Technology Event

Fieldbus Foundation – Changing the Playing Field

Date: 21st June, 2008 (Saturday)
Venue: TROPICANA Conference Room.
Hotel: Taj Residency,
Akota Gardens,
Vadodara - 390 020 INDIA

Foundation Fieldbus Devices – A General Review

Presentation by
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Executive Manager – Field Instruments Business Unit
Yokogawa India Ltd

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Definition

What is FOUNDATION technology?
The FOUNDATION solution is a systemic technology comprised of a bi-directional communications protocol used for: communications among field devices and to the control system.

Function Block structure for true distributed control,
Device Description (DD) technology for parameterization and integration of data,

A network hierarchy for subsystem integration and a well-defined system management structure for reliability and determinism of functional execution.
Device Availability.
Source to verify available devices.

Benefits
- Reduction of CAPEX / OPEX
- More information – Multi sensing
- Diagnostics – Device Status.
- Freedom for user to select multiple vendor products.
- Device Firmware upgrade to keep updating features

Function Blocks
Device / DD identification

What’s coming
FF Device Availability
FOUNDATION fieldbus device line up

Flow
- Coriolis
- Vortex
- Electro-magnetic

Analytical
- pH
- Conductivity
- Dissolved O₂

Configuration Tools
- FieldMate

Positioner
- FOUNDATION - P converter
- Valve Management software

Pressure

Temperature
- Transmitter
- Multiplexer

Recorder, Indicator
- DAQSTATION
- Fieldbus Display

Level

Multivariable
Source to verify device availability.
- http://www.fieldbus.org
- Individual product manufacturer’s web page
Registered Products Catalog

Search Results

Results 251 - 275 of 276 for

YOKOGAWA ELECTRIC CORPORATION
digital YEWFLO Vortex Flowmeter

YOKOGAWA ELECTRIC CORPORATION EJA Pressure Transmitters

YOKOGAWA ELECTRIC CORPORATION EJA (Software Download) Pressure Transmitter

YOKOGAWA ELECTRIC CORPORATION YPK FF - Pneumatic Converter

YOKOGAWA ELECTRIC CORPORATION ROTAMASS Coriolis Mass Flowmeter

YOKOGAWA ELECTRIC CORPORATION VTMA Temperature Transmitter
Benefits.

- Reduction of CAPEX / OPEX
- More information – Multi sensing.
- Diagnostics – Device Status.
- Freedom for user to select multiple vendor products.
- Device Firmware upgrade to keep updating features
Summary of benefits

4-20mA conventional system
1-pair of cable sends 1 signal to 1 direction

- Partially seen
- Partially reached

FF_H1 system
1-pair of cable sends multi signals to both direction

- Everything seen
- Everything reached

- Cable & wiring cost reduction (CAPEX reduction)
- Device Q’ty reduction by multi-variable sensors (CAPEX & OPEX reduction)
- Earlier drift detection & D/ A - A/ D less improve signal quality
  (Op cost reduction & product quality improvement -> OPEX reduction)
- Device availability improvement, defects & downtime reduction
  -> Not just Good or Bad status, how good or how bad status allows trend
  monitoring (OPEX reduction)

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*CAPEX: Capital Expenditure, OPEX: Operational Expenditure
Full Digital System

Conventional

Digital

Analog
4-20 mA

Digital

FOUNDATION fieldbus

Digital

Full Digital System

Digital
More Data from Field

Conventional

One direction with one variable

FOUNDATION fieldbus

Both direction with multivariable

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View Expansion

Conventional

View stops at I/O modules

FOUNDATION fieldbus

View expands into field devices and process interfaces

Device alarms

Diagnostics

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Control in Field

Conventional

FOUNDATION fieldbus

Control function in field devices

PID

PID

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Installation Cost Saving

Conventional

FOUNDATION fieldbus

Reduction in I/O modules & marshalling cabinets
Less cables
One barrier for several devices

