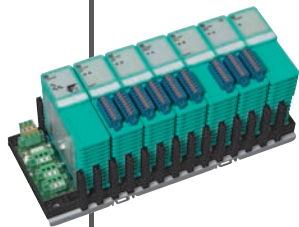


MANUAL

REMOTE I/O MODULES AND FOUNDATION FIELDBUS COM UNIT LB8110 / FB8210



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1 Introduction

Pepperl+Fuchs is the proven market leader for innovative and highly available components for your fieldbus according to IEC 61158-2. In addition to fieldbarriers, fieldbus power hubs, and advanced diagnostics there is now a modular Remote I/O to bring all the signals to the bus which did not readily lend themselves to fieldbus applications in the past.

The High-Power Trunk Concept with Entity or FISCO devices allows you to connect the maximum number of devices to the same fieldbus trunk and at the same time make use of maximum cable lengths. This concept utilizes standard power supplies such as the easy to install and configuration free Power Hub. Segment Protectors and FieldBarriers are installed close to field devices and limit the energy at the spur. You are free to work on field devices without a hot work permit.

Advanced Diagnostics takes control of your fieldbus installation. This recent innovation brings transparency to Fieldbus. Speed up commissioning with automated documentation. Measure fieldbus performance and detect changes in the control room before they become critical to your plant's operation.

Fieldbus Remote I/O is the new modular approach to bring intrinsically safe inputs and outputs from sensors and actuators to the bus which previously did not have a direct Foundation Fieldbus connection.

It accepts signals from NAMUR and switch type inputs and drives high power IS solenoids or even increased safety power relays as well as sounders, and alarm LEDs. It supplies 4-20mA transmitters and accepts input from 20mA current sources or temperature sensors. It drives I/P converters, proportional valves, and positioners.

It does not load the bus by more than the minimum required 10mA since it derives its power from its own power supply making it independent from the power available on the trunk line.

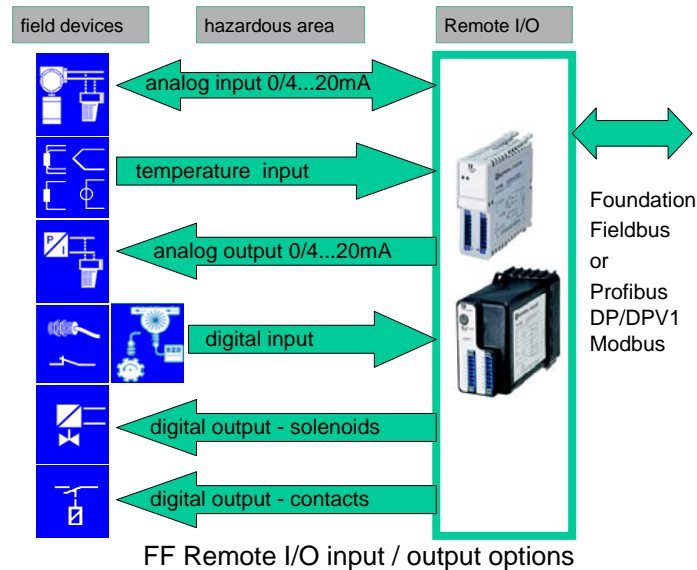


Fig.1 Inputs and Outputs of a Remote I/O

2 Abstract

This manual covers the significant benefits of this new Remote I/O approach for Foundation Fieldbus which makes use of proven principles with more hundreds of thousands of modules already installed world-wide.

3 Basic Considerations

Foundation Fieldbus is the power horse of modern process instrumentation. Compared with conventional instrumentation using point-to-point DIN rail devices or Eurocards the bus offers considerable savings and technical improvements. This holds particularly true where Asset Management is employed to obtain information for advance maintenance or to avoid unnecessary service activities.

Although most manufacturers now offer devices with direct Fieldbus connection there are still many signals which do not lend themselves to this approach. Either the signals consist of simple ON/OFF status information and it would be too costly to fit them with a Foundation Fieldbus interface individually, or the field device manufacturer only offers the classic 4-20 mA control and instrumentation signal.

This has led to the development of digital I/O boxes and temperature multiple inputs which Pepperl+Fuchs offer alongside a complete range of Fieldbus equipment. These are ideally suited for low power applications where the number of signals per location is small and analogue signals are not on the agenda.

Yet, there are installations where a fair number of digital I/O and 20mA loops for analysers or positioners are required, or power solenoids have to be used which require more energy than the loop powered fieldbus can offer.

FF Remote I/O now fills this gap. It even offers advanced diagnostics where traditionally, the attention applied to the 4-20 mA cable systems and instruments during the construction and commissioning phases would have involved manually operated test equipment or loop testers used by highly qualified engineers in a reactionary way – if a fault is discovered, a repair is made. Under ‘time pressure’, many loops may have been left unchecked or not fully assessed for less obvious (but tolerated) faults that could cause problems later down the line during operation.

In a way FF Remote I/O can be seen as automatic test equipment, providing diagnostic information via the bus, attached to every 4-20 mA loop and operated continuously. This automatic test equipment is left in place to continue monitoring the health of each loop during the plant’s operational lifetime.

The cost reductions can be quite apparent when you consider the key features offered by automatic diagnostic test equipment to each phase of the project lifecycle and the fact that FF Remote I/O collects all the NON FF signals to bring them to the bus monitoring their state of health:

Phase: Construction and commissioning

Collect all non FF signals and continuously, and thoroughly, test every loop. Print off fully completed and accurate test reports as well as computer generated sign-off sheets using the Host's own tools.

Phase: Operation

Remote I/O is connected and available and will continue automatically monitoring and reporting 24 hours a day, seven days a week, year on year.

4 Foundation Fieldbus Remote I/O brings Analogue and Digital Signals to the Bus

4.1 Well Proven System

Pepperl+Fuchs have made a considerable contribution to fieldbus technology over the past ten years. In 1995 LB Remote IO for Zone 2 or safe area mounting was connected to a number of DCS or PLC systems via PROFIBUS or MODBUS. In 1998 FB Remote IO was added for Zone 1 mounting. Hundreds of thousands of I/O modules are in use worldwide. Now we have reached another milestone. While many different components were needed in the past to build a complete system, P+F are now offering a total concept founded on stability and experience. In addition to temperature multiple inputs and discrete digital I/O boxes driving low power valves there is now a modular Foundation Fieldbus Remote I/O which adds all the functionalities required for process instrumentation in an ideal combination.

4.2 FF Remote I/O for Foundation Fieldbus

By adding a Foundation Fieldbus ComUnit or gateway we have created a new FF Remote I/O to support all non foundation fieldbus signals.

It makes use of the established reliable hardware and employs standard FF multi function blocks to offer a modular fieldbus Remote I/O for the very first time.

Also the bus speed of 31.25 kBd is exploited more efficiently whilst reducing cost compared with discrete field devices which are on offer to fulfil similar tasks.

4.3 FF Inputs and Outputs - digital or analogue

In contrast to dedicated digital input devices the modular I/O approach allows you to combine analogue and digital I/O in the same device. It supports NAMUR or switch type inputs as well as solenoid outputs, temperature signals or supply circuits for two or four wire transmitters, proportional valves and positioners.

These often do not have a Foundation Fieldbus connection themselves.

The modular approach arrives at a very compact solution offering up to 40 digital inputs or outputs or 20 analogue I/O or any combination of analogue and digital I/O.

Example combinations:

- 24 digital inputs + 16 outputs
- 16 digital inputs + 8 outputs + 8 temperature inputs
- 16 digital inputs + 8 outputs + 8 analogue inputs

Modules can be added within this framework whenever required. This allows for a modular expansion with modules on demand. Housings in glass fibre reinforced polyester (GRP) or stainless steel also offer space for fieldbarriers and valve banks.

4.4 FF Hardware Connection and Trunk Line Integrity

The FF Remote I/O can be regarded as any other individual FF device with several variables and therefore it can be connected directly to the high power trunk. It does not require segment protectors or IS Fieldbarriers. Instead it uses Ex-e connections for explosion protection in the same way as a Fieldbarrier.

The field loops are completely isolated and segregated from the trunk line. Therefore any work carried out on the field loops will not have any adverse effect on the trunk. A short of any input or output

channel will not affect other channels. Modules including the gateway can be removed or inserted without jeopardizing the trunk.

The FF Remote I/O would often be the only participant in a segment depending on the timing required for the total number of I/O. If it is combined with a fieldbarrier on the same trunk a single segment protector would be sufficient. If a segment protector is not used caution would be needed, when installing or removing the complete FF Remote I/O carrier.

4.5 FF Response Times

The Foundation Fieldbus physical layer is based on IEC 61158-2. This bus uses 31.25 kBd transmission speeds. Employing single function blocks would have meant slow responses. It was therefore decided to make use of the most modern Multi Function Blocks (MFB). These are already supported by most DCS or PLC vendors and offer much faster response times for data exchange.

Although the cyclic bus communication for the MFB is governed by the FF standard and is the same as for single function blocks, it was possible to reduce the internal execution time. Looking at an eight channel digital input module it would take 8 simple function blocks to prepare the signals ready for transmission to the host. Using a multi function block will achieve this in a single operation.

Assuming that it takes 50ms per signal, a simple function block would result in all the data arriving in the gateway after 8x50ms. Add to that the time it takes the host to collect the data via the fieldbus (350ms see fig.2a), the total data acquisition time for 8 signals would be 750ms. These values largely depend on the host.

In contrast our multi function block MFB sends all 8 signals to the gateway in one operation itself only taking 50ms. The total data acquisition time therefore is just 350ms+50ms = 400ms using the same host (fig.2b).

Equally if an input is directly linked to an output inside the FF Remote I/O, reaction times are much faster than when the signals have to be transmitted to the host and sent to another Fieldbus device.

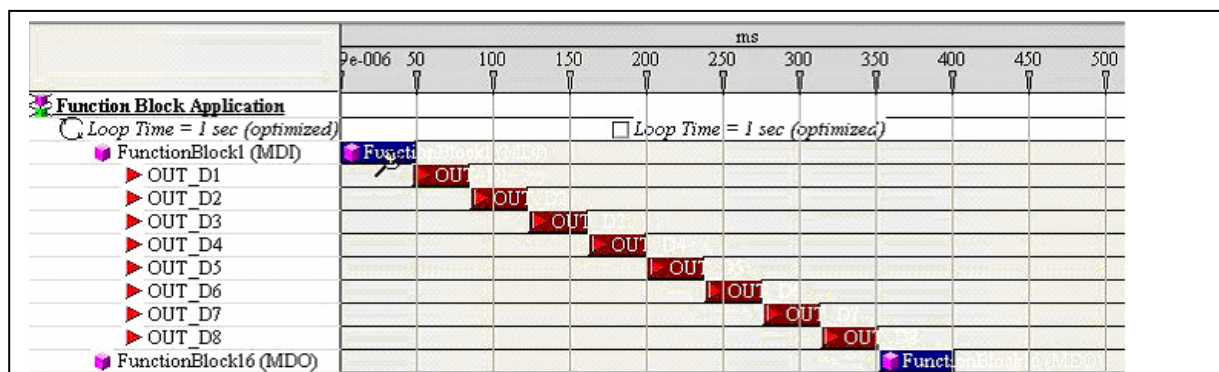


fig. 2a timing for data transmission via FF trunk (host dependent)

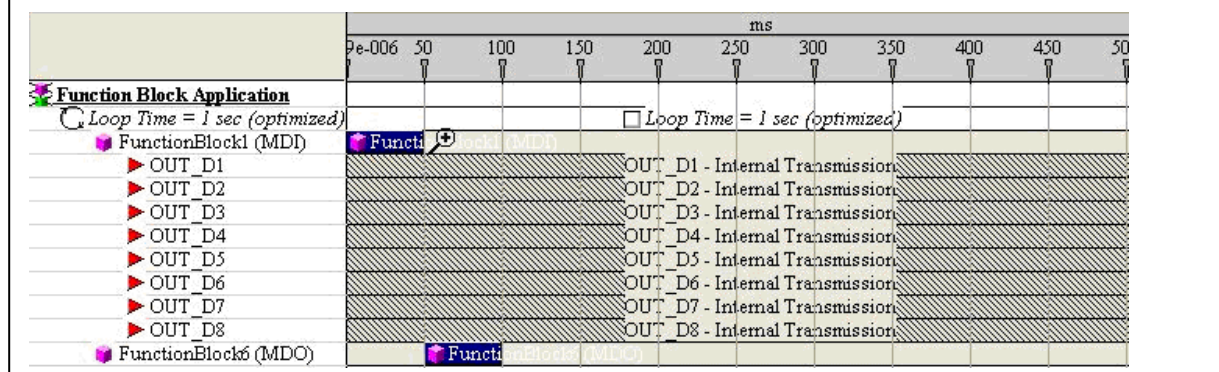


fig. 2b timing for data acquisition from module to gateway using MFB (independent of host)

4.6 Host Integration via DD

The integration of the FF Remote I/O into suitable host DCS or PLC systems is accomplished by the well established DD technology (device description) and CFF (configuration file) Files. Foundation Fieldbus thus arrives at an easy to use configuration tool which is part of the DCS or PLC environment (fig.3).

The Remote I/O stations can, therefore, be engineered as a constituent part of the overall system with a uniform operating system. Duplicating tasks such as parameter settings and data storage become superfluous.

Requirements related to the handling of software components and the necessary resources are minimal. The software is integrated into the host DCS or PLC via EDDL and CFF files available in German and English. Software upgrades guarantee compatibility with existing systems of the same

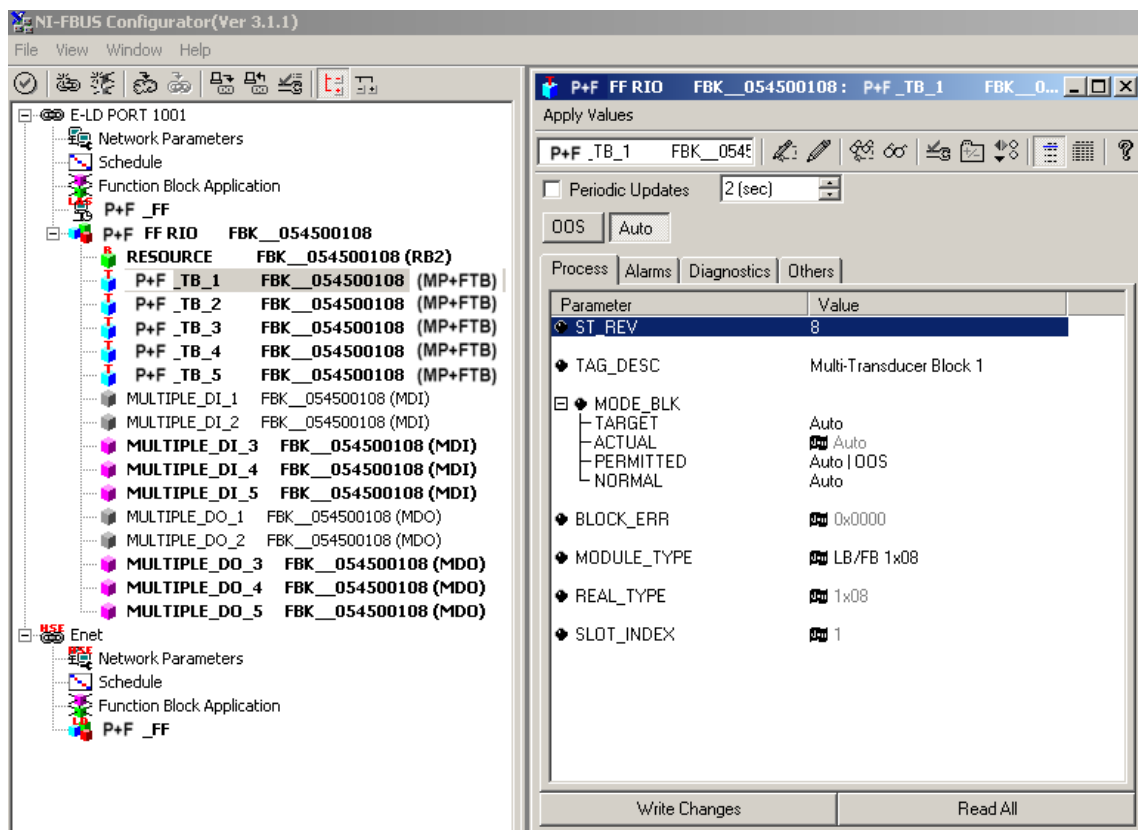


fig.3 System integration example

type.

4.7 Compatibility - Life Cycle Management

Compatibility with existing installations and a new design have been combined with a view to the future. This ensures that a product line will operate reliably during its life cycle and the transition to the next generation is smooth.

Based on proven technology and hardware the best possible solution for Fieldbus in hazardous areas has been found by just adding a few new items.

Foundation Fieldbus make use of identical I/O modules as other P+F Remote I/O. No matter which bus you take, P+F will provide you with the suitable components. You can switch from bus to bus simply by exchanging the gateway. Based on proven technology it is now possible to achieve a breakthrough for hazardous area Fieldbus installations by adding a Foundation Fieldbus communication unit. During the Life Cycle of your plant we at P+F will do whatever is in our power to ensure the necessary system adaptations. Software updates and version control will follow accepted standards.

