PAC8000 Modular I/O
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PAC8000 - 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 or Controllers and power supply options.

PAC8000 - 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 or Controllers and power supply options.
PAC8000-2/x Series Modular I/O

Overview

GENERAL
PAC8000 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) or Controller.

1 I/O Modules
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 or Controller. Output modules receive commands from the BIM or Controller 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 can have 4, 8, 16, or 32 field channels.

2 Field terminals
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 helps prevent 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.

3 Carriers
Carriers form PAC8000’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 or Controller, 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.

4 Power supplies
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 or Controller and I/O modules. Supply redundancy is supported.

5 Bus Interface Module (BIM)
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 64 I/O modules.

Controllers
Controllers are an alternative to BIMs - and are used where distributed control is required, rather than distributed IO. A number of different Controllers are available which are suited to particular applications. The Logic Controller runs applications based on IEC61131 languages, the Process Controller has a control package that uses DCS-style function blocks and the Hybrid Controller can run both application packages in a single unit. The SafetyNet Controller is SIL 2 compliant for emergency shut-down and fire and gas applications. The RTU Controller runs IEC61131 application programmes and supports DNP3 communication protocol.

“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 asset management software.

Specifically, the PAC8000 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, PAC8000’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 further details.
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.

Wide choice of fieldbus options
F8000 supports a number of popular fieldbus protocols: Modbus® (RTU mode), Profibus–DP, eDNP3 and Modbus TCP over Ethernet.

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. All Controllers can be used in redundant configurations, as can the 8507-BI-DP BIM for Profibus DP remote IO. 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 minimizes the backplane/carrier wiring.

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

Figure 2 illustrates the connection of field devices for these various options.
### PAC8000 with general purpose field wiring

The PAC8000 2/2 IO module range is used for general purpose and Zone 2 / Division 2 applications (where the node or the field instrumentation are sited in the hazardous area). See Figure 2. PAC8000 supports a full range of IO module types covering inputs and outputs for both analog and discrete circuits. The node can be mounted on the plant with a suitable enclosure providing protection against the environment. Figure 3 shows a node containing all the key components: a Bus Interface Module or Controller, I/O modules on carriers and a pair of carrier-extenders linked with an extension cable. Power supplies are not shown, but arrows indicate the location of the BFP connectors.

### PAC8000 with intrinsic safety field wiring

The PAC8000 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 Figures 2 and 4). A range of I/O module types with IS field circuits for industry standard DI, DO, AI and AO applications is supported. (Note, there is no concept of Bussed Field Power with 2/1 IO modules, all field power is sourced from internal power supply connections, via the I/O module power supply, see below).

### 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 coloring of the housing. A unique and sophisticated mechanical keying mechanism helps to prevent 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.
Mixed I/O types within a single node
IS and non-IS field wiring types can also be incorporated within one PAC8000 node (see Figure 5). In this arrangement, the two parts of the node are separated by a ‘Railbus Isolator’ module. The Railbus Isolator provides a section of internal communications bus (‘Railbus’) for the IS I/O modules which is protected from invasion by damaging fault voltages. A single PAC8000 node (under the command of one Bus Interface Module or Controller) can then support a mixture of certified 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 PAC8000 node.

Related 8000 Literature
INM8000
Installation Guide

Figure 5  Illustration of a mixed 2/2 and 2/1 node
I/O Modules

Overview

GENERAL
All I/O modules are connected to the Bus Interface Module (BIM) or Controller via a proprietary bus system called ‘Railbus’ and one BIM can control up to 64 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 or Controller in terms of their position, or slot, in the total chain of 64 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 system of the change. During configuration, the node 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.

IMPORTANT MODES

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

1. A module can be forced 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. 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 reported value is forced 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(initialization state
When powering-up a node it is essential for plant safety that the state of each of the outputs is known. While the node is initializing, the I/O modules are held in the power-up state (see following pages). After node initialization and before establishing external communication, the outputs are set to predefined “initialization” 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 non-volatile memory (NVM). When a module is replaced, when the node is powered up or following a reset, the node 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.

GSD files are available for either of the above options.

MODULE ‘FAULT’ LED (RED)

<table>
<thead>
<tr>
<th>State</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td>Failsafe</td>
</tr>
<tr>
<td></td>
<td>A/D error on Al</td>
</tr>
<tr>
<td></td>
<td>BFP failure on 2/2 Al</td>
</tr>
<tr>
<td>Off</td>
<td>Normal</td>
</tr>
<tr>
<td>Flashing</td>
<td>Initialization error</td>
</tr>
</tbody>
</table>

BFP = Bussed Field Power of 2/2 modules

MODULE ‘POWER’ LED (GREEN)

<table>
<thead>
<tr>
<th>State</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td>Power OK</td>
</tr>
<tr>
<td>Off</td>
<td>Power failure</td>
</tr>
</tbody>
</table>

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-BI-DP 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 digitized 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.

IMPORTANT MODES
Output failsafe mode
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 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 cycle 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)

<table>
<thead>
<tr>
<th>On</th>
<th>Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td>Sensor loop OK</td>
</tr>
<tr>
<td>Off</td>
<td>Open circuit sensor and channel inactive</td>
</tr>
<tr>
<td>Flashing</td>
<td>Open circuit sensor and channel active OR Error condition</td>
</tr>
</tbody>
</table>

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.
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 and 8132 modules store data as 15-bit plus sign integers (–32768 to +32768). The 8205/6 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
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 (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 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)

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td>Sensor loop OK</td>
</tr>
<tr>
<td>Off</td>
<td>Open circuit sensor and channel inactive</td>
</tr>
<tr>
<td>Flashing</td>
<td>Open circuit sensor and channel active OR Error condition</td>
</tr>
</tbody>
</table>
PAC8000 Modular I/O – Overview

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 or Controller 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. deenergized.

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 summarize 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 indicators

<table>
<thead>
<tr>
<th>CHANNEL “STATUS” LED (YELLOW)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td>Field circuit OK</td>
</tr>
<tr>
<td>Off</td>
<td>Open circuit field loop and channel inactive</td>
</tr>
<tr>
<td>Flashing</td>
<td>Open circuit field loop and channel active OR Error condition</td>
</tr>
</tbody>
</table>

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.
Discrete Input Modules

GENERAL
DI modules can accept up to 8, 16, or 32 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 (rather than a Controller) 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

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td>Channel input “high” or latched</td>
</tr>
<tr>
<td>Off</td>
<td>Channel input “low”</td>
</tr>
<tr>
<td>Flashing</td>
<td>Line fault detect (2/1 only)</td>
</tr>
</tbody>
</table>

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.
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) or Controller signals an ON or OFF condition on demand.

**Single 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-energized). 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.
   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

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td>Channel input “high” or latched</td>
</tr>
<tr>
<td>Off</td>
<td>Channel input “low”</td>
</tr>
<tr>
<td>Flashing</td>
<td>Line fault detect (2/1 only)</td>
</tr>
</tbody>
</table>

On the DO 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.

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.
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

Threshold 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 pulse 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 node 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 or Controller 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)
## 2/2 I/O Modules

### 4-20mA analog 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
- 8-channel, 4–20 mA, Thermocouple, RTD and Voltage isolated, universal input 8132-AI-UN

### 4-20mA analog 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 24Vdc, non-isolated, powered inputs and outputs 8129-IO-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
- 16-channel, 115 V ac, block-isolated, sinking 8140-DI-AC
- 32-channel, Switch/Proximity Detector Inputs, Module Powered 8125-DI-DC

### 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
- 16-channel, 12-42 V dc, non-isolated, module powered 8142-DO-DC

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

### Sequence of Events
- 32-Channel Sequence Of Events, non-isolated, module powered 8127-DI-SE

### Addressable Smoke and Heat Detector
- 126-Channel, 24V dc, non-isolated, module-powered 8139-SH-DC
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

<table>
<thead>
<tr>
<th>Number of channels</th>
<th>8, single-ended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal signal range (span)</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td>Full signal range</td>
<td>1 to 23 mA</td>
</tr>
</tbody>
</table>
| 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)
- \( V_{oc} = 28.7 \, \text{V}, \, I_{sc} = 33 \, \text{mA}, \, C_{sc} = 0.17 \, \mu\text{F}, \, L_{sc} = 11.0 \, \text{mH} \)

POWER SUPPLIES

Railbus (12V) current
- 100 mA [typ.]
- 150 mA [max.]

