Pertemuan ke-3

Ihog#Ghylfhv

P hdvxuhp hqw#Ydulde dnv

- Sensors
  - level/volume
  - mass
  - pressure
  - flow
  - temperature
  - status
  - voltage, current
  - pH
  - gas detector
  - moisture
  - valve positioner
  - proximity
  - etc
- Actuators
  - motors
    - AC motor
    - DC motor
  - valves
    - block valve
    - control valve
  - relay
  - buzzer
  - etc

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- Range of measurement
- Operating conditions
- Accuracy
- Precision
- Linearity
- Hysteresis
- Physical characteristics
  - temperature effects
  - overpressure effects
  - vibration effects
  - humidity effects
  - power supply effects
  - load effects
  - etc
- Calibration method
- Dimensions
- Age
- Availability
- Product support (maintenance)
- Spare parts

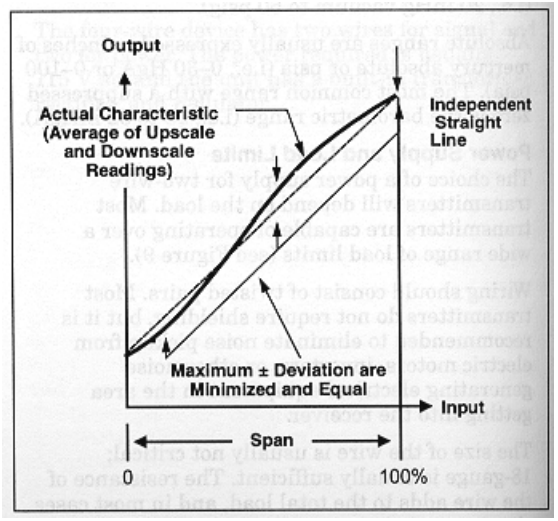
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- Range
  - Minimum and maximum value of physics quantity that can be measured under reference operating conditions
- Accuracy
  - A number or quantity that defines the limit that errors will not exceed when the device is used under reference operating conditions
  - example :
    - ± 1 ^{o}F
    - ± 1% of actual output reading
- Reference Operating Conditions
  - Specify the range of operating conditions of a device, within which operating influences are negligible

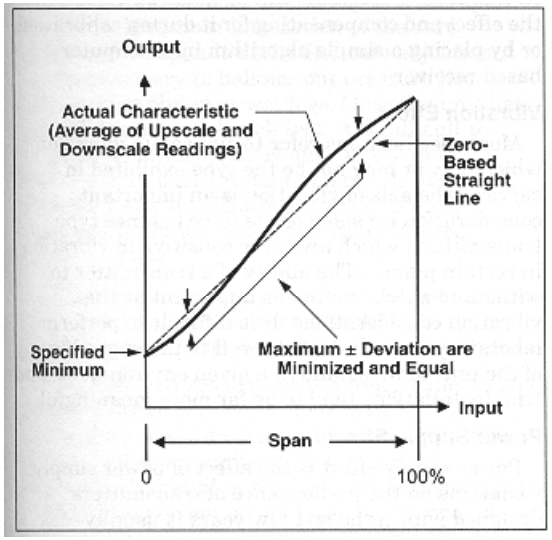
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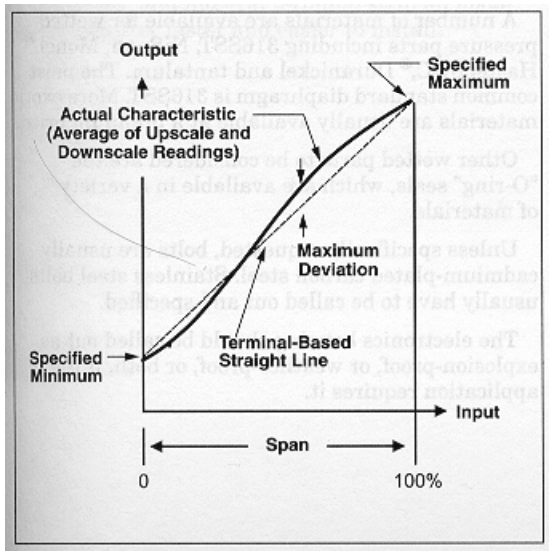
- The closeness to which a curve approximates a straight line
  - (a) independent linearity
  - (b) zero-based linearity
  - (c) terminal-based linearity

