Siemens Energy & Automation, Inc.	Configuration Guide

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APACS+™
I/O Module Configuration
for Version 4.40 or Higher

Notes

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Significant Changes for Revision 4

Entire document updated for consistency with current Help Files.

1.0 Introduction

This Configuration Guide provides information on the configurable elements of the APACS+™ I/O modules. This guide is intended to be used in conjunction with the configuration procedures located in *Using the ProcessSuite 4-mation Configuration Software* (document number CG39-20).

Starting with section 2, each section in this guide presents the parameters and channel types of an individual APACS+ I/O module, as follows:

- Section 1, Introduction
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- Section 4, Input Discrete Module (IDM)
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- Section 12, Standard Discrete Module (SDM+)
- Section 13, Voltage Input Module (VIM)
- Section 14, PROFIBUS Fieldbus Module

1.1 Product Description

APACS+ incorporates a modular design for flexible control of plant operations. The APACS+ modules are rack-mounted, DIN-sized intelligent (microprocessor-based) modules designed to perform a specific application function, such as control, communications, or I/O. They are selected individually and combined to accommodate a process application. Each APACS+ system typically consists of a power supply module, a computer module, a control module, and a complement of I/O modules.

Connection between the individual APACS+ modules is provided by three busses:

- MODULBUS — Used by control, communications, and computer modules to share process and system information.
- IOBUS — Provides a control module with dedicated, secure access to field I/O points which terminate at I/O modules.
- POWER BUS — A triple-redundant bus providing power to APACS+ modules.

The APACS+ I/O modules are a series of configurable modules acting as interfaces between control modules and field termination signals, offering a broad range of analog, discrete, and special condition I/O points.

All APACS+ I/O modules are configured using *4-mation*™ software. During configuration, *4-mation* is used to define the channel type and several parameters which vary according to channel type. After a configuration is created, it is loaded into the I/O module's memory, and a copy of the configuration is stored in the control module's non-volatile memory. This allows on-line removal and replacement of the module without the need for reconfiguration.

1.2 Product Support

Product support can be obtained from a Technical Information Center (TIC). Each regional TIC is a customer service center that provides direct telephone support on technical issues related to the functionality, application, and integration of all products supplied by Siemens regional TIC contact information is provided in Table 1–1. Your regional TIC is the first place you should call when seeking product support information. When calling, it is helpful to have the following information ready:

- Caller name and company name
- Product part number or model number and version
- If there is a problem with product operation:
  - Whether the problem is intermittent
  - The steps performed before the problem occurred
  - Any error messages or LED indications displayed
  - Installation environment

Customers that have a service agreement (ServiceSuite or Field Service Agreement) are granted access to the secure area of our Web site (http://www.smpa.siemens.com/TechServices/TechLibrary.asp). This area contains a variety of product support information. To log on, you will be prompted to enter your username and password.

Table 1–1 TIC Contact Information

TIC NORTH AMERICA	Tel:	+1 215 646 7400, extension 4842
	Fax:	+1 215 283 6343
	E-mail:	TICGroupNA@sea.siemens.com
	Hours of Operation:	8 a.m. to 5 p.m. eastern time Monday – Friday (except holidays)
	Secure Web Site:	www.smpa.siemens.com/techservices

TIC ASIA	Tel:	+65 299 6051
	Fax:	+65 299 6053
	E-mail:	TICGroupAP@moore-solutions.com
	Hours of Operation:	9 a.m. to 6 p.m. Singapore time Monday – Friday (except holidays)
	Secure Web Site:	www.smpa.siemens.com/techservices

TIC EUROPE	Tel:	+44 1935 470172
	Fax:	+44 1935 706969
	E-mail:	TICGroupEurope@moore-solutions.com
	Hours of Operation:	8:30 a.m. to 5:15 p.m. GMT/BST Monday – Thursday (except holidays) 8:30 a.m. to 4:00 p.m. GMT/BST Friday (except holidays)
	Secure Web Site:	www.smpa.siemens.com/techservices

1.3 Related Literature

The following literature is available from Siemens. Generally, all needed documentation is supplied on a CD-ROM supplied with your system. Refer to it as needed or as directed in text.

- *Getting Started with APACS+ 4-mation Configuration Software* (document number SG39-12)
- *Using the APACS+ 4-mation Configuration Software* (document number CG39-20)
- *APACS+ Control Simulator* (document number CG39CTRLSIM-1)
- *APACS+ 4-mation Configuration Software Messages and Diagnostic Codes* (document number CG39-21)
- *APACS+ Module Diagnostic Error Codes* (document number CG39-19)

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2.0 Enhanced Analog Module (EAM)

The Enhanced Analog Module (EAM) can interface both analog and discrete I/O signals to the control module's IOBUS. Each of its 16 configurable channels can be configured as an analog input, analog output, frequency input, totalizer input, discrete input, or discrete output. Related signals, such as the I/O for a particular loop, can be grouped together to permit isolation and ease in responding to faults. Each channel is electrically isolated from the module's CPU, IOBUS, and ground, as well as from every other channel.

2.1 EAM Module Scope Parameter

Table 2-1 shows the Module Scope softlist parameter for the EAM.

Table 2–1 EAM Module Scope Parameter

PARAMETER	SELECTION	DEFAULT
ScanRate	N/A	N/A

To view/edit the module scope parameters, place the cursor on the desired module in the module tree and select the Edit, Object/Item menu item. The Hardware Modules dialog box opens. Choose the "Softlist" command button. The Module Scope Softlist dialog box opens.

ScanRate: This is a read-only parameter that displays the current scan period of the module. In general, the scan rate is the same as the scan period of the ACM, but may be an integer multiple of the ACM's scan period.

2.2 EAM Channel Types

The following channel types are supported for the EAM module:

- EAM Analog In Current
- EAM Analog Out Current
- EAM Analog In Voltage
- EAM Voltage Pulse In-Freq
- EAM Current Pulse In-Freq
- EAM Voltage Pulse In-Total
- EAM Current Pulse In-Total
- EAM Disc In Voltage
- EAM Disc In Current
- EAM Disc Out Channel

2.2.1 EAM Analog In Current

The EAM Analog In Current channel type returns a REAL variable.

Table 2-2 shows the softlist parameters for the EAM Analog Input Current channel type.

Table 2–2 EAM Analog In Current Softlist Parameters

PARAMETER	SELECTION	DEFAULT
InputRange	4-20 mA, 0-20 mA	4-20 mA
Resolution	13, 14, 15, and 16 bits	13 bits
MinScale	Any Real Number	0.0
MaxScale	Any Real Number	100.0
EngUnits	in, ft, mm, cm, m, in3, ft3, bbl, ml, liter, m3, lb, ton, mol, g, kg, ft/sec, m/sec,ft/sec2, msec2, DegF, DegR, DegC, DegK, psi, psia, psig, InH2O, InHg, ATM, kPa, kPaa, kPag, mmHg, kg/cm2, mbar, bar, lb/ft3, g/cm3, kg/m3, mol/m3, ft3/lb, m3/kg, ppm, pH, PPH, KPPH, t/day, kg/hr, kg/day, gal/min, GPM, GPH, GPD, ACFM, ACFH, SCCM, SCFH, SCFM, MCFH, yd3/hr, yd3/day, BPD, gal/hr, gal/day, m3/hr, m3/day, l/min, l/hr, l/day, mV, Volts, mA, AMPS, Ohms, mhos, W, kW, MW, Btu, Btu/SCF, Btu/lbm, Btu/hr, hp, bhp, vars, VA, kVA, joules, Percent, pulses, Hz, rpm, deg, rad, cal/SCF, cal/hr, cal/lbm, kcal, kcal/SCF, kcal/hr, kcal/lbm	Percent

InputRange: EAM Analog Input channels are configurable to operate with two current ranges: 4-20 mA or 0-20 mA.

Resolution: The EAM employs sigma-delta method of analog-to-digital conversion. Both the resolution of a sigma-delta converter and normal mode rejection are improved by increasing the filtering amount. The degree of filtering appropriate for the selected resolution is applied to the signal within the EAM, before the signal is scanned by the ACM.

MinScale: The module linearly scales raw data (mA) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale and InputRange parameters set by the user. For example, given a MinScale of 0.0, a MaxScale of 100.0, and an InputRange of 4-20 mA, if the input to the channel is 12 mA, the scaled value is 50.0 mA.

MinScale can be any real (REAL) number (Real numbers are valid between -3.4028E38 and +3.4028E38.).

MaxScale: MaxScale can be any real (REAL) number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

2.2.2 EAM Analog Out Current

The EAM Analog Out Current channel type accepts a REAL variable.

Table 2-3 lists the softlist parameters for the EAM Analog Output Current channel type.

Table 2–3 EAM Analog Out Current Softlist Parameters

PARAMETER	SELECTION	DEFAULT
OutputRange	4-20 mA, 0-20 mA	4-20 mA
MinScale	Any Real Number	0.0
MaxScale	Any Real Number	100.0
EngUnits	in, ft, mm, cm, m, in3, ft3, bbl, ml, liter, m3, lb, ton, mol, g, kg, ft/sec, m/sec,ft/sec2, msec2, DegF, DegR, DegC, DegK, psi, psia, psig, InH2O, InHg, ATM, kPa, kPaa, kPag, mmHg, kg/cm2, mbar, bar, lb/ft3, g/cm3, kg/m3, mol/m3, ft3/lb, m3/kg, ppm, pH, PPH, KPPH, t/day, kg/hr, kg/day, gal/min, GPM, GPH, GPD, ACFM, ACFH, SCCM, SCFH, SCFM, MCFH, yd3/hr, yd3/day, BPD, gal/hr, gal/day, m3/hr, m3/day, l/min, l/hr, l/day, mV, Volts, mA, AMPS, Ohms, mhos, W, kW, MW, Btu, Btu/SCF, Btu/lbm, Btu/hr, hp, bhp, vars, VA, kVA, joules, Percent, pulses, Hz, rpm, deg, rad, cal, cal/SCF, cal/hr, cal/lbm, kcal, kcal/SCF, kcal/hr, kcal/lbm	Percent
IOBUSFault	OFF, HOLD LAST STATE, PRESET VALUE	OFF
PresetValue	0.0 to 100.0 %	0.0
FailSafe	ENABLED, DISABLED	DISABLED

OutputRange: EAM Analog Output Current channels are configurable to operate with two current ranges: 4-20 mA or 0-20 mA.

MinScale: The module performs a linear conversion from engineering units to the selected OuputRange for each channel. The scaling algorithm uses the MinScale/MaxScale and OutputRange parameters set by the user. For example, given a MinScale of 0.0, a MaxScale of 100.0, and an OutputRange of 4-20 mA, if the value written to the EAM Analog Output Channel is 50, the module will output 12 mA.

MinScale can be any real (REAL) number (Real numbers are valid between -3.4028E38 and +3.4028E38.).

MaxScale: MaxScale can be any real number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

IOBUSFault: Each analog output can be configured to respond to an IOBUS fault (loss of communications with the controller) in a particular manner. The available fault states are:

OFF Output is turned off (0 mA).
HOLD_LAST_STATE Output holds its last value.
PRESET_VALUE Output goes to the value specified by the PresetValue parameter.

NOTE

All channels power up in the OFFstate.

PresetValue: Any real (REAL) number between 0.0 and 100.0. This parameter need only be specified when IOBUSFault is specified as "Preset_Value."

FailSafe: If FailSafe is enabled and an error condition exists for which the channel cannot be turned off individually, then all channels of the module are powered down. The user may wish to configure an output as Failsafe that is critical to the process or that may present a hazard to personnel or equipment.

2.2.3 EAM Analog In Voltage

The EAM Analog In Voltage channel type returns a REAL variable.

Table 2-4 lists the softlist parameters for the EAM Analog Input Voltage channel type.

Table 2–4 EAM Analog In Voltage Softlist Parameters

PARAMETER	SELECTION	DEFAULT
InputRange	1-5 V, 0-5 V	1-5 V
Resolution	13, 14, 15, and 16 bits	13 bits
MinScale	Any Real Number	0.0
MaxScale	Any Real Number	100.0
EngUnits	In, ft, mm, cm, m, in3, ft3, bbl, ml, liter, m3, lb, ton, mol, g, kg, ft/sec, m/sec,ft/sec2, msec2, DegF, DegR, DegC, DegK, psi, psia, psig, InH2O, InHg, ATM, kPa, kPaa, kPag, mmHg, kg/cm2, mbar, bar, lb/ft3, g/cm3, kg/m3, mol/m3, ft3/lb, m3/kg, ppm, pH, PPH, KPPH, t/day, kg/hr, kg/day, gal/min, GPM, GPH, GPD, ACFM, ACFH, SCCM, SCFH, SCFM, MCFH, yd3/hr, yd3/day, BPD, gal/hr, gal/day, m3/hr, m3/day, l/min, l/hr, l/day, mV, Volts, mA, AMPS, Ohms, mhos, W, kW, MW, Btu, Btu/SCF, Btu/lbm, Btu/hr, hp, bhp, vars, VA, kVA, joules, Percent, pulses, Hz, rpm, deg, rad, cal, cal/SCF, cal/hr, cal/lbm, kcal, kcal/SCF, kcal/hr, kcal/lbm	Percent

InputRange: EAM Analog In Voltage channels are configurable to operate with two voltage ranges, 1-5 V or 0-5 V.

Resolution: The EAM employs sigma-delta method of analog-to-digital conversion. The resolution of a sigma-delta converter and normal mode rejection are improved by increasing the amount of filtering. The degree of filtering, appropriate for the selected resolution, is applied to the signal within the EAM, before the signal is scanned by the ACM.

MinScale: The module will linearly scale raw data (volts) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale and InputRange parameters set by the user. For example, given a MinScale of 0.0, a MaxScale of 100.0, and an InputRange of 1-5 Volts, if the input to the channel is 3 Volts, the scaled value will be 50.0.

MinScale can be any real (REAL) number. (Real numbers are valid between -3.4028E38 and +3.4028E38).

MaxScale: MaxScale can be any real number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

2.2.4 EAM Voltage Pulse In-Freq

The Voltage Pulse In-Freq channel type returns a REAL variable.

Table 2-5 shows the softlist parameters for the Voltage Pulse Input-Frequency channel type.

Table 2–5 EAM Voltage Pulse In-Freq Softlist Parameters

PARAMETER	SELECTION	DEFAULT
Threshold	Regular, TTL	Regular
MinRange	0.0 to 45,000 Hz	0.0
MaxRange	0.0 to 45,000 Hz	45,000.0
MinScale	Any Real Number	0.0
MaxScale	Any Real Number	45,000.0
EngUnits	In, ft, mm, cm, m, in3, ft3, bbl, ml, liter, m3, lb, ton, mol, g, kg, ft/sec, m/sec,ft/sec2, msec2, DegF, DegR, DegC, DegK, psi, psia, psig, InH2O, InHg, ATM, kPa, kPaa, kPag, mmHg, kg/cm2, mbar, bar, lb/ft3, g/cm3, kg/m3, mol/m3, ft3/lb, m3/kg, ppm, pH, PPH, KPPH, t/day, kg/hr, kg/day, gal/min, GPM, GPH, GPD, ACFM, ACFH, SCCM, SCFH, SCFM, MCFH, yd3/hr, yd3/day, BPD, gal/hr, gal/day, m3/hr, m3/day, l/min, l/hr, l/day, mV, Volts, mA, AMPS, Ohms, mhos, W, kW, MW, Btu, Btu/SCF, Btu/lbm, Btu/hr, hp, bhp, vars, VA, kVA, joules, Percent, pulses, Hz, rpm, deg, rad, cal, cal/SCF, cal/hr, cal/lbm, kcal, kcal/SCF, kcal/hr, kcal/lbm	Hz
Resolution	10, 12, 14, 16 bit	12 bit

Threshold: The user can select the threshold for voltage input pulses. The regular threshold is 2.5 V with 130 mV of hysteresis. The TTL threshold is 1.4 V with 130 mV of hysteresis.

MinRange: The MinRange parameter allows the user to specify a minimum operating value in Hz. If the reading drops below this value, an underrange error is reported.

MaxRange: The MaxRange parameter allows the user to specify a maximum operating value in Hz. If the reading goes above this value, an overrange error is reported.

MinScale: The module linearly scales raw data (Hz) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale and MinRange/MaxRange parameters set by the user. For example, given a MinScale of 0.0, a MaxScale of 100.0, a MinRange of 0 and a MaxRange of 10,000, if the input to the channel is 5,000 Hz, the scaled value is 50.0 Hz.

MinScale can be any real number (Real numbers are valid between -3.4028E38 and +3.4028E38.).

MaxScale: MaxScale can be any real number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

Resolution: The EAM counts the number of pulses occurring in a measured length of time. The frequency of the waveform is calculated by dividing the number of pulses by the corresponding length of time. Increasing the resolution increases the length of time in which pulses are accumulated.

To meet certain application requirements, the selection of 10-bit resolution actually yields 11-bit resolution. This provides better than 0.06% accuracy, with a minimal delay.

2.2.5 EAM Current Pulse In-Freq

The Current Pulse In-Freq channel type returns a REAL variable.

Table 2-6 lists the softlist parameters for the Current Pulse Input-Frequency channel type.

Table 2–6 EAM Current Pulse In-Freq Softlist Parameters

PARAMETER	SELECTION	DEFAULT
InputRange	4-20 mA, 0-20 mA	0-20 mA
MinRange	0.0 to 45,000 Hz	0.0
MaxRange	0.0 to 45,000 Hz	45,000.0
MinScale	Any Real Number	0.0
MaxScale	Any Real Number	45,000.0
EngUnits	in, ft, mm, cm, m, in3, ft3, bbl, ml, liter, m3, lb, ton, mol, g, kg, ft/sec, m/sec,ft/sec2, msec2, DegF, DegR, DegC, DegK, psi, psia, psig, InH2O, InHg, ATM, kPa, kPaa, kPag, mmHg, kg/cm2, mbar, bar, lb/ft3, g/cm3, kg/m3, mol/m3, ft3/lb, m3/kg, ppm, pH, PPH, KPPH, t/day, kg/hr, kg/day, gal/min, GPM, GPH, GPD, ACFM, ACFH, SCCM, SCFH, SCFM, MCFH, yd3/hr, yd3/day, BPD, gal/hr, gal/day, m3/hr, m3/day, l/min, l/hr, l/day, mV, Volts, mA, AMPS, Ohms, mhos, W, kW, MW, Btu, Btu/SCF, Btu/lbm, Btu/hr, hp, bhp, vars, VA, kVA, joules, Percent, pulses, Hz, rpm, deg, rad, cal, cal/SCF, cal/hr, cal/lbm, kcal, kcal/SCF, kcal/hr, kcal/lbm	Hz
Resolution	10, 12, 14, 16 bit	12 bit

InputRange: Current Pulse In-Freq channels are configurable to operate with two current ranges, 4-20 mA or 0-20 mA. The threshold for both ranges is fixed at 10 mA, with a hysteresis of 0.5 mA.