Bussed Field Power
- 2-wire Tx – 300 mA [max.]
- (\(@24 \, \text{V dc} \pm 10\%) \, 4\text{-wire Tx} – 60 \, \text{mA} [\text{max.}]\)

MECHANICAL

Module Key Code | A1

Module width | 42 mm

Weight | 200 g

Field Terminals (2-Wire TX)

<table>
<thead>
<tr>
<th>Field Wiring</th>
<th>Recommended Field Terminal</th>
<th>Compatible Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose</td>
<td>8602-FT-ST Standard</td>
<td>8604-FT-FU Fused</td>
</tr>
<tr>
<td>Class 1, Div 2 or Zone 2 hazardous area</td>
<td>8601-FT-NI Non-incendive</td>
<td>8603-FT-FU Non-incendive Fused</td>
</tr>
</tbody>
</table>

Field Terminals (4-Wire TX)

<table>
<thead>
<tr>
<th>Field Wiring</th>
<th>Recommended Field Terminal</th>
<th>Compatible Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose</td>
<td>8615-FT-4W</td>
<td>–</td>
</tr>
<tr>
<td>Class 1, Div 2 or Zone 2 hazardous area</td>
<td>8615-FT-4W</td>
<td>–</td>
</tr>
</tbody>
</table>
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)
- 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)
- 0.5 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)
- \( V_{oc} = 28.7 \text{ V}; \quad I_{sc} = 33 \text{ mA}; \quad C_a = 0.17 \mu\text{F}; \quad L_a = 11.0 \text{ mH} \)

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)

<table>
<thead>
<tr>
<th>Field Wiring</th>
<th>Recommended Field Terminal</th>
<th>Compatible Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose</td>
<td>8602-FT-ST Standard</td>
<td>8604-FT-FU Fused</td>
</tr>
<tr>
<td>Class 1, Div 2 or Zone 2 hazardous area</td>
<td>8601-FT-NI Non-incendive</td>
<td>8603-FT-FU Non-incendive Fused</td>
</tr>
</tbody>
</table>

www.ge-ip.com/process 21
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
- 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):
  - \( V_{oc} = 28.7 \text{ V}; \ I_{sc} = 33 \text{ mA}; \ C_a = 0.17 \mu\text{F}; \ L_a = 11.0 \text{ mH} \)

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

SAFE AREA OR ZONE 2/ DIV2 HAZARDOUS AREA

FIELD TERMINALS

<table>
<thead>
<tr>
<th>Field Wiring</th>
<th>Recommended Field Terminal</th>
<th>Compatible Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose</td>
<td>8615-FT-4W 4-wire transmitter</td>
<td>—</td>
</tr>
<tr>
<td>Class 1, Div 2 or Zone 2 hazardous area</td>
<td>8615-FT-4W 4-wire transmitter</td>
<td>—</td>
</tr>
</tbody>
</table>
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,N,R,S, or T to EN 60584-2, IEC584-2, BS4937; W3 and W5

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

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 average / running average

Drive on open circuit fault
• Disabled / upscale / downscale

Alarms
• High and low

Channel status
• Active / Inactive

RESPONSE TIMES
Signal change to availability on Railbus
• 120 ms [min.]
• 420 ms [max.]

O/C sensor detection
• ≤ 10 s

SAFE AREA OR ZONE 2/ DIV2 HAZARDOUS AREA

FIELD TERMINALS

<table>
<thead>
<tr>
<th>Field Wiring</th>
<th>Recommended Field Terminal</th>
<th>Compatible Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose</td>
<td>8605-FT-TC THC</td>
<td>_</td>
</tr>
<tr>
<td>Class 1, Div 2 or Zone 2 hazardous area</td>
<td>8605-FT-TC THC</td>
<td>_</td>
</tr>
</tbody>
</table>

MECHANICAL

| Module Key Code | C1 |
| Module width    | 42 mm |
| Weight          | 200 g |

SAFETY
FM non-incendive field wiring parameters (each channel)
• \( V_{oc} = 10.5 \text{ V} \), \( I_{oc} = 3.6 \text{ mA} \), \( C_{oc} = 14.9 \mu\text{F} \), \( L_{oc} = 1000 \text{ mH} \)

POWER SUPPLIES
Railbus (12V) current
• 150 mA [typ.]
• 200 mA [max.]

Bussed Field Power
• Not required

* Consult GE for availability
† CJ compensation located in recommended field terminal
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

<table>
<thead>
<tr>
<th>Input Type</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance</td>
<td>Consult GE for availability</td>
</tr>
<tr>
<td>RTDs: Pt100</td>
<td>-200 to +850 °C</td>
</tr>
<tr>
<td>jPt100</td>
<td>-200 to +510 °C</td>
</tr>
<tr>
<td>Ni120</td>
<td>-80 to +320 °C</td>
</tr>
</tbody>
</table>

Input resistance range (span)
- 0 to 500 Ω

Accuracy (% of span)

<table>
<thead>
<tr>
<th>Tamb</th>
<th>(RTD &amp; Ω inputs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25°C</td>
<td>± 0.05%</td>
</tr>
<tr>
<td>+10 to +40°C</td>
<td>± 0.1%</td>
</tr>
<tr>
<td>-40 to +70°C</td>
<td>± 0.2%</td>
</tr>
</tbody>
</table>

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 average / running average

Drive on open circuit fault
- Disabled / upscale

Alarms
- High and low

Channel status
- Active / inactive

Offset (2-wire RTD mode)
- User defined value

RESPONSE TIME

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)
- $V_{oc} = 10.5\, V; I_{sc} = 3.6\, mA; C_s = 14.9\, \mu F; L_s = 1000\, mH$

POWER SUPPLIES

Railbus (12V) current
- 1150 mA (typ.)
- 200 mA (max.)

Busied Field Power
- Not required

MECHANICAL

Module Key Code
- C3

Module width
- 42 mm

Weight
- 200 g

* Consult GE for availability
8-channel Analog Input
4-20mA, Thermocouple, RTD and Voltage isolated, universal input

8132-AI-UN
- 8 isolated, universal, input channels
- Configurable on a channel by channel basis: 4-20mA, THC, RTD, resistance & voltage
- 250V ac rms channel to channel isolation
- RTD Types Pt100, jPt100, Pt200, Pt500, Ni120, Cu10
- Volt input types ±120mV, 0-1V, 0-5V, 1-5V, 0-10V, ±10V
- 2 or 3-wire RTDs
- 2 or 4-wire transmitters
- Non-incendive field circuits
- 24 V dc bussed field power required

MODULE SPECIFICATION
See also System Specification

INPUTS
Number of configurable channels
- 8, isolated

4-20MA INPUTS
Nominal signal range
- 4 to 20mA
Span
- 0 to 25mA
Output voltage (20mA)
- 13.5 V (min.)
Output current (linear operation)
- 25 mA (max.)
Output short circuit current (max.)
- 75 mA for 100ms (Output turns off after ~100ms at more than 25mA)
Input current (max.)
- 30mA (continuous)
Calibration accuracy
- 10°C to 40°C – ± 0.1% of span
- -40°C to 70°C – ± 0.3% of span

THERMOCOUPLE INPUTS
THC Types
(See table for temperature ranges)
Calibration accuracy (See table for ranges & error)
- 10°C to 40°C – ± 0.1% of span (typ.)
- -40°C to 70°C – ± 0.2% of span (typ.)
Cold junction compensation error
- < ±1°C (~-40°C to +70°C)
Resolution
- 14 bits (typ.)
Optional open circuit bleed current
- ± 0.9µA (nom.)
Open circuit detection time
- 1 sec (with < 0.5µF cable capacitance)

RTD INPUT (2 OR 3 WIRE)
RTD types
- Pt100, Pt200, Pt500, Cu10, Ni120, jPt100
Maximum wire resistance
- 40 ohms
Calibration accuracy 3-wire (See table for ranges & error)
- 10°C to 40°C – ± 0.2% of span
- -40°C to 70°C – ± 0.4% of span
Calibration accuracy 2-wire
- 10°C to 40°C (except 110 Ohm scale) – +/−0.2% of span
- 10°C to 40°C (110 Ohm scale) – +/−0.3% of span
- 70°C to -40°C (except 110 Ohm scale) – +/−0.4% of span
- 70°C to -40°C (110 Ohm scale) – +/−0.5% of span
Maximum wire resistance
- 40 ohms
Resistance excitation current
- Selected for ~1.0 mW at max R
Resolution
- 14 bits (typ.)

VOLTAGE INPUT
Nominal signal range 1 (span)
- ±120 mV, 0-1 V, 0-5V, 1-5V, 0-10V, ±10V (see table for calibration accuracy over temperature)
Resolution
- 14 bits (typ.)

RESISTANCE INPUT (2 OR 3 WIRE)
Input resistance range (span)
- 0 to 110, 280, 470 and 1000 ohms
Calibration accuracy 3-wire
- 10°C to 40°C – ± 0.2% of span
- -40°C to 70°C – ± 0.4% of span
Calibration accuracy 2-wire
- 10°C to 40°C (except 110 Ohm scale) – +/−0.2% of span
- 10°C to 40°C (110 Ohm scale) – +/−0.3% of span
- 70°C to -40°C (except 110 Ohm scale) – +/−0.4% of span
- 70°C to -40°C (110 Ohm scale) – +/−0.5% of span
Maximum wire resistance
- 40 ohms
Resistance excitation current
- Selected for ~1.0 mW at max R
Resolution
- 14 bits (typ.)

RESISTANCE INPUT (2 OR 3 WIRE)
Input resistance range (span)
- 0 to 110, 280, 470 and 1000 ohms
Calibration accuracy 3-wire
- 10°C to 40°C – ± 0.2% of span
- -40°C to 70°C – ± 0.4% of span
Calibration accuracy 2-wire
- 10°C to 40°C (except 110 Ohm scale) – +/−0.2% of span
- 10°C to 40°C (110 Ohm scale) – +/−0.3% of span
- 70°C to -40°C (except 110 Ohm scale) – +/−0.4% of span
- 70°C to -40°C (110 Ohm scale) – +/−0.5% of span
Maximum wire resistance
- 40 ohms
Resistance excitation current
- Selected for ~1.0 mW at max R
Resolution
- 14 bits (typ.)

VOLTAGE INPUT
Nominal signal range 1 (span)
- ±120 mV, 0-1 V, 0-5V, 1-5V, 0-10V, ±10V (see table for calibration accuracy over temperature)
Resolution
- 14 bits (typ.)

RESISTANCE INPUT (2 OR 3 WIRE)
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Calibration accuracy 3-wire
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Calibration accuracy 2-wire
- 10°C to 40°C (except 110 Ohm scale) – +/−0.2% of span
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Maximum wire resistance
- 40 ohms
Resistance excitation current
- Selected for ~1.0 mW at max R
Resolution
- 14 bits (typ.)

