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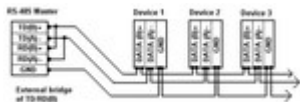
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News Article Valve Operation With Digital Technology

Valve Operation With Digital Technology

September 18 2015



By C.Sailaja and

A.Gugharaja, TATA Consulting Engineers Ltd, Chennai

Valves commonly used in process Industry are either pneumatically operated or electrically operated depending on the availability of Instrument air / power at that location and its application. The control & monitoring of the valves shall be from the control room. This involves a large amount of cabling from the field / MCC, junction boxes, I/O cards etc. With the advancement in technology, valve operation on Digital communication system has been introduced.

DIGITAL COMMUNICATION

In a digital communication channel, the information is represented by

individual data bits, which may be encapsulated into multi bit message units. A group of eight bits is called a byte. A collection of bytes are grouped into a frame or higher level message unit. Such multiple levels of encapsulation facilitate the handling of messages in a complex data communication network.

Digital communication comprises of two types

- 2 wire or Serial communication or Half Duplex
- 4 wire or Parallel communication or Full Duplex

2-WIRE COMMUNICATION

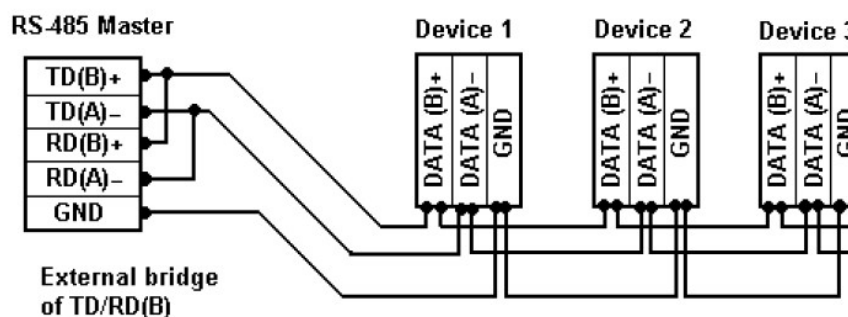
A two wire communication protocol is capable of transmitting data in terms of pulse duration together with power to at least one but preferably a multiplicity of modules connected to the two-wire conductor.

Two wire communications is also known as Half Duplex or Serial Communication where messages may flow in both the directions, but never simultaneously, flow directions may be reversed.

The protocols based on serial communication are:

- Modbus
- Foundation Field Bus
- Actuator Sensor Interface
- ProfiBus
- Device Net

The multi drop two wire communication can be established between Field actuators and PLC / DCS Gateways.