MinRange: The MinRange parameter allows the user to specify a minimum operating value in Hz. If the reading drops below this value, an underrange error is reported.

MaxRange: The MaxRange parameter allows the user to specify a maximum operating value in Hz. If the reading goes above this value, an overrange error is reported.

MinScale: The module linearly scales raw data (Hz) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale and MinRange/MaxRange parameters set by the user. For example, given a MinScale of 0.0, a MaxScale of 100.0, a MinRange of 0, a MaxRange of 10,000, and if the input to the channel is 5,000 Hz, the scaled value is 50.0 Hz.

MinScale can be any real number (Real numbers are valid between -3.4028E38 and +3.4028E38.).

MaxScale: MaxScale can be any real number.

Units: Engineering units for the scaled value can be selected from a list of common engineering units.

Resolution: The EAM counts the number of pulses occurring in a measured length of time. The frequency of the waveform is calculated by dividing the number of pulses by the corresponding time. Increasing the resolution increases the length of time in which pulses are accumulated.

To meet certain application requirements, the selection of 10-bit resolution actually yields 11-bit resolution. This provides better than 0.06% accuracy with a minimal delay.

2.2.6 EAM Voltage Pulse In-Total

The EAM Voltage Pulse In-Total channel type returns a UDINT variable.

The EAM Voltage Pulse In-Total channel type must be used with the EAM_TOT function block. For more information on this function block, refer to *APACS+ ACM Standard Function Blocks Version 4.40 or Higher Configuration Guide* (document number CG39-22).

Table 2-7 shows the softlist parameter for the EAM Voltage Pulse Input-Total channel type.

Table 2–7 EAM Voltage Pulse In-Total Softlist Parameter

PARAMETER	SELECTION	DEFAULT
Threshold	Regular, TTL	Regular

Threshold: The user can select the threshold for voltage input pulses. The Regular threshold is 2.5 V, with 130 mV of hysteresis. The TTL threshold is 1.4 V, with 130 mV of hystersis.

2.2.7 EAM Current Pulse In-Total

The Current Pulse In-Total channel type returns a UDINT variable.

The Current Pulse In-Total channel type must be used with the EAM_TOT function block.

Table 2-8 shows the softlist parameter for the EAM Current Pulse In-Total:

Table 2–8 EAM Current Pulse In-Total Softlist Parameter

PARAMETER	SELECTION	DEFAULT
InputRange	4-20 mA, 0-20 mA	0-20 mA

InputRange: Current Pulse In-Total channels are configurable to operate with two current ranges, 4-20 mA or 0-20 mA. The threshold for both ranges is fixed at 10 mA, with a hysteresis of 0.5 mA.

NOTE

Selecting 0-20 mA disables "open-input" diagnostic errors.

2.2.8 EAM Disc In Voltage

The EAM Disc In Voltage channel type returns a BOOL variable.

Table 2-9 shows the softlist parameters for the EAM Discrete Input Voltage channel type.

Table 2–9 EAM Disc In Voltage Softlist Parameters

PARAMETER	SELECTION	DEFAULT
MinOnStatePct	0.0 to 100	80.0
MaxOffStatePct	0.0 to 100	20.0

MinOnStatePct: The reading is automatically scaled from 0-5 V to 0-100%. A scaled reading greater than or equal to MinOnStatePct will report a boolean TRUE to the controller.

MaxOffStatePct: The reading is automatically scaled from 0-5 V to 0-100%. A reading less than or equal to MaxOffStatePct will report a boolean FALSE to the controller.

2.2.9 EAM Disc In Current

The EAM Disc In Current channel type returns a BOOL variable.

Table 2-10 shows the softlist parameters for the EAM Discrete Input Current channel type.

Table 2–10 EAM Disc Input Current Softlist Parameters

PARAMETER	SELECTION	DEFAULT
MinOnStatePct	0.0 to 100	80.0
MaxOffStatePct	0.0 to 100	20.0

MinOnStatePct: The reading is automatically scaled from 0-20 mA to 0-100%. A scaled reading greater than or equal to MinOnStatePct reports a boolean TRUE to the control module.

MaxOffStatePct: The reading is automatically scaled from 0-20 mA to 0-100%. A reading less than or equal to MaxOffStatePct reports a boolean FALSE to the control module.

2.2.10 EAM Disc Out

The EAM Disc Out Channel type accepts a BOOL variable.

Table 2-11 shows the softlist parameters for the EAM Disc Output channel type.

Table 2–11 EAM Disc Output Softlist Parameters

PARAMETER	SELECTION	DEFAULT
IOBUSFault	OFF, ON, HOLD_LAST_STATE	OFF
FailSafe	ENABLED, DISABLED	DISABLED

IOBUSFault: Each EAM Disc Output channel can be configured to respond to an IOBUS fault (loss of communications with the controller) in a particular manner. The available fault states are:

OFF Output is turned off.
ON Output is turned on.
HOLD_LAST_STATE Output holds its last value.

NOTE

All channels power up in the OFF state.

FailSafe: If FailSafe is enabled and an error condition exists for which the channel cannot be turned off individually, then all channels of the module are powered down. The user may wish to configure an output as FailSafe that is critical to the process or that may present a hazard to personnel or equipment. ■

3.0 HART® Fieldbus Module (HFM)

The HART® Fieldbus Module (HFM) is an I/O module that integrates smart transmitters with the APACS+ system. Smart transmitters that incorporate the HART protocol, such as the Siemens XTC and Rosemount products, are supported. The HFM provides analog input and digital (HART) communication with the transmitter. For most transmitters, the HFM can completely configure the parameters in the transmitter. Configuration is performed by editing the softlist for each channel. The HFM can also connect to a non-smart transmitter that simply uses a 4 to 20 mA signal.

3.1 HFM Transmitter Connections

The HFM has 16 "fieldbuses" to which transmitters are wired. A fieldbus consists of a set of four screw terminals, PWR, VIN, COM and SHLD. The fieldbus number is silkscreened on the HFM termination strip (16112-21) or marshalled termination assembly (16191-1). Refer to the service instructions (document number SD39HFM) on the HFM for wiring and power supply information. Note that the HFM has an on-board power supply that can output up to 360 mA to power transmitters (a total of 90 transmitters can be powered with 360 mA). An external power supply (28VDC) can be connected to the termination strip for backup or additional power.

Transmitters can be connected to an HFM in single-drop or multi-drop mode. Note that any mix of single-drop and multi-drop fieldbuses is permitted on a single HFM. In single-drop mode, one transmitter is wired to a fieldbus, and the HFM provides a fast update of the analog value from the transmitter. Transmitters that are providing a process variable for use in control algorithms in an ACM are typically connected in single-drop mode. The poll address of the transmitter should be set to 0 during single-drop mode. For a normal transmitter, a poll address of 0 causes the analog current to respond proportionally to the primary variable. However, for an XTC with controller enabled, the analog current corresponds to the valve signal, which typically drives an I/P transducer or valve positioner.

In multi-drop mode, up to eight transmitters can be wired to a single fieldbus. Each transmitter must be assigned a unique poll address from 1 to 15, which will park each transmitter's current to 4 mA. XTC transmitters with the controller enabled should not be connected in multi-drop mode. Note that although the HART specification indicates that 15 transmitters can be wired on a single fieldbus, we have chosen the limit to be eight in order to provide reasonable HART communication updates.

To summarize the capacities, 16 HART transmitters (one per fieldbus) can be connected to a HFM in single-drop mode. XTC transmitters with controller enabled must be connected in single-drop mode, and therefore up to 16 can be connected to one HFM. A maximum of 90 HART transmitters with up to eight per fieldbus can be connected to a HFM in multi-drop mode without an external supply or up to 128 HART transmitters with an external supply.

3.2 HFM I/O Configuration

Similar to other APACS+ I/O modules, each field device (transmitter) is assigned a channel number in the I/O channel table. Along with the channel number, the user identifies the channel type, which in this case selects what type of transmitter will be connected. The channel types are listed in section 3.4. The user can also enter a TagName that will become the global variable name for that I/O channel in the APACS+

system. (The default tagname is the physical address, RxxSxxCxxx). This value is updated every scan of the IOBUS. An I/O global TagName is delimited by the preceding percent symbol (%).

Note that the specific transmitter value that corresponds to the global TagName depends on the chosen channel type. For example, if the channel type is Siemens XTC w/Controller, then the global TagName corresponds to the digitally-read ProcessVariable. If the channel type is Generic XMTR SingleDrop, then the global TagName is the analog current signal that corresponds to the primary variable.

Each transmitter or channel number has a softlist with additional parameters to configure and view. It is important to configure the Fieldbus_Number parameter properly because this identifies the physical set of screws to which a transmitter is wired. Since it is possible to have multiple transmitters wired on a Fieldbus, several channel numbers may have the same Fieldbus_Number. However, the channel number, from 1 to 128, is always unique for each device. Each channel has a default Fieldbus. Table 3-1 shows the default Fieldbus_Number for each channel.

Table 3–1 Channel Default Fieldbus Number

FIELDBUS NUMBER	CHANNELS							
1	1	17	33	49	65	81	97	113
2	2	18	34	50	66	82	98	114
3	3	19	35	51	67	83	99	115
4	4	20	36	52	68	84	100	116
5	5	21	37	53	69	85	101	117
6	6	22	38	54	70	86	102	118
7	7	23	39	55	71	87	103	119
8	8	24	40	56	72	88	104	120
9	9	25	41	57	73	89	105	121
10	10	26	42	58	74	90	106	122
11	11	27	43	59	75	91	107	123
12	12	28	44	60	76	92	108	124
13	13	29	45	61	77	93	109	125
14	14	30	46	62	78	94	110	126
15	15	31	47	63	79	95	111	127
16	16	32	48	64	80	96	112	128

3.3 HFM Module Scope Parameters

Table 3-2 lists the Module Scope softlist parameters for the HFM.

Table 3–2 HFM Module Scope Softlist Parameters

PARAMETER	SELECTION	DEFAULT
ScanRate	T#100ms	T#100ms
FB_01_Timeout	256-10,000	256
FB_01_Preambles	5-40	5
FB_02_Timeout	256-10,000	256
FB_02_Preambles	5-40	5
FB_03_Timeout	256-10,000	256
FB_03_Preambles	5-40	5
FB_04_Timeout	256-10,000	256
FB_04_Preambles	5-40	5
FB_05_Timeout	256-10,000	256
FB_05_Preambles	5-40	5
FB_06_Timeout	256-10,000	256
FB_06_Preambles	5-40	5
FB_07_Timeout	256-10,000	256
FB_07_Preambles	5-40	5
FB_08_Timeout	256-10,000	256
FB_08_Preambles	5-40	5
FB_09_Timeout	256-10,000	256
FB_09_Preambles	5-40	5
FB_10_Timeout	256-10,000	256
FB_10_Preambles	5-40	5
FB_11_Timeout	256-10,000	256
FB_11 Preambles	5-40	5
FB_12_Timeout	256-10,000	256
FB_12_Preambles	5-40	5
FB_13_Timeout	256-10,000	256
FB_13_Preambles	5-40	5
FB_14_Timeout	256-10,000	256
FB_14_Preambles	5-40	5
FB_15_Timeout	256-10,000	256
FB_15_Preambles	5-40	5
FB_16_Timeout	256-10,000	256
FB_16_Preambles	5-40	5

To view/edit the Module Scope parameters, place the cursor on the desired Module in the module tree and select the Edit, Object/Item menu item. The Hardware Modules dialog box opens. Choose the Softlist command button. The Module Scope Softlist dialog box opens.

ScanRate: The effective scan rate of the HFM analog Inputs and collection of scan data can be changed. If the HFM cannot scan at the ACM rate, the HFM will bump up its scan rate by the ACM rate until the scan rate is managed by the HFM.

FB_01_Timeout thru FB_16_Timeout Each Fieldbus Timeout parameter determines the amount of time a Fieldbus will wait before reporting that the command sent did not receive a response. The time unit is milliseconds and the allowable range of values is 256 to 10,000.

FB_01_Preambles Thru FB_16_Preambles Each Fieldbus Preamble parameter determines the number of hexadecimal "F" characters prefixed to the HART command. These characters give HART devices a warning that a command is coming. The allowable range of values is 5 to 40.

3.4 HFM Channel Types

This section describes the channel types and softlist parameters for the HFM and includes Table 3-3, HFM Channel Types and Related Softlist Parameters.

Each channel type in the HFM has many of the same parameters. Because of the large number of HFM parameters, a “shorthand” list of the parameters, with those that apply to each channel type indicated, is provided in Table 3-3. This section also provides other tables listing all of the HFM softlist parameters for transmitters and those for the Model 348 FieldPac.

Table 3–3 HFM Channel Types and Related Softlist Parameters

CHANNEL TYPE	SOFTLIST PARAMETER	GLOBAL VALUE
Siemens XTC SingleDrop	All but parameters 60-88	Analog-read process variable
Siemens XTC w/Controller	All but parameters 51,52,54,55	HART-read process variable
Siemens XTC MultiDrop	All but parameters 51,52,54,55 from standard list.	HART-read process variable
Generic XMTR SingleDrop	All but parameters 18,19,24-26,38,44-46 from standard list.	Analog-read primary variable
Generic XMTR MultiDrop	All but parameters 18,19,24-26,38,44-46,51, 52,54,55 from standard list.	HART-read primary variable
Analog Only	Only parameters 51-55 from standard list.	Analog-read current input
Siemens 348 FieldPac	All but parameters 18,19,24-26,38,44-46,51, 58 from standard list, plus those in FIELDPAC specific list.	HART-Read Process Variable

The complete list of softlist parameters is shown in the following tables. The transmitter softlist parameters (parameter numbers 1 through 59), shown in the standard table, are standard for **each** channel type. Softlist parameters 56-58 were intentionally omitted. Each channel type that requires parameters beyond the standard list will begin these parameters at parameter number 60. These additional parameters are shown in additional lists. The parameter numbers shown here will not appear in the *4-mation* softlist, however, they are significant. These parameter numbers appear in Siemens internal diagnostic software that can be used during staging to help find configuration problems.

Depending on the channel type, the HFM will provide the indicated global value as part of the IOBUS scan update. Scaling of the global value is accomplished by the softlist parameters, as noted below, depending on the channel type.

Siemens XTC SingleDrop	PV_Range_Lo and _Hi scale the process variable. MinScale and MaxScale parameters are automatically set equal to PV_Range _Lo and PV_Range_Hi respectively.
Siemens XTC w/Controller	PV_Range_Lo and _Hi scale the process variable. MinScale and MaxScale parameters are not provided.
Siemens XTC MultiDrop	PV_Range_Lo and _Hi scale the process variable. MinScale and MaxScale parameters are not provided.
Generic XMTR SingleDrop	PV_Range_Lo and _Hi scale the process variable. MinScale and MaxScale parameters are automatically set equal to PV_Range _Lo and PV_Range_Hi respectively.
Generic XMTR MultiDrop	PV_Range_Lo and _Hi scale the percent-of-range value read from the transmitter to calculate the process variable.
Analog Only	MinScale and MaxScale parameters scale the analog current input.
Siemens 348 FIELDPAC	PV_Range_Lo and _Hi scale the process variable.

The channel type assigned must be the correct type for the device. If the assigned channel type does not match the actual device connected, the Generic HART device type will be used.

Table 3-4 lists the standard softlist parameters for all channel types.