4.8 Safety Integrity Level (SIL2)

In the past safety applications with Remote I/O would always require additional discrete loops since the question of the SIL level of the bus would always have to be considered first.

In order to achieve functional safety independent of the bus we decided to develop a shut-down path totally unrelated to the bus (fig.4).

This enables you to switch off outputs overriding the commands transmitted via the bus line. This is also possible with a Foundation Fieldbus installation.

Pepperl+Fuchs have developed valve drivers which can be controlled via the bus as well as a separate shut-down input which de-energizes outputs with a single action.

In order to avoid unnecessary diagnostic messages we do not simply turn off the power supply to the module but interrupt the output loop.

Modules with output shutdown inputs can be combined with modules without shut-down inputs in the same Fieldbus Remote I/O, if they are equipped with the shutdown contact.

Modules without shutdown input are consistently controlled by the bus, independent of the setting of the external shutdown contact.

Modules with shutdown inputs are only controlled by the bus when the shutdown contact is closed.

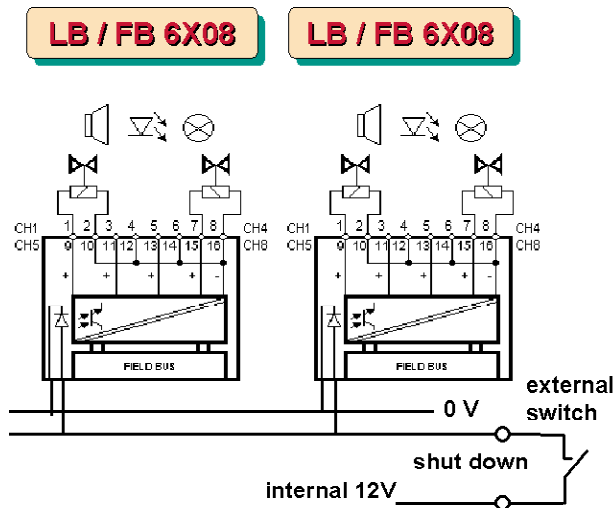


fig.4 SIL 2 Valve Shut-Down Circuit

Please ensure you use the dedicated output modules with the shut-down input when making use of the SIL 2 feature. SIL2 safety parameters are available at request.

4.9 Power Outputs

The FF Remote I/O does not load the bus by more than the 10mA required by the standard since it derives its power from its own power supply. This makes it independent from the power available on the trunk line.

It drives digital as well as analogue output signals including high power IS solenoids (fig.5+6) or even increased safety power relays.

An added advantage can be seen in the fact that intrinsically safe loops can be operated directly adjacent to power circuits.



fig.5 High Power IS Solenoid Driver Zone 2



Fig.6 typical IS solenoid valve bank

5 Zones and Divisions

LB and FB Remote I/O are suitable for Zone 2 (LB) and Zone 1 (FB) gas hazardous area mounting. The inputs and outputs can be connected to "ia" or "ib" loops in Zone 0 or Zone 1 depending on the module certificate. The enclosures must be hazardous area certified and must have a minimum IP54 ingress protection. Enclosures may be opened and modules may be hot swapped without the need for a hot work permit.

When mounted in a suitable IP66 enclosure the modules can also be mounted in hazardous areas Zone 22 (LB) and Zone 21 (FB) for flammable dust. Enclosures may NOT be opened and modules may NOT be hot swapped without a hot work permit.

Enclosures supplied by Pepperl+Fuchs are certified with the maximum number of modules that fit in the box. Therefore the user is permitted to add modules to fill empty spaces without having to contact us for recertification. It is also not necessary to recalculate the heat dissipation inside the enclosure since the maximum permissible power inside the enclosure has been considered for ATEX certification.

LB Remote I/O is also UL certified for Class 1 / DIV 2 applications. The control drawings are available for download.

6 Increased Safety

6.1 Input and Outputs in the Increased Safety type of protection

Many applications in ZONE 1 require non intrinsically safe circuits in addition to intrinsically safe signals.

These can be realized in the Increased Safety type of protection. They include, for example, digital inputs, analogue inputs, and relay outputs (e.g. digital inputs FB 1308, analogue inputs FB 3305 and relay outputs FB 6305, 6306, 6308).

Unlike intrinsically safe circuits, increased safety circuits are only accessible in a volt free state. Although the modules themselves can be exchanged during operation (hot-swapped) in ZONE 1, the non IS circuits connected to the front of these devices have to be volt free prior to removing the modules. This concerns the wire ends or cable tails emerging from the high power Zone 1 modules in figure 7.



fig.7 High Power Ex-e Relay Output Zone 1

6.2 Hot Work Permit free Hot Swap

Off-the-shelf Ex-e isolating switches or flameproof modules from the P+F product range can be used to work on live power loops in hazardous areas.

The isolating switch can, for example, be a module with a built-in fuse.

Multi function terminals can be used to act as isolating switches (fig.8a). They are also available with built-in relays or other electronic components.

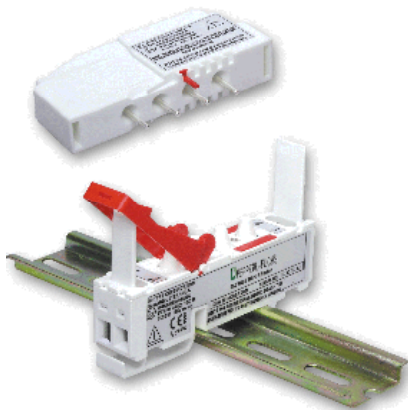


Fig. 8a Multi Function Terminal (MFT) used to break Ex-e circuits without the need for a hot work permit.

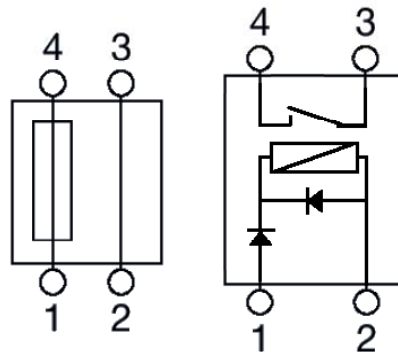


fig 8b Multi Function Terminal (MFT) Fuse and Relay Options

These Ex-d connectors allow you to connect and disconnect increased safety cables and wires under live operating conditions without a hot work permit.

Figure 8b shows two examples of the electronics built into the flameproof modules which can be hot swapped in the same way that the Zone 1 Remote I/O modules can be plugged in or removed without the need for a hot work permit.

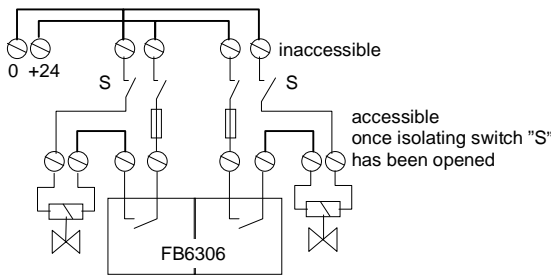


Fig. 9 Relay output

6.3 Digital Inputs and Outputs

Digital inputs and outputs are handled by switching the contacts voltfree. The contacts can, for example, be part of an externally powered, encapsulated (flameproof) device (Fig. 9).

Once the isolating switch "S" has been opened, the FB 6306 module can be exchanged during operation. The solenoids also become accessible at the same time.

6.4 Safety instructions

Increased safety circuits are only accessible in a voltfree state. The conductors of increased safety circuits have to be kept separate from those of IS circuits.

Terminals in the Increased Safety type of protection must be installed in an inaccessible terminal compartment and may only be handled in a voltfree state.

Conductors in the Increased Safety type of protection must not be unprotected when leaving the enclosure. It is permissible to wire onto terminals in the Increased Safety type of protection in a terminal box flanged underneath the enclosure of the REMOTE I/O. Modules with cable tails can be wired to a separate terminal box that is not flanged on.

6.5 Mounting example

Modules for connection to non IS circuits are preferably grouped together to ensure the required clearances to the IS circuits for terminals and wiring. Terminals in the Increased Safety type of protection are mounted in a separate terminal box that bears the inscription:

“Do not open while energized”. Alternatively, the terminals can be provided with a separate cover and mounted in an enclosure that can be opened (Fig. 10).

6.6 Multi Channel Devices

The catalogue contains many more devices which make use of increased safety. Make sure to employ the same safety considerations as explained above.

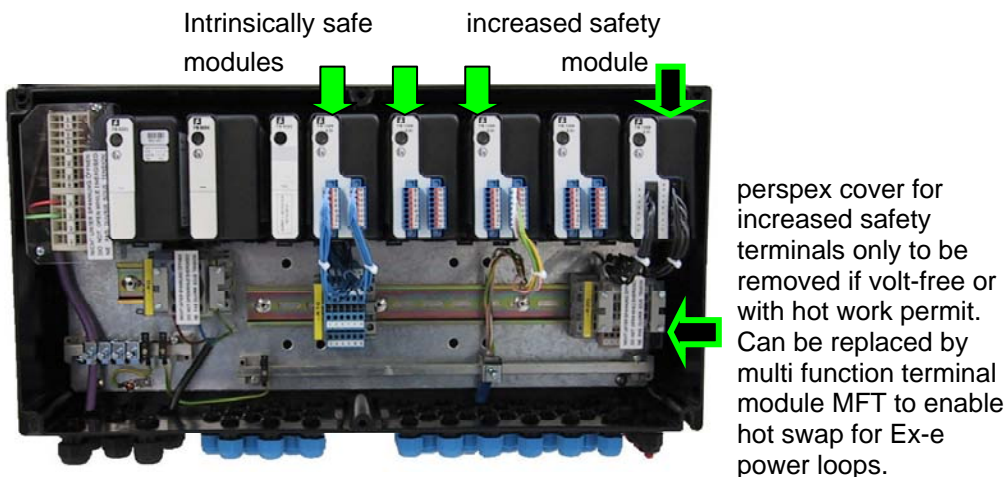


Fig. 10
Example of a Zone 1 Foundation Fieldbus Remote I/O with a combination of IS and Ex-e modules

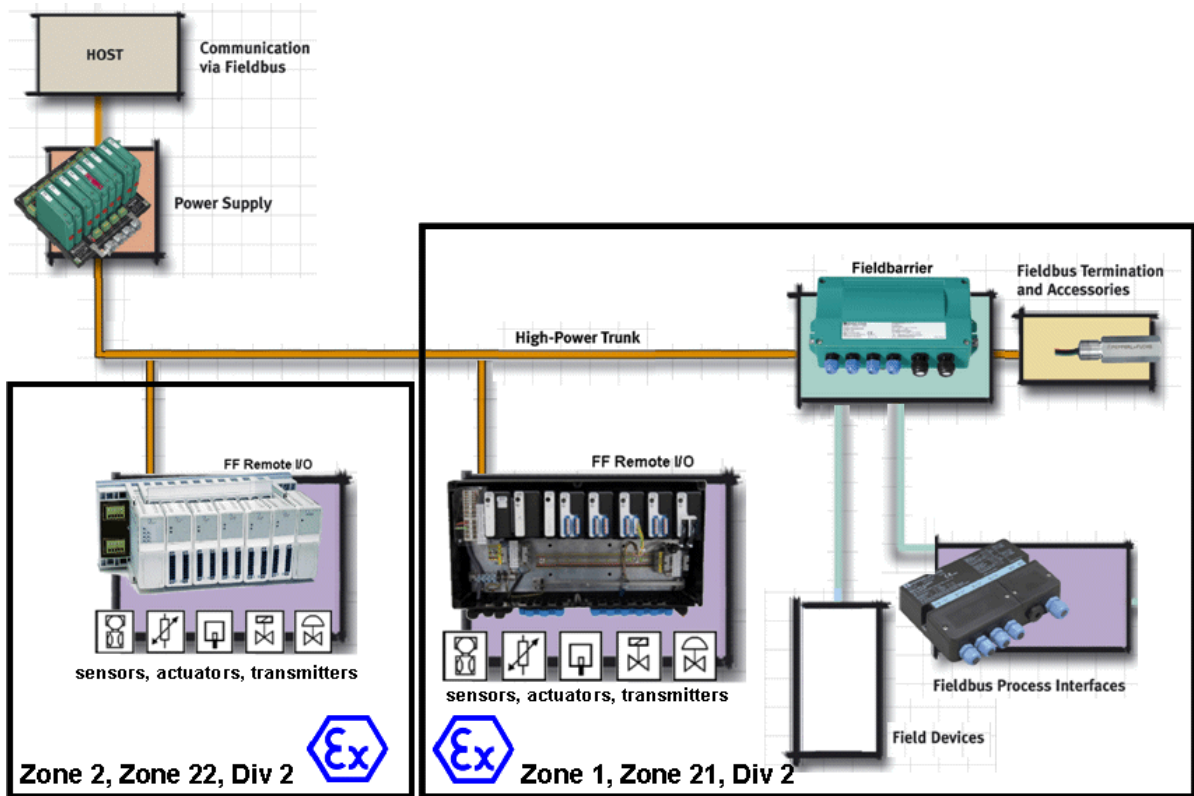


fig 11 Foundation Fieldbus Segment

6.7 Complete System with Fieldbarrier and Remote I/O for Foundation Fieldbus



fig.12 Zone 2, DIV 2 or safe area

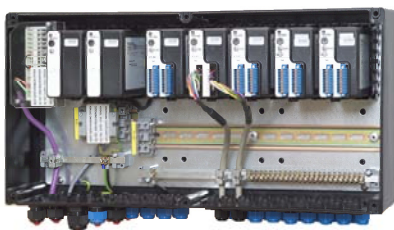


fig. 13 Zone 1, Zone 21, DIV 2

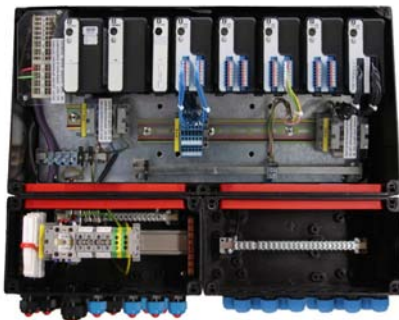


fig. 14 Zone 1, DIV 2 with space for Fieldbarrier

Foundation Fieldbus field devices can be directly connected to the fieldbus host using fieldbarriers. While the bus supplies the field devices it also enables digital communication via a single twisted pair (fig.11).

The fieldbarrier reduces the number of trunks in hazardous areas considerably compared with a totally intrinsically safe approach thus reducing cost.

The system architecture starts in the control room which is often connected to distributed controllers via Ethernet. These in turn use FF-H1 cards or FF-LINKs and segment power supplies or redundant power hubs to communicate with the field devices. Details about the properties of fieldbarriers can be found on the Internet under www.pepperl-fuchs.com.

Power and trunk lines are wired to the hazardous area using Ex-e increased safety techniques. This eliminates the need for energy limitations normally encountered with intrinsic safety. The field devices use the traditional intrinsic safety wiring to FISCO or ENTITY.

The Foundation Fieldbus Remote I/O can take on various shapes within this concept (fig.12-14). They are also available in stainless steel enclosures.

7 FF Remote I/O Components

7.1 System concept

The system can be adapted to the installation structure. This is based on a high modularity and a wide range of products. The architecture of a system is determined by the number of Remote I/O stations and field devices per bus line.

5 modules corresponding to 20 analogue or 40 digital channels or any combination desired are available per FF Remote I/O.

In accordance with the Fieldbus Standard, the maximum bus expansion is 1900 m with 31.25 kBaud.

Even in ZONE 1, PEPPERL+FUCHS Remote I/Os do not require barriers, as connection is made in the Increased Safety type of protection.

7.2 Lightning protection concept

As required by EMC directives, respective measures have been taken. However, external protective measures, e.g. lightning protectors or similar are necessary for full lightning protection.

7.3 Earthing

The screens of the field wiring are connected via metal glands into the enclosures or via separate earth rails inside the enclosure.

There is a separate chapter on earthing at the back of this manual.

7.4 International approvals

PTB, UL (USA), others upon enquiry.

7.5 Available devices

The signal processing I/O devices shown here are available (Fig. 15, next page). The serial data links used comply with international standards.

Continuous Remote diagnostics and self-monitoring are an essential part of the system. Analogue and digital signals are supported. Here PEPPERL+FUCHS offers a very wide range of I/O devices built upon extensive field experience.

