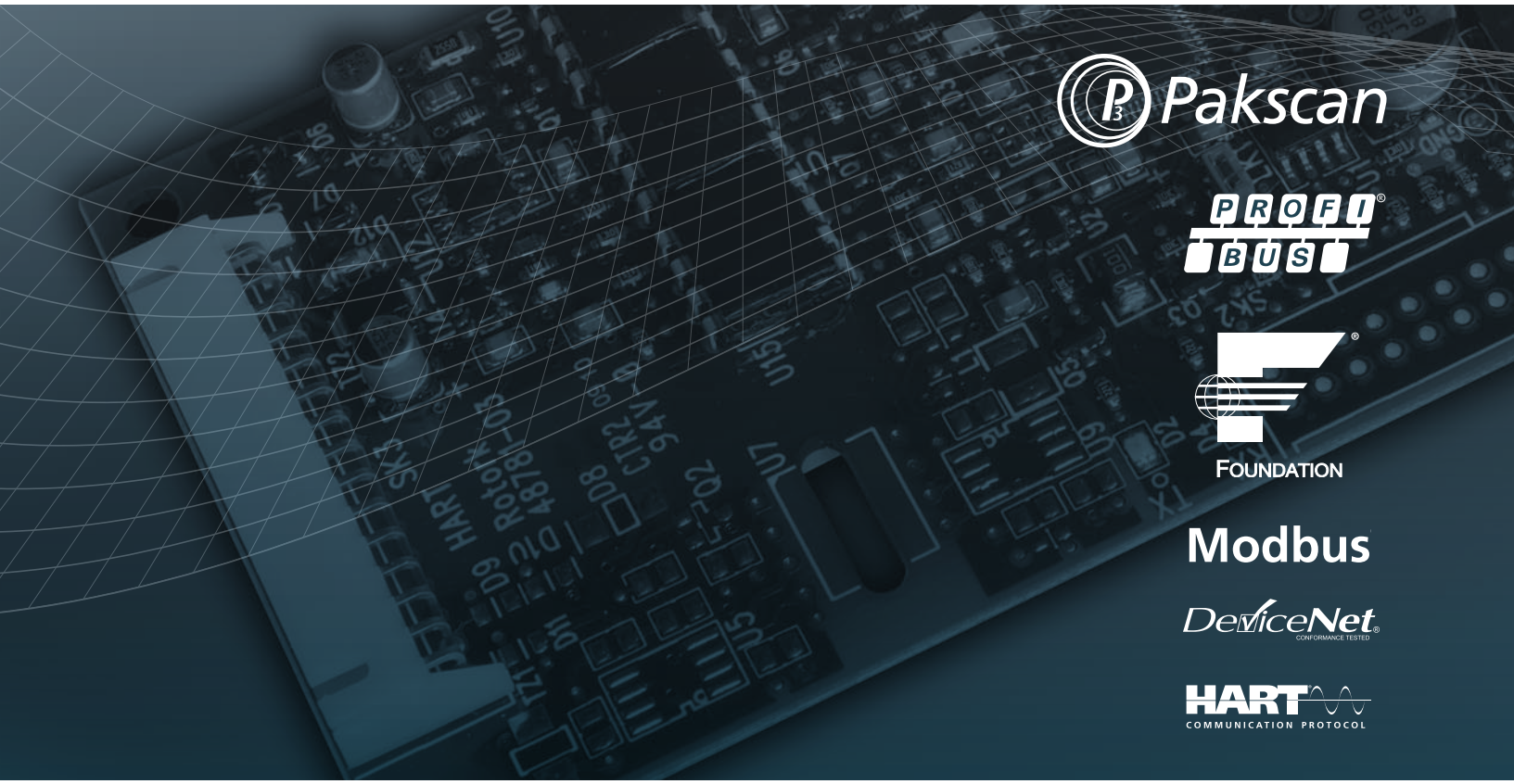
rotork®

# **Network** Compatibility




**Network Control Systems**

**Redefining** Flow Control

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**Rotork is the global market leader in valve automation and flow control. Our products and services are helping organisations around the world to improve efficiency, assure safety and protect the environment.**

We strive always for technical excellence, innovation and the highest quality standards in everything we do. As a result, our people and products remain at the forefront of flow control technology.

Uncompromising reliability is a feature of our entire product range, from our flagship electric actuator range through to our pneumatic, hydraulic and electro-hydraulic actuators, as well as instruments, gear boxes and valve accessories.