Table 3–4 Standard Softlist Parameters

NUMBER	TRANSMITTER PARAMETER	SELECTION	DEFAULT
1	Fieldbus_Number	1-16	See Table 3-1
2	Poll_Address	0-15	Defaults to 0 for single- drop channel
3	Transmitter_Tag	*** (8 char)	"
4	OverwriteXmtrCfg	TRUE, FALSE	FALSE
5	Descriptor	*** (16 char)	"
6	Message_Part_A	*** (16 char)	"
7	Message_Part_B	*** (16 char)	"
8	Date_Month	1-12	12
9	Date_Day	1-31	1
10	Date_Year	00 - 99	93
11	DeviceSerialNum	0 - 16,777,214	0d
12	MeasuredVariable	N/A	N/A - Read Only
13	MV_Units	***	0
14	MV_Range_Lo	***	0.0
15	MV_Range_Hi	***	0.0
16	Damping	***	0.0
17	TransferFunction	0=Linear, 1=SQ Root	0
18	InputType	0=Narrow mV, 1=R thermocouple (tc), 2=S tc, 3=T tc, 4=B tc	0
19	BurnoutDirection	0=Upscale, 1=Downscale	0
20	ProcessVariable	N/A	N/A - Read Only
21	PV_Units	(4 char)	ENGU
22	PV_Range_Lo	***	0.0000
23	PV_Range_Hi	***	100.00
24	AutoRerange	TRUE, FALSE	FALSE
25	LocalDisplayCode	0=Percent, 1=Measured, Variable, 2=Process Variable	0
26	FailsafeLevel	0=Lo, 1=Hi, 2=LPBFS	0
27	Current	4 to 20 mA fixed current	0
28	PercentOfRange	N/A	N/A - Read Only
29	Manuf_ID_Code	N/A	N/A - Read Only
30	DeviceTypeCode	N/A	N/A - Read Only
31	DeviceID_Number	N/A	N/A - Read Only
32	SensorSerialNum	N/A	N/A - Read Only
33	SensorLimitUnits	***	N/A - Read Only
34	LowerSensorLimit	***	N/A - Read Only
35	UpperSensorLimit	***	N/A - Read Only
36	Minimum_Span	***	N/A - Read Only

NUMBER	TRANSMITTER PARAMETER	SELECTION	DEFAULT
37	AlarmSelectCode	0=High, 1=Low	N/A - Read Only
38	MooreModelNum	***	N/A - Read Only
39	SupplierCode	N/A	N/A - Read Only
40	DataBaseRevNum	N/A	0
41	S_H_RevLevels	N/A	N/A - Read Only
42	Misc_Status	See description below	0
43	DeviceStatus	See description below	0
44	MooreStatus	See description below	0
45	MooreTransState	3=Off-line, 5=On-line, 7=Configuration Hold	N/A - Read Only
46	MooreDeviceError	0=no error, 1=Communication Error, 2=ROM Error, 3=RAM Error, 4=EEPROM Error, 5=Watchdog Error, 6=Sensor Error	N/A - Read Only
47	DeviceErrStat_1	***	N/A - Read Only
48	DeviceErrStat_2	***	N/A - Read Only
49	DeviceErrorMsg	N/A	N/A - Read Only
50	WriteRspMessage	N/A	N/A - Read Only
51	MinScale	Any Real Number	0.0
52	MaxScale	Any Real Number	100.0
53	EngUnits	in, ft, mm, cm, m, in3, ft3, bbl, ml, liter, m3, lb, ton, mol, g, kg, ft/sec, m/sec,ft/sec2, msec2, DegF, DegR, DegC, DegK, psi, psia, psig, InH2O, InHg, ATM, kPa, kPaa, kPag, mmHg, kg/cm2, mbar, bar, lb/ft3, g/cm3, kg/m3, mol/m3, ft3/lb, m3/kg, ppm, pH, PPH, KPPH, t/day, kg/hr, kg/day, gal/min, GPM, GPH, GPD, ACFM, ACFH, SCCM, SCFH, SCFM, MCFH, yd3/hr, yd3/day, BPD, gal/hr, gal/day, m3/hr, m3/day, l/min, l/hr, l/day, mV, Volts, mA, AMPS, Ohms, mhos, W, kW, MW, Btu, Btu/SCF, Btu/lbm, Btu/hr, hp, bhp, vars, VA, kVA, joules, Percent, pulses, Hz, rpm, deg, rad, cal cal/SCF, cal/hr, cal/lbm, kcal, kcal/SCF, kcal/hr, kcal/lbm	Percent
54	DigFiltTimeCnst	0.0 to 159.0 sec	0.0
55	StepResponseTime	0.050 to 2.000 sec	1.0
59	CommErrorRate	0	0

N/A indicates not applicable.

*** indicates “refer to the appropriate transmitter documentation.”

NOTE

Because all Siemens devices use packed ASCII for the parameters of string data type, any changes to these parameters must be entered in uppercase letters.

Table 3-5 is a list of the transmitter with controller specific softlist parameters.

Table 3–5 Transmitter with Controller Softlist Parameters

NUMBER	XTC w/CONTROLLER PARAMETER	SELECTION	DEFAULT
60	LoopProcess	N/A	N/A - Read Only
61	LoopSetpoint	***	0.0
62	LoopValve	***	0.0
63	LoopStatus	See description below	0
64	AutomaticMode	TRUE =Automatic FALSE=Manual	FALSE
65	ControllerOn	TRUE, FALSE	TRUE
66	ControllerType	1=PID,2=PD,3=ID	1
67	DirectAction	TRUE=Direct, FALSE=Reverse	TRUE
68	LoopPG	***	1.0000
69	LoopTI	***	100.00
70	LoopTD	***	0.0000
71	LoopDG	***	10.000
72	LoopMR	***	0.0000
73	ManualResetTrack	TRUE, FALSE	FALSE
74	TrackingSetpoint	TRUE, FALSE	FALSE
75	PowerUpSetpoint	***	50.0
76	PowerUpManual	TRUE=Manual, FALSE=Automatic	FALSE
77	AutoModeOnly	TRUE, FALSE	FALSE
78	PowerUpValve	-1.0 to 110.0	0.0
79	AlarmStatus	See description below	N/A
80	AlarmCommand	***	0
81	ALARM1_Enable	TRUE=Enabled , FALSE=disabled	FALSE
82	ALARM1_Limit	***	0.0
83	ALARM1_Type	0=LOW, 1=HIGH	0
84	ALARM2_Enable	TRUE=Enabled , FALSE=disabled	FALSE
85	ALARM2_Limit	***	0.0
86	ALARM2_Type	0=LOW, 1=HIGH	0
87	SelfClearingNaks	TRUE, FALSE	FALSE
88	AlarmsOutOfServ	TRUE, FALSE	FALSE

N/A indicates not applicable.

*** indicates "refer to the appropriate transmitter documentation."

Table 3-6 lists the 348 FIELDPAC specific softlist parameters.

Table 3–6 Model 348 FIELDPAC Softlist Parameters

NUMBER	348 FIELDPAC PARAMETER	SELECTION	DEFAULT
60	LoopNumber	1=Loop1, 2=Loop2	1
61	LoopTagName (LD)	(12 char)	"
62	ProcessVariable (LD)	N/A	0.0
63	PV_Units (LD)	(4 char)	"
64	PV_Range_Hi (LD)	***	100.0
65	PV_Range_Lo (LD)	***	0.0
66	Setpoint (LD)	***	0.0
67	Valve (LD)	***	0.0
68	LoopStatus (LD)	See description below	0u
69	AutomaticMode (LD)	TRUE=Automatic FALSE=Manual	TRUE
70	ConsoleMode (LD)	TRUE=Console FALSE=Local	FALSE
71	ControllerOn (LD)	TRUE=On, FALSE=Off	TRUE
72	DirectAction (LD)	TRUE=Direct, FALSE=Reverse	TRUE
73	AlarmStatus (LD)	See description below	0u
74	AlarmCommand (LD)	See description below	0u
75	StationStatus	See description below	0u
76	LoopPG (LD)	***	1.0
77	LoopTI (LD)	***	100.0
78	LoopTD (LD)	***	0.0
79	LoopDG (LD)	***	10.0
80	LoopMR (LD)	***	0.0
81	TargetSetpoint (LD)	***	1.0
82	RampTime (LD)	***	0.0
83	RampRate (LD)	***	0.0
84	Ramp (LD)	TRUE=Ramp, FALSE=DoNotRamp	FALSE
85	HiLimit (LD)	***	100.0
86	LoLimit (LD)	***	0.0
87	VariableX	N/A	0.0
88	X_Units	(4 char)	"
89	X_Range_HI	***	0.0
90	X_Range_Lo	***	0.0
91	VariableY	N/A	0.0
92	Y_Units	(4 char)	0.0
93	Y_Range_HI	***	0.0
94	Y_Range_Lo	***	0.0
95	FB98_IND	N/A	0.0

NUMBER	348 FIELDPAC PARAMETER	SELECTION	DEFAULT
96	FB98_INE	N/A	0.0
97	FB98_INF	N/A	0.0
98	FB98_ING	N/A	0.0
99	FB98_70	***	0.0
100	FB98_71	***	0.0
101	FB98_72	***	0.0
102	FB98_73	***	0.0
103	FB98_74	***	0.0
104	Ratio	***	0.0
105	Bias	***	0.0
106	Preset1	***	0.0
107	Preset2	***	0.0
108	TotalizerCounts	N/A	0.0
109	TotalizeMult	***	0.0
110	TotalizerUnits	(4 char)	"
111	HoldOutput	N/A	0.0
112	ALARM1_Enable (LD)	TRUE=Enabled , FALSE=disabled	FALSE
113	ALARM2_Enable (LD)	TRUE=Enabled , FALSE=disabled	FALSE
114	ALARM3_Enable (LD)	TRUE=Enabled , FALSE=disabled	FALSE
115	ALARM4_Enable (LD)	TRUE=Enabled , FALSE=disabled	FALSE
116	ALARM1_Limit (LD)	***	0.0
117	ALARM2_Limit (LD)	***	0.0
118	ALARM3_Limit (LD)	***	0.0
119	ALARM4_Limit (LD)	***	0.0
120	ALARM1_Type (LD)	See following description	0u
121	ALARM2_Type (LD)	See following description	0u
122	ALARM3_Type (LD)	See following description	0u
123	ALARM4_Type (LD)	See following description	0u

N/A indicates not applicable.
LD indicates loop dependent.
*** indicates "refer to the appropriate transmitter documentation."

3.5 Parameter Details

Some of the softlist parameters are explained in more detail below. For further explanation or a description of parameters not shown, refer to the appropriate manual(s) provided by the transmitter's manufacturer. For example, such reference documents from Siemens include AD340-10, AD340-80, AD340-510, AD344-10 and AD344-70. The Rosemount HART - Smart Communications Protocol manual should also be referenced as needed.

Fieldbus_Number (1 in Standard List): This parameter specifies the physical set of screws to which a transmitter or FIELDPAC is wired. Note that the same Fieldbus_Number can be used for more than one device, such as in multi-drop mode.

Poll_Address (2 in Standard List): The poll address must be set to 0 if the analog current is to be active. An address other than 0, will park the current at 4mA. For multi-drop operation, the poll address should be set 1 to 15 and should be unique for each device on that Fieldbus.

NOTE

If the poll address of a channel is written **while the device is communicating**, the poll address of the communicating device is changed; the HFM does NOT search for a new device with that poll address. The HFM does search for a device with the new poll address if the channel has never communicated with an actual device.

Transmitter_Tag (3 in Standard List): This is the eight character string stored in the transmitter.

OverWriteXmtrCfg (4 in Standard List): With the HFM's softlist, it is possible to configure a transmitter's database by entering the desired data in each softlist parameter. This configuration can be done without the presence of the HFM or the transmitter, such as in the off-line mode of *4-mation*. However, the transmitter will have its own database which may be different from that entered in the softlist. By setting this parameter to TRUE, the HFM will overwrite the configuration of the attached transmitter upon HFM power-up (writeable parameters only). If this parameter is FALSE, the transmitter's database will be uploaded during HFM power-up and overwrite the softlist. Note that this parameter is only executed during HFM power-up; during normal operation, changes made to the softlist or the transmitter will be processed in both databases as appropriate.

MV_Units (13 in Standard List): The measured variable unit descriptor is read and written as an integer number. Refer to the appropriate transmitter's HART communication manual for a look-up table.

SensorLimitUnits (33 in Standard List): The sensor limit unit descriptor is read and written as an integer number. Refer to the appropriate transmitter's HART communication manual for a look-up table.

Misc_Status (42 in Standard List): Each bit in this 16-bit word represents a status condition although the word is read as an integer. The bits that are editable are marked with an appended asterisk below. See the end of this section for information on how to change these bits.

Bit 01:	1=Issue HART Cmd #37 *****, magnitude of applied process becomes MV_Range_Lo.
Bit 02:	1=Issue HART Cmd #36 *****, magnitude of applied process becomes MV_Range_Hi.
Bit 03:	1=Issue HART Cmd #43 *****, zeroes the primary variable so it reads zero with the applied
Bit 04	Unused
Bit 05	Unused
Bit 06:	1=Controller Enabled ***** (XTC with Controller only)
Bits 09-16	Unused

DeviceStatus (43 in Standard List): Each bit in this 16-bit word represents a status condition, although the word is read as an integer. The following bits that are editable are marked with an appended asterisk. See the end of this section for information on how to change these bits. Note that bits 01 through 08 comprise the HART Field Device Status Word.

Bit 01: Primary variable out of limits
Bit 02: Non-Primary variable out of limits
Bit 03: Analog output saturated
Bit 04: Output in fixed current Mode
Bit 05: Reserved
Bit 06: Cold start occurred
Bit 07: Configuration change
Bit 08: Error
Bit 09: 1=Transmitter not communicating
Bit 10: Unused
Bit 11: 1=Square root enabled *****
Bit 12: 1=Write Command failed
Bit 13: Unused
Bit 14: 1=Device configuration change *****
Bit 15: 1=Device error NAK *****
Bit 16: 1=Device error

MooreStatus (44 in Standard List): Each bit in this 16-bit word represents a status condition although the word is read as an integer. The following bits that are editable are marked with an appended asterisk. See the end of this section for information on how to change these bits.

Bit 01: 1=AutoRerange enabled *****
Bit 02: 1=Pushbutton enabled
Bit 03: 1=Write protect mode *****
Bit 04-16: Unused

MooreTransState (45 in Standard List): This parameter indicates the state of the HART device. The possible states are: 3=Off-line, 5=On-line, and 7=Configuration Hold. If other states are obtained, call your Siemens representative for assistance.

MooreDeviceError (46 in Standard List): This parameters indicates the Moore device errors.

DeviceErrStat_1 (47 in Standard List): See appropriate transmitter HART manual.

DeviceErrStat_2 (48 in Standard List): See appropriate transmitter HART manual.

DeviceErrorMsg (49 in Standard List): The HFM will return a message that describes selected error conditions.

WriteRspMessage (50 in Standard List): The HFM will return a message in response to selected writes to the transmitter. This message automatically clears after a successful write.

MinScale (51 in Standard List): The module will linearly scale raw data (4-20 mA) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale parameters set by the user. For example, assume values of MinScale of 0.0 and a MaxScale of 100.0. If the input to the channel is 12mA, the scaled value will be 50.0. Note that for some channel types, MinScale will be automatically set equal to PV_Range_Lo. MinScale can be any REAL number (REAL numbers are valid between -3.4028E38 and +3.4028E38).

MaxScale (52 in Standard List): MaxScale can be any REAL number. Note that for some channel types, MaxScale will be automatically set equal to PV_Range_Hi.

EngUnits (53 in Standard List): Engineering units for the scaled value may be selected from a list of common engineering units.

DigFiltTimeCnst (54 in Standard List): Digital filtering can be applied to analog input signals to reduce the effects of electrical noise. The digital filter is a first order lag, adjustable for time constants of 0.0159 to 159.0 seconds. Equivalent breakpoint frequencies are 10.0 to 0.001 Hz. The value can be increased for noisy signals.

StepResponseTime (55 in Standard List): This parameter determines the time for the channel to fully respond to a step input. A longer StepResponseTime will provide more accurate readings.

LoopStatus (63 in XTC w/Controller List and 68 in FIELDPAC List): Each bit in this 16-bit word represents a status condition, although the word is read as an integer. The following bits that are editable are marked with an appended asterisk. See the end of this section for information on how to change these bits.

- Transmitter Loop Status:

  Bit 01: Auto/Manual Status1 = Auto, 0 = Manual *****
  Bit 02-16: Unused

- FIELDPAC Loop Status:

  Bit 01: Auto/Manual Status, 1=Auto *****
  Bit 02: Local status *****
  Bit 03: Standby Sync
  Bit 04: External/Internal Status, 1=External *****
  Bit 05: Console Status *****
  Bit 06: Unused
  Bit 07: Setpoint Ramp Status *****
  Bit 08: Unused
  Bit 09: Emergency Manual
  Bit 10: User 1 or 2 Status
  Bit 11: High limit Exceeded
  Bit 12: Low Limit Exceeded
  Bit 13: Unused
  Bit 14: Unused
  Bit 15: Auto/Manual Transfer Function Block Configured
  Bit 16: 1 = Direct Valve Bar Action, 0 = Reverse

StationStatus (75 in FIELDPAC List): Each bit in this 16-bit word represents a status condition although the word is read as an integer. The following bits that are editable are marked with an appended asterisk. See the end of this section for information on how to change these bits.

Bit 01: Active Alarm Exists
Bit 02: Alarm Not Acknowledged
Bit 03: Flashing Bargraph
Bit 04: Unused
Bit 05: Configuration Hold *****
Bit 06: Unused
Bit 07: Unused
Bit 08: Console = 1, Local = 0 *****
Bit 09: Unused
Bit 10: Override Status Output of Function Block 10
Bit 11: Unused
Bit 12: Configuration Changed
Bit 13: Unused
Bit 14: Unused
Bit 15: Error
Bit 16: Unused

AlarmStatus (79 in Transmitter w/Controller List and 73 in FIELDPAC List): Each bit in this 16-bit word represents a status condition, although the word is read as an integer. The structure mimics that of the MYCRO Alarm Status Word. This parameter is edited using the AlarmCommand parameter (described below) so that the status word can be preserved.

NOTE

The transmitter-controller only has two alarms, so that bits 6-11 are unused in the Alarm Status parameter.

Bit 01: Alarm1 Exists
Bit 02: Alarm1 Not Acknowledged *
Bit 03: Alarm1 Enabled *
Bit 04: Alarm2 Exists
Bit 05: Alarm2 Not Acknowledged *
Bit 06: Alarm2 Enabled *
Bit 07: Alarm3 Exists
Bit 08: Alarm3 Not Acknowledged *
Bit 09: Alarm3 Enabled *
Bit 10: Alarm4 Exists
Bit 11: Alarm4 Not Acknowledged *
Bit 12: Alarm4 Enabled *
Bit 13: Alarms Out of Service * (XTC with Controller Only)

AlarmCommand (80 in Transmitter List and 74 in FIELDPAC List): Each bit in this 16-bit word represents a status condition identical to the AlarmStatus parameter described above. The 16-bit word is read and written as an integer. The bits that are editable are marked with an asterisk appended to the bit definitions shown above. See the end of this section for information on how to change these bits.

AlarmN_Type (120 through 123 in FIELDPAC List): Sets of bits in this 16-bit word determine the type and settings of the alarms. All bits in this word can be edited. Note that this word is NOT a status word so does NOT require the procedure outlined at the end of this section to modify the bits.

Bits	**3**	**2**	**1**	
	0	0	0	- No alarm action required
	0	0	1	- High alarm
	0	1	0	- Low alarm
	0	1	1	- High Deviation alarm
	1	0	0	- Low Deviation alarm
	1	0	1	- Absolute Deviation alarm
	1	1	0	- Out of Range alarm
	1	1	1	- No alarm action required

NOTE

XTC with Controller only has the High alarm or Low alarm options.

Bits	**5**	**4**	
	0	0	- 0.1% alarm deadband
	0	1	- 0.5% alarm deadband
	1	0	- 1.0% alarm deadband
	1	1	- 5.0% alarm deadband

NOTE

XTC with Controller only has 0.5% deadband option.