(a) independent linearity



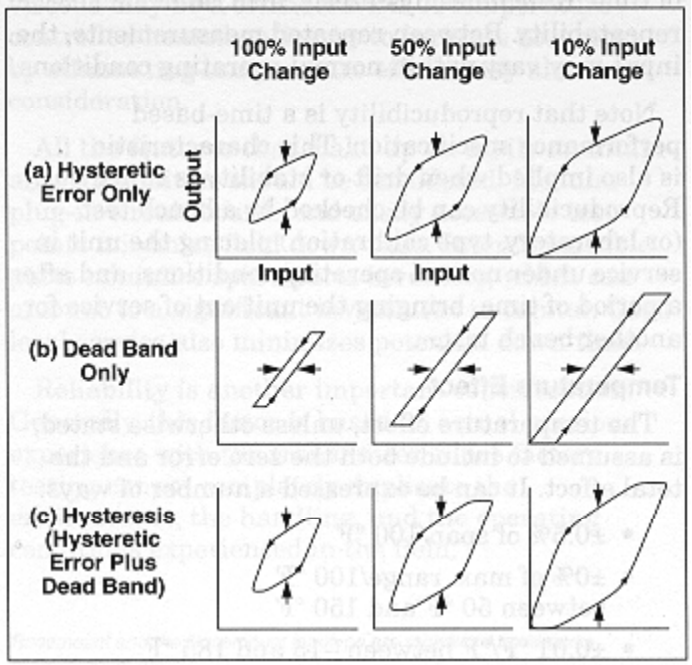
(b) zero-based linearity





(c) terminal-based linearity

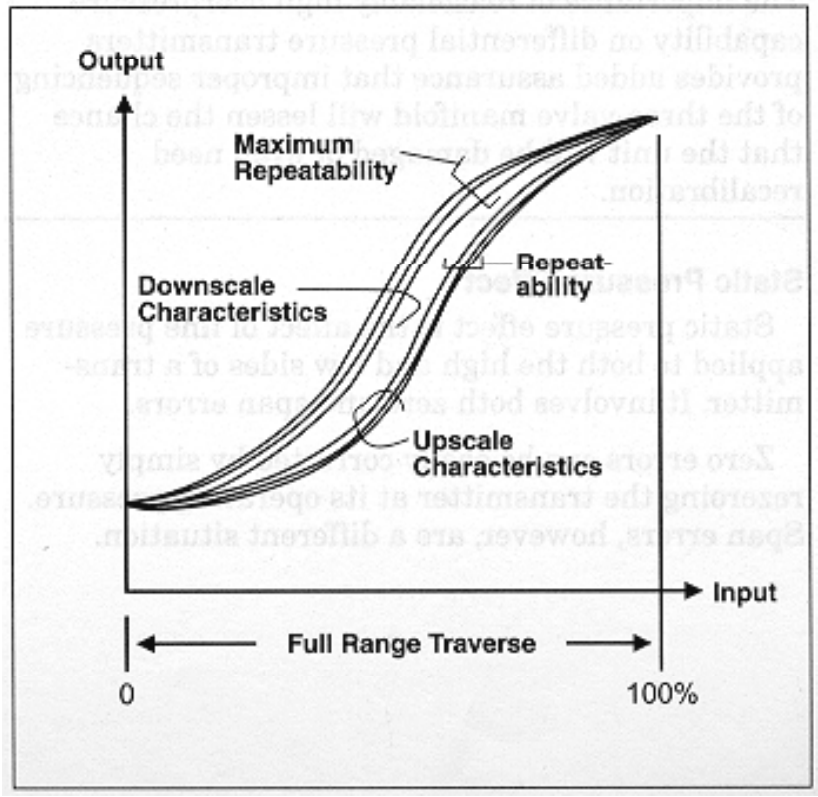
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- Hysteresis
  The maximum difference for the same input between the upscale and downscale output values during a full range traverse in each direction
  - hysteresis
  - deadband

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- Repeatability
  The closeness of agreement among a number of consecutive measurements of the output for
  - the same value of the input
  - under the same operating conditions
  - approaching from the same direction
- Reproducibility
  The closeness of agreement among repeated measurements of the output for :
  - the same value of input mode
  - under the same operating conditions over a period of time
  - approaching from both directions



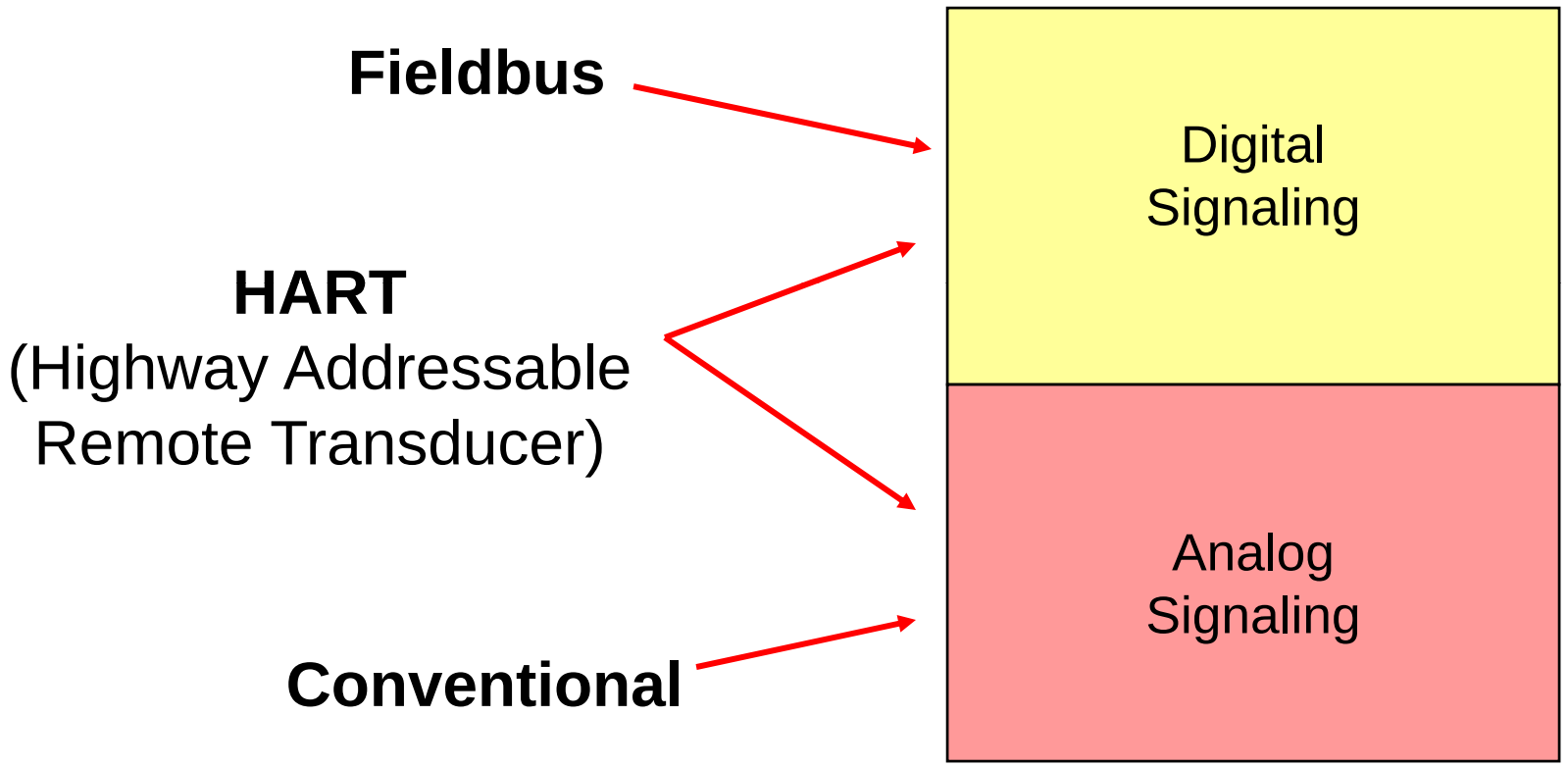
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- Humidity
  - Field device should be capable of operating in environments with 0-100% humidity
  - Working fluid and the ambient environment should be considererd for corrosiveness
- Temperature effect
  - High ambient temperature on solid state electronics adversely affect component life
  - Causing some electronic failures
- Vibration effect
- Hazardous Locations
  - flammable gases or vapors
  - combustible dust
  - metal dust, carbon/coke dust