Rotork is committed to providing first class support to each client throughout the whole life of their plant, from initial site surveys to installation, maintenance, audits and repair. From our network of national and international offices, our engineers work around the clock to maintain our position of trust.

**Rotork. Redefining flow control.**

# Network Overview

Modern facilities require up to date communications right down to plant level. Plant managers demand more information quicker than ever before. Process operators need full control facilities at all times of the day and night. Maintenance managers want information so that their services can be scheduled economically. To meet these requirements, design engineers include field communications networks to allow every piece of critical plant to be controlled and monitored by computer. These computers are assigned to management operations and maintenance tasks within their own network, exchanging data about the equipment and processes under their control.

Integration of the plant controls by use of network connectivity has been a hallmark of Rotork actuator products for many years. The use of network bus systems makes commissioning of the plant and the subsequent control and monitoring a simple, quick and reliable task.

Rotork actuators are compatible with a wide range of communication and process control systems by including the appropriate network option card during manufacture. The actuator prioritises valve commands sent from the overall plant control system (DCS or PLC) and is able to report its entire digital and analogue status back to plant controller, via the field highway.

Our own Pakscan system offers advanced actuator network control similar to network control from Profibus, Foundation Fieldbus, Modbus and DeviceNet open systems. Innovative technology together with expert bus system knowledge ensures that Rotork can always provide the ideal solution for the control system.

### Wired Networks

The advantage of using a wired network has long been known and Rotork have been providing wired networks since the introduction of Pakscan in 1986. Approximately 30% of the actuators we ship are now specified with a network card fitted. Serial field networks have improved valve control in a number of ways over previous hardwired input control or manual operation via local controls. When comparing Network systems to hardwired controls:

- The initial design costs are lower, due to a simplified plant cabling.
- Installation and commissioning costs are reduced significantly, as there are less connections to make and test.
- Maintenance and fault finding is simplified due to the additional diagnostic data available via the highway.
- Cable costs are reduced due to less cable being used.
- Fewer marshalling cabinets are required as I/O racks are not needed.
- Device upgrades are easier to incorporate as additional wiring runs are not needed.
- Much more data is available to the user; which can be used for asset management and predictive maintenance.

### Wireless Networks

Wireless networks further increase the advantages of the wired networks. There are obvious savings to be made in plant cabling design and the removal of network cables, as each device now only needs to be supplied with power. Furthermore, due to the system bandwidth it is also possible to extract huge amounts of data from the actuators, very quickly. Entire actuator data logger records can up uploaded in a matter of seconds.

Wireless can be used as the sole communication network for a device, offering control and monitoring, but it is also possible to add the wireless modules to existing actuators. In this scenario, control is performed by a conventional hard-wired or copper cable bus network with the wireless option allowing the user to quickly extract additional monitoring data.

Pakscan PROFIBUS FOUNDATION HART COMMUNICATION PROTOCOL DeviceNet CONFORMANCE TESTED Modbus®

# Pakscan P3 (2-wire) System

**The Rotork Pakscan system is a world leader in flow control automation. First launched in 1986, Pakscan has been at the forefront of network technology since its inception, helping to control over 100,000 actuators worldwide.**

Pakscan network systems offer the customer unrivalled control, reliability and support. This is backed-up by a worldwide service and support network to help keep your plant running 24 hours a day, 7 days a week.

The Pakscan system provides the vital link between valve actuators and supervisory control. It is an intelligent, reliable, high integrity, fast and easy to install network between field equipment and the control room, designed specifically for use with Rotork products.

Pakscan

**Pakscan P3 (2-wire) system:**

- Defined transaction times based on cable parameters and length.
- Automatic cable monitoring and fault isolation.
- Field cable fault tolerant.
- Fully pre-programmed master station.
- Master station with HMI Screen, keypad and built-in web server for full system diagnostics.
- Hot standby master station capability.
- Easily expanded.
- Simple Modbus RTU (RS232/RS485) / TCP (Ethernet) host communications.
- Field and host communication diagnostics and data logging.
- Commission without the need for a host DCS or PLC.
- Proven track record.
- Over 100,000 installed nodes.
- Multiple host connections supported.
- Network with the capacity for up to 240 actuators on a single 20 km 2-wire loop.

*See publication PUB059-030 for further details.*

# Pakscan P3 *Wireless*

**The world-leading Rotork Pakscan network control system is now even more flexible and cost-effective to deploy thanks to the new P3 Wireless option. Over a secure wireless mesh network it maintains control of actuators and other field devices, as well as gathering extensive operating data for efficient, centralised asset management.**

Whether you are installing a completely new control network or adding to an existing wired installation, Pakscan P3 Wireless provides a secure, resilient, control and monitoring solution.

