

I/A Series[®] Software Field Device Integration



The I/A Series system provides seamless integration of measurements from Intelligent Field Devices such as Pressure Transmitters, Mass Flow Transmitters, Magnetic Flow Transmitters, Temperature Transmitters, Vortex Transmitters, Gas Chromatographs, Hydrostatic Tank Gauges, and Valve Positioners.

OVERVIEW

Field device integration provides an easy, efficient integration of measurement outputs from a wide range of Intelligent Field Devices (IFDs) into I/A Series Control Systems. Seamless, full system integration is achievable given the intelligence located in the IFDs as well as the flexibility of the hardware and software provided in the I/A Series system architecture. IFD integration includes digital outputs in addition to the analog 4 to 20 mA outputs from Foxboro and other field devices that have been available for years. I/A Series field device integration provides the following advantages:

- simplified system and instrument configuration
- · faster and easier calibration and loop checks
- improved accuracy, quality, validity, and security of measurement data
- improved end-user product quality and personnel safety
- simplified field maintenance
- improved calibration and maintenance record keeping.



INTELLIGENT FIELD DEVICES

With the introduction of microprocessor electronics, Intelligent Field Devices provide digital outputs for full system integration utilizing complete bidirectional communication. These Intelligent Field Devices include instruments such as the Magnetic Flow Transmitter, Vortex Transmitter, Mass Flow Transmitter, Pressure Transmitters (for gauge, absolute, and differential pressure), Liquid Level Transmitter (for density or interface), Temperature Transmitter, Valve Positioners, and analytical products (for pH level and conductivity). The broad spectrum of offerings for each of these devices provides flexibility in satisfying a wide range of process and mounting applications.

Long term field-proven sensing technologies and application experience contribute to the superior reliability associated with the design of the devices. Reliability and improved long term accuracy facilitate operations and reduce maintenance and downtime.

The Intelligent Field Devices are monitored and configured through either a Hand-Held Terminal (HHT), a PC-based configurator (PC20), or a workstation in an I/A Series system, which use bidirectional digital communications, and perform/display the following functions:

- remote reconfiguration
- complete device information viewable on I/A Series displays
- · measurements appearing in engineering units
- reranging/recalibration
- continuous self-diagnostics for validating measurements
- · remote troubleshooting capability
- transmitter database uploading/downloading
- database copying between transmitters.

The HHT or PC20 is used to perform these functions locally, while the workstation is used to perform these functions remotely. Refer to PSS 2A-1Z3 A for additional information on the HHT, and PSS 2A-1Z3 E for additional information on the PC20.

Workstations in the I/A Series system use a software package called the Intelligent Transmitter Configuration/Maintenance Environment. This software package incorporates the functionality of an HHT, while taking advantage of the display, keyboard, storage, and print capabilities of a personal computer system. Installation of Intelligent Field Devices is simplified using existing field wiring, which supports both the measurement signal(s) and remote bidirectional communications. The measurement signal(s) is not disturbed when reading transmitter data or values.

Intelligent Field Device design includes protection against electrical influences such as reverse polarity, voltage surge, lightning and radio-frequency interference (RFI) and electromagnetic interference (EMI) as well as protection from environmental extremes or hazards. The devices meet the approval requirements of many agencies for use in hazardous location installations.

Intelligent Field Devices contribute to personnel safety, especially when located in hazardous locations. The safety features of the devices include:

- configurable fail-safe options
- device security via HHT access and I/A Series workstation environment passwords
- user friendly menu-driven I/A Series system software and HHT or PC20 firmware
- continuous self-prompting diagnostics and remote diagnostics via remote communications
- entire family of Intelligent Transmitters uses a common HHT that is able to connect at any wiring termination point
- EEPROM transmitter memory eliminating need for batteries
- storage of maintenance information in database.