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- Range adjustability → reduce the number of spare parts that have to be kept on hand
- Adjustable damping
- Protective features
  - Reverse polarity protection
  - Current limiting
  - Lightning suppression
  - Corrosive and ambient temperature control
- Installation consideration
  - Mounting flexibility
  - Easy installation
  - Weight and size
- Modular plug-in circuit boards and easily accessible test points → minimize field down-time
- Interchangeable parts minimize spare parts inventory
- Good local service and spare parts availability → minimizes potential down-time
- Reliability based on field experience

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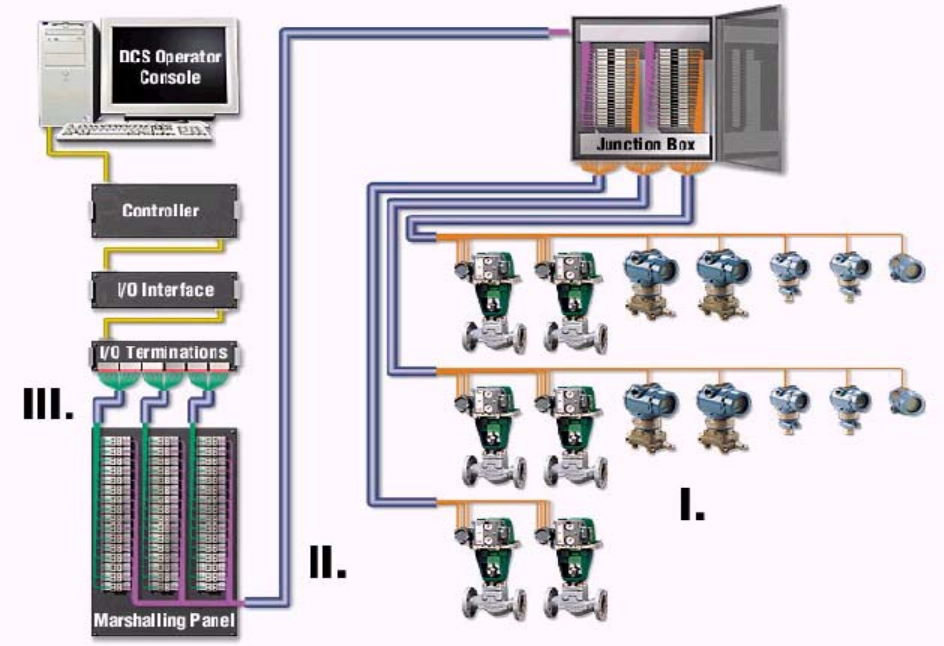


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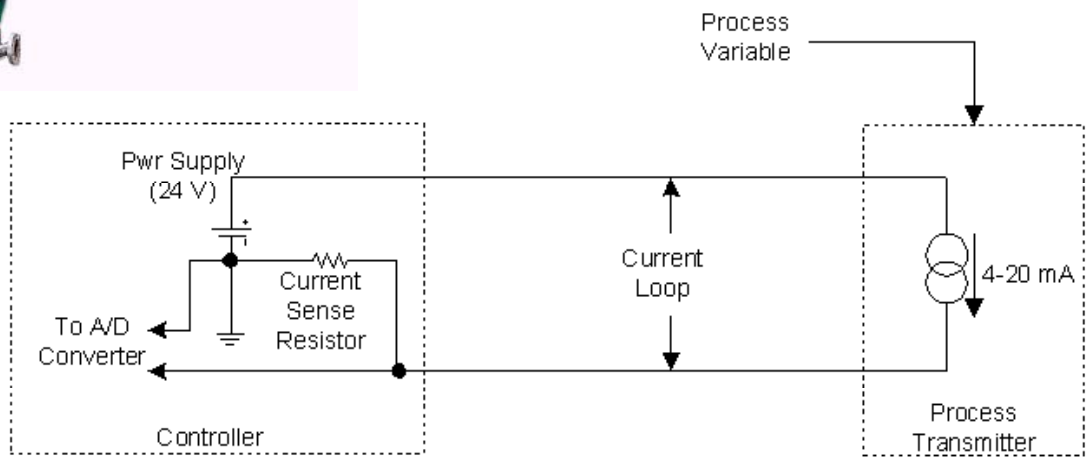
- Analog data (0 - 100%) is represented by analog signal
  - electrical : 4-20 mA or 1-5 V
  - pneumatic :
- Example :
  Differential pressure transmitter (0-150 psi operating range and 4-20 mA output)
  - 4 mA $\rightarrow$ 0 psi
  - 20 mA $\rightarrow$ 150 psi

