

Foundation Fieldbus

Overview and analysis

Foundation Fieldbus H1 level has been designed as a digital replacement of the 4 to 20mA standard in the process industries. Foundation Fieldbus is also a LAN (Local Area Network) for instruments used in both process and manufacturing automation with built-in capability to distribute the control application across the network. The physical wiring is also fully compatible with intrinsic safety (IS) or nonincendive wiring standards and may be used in hazardous, as well as general purpose areas. In hazardous areas standard explosionproofing or power limited concepts may be used, as well as IS concepts, offering greater cabling design flexibility.

Foundation Fieldbus has a unique user layer that defines the interface by which users can communicate with devices through a set of blocks. These blocks are 1) resource blocks, 2) function blocks and 3) transducer blocks. Resource blocks provide on-line information of name, manufacturer, and serial number. Function blocks describe control and I/O behavior. Transducer blocks decouple the function blocks from the functions required to read/write inputs and outputs. With Foundation Fieldbus, the user is able to interconnect the function blocks and schedule the running of the blocks to create control algorithms. The control may reside in the field devices rather than in the centralized controller depending on the capability of the field device.

Foundation Fieldbus (FF) features

- Reduce field wiring costs.
- Intrinsic safety wiring option available to further reduce costs in hazardous environments.
- Same bus used for analog and discrete devices.
- Control (LAS) for the segment may reside in the field devices freeing up space in central controllers.
- Time stamping of control parameters performed in field devices and coupled to control data to optimize operating performance.
- Provides greater controllability and process information.
- Standardized function blocks, representing control and I/O; speed set up.
- Long bus length of 1900m (6,175 ft) and spurs up to 120m (390 ft) span most process systems.
- Supported by over 80% of the world's process instrumentation suppliers.

Foundation Fieldbus vs conventional systems

The Foundation Fieldbus network may consist of 16 instruments connected to a 2-wire bus. This translates into significant savings over conventional point-to-point wiring due to less expensive wiring, reduced space, and greater flexibility. In control loops, Foundation Fieldbus offers greater controllability and transfers control to the field for better reliability.

Conventional System

Analog and discrete instruments are wired individually to centralized controllers in a conventional system. Control functions are processed in the centralized controller with passive devices accepting commands and providing feedback. See figure 1. No on-line diagnostics may be performed and instrument parameters, as well as descriptive device information, is recorded manually.

Critical factors to consider in evaluating a conventional system include:

1. Design layout for I/O racks and conduit runs.
2. Space allocation for cabinets and conduit.
3. Conduit, wiring and fittings cost and installation time.
4. System commissioning and trouble-shooting.

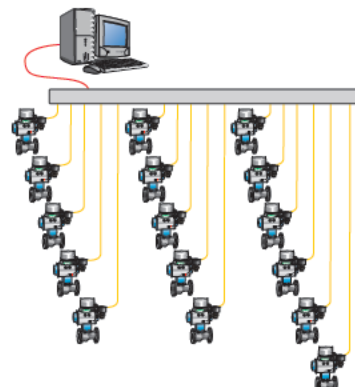
Foundation Fieldbus system

In a Foundation Fieldbus system, typically from 2 to 16 devices may be included on a common network. See figure 2. One of the devices must be a Link Active Scheduler (LAS) or Link Master, which manages the communication network. There may be multiple Link Masters on the same bus. If the current LAS fails, another Link Master may take over the LAS function and the operation of the fieldbus will continue. Wiring topology may be bus or tree topology with the bus topology illustrated. Since Foundation Fieldbus has limited power delivery capability, two more power wires are used in the example to provide power for solenoid coils. Any Foundation Fieldbus compliant device may be connected into the network.

Foundation Fieldbus economic analysis

When using a Stonel VCT module and integrating it into the Foundation Fieldbus (FF) network illustrated, there are significant savings. This system consists of 16 automated valve systems located in a cluster approximately 200 feet from the I/O rack. Each of the automated valves is located 20 feet apart in the cluster. Following is an estimated comparison:

Figure 1
Conventional system



Installation cost comparison (per field device)		
	Conventional	FF*
Computer I/O; Master/Gateway	\$70	\$160
Conduit, cable tray, wiring, and fittings	\$1,400	\$290
Valve monitor/VCT and pneumatic valve	\$510	\$1,130
Switch protected drop connector	NA	\$90
Installation and commissioning labor	\$600	\$250
Power supply	\$50	\$40
Total installed cost	\$2,630	\$1,960
Total installation savings \$670 per device		
* Foundation Fieldbus is not directly comparable. Analog instruments require minimal adder over conventional 4 to 20mA system making this system cost effective when combining analog and discrete field instruments on the same segment. Functionality for Foundation Fieldbus devices is also significantly greater, offering increased diagnostic and operational capabilities.		