I/O modules, marshalling cabinets

Barrier

Barrier

Barrier

Barrier

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Multi sensing

No longer required

No Longer Required

Flow
Pressure
Temperature

PT1000
Class A

Saturated Steam Curve

Pressure (kgf/cm²)

Temp

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FOUNDATION Fieldbus Benefits

Reduced number of wires and marshaling panels
Reduced number of input/output converters
Reduced number of intrinsic safety barriers
Reduced number of power supplies and cabinets
Reduced size of equipment rooms
Reduced number of devices by multivariable function

"Saving can exceed 9% of installation budget." by ARC

Remote configuration of devices
More information available for operations
Increased accuracy of measurements
Easier evolution due to standardized function blocks
Increased sophistication and flexibility of instrumentation
Increased uptime due to less equipment, better self diagnostics, and remote diagnostics

"Saving can exceed 20% of continuation budget." by ARC
Benefits.
- Reduction of CAPEX / OPEX
- More information – Multi sensing.

Diagnostics – Device Status.
- Freedom for user to select multiple vendor products.
- Device Firmware upgrade to keep updating features.
### FF Field Device - Key Features

#### Flow
- **Vortex**
  - Amplifier temperature monitoring and alarming
  - Abnormal flow condition identification
  - Excessive flow fluctuations - pulsating flow - Excessive vibration
- **Coriolis diagnostics**
  - Mass and volumetric flow, density, concentration
  - Advanced diagnostic capability
  - Excessive zero fluctuation, corrosion and abrasion detection
- **Magnetic flow diagnostics**
  - Measurement exceeds range limits / Empty tube detection
  - Short or open coil circuit
  - Electrode deposition monitoring.

#### Pressure
- **Impulse Line Blocking Detection (ILBD)**
- **Steam tracing system failure detection**
- **Capsule temperature monitoring and alarming**
- **Primary measurement exceeds range limits**
- **Static pressure exceeds static pressure limits**
- **Amplifier temperature monitoring and alarming**

#### Temperature
- Measurement exceeds range limits
- **Broken sensor - short or open circuit**
- **Amplifier temperature monitoring and alarming**
- **Hot backup**
- **Sensor drift alert**

#### Analyzers
- **PH/ ORP Diagnostics**
  - Sensor impedance checking
  - Detection of fouling, ageing and breakage
  - Non immersion detection
- **Conductivity diagnostics**
  - Measurement exceeds range limits
  - Polarization detection and reporting
  - Broken sensor - short or open circuit
  - Conductivity and process temperature

#### Valve Positioner
- **Offline Diagnostics, friction dead band**
- **Online diagnostics, friction, hysteresess**
- **Travel (Total, open, close), read back signals**

#### Overall Features
- Multi-sensing, multi-variable
- Low current, high performance
- Flash memory for Software upgrade
- LAS standard, PID option
Advanced device diagnostics

Mag meter adhesion diagnosis
Constantly monitors the changes of the fluid impedance by the amount of insulating adhesion on electrodes.

Flow tube inside

0.996 m³/h
19.938 mA

Indicating the amount of adhesion on electrodes!

DP Flow Trx impulse line clogging

- Signs of pipe line plugging
  - Change of fluctuation of process pressure by plugging
  - Imbalance of fluctuation between differential pressure (DP) signal and static pressure (SP) signal

<table>
<thead>
<tr>
<th>SP signal</th>
<th>H/L side plugging</th>
<th>H side plugging</th>
<th>L side plugging</th>
<th>No plugging</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP signal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP, DP</td>
<td>SP, DP Low fluctuation</td>
<td>SP Low fluctuation</td>
<td>SP, DP Similar fluctuation</td>
<td>Independent fluctuation</td>
</tr>
</tbody>
</table>

Trx can detect both of deferential pressure and static pressure. By comparing the fluctuation of these two signals, we can identify plugged side (H/L) of impulse line.
Benefits.

- Reduction of CAPEX / OPEX
- More information – Multi sensing.
- Diagnostics – Device Status.