$$10mA \rightarrow \frac{10-4}{20-4} \times (150-0) = 56.25\,psi$$

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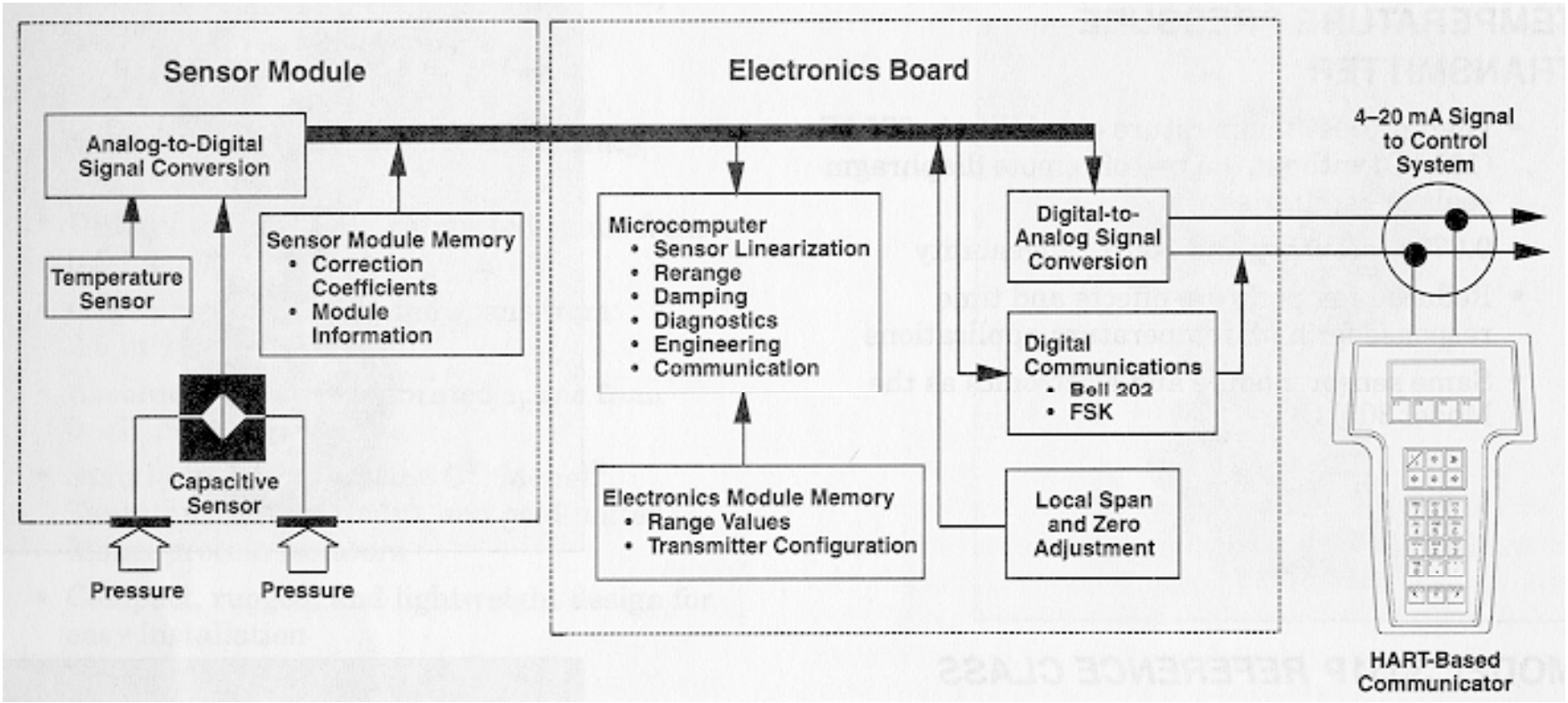
- Point-to-point configuration
- Requires dedicated wiring for each devices



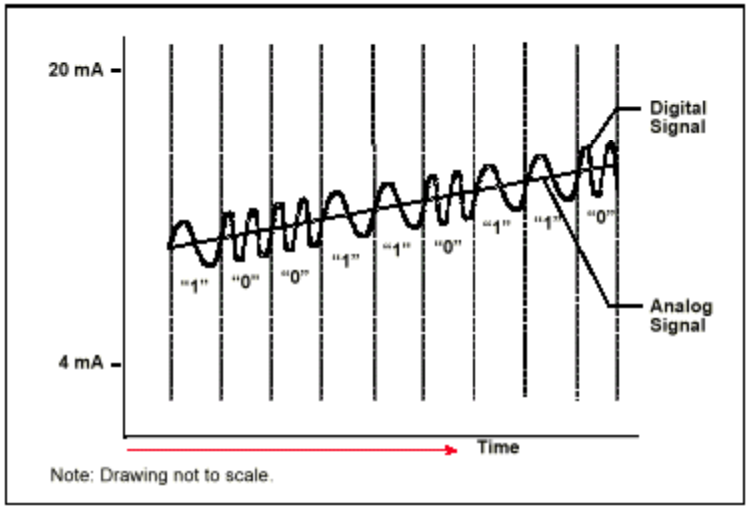
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- Interconnects smart transmitters in a two-wire network
- Simultaneous analog and digital signaling
- 1200 bps data rate
- Shielded Twisted Pair (2 wire loop)
- Support multivariable transmitter with the use of HART splitter
- Can be used as either conventional transmitter or smart transmitter
- Normally not used for control caused by low data rate