Bits	**8**	**7**	**6**	
	0	0	0	- 0.0 seconds delay time in
	0	0	1	- 0.4 seconds delay time in
	0	1	0	- 1.0 seconds delay time in
	0	1	1	- 2.0 seconds delay time in
	1	0	0	- 5.0 seconds delay time in
	1	0	1	- 15.0 seconds delay time in
	1	1	0	- 30.0 seconds delay time in
	1	1	1	- 60.0 seconds delay time in

Bits 11 10 9

0	0	0	- 0.0 seconds delay time out
0	0	1	- 0.4 seconds delay time out
0	1	0	- 1.0 seconds delay time out
0	1	1	- 2.0 seconds delay time out
1	0	0	- 5.0 seconds delay time out
1	0	1	- 15.0 seconds delay time out
1	1	0	- 30.0 seconds delay time out
1	1	1	- 60.0 seconds delay time out

Bit 12

0 - Ring back not required
1 - RINGBACK

Bits 13 through 16 - set to 0

FIELDPAC parameters 81-84 come from the setpoint block (function block 17 if Loop1 and function block 68 if Loop2) in the 348. Consult the *348 Configuration Guide* (CG348-2) for details. Note the Loop Number softlist parameter determines to which 348 setpoint function block communication is made.

FIELDPAC parameters 85-86 come from the limit blocks (function block 08 if Loop 1 and 51 if Loop 2) in the 348. Consult the *348 Configuration Guide* (CG348-2) for details.

FIELDPAC parameters 87-94 come from the Link Display block (function block 15) in the 348. Consult the *348 Configuration Guide* (CG348-2) for details.

FIELDPAC parameters 95-103 come from the HART Interface block (function block 98) in the 348. Consult the *348 Configuration Guide* (CG348-2) for details.

Ratio (parameter 104 in the FIELDPAC List) comes from the RATIO function block (function block 07) in the 348. Consult the *348 Configuration Guide* (CG348-2) for details.

Bias (parameter 105 in the FIELDPAC List) comes from the BIAS function block (function block 08) in the 348. Consult the *348 Configuration Guide* (CG348-2) for details.

Parameters 106-110 come from the TOTALIZER function block (16) in the 348. Consult the *348 Configuration Guide* (CG348-2) for details.

Parameter 111 comes from the HOLD function block. Consult the 348 Configuration Guide (CG348-2) for details.

Parameters 112-123 are read from and written to the ALARM block (function block 12 if Loop 1 and 73 if Loop 2) of the 348. Note that the Loop Number softlist parameter determines to which 348 Alarm block the communication is made.

3.6 Changing Status Bits

Various bits in the HFM status parameters (Misc_Status, DeviceStatus, MooreStatus, LoopStatus) are editable. Most of these bits also have individual boolean softlist parameters for easy access, so it is not necessary to use the status words for writing. However, if desired, the following paragraphs describe the procedure.

Each bit that can be modified has an asterisk "*"appended to the bit definition. To change a specific bit to a 1, a mask on command is used. To change the bit to a 0, the mask off command is used. To create the mask on or mask off command:

1. In 16-bit binary format, put a 1 in the position of the bit to be masked-on/masked-off.

2. Bit position 16 (most significant bit position) in a 16 bit, one-based word is the mask-on bit. Place a 1 in this position for a mask-on command or a 0 for a mask-off command.

3. Determine the decimal equivalent of this binary number.

4. Select the status word in the softlist.

5. Enter the calculated decimal value in the edit box.

6. Choose the Change command button. The command is sent.

For example, to enable the write protect mode, a 1 should be placed both in bit position 03 of a 16-bit one-based word (because the write protect bit is bit 03), and in bit position 16 (because this is the mask-on bit). Then, the binary word is converted to decimal (1000 0000 0000 0100 = 32772). This decimal value is used to write to the MooreStatus softlist parameter.

■

4.0 Input Discrete Module (IDM)

The IDM interfaces discrete 115 or 230 Volt AC input devices with the controller's IOBUS. The IDM supports 32 AC inputs in eight isolated groups of four channels each. This allows AC inputs from different power sources to be connected to the same module. To isolate field faults, each channel is electrically isolated from the module's CPU, IOBUS, and ground.

4.1 IDM Module Scope Parameter

Table 4-1 shows the module scope softlist parameter for the IDM:

Table 4–1 IDM Module Scope Parameter

PARAMETER	SELECTION	DEFAULT
ScanRate	N/A	N/A

To view/edit the Module Scope Parameters, place the cursor on the desired Module in the module tree and select the Edit, Object/Item menu item. The Hardware Modules Dialog Box opens. Choose the "Softlist" command button. The Module Scope Softlist Dialog Box opens.

ScanRate: This is a read-only parameter that displays the current scan rate of the module.

4.2 IDM Channel Types

The following channel type is supported for the IDM module:

- IDM Disc In

4.2.1 IDM Disc In

The IDM Discrete Input (Disc In) channel type returns a boolean (BOOL) variable. Table 4-2 shows the Disc In softlist parameter for the IDM:

Table 4–2 IDM Disc In Softlist Parameter

PARAMETER	SELECTION	DEFAULT
InputFaultState	TRUE FALSE	TRUE

InputFaultState: When an input channel has a hardware failure that makes the channel value impossible to discern, the channel reports the value configured in this softlist parameter.

■

5.0 Isolated Discrete Input Modules (IDI)

The Isolated Discrete Input (IDI) modules are available in AC (IDI_AC) and DC (IDI_DC) versions.

5.1 IDI_AC Description

The IDI_AC module interfaces discrete 115 Vac input signals with a control module's IOBUS, supporting 16 isolated AC input channels. This enables AC inputs from different power sources to be connected to the same module. Each channel is electrically isolated from the module's CPU, IOBUS, and ground.

Event recording inputs are high-speed channels used in conjunction with the functions blocks of the Sequence of Events Recorder Function Block Library for detecting, monitoring, controlling, and recording discrete state changes (i.e. events). This data is collected by a Sequence of Events (SOE)-compatible module, such as the IDI_AC module, that is capable of high-speed event gathering. Events are stored to an array of strings. The data can then be viewed through the Sequence of Events Viewer, a utility program. Refer to the APACS+ Sequence of Events Viewer Operator's Guide (document number OG39SOE-2) for information on using this utility.

5.1.1 IDI_AC Module Scope Parameter

Table 5-1 shows the Module Scope softlist parameter for the IDI_AC module. To view/edit the module scope parameter, place the cursor on the desired module in the module tree. From the Main Menu bar, select the Edit, Object/Item to open the Hardware Modules dialog box. Press the Softlist command button to open the Module Scope Softlist dialog box.

Table 5–1 IDI_AC Module Scope Parameter

PARAMETER	SELECTION	DEFAULT
ScanRate	Not applicable	25 ms

ScanRate: This is a read-only parameter that displays the current scan rate of the module.

5.1.2 IDI Discrete AC Input Channel Type

The IDI Discrete AC Input channel type returns a boolean (BOOL) variable. Table 5-2 shows the softlist parameters for this channel type.

Table 5–2 Softlist Parameters for the IDI Discrete AC Input Channel Type

PARAMETER	SELECTION	DEFAULT
SOE_Recording	ENABLE, DISABLE	DISABLE
Description	Any 28 characters	‘’
EventPriority	1-4	1
AlarmState	TRUE, FALSE	FALSE

SOE_Recording: This parameter enables or disables SOE recording for this channel.

Description (only relevant if SOE_Recording is enabled)**:** This is a description, up to 28 characters, of the channel that is monitored for configuration by the Sequence of Events Recorder block. The description is formatted as a STRING data type. It is inserted as a substring within the EVENTS string of the Sequence of Events Recorder block.

EventPriority (only relevant if SOE_Recording is enabled)**:** This data is used for establishing an event’s priority. You can set a channel’s priority from 1 (highest) to 4 (lowest). This priority value can then be used to sort events, such as during the time that they are being formatted for viewing. This priority value is inserted within the EVENTS string of the Sequence of Events Recorder block.

AlarmState: This parameter is used to establish the alarm state of the channel. You can choose which state, TRUE or FALSE, represents an alarm condition. For example, if you set this parameter to TRUE, the channel is said to be **in alarm** when the channel’s value toggles from FALSE to TRUE. This also inserts an “A” character in the last character position in the EVENTS string of the Sequence Of Events block. Otherwise, it is an “N” character (no alarm).

5.2 IDI_DC Description

The IDI_DC module interfaces discrete 125 Vdc input signals with a control module's IOBUS, supporting 24 isolated DC input channels. This enables DC inputs from different power sources to be connected to the same module. Each channel is electrically isolated from the module's CPU, IOBUS, and ground.

Event recording inputs are high-speed channels used in conjunction with the function blocks of the Sequence of Events Recorder Function Block Library for detecting, monitoring, controlling, and recording discrete state changes (i.e. events). This data is collected by a Sequence of Events (SOE)-compatible module, such as the IDI, that is capable of high-speed event gathering. Events are stored to an array of strings. The data can then be viewed through the Sequence of Events Viewer, a utility program. Refer to the APACS+ Sequence of Events Viewer Operator's Guide (document number OG39SOE-2) for information on the use of this utility.

5.2.1 IDI_DC Module Scope Parameter

Table 5-3 shows the Module Scope softlist parameter for the IDI_DC module. To view/edit the module scope parameter, place the cursor on the desired module in the module tree. From the Main Menu bar, select the Edit, Object/Item to open the Hardware Modules dialog box. Press the Softlist command button to open the Module Scope Softlist dialog box.

Table 5–3 IDI_DC Module Scope Parameter

PARAMETER	SELECTION	DEFAULT
ScanRate	Not applicable	25 ms

ScanRate: This is a read-only parameter that displays the current scan rate of the module.

5.2.2 IDI Discrete DC Input Channel Type

The IDI Discrete DC Input channel type returns a boolean (BOOL) variable. Table 5-4 shows the softlist parameters for this channel type.

TABLE 5-4 IDI Discrete DC Output Softlist Parameters

PARAMETER	SELECTION	DEFAULT
SOE_Recording	ENABLE, DISABLE	DISABLE
Description	Any 28 char.	‘’
EventPriority	1-4	1
AlarmState	TRUE, FALSE	FALSE

SOE_Recording: This parameter enables or disables SOE recording for this channel.

Description (only valid if SOE_Recording is enabled)**:** This is a description, up to 28 characters, of the channel that is monitored for configuration by the Sequence of Events Recorder block. The description is formatted as a STRING data type. It is inserted as a substring within the EVENTS string of the Sequence of Events Recorder block.

EventPriority (only valid if SOE_Recording is enabled)**:** This data is used for establishing an event’s priority. You can set a channel’s priority from 1 (highest) to 4 (lowest). This priority value can then be used to sort events, such as during the time that they are being formatted for viewing. This priority value is inserted within the EVENTS string of the Sequence of Events Recorder block.

AlarmState: This parameter is used to establish the alarm state of the channel. You can choose which state, TRUE or FALSE, represents an alarm condition. For example, if you set this parameter to TRUE, the channel is said to be **in alarm** when the channel’s value toggles from FALSE to TRUE. This also inserts an ‘A’ character in the last character position in the EVENTS string of the Sequence Of Events block. Otherwise, it is an ‘N’ character (no alarm).

■

6.0 Isolated Discrete Output Modules (IDO)

The Isolated Discrete Output (IDO) modules are available in AC (IDO_AC) and DC (IDO_DC) versions.

6.1 IDO_AC Description

The IDO interfaces discrete 24 to 125 Vac output devices with a control module's IOBUS, supporting 16 isolated output channels. This enables outputs requiring different power sources to be connected to the same module. Furthermore, each channel is electrically isolated from the module's CPU, IOBUS, and ground.

6.1.1 IDO_AC Module Scope Parameter

Table 6-1 shows the Module Scope softlist parameter for the IDO_AC module. To view/edit the module scope parameter, place the cursor on the desired module in the module tree. From the Main Menu bar, select the Edit, Object/Item to open the Hardware Modules dialog box. Press the Softlist command button to open the Module Scope Softlist dialog box.

Table 6–1 IDO_AC Module Scope Parameter

PARAMETER	SELECTION	DEFAULT
ScanRate	Not applicable	25 ms

ScanRate: This is a read-only parameter that displays the current scan rate of the module.

6.1.2 IDO Discrete AC Output Channel Type

The IDO Discrete AC Output channel type accepts a boolean (BOOL) variable. Table 6-2 shows the softlist parameters for this channel type.

Table 6–2 Softlist Parameters for the IDO Discrete AC Output Channel Type

PARAMETER	SELECTION	DEFAULT
IOBUSFault	OFF, ON, HOLD	OFF
FailSafe	ENABLE, DISABLE	DISABLE
FieldWiringDiag	ENABLE, DISABLE	ENABLE
Readback	ENABLE, DISABLE	ENABLE
SOE_Recording	ENABLE, DISABLE	DISABLE
Description	Any 28 characters	‘’
EventPriority	1-4	1
AlarmState	TRUE, FALSE	FALSE

IOBUSFault: If the IDO module is unable to communicate with the control module (loss of IOBUS), the output is set to the IOBUSFault state. Once set to the IOBUSFault state, the diagnostic must be acknowledged for normal output updates to occur again.

FailSafe: When FailSafe is set to ENABLE, the module turns off the output via the diagnostic cut-off switch if diagnostics detect that the output is ON when it is supposed to be OFF.

FieldWiringDiag: These diagnostics determine whether an open-circuit is present on a channel that is currently OFF. Disabling FieldWiringDiag prevents the brief pulse ON required for these diagnostics from occurring. Note that loads of less than 50 mA (100 mA Node-to-Node redundant) may not be reported correctly by these diagnostics.

Readback: The IDO contains circuitry on every output to "read back" the actual output current. Readback is used to diagnose channel faults, such as an open circuit, short circuit, blown fuse on Marshalled Termination Assembly, module hardware fault field device hardware fault, or excessive current draw. Disabling Readback inhibits reporting of Readback-related diagnostics.

Disabling ReadBack does not disable the controller readback diagnostic.

SOE_Recording: This parameter enables or disables SOE recording for this channel.

Description (only valid if SOE_Recording is enabled)**:** This is a description, up to 28 characters, of the channel that is monitored for configuration by the Sequence of Events Recorder block. The description is formatted as a STRING data type. It is inserted as a substring within the EVENTS string of the Sequence of Events Recorder block.

EventPriority (only valid if SOE_Recording is enabled)**:** This data is used for establishing an event's priority. You can set a channel's priority from 1 (highest) to 4 (lowest). This priority value can then be used to sort events, such as during the time that they are being formatted for viewing. This priority value is inserted within the EVENTS string of the Sequence of Events Recorder block.

AlarmState: This parameter is used to establish the alarm state of the channel. You can choose which state, TRUE or FALSE, represents an alarm condition. For example, if you set this parameter to TRUE, the channel is said to be **in alarm** when the channel's value toggles from FALSE to TRUE. This also inserts an 'A' character in the last character position in the EVENTS string of the Sequence Of Events block. Otherwise, it is an 'N' character (no alarm).

6.2 IDO_DC Description

The IDO_DC module interfaces discrete 24 to 125 Vdc output devices with a control module's IOBUS, supporting 16 isolated output channels. This enables outputs requiring different power sources to be connected to the same module. Each channel is electrically isolated from the module's CPU, IOBUS, and ground.

6.2.1 IDO_DC Module Scope Parameter

Table 6-3 shows the Module Scope softlist parameter for the IDO_DC module. To view/edit the module scope parameter, place the cursor on the desired module in the module tree. From the Main Menu bar, select the Edit, Object/Item to open the Hardware Modules dialog box. Press the Softlist command button to open the Module Scope Softlist dialog box.

Table 6–3 IDO_DC Module Scope Parameter

PARAMETER	SELECTION	DEFAULT
ScanRate	Not applicable	25 ms

ScanRate: This is a read-only parameter that displays the current scan rate of the module.

6.2.2 IDO Discrete DC Output Channel Type

The IDO Discrete DC Output channel type accepts a boolean (BOOL) variable. Table 6-4 shows the softlist parameters for this channel type.

Table 6–4 IDO Discrete DC Output Softlist Parameters

PARAMETER	SELECTION	DEFAULT
IOBUSFault	OFF, ON, HOLD	OFF
FailSafe	ENABLE, DISABLE	DISABLE
FieldWiringDiag	ENABLE, DISABLE	ENABLE
Readback	ENABLE, DISABLE	ENABLE
SOE_Recording	ENABLE, DISABLE	DISABLE
Description	Any 28 characters	‘’
EventPriority	1-4	1
AlarmState	TRUE, FALSE	FALSE

IOBUSFault: If the IDO module is unable to communicate with the control module (loss of IOBUS), the output is set to the IOBUSFault state. Once set to the IOBUSFault state, the diagnostic must be acknowledged for normal output updates to occur again.

FailSafe: When FailSafe is set to ENABLE, the module turns off the output via the diagnostic cut-off switch if diagnostics detect that the output is ON when it is supposed to be OFF.

FieldWiringDiag: These diagnostics determine whether an open-circuit, normal load, or short circuit, is present on a channel that is currently OFF. Disabling FieldWiringDiag prevents the brief pulse ON required for these diagnostics from occurring. Note that loads of less than 50 mA (100 mA Node-to-Node redundant) may not be reported correctly by these diagnostics.

Readback: The IDO contains circuitry on every output to "read back" the actual output current. Readback is used to diagnose channel faults, such as an open circuit, short circuit, blown fuse on Marshalled Termination Assembly, module hardware fault field device hardware fault, or excessive current draw. Disabling Readback inhibits reporting of Readback-related diagnostics.

Disabling ReadBack does not disable the controller readback diagnostic.

SOE_Recording: This parameter enables or disables SOE recording for this channel.

Description (only valid if SOE_Recording is enabled)**:** This is a description, up to 28 characters, of the channel that is monitored for configuration by the Sequence of Events Recorder block. The description is formatted as a STRING data type. It is inserted as a substring within the EVENTS string of the Sequence of Events Recorder block.

EventPriority (only valid if SOE_Recording is enabled)**:** This data is used for establishing an event's priority. You can set a channel's priority from 1 (highest) to 4 (lowest). This priority value can then be used to sort events, such as during the time that they are being formatted for viewing. This priority value is inserted within the EVENTS string of the Sequence of Events Recorder block.

AlarmState: This parameter is used to establish the alarm state of the channel. You can choose which state, TRUE or FALSE, represents an alarm condition. For example, if you set this parameter to TRUE, the channel is said to be **in alarm** when the channel's value toggles from FALSE to TRUE. This also inserts an 'A' character in the last character position in the EVENTS string of the Sequence Of Events block. Otherwise, it is an 'N' character (no alarm).