I/A Series HARDWARE AND SOFTWARE FOR FIELD DEVICE INTEGRATION

The I/A Series system architecture is structured around the concept of a node consisting of interchangeable hardware and software modules that can be mixed and matched to fit a broad range of application requirements. The node comprises a set of modules in an enclosure together with workstations and field devices. This node can be connected to other I/A Series nodes as well as other Foxboro and non-Foxboro computers and devices via compatible networks.

The key hardware modules and devices associated with field device integration include:

- Intelligent Field Devices that connect to a Fieldbus Module or directly to a Control Processor via an I/A Series Fieldbus.
- Fieldbus Modules (FBMs) that support specific types of IFDs and connect via a Fieldbus to a Control Processor (CP).
- Control Processors to integrate the IFD data into the control scheme via the control database and control software.

- Application Processors (APs) that support the I/A Series software and provide bidirectional information flow for IFD configuration, Integrated Control configuration, process displays, control displays, system management displays, and so forth.
- Workstation Processor (WP), Application Workstation Processor (AW), or Personal Workstation Processor (PW) to view, configure, control, and maintain information via the CRT.

The software supporting field device integration includes:

- an efficient and secure message protocol to the IFDs for the transfer of data.
- integrated control software that provides each device with its own input/output (I/O) function block for direct connection to control blocks.
- IFD configuration/maintenance software located in a separate secure environment for fast efficient configuration of IFDs.
- user-friendly detail displays for viewing IFD measurements, status, and configuration information and performing operator actions.

- system management screens:
 - to view the graphic representation of the I/A Series hardware hierarchy and the health of hardware such as Control Processors (CPs), Fieldbus Modules (FBMs), associated IFDs
 - to view health, status, and maintenance information for a selected IFD
 - to perform actions on a selected IFD such as on/off-line actions and EEPROM updates.

See Figure 1 for an example of the modules and stations related to field device integration in an I/A Series Node and Figure 2 for an example of IFD field device integration software related to the I/A Series Modules.

For a complete explanation of I/A Series systems, see the following PSSs:

- PSS 21A-1A1 A1 I/A Series System Overview
- PSS 21A-1C1 C2 Software Overview
- PSS 21A-1B1 B2 Hardware Overview



Figure 1. Example of Field Device Integration Components in I/A Series Node



Figure 2. Intelligent Field Device Information Integrated into an I/A Series System

Integrated Control Software

Integrated control software provides a selection of continuous, sequential, and ladder logic control domains. The basic element for implementing any of the control domains is the block. A logical collection of blocks can be combined in a compound to perform a specific control task.

In addition to the standard control blocks, there are Equipment Control Blocks (ECBs) containing communication information from Fieldbus Modules (FBMs) that receive control signals from IFDs.

Window Equipment Control Blocks (ECBs) provide a "window" into the Intelligent Field Device for accessing both dynamic and non-dynamic data. The measurements and select configuration data can easily be incorporated into the I/A Series control scheme by connecting those inputs through the Window ECB as inputs directly into standard control blocks (for example, a PID Block).

Window ECBs do not have alarming or message generation associated with them. When needed, device inputs can be connected to an alarm block.

The Integrated Control Configurator allows you to create compounds in which you configure.

- standard control blocks
- sequence control
- ladder logic
- ECBs for FBMs
- Window ECBs for IFDs.

The Window ECBs for Intelligent Field Devices that provide the foundation for field device integration are device-type specific and include:

ECB18	Intelligent Transmitters (Pressure,
	Temperature, Magnetic Flow, and Vortex)
ECB22	Mass Flow Transmitters
ECB13	Hydrostatic Tank Gauge Interface Unit
AMSPRI	Process Gas Chromatograph (PGC)
ECB73	Intelligent Positioner

The PGC also has a standard secondary block (AMSSEC) available to accommodate additional data sets and status information.

The capability to configure ECBs and Window ECBs via the Integrated Control Configurator allows you to add new FBMs and transmitters on-line easing the task of system reconfiguration each time a new FBM or Intelligent Field Device is added to the system.