Inside a HART Transmitter



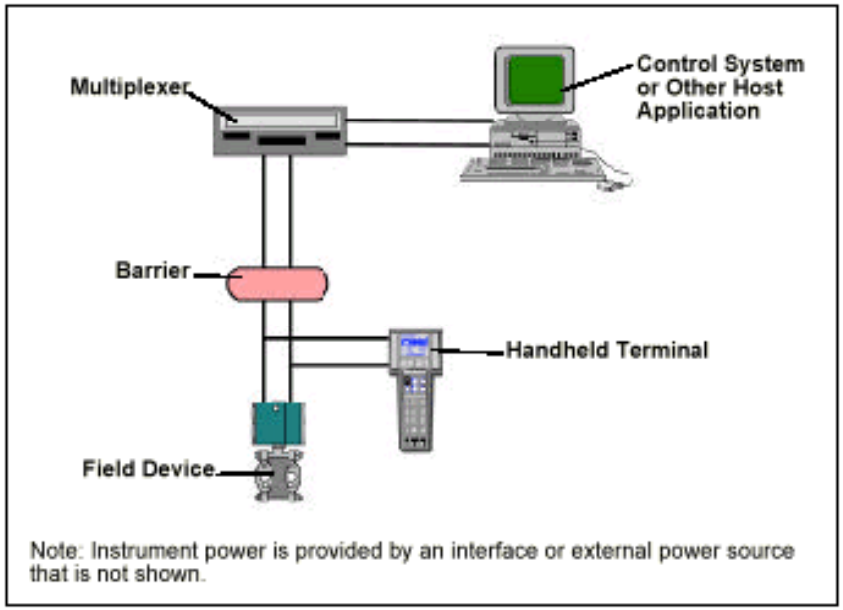
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- Simultaneous transmission of analog and digital signal

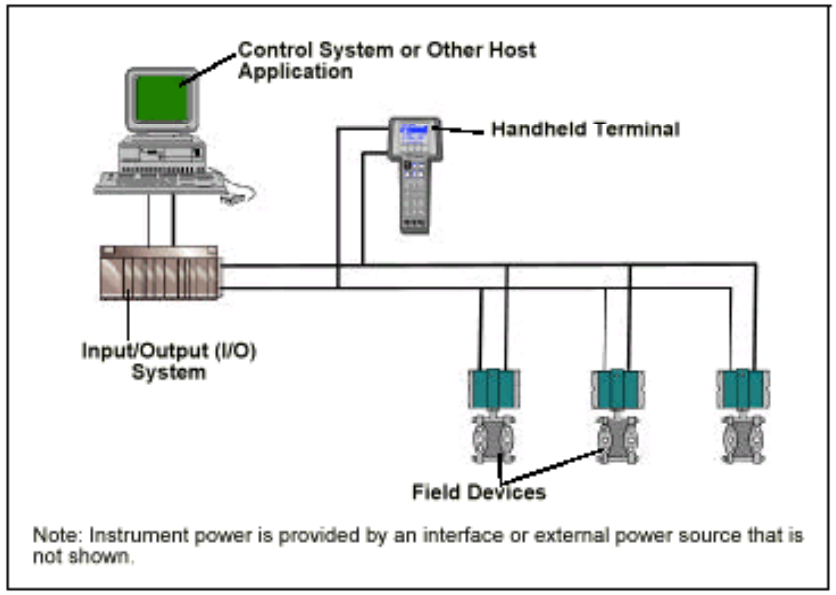
- Uses Bell202 modem frequencies and handshakes
  - ±0.5 mA variation of conventional 4-20 mA signal
  - 1200 Hz for logic 1
  - 2200 Hz for logic 0
- Because the average value of the FSK signal is always zero, the 4–20 mA analog signal is not affected.
- The digital signal has a response time of approximately 2–3 data updates per second
- A minimum loop impedance of 230 **W** is required

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- 4–20 mA signal is used to communicate one process variable
- Additional process variables, configuration parameters, and other device data are transferred digitally for
  - operations
  - commissioning
  - maintenance
  - diagnostic
- The 4–20 mA analog signal can be used for control in the normal way.

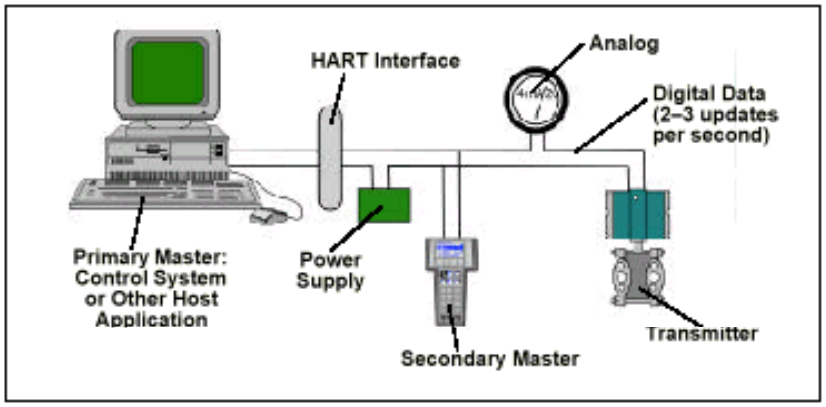
KDUW#Pxowigurs



- Used for supervisory control installations that are widely spaced, such as pipelines, custody transfer stations, and tank farms.

- Requires only a single pair of wires and, if applicable, safety barriers and an auxiliary power supply for up to 15 field devices
- All process values are transmitted digitally.
- All field device polling addresses are >0
- The current through each device is fixed to a minimum value (typically 4 mA).