■

7.0 Output Discrete Module (ODM)

The ODM interfaces discrete 115 Volt AC devices with the controller's IOBUS. The ODM supports 32 AC outputs in four isolated groups of eight channels each. This allows each group to use a separate power supply. Each group is individually fused with a 5 amp fuse to protect the group from a short circuit in the field wiring and prevents the short circuit from affecting other channel groups in the module. To isolate field faults, every output circuit is electrically isolated from the ODM's CPU, IOBUS, and ground.

7.1 ODM Module Scope Parameter

Table 7-1 shows the Module Scope softlist parameter for the ODM:

Table 7–1 ODM Module Scope Parameter

PARAMETER	SELECTION	DEFAULT
ScanRate	N/A	N/A

To view/edit the Module Scope Parameters, place the cursor on the desired Module in the module tree and select the Edit, Object/Item menu item. The Hardware Modules Dialog Box opens. Choose the "Softlist" command button. The Module Scope Softlist Dialog Box opens.

ScanRate: This is a read-only parameter that displays the current scan rate of the module.

7.2 ODM Channel Type

The following channel type is supported for the ODM.

- ODM Disc Out

7.2.1 ODM Disc Out

The Discrete Ouput (Disc Out) channel type accepts a boolean (BOOL) variable.

Table 7-2 shows the softlist parameters for the Disc Out channel type.

Table 7–2 ODM Discrete Output Softlist Parameters

PARAMETER	SELECTION	DEFAULT
IOBUSFault	OFF, ON, HOLD_LAST_STATE	OFF
FailSafe	ENABLED, DISABLED	DISABLED
Readback	ENABLED, DISABLED	ENABLED

IOBUSFault: Each output can be configured to respond to an IOBUS fault (loss of communications with the controller) in a particular manner. The available fault states are:

OFF	Output is turned off.
ON	Output is turned on.
HOLD_LAST_STATE	Output holds its last value.

NOTE

All channels power up in the OFF state.

FailSafe: Each output can be configured to turn off all module outputs in the group in the event that a channel is intended to be off, but diagnostics have determined that it is on or open-circuited. The user may wish to configure an output as FailSafe that is critical to the process or may present a hazard to personnel or equipment.

Readback: The state of an output channel is automatically "read back" by circuitry on the same channel. The Readback is used to diagnose and report faults. The user can disable Readback, which in turn disables the reporting of Readback-related faults (Output Open Circuit or Failed On, Output Failed Off, Critical Output Open Circuit or Failed On).

■

8.0 Resistance Temperature Module (RTM)

The RTM interfaces RTD and other resistance input signals to the controller's IOBUS. The RTM provides 16 configurable channels isolated into eight groups of two channels each. Each input circuit is isolated from the Module's CPU, IOBUS, and ground. In addition, each two-channel group is isolated from the other groups.

8.1 RTM Module Scope Parameter

Table 8-1 shows the Module Scope softlist parameter for the RTM:

Table 8–1 RTM Module Scope Parameter

PARAMETER	SELECTION	DEFAULT
ScanRate	NA	NA

To view/edit the Module Scope Parameters, place the cursor on the desired module in the module tree and select the Edit, Object/Item menu item. The Hardware Modules dialog box opens. Choose the "Softlist" command button. The Module Scope Softlist dialog box opens.

ScanRate: This is a read-only parameter that displays the current scan rate of the module. In general, the scan rate is the same as the scan rate of the ACM, but may be a multiple of the ACM's scan rate.

Shared_RTD: This parameter is no longer used.

8.2 RTM Channel Types

The following channel types are supported for the RTM module:

- RTM RTD Input
- RTM Resistance Input

8.2.1 RTM RTD Input

The RTD Input channel type returns a REAL variable.

Table 8-2 shows the softlist parameters for the RTD Input channel type.

Table 8–2 RTM RTD Input Softlist Parameters

PARAMETER	SELECTION	DEFAULT
RTD_Type	Pt_100_IEC/DIN Pt_100_JIC/SAMA Pt_200_IEC/DIN Pt_200_JIC/SAMA Ni_100 _DIN Linear	Pt_100_IEC/DIN
Alpha	Any Real Number	0.00385
Resistance	10.0 to 200.0 Ohms	100.0
Bias	Any Real Number	0.0
EngUnits	DegF, DegC, DegK, Deg R	Deg C
MinRange	Any Real Number >= MinRange of selected RTD	Min Range of selected RTD Type
MaxRange	Any Real Number <= MaxRange of selected RTD	Max Range of selected RTD Type
Scale_To_Percent	Yes_No Enforced by RTM board	No
Input_Fault_State	No_Change, MinRange, MaxRange	MinRange
DigFiltTimeCnst	0.0 to 159.0 sec.	0.016
StepResponseTime	0.100 to 40.000 sec.	1.0

RTD_Type: Select from the list of supported RTD types. If "Linear" is selected, the measured input, R, is linearized using a straight line approximation based on the Alpha, α, and Resistance, R_0, specified.

$$T(^\circ C) = \frac{R\,R_0}{\alpha\,R_0}$$

Alpha: Alpha is the average percent change in resistance per degree of a pure metal resistance device between 0 and 100º C. The most commonly used element material is standard platinum with a resistance of 100 Ohms at 0º C and a temperature coefficient of resistance of 0.00385 ohms/ohm/ºC (IEC 751 and DIN 43760).

This parameter need only be specified when the RTD type specified is "Linear."

Resistance: The resistance in ohms of the RTD at 0º C.

This parameter need only be specified when the RTD type specified is "Linear."

Bias: The user can enter a bias (in engineering units) on a per channel basis to compensate for known offsets. The bias value is added to the linearized input.

EngUnits: The user can select from the following engineering units: DegF, DegC, DegK, DegR

MinRange: MinRange is an optional parameter that allows the user to specify a minimum operating value in EngUnits. If the reading drops 5% below this value, an underrange error is reported.

MaxRange: MaxRange is an optional parameter that allows the user to specify a maximum operating value in EngUnits. If the reading goes 5% above this value, an overrange error is reported.

Scale_To_Percent: If Scale_To_Percent is TRUE, the linearized temperature reading, T, is scaled to a percent by the following formula:

$$\% = \frac{TMinRange}{MaxRangeMinRange} x100$$

Input_Fault_State: If a channel is faulted (Quality is set to BAD or QUESTIONABLE), the user can select to have the module return the actual reading (No_Change), the largest value for the channel (Maxscale), or the smallest value (Minscale). The default is to return the actual reading.

DigFiltTimeCnst: Digital filtering can be applied to RTD input signals to reduce the effects of electrical noise. The digital filter is a first-order lag, adjustable for time constants of 0.0159 to 159.0 seconds. Equivalent breakpoint frequencies are 10.0 to 0.001 Hz. The default value can be increased for noisy signals.

StepResponseTime: This parameter determines the time for the channel to fully respond to a step input. A longer StepResponseTime provides more accurate readings. The valid range is between 0.100 and 40.00 seconds.

8.2.2 RTM Resistance Input

The Resistance Input channel type returns a REAL variable.

DigFiltTimeCnst: This parameter sets the time constant of a low-pass digital filter applied to the input data. This filter reduces non-repetitive noise from the input data and can be disabled by setting this parameter to 0.0.

StepResponseTime: This parameter sets the length of a moving-average digital filter applied to the input data. It determines the time to fully respond to an input step. Increasing this parameter reduces periodic or repetitive input noise and improves repeatability and resolution. The recommended setting for this parameter is between 1.0 and 10.0 seconds.

Table 8-3 shows the softlist parameters for the RTM Resistance Input channel type.

Table 8–3 RTM Resistance Input Softlist Parameters

PARAMETER	SELECTION	DEFAULT
MinRange	15 to 1015 Ohms	15.0
MaxRange	15 to 1015 Ohms	1015.0
MinScale	Any Real Number	0.0
MaxScale	Any Real Number	100.0
EngUnits	in, ft, mm, cm, m, in3, ft3, bbl, ml, liter, m3, lb, ton, mol, g, kg, ft/sec, m/sec,ft/sec2, msec2, DegF, DegR, DegC, DegK, psi, psia, psig, InH2O, InHg, ATM, kPa, kPaa, kPag, mmHg, kg/cm2, mbar, bar, lb/ft3, g/cm3, kg/m3, mol/m3, ft3/lb, m3/kg, ppm, pH, PPH, KPPH, t/day, kg/hr, kg/day, gal/min, GPM, GPH, GPD, ACFM, ACFH, SCCM, SCFH, SCFM, MCFH, yd3/hr, yd3/day, BPD, gal/hr, gal/day, m3/hr, m3/day, l/min, l/hr, l/day, mV, Volts, mA, AMPS, Ohms, mhos, W, kW, MW, Btu, Btu/SCF, Btu/lbm, Btu/hr, hp, bhp, vars, VA, kVA, joules, Percent, pulses, Hz, rpm, deg, rad, cal, cal/SCF, cal/hr, cal/lbm, kcal, kcal/SCF, kcal/hr, kcal/lbm	Percent
Bias	Any Real Number	0.0
Input_Fault_State	No_Change, MinRange, MaxRange	MinRange
DigFiltTimeCnst	0.0 to 159.0 sec.	0.016
StepResponseTime	0.100 to 40.000 sec.	1.0

MinRange: MinRange is an optional parameter that allows the user to specify a minimum operating value in EngUnits. If the reading drops below this value, an underrange error is reported.

MaxRange: MaxRange is an optional parameter that allows the user to specify a maximum operating value in EngUnits. If the reading goes above this value, an overrange error is reported.

MinScale: The module will linearly scale raw data (ohms) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale and MinRange/MaxRange parameters set by the user. For example, given a MinScale of 0.0, a MaxScale of 100.0, a MinRange of 0, and a MaxRange of 1000, if the input to the channel is 500 Ohms, the scaled value will be 50.0.

MinScale can be any REAL number (REAL numbers are valid between -3.4028E38 and +3.4028E38).

MaxScale: MaxScale can be any REAL number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

Bias: The user can enter a bias (in engineering units) on a per channel basis to compensate for known offsets. The bias value is added to the linearized input.

Input_Fault_State: If a channel is faulted (Quality is set to “Bad” or “Questionable”), the user can select to have the module return the actual reading (No_Change), the largest value for the channel (Maxscale), or the smallest value (Minscale). The default is to return the actual reading.

DigFiltTimeCnst: Digital filtering can be applied to RIC input signals to reduce the effects of electrical noise. The digital filter is a first-order lag, adjustable for time constants of 0.0159 to 159.0 seconds. Equivalent breakpoint frequencies are 10.0 to 0.001 Hz. The default value can be increased for noisy signals.

StepResponseTime: This parameter determines the time for the channel to fully respond to a step input. A longer StepResponseTime provides more accurate readings. The valid range is between 0.100 and 40.00 seconds.

■

9.0 Standard Analog Input (SAI) Module

The SAI Module interfaces up to 32 channels of analog input signals from field devices to a control module's IOBUS.

9.1 SAI Module Scope Parameter

To view/edit the module scope parameter, place the cursor on the desired module in the module tree. From the Main Menu Bar, select the Edit, Object/Item to open the Hardware Modules dialog box. Press the Softlist command button to open the Module Scope Softlist dialog box.

Softlist Parameter

ScanRate: This is a read-only parameter that displays the current scan rate of the module. The scan rate is fixed at 25 msec. The SAI module scans asynchronous to the ACM.

9.2 SAI Channel Type

The SAI Analog In channel type for the SAI Module is described here.

The SAI Analog In channel type returns a REAL variable.

Softlist Parameters

MinScale: The module linearly scales raw data (4-20 mA) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale parameter values that you set. For example, given a MinScale of 0.0 and a MaxScale of 100.0. If the input to the channel is 12 mA, the scaled value is 50.0. MinScale can be any REAL number (REAL numbers are valid between -3.4028E38 and +3.4028E38)

MaxScale: MaxScale can be any REAL number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

DigFiltTimeCnst: Digital filtering can be applied to analog input signals to reduce the effects of electrical noise. The digital filter is a first order lag, adjustable for time constants of 0.0159 to 159.0 seconds (0.0 disables the filter). Equivalent breakpoint frequencies are 10.0 to 0.001 Hz. The default value can be increased for noisy signals.

Bias: You can enter a bias in engineering units, on a per channel basis, to compensate for known offsets. The bias value is added to the scaled input.

InputRange: SAI analog input channels are configurable to operate with one of two voltage ranges ranges:

1-5 Vdc (corresponds to current range 4 - 20 ma) (default)
0-5 Vdc (corresponds to current range 0 - 20 ma)

OpenCircuitTest: You can enable or disable open circuit testing. An open circuit condition exists if the reading is < 0.3.6 mA.

XTC_CriticalXMTR: When this parameter is TRUE, the Siemens Model 345 XTC Critical Transmitter limits are used for over/under range, open/short circuit, and transducer failure indications as defined in the following table. When this parameter is FALSE, the over/under range is extended to include the transmitter failure range, so transmitter failure is not reported. This parameter should be set to FALSE for non-critical transmitters.

Table 9–1 XTC_CriticalXMTR Analog Input Current Range Definitions

CURRENT RANGE (MA)	XTC_CriticalXMTR=TRUE	XTC_CriticalXMTR=FALSE
>=21.0	Short circuit (or transducer failed high)	Short circuit
>20.5 to <21.0	Transducer failed high	Over range
>20.0 to <20.5	Over range	Over range
20.0	MaxScale	MaxScale
4.0	MinScale	MinScale
>=3.8 to <4.0	Under range	Under Range
>3.6 to <3.8	Transducer failed (safe) low	Under Range
<=3.6	Open circuit (or transducer failed low)	Open circuit

10.0 Standard Analog Module (SAM)

The Standard Analog Module (SAM) can interface both analog and discrete I/O signals to the controller's IOBUS. The SAM provides 32 channels, each of which can be configured for standard I/O types. Related signals, such as the I/O for a particular loop, can be grouped together. To isolate field faults, each channel is electrically isolated from the Module's CPU, IOBUS, and ground. Also, each channel uses an isolated 24 V power source, and all channels are current-limited to protect against short circuits.

10.1 SAM Module Scope Parameter

Table 10-1 shows the Module Scope softlist parameter for the SAM:

Table 10–1 SAM Module Scope Parameter

PARAMETER	SELECTIONS	DEFAULT
ScanRate	N/A	N/A

To view/edit the module scope parameters, place the cursor on the desired module in the module tree and select the Edit, Object/Item menu item. The Hardware Modules dialog box opens. Choose the "Softlist" command button. The Module Scope Softlist dialog box opens.

ScanRate: This is a read-only parameter that displays the current scan rate of the module. In general, the scan rate is the same as the scan rate of the ACM, but may be a multiple of the ACM's scan rate.

10.2 SAM Channel Types

The following channel types are supported for the SAM module.

- SAM Analog In
- SAM Analog Out
- SAM Disc In
- SAM Disc Out

10.2.1 SAM Analog In

The SAM Analog Input (Analog In) channel type returns a real (REAL) variable.

Table 10-2 shows the softlist parameters for the SAM Analog In channel type.

Table 10–2 SAM Analog In Softlist Parameters

PARAMETER	SELECTION	DEFAULT
MinScale	Any Real Number	0.0
MaxScale	Any Real Number	100.0
EngUnits	in, ft, mm, cm, m, in3, ft3, bbl, ml, liter, m3, lb, ton, mol, g, kg, ft/sec, m/sec,ft/sec2, msec2, DegF, DegR, DegC, DegK, psi, psia, psig, InH2O, InHg, ATM, kPa, kPaa, kPag, mmHg, kg/cm2, mbar, bar, lb/ft3, g/cm3, kg/m3, mol/m3, ft3/lb, m3/kg, ppm, pH, PPH, KPPH, t/day, kg/hr, kg/day, gal/min, GPM, GPH, GPD, ACFM, ACFH, SCCM, SCFH, SCFM, MCFH, yd3/hr, yd3/day, BPD, gal/hr, gal/day, m3/hr, m3/day, l/min, l/hr, l/day, mV, Volts, mA, AMPS, Ohms, mhos, W, kW, MW, Btu, Btu/SCF, Btu/lbm, Btu/hr, hp, bhp, vars, VA, kVA, joules, Percent, pulses, Hz, rpm, deg, rad, cal, cal/SCF, cal/hr, cal/lbm, kcal, kcal/SCF, kcal/hr, kcal/lbm	Percent
DigFiltTimeCnst	0.0 to 159.0 sec	0.0
Bias	Any Real Number	0.0
OpenCircuitTest	ENABLED, DISABLED	ENABLED

MinScale: The module linearly scales raw data (4-20 mA) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale parameters set by the user. For example, given a MinScale of 0.0 and a MaxScale of 100.0, if the input to the channel is 12mA, the scaled value is 50.0.

MinScale can be any real (REAL) number (Real numbers are valid between -3.4028E38 and +3.4028E38.)

MaxScale: MaxScale can be any real (REAL) number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

DigFiltTimeCnst: Digital filtering can be applied to analog input signals to reduce the effects of electrical noise. The digital filter is a first-order lag, adjustable for time constants of 0.0159 to 159.0 seconds (0.0 disables the filter). Equivalent breakpoint frequencies are 10.0 to 0.001 Hz. The default value can be increased for noisy signals.

Figure 10-1 shows the step release time of the digital filter.