With its flexible wireless connectivity, it allows you to add new actuators to your control system faster, without the delays and costs involved in new cable runs. Fast data throughput means it can collect all the operating data you need to both monitor and predict the maintenance needs of Rotorkactuators.

The P3 Wireless network has been designed to provide high levels of security and a degree of redundancy comparable to Rotork's 2-wire systems. P3 Wireless, like P3 2-wire, is fully integrated and controlled through the Pakscan P3 master station.

Pakscan

**P3 *Wireless*:**

- Fast, cost-effective installation and implementation.
- Proven actuator control technology.
- Detailed, centralised asset monitoring.
- Minimal maintenance overhead.
- Fully integrated add-on for P3 master station.
- Add new actuators quickly, cost-effectively.
- Seamless integration of wired and wireless.
- Secure and resilient.
- Using the web pages, the actuator datalogger is available to download and can be viewed using Rotork Insight. The datalogger includes historical torque data, useful for predictive maintenance.

*See publication PUB059-030 for further details. For Rotork In-Sight See publication PUB002-015.*

# Profibus®

**Profibus is a leading international network protocol for high speed data communications in industrial automation and control. The Rotork Profibus DP interface card provides comprehensive control and feedback data about the valve and actuator using DP-V0 cyclic communications whilst extended actuator diagnostics and configuration is included in the DP-V1 acyclic data supported by this module.**

The Profibus-DP network can operate over a range of communication speeds and provides the mechanism for control of the actuator and feedback of data about the valve. EDD and Certified DTM files allow the Rotork device to be incorporated into asset management systems giving access to performance critical parameters and are free to download from www.rotork.com. The independently certified GSD file guarantees device interoperability.

Rotork provide an optional network disconnect module for ease of installation and maintenance. Also there are multiple configuration options within the GSD file to enable a choice of data collection. In addition to the standard actuator feedback a further analogue input is included as standard on the single channel options. This coupled with the four auxiliary inputs and additional four digital outputs, enable integration of field equipment onto the Profibus network.

**Rotork Profibus DP-V1 module:**

- International open standard IEC 61158-CPF3.
- Suitable for RS485 Profibus DP bus.
- Certified DP-V0 cyclic and DP-V1 acyclic compliant.
- Highly reliable standardised communications.
- Compatible with Rotork electric and Electro-hydraulic actuators.
- Low installation and maintenance costs with high control system flexibility.
- Data transfer between 9,600 baud and 1.5 Mbaud.
- Support for Dual Channel Redundancy, including RedCom Redundancy to PNO spec 2.212.
- Support for Process Device Manager (PDM) and Field Device Tool (FDT) utilities.
- GSD, EDD and DTM device description files available.
- Three versions of the device: Single Channel with additional Analogue input, Dual Channel and Dual Channel with RedCom compliance.
- Using the DTM, the actuator datalogger is available to download and can then be viewed using Rotork In-Sight. The datalogger includes historical torque data useful for predictive maintenance.

*See publication PUB088-001 for further details. For Rotork In-Sight See publication PUB002-015.*

# Foundation Fieldbus®

**Foundation Fieldbus has become widely accepted for use in process control systems. Its primary feature is the ability to distribute control away from the central DCS. The Rotork Foundation Fieldbus interface card connects directly onto the standard Foundation H1 bus system and provides control and monitoring of the valve and actuator.**

The Rotork FF module (Rotork FF01 Mk2) is fitted inside the actuator electrical housing and interfaces directly with the actuator electronics. Once fitted, the normal commands associated with moving the actuator, together with feedback and historical data, become available on the Foundation 2-wire H1 highway. Controls include discrete DO functions for isolating valve duty and a position controller in the AO block.

The FF card is simple and easy to use, using the certified Device Description files. The ability to report extensive actuator feedback within a single input block as well as system diagnostic information makes Rotork the first choice for use with a Foundation Fieldbus system.

**Rotork Foundation Fieldbus module:**

- International open standard IEC61158-CPF1.
- Compatible with all current Rotork electric actuators.
- Uses IEC61158-2, 2-wire communication.
- Connects with H1 communication bus.
- Communication speed 31.25 kbits/sec.
- Network can use trunk and spur topology, ideal for replacing existing devices.
- Maximum of 32 devices per segment without repeaters.
- Includes Link Master capability.
- Contains fully configured AI, AO, DI, DO, PID, CS blocks.
- Independent HIST approval by major DCS vendors.
- Foundation ITK certified for inter-operability.
- Device description files with 'Methods' for simple set up.

