

GENERAL SPECIFICATION

INSTRUMENTATION

GS EP INS 196

Input and Output Standard Functions

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1. Scope

The purpose of this document is to define a set of Standard Functions for most common inputs and outputs.

It includes the following functions with some options:

- Process digital input
- Safety digital input
- Line monitored digital input
- Process analogue input
- Safety analogue input
- Digital output
- Analogue output
- Redundant analogue inputs.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
Not applicable	

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP EXP 139	Alarm management
GS EP INS 150	Design method for system configuration - Standard functions
GS EP INS 156	Human Machine Interfaces (HMI)
GS EP INS 198	Safety and Fire & Gas Standard Functions

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Chapter 1 Digital Input Standard Function - DI -

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1. Scope

The purpose of this document is to define the Standard Function for a digital input to the PCS, with alarm detection in option.

Digital inputs may concern:

- Field switches processed by the PCS
- Digital inputs from serial inks.

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**.

2. General Description of Functions

2.1 List of main functions

- ON/OFF signal acquisition
- Alarm detection (option DI_AL)
- Fault detection (Input card fault)
- Maintenance mode
- Selectable DI-D/ DI-E
- Automatic Masking.

3. Description of Interfaces

INPUTS							OUTPUTS		
Field	HMI	Internal					Internal	HMI	Field
•			Digital input	DI Standard Function	Input Status		•	Alm	
		•	Input card fault		Fault status		•	Alm	
		•	Automatic Alm masking		Maintenance mode status				
	•		Maintenance mode command		Opt. = optional				
		•	DI-D / DI-E selection		Alm = Alarm				

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4. Detailed Description of Functions

There are two field wiring principles possible, the DI-D / DI-E selector is used to select the corresponding software treatment:

DI-D = “De-energised to trip” principle:

Contact OPEN (loop electrical status = “0”) → *ACTIVE* or *ALARM* status

Contact CLOSED (loop electrical status = “1”) → *INACTIVE* or *NORMAL* status

DI-E = “Energised to trip” principle:

Contact CLOSED (loop electrical status = “1”) → *ACTIVE* or *ALARM* status

Contact OPEN (loop electrical status = “0”) → *INACTIVE* or *NORMAL* status

4.1 Maintenance Mode

One maintenance mode command is required for each DI processed by the PCS.

When the maintenance mode is active, yCH/L or yAH/L is forced to its *INACTIVE* state and the alarm is masked. In addition the loop fault alarm is also masked. However, the status of the input is still available and displayed.

Maintenance mode command is available in MAINTENANCE access level.

4.2 Fault Status

Input card fault. The definition of input card fault is that the card(s) is no longer capable of processing the input or that the input is considered invalid.

4.3 Automatic Masking

Each individual alarm can be masked by an external event (as per [GS EP INS 150](#)).

5. Tuning parameters and variables

Parameter	Access level
Filtering pre-set value	Engineer

6. Representation and Animation (HMI)

6.1 Events to be recorded

- Alarm (option DI_AL)
- Fault status
- Maintenance mode (PCS).

6.2 Alarm handling

Alarm Description	Priority
Input alarm	Note 1
Fault alarm	Note 1

Note 1: For alarm priority level determination, refer to **GS EP EXP 139**. Colours of alarms shown in the hereafter tables are given for information and will follow the alarm priority level identification rules.

6.3 HMI Animation

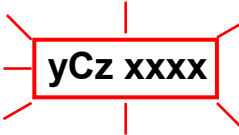
The animation principles in the tables below are intended for the detailed views at hierarchy level 4, as described in **GS EP INS 156**. A simplified animation may be developed for overviews at display hierarchy levels 1, 2, and 3.

The DI standard function shall have a faceplate as detailed in **GS EP INS 156**.

The events which drive the HMI animation may not be mutually exclusive. Therefore, the precedence on the display, from most to least important, shall be: magenta, white, blue, yellow.