VOLTAGE INPUT
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Calibration accuracy 3-wire
- 10°C to 40°C – ± 0.2% of span
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Calibration accuracy 2-wire
- 10°C to 40°C (except 110 Ohm scale) – +/−0.2% of span
- 10°C to 40°C (110 Ohm scale) – +/−0.3% of span
- 70°C to -40°C (except 110 Ohm scale) – +/−0.4% of span
- 70°C to -40°C (110 Ohm scale) – +/−0.5% of span
Maximum wire resistance
- 40 ohms
Resistance excitation current
- Selected for ~1.0 mW at max R
Resolution
- 14 bits (typ.)

VOLTAGE INPUT
Nominal signal range 1 (span)
- ±120 mV, 0-1 V, 0-5V, 1-5V, 0-10V, ±10V (see table for calibration accuracy over temperature)
Resolution
- 14 bits (typ.)

RESISTANCE INPUT (2 OR 3 WIRE)
Input resistance range (span)
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Calibration accuracy 3-wire
- 10°C to 40°C – ± 0.2% of span
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Calibration accuracy 2-wire
- 10°C to 40°C (except 110 Ohm scale) – +/−0.2% of span
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- 70°C to -40°C (110 Ohm scale) – +/−0.5% of span
Maximum wire resistance
- 40 ohms
Resistance excitation current
- Selected for ~1.0 mW at max R
Resolution
- 14 bits (typ.)

VOLTAGE INPUT
Nominal signal range 1 (span)
- ±120 mV, 0-1 V, 0-5V, 1-5V, 0-10V, ±10V (see table for calibration accuracy over temperature)
Resolution
- 14 bits (typ.)
CONFIGURABLE PARAMETERS

Sensor type
• User selectable

Alarms
• High-high, high, low and low-low

Alarm deadband (hysteresis)
• User defined value

Input dead zone
• User defined value

Channel status
• Active / inactive

Filter/sample rates
• User selectable

GENERAL SPECIFICATIONS

Common mode rejection (using 50/60Hz filter)
• > 120 dB @ 50/60 Hz

Series mode rejection (using 50/60Hz filter)
• > 65 dB @ 50/60 Hz

Maximum input voltage (except current I/P)
• ± 25V

Common mode voltage between channels
• 250 V ac rms

Isolation
• Channel to channel – 250 V ac rms
• Any channel to Railbus – 250 V ac rms
• Any channel to Bussed Field Power – 250 V ac rms
• Railbus to Bussed Field Power – 150 V ac rms

Input filter response
• Time constant 4 ms

Input impedance
• > 1 M ohm

Data Format
• 0 to 65535 corresponds to selected span

RESPONSE TIME

Signal change on any channel to availability on Railbus
• Dependent on user-selectable filter/sample rates

Sample Rates

<table>
<thead>
<tr>
<th>Filter</th>
<th>Response Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast (10ms) 1366Hz</td>
<td>11 ms</td>
</tr>
<tr>
<td>Medium (20ms) 683Hz</td>
<td>21 ms</td>
</tr>
<tr>
<td>60Hz reject</td>
<td>18 ms</td>
</tr>
<tr>
<td>50Hz reject</td>
<td>21 ms</td>
</tr>
<tr>
<td>50 ms</td>
<td>55 ms</td>
</tr>
<tr>
<td>100 ms</td>
<td>105 ms</td>
</tr>
<tr>
<td>300 ms (50/60 Hz noise reductions)</td>
<td>305 ms</td>
</tr>
<tr>
<td>500 ms</td>
<td>505 ms</td>
</tr>
</tbody>
</table>

Note: For those inputs requiring multiple measurements, i.e. resistance and RTD, the minimum response time is 55 ms. See also on this page Tradeoff of Resolution for module throughput.

Open circuit detection
• < 1 sec (with < 0.5μF cable capacitance)

SAFETY

FM non-incendive field wiring parameters (each channel)
• \( V_{oc} = 20 \text{V} \), \( I_{oc} = 75 \text{mA} \), \( C_a = 0.61 \mu \text{F} \), \( L_a = 11.3 \text{mH} \)

POWER SUPPLIES

Railbus (12V) current
• 60 mA (typ.)
• 100 mA (max.)

Bussed Field Power
• @ 24 V dc ± 10%
• All configurations (except 4/20mA with excitation) – 125 mA (max.)
• 4/20mA with excitation – 300 mA (max.)

MECHANICAL

Module Key Code
• A1

Module width
• 42mm

Weight
• 230g

WARNING
If this module is being used in an application that requires 250V ac rms channel-to-channel isolation, it must be replaced only with an A1 key code module that has equivalent, or better, channel-to-channel isolation rating.

Tradeoff of Resolution for Module Throughput

The module offers ~15 bit effective resolution on all channels. The module also offers several analog-to-digital conversion options that allow higher speed signals to be selectively read more quickly on a channel-by-channel basis.

Note however, that at the highest speeds, uncertainty in value of the lower bits will increase, resulting in reduced resolution. The following table indicates the approximate effect on resolution of higher speeds.

<table>
<thead>
<tr>
<th>Channel response time</th>
<th>Digital Filter</th>
<th>Approximate Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 ms</td>
<td>none</td>
<td>8 bits (0.4%)</td>
</tr>
<tr>
<td>25 ms</td>
<td>none</td>
<td>9 bits (0.2%)</td>
</tr>
<tr>
<td>55 ms</td>
<td>50 ms</td>
<td>14 bits (0.006%)</td>
</tr>
<tr>
<td>105 ms</td>
<td>100 ms</td>
<td>15 bits</td>
</tr>
<tr>
<td>305 ms</td>
<td>300 ms</td>
<td>15 bits</td>
</tr>
<tr>
<td>505 ms</td>
<td>500 ms</td>
<td>15 bits</td>
</tr>
</tbody>
</table>

FIELD TERMINALS

Field Wiring

<table>
<thead>
<tr>
<th>Field Wiring</th>
<th>Recommended Field Terminal</th>
<th>Compatible Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose</td>
<td>8608-FT-NI (No internal CJ)</td>
<td>8607-FT-TC (See Note) (Internal CJ)</td>
</tr>
<tr>
<td>THC</td>
<td>8607-FT-TC (Internal CJ)</td>
<td>8608-FT-NI (See Note) (No internal CJ)</td>
</tr>
</tbody>
</table>

Note: For further advice on field terminals for this module and for operation with more than one type of sensor, see Technical Support Note TSN113 - Getting the most from 8607 and 8608 field terminals.
**Current Input Ranges**

<table>
<thead>
<tr>
<th>Current</th>
<th>Full Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 25 mA</td>
<td>0 to 25 mA</td>
</tr>
</tbody>
</table>

**Table of RTD types with calibration error in +/- °C**

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Bottom of range</th>
<th>Middle of range</th>
<th>Top of range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt100</td>
<td>-200°C to +850°C</td>
<td>0.5</td>
<td>0.9</td>
<td>12</td>
</tr>
<tr>
<td>jPt100</td>
<td>-200°C to +650°C</td>
<td>0.5</td>
<td>0.9</td>
<td>12</td>
</tr>
<tr>
<td>Pt200</td>
<td>-200°C to +850°C</td>
<td>0.5</td>
<td>0.8</td>
<td>12</td>
</tr>
<tr>
<td>Pt500</td>
<td>-200°C to +850°C</td>
<td>0.5</td>
<td>0.8</td>
<td>14</td>
</tr>
<tr>
<td>Ni120</td>
<td>-60°C to +250°C</td>
<td>0.8</td>
<td>0.6</td>
<td>06</td>
</tr>
<tr>
<td>Cu10</td>
<td>-30°C to +220°C</td>
<td>1.7</td>
<td>3.9</td>
<td>4.1</td>
</tr>
</tbody>
</table>

**Table of Thermocouple types with calibration error in +/- °C**

<table>
<thead>
<tr>
<th>Type</th>
<th>Normal operating range</th>
<th>Bottom of range</th>
<th>Middle of range</th>
<th>Top of range</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>500 to 1810</td>
<td>6.1</td>
<td>2.9</td>
<td>2.8</td>
</tr>
<tr>
<td>E</td>
<td>-200 to 1000</td>
<td>1.3</td>
<td>0.5</td>
<td>0.6</td>
</tr>
<tr>
<td>J</td>
<td>-190 to +1200</td>
<td>1.1</td>
<td>0.6</td>
<td>0.8</td>
</tr>
<tr>
<td>K</td>
<td>-200 to +1372</td>
<td>2.0</td>
<td>0.8</td>
<td>1.3</td>
</tr>
<tr>
<td>N</td>
<td>-190 to +1300</td>
<td>2.7</td>
<td>0.9</td>
<td>1.2</td>
</tr>
<tr>
<td>R</td>
<td>0 to +1768</td>
<td>6.1</td>
<td>2.5</td>
<td>3.0</td>
</tr>
<tr>
<td>S</td>
<td>0 to +1768</td>
<td>6.1</td>
<td>2.9</td>
<td>3.2</td>
</tr>
<tr>
<td>T</td>
<td>-200 to +400</td>
<td>2.0</td>
<td>0.7</td>
<td>0.6</td>
</tr>
<tr>
<td>W3</td>
<td>0 to +2000</td>
<td>3.1</td>
<td>1.8</td>
<td>2.7</td>
</tr>
<tr>
<td>W5</td>
<td>0 to +2000</td>
<td>2.2</td>
<td>2.0</td>
<td>4.2</td>
</tr>
<tr>
<td>Russian K</td>
<td>-200 to +1300</td>
<td>2.0</td>
<td>0.8</td>
<td>1.3</td>
</tr>
<tr>
<td>Russian L</td>
<td>-200 to +800</td>
<td>1.0</td>
<td>0.5</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Ohms Ranges**

