8000-2/x Series Modular I/O

8000
- 2/2 components

Use this option for general purpose or non-hazardous applications, or where the equipment and/or field wiring has to be mounted in Zone 2 or Division 2 hazardous areas. Select I/O modules and their field terminals followed by module carriers, Bus interface modules and power supply options.

8000
- 2/1 components

Use this option for Zone 2 or Division 2 hazardous area mounting where the field wiring must connect into Zone 1, Zone 0 or Division 1 hazardous areas. The modules have intrinsic safety (IS) interfaces built in. Select I/O modules and their appropriate IS field terminals followed by module carriers, Bus interface modules and power supply options.

Overview

I/O Modules

I/O Modules - Overview

2/2 Modules
Analog Input
Analog Output
Discrete Input
Discrete Output
Pulse Input

2/1 Modules
Analog Input
Analog Output
Discrete Input
Discrete Output
Pulse Input

Field Terminals

2/2 and 2/1 Terminals

Carriers, Extenders, Cables

2/2 Carriers
2/2 Extenders
2/2 Cables

2/1 Carriers
2/1 Extenders
2/1 Cables

Power Supplies

DC/DC Power supplies - 2/2 and 2/1
AC/DC Power supplies - 2/2

Railbus Isolator

Bus Interface Modules

Modbus BIM
Profibus-DP BIM
Configurator Software
Node Services Module
Hart Interface Module

System Specification

System specification
Cable parameters and approvals
Thermocouple characterisation

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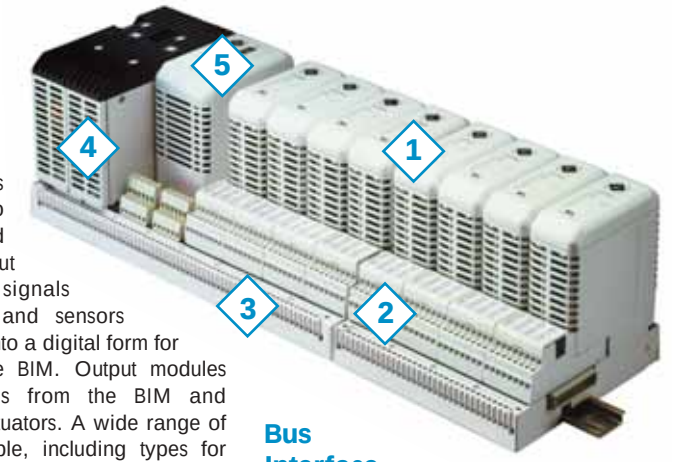
8000-2/x Series - Overview

General

8000 I/O is a completely modular I/O solution for both general purpose and hazardous area applications. Based upon a carrier system that supports a range of modules, it offers a wide variety of I/O functions, including AC mains and intrinsic safety signals - even within the same node. It has an "open" architecture that allows communication with a variety of different field-buses by selecting the appropriate type of Bus Interface Module (BIM).



I/O Modules 1

I/O modules transfer signals to and from field instruments. Input modules receive signals from transmitters and sensors and convert them into a digital form for presentation to the BIM. Output modules receive commands from the BIM and transfer them to actuators. A wide range of modules is available, including types for low-level instrumentation, AC mains and intrinsically safe signals. I/O modules typically have 4, 8 or 16 field channels.

Field terminals 2

Field terminals provide the interface between the I/O modules and the field wiring. They include fusing and loop-disconnect as options. A mechanical keying system prevents an I/O module from being connected to the wrong type of field terminal.

Field terminals mount onto the module carrier, one to each I/O module. They are clamped firmly by the I/O module to form an electrical and mechanical assembly of high integrity. They may be replaced in service without removing carriers or disturbing the operation of other modules.

Carriers 3

Carriers form 8000's physical and electrical backbone by providing a mounting onto a flat panel or T- or G-section DIN rail. They support and interconnect the BIM, power supplies, I/O modules and field terminals, and carry the address, data and power lines of the internal Railbus. They provide a termination points for the LAN and field wiring cable screens and can also distribute bussed field power to the I/O modules.

I/O module carriers are available to support four or eight I/O modules.

Power supplies 4

Good power management lies at the heart of a true distributed I/O system. 8000 power supplies accept locally available unregulated power and provide a regulated supply for the BIM and I/O modules. Supply redundancy is supported.

Bus Interface Module (BIM) 5

The BIM provides a serial data connection to a host controller, which could be a distributed control system (DCS), a programmable logic controller (PLC), or a PC running a soft control package. A choice of BIMs allows you to accommodate the most popular fieldbus protocols. The BIM also uses a fast internal bus to pass data to, and obtain data from, the I/O modules. Only one BIM is required at each node to control up to 32 I/O modules.

"HART-ability"

The use of 'smart' instruments on process plants is growing but this investment is not always fully exploited. Whether it is for a new installation, or the upgrade of an existing one, we have solutions that provide the connections between the HART field instruments, the control systems and the process automation maintenance software.

Specifically, the 8000 Process I/O system has been designed to be transparent to HART signals, thus allowing the host control software and any HART field instruments to communicate directly with each other.

In addition, 8000's HART connection system provides on-line access from a PC to the HART field devices for monitoring device performance. HART devices may be selected for regular status monitoring and alerts can be issued if the status changes. The benefits from this approach are:

- Reduced commissioning time and cost
- Reduced process downtime through status monitoring
- Lower loop maintenance costs by using field device diagnostics

Consult a GE representative for fur ther details.

System specification

See end of section.

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8000-2/x Series - Overview

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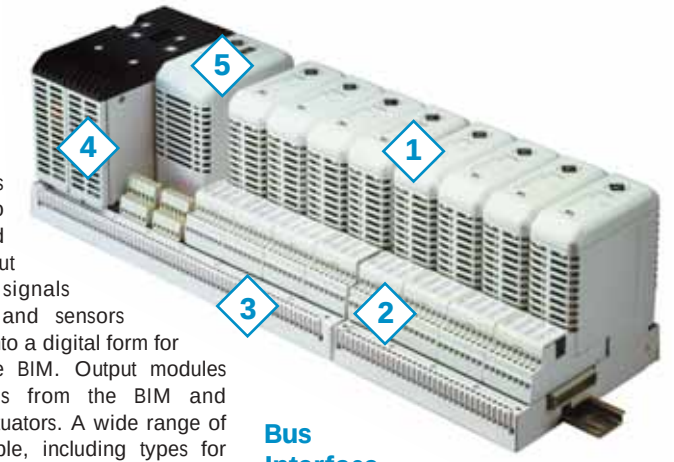

I/O Modules 1

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Field terminals 2

Field terminals provide the interface between the I/O modules and the field wiring. They include fusing and loop-disconnect as options. A mechanical keying system prevents an I/O module from being connected to the wrong type of field terminal.

Field terminals mount onto the module carrier, one to each I/O module. They are clamped firmly by the I/O module to form an electrical and mechanical assembly of high integrity. They may be replaced in service without removing carriers or disturbing the operation of other modules.

Carriers 3

Carriers form 8000's physical and electrical backbone by providing a mounting onto a flat panel or T- or G-section DIN rail. They support and interconnect the BIM, power supplies, I/O modules and field terminals, and carry the address, data and power lines of the internal Railbus. They provide a termination points for the LAN and field wiring cable screens and can also distribute bussed field power to the I/O modules.

I/O module carriers are available to support four or eight I/O modules.

Power supplies 4

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Bus Interface Module (BIM) 5

The BIM provides a serial data connection to a host controller, which could be a distributed control system (DCS), a programmable logic controller (PLC), or a PC running a soft control package. A choice of BIMs allows you to accommodate the most popular fieldbus protocols. The BIM also uses a fast internal bus to pass data to, and obtain data from, the I/O modules. Only one BIM is required at each node to control up to 32 I/O modules.

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- Reduced commissioning time and cost
- Reduced process downtime through status monitoring
- Lower loop maintenance costs by using field device diagnostics

Consult a GE representative for fur ther details.

System specification

See end of section.

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8000-2/x Series - Overview

8000 in your system

Figure 1 shows two possible methods for linking the 8000 into a system. On the left is a host controller system that uses fieldbus as the main distribution medium. On the right is a section of a typical DCS/PLC information network, with an operator station that uses a separate interface to the process fieldbus.

The number of 8000 nodes that can be accommodated depends upon the addressing capability of the fieldbus in use. Each 8000 node can address 32 I/O modules which, depending upon the number of channels per module, can provide up to 512 I/O points at a single node! A node can consist of a mixture of analog and discrete modules and this gives maximum flexibility to the system designer. Where supported by the fieldbus, full HART pass-through is provided—the 8000 appears "transparent", allowing the host controller to access the HART capabilities of field instruments.

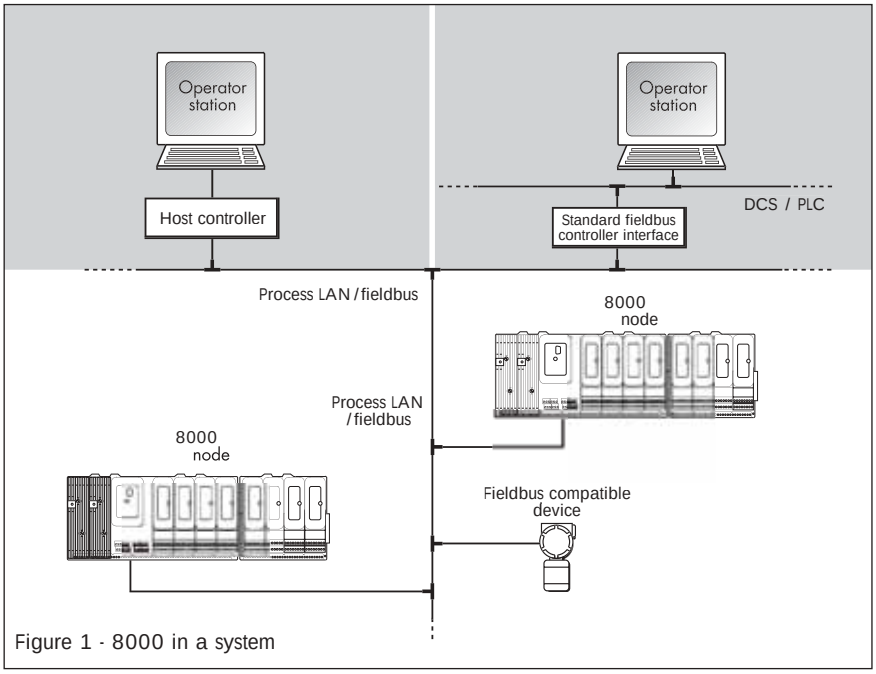

Figure 1 - 8000 in a system

Wide choice of fieldbus options

8000 supports a number of popular fieldbus protocols: Modbus® (RTU mode), Profibus–DP, etc., and the range is growing. If your protocol is not mentioned then consult us. We are also interested in talking to OEM partners who want to develop their own fieldbus variations. A software core has been developed that simplifies the design of alternative control interfaces for the system.

Redundancy options

8000 has been designed to increase availability and minimise downtime. Redundant LAN channels and power supplies can be specified as options to increase system availability. Possible downtime is further reduced by ensuring that the system components using active circuitry can be removed and replaced quickly and easily. Even the field terminals can be replaced without interrupting the operation of adjacent I/O modules. Carriers have no active circuitry and are unlikely to need replacement.

System power supplies

The system power supply at an 8000 node converts the local DC supply to power the node and can also provide field power for I/O modules with low-level field circuits. Where heavy-current or AC mains circuits are handled by the I/O modules, 8000's innovative Bussed Field Power scheme for distributing field power avoids complex wiring at the field terminal and minimises the backplane/carrier wiring.

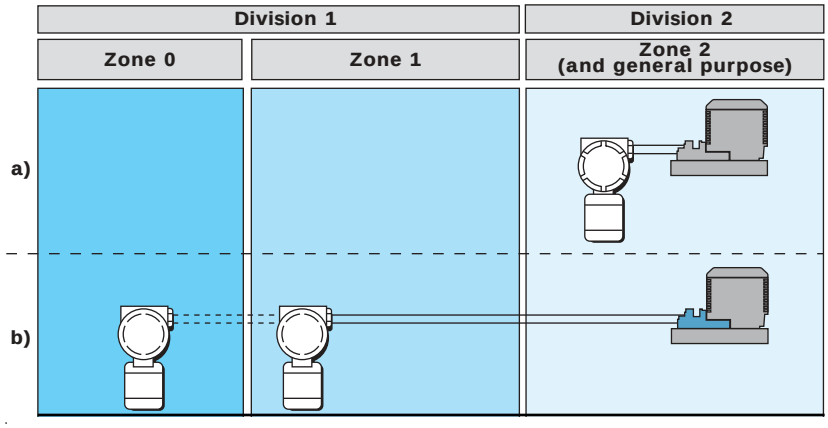

Figure 2 - 8000 in hazardous areas

Hazardous area applications

The 8000 is a truly field mountable system even in areas where flammable gases are present. It is available in versions to suit different area classification schemes:

a) Equipment and field wiring located in general purpose areas, Class 1, Division 2 hazardous locations or Zone 2 hazardous areas.

b) Equipment mounted in general purpose areas, Class 1, Division 2 hazardous locations or Zone 2 hazardous areas, with field wiring located in Division 1 hazardous locations or Zone 0 hazardous areas.

Figure 2 illustrates the connection of field devices for these various options.

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8000 with general purpose field wiring

Many industry applications do not present an explosion risk from gas or dust hazards. In others, the environment may be classified as a Zone 2 or Division 2 hazardous area, where flammable material is expected to occur only in abnormal conditions. For both of these the 2/2 system provides effective distributed I/O for process control. 8000 supports a full range of I/O module types covering inputs and outputs for both analog and discrete circuits. The node can be mounted out on the plant in a suitable enclosure providing protection against the environment. Figure 3 shows a node containing all the key components: a Bus Interface Module, PSU modules (including a redundant one), I/O modules on carriers and a pair of carrier-extenders linked with an extension cable.

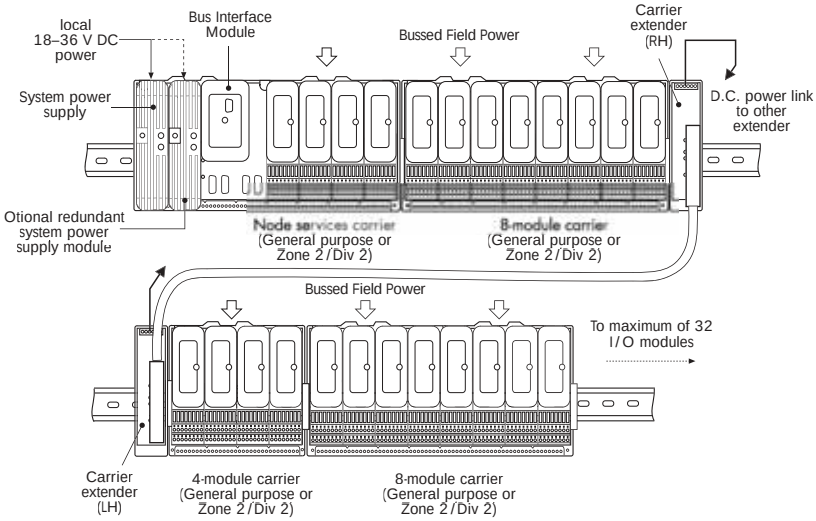

Figure 3 8000 node

8000 with intrinsic safety field wiring

The 8000 Process I/O System is capable of supporting I/O modules with intrinsic safety (IS) field wiring, for connection to certified or 'simple apparatus' field devices in Division 1 or Zone 0 hazardous areas (see Figure 4). A range of I/O module types with IS field circuits for industry-standard DI, DO, AI and AO applications is supported.

I/O modules with built-in protection

All voltage and current-limiting components required for IS protection are incorporated within the I/O module housings, so no external, add-on zener barriers or galvanic isolators are necessary. IS field terminals are distinguished from other types by blue colouring of the terminal housing. A unique and sophisticated mechanical keying mechanism prevents modules with different protection techniques from being interchanged, so that potentially explosive or damaging conditions cannot occur.

Integrated power supplies

Power for IS I/O modules is derived from integrated, modular power supply units. Each power unit is capable of supplying between eight and twenty I/O modules, depending on the I/O type and mix. Optional power supply redundancy is supported by means of an additional, redundant supply unit connected in an 'n+1' arrangement. In applications with mixed IS and non-IS field wiring, the full facilities of the 'Bussed Field Power' regime are retained for the non-IS part of the system.

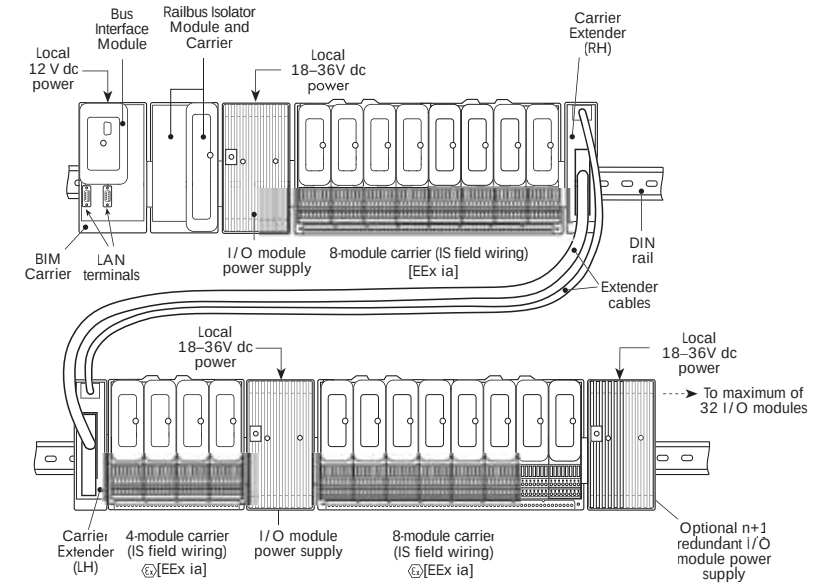

Figure 4 8000 node with IS field wiring

In nodes populated only with IS I/O modules, a separate system power supply module provides power for the Bus Interface Module and 'node services'. Redundancy of this supply is also supported.

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Mixed I/O types within a single node

IS and non-IS field wiring types can also be incorporated within one 8000 node (see Figure 5). In this arrangement, the two par ts of the node are separated by a 'Railbus Isolator' module. The Railbus Isolator provides a section of inter nal communications bus ('Railbus') for the IS I/O modules which is protected from invasion by damaging fault voltages Uniquely, a single 8000 node (under the command of one Bus Inter face Module) can then suppor t a mixture of cer tified IS field devices, certified Division 2 or Zone 2 field devices and general purpose I/O, including AC mains circuits. Only one Railbus Isolator is used per 8000 node.

Related 8000 Literature

AN8000
System Specifier's Guide - Modular I/O

INM8000
Installation Guide

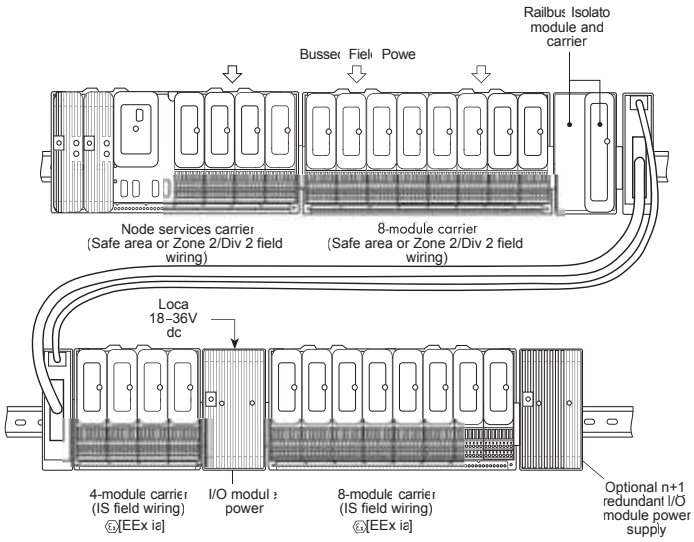

Figure 5 8000 node with mixed IS and non IS field wiring

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I/O Modules - Overview

General

All I/O modules are connected to a high speed Bus Interface Module (BIM) via a proprietary bus system called 'Railbus' and one BIM can control up to 32 modules.

The module carrier provides the transmission medium for the Railbus and, by plugging a module onto a carrier, connections are made between the module and the bus. The connectors on the carrier also provide the power supply links to the module and, when required, power for the field wiring.

Addressing of I/O modules

Modules are addressed by the BIM in terms of their position, or slot, in the total chain of 32 modules not by individual module types. As a result, a module can be removed and replaced by another of its own type without the need to 'tell' the BIM of the change. During configuration, the BIM is told the characteristics of each necessary module position whether or not the module is present at the time. Consequently, if a module is removed for service replacement, the properties of the 'slot' are still retained by the BIM.

Important modes

Output failsafe mode

Output modules have the ability to assume a failsafe state. This can happen for two reasons.

1) The BIM can force a module into a failsafe state by issuing a specific command to it.
2) Modules have a configurable "timeout" parameter. This defines the maximum time period of communication inactivity with the BIM. If this period is exceeded the module adopts a failsafe state.

The different module types have their own response to a failsafe command, and those responses are described in the individual sections that follow.

Input fail values

In the event of failure of an input module, the BIM forces the reported value to a predefined state – low, high or hold last value.

This ensures that the host adopts a state consistent with safe operation of the plant.

Power-up/initialisation state

When powering-up a node it is essential for plant safety that the state of each of the outputs is known. While the BIM is initialising, the I/O modules are held in the power-up state (see following pages). After BIM initialisation and before establishing communication with the host, the outputs are set to predefined "initialisation" states. This "safe-state" can be defined by the user for each output channel.

Non-volatile configuration memory

The configuration information for all I/O modules in a node is stored in the BIM in non-volatile memory (NVM). When a module is replaced, when the node is powered up or following a reset, the BIM will download the stored configuration information to the relevant I/O modules.

Visual indicators

LEDs are provided on each module to indicate Power, Fault and channel Status information. These are based on the NAMUR NE44 specification for LED indicators.

The Power and Fault indicators are common to all I/O modules and their states are shown in the following tables.

Module 'Fault' LED (red)

On	Æ Failsafe Æ A/D error on AI Æ BFP failure on 2/2 AI
Off	Normal
Flashing	Initialisation error

BFP = Bussed Field Power of 2/2 modules

Module 'Power' LED (green)

On	Power OK
Off	Power failure

Module 'Status' LED (yellow)

The channel "Status" indicators have different meanings according to the module type and are described in the individual module sections.

Important note

If, when using the 8502 Profibus BIM, the node is configured over Profibus, a reduced set of configuration parameters is available. In this case, the module specifications should be read in conjunction with the Profibus BIM instruction manual INM8502 which explains the configuration options.

Alternatively, if the 8455 Configurator Software is used to configure a Profibus node, a fully detailed range of module configuration parameters is available.

GSD files are available for either of the above options.

Analog Input Modules - 4-20mA

General

The 4–20 mA AI modules provide digitised data and status information from 4–20 mA current loop sensors.

HART® capability

AI modules "with HART" can obtain information from HART instruments of protocol revision 5.0 or later. Each channel can communicate with a single HART instrument. HART universal command 3 is used to gather up to 4 dynamic variables and status from each HART instrument. This provides more process information to the control system from each device. Greater accuracy can also be achieved by eliminating A/D and D/A errors.