*See publication PUB089-001 for further details.*

# Modbus

**Modbus remains the most popular process communication protocol in use today with the widest acceptance and highest number of applied systems of any automation protocol. Rotork's Modbus interface card allows actuators to be connected to a 2-wire RS485 network for direct communication to a PLC using Modbus RTU protocol. The resulting network is able to monitor and control the connected actuators.**

The main advantage with Modbus is its simplicity coupled with the vast amount of user knowledge. There are no complications with device description files or special programming tools required when setting up a Modbus system.

The Modbus module is fitted inside the actuator electrical housing and interfaces directly with the actuator electronics. Once fitted, all the normal commands associated with moving the actuator together with feedback and some historical data become available on the Modbus RS485 highway.

With Modbus a short write command and read request is sufficient for full control and monitoring of the actuator. Using Modbus, commands can be sent on demand (acyclically) in order to reduce the highway traffic and increase frequency of status updates from the field. Acyclic read requests can also be used to extract actuator performance data such as the torque profile. In addition to the standard actuator status feedback a further analogue input is included as standard on the single channel option.

This coupled with the four auxiliary inputs and additional four digital outputs, enable integration of field equipment onto the Modbus network.

There are a number of user settings to be made for the system variables and actuator performance, such as the baud rate and the slave address of the actuator. These are set by either using the Rotork setting tool or by writing over the network to the appropriate registers in the module's database.

**Rotork Modbus module:**

- Compatible with IQ, IQT, SI/EH *Pro*, CVA, CMA, ROMpak and Q actuators.
- RS485, RTU communication.
- Low installation and maintenance costs.
- High control system flexibility.
- Data transfer between 300 baud and 115 kbaud.
- Simple plant expansion.
- Cabling requires 2 wires only per channel provided the ground potentials are equal.
- Three versions available: Single Channel, with and without repeater and Dual Channel.

*See publication PUB091-001 for further details.*

**Modbus**

# DeviceNet®

**DeviceNet is an Open Network Standard for communication networks using the main features of CANbus in an industrial environment. The Rotork DeviceNet interface module provides easy access to actuator process control and feedback information. The Electronic Data Sheet description file is used to set up the actuator parameters to allow the system performance to be optimised.**

DeviceNet is a low cost, high speed, communications link to connect process control or industrial devices such as actuators, pressure transmitters and level sensors to a network and eliminate expensive cabling. The direct connectivity provides process control information as well as important diagnostic data that would otherwise not be accessible over a conventional hardwired system.

In addition to the standard actuator torque and position feedback a further analogue input is included as standard. This coupled with the four auxiliary inputs and additional four digital outputs, enable integration of external equipment onto the DeviceNet network.

DeviceNet is an Open Network Standard and Rotork is one of over 300 registered manufacturers who supply equipment that meets this standard.

The Open DeviceNet Vendor Association (ODVA) controls the standard and enforces the registration and acceptability of equipment for use on DeviceNet networks.

The Rotork module has been certified by the Open DeviceNet Vendor Association to ensure its interoperability with other devices.

**Rotork DeviceNet module:**

- International open standard IEC61158-CPF2.
- Up to 63 devices on each network.
- 3 baud rates available; 125 kB, 250 kB and 500 kB.
- 4 wire cable, 2 for signal, 2 for power.
- Trunk and Drop line permitted.
- ODVA certified to ensure compatibility.
- EDS electronic device description file.

*See publication PUB090-001 for further details.*

DeviceNet® CONFORMANCE TESTED

# HART®

**HART (Highway Addressable Remote Transducer) is a process control communication protocol based upon the Bell 202 telephone communication standard and uses the FSK (frequency shift keying) principle. The signal consists of two parts, the analogue 4 to 20 mA current loop and a superimposed digital variable frequency signal.**

Traditionally the 4 to 20 mA loop is used for position control and the superimposed digital signal for feedback, diagnostics and configuration. Configuration and feedback using the HART digital signal can be achieved using a host device connected via the HART highway to the actuator, to select the parameters required. With this approach, the majority of the user configurable settings can be made using the HART communication protocol.

Rotork actuators fitted with HART interface cards connect seamlessly with a standard HART communication network. They provide a wealth of control and feedback capabilities.

HART enabled actuators function as slaves to master controllers on the network. The HART protocol allows commands, position feedback and diagnostics to be sent digitally over a current loop. A maximum of 64 HART actuators, transmitters, or other field instruments, may be connected to one HART network.