<table>
<thead>
<tr>
<th>Resistance</th>
<th>Full Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohms 110</td>
<td>0 to 110 ohms</td>
</tr>
<tr>
<td>Ohms 280</td>
<td>0 to 280 ohms</td>
</tr>
<tr>
<td>Ohms 470</td>
<td>0 to 470 ohms</td>
</tr>
<tr>
<td>Ohms 1000</td>
<td>0 to 1000 ohms</td>
</tr>
</tbody>
</table>

**Voltage Ranges showing calibration accuracy**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Calibration accuracy as % of span</th>
</tr>
</thead>
<tbody>
<tr>
<td>-120 to 120mV</td>
<td>0.1% to 0.15%</td>
</tr>
<tr>
<td>0 to +1V</td>
<td>0.1% to 0.15%</td>
</tr>
<tr>
<td>0 to +5V</td>
<td>0.15% to 0.4%</td>
</tr>
<tr>
<td>1 to +5V</td>
<td>0.15% to 0.5%</td>
</tr>
<tr>
<td>0 to +10V</td>
<td>0.15% to 0.4%</td>
</tr>
<tr>
<td>-10 to +10V</td>
<td>0.1% to 0.2%</td>
</tr>
</tbody>
</table>
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
- 24V 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 range**
  - 1 to 23 mA
- **Open loop detection threshold**
  - 0.7 ± 0.25 mA
- **Output compliance**
  - 20 mA at 21.6V 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
- **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

**SAFE AREA OR ZONE 2/ DIV2 HAZARDOUS AREA**

**FIELD TERMINALS**

<table>
<thead>
<tr>
<th>Field Wiring</th>
<th>Recommended Field Terminal</th>
<th>Compatible Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose</td>
<td>8602-FT-ST Standard</td>
<td>8604-FT-FU Fused</td>
</tr>
<tr>
<td>Class 1, Div 2</td>
<td>8601-FT-NI Non-incendive</td>
<td>8603-FT-FU Non-incendive Fused</td>
</tr>
</tbody>
</table>
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

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

Initialization 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)
- \( V_{oc} = 28.7 \, \text{V} \), \( I_{oc} = 33 \, \text{mA} \), \( C_a = 0.17 \, \mu\text{F} \), \( L_a = 11.0 \, \text{mH} \)

POWER SUPPLIES

Railbus (12V) current
- 100 mA (typ.)
- 150 mA (max.)

Bussed Field Power
- 300 mA (max.) at 24 Vdc ± 10%

Quiescent current
- 60 mA

MECHANICAL

Module Key Code
- A4

Module width
- 42 mm

Weight
- 200 g

FIELD TERMINALS

<table>
<thead>
<tr>
<th>Field Wiring</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose</td>
</tr>
<tr>
<td>Class 1, Div 2 or Zone 2 hazardous area</td>
</tr>
</tbody>
</table>

SAFE AREA OR ZONE 2/ DIV2 HAZARDOUS AREA

FIELD TERMINALS

<table>
<thead>
<tr>
<th>Field Wiring</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose</td>
</tr>
<tr>
<td>Class 1, Div 2 or Zone 2 hazardous area</td>
</tr>
</tbody>
</table>

www.ge-ip.com/process
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)
- $V_{max} = 30 \text{ V}$; $I_{max} = 100 \text{ mA}$; $C = 0 \mu\text{F}$; $L = 0 \text{ mH}$

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

SAFE AREA OR ZONE 2/ DIV2 HAZARDOUS AREA

FIELD TERMINALS

<table>
<thead>
<tr>
<th>Field Wiring</th>
<th>Recommended Field Terminal</th>
<th>Compatible Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose</td>
<td>8602-FT-ST Standard†</td>
<td>8604-FT-FU Fused</td>
</tr>
<tr>
<td>Class 1, Div 2 or Zone 2 hazardous area</td>
<td>8610-FT-NA Non-arcing†</td>
<td>8611-FT-FU Non-arcing Fused</td>
</tr>
</tbody>
</table>

† External fusing of the Field Power supply is recommended in order to protect the field wiring.
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 threshold
- 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
- 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
- Field event to new data available on Railbus – 5 ms (max.)

SAFETY

FM non-incendive field wiring parameters (each channel)
- \( V_{\text{max}} = 30 \text{ V} \), \( I_{\text{max}} = 100 \text{ mA} \), \( C_i = 0 \mu\text{F} \), \( L_i = 0 \text{ mH} \)

POWER SUPPLIES

Railbus (12V) current
- 90 mA (typ.)
- 135 mA (max.)

Bussed Field Power
- Required

MECHANICAL

Module Key Code
- E2

Module width
- 42 mm

Weight
- 210 g

SAFE AREA OR ZONE 2/ DIV2 HAZARDOUS AREA

FIELD TERMINALS

<table>
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<tr>
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<td>General purpose</td>
<td>8617-FT-N † 16 Channel DI</td>
<td>–</td>
</tr>
<tr>
<td>Class 1, Div 2 or Zone 2 hazardous area</td>
<td>8617-FT-N † 16 Channel DI</td>
<td>–</td>
</tr>
</tbody>
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† External fusing of the Field Power supply is recommended in order to protect the field wiring.
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 2 ms 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)
- \( V_{oc} = 30 \text{ V}, I_{oc} = 15.2 \text{ mA}, C_a = 0.12 \mu \text{F}, L_a = 151 \text{ mH} \)

**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 TERMINALS**

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<tr>
<td>Class 1, Div 2 or Zone 2 hazardous area</td>
<td>8601-FT-Ni Non-incendive†</td>
<td>8603-FT-FU Non-incendive Fused</td>
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† External fusing of the Field Power supply is recommended in order to protect the field wiring.

External fusing of the Field Power supply is recommended in order to protect the field wiring.
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
- Field event to new data available on Railbus – 5 ms (max.)

SAFETY
FM non-incendive field wiring parameters
- \( V_{oc} = 30 \text{ V}, I_{oc} = 3.5 \text{ mA}, C_a = 0.12 \mu F, L_a = 1000 \text{ mH} \)

POWER SUPPLIES
Railbus (12 V) 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

SAFE AREA OR ZONE 2/
DIV 2 HAZARDOUS AREA

FIELD TERMINALS

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† External fusing of the Field Power supply is recommended in order to protect the field wiring.
8-channel Discrete Input
24 V dc, non-isolated, powered inputs and outputs

8129-IO-DC
- 8 inputs - any combination of inputs and outputs
- Non-arcing inputs and outputs
- Output channels rated up to 2A continuous
- Inputs for dry contact switches
- 24 V dc Bussed Field Power required from 8914-PS-AC

MODULE SPECIFICATION
See also System Specification

Number of channels
- 8 (independently configured as inputs or outputs)

INPUTS
ON/OFF threshold current
- 0.9mA (typ.)
O/C Voltage
- 24V dc (typ.) - depends on BFP Supply
Wetting current
- 1.2mA (typ.)
Minimum pulse width detected
- 5ms
Max input frequency in pulse counting mode (no debounce)
- 30Hz
Isolation (any channel to Railbus)
- 250V ac

OUTPUTS
Maximum Output Current per Channel
- 2A
Maximum Output Current per Module
- Continuous – 6A
- Non-continuous (<10 seconds) – 8A

INPUT CONFIGURABLE PARAMETERS
Filter time interval
- 0 to 8s (in 1ms steps)
Earth Leakage Detection Channel
- ON / OFF

Latch inputs
- Enable / disable
Latch polarity
- Latch on high / latch on low
Pulse counting
- Up transition / down transition / disable
Line fault detection
- None / open circuit / open & short circuit

OUTPUT CONFIGURABLE PARAMETERS
Output type
- Pulse / discrete / pattern
Pulse width
- 1ms to 60s
Line fault detection*
- Open line & short circuit detect / disable

RESISTANCE MEASUREMENT ACCURACY
(For normally de-energised output open and short-circuit detection)
With forward biased test current
- ±(3.4%+5.3Ω) for line resistance ≤ 220Ω
- Greater of: ±7% or ±(3.1%+27Ω) for line resistance >220Ω, <1kΩ
With reverse biased test current
- Greater of: ±7% or ±(3.1%+430Ω)

RESPONSE TIME
I/P Signal change to availability on Railbus
- 5ms (max.)
Railbus command to O/P change
- 1ms (max.)

POWER SUPPLIES
Railbus (12V) current
- 50mA (typ.), 70mA (max.)
Bussed Field Power
- All channels configured as inputs – 50mA (max)
- Any channels configured as output – 50mA + o/p load currents

MECHANICAL
- Module key code – B6
- Module width – 42mm
- Weight – 210g

* Normally de-energised channels only
General
The 8129-IO-DC Discrete Input/Output Module provides the interface to 8 channels, which may be configured in any combination of discrete inputs and outputs.

Combined inputs and outputs
Each of the 8 channels of the 8129-IO-DC Discrete Input/Output Module may be configured, on a channel-by-channel basis, as either an input or an output.

When configured as an input, the channel is suitable for use with dry contacts – with power supplied from the Module.

When configured as an output, the channel is capable of switching up to 2.0A (maximum of 6.0A continuous per module). Output channels are used with solenoids, valves and alarms.

Diagnostics
Comprehensive diagnostic tests are performed on the module and each of its channels, including tests for stuck ON and stuck OFF output switches.