Each standard block, ECB, and Window ECB has an associated detail display for viewing control block or ECB information. These displays, one for each block type, become available automatically for each configured block.

Block detail displays allow you to:

- tune loops
- take corrective action
- perform process control actions (manually)
- view parameters and alarm levels or indicators.

Window ECB detail displays provide the operator access to information pertaining to the Intelligent Field Devices, such as:

- · device values
- · status information
- device identification
- configuration information.

A bypass feature available with Window ECBs allows a device value to be "bypassed" while a measurement for control simulation can be manually entered. The detail display indicates both the measurement entered and the actual device value. These fields are identical when the bypass feature is off. See Figure 3 for an example of Intelligent Transmitter measurements and Figure 4 for an example of Intelligent Transmitter status information. For additional information regarding Integrated Control Software, see PSS 21S-3B1 B3.

	FOXBORO: Display Manager C55AW5:C55AW5				
				18:	50 6-6-94
Sys Alarm	ConfigDisp	Disp_1_D	isp_2_SftMnt	Selec	;†
		XMTR MEAS XMTR INFO	XMTR XMTR STATUS RANGE	C54ECBS COR20C COR20C ¹ -0.001 ² 245.71	ON SCAN ⁵ 0.0002 6 -1592 7
			CONFIG DISP	65.01 4 6.00	8
TRANSMITTER MEASU	JREMENTS				
	MEASUREMENT	DEVICE	BYPASS	LAST GOOD	VALUE
MASS FLOW	0.0044 kg/s	0.0044	OFF	OFF	
DENSITY	245.73 kg/m3	245.73	OFF	OFF	
TEMPERATURE	65.01 F	65.01	OFF	OFF	
TOTAL	6.00 kg	6.00	OFF	OFF	
VOLUMETRIC FLOW	-0.0003 1/min	-0.0003	OFF	OFF	
% SOLIDS	-1591.7	-1591.7	OFF	OFF	
			▼ ₹		ON/ OFF

Figure 3. Example of Measurement Information on Detail Display for Mass Flow Transmitter

<u>_</u>	FOXBORO: Dis	play Ma	anager C5	5A₩5:C55A₩	5		Ξ.
						18	:52 6-6-94
Sys Alarm Cont	fig_Disp	Dis	sp_1_D	i sp_2	ftMnt	Sele	ct
			XMTR MEAS XMTR INFO	XMTR STATUS CONFIG	XMTR RANGE IT MAINT PREV DISP	C54ECBS COR20C COR20C ¹ -0.003 ² 245.77 ³ 64.97 ⁴ 6.00	ON 5CAN 5 0.0017 6 -1591 7 8
TRANSMITTER STATUS							
FBM/XHTR STAT 00000000	XMTR STA	NT 1	00000	300			
			ON LI	NE			
DIAGNOSTIC ERROR HISTORY 0000							
АСК					¥		

Figure 4. Example of Status Information on Detail Display for Mass Flow Transmitter

Intelligent Transmitter Configuration/Maintenance Environment

The Intelligent Transmitter Configuration/ Maintenance (IT_Maint) Environment is a separate environment, secured (via password), providing easy handling of both configuration and maintenance tasks. It consists of two software packages: the Intelligent Field Device Configurator (IFDC) and the Intelligent Transmitter Maintenance Workbench (ITMW). The IFDC is responsible for configuring and maintaining databases for the following types of Intelligent Field Devices:

- Intelligent Pressure Transmitters, Magnetic Flow Transmitters, Temperature Transmitters, and Vortex Transmitters
- Intelligent Valve Positioners
- Mass Flow Transmitters

The selectable tasks which the IFDC software package can perform include the following:

• Configuring or printing the database for a new or existing field device (see Figure 5).