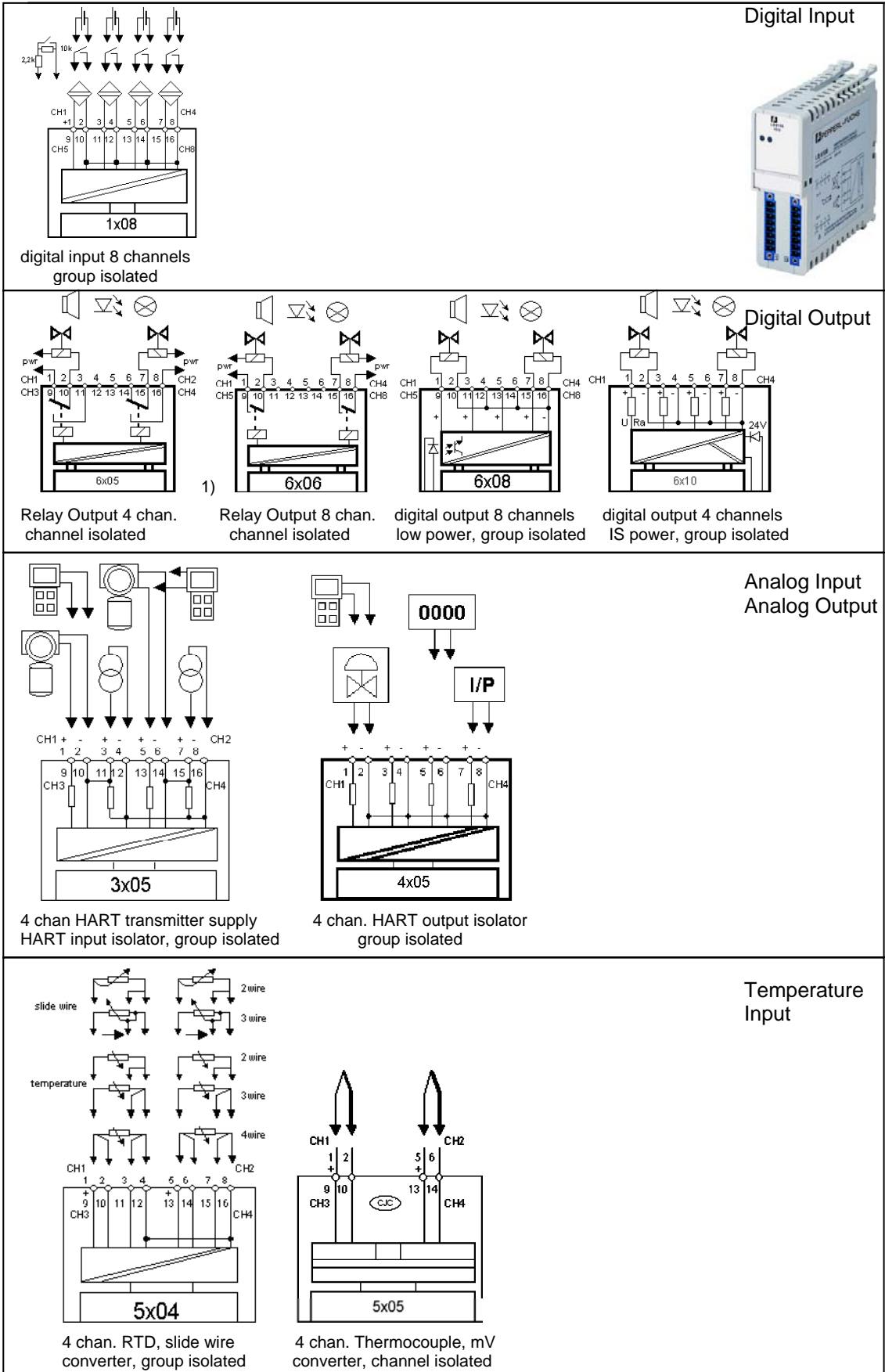


Fig. 15 Available Devices

X=0 non IS, X=1 IS, X=2 IS Zone 1, X=3 increased safety Zone 1

7.6 Fault response strategy

The functional safety of the installation must be guaranteed by suitable failure strategies. This requires the interaction of the control system with the Remote I/O. The adjustable failure behaviour of the PEPPERL+FUCHS stations is defined separately for each device. The failure of a module or channel is detected and reported to the Host control system. The start-up behaviour after a failure is determined on the whole by the Host (DCS or PLC).

7.7 System components

The functional groups and the ports for the field devices are easy to fit and are easily accessible. As the connection technique of the field devices influences the amount of installation work involved, plug-in modules were chosen. These feature plug-in terminals and allow the modules to be replaced without having to change the wiring.

They are mounted on DIN rails or in ready-made enclosures for ZONE 1.

List of available devices

1x08	8 digital inputs
3x05	4 HART supply, input
4x05	4 HART output isolator
5x04	4 RTD, slide wire inputs
5x05	4 Thermocouple inputs
6x05	4 relay outputs 230V
6x06	8 relay outputs 24V
6x08	8 digital outputs
6x10-15	4 digital IS power outputs
	x = options
x=0 non IS, x=1 IS, x=2 IS Zone 1, x=3 increased safety Zone 1	

7.8 Power supply units

In order to meet the international requirements, the system offers various supply voltages.

In ZONE 1:

- 24V DC, 230V AC, and 110V AC

In ZONE 2 and outside the potentially explosive atmosphere:

- 24V DC (other voltages by using separate supply units)

7.9 Noise immunity

The system fulfils the general requirements relating to immunity to voltage surges and bridging of mains failures (see NE 21 and EMC regulations).

7.10 Power supply redundancy

To ensure the integrity of installations it is often necessary to guarantee the voltage supply by means of a redundant supply or buffer-battery operation. In addition, redundant power supplies also ensure a high availability. Standard FF Remote I/O for Zone 2 make use of backplanes LB9035. Power supply redundancy is available using backplanes LB9026. When using the latter please make not to use more than 5 I/O modules. Also while LB9035 has the Fieldbus connected via terminals LB9026 has the Fieldbus connected via a Sub-D connector.

Redundant power supplies are not available for ZONE 1 mounting. The use of redundant power supply units does not have any effect on the number of modules that can be connected.

7.11 Diagnostics

All modules, including the power supply, feature status indication (green POWER ON LED). Communication units have LEDs for indicating the bus activity on the transmission and receiving lines. The I/O modules have further LEDs for indicating the channel status on/off (digital cards), line break (open line) and short circuit.

The status diagnostics are reported to the host system via the internal protocol.

Interfering signals are filtered to a large degree. Nevertheless, a screening technique in accordance with the latest technological developments should be applied. Some modules feature adjustable filtering functions.

The following monitoring functions are installed:

- Monitoring of the system bus
- Monitoring of the internal data traffic
- Self-monitoring of the modules
- Line monitoring of the field signals
- Defined output drive in the event of a failure
- Outputs fitted with a watchdog function

The devices feature an automatic slot identification.

7.12 Quality of modules

The reliability of devices is partly determined by the number of channels per card. For this reason, PEPPERL+FUCHS offer 8-channel (digital) or 4-channel (analogue) compact construction. MTBF figures are available on request.

7.13 Galvanic isolation

The channels are galvanically isolated from each other and from the internal system bus. Module channels are often isolated individually while some modules are isolated as a group.

7.14 Settings

The devices do not have switches or potentiometers. When a module is replaced, the configuration of its predecessor is adopted and it does not have to be set. The setting of parameters is only carried out once during commissioning and stored in the non volatile COM unit memory.

Protection against confusion of poles and short circuits, as well as an adjustable failure behaviour are also available.

7.15 Extensions / Replacements

Modules can be exchanged during operation. The hot-swapping of cards is possible with all control systems.

7.16 Bus system

The field bus system fulfills the following criteria:

- Physical properties according to IEC1158-2 standards
- Topology: line structure
- Number of slaves: 31 without repeaters (theoretical)
- Max. length 1900m adding up all trunk and spur lines
- Transmission medium (twisted pair)

7.17 Protocol properties

Bus access to Foundation Fieldbus H1 specifications.
Transmission rate 31.25 kb/s.

7.18 Communication units

The communication unit transfers the data of the internal system bus to the protocols of the host bus system. The scope of application of the Remote I/Os is largely determined by the field bus system. For this reason, a connection to the field bus systems that are currently most frequent was realized. The following bus connections are also supported:

- Foundation Fieldbus H1
- PROFIBUS DP or DPV1
- MODBUS.

Bus connections are supported by their respective ComUnits (gateways).

7.19 Trunk Line Protection

All slaves are connected in parallel to the bus and are not, therefore, a potential bottleneck for the subsequent stations. Additional short circuit protection is available using spur protectors.

However, spur protectors are not considered necessary since the I/O modules themselves protect the trunk line. Any work being conducted on loops in the field will not affect the trunk line because the I/O devices are fully isolated and segregated from the trunk.

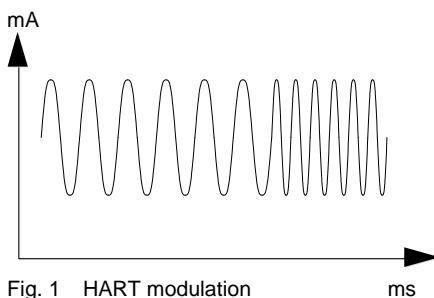
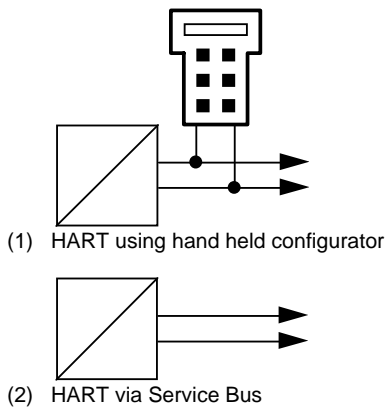
7.20 Marking

Space is provided on the module and slot for the apparatus marking, the I/O assignment and terminals of the field devices. TAG numbers can be printed onto the pre-punched labels supplied.

7.21 Installation

The system can be installed without any specific knowledge of the system or tools by installation companies provided they are familiar with hazardous area rules and regulations. All the components and ports are easily accessible. It is not necessary to pre-configure the devices. Similarly, there is no need for extra barriers. Installation instructions and regulations are included with the components (German/English, other languages on request).

The communication unit checks whether the devices installed match the module parameters as set by the engineering department. If there are any irregularities, an error message is generated.



7.22 HART Communication

Foundation Fieldbus offers intelligent communication with field devices that goes beyond the scope of HART. Since there is no standard to accommodate HART protocols on Foundation Fieldbus existing HART transmitters can only make use of the 20mA signal. Hand-held communicators then give access to the device parameters. The 250 Ω communication resistance is incorporated in the transmitter power supply for the FF Remote IO. The ComUnit / Gateway is however open for HART communication via the service bus.

Analogue inputs and outputs with HART features (types 3x05, 4x05) are available for communication with intelligent field devices according to the HART protocol.

These modules receive the HART telegrams from a communication unit (LB8110 or FB8210) that is also designed for HART communication via the service bus.

HART communication follows the BELL standard by sending out frequency packages

(1200 Hz = 1 and 2200 Hz = 0).

These are superimposed by the I/O modules onto the 20mA signals in the FSK (frequency shift keying) mode (Fig. 1).

- (1) Communication with certified hand held units at the terminals of the I/O modules. The 250 Ohm communication resistor is included in all analogue I/O modules.
- (2) Communication to the communication unit and the I/O modules via the service bus without handhelds.

For the latter, call up the functions of the HART field devices via the service bus using a suitable communication program. HART communication is carried out with the aid of the non periodic services of the Fieldbus (asynchronous).

Each transmitter requires an individual address to avoid address conflicts between measuring points. Some commercially available software packages have learning functions that automate the reading-in of all the field device addresses. In this case, the sequential connection of the field devices for first-time operation described below is not necessary.

If the available software does not have such a learning function, to begin with only connect one transmitter and establish connection to the field device with the HART software.

Give the field device a so-called "communication address" (e.g. addressing using the TAG No.). After this, put the second device into operation, etc. Once all the transmitters have been given the communication address, they can all be connected to the system simultaneously.

With all systems it is necessary to ensure that the field devices have an unmistakable address, as, depending upon the software being used, the HART communication can address all the field devices at the same time via the REMOTE I/O, whereby only the transmitter with the correct address should respond.

7.22.1 Practical Experience

Tests revealed the following limitations:

HART communication is possible with transmitters within an operating range of 4-20mA.

If there is no input signal (line break), some transmitters go into overrange (22mA). HART communication with this transmitter is often not possible in this state. This also applies when hand held units are used.

7.23 Monitoring

During operation it is possible to monitor the status of system components and signal status values online.

7.24 Simulation

A simulation feature allows offline simulation when no automation components are connected. Forcing of in- and outputs is possible for test functions and commissioning.

7.25 Documentation

During configuration the documentation is generated by the Host's own software. This is done per FF Remote I/O including all parameter tables. Our engineering department also offers additional installation documentation.

8 FF Remote I/O Data Structure

8.1 Basics

Hardware of FF Remote I/O:

- COM Unit: Type FB8210 for Zone 1 hazardous areas and LB8110 for other areas including Zone 2 containing identical firmware
- Backplane:
Zone 1 FB Backplane model FB9251 and FB9252 with space for 5 I/O modules;
Zone 1 LB Backplane model LB9035 with space for 5 I/O modules
- I/O Module: LB/FB 1x08, LB/FB 6x05, LB/FB 6x06, LB/FB 6x08, LB/FB 6x10
LB/FB 3x05, LB/FB 4x05,
LB/FB 5x04, LB/FB 5x05
- Bus connections: Foundation Fieldbus H1; also Service Bus.

8.2 Function Block Structure

FF Remote I/O supports the Foundation Fieldbus Spec. FF-893 FS 1.0 for multi function block applications. A maximum of 5 multi channel I/O modules can be freely assigned to a single substation.

FF Remote I/O contains 26 blocks:

- 1 Resource Block
- 5 Transducer Blocks
- 20 Multi-Functions blocks, and thereof
 - 5 MDI
 - 5 MDO
 - 5 MAI
 - 5 MAO

At present FF Remote I/O does not contain a LM (Link Master) option.

8.3 Resource Block

The Resource Block describes the physical layer of the FF Remote I/O device.

8.4 Transducer Block (TB)

There are 5 identical Transducer Blocks. PFTB (defined in the DDs). The FF Remote I/O can handle 5 different multi channel I/O modules at the same time. The Transducer Blocks are assigned to the 5 available physical slots on the backplane.

The transducer block parameters are divided into the following groups:

FF standard Transducer Parameter:

CHARACTERISTICS
ST_REV
TAG_DESC

STRATEGY

ALERT_KEY
MODE_BLK
BLOCK_ERR
UPDATE_EVT

BLOCK_ALM

Parameter ST_REV allows you to monitor changes of critical TB parameters (defined as **Static** parameters). MODE_BLK defines the operating modes of a TB. The following modes are supported by the TB:

OOS (Out of Service)

AUTO

8.5 Specific Parameters (global):

The most important global parameters:

MODULE_TYPE
REAL_TYPE
SLOT_IDX

MODULE_TYPE defines the type of I/O module and its configuration. The parameter will appear in a FF engineering tool in the form of a selection chart (see fig.). The list shows all the permitted I/O modules. In order to change these parameters you have to set the operating mode of the transducer block to „OOS“. The mode has to be taken back to AUTO for normal operation.

Parameter REAL_TYPE is a „Read only“ parameter. It indicates the type of module which occupies the slot in reality.

SLOT_IDX shows which slot the Transducer Block belongs to. The assignment of the 5 TB is fixed and cannot be changed.

8.6 Module Specific Parameters

The Transducer Block contains all the parameters necessary to configure the I/O modules. Depending on the selected type of I/O module (Parameter MODULE_TYPE), the relevant configuration parameters are listed.

Digital Input Module 1x08:

PARAM_1x08_CHN_1, ..., 8, contains,

LFD: {On, Off},
 INVERT: {On, Off},
 ON_DELAY: {0, 10, 100, 1000ms},
 OFF_DELAY: {0, 10, 100, 1000ms},
 SIGNAL_TYPE: {NAMUR, 24V, 5V}

Digital Output Module (relay) 6x05:

PARAM_6X05, each channel contains:

INVERT: {On, Off}

Digital Output Module (relay) 6x06:

PARAM_6X06, each channel contains:

INVERT: {On, Off}

Digital Output Module (solid state) 6x08:

PARAM_6X08, each channel contains:

LFD: {On, Off},
 INVERT: {On, Off}

Digital Output Module (solid state) 6x10 – 6x15:

PARAM_6X1Y, each channel contains:

LFD: {On, Off},
 INVERT: {On, Off}

Analog Input Module 3x05:

PARAM_3x05_CHN_1, ..., 4, each channel contains:

LFD: {On, Off},
 OPERATION_MODE: {4-20mA, 0-20mA},
 ANALOG_FILTER: {0, 1%, 10%, 100%}

Analog Output Module 4x05:

PARAM_4x05_CHN_1, ..., 4, each channel contains:

LFD: {On, Off},
 OPERATION_MODE: {4-20mA, 0-20mA},
 ANALOG_FILTER: {0, 1%, 10%, 100%}

RTD Input Module 5x04:

PARAM_5x04_CHN_1, ..., 4, each channel contains:

LFD: {On, Off},
 ANALOG_FILTER: {0, 1%, 10%, 100%},
 MODE: {2-wire, 3-wire, 4-wire},
 RANGE: {Pt100, Pt200, Pt500, Pt1000
 Ni100, Ni500, Ni1000
 RTD 2-wire, RTD 3-wire}

TC Input Module 5x05:

PARAM_5x05_CHN_1, ..., 4, each channel contains:

- LFD: {On, Off},
- ANALOG_FILTER: {0, 1%, 10%, 100%},
- Ext_CJC: {0°C, 50°C},
- CJC_MODE: {internal, external},
- RANGE: {mV, Type U, Type B, Type E, Type T, Type K, Type S, Type R, Type L, Type J, Type N, Pallaplat}

8.7 Function Block

FF Remote I/O supports Multi Function Block Applications (see Spec. FF-893 Part 4). The following MFB Types are available: MDI, MDO, MAI and MAO. Since the analog multi function blocks have to follow the 8 channel FF standard only the first 4 are used for data. The rest remain empty.