Multiple Master Feature



- The use of common tools for products of different vendors minimizes the amount of equipment and training needed to maintain a plant.

- Allows two masters (primary and secondary) to :
  - communicate with slave devices
  - provide additional operational flexibility.
- Ensures interoperablility among devices through universal commands
- Enable hosts to easily access and communicate the most common parameters used in field devices.

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- Improved plant operation
  - Cost saving in comissioning
  - Improved quality of measurement
  - Cost saving in maintenance
- Operational flexibility
- Instrumentation investment protection
  - compatibility of HART revision
  - backward compatibility
  - open system connection
- Digital communication

Benefits	HART Instruments
Accuracy and stability	✓
Reliability	✓
Multivariable	✓
Computations	✓
Diagnostics	✓
Multiple sensor inputs	✓
Ease of commissioning	✓
Tag ID	✓
Remote configuration	✓
Loop checks	✓
Adjustable operational parameters	✓
Access to historical data	✓
Multidrop networking	✓
Access by multiple host devices	✓
Extended communication distances	✓
Field-based control	✓
Interoperability	✓

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- Devices are configured in a 2 wire network
- 31.25 Kbps, 1 Mbps, and 2.5 Mbps data rate
- Analog/digital data is sent as digital signal
- Data communication within devices is conformed to a standard protocol (Foundation Fieldbus or Profibus)
- Based on microprocessor and embedded system technology
- Allows point-to-point or multi-drop configuration
- Simplified wiring, drawings, and easier control engineering
- Enable embedded control algorithm

Inside a Fieldbus Transmitter

HARDWARE

- Medium Attachment Unit (MAU) comprises the circuit needed to connect the device to the actual bus wires.
- Microprocessor
- A/D converter
- Sensor converts the physical phenomenon change into electric signal
  - Conventional
  - Silicon-based

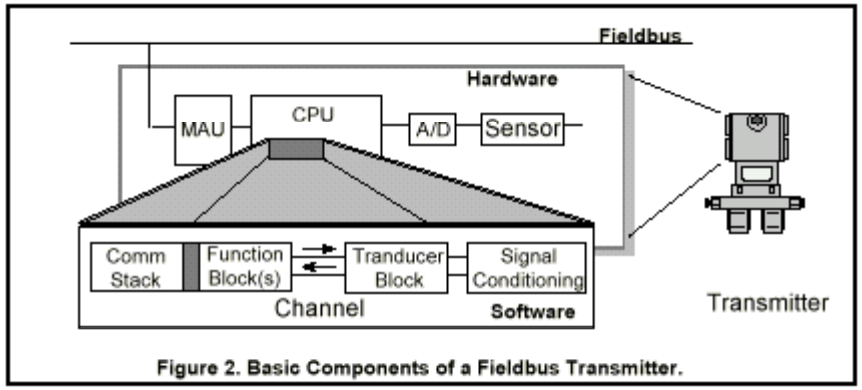


Figure 2. Basic Components of a Fieldbus Transmitter.

SOFTWARE

- Signal conditioning
- Transducer block
  - diagnostics
  - calibration
- Function block
  - high/low/rate of change limits
  - control algorithm
- Communication stack

Inside a Fieldbus Control Valve

HARDWARE

- Medium Attachment Unit (MAU)
- Microprocessor
- D/A and A/D converter
- Electric to pneumatic converter (E/P) provide pressure signal to modulate actuator
- Mechanical to electric transducer (M/E) to monitor actuator position