Foundation Fieldbus analog point addition to Stonel I/O modules

The Stonel Foundation Fieldbus I/O modules have an auxiliary 4 to 20mA input and a 4 to 20mA output which is powered from the supplemental 24VDC supply bus. Additional savings may result from connecting the 4 to 20mA device directly to the Stonel I/O instead of running wires back to I/O at the controller. See figure 3. The additional analog input would be represented as an AI (Analog Input) function block as part of our device description. Stonel I/O analog 4 to 20mA point addition is illustrated.

The 4 to 20mA instrument may be conveniently wired directly into the Stonel I/O module. With a conventional system the control would need a 200 foot run back to the controller. Other savings would result from:

- Reduction in design time because of simpler conduit and cabling systems.
- Reduction in conduit and cabinetry space.
- Right first-time wiring and easier trouble-shooting.
- Faster commissioning.

Analog installation cost comparison		
	Conventional	FF
Conduit and wiring (\$8/ft)	\$1,600	\$160
Analog input point	\$30	\$650
Total installed cost	\$1,630	\$810
Total installation savings \$820 per device		

Foundation Fieldbus network specifications		
Topology	Bus/tree; terminators required	
Cabling	Shielded twisted pair	
Bus power	Typically 20 mA/device @ 9 to 32 VDC	
Number of devices	2 to 16 typical (theoretically 32)	
Data delivery	Unlimited	
Max. cable length	1900 m (6,125 ft) total of trunk length and all spurs.	
Spur length	<u># of devices</u>	<u>Max length</u>
	15 to 16	60 m (197 ft)
	13 to 14	90 m (295 ft)
	2 to 12	120 m (394 ft)
Transmission rate	31.25 kbit/second	
Cycle time	Link active scheduler determines priority	
Communication method	Publisher/subscriber: delegated token passing with cyclic and acyclic options.	
Link active scheduler	Acts as master for bus; schedules communication; maintains live list of segment devices.	
Data signal	Manchester Biphase-L with synchronous serial signaling.	
Error checking	Frame check sequence comparison	
Addressing	May be done off-line or performed on-line automatically by system management	
Support organization	Fieldbus Foundation www.fieldbus.org	

Figure 2
Foundation Fieldbus network

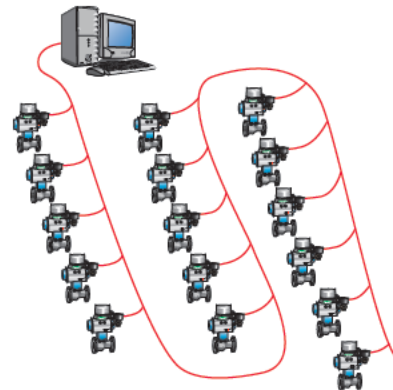
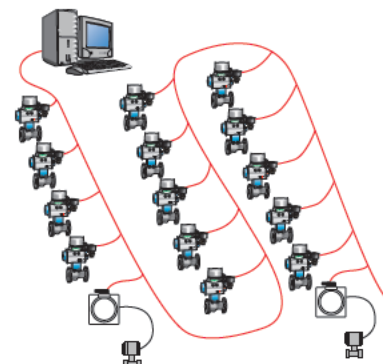


Figure 3
Foundation Fieldbus analog point addition





Valmet's professionals around the world work close to our customers and are committed to moving our customers' performance forward – every day.

Valmet Flow Control Oy

Vanha Porvoontie 229
01380 Vantaa, Finland
flowcontrol@valmet.com
+358 10 417 5000
valmet.com/flowcontrol

**Valmet Flow Control Inc.
Stonel product center**

26271 US Hwy 59, Fergus Falls, MN 56537 USA.
Tel. +1 218 739 5774.
sales.stonel@valmet.com
valmet.com/flowcontrol