The following parameter are particularly important:

For MDI (multiple digital input) and MAI (multiple analog input):

8.7.1 CHANNEL

MODE_BLK
OUT_1, ..., OUT_8

For MDO (multiple digital output) MAO (multiple analog output):

8.7.2 CHANNEL

MODE_BLK
IN_1, ..., IN_8

The CHANNEL parameter defines a channel which uses a Function block, with which process values are exchanged by means of transducer blocks. FF Remote I/O are freely configurable modular devices. The 5 available slots can carry any of the modules listed in chapter 7.5. The transducer block represents a physical I/O-Module and is assigned to the appropriate slot. The transducer block contains all the parameters necessary to configure the available I/O modules which are separated in the TB under „Transducer Type“. Depending on the selected module type using the parameter „MODULE_TYPE“, the related parameter sets become available for adaptation to the application.

For analog I/O modules, the engineering unit of the I/O data is defined implicitly in the multi function blocks (MAI and MAO), depending on the selected module and the sensor type.

Each TB opens internal data channels to the Function Blocks. The channel number is a two digit number combining slot index type of I/O data as shown in the following table:

	MDI	MDO	MAI	MAO
TB2 (Slot 1)	11	12	13	14
TB2 (Slot 2)	21	22	23	24
TB3 (Slot 3)	31	32	33	34
TB4 (Slot 4)	41	42	43	44
TB5 (Slot 5)	51	52	53	54

A Function block will use its CHANNEL parameter to interface with one of the 5 TB (transducer blocks) via Link Object in order to exchange data. A TB only offers one valid data channel at any time depending on the setting of the TB parameter „MODULE_TYPE“.

9 Configuration of a FF Remote I/O

When a Remote I/O is connected to the FF H1-Bus it will automatically register with the host DCS or PLC. The host will use the DD (device description) delivered with the REMOTE I/O to establish a data link to the REMOTE I/O field device.

The way the configuration of a field device is conducted is defined by the Foundation Fieldbus specification and differs only slightly from DCS to DCS. The FF Remote I/O, offers more choice than other typical compact FF devices. It is freely configurable just like a Profibus Remote I/O. This makes it necessary to follow a few basic rules to commission a FF REMOTE I/O.

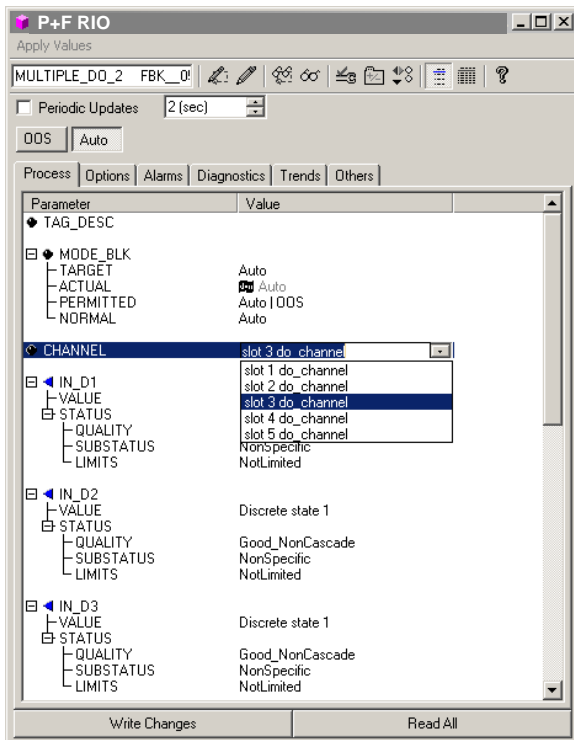
The selected „MODULE_TYPE“ of the TB must be the same as the real I/O Module in the corresponding slot. You can check the real module type using „REAL_TYPE“.

The „MODULE_TYPE“ of the TB decides which of the internal data channels of the TB will become active and valid. If you configure **1x08** the DI-channel of the TB will generate valid data for the multiple digital input MDI while all other data channels will be marked „Out of Service“.

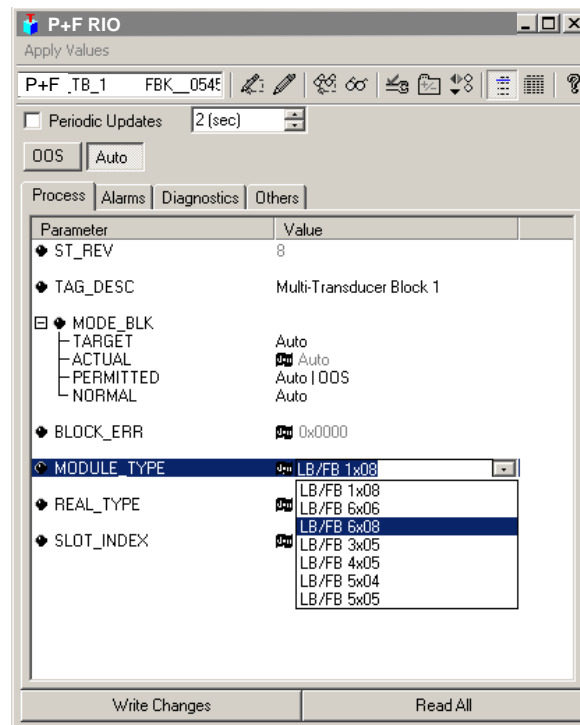
A Multi Function Block will exchange data with one of the 5 TB (freely selectable) via its „CHANNEL“. The possible combinations are listed in the table above.

If an MDO chooses „CHANNEL“-Number 42, the MDO will be connected to the internal DO-Data channel of TB4 (**Slot 4**). In order to achieve the correct data exchange the TB4 parameter, must be set accordingly as explained above. So „MODULE_TYPE“ and „REAL_TYPE“ of the TB4 must be identical and correct (e.g. 6x08 or 6x06).

In order to simplify matters for the user the DD redefines the „CHANNEL“ parameters of the FB (function block) for the FF Remote I/O. The user does not have to trouble himself with the table above. Instead the engineering tool of the DCS or PLC will use the DD to replace the channel number by a defined text message as shown in the following figures.



Example showing module slot no.



Example showing module type

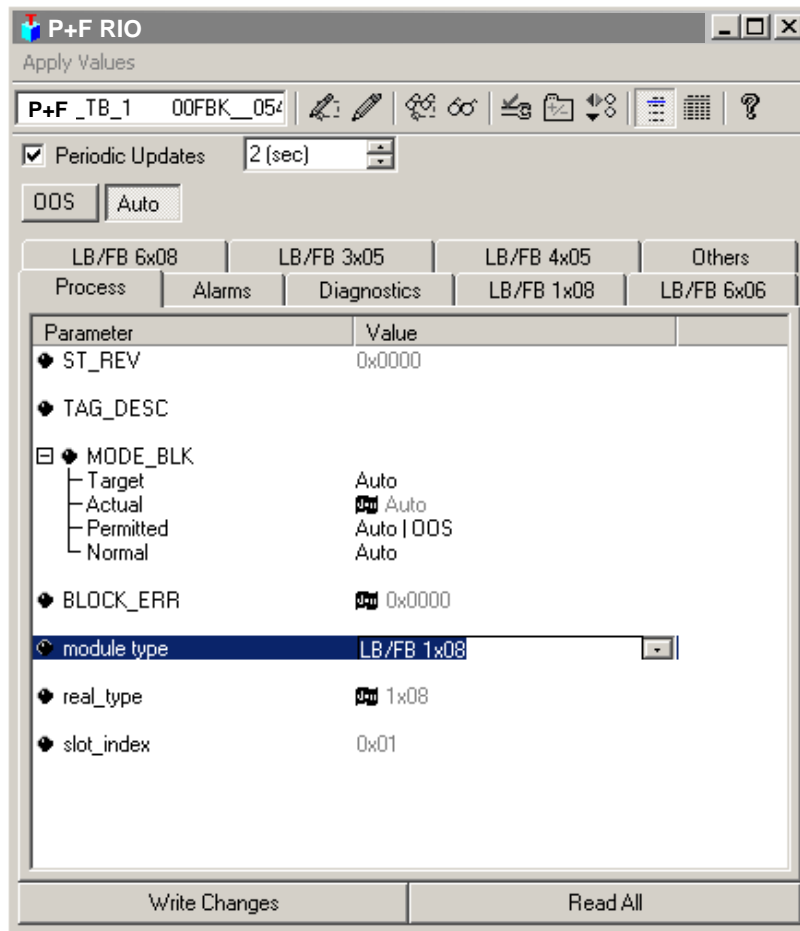
9.1 Block Mode of the FF Remote I/O

FF Remote I/O supports the following Block Modes:

	Block Mode		
Resource Block (RS)	OOS	Auto	Man
Multi Function Block	OOS	Auto	
Transducer Block	OOS	Auto	

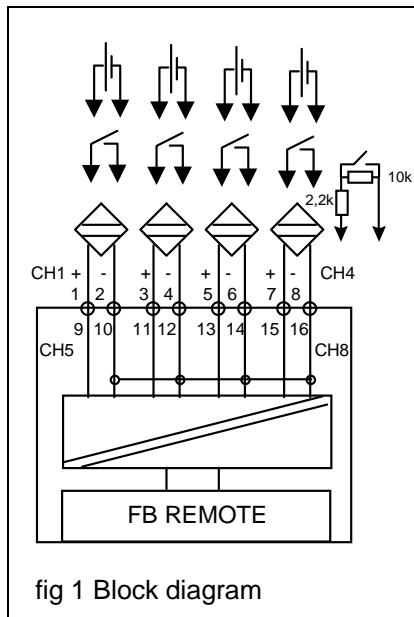
The FF Remote I/O deviates slightly from the FF Specification in the following point: when the Resource Block (RS) changes from **Auto** Mode to **OOS** (Out of Service) the Transducer block modes of the FF Remote I/O remain unchanged. This is to avoid a massive amount of communication data appearing on the FF Bus (H1) simultaneously registering a large number of alarms.

The "long" list of parameters of the TB was broken down into various groups as indicated by the TABS in the following figure. Many engineering tools offer similar features.



Module selection

10 How to Configure I/O Modules



10.1 Digital Input, 8-channels Types LB1108 and LB1008 and FB1208 and FB1308

The digital input module interfaces process signals of mechanical contacts, NAMUR initiators, or opto-couplers as well as active status signals with the DCS or PLC. The device features 8 independent channels which are group isolated from the bus and have a common minus line.

Options

LB1008 LB REMOTE, non IS
 LB1108 LB REMOTE intrinsically safe (IS)
 FB1208 FB REMOTE intrinsically safe (IS)
 FB1308 FB REMOTE increased safety (Ex-e)

Features:

- NAMUR to DIN 19234 or
- 24V DC or 5V DC (NON IS only)

10.1.1 Acquisition Time, Cycle Time

Signals are transmitted to the ComUnit or gateway in block mode taking just 50ms for all 8 channels. The total data acquisition time depends on the host.

10.1.2 Data Exchange

The data exchange follows the FOUNDATION FIELDBUS specification. The valid standards are available from the FF User Organisation.

The standard ensures that devices from various manufacturers work on the same bus.

The user does not have to concern himself with the data structure since this is relayed to the DCS or PLC via the device DD.

10.1.3 Line Monitoring

Each channel is fitted individually with a line fault detection (LFD) feature to test for open or short circuits. This monitoring function can be deactivated via the software.

24V/5V inputs do not offer line monitoring.

In the case of mechanical contacts, it is either necessary to deactivate the line monitoring feature or the switch has to be wired to a resistor combination to emulate a NAMUR initiator. Only then is it possible for the electronics to distinguish between a closed contact and a short circuit (see block diagram fig.1). The resistor network is available as an accessory.

10.1.4 Light Emitting Diodes (LEDs)

Front LEDs indicate the module status.

- A green LED indicates that the module is connected properly to the auxiliary power supply and that the fuse of the module is intact.
- A red LED indicates the state of the field wiring. It lights up in the event of a short or open circuit in any input. It flashes in case the module does not communicate with the ComUnit.

10.1.5 Diagnostics

The FOUNDATION FIELDBUS offers the standard diagnostic functions.

The switch amplifier features 8 channels.

Therefore a channel-related error is indicated when a fault occurs at any input.

Besides, the device related error gives further detailed information in cases of a missing module or a wrong module in the slot. It is up to the DCS or PLC to make use of the diagnostic information.

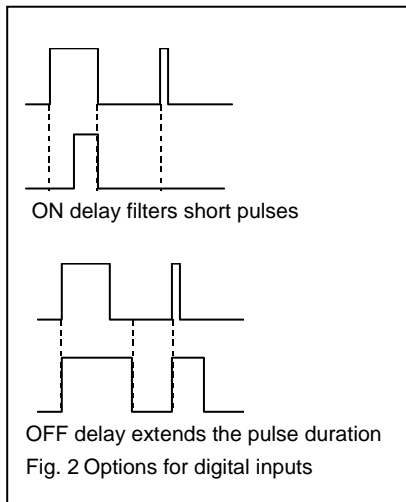
10.1.6 Fault Response

In the event of a fault the input will take on the actual value be it line open or short circuit.

10.1.7 Line fault detection and Signal Inversion

With the option "line fault detection" the line monitoring on the individual input channels can be switched on/off. If this parameter is set, the error information will be immediately added in the next diagnostic telegram by the ComUnit or gateway, when a fault occurs at the input.

You can also choose between a positive or negative logic to determine the switch position of the digital input using parameter "inverter".



10.1.8 ON/OFF Delay

The ON delay can be used to filter out short interference pulses (contact chatter).

The OFF delay can be used to extend the duration of pulses that are too short, so that they can be acquired by the bus cycle (e.g. „go-devil“ control). See Fig. 2.

Note:

All the parameters can be set individually per channel.

10.1.9 How to Configure Digital Inputs

The table shown at the bottom of the page presents all the parameters of the module which can be configured via the DCS or PLC.

After adding the module 1X08 to a slot, you will see the module settings defined according to the configuration table described completely in the DD file. The individual parameter of the module can be easily configured via the corresponding user interface of the host.

It is up to the host to load the device description file into it's own data base and to provide the corresponding user interface, enabling the correct presentation and setting of the module parameters.

Module Settings of LB/FB-1X08:

Data_1... Data_8 (channel 1 ~ 8) Definition:

Bit mapping	Parameter	Selection
0	Line fault detection	0: off 1: on
1	Inverter	0: off 1: on
2-3	ON delay	0: 0 ms 1: 10 ms 2: 100 ms 3: 1000 ms
4-5	OFF delay	0: 0 ms 1: 10 ms 2: 100 ms 3: 1000 ms
6-7	Type of signal	0: NAMUR 1: 24 V 2: 5 V

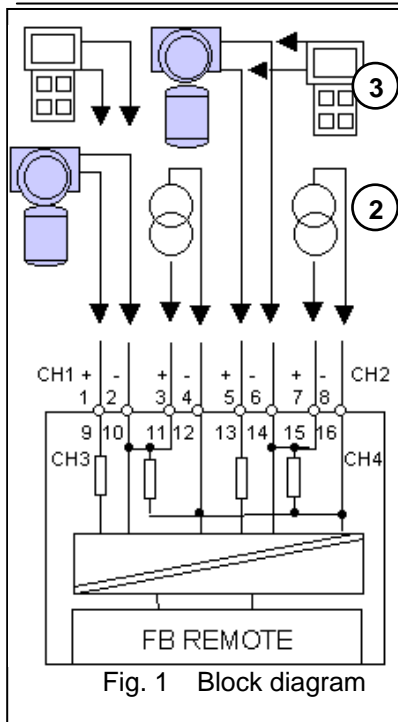


Fig. 1 Block diagram

10.2 Analog Input Modules HART Transmitter Power Supply, Input Isolator, 4 channels Types LB3104, LB 3105, LB3005 and FB3204, FB3205, FB3305

The analog input module 3X0X interfaces process signals of pressure and differential pressure transmitters, sensor transmitters or remotely powered analysers, flow and level gauges with the DCS or PLC.

Options

LB3005 LB REMOTE, non IS, HART
LB3104 LB REMOTE, (IS),
LB3105 LB REMOTE, (IS), HART
FB3204 FB REMOTE, (IS),
FB3205 FB REMOTE, (IS), HART
FB3305 FB REMOTE, Exe, HART
IS = intrinsically safe

(1) For transmitter power supply applications use terminals 1(+) - 2 and 5(+) - 6, and 9(+) - 10, and 13(+) - 14.

(2) For applications as input isolators for active signals from the field use terminals 3(+) - 4, and 7(+) - 8, and 11(+) - 12, and 15(+) - 16. Input resistance 150hms (non HART).

