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

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On behalf of Fieldbus Foundation –India Marketing Committee
What is a Fieldbus?

A fieldbus is a serial digital bus optimised for response time and predictable data transmission between field devices, sensors and actuators.

... optimised can mean many different things.
How is Fieldbus Different from 4-20mA?

- Parallel connection
- Cable carries digital data from/to all the devices on the bus
- Plenty of information
- Data integrity checks
How does it work?

4-20mA

4

20

mA

time

4-20mA

4-20mA

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How does it work?

4-20mA + HART

1200 bps (bit per second)

Speed: approx. 2 values per second
Loop time: 500ms

4-20mA
How does it work?

- Speed: approx. 25 values per second
- Loop time for 3 devices: 120ms

Typically 20mA per device base current

31250 bps (bit per second)
Fieldbus Terminology

Segment

Power Cond

HOST Cards

DCS

Spurs

Terminator

Trunk

SPD
Physical layer elements – Gen. Purpose

This concept is typically applied to:

- Any kind of instrument in the safe (non hazardous) area
- Ex nA instruments in Zone 2
- Ex d instruments in Zone 1
Physical Layer

IEC 61158-2 Physical Layer standard
31.25kbit/s transmission rate
Up to 32 devices per segment - depends on several factors
- Limited to 16 by host
- Limited to less by distance
- Limited to less by process cycle time

Shielded twisted pair recommended – can use existing field wiring
2-core-cable carries power and signal (like HART)
Up to 1900m (total) with best cable – up to 9.5km with repeaters
Up to 120m spur length
## Fieldbus Foundation

### Cable Type and Description

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Description</th>
<th>Max Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>Multi or single-twisted-pair, individually shielded</td>
<td>1900 m (6232 ft.)</td>
</tr>
<tr>
<td>Type B</td>
<td>Multi-twisted-pair, with an overall shield</td>
<td>1200 m (3936 ft.)</td>
</tr>
<tr>
<td>Type C</td>
<td>Multi-twisted-pair, without a shield</td>
<td>400 m (1312 ft.)</td>
</tr>
<tr>
<td>Type D</td>
<td>Multi-core, without twisted pairs, with an overall shield</td>
<td>200 m (656 ft.)</td>
</tr>
</tbody>
</table>

### Instrumentation Cables

- Electrical power cable with poor noise immunity

## Fieldbus Cable
Example: Type A cable: Shielded twisted pair

Recommended

“Type A” does not specify the diameter; You can get type A cable in AWG 22, AWG 18, AWG 16, etc

“Type A” is also available as multicore: as long as individual pairs are twisted and shielded, it is “type A”
Permitted Spur Lengths

The spur length is reduced by 30 meters for each additional device on a spur.

<table>
<thead>
<tr>
<th>Total Device</th>
<th>1 Device</th>
<th>2 Devices</th>
<th>3 Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-12</td>
<td>120 m</td>
<td>90 m</td>
<td>60 m</td>
</tr>
<tr>
<td>13-14</td>
<td>90 m</td>
<td>60 m</td>
<td>30 m</td>
</tr>
<tr>
<td>15-16</td>
<td>60 m</td>
<td>30 m</td>
<td>1 m</td>
</tr>
</tbody>
</table>

Not recommended
Power Conditioners: Example

Single

Redundant, Multi-segment

Redundant, Multi-segment

FISCO, FNICO

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Fieldbus Electrical Circuit Diagram

Power Conditioner

Near-End Terminator

Field Devices

Far-End Terminator

9-32V

Signal Isolation Inductors

100 Ω

1 μF

1900M Max.

To H1 Interface Card

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Wiring Blocks (Examples)

Fieldbus Barriers
Ex me [ia]

Zone 1/0
Ex ia

Zone 2
Ex nL

Zone 1
Ex me

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Terminators

- Required for all balanced transmission lines (= differential signal not referenced to ground, 0V, earth or so)
- Eliminates reflection (matches cable impedance)
- Converts +/- 9mA comms’ current signal into voltage signal
- There should be exactly two terminators per bus segment: one at each end
  - Each terminator has 100 Ohms (for AC signal), they are in parallel: resulting resistance is 50 Ohms
  - +/- 9mA into 50 Ohm → 900mVpp signal amplitude
  - If one terminator is missing:
    +/- 9mA into 100 Ohm → 1800mVpp signal amplitude
  - If 3 terminators connected:
    +/- 9mA into 33 Ohm → 600mVpp signal amplitude
- Integrated into FF power supplies and wiring blocks
Surge Protection

