Base Load Power Hub (BLPH)

PCS and SAFETY SYSTEMS Software Functional Design Specification (FDS-SW)

Document Number: 1724000594-IN-SP-00018

Supplier Document Number: E366772C00-FDS_SW

Document Class: 2

03	17/02/2025	Accepted for Construction (AFC)	KS	AB	SC
02	18/10/2024	Accepted for Construction (AFC)	KS	AB	SC
01	09/09/2024	Issue for Review (IFR)	KS	AB	SC
00	04/05/2024	Issue for Review (IFR)	KS	AB	SC
Rev.	Date	Description	Prepared	Reviewed	Approved

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Revision / Change Log

Rev.	Description
00	Issue for Review (IFR)
01	Issue for Review (IFR)
02	Accepted for Construction (AFC)
03	Accepted for Construction (AFC)

PCS HOLDS LIST

S No.	Description
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SIS/FGS HOLDS LIST

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CI SERVER HOLDS LIST

S No.	Description

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Appendix-3 List of Supported Devices

Appendix-4 PRM user groups and Account configuration

Appendix-5 HMI Graphic Symbols

1 INTRODUCTION

1.1 PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.1.1 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

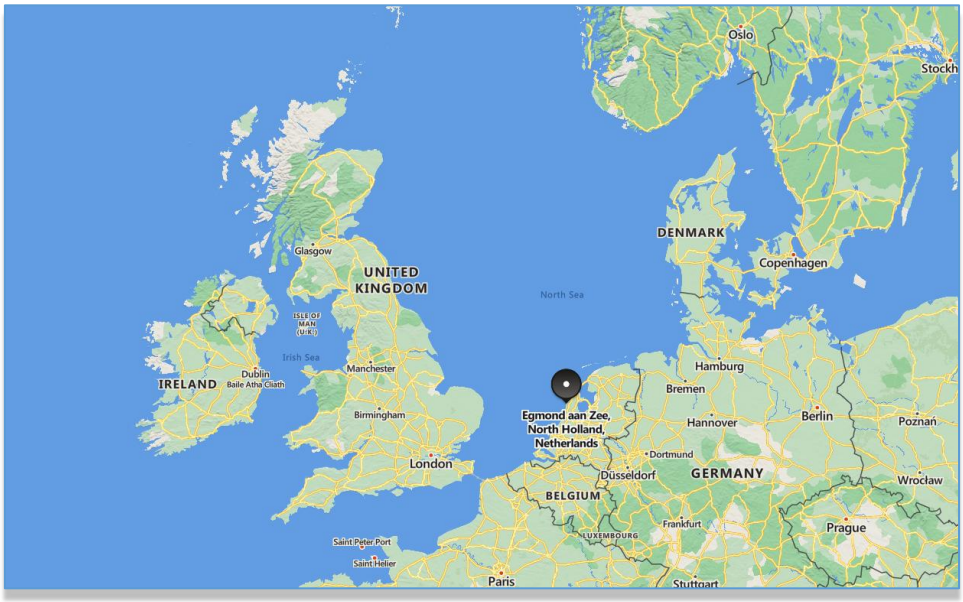


Figure 1 – HOLLANDSE KUST NOORD WIND PARK Location Map

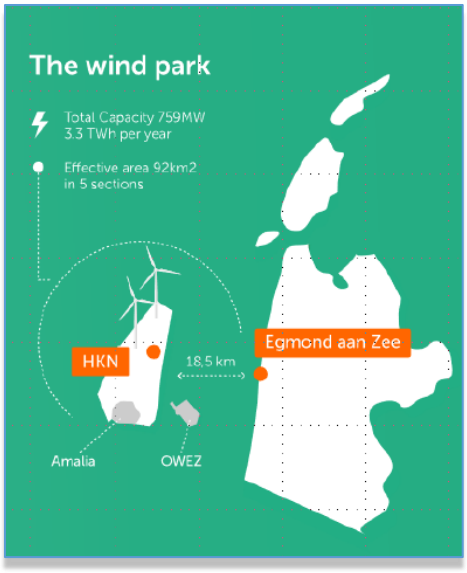


Figure 2 – Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.1.2 Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

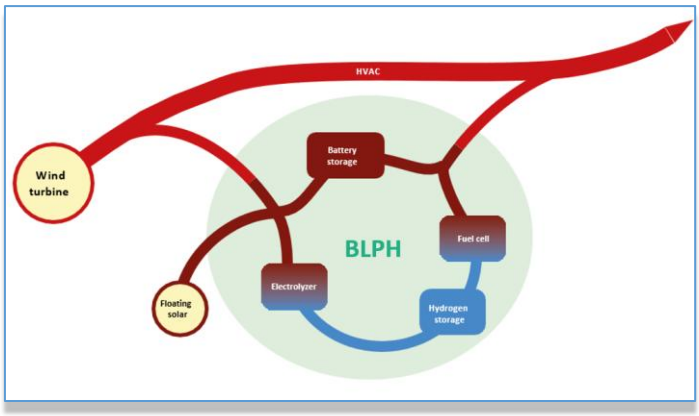


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting

wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

2 DOCUMENT SCOPE

The purpose of the of the document is to provide the Functional design specification of CI Server, PCS, SIS/FGS software for Hollandse Kust Noord Wind Park project realized using Yokogawa CI Server, Centum VP and Prosafe RS System.