Live maintenance
The field wiring connections to the 8129-IO-DC Discrete I/O Module are classified as non-sparking and can only be worked on in a Class 1, Division 2 or Zone 2 hazardous area once the Bussed Field Power connection has been isolated.

Note: the Bussed Field Power connection must also be isolated before removing or replacing the module.

Input configuration
Input channels are used to interface to volt free contacts. Line fault detection can be turned OFF or can detect open circuits or both open and short.

Input filtering
A change in the input state is recorded only if the states observed at the start and end of the filter time interval are the same. If they are different the previous state is maintained. (This reduces the chance of noise being incorrectly interpreted as a change of input value). The filter time interval can be configured between 0 and 8s, in 1ms intervals.

Input transition counting
A counter can record the number of filtered transitions of a particular type. Depending on the polarity setting, the counter will either count transitions from 0 to 1, or from 1 to 0.

The counter “wraps around” from 65 535 to zero without indication.

Transitions are counted even if the channel is configured to “latching”.

Earth leakage detection
Where earth leakage fault detection is required, a single channel of an 8129-IO-DC module must be configured to monitor earth leakage and wired to the appropriate terminals of an 8751-CA-NS Controller Carrier.

Input latching
Inputs can be configured to “latch” a particular (filtered) input transition and maintain the output in the latched state until the latch is cleared. “Normal Polarity” will latch a transition from 0 to 1 as 1, “Inverse Polarity” will latch a transition 1 to 0 as 0. The operation is described in figure 1.

Normally energized and normally de-energized outputs
Individual output channels can be either normally energized or de-energized. Each output channel comprises 2 switches that operate in series with the load – one on the supply line, the other on the return.

For normally energized outputs, if a single switch fails short circuit, the other switch can still de-energise the load. If either fails open circuit, the load will be immediately de-energized by the fault.

For normally de-energized outputs, if a single switch fails short circuit, the other switch can energise the load. If either fails open circuit, the load cannot be energized.

Switches are tested by pulsing them ON or OFF for a maximum of 5 ms – the load must not respond to this length of pulse. This test can be disabled if required.

Short circuit protection
Channels that are configured as outputs and which are short-circuited are protected by over-temperature thermal detection. If an output channel is short-circuited it will briefly conduct an over specification current, but this will be identified by the thermal detection and the relevant channel made inactive.

Pulsed output
Output channels can be configured to give a pulsed output – of either single static, single dynamic, continuous or continuous dynamic form.

The single static pulse is ON for a pre-determined time. It then remains OFF until a new pulse instruction is received.

The single dynamic pulse is ON for a period that may be changed by the application, then remains OFF until a new instruction to write is received.

### Figure 1 Recording of input states
In continuous pulse mode a series of pulses of defined ON period are sent, with a defined OFF period between.

Continuous dynamic pulse mode allows the application to continually vary the ON and OFF times of the pulse train.

For all types of Pulsed Output, the ON time of the pulse may be between 0 and 60s in 1ms intervals.

For the continuous pulse mode, the OFF period can be set between 0 and 60s, in 1ms intervals.

Pre-configured output patterns
A number of different, pre-defined output patterns are available, which can be used to indicate the occurrence of different events, using the same alarm hardware. The patterns comply with the requirements of NFPA 72 and are shown in Figure 2.

Input channel line fault detection
Line fault detection (LFD) for open and short circuit line faults will normally be enabled for safety related input channels. Series resistors are required for short circuit detection and end of line resistors for open circuit detection, as shown in figure 3.

Output channel line fault detection
Line fault detection (LFD) for open and/or short circuit line faults can optionally be enabled for normally de-energized outputs. Normally energized loads would be de-energized by either open or short circuit line faults, of these only short circuit faults will be detected and reported by the IO Module.

An open circuit fault will be reported for line resistances above 30kΩ.

Short circuit line fault detection can be enabled with forward or reverse biased test currents. With forward biased test currents, the threshold at which a short circuit fault is reported is configurable up to 1kΩ. With reverse biased test currents, the threshold is fixed at 1.95kΩ.

Pre-configured output patterns
A number of different, pre-defined output patterns are available, which can be used to indicate the occurrence of different events, using the same alarm hardware. The patterns comply with the requirements of NFPA 72 and are shown in Figure 2.

Output channel line fault detection
Line fault detection (LFD) for open and/or short circuit line faults can optionally be enabled for normally de-energized outputs. Normally energized loads would be de-energized by either open or short circuit line faults, of these only short circuit faults will be detected and reported by the IO Module.

An open circuit fault will be reported for line resistances above 30kΩ.

Module operating states
Input “Failsafe” mode
The module supports failsafe mode as defined in the earlier I/O module introductory section.

Output “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.

Visual indicators
For the operation of the Power and Fault LED’s see IO Module Overview.

Channel “Status” LED (yellow)
The yellow “Status” LED reacts in the following way to module conditions.

For the operation of the Power and Fault LEDs see the IO Module Overview.
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
Maximum 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 2 ms 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
- Not required

MECHANICAL
Module Key Code
- E4
Module width
- 42 mm
Weight
- 170 g

FIELD TERMINALS

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<td>8602-FT-ST Standard(^1)</td>
<td>8604-FT-FU Fused</td>
</tr>
<tr>
<td>Class 1, Div 2 or Zone 2 hazardous area</td>
<td>8601-FT-NA Non-arching(^1)</td>
<td>8611-FT-FU Non-arching Fused</td>
</tr>
</tbody>
</table>

\(^1\) External fusing of the Field Power supply is recommended in order to protect the field wiring.

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

SAFE AREA OR ZONE 2/ DIV2 HAZARDOUS AREA

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

FIELD TERMINALS

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<td>8602-FS-ST Standard†</td>
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<td>8611-FT-FU Non-arching Fused</td>
<td>8610-FT-NA Non-arching†</td>
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† Alternative fusing in the field wiring is recommended if it is not provided in the field terminal.
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
Maximum 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

SAFE AREA OR ZONE 2/
DIV2 HAZARDOUS AREA

FIELD TERMINALS

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

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

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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 2 ms steps)
Latch inputs
- Enable / Disable
Latch polarity
- Latch on high / latch on low
Pulse counting
- Enable / Disable

MECHANICAL
Module Key Code
- E2
Module width
- 42 mm
Weight
- 170 g

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

SAFE AREA OR ZONE 2/ DIV2 HAZARDOUS AREA

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† Alternative fusing in the field wiring is recommended if it is not provided in the field terminal.
16-channel Discrete Input
115 V ac, block isolated, sinking

8140-DI-AC

- 16 input channels
- 115V ac field voltage sources
- Pulse counting option
- Channels isolated in four blocks of four channels

MODULE SPECIFICATION
See also System Specification

INPUTS
Number of configurable channels
- 16

Number of isolated IO blocks
- 4 blocks of 4 channels

Off voltage
- < 34V ac

On voltage
- > 84V ac

Input impedance
- 60KΩ (nom)

Wetting current
- 1.9mA (nom)

Frequency
- 50 / 60Hz

CONFIGURABLE PARAMETERS

Latch inputs
- Enable / disable

Latch polarity
- Latch on high / latch on low

Pulse counting
- Enable / disable

ELECTRICAL ISOLATION

Channel to railbus
- 275V ac (max)

Between blocks (1-4, 5-8, 9-12, 13-16)
- 275V ac (max)

Channel to Channel and Ch+ to Ch- within one block
Ch. 1-4, 5-8, 9-12, 13-16
- 130V ac (max)

RESPONSE TIME

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

POWER SUPPLIES

Railbus (12V) Current
- 110mA

Bussed Field Power
- Not required

MECHANICAL

Module Key Code
- E3, non-arcing

Module width
- 42mm

Weight
- 170g
32-Channel Discrete Input
Switch/Proximity Detector Inputs, Module Powered

8125-DI-DC

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

MODULE SPECIFICATION
See also System 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)
- \( V_{oc} \leq 8.64 \text{ V}; I_{sc} \leq 18.5 \text{ mA}; C_a \leq 28 \text{ μF}; L_a \leq 23.6 \text{ mH} \)

POWER SUPPLIES

Railbus (12 V) 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

SAFE AREA OR ZONE 2/ DIV2 HAZARDOUS AREA

Resistors are required for line fault detection

CHANNEL 1 OF 32

24 V dc
Bussed Field Power

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<td>8619-FT-MT 32 Channel DI</td>
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<td>8619-FT-MT 32 Channel DI</td>
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</tbody>
</table>
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

**INPUTS**

- 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

**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 Cod
  - B6
- Module width
  - 42 mm
- Weight
  - 200 g

**SAFE AREA OR ZONE 2/ DIV2 HAZARDOUS AREA**

**FIELD TERMINALS**

<table>
<thead>
<tr>
<th>Field Wiring</th>
<th>Recommended Field Terminal</th>
<th>Compatible Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose</td>
<td>8604-FT-FU Fused</td>
<td>8602-FT-ST Standard</td>
</tr>
<tr>
<td>Class 1, Div 2 or Zone 2 hazardous area</td>
<td>8611-FT-FU Fused</td>
<td>8610-FT-NA Non-arching</td>
</tr>
</tbody>
</table>

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

†† 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
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

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.)
  - From Railbus command to output change – 2 ms + 11/42 cycle of mains frequency

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

SAFE AREA OR ZONE 2/ DIV2 HAZARDOUS AREA

FIELD TERMINALS

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<td>8610-FT-NA Non-arching†</td>
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† Alternative fusing in the field wiring is recommended if it is not provided in the field terminal.

* Limited to 3 A per module
† 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 <308 operations
‡ Consult GE for availability
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.)