- Copying a selected configuration file to one of more field devices.
- Saving the configuration database to another file, to a disk, or directly to a field device.
- Viewing or adding comments attached to the configuration file.
- Calibrating the parameters for a specific field device.
- Comparing the current configuration file against both the stored database for the field device, and the current values in the field device (see Figure 6).
- Testing power connections between field devices.
- Displaying the raw inputs for specific field devices.
- Setting a field device to either On-line or Off-line mode.
- Executing additional applications, such as FoxDoc, Microsoft Word, or any other specific applications required by the user.

820 Transmitter Configura	tion				×
Identifier Transmitter Param	neter Configuration	٦			
Measurement #1	Custom 3.000004 5.999994	Swap Measures 1 and 2:	-Measurement	#2 bt mode Turn Off Custom Value : 83.18938 Value : 166.3784 Link 150	
C Active	External Ze C Enable C Disable		Upper Hange Dutput Mode Digital 0 4-20 mA	mA Output Fail Safe	,
Output Damping :	16.0 sec 💌		C Fail	Strategy © Continue	
	(эк	Cancel	<u>Apply</u> Help)

Figure 5. Configuration Feature of Intelligent Field Device Configurator (IFDC)

Tag NumberTag TestTag NameGreg TagDevice NameTTGeo LocationGM'sSensor Number0x4Upper Range Limit850.Lower Range Limit-200.Sensor Validation0.400000006Failsafe0x1Cocal Indic Keys0x0Local Indic Disp0x6Output Mode0x0Ox00x0Ox40x0Ox10x1Cocal Indic Lang0x0Ox60x0Output Mode0x0Ox200x20	alues	Transmitter Values	Database Values	Parameter Description
Intel Smoothing 21.10000038 21.10000038 Sensor Type 0x1 0x1 Damping 32. 32. URV 850. 850.		Tag Test Greg Tag TT GM's 0x4 850. -200. 0.400000006 0x1 20.829999992 0x0 0x0 0x0 0x0 0x6 0x0 0x20 21.10000038 0x1 32. 850.	Tag Test Greg Tag TT GM's 0x4 850. -200. 0.400000006 0x1 20.82999992 0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x20 21.10000038 0x1 32. 850.	Tag Number Tag Name Device Name Geo Location Sensor Number Upper Range Limit Lower Range Limit Sensor Validation Failsafe Failsafe Value Local Indic Keys Local Indic Keys Local Indic Lang Local Indic Lang Local Indic Disp Output Mode Measurement Units Intel Smoothing Sensor Type Damping URV

Figure 6. Compare Feature of Intelligent Field Device Configurator (IFDC)

The ITMW is responsible for configuring and maintaining databases for the Hydrostatic Tank Gauge (HTG) Interface Units.

Configuration of Intelligent Field Devices can also be performed in the field using a Hand-Held Terminal (HHT), or portable laptop containing the PC20⁽¹⁾ configurator. The same HHT or PC20 is used to configure different types of ITs with the exception of the HTG. Configuration changes made via the HHT/PC20 result in an automatic update of the information in the Window ECB for the Intelligent Field Device and the CP database files.

System Management Software

System Management Software is a distributed software system that allows you to monitor the health and performance of all components of the configured system and to intervene in network operations. This software allows you to:

• view hierarchical system displays that indicate the health of the system equipment

- view hierarchical network displays that indicate the health of network communications
- analyze network performance by monitoring communication counters
- view station configuration information
- view equipment information for each station and peripheral device (for example, CP, FBM, and Intelligent Field Devices)
- perform equipment change options for stations and peripherals
- perform on-line cable tests for stations and offline station diagnostic tests.

System Management provides unique Equipment Information Displays for each Intelligent Field Device type: ITs, Mass Flow, HTG, and so forth. These displays include device-specific fields that relate to the parameter names used in the IT configurator. Device-specific health status information is textual for easy and rapid review. See Figure 7 (Screen 1/3), Figure 8 (Screen 2/3), and Figure 9 (Screen 3/3).