HART enabled actuators can be added to wireless HART networks by utilising one of the wireless HART adaptors available from a number of suppliers.

**HART Communications module:**

- HART protocol Revision 6.0 or 7.1 (7.1 – CVA only).
- Compatible with LA-2400, LA-2500, SM-6000 S2, GPSA and CVA electric actuators.
- Utilises existing 4 to 20 mA wiring.
- Communication speed 1,200 bits/sec.
- Single point-to-point or multi-drop topologies allowing analogue or digital positioning.
- Device Descriptor file with ‘methods’ for simple setup.
- Monitor process data of valve.
- Capture fault information supplied by actuator.
- Monitor valve state.

*See publication PUB092-001 for further details.*

HART® COMMUNICATION PROTOCOL

## Actuator Compatibility Table

| Model | Pakscan P3 (2-wire) | Pakscan P3 Wireless | Profibus | Foundation Fieldbus | Modbus | DeviceNet | HART |
|---|---|---|---|---|---|---|---|
| **IQ Range** | ✔ | ✔ | ✔ | ✔ | ✔ | ✔† | ✔† |
| **CVA** | ✔ | ✗* | ✔ | ✔ | ✔ | ✗ | ✔ |
| **CMA** | ✔ | ✗* | ✔ | ✔ | ✔ | ✗ | ✔ |
| **GPSA** | ✗ | ✗ | ✔ | ✔ | ✗ | ✗ | ✔ |
| **LA-2400** | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✔ |
| **LA-2500** | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✔ |
| **SM-6000** | ✗ | ✗ | ✔ | ✔ | ✗ | ✗ | ✔ |
| **SI/EH *Pro*** | ✔ | ✗* | ✔ | ✔ | ✔ | ✔ | ✗ |
| **ROMpak** | ✔ | ✗* | ✔ | ✔ | ✔ | ✗ | ✗ |
| **Q** | ✔ | ✗* | ✔ | ✔ | ✔ | ✔ | ✗ |

* Can be integrated using the P3 Wireless Modbus Adaptor.

† For DeviceNet and HART compatibility contact Rotork.

# Choosing a Network

**With so many different networks and different interface solutions it's hardly surprising that engineers get confused when trying to find the ideal network for each particular application.**

Often they will follow slavishly the instructions of their client, or simply repeat the choice they made on the last project, irrespective of differences in the application. Because there are several potential solutions for each application, Rotork can advise on the merits of each and assist in the choice of the system that is most likely to meet with satisfaction on completion of the project.

In order to make the subject a little easier we will only consider three wired networks, each with its own merits and drawbacks. These three represent the most requested network choices.

- Pakscan
- Profibus DP
- Foundation Fieldbus.

In addition, the network choice will depend on some assumptions, the most important of which is the type of equipment to be connected. In our case this is almost exclusively electric valve actuators, with the occasional inclusion of other actuation products or field measuring instruments.

Control systems using actuators have a primary function which is to ensure that the valve can be moved whenever the process demands a new position. A secondary, slightly less important, function is to be able to report the actual position of the valve. (If the process flow is monitored, then the valve position is less important than the flow itself).

## Direct Hard Wiring v Network

### Direct Cabling

Traditionally, many applications have been designed with direct cabling between an operator panel and the actuator. This generally uses 7 conductors and allows isolating duty valves to be controlled and their end limit position to be monitored. The controls are usually push buttons or switches and the indication is by lights. This is simple, easy to use and ideal for installations where the controls are spread around the site in panels and local operator stations. If the site uses a central control room or similar location for control of the process then providing buttons and lights can become expensive in several ways including the cable cost itself, the space needed for the cable termination equipment in rack rooms and the actual panel space needed in the control room.

Control rooms use screen based displays and controls from a keyboard, mouse or touch screen. Interfacing hard wired systems to these controllers presents another problem and more hardware is needed to connect the PLC or DCS to the actuator itself.

There are some potential benefits with hard wired systems. The simplicity of operation is a major consideration as installing, commissioning and fault finding on hard-wired systems require a low knowledge base. Another possible advantage, is the improvement in the system integrity when compared to simple bus systems due to the point to point nature of the control lines. It can be argued that this integrity advantage is lost once the network includes for redundant control paths. However, since the hard wired system has fewer components it will generally be capable of a higher availability rating than a network solution.

Direct hard wiring is often preferred for shut down or high integrity control schemes.