In addition, HART pass-through may be used for device configuration, calibration and advanced diagnostics.

Input sampling

The AI modules have eight user-channels that are sampled every 27 ms (2/2) or 33 ms (2/1).

Data format

The input signal is stored as a 16-bit unsigned value. In this range 0 is equivalent to 0mA and 65,535 is equivalent to 25mA. Any digital HART data is stored in its original IEEE754 floating point format.

Filtering

The Analog Input modules use a first-order software filter that provides 12 dB attenuation at the Nyquist frequency of the algorithm. The filter supports a set of options that can be matched with control algorithm execution rates.

Input alarms

Four configurable alarm levels are provided for each channel—two high and two low (see figure below). When an input value exceeds an alarm limit a flag is set and the BIM gets a new alarm status.

Alarm deadband

The Alarm Deadband prevents the alarm from tripping on and off because of system noise. It can be configured for each channel and is always set on the 'inner' side of the alarm limit to be, typically, greater than the system noise in the plant. If an alarm is activated, it will remain until the input moves the full extent of the deadband towards a "safer" value.

The Hi-Hi and Lo-Lo alarms support the NAMUR recommendations, i.e. if the alarm limit is set less than 3.6 mA (Lo-Lo), or greater than 21.0 mA (Hi-Hi), the alarms must be active for 4 seconds before the alarm is set. The Deadband does not apply to NAMUR alarms. If the alarm limits are set at values between the NAMUR limits, the alarms function normally.

Dead zone

Each channel has a definable "dead zone". This is to reduce the need for the module to report to the BIM every minor change in input value. If the input value differs by the amount defined by the Dead Zone, or more, then the new value is reported, otherwise it is not. This reduces traffic on the internal bus which improves the system response time. If the Dead Zone value is set to zero (the default), then every input value read will set a 'New Data' flag, and be reported.

Module operating states

Normal/Failsafe mode

The AI modules support failsafe mode as defined in the earlier I/O module introductory section. When not in failsafe the module adopts Normal mode.

Channel Active/Inactive

A channel can be made active or inactive individually. When a channel is made inactive inputs will not be processed.

Default/Power-up conditions

These modules use the following values when they power up.

Module mode
Normal (not "failsafe")

Active/inactive
All channels power up in the active state.

Alarms
All alarms are made inactive by having their values set to high or low extremes, as appropriate.

Dead Zone
0 (i.e. all changes of A/D data are reported for an active channel)

Software Filtering
Disabled.

Passthrough
Passthrough messages to HART instruments are always allowed.

Visual indicators

Channel "Status" LED (yellow)

On	Sensor loop OK
Off	Open circuit sensor and channel inactive
Flashing	Open circuit sensor and channel active OR Error condition

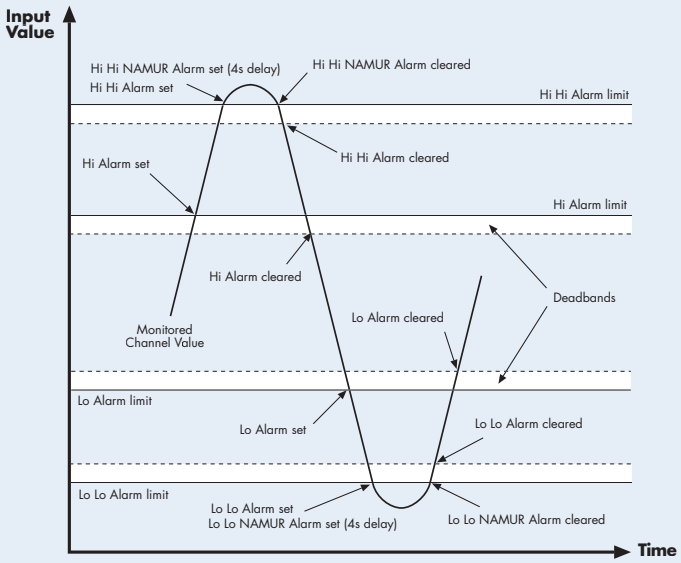
An error – i.e. a flashing LED – could be as a result of any of the following conditions:

a) a loss of HART signal,

b) an error in the A/D converter,

c) a NAMUR alarm or

d) a Hi (-Hi) or Low (-Low) alarm.



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Analog Input Modules - THC and RTD

General

These modules provide digitised data and status information of analog measurements from thermocouples, mV sources, RTDs and resistance sources.

Thermocouple modules provide four or eight channels for monitoring input signals from thermocouples or mV sources. The function of the module is set up during configuration. Cold junction compensation for thermocouple applications is provided by means of a sensor in the field terminal. Only the recommended field terminals can be used with these modules.

RTD modules provide four or eight channels for monitoring input signals from RTD or resistance sources. The function of the module is set up during configuration. The RTD can be 2-, 3- or 4-wire type. Only the recommended field terminals can be used with these modules.

Input sampling

Thermocouple modules sample at intervals of 60 ms per channel. In addition, the module has cold junction temperature compensation that is refreshed every 1.8 seconds for 4-channel modules and every 2.4 seconds for 8-channel modules. The sampling technique for the RTD module is similar where samples of the voltage across, and the current through, the RTD are measured at intervals of 60 ms per channel. Compensation methods reject the effect of resistance in the cable conductors for 3-wire and 4-wire RTD/Resistance.

Data format

The 8105/6 4-channel modules store data as 15-bit plus sign integers (–32768 to +32768). The 8205/6 8-channel modules store data as 16-bit unsigned integers (0 to 65535).

Filtering

An Infinite Impulse Response (IIR) filter is used on the input data before it reaches the A/D converter. Depending upon the coefficients selected, the output from the filter will be:

a) the input value (filter OFF)

b) an average of the last two readings (filter ON - setting 1)

c) a running average of readings (filter ON - setting 2)

The coefficients can be selected individually for each channel.

Input alarms

The modules provide two configurable alarm levels for each channel—a high limit and a low one. See figure.

When an input value exceeds an alarm limit the appropriate alarm bit (high or low) is set in the channel status byte. In addition, the "new data" signal is set to allow the controller to collect the new alarm status information and the affected channel LED will flash.

Alarm deadband

The alarm deadband (not shown on the diagram) is fixed at 1%.

Dead zone

Each channel has a definable "dead zone". This is to reduce the need for the module to report to the BIM every minor change in input value. If the input value differs by the amount defined by the Dead Zone, or more, then the new value is reported, otherwise it is not. This reduces traffic on the internal bus which improves the system response time. If the Dead Zone value is set to zero (the default), then every input value read will set a 'New Data' flag, and be reported.

Open sensor detection

When configured to do so, the modules will detect an open circuit sensor and report it within 10 seconds. When this occurs a status bit is set in the module and the affected channel LED flashes. The detection options for the two module types are configurable as follows:

THC and mV
Off, drive upscale or drive downscale

RTD and resistance
Off or drive upscale

These choices can be made for each channel.

Module operating states

Normal/Failsafe mode

The THC and RTD modules support failsafe mode as defined in the earlier I/O module introductory section. When not in failsafe the module adopts Normal mode.

Channel Active/Inactive

A channel can be made active or inactive individually. When a channel is made inactive inputs will not be processed.

Power-up conditions

The module uses the following values when it powers up.

Module mode
Normal (not "failsafe")

Active/inactive
All channels power up in the active state.

Alarms
All alarms are made inactive by having their values set to high or low extremes, as appropriate.

Dead zone
0 (i.e. all changes of A/D data are reported for an active channel)

Software filtering
Disabled

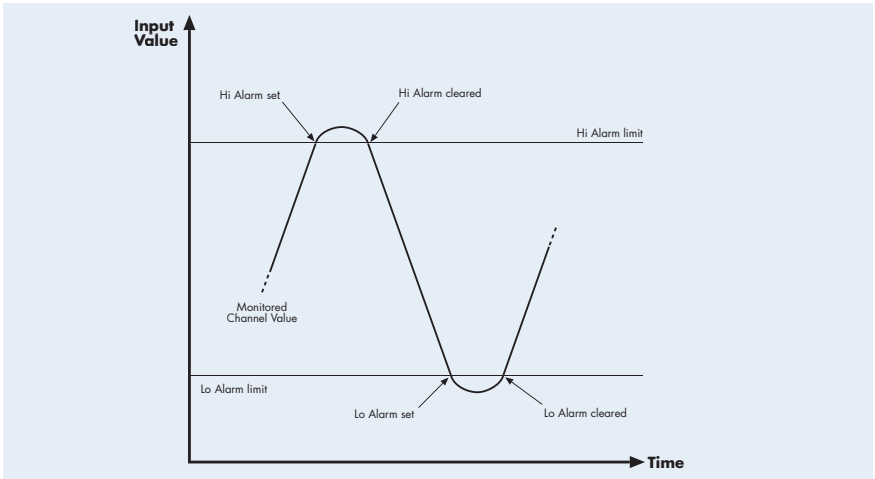
Channel type
Type K thermocouple or
3-wire RTD - Pt100

O/C sensor
Off

Visual indicators

Channel "status" LED (yellow)

On	Sensor loop OK
Off	Open circuit sensor and channel inactive
Flashing	Open circuit sensor and channel active OR Error condition



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Analog Output Modules - 4-20mA

General

The 4–20 mA AO modules use a single D/A converter in a sample-and-hold configuration to drive each of the output channels. The processor sets the current value for each of the active channels once every 20 ms. Any requested output values below 1mA are clamped to 1mA to ensure that the open-loop detection mechanism is always operable.

To verify that active output channels have current flowing to the field, the processor reads a hardware signal every time an output is written to the D/A converter. If the signal indicates "no current flowing", i.e. < 1 mA, for 50 consecutive scans (i.e. one second), an Open-Loop Detection failure is set for that channel.

HART® capability

AO modules "with HART" are compatible with all HART devices of protocol revision 5.0 or later. Each channel can communicate with a single HART instrument and supports HART communication with the wide range of HART valve positioners now available. HART universal command 3 can be used to gather up to 4 dynamic HART variables such as valve position, air pressure, etc., together with HART status variables. These are scanned by the BIM and may be communicated over the LAN for easy integration into the control system.

In addition, HART pass-through may be used for device configuration, calibration and advanced diagnostics.

Data format

The output data has a resolution of 12 bits but is stored as a 16-bit unsigned value. In this range 0 is equivalent to 0mA and 65,535 is equivalent to 25mA.

Module operating states

Failsafe mode

The module supports failsafe mode as defined in the earlier I/O module introductory section. When put in failsafe mode the output can be made to adopt one of the following options.

1) Use configured failsafe values

In this (default) mode, the module forces the output to a predefined percentage value. The default value is 0%.

2) Hold last value

In this mode the channel holds the last value it output.

When not in failsafe the module adopts Normal mode.

Channel Active/Inactive

Each channel can be made active or inactive individually. When a channel is made inactive the output is disabled, i.e. de-energised.

When a channel is made Active again the output is driven based upon the current configuration.

Default/Power-up conditions

The module uses predefined values when it powers up. The following parameters summarise the state of the module when it powers up.

Module mode:
Normal (not "failsafe")

Active/inactive:
All channels power up in the Inactive state.

Visual indicator

Channel "Status" LED (yellow)

On	Field circuit OK
Off	Open circuit field loop and channel inactive
Flashing	Open circuit field loop and channel active OR Error condition

On the AO modules the yellow "Status" LED reacts in the following way to module conditions.

An error condition – i.e. a flashing LED – could be as the result of the loss of the HART communications signal.

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Discrete Input Modules

General

DI modules can accept up to 8 or 16 discrete inputs, depending upon module type, from dry contacts, NAMUR standard proximity detectors, or switched voltages. The source voltage for field switching can be provided through the module or from an independent supply out in the field.

In operation, the input voltage is compared against a threshold voltage to create a 'true' or 'false' condition. If the inputs are from Zone 2/ Zone 1 or Zone 0 hazardous areas, the appropriate (2/1) module provides certified isolation for these signals. A pulse counter is also included which can count the number of input pulses for each of the channels.

Input filter

An input filter can be set individually for each channel to introduce a delay period that allows the input to settle to a stable value.

When switched off, the bandwidth of the DI input is 250 Hz (100 Hz for 2/1 modules). The timeout filter can introduce a timeout delay of between 2 and 512 ms in 2 ms steps for 2/2 modules and between 3 and 512 ms in 3 ms steps for 2/1 modules. Alternatively, preset values of "Fast" (22 ms) or "Slow" (258 ms) may be used.

Latch

Any channel input can be configured to be "real time" or latched. If the latch feature is enabled, the polarity can also be set so that an input signal that goes:

- high will be held high
- low will be held low

until the latch is released by a command from the controller. All channels are latched independently and can be cleared simultaneously, or independently, by a Write instruction to the module's latch reset register. If controlled by a BIM this will occur automatically in 2 to 3 seconds.

Line fault detection (2/1 only)

When enabled, this will cause a flag to be set to indicate a short or open circuit fault.

Low-frequency pulse counter

The DI modules contain a continuously running 16-bit pulse counter that counts each low-frequency pulse received on the input. The maximum pulse rate, with the timeout filter switched off, depends upon the module selected; consult the individual data sheets for details. With the filter active, the maximum pulse rate will be determined by the timeout period used. In order to start a particular count the counter must be reset to zero by a host instruction. When the counter overflows (i.e. > 65,536 counts) it will restart from zero.

Module operating states

"Failsafe" mode

The module supports failsafe mode as defined in the earlier I/O module introductory section.

Channel Active/Inactive

Each channel can be made active or inactive individually. When a channel is made inactive:

- inputs are not processed—i.e. the last input value is held and not refreshed
- channel events are not generated
- the counter is not incremented

Power-up conditions

On power-up, or if a reset is executed, the configuration will automatically adopt predefined states:

Module mode:
Normal (not "failsafe")

Channel types:
All latches and filters are off

Active/Inactive:
All channels power-up in the Active state

Visual indicators

On	Channel input "high" or latched
Off	Channel input "low"
Flashing	Line fault detect (2/1 only)

Channel "Status" LED (yellow)

On the DI modules the yellow "Status" LED reacts in the following way to module conditions.

Note: the LED may appear to flash when the input goes high and low repeatedly.

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Discrete Output Modules

General

DO modules can provide up to 4 or 8 discrete outputs, depending upon module type. Line fault detection is also provided on the 2/1 modules for both open- and short-circuit conditions.

Output Mode

The DO module outputs may be configured for one of three different types of output:

- Discrete
- Single pulse
- Continuous pulse

Discrete

The Bus Interface Module (BIM) signals an ON or OFF condition on demand.

Singe Pulse

(See Notes 1 & 2)

This is an individual "single-shot" action, creating a single ON pulse of specified duration that occurs at a definable time. The pulse on-time can be varied between 2ms and 130s in increments of 2ms. If a new ON command (i.e. trigger) is given during the ON period the pulse will restart. If a new pulse width is supplied during the ON period, it will not take effect until the next ON period.

A pulse can experience a small amount of time dither that depends upon the amount of Railbus activity. This can be ± 1% of the pulse width or ± 3.5 ms, whichever is the longer.

Continuous Pulse

(see Notes 2, 3 & 4)

This type of output provides a continuous pulse train that is defined by the pulse on-time, and the pulse period (the time between the start of each ON time). The pulse period is configurable to any value between 4 ms and 130,000 ms in 2 ms steps. The pulse on-time is the same as for the momentary action described above. The on-time must not exceed the setting for the pulse period. (See also the above note regarding AC modules.)

Pulses can experience a small amount of time dither that depends upon the amount of Railbus activity. This can be ± 1% of the pulse period, or ± 3.5 ms, whichever is the longer.

Continuous pulse operation has two distinct modes—static and dynamic. When in static mode, the pulse parameters are cleared from memory when the channel is made inactive; in dynamic mode the values are retained for use when the channel is made active once again.

Line Fault detection (2/1 only)

When enabled, this will cause a flag to be set to indicate a short or open circuit fault even when channel output is in OFF state.

Module operating states

Failsafe mode

The module supports failsafe mode as defined in the earlier I/O module introductory section, with the following two additions:

1) Channel using "Configured failsafe values"

In this mode, the module will force the outputs to predefined levels— defined on a per channel basis.

On entering "failsafe":

a) If channel is in **Static** mode of operation:

Pulse mode is disabled and the channel is configured as a latched output and is driven to its failsafe value.

b) If channel is in **Dynamic** mode of operation:

If in single pulse (momentary) mode, the configuration is not cleared, but the output is driven to its failsafe value.

On leaving failsafe:

Channel will adopt the mode defined below for a channel going from inactive to active state

2) Channel using "Hold last value"

If the module goes into failsafe during a single pulse, it is allowed to complete the pulse before adopting the failsafe state. A latched (discrete) output will remain at its current value.

Channel Active/ Inactive

Each channel can be made active or inactive individually.

When a channel is made inactive the output is turned OFF (i.e. de-energised).

When a channel changes from inactive to active the following situations apply:

a) If channel is in **Static** mode of operation:

It becomes a latched output and will remain so until reconfigured by the BIM.

b) If channel is in **Dynamic** mode of operation:

The channel will resume operation with its previous configuration and output.

Power-up conditions

On power-up, or if a reset is executed, the configuration will automatically adopt predefined states:

Module mode:

Normal (not failsafe)

Channel types

All channels are configured as Discrete outputs

Active/Inactive

All channels power-up in the Inactive state

Line fault detection (2/1 only)

Disabled on all channels

Visual indicators

Channel "Status" LED (yellow)

On	Field circuit OK
Off	Open circuit field loop and channel inactive
Flashing	Open circuit field loop and channel active OR Error condition

On the DO modules the yellow "Status" LED reacts in the following way to module conditions.

Note: the LED may appear to be flashing when input goes high and low repeatedly.

Notes:
1. This action is only available in Static mode.
2. AC modules will react differently to the on-time length and trigger time. The module can only be triggered ON during a zero crossing of the AC waveform; similarly, the module can only switch OFF at a zero crossing point. The minimum on-time is therefore restricted to half the total period of a regular waveform.
3. Continuous pulse operation is supported only by Version 2 models of BIMs 8502 and 8505.
4. On 2/2 modules, this action is only available in Static mode.

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Pulse Input Modules - 2-channel pulse/quadrature

General

These modules are designed to meet the requirements of a very wide range of mechanical positioning and flow applications. When used separately, the two input channels will accept pulse inputs to measure:

- frequency
- acceleration / rate
- number of pulses (i.e. counter)

When combined, they provide:

- rotational position and direction data from quadrature encoding devices

In addition, the module has two digital outputs and one digital input to gate (start/stop) the channel 1 internal counter.

Pulse inputs

Pulse inputs can come from a range of sensors having different amplitudes, trigger levels and input impedance requirements. Inputs types accepted are:

- Proximity detectors (NAMUR/DIN19234)
- Current inputs
- Voltage inputs
- Switch / electro-mechanical inputs

Theshold levels for the current and voltage input can be set to suit the application.

Dynamic data

Several values are calculated, for each channel, from the signal pulses received.

Frequency

This is calculated by measuring the time interval between pulses. An average is calculated over a period (20 ms to 200 s) defined by the user. The time interval is measured from the edge of one pulse to the same edge of the next pulse. The polarity (rising or falling edge) can be configured. The default is the rising edge.

There are ten frequency measurement ranges. They start at 0 – 100 Hz and rise in ratios of 3, 5 and 10. However, the maximum frequency of the module is 50kHz, so any values in the 100 kHz range that exceed this should be considered as "out-of-range".

Acceleration

This is calculated from the difference in frequency from the start to the end of the sample period. A positive value indicates an increase in the rate of frequency and a negative value is a decrease in the rate.

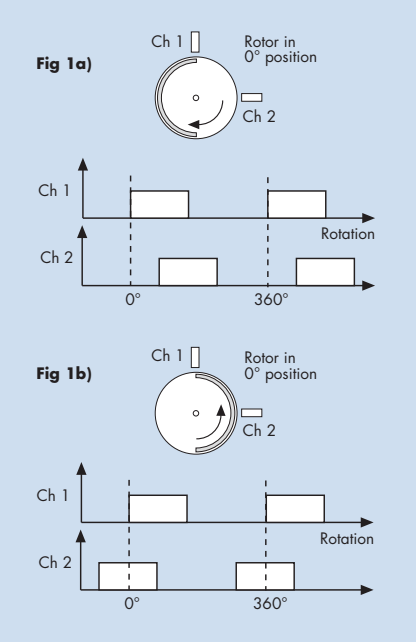
Counting

Each channel has a 32-bit counter that indicates the total number of input pulses since the counter was reset. The counter on Channel 1 can be started and stopped by the control gate input and both channel counters can be started, stopped and reset by BIM commands.

Counters can be configured to count up (the default) or down. If the quadrature calculation is enabled (see below) then the configured counter direction is ignored; instead counter direction is determined by the quadrature value (up for forward, down for reverse).

A counter preset value can be configured by a BIM command which also resets the counter. On reaching the preset count value an event is triggered which can also be passed to the channel's digital output. This state is cleared by resetting the counter or assigning a new preset value.

Quadrature (rotation direction)



The second channel can be used to determine direction of rotation by comparing the phase of its input p ulse with that of the first channel.

If the Ch 2 input is in a low state on the rising edge of the Ch 1 pulse then the rotation is forward (Fig 1a). If the Ch 2 input is high on the rising edge of the Ch 1 pulse then the rotation is backward (Fig 1b).

Filtering

The module has a hardware filter which can be used to minimise the effects of contact bounce. The available settings are 1, 5, 20 kHz and Off.

Alarms

High / Low alarms

High and low alarms can be configured for each channel. When the input value goes beyond an alarm limit, channel and module flags are set, the channel LED flashes and, if configured, the channel's digital output state will change.

Acceleration alarms

An acceleration alarm limit can also be set. If the limit is exceeded the actions taken are identical to those for the high/low alarms.

Alarm deadband

A deadband can be specified for the high, low and acceleration alarms. This provides hysteresis to avoid repetitive alarms in noisy signal environments.

Missing pulse alarm

Both channels can be configured to detect a "missing pulse". If no input pulse is detected for a defined time period an alarm is signalled in the same way as the high/low alarms.

The alarm is cleared on receipt of a pulse or on reconfiguration of the alarm. The time period is restarted after each sample period in which at least one pulse occurs.

Line Fault Detect

Each channel can be configured to sense an open or a short circuit condition on inputs. On detection, the actions are those for the high/low alarms.

On fault, the BIM can: report the frequency value as being at the top or the bottom of the range, freeze the counter, set the acceleration to zero; depending on how the BIM is configured.

Control data

The host can write data to control each channel counter. The available parameters are: start, stop, set, reset and preset value.