Figure 7. Example of Equipment Information Display for Intelligent Transmitter (Screen 1/3)

⁽¹⁾ The PC20 is a PC-specific portable version of the Intelligent Field Device Configurator (IFDC) described earlier in this document.

7 System Management Display Handler
03-22-94 15:34:12 C54CP3 * : Equipment Unknown to station
HELP CLOSE HOME DOMAIN CLR MSG ACK CBL ACK
EQUIPMENT INFORMATION - SMN1C5 +-C54CP3 +-IT3239 +-IT3901 +
IT3239*
FBM 39
IT3904 IT3903 IT3902 IT3901+
XHTR XMTR XMTR XMTR
DIAGNOSTIC ERROR : <none> XMTR STATUS ERR : <none> XMTR MODE : On Line FBM STATUS ERRORS : Initializing Comm Failure</none></none>
CONTINUED NEXT PAGE
EQUIP CHG FQUTP TREG

Figure 8. Example of Equipment Information Display for Intelligent Transmitter (Screen 2/3)



Figure 9. Example of Equipment Information Display for Intelligent Transmitter (Screen 3/3)

The Equipment Change Display shown in Figure 10 presents those operator actions associated with the Intelligent Field Devices. These device actions include:

- Go on-line
- Go off-line
- Download (Mass Flow Transmitter and HTG)
- EEPROM Update (Mass Flow Transmitter and HTG)
- Enable Device Alarming
- Inhibit Device Alarming.

For effective health monitoring and maintenance tasks the go on-line/go off-line and alarm inhibit/alarm enable actions are available. The alarm inhibit/alarm enable actions allow the logical disconnect and reconnect of devices from the System Monitor domain to allow or disallow system alarming for those devices not physically connected to the system or in maintenance.

Calibration actions for selected devices available on the Calibration Screen include the following capabilities:

- calibrate any of the transmitters in the HTG system to zero pressure
- perform density equalization calibration in the HTG Interface Unit
- perform level equalization calibration in the HTG Interface Unit.

For additional information on System Management, see PSS 21S-2B3 B3.

System Management Display Handler 03-11-94 17:15:27 SYSTEM MONITOR RESTORED = SNN1V1						
HELP CLOSE HOME	DOMAIN CLR MSG ACK (CBL				
EQUIPMEN	CHANGE - SMN1C5 *-C54CP3	*-COR20C <				
GO ON-LINE	PERIODIC PIO BUS SWITCH	ENABLE DEVICE ALARMING				
GO OFF-LINE	BUS A: ENABLE SWITCHING	INHIBIT DEVICE ALARMING				
GENERAL DOWNLOAD	BUS B: ENABLE SWITCHING	RESET ATTENTION BIT				
DOWNLOAD	BUS A: DISABL SWITCHING					
EEPROM UPDATE	BUS B: DISABL SWITCHING					
	INFO CALIB					

Figure 10. Example of Equipment Change Actions Display for Mass Flow Transmitter

Safety Shutdown Systems

Most users require a separate control system for safety shutdown systems. This allows the safety shutdown system to "safely" shut down the dangerous process loops during an emergency even if access to the main control system has been limited or terminated. In many instances, the loop would require redundant field devices to be "safely" shut down by the safety shutdown system.

Foxboro I/A Series system can be easily configured to incorporate safety shutdown loops using the same field devices already integrated in the loop, without the need for an entire separate safety shutdown system. If the I/A Series system should fail for any reason, the PLC or controller integrated in the loop takes control of the process and "safely" shuts down the loop. The Intelligent Transmitters can be configured with a 4 to 20 mA output and a separate power supply and still communicate digitally to I/A Series for control. This allows them to remain under the control of the loop if the main control system fails in the event of an emergency.

Figure 11 illustrates the difference between a normal control loop and a safety shutdown loop. Both loops incorporate a Fieldbus module (FBM) and an Intelligent Transmitter for exemplary purposes.



Figure 11. Comparison of Normal and Safety Shutdown Loops

NORMAL LOOP

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