### Direct Cabling

| Advantages | Drawbacks |
|---|---|
| Simple to understand | Cable cost |
| Easy to install | Rack rooms for cable termination |
| Can give High reliability | Panel space for buttons/lights |
| | Hardware for control scheme interface |
| | Limited data reported |

### Network

When a site has several actuators to be controlled from a central control room, or by an automatic process, the introduction of a network becomes a possibility. Even if there are only a few actuators the advantages of using a network may still be attractive.

A network approach uses a simpler field cable, usually with 2 cores, and interconnects a number of actuators to a PLC interface that in turn reports the information to and receives control commands from the site automation system, usually a DCS. The automation system may be within the site containing the actuators and valves, or it may be located some considerable distance away. There may be more than one control system operating the valves, and there may be more than one field network on a site.

The initial cost of installation when using a network will be lower than a hard wired system since there are fewer terminations to make and the cable itself is usually lower in cost than the multi-core used for conventional wiring. This cost is offset by an increase in the actuator cost for the inclusion of the network interface and this is often used as an argument for not including network control.

- It is important to make sure the customer looks at the entire cost for network control, initial design costs, cable costs, installation and commissioning costs and life time maintenance costs as well as the purchase cost of the actuator itself.

A network also offers a number of other advantages compared to a conventional system. The amount of data that can be obtained from the actuator is increased to a level where asset management, planned maintenance, as well as direct performance diagnostics can be included in the

# Choosing a Network

controls package. Lifetime costs for the plant can be reduced when more information is available. Full position control, direct at the valve, is usually included at no extra cost for actuators that are required for modulating duty. The network controller will require very little rack room space and often it can link into several host systems at the same time. True remote control is possible once a network is installed.

When redundancy is included, usually of the cable network, the system integrity is increased to a level allowing safe control of many critical systems. In some cases the actual reduction of weight by saving on multicore cable can be an advantage – particularly on oil rigs and vessels, whilst the saving in buildings to house interface racks can reduce overall running costs due to the saving in environmental control.

### Network Control

| Advantages | Drawbacks |
|---|---|
| Increased data availability | Higher actuator cost |
| Reduced engineering costs | Increased commissioning complexity |
| Lower installation cost | Can tie in to one supplier |
| Easy interfacing to PLC/DCS | |
| Lower lifetime running costs | |

## Open v Proprietary Network

Once the primary decision to use a network has been taken, the next problem is to choose the system best suited for the job. Most of the control networks are capable of collecting reasonable amounts of data from the actuator and controlling the valve position. Some do this faster than others, or over longer distances, or from more devices on the highway.

In general, a proprietary network will be more suited to valve control than an open network. This is true for any specialist network or system since the dedicated system has one specific target, whilst the open system has no particular target application. Open systems must try to match their capability to any and all applications. So, for example, they must deliver commands to actuators with equal priority to collecting data from flow transmitters. A dedicated actuator control system can place a higher priority on moving the valve than reporting valve position, since control output is the primary activity for the valve actuator.

### Open Systems

Examples of Open systems include Profibus and Foundation Fieldbus.

With these systems a manufacturer or a group of manufacturers and end users co-operate to produce a specification for the operation of a network. The system specification includes how to connect devices, what kind of electrical signals are to be sent along the highway, the format of the data string, how many wires will be used, how fast the data can be transmitted and how many devices can be connected. This specification is then offered to a standards authority and made available to other manufacturers, who may be interested in making devices to connect to this highway. Once they have a device, there is often an accreditation procedure to verify the compatibility of the device with the network and a certificate will be produced confirming the compatibility.

In Rotork's case we have actuators that can be connected to Profibus and Foundation Fieldbus systems. They require different interface cards and have different capabilities once connected, due to the performance differences in the networks. In both cases we have a certified device, meaning that it has been tested independently to ensure it meets the requirements of the specification. The certification has nothing to do with the performance of the actuator itself, only that the interface meets the required standard, i.e. it is a guarantee of interoperability.

The PLC or DCS configuration engineer will always need to understand the performance of the actuator or field device when programming the host. But, they do not need to know the actual communications capabilities and default settings of the device, as these are described to the host system using a device description file.

### Open Systems

| Advantages | Drawbacks |
|---|---|
| Products from several different suppliers may be connected to the same highway | Tries to meet all the different requirements with one solution |
| Network has a defined performance | No flexibility |
| Specifications allow users access to the network hidden data | Performance claims often found to be optimistic |
| Easy interfacing to PLC/DCS | System responsibility rests with the purchaser, not the component suppliers |
| Potential lower lifetime running costs | |

### Proprietary Systems

Pakscan is a proprietary field network system, with an open connection to the host (Modbus).