(3) Connect HART hand held devices with a Certificate of Conformity to the terminals in parallel to the field device.

(4) HART communication via the service bus is possible in the supply circuit only.

Features:

The minimum supply voltage at 20mA is 15 V. Up to this maximum value, the voltage is adapted to suit the requirements of the respective field device. In the event of a drop in load to 4 mA, the supply voltage increases to ca. 19 V.

10.2.1 Acquisition Time, Cycle Time

Signals are transmitted to the ComUnit or gateway in block mode taking just 50ms for all 4 channels. The total data acquisition time depends on the host.

During HART communications the internal cycle transmits new values to the ComUnit or gateway only once every third cycle adding another 50ms to the total time which now becomes 130ms.

10.2.2 Data Exchange

The data exchange follows the FOUNDATION FIELDBUS specification. The valid standards are available from the FF User Organisation.

The standard ensures that devices from various manufacturers work on the same bus.

The user does not have to concern himself with the data structure since this is relayed to the DCS or PLC via the device DD.

10.2.3 Line Monitoring

The module is fitted with a line fault detection (LFD) feature to test for open or short circuits (LFD = 1 in event of fault). This monitoring function can be deactivated via software. The alarm points are set at <3.6mA, >21mA.

10.2.4 Light Emitting Diodes (LEDs)

Front LEDs indicate the module status.

- A green LED indicates that the module is connected properly to the auxiliary power supply and that the fuse of the module is intact.
- A red LED indicates the state of the field wiring. It lights up in the event of a short or open circuit in any input. It flashes in case the module does not communicate with the ComUnit.

10.2.5 Diagnostics

The FOUNDATION FIELDBUS offers standard diagnostic functions.

The analog input features 4 channels.

Therefore a channel-related error is indicated when a fault occurs at any input.

10.2.6 Fault Response

In the event of a fault the input will take on the actual value be it line open or short circuit.

10.2.7 How to Configure Analog Inputs

After adding the module to a slot, you will see the module settings defined according to the configuration table (described completely in the DD file) at the user interface of your DCS or PLC systems. The individual parameter of the module can be easily configured via the corresponding user interface of the host.

It is up to the host to load the device description file (DD or CFF file) into its own data base and to provide the corresponding user interface, enabling the correct presentation and setting of the module parameters.

Here you can define the module settings.

- the parameter "operating mode" specifies the analog input signal range. You can have the module working in a range of 0 ~ 20 mA or 4 ~ 40 mA.
- With "line fault detection" you can enable/disable the line monitoring feature (LFD) on the individual input/output channels. If this feature is set, the corresponding "channel related error" will be added to the diagnostics by the ComUnit or gateway, when a line fault occurs.
- In addition, you can add a filter between the analog input and the processed data. It is possible to set the rate of change that will be allowed to pass through the filter. The slowest option will take 90 sec to pass a 90% change of input at 1% per sec.

10.2.8 Scaling

The module uses 16bits of which 12Bits represent the analog input value. Input signals ranging from 0-25mA use this 12-bit resolution. The actual measuring range is calculated on this basis. Thus, the resolution for the range 4-20 mA or 0-100% is more than 11 bits (better than 0.1%).

Depending on the chosen scaling factor and the operating mode, as listed in the scaling table, the output value can be mapped into different areas for a full input range of 0% ~ 100%.

In the present version, the scaling factor is a global parameter which can be set in the ComUnit. Once the scaling factor is chosen, it applies to all the analog modules within that station. (factory setting 4mA = 10,000 and 20mA = 50,000).

10.2.9 HART Communication

The module 3X05 is suitable for HART signals. You can communicate with suitable field devices via the service bus.

For FDT based systems we offer a device type manager (DTM) for the HART feature of the REMOTE I/O. The manufacturers of the field devices supply the software house with DTMs for their own field devices, so that all the functions of the field devices are accessible with the HART protocol via the service bus.

Note:

It is also possible to set field devices with the HART protocol at the device terminals using Ex-approved handheld devices of the field device manufacturer. LB/FB I/O modules have a built-in 250Ω communication resistor.

The device does NOT support HART communications for remotely powered field devices which send active 20mA signals to the module.

Modules LB3104 and FB3204 do not support HART. However, they can be used together with handheld devices. There is a built-in 250Ω communication resistor.

In the case of transmitters that do not use a standard HART protocol, this does not affect the module.

Module Settings of LB/FB-3X04:

Data_1, ..., Data_4 (channel 1 ~ 4) Definition:

Bit mapping	Parameter	Selection
0	line fault detection	0 : off 1 : on
1	operating mode	0 : 4...20 mA 1 : 0...20 mA
2-3	analog filter	0 : off 1 : 100 % / sec 2 : 10 % / sec 3 : 1 % / sec
4-7	-	

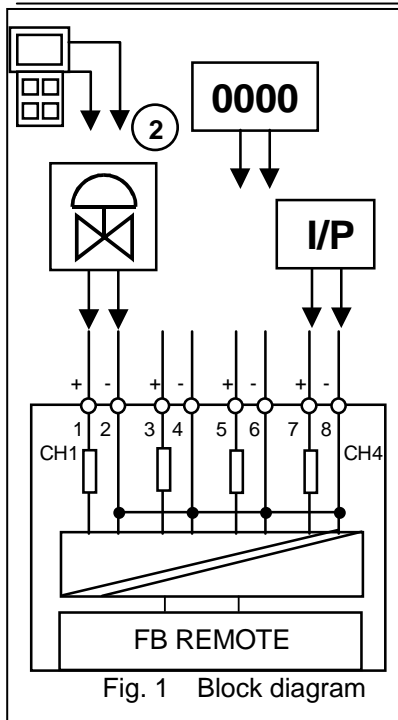
Module Settings of LB/FB-3X05:

Data_1, ..., Data_4 (channel 1 ~ 4) Definition:

Bit mapping	Parameter	Selection
0	line fault detection	0 : off 1 : on
1	operating mode	0 : 4...20 mA 1 : 0...20 mA
2-3	analog filter	0 : off 1 : 100 % / sec 2 : 10 % / sec 3 : 1 % / sec
4-7	-	-

Scaling Table:

	0% ~ 100%	Operating mode	Mapping range
scaling	10000 – 50000	live zero	10000 – 50000
		dead zero	18000 – 50000
scaling	0 – 60000	live zero	0 – 60000
		dead zero	12000 – 60000
scaling	5000 – 25000	live zero	5000 – 25000
		dead zero	9000 – 25000
scaling	0 – 30000	live zero	0 – 30000
		dead zero	6000 – 30000
scaling	625 – 3125	live zero	625 – 3125
		dead zero	1125 – 3125
scaling	0 – 4000	live zero	0 – 4000
		dead zero	800 – 4000



10.3 Analog Output Modules HART Output Isolator, 4 channels Types LB4104, LB 4105, LB4005 and FB4204, FB4205, FB4305

The analog output module 4X0X interfaces process signals of positioners, I/P converters, proportional valves and local indicators with the DCS or PLC (Fig.1).

Options

LB4005 LB REMOTE, non IS, HART

LB4104 LB REMOTE, (IS),

LB4105 LB REMOTE, (IS), HART

FB4204 FB REMOTE, (IS),

FB4205 FB REMOTE, (IS), HART

FB4305 FB REMOTE, Exe, HART

IS = intrinsically safe

(1) use terminals 1(+) – 2, 3(+) – 4, 5(+) – 6, and 7(+) – 8 for all types of output isolator applications.

(2) Connect HART hand held devices with a Certificate of Conformity to the terminals in parallel to the field device.

Features:

- Output load 750 Ohms
- Open circuit voltage 27.3 V (Ex i)
- Short circuit current 87 mA (Ex i)

The minimum output voltage at 20 mA is 15 V. The voltage adapts itself to the requirements of the field device.

10.3.1 Acquisition Time, Cycle Time

Signals are transmitted from the ComUnit in block mode taking just 50ms for all 4 channels. The total data transfer time depends on the host.

During HART communications the internal cycle transmits new values to the ComUnit only once every third cycle adding another 50ms to the total time which now becomes 130ms.

10.3.2 Data Exchange

The data exchange follows the FOUNDATION FIELDBUS specification. The valid standards are available from the FF User Organisation.

The standard ensures that devices from various manufacturers work on the same bus.

The user does not have to concern himself with the data structure since this is relayed to the DCS or PLC via the device DD.

10.3.3 Line Monitoring

Depending on the device order number the module may be fitted with a line fault detection (LFD) feature to test for open circuits (LFD = 1 in event of fault). This monitoring function can be deactivated via software.

10.3.4 Light Emitting Diodes (LEDs)

Front LEDs indicate the module status.

- A green LED indicates that the module is connected properly to the auxiliary power supply and that the fuse of the module is intact.
- A red LED indicates the state of the field wiring. It lights up in the event of an open circuit in any output. It flashes in case the module does not communicate with the ComUnit.

10.3.5 Diagnostics

The FOUNDATION FIELDBUS offers the standard diagnostic functions.

The analog output features 4 channels.

Therefore a channel-related error is indicated when a fault occurs at any output.

10.3.6 Fault Response

In the event of a fault in the communication between the module and the ComUnit a watchdog circuit will drive the output to zero after about 2 sec.

10.3.7 How to Configure Analog Outputs

After adding the module to a slot, you will see the module settings defined according to the configuration table (described completely in the DD file) at the user interface of your DCS or PLC systems. The individual parameter of the module can be easily configured via the corresponding user interface of the host.

It is up to the host to load the device description file (DD or CFF file) into its own data base and to provide the corresponding user interface, enabling the correct presentation and setting of the module parameters.

Here you can define the module settings.

- the parameter "operating mode" specifies the analog output signal range. You can have the module working in a range of 0 ~ 20 mA or 4 ~ 40 mA.
- With "line fault detection" you can enable/disable the line monitoring feature (LFD) on the individual input/output channels. If this feature is set, the corresponding "channel related error" will be added to the diagnostics by the ComUnit, when a line fault occurs.
- In addition, you can add a filter between the analog output and the processed data. It is possible to set the rate of change that will be allowed to pass through the filter. The slowest option will take 90 sec to pass a 90% change of output at 1% per sec.

10.3.8 Scaling

The module uses 16bits of which 12Bits represent the analog output value. Output signals ranging from 0-25mA use this 12-bit resolution. The actual range is calculated on this basis. Thus, the resolution for the range 4-20 mA or 0-100% is more than 11 bits (better than 0.1%).

Depending on the chosen scaling factor and the operating mode, as listed in the scaling table, the output value can be mapped into different areas for a full range of 0% ~ 100%.

In the present version, the scaling factor is a global parameter which can be set in the ComUnit. Once the scaling factor is chosen, it applies to all the analog modules within that station. (factory setting 4mA = 10,000 and 20mA = 50,000).

10.3.9 HART Communication

The module 4X05 is suitable for HART signals. You can communicate with suitable field devices via the service bus.

For FDT based systems we offer a device type manager (DTM) for the HART features of the REMOTE I/Os. The manufacturers of the field devices supply the software house with DTMs for their own field devices, so that all the functions of the field devices are accessible with the HART protocol via the service bus.

Note:

It is also possible to set field devices with the HART protocol at the device terminals using Ex-approved handheld devices of the field device manufacturer. LB/FB I/O modules have a built-in 250Ω communication resistor.

In the case of transmitters that do not use a standard HART protocol, this does not affect the module.

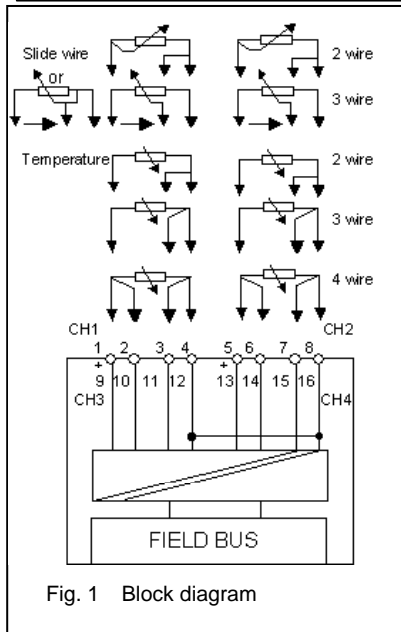
Module Settings of LB/FB-4X04 and LB/FB-4X05:

Data_1,..., Data_4 (channel 1 ~ 4) Definition:

Bit mapping	Parameter	Selection
0	-	-
1	operating mode	0 : 4...20 mA 1 : 0...20 mA
2-3	analog filter	0 : off 1 : 100 % / sec 2 : 10 % / sec 3 : 1 % / sec
4-6	substitute value	0 : 0 mA 1 : 4 mA 2 : 20 mA 3 : 25 mA 4 : last valid data 5 : actual value
7	minimum output value	0 : 0 mA 1 : 4 mA

Scaling Table:

	0% ~ 100%	Operating mode	Mapping range
scaling	10000 – 50000	live zero	10000 – 50000
		dead zero	18000 – 50000
scaling	0 – 60000	live zero	0 – 60000
		dead zero	12000 – 60000
scaling	5000 – 25000	live zero	5000 – 25000
		dead zero	9000 – 25000
scaling	0 – 30000	live zero	0 – 30000
		dead zero	6000 – 30000
Scaling	625 – 3125	live zero	625 – 3125
		dead zero	1125 – 3125
Scaling	0 – 4000	live zero	0 – 4000
		dead zero	800 – 4000



10.4 RTD Temperature / Resistance Converters, 4 channels Types LB5104 and LB5004 and FB5204

The Pt100 (RTD) converter interfaces signals from Pt100/200/500/1000, Ni100/500/1000 sensors in 2-, 3- or 4-wire configuration with the DCS or PLC (Fig.1). The connection of slide wire sensors of up to 10.000 Ω is possible.

For slide wire sensors in 2-wire configuration bridge the corresponding terminals 3-4, 7-8, 11-12, 15-16. Note: the line resistance in 1,5,9,13 will influence the result.

For 3-wire configuration connect as shown.

Pt100 sensors can be connected in 2, 3, 4-wire configuration as shown.

Options

LB5004 LB Remote, NON IS

LB5104 LB Remote, intrinsically safe (IS)

FB5204 FB Remote, intrinsically safe (IS)

Features:

Measuring range Pt100 (-200...+850°C) or 18 - 390 Ohms (500 Ohms incl. line), Pt200 (37-780 Ohms), Pt500 (92-1952 Ohms), Pt1000 (185-3905 Ohms)

Ni100 (50-300 Ohms), Ni500 (345-1350 Ohms), Ni1000 (690-2700 Ohms),

slide wire sensors 0-10.000 Ohms

smallest span for 0,1% is 50 Ohms(or 1/10 of full scale)

Max. compensated line resistance 50 Ω

Non-linearity 0.025% of max span

temp. drift 0.025%/10K of max span

Sensor current 250 μ A

10.4.1 Acquisition Time, Cycle Time

The module-related processing times are dependent upon the selected measuring method typically an A/D conversion will take 500ms including all 4 channels.

Signals are transmitted to the ComUnit in block mode taking just 50ms for all 4 channels. The total data transfer time depends on the host.

10.4.2 Data Exchange

The data exchange follows the FOUNDATION FIELDBUS specification. The valid standards are available from the FF User Organisation.

The standard ensures that devices from various manufacturers work on the same bus.

The user does not have to concern himself with the data structure since this is relayed to the DCS or PLC via the device DD.

10.4.3 Line Monitoring

The module is fitted with a line fault detection (LFD) feature to test for open (e.g. > 1 kOhm, or short circuits < 10 Ohms for Pt100 sensors other trip points apply to other sensors).

With the exception of 2-wire configurations, the line resistance does not have any effect on the acquired values. This monitoring function can be deactivated via the software.

To avoid a constant changeover between the measured value and a fault, e.g. if there is a loose contact, an LFD (burn-out) delay makes it possible to release acquired values only after a given time has elapsed after a line fault has been repaired.

10.4.4 Light Emitting Diodes (LEDs)

Front LEDs indicate the module status.

- A green LED indicates that the module is connected properly to the auxiliary power supply and that the fuse of the module is intact.
- A red LED indicates the state of the field wiring. It lights up in the event of a short or open circuit in any input. It flashes in case the module does not communicate with the ComUnit.

10.4.5 Configure Temperature Inputs

After adding the module to a slot, you will see the module settings, defined according to the configuration table (described completely in the DD file), at the user interface of your DCS or PLC systems. The individual parameters of the module can be easily configured via the corresponding user interface of the host.

It is up to the host to load the device description file (DD file) into its own data base and to provide the corresponding user interface, enabling the correct presentation and setting of the module parameters. Here you can define the module settings.

With "line fault detection" you can enable/disable the line monitoring feature (LFD) of the individual input channels. If this feature is set, the corresponding "channel related error" will be added to the diagnostics by the ComUnit, when a line fault occurs.

In addition, you can add a filter between the analog input and the processed data. It is possible to set the rate of change that will be allowed to pass through the filter. The slowest option will take 90 sec to pass a 90% change of input at 1% per sec.

