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The application of fieldbus in hazardous areas

Prior to reading this document we suggest you read our e-training document "Introduction to Fieldbus Systems."

Introduction

One of the inherent problems with fieldbus is that more devices need to be powered via a single cable than would otherwise be the case. In addition an addressable circuit in each field device increases the power requirement still further.

Intrinsic safety (Exi) relies on limiting the power than can pass from the safe to hazardous area via a safety barrier. The power in a particular circuit must not exceed the ignition energy limits of a particular hazardous gas. As intrinsic safety is a "power limiting" technique and fieldbus is a "power hungry" technique a specific Exia system has been developed for fieldbus applications.

With conventional intrinsically safe applications the safety of a circuit comprising a field device, safety barrier and interconnecting cable is determined using a number of defined parameters (E.g. voltage, current, power, inductance and capacitance). This is known as the **Entity Concept**. Once the calculations have been performed for each circuit the results have to be clearly documented (see EN 50 020). The increased power requirements of a field bus system, combined with the need to frequently modify the often complex arrangement of trunk and spur cables has resulted in the development of FISCO.

FISCO

Fieldbus Intrinsically Safe COncept. FISCO Technical Specification IEC TS 60079-27: 2002 sets out the design parameters for field instruments, terminators, power supplies and interconnected systems. It was developed by PTB in Germany. Unlike conventional parallel wired installations safety has been determined as a result of practical testing of all the parts used. Using FISCO the inductance and capacitance of a particular cable does not need to be considered in the safety analysis provided a particular cable type is used. As fieldbus cabling architecture is usually quite complex and can be subject to frequent modification, this simplifies matters considerably. Different FISCO power supplies have also been developed that permit higher levels of voltage and current to pass into a group IIB hazardous area.

As an example using the Entity Concept and assuming 20mA per device, 3 or 4 devices could be fitted on a fieldbus trunk in a Zone 1 hazardous area IIB/IIC gas groups. Using FISCO this can be extended to 6 devices in a IIC application and 13 devices in a IIB application. Using FISCO live maintenance is still permitted and the administration of safety documentation is simplified.

K Controls designs and manufactures valve networking monitoring and control products:

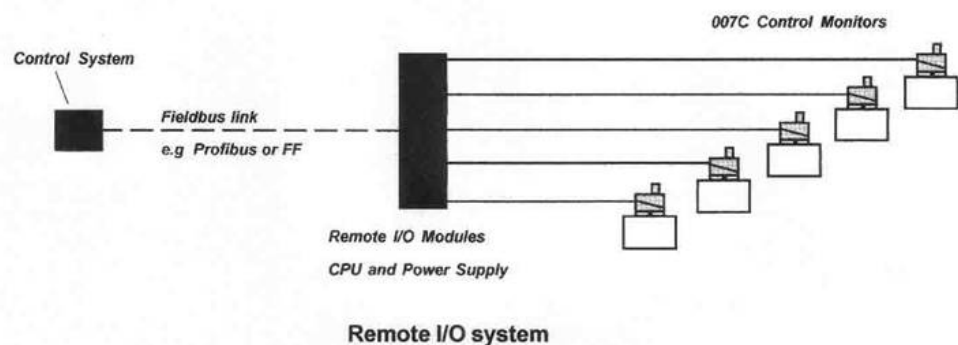
Switchboxes
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 IP68 for submersion
 Low powered solenoids
 Remote I/O compatible
 AS-interface®
 DeviceNet™
 PROFIBUS® PA
 FOUNDATION™ FIELDBUS
 4-20mA + HART®
 Wireless solutions
 Linear or rotary adaptation

K Controls can also supply your positioner requirements

Intrinsically Safe Remote I/O Systems

Often used where a large number of on/off devices are to be installed in an extensive hazardous area. The link between the remote I/O unit and the PLC or DCS can be PROFIBUS®, FOUNDATION™ fieldbus, or an alternative bus.

In hazardous areas these systems are suitable for use in Zone 1. If we take as an example an installation of 16 valves a typical system would consist of an isolating repeater, a gateway, a 16 channel input module, four output modules a terminal base for each module and two EExd power supply units.