Digital outputs

Both digital output channels can reflect the status of the inputs by indicating:

- frequency or acceleration alarm
- counter preset value reached while the main channel can also output:
- quadrature forward or reverse signal
- scaled retransmission (a "divided by N" version of the input)

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I/O Modules - Overview

I/O module types

2/2 modules

Analog input modules

8-channel, 4–20 mA with HART® 8101–HI–TX
8-channel, 4–20 mA 8103–AI–TX
8-channel, 1–5 V 8119–VI–05

THC and RTD modules

4-channel, THC and mV 8105–TI–TC
4-channel, RTD and Ω 8106–TI–RT

Analog output modules

8-channel, 4–20 mA with HART® 8102–HO–IP
8-channel, 4–20 mA 8104–AO–IP

Discrete input modules

8-channel, 24 V dc, isolated, sinking 8109–DI–DC
16-channel, 24 V dc, isolated, sinking 8122–DI–DC
8-channel, 24 V dc, non-isolated, module powered 8110–DI–DC
16-channel, 24 V dc, non-isolated, module powered 8121–DI–DC
8-channel, 115 V ac, isolated, sinking 8111–DI–AC
8-channel, 115 V ac, non-isolated, module powered 8112–DI–AC
8-channel, 230 V ac, isolated, sinking 8113–DI–AC
8-channel, 230 V ac, non-isolated, module powered 8114–DI–AC

Discrete output modules

8-channel, 2–60 V dc, non-isolated, module powered 8115–DO–DC
8-channel, 20–265 V ac, non-isolated, module powered 8116–DO–AC
8-channel, 2–60 V dc, isolated, unpowered 8117–DO–DC
8-channel, 20–265 V ac, isolated, unpowered 8118–DO–AC

Pulse input modules

2-channel, pulse/quadrature input 8123–PI–QU

2/1 modules

Analog input modules

8-channel, 4–20 mA with HART® 8201–HI–IS
8-channel, 0–10V/potentiometer 8230–AI–IS

THC and RTD modules

8-channel, THC and mV 8205–TI–IS
8-channel, RTD and Ω 8206–TI–IS

Analog output modules

8-channel, 4–20 mA with HART® 8202–HO–IS
8-channel, 4–20 mA 8204–AO–IS

Discrete input modules

16 (8)* -channel, switch/proximity detector 8220–DI–IS

Discrete output modules

4-channel, solenoid driver, IIC gas groups 8215–DO–IS

Pulse input modules

2-channel, pulse/quadrature input 8223–PI–IS

**8-channel when used with 8624-FT-IS field terminal*

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I/O Modules - Overview

General

All I/O modules are connected to a high speed Bus Interface Module (BIM) via a proprietary bus system called 'Railbus' and one BIM can control up to 32 modules.

The module carrier provides the transmission medium for the Railbus and, by plugging a module onto a carrier, connections are made between the module and the bus. The connectors on the carrier also provide the power supply links to the module and, when required, power for the field wiring.

Addressing of I/O modules

Modules are addressed by the BIM in terms of their position, or slot, in the total chain of 32 modules not by individual module types. As a result, a module can be removed and replaced by another of its own type without the need to 'tell' the BIM of the change. During configuration, the BIM is told the characteristics of each necessary module position whether or not the module is present at the time. Consequently, if a module is removed for service replacement, the properties of the 'slot' are still retained by the BIM.

Important modes

Output failsafe mode

Output modules have the ability to assume a failsafe state. This can happen for two reasons.

1) The BIM can force a module into a failsafe state by issuing a specific command to it.
2) Modules have a configurable "timeout" parameter. This defines the maximum time period of communication inactivity with the BIM. If this period is exceeded the module adopts a failsafe state.

The different module types have their own response to a failsafe command, and those responses are described in the individual sections that follow.

Input fail values

In the event of failure of an input module, the BIM forces the reported value to a predefined state – low, high or hold last value.

This ensures that the host adopts a state consistent with safe operation of the plant.

Power-up/initialisation state

When powering-up a node it is essential for plant safety that the state of each of the outputs is known. While the BIM is initialising, the I/O modules are held in the power-up state (see following pages). After BIM initialisation and before establishing communication with the host, the outputs are set to predefined "initialisation" states. This "safe-state" can be defined by the user for each output channel.

Non-volatile configuration memory

The configuration information for all I/O modules in a node is stored in the BIM in non-volatile memory (NVM). When a module is replaced, when the node is powered up or following a reset, the BIM will download the stored configuration information to the relevant I/O modules.

Visual indicators

LEDs are provided on each module to indicate Power, Fault and channel Status information. These are based on the NAMUR NE44 specification for LED indicators.

The Power and Fault indicators are common to all I/O modules and their states are shown in the following tables.

Module 'Fault' LED (red)

On	◆ Failsafe ◆ A/D error on AI ◆ BFP failure on 2/2 AI
Off	Normal
Flashing	Initialisation error

BFP = Bussed Field Power of 2/2 modules

Module 'Power' LED (green)

On	Power OK
Off	Power failure

Module 'Status' LED (yellow)

The channel "Status" indicators have different meanings according to the module type and are described in the individual module sections.

Important note

If, when using the 8502 Profibus BIM, the node is configured over Profibus, a reduced set of configuration parameters is available. In this case, the module specifications should be read in conjunction with the Profibus BIM instruction manual INM8502 which explains the configuration options.

Alternatively, if the 8455 Configurator Software is used to configure a Profibus node, a fully detailed range of module configuration parameters is available.

GSD files are available for either of the above options.

Analog Input Modules - 4-20mA

General

The 4–20 mA AI modules provide digitised data and status information from 4–20 mA current loop sensors.

HART® capability

AI modules "with HART" can obtain information from HART instruments of protocol revision 5.0 or later. Each channel can communicate with a single HART instrument. HART universal command 3 is used to gather up to 4 dynamic variables and status from each HART instrument. This provides more process information to the control system from each device. Greater accuracy can also be achieved by eliminating A/D and D/A errors.

In addition, HART pass-through may be used for device configuration, calibration and advanced diagnostics.

Input sampling

The AI modules have eight user-channels that are sampled every 27 ms (2/2) or 33 ms (2/1).

Data format

The input signal is stored as a 16-bit unsigned value. In this range 0 is equivalent to 0mA and 65,535 is equivalent to 25mA. Any digital HART data is stored in its original IEEE754 floating point format.

Filtering

The Analog Input modules use a first-order software filter that provides 12 dB attenuation at the Nyquist frequency of the algorithm. The filter supports a set of options that can be matched with control algorithm execution rates.

Input alarms

Four configurable alarm levels are provided for each channel—two high and two low (see figure below). When an input value exceeds an alarm limit a flag is set and the BIM gets a new alarm status.

Alarm deadband

The Alarm Deadband prevents the alarm from tripping on and off because of system noise. It can be configured for each channel and is always set on the 'inner' side of the alarm limit to be, typically, greater than the system noise in the plant. If an alarm is activated, it will remain until the input moves the full extent of the deadband towards a "safer" value.

The Hi-Hi and Lo-Lo alarms support the NAMUR recommendations, i.e. if the alarm limit is set less than 3.6 mA (Lo-Lo), or greater than 21.0 mA (Hi-Hi), the alarms must be active for 4 seconds before the alarm is set. The Deadband does not apply to NAMUR alarms. If the alarm limits are set at values between the NAMUR limits, the alarms function normally.

Dead zone

Each channel has a definable "dead zone". This is to reduce the need for the module to report to the BIM every minor change in input value. If the input value differs by the amount defined by the Dead Zone, or more, then the new value is reported, otherwise it is not. This reduces traffic on the internal bus which improves the system response time. If the Dead Zone value is set to zero (the default), then every input value read will set a 'New Data' flag, and be reported.

Module operating states

Normal/Failsafe mode

The AI modules support failsafe mode as defined in the earlier I/O module introductory section. When not in failsafe the module adopts Normal mode.

Channel Active/Inactive

A channel can be made active or inactive individually. When a channel is made inactive inputs will not be processed.

Default/Power-up conditions

These modules use the following values when they power up.

Module mode
Normal (not "failsafe")

Active/inactive
All channels power up in the active state.

Alarms
All alarms are made inactive by having their values set to high or low extremes, as appropriate.

Dead Zone
0 (i.e. all changes of A/D data are reported for an active channel)

Software Filtering
Disabled.

Passthrough
Passthrough messages to HART instruments are always allowed.

Visual indicators

Channel "Status" LED (yellow)

On	Sensor loop OK
Off	Open circuit sensor and channel inactive
Flashing	Open circuit sensor and channel active OR Error condition

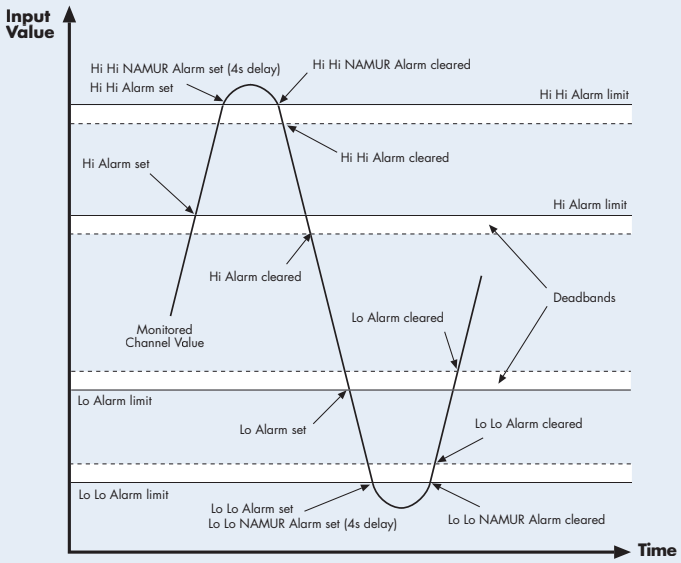
An error – i.e. a flashing LED – could be as a result of any of the following conditions:

a) a loss of HART signal,

b) an error in the A/D converter,

c) a NAMUR alarm or

d) a Hi (-Hi) or Low (-Low) alarm.



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Analog Input Modules - THC and RTD

General

These modules provide digitised data and status information of analog measurements from thermocouples, mV sources, RTDs and resistance sources.

Thermocouple modules provide four or eight channels for monitoring input signals from thermocouples or mV sources. The function of the module is set up during configuration. Cold junction compensation for thermocouple applications is provided by means of a sensor in the field terminal. Only the recommended field terminals can be used with these modules.

RTD modules provide four or eight channels for monitoring input signals from RTD or resistance sources. The function of the module is set up during configuration. The RTD can be 2-, 3- or 4-wire type. Only the recommended field terminals can be used with these modules.

Input sampling

Thermocouple modules sample at intervals of 60 ms per channel. In addition, the module has cold junction temperature compensation that is refreshed every 1.8 seconds for 4-channel modules and every 2.4 seconds for 8-channel modules. The sampling technique for the RTD module is similar where samples of the voltage across, and the current through, the RTD are measured at intervals of 60 ms per channel. Compensation methods reject the effect of resistance in the cable conductors for 3-wire and 4-wire RTD/Resistance.

Data format

The 8105/6 4-channel modules store data as 15-bit plus sign integers (–32768 to +32768). The 8205/6 8-channel modules store data as 16-bit unsigned integers (0 to 65535).

Filtering

An Infinite Impulse Response (IIR) filter is used on the input data before it reaches the A/D converter. Depending upon the coefficients selected, the output from the filter will be:

a) the input value (filter OFF)

b) an average of the last two readings (filter ON - setting 1)

c) a running average of readings (filter ON - setting 2)

The coefficients can be selected individually for each channel.

Input alarms

The modules provide two configurable alarm levels for each channel—a high limit and a low one. See figure.

When an input value exceeds an alarm limit the appropriate alarm bit (high or low) is set in the channel status byte. In addition, the "new data" signal is set to allow the controller to collect the new alarm status information and the affected channel LED will flash.

Alarm deadband

The alarm deadband (not shown on the diagram) is fixed at 1%.

Dead zone

Each channel has a definable "dead zone". This is to reduce the need for the module to report to the BIM every minor change in input value. If the input value differs by the amount defined by the Dead Zone, or more, then the new value is reported, otherwise it is not. This reduces traffic on the internal bus which improves the system response time. If the Dead Zone value is set to zero (the default), then every input value read will set a 'New Data' flag, and be reported.

Open sensor detection

When configured to do so, the modules will detect an open circuit sensor and report it within 10 seconds. When this occurs a status bit is set in the module and the affected channel LED flashes. The detection options for the two module types are configurable as follows:

THC and mV
Off, drive upscale or drive downscale

RTD and resistance
Off or drive upscale

These choices can be made for each channel.

Module operating states

Normal/Failsafe mode

The THC and RTD modules support failsafe mode as defined in the earlier I/O module introductory section. When not in failsafe the module adopts Normal mode.

Channel Active/Inactive

A channel can be made active or inactive individually. When a channel is made inactive inputs will not be processed.

Power-up conditions

The module uses the following values when it powers up.

Module mode
Normal (not "failsafe")

Active/inactive
All channels power up in the active state.

Alarms
All alarms are made inactive by having their values set to high or low extremes, as appropriate.

Dead zone
0 (i.e. all changes of A/D data are reported for an active channel)

Software filtering
Disabled

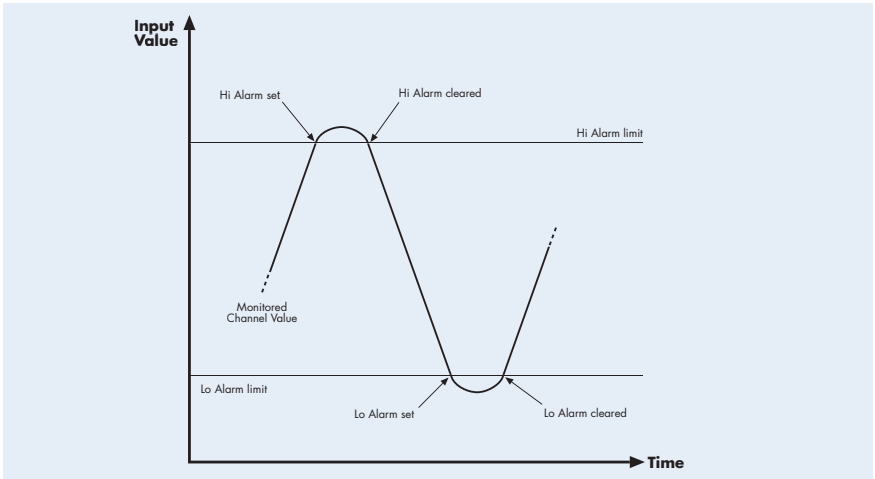
Channel type
Type K thermocouple or
3-wire RTD - Pt100

O/C sensor
Off

Visual indicators

Channel "status" LED (yellow)

On	Sensor loop OK
Off	Open circuit sensor and channel inactive
Flashing	Open circuit sensor and channel active OR Error condition



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Analog Output Modules - 4-20mA

General

The 4–20 mA AO modules use a single D/A converter in a sample-and-hold configuration to drive each of the output channels. The processor sets the current value for each of the active channels once every 20 ms. Any requested output values below 1mA are clamped to 1mA to ensure that the open-loop detection mechanism is always operable.

To verify that active output channels have current flowing to the field, the processor reads a hardware signal every time an output is written to the D/A converter. If the signal indicates "no current flowing", i.e. < 1 mA, for 50 consecutive scans (i.e. one second), an Open-Loop Detection failure is set for that channel.

HART® capability

AO modules "with HART" are compatible with all HART devices of protocol revision 5.0 or later. Each channel can communicate with a single HART instrument and supports HART communication with the wide range of HART valve positioners now available. HART universal command 3 can be used to gather up to 4 dynamic HART variables such as valve position, air pressure, etc., together with HART status variables. These are scanned by the BIM and may be communicated over the LAN for easy integration into the control system.

In addition, HART pass-through may be used for device configuration, calibration and advanced diagnostics.

Data format

The output data has a resolution of 12 bits but is stored as a 16-bit unsigned value. In this range 0 is equivalent to 0mA and 65,535 is equivalent to 25mA.

Module operating states

Failsafe mode

The module supports failsafe mode as defined in the earlier I/O module introductory section. When put in failsafe mode the output can be made to adopt one of the following options.

1) Use configured failsafe values

In this (default) mode, the module forces the output to a predefined percentage value. The default value is 0%.

2) Hold last value

In this mode the channel holds the last value it output.

When not in failsafe the module adopts Normal mode.

Channel Active/Inactive

Each channel can be made active or inactive individually. When a channel is made inactive the output is disabled, i.e. de-energised.

When a channel is made Active again the output is driven based upon the current configuration.

Default/Power-up conditions

The module uses predefined values when it powers up. The following parameters summarise the state of the module when it powers up.

Module mode:
Normal (not "failsafe")

Active/inactive:
All channels power up in the Inactive state.

Visual indicator

Channel "Status" LED (yellow)

On	Field circuit OK
Off	Open circuit field loop and channel inactive
Flashing	Open circuit field loop and channel active OR Error condition

On the AO modules the yellow "Status" LED reacts in the following way to module conditions.

An error condition – i.e. a flashing LED – could be as the result of the loss of the HART communications signal.

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Discrete Input Modules

General

DI modules can accept up to 8 or 16 discrete inputs, depending upon module type, from dry contacts, NAMUR standard proximity detectors, or switched voltages. The source voltage for field switching can be provided through the module or from an independent supply out in the field.

In operation, the input voltage is compared against a threshold voltage to create a 'true' or 'false' condition. If the inputs are from Zone 2/ Zone 1 or Zone 0 hazardous areas, the appropriate (2/1) module provides certified isolation for these signals. A pulse counter is also included which can count the number of input pulses for each of the channels.

Input filter

An input filter can be set individually for each channel to introduce a delay period that allows the input to settle to a stable value.

When switched off, the bandwidth of the DI input is 250 Hz (100 Hz for 2/1 modules). The timeout filter can introduce a timeout delay of between 2 and 512 ms in 2 ms steps for 2/2 modules and between 3 and 512 ms in 3 ms steps for 2/1 modules. Alternatively, preset values of "Fast" (22 ms) or "Slow" (258 ms) may be used.

Latch

Any channel input can be configured to be "real time" or latched. If the latch feature is enabled, the polarity can also be set so that an input signal that goes:

- high will be held high
- low will be held low

until the latch is released by a command from the controller. All channels are latched independently and can be cleared simultaneously, or independently, by a Write instruction to the module's latch reset register. If controlled by a BIM this will occur automatically in 2 to 3 seconds.

Line fault detection (2/1 only)

When enabled, this will cause a flag to be set to indicate a short or open circuit fault.

Low-frequency pulse counter

The DI modules contain a continuously running 16-bit pulse counter that counts each low-frequency pulse received on the input. The maximum pulse rate, with the timeout filter switched off, depends upon the module selected; consult the individual data sheets for details. With the filter active, the maximum pulse rate will be determined by the timeout period used. In order to start a particular count the counter must be reset to zero by a host instruction. When the counter overflows (i.e. > 65,536 counts) it will restart from zero.

Module operating states

"Failsafe" mode

The module supports failsafe mode as defined in the earlier I/O module introductory section.

Channel Active/Inactive

Each channel can be made active or inactive individually. When a channel is made inactive:

- inputs are not processed—i.e. the last input value is held and not refreshed
- channel events are not generated
- the counter is not incremented

Power-up conditions

On power-up, or if a reset is executed, the configuration will automatically adopt predefined states:

Module mode:
Normal (not "failsafe")

Channel types:
All latches and filters are off

Active/Inactive:
All channels power-up in the Active state

Visual indicators

On	Channel input "high" or latched
Off	Channel input "low"
Flashing	Line fault detect (2/1 only)

Channel "Status" LED (yellow)

On the DI modules the yellow "Status" LED reacts in the following way to module conditions.

Note: the LED may appear to flash when the input goes high and low repeatedly.

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Discrete Output Modules

General

DO modules can provide up to 4 or 8 discrete outputs, depending upon module type. Line fault detection is also provided on the 2/1 modules for both open- and short-circuit conditions.

Output Mode

The DO module outputs may be configured for one of three different types of output:

- Discrete
- Single pulse
- Continuous pulse

Discrete

The Bus Interface Module (BIM) signals an ON or OFF condition on demand.

Singe Pulse

(See Notes 1 & 2)

This is an individual "single-shot" action, creating a single ON pulse of specified duration that occurs at a definable time. The pulse on-time can be varied between 2ms and 130s in increments of 2ms. If a new ON command (i.e. trigger) is given during the ON period the pulse will restart. If a new pulse width is supplied during the ON period, it will not take effect until the next ON period.

A pulse can experience a small amount of time dither that depends upon the amount of Railbus activity. This can be ± 1% of the pulse width or ± 3.5 ms, whichever is the longer.

Continuous Pulse

(see Notes 2, 3 & 4)

This type of output provides a continuous pulse train that is defined by the pulse on-time, and the pulse period (the time between the start of each ON time). The pulse period is configurable to any value between 4 ms and 130,000 ms in 2 ms steps. The pulse on-time is the same as for the momentary action described above. The on-time must not exceed the setting for the pulse period. (See also the above note regarding AC modules.)

Pulses can experience a small amount of time dither that depends upon the amount of Railbus activity. This can be ± 1% of the pulse period, or ± 3.5 ms, whichever is the longer.

Continuous pulse operation has two distinct modes—static and dynamic. When in static mode, the pulse parameters are cleared from memory when the channel is made inactive; in dynamic mode the values are retained for use when the channel is made active once again.

Line Fault detection (2/1 only)

When enabled, this will cause a flag to be set to indicate a short or open circuit fault even when channel output is in OFF state.

Module operating states

Failsafe mode

The module supports failsafe mode as defined in the earlier I/O module introductory section, with the following two additions:

1) Channel using "Configured failsafe values"

In this mode, the module will force the outputs to predefined levels— defined on a per channel basis.

On entering "failsafe":

a) If channel is in **Static** mode of operation:

Pulse mode is disabled and the channel is configured as a latched output and is driven to its failsafe value.

b) If channel is in **Dynamic** mode of operation:

If in single pulse (momentary) mode, the configuration is not cleared, but the output is driven to its failsafe value.

On leaving failsafe:

Channel will adopt the mode defined below for a channel going from inactive to active state

2) Channel using "Hold last value"

If the module goes into failsafe during a single pulse, it is allowed to complete the pulse before adopting the failsafe state. A latched (discrete) output will remain at its current value.

Channel Active/ Inactive

Each channel can be made active or inactive individually.

When a channel is made inactive the output is turned OFF (i.e. de-energised).

When a channel changes from inactive to active the following situations apply:

a) If channel is in **Static** mode of operation:

It becomes a latched output and will remain so until reconfigured by the BIM.

b) If channel is in **Dynamic** mode of operation:

The channel will resume operation with its previous configuration and output.

Power-up conditions

On power-up, or if a reset is executed, the configuration will automatically adopt predefined states:

Module mode:

Normal (not failsafe)

Channel types

All channels are configured as Discrete outputs

Active/Inactive

All channels power-up in the Inactive state

Line fault detection (2/1 only)

Disabled on all channels

Visual indicators

Channel "Status" LED (yellow)

On	Field circuit OK
Off	Open circuit field loop and channel inactive
Flashing	Open circuit field loop and channel active OR Error condition

On the DO modules the yellow "Status" LED reacts in the following way to module conditions.

Note: the LED may appear to be flashing when input goes high and low repeatedly.

Notes:
1. This action is only available in Static mode.
2. AC modules will react differently to the on-time length and trigger time. The module can only be triggered ON during a zero crossing of the AC waveform; similarly, the module can only switch OFF at a zero crossing point. The minimum on-time is therefore restricted to half the total period of a regular waveform.
3. Continuous pulse operation is supported only by Version 2 models of BIMs 8502 and 8505.
4. On 2/2 modules, this action is only available in Static mode.

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Pulse Input Modules - 2-channel pulse/quadrature

General

These modules are designed to meet the requirements of a very wide range of mechanical positioning and flow applications. When used separately, the two input channels will accept pulse inputs to measure:

- frequency
- acceleration / rate
- number of pulses (i.e. counter)

When combined, they provide:

- rotational position and direction data from quadrature encoding devices

In addition, the module has two digital outputs and one digital input to gate (start/stop) the channel 1 internal counter.

Pulse inputs

Pulse inputs can come from a range of sensors having different amplitudes, trigger levels and input impedance requirements. Inputs types accepted are:

- Proximity detectors (NAMUR/DIN19234)
- Current inputs
- Voltage inputs
- Switch / electro-mechanical inputs

Theshold levels for the current and voltage input can be set to suit the application.

