FOUNDATION™ Fieldbus Basics

Freedom to Choose. Power to Integrate.
Topics

- FOUNDATION fieldbus Architecture
- H1 Overview
- H1 Technology
- High Speed Ethernet (HSE) Overview
FOUNDATION fieldbus Architecture

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What is Fieldbus?

- A fieldbus is an all-digital, serial two-way, multi-drop communication System.
- H1 (31.25kbps) interconnects field equipment (Sensors, Actuators & I/O).
- HSE (High Speed Ethernet, 100mbps) provides integration of high speed controllers, subsystems (via Linking Device) and data servers and workstation.
Integrated Architecture

- Management Information Systems (MIS), Enterprise Resource Planning (ERP), and Human Machine Interface (HMI) access the H1 Fieldbus information via the Data Servers.

![Diagram of integrated architecture]

Business Enterprise and Plant Application Packages

H1 and HSE Factory/Plant Instrumentation and Control devices
H1 Overview

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Multiple Variables

- Fieldbus allows “multiple variables” from each device to be brought into the control system for archiving, trend analysis, process optimization, reporting, predictive maintenance and for asset management.
- Fieldbus distortion-free characteristics digital communication enables improved control capability which can improve product yields.
Diagnostics

- Self Diagnostics and communication capabilities of microprocessor based fieldbus devices helps reduce downtime and improve plant safety.
- Plant operation and Maintenance personnel can be notified and corrective actions taken quickly and safely.
Control Strategy

- Standard Function Blocks is used to implement the Control Strategy.
- Many control system functions such as AI, PID and AO can be performed by the field device through the use of these Standard Function Blocks.
- Distribution of control into field devices can reduced the amount of hardware and cabinet footprint needed.
**H1 Physics**

- Multi-Drop wire pair with Power and Signal on same cable.
- Support Intrinsic Safety.
- Function Blocks built into Field Devices.
- Control on the Wire – single loop integrity
- Distance up to 1900 meters
- Add Repeaters to extend > 1900 meters
- Max. of 4 repeaters can be used to a maximum distance of 9500 meters

![Fieldbus Signal Diagram](image-url)

- Fieldbus Signal
  - Voltage: 0.75 to 1.0 V p-p
  - Power: 9 to 32 Volts
  - Time

- HSE

- H1 Digital Signal
  - 0 to 32 Vdc: 100 mV
  - 32 Vdc to 3125 kbps
  - 9 to 32 Vdc: 0.3 ns
  - 1900 meters

- Distance > 1900 meters
Intrinsic Safety

Intrinsic Safety Interface

Control room

Field

Power supply
Conditioner

I.S Interface

Wiring block

I.S certified devices

Field device

Host Control System
EDDL and CFF Files

- Field Devices will consist of:
  - Actual Physical Device.
  - Device Description (DD).
  - Common File Format (CFF).
- DDs and CFFs made by the Device Supplier
- Parameters and Capabilities are defined in device files – DD and CFF
  - Defines how device shall be displayed in the system
**DD and CFF Files**

- **Device Descriptor (DD) File** allow operation of devices from different suppliers on the same fieldbus with single host system.
- **Common File Format (CFF)** is a file which describes the functions and capabilities of a field device.
- The CFF file is used in conjunction with the Device Descriptor file to enable a host system to configure the system off-line.
- CFF files are standard ASCII text file.
Typical Fieldbus Installation

- An example of the Chicken foot (tree) topology.
- Redundant, isolated power conditioning defined.
- Typically 10-12 bus-powered fieldbus devices per segment.
- 120 m distance from FF JB to FF Device.
- Spur short-circuit protection.
- Up to 1900 meters.
- Maximum of 9500 meters via repeaters.
Fieldbus Components

- Power Supply
- Workstation
- Fieldbus Interface Module
- Workstation
- HMI
- Fieldbus Controller
- Safe Area (Host)
- Hazardous Area (Field)
- Terminator
- Junction Box
- H1 Bus Wire (Spurs)
- Transmitters
- Analyzer
- Actuator Valve

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Resource Block

- The Resource Block describes characteristics of the fieldbus device such as device name, manufacturer and serial number, etc.
- There is only one Resource Block in a device.
Transducer Block

- Transducer Blocks are used to configure devices.
- Transducer Blocks are required to Read sensors value and command output value.

Control Builder Project tab
Function Blocks

- The Control System Strategy is built using Function Blocks.
- Input and output parameters of Function Blocks can be linked over the fieldbus.
- The execution of each Function Blocks is precisely scheduled and there can be many function blocks in a single user application.
# Standard Function Blocks

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Example of a Control Loop

- Control Strategy can be built using Function Blocks built into field devices.
- A simple temperature transmitter may contain an AI function block. A Control Valve might contain a PID function block as well as the expected AO Block.
- Thus, a complete control loop can be built using a simple transmitter and a control valve. Control in the Field does need a Controller.
H1 Link Master Redundancy

- **Two types of devices:**
  - Link Master
    - Capable of becoming Link Active Scheduler (LAS).
  - Basic Device

- **Link Master Device are**
H1 Link Active Scheduler

- PID Loop scheduled and unscheduled communication.

Function blocks:
- AI 110
- PID 110
- AO 110

Scheduled Communication

- Function Block Execution
- Scheduled Communication
- Unscheduled Communication

Unscheduled Communication

- Alarms/Events
- Maintenance/Diagnostic Information
- Program Invocation
- Permissives/Interlocks
- Display Information
- Trend Information
- Configuration

loop 110 period of execution
High Speed Ethernet (HSE) Overview

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FF Integrated Architecture
HSE – Subsystem Integration

- High Performance Control Backbone
- Standard Ethernet Equipment and Wiring
- Standard Function Blocks  PLUS
- Flexible Function Blocks for Discrete/Batch/PLC
- Redundant HSE Interfaces and Devices
- Linking Devices (LD) Integrate H1
- HSE Provides the Open Interface for Data Servers
High Speed Ethernet Devices

HSE Client

100 Mbit/s Switch

Gateway

I/O Network

MIO inside

HSE Field Device

Linking Device

Plant

Plant

Plant

H1

H1

H1

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HSE - LAN Redundancy

HSE Client

HSE Field Device

Gateway

I/O Network

Linking Device

Plant

Plant

Plant
HSE - Device Redundancy

HSE Client

HSE Field Device

Gateway

Linking Device

I/O Network

Plant

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Additional Points

- FOUNDATION fieldbus is tried and tested since 15 years
- Only FF supports temporary master like handheld or laptop
- 8 channel temperature transmitters replace 8 regular transmitters
- Fieldbus electric actuators eliminate 6-12 pair of wires
- Only FF supports firmware upgrade instead of circuit replacement
- FF provides closed loop digital control: sensor to actuator
- Fieldbus provides flexibility to add devices to the bus
- Fieldbus provides flexibility to use additional signals in the device
- Fieldbus eliminates proprietary MOV bus
- No need to change I/O card type when device type is changed
- FF integrates gas chromatograph in asset management software
- Fieldbus is made easy thanks to wizards and EDDL etc.