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

SAFE AREA OR ZONE 2/ DIV2 HAZARDOUS AREA

FIELD TERMINALS

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<td>8611-FT-FU Non-arching Fused</td>
<td>8610-FT-NA Non-arching†</td>
</tr>
</tbody>
</table>

NOTE: External fusing to protect field wiring is recommended.

‡ Consult GE for availability.

8117-DO-DC

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 265 V ac
- Discrete or pulsed outputs
- 1A per channel switched

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

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.)
- From Railbus command to output change – 2 ms + 11/42 cycle of mains frequency

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

SAFE AREA OR ZONE 2/
DIV2 HAZARDOUS AREA

FIELD TERMINALS

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<th>Compatible Field Terminal</th>
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</thead>
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<td>8602-FS-ST Standard</td>
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<tr>
<td>Class 1, Div 2 or Zone 2</td>
<td>8611-FT-FU Non-arching</td>
<td>8610-FT-NA Non-arching</td>
</tr>
<tr>
<td>hazardous area</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: External fusing to protect field wiring is recommended.

† 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 <108 operations.
* Limited to 3 A per module.
‡ Consult GE for availability.
16-channel Discrete Output
24V dc, non-isolated, module powered

8142-DO-DC

- 16 output channels
- Controls solenoids and relays
- Common load supply for up to 42V dc
- Discrete or pulsed outputs
- 0.5A per channel switched current
- 12-42V dc bussed field power required

MODULE SPECIFICATION
See also System Specification

OUTPUTS
Number of channels
• 16
Output voltage range
• 12-42 V dc
ON voltage drop
• <0.25V @ 0.5A for one channel on
• <0.75V @ 6A total for module
OFF leakage current
• < 1mA
Output current
• Per channel – 0.5A (max)
• Per module – 6A (max)
• Channel current – Thermally limited to 3A (typ)
  at 25°C, short circuit protected

CONFIGURABLE PARAMETERS
Channel Status*
• Active / inactive
Output initialization state
• Predefined value
Fail-safe
• Predefined value / last value
Output
• Discrete, momentary or continuous pulse
Pulse width
• 500ms to 60s

ELECTRICAL ISOLATION
Channel to railibus
• 275Vrms (max)
Channel to Channel and Ch+ to Ch-
• <50V

RESPONSE TIME
I/O response time
• Railbus command to output change – 2ms (max)

POWER SUPPLIES
Railbus (12V) Current
• 125mA (max)
• 80mA (typ)
Bussed Field Power
• 12 to 42V dc, 6A (max)

MECHANICAL
Module Key Code
• B4, non-arcing
Module width
• 42mm
Weight
• 220g

SAFE AREA OR ZONE 2/
DIV2 HAZARDOUS AREA

FIELD TERMINALS

<table>
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<tr>
<th>Field Wiring</th>
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<th>Compatible Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose</td>
<td>8612-FT-NA</td>
<td>8619-FT-MT</td>
</tr>
<tr>
<td>Class 1, Div 2 or Zone 2 hazardous area</td>
<td>8612-FT-NA</td>
<td>—</td>
</tr>
</tbody>
</table>

NOTE: When using the 8619-FT-MT, the channel current should be externally limited to 250mA; ensure both ribbon cables are in place.

* It is recommended that all unused channels be set to inactive to assure proper LFD operation

www.ge-ip.com/process
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 transmitted 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 Specification

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

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

**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

**FREQUENCY RANGES**
- 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

**MECHANICAL**

**Module Key Code**
- F2

**Module width**
- 42 mm

**Weight**
- 260 g

**TERMINAL ASSIGNMENTS**

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Current input</td>
</tr>
<tr>
<td>2</td>
<td>Voltage input</td>
</tr>
<tr>
<td>3</td>
<td>NAMUR input</td>
</tr>
<tr>
<td>4</td>
<td>Common</td>
</tr>
<tr>
<td>5</td>
<td>Power supply +ve</td>
</tr>
<tr>
<td>6</td>
<td>Power supply +ve</td>
</tr>
<tr>
<td>7</td>
<td>Current input</td>
</tr>
<tr>
<td>8</td>
<td>Voltage input</td>
</tr>
<tr>
<td>9</td>
<td>NAMUR input</td>
</tr>
<tr>
<td>10</td>
<td>Common</td>
</tr>
<tr>
<td>11</td>
<td>NAMUR gate/control input</td>
</tr>
<tr>
<td>12</td>
<td>Common</td>
</tr>
<tr>
<td>13</td>
<td>Output +ve</td>
</tr>
<tr>
<td>14</td>
<td>Output -ve</td>
</tr>
<tr>
<td>15</td>
<td>Output +ve</td>
</tr>
<tr>
<td>16</td>
<td>Output -ve</td>
</tr>
</tbody>
</table>

**LED INDICATORS**

**POWER - Green LED**
--off:
- Power failure
- Power OK
- Not Applicable

**FAULT - Red LED**
--off:
- In running state
- Fault
- Awaiting module training

**PULSE INPUT CHANNEL - Yellow LED**
--off:
- Channel inactive
- Channel active and operating normally
- Channel active but in alarm condition

**DIGITAL OUTPUT CHANNEL - Yellow LED**
--off:
- Channel inactive
- Channel active and operating normally
- Not applicable

**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

**FIELD TERMINALS**

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<th>Field Wiring</th>
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<td>General purpose</td>
<td>8602-FT-ST Standard</td>
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<tr>
<td>Class 1, Div 2 or Zone 2 hazardous area</td>
<td>8601-FT-NI Non-incendive</td>
</tr>
</tbody>
</table>

**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 = 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 = 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
- Vmax=30 Vdc, Imax=100 mA, Ci=0 μF, Li=0 mH

**MECHANICAL**

**Module Key Code**
- F2

**Module width**
- 42 mm

**Weight**
- 260 g

**TERMINAL ASSIGNMENTS**

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**LED INDICATORS**

**POWER - Green LED**
- Off:
- Power failure
- Power OK
- Not Applicable

**FAULT - Red LED**
- Off:
- In running state
- Fault
- Awaiting module training

**PULSE INPUT CHANNEL - Yellow LED**
- Off:
- Channel inactive
- Channel active and operating normally
- Channel active but in alarm condition

**DIGITAL OUTPUT CHANNEL - Yellow LED**
- Off:
- Channel inactive
- Channel active and operating normally
- Not applicable

**ISOLATION**

**Any channel to Railbus**
- 100 V ac

**Line fault detect**
- Enable / Disable

**Channel status**
- Active / Inactive

**Counter**
- Enable / Disable

**Counting direction**
- Count up / Count down

**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.

**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

**RESPONSE TIMES**

**Signal change to availability on Railbus**
- 25 ms (max.)
32-Channel Sequence Of Events
Non-Isolated, Module-Powered

8127-DI-SE
- 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 timestamped 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. The event logging software can also be used 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 to your field devices in order to record events locally on a more reliable and 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.

**MODULE SPECIFICATION**

See also System 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)

**SAFE AREA OR ZONE 2/ DIV2 HAZARDOUS AREA**

**FIELD TERMINALS**

<table>
<thead>
<tr>
<th>Field Wiring</th>
<th>Recommended Field Terminal</th>
<th>Compatible Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose</td>
<td>8617-FT-NI 30 channel SOE</td>
<td>8619-FT-MT 30 channel SOE</td>
</tr>
<tr>
<td>Class 1, Div 2 or Zone 2 hazardous area</td>
<td>8617-FT-NI 30 channel SOE</td>
<td>8619-FT-MT 30 channel SOE</td>
</tr>
</tbody>
</table>

**SAFETY**

FM non-incendive field wiring parameters (each channel)
- $V_{oc} \leq 8.64 V$, $I_{sc} \leq 18.5 mA$, $C_a \leq 28 \mu F$, $L_a \leq 23.6 mH$

**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
126-channel Addressable Smoke and Heat Detector Module

24V dc, non-isolated, module-powered

**8139-SH-DC**

- Up to 126 input channels on each loop
- Use with any PAC8000 Controller
- Non-interfering on SIL2 SafetyNet node
- Up to 10 8139 modules per node
- ‘Normal mode’ Apollo Discovery protocol

Supports:
- XP95 detectors
- Discovery detectors (normal mode)
- Intrinsic safe Apollo instruments (via protocol converter and isolator)
- Zone & Switch monitors & IO
- Mini Switch Interfaces
- Sounders & beacons

- Detector alarm state notification
- Detector fault notification
- Channel fault detection
- 24V dc bussed field power required

**MODULE SPECIFICATION**

See also System Specification

<table>
<thead>
<tr>
<th>INPUT</th>
<th>MECHANICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of channels</td>
<td>Module Keyode</td>
</tr>
<tr>
<td>126</td>
<td>C2</td>
</tr>
<tr>
<td>Isolation (channel to Railbus)</td>
<td>Module Width</td>
</tr>
<tr>
<td>250V ac</td>
<td>42mm</td>
</tr>
</tbody>
</table>

**RESPONSE TIME**

Poll time (per device - not in alarm state)
- 45ms, typical

Poll time (per device - in alarm state)
- 135ms, typical

Total poll time (126 devices - no alarms)
- 5.7s, typical

Minimum Poll time
- 600ms

**POWER SUPPLIES**

Railbus (12V) current
- <100 mA

Bussed field power
- 1500mA (max) at 24V dc (max)

Supply to field
- 900mA (450mA from each loop end)