- **Freedom for user to select multiple vendor products.**
- Device Firmware upgrade to keep updating features
What makes FF device interoperable?

- Interoperability is made possible by the fact that devices and software are conforming to the same standard.
- Testing and registration ensures that FOUNDATION devices bearing the official "checkmark" seal can be connected on the same bus or network and exchange information without an heroic integration effort.
- **End users can select the best device** for a specific measurement or control task, regardless of the manufacturer.

What is interoperability?

- Interoperability refers to the ability of any ITK-registered device to work with any HIST-analyzed host. Users want to operate their entire plant from one operator interface and maintain all devices on the system with one maintenance application.
Fieldbus Foundation Certification

Quality guarantee - independent of manufacturer:

Fieldbus Foundation has a qualified certificate system for fieldbus devices and therefore guarantees the 
*interoperability* and *interchangeability*.
ITK revisions

**ITK 4.0 (March 2000)**
- All devices are requested to be re-tested with this version
- Update from previous version includes addition of a parameter showing ITK revision

**ITK 4.01 (April 2001)**
- Minor modification of some test cases including
  - I3300_00 status propagation test

**ITK 4.51 (November 2002)**
- Addition of test for eight new function blocks (MDI, MDO, MAI, MAO, IS, AR, SC and IT)
- Additional tests of CFF (based on Infraserv experience)
- Minor modification of some test cases

**ITK 4.6 (June 2004)**
- All devices are requested to be re-registered with this version by April, 2007.
- New test cases for the Standard Pressure Transducer Block
- Support for devices with Common Software Download
- Updated CFF testing compliant with FF-103 FS 1.7
- Enhancements to the ITK Automation Toolkit
- Other minor bug fixes and enhancements
ITK revisions

ITK 4.61 (July 2005)
- Support for Software Download function
- Support for CS function block
- Enhancements to the ITK Automation Toolkit
- Other minor bug fixes and enhancements

ITK 5.0 (January 2006)
- Enhancement for Software Download function
- Multivariable and Block Instantiation test support
- Support for EDDL enhancement

ITK 5.0.1 (May 2007)
- No new test cases
- Minor bug fixes
How is Interoperability Ensured

FF provides key technology for interoperability:
- Device Description (DD) technology in parameter access
- Capability File (CF) in segment and device configuration
- Communication profile specification for communication

FF provides the following test programs to verify interoperability.

A Basic Communication Functions:
- Conformance Test,
  + Communication Profile,
  + Physical Layer Test

B Control and Monitoring Functions:
  + Interoperability Test (Field Device)

C Engineering/Configuration Functions:
  + Capability File Test

D Device Management Functions:
  + Device Description Test
Interoperability Scheme of FF System

Control
Operation
Monitoring
Communication

Engineering
Communication

Device
Management
Communication

Host
Applications

Fieldbus

Field Devices

Function Block
Communication
Sensor

Function Block
Communication
Actuator

Process
Interoperability Scheme of FF System

Fieldbus Foundation (FF) determined to provide “Interoperability” according to the “open” Foundation technology for all device suppliers;

- Capability File (CF)
- Device Description (DD)

The reasons are:

- The open technology of CF and DD brings real benefits for multi-vendor device selection
- CF and DD enable to achieve off-line engineering without actual devices. On-line engineering work at site with actual devices might bring a lot of inconvenience of application software creation and test, and might influence on project schedule much.
- Modification or update of CF and DD does not influence on the host system software. In case of vendor proprietary file, all the time, revision of software has to be checked.
Host Interoperability Support Test

Purpose of (HIST):

- Perform **additional interoperability** testing
- Defined by the HIST Test Procedures document
- Participation is on a voluntary basis
- Provides additional assurance that a host system and registered device are interoperable
- There is no additional registration given to participants, but there is a Letter of Confirmation for participants.
- Up to the Host System Vendor to define what functions are supported by the host system under test
Interoperability Demonstration at ISA show
Benefits.