Dynamic data

Several values are calculated, for each channel, from the signal pulses received.

Frequency

This is calculated by measuring the time interval between pulses. An average is calculated over a period (20 ms to 200 s) defined by the user. The time interval is measured from the edge of one pulse to the same edge of the next pulse. The polarity (rising or falling edge) can be configured. The default is the rising edge.

There are ten frequency measurement ranges. They start at 0 – 100 Hz and rise in ratios of 3, 5 and 10. However, the maximum frequency of the module is 50kHz, so any values in the 100 kHz range that exceed this should be considered as "out-of-range".

Acceleration

This is calculated from the difference in frequency from the start to the end of the sample period. A positive value indicates an increase in the rate of frequency and a negative value is a decrease in the rate.

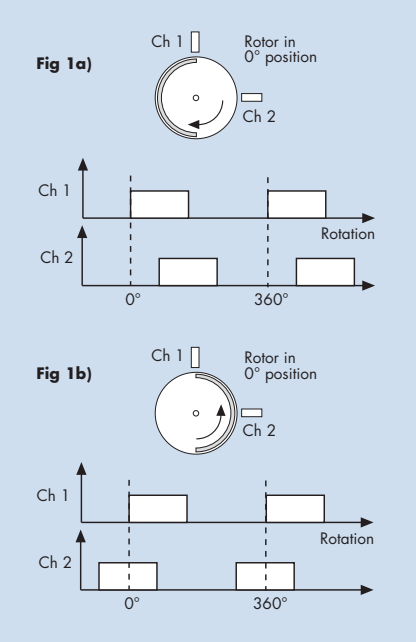
Counting

Each channel has a 32-bit counter that indicates the total number of input pulses since the counter was reset. The counter on Channel 1 can be started and stopped by the control gate input and both channel counters can be started, stopped and reset by BIM commands.

Counters can be configured to count up (the default) or down. If the quadrature calculation is enabled (see below) then the configured counter direction is ignored; instead counter direction is determined by the quadrature value (up for forward, down for reverse).

A counter preset value can be configured by a BIM command which also resets the counter. On reaching the preset count value an event is triggered which can also be passed to the channel's digital output. This state is cleared by resetting the counter or assigning a new preset value.

Quadrature (rotation direction)



The second channel can be used to determine direction of rotation by comparing the phase of its input p ulse with that of the first channel.

If the Ch 2 input is in a low state on the rising edge of the Ch 1 pulse then the rotation is forward (Fig 1a). If the Ch 2 input is high on the rising edge of the Ch 1 pulse then the rotation is backward (Fig 1b).

Filtering

The module has a hardware filter which can be used to minimise the effects of contact bounce. The available settings are 1, 5, 20 kHz and Off.

Alarms

High / Low alarms

High and low alarms can be configured for each channel. When the input value goes beyond an alarm limit, channel and module flags are set, the channel LED flashes and, if configured, the channel's digital output state will change.

Acceleration alarms

An acceleration alarm limit can also be set. If the limit is exceeded the actions taken are identical to those for the high/low alarms.

Alarm deadband

A deadband can be specified for the high, low and acceleration alarms. This provides hysteresis to avoid repetitive alarms in noisy signal environments.

Missing pulse alarm

Both channels can be configured to detect a "missing pulse". If no input pulse is detected for a defined time period an alarm is signalled in the same way as the high/low alarms.

The alarm is cleared on receipt of a pulse or on reconfiguration of the alarm. The time period is restarted after each sample period in which at least one pulse occurs.

Line Fault Detect

Each channel can be configured to sense an open or a short circuit condition on inputs. On detection, the actions are those for the high/low alarms.

On fault, the BIM can: report the frequency value as being at the top or the bottom of the range, freeze the counter, set the acceleration to zero; depending on how the BIM is configured.

Control data

The host can write data to control each channel counter. The available parameters are: start, stop, set, reset and preset value.

Digital outputs

Both digital output channels can reflect the status of the inputs by indicating:

- frequency or acceleration alarm
- counter preset value reached while the main channel can also output:
- quadrature forward or reverse signal
- scaled retransmission (a "divided by N" version of the input)

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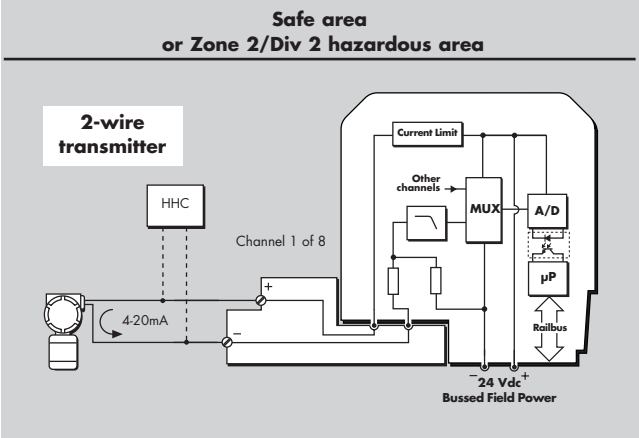
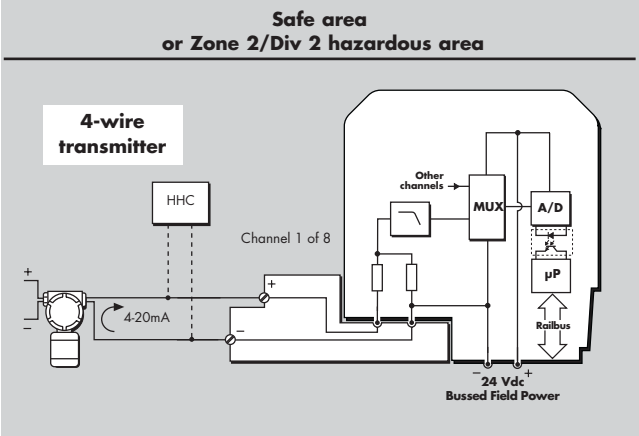
8-channel Analog Input

4–20 mA with HART®

8101-HI-TX

- *8 single-ended 4-20 mA input channels*
- *non-incendive field circuits*
- *HART pass-through*
- *HART variable and status reporting*
- *2- or 4-wire transmitters*
- *open and short circuit detection*
- *24 V dc bussed field power required*





MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels .....8, single-ended
Nominal signal range (span) .....4 to 20 mA
Full signal range.....1 to 23 mA
Line fault detection
Short circuit current .....> 23.5 mA
Open circuit current .....< 0.5 mA
Output voltage (@ 20mA).....13.5 V (min.)
Output current .....32 mA (max.)
Accuracy (over temp range) .....± 0.1% of span
Resolution .....16 bits
Repeatability .....0.05% of span
Isolation
(any channel to Railbus) .....100 V ac
(between channels).....none

CONFIGURABLE PARAMETERS

Alarms.....high, high-high, low and low-low
Alarm deadband (hysteresis).....user defined value
Input filter time constant.....user defined value
Input dead zone.....user defined value
Drive on failsafe..... disabled /upscale /downscale
Channel status..... active /inactive
HART variable and status reporting ..... enable /disable

RESPONSE TIME

Signal change to availability on Railbus
4–20 mA mode .....27 ms (max.)
HART mode.....0.75 s per channel

SAFETY

FM non-incendive field wiring parameters (each channel)
.....V_{oc} = 28.7 V; I_{sc} = 33 mA; C_a = 0.17 µF; L_a = 11.0 mH

POWER SUPPLIES

Railbus (12V) current .....100 mA (typ.)
.....150 mA (max.)
Bussed Field Power 2-wire Tx.....300 mA (max.)
(@ 24 V dc ±10%) 4-wire Tx.....60 mA (max.)

MECHANICAL

Module Key Code A1
Module width .....42 mm
Weight.....200 g

FIELD TERMINALS (2-WIRE TX)

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General Purpose	8602-FT-ST Standard	8604-FT-FU Fused
Class 1, Div 2 or Zone 2 hazardous area	8601-FT-NI Non-incendive	8603-FT-FU Non-incendive Fused

FIELD TERMINALS (4-WIRE TX)

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General Purpose	8615-FT-4W	-
Class 1, Div 2 or Zone 2 hazardous area	8615-FT-4W	-

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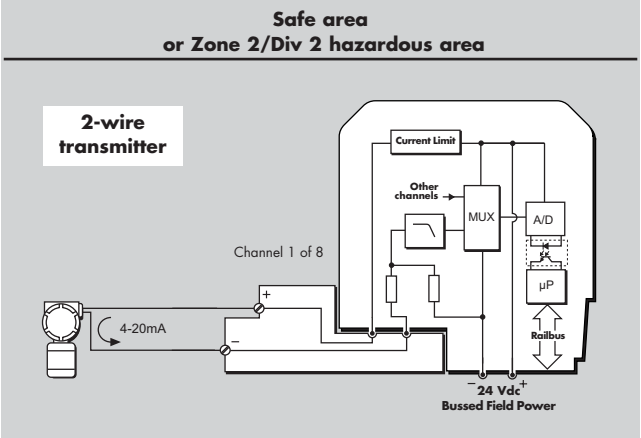
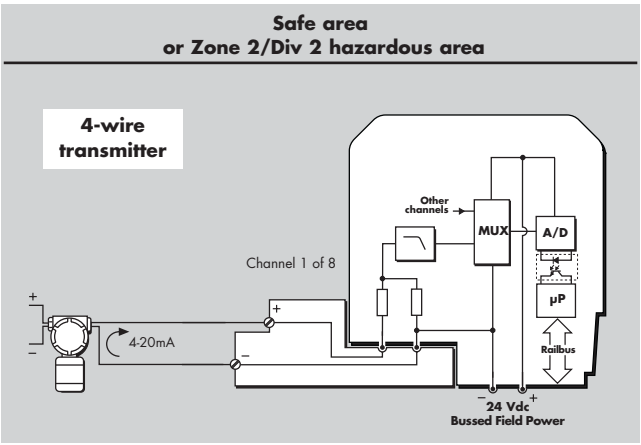
8-channel Analog Input

4–20 mA

8103-AI-TX

- *8 single-ended 4-20 mA input channels*
- *non-incendive field circuits*
- *4–20 mA*
- *2- or 4-wire transmitters*
- *open and short circuit detection*
- *24 V dc bussed field power required*





MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels .....8, single-ended
Nominal signal range (span) .....4 to 20 mA
Full signal range.....1 to 23 mA
Out of range alarm
Lower threshold.....> 23.5 mA
Upper threshold .....< 0.5 mA
Output voltage (@ 20 mA) .....13.5 V (min.)
Output current .....32 mA (max.)
Accuracy (over temp range) .....± 0.1% of span
Resolution .....16 bits
Repeatability .....0.05% of span
Isolation
(any channel to Railbus) .....100 V ac
(between channels).....none

CONFIGURABLE PARAMETERS

Alarms.....high, high-high, low and low-low
Alarm deadband (hysteresis) .....user defined value
Input filter time constant.....user defined value
Input dead zone.....user defined value
Drive on failsafe..... disabled /upscale /downscale
Channel status..... active /inactive

RESPONSE TIME

Signal change to availability on Railbus.....27 ms (max.)

SAFETY

FM non-incendive field wiring parameters (each channel)
.....V_{oc} = 28.7 V; I_{sc} = 33 mA; C_a = 0.17 μF; L_a = 11.0 mH

POWER SUPPLIES

Railbus (12V) current .....100 mA (typ.)
.....150 mA (max.)
Bussed Field Power .....2-wire Tx 300 mA (max.)
(@ 24 Vdc ± 10%) 4-wire Tx 60 mA (max.)

MECHANICAL

Module Key Code A1
Module width .....42 mm
Weight.....200 g

FIELD TERMINALS (2-WIRE TX)

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General Purpose	8602-FT-ST Standard	8604-FT-FU Fused
Class 1, Div 2 or Zone 2 hazardous area	8601-FT-NI Non-incendive	8603-FT-FU Non-incendive Fused

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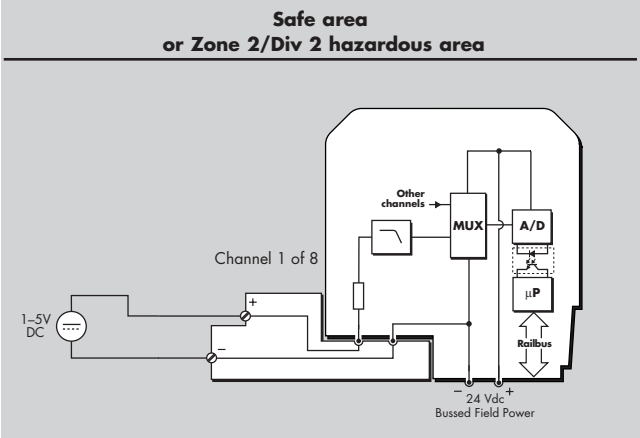
8-channel Analog Input

1–5 V

8119-VI-05

- *8 single-ended input channels*
- *non-incendive field circuits*
- *1–5 V inputs*
- *open circuit and short circuit detection*
- *24 V dc bussed field power required*



MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels .....8, single-ended
Nominal signal range (span).....1 to 5 V
Full signal range .....0.19 to 5.64 V
Input impedance.....2 MΩ
Out of range alarm
Lower threshold .....< 0.19 V
Upper threshold .....> 5.64 V
Accuracy (over temp range).....± 0.1% of span
Resolution .....16 bits
Repeatability .....0.05% of span
Isolation (any channel to Railbus).....100 V ac
(between channels).....none

CONFIGURABLE PARAMETERS

Alarms.....high, high-high, low and low-low
Alarm deadband (hysteresis) .....user defined value
Input filter time constant.....user defined value
Input dead zone.....user defined value
Drive on failsafe..... disabled /upscale /downscale
Channel status..... active /inactive

RESPONSE TIME

Signal change to availability on Railbus.....27 ms (max.)

SAFETY

FM non-incendive field wiring parameters (each channel)
.....V_{oc} = 28.7 V; I_{sc} = 33 mA; C_a = 0.17 µF; L_a = 11.0 mH

POWER SUPPLIES

Railbus (12V) current .....100 mA (typ.)
.....150 mA (max.)
Bussed Field Power ..... 60 mA (max.) at 24 Vdc ± 10%

MECHANICAL

Module Key Code A1
Module width .....42 mm
Weight.....200 g

FIELD TERMINALS

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General Purpose	8615-FT-4W 4-wire transmitter	–
Class 1, Div 2 or Zone 2 hazardous area	8615-FT-4W 4-wire transmitter	–

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4-channel Analog Input

Thermocouple and mV

8105-TI-TC

- *4 thermocouple or mV* input channels*
- *cold junction compensation*

MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels 4

THCs types

.....B,E,J,K,N,R,S, or T to EN 60584-2, IEC584-2, BS4937;

.....W3 and W5.

Input type	Range	Overall accuracy
mV	0 to + 120mV	±0.1% of span (+10 to +40°C)
		±0.2% of span (–40 to +70°C)
THC: B	0 to + 1820°C	< 600°C 1.5°C + BTA
		≥ 600°C 0.45°C + BTA
E	– 270 to + 1000°C	0.3°C + BTA
J	– 210 to + 1200°C	0.3°C + BTA
K	– 270 to + 1372°C	0.3°C + BTA
N	– 270 to + 1300°C	0.3°C + BTA
R	– 50 to + 1767°C	0.6°C + BTA
S	– 50 to + 1767°C	0.4°C + BTA
T	– 270 to + 400°C	0.3°C + BTA
W3	0 to + 2320°C	0.6°C + BTA
W5	0 to + 2320°C	0.4°C + BTA

Basic THC accuracy (BTA).....25°C ±0.05% of THC span

.....+10°C to +40°C ±0.1% of THC span

.....–40°C to +70°C ±0.3% of THC span

Cold junction compensation error† <± 1°C (–40 to + 70°C)

Resolution .....15 bits plus sign bit

Common mode rejection.....> 80 dB @ 50/60 Hz

Series mode rejection.....> 40 dB @ 50/60 Hz

Maximum input voltage .....± 4.0 V

Common mode voltage between channels..± 4.5 V (max.)

Isolation (any channel to Railbus) .....250 V ac rms

Open circuit bleed current.....± 0.5 µA (nom.)

CONFIGURABLE PARAMETERS

Sensor type.....user selectable

Input dead zone (hysteresis).....user defined value

Selectable input filtering ..off /2 reading avge./running avge.

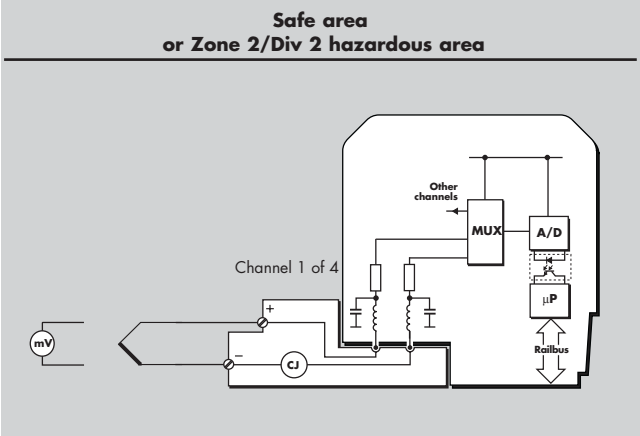
Drive on open circuit fault..... disabled /upscale /downscale

Alarms.....high and low

Channel status.....active/ inactive

** Consult GE for availability*

† C J compensation located in recommended field terminal



RESPONSE TIMES

Signal change to availability on Railbus

.....120 ms (min.)

.....420 ms (max.)

O/C sensor detection.....≤ 10 s

SAFETY

FM non-incendive field wiring parameters (each channel)

.....V_{oc} = 10.5 V; I_{sc} = 3.6 mA; C_a = 14.9 µF; L_a = 1000 mH

POWER SUPPLIES

Railbus (12V) current.....150 mA (typ.)

.....200 mA (max.)

Bussed Field Power .....not required

MECHANICAL

Module Key Code C1

Module width .....42 mm

Weight.....200 g

FIELD TERMINAL

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General purpose	8605-FT-TC THC	–
Class 1, Div 2 or Z one 2 hazadous area	8605-FT-TC THC	–

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4-channel Analog Input

RTD and Ω

8106-TI-RT

- *4 RTD or resistance* source inputs*
- *function defined by configuration*
- *2-, 3- or 4-wire RTD types accommodated*

MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels 4

RTD input (2,3, or 4 wire)

.....Pt100 to BS1904/DIN43760/IEC 75

.....Ni120; jPt100 to JIS C1604: 1989

Input range

Input type	Range
Resistance	Consult GE for availability
RTDs: Pt100	– 200 to + 850 °C
jPt100	– 200 to + 510 °C
Ni120	– 80 to + 320 °C

Input resistance range (span).....0 to 500 Ω

Accuracy (% of span)

Tamb	(RTD & Ω inputs)
25°C	± 0.05%
+10 to + 40°C	± 0.1%
– 40 to + 70°C	± 0.2%

RTD excitation current .....200 µA (nom.)

Resolution .....15 bits plus sign bit

Common mode rejection.....> 80 dB @ 50/60 Hz

Series mode rejection.....> 40 dB @ 50/60 Hz

Isolation (any channel to Railbus).....250 V ac rms

Open circuit bleed current.....0.5 µA (nom.)

CONFIGURABLE PARAMETERS

Sensor type.....user selection

Input deadzone .....user defined value

Selectable input filtering...off /2-reading avge./running avge.

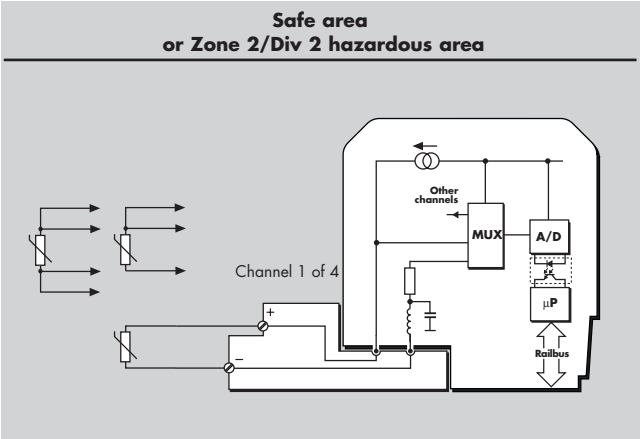
Drive on open circuit fault..... disabled /upscale

Alarms.....high and low

Channel status.....active/ inactive

Offset (2-wire RTD mode).....user defined value

** consult GE for availability*



RESPONSE TIMES

Signal change to availability on Railbus

.....180 ms (min.)

.....840 ms (max.)

O/C sensor detection.....≤ 10 s

SAFETY

FM non-incendive field wiring parameters (each channel)

.....V_{oc} = 10.5 V; I_{sc} = 3.6 mA; C_a = 14.9 µF; L_a = 1000 mH

POWER SUPPLIES

Railbus (12V) current.....150 mA (typ.)

.....200 mA (max.)

Bussed Field Power .....not required

MECHANICAL

Module Key Code C3

Module width .....42 mm

Weight.....200 g

FIELD TERMINAL

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General purpose	8606-FT-RT RTD	–
Class 1, Div 2 or Zone 2 hazardous areas	8606-FT-RT RTD	–

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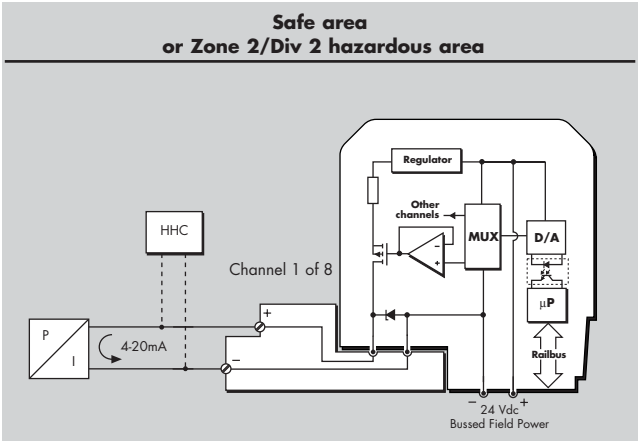
8-channel Analog Output

4–20 mA with HART®

8102-HO-IP

- *8 single-ended 4-20 mA output channels*
- *non-incendive field circuits*
- *HART pass-through*
- *HART variable and status reporting*
- *valve positioners and remote indicators, etc.*
- *open circuit detection on each channel*
- *24 V dc bussed field power required*



MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels .....8, single-ended
Nominal signal range (span) .....4 to 20 mA
Full signal range.....1 to 23 mA
Open loop detection threshold .....0.7 ± 0.25 mA
Output compliance .....20 mA at 21.6 V dc supply
.....(into 700 Ω load)
Accuracy (over temp range).....± 0.25% of span
Resolution .....12 bits
Isolation
(any channel to Railbus) .....100 V ac
(between channels).....none

CONFIGURABLE PARAMETERS

Initialisation state.....predefined value
Drive on fail-safe .....predefined value/last value
Channel status..... active /inactive
HART variable and status reporting.....enable /disable

RESPONSE TIME

Signal change to availability on Railbus
4–20 mA mode .....25 ms (max.)
HART mode.....0.75 s per channel

SAFETY

FM non-incendive field wiring parameters (each channel)
.....V_{oc} = 28.7 V; I_{sc} = 33 mA; C_a = 0.17 µF; L_a = 11.0 mH

POWER SUPPLIES

Railbus (12V) current .....100 mA (typ.)
.....150 mA (max.)
Bussed Field Power ..... 300 mA (max.) at 24 Vdc ± 10%

MECHANICAL

Module Key Code A4
Module width .....42 mm
Weight.....200 g

FIELD TERMINALS

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General Purpose	8602-FT-ST Standard	8604-FT-FU Fused
Class 1, Div 2 or Zone 2 hazardous area	8601-FT-NI Non-incendive	8603-FT-FU Non-incendive Fused

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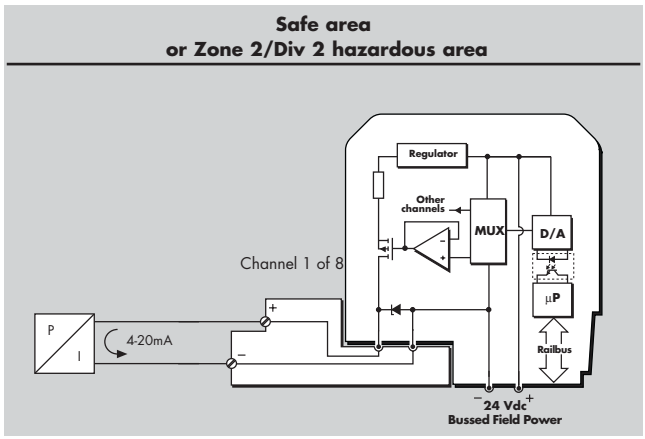
8-channel Analog Output

4–20 mA

8104-AO-IP

- *8 single-ended outputs*
- *4–20 mA*
- *for I/P converters and remote indicators, etc*
- *open circuit detection is provided on each channel*
- *24 V dc bussed field power required*



MODULE SPECIFICATION

See also System Specification

OUTPUTS

Number of channels .....8, single-ended
Nominal signal range (span) .....4 to 20 mA
Full signal output range .....1 to 23 mA
Open loop detection threshold .....0.7 ± 0.25 mA
Output compliance
.....20 mA at 21.6 V dc supply (into 700 Ω load)
Accuracy (over temp range) .....± 0.25% of span
Output ripple .....< 0.02% of span
Resolution .....12 bits
Isolation
any channel to Railbus .....100 V ac

CONFIGURABLE PARAMETERS

Initialisation state .....predefined value
Drive on fail-safe .....predefined value / last value
Channel status .....active / inactive

RESPONSE TIME

Response time
From Railbus command to output change .....25 ms (max.)