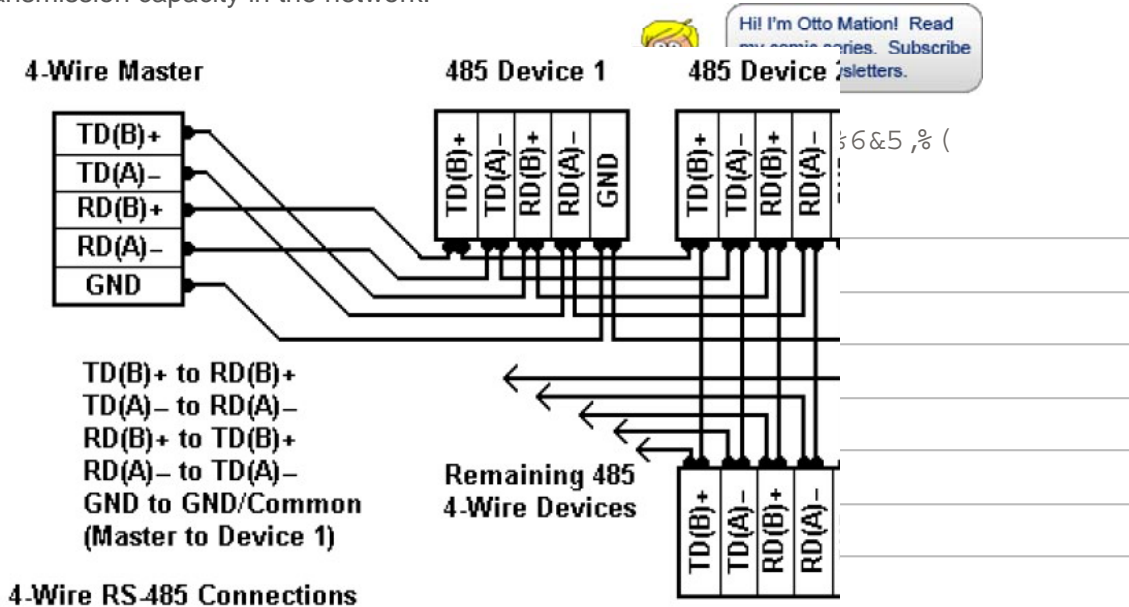


4-WIRE COMMUNICATION

4-wire communication is also known

as Full Duplex or Parallel Communication where it allows simultaneous exchange of messages in both directions, a forward and a reverse channel, connecting the same points.

Connection in a 4-wire communication is made using two no's of twisted pair cables inside the same jacket. One pair for receiving and the other pair for sending the packets of information. This effectively makes the communication collision free and doubles the transmission capacity in the network.



* Required Fields

SUBMIT

The protocols based on 4-wire serial communication are:-

- Device net
- Industrial Ethernet.

The Industrial Ethernet communication can be established between PLC /DCS gateway and its corresponding controllers. Device net communication can be established between Field actuators and PLC /DCS Gateways.

COMPARISON OF COMMUNICATION PROTOCOLS

S.NO	FEATURES	DEVICE NET	MOD BUS	FOUND FIELD I
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1 Baud Rate 125 -500KB/S

2 Communication Between Field & Gateway Multi Drop



3 Communication Between Gateway & Controller Industrial Ethernet



4 Total Distance 500 Metres

5. Number of nodes without Repeaters 64

6. Number of nodes with Repeaters Not feasible with repeaters

7. Communication Type Full Duplex

8 Hazardous Area Feasible



ADVANTAGES:

The digital communication provides a vital link between the valve actuator in the field and the Control System in the Control / Equipment room. Digital communication is a highly reliable, smart, quick and easy to install network connecting the field to the Control room.

The advantages of digital communication over the conventional 'multi-wire' method are:-

- A twisted pair cable can be used instead of expensive multicore cables.
- Installation & Commissioning costs are reduced as there are minimum connections to make and test.
- Commissioning time is reduced due to faster and easier Installation.
- Reduced downtime and increase of plant productivity if the same is implemented in an operating plant.
- Use of Industry standard protocols for communication in the field and with the Control system such as DCS / PLC.
- Highly reliable and secured communication protocols and all parameters can be set remotely.
- Easily expandable.
- Easy to upgrade devices in the field as no additional cabling is required
- Full diagnostics are available.
- Non Intrusive Operation in Field
- Faster response time
- Predictive failure warnings and troubleshooting
- More data is available in the control room for predictive maintenance and centralized asset management.

DIAGNOSTICS:

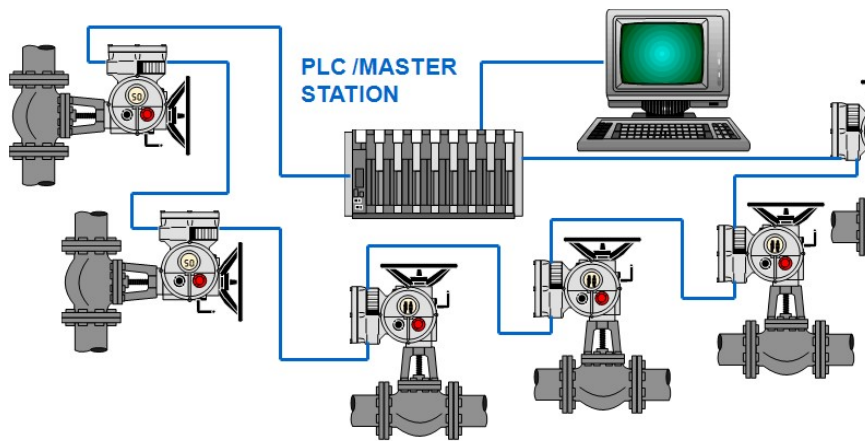
The diagnostic feature comprises of the following

- Obstructed valve
- Jammed Valve Protection
- Torque Switch By Pass
- Anti Hammer Protection
- Incorrect Phase Rotation
- Motor Overheating
- Reversal Protection
- Actuator fault
- Remote Control Failure
- Spurious Operation

ARCHITECTURE OF ACTUATORS WITH DIGITAL COMMUNICATION



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ELECTRIC ACTUATORS:

The actuators of valves / dampers are modular in construction. It comprises of an Electric motor, Gear mechanism, Integral starter with Local indication & control, Torque limitation with logic controls and LCD display unit for monitoring.