- Reduction of CAPEX / OPEX
- More information – Multi sensing.
- Diagnostics – Device Status.
- Freedom for user to select multiple vendor products

- **Device Firmware upgrade tools for updating features**
On-line update with flash memory

- No amplifier replacement is required for software updating
  - Reduce material cost
- Reduce maintenance work for software updating
  - Reduce man-hour cost
  - Reduce safety cost

Device with flash memory supporting software update function
Download class: Class I (Fieldbus Foundation Specification)

S/W download tool
(standalone tool)

S/W download tool
(system tool)

OPEX Reduction
Function Blocks
Function Block types

- Resource Block
- Transducer Block
- Function Block

- maintenance
- field technician
- programmer
This block contains data that is specific to the hardware and associated with the resource. The mode of the Resource Block controls the mode of all other blocks in the device.
Transducer blocks insulate function blocks from the specifications of I/O devices, such as sensors, actuators, and switches. Transducer blocks control access to I/O devices through a device independent interface defined for use by function blocks.
The Function Blocks are part of the Foundation Fieldbus specification and the key to the possibility of using control loops in the field.

It is the responsibility of the device manufacturer, what kind of function block he wants to implement.
Examples of supported function blocks

- **Pressure**
  - AI
  - AI
  - AI
  - IT
  - IS
  - SC
  - AR
  - PID

- **Vortex**
  - AI
  - AI
  - DI
  - DI
  - PID

- **Positioner**
  - AO
  - DI
  - DI
  - OS
  - PID

- **Coriolis**
  - IT
  - IT
  - PID

- **Magmeter**
  - DI
  - DI
  - IT
  - IT
  - AR
  - PID

**New function blocks**
- IT: Integrator
- IS: Input Selector
- SC: Signal Characterizer
- AR: Arithmetic

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Device Identification
Device Identification

- Tag Name
  - Each device also have a user-definable tag name.
  - There are 32 characters available for assigning tag names to a device.
  - This tag name becomes a reference name for the Host system or configuration tools

- Node Address
  - A Fieldbus device has a node address in the ranges between 0x10 and 0xFF,
  - Classified into LM range, BASIC range, default range and temporary range.
  - Usually devices are in LM or BASIC range according to their device classes.
  - When a device loses the node address, it communicates using one address in the default range.
  - A temporary device such as a handheld communicator has node address in the temporary range.
  - Link Active Scheduler has a node address of 0x04.

- Device ID
  - This is a unique ID for each types of Device
Device Identification

How does the system know what kind of device is connected on the bus?

- Tag Number
- User Defined (PDT-1001)
- Device ID
- Unique ID – FF Defined
- Node Address
- User Defined (0x04)
Device Identification - Example

- How is Device ID identified?
  - Every FF device has a specific device ID.
    - (vendor number // device number // serial number)
  - Manufacturer ID.
    - (Yokogawa – 594543)
  - Device Type
    - (EJX - Pressure Trx -- 000C)
  - Serial Number
    - (12 C 405540)
  - This information is readable from the DD’s file (.cff)
Device Identification - Example

```c
// Header
// ------------------------------
[File Header]
Description = "This is a Capabilities File for the EJX Pressure Transmitter"
FileType = CapabilitiesFile
FileDate = 2006,02,08
FileVersion = 1,7

// Device Header
// ------------------------------
[Device Header]
DeviceName = "EJX"
DeviceClass = LINKMASTER
CommGroup = 3
CommClass = Class31 + Class32
CommSubClass = Class3Publisher + Class3Subscriber + Class3LinkMaster + Class3TimePublisher

[Device VFD 1] // Management VFD
VendorName = "Yokogawa Electric"
ModelNumber = "EJX"
Revision = "R1.01"
VersionOD = 0x00
ProfileNumber = 0x4047

[Device VFD 2] // Function Block VFD
VendorName = "Yokogawa Electric"
ModelNumber = "EJX"
Revision = "R1.01"
VersionOD = 0x01
ProfileNumber = 0x0000

// ------------------------------
// NM Section
// ------------------------------
[NM OD Directory]
DirectoryRevisionNumber = 1
NumberOfDirectoryObjects = 1
TotalNumberOfDirectoryEntries = 0
```
What's coming
What’s coming

- Safety Instrumented Functions – Under Demonstration.
- FDT / DTM – Register
- Wireless
Field Device Tool (FDT) technology, what is it?

