches its limit (SP - PV). When PV = SP, the parameter SO is set to On indicating the timer has elapsed. The values in PV and SP can range from 0 to 2047 timebase units, in accordance with the FSC program. Thus the maximum time a timer can run is 34 hours and 7 minutes. The value of PV is an integer value. Thus, for example, if the TIMEBASE is minutes, the PV is updated every minute, and remains constant during one minute.

The timer point in an FSC-SMM does not perform the timer function itself. This is done by a Timer variable in the control program in the FSC. This FSC timer is a countdown timer, and communicates the RV to the FSC-SMM. The FSC-SMM Timer point translates the COMMAND parameter to the Boolean signals Set and Reset, and calculates PV from SP and RV.

*Continued on next page*

**Point processing,** continued

If the command Start is given when the timer is in STATE Disable, the timer starts running, and the PV increases from 0. If the command Start is given when the timer is in STATE Enable, the value of PV is set to 0, and the timer keeps running.

When the command Reset is given when the timer is in STATE Disable, the timer remains stopped, and the PV remains 0. When the command Reset is given when the timer is in STATE Enable, the timer stops running, and the PV is set to 0.

It is not possible to write SP with time running. Also, if the timer has stopped and SP is written to another larger value, the timer will begin timing up to the new SP value.

Figure 4-11 illustrates the FSC-SMM processing associated with the timer point.

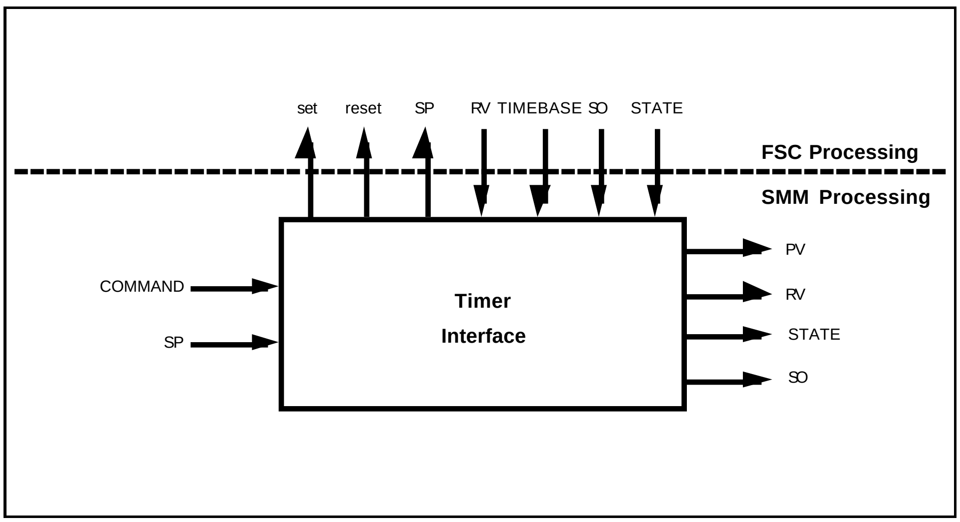


Figure 4-11 – Timer Point Processing, Functional Diagram

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