Following provisions are made on the actuator's field unit locally

- Open, Stop & Close commands
- Local / Remote selection
- ESD command and "Go to the position" command
- Alarm messages
- Limit & Torque status check back
- User Analog input feedback
- Redundant isolated communication channels
- Non-intrusive configuration from the hand held terminal

The Master Station in the Control room has the following features

- LED indicator for Network status.
- DCS interface via RS-232, RS-422 or RS-485 Modbus
- Modbus TCP/IP for interface with Web server.
- HMI for configuration & operation

The electric actuators are available with all types of communication buses which are mentioned above.

The following actions / feedbacks are possible via Communication bus.

The following actions & feedbacks are possible via Communication bus

- a) ON-OFF Operation
- Opening & Closing of the valve by activating / deactivating the communication network.
 - Status check back of stroke end position, opening / closing, over torque or Motor switch faults.
 - Status check back of Motor winding temperature, running torque, maximum torque, heater element On/Off, Stroke position.
- b) Modulating Operation
- Initialisation of actuator from a remote location such as a Control room via the Communication bus.
 - Dead band / Sensitivity adjustment.
 - Zero range adjustment
 - Adjustment of High & low signal action

In addition to the 2-wire communication, Hardwired connections are also available. Provision on the actuator for hardwired signals , such as Digital Inputs (DI), Digital Outputs (DO) and Analog Inputs (AI) are available for status monitoring on the Local Control Panel in the field or Control room.

OPERATION OF VALVES

Operation of valve involves Local and Remote selection.

- Local Operation by non-Intrusive control switches for Open /Close/ Stop and Local / Remote selections.
- Remote Operation by user from PLC /DCS for Open /Close/ Stop and Interlock signals.

FEATURES OF ACTUATORS

- The most important feature of these actuators is that the parameter setting is "Non-intrusive " for eg. limit & torque switch settings can be done with a hand held terminal.
- Actuators have an option of a RS-232 communication port for connecting it to a laptop for retrieving the operational parameters such as

running time, number of switching / starts-stops, number of faults from the actuator. Similarly the parameters can also be uploaded to the actuator.

- The actuators have an auto commissioning Set Up.
- The conventional mechanical sensors are replaced by electronic sensors (Torque, overload sensing etc)
- Actuators have the option of communicating via Bluetooth or Internet, thereby offering the advantages of wireless communication.
- Data Logging facility.
- Actuators are also available with SIL rating for functional safety applications.

APPLICABLE INTERNATIONAL CODES:

The actuators available conform to the following Industry Standards such as:-

- IEC 60529 (1989-11) , BS EN 60529 (1992), NEMA (US), CSA (CANADIAN).
- EExd IIB, IIC T4 & EExde IIB, IIC (ATEX & IECEX), FM, CSA EP) to EN 50014/ EN50018, ICS 6-110.24.
- ISO 5211 and DIN 3337.
- Electromagnetic Compatibility to 89/336/EEC as amended by 92/31/EEC
- Electrical safety in accordance to 73/23/EEC amended by 93/68/EEC by the application of EN 60204-1 1993

ELECTRIC ACTUATOR SUPPLIERS

Following are few of the renowned Vendors manufacturing & Supplying Electric actuators

- M/S. AUMA India Pvt Ltd.
- M/S. EL- O- MATIC – Emerson Process Management
- M/S. FISHER – Emerson Process Management
- M/S. LIMITORQUE – Flowserve Corporation
- M/S. ROTORK Controls

About the Authors

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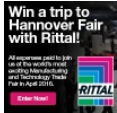
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