The Content of this document are limited to the scope and design specification aspects.

The Functional Design Specification (FDS) covers the conceptual system design of:

- CI Server, PCS, SIS & FGS functional requirements and Tag naming philosophy.
- Software and License.
- SIS/FGS System Design Philosophies such as Overrides, Reset, First up
- Application Program Specification
- Interface to Yokogawa CI Server
- Interface to 3 party subsystems
- Security Management of SCS
- Sequence of Events (SOE) Facilities
- Time Synchronization
- Displaying Diagnostic Information
- Typical list of this project.

This document shall be further updated during execution phase to confirm as final design.

2.1 REFERENCES

2.1.1 Project Reference Documents

Doc. No.	Description
K559-2254-IC-SPE-001	System specification for Main Automation Contractor
K559-2254-IC-PHI-001	Control System Philosophy
K559-2254-IC-REP-003	Cyber Security Assessment
K559-2254-EL-LST-001	BLPH Control Alarm and Monitoring Table

Table 1 – Project Reference Documents

2.1.2 Yokogawa Standard Product Reference Document

Sl No	Document Title	Document Number
Instruction Manuals (IM):		

Sl No	Document Title	Document Number
1	ProSafe-RS User's Guide	IM 32P01B10-01EN
2	Engineering Guide Vol.1	IM 32P01C10-01EN
3	Engineering Guide Vol.2	IM 32P01C20-01EN
4	Installation Guide	IM 32P01C50-01EN
5	License Management Guide	IM 32P01C60-01EN
6	ProSafe-RS Security Guide	IM 32P01C70-01EN
7	Safety Manual	IM 32P01S10-01EN
8	Messages Reference Manual	IM 32P02B10-01EN
9	Engineer's Reference Manual	IM 32P04B10-01EN
10	POU Reference Manual	IM 32P03B20-01EN
General Specification (GS):		
1	ProSafe-RS Safety Instrumented System Overview (for Vnet/IP)	GS 32P01B10-01EN
2	ProSafe-RS Safety Control Function (for S2SC70X), Safety Control Function for SCS Simulator (for S2SC70X)	GS 32P03B30-01EN
3	ProSafe-RS / ProSafe-RS Lite Electronic Instruction Manual	GS 32P01W10-01EN
4	ProSafe-RS / ProSafe-RS Lite Project ID License	GS 32P01B50-01EN
5	ProSafe-RS Project I/O License	GS 32P03A10-01EN
6	ProSafe-RS / ProSafe-RS Lite I/O List Engineering Package	GS 32P04C20-01EN
7	ProSafe-RS / ProSafe-RS Lite CENTUM VP Integration Package	GS 32P04D10-01EN
Technical Instruction (TI):		
1	Safety Instrumented System ProSafe-RS System Overview	TI 32P01A10-01EN
2	ProSafe-RS Installation Guidance	TI 32P01J10-01EN
3	Security Standard of System Product	TI 33Y01B30-01E

2.1.3 Yokogawa Project Document

Doc. No.	Description
1724000594-IN-LIS-00003	Bill of Material
1724000594-IN-LIS-00004	PCS and Safety System IO List (HW and SW)
1724000594-IN-LIS-00005	EMCS IO List (HW and SW)
1724000594-IN-CA-00006	Power Consumption and Heat Dissipation
1724000594-IN-LIS-00007	Systems Cables List
1724000594-IN-RE-00008	Safety Controller loading estimation