- For This and Noise Reasons, the Shield Should be Grounded Near the Power System.
- With Our System, A Gas Discharge Tube is Provided in the Terminator to Shunt Surge Currents When an Over-Voltage Condition Exists on the Shield. This Does Not Introduce Ground Currents.
- We Also Provide Differential Over-Voltage Protection in Our Connection Blocks.
This concept is typically applied to:
- Ex nL instruments in Zone 2
- Ex i instruments in Zone 1 or 0
High Energy Trunk concept for Zone 1

- Redundant FF power supply
- Control system
- GAS
  - Zone 1
    - Division 2
      - High energy Ex e trunk
  - Zone 1/0
    - Division 1
      - FISCO or Entity fieldbus devices
- DUST
  - Zone 21
  - Zone 21/20

- Control system
- 9311-FB fieldbus barriers
- Live-workable Ex i spurs

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Topology – FISCO

This concept is applied to:
• Ex i/FISCO instruments in Zone 1 or 0
FISCO Multi dropping

Maximum reliability
Redundant FISCO – key features

- Enhancement of field-proven 912x-IS FISCO power supply
- Rugged construction for easy cabinet mounting and resistance to shock and vibration
- Redundancy achieved by active/hot standby mode
  - Supply arbitration circuit electronically transfers field load to standby module, if loss of output of active module is detected
  - Rapid fail-over occurs according to FF specifications, without risk of losing fieldbus devices from bus
Redundant FISCO architecture

Fieldbus control system (DCS)

Bulk power input

24Vdc

Redundant FISCO power supply

CONTROL ROOM

FIELD
Zone 1

Intrinsically Safe trunk and spurs

Intrinsically Safe Field wiring hub

Intrinsically safe FISCO Fieldbus devices

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This concept is applied to:
- Ex nL/FNICO instruments in Zone 2
How many field devices?

120mA available, typically 6+ devices
FISCO, IIC Gas Groups

265mA available, typically 13+ devices
FISCO, IIB Gas Groups

180mA available, typically 9+ devices
FNICO, IIC Gas Groups

320mA available, typically 16+ devices
FNICO, IIB Gas Groups

Assumes 20mA per field device
Fieldbus handheld Diagnostic monitor

FBT-3 features +
Noise measurement in 3 bands
- low frequency
- fieldbus frequency
- high frequency
Monitor signal level for all devices
Monitor signal to shield faults
Hazardous Area certification
Fieldbus On-line Diagnostic monitor

Instrument Management Software
(including fieldbus diagnostics)

Controller I/O

Fieldbus power supply system

Segment 1 of 8

Field junction box

H1 Fieldbus

Basic failure alarms

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Typical measured parameters

**Shield short**
- Easy to measure and understand
- Further measurements can identify location

**Signal level**
- Minimum level is specified by Fieldbus specification
- Low or high levels on all devices suggests incorrect bus termination
- If only one device, suggests problem on single spur

**DC voltage**
- Indicates correct function of power supply/conditioner
- Instrument supposed to operate from 9V onwards

**Noise**
- Maximum level is specified by Fieldbus specification
- Tri-band measurement helps identify source

**Retransmissions**
- Good measurement of physical layer health
- Re-tries can obscure faulty device or network
Good Wiring Practices

Lessons learned:
- Torque screwdriver
- Wire end ferrules
- Right (!) wire strippers
- Fieldbus tester

Choose the right size

Harms wire strands

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Fieldbus Design Tools
(Examples)
Measurement setup

Cable Installation
Segment Checkout
Earthing/Grounding

- Host Computer
- H1 Interface
- 24VDC
- FF Power Supply & Conditioner & Terminator
- Wiring Block & Terminator
- Device 1
- Device 2
- Device 3
- FFPS

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Earthing/Grounding

Diagram:

- Host Computer
- H1 Interface
- 24VDC
- FFPS & Terminator
- FF Power Supply & Conditioner & Terminator
- Fieldbus barrier & Terminator
- Intrinsically Safe Spurs
- Device 1
- Device 2
- Device 3