SAFETY

FM non-incendive field wiring parameters (each channel)
.....V_{oc} = 28.7 V; I_{sc} = 33 mA; C_a = 0.17 µF; L_a = 11.0 mH

POWER SUPPLIES

Railbus (12V) current .....100 mA (typ.)
.....150 mA (max.)
Bussed Field Power .....300 mA (max.) @ 24 V dc ±10%
Quiescent current .....60 mA

MECHANICAL

Module Key Code A4
Module width .....42 mm
Weight .....200 g

FIELD TERMINAL

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General purpose	8602-FT-ST Standard	8604-FT-FU Fused
Class 1, Div 2 or Zone 2 hazardous areas	8601-FT-NI Non-incendive	8603-FT-FU Non-incendive, fused

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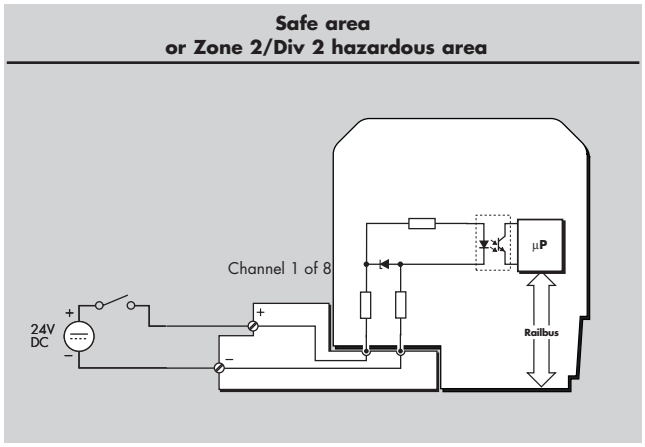
8-channel Discrete Input

24 V dc, isolated, sinking

8109-DI-DC

- *8 discrete isolated inputs*
- *24 V dc field voltage sources*
- *user definable input threshold*
- *pulse counting option*



MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels 8
OFF voltage.....< 3.2 V dc
ON voltage .....> 11 V dc
Wetting current .....6.3 mA (nom.) @ 24 V dc
Minimum pulse width detected .....3 ms
Maximum switching frequency (no-filtering).....200 Hz
Maximum voltage
Input .....30 V dc
Reverse input.....– 25 V dc

CONFIGURABLE PARAMETERS

Selectable input filter.....fast, slow or user defined
(User defined permits 0 to 512 ms values in 2ms steps)
Latch inputs.....enable /disable
Latch polarity.....latch on high / latch on low
Pulse counting .....enable /disable

RESPONSE TIME

I/O response time
Field event to new data available on Railbus.....3 ms (max.)

SAFETY

FM non-incendive field wiring parameters (each channel)
.....V_{max} = 30 V; I_{max} = 100 mA; C_i = 0 µF; L_i = 0 mH

POWER SUPPLIES

Railbus (12V) current.....35 mA (typ.)
.....55 mA (max.)
Bussed Field Power .....not required

MECHANICAL

Module Key Code.....B2
Module width .....42 mm
Weight.....170 g

FIELD TERMINAL

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General purpose	8602-FT-ST Standard †	8604-FT-FU Fused
Class 1, Div 2 or Zone 2 hazardous areas	8610-FT-NA Non-arcing †	8611-FT-FU Non-arcing Fused

† External fusing of the Field Power supply is recommended in order to protect the field wiring.

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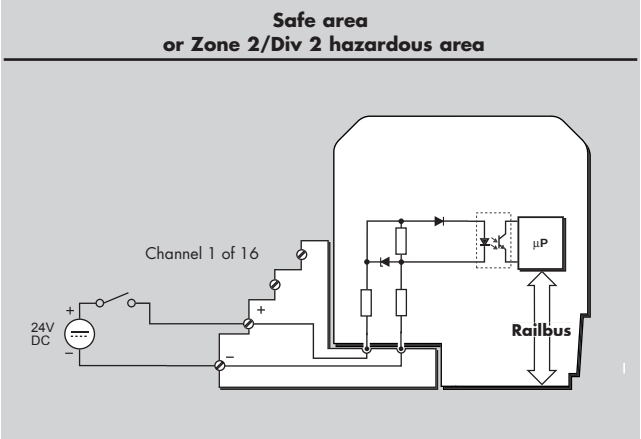
16-channel Discrete Input

24 V dc, isolated, sinking

8122-DI-DC

- *16 input channels*
- *24 V dc field voltage sources*
- *individually isolated channels*
- *user definable input threshod*
- *pulse counting option*



MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels 16
OFF voltage.....< 3.4 V dc
ON voltage .....> 11 V dc
Wetting current .....2.8 mA (nom.) @ 24 V dc
Minimum pulse width detected .....5 ms
Max input freq in pulse counting mode (no-debounce)
.....100 Hz
Maximum voltage
Input .....30 V dc
Reverse input .....– 25 V dc
Isolation (Any Channel to railbus).....250 V ac
Isolation (channel to channel) .....150 V peak

CONFIGURABLE PARAMETERS

Selectable input filter.....fast, slow or user defined
(User defined permits 0 to 512 ms values in 2ms steps)
Latch inputs.....enable /disable
Latch polarity.....latch on high / latch on low
Pulse counting .....enable /disable

RESPONSE TIME

I/O response time .....5 ms (max.)
(Field event to new data available on Railbus)

SAFETY

FM non-incendive field wiring parameters (each channel)
.....V_{max} = 30 V; I_{max} = 100 mA; C_i = 0 µF; L_i = 0 mH

POWER SUPPLIES

Railbus (12V) current.....90 mA (typ.)
.....135 mA (max.)
Bussed Field Power .....not required

MECHANICAL

Module Key Code.....E2
Module width .....42 mm
Weight.....210 g

FIELD TERMINAL

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General purpose	8617-FT-NI † 16 channel DI	–
Class 1, Div 2 or Zone 2 hazardous areas	8617-FT-NI † 16 channel DI	–

† External fusing of the Field Power supply is recommended in order to protect the field wiring.

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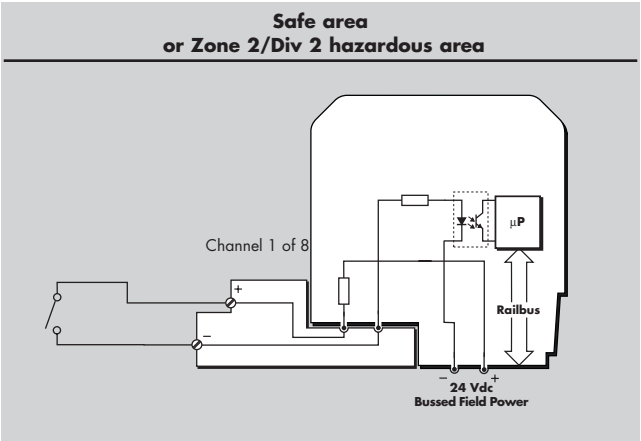
8-channel Discrete Input

24 V dc, non-isolated, module powered

8110-DI-DC

- *8 discrete inputs*
- *for dry contact switches*
- *24 V dc provided on input high side*
- *returns commoned internally*
- *pulse counting option*
- *24 V dc bussed field power required*



MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels 8
OFF current .....< 0.69 mA
ON current .....> 2.24 mA
Wetting current .....5 mA (typ.)
Minimum pulse width detected .....3 ms
Maximum switching frequency (no-filtering).....200 Hz
Isolation (any channel to Railbus) .....250 V ac

CONFIGURABLE PARAMETERS

Selectable input filter .....fast, slow or user defined
(User defined permits 0 to 512 ms values in 2ms steps)
Latch inputs .....enable /disable
Latch polarity.....latch on high / latch on low
Pulse counting .....enable /disable

RESPONSE TIME

I/O response time
Field event to new data available on Railbus.....3 ms (max.)

SAFETY

FM non-incendive field wiring parameters (each channel)
.....V_{oc} = 30 V; I_{sc} = 15.2 mA; C_a = 0.12 µF; L_a = 151 mH

POWER SUPPLIES

Railbus (12V) current.....35 mA (typ.)
.....55 mA (max.)
Bussed Field Power .....40 mA, @ 18—30 V dc

MECHANICAL

Module Key Code.....B1
Module width .....42 mm
Weight.....170 g

FIELD TERMINAL

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General purpose	8602-FT-ST Standard †	8604-FT-FU Fused
Class 1, Div 2 or Zone 2 hazardous areas	8601-FT-NI Non-incendive †	8603-FT-FU Non-incendive, fused

† External fusing of the field power supply is recommended in order to protect the field wiring.

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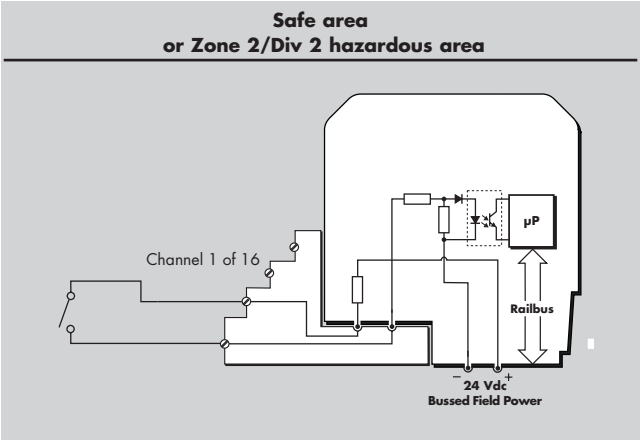
16-channel Discrete Input

24 V dc, non-isolated, module-powered

8121-DI-DC

- *16 input channels*
- *for dry contact switches*
- *24 V dc provided on input high side*
- *returns commoned internally*
- *pulse counting option*
- *24 V dc bussed field power required*



MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels 16
OFF current .....< 0.3 mA
ON current .....>1.2 mA
Wetting current .....2.8 mA (typ.)
Minimum pulse width detected .....5 ms
Max input freq in pulse counting mode (no-debounce)
.....100 Hz
Isolation (any channel to Railbus) .....250 V ac

CONFIGURABLE PARAMETERS

Selectable input filter .....fast, slow or user defined
(User defined permits 0 to 512 ms values in 2ms steps)
Latch inputs .....enable /disable
Latch polarity .....latch on high / latch on low
Pulse counting .....enable /disable

RESPONSE TIME

I/O response time .....5 ms (max.)
(Field event to new data available on Railbus)

SAFETY

FM non-incendive field wiring parameters (each channel)
.....V_{oc} = 30 V; I_{sc} = 3.5 mA; C_a = 0.12 µF; L_a = 1000 mH

POWER SUPPLIES

Railbus (12V) current .....90 mA (typ.)
.....135 mA (max.)
Bussed Field Power .....60 mA, @ 18–30 V dc

MECHANICAL

Module Key Code E1
Module width .....42 mm
Weight .....210 g

FIELD TERMINAL

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General purpose	8617-FT-NI 16 channel DI	–
Class 1, Div 2 or Zone 2 hazardous areas	8617-FT-NI 16 channel DI	–

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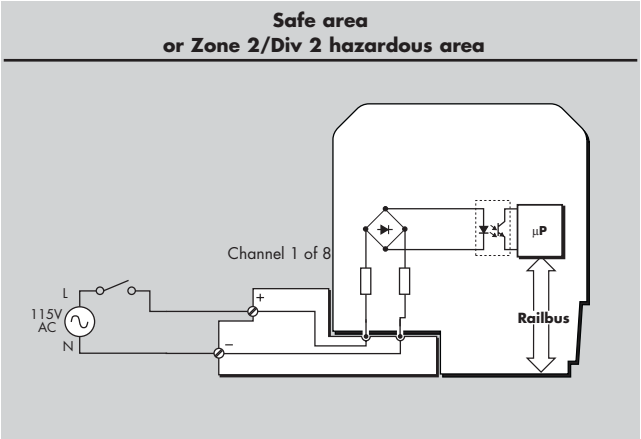
8-channel Discrete Input

115 V ac, isolated, sinking

8111-DI-AC

- *8 discrete inputs*
- *115 V ac field voltage sources*
- *user definable input threshold*
- *pulse counting option*



MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels 8
OFF voltage.....< 34 V ac
ON voltage .....> 84 V ac
Wetting current .....2 mA (nom.) @ 115 V ac
Max. input voltage .....130 V ac
Frequency .....50 / 60 Hz

CONFIGURABLE PARAMETERS

Selectable input filter.....fast, slow or user defined
(User defined permits 0 to 512 ms values in 2ms steps)
Latch inputs.....enable /disable
Latch polarity.....latch on high / latch on low
Pulse counting .....enable /disable

RESPONSE TIME

I/O response time
Field event to new data available on Railbus.....33 ms (max.)

POWER SUPPLIES

Railbus (12V) current.....40 mA (typ.)
.....60 mA (max.)
Bussed Field Power .....not required

MECHANICAL

Module Key Code.....E4
Module width .....42 mm
Weight.....170 g

FIELD TERMINAL

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General purpose	8602-FT-ST Standard †	8604-FT-FU Fused
Class 1, Div 2 or Zone 2 hazardous areas	8610-FT-NA Non-arching †	8611-FT-FU Non-arching, fused

† External fusing of the Field Power supply is recommended in order to protect the field wiring.

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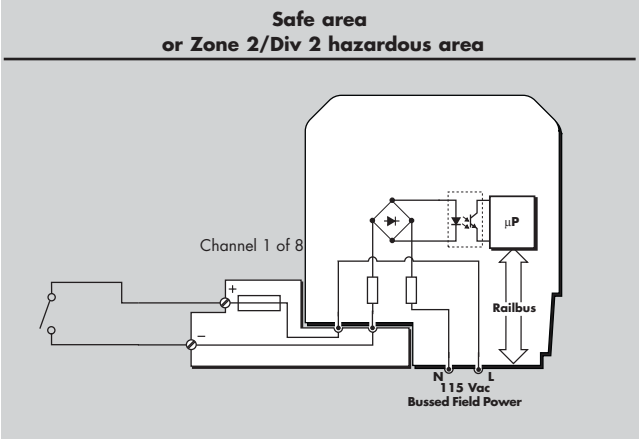
8-channel Discrete Input

115 V ac, non-isolated, module powered

8112-DI-AC

- *8 discrete inputs*
- *for dry contact switches.*
- *115 V ac provided on input high side*
- *returns commoned internally*
- *pulse counting option*
- *115 V ac Bussed Field Power required*



MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels 8
OFF current .....< 0.56 mA
ON current .....> 1.4 mA
Wetting current .....2 mA (nom.) @ 115 V ac

CONFIGURABLE PARAMETERS

Selectable input filter .....fast, slow or user defined
(User defined permits 0 to 512 ms values in 2ms steps)
Latch inputs .....enable /disable
Latch polarity .....latch on high / latch on low
Pulse counting .....enable /disable

RESPONSE TIME

I/O response time
Field event to new data available on Railbus.....33 ms (max.)

POWER SUPPLIES

Railbus (12V) current .....40 mA (typ.)
.....60 mA (max.)
Bussed Field Power .....115 V ac ±10%
Frequency .....50 / 60 Hz

MECHANICAL

Module Key Code E1
Module width .....42 mm
Weight .....170 g

FIELD TERMINAL

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General purpose	8604-FT-FU Fused	8602-FT-ST Standard †
Class 1, Div 2 or Zone 2 hazardous areas	8611-FT-FU Non-arcing, Fused	8610-FT-NA Non-arcing †

† Alternative fusing in the field wiring is recommended if it is not provided in the field terminal.

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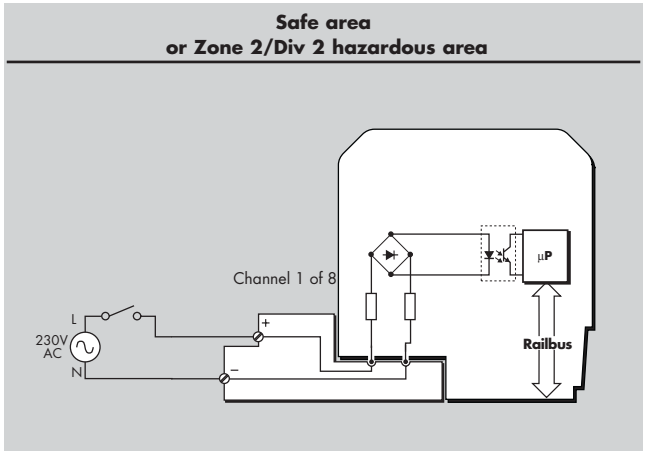
8-channel Discrete Input

230 V ac, isolated, sinking

8113-DI-AC

- *8 discrete isolated inputs*
- *230 V ac field voltage sources*
- *user definable input threshold*
- *pulse counting option*



MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels 8
OFF voltage.....< 68 V ac
ON voltage .....> 168 V ac
Wetting current .....1 mA (nom.) @ 230 V ac
Max. input voltage .....265 V ac
Frequency .....50 / 60 Hz

CONFIGURABLE PARAMETERS

Selectable input filter.....fast, slow or user defined
(User defined permits 0 to 512 ms values in 2ms steps)
Latch inputs.....enable /disable
Latch polarity.....latch on high / latch on low
Pulse counting .....enable /disable

RESPONSE TIME

I/O response time
Field event to new data available on Railbus.....33 ms (max.)

POWER SUPPLIES

Railbus (12V) current.....40 mA (typ.)
.....60 mA (max.)
Bussed Field Power .....not required

MECHANICAL

Module Key Code.....E5
Module width .....42 mm
Weight.....170 g

FIELD TERMINAL

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General purpose	8602-FT-ST Standard †	8604-FT-FU Fused
Class 1, Div 2 or Zone 2 hazardous areas	8610-FT-NI Non-arcing †	8611-FT-FU Non-arcing, fused

† External fusing of the Field Power supply is recommended in order to protect the field wiring.

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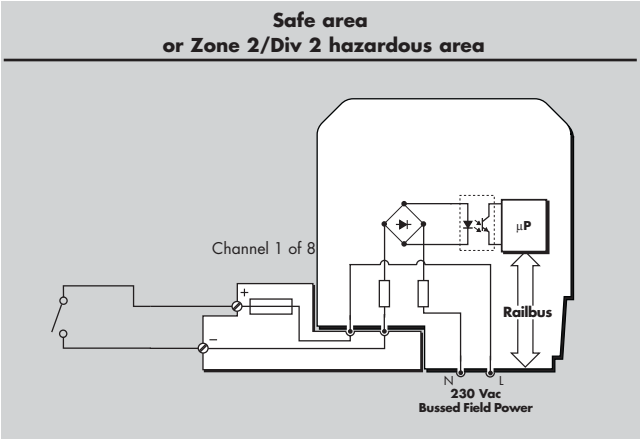
8-channel Discrete Input

230 V ac, non-isolated, module powered

8114-DI-AC

- *8 discrete inputs*
- *for dry contact switches.*
- *230 V ac provided on input high side*
- *returns commoned internally*
- *pulse counting option*
- *230 V ac Bussed Field Power required*



MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels 8
OFF current .....< 0.28 mA
ON current .....> 0.71 mA
Wetting current .....1 mA (nom.) @ 230 V ac

CONFIGURABLE PARAMETERS

Selectable input filter .....fast, slow or user defined
(User defined permits 0 to 512 ms values in 2ms steps)
Latch inputs .....enable /disable
Latch polarity .....latch on high / latch on low
Pulse counting .....enable /disable

RESPONSE TIME

I/O response time
Field event to new data available on Railbus.....33 ms (max.)

POWER SUPPLIES

Railbus (12V) current .....40 mA (typ.)
.....60 mA (max.)
Bussed Field Power .....207 to 265 V ac
Frequency .....50 / 60 Hz

MECHANICAL

Module Key Code E2
Module width .....42 mm
Weight .....170 g

FIELD TERMINAL

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General purpose	8604-FT-FU Fused	8602-FT-ST Standard †
Class 1, Div 2 or Zone 2 hazardous areas	8611-FT-FU Non-arcing, Fused	8610-FT-NA Non-arcing †

† Alternative fusing in the field wiring is recommended if it is not provided in the field terminal.

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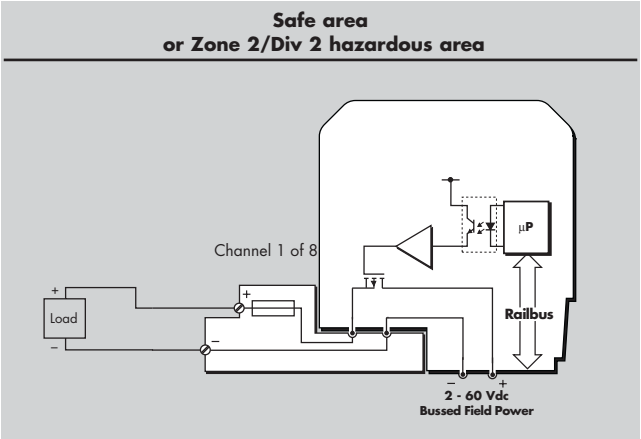
8-channel Discrete Output

2–60 V dc, non-isolated, module powered

8115-DO-DC

- *8 powered outputs*
- *controls solenoids and relays*
- *common load supply of up to 60 V dc*
- *discrete or pulsed outputs*
- *1A per channel switched current*
- *2–60 V dc bussed field power required*



MODULE SPECIFICATION

See also System Specification

OUTPUTS

Number of channels 8
Output voltage range.....2–60 V dc
ON voltage drop.....0.25 V (max.)
OFF leakage current .....1.0 mA (max.)
Switched current per channel ††
Continuous *.....1 A
For < 100 ms.....4 A
For < 20 ms.....6 A

CONFIGURABLE PARAMETERS

Output initialisation state.....predefined value
Fail-safe.....predefined value/last value
Output .....discrete, momentary or continuous pulse‡
Pulse width.....2 ms to 130 s

†† *The total instantaneous switched current should not exceed the following:*
10 A for < 100 ms
18 A for < 20 ms
**Limited to 6 A per module*
‡*Consult GE for availability*

RESPONSE TIME

Response time
From Railbus command to output change .....1 ms (max.)