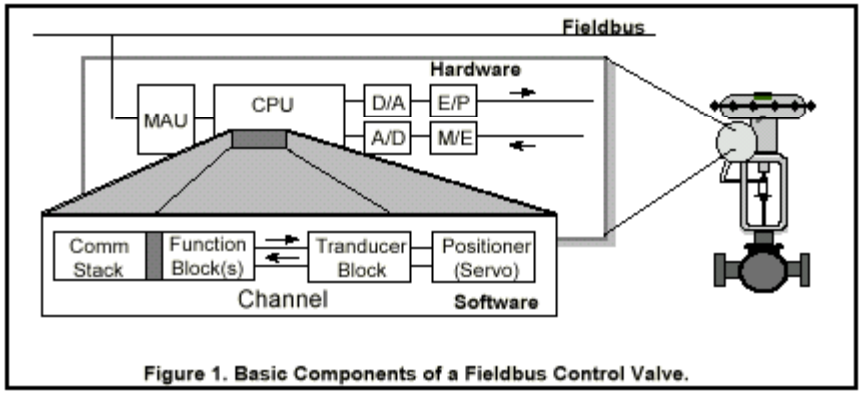
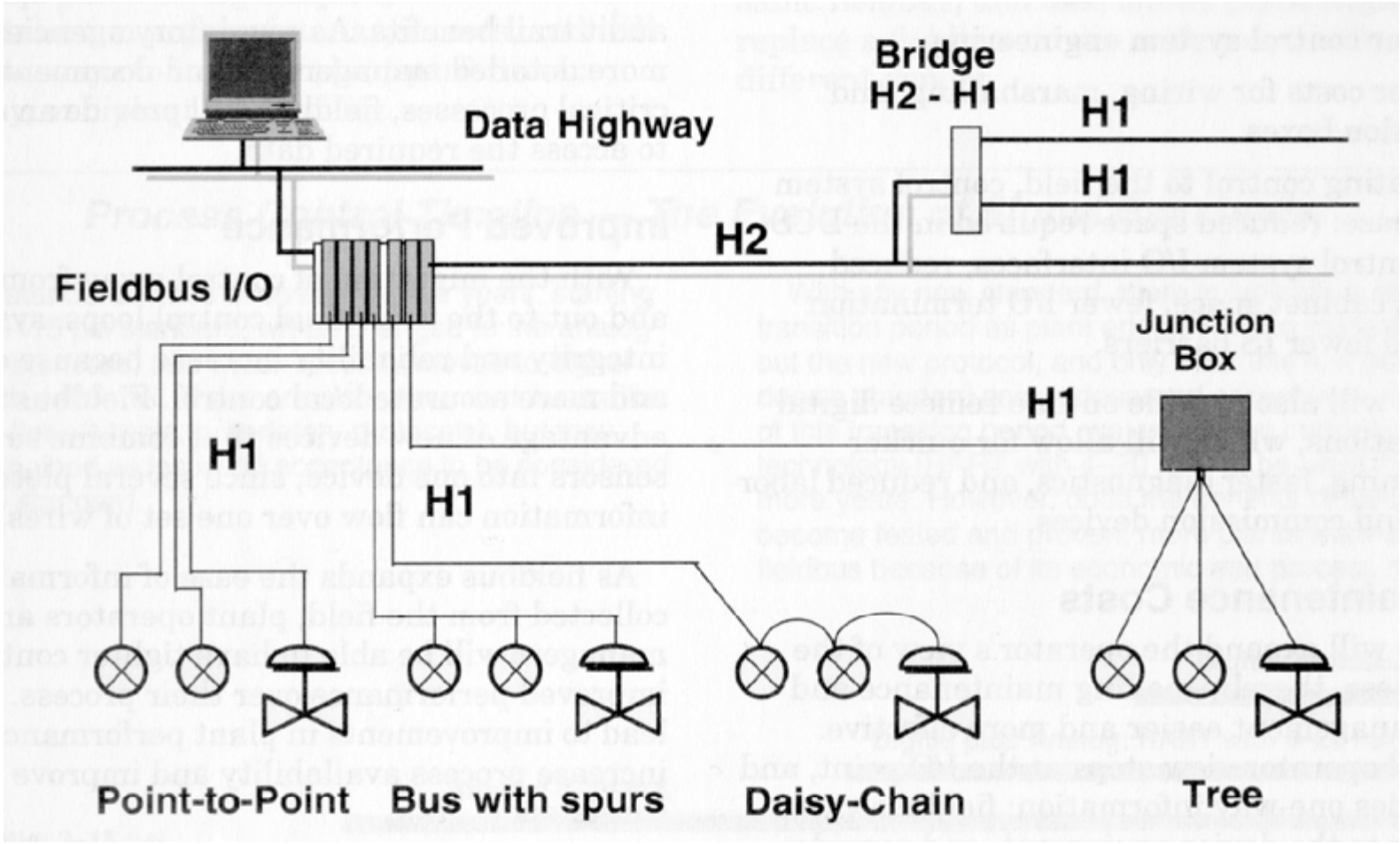


Figure 1. Basic Components of a Fieldbus Control Valve.