6.3.1 PCS digital input without alarm for process / utility views.

yCz xxxx: Tag name of signal (e.g. position switch)

Internal data	Display	Text	Frame
Input status = <i>INACTIVE</i>	yCz xxxx	Grey (visible)	NA
Input status = <i>ACTIVE</i>	yCz xxxx	Green	NA
Fault status = <i>ACTIVE</i> Alarm unacknowledged		As above	Flashing red (internal frame)
Fault status = <i>ACTIVE</i> Alarm acknowledged		As above	Steady red (internal frame)
Maintenance mode = <i>ACTIVE</i>		As above	Yellow (external frame)
Communication fault = <i>ACTIVE</i>		White	Magenta (external frame)

6.3.2 PCS digital input with alarm (option DI_AL) for process / utility views.

yAz xxxx: Tag name of signal (e.g. digital alarm)

Internal data	Display	Text	Frame
Input status = <i>NORMAL</i>	yAz xxxx	Grey (visible)	NA
Input status = <i>ALARM</i> Alarm unacknowledged	yAz xxxx	Flashing colour (colour depends on alarm priority level- Note 1)	NA
Input status = <i>ALARM</i> Alarm acknowledged	yAz xxxx	Colour steady (colour depends on alarm priority level – Note 1)	NA
Fault status = <i>ACTIVE</i> Alarm unacknowledged	yAz xxxx	As above	Flashing red (internal frame)
Fault status = <i>ACTIVE</i> Alarm acknowledged	yAz xxxx	As above	Steady red (internal frame)
Maintenance mode = <i>ACTIVE</i>	yAz xxxx	As above	Yellow (external frame)
Communication fault = <i>ACTIVE</i>	yAz xxxx	White	Magenta (external frame)

Note 1: For alarm priority level determination, refer to [GS EP EXP 139](#).

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1. Scope

The purpose of this document is to define the Standard Function for a digital input to the PSS, ESD and F&G system.

Safety Digital inputs may concern:

- Hardwired trip signals from packages to the safety system.
- Hardwired or SIS Safety Network signals between Safety logic solvers.

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**.

2. General Description of Functions

2.1 List of main functions

- ON/OFF signal acquisition
- Input trip signal and alarm
- Fault detection (Input card fault)
- Maintenance inhibit
- Start-up inhibit
- Automatic Alarm Masking.

3. Description of Interfaces

INPUTS					OUTPUTS			
Field	HMI	Internal			Internal	HMI	Field	
Opt			Digital input	DIS Standard Function		Input Trip signal		Alm
			Input card fault			Input Trip raw status		
		Opt	Automatic Alm masking			Fault signal		Alm
			Start-up inhibit			Fault raw status		
			Start-up inhibit removal initiator			Start-up inhibit status		Opt
		Opt	Maintenance Inhibit Command			SU Inhibit timer countdown		Opt
			Master key-switch			Maintenance inhibit status		
			Inhibit key-switch					
			DIS-D / DIS-E selection					
			Opt. = Optional Alm. = Alarm					

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4. Detailed Description of Functions

There are two field wiring principles possible, the DI-D / DI-E selector is used to select the corresponding software treatment:

DIS-D = "De-energised to trip" principle:

Contact OPEN (loop electrical status = "0") → *ACTIVE* or *ALARM* status

Contact CLOSED (loop electrical status = "1") → *INACTIVE* or *NORMAL* status

DIS-E = "Energised to trip" principle:

Contact CLOSED (loop electrical status = "1") → *ACTIVE* or *ALARM* status

Contact OPEN (loop electrical status = "0") → *INACTIVE* or *NORMAL* status

DIS-E is generally only used for non executive safety signals. For hardwired executive safety signals which are non-failsafe, the loop shall be line-monitored using the DIS_LM standard function.

4.1 Maintenance Inhibit

Activation of the maintenance inhibit command will force the input trip signal and fault signal to their healthy state. The raw status of the input trip and loop fault are still animated but not alarmed.

When the maintenance inhibit is applied, any downstream voting logic arrangement shall automatically be reconfigured in accordance with the downgraded voting logic arrangement defined in the Voting Logic Standard Function (Refer to the [GS EP INS 198](#)).

The definition of the MASTER Inhibit Enable key-switch and the Inhibit Command Authorisation key-switch, located in the central control room on the ESD/FGS matrix panel, is detailed in [GS EP INS 150](#).

The MASTER key-switch must be in the ENABLE position for the maintenance inhibit function to be enabled. All PSS, ESD and FGS maintenance inhibits will be reset (i.e. removed) when the MASTER key-switch is switched to the DISABLE position.

The Inhibit Command Authorisation keyswitch will authorise maintenance inhibit commands to be applied and removed during a limited time window (default 30 minutes). After the timer is elapsed, it will no longer be possible to apply or remove inhibits from the OWS / MWS.

The inhibit will be set (applied) and latched in the safety system logic until it is reset (removed) from the designated workstation or by the MASTER key-switch DISABLE position.

In case of brown field development and potentially new development within the same asset, the existing maintenance inhibit procedure will be maintained, unless otherwise specified by the project.