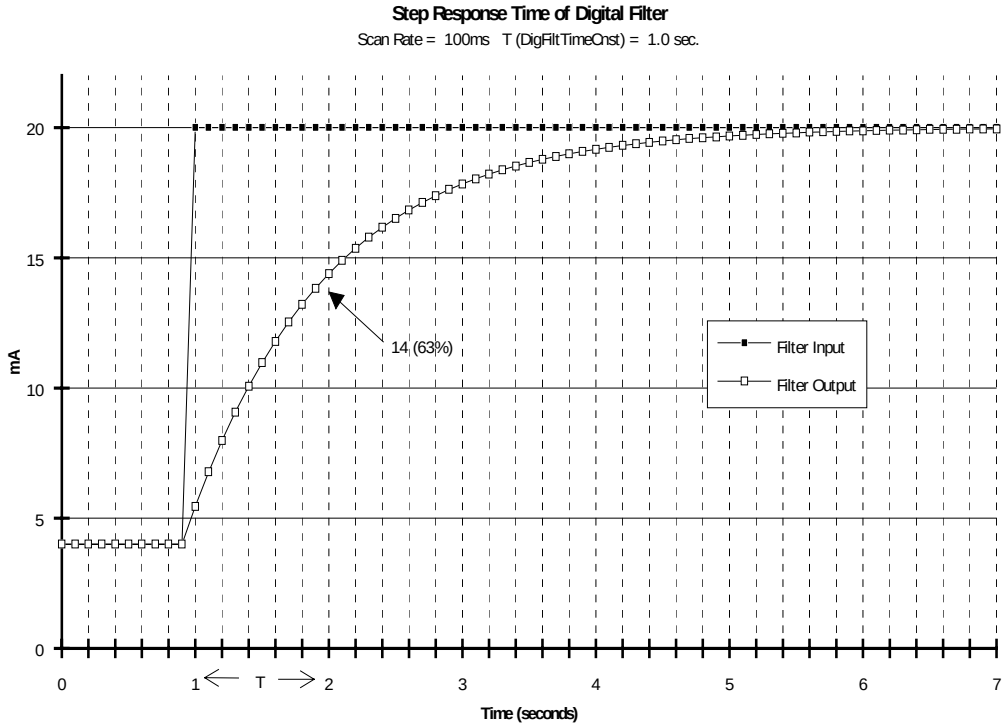


Figure 10–1 Step Time Response of Digital Filter

Bias: The user can enter a bias (in engineering units) on a per channel basis to compensate for known offsets. The bias value is added to the scaled input.

OpenCircuitTest: The user can enable or disable open circuit testing. An open circuit condition exists if the reading is < 0.2mA.

10.2.2 SAM Analog Out

The SAM Analog Output (Analog Out) channel type accepts a REAL variable.

Table 10-3 shows the softlist parameters for the SAM Analog Out channel type.

Table 10–3 SAM Analog Out Softlist Parameters

PARAMETER	SELECTION	DEFAULT
OutputRange	mA_4to20, mA_0to20	mA_4to20
MinScale	Any Real Number	0.0
MaxScale	Any Real Number	100.0
EngUnits	in, ft, mm, cm, m, in3, ft3, bbl, ml, liter, m3, lb, ton, mol, g, kg, ft/sec, m/sec,ft/sec2, msec2, DegF, DegR, DegC, DegK, psi, psia, psig, InH2O, InHg, ATM, kPa, kPaa, kPag, mmHg, kg/cm2, mbar, bar, lb/ft3, g/cm3, kg/m3, mol/m3, ft3/lb, m3/kg, ppm, pH, PPH, KPPH, t/day, kg/hr, kg/day, gal/min, GPM, GPH, GPD, ACFM, ACFH, SCCM, SCFH, SCFM, MCFH, yd3/hr, yd3/day, BPD, gal/hr, gal/day, m3/hr, m3/day, l/min, l/hr, l/day, mV, Volts, mA, AMPS, Ohms, mhos, W, kW, MW, Btu, Btu/SCF, Btu/lbm, Btu/hr, hp, bhp, vars, VA, kVA, joules, Percent, pulses, Hz, rpm, deg, rad, cal, cal/SCF, cal/hr, cal/lbm, kcal, kcal/SCF, kcal/hr, kcal/lbm	Percent
IOBUSFault	OFF, HOLD_LAST_STATE, PRESET_VALUE	OFF
PresetValue	%	0.0
FailSafe	ENABLED, DISABLED	DISABLED
Bias	Any Real Number	0.0
ReadBack	ENABLED, DISABLED	ENABLED

OutputRange: SAM Analog Output channels are configurable to operate with two current ranges:

- 4-20mA
- 0-20mA

MinScale: The module performs a linear conversion from engineering units to the selected OuputRange for each channel. The scaling algorithm uses the MinScale/MaxScale and OutputRange parameters set by the user. For example, given a MinScale of 0.0, a MaxScale of 100.0 and an OutputRange of 4-20mA, if the value written to the SAM Analog Output Channel is 50, the module outputs 12mA.

MinScale can be any real (REAL) number (Real numbers are valid between -3.4028E38 and +3.4028E38).

MaxScale: MaxScale can be any Real number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

IOBUSFault: Each analog output can be configured to respond to an IOBUS fault (loss of communications with the controller) in a particular manner. The available fault states are:

- **OFF** Output is turned off (0 mA)
- **HOLD_LAST_STATE** Output holds its last value
- **PresetValue** Output goes to the value specified by the PresetValue parameter.

NOTE

All channels power up in the OFF state.

PresetValue:. Percent (0.0 to 100.0%) of Scale. This parameter need only be specified when IOBUSFault is specified as "Preset_Value."

FailSafe: Each output can be configured to turn off (0 mA = -25%) all of the SAM s outputs in the event that diagnostics determine that the output current is greater than it is intended to be by 9% or more. You may wish to configure an output as FailSafe, which is critical to the process or may present a hazard to personnel or equipment.

Bias: The user can enter a bias (in engineering units) on a per channel basis to compensate for known offsets. The bias value is added to the scaled output.

ReadBack: The state of an output channel is automatically "read back" by input circuitry on the same channel. The Readback is used to diagnose and report faults. The user can disable Readback, which will in turn disable reporting of Readback-related faults (Open Circuit, Readback Lower than Output, Readback > Output, Readback > Output on Critical Channel).

10.2.3 SAM Disc In

The SAM Discrete Input (Disc In) channel type returns a boolean (BOOL) variable.

Table 10-4 shows the softlist parameters for the SAM Disc Input channel type.

Table 10–4 SAM Discrete Input Softlist Parameters

PARAMETER	SELECTION	DEFAULT
MinOnStatePct	0.0 to 100.0	80.0
MaxOffStatePct	0.0 to 100.0	20.0

MinOnStatePct: The reading is automatically scaled from 0-10 mA to 0-100%. A scaled reading greater than or equal to MinOnStatePct reports a boolean TRUE to the controller.

MaxOffStatePct: The reading is automatically scaled from 0-10 mA to 0-100%. A reading less than or equal to MaxOffStatePct reports a boolean FALSE to the controller.

10.2.4 SAM Disc Out

The SAM Discrete Output (Disc Out) channel type accepts a boolean (BOOL) variable.

Table 10-5 shows the softlist parameters for the SAM Disc Output channel type.

Table 10–5 SAM Discrete Output Softlist Parameters

PARAMETER	SELECTION	DEFAULT
IOBUSFault	OFF, ON, HOLD_LAST_STATE	OFF
FailSafe	ENABLED, DISABLED	DISABLED
ReadBack	ENABLED, DISABLED	ENABLED

IOBUSFault: Each SAM Disc Output channel can be configured to respond to an IOBUS fault (loss of communications with the controller) in a particular manner. The available fault states are:

- **OFF** Output is turned off (0 mA)
- **ON** Output is turned on (100%) (23mA)
- **HOLD_LAST_STATE** Output holds its last value

NOTE

All channels power up in the OFF state.

FailSafe: Each output can be configured to turn Off (0mA) all of the SAM's outputs in the event that diagnostics determine that the output current is greater that it is intended to be by 9% or more. You may wish to configure an output as FailSafe that is critical to the process, or which may present a hazard to personnel or equipment.

ReadBack: The state of an output channel is automatically "read back" by input circuitry on the same channel. The Readback is used to diagnose and report faults. The user can disable Readback, which in turn disables reporting of Readback-related faults (Readback Lower than Output, Readback > Output, Readback > Output on Critical Channel).

■

11.0 Standard Discrete Module (SDM)

The Standard Discrete Module (SDM) interfaces discrete DC sensors and actuators with the APACS+ controller's IOBUS. The SDM provides 32 channels, each of which can be configured to be an input, output, or pulse output. The SDM's inputs are current sinking (i.e. the input device is wired between the power supply positive (+) and the I/O terminal). Outputs are sourced (i.e. the output device is wired between the output terminal and the power supply common). A pulsed output is an output channel that is "ON" for a user-defined duration (within the range of 10 to 2000 msec).

All input and output circuits are electrically isolated from the SDM's CPU, IOBUS, and ground. In addition, each output is individually fused with a replaceable miniature fuse. This protects the output channel from a short circuit in the field wiring and prevents the short circuit from affecting other channels on the module.

11.1 SDM Module Scope Parameter

Table 11-1 shows the Module Scope softlist parameter for the SDM:

Table 11–1 SDM Module Scope Parameter

PARAMETER	SELECTION	DEFAULT
ScanRate	NA	NA

To view/edit the module scope parameters, place the cursor on the desired module in the module tree and select the Edit, Object/Item menu item. The Hardware Modules dialog box opens. Choose the "Softlist" command button. The Module Scope Softlist dialog box opens.

ScanRate: This is a read-only parameter that displays the current scan rate of the module.

11.2 SDM Channel Types

The following channel types are supported for the SDM module:

- SDM Disc In
- SDM Disc Out
- SDM Pulse Out

11.2.1 SDM Disc In

The SDM Discrete Input (Disc In) channel returns a boolean (BOOL) variable. There are no softlist parameters for the Disc In channel.

11.2.2 SDM Disc Out

The SDM Discrete Output (Disc Out) channel type accepts a boolean (BOOL) variable.

Table 11-2 shows the softlist parameters for the SDM Discrete Output channel type.

Table 11–2 SDM Discrete Output Softlist Parameters

PARAMETER	SELECTION	DEFAULT
IOBUSFault	OFF, ON, HOLD_LAST_STATE	OFF
FailSafe	ENABLED, DISABLED	DISABLED
Readback	ENABLED, DISABLED	ENABLED

IOBUSFault: Each output can be configured to respond to an IOBUS fault (loss of communications with the controller) in a particular manner. The available fault states are:

OFF Output is turned off.
ON Output is turned on.
HOLD_LAST_STATE Output holds its last value.

NOTE

All channels power up in the OFF state.

FailSafe: Each output can be configured to turn off all module outputs in the event that a channel is intended to be off, but diagnostics have determined that it is on. The user may wish to configure an output as FailSafe that is critical to the process or that may present a hazard to personnel or equipment.

Readback: The state of an output channel is automatically “read back” by input circuitry on the same channel. Readback is used to diagnose and report faults. The user can disable Readback which will, in turn, disable reporting of Readback-related faults (Output Channel failed ON, Output Channel failed OFF, Critical Channel failed ON).

11.2.3 SDM Disc Pulse Out

The SDM Discrete Pulse Output (Disc Pulse Out) channel type accepts a boolean (BOOL) variable.

The Disc Pulse Out channel type turns on its assigned output for a pre-determined time period (the resolution of the pulse output is ∀10 ms, accurate to within ∀2 ms). The time period is established by the Duration softlist parameter and can be set between 10 ms and 2,000 ms.

When the boolean output value sent from the ACM to the SDM module transitions from FALSE to TRUE, the corresponding output turns on for the specified duration. Once the output has been triggered, it can be re-triggered before the end of the pulse duration.

Configuring a Disc Pulse Out channel type causes the module to change its method of scanning from synchronous to asynchronous. When the SDM is scanning asynchronously, it writes its outputs and reads its inputs every 10 ms, regardless of the ACM scan rate. This fixed 10 ms scan rate allows the SDM to change the state of its outputs every 10 ms.

The following timing diagram shows the output value being sent from the ACM to the SDM. In this example, the ACM scan rate is set to 20 ms; therefore, the ACM can only change the state of the output every 20 ms. The SDM output is configured as a Disc Pulse Out Channel with a duration of 50 ms. Figure 10-1 shows how a FALSE-to-TRUE transition of the ACM output triggers a pulse output. The figure also illustrates that once a pulse output has been triggered, it can be re-triggered before the end of the pulse duration.

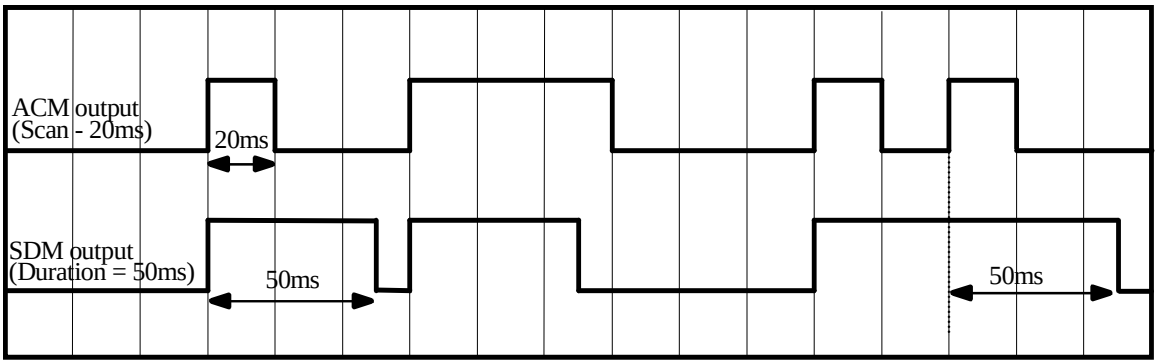


Figure 11–1 SDM Discrete Pulse Output Timing Diagram

Table 11-3 shows the softlist parameters for the SDM Discrete Output Pulse channel type.

Table 11–3 SDM Discrete Output Softlist Parameters

PARAMETER	SELECTION	DEFAULT
Duration	10 to 2000 ms	20 ms
Readback	ENABLED, DISABLED	DISABLED

Duration: The duration of a pulse output channel can be specified between 10ms and 200ms. Since the resolution of the pulse output is ±10ms, duration values will be rounded to the nearest 10ms. For example, if the duration specified is 13ms, the actual pulse will be 10ms long. Likewise, if the duration specified is 18ms, the actual pulse will be 20ms long.

Readback: The state of an output channel is automatically "read back" by input circuitry on the same channel. The readback is used to diagnose and report faults. The user can disable readback which will in turn disable reporting of readback related faults (Output Channel failed ON, Output Channel failed OFF).

■

Notes

12.0 Standard Discrete Module Plus (SDM+)

The Standard Discrete Module Plus (SDM+) interfaces discrete DC sensors and actuators with the APACS+ control module's IOBUS. The SDM+ provides 32 channels, each of which can be configured to be an input, output, or pulse output. The SDM+'s inputs are current sinking (i.e. the input device is wired between the power supply positive (+) and the I/O terminal). Outputs are sourced (i.e. the output device is wired between the output terminal and the power supply common). A pulsed output is an output channel that is "ON" for a user-defined duration (within the range of 10 to 2000 msec).

Two Sequence Of Event (SOE) channel types are provided for recording events that can be collected by Sequence Of Events Recorder function blocks. The data is intended for recording SDM+ I/O channel state changes. This information can then be used for optimizing process operations or for troubleshooting purposes, such as determining the sequence of events that led to specific alarm conditions.

All input and output circuits are electrically isolated from the SDM+'s CPU, IOBUS, and ground. In addition, softfuse circuits protect the output channels from short circuits and can be reset locally or remotely.

12.1 SDM+ Module Scope Parameter

Table 12-1 shows the Module Scope softlist parameter for the SDM+:

Table 12–1 SDM+ Module Scope Parameter

PARAMETER	SELECTION	DEFAULT
ScanRate	NA	NA

To view/edit the module scope parameters, place the cursor on the desired module in the module tree and select the Edit, Object/Item menu item. The Hardware Modules dialog box opens. Choose the "Softlist" command button. The Module Scope softlist dialog box opens.

ScanRate: This is a read-only parameter that displays the current scan rate of the module.

12.2 SDM+ Channel Types

The following channel types are supported for the SDM+ module:

- Disc In
- Disc Out
- Pulse Out
- SOE Disc In
- SOE Disc Out

12.2.1 SDM+ Disc In

The Discrete Input (Disc In) channel type returns a boolean (BOOL) variable. Table 12-2 shows the Disc In softlist parameter for the SDM+:

Table 12–2 SDM+ Disc In Softlist Parameter

PARAMETER	SELECTION	DEFAULT
InputFaultState	TRUE, FALSE	FALSE

InputFaultState: When an input channel has a hardware failure that makes the channel value impossible to discern, the channel will report the value configured in this softlist parameter.

12.2.2 SDM+ Disc Out

The Disc Out channel type accepts a BOOL variable. Table 12-3 lists the softlist parameters for the SDM+ Discrete Output channel type.

Table 12–3 SDM+ Disc Out Softlist Parameters

PARAMETER	SELECTION	DEFAULT
IOBUSFault	OFF, ON, HOLD_LAST_STATE	OFF
FailSafe	ENABLED, DISABLED	DISABLED
Readback	ENABLED, DISABLED	ENABLED

IOBUSFault: Each output can be configured to respond to an IOBUS fault (loss of communications with the controller) in a particular manner. The available fault states are:

- **OFF** Output is turned off.
- **ON** Output is turned on.
- **HOLD_LAST_STATE** Output holds its last value.

NOTE

All channels power up in the OFF state.

FailSafe: Each output can be configured to turn off all module outputs in the event that a channel is intended to be off, but diagnostics have determined that it is on. The user may wish to configure an output as FailSafe that is critical to the process or that may present a hazard to personnel or equipment.

Readback: The state of an output channel is automatically “read back” by input circuitry on the same channel. Readback is used to diagnose and report faults. The user can disable Readback, which in turn disables reporting of Readback-related faults (Output Channel failed ON, Output Channel failed OFF, Critical Channel failed ON).

12.2.3 SDM+ Disc Pulse Out

The SDM+ Discrete Pulse Output (Disc Pulse Out) channel type accepts a boolean (BOOL) variable.

The Disc Pulse Out channel type turns on its assigned output for a pre-determined time period (the resolution of the pulse output is ∀10 ms, accurate to within ∀2 ms). The time period is established by the Duration softlist parameter and can be set between 10 ms and 2,000 ms.

When the boolean output value sent from the ACM to the SDM+ module transitions from FALSE to TRUE, the corresponding output turns on for the specified duration. Once the output has been triggered, it can be re-triggered before the end of the pulse duration.

Configuring a Disc Pulse Out channel type causes the module to change its method of scanning from synchronous to asynchronous. When the SDM+ is scanning asynchronously, it writes its outputs and reads its inputs every 10 ms, regardless of the ACM scan rate. This fixed 10 ms scan rate allows the SDM+ to change the state of its outputs every 10 ms.