With a proprietary network the performance is aimed to maximise the efficiency for a particular type of application. With a data logging application the priority is on collecting data. With a control scheme the priority may be on issuing commands to the actuators. The system performance will be specified in the same way as the open system, but how it is achieved is often a trade secret retained by the manufacturer. The equipment that can be connected to the network will only be available from the original manufacturer, or from a licenced associate.

Proprietary systems also have the ability to allow for the connection of products from other manufacturers by including a special interface unit for the network. Sometimes these will include a standard protocol on one side and the proprietary protocol on the other – a device known as a bridge.

# Choosing a Network

- When the system is purchased from a single source the responsibility for the overall performance is clearly defined and rests with the one supplier.

Additional features such as multiple host connections, to enhance the overall performance, can be included. In general a connection device such as the Pakscan master station has to be included to act as a translation between the proprietary network and a standard communication interface such as Modbus or Ethernet. This also provides an extra benefit as the master station also includes data about the system and provides a local HMI actuator control interface and highway monitor.

### Proprietary Systems

| Advantages | Drawbacks |
|---|---|
| Network has a defined performance | Limits the purchaser to a single supplier |
| Optimised fro the target application | Future expansion has to be with the original supplier's products |
| Special features can be included such as those on the Pakscan master station | Product may become obsolete |
| System responsibility rests with the supplier – Rotork for Pakscan | |

## Comparing the Systems

In order to make a logical choice between one system and another it is helpful to have a broad knowledge of the features, benefits and drawbacks of each.

### Foundation Fieldbus

Foundation Fieldbus is intended to replace all 4-20 mA type instrumentation with an equivalent bus based product and to provide 'control in the field' by doing away with DCS based control loops. It is primarily designed for transmitters and controllers rather than digital devices or actuators. Data transmission is based on specific 'Function Blocks' for inputs and outputs, rather than database locations to move data around.

The data highway and Fieldbus node power supply both use the same pair of wires. The node power is provided by an external source, coupled onto the highway, which has to be able to provide sufficient power to all nodes. Foundation Fieldbus can offer some form of limited redundancy; the network gateway, the power supply, the main trunk (cable) run and the field junction box can be redundant but in practice rarely are. It is also possible to use field nodes which have LAS capabilities to act as a secondary master, should the network gateway fail. However, most end-users like to maintain visibility of their processes so this option is infrequently used.

Typically a network will be a few hundred metres from end to end and there will be no more than 12 to 16 simple transducers or single Function Block devices connected. The number of actuators that may be connected is limited by the number of function blocks that the DCS can use. Each of these uses up some of the DCS system resources and there is a finite limit. With the Rotork Foundation Fieldbus interface, most systems can be configured using only 4 function blocks per actuator, allowing around 4 to 6 actuators to be connected to one segment.

The communication speed is fixed at 31.25 Kbaud and although this seems quite fast the highway traffic involves a lot of overhead with system information and looking for new devices. In practice, DCS screen responses to actuator output have been known to disappoint the users. It is possible to switch off an actuator without causing too much disruption unless the function blocks in that actuator are being used in conjunction with others on the highway. If this is the case the remaining actuators may declare control errors causing them to fail to respond to scheduled commands.

In practice, 'in the field' controls are not often used, so losing a device does not cause a problem. If there is interlocking (or permissive control) between the actuators, then loss of one actuator may result in unscheduled control actions on another.

Foundation Fieldbus is traditionally more popular in the hydrocarbons industry and is generally chosen by the consultant or end user, without concern for its suitability for isolating valve actuator control. It is quite good for control valves and their actuators however.

### Profibus

Profibus open system protocol has been around almost as long as Pakscan. There are three major variants of Profibus, PA, DP and Profinet and Rotork actuators use Profibus-DP. Profibus PA is a field network designed for small data packet transfer to / from bus powered devices that sometimes are part of an intrinsically safe system. Profibus PA needs a Profibus DP network to transmit data to / from the host. Profibus DP is also a field network and allows many more devices to be connected to the highway than PA. It also has a much faster baud rate capability, can transport larger data packets, can be supplied with redundant highways and is ideally suited to actuator monitoring and control.

Profibus-DP is a master-slave system where the master is usually a comms card in a PLC or DCS. It is aimed at process control and factory automation applications and is generally found in water, chemical and factory automation systems. However, it is becoming increasing popular in hydro-carbon applications, especially where fast data update rates are required.

The data highway uses two wires and a special low capacitance "Type A" cable specification to ensure the network will perform as stated in the data sheets. There is a need for powered termination devices at each end, so it is often wired out from the control room and back, but not in a ring or loop. The return is simply to ensure that a suitable terminator is fitted. Cable redundancy is possible if redundant field interfaces are incorporated in the cards fitted in the actuators.