POWER SUPPLIES

Railbus (12V) current.....45 mA (typ.)
.....70 mA (max.)
Bussed Field Power .....2 to 60 V dc

MECHANICAL

Module Key Code.....B6
Module width .....42 mm
Weight.....200 g

FIELD TERMINAL

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General purpose	8604-FT-FU Fused	8602-FT-ST Standard †
Class 1, Div 2 or Zone 2 hazardous areas	8611-FT-FU Non-arcing, Fused	8610-FT-NA Non-arcing †

† Alternative fusing in the field wiring is recommended if it is not provided in the field terminal.

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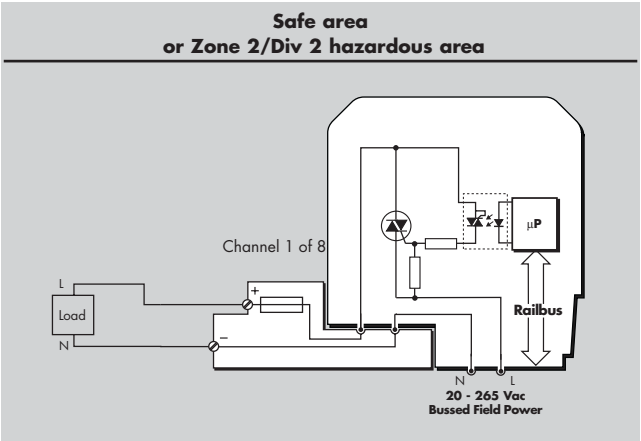
8-channel Discrete Output

20–265 V ac, non-isolated, module powered

8116-DO-AC

- *8 powered outputs*
- *controls solenoids and relays*
- *common load supply of up to 265 V ac*
- *discrete or pulsed outputs*
- *1A per channel maximum*
- *20–265 V ac bussed field power required*



MODULE SPECIFICATION

See also System Specification

OUTPUTS

Number of channels 8
Output voltage range.....20–265 V ac
Frequency .....50 / 60 Hz
ON voltage drop.....< 1.2 V
OFF leakage current .....< 4mA
Switched current per channel †
Continuous.....1 A*
For < 100 ms.....5 A
For < 20 ms.....20 A
Minimum load current, per channel
@ 115 V ac.....11 mA
@ 230 V ac.....5 mA

† Stated figures are for operation with unfused field terminal. When operating with 2 A fused field terminal part no. 8604-FT-FU, maximum switched current is 5 A inrush for <10 ms pulse width at 0.1% duty cycle and <10^8 operations

**Limited to 3 A per module.*
‡Consult GE for availability

CONFIGURABLE PARAMETERS

Output initialisation state.....predefined value
Fail-safe.....predefined value/last value
Output .....discrete, momentary or continuous pulse‡
Pulse width.....2 ms to 130 s

RESPONSE TIME

Response time (max.) .....2 ms + 1½ cycle of mains frequency
(From Railbus command to output change)

POWER SUPPLIES

Railbus (12V) current.....75 mA (typ.)
.....125mA (max.)
Bussed Field Power (voltage).....20 to 265 V ac

MECHANICAL

Module Key Code F1
Module width .....42 mm
Weight.....220 g

FIELD TERMINAL

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General purpose	8604-FT-FU Fused	8602-FT-ST Standard †
Class 1, Div 2 or Zone 2 hazardous areas	8611-FT-FU Non-arcing, Fused	8610-FT-NA Non-arcing †

† Alternative fusing in the field wiring is recommended if it is not provided in the field terminal.

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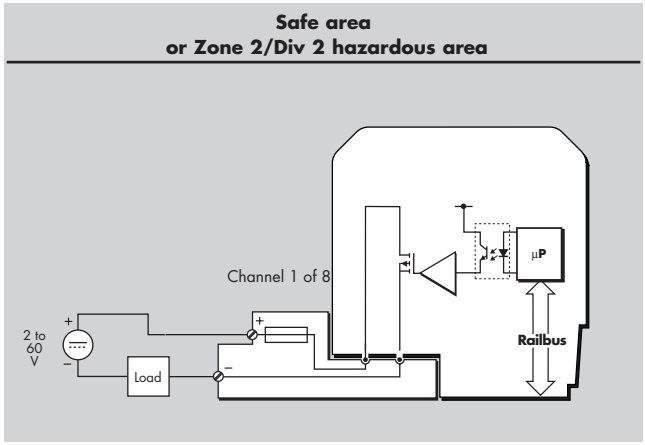
8-channel Discrete Output

2–60 V dc, isolated, unpowered

8117-DO-DC

- *8 fully isolated semiconductor switched outputs*
- *controls solenoids and relays*
- *for load supplies of up to 60 V dc*
- *discrete or pulsed outputs*
- *1A per channel switched*



MODULE SPECIFICATION

See also System Specification

OUTPUTS

Number of channels 8
Output voltage range ..... 2–60 V dc
ON voltage drop ..... 0.25 V (max.)
OFF leakage current ..... 1.0 mA (max.)
Switched current per channel
Continuous ..... 1 A
For < 100ms ..... 4 A
For < 20ms ..... 6 A

CONFIGURABLE PARAMETERS

Output initialisation state ..... predefined value
Fail-safe ..... predefined value/last value
Output ..... discrete, momentary or continuous pulse‡
Pulse width ..... 2 ms to 130 s

RESPONSE TIME

Response time
From Railbus command to output change ..... 3 ms (max.)

‡*Consult GE for availability*

POWER SUPPLIES

Railbus (12V) current ..... 45 mA (typ.)
..... 70 mA (max.)
Bussed Field Power ..... not required

MECHANICAL

Module Key Code B5
Module width ..... 42 mm
Weight ..... 200 g

FIELD TERMINAL

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General purpose	8604-FT-FU Fused	8602-FT-ST Standard
Class 1, Div 2 or Zone 2 hazardous areas	8611-FT-FU Non-arcing, Fused	8610-FT-NA Non-arcing

Note: External fusing to protect field wiring is recommended.

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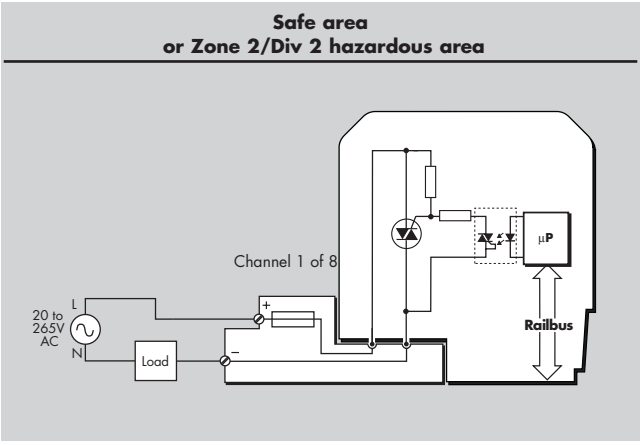
www.ge-ip.com/process

8-channel Discrete Output

20–265 V ac, isolated, unpowered

8118-DO-AC

- *8 fully isolated semiconductor switched outputs*
- *controls solenoids and relays*
- *for load supplies of up to 250 V ac*
- *discrete or pulsed outputs*
- *1A per channel maximum*



MODULE SPECIFICATION

See also System Specification

OUTPUTS

Number of channels 8
Output voltage range.....20–265 V ac
Frequency .....50 / 60 Hz
ON voltage drop.....< 1.2 V
OFF leakage current .....< 4 mA
Switched current per channel †
Continuous.....1 A*
For < 100ms.....5 A
For < 20ms.....20 A
Minimum load current, per channel
@ 115 V ac.....11 mA
@ 230 V ac.....5 mA

† Stated figures are for operation with unfused field terminal. When operating with 2 A fused field terminal part no. 8604-FT-FU, maximum switched current is 5 A inrush for <10 ms pulse width at 0.1% duty cycle and <10^8 operations.

** Limited to 3 A per module.*
‡Consult GE for availability

CONFIGURABLE PARAMETERS

Output initialisation state.....predefined value
Fail-safe.....predefined value/last value
Output .....discrete, momentary or continuous pulse‡
Pulse width.....2 ms to 130 s

RESPONSE TIME

Response time (max.) .....2 ms + 1½ cycle of mains frequency
(From Railbus command to output change)

POWER SUPPLIES

Railbus (12V) current.....75 mA (typ.)
.....125 mA (max.)
Bussed Field Power .....not required

MECHANICAL

Module Key Code F4
Module width .....42 mm
Weight.....220 g

FIELD TERMINAL

Field wiring	Recommended Field Terminal	Compatible Field Terminal
General purpose	8604-FT-FU Fused	8602-FT-ST Standard
Class 1, Div 2 or Zone 2 hazardous areas	8611-FT-FU Non-arcing, Fused	8610-FT-NA Non-arcing

Note: External fusing to protect field wiring is recommended.

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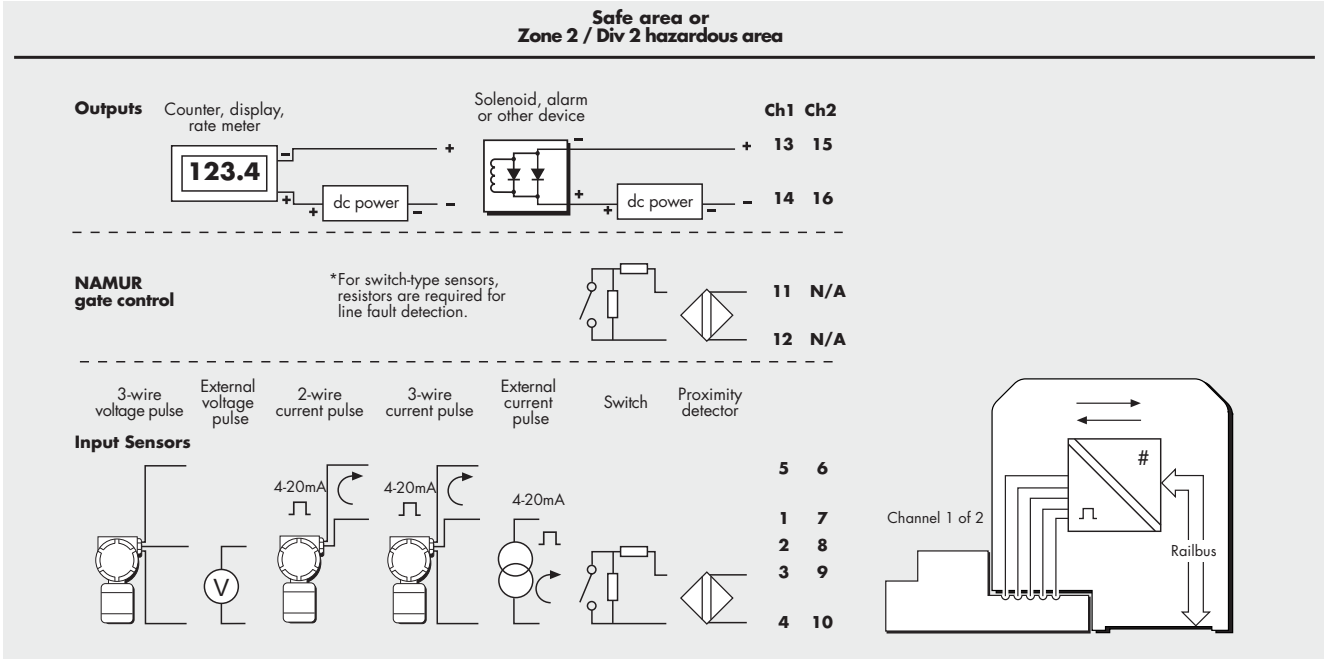
Pulse Input Module

2-channel pulse/quadrature input

8123-PI-QU



- *2 input channels with power supplies or single quadrature input*
- *1 Hz to 50 kHz signal capability*
- *frequency & acceleration measurement*
- *2-alarm/repeater retransmitted output channels*
- *2- and 3-wire pulse transmitter format*
- *pulse counting (with gate control)*
- *channels independently configurable*
- *open circuit, short circuit and missing pulse detection*

MODULE SPECIFICATION

See also System and Common Module Spec.

INPUTS

PULSE/FREQUENCY

Number of channels 2
Frequency range.....50 kHz
(in quadrature mode) .....12.5 kHz
Accuracy (25°C).....± 0.05% of span
Temperature Stability .....0.005% / °C

CONTROL GATE (for gating Channel 1 only)

Switching thresholds.....1.2 mA / 2.1 mA
Input impedance .....1 kΩ
Supply voltage .....8.1 V (nom.) at 8 mA

SENSOR INPUT CHARACTERISTICS

NAMUR 1

Switching thresholds.....1.2 mA / 2.1 mA
Input impedance .....1 kΩ
Supply voltage .....8.1 V (nom.) at 8 mA

CURRENT

Input signal.....20 mA (max.)
Threshold .....configurable in 8 levels
Input impedance.....25 Ω
Open circuit current .....< 0.5 mA
Short circuit current.....> 21.5 mA

VOLTAGE

Input signal.....0 - 24 V dc (50 V max.)
Threshold .....configurable in 8 levels
Input impedance .....> 10 kΩ
Switching hysteresis..... 100 mV

SWITCH

Input voltage range .....0 – 10 V dc

OUTPUTS

The outputs are **open-collector type** for separately powered devices such as LED clusters, annunciators or solenoids

Number of channels 2
OFF state voltage .....30 V (max)
OFF state leakage current.....10µA (max)
ON state voltage drop.....<1.0V @ 50 mA
ON state current.....100 mA
Retransmission bandwidth .....1 – 2000 Hz

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Pulse Input Module

2-channel pulse/quadrature input

8123-PI-QU

CONFIGURABLE PARAMETERS

INPUTS

Channel .....enable / disable
Sensor type.....NAMUR prox. type (select low / high speed)
.....current pulse input
.....voltage pulse input
.....switch input
Frequency ranges... 0.1, 0.3, 0.5, 1, 3, 5, 10, 30, 50, 100* kHz
Sample period.....20 ms to 200 s
Quadrature .....enable / disable
Threshold level.....user defined values
Triggering.....rising edge / falling edge
Filtering.....off, 1, 5, 20, 100 kHz
Alarms.....frequency / acceleration
Alarm limits.....high / low
Alarm deadband (hysteresis) .....user defined value
Line fault detect.....enable / disable
Channel status.....active / inactive
Counter.....enable / disable
Counting direction .....count up / count down
**While measurements can be made in the upper half of this range, the stated accuracy applies only to frequencies up to 50 kHz.*

DISCRETE OUTPUT

Function selection.....disabled
.....high / low alarm
.....acceleration alarm
.....counter preset value reached
.....quadrature output (channel 1 only)
.....scaled retransmission (channel 1 only)
Retransmission scaling (K factor – channel 1 only) ....1 – 256

AUXILIARY DISCRETE INPUT

Counter (channel 1).....start (count)/pause

DYNAMIC DATA (READ ONLY)

PROCESS VALUES

Frequency.....16 bit unsigned
Count.....32 bit signed
Acceleration.....16 bit signed

STATUS VALUES

Frequency / acceleration alarms .....High / low
.....missing pulse detect
Line fault detect .....open/short circuit
Quadrature direction.....1 =clockwise, 2 =anti-clockwise
Counter alarms.....preset value reached

CONTROL DATA (WRITE ONLY)

Counter preset value.....32 bit signed
.....load preset value = 0 to disable
Counter commands.....start / stop / reset
Note: Channel 1 counter can also be controlled by control gate input: 1= start (count), 0 = pause

ISOLATION

Any channel to Railbus .....100 V ac
Between input channels.....none (common 0V connection)
Between output channels.....30 V ac

RESPONSE TIMES

Signal change to availability on Railbus.....25 ms (max.)

POWER SUPPLIES

Railbus current (both channels @22 mA).....300 mA (max.)
Bussed field power .....20 mA @ 24 ± 10% V dc
Power dissipation (both channels @22 mA)..2.8 W (max.)
(no load) .....2.0 W (max.)

MECHANICAL

Module Key Code.....F2
Module width.....42 mm
Weight.....260 g

TERMINAL ASSIGNMENTS

Terminal	Description	
1	Current input	Channel #1
2	Voltage input	
3	NAMUR input	
4	Common	
5	Power supply +ve	
6	Power supply +ve	Channel #2
7	Current input	
8	Voltage input	
9	NAMUR input	
10	Common	
11	NAMUR gate/control input	Channel #1
12	Common	
13	Output +ve	
14	Output –ve	
15	Output +ve	Channel #2
16	Output –ve	

FIELD TERMINALS

Field wiring	Recommended Field Terminal
General Purpose	8602-FT-ST Standard
Class 1, Div 2 or Zone 2 hazardous area	8601-FT-NI Non-incendive

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Pulse Input Module

2-channel pulse/quadrature input

8123-PI-QU

SAFETY

Field wiring protection.....non-incendive

FM and ATEX Cat 3 NON-INCENDIVE FIELD WIRING PARAMETERS

The following figures are for Gas Groups A/B (IIC) unless otherwise stated.

Current inputs (Ch1 & Ch2)

.....Uo ≤ 0.6 V, Io ≤ 0.5 mA, Po ≤ 75 µW

.....Ca = 1000 µF, La = 1000 mH

3-wire current inputs (Ch1 & Ch2)

.....Uo 30 V, Io ≤ 102.5 mA, Po ≤ 765.7 mW

.....Ca = 0.165 µF, La = 6 mH, La/Ra = 82 µH/Ω

Voltage inputs (Ch1 & Ch2)

.....Uo ≤ 5.5 V, Io ≤ 0.58 mA, Po ≤ 0.8 mW

.....Ca = 535 µF, La = 1000 mH

3-wire voltage inputs (Ch1 & Ch2)

.....Uo ≤ 30 V, Io ≤ 102.6 mA, Po ≤ 765.8 mW

.....Ca = 0.165 µF, La = 6 mH, La/Ra = 82.1 µH/Ω

NAMUR inputs (Ch1 & Ch2)

.....Uo ≤ 9.1 V, Io ≤ 10.6 mA, Po ≤ 24 mW

.....Ca = 20 µF, La = 490 mH

NAMUR gate input (Ch1)

.....Uo ≤ 9.1 V, Io ≤ 10.6 mA, Po ≤ 24 mW

.....Ca = 20 µF, La = 490 mH

Discrete outputs (Ch1 & Ch2)

Each pair of field terminals may be considered as non-incendive when connected into a field circuit with the following parameters

.....V_{max}=30 Vdc, I_{max}=100 mA, C_i=0 µF, L_i=0 mH

LED INDICATORS

POWER – Green LED

OFF	ON	FLASHING
Power failure	Power OK	Not applicable

FAULT – Red LED

OFF	ON	FLASHING
In running state	Fault	Awaiting module training

PULSE INPUT CHANNEL – Yellow LED

OFF	ON	FLASHING
Channel inactive	Channel active and operating normally	Channel active but in alarm condition

DIGITAL OUTPUT CHANNEL – Yellow LED

OFF	ON	FLASHING
Channel inactive	Channel active and operating normally	Not applicable

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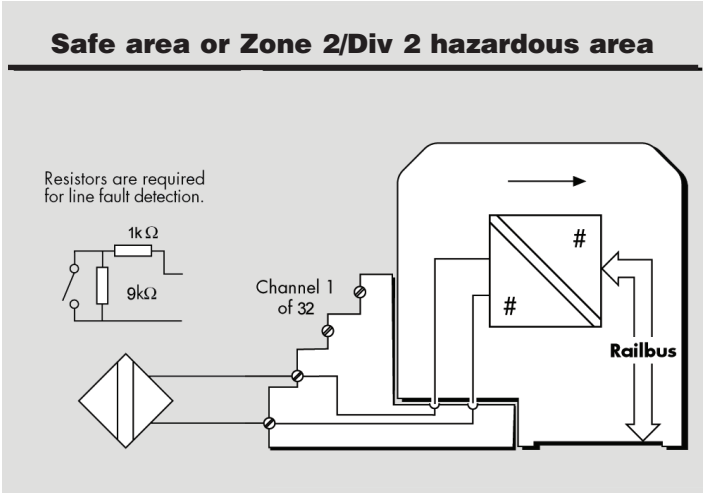
32-Channel Discrete Input

Switch/Proximity Detector Inputs, Module Powered — 8125-DI-DC

Features:

- 32 input channels
- For Dry Contact Switches or Proximity Detectors
- Pulse Counting and Latching Option
- 24 Vdc bussed field power required
- Line fault detection on all inputs (switch inputs need resistors)



SPECIFICATIONS

See also System and Common Module Specification

Number of Channels 32

INPUT SPECIFICATION

OFF current.....<1.2 mA
ON current .....>2.1 mA
Short Circuit Current .....8.6 mA (typ)
Output Resistance .....950 Ω (typ)
Open Circuit output voltage .....8.2V dc (typ)
Line Fault Detection
Short Circuit.....<100 Ω
Open Circuit.....<50 μA
Input voltage range without damage ..... 0 to +12 V dc
Isolation (channel to Railbus) .....250 V ac
Input sampling rate(all 32) .....8 kHz
Input Pulse Width .....250 μS (min)
DI Counting frequency without loss.....500 Hz (max)
Applicable Specification.....NAMUR, DIN 19234

CONFIGURABLE PARAMETERS

Input Filter.....0 to 8.192 secs in 250 μS steps
Pulse Counting .....on/off
Latching .....on/off

RESPONSE TIME

Input Module Scan Time .....<1 mS
(Inputs sampled at 8kHz and processed every 1 mS)

SAFETY

FM non-incendive field wiring parameters (each channel)
Voc ≤ 8.64 V; Isc ≤ 18.5 mA; Ca ≤ 28 μF; La ≤ 23.6 mH

POWER SUPPLIES

Railbus(12V) current.....<50 mA
Bussed Field Power .....190 mA (max) at 24V dc

MECHANICAL

Module Key Code.....B3 Non Arcing
Module Width .....42 mm
Weight .....185 g

FIELD TERMINAL

Field Wiring	Recommended Field Terminal	Mass Field Terminal
General Purpose	8617-FT-NI 30 channel DI	8619-FT-MT 32 channel DI
Class 1, Div 2 Or Zone 2 Hazardous area	8617-FT-NI 30 channel DI	8619-FT-MT 32 channel DI

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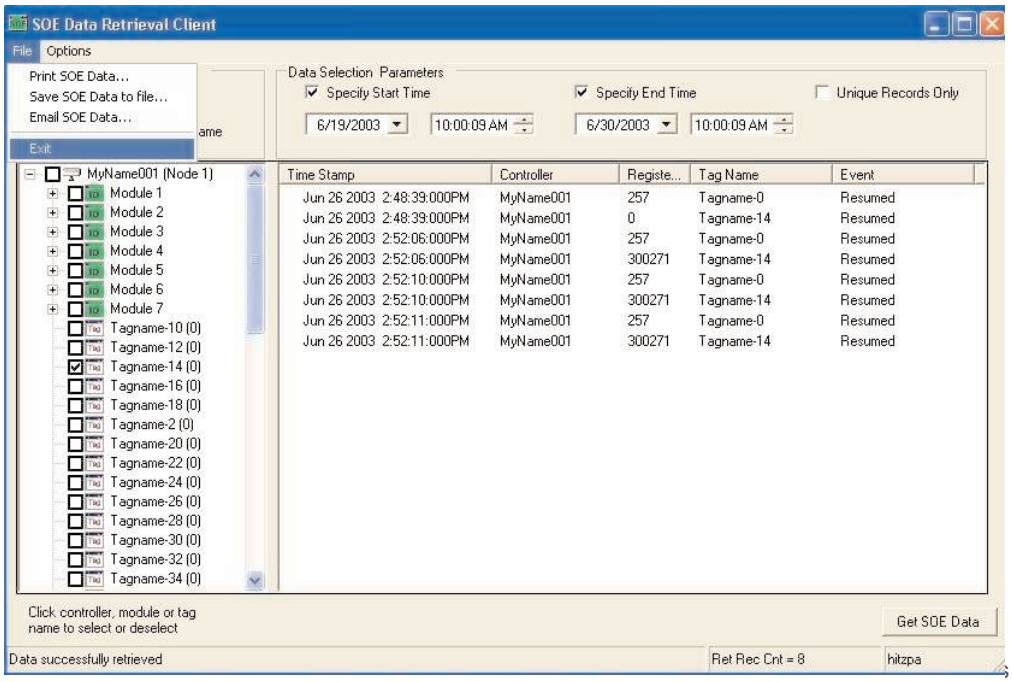
32-Channel Sequence Of Events

Non-Isolated, Module-Powered 8127-DI-SE

Features:

- 32 channel module, configurable channel by channel as DI, SOE or both
- Switch or Proximity Detector Inputs
- Captures events with 1/4 ms resolution
- Distributed architecture provides accurate event recording
- Line fault detection on all inputs (switch inputs need resistors)
- 24 Vdc bussed field power required
- Module provides power to all field inputs, simplifying field wiring
- High time stamp resolution for more accurate event sequencing
- Log data from other events, including controller status and module alarms
- Export data to PC applications for reporting or further analysis



32 Channel Sequence of Events 8127-DI-SE Non-Isolated, Module-Powered

Sequence of Events (SOE recording is needed to capture both the first event and the sequence of a number of events that occurred during a shut-down or trip sequence in order to better understand the cause of the event. When this occurs, events can take place very rapidly throughout your process area. The SOE Modules and companion Event Logger Software provide a means of recording these events and use highly accurate time stamps to determine the precise order in which they occurred.