**FIELD TERMINALS**

<table>
<thead>
<tr>
<th>Field Wiring</th>
<th>Recommended Field Terminal</th>
<th>Compatible Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose</td>
<td>8610-FT-NA Non-arcing</td>
<td>8611-FT-FU Non-arcing Fused</td>
</tr>
<tr>
<td>Class 1, Div 2 or Zone 2 hazardous area</td>
<td>8610-FT-NA Non-arcing</td>
<td>8611-FT-FU Non-arcing Fused</td>
</tr>
</tbody>
</table>

Consideration must be given to operation in case of a loop breakage.
# 2/1 I/O Modules

## Analog input modules
- 8-channel, 4–20 mA with HART®
- 8-channel, 0–10V/potentiometer input
- 8-channel, Thermocouple and mV
- 8-channel, RTD and Ω
- 8-channel, 4–20 mA with HART®

## Analog output modules
- 8-channel, 4–20 mA

## Discrete input modules
- 16-channel, Switch/proximity detector

## Discrete output modules
- 4-channel, 4Solenoid driver, IIC gas groups

## Pulse input modules
- 2-channel, pulse input
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

SAFETY

Field wiring protection
- [EEx ia] IIC

Safety description (each channel)
- \( U_i = 28 \text{ V}, I_i = 93 \text{ mA}, P_i = 0.65 \text{ W} \)

FM entity parameters
- \( V_{oc} \leq 28 \text{ V dc}, I_{sc} \leq 93 \text{ mA}, C_i \leq 0.14 \mu \text{F}, L_i \leq 4.38 \mu \text{H} \)

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 TERMINALS

<table>
<thead>
<tr>
<th>Field Wiring Type</th>
<th>Recommended Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intrinsically safe standard</td>
<td>8621-FT-IS</td>
</tr>
<tr>
<td>Intrinsically safe loop disconnect</td>
<td>8622-FT-IS</td>
</tr>
</tbody>
</table>
8-channel Analog Input

0-10V/potentiometer input

**8230-AI-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, 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

**RESPONSE TIME**

Signal change to availability on Railbus
- ≤ 5 s

Open circuit line fault detection time
- ≤ 5 s

**SAFETY**

**Field wiring protection**
- [EExia] IIC

**Safety description (each channel non linear output)**
- \( U_v \leq 15.75 \text{ V}, I_v \leq 20 \text{ mA}, P_v \leq 0.315 \text{ W} \)

**FM entity parameters**
- \( V_{oc} = 15.75 \text{ V}, I_{sc} = 20 \text{ mA} \)
- \( C_a = 0.22 \mu \text{F}, L_y = 5 \text{ mH} \)

**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 TERMINALS**

<table>
<thead>
<tr>
<th>Field Wiring Type</th>
<th>Recommended Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intrinsically safe, standard</td>
<td>8623-FT-IS</td>
</tr>
</tbody>
</table>
2/1 I/O Modules

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 rOCT 3044-84
- User definable linearisation table, NOTE 1

ACCURACY (% OF SPAN)

<table>
<thead>
<tr>
<th>Tamb</th>
<th>mV inputs</th>
<th>THC inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>25°C</td>
<td>± 0.05%</td>
<td>± 0.05%</td>
</tr>
<tr>
<td>+10 to +45°C</td>
<td>± 0.08%</td>
<td>± 0.1%</td>
</tr>
<tr>
<td>-60 to +70°C</td>
<td>± 0.18%</td>
<td>± 0.3%</td>
</tr>
</tbody>
</table>

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

CONFIGURABLE PARAMETERS

Sensor type
- User selectable

Alarms
- High and low

Input dead zone
- User defined value

Selectable input filtering
- Off / 2 reading average / running average

Drive on open circuit fault
- Disabled / upscale / downscale

Channel status
- Active / Inactive

Cold junction compensation
- Enable / disable / channel number

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 – $U_i = 16.4 \text{ V}, I_i = 63.7 \text{ mA}, P_i = 131 \text{ mW}$
- Channels 5 and 6, wired as separate IS circuits – $U_i = 3 \text{ V}, I_i = 1 \text{ mA}, P_i = 0.25 \text{ mW}$

FIELD TERMINALS

Field Wiring Type | Recommended Field Terminal
-------------------|-----------------------------
Intrinsically safe THC | 8625-FT-IS

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

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

* Cold junction compensation located in recommended field terminal.

ACCURACY (% OF SPAN)

<table>
<thead>
<tr>
<th>Tamb</th>
<th>mV inputs</th>
<th>THC inputs</th>
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<tbody>
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<td>± 0.05%</td>
<td>± 0.05%</td>
</tr>
<tr>
<td>+10 to +45°C</td>
<td>± 0.08%</td>
<td>± 0.1%</td>
</tr>
<tr>
<td>-60 to +70°C</td>
<td>± 0.18%</td>
<td>± 0.3%</td>
</tr>
</tbody>
</table>

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

CONFIGURABLE PARAMETERS

Sensor type
- User selectable

Alarms
- High and low

Input dead zone
- User defined value

Selectable input filtering
- Off / 2 reading average / running average

Drive on open circuit fault
- Disabled / upscale / downscale

Channel status
- Active / Inactive

Cold junction compensation
- Enable / disable / channel number

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 – $U_i = 16.4 \text{ V}, I_i = 63.7 \text{ mA}, P_i = 131 \text{ mW}$
- Channels 5 and 6, wired as separate IS circuits – $U_i = 3 \text{ V}, I_i = 1 \text{ mA}, P_i = 0.25 \text{ mW}$

FIELD TERMINALS

Field Wiring Type | Recommended Field Terminal
-------------------|-----------------------------
Intrinsically safe THC | 8625-FT-IS

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

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

* Cold junction compensation located in recommended field terminal.

In addition, see error table in System specification section.
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

<table>
<thead>
<tr>
<th>Input type</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt100, Pt500</td>
<td>-200 to +850° C</td>
</tr>
<tr>
<td>jPt100</td>
<td>-200 to +650° C</td>
</tr>
<tr>
<td>Ni120</td>
<td>-60 to +250° C</td>
</tr>
</tbody>
</table>

RESISTANCE INPUT

<table>
<thead>
<tr>
<th>Excitation current</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>211 μA</td>
<td>0 to 110 Ω</td>
</tr>
<tr>
<td>211 μA</td>
<td>0 to 280 Ω</td>
</tr>
<tr>
<td>211 μA</td>
<td>0 to 470 Ω</td>
</tr>
<tr>
<td>48 μA</td>
<td>0 to 2000 Ω</td>
</tr>
</tbody>
</table>

ACCURACY (% OF SPAN), SEE NOTE 2

<table>
<thead>
<tr>
<th>Tamb</th>
<th>RTD &amp; Ω inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>25° C</td>
<td>± 0.05%</td>
</tr>
<tr>
<td>+10 to +40° C</td>
<td>± 0.1%</td>
</tr>
<tr>
<td>-40 to +70° C</td>
<td>± 0.2%</td>
</tr>
</tbody>
</table>

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

CONFIGURABLE PARAMETERS

Sensor type
- User selectable

Alarms
- High and low

Input dead zone
- User defined value

Selectable input filtering
- Off / 2 reading average / running average

Drive on open circuit fault
- Disabled / upscale / downsparse

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
- [Ex ia] IIC

Safety Description (all channels combined)
- \( V_{in} = 16.4 \text{ V}, I_x = 217 \text{ mA}, P_x = 0.9 \text{ W} \)

FM entity parameters
- \( V_{in} = 16.4 \text{ V dc}, I_{in} = 350 \text{ mA}, P_{in} = 718 \text{ mW} \)

POWER SUPPLIES

IS Railbus (12V) current
- 120 mA [max.]

Power dissipation within module
- 1.5 W [max.]

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.
8-channel Analog Input
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.)
(iso 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

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_o ≤ 24.6 V dc, I_o ≤ 93 mA
• C_a ≤ 0.42 μF, L_a ≤ 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 TERMINALS
Field Wiring Type | Recommended Field Terminal
---|---
Intrinsically safe standard | 8621-FT-IS
Intrinsically safe loop disconnect | 8622-FT-IS

* Time to reach 90% level for 4-20 mA step into 650 Ω load
8-channel Analog Output
4–20 mA

8204-AO-IS

- 8 single-ended output channels
- Intrinsically safe
- Conventional 4–20 mA
- 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

SAFETY
Field wiring protection
- [Ex ia] IIIC
Safety description
- V_o = 24.6 V, I_o = 93 mA, P_o = 0.57 W

POWER SUPPLIES
IS Railbus (12V) current
- All channels @ 22 mA into 530 Ω load) – 630 mA
Power dissipation within module
- 3.8 W (max.)