4.2 Fault Status

Input card fault. The definition of input card fault is that the card(s) is no longer capable of processing the input or that the input is considered invalid (i.e. TMR input cards with one out of three faulty legs shall not be considered as an input fault). The input card shall force the signal low when the card is in fault.

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4.3 Automatic Masking

Each individual alarm can be masked by an external event (as per **GS EP INS 150**).

4.4 Start-up Inhibit (Optional)

The requirement for start-up inhibit (SUI) on individual inputs shall be defined on the safety logic diagram. Care shall be exercised to ensure that the automatic SUI is only applied when the protective function is not needed. The automatic conditions for applying and removing the SUI shall be subject to process and safety review.

Typical SUI application:

- P3 Package trip input to the SBAR due to mutual tripping, i.e. where the SBAR trips the package and in return the package trips the SBAR which would otherwise be impossible to reset.

Setting the SUI: There may be two methods of setting the SUI;

- Automatically on a pre-determined event, such as pump stopped, SBAR tripped.
- Manually using a start-up inhibit command associated with the safety bar.

Resetting the SUI: The start-up inhibit removal initiator (e.g. pump started, SBAR reset) will launch the SUI timer countdown. There are then two possibilities:

- If during this countdown the digital input has returned to healthy, then the SUI shall be reset after a stabilisation delay.
- After the start up inhibit count-down timer elapses, the SUI shall be reset (i.e. removed) regardless of the digital input status and regardless of any stabilisation delay.

Activation of the SUI will force the input trip signal to its healthy state. The raw status of the digital input and fault are still displayed.

5. Tuning parameters and variables

Parameter	Access level
Start-up inhibit timer preset value	Method
Stabilisation delay preset value	Method

6. Representation and Animation (HMI)

6.1 Events to be recorded

- Input trip signal
- Fault status
- Maintenance inhibit
- Start-up inhibit
- Automatic masking.

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6.2 Alarm handling

Alarm Description	Priority
PSS / ESD / FGS input alarm	Note 1
PSS / ESD / FGS Fault alarm	Note 1

Note 1: For alarm priority level determination, refer to [GS EP EXP 139](#). Colours of alarms shown in the hereafter tables are given for information and will follow the alarm priority level identification rules.

6.3 HMI Animation

The animation principles in the tables below are intended for the detailed views at hierarchy level 4, as described in [GS EP INS 156](#). A simplified animation may be developed for overviews at display hierarchy levels 1, 2, and 3.

The DIS standard function shall have a faceplate as detailed in [GS EP INS 156](#).

The events which drive the HMI animation may not be mutually exclusive. Therefore, the precedence on the display, from most to least important, shall be: magenta, white, blue, yellow.

6.3.1 Safety digital input for process / utility views

ySzz xxxx: Tag name of signal

Internal data	Display	Text	Frame
Input Trip status = <i>NORMAL</i>	ySzz xxxx	Grey (visible)	NA
Input Trip status = <i>ALARM</i> Alarm unacknowledged		Flashing colour (colour depends on alarm priority level- Note 1)	NA
Input Trip status = <i>ALARM</i> Alarm acknowledged	ySzz xxxx	Colour steady (colour depends on alarm priority level - Note 1)	NA
Fault status = <i>ACTIVE</i> Alarm unacknowledged		As above	Flashing red (internal frame)
Fault status = <i>ACTIVE</i> Alarm acknowledged		As above	Red Steady (internal frame)
Maintenance inhibit active		As above depending on input trip raw status	Yellow (external frame)
Start-up inhibit active		As above depending on input trip raw status	Yellow (external frame)
Communication fault = <i>ACTIVE</i>		White	Magenta (external frame)

Note 1: For alarm priority level determination, refer to **GS EP EXP 139**.

6.3.2 Safety digital input for shutdown views

ySzz xxxx: Tag name of signal (example for a Safety bar input)

Internal data	Display	Text	Frame
Input Trip status = <i>NORMAL</i>	ySzz xxxx	Blue	NA
Input Trip status = <i>ALARM</i> Alarm unacknowledged		Flashing red	NA
Input Trip status = <i>ALARM</i> Alarm acknowledged	ySzz xxxx	Steady red	NA
Fault status = <i>ACTIVE</i> Alarm unacknowledged		As above	Flashing red (internal frame)
Fault status = <i>ACTIVE</i> Alarm acknowledged		As above	Red steady (internal frame)
Maintenance inhibit active		As above depending on input trip raw status	Yellow (external frame)
Start-up inhibit active		As above depending on input trip raw status	Yellow (external frame)
Communication fault = <i>ACTIVE</i>		White	Magenta (external frame)

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Chapter 3 Line Monitored Digital Input Safety Standard Function DIS_LM

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6.3 HMI Animation	20

1. Scope

The purpose of this document is to define the Standard Function for a Line monitored Safety Digital Input.