Links to datasheets showing typical remote I/O modules

http://www.pepperl-fuchs.com/selector/navi/productInfo/edb/039065_eng.pdf

<http://www.stahl.de/en/products-and-systems/remote-io-is-1.html>

<http://www.mtl->

[inst.com/download.nsf/854270a29370dec5002568ac0041c57b/3af6d534f89ddbe0002568dd0051be6f/\\$FILE/MTL8000%202X%20Introduction.pdf](http://www.mtl-inst.com/download.nsf/854270a29370dec5002568ac0041c57b/3af6d534f89ddbe0002568dd0051be6f/$FILE/MTL8000%202X%20Introduction.pdf)

Exi version of the AS-interface

Often used where a number of on/off devices are to be installed in a relatively compact hazardous area. AS-i allows the field modules to be located close to small clusters of valves thereby minimising conventional parallel wiring.

A recent development enables AS-i to be taken into hazardous areas.

AS-i is a simple two-wire bus with a maximum network length of 100 m and is ideal for valves and actuators.

A typical system would use Profibus DP in conjunction with an AS-I gateway and power supply in the safe area. The gateway would be located near the junction with the hazardous area. The AS-interface cable would then be taken into a Zone 1 or 2 hazardous area using increased safety (EEx e) techniques. EEx m AS-i I/O connector modules are then sited close to small clusters of valves. The modules use increased safety (EEx e) and encapsulation (EEx m) as the method of protection, no additional barrier to the safe area is required. The signals are converted to intrinsically safe signals (EEx i). The modules are available in two I/O combinations, 4 inputs / 2 outputs or 4 outputs only. Up to 31 modules can be fitted to a single AS-I bus (62 valves).

K Controls designs and manufactures valve networking monitoring and control products:

- Switchboxes
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- Position Transmitters
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- Low powered solenoids
- Remote I/O compatible
- AS-interface®
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- FOUNDATION™ FIELDBUS
- 4-20mA + HART®
- Wireless solutions
- Linear or rotary adaptation

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Individual network segments can be up to 100m, repeaters enable network extensions of up to 100m but safe area mounting is required for the repeater.

Link to a datasheet showing a typical AS-I Ex valve connector modules

http://www.pepperl-fuchs.com/selector/navi/productInfo/edb/102352_eng.pdf

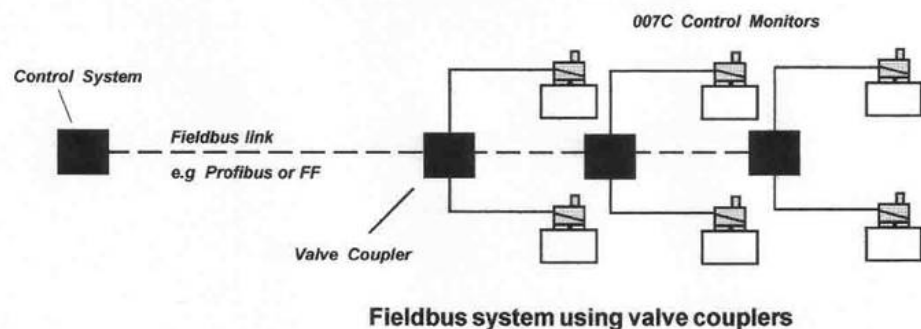


Exd AS-i Control Monitor



As an alternative to intrinsic safety K Controls can offer the Exd Control Monitor complete with an integrated AS-i I/O module. Like all Exd equipment Ex cable glands and armoured interconnecting cable has to be used. No live maintenance or calibration is permitted.

PROFIBUS® PA and FOUNDATION™ fieldbus (FF) Ex valve Couplers



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PROFIBUS® PA

Often used where on/off devices are to be mixed with instruments on a single bus. This option takes PROFIBUS® DP (93.75 k/bits / RS485) and passes it through a segment coupler which converts it to PROFIBUS® PA (31.25 kbits/sec IEC 1158-2). (The maximum current per segment is 100mA). The PROFIBUS® PA valve coupler conforms to the FISCO model and has 4 outputs and 8 inputs using the 2:1 wiring mode* (see below) (four valves per coupler). A maximum of three valve couplers can be attached to one segment coupler. This allows 12 valves per segment. The coupler features short circuit and lead break monitoring, limit position and actuation time monitoring and a full stroke counter. It can be installed in a Zone 1 hazardous area.