The "operating mode" allows you to choose whether the sensor is to be connected in 2-, 3- or 4-wire configuration. In the case of 2-wire configurations, the line resistance is set fixed to be $R_l=20\ \Omega$.

With the "Measuring range" you can choose the different ranges for the measurement with the sensors connected to the module. Depending on the used sensor type, it can be either in °C or in Ohms.

10.4.6 Scaling

The module uses 16 bits of which 12bits represent the analog input value. Depending on the chosen scaling factor and the operating mode, as listed in the scaling table, the input value can be mapped into different areas for a full input range of 0% ~ 100%. In the present version, the scaling factor is a global parameter which can be set in the ComUnit. Once the scaling factor is chosen, it applies to all the analog modules within that station. (factory setting 0% = 10,000 and 100% = 50,000).

Module Settings of LB/FB 5X04:

Data_1 Definition:

Bit mapping	Parameter	Selection
0	line fault detection	0 : off 1 : on
1-2	analog filter	0 : off 1 : 100 % / sec 2 : 10 % / sec 3 : 1 % / sec
3-4	operating mode	0 : 4 wire 1 : 3 wire 2 : 2 wire (RI=20 Ω)
5-7	-	-

Data_2 Definition: LB/FB 5X04 used with ComUnit LB/FB 8x10 H* (temperature measured in deg. Celsius)

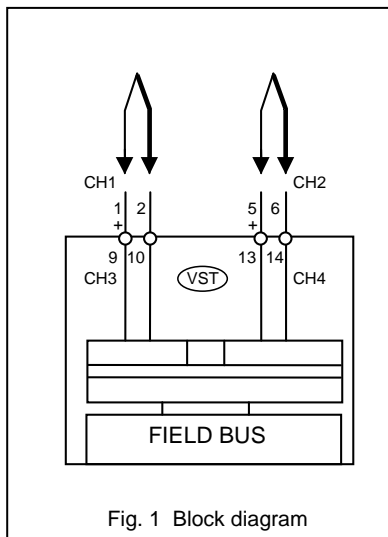
Bit	Parameter	Selection	Selection	Selection	Selection	Selection		
0-4	Measuring range	Pt100 0 : 0 ... 50 °C 1 : 0 ... 100 °C 2 : 0 ... 200 °C 3 : 0 ... 500 °C 4 : -200 ... 850 °C 5 : -200 ... 300 °C 6 : 300 ... 850 °C	Pt500 20 : 0 ... 50 °C 21 : 0 ... 100 °C 22 : 0 ... 200 °C 23 : 0 ... 500 °C 24 : -200 ... 850 °C 25 : -200 ... 300 °C 26 : 300 ... 850 °C	Ni100 40 : 0 ... 50 °C 41 : 0 ... 100 °C 42 : 0 ... 150 °C 43 : 0 ... 200 °C 44 : -50 ... 50 °C 45 : -50 ... 150 °C 46 : -70 ... 230 °C	Ni1000 60 : 0 ... 50 °C 61 : 0 ... 100 °C 62 : 0 ... 150 °C 63 : 0 ... 200 °C 64 : -50 ... 50 °C 65 : -50 ... 150 °C 66 : -70 ... 230 °C	3-wire Slide wire 90 : 0...50 Ohm 91 : 0...100 Ohm 92 : 0...500 Ohm 93 : 0...1000 Ohm 94 : 0...5000 Ohm 95 : 0..10000 Ohm		
		Pt200 10 : 0 ... 50 °C 11 : 0 ... 100 °C 12 : 0 ... 200 °C 13 : 0 ... 500 °C 14 : -200 ... 850 °C 15 : -200 ... 300 °C 16 : 300 ... 850 °C	Pt1000 30 : 0 ... 50 °C 31 : 0 ... 100 °C 32 : 0 ... 200 °C 33 : 0 ... 500 °C 34 : -200 ... 850 °C 35 : -200 ... 300 °C 36 : 300 ... 850 °C	Ni500 50 : 0 ... 50 °C 51 : 0 ... 100 °C 52 : 0 ... 200 °C 53 : 0 ... 500 °C 54 : -50 ... 50 °C 55 : -50 ... 150 °C 56 : -70 ... 230 °C	2-wire Slide wire 80 : 0...50 Ohm 81 : 0...100 Ohm 82 : 0...500 Ohm 83 : 0...1000 Ohm 84 : 0...5000 Ohm 85 : 0..10000 Ohm			
		5-7	-	-	-		-	

Data_2 Definition: LB/FB 5X04 used with ComUnit LB/FB 8x10 C* (temperature measured in deg. Fahrenheit)

Bit	Parameter	Selection	Selection	Selection	Selection	Selection		
0-4	Measuring range	Pt100 0 : 32 ... 122 °F 1 : 32 ... 212 °F 2 : 32 ... 392 °F 3 : 32 ... 932 °F 4 : -328 ... 1562 °F 5 : -328 ... 572 °F 6 : 572 ... 1562 °F	Pt500 20 : 32 ... 122 °F 21 : 32 ... 212 °F 22 : 32 ... 392 °F 23 : 32 ... 932 °F 24 : -328 ... 1562 °F 25 : -328 ... 572 °F 26 : 572 ... 1562 °F	Ni100 40 : 32 ... 122 °F 41 : 32 ... 212 °F 42 : 32 ... 302 °F 43 : 32 ... 392 °F 44 : -58 ... 122 °F 45 : -58 ... 302 °F 46 : -94 ... 446 °F	Ni1000 60 : 32 ... 122 °F 61 : 32 ... 212 °F 62 : 32 ... 302 °F 63 : 32 ... 392 °F 64 : -58 ... 122 °F 65 : -58 ... 302 °F 66 : -94 ... 446 °F	3-wire Slide wire 90 : 0...50 Ohm 91 : 0...100 Ohm 92 : 0...500 Ohm 93 : 0...1000 Ohm 94 : 0...5000 Ohm 95 : 0..10000 Ohm		
		Pt200 10 : 32 ... 122 °F 11 : 32 ... 212 °F 12 : 32 ... 392 °F 13 : 32 ... 932 °F 14 : -328 ... 1562 °F 15 : -328 ... 572 °F 16 : 572 ... 1562 °F	Pt1000 30 : 32 ... 122 °F 31 : 32 ... 212 °F 32 : 32 ... 392 °F 33 : 32 ... 932 °F 34 : -328 ... 1562 °F 35 : -328 ... 572 °F 36 : 572 ... 1562 °F	Ni500 50 : 32 ... 122 °F 51 : 32 ... 212 °F 52 : 32 ... 392 °F 53 : 32 ... 932 °F 54 : -58 ... 122 °F 55 : -58 ... 302 °F 56 : -94 ... 446 °F	2-wire Slide wire 80 : 0...50 Ohm 81 : 0...100 Ohm 82 : 0...500 Ohm 83 : 0...1000 Ohm 84 : 0...5000 Ohm 85 : 0..10000 Ohm			
		5-7	-	-	-		-	

Scaling Table:

	0% ~ 100%	Operating mode	Mapping range
Scaling	10000 – 50000	live zero	10000 – 50000
		dead zero	18000 – 50000
Scaling	0 – 60000	live zero	0 – 60000
		dead zero	12000 – 60000
Scaling	5000 – 25000	live zero	5000 – 25000
		dead zero	9000 – 25000
Scaling	0 – 30000	live zero	0 – 30000
		dead zero	6000 – 30000
Scaling	625 – 3125	live zero	625 – 3125
		dead zero	1125 – 3125
Scaling	0 – 4000	live zero	0 – 4000
		dead zero	800 – 4000



10.5 Thermocouple and Millivolt Converters Types LB5105 and LB5005 and FB5205

The thermocouple converter interfaces signals from temperature sensors with the DCS or PLC (Fig.1). Millivolt signals can also be connected.

Connect temperature sensors or mV sources to terminals 1-2, 5-6, 9-10 and 13-14 respectively for channel 1, 2, 3 and 4.

Internal cold junction compensation is built in and can be activated via the appropriate parameter. External cold junction temperature compensation by way of thermostats is connected in series with the thermocouple forming a 2-wire configuration.

Options

LB5005 LB Remote, non IS

LB5105 LB Remote, intrinsically safe (IS)

FB5205 FB Remote, intrinsically safe (IS)

Features:

Measuring range: -65...+75 mV

Smallest span 5 mV for 0.1% accuracy

Non-linearity 0.1%

10.5.1 Resolution

Temperatures ranging from $-200\text{ }^{\circ}\text{C}$ to $+1850\text{ }^{\circ}\text{C}$ are measured with a 16-bit resolution. The actual measuring range is calculated on this basis. The resolution for the smallest range of 5mV or 0-100% is more than 11 bits (better than 0.1%). The curves of all commercially available thermocouples and PALLAPLAT are linearized.

The 16-bit data word is made up of low and high bytes. Integers with no polarity sign ranging from 0-65535 are transmitted. The lower 4 bits are overlaid by status information, as they are of no significance for the measurement accuracy. The status information is omitted when the measured values are scaled to anything other than 10,000 – 50,000.

10.5.2 Acquisition Time, Cycle Time

The module-related processing times are dependent upon the selected measuring method typically an A/D conversion will take 200ms without line monitoring including all 4 channels and 300ms with line monitoring.

Signals are transmitted to the ComUnit in block mode taking just 50ms for all 4 channels. The total data transfer time depends on the host.

10.5.3 Data Exchange

The data exchange follows the FOUNDATION FIELDBUS specification. The valid standards are available from the FF User Organisation.

The standard ensures that devices from various manufacturers work on the same bus.

The user does not have to concern himself with the data structure since this is relayed to the DCS or PLC via the device DD.

10.5.4 Line Monitoring

The module is fitted with a line fault detection (LFD) feature to test for open circuits.

This monitoring function can be deactivated via the software.

To avoid a constant changeover between the measured value and a fault, e.g. if there is a loose contact, an LFD (burn-out) delay makes it possible to release acquired values only after a given time has elapsed after a line fault has been repaired.

10.5.5 Light Emitting Diodes (LEDs)

Front LEDs indicate the module status.

- A green LED indicates that the module is connected properly to the auxiliary power supply and that the fuse of the module is intact.
- A red LED indicates the state of the field wiring. It lights up in the event of an open circuit in any input. It flashes in case the module does not communicate with the ComUnit.

10.5.6 Configure Temperature Inputs

After adding the module to a slot, you will see the module settings, defined according to the configuration table (described completely in the DD file), at the user interface of your DCS or PLC systems. The individual parameters of the module can be easily configured via the corresponding user interface of the host.

It is up to the host to load the device description file (DD file) into its own data base and to provide the corresponding user interface, enabling the correct presentation and setting of the module parameters. Here you can define the module settings.

With "line fault detection" you can enable/disable the line monitoring feature (LFD) of the individual input channels. If this feature is set, the corresponding "channel related error" will be added to the diagnostics by the ComUnit, when a line fault occurs.

In addition, you can add a filter between the analog input and the processed data. It is possible to set the rate of change that will be allowed to pass through the filter. The slowest option will take 90 sec to pass a 90% change of input at 1% per sec.

The "operating mode" allows you to select the type of sensor configuration. With the "Measuring range" you can choose the different ranges for the measurement with the sensors connected to the module. Depending on the used sensor type, it can be either in °C or in Ohms.

With the "Measuring range" you can choose the different ranges for the measurement with the sensors connected to the module. Depending on the used sensor types, it can be either use a temperature scale or millivolts.

10.5.7 Cold Junction Compensation

For measurements using thermocouples, you have to avoid measurement errors due to ambient temperature variations by using compensation wires to be run from the sensor to the measuring device or to the cold junction. This is because new thermocouples are formed at the junction between the comp. cable and the copper wires. Thus, the thermocouple measurement becomes dependent on the ambient temperature at the junction. This temperature dependence can be compensated in various ways.

Cold Junction Thermostat

A thermostat is usually used for external cold junctions. This ensures the temperature at the transition point of the comp. cable to the copper cable is held at a constant 50°C (or 0°C). In this case the external cold junction must be chosen in the user interface of the 5X05. The cold junction temperature has to be entered as a fixed value. This method provides very accurate results, but it is somewhat complex. Alternatively, it is possible to measure the temperature at the cold junction.

Internal Cold Junction CJC

Cold junction measurement provides a good compromise between the complex method described above and accuracy. The temperature converter type 5X05 is set to "Internal CJC". With I/O modules, a temperature sensor is used for measuring the temperature at the junction between the copper and the compensation wires. The sensor is mounted inside the module close to the terminals. The temperature registered by this sensor at the junction is used by the module to compensate any ambient temperature influences.

10.5.8 Scaling

The module uses 16 bits of which 12bits represent the analog input value. Depending on the chosen scaling factor and the operating mode, as listed in the scaling table, the input value can be mapped into different areas for a full input range of 0% ~ 100%. In the present version, the scaling factor is a global parameter which can be set in the ComUnit. Once the scaling factor is chosen, it applies to all the analog modules within that station. (factory setting 0% = 10,000 and 100% = 50,000).

Module Settings of LB/FB-5X05:

Data_1, 3, 5, 7 (channel 1~4):

Bit mapping	Parameter	Selection
0	line fault detection	0 : off 1 : on
1-2	analog filter	0 : off 1 : 100 % / sec 2 : 10 % / sec 3 : 1 % / sec
3	cold junction compensation	0 : internal 1 : external
4	ext. cold junction temperature	0 : 0°C 1 : 50°C
5-7	-	-

Data_2, 4, 6, 8 (channel 1 ~ 4):

Bit mapping	Parameter	Selection (5X05 with bus coupler LB/FB 8x10 H*, temp. measured in °C)	Selection (5X05 with bus coupler LB/FB 8x10 C*, temp. measured in °F)
0-4	Measuring range	0 : -65 ... 75 mV 1 : 0 ... 75 mV 2 : 0 ... 50 mV 3 : 0 ... 25 mV 4 : Type U -200 ... 600 °C 5 : Type U -200 ... 200 °C 6 : Type U 0 ... 200 °C 7 : Type U 200 ... 600 °C 8 : Type B 0 ... 1800 °C 9 : Type B 0 ... 900 °C 10 : Type B 450 ... 1350 °C 11 : Type B 900 ... 1800 °C 12 : Type E -270 ... 1000 °C 13 : Type E -270 ... 360 °C 14 : Type E 50 ... 680 °C 15 : Type E 360 ... 1000 °C 16 : Type T -270 ... 400 °C 17 : Type T -270 ... 60 °C 18 : Type T -148 ... 230 °C 19 : Type T 60 ... 400 °C 20 : Type K -200 ... 1370 °C 21 : Type K -200 ... 500 °C 22 : Type K 150 ... 850 °C 23 : Type K 500 ... 1370 °C 24 : Type S 0 ... 1760 °C 25 : Type S 0 ... 900 °C 26 : Type S 450 ... 1350 °C 27 : Type S 900 ... 1760 °C	0 : -65 ... 75 mV 1 : 0 ... 75 mV 2 : 0 ... 50 mV 3 : 0 ... 25 mV 4 : Type U -328 ... 1112 °F 5 : Type U -328 ... 392 °F 6 : Type U 32 ... 392 °F 7 : Type U 392 ... 1112 °F 8 : Type B 32 ... 3272 °F 9 : Type B 32 ... 1652 °F 10 : Type B 842 ... 2462 °F 11 : Type B 1652 ... 3272 °F 12 : Type E -454 ... 1832 °F 13 : Type E -454 ... 680 °F 14 : Type E 122 ... 1256 °F 15 : Type E 680 ... 1832 °F 16 : Type T -454 ... 752 °F 17 : Type T -454 ... 140 °F 18 : Type T -100 ... 446 °F 19 : Type T 140 ... 752 °F 20 : Type K -328 ... 2498 °F 21 : Type K -328 ... 932 °F 22 : Type K 302 ... 1562 °F 23 : Type K 932 ... 2498 °F 24 : Type S 32 ... 3200 °F 25 : Type S 32 ... 1652 °F 26 : Type S 842 ... 2462 °F 27 : Type S 1652 ... 3200 °F
5-7	-	-	-

Scaling Table:

	0% ~ 100%	Operating mode	Mapping range
scaling	10000 – 50000	live zero	10000 – 50000
		dead zero	18000 – 50000
scaling	0 – 60000	live zero	0 – 60000
		dead zero	12000 – 60000
scaling	5000 – 25000	live zero	5000 – 25000
		dead zero	9000 – 25000
scaling	0 – 30000	live zero	0 – 30000
		dead zero	6000 – 30000
scaling	625 – 3125	live zero	625 – 3125
		dead zero	1125 – 3125
scaling	0 – 4000	live zero	0 – 4000
		dead zero	800 – 4000

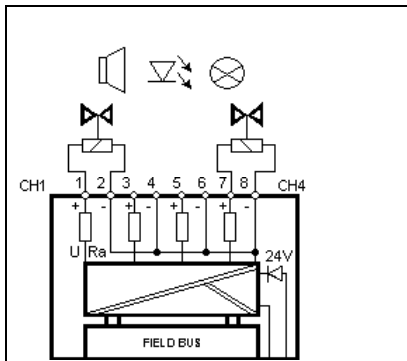


fig. 1.1 LB regular device

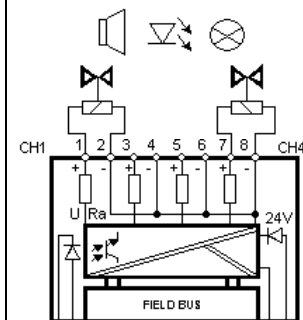


fig. 1.2 LB shut down option

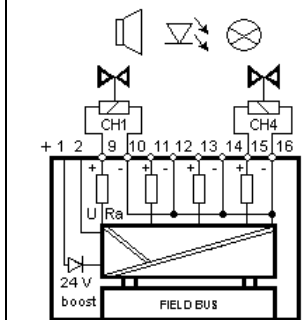
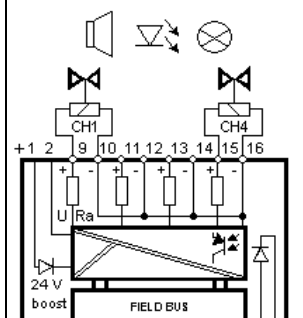


fig. 1.3 FB Zone 1 regular device

fig. 1.4
FB Zone 1 shut down option

10.6 Digital Output, 4 channels Type LB6X10-15 and FB6X10-15

The digital output module 6x10-15 interfaces the DCS and PLC systems with solenoid valves, acoustic sounders (signal devices) or lamps (LEDs) see Fig.1. It can also drive the control circuits of contactors. The device features 4 intrinsically safe or safe power channels.