The following timing diagram shows the output value being sent from the ACM to the SDM+. In this example, the ACM scan rate is set to 20 ms; therefore, the ACM can only change the state of the output every 20 ms. The SDM+ output is configured as a Disc Pulse Out channel with a duration of 50 ms. Figure 11-1 shows how a FALSE-to-TRUE transition of the ACM output triggers a pulse output. The figure also illustrates that once a pulse output has been triggered, it can be re-triggered before the end of the pulse duration.

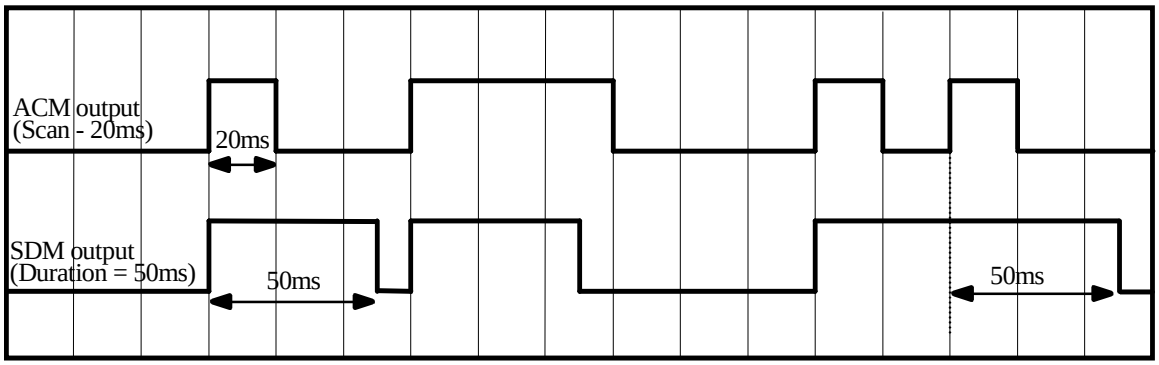


Figure 12–1 SDM+ Discrete Pulse Output Timing Diagram

Table 12-4 lists the softlist parameters for the SDM+ Discrete Output Pulse channel type.

Table 12–4 SDM+ Disc Pulse Out Softlist Parameters

PARAMETER	SELECTION	DEFAULT
Duration	10 to 2000 ms	20 ms
Readback	ENABLED, DISABLED	ENABLED

Duration: The duration of a pulse output channel can be specified between 10 ms and 200 ms. Because the resolution of the pulse output is ∀10 ms, duration values are rounded to the nearest 10 ms. For example, if the duration specified is 13 ms, the actual pulse is 10 ms long. Similarly, if the duration specified is 18 ms, the actual pulse is 20 ms long.

Readback: The state of an output channel is automatically read back by input circuitry on the same channel. Readback is used to diagnose and report faults. The user can disable Readback, which in turn disables reporting of Readback-related faults (Output Channel failed ON, Output Channel failed OFF).

12.2.4 SDM+ SOE Disc In

The SDM+ Sequence of Events (SOE) Discrete Input (Disc In) channel type returns SOE information. Table 12-5 lists SOE Disc In softlist parameters for the SDM+:

Table 12–5 SDM+ SOE Disc In Softlist Parameters

PARAMETER	SELECTIONS	DEFAULT
InputFaultState	TRUE, FALSE	FALSE
Description	28 Character String	‘’ (null string)
EventPriority	1,2,3, or 4	1
AlarmState	TRUE, FALSE	FALSE

InputFaultState: When an input channel has a hardware failure that makes the channel value impossible to discern, the channel reports the value configured in this softlist parameter.

Description: This is a description, up to 28 characters, of the channel that is configured to be monitored by the Sequence Of Events Recorder (SOER) block. The description is formatted as a String data type and is inserted as a substring within the Events string of the SOER block.

Event Priority: This data is used for establishing an event s priority. Set a channel’s priority from 1 (highest) to 4 (lowest). This priority value can then be used to sort events, as in the case of formattting them for viewing. This priority value is inserted within the Events string of the SOER block.

AlarmState: This parameter is used to establish the alarm state of the channel. Choose either state, TRUE or FALSE, that represents an alarm condition. For example, if you set this parameter to TRUE, the channel is said to be **in Alarm** when the channel s value toggles from FALSE to TRUE. This also inserts an “A” character in the last character position in the Events string of the SOER block. Normally, this character is an “N” character (No alarm).

12.2.5 SDM+ SOE Disc Out

The SDM+ SOE Discrete Output (Disc Out) channel type returns SOE information. Table 12-6 lists SOE Disc Out softlist parameters for the SDM+:

Table 12–6 SDM+ SOE Disc Out Softlist Parameters

PARAMETER	SELECTION	DEFAULT
IOBUSFault	OFF, ON, HOLD_LAST_STATE	OFF
FailSafe	ENABLED, DISABLED	DISABLED
Readback	ENABLED, DISABLED	ENABLED
Description	28-character string	‘’ (null string)
EventPriority	1, 2, 3, or 4	1
AlarmState	TRUE, FALSE	FALSE

IOBUSFault: Each output can be configured to respond to an IOBUS fault (loss of communications with the controller) in a particular manner. The available fault states are:

OFF Output is turned off.
ON Output is turned on.
HOLD_LAST_STATE Output holds its last value.

NOTE

All channels power up in the OFF state.

FailSafe: Each output can be configured to turn off all module outputs in the event that a channel is intended to be off, but diagnostics have determined that it is on. The user may wish to configure an output as FailSafe that is critical to the process or that may present a hazard to personnel or equipment.

Readback: The state of an output channel is automatically “read back” by input circuitry on the same channel. Readback is used to diagnose and report faults. The user can disable Readback, which in turn disables reporting of Readback-related faults (Output Channel failed ON, Output Channel failed OFF, Critical Channel failed ON).

Description: This is a description, up to 28 characters, of the channel that is configured to be monitored by the Sequence Of Events Recorder (SOER) block. The description is formatted as a String data type and is inserted as a substring within the Events string of the SOER block.

Event Priority: This data is used for establishing an event s priority. Set a channel’s priority from 1 (highest) to 4 (lowest) to sort events, as in the case of formatting them for viewing. This priority value is inserted within the Events string of the SOER block.

AlarmState: This parameter is used to establish the alarm state of the channel. Choose either state, TRUE or FALSE, to represent an alarm condition. For example, if you set this parameter to TRUE, the channel is said to be **in Alarm** when the channel’s value toggles from FALSE to TRUE. This also inserts an “A” character in the last character position in the Events string of the SOER block. Normally, this character is an “N” character (No alarm).

■

Notes

13.0 Voltage Input Module (VIM)

The Voltage Input Module (VIM) interfaces thermocouple and voltage input signals to the control module's IOBUS. The VIM provides 16 channels, each of which can be configured to be a thermocouple or voltage input. The VIM can accommodate many input types with minimal configuration and high accuracy. Each input is electrically isolated from the module's CPU, IOBUS, and ground to isolate field faults. In addition, each channel is isolated from other channels.

13.1 VIM Module Scope Parameters

Table 13-1 lists the Module Scope softlist parameters for the VIM.

Table 13–1 VIM Module Scope Parameters

PARAMETER	SELECTION	DEFAULT
ScanRate	NA	NA
LineFreq	50 Hz, 60 Hz	60 Hz
SharedTC	YES, NO	YES

To view/edit the module scope parameters, place the cursor on the desired module in the module tree and select the Edit, Object/Item menu item. The Hardware Modules dialog box opens. Choose the "Softlist" command button. The Module Scope Softlist dialog box opens.

ScanRate: This is a read-only parameter that displays the current scan rate of the module. In general, the scan rate is the same as the scan rate of the ACM, but may be a multiple of the ACM's scan rate.

LineFreq: The module software utilizes a notch filter to reduce noise from AC power sources. Specifying the line frequency of AC power optimizes the filtering algorithm.

SharedTC: This parameter only applies when using VIMs in a redundant system. Often one thermocouple is wired to both the primary and the backup VIM. If this is the wiring arrangement for the VIM being configured, specify SharedTC to be YES. If each VIM has its own thermocouples, then SharedTC should be NO. For non-redundant VIM's, specify the default (NO).

13.2 VIM Channel Types

The following channel types are supported for the VIM module:

- VIM TIC - Thermocouple Input
- VIM VIC - Voltage Input

13.2.1 VIM TIC - Thermocouple Input Channel

The VIM Thermocouple Input Channel (TIC) type returns a real (REAL) variable.

Table 13-2 shows the softlist parameters for the VIM Thermocouple Input channel type.

Table 13–2 VIM Thermocouple Input Channel Softlist Parameters

PARAMETER	SELECTION	DEFAULT
TCType	B, E, J, K, N1, R, S, T, N2	J
EngUnits	Deg°F, Deg°C, Deg°K, Deg°R	Deg°C
StepResponseTime	0.100 to 40.0	1.0
Bias	Any Real Number	0.0
MinRange	Any Real Number	Min. range of TC type selected.
MaxRange	Any Real Number	Max. range of TC type selected.
Scale_To_Percent	YES, NO	NO
Burnout	DISABLE, UP, DOWN	DISABLE
DigFiltTimeCnst	0.0 to 159.0 sec	0.016 sec

TCType: This parameter specifies the type of thermocouple used (i.e. B, E, J, K, N1, R, S, T, N2) the default is type J.

EngUnits: The user can select from the following engineering units: Deg°F, Deg°C, Deg°K, Deg°R.

Bias: A bias value can be entered to adjust for any known offset (usually due to thermocouple aging). The bias value can be any real number and is added to the scaled thermocouple reading.

MinRange: MinRange is an optional parameter that allows the user to specify a minimum

operating value in EngUnits. If the reading drops below this value, an underrange error is reported. The MinRange can be any real number.

MaxRange: MaxRange is an optional parameter that allows the user to specify a maximum operating value in EngUnits. If the reading goes above this value, an overrange error is reported. The MaxRange can be any real number.

Scale_To_Percent: This is a Boolean softlist parameter whose default value is FALSE.

Burnout: The user can specify burnout detection or open circuit detection for a thermocouple:

DISABLE No burnout or open circuit detection

UP Return maximum operating value for TIC type selected

DOWN Return minimum operating value for TIC type selected

DigFiltTimeCnst: Digital filtering can be applied to thermocouple input signals to reduce the effects of electrical noise. The digital filter is a first-order lag, adjustable for time constants of 0.0159 to 159.0 seconds. Equivalent breakpoint frequencies are 10.0 to 0.001 Hz. The default value can be increased for noisy signals.

StepResponseTime: This parameter determines the time for the channel to fully respond to a step input. A longer StepResponseTime provides higher resolution and better repeatability of the signal.

12.2.2 VIM VIC - Voltage Input

The VIM Voltage Input Channel (VIC) type returns a real (REAL) variable.

Table 13-3 lists the softlist parameters for the VIM Voltage Input channel type.

Table 13–3 VIM Voltage Input Softlist Parameters

PARAMETER	SELECTION	DEFAULT
InputRange	VDC1to5, VDC0to5, VDCNeg10to10, VDCNeg5to5, VDCNeg1to1, Custom	VDC1to5
Custom_Range_Low	-10 to 10	0
Custom_Range_High	-10 to 10	0
MinScale	Any Real Number	0.0
MaxScale	Any Real Number	100.0
EngUnits	in, ft, mm, cm, m, in3, ft3, bbl, ml, liter, m3, lb, ton, mol, g, kg, ft/sec, m/sec,ft/sec2, msec2, DegF, DegR, DegC, DegK, psi, psia, psig, InH2O, InHg, ATM, kPa, kPaa, kPag, mmHg, kg/cm2, mbar, bar, lb/ft3, g/cm3, kg/m3, mol/m3, ft3/lb, m3/kg, ppm, pH, PPH, KPPH, t/day, kg/hr, kg/day, gal/min, GPM, GPH, GPD, ACFM, ACFH, SCCM, SCFH, SCFM, MCFH, yd3/hr, yd3/day, BPD, gal/hr, gal/day, m3/hr, m3/day, l/min, l/hr, l/day, mV, Volts, mA, AMPS, Ohms, mhos, W, kW, MW, Btu, Btu/SCF, Btu/lbm, Btu/hr, hp, bhp, vars, VA, kVA, joules, Percent, pulses, Hz, rpm, deg, rad, cal, cal/SCF, cal/hr, cal/lbm, kcal, kcal/SCF, kcal/hr, kcal/lbm	Percent
StepResponseTime	0.050 to 2.000 sec.	1.0
DigFiltTimeCnst	0.0 to 159.0 sec.	0.016

InputRange: VIC channels are able to read any voltage between -10 and +10. The module utilizes auto-ranging circuitry to provide high resolution even at millivolt levels. For scaling and diagnostic purposes, the range of values being measured by the channel must be specified. Several standard ranges are selectable from a list, or, a custom range can be selected by specifying "Custom" for the InputRange and editing Custom_Range_Low and Custom_Range_High values.

Custom_Range_Low: This is an optional parameter that allows the user to specify a minimum input range in volts. If the reading drops below this value, an underrange error is reported. This parameter is only used when InputRange is specified as "custom."

Custom_Range_High: This is an optional parameter that allows the user to specify a maximum input range in volts. If the reading goes above this value, an underrange error is reported. This parameter is only used when InputRange is specified as "custom."

MinScale: The module will linearly scale raw data (volts) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale parameters set by the user. For example, given a MinScale of 0.0, a MaxScale of 100.0, and an InputRange of 1-5 volts, if the input to the channel is 3 volts, the scaled value will be 50.0. MinScale can be any real number (REAL numbers are valid between -3.4028E38 and +3.4028E38.).

MaxScale: MaxScale can be any real (REAL) number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

DigFiltTimeCnst: This parameter sets the time constant of a low-pass digital filter applied to the input data. This filter reduces non-repetitive noise from the input data and can be disabled by setting this parameter to 0.0.

StepResponseTime: This parameter sets the length of a moving-average digital filter applied to the input data. StepResponseTime determines the time to fully respond to an input step. Increasing this parameter reduces periodic or repetitive noise and improves repeatability and resolution. The recommended setting for this parameter is between 0.5 and 4.0 seconds.

■

14.0 PROFIBUS Fieldbus Module (PFM)

The PROFIBUS Fieldbus Module (PFM) creates a seamless interface between an APACS+ control system and PROFIBUS DP (Decentralized Periphery) devices. This interface maps PROFIBUS devices to I/O channels in an APACS+ environment, extending the domain of ProcessSuite process automation software, including the R4 Framework, an advanced HMI (human-machine interface). The PFM makes it possible for control architectures to include proven APACS+ hardware and software as well as third-party PROFIBUS field devices.

14.1 PFM Channel Types

In the PFM, channel types refers to *4-mation* I/O channels. PROFIBUS data types refers to data and data structures defined by PROFIBUS specifications. Channels in parentheses (X) are default mappings. If in *4-mation* you define a channel as an analog input, for example, the default PROFIBUS data structure is a DP Float (DP floating point value).

Table 14–1 Data to Channel Type Mapping

	PFM Channel Types					
PROFIBUS Data Types	**Analog In**	**Analog out**	**BOOLEAN In**	**BOOLEAN Out**	**Packed Discrete In**	**Packed Discrete Out**
PA BOOLEAN			X	X		
DP BOOLEAN			X	X		
DP UINT8			(X)	(X)	(X)	(X)
DP UINT16	X	X	X	X	X	X
DP UINT32	X	X				
DP INT8	X	X				
DP INT16	(X)	(X)				
DP INT32	X	X				
DP Float	X	X				
PA Float	X	X				

14.2 PFM Module Scope

To examine the softlist parameters that apply to the entire module:

1. In *4-mation*, open the application and display the module tree.
2. Select the PFM module.
3. Select Edit > Object/Item.
4. Select PFM1
5. Select Softlist…
   A window displays the softlist parameters for the module.

ProfiBitRateKbps—a read-only softlist parameter that corresponds to DP baud rate and is given in kbps (default: 1500.0 kbps)

The remaining parameters are reserved for future use.

14.3 PFM I/O Channel Softlist Parameters

I/O channel softlist parameters enable 4-mation to translate between raw binary field I/O and three supported 4-mation channel types:

- Boolean
- Packed Discrete
- Analog

Softlist parameters vary according to the channel type.

DP_Slave_Addr—default is 126, which must be changed to the PROFIBUS address assigned to the device. All the APACS+ channels mapped to a multichannel PROFIBUS device have the same DP_Slave_Addr.

Byte_Offset—The Byte_Offset is the distance in bytes between the beginning of an input or output data block in the PFM and the first byte of the channel of interest.

The procedures for determining the Byte_Offset for input channels and for output channels are based upon similar underlying principles. For each of its DP slaves, the PFM allocates an input block and output block in its memory.

A DP device presents its inputs to the PFM in an unstructured I/O string not longer than 244 bytes. The PFM extracts input data from the string and stores it in its input block it has allocated for the device. The block is uniquely identified by the DP slave address of the device that provides the data. The location and length of individual channel data in the block is determined by three softlist parameters: DP slave address of the DP device, the PROFIBUS data type, and the Byte_Offset. For input channels, the Byte_Offset points to the first byte of the channel's data in the PFM input block for the device. For output channels, the Byte_Offset points to the first byte of a channel's output data in the output block.

Determining the byte offset so that you can set a channel's softlist parameters requires an understanding of the device supplying or receiving data.

In the following illustration, an ET200M, a DP slave that connects with a variety of multichannel I/O modules, has a PROFIBUS DP address of 9. The ET200M is connected to three modules, a 4 channel analog input module (4AI), a 4 channel analog output module (4AO), and another 4 channel input module (4AI). The data type for the analog channels is signed 16-bit integer (each channel is 2 bytes long). Given the DP address of the module and the PROFIBUS data type, the Byte_Offset parameter identifies the beginning of individual channel data in the PFM block. As this illustration shows, the PFM block for input channels is separate and distinct from the PFM

block for output channels. Note, too, that although the input modules are not contiguous, there are no gaps in the input data block.