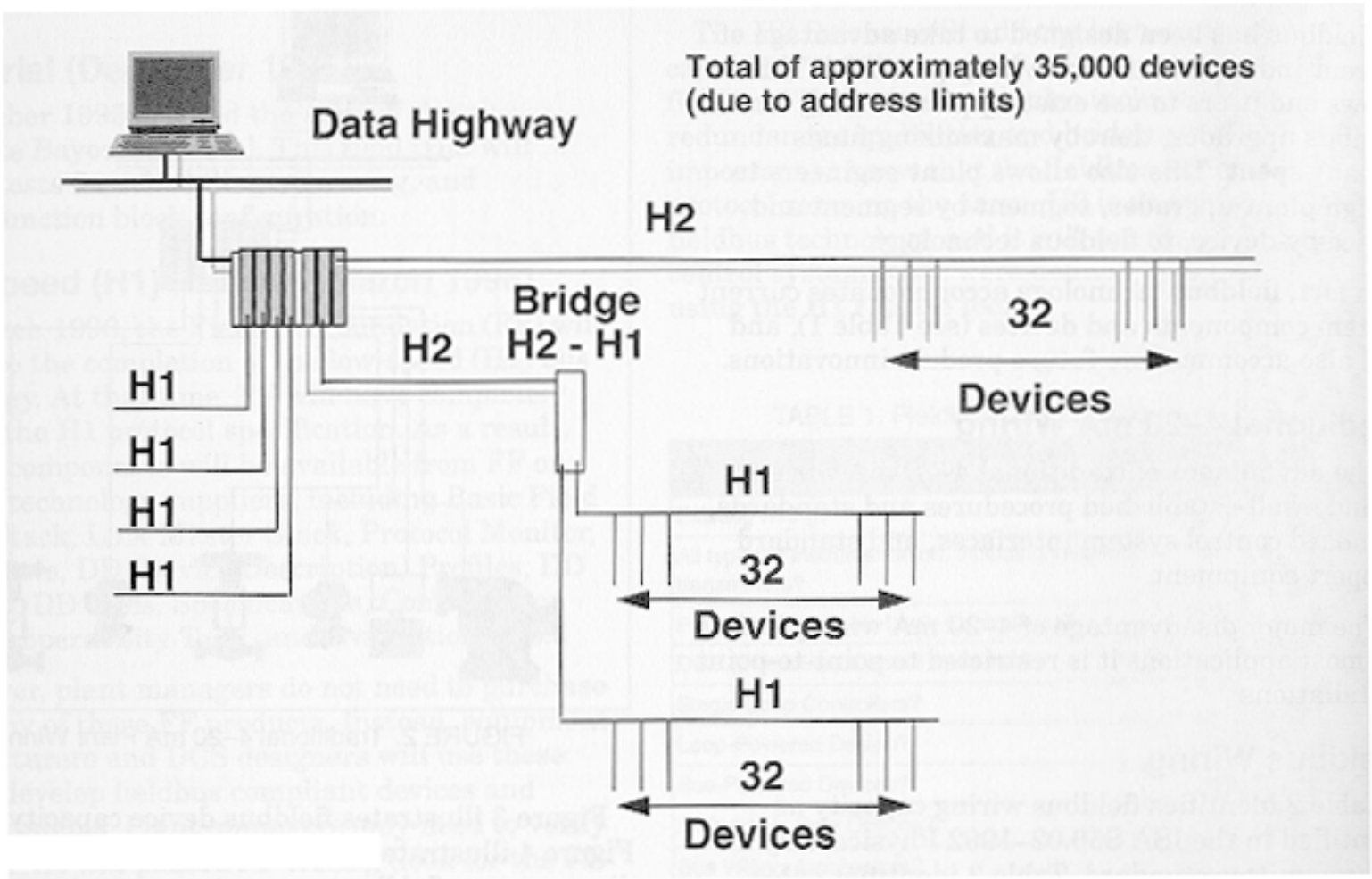
SOFTWARE

- Positioner and servo function
- Transducer block : diagnostics and calibration
- Function block
  - high/low/rate of change limits
  - control action
  - fault-state mechanism
  - readback parameter
- Communication stack

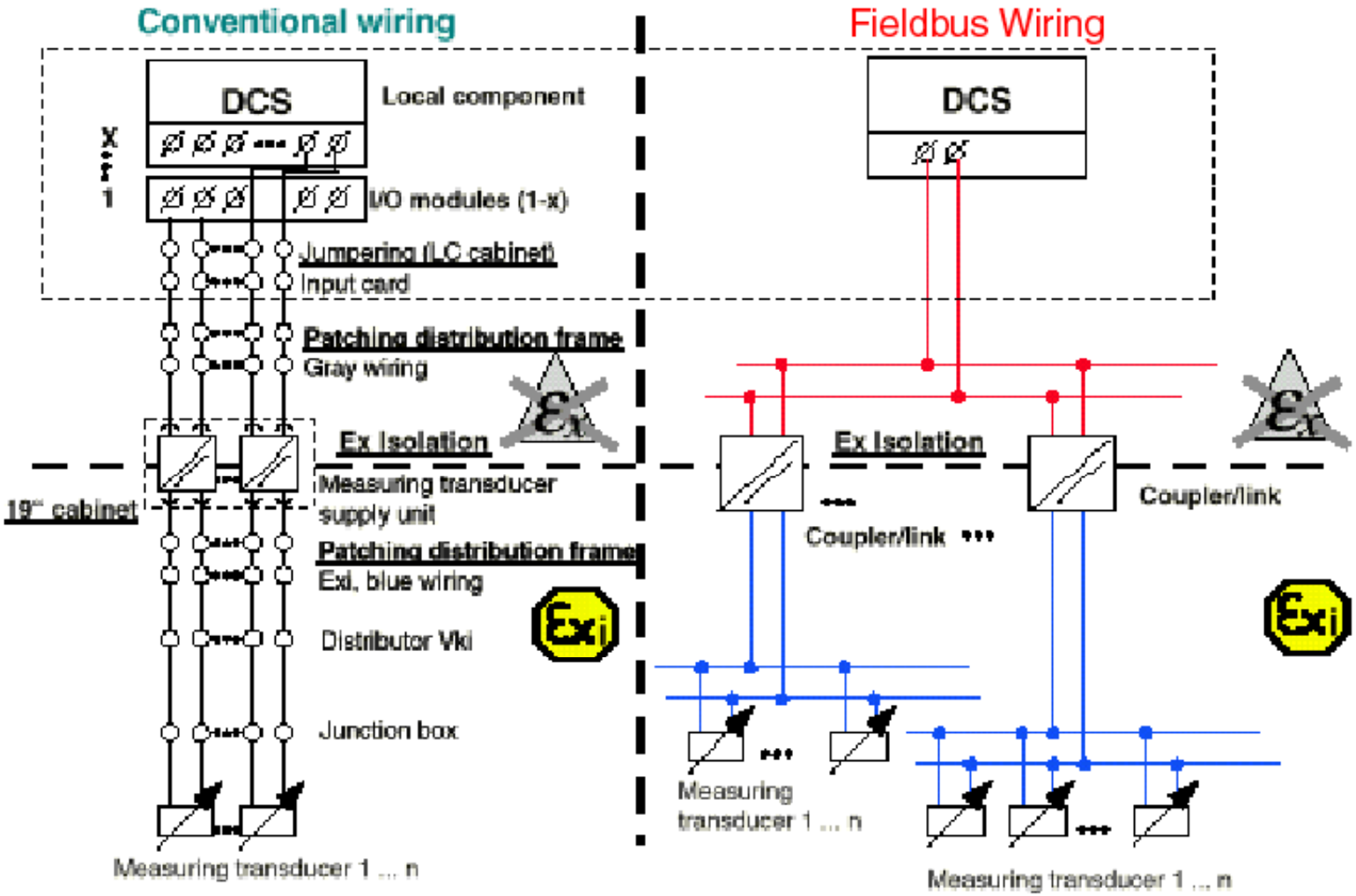
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Qxp ehu#ri#Frqqhfwhg#Ghylfhv



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- Reduced installation cost
  - wiring
  - terminators
  - I/O cards
  - control panel space
- Improved quality of measurement
- Distributed control design
- Interoperability
- Online diagnostics, troubleshooting and calibration
- *Open system connection* : seamless integration within different brands