This standard function is used for safety digital input loops based on “energise to trip” principle (e.g. local Manual Call Points, F&G matrix and ESD matrix push buttons, local ESD push buttons).

In order to assist in understanding, this document should be read in conjunction with **GS EP INS 150**.

2. General description of functions

2.1 List of main functions

- ON/OFF signal acquisition including signal filtering function
- Input signal and alarm
- Loop fault detection (open & short circuits)
- Maintenance inhibit.

Signal acquisition may be achieved through a standard analogue input card. The loop may include up to four individual contacts.

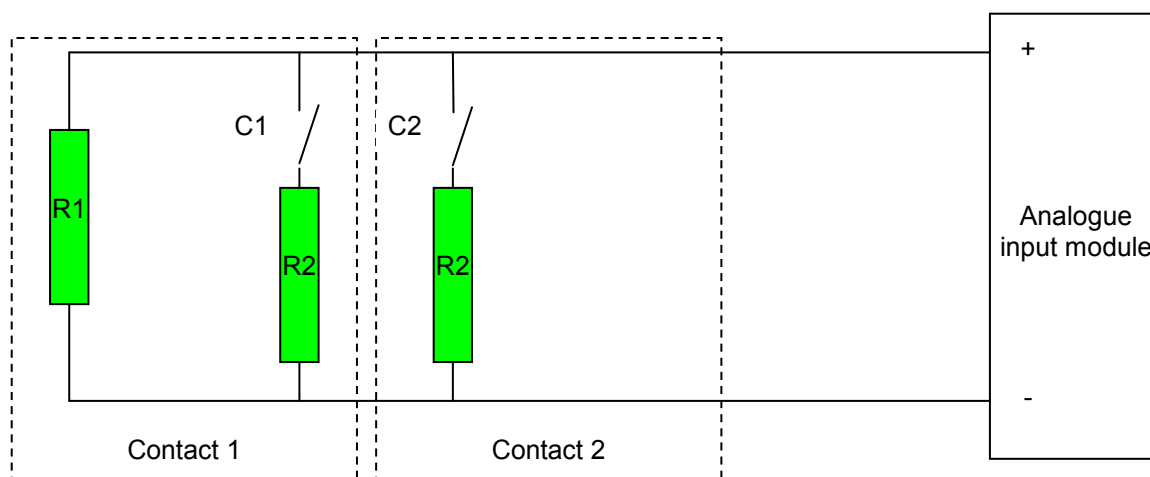
3. Interfaces description

3.1 General description

INPUTS				OUTPUTS			
Field	HMI	Internal		Internal	HMI	Field	
			DIS_LM Standard Function	Analogue Input signal	Input Trip signal		Alm
				Input Card Fault	Input Trip raw status		
				Maintenance Inhibit Command	Loop fault signal		Alm
					Loop fault raw status		
				Master key-switch	Maintenance inhibit status		
				Inhibit key-switch			
					Opt. = Optional		
					Alm = Alarm		

3.2 Field interface description

The field wiring principle for this type of ON/OFF data acquisition shall be designed as below (example showing two individual contacts):



R1 = 4.7 Kohm

R2 = 3.3 Kohm

The resistors R1 and R2 shall be calculated to ensure the signal levels suit the system capabilities.

Typical input signal characteristics:

- Signal ≤ 0.8 mA Loop status = INVALID (open circuit)
- Signal = 4 mA Loop status = NORMAL (loop healthy, no contacts activated)
- Signal ≥ 7 mA Loop status = ALARM (at least 1 contact activated)
- Signal ≥ 23.2 mA Loop status = INVALID (short circuit).

4. Detailed description of functions

4.1 Status definition

Internal data	Calculation rules	Status
Input Trip Signal	7 mA < signal (at least 1 contact activated) < 23.2 mA	ALARM
	Else	NORMAL
Loop fault	Signal < 0.8 mA or > 23.2 mA or Input card fault.	ALARM
	Else	NORMAL

The definition of input card fault is that the card(s) is no longer capable of processing the input or that the input is considered invalid (i.e. TMR input cards with one out of three faulty legs shall not be considered as an input fault).