8127-DI-SE is a 32-channel SOE module whose primary focus is to monitor the status of digital inputs and record state changes to an internal buffer. The state changes are time-stamped to the nearest 1/4 millisecond. Once recorded the states the state data is periodically transferred to the controller. Each module has a buffer size of 512 events which the controller can empty in about 500 ms, capturing approximately 1000 events per second.

SOE Event Logger Software

SOE event logger software is provided with all PAC8000 Workbench products. The event logger software collects time stamped data from the controller, merges information from multiple controllers into a chronological journal and exports the data to standard event viewers. Other data export options include OPC Event format or a basic text file.

to record other events in addition to SOE activity. For example, it could be used to record changes of state in the controller, such as when control switches between redundant controllers. It could be used to record when an analog limit has been exceeded or when a digital module changes state. This powerful capability enables you to record all the critical events in your process, providing you with a complete picture for further analysis.

Benefits

• More accurate event sequencing

All logged events are time stamped using 1/8 ms resolution for 1/4 ms accuracy. The Controller uses Network Time Protocol (NTP) to assure time stamp accuracy between modules across the network. When using NTP, all controllers are synchronized across the network to ± 3 ms, resulting in very accurate event sequencing.

• Identify problems quickly

Each SOE input has a unique line fault detection feature that detects whether there is a short circuit or open circuit on each input. Problems are identified immediately for correction, saving considerable maintenance time.

• Simplifies field wiring

Field circuits are module-powered, eliminating the need to "daisy chain" power supply wiring at field terminals. Field circuits are powered with a minimum of wiring and termination effort.

• Locate SOE modules in the process

Like the rest of the control platform, SOE modules can be located in your process, next locally on a more reliable & timely basis.

• Easy integration with other applications

Events from multiple modules and controllers can be stored in a single SOE Event Logger providing an easy interface to other applications.

32 Discrete Channels

The 8127-DI-SE has 32 discrete input channels and each channel can be configured as either an SOE input or a standard discrete input. SOE input signals can also be used as standard discrete inputs as part of any control strategy. Each module can buffer up to 512 events. Events are communicated to the controller, which uses Network Time Protocol (NTP) to accurately convert the module's time stamp data to real time. The SOE Event Logger, which constantly polls the controller for new events (typically every 2 seconds), collects each time-stamped event. After recording the events, the Event Logger sends and acknowledgement to the controller, which then clears the event from its memory. The controller retains all events until all active Event Loggers acknowledge them. Multiple Event Loggers can be used for redundant event recording and will always have consistent time stamps since all events are time stamped by the controller.

Events are displayed by the SOE data Retrieval Client. Following data retrieval, the user can select to email the SOE data, Print it or Save it to a CSV file. The user can easily create a custom report, selecting the columns to be viewed and printed.

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Non-Isolated, Module-Powered

8127-DI-SE

MODULE SPECIFICATION

See also System and Common Module Specification

Number of Channels 32
(Each DI channel can be configured with or without SOE)

INPUT SPECIFICATION

OFF current.....<1.2 mA
ON current .....>2.1 mA
Short Circuit Current .....8.6 mA (typ)
Output Resistance.....950 Ω (typ)
Open Circuit output voltage .....8.2 V dc (typ)
Line Fault Detection
Short Circuit.....<100 Ω
Open Circuit.....<50 μA
Input voltage range without damage ..... 0 to +12 V dc
Isolation (channel to Railbus) .....250 V ac
Input sampling rate(all 32) .....8 kHz
Input Pulse Width .....250 μS (min)
DI Counting frequency without loss.....500 Hz (max)
Applicable Specification.....NAMUR, DIN 19234

SOE SPECIFICATION

Module Event Buffer.....480 Events+32 Overflow
Event Recording peak rate, module.....64000 events/sec
Duration of peak rate.....7.5 ms (max)
(for 32 SOE channels enabled)
Event Recording continuous rate, module 220 events/sec (min)
Each of 32 inputs.....6.8 events/sec (min)
Excessive Event Threshold (for 32 inputs) .....150 events/sec
.....(for each channel)
SOE Module time stamping resolution .....125 μS
System Time Stamping resolution .....250 μS
Simultaneous Inputs, Time Stamping error
Within one module .....0.25 ms (max)
Within one 8000 Node.....1.0 ms (max)
Between 8000 Nodes.....5.0 ms (typ)
(Absolute time stamping accuracy will depend on Network Time Reference in use)

CONFIGURABLE PARAMETERS

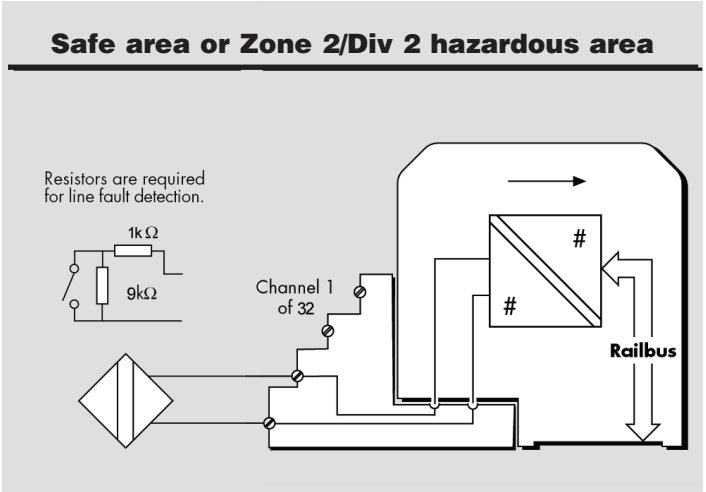
SOE Logging.....Configurable per channel
Input Filter.....0 to 8.192 secs in 250 μS steps
Pulse Counting .....on/off
Latching .....on/off

RESPONSE TIME

Input Module Scan Time .....<1 mS
(Inputs sampled at 8KHz and processed every 1 mS)

SAFETY

FM non-incendive field wiring parameters (each channel)
Voc ≤ 8.64 V; Isc ≤ 18.5 mA; Ca ≤ 28 μF; La ≤ 23.6 mH



POWER SUPPLIES

Railbus(12V) current.....<50 mA
Bussed Field Power .....190 mA (max) at 24 V dc

MECHANICAL

Module Key Code.....B3 Non Arcing
Module Width .....42 mm
Weight .....185 g

FIELD TERMINALS

Field Wiring	Recommended Field Terminal	Mass Field Terminal
General Purpose	8617-FT-NI 30 channel SOE	8619-FT-MT 32 channel SOE
Class 1, Div 2 Or Zone 2 Hazardous area	8617-FT-NI 30 channel SOE	8619-FT-MT 32 channel SOE

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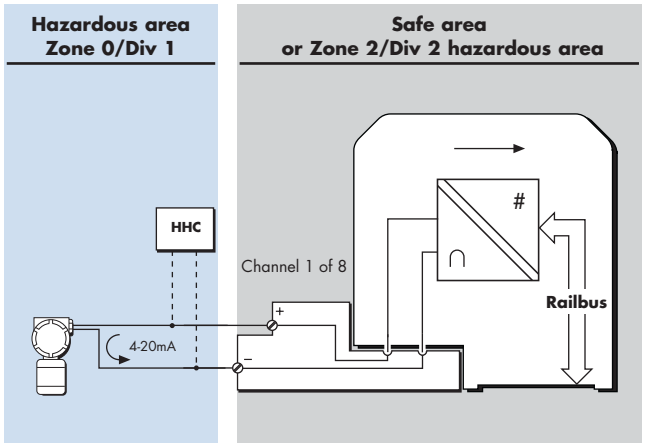
8-channel Analog Input

4–20 mA with HART®

8201-HI-IS

- *8 single-ended input channels*
- *intrinsically safe field circuits*
- *conventional 4–20 mA*
- *HART pass-through*
- *HART variable and status reporting*
- *for 2-wire transmitters*
- *in-built power supply*



MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels 8
Nominal signal range (span) .....4 to 20 mA
Full signal range.....0.5 to 22 mA
Line fault detection
Short circuit current .....> 21.5 mA
Open circuit current.....< 0.5 mA
Voltage to transmitter @ 20mA .....15 V (min.)
Accuracy (@25 °C) .....± 20 µA
Resolution .....16 bits
Temperature Stability
(– 40 °C to +70 °C) .....± 0.006% of span per °C
Isolation
(any channel to Railbus) .....60 V ac
(between channels in same module) .....none

CONFIGURABLE PARAMETERS

Alarms.....high, high-high, low, low-low
Alarm deadband (hysteresis) .....user defined value
Input filter time constant.....user defined value
Input dead zone.....user defined value
Drive on failsafe.....user defined value
Channel status..... active /inactive
HART comms..... enable /disable

RESPONSE TIME

Analog signal change to availability on Railbus
4–20 mA mode .....33 ms (max.)
HART mode .....0.75 s per channel

SAFETY

Field wiring protection.....[EEx ia] IIC
Safety description (each channel)
.....U_o = 28 V, I_o = 93 mA, P_o = 0.65 W
FM entity parameters.....$V_{OC} \leq$ 28 V dc, $I_{sc} \leq$ 93 mA
.....$C_a \leq$ 0.14 µF, $L_a \leq$ 4.38 mH

POWER SUPPLIES

IS Railbus (12V) current (all channels @ 22 mA)
.....600 mA (typ.)
Power dissipation within module.....4.2 W (max.)

MECHANICAL

Module Key Code A1
Module width .....42 mm
Weight.....260 g

FIELD TERMINAL

Field wiring type	Recommended Field Terminal
Intrinsically safe standard	8621-FT-IS
Intrinsically safe loop disconnect	8622-FT-IS

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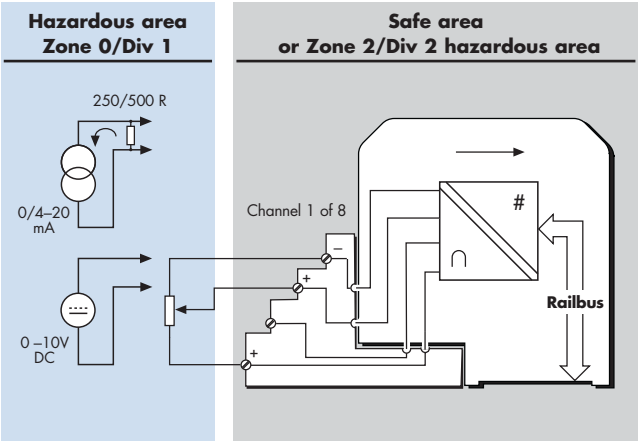
8-channel Analog Input

0-10V/potentiometer input

8230-AI-IS

- *8 single-ended input channels*
- *intrinsically safe field circuits*
- *0–10V/100Ω–10kΩ potentiometer*
- *0/4 - 20mA current input with additional burden resistor*
- *true zero on voltage input*
- *open circuit field wiring detection*



MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels .....8, single-ended

0–10V input characteristics

Nominal signal range (span) .....0 to 10 V
Full signal range .....0 to +11 V
Resolution.....16 bits
Input impedance.....> 100 kΩ
Under-range indication .....–100 mV

Potentiometer input characteristics

Nominal signal range (span).....0 to 100 % of travel
Potentiometer resistance.....100Ω to 10 kΩ
Excitation voltage (nom.).....10 V (from 2.2 kΩ source)
Resolution (≥1kΩ potentiometer).....14 bits
Resolution (100Ω potentiometer).....11 bits
Accuracy (at 25°C) .....± 0.1% of span

Isolation

(any channel to Railbus) .....100 V ac
(between channels).....none

CONFIGURABLE PARAMETERS

Input type (per channel) .....voltage/potentiometer
Alarms.....high and low
Alarm deadband (hysteresis).....user defined value
Input filter time constant.....user defined value
Input dead zone.....user defined value
Drive on open circuit..... disabled /upscale /downscale
Channel status..... active/inactive
Lead compensation.....user defined value

RESPONSE TIME

Signal change to availability on Railbus.....33 ms (max.)
Open circuit line fault detection time.....≤ 5 s

SAFETY

Field wiring protection.....[EExia] IIC
Safety description (each channel - non linear output) .....
.....$U_o \leq 15.75$ V, $I_o \leq 20$ mA, $P_o \leq 0.315$ W
FM entity parameters.....$V_{oc} = 15.75$ V, $I_{sc} = 20$ mA
.....$C_a = 0.22$ µF, $L_a = 5$ mH

POWER SUPPLIES

IS Railbus (12V) current

Typical .....200 mA
Max with voltage/current inputs .....250 mA
Max. with 100Ω potentiometer inputs .....350 mA

Power dissipation within module

Max with voltage/current inputs.....3 W
Max. with 100Ω potentiometer inputs.....4.2 W

MECHANICAL

Module Key Code C4
Module width.....42 mm
Weight.....200 g

FIELD TERMINAL

Field wiring type	Recommended Field Terminal
Intrinsically safe, standard	8623-FT-IS

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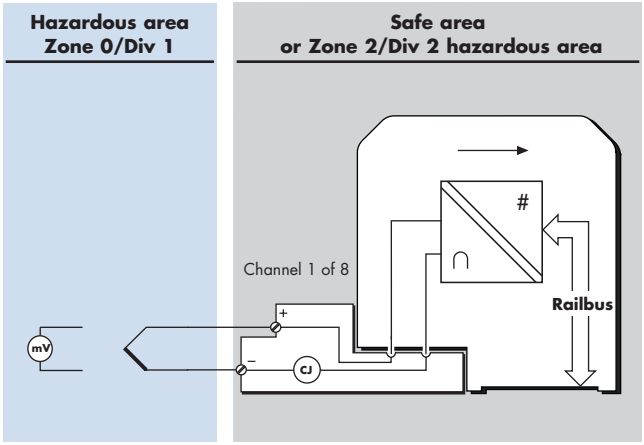
8-channel Analog Input

Thermocouple and mV

8205-TI-IS

- *8 input channels*
- *intrinsically safe field circuits*
- *thermocouple and mV*
- *cold junction compensation (internal or remote)*
- *built-in thermocouple linearisation*
- *channels independently configurable*
- *open-circuit field wiring detection*



MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels 8
THC inputs .....B,E,J,K,N,R,S or T to EN 60584-1: 1995;
.....W3 and W5 to ASTM E 988-96
.....Russian K and Russian L to ГОСТ 3044-84
.....user definable linearisation table, note 1

Input type		Range
Thermocouples:	B	0 to + 1820°C
	E	– 270 to + 1000°C
	J	– 210 to + 1200°C
	K	– 270 to + 1372°C
	N	–270 to + 1300°C
	R & S	– 50 to + 1768.1°C
	T	– 270 to + 400°C
	W3 & W5	0 to + 2315°C
	Russian K	-200 to + 1300°C
	Russian L	-200 to + 800°C
mV		– 8 to + 24 mV
		– 20 to + 60 mV
		– 33.333 to + 100 mV
		– 100 to + 100 mV

In addition, see error table in System specification section

Accuracy (% of span)

Tamb	mV inputs	THC inputs
25°C	± 0.05%	± 0.05%
+10 to + 40°C	± 0.08%	± 0.1%
– 40 to + 70°C	± 0.18%	± 0.3%

Temperature drift .....< ± 0.003% of span/°C
Cold junction compensation error* < ± 1°C (– 40 to + 70°C)
Resolution .....16 bits
Common mode rejection .....> 87 dB @ 50/60 Hz
Series mode rejection.....> 50 dB @ 50/60 Hz
Common mode voltage between channels.....± 5 V (max.)
Absolute maximum input voltage .....± 30 V
Isolation (any channel to Railbus).....60 V peak

Note 1: Consult GE for support in BIM/configurator.

CONFIGURABLE PARAMETERS

Sensor type .....user selectable
Alarms.....high and low
Input dead zone.....user defined value
Selectable input filtering.....off /2 reading avg./running avg.
Drive on open circuit fault..... disabled/upscale/downscale
Channel status.....active/inactive
Cold junction compensation.....enable/disable/channel no.

RESPONSE TIME

Analog signal change to availability on Railbus
.....600 ms (max.)

SAFETY

Field wiring protection.....[EEx ia] IIC
Safety Description (each channel)
Channels 1, 2, 3, 4, 7 and 8, wired as separate IS circuits
.....Uo = 16.4 V, Io = 79 mA, Po = 0.33 W
Channels 5 and 6, wired as separate IS circuits
.....Uo = 1 V, Io = 1.1 mA, Po = 0.3 mW
(Input terminals are equivalent to non-energy storing apparatus)
FM entity parameters .....
Channels 1, 2, 3, 4, 7 and 8, wired as separate IS circuits
.....Voc = 16.4 V, Isc = 63.7 mA, Po = 131mW
Channels 5 and 6, wired as separate IS circuits
.....Uo = 1 V, Io = 1 mA, Po = 0.25 mW

POWER SUPPLIES

IS Railbus (12V) current.....120 mA (max.)
Power dissipation within module.....1.5 W (max.)

MECHANICAL

Module Key Code C1
Module width .....42 mm
Weight.....245 g

** Cold junction compensation located in recommended field terminal.*

FIELD TERMINAL

Field wiring type	Recommended Field Terminal
Intrinsically safe THC	8625-FT-IS

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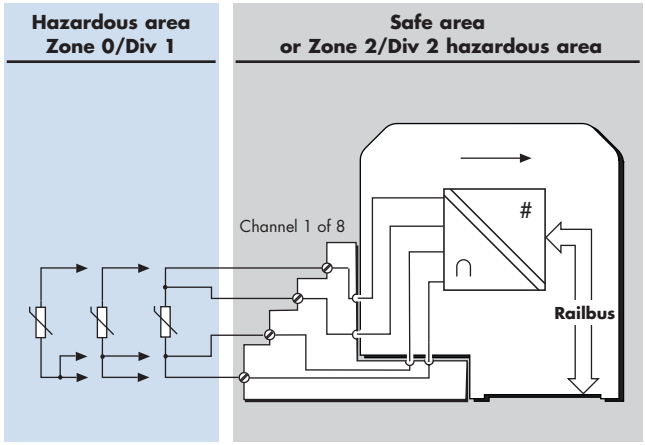
8-channel Analog Input

RTD and Ω

8206-TI-IS

- *8 input channels*
- *intrinsically safe field circuits*
- *RTD and Ω*
- *2-, 3- and 4-wire RTD format*
- *channels independently configurable*
- *channels are o/c failure independent*



MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels 8
RTD inputs.....(2-, 3- or 4-wire)
.....Pt100, Pt500 to BS EN60751: 1996
.....Ni120 to DIN 43 760: 1985
.....jPt100 to JIS C1604: 1981
.....user definable linearisation table, note 1

RTD input

Input type	Range
RTDs: Pt100, Pt500	– 200 to + 850°C
jPt100	– 200 to + 650°C
Ni120	– 60 to + 250°C

Resistance input

Excitation current	Range
211 µA	0 to 110 Ω
211 µA	0 to 280 Ω
211 µA	0 to 470 Ω
48 µA	0 to 2000 Ω

Accuracy (% of span), see note 2

Tamb	(RTD & Ω inputs)
25°C	± 0.05%
+10 to + 40°C	± 0.1%
– 40 to + 70°C	± 0.2%

Cable resistance per loop .....50 W (max)
RTD excitation current .....211 µA (nom.)
Compliance voltage of current source .....6.8 V
Resolution .....16 bits
Series mode rejection.....> 50 dB @ 50/60 Hz
Isolation (any channel to Railbus).....60 V peak

Note 1: Consult GE for support in BIM/configurator.
Note 2: For Pt500 and 0 to 2000 Ω ranges a deviation of 0 to + 0.1% of reading is to be added for channel 1 or any channel preceded by a lower resistance range.

CONFIGURABLE PARAMETERS

Sensor type .....user selectable
Alarms .....high and low
Input dead zone .....user defined value
Selectable input filtering.....off /2 reading avg./running avg.
Drive on open circuit fault..... disabled /upscale /downscale
Channel status.....active/ inactive
Offset (2-wire RTD mode).....user defined value

RESPONSE TIME

Signal change to availability on Railbus.....600 ms (max.)

SAFETY

Field wiring protection.....[EEx ia] IIC
Safety Description (all channels combined).....
.....Uo = 16.4 V, Io = 217 mA, Po = 0.9 W
FM entity parameters
.....Voc = 16.4 V dc , Isc = 350 mA, Po = 718 mW

POWER SUPPLIES

IS Railbus (12V) current.....120 mA (max.)
Power dissipation within module.....1.5 W (max.)