Options

LB6010 LB Remote, non IS

LB6110-15 LB Remote, IS

FB6210-15 FB Remote, IS

IS = intrinsically safe

Features:

rating see data sheet

LFD monitoring current 0.3mA when activated

10.6.1 Acquisition Time, Cycle Time

The output response time is 10 ms. Signals are transmitted from the ComUnit in block mode taking just 50ms for all 8 channels. The total data transfer time depends on the host.

10.6.2 Data Exchange

The data exchange follows the FOUNDATION FIELDBUS specification. The valid standards are available from the FF User Organisation. The standard ensures that devices from various manufacturers work on the same bus.

The user does not have to concern himself with the data structure since this is relayed to the DCS or PLC via the device DD.

10.6.3 Input / Output Data

The module offers 2 Bytes of output data. The output data will set the channels or declare the settings valid.

10.6.4 Diagnostics

The FOUNDATION FIELDBUS offers the standard diagnostic functions. A device related error gives information in cases of a missing module or a wrong module in the slot. It is up to the DCS or PLC to make use of the diagnostic information.

10.6.5 Fault Response

In the event of a fault in the communication between the module and the ComUnit a watchdog circuit will drive the output to zero after about 2 sec.

10.6.6 Line Monitoring

The digital outputs are fitted with a line fault detection (LFD) feature to test for open or short circuits. This monitoring function can be deactivated via the software.

The circuit is monitored by means of a current small enough so that a connected valve does not respond.

10.6.7 Light Emitting Diodes (LEDs)

Front LEDs indicate the module status:

- A green LED indicates that the module is connected properly to auxiliary power supply and that the fuse of the module is intact.
- A red LED indicates the state of the communication with the ComUnit. It flashes in case the module does not communicate with the ComUnit.

10.6.8 How to configure digital outputs

The table shown at the bottom of the page presents all parameters of the module which can be configured via the DCS or PLC.

After adding the module 6xxx to a slot, you will see the module settings defined according to the configuration table described completely in the DD file. The individual parameters of the module can be easily configured via the corresponding user interface of the host.

It is up to the host to load the device description file into its own data base and to provide the corresponding user interface, enabling the correct presentation and setting of the module parameters.

- With "line fault detection" you can enable/disable the line monitoring feature (LFD) of the individual output channels. If this feature is set, the corresponding "channel related error" will be added to the diagnostics by the ComUnit, when a line fault occurs.
- You can also choose between positive or negative logic to determine the switch position of the digital output using the "inverter" parameter.

10.6.9 HCIR and Digital Outputs

Hot configuration in run is possible with outputs frozen during short transition periods.

Note:

All the parameters can be set individually per channel.

Module Settings of LB/FB 6X10 - 6x15:

Data_1 ... Data_4 (channel 1 ~ 4) Definition:

Bit mapping	Parameter	Selection
0	Line fault detection	0 : off 1 : on
1	Inverter	0 : off 1 : on
2-3	Substitute value	Not used
4-7	-	-

10.6.10 Shut down of digital outputs

Provided that an authorized safety expert agrees to it, it is possible to use digital output modules with a bus independent shut down input for a "plant shut down" function (Fig. 2). This may be a useful feature in certain applications. In all other cases the module is used as a standard output driver. The modules are fitted with a separate shut down input.

The block diagram shows how the control circuit to the output can be interrupted via a bus independent optocoupler input.

The control input for the shut down of the output is switched via an external, volt-free contact with the aid of the internal 12V supply. When the contact is closed, the outputs are controlled via the BUS. When the contact is open, there is no current to the outputs.

The volt free control contact avoids stray potentials. When used in Zone 1, a special Exe contact is employed.

Alternatively to control through a volt free contact, an external DC voltage between 12 and 24V DC can be used as well. Here it has to be taken into account that the ground of the 24V control line is connected with the internal ground of the bus station. If there are bus stations operated in distributed systems from the same 24V control for the output shutdown, equipotential earth is necessary in order to avoid differences of potential between the bus stations. Control through galvanically separated 24V DC would be a preferred option.

10.6.11 Combination of modules with and without output shutdown

Modules with output shutdown inputs can be combined with modules without shutdown inputs in the same field bus station, if they are equipped with the shutdown contact.

Modules without shutdown input are consistently controlled by the bus, independent of the setting of the external shutdown contact.

Modules with shutdown inputs are only controlled by the bus when the shutdown contact is closed.

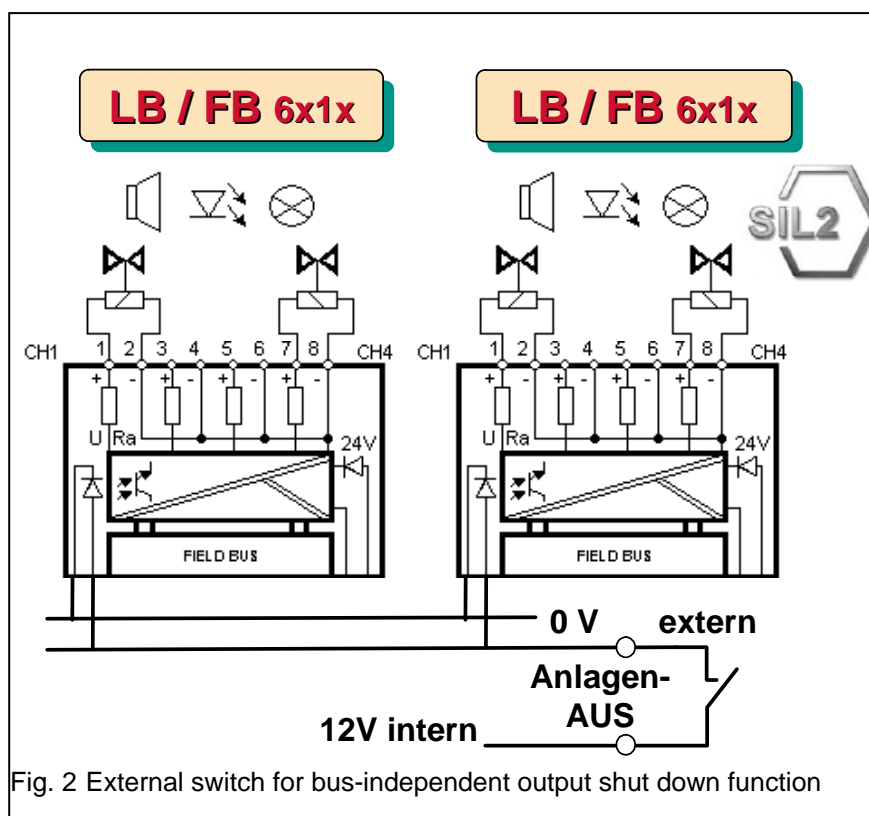


Fig. 2 External switch for bus-independent output shut down function

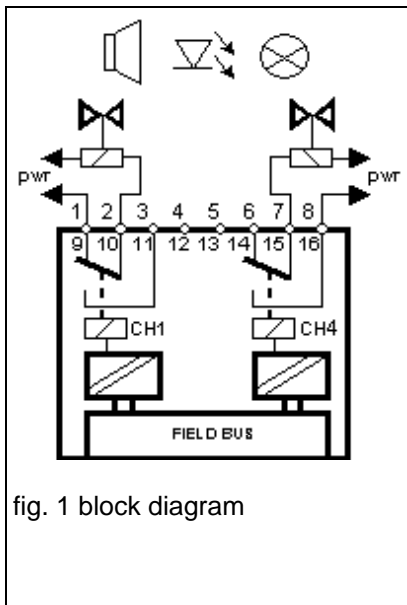


fig. 1 block diagram

10.7 Relay Output, 4-channels, Type LB6005 and FB6305

The relay output 6x05 is used for activating volt-free contacts from the DCS or PLC (Fig.1). The device features 4 non intrinsically safe channels and each channel features a normally open contact. The relay module is suited, for example, for the following applications:

- Activation of lamps or acoustic signal devices from the DCS or PLC.
- Switching of Ex-d valves or contactors.

Options

LB6005 LB REMOTE, non IS

FB6305 FB REMOTE, Exe

Features:

- rating 24V AC/DC, 230VAC / 1A
- 30 W, 230 VA ohmic load
- max voltage 30V DC / 253VAC

10.7.1 Acquisition Time, Cycle Time

The response time of the relay is 20 ms. Signals are transmitted from the ComUnit in block mode taking just 50ms for all 8 channels. The total data transfer time depends on the host.

10.7.2 Data Exchange

The data exchange follows the FOUNDATION FIELDBUS specification. The valid standards are available from the FF User Organisation. The standard ensures that devices from various manufacturers work on the same bus.

The user does not have to concern himself with the data structure since this is relayed to the DCS or PLC via the device DD.

10.7.3 Input / Output Data

The module offers 1 Byte of output data. The output data will set the relays or declare the settings valid.

10.7.4 Diagnostics

The FOUNDATION FIELDBUS offers the standard diagnostic functions.

A device related error gives information in cases of a missing module or a wrong module in the slot. It is up to the DCS or PLC to make use of the diagnostic information.

10.7.5 Fault Response

In the event of a fault in the communication between the module and the ComUnit a watchdog circuit will drive the output to zero after about 2 sec.

10.7.6 Light Emitting Diodes (LEDs)

Front LEDs indicate the module status:

- A green LED indicates that the module is connected properly to auxiliary power supply and that the fuse of the module is intact.
- A red LED indicates the state of the communication with the ComUnit. It flashes in case the module does not communicate with the ComUnit.

10.7.7 How to Configure Relay Outputs

The table shown at the bottom of the page presents all the parameters of the module which can be configured via the DCS or PLC .

After adding the module 6x05 to a slot, you will see the module settings defined according to the configuration table described completely in the DD file. The individual parameters of the module can easily be configured via the corresponding user interface of the host.

- It is up to the host to load the device description file into it's own data base and to provide the corresponding user interface, enabling the correct presentation and setting of the module parameters.

10.7.8 HCIR and Relay Outputs

Hot configuration in run is possible with outputs frozen during short transition periods.

Note:

All the parameters can be set individually per channel

Module Settings of LB/FB-6X05:

Data_1 ... Data_4 (channel 1 ~ 4) Definition:

Bit mapping	Parameter	Selection
0	-	-
1	Inverter	0 : off 1 : on
2-3	Substitute value	not used
4-7	-	-

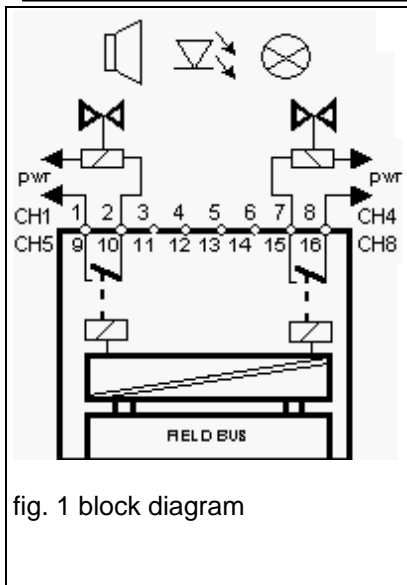


fig. 1 block diagram

10.8 Relay Output, 8-channels, Type LB6006 and FB6306

The relay output 6x06 is used for activating volt-free contacts from the DCS or PLC (Fig.1). The device features 8 non intrinsically safe channels and each channel features a normally open contact. The relay module is suited, for example, for the following applications:

- Activation of lamps or acoustic signal devices from the DCS or PLC.
- Switching of Ex-d valves or contactors.

Options

LB6006 LB Remote, non IS

FB6306 FB Remote, Exe

Features:

rating 24V AC/DC / 1A
30 W, 30 VA ohmic load
max voltage 30V DC

10.8.1 Acquisition Time, Cycle Time

The response time of the relay is 20 ms. Signals are transmitted from the ComUnit in block mode taking just 50ms for all 8 channels. The total data transfer time depends on the host.

10.8.2 Data Exchange

The data exchange follows the FOUNDATION FIELDBUS specification. The valid standards are available from the FF User Organisation. The standard ensures that devices from various manufacturers work on the same bus.

The user does not have to concern himself with the data structure since this is relayed to the DCS or PLC via the device DD.

10.8.3 Input / Output Data

The module offers 2 Bytes of output data. The output data will set the relays or declare the settings valid.

10.8.4 Diagnostics

The FOUNDATION FIELDBUS offers the standard diagnostic functions.

A device related error gives information in cases of a missing module or a wrong module in the slot. It is up to the DCS or PLC to make use of the diagnostic information.

10.8.5 Light Emitting Diodes (LEDs)

Front LEDs indicate the module status:

- A green LED indicates that the module is connected properly to auxiliary power supply and that the fuse of the module is intact.
- A red LED indicates the state of the communication with the ComUnit. It flashes in case the module does not communicate with the ComUnit.

10.8.6 How to Configure Relay Outputs

The table shown at the bottom of the page presents all the parameters of the module which can be configured via the DCS or PLC .

After adding the module 6x06 to a slot, you will see the module settings defined according to the configuration table described completely in the DD file. The individual parameters of the module can easily be configured via the corresponding user interface of the host.

- It is up to the host to load the device description file into it's own data base and to provide the corresponding user interface, enabling the correct presentation and setting of the module parameters.

10.8.7 HCIR and Relay Outputs

Hot configuration in run is possible with outputs frozen during short transition periods.

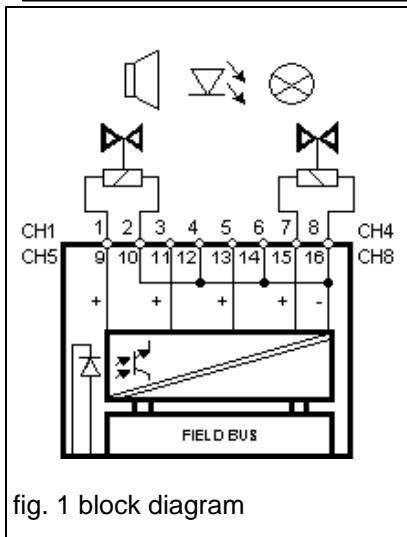
Note:

All the parameters can be set individually per channel

Module Settings of LB/FB-6X06:

Data_1 ... Data_8 (channel 1 ~ 8) Definition:

Bit mapping	Parameter	Selection
0	-	-
1	Inverter	0 : off 1 : on
2-3	Substitute value	not used
4-7	-	-



10.9 Digital Output, 8 channels, Type LB6X08 and FB6X08

The digital output module 6x08 interfaces the DCS and PLC systems with solenoid valves, acoustic sounders (signal devices) or lamps (LEDs) (Fig.1). It can also drive the control circuits of contactors. The device features 8 intrinsically safe or safe low power channels.

Options

- LB6008 LB Remote, non IS
- LB6108 LB Remote, IS
- FB6208 FB Remote, IS
- FB6308 FB Remote, Exe
- IS = intrinsically safe

Features:

- rating 20V DC / 8mA
- LFD monitoring current 0.3mA when activated

10.9.1 Acquisition Time, Cycle Time

The response time of the relay is 20 ms. Signals are transmitted from the ComUnit in block mode taking just 50ms for all 8 channels. The total data transfer time depends on the host.

10.9.2 Data Exchange

The data exchange follows the FOUNDATION FIELDBUS specification. The valid standards are available from the FF User Organisation.

The standard ensures that devices from various manufacturers work on the same bus.

The user does not have to concern himself with the data structure since this is relayed to the DCS or PLC via the device DD.

10.9.3 Input / Output Data

The module offers 2 Bytes of output data. The output data will set the output or declare the settings valid.

10.9.4 Diagnostics

The FOUNDATION FIELDBUS offers the standard diagnostic functions.