FDT (Field Device Tool) technology standardizes the communication interface between field devices and systems. The key feature is its independence from the communication protocol and the software environment of either the device or the host system. FDT allows any device to be accessed from any host through any protocol.

The latest news, activities and events of the FDT Group

FDT/DTM or EDOL for Asset Management using Foundation Fieldbus technology

The most commonly used technologies for integration of smart devices in automation systems are FDT/DTM and EDOL.

The International Instrument Users Association IUE decided to perform an evaluation of these technologies as applied in Foundation Fieldbus (FF) systems. They commissioned Shell Global Solutions International (SGSI) to do the comparison.

This test provides an objective assessment by an independent laboratory recognized for its competence and experience.

The final report is now available and presents their findings and evaluation. A summary of the main conclusions is in the news section below. If you wish to receive a copy of the complete report, please ask at marketing@fdtgroup.org.
FDT / DTM Integration

Certified DTM

The Member Companies

FDT Group

List of certified devices

Certification checks that the device model (DTM) adheres to the FDT specification and that it will be interoperable with other certified DTM devices. This ensures a smooth project implementation, with minimal trouble and gives the end-user the freedom to choose devices that provide maximum plant assets efficiency without being restricted by system integration constraints.

The FDT/DTM specification provides an interface between the host system (frame application) and the device model (DTM). In FDT/DTM technology, one DTM may support several device types and one device may be supported by several DTM devices. A single DTM may support a pressure transmitter as well as several versions of a temperature transmitter (generic HART DTM) or one flow transmitter may be supported by two different DTMs for example, Basic and Advanced diagnostic versions. FDT standards require that DTMs be certified to ensure conformity to the specification. However, these devices do not require FDT certification. Device (types) specifics are included or "wrapped" in the DTM. This is why, as of November 2007, there are about 68 certified DTMs supporting over 500 device types.

So, the FDT/DTM approach provides significant advantages for the device supplier while preserving for the end user all the quality and reliability of the rigorous certification process.

Make your selection below:

- Check/selected items and click "Search".
- Manufacturer: Phoenix Contact GmbH & Co KG
  - Type: Actuator
  - Protocol: HART
- Pixxis
  - Type: Analysis
  - Protocol: Interbus
- ProSoft Technology Inc.
  - Type: Drive
  - Protocol: PROFIBUS
- Rockwell Automation
  - Type: Others
### FDT / DTM Integration

User all the quality and reliability of the rigorous certification process.

Make your selection below:

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<tr>
<th>Manufacturer</th>
<th>Type</th>
<th>Protocol</th>
<th>Device Name</th>
<th>Device Type</th>
<th>FDT spec Version</th>
<th>Style guide conform</th>
<th>tested by dtmInspector</th>
<th>Windows Operating System</th>
<th>DTM Version</th>
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<tr>
<td>CodeWrights GmbH</td>
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<td>Foundation Fieldbus</td>
<td>EE H1 Communication DTN</td>
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</tr>
</tbody>
</table>

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- FF wireless specification under evaluation & discussions.
- FF wireless aims to be one of protocols on the SP100 standard.

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Maintenance Planning Assistance

- Maintenance Planning
- Maintenance Scheduling
- Remote maintenance
- Condition-based maintenance
- Predictive maintenance
- Automated maintenance & Calibration

Resource Manager

- Condition based failure prediction
- Loop diagnostics
- Device & Installation Diagnostics
- Maintenance diagnosis assistance

To Summarize with FF

See more

Know in advance

Act early
Thank you