MECHANICAL
Module Key Code
- A4
Module width
- 42 mm
Weight
- 245 g

FIELD TERMINALS

<table>
<thead>
<tr>
<th>Field Wiring Type</th>
<th>Recommended Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intrinsically safe standard</td>
<td>8621-FT-IS</td>
</tr>
<tr>
<td>Intrinsically safe loop disconnect</td>
<td>8622-FT-IS</td>
</tr>
</tbody>
</table>

HAZARDOUS AREA
ZONE 0/DIV1
SAFE AREA OR ZONE 2/
DIV2 HAZARDOUS AREA
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**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of channels</td>
<td>16</td>
</tr>
<tr>
<td>OFF current</td>
<td>&lt;1.2 mA</td>
</tr>
<tr>
<td>ON current</td>
<td>&gt;2.1 mA</td>
</tr>
<tr>
<td>Switching hysteresis</td>
<td>200 µA (nom.)</td>
</tr>
<tr>
<td>Applicable specifications</td>
<td>NAMUR, DIN19234</td>
</tr>
<tr>
<td>Voltage applied to sensor</td>
<td>7.0 to 9.0 V from 1 kΩ ±10%</td>
</tr>
<tr>
<td>Output (wetting) current</td>
<td>@ 100Ω line impedance</td>
</tr>
<tr>
<td>Line fault detection</td>
<td>&gt;6 mA</td>
</tr>
<tr>
<td>Maximum input frequency in pulse counting mode</td>
<td>20 Hz</td>
</tr>
<tr>
<td>Minimum pulse width detected</td>
<td>45 ms</td>
</tr>
</tbody>
</table>

**CONFIGURABLE PARAMETERS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selectable input filter</td>
<td>Fast, slow or user defined (User defined permits 0 to 512 ms values in 3ms steps)</td>
</tr>
<tr>
<td>Latch inputs</td>
<td>Enable / Disable</td>
</tr>
</tbody>
</table>

**SAFETY**

Field wiring protection
- [EEx ia] IIC

Safety Description (each channel)
- \( U_i = 10.5 \text{ V}, I_i = 14 \text{ mA}, P_i = 0.04 \text{ W} \)

FM Entity parameters
- \( V_{oc} \leq 10.5 \text{ V} \text{ dc}, I_{oc} \leq 14 \text{ mA} \)
- \( C_a \leq 2.67 \mu\text{F}, L_a \leq 176 \text{ mH} \)

Isolation
- Any channel to Railbus – 60 V ac (channels arranged in two groups of eight, with returns communized 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
- 81

Module width
- 42 mm

Weight
- 170 g

**RESPONSE TIME**

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

**FIELD TERMINALS**

<table>
<thead>
<tr>
<th>Field Wiring Type</th>
<th>Recommended Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intrinsically safe, 16-channel</td>
<td>8623-FT-IS</td>
</tr>
<tr>
<td>Intrinsically safe, 8-channel loop disconnect</td>
<td>8624-FT-IS</td>
</tr>
</tbody>
</table>

Resistors are required for line fault detection.

<table>
<thead>
<tr>
<th>Railbus</th>
<th>Channel 1 of 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>680</td>
<td>22k</td>
</tr>
</tbody>
</table>

SAFE AREA OR ZONE 2/
HAZARDOUS AREA
ZONE 0/DIV1
HAZARDOUS AREA
ZONE 0/DIV2 HAZARDOUS AREA
4-channel Discrete Output
4 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

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)
• \( V_o = 25 \text{ V}, I_o = 110 \text{ mA}, P_o = 0.69 \text{ W} \)

FM Entity parameters
• \( V_{oc} \leq 25 \text{ V} \text{ dc}, I_{oc} \leq 110 \text{ mA} \)
• \( C_o \leq 0.19 \mu F, L_o \leq 3.15 \mu H \)

POWER SUPPLIES

• IS Railbus (12 V) 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 TERMINALS

<table>
<thead>
<tr>
<th>Field Wiring Type</th>
<th>Recommended Field Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intrinsically safe standard</td>
<td>8621-FT-IS</td>
</tr>
<tr>
<td>Intrinsically safe loop disconnect</td>
<td>8622-FT-IS</td>
</tr>
</tbody>
</table>
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 and 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 Specification

PULSE/FREQUENCY

<table>
<thead>
<tr>
<th>Number of channels</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency range</td>
<td>50 kHz</td>
</tr>
<tr>
<td></td>
<td>In quadrature mode – 12.5 kHz</td>
</tr>
<tr>
<td>Accuracy (25°C)</td>
<td>± 0.05% of span</td>
</tr>
<tr>
<td>Temperature Stability</td>
<td>0.005% / °C</td>
</tr>
</tbody>
</table>

CONTROL GATE (FOR GATING CHANNEL 1 ONLY)

<table>
<thead>
<tr>
<th>Switching thresholds</th>
<th>1.2 mA / 2.1 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input impedance</td>
<td>1 kΩ</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>8.1 V (nom.) at 8 mA</td>
</tr>
</tbody>
</table>

SENSOR INPUT CHARACTERISTICS

NAMUR 1

<table>
<thead>
<tr>
<th>Switching thresholds</th>
<th>1.2 mA / 2.1 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input impedance</td>
<td>1 kΩ</td>
</tr>
</tbody>
</table>

Supply voltage
- 8.1 V (nom.) at 8 mA

CURRENT

<table>
<thead>
<tr>
<th>Input signal</th>
<th>20 mA (max.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold</td>
<td>Configurable in 8 levels</td>
</tr>
<tr>
<td>Input impedance</td>
<td>25 Ω</td>
</tr>
<tr>
<td>Open circuit current</td>
<td>&lt;0.5 mA</td>
</tr>
<tr>
<td>Short circuit current</td>
<td>&gt;21.5 mA</td>
</tr>
</tbody>
</table>

VOLTAGE

<table>
<thead>
<tr>
<th>Input signal</th>
<th>0 - 24 V dc (50 V max.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold</td>
<td>Configurable in 8 levels</td>
</tr>
<tr>
<td>Input impedance</td>
<td>&gt;10 kΩ</td>
</tr>
<tr>
<td>Switching hysteresis</td>
<td>100 mV</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Number of channels</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF state voltage</td>
<td>30 V (max)</td>
</tr>
<tr>
<td>OFF state leakage current</td>
<td>10µA (max)</td>
</tr>
<tr>
<td>ON state voltage drop</td>
<td>&lt;1.0V @ 50 mA</td>
</tr>
<tr>
<td>ON state current</td>
<td>100 mA</td>
</tr>
<tr>
<td>Retransmission bandwidth</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2000 Hz</td>
</tr>
</tbody>
</table>

CONFIGURABLE PARAMETERS

INPUTS

<table>
<thead>
<tr>
<th>Channel</th>
<th>Enable / Disable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor type</td>
<td>NAMUR prox. type (select low / high speed)</td>
</tr>
<tr>
<td>Current pulse input</td>
<td></td>
</tr>
<tr>
<td>Voltage pulse input</td>
<td></td>
</tr>
<tr>
<td>Switch input</td>
<td></td>
</tr>
</tbody>
</table>
**TERMINAL ASSIGNMENTS**

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Current input</td>
</tr>
<tr>
<td>2</td>
<td>Voltage input</td>
</tr>
<tr>
<td>3</td>
<td>NAMUR input</td>
</tr>
<tr>
<td>4</td>
<td>Common</td>
</tr>
<tr>
<td>5</td>
<td>Power supply +ve</td>
</tr>
<tr>
<td>6</td>
<td>Power supply +ve</td>
</tr>
<tr>
<td>7</td>
<td>Current input</td>
</tr>
<tr>
<td>8</td>
<td>Voltage input</td>
</tr>
<tr>
<td>9</td>
<td>NAMUR input</td>
</tr>
<tr>
<td>10</td>
<td>Common</td>
</tr>
<tr>
<td>11</td>
<td>NAMUR gate/control input</td>
</tr>
<tr>
<td>12</td>
<td>Common</td>
</tr>
<tr>
<td>13</td>
<td>Output +ve</td>
</tr>
<tr>
<td>14</td>
<td>Output -ve</td>
</tr>
<tr>
<td>15</td>
<td>Output +ve</td>
</tr>
<tr>
<td>16</td>
<td>Output -ve</td>
</tr>
</tbody>
</table>

**TERMINAL ASSIGNMENTS (cont.)**

* Channel 1

**FIELD TERMINALS**

**Recommended Field Terminal**

<table>
<thead>
<tr>
<th>Field Wiring Type</th>
<th>8621-FT-IS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Po = 639 mW, Co = 0.078 μF, Lo = 1.28 mH</td>
<td></td>
</tr>
</tbody>
</table>

**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 together)**
- Uo = 27.4 V, Io = 186.4 mA, Po = 1.28 W
- Ca = 0.67 μF, La = 6.4 mH

**Current inputs (Ch1 & Ch2)**
- Uo = 1.2 V, Io = 57.4 mA, Po = 17.2 mW
- Co = 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, Li = 100 mA
- Ci = 0 μF, Li = 0 mH
# 2/1 I/O Modules

## LED INDICATORS

### POWER - Green LED

<table>
<thead>
<tr>
<th></th>
<th>OFF</th>
<th>ON</th>
<th>FLASHING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power failure</td>
<td></td>
<td></td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Power OK</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### FAULT - Red LED

<table>
<thead>
<tr>
<th></th>
<th>OFF</th>
<th>ON</th>
<th>FLASHING</th>
</tr>
</thead>
<tbody>
<tr>
<td>In running state</td>
<td></td>
<td></td>
<td>Awaiting module training</td>
</tr>
<tr>
<td>Fault</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### PULSE INPUT CHANNEL - Yellow LED

<table>
<thead>
<tr>
<th></th>
<th>OFF</th>
<th>ON</th>
<th>FLASHING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel inactive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel active and operating normally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel active but in alarm condition</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### DIGITAL OUTPUT CHANNEL - Yellow LED

<table>
<thead>
<tr>
<th></th>
<th>OFF</th>
<th>ON</th>
<th>FLASHING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel inactive</td>
<td></td>
<td></td>
<td>Not applicable</td>
</tr>
<tr>
<td>Channel active and operating normally</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
About GE Intelligent Platforms

GE Intelligent Platforms provides industrial software, control systems and embedded computing platforms to optimize our customers’ assets and equipment. Our goal is to help our customers grow the profitability of their businesses through high-performance solutions facilitated by the Industrial Internet. We work across industries, including manufacturing, water, oil & gas, mining, power, defense and aerospace. A division of GE, we are headquartered in Charlottesville, VA. www.ge-ip.com

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