A device related error gives information in cases of a missing module or a wrong module in the slot. It is up to the DCS or PLC to make use of the diagnostic information.

10.9.5 Line Monitoring

The digital outputs are fitted with a line fault detection (LFD) feature to test for open or short circuits.

This monitoring function can be deactivated via the software.

The circuit is monitored by means of a current small enough so that a connected valve does not respond.

10.9.6 Light Emitting Diodes (LEDs)

Front LEDs indicate the module status.

- A green LED indicates that the module is connected properly to the auxiliary power supply and that the fuse of the module is intact.
- A red LED indicates the state of the field wiring. It lights up in the event of a short or open circuit in any output. It flashes in case the module does not communicate with the ComUnit.

10.9.7 How to configure digital outputs

The table shown at the bottom of the page presents all parameters of the module which can be configured via the DCS or PLC.

After adding the module 6x08 to a slot, you will see the module settings defined according to the configuration table described completely in the DD file. The individual parameters of the module can be easily configured via the corresponding user interface of the host.

It is up to the host to load the device description file into its own data base and to provide the corresponding user interface, enabling the correct presentation and setting of the module parameters.

- With "line fault detection" you can enable/disable the line monitoring feature (LFD) of the individual output channels. If this feature is set, the corresponding "channel related error" will be added to the diagnostics by the ComUnit, when a line fault occurs.
- You can also choose between positive or negative logic to determine the switch position of the digital output using the "inverter" parameter.

10.9.8 HCIR and Digital Outputs

Hot configuration in run is possible with outputs frozen during short transition periods.

Note:

All the parameters can be set individually per channel.

Module Settings of LB/FB-6X08:

Data_1 ... Data_8 (channel 1 ~ 8) Definition:

Bit mapping	Parameter	Selection
0	Line fault detection	0 : off 1 : on
1	Inverter	0 : off 1 : on
2-3	Substitute value	not used
4-7	-	-

10.9.9 Shut down of digital outputs

Provided that an authorized safety expert agrees to it, it is possible to use digital output modules with a bus independent shut down input for a "plant shut down" function (Fig. 2). This may be a useful feature in certain applications. In all other cases the module is used as a standard output driver.

The modules are fitted with a separate shut down input.

The block diagram shows how the control circuit to the output can be interrupted via a bus independent optocoupler input.

The control input for the shut down of the output is switched via an external, volt-free contact with the aid of the internal 12V supply. When the contact is closed, the outputs are controlled via the BUS. When the contact is open, there is no current to the outputs.

The volt free control contact avoids stray potentials. When used in Zone 1, a special Exe contact is employed.

Alternatively to control through a volt free contact, an external DC voltage between 12 and 24V DC can be used as well. Here it has to be taken into account that the ground of the 24V control line is connected with the internal ground of the bus station. If there are bus stations operated in distributed systems from the same 24V control for the output shutdown, equipotential earth is necessary in order to avoid differences of potential between the bus stations. Control through galvanically separated 24V DC would be a preferred option.

10.9.10 Combination of modules with and without output shutdown

Modules with output shutdown inputs can be combined with modules without shutdown inputs in the same field bus station, if they are equipped with the shutdown contact.

Modules without shutdown input are consistently controlled by the bus, independent of the setting of the external shutdown contact.

Modules with shutdown inputs are only controlled by the bus when the shutdown contact is closed.

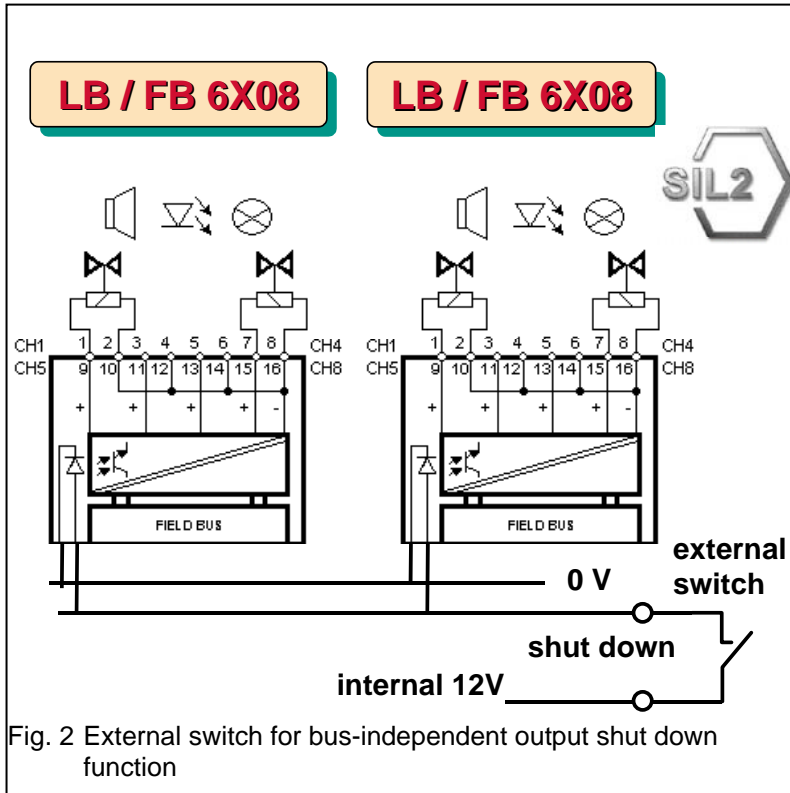


Fig. 2 External switch for bus-independent output shut down function

11 Equipotential earth and screening

11.1 Introduction

In technical installations you have to expect electro magnetic noise. NAMUR recommendations NE21 in combination with the law on EMC endeavour to set up test criteria for equipment used in these areas.

The user will himself strive to keep noise levels down. The following chapters try to give some guidance on these matters.

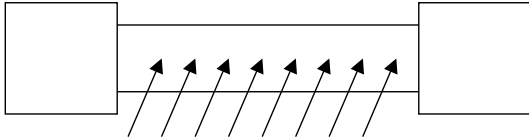


fig 1 induced noise in parallel conductors

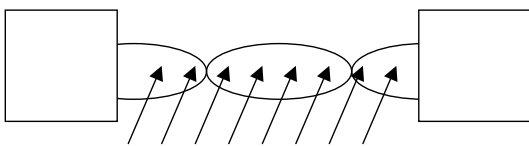


fig 2 largely compensated induced noise in twisted pairs

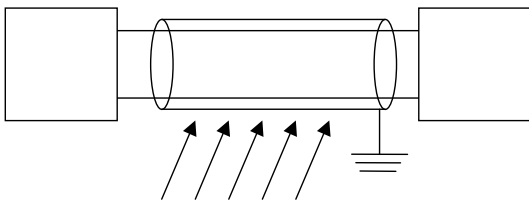


fig 3 screen to avoid entry of noise fields

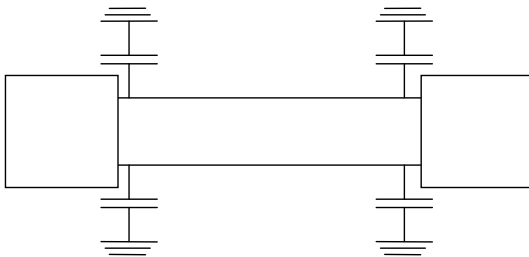


fig 4 EMC Filter in signal paths

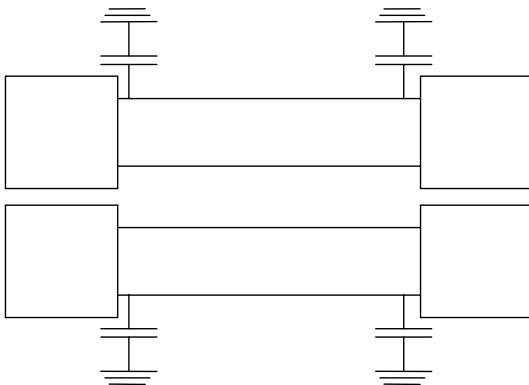


Fig. 5 EMC Filter in a network (simplified representation)

11.2 Noise Influences

Signal paths can be disturbed electro-magnetic fields (fig 1). The use of a twisted pair greatly reduces the influence of induced noise as compared with parallel wiring. Fig 2 shows that the direction of the noise field in a twisted pair is reversed again and again. Thus the field soaked areas cancel each other out, while the field will be active over the whole area in parallel wires.

Fig 3 shows how a screen will keep the noise away from the signal path.

Fig 4 point to EMC filters which are present in many devices to divert the noise to earth. Naturally the capacitors are present in all the wires to achieve symmetry. You will notice that high frequency interference will find a capacitive path which is largely cancel out due to the symmetry.

Fig 5 shows that this also holds true for galvanically isolated signals. However, networks created by multi channel I/O devices without isolators may lead to unexpected results as the filter capacitors may even run in parallel depending on the constellation. In case of interference this can often be eliminated by introducing isolated channels.

11.3 Wiring

It is common practice to segregate signal wiring and energy cables. It also has to be noted that alternating currents and surge currents can induce stray voltages in neighbouring cables. Therefore you normally use screened cables even for EMC tested devices.



In hazardous areas you must always observe the rules and regulations laid down EN 60079-14 (VDE 0165).

Furthermore you have to take note of the operating instructions (see FB92XX or LB9051). As an example equipotential earth is used to ensure that the maximum resistance between plant section is less than 1 Ohm. This helps you to calculate the required cable diameter depending on the distance between these areas.

The earth rail can be laid separate from the screen (see figure in EN60079). The screen will then be earthed at one point.

11.4 Signal Paths

Digital inputs are normally connected to NAMUR-Initiators which offer a low impedance termination. In this case stray signals will not have as much of an effect as with open loops seen in switch applications not featuring NAMUR replacement resistors. Unused inputs should therefore not be connected to loop wiring with open ends.

Analogue signals are particularly prone to noise when we are dealing with small signals as in RTDs or thermocouples. LB and FB REMOTE modules feature converters with built-in filters. These can be activated when fluctuations in the measured signal cannot be reduced by any other means.

Depending on the application screens for cables and wiring must be earthed at one end or both ends. Dual earthing must be avoided if this were to result in ground loops or when the screen is also used as the return path.

Good results can be achieved for single ended earthing if the cable is mounted on an earthed metal cable tray. The metal frame in the immediate vicinity of the conductor will ensure that the area subjected to the field remains small thus widely reducing any possible interference.

11.5 Metallised Housings in Zone 1

Large surface area earthing of the screen is possible for P+F's field enclosures with metal cable glands. The input / output loop screens will thus be connected to the earthing terminal X1.3 via the metal enclosure or the metallised GRP enclosure (see operating instructions FB92XX). This earth must be connected to equipotential earth for ZONE 1 applications. Metallised housings are no longer used as a standard option. They can be produced by special request. Normal industry standard RFI suppression can also be achieved with standard GRP enclosures.

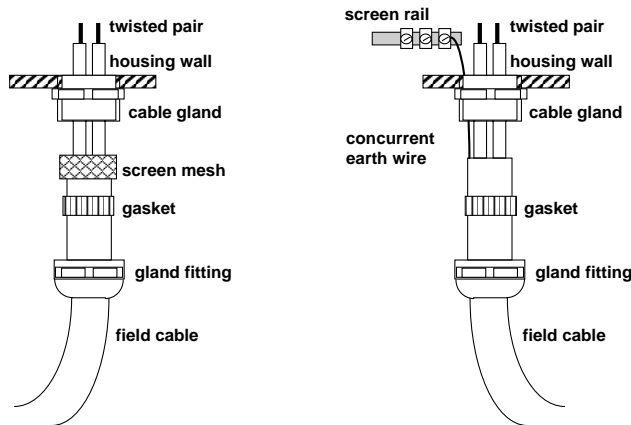
It is possible to connect the cable screen to separate earth rails inside the enclosures.

Should you want to mount screen rails inside the enclosure you will find the order numbers under accessories in our catalogue (other mounting arrangements on enquiry).

In this case screen rails may be isolated from the earth of the housing as long as the rules for hazardous areas are observed. Earthing and screening may be segregated. (observe EN60079-14 chapter 12.2.2.3 a or VDE0165).

11.6 Non Metallised Housings

Apart from metallised or stainless enclosures for Zone 1 there are glass reinforced plastic enclosures with plastic cable glands available. These are fitted with backplane circuit boards featuring a screen layer. A large metal underplate serves as an earth plate for the backplane. The cable screens have to be connected to separate screen rails (fig 7). Similar conditions apply to Zone 2.



good screen effect

medium screen effect

fig 6 comparison of screening via mesh and inlaid screen wire using metal cable glands

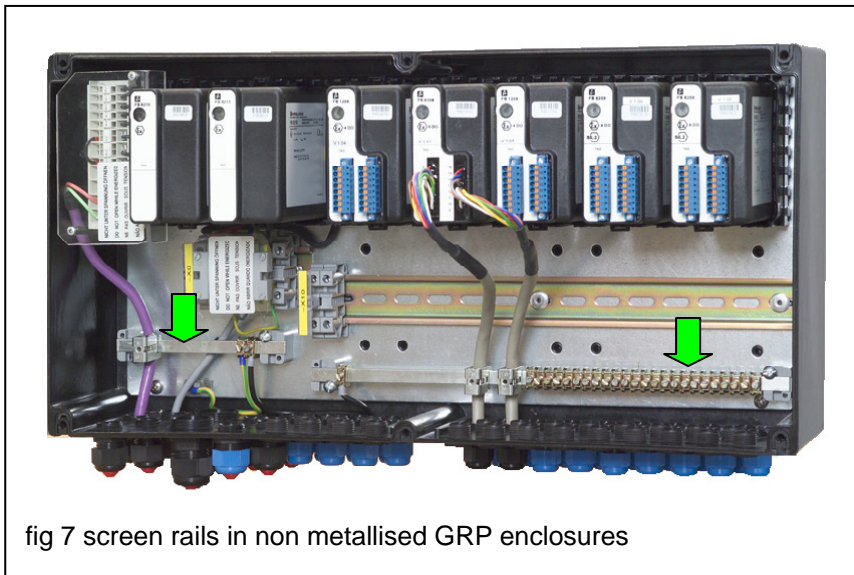


fig 7 screen rails in non metallised GRP enclosures

11.7 Bus Connections

In the LB/FB REMOTE I/O manual we refer to accepted recommendations about the necessity to screen the bus cable.

They recommend earthing at both ends. (observe EN60079-14 chapter 12.2.2.3 b or VDE0165). A single ended earth is sufficient if the bus is run close to earth (e.g. on metal cable trays).

11.8 Earthing Practice

In recent years practical experience has shown that installations with unscreened cables can also work satisfactorily. However, certain minimum requirements should be fulfilled. It is therefore recommended that the standard practice for conventional equipment is observed, where small signals should not be placed in close proximity of high energy sources of interference (e.g. frequency converters etc).

The individual P+F REMOTE I/O modules carry the CE mark based on type tests to satisfy the demands of the law on EMC.

Furthermore we have also subjected complete REMOTE I/O cabinets to EMC tests exceeding the standard practice for conventional installations. The test results have been certified by way of a manufacturer's declaration.

Should it become necessary to apply the CE mark to cabinets and housings for unscreened cables, individual tests can be carried out. The results would show what kind of restrictions if any would apply. P+F cabinets and housings carry the CE mark.

As it is impossible to foresee and test every feasible constellation the recorded results although offering a high degree of security only refer to the actual test arrangement under standard test conditions. In order to achieve exact results it would be necessary to perform the measurements on site under operating conditions.

In practice these complex measurements are not normally undertaken as P+F's components and various combinations of devices have passed the tests.

P+F expect that the signal quality for unscreened cables will yield comparable results to similar measurements with conventional equipment using Eurocards or DIN RAIL mounted devices. We want to point out that screened cables will lead to a considerable reduction in interference which could be caused by external noise sources. This is particularly important in the vicinity of strong sources of interference.

11.9 Typical Industrial Installations

In a „typical environment“ you would normally not require any additional EMC protection to achieve a reliable operation of Remote IO devices. This particularly concerns uncreened field wiring to sensors and actuators.

A “ typical environment“ is considered to be a chemical plant in which all the electrical systems are in accordance with NE 21 recommendations (especially with reference to their noise emittance) or NE 21-conforming apparatus works satisfactorily.

Should it however be prudent to expect burst or surge signals on the signal and power supply lines even to the NE21 levels it has to be assumed that signals will show some level of interference while the noise is present. This is because the noise cannot be diverted to earth in an unscreened system which subsequently will find different routes through the devices.

These noise sources can be expected when signal cables are laid in trays together with power cables or near frequency commutators without sinus filters or similar noise sources (devices which do not satisfy NE21).

In these cases the use of screened cables is strongly recommended.

Should it not be possible to establish a noise free system during the modernisation of a plant the following corrective action may lead to an improved performance:

- 1) Introduction of power line filters
- 2) Introduction of lightning or surge protectors in the noise signal lines
- 3) Using galvanically isolated circuits

11.10 Conclusion

The given advice cannot claim to give a comprehensive picture of all the demands on earthing, screening, and lightning protection. Detailed information can be found in the literature and in the relevant standards.

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