FOUNDATION™ fieldbus (FF)

Often used where on/off devices are to be mixed with instruments on a single bus. This option takes FF directly from an H1 card via a FISCO power repeater. (The maximum current per segment is 100mA). The FF valve coupler conforms to the FISCO model and has 4 outputs and 8 inputs using the 2:1 wiring mode (see below) (four valves per coupler). A maximum of three valve couplers can be attached to one segment coupler. This allows 12 valves per segment.

The coupler features short circuit and lead break monitoring, limit position and actuation time monitoring and a full stroke counter. It can be installed in a Zone 1 hazardous area.

Web link to FDO-VC-EX4.FF FOUNDATION™fieldbus valve coupler

[http://www.pepperl-](http://www.pepperl-fuchs.com/selector/navi/productInfo/edb/097318_eng.pdf)

[fuchs.com/selector/navi/productInfo/edb/097318_eng.pdf;jsessionid=9A7476C7C44ED19C740996AFF589B9B6](http://www.pepperl-fuchs.com/selector/navi/productInfo/edb/097318_eng.pdf)

Web link to FDO-VC-EX4.PA PROFIBUS® PA fieldbus valve coupler

http://www.pepperl-fuchs.com/selector/navi/productInfo/edb/037697_eng.pdf

007C Control Monitors from K Controls can be fitted with Exia pilot valves compatible with the latest barriers, remote I/O systems and fieldbus couplers



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 4-20mA + HART®
 Wireless solutions
 Linear or rotary adaptation

K Controls can also supply your positioner requirements

A pilot solenoid and the associated control valve are often mounted separately from the switchbox on an actuated valve assembly. The 007C Control Monitor incorporates limit switches, pilot valve and the associated control valve in an integrated unit that is fitted to the top of a quarter turn valve actuator or to the yoke of a linear actuator.

The 007C is available 3/2 single acting, 5/2 double acting or 5/2 double acting 'stayput'. The connections are 0.25 inch BSP and the CV is 0.5. Optional manual override is available on the pilot valve and the cover has to be deliberately removed to access it.

This integrated approach protects all the electrical equipment within the IP66 enclosure, reduces the overall dimensions of the actuated valve and permits connection via a single multicore cable.

Remote I/O systems and fieldbus valve couplers reduce the number of cables running between the control room and the valves. Many of the latest remote I/O systems are designed to operate with Piezotronic pilot valves that require less power from the system than conventional solenoid valves. This can result in an increased I/O count per rack and a reduction in the size or number of power supplies required.

The Piezotronic valves used in the 007C Control Monitor are manufactured by ASCO Joucomatic in Germany. The following versions are available: 6volt (3mW), 8volt (22mW), 12volt (12mW), 12volt (32mW), 24volt (46mW) and 24volt (125mW).

The 007C is certified as a complete entity to ATEX II 2 GD Exia for use with both gas and dust hazards. The 007C can be used with remote I/O systems from manufacturers such as ABB, CEAG, MTL, Pepperl and Fuchs, Stahl and Turck.

2:1 Wiring Mode for fieldbus valve couplers



Some solid state proximity sensors have the technology that permits two signals to be monitored through one dual lead via a 2:1 mode of operation. The benefits of this approach are particularly significant when using fieldbus valve couplers as the number of inputs per coupler can typically be increased to 8 thereby saving the number of



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K Controls Ltd

2 Crown Way
Crown Business Centre
Horton Road
West Drayton UB7 8HZ
United Kingdom

Phone:
+44 (0)1895 449601

Fax:
+44 (0)207 990 8111

E-mail:
sales@k-controls.co.uk

Web:
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couplers needed per installation. Up to four 007 switchboxes or four 007C switch solenoid control centres can therefore be connected to each fieldbus valve coupler.

The NJ2-V3-N is one such sensor (K Controls designation P2). For a full list please contact our sales office. K Controls takes a pair of wires from each proximity sensor and configures them via the terminal strip inside the enclosure to permit client connection to the valve coupler via a single two core cable.

Monitoring the position of modulating valves

Where the position of a valve needs monitoring throughout its travel a position transmitter is required. The addition of a fieldbus capability to a 4-20mA position transmitter can allow a number of devices to be added to a fieldbus spur and also for remote calibration to take place. Exi or Exd versions are available, HART®, PROFIBUS® or FOUNDATION™ fieldbus enabled.

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