# Choosing a Network

A maximum of 32 devices (31 actuators and a PLC scanner card) can be connected to each highway segment and the segment length is dependent on the desired speed. In general 1,200 metres is the maximum although repeaters do allow this to be extended, together with the number of devices (up to the maximum of 125).

- Failure of a Repeater generally means loss of communication with everything beyond the repeater.

Speeds as high as 1.5 Mbit/s can be achieved up to a distance of 200 metres, for 1,200 metres the top speed is 93.75 kbit/s. Because the system is master-slave based, increases in speed produce a corresponding reduction in scanning time. However, if the PLC or DCS cannot process the data, then the high speed is of no value.

Switching off the power to an actuator does not upset the network unless the actuator contains the line termination device.

Profibus is proving popular in the water market as the PLCs used are often relatively inexpensive and configuration is fairly straightforward. It works well with both isolating duty actuators and, due to the relatively fast update rates, also in position control applications.

### Pakscan

This is the Rotork proprietary actuator control system. It uses a master slave protocol and requires a master station to interface to the DCS or PLC. It can interface to a desktop PC without the need for any special software using an Ethernet connection either directly to the master station or over the Internet.

The field data highway uses a two wire cable and is wired in a ring to provide full system redundancy to every actuator on the system. The Pakscan loop protocol utilises a "report by exception" protocol which means that only new data is ever reported, reducing the highway traffic and increasing the status update rate. The field highway can be up to 20 km in length, without the need for repeaters, allowing large areas to be covered. Up to 240 actuators can be connected on a single cable but in practice, the typical site comprises of 50 - 60 actuators and a 5km loop length. With these parameters, a complete site MOV status refresh time in the order of 2 – 3 seconds will be achieved.

The master station controls all of the network communication and interfaces to the DCS or PLC using Modbus over RS232/ RS485 or Ethernet. The included web server allows direct PC connection with a web browser interface.

The system integrity is unaffected if any number of actuators are switched on or off at any time. The field network requires no repeaters and the system will operate correctly despite these changes in loading. Where full system redundancy is required (as well as field cable redundancy), a hot standby master station is available complete with multiple host connections. Rotork are continually developing their products and Pakscan is no exception to this philosophy. Despite being on the market for over 25 years, it is still being enhanced, recently with pakscan wireless. It is has always been very well received and continues to account for about 20% of all electric actuator sales. Pakscan is particularly popular in tank side MOV applications for the hydrocarbon market where its reliability, integrity, simplicity of use and large distance coverage capability are often praised.

### Making the Choice

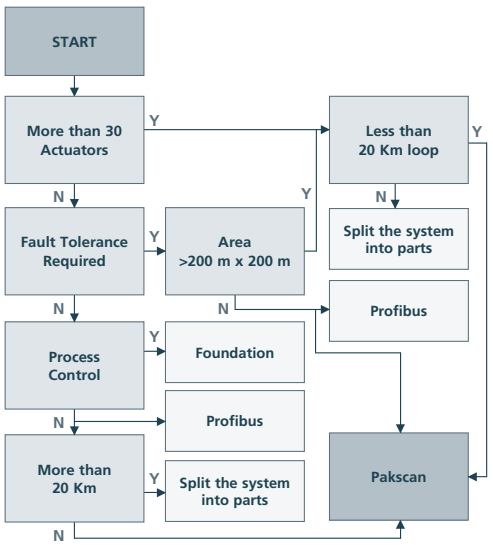
One of the most important choices in determining the network to use is the required update time at the control room operator's screens. Most MOVs are operated infrequently and as a consequence they do not change their information to report very often. This leads to acceptable update times in the order of 1 to 2 seconds. Once the update period is determined the second factor will be the distance from the equipment room to the actuator. This can often be quite long and may compromise the update time that is desired. Greater distances slow down the data access time. The need for redundancy also has to be considered, as control of the actuators may be critical. Finally, the number of actuators on each highway needs to be determined as each system has finite limits. In practice, these three fundamental decisions are often reversed in their selection order, but they are so inter-related that the order of choice is not very important. Speed may be compromised for reliability and so on.

In the final analysis the DCS or PLC to be used will also be a factor in the choice of network. The control system must be capable of supporting the chosen network system.

Key decisions to be reached:

- Distance
- Number of Devices
- Scanning Time
- Compatibility
- Redundancy

The network selector chart below shows some of the basic choices and how the decisions could be made.



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