MECHANICAL

Module Key Code C3
Module width .....42 mm
Weight.....245 g

FIELD TERMINAL

Field wiring type	Recommended Field Terminal
Intrinsically safe RTD	8626-FT-IS

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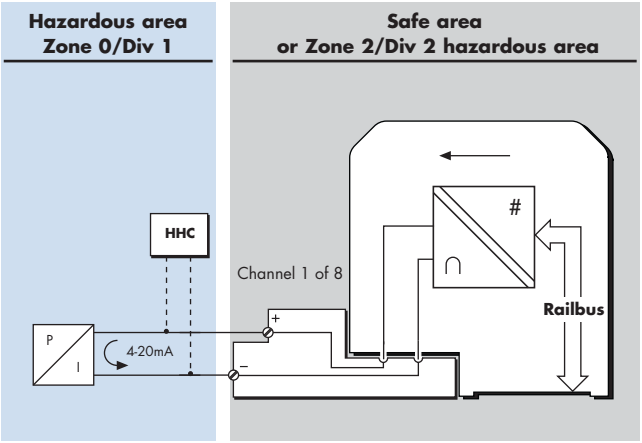
8-channel Analog Output

4–20 mA with HART®

8202-HO-IS

- *8 single ended output channels*
- *intrinsically safe field circuits*
- *4–20 mA for I/P converters*
- *open-circuit field wiring detection*
- *HART pass-through*
- *HART variable and status reporting*



MODULE SPECIFICATION

See also System Specification

OUTPUTS

Number of channels 8
Nominal signal range (span) ..... 4 to 20 mA
Full signal range ..... 1 to 22 mA
Voltage to load ..... 13 V min. @ 20 mA
Load resistance ..... 0 to 650 Ω max.
Accuracy (@ 25 °C) ..... ± 20 µA
Temperature stability
(– 40°C to + 70 °C) ..... ± 0.006% of span per °C
Resolution ..... 12 bits
Open circuit detection threshold ..... > 685 Ω (typ.)
(also detects loads greater than driveable range)
Isolation
(any channel to Railbus) ..... 60 V ac
(between channels) ..... none

CONFIGURABLE PARAMETERS

Output initialisation state ..... predefined value
Drive on "fail-safe" ..... upscale /downscale /last value
Channel status ..... active /inactive
HART variable and status reporting ..... enable/disable

RESPONSE TIME

Railbus command to output change
4-20 mA mode ..... 20 ms (typ.)
..... 80 ms* (max.)
HART mode ..... 1 s per channel

**Time to reach 90% level for 4–20 mA step into 650 Ω load*

SAFETY

Location of module
Field wiring protection ..... [EEx ia] IIC
Safety description
(each channel) ..... V_o = 24.6 V, I_o = 93 mA, P_o = 0.57 W
FM entity parameters ..... $V_{OC} \leq$ 24.6 V dc, $I_{SC} \leq$ 93 mA
..... $C_a \leq$ 0.42 µF, $L_a \leq$ 4.2 mH

POWER SUPPLIES

IS Railbus (12V) current
(all channels @ 22 mA into 650 Ω load) ..... 630 mA
Power dissipation within module ..... 4.1 W (max.)

MECHANICAL

Module Key Code A4
Module width ..... 42 mm
Weight ..... 265 g

FIELD TERMINAL

Field wiring type	Recommended Field Terminal
Intrinsically safe standard	8621-FT-IS
Intrinsically safe loop disconnect	8622-FT-IS

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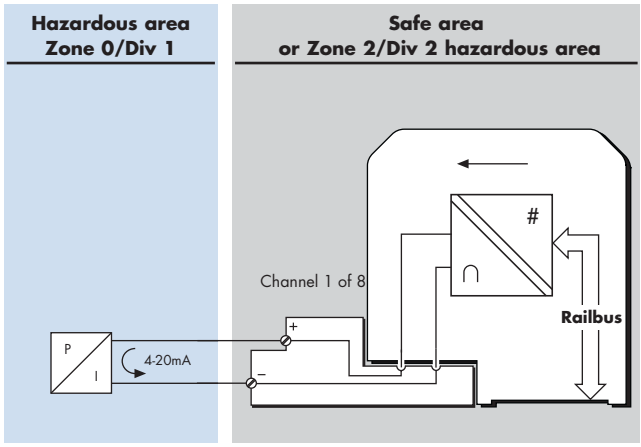
8-channel Analog Output

4–20 mA

8204-AO-IS

- *8 single ended output channels*
- *intrinsically safe*
- *conventional 4–20 mA*
- *for I/P converters*
- *open-circuit field wiring detection*



MODULE SPECIFICATION

See also System Specification

OUTPUTS

Number of channels 8
Nominal signal range (span) .....4 to 20 mA
Full signal range.....1 to 22 mA
Voltage to load.....13 V min. @ 20 mA
Load resistance.....450 Ω max.
Accuracy (@ 25°C) .....± 20 µA
Temperature stability
(– 40°C to + 70°C) .....± 0.006% of span per °C
Resolution .....12 bits
Open circuit detection threshold.....0.7 mA ± 0.2 mA
Isolation
(any channel to Railbus) .....60 V ac
(between channels).....none

CONFIGURABLE PARAMETERS

Output initialisation state.....predefined value
Drive on "fail-safe" ..... upscale /downscale /last value
Channel status..... active /inactive

RESPONSE TIME

Railbus command to output change
.....25 ms (typ.)
.....80 ms (max.)

SAFETY

Field wiring protection.....[EEx ia] IIC
Safety description
(each channel).....V_o = 24.6 V, I_o = 93 mA, P_o = 0.57 W

POWER SUPPLIES

IS Railbus (12V) current
(all channels @ 22 mA).....530 mA
Power dissipation within module.....3.8 W (max.)

MECHANICAL

Module Key Code A4
Module width .....42 mm
Weight.....245 g

FIELD TERMINAL

Field wiring type	Recommended Field Terminal
Intrinsically safe, standard	8621-FT-IS
Intrinsically safe, loop disconnect	8622-FT-IS

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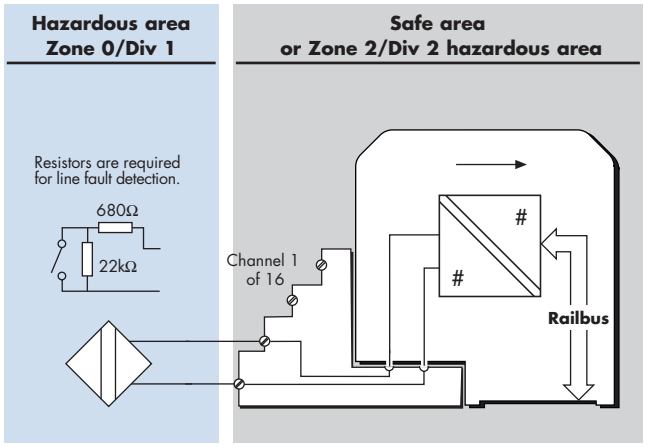
16-channel Discrete Input

Switch/proximity detector

8220-DI-IS

- *16 single-ended input channels*
- *intrinsically safe field circuits*
- *simple apparatus, dry contacts or IS proximity detectors*
- *open and short-circuit field wiring detection*



MODULE SPECIFICATION

See also System Specification

INPUTS

Number of channels 16
OFF current .....< 1.2 mA
ON current .....> 2.1 mA
Switching hysteresis .....200 µA (nom.)
Applicable specifications .....NAMUR, DIN19234
Voltage applied to sensor.....7.0 to 9.0 V from 1 kΩ ±10%
Output (wetting) current
@ 100Ω line impedance..... > 6 mA
Line fault detection
Short circuit .....< 100 Ω
Open circuit .....> 90 kΩ
Maximum input frequency
in pulse counting mode.....20 Hz
Minimum pulse width detected .....45 ms

CONFIGURABLE PARAMETERS

Selectable input filter.....fast, slow or user defined
(User defined permits 0 to 512 ms values in 3ms steps)
Latch inputs.....enable /disable
Latch polarity.....latch on high / latch on low
Pulse counting .....enable /disable
Line fault detection.....enable /disable

RESPONSE TIME

Field event to availability on Railbus.....6 ms (max.)

SAFETY

Field wiring protection.....[EEx ia] IIC
Safety Description (each channel)
(each channel) .....U_o = 10.5 V, I_o = 14 mA, P_o = 0.04 W
FM Entity parameters .....$V_{OC} \leq$ 10.5 V dc, $I_{sc} \leq$ 14 mA
.....$C_a \leq$ 2.67 µF, $L_a \leq$ 176 mH
Isolation
(any channel to Railbus) .....60 V ac
(channels arranged in two groups of eight, with returns commoned within each group)

POWER SUPPLIES

IS Railbus (12V) current
(16-channel mode) .....350 mA (max.)
(8-channel mode) .....285 mA (max.)

MECHANICAL

Module Key Code.....B1
Module width .....42 mm
Weight.....170 g

FIELD TERMINAL

Field wiring type	Recommended Field Terminal
Intrinsically safe, 16-channel	8623-FT-IS
Intrinsically safe, 8-channel loop disconnect	8624-FT-IS

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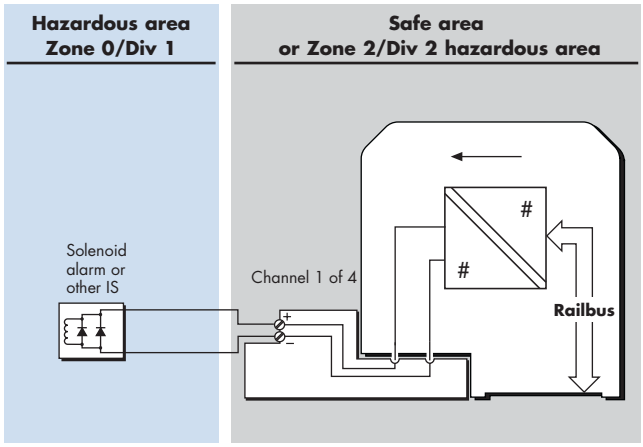
4-channel Discrete Output

Solenoid driver, IIC gas groups

8215-DO-IS

- *4 single-ended output channels*
- *intrinsically safe field circuits*
- *solenoid valves and alarms or LED indicators*
- *line-fault detection*



MODULE SPECIFICATION

See also System Specification

OUTPUTS

Number of channels 4
Minimum output voltage
Open circuit ..... 22 V
45 mA load ..... 11 V
Maximum output voltage ..... 25 V
Current limit per channel ..... 45 mA (min.)
Output supply ripple ..... <0.5% of output (pk. to pk.)
Line fault detection
Short circuit ..... < 15 Ω
Open circuit ..... > 13 kΩ
Isolation
(any channel to Railbus) ..... 60 V ac
(between channels) ..... none

CONFIGURABLE PARAMETERS

Output initialisation state ..... high /low
Output state on "fail-safe" ..... high /low /last value
Channel status ..... active /inactive
Operation mode ..... static /dynamic
Output ..... discrete /momentary pulse /continuous pulse
Pulse width ..... 2 ms to 130 s
Duty cycle ..... 2 ms to 130 s (0.01% to 99.99%)
Line fault detection ..... enable /disable

RESPONSE TIME

Railbus command to output change ..... 10 ms (typ.)

SAFETY

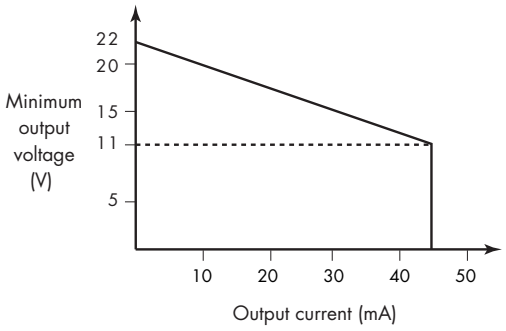
Field wiring protection ..... [EEx ia] IIC
Safety description
(each channel) ..... V_o = 25 V, I_o = 110 mA, P_o = 0.69 W
FM Entity parameters ..... $V_{OC} \leq 25$ V dc, $I_{sc} \leq 110$ mA
..... $C_a \leq 0.19$ µF, $L_a \leq 3.15$ mH

POWER SUPPLIES

IS Railbus (12V) current ..... 560 mA (max.)
Power dissipation within module ..... 3.7 W (max.)

MECHANICAL

Module Key Code B5
Module width ..... 42 mm
Weight ..... 220 g



FIELD TERMINAL

Field wiring type	Recommended Field Terminal
Intrinsically safe, standard	8621-FT-IS
Intrinsically safe, loop disconnect	8622-FT-IS

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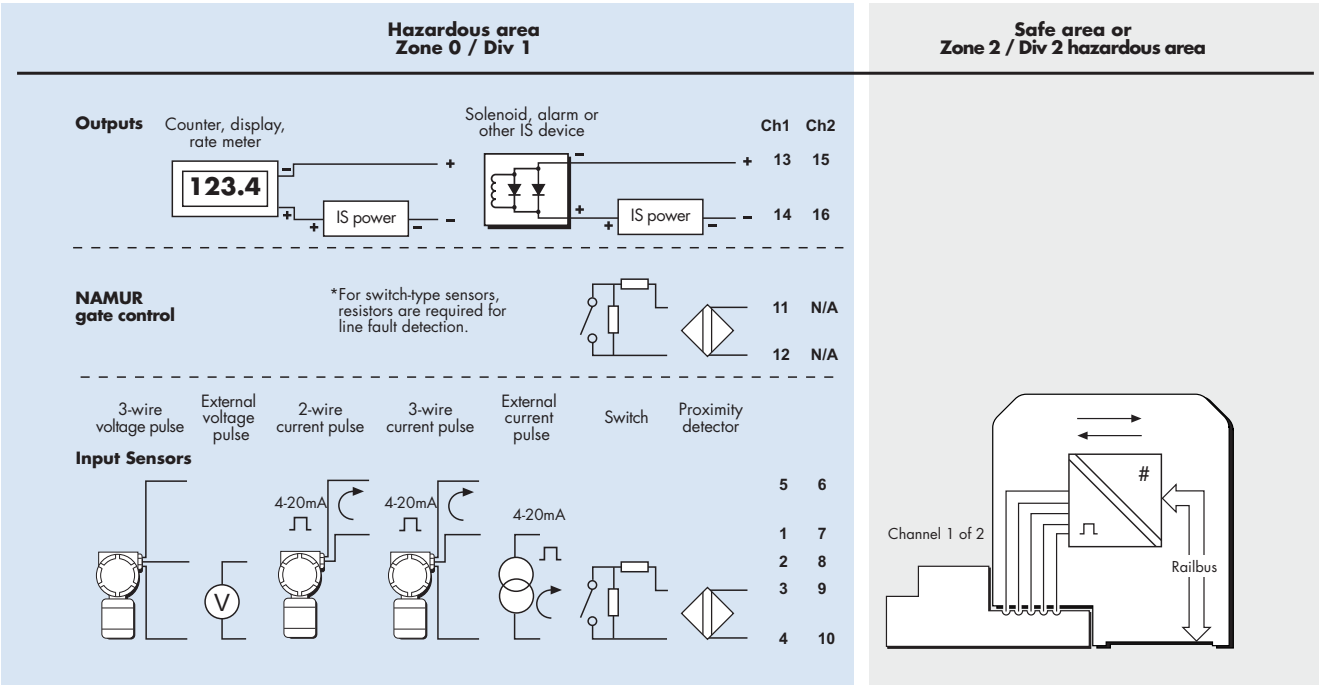
Pulse Input Module

2-channel pulse input

8223-PI-IS



- *2 input channels with power supplies or single quadrature input*
- *1 Hz to 50 kHz signal capability*
- *frequency & acceleration measurement*
- *2 alarm/repeater retransmitted output channels*
- *2- and 3-wire pulse transmitter format*
- *pulse counting (with gate control)*
- *channels independently configurable*
- *open circuit, short circuit and missing pulse detection*

MODULE SPECIFICATION

See also System and Common Module Spec.

PULSE/FREQUENCY

Number of channels 2
Frequency range.....50 kHz
(in quadrature mode) .....12.5 kHz
Accuracy (25°C).....± 0.05% of span
Temperature Stability .....0.005% / °C

CONTROL GATE (for gating Channel 1 only)

Switching thresholds.....1.2 mA / 2.1 mA
Input impedance .....1 kΩ
Supply voltage .....8.1 V (nom.) at 8 mA

SENSOR INPUT CHARACTERISTICS

NAMUR 1

Switching thresholds.....1.2 mA / 2.1 mA
Input impedance .....1 kΩ
Supply voltage .....8.1 V (nom.) at 8 mA

CURRENT

Input signal.....20 mA (max.)
Threshold .....configurable in 8 levels
Input impedance.....25 Ω
Open circuit current .....< 0.5 mA
Short circuit current.....> 21.5 mA

VOLTAGE

Input signal.....0 - 24 V dc (50 V max.)
Threshold .....configurable in 8 levels
Input impedance .....> 10 kΩ
Switching hysteresis..... 100 mV

SWITCH

Input voltage range.....0 – 10 V dc

OUTPUTS

The outputs are open-collector type for separately powered IS devices such as LED clusters, annunciators or solenoids

Number of channels 2
OFF state voltage .....30 V (max)
OFF state leakage current.....10µA (max)
ON state voltage drop.....<1.0V @ 50 mA
ON state current.....100 mA
Retransmission bandwidth .....1 – 2000 Hz

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Pulse Input Module

2-channel pulse input

8223-PI-IS

CONFIGURABLE PARAMETERS

INPUTS

Channel .....enable / disable
Sensor type.....NAMUR prox. type (select low / high speed)
.....current pulse input
.....voltage pulse input
.....switch input
Frequency ranges... 0.1, 0.3, 0.5, 1, 3, 5, 10, 30, 50, 100* kHz
Sample period.....20 ms to 200 s
Quadrature .....enable / disable
Threshold level.....user defined values
Triggering.....rising edge / falling edge
Filtering.....off, 1, 5, 20, 100 kHz
Alarms.....frequency / acceleration
Alarm limits .....high / low
Alarm deadband (hysteresis) .....user defined value
Line fault detect .....enable / disable
Channel status.....active / inactive
Counter.....enable / disable
Counting direction .....count up / count down

**While measurements can be made in the upper half of this range, the stated accuracy applies only to frequencies up to 50kHz.*

DISCRETE OUTPUT

Function selection.....disabled
.....high / low alarm
.....acceleration alarm
.....counter preset value reached
.....quadrature output (channel 1 only)
.....scaled retransmission (channel 1 only)
Retransmission scaling (K factor – channel 1 only) ....1 – 256

CONTROL GATE INPUT

Counter (channel 1).....start (count)/pause

DYNAMIC DATA (READ ONLY)

PROCESS VALUES

Frequency.....16 bit unsigned
Count.....32 bit signed
Acceleration.....16 bit signed

STATUS VALUES

Frequency / acceleration alarms .....High / low
.....missing pulse detect
Line fault detect .....open/short circuit
Quadrature direction .....1 = clockwise, 2 = anti-clockwise
Counter alarms.....preset value reached

CONTROL DATA (WRITE ONLY)

Counter preset value.....32 bit signed
.....load preset value = 0 to disable
Counter commands.....start / stop / reset
Note: Channel 1 counter can also be controlled by control gate input: 1= start(count), 0 = pause

ISOLATION

Any channel to Railbus .....60 V ac
Between input channels.....none (common 0V connection)
Between output channels.....30 V ac

RESPONSE TIMES

Signal change to availability on Railbus.....25 ms (max.)

POWER SUPPLIES

Railbus current (both channels @22 mA).....300 mA (max.)
Power dissipation (both channels @22 mA)..2.8 W (max.)
(no load) .....2.0 W (max.)

MECHANICAL

Module Key Code.....F2
Module width.....42 mm
Weight.....260 g

TERMINAL ASSIGNMENTS

SAFETY

Field wiring protection.....[EEx ia] IIC*
*[EEx ia] IIB with BEI Optical Encoder
The following figures are for Gas Groups A/B (IIC) unless otherwise stated.
24V TX supplies (Ch1 & Ch2)
.....Uo = 27.4 V, Io = 93.2 mA, Po = 639 mW

Terminal	Description	
1	Current input	Channel #1
2	Voltage input	
3	NAMUR input	
4	Common	
5	Power supply +ve	
6	Power supply +ve	Channel #2
7	Current input	
8	Voltage input	
9	NAMUR input	
10	Common	
11	NAMUR gate/control input	Channel #1
12	Common	
13	Output +ve	
14	Output –ve	
15	Output +ve	Channel #2
16	Output –ve	

FIELD TERMINAL

Field wiring type	Recommended Field Terminal
Intrinsically safe, standard	8621-FT-IS

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Pulse Input Module

2-channel pulse input

8223-PI-IS

.....C_o = 0.087 µF, L_o = 4.2 mH

Current inputs (Ch1 & Ch2)

.....Uo = ± 1.1 V, Io = 53 mA, Po = 15 mW

.....Ui = 1.1 V, Ii = 50 mA

.....C_o = 1000 µF, L_o = 13.1 mH

Voltage inputs (Ch1 & Ch2)

NAMUR inputs (Ch1 & Ch2)

NAMUR gate input (Ch1)

.....Uo = 9.6 V, Io = 25 mA, Po = 57 mW

.....Ui = 18.2 V, Pi = 333 mW

.....C_o = 3.6 µF, L_o = 56.6 mH

Discrete outputs (Ch1 & Ch2)

.....Ui = 30 V, Pi = 333 mW

All circuits combined within one channel

Uo = 28.5 V, Io = 93.2 mA (or 169mA at 13.4V), Po = 639 mW

.....C_o = 0.078 µF, L_o = 1.28 mH

FM ENTITY PARAMETERS

24V TX supplies (Ch1 & Ch2)

.....Uo = 27.4 V, Io = 93.2 mA, Po = 639 mW

.....Ca = 0.08 µF, La = 4.1 mH

24V TX supplies (Ch1 & Ch2 connected togther)

Gas Groups C,E (IIB)

.....Uo = 27.4 V, Io = 186.4 mA, Po = 1.28 W

.....Ca = 0.67 µF, La = 4.3 mH

Current inputs (Ch1 & Ch2)

.....Uo = 1.2 V, Io = 57.4 mA, Po = 17.2 mW

.....Ca = 1000 µF, La = 10.6 mH

3-wire current inputs (Ch1 & Ch2)

Gas Groups C,E (IIB)

.....Uo = 27.4 V, Io = 150.6 mA, Po = 656 mW

.....Ca = 0.67 µF, La = 6.4 mH

Voltage inputs (Ch1 & Ch2)

.....Uo = 9.56 V, Io = 1.0 mA, Po = 2.39 mW

.....Ca = 3.7 µF, La = 1000 mH

3-wire voltage inputs (Ch1 & Ch2)

.....Uo = 27.4 V, Io = 93.2 mA, Po = 642 mW

.....Ca = 0.08 µF, La = 4.0 mH

NAMUR inputs (Ch1 & Ch2)

NAMUR gate input (Ch1)

.....Uo = 9.56 V, Io = 11.1 mA, Po = 26.4 mW

.....Ca = 3.7 µF, La = 263 mH

Discrete outputs (Ch1 & Ch2)

.....Ui = 30 V, Ii = 100 mA

.....Ci = 0 µF, Li = 0 mH

LED INDICATORS

POWER – Green LED

OFF	ON	FLASHING
Power failure	Power OK	Not applicable

FAULT – Red LED

OFF	ON	FLASHING
In running state	Fault	Awaiting module training

PULSE INPUT CHANNEL – Yellow LED

OFF	ON	FLASHING
Channel inactive	Channel active and operating normally	Channel active but in alarm condition

DIGITAL OUTPUT CHANNEL – Yellow LED

OFF	ON	FLASHING
Channel inactive	Channel active and operating normally	Not applicable

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