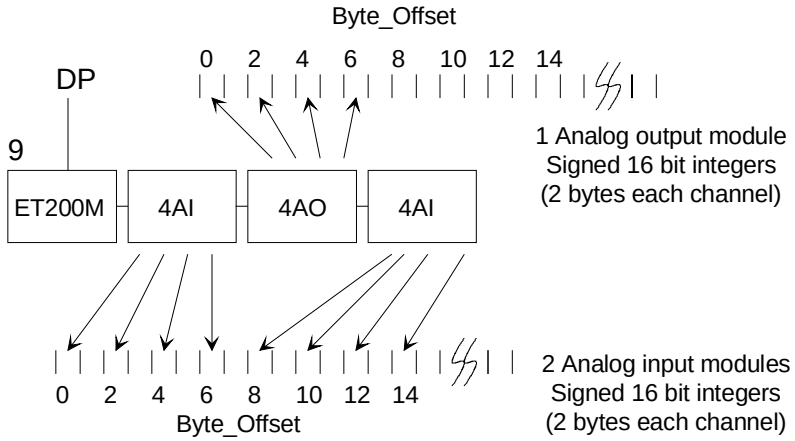


Figure 14–1 Byte_Offset for Typical Input and Output Block

A DP/PA link is another common DP device that sends and receives an I/O string. In the case of the DP/PA link, downstream PA devices supply or receive the I/O data.

In the case of PA devices connected to the PFM through a DP/PA link, the PA input device with the lowest PROFIBUS address has its data stored in the input block of the PFM at Byte_Offset 0. The next PA input device on the bus, in order of ascending PROFIBUS address, has a Byte_Offset equal to the bytes used by the first device. The third input device has a Byte_Offset equal to the bytes used by the first two devices, and so forth. Byte_Offset for output devices is calculated in the same way.

In the illustration below, the DP/PA link device has a PROFIBUS address of 11. The addresses of the PA devices (5, 7, and 8) must be unique to their PA bus, and there may be gaps. In the illustration, the data type of each PA device is a PA floating point structure, which consists of 4 bytes of data and 1 byte of status per channel. The Byte_Offset for the channel associated with the PA address 5 is 0, the Byte_Offset of device with address 7 is 5, and the Byte_Offset of the device with address 8 is 10. See Figure 14–2

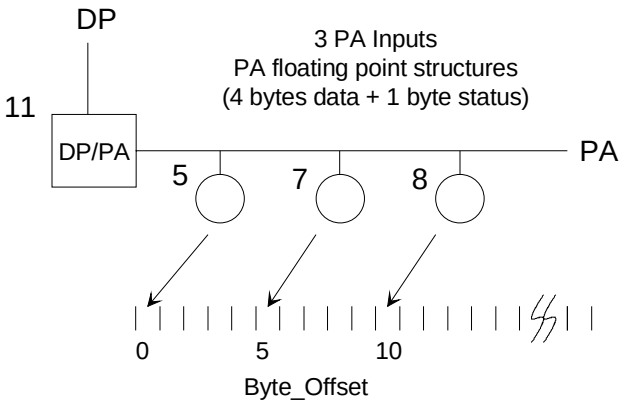


Figure 14–2 Byte_Offset for Typical Input String

Input and output data blocks in the PFM are distinct and independent of one another. The Byte_Offset for an input channel is thus independent of the Byte_Offset for an output channel.

The COM PROFIBUS program provides a useful tool for determining or confirming Byte_Offset:

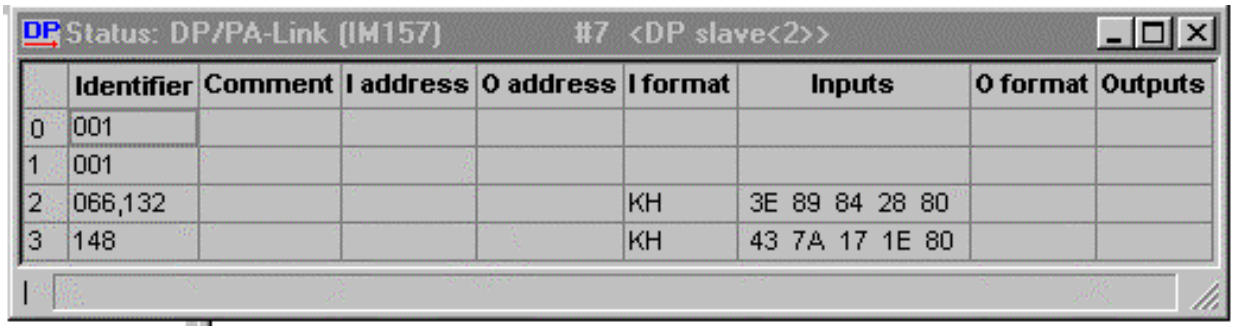
1. With the PROFIBUS network configured through COM PROFIBUS and Simatic PDM, open COM PROFIBUS and either open the current configuration or import it from the DP master

2. Select the DP/PA link.

3. From the menu bar select Services > Observe/Control/Inputs/Outputs.
The resulting display shows the current value in bytes of PA devices connected to the DP/PA link. You can count the bytes of input or output preceding a device of interest to determine the device's Byte_Offset. Keep in mind that the data stream from a PA device includes one byte of status per channel. The illustration below shows data input from two PA floating point devices, both providing four bytes in data and one byte of status (for example, 80 hex).

   In the example, the PROFIBUS PA address of the first device is 5, so the device is located in position 2 (if its PROFIBUS address were 3, the lowest permissible address for a PA device connected to a DP/PA link, the device would be located in position 0). The Byte_Offset of the input channel of the first device, regardless of its address, is always 0.

   The Byte_Offset of the input channel of the next device (in position 3) is 5, which is the number of input bytes preceding it. If there were a device in position 4, the Byte_Offset for its input channel would be 10, again determined simply by counting the preceding input bytes. See Figure 14–3.



	Identifier	Comment	I address	O address	I format	Inputs	O format	Outputs
0	001							
1	001							
2	066,132				KH	3E 89 84 28 80		
3	148				KH	43 7A 17 1E 80		

Figure 14–3 Using COM PROFIBUS to Determine Byte_Offset

Profibus_Slot_Number—in devices with more than one slot (module), the slot number identifies the slot if a PROFIBUS diagnostic message is reported. The Profibus_Slot_Number parameter has no effect on data I/O; it is used only for APACS error reporting.

Profibus_Ch_Number—in devices or modules with more than one channel, the channel number identifies the channel if a PROFIBUS diagnostic message is reported. The Profibus_Ch_Number parameter has no effect on data I/O; it is used only for APACS error reporting.

PA_SlaveAddr—default is 0, and the parameter is only applicable for PA devices connected to the PFM by a DP/PA link. The valid range is 0 through 125, corresponding to the PROFIBUS address of the PA device.

ProfiDataType—(default in parentheses). Table 14–2 show available PROFIBUS data types and lengths for PFM channels.

Table 14–2 ProfiDataType SoftList Parameters

PFM Channel	ProfDataType	Length (bytes)
Analog input (DP INT16) Analog output (DP INT16)	DP UINT8	1
	DP UINT16	2
	DP INT8	1
	DP INT16	2
	DP INT32	4
	DP Floating Point	4
	PA Floating Point Structure	5
BOOLEAN input (DP UINT8) BOOLEAN output (DP UINT8)	DP BOOLEAN	1
	PA BOOLEAN structure	2
	DP INT8 (as packed discrete)	1
	DP INT16 (as packed discrete)	2
Packed Discrete Input (DP UINT8) Packed Discrete Output (DP UINT8)	DP UNIT8	1
	DP UNIT16	2

BitNumber—default is 0, applicable only for BOOLEAN channel types mapped to PROFIBUS integer types. The bit number corresponds with the position of the data in the 8 or 16 bit data structure. Valid bit numbers range from 0 to 15, where 0 represents the first bit, and corresponds to labeling on commonly used DP discrete modules. Figure 14–4shows a how a single BOOLEAN value is stored in a 2-byte packed discrete value.

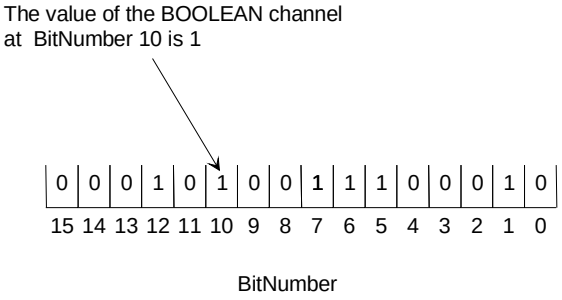


Figure 14–4 BitNumber in a Packet Discrete Data Type

14.3.1 BOOLEAN Input and Output Channels

Table 14–3 BOOLEAN Input and Output Channels SoftList Parameters

Parameter	Selection	Default
BitNumber	0-15	0
DP_Slave_Addr	1-125 (valid range differs from default value, which must be changed)	126
Byte_Offset	0-243	0
Profibus_Slot_Number	0-63	0
Profibus_Ch_Number	0-63	0
ProfiDataType	DP BOOLEAN PA BOOLEAN Structure DP UINT8 DP UINT16	DP UINT8
PA_SlaveAddr		0
PA_Status	(input:read only, output: read/write 0-255) USINT	128

14.3.2 Packed Discrete Input and Output Channels

Table 14–4 Packed Discrete Input and Output SoftList Parameters

Parameter	Selection	Default
DP_Slave_Addr	1-125 (valid range differs from default value, which must be changed)	126
Byte_Offset	0-243	0
Profibus_Slot_Number	0-63	0
Profibus_Ch_Number	0-63	0
ProfiDataType	ProfiPackDisc_DTYP DP UINT8 DP UINT16	DP UINT8

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

DigFiltTimeCnst: (Input only) Digital filtering can be applied to analog input signals to reduce the effects of electrical noise. The digital filter is a first-order lag, adjustable for time constants of 0.0159 to 159.0 seconds (0.0 disables the filter). Equivalent breakpoint frequencies are 10.0 to 0.001 Hz. The default value can be increased for noisy signals.

Figure 14–5shows the step release time of the digital filter.

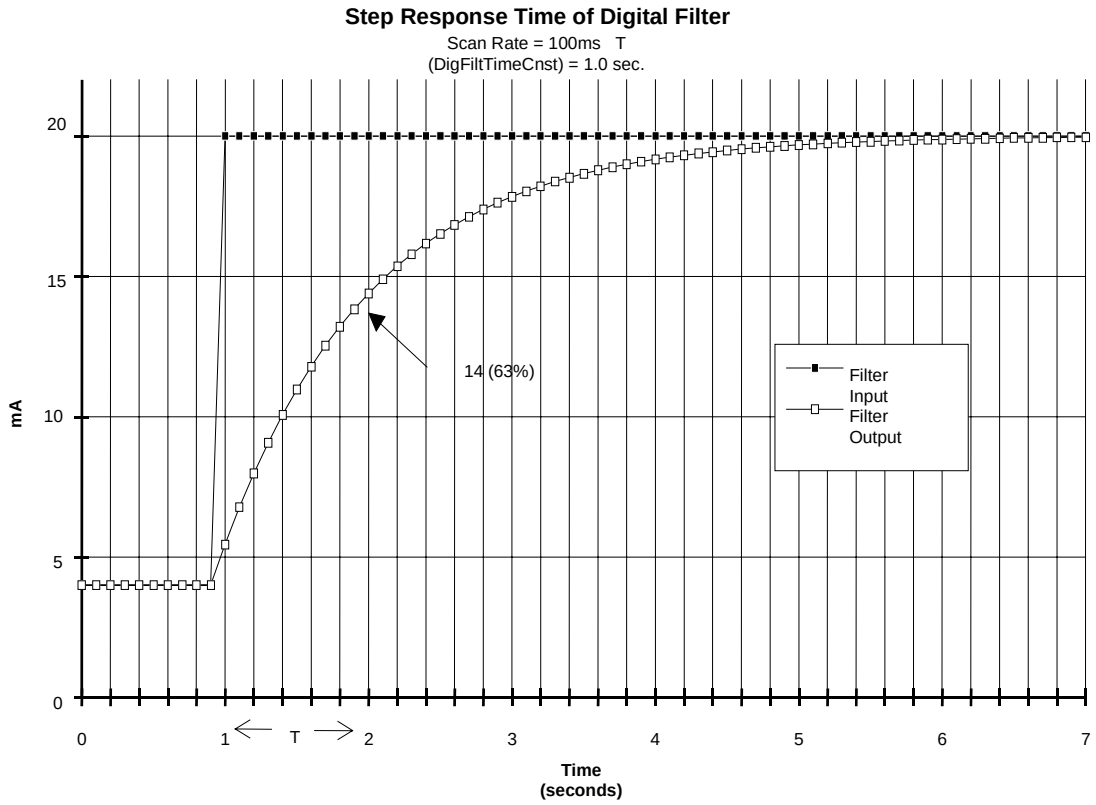


Figure 14–5 Step Time Response of Digital Filter

14.3.3 Analog Input and Output

The PFM Analog input and output channel types use real (REAL) variables. The softlist parameters Bias, Min_Scale, Max_Scale, RawLo, and RawHi are all interrelated by equations provided in subsection 14.4.

Table 14–5 shows the softlist parameters for the analog channel types.

Table 14–5 Analog Input and Output SoftList Parameters

Parameter	Selection	Default
Min_Scale	Any Real Number	4
Max_Scale	Any Real Number	20
EngUnits	in, ft, mm, cm, m, in3, ft3, bbl, ml, liter, m3, lb, ton, mol, g, kg, ft/sec, m/sec,ft/sec2, msec2, DegF, DegR, DegC, DegK, psi, psia, psig, InH2O, InHg, ATM, kPa, kPaa, kPag, mmHg, kg/cm2, mbar, bar, lb/ft3, g/cm3, kg/m3, mol/m3, ft3/lb, m3/kg, ppm, pH, PPH, KPPH, t/day, kg/hr, kg/day, gal/min, GPM, GPH, GPD, ACFM, ACFH, SCCM, SCFH, SCFM, MCFH, yd3/hr, yd3/day, BPD, gal/hr, gal/day, m3/hr, m3/day, l/min, l/hr, l/day, mV, Volts, mA, AMPS, Ohms, mhos, W, kW, MW, Btu, Btu/SCF, Btu/lbm, Btu/hr, hp, bhp, vars, VA, kVA, joules, Percent, pulses, Hz, rpm, deg, rad, cal, cal/SCF, cal/hr, cal/lbm, kcal, kcal/SCF, kcal/hr, kcal/lbm	mA
RawLoCounts	INT	-27648 (0x9400)
RawHiCounts	INT	27648 0x6c00)
DigFiltTimeCnst (input only)	0.0 to 159.0 sec	0.0
Bias	Any Real Number	0.0
DP_Slave_Addr	1-125 (valid range differs from default value, which must be changed)	126
Byte_Offset	0-243	0
Profibus_Slot_Number	0-63	0
Profibus_Ch_Number	0-63	0
ProfiDataType	DP UINT8 DP UINT16 DP UINT32 DP INT8 DP INT16 DP INT32 DP Floating Point PA Floating Point Structure	DP INT16
PA_SlaveAddr		0
PA_Status	(input:read only; output:read/write, 0-255)USINT	128

14.4 Mapping Analog Channels to PROFIBUS Integer Data Types

Bias: The user can enter a bias (in engineering units) on a per channel basis to compensate for known offsets. The bias value is added to a scaled input or subtracted from a scaled output.

Min_Scale/ Max_Scale: The module linearly scales raw data to engineering units for each channel. The scaling algorithm (equation below) uses the Min_Scale/Max_Scale parameters set by the user.

For example, given a 4 to 20 mA input, a MinScale of 0.0 and a MaxScale of 100.0; if the input to the channel is 12 mA, the scaled value is 50.0.

Min_Scale and Max_Scale can be any real (REAL) number (Real numbers are valid between -3.4028E38 and +3.4028E38.)

RawLoCounts: specified by the user to define the value of the associated process variable. The default is –27648 (0x9400) when the channel value equals min scale.

RawHiCounts: specified by the user to define the value of the associated process variable. The default is 27648 (0x6c00) when the channel value equals max scale.

The following equations describe how analog values are mapped to integers. The result of equation (1) is used in equations (2) and (3).

APACS output analog channel mapped to PROFIBUS integer analog output:

$$counts\ per\ unit = \frac{(RawHiCounts - RawLoCounts)}{(Max\_Scale - Min\_Scale)} \quad (1)$$

$$PROFIBUS\ value\ = RawHiCounts - ((Max\_Scale - (Analog\ value - Bias\ )) * counts\ per\ unit \quad (2)$$

NOTE

MaxScale may be less than MinScale, as might be required by a “reverse acting” device such as a reverse acting valve.

APACS analog input channels mapped to PROFIBUS integer analog input:

$$APACS\ value\ = \left(Max\_Scale - \frac{(RawHiCounts - PROFIBUS\ value)}{counts\ per\ unit} \right) + Bias \quad (3)$$

14.5 Out of Range Errors

Range is defined as Max_Scale – Min_Scale. The *4-mation* program sets an out-of-range error for a channel value that exceeds the absolute magnitude 0.05 x range (5%). A built-in hysteresis mechanism prevents the error from clearing until the channel value falls to the absolute magnitude of 0.03 x range (3%). See Figure 14–6.

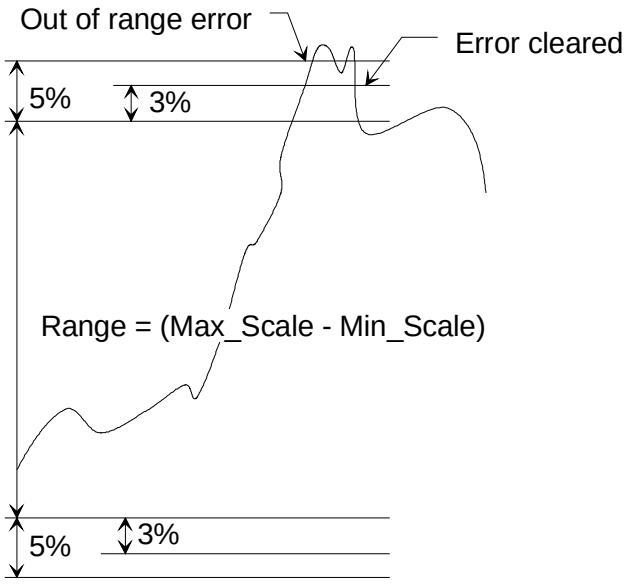


Figure 14–6 Out of Range Error and Hysteresis

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