1724000594-IN-DA-00009	PCS CABINETS GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT
1724000594-IN-DA-00010	SAFETY SYSTEMS CABINETS (SIS AND FGS) GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT
1724000594-IN-DA-00011	NETWORK AND SERVER CABINETS IN ITER ROOM GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT
1724000594-IN-DA-00012	NETWORK AND SERVER CABINETS IN OER ROOM GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT
1724000594-IN-DA-00013	EMCS CABINETS GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT
1724000594-PM-PL-00014	Project Execution Plan (PEP)
1724000594-IN-DD-00015	System Architecture
1724000594-IN-DG-00016	Network Connection Diagram
1724000594-IN-SP-00017	PAS Hardware Functional Design Specification (FDS-HW)
1724000594-IN-SP-00019	EMCS Software Functional Design Specification (FDS-SW)
1724000594-IN-RE-00043	Cyber Security Settings (NSS FDS)
1724000594-IN-DG-00020	PCS CABINETS WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-IN-DG-00021	SAFETY SYSTEMS CABINETS (SIS AND FGS) WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-IN-DG-00022	NETWORK AND SERVER CABINETS IN ITER ROOM WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-IN-DG-00023	NETWORK AND SERVER CABINETS IN OER ROOM WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-IN-DG-00024	EMCS CABINETS WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-IN-DG-00025	SAFETY SYSTEMS CABINETS (SIS AND FGS) WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-IN-DG-00026	NETWORK AND SERVER CABINETS IN ITER ROOM WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-IN-DG-00027	NETWORK AND SERVER CABINETS IN OER ROOM WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-IN-DD-00028	EMCS CABINETS WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-IN-PL-00029	Logic diagrams print out PCS
1724000594-QC-PRO-00030	Logic diagrams print out SIS and FGS
1724000594-QC-PRO-00031	Logic diagrams print out EMCS
1724000594-QC-PRO-00032	HMI screens print out

1724000594-IN-LIS-00003	Safety Validation Plan (SVP)
1724000594-IN-LIS-00004	HW FACTORY ACCEPTANCE TEST (FAT) PROCEDURE
1724000594-IN-LIS-00005	SW FACTORY ACCEPTANCE TEST (FAT) PROCEDURE
1724000594-IN-CA-00006	Site Acceptance Test (SAT) PROCEDURE
1724000594-IN-MAN-00037	INSTALLATION, OPERATING AND MAINTENANCE MANUAL (IOM)

Table 2 – Yokogawa Reference Documents.

2.2 DEFINITIONS AND ABBREVIATIONS

ALE	Yokogawa Ethernet Communication Module
AMS	Alarm Management System
ATEX	Appareils destinés à être utilisés en ATmosphères EXplosibles (Equipment intended for use in explosive atmospheres)
BESS	Battery Energy Storage System
BLPH	Base Load Power Hub
CAMS	Consolidated Alarm Management Software
CAP	Critical Action Panel
CAPEX	Capital Expenditure
CAT	Category
CCN	Central Control Network
CCR	Central Control Room
Centum VP	Yokogawa's DCS Product
PCS	Process Control System
CI	Collaborative Information
COMPANY	Crosswind
CONTRACTOR (CTR)	ROSETTI MARINO S.p.A.
DCS	Distributed Control System
DEM	Design Engineering Manual
DEP	Design and Engineering Practice
DOCUMENT NAME	Document Title
EMCS	Electrical Monitoring and Control System
EN	Engineering Notice

EPC	Engineering, Procurement Construction
EWS	Engineering Workstation
Ex	Explosion Proof
FC	Fuel Cell
FCS	Field Control Station
FEED	Front End Engineering Design
FEED CONTRACTOR	Organisation contracted directly by COMPANY to provide engineering, design, or other services.
FGS	Fire & Gas System
FO	Fibre Optic
FTP	File Transfer Protocol
GPS	Global Positional Satellite
GSD	General Station Description
HART	Highway Addressable Remote Transducer
HAZOP	Hazardous Operability Study
HKN	Hollandse Kust Noord
HMI	Human Machine Interface
HV	High Voltage
HVAC	Heating, Ventilation and Air Conditioning
HV-SCADA	The given name for the COMPANY's control system for the HKN wind farm infrastructure. BLPH's control system shall operate autonomously but will interface with HV-SCADA.
IACS	Industrial Automation and Control Systems
IAMS	Instrument Asset Management System
IEC	International Electrotechnical Commission
IP PROTECTION	Ingress Protection
IS	Intrinsically Safe
ISO	International Organization for Standardization
ITER	Instrument & Telecoms Equipment Room
KVM	Keyboard Video Mouse
LV	Low Voltage
MAC	Main Automation Contractor
MCC	Motor Control Centre
MQTT	Message Queuing Telemetry Transport

MRC	Media Redundancy Clients
MRM	Media Redundancy Manager
MRP	Media Redundancy Protocol
NA	Not Applicable
NAMUR	Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie
OHVS	Offshore High Voltage Station
OER	Onshore Equipment Room
OPC	OLE (Object Linking Embedded) for Process Control
P&ID	Piping and Instrument Diagram
PAS	Process Automation, is the term used to describe all functionality required for the monitoring and controlling of all process, safety and fire and gas systems selected for the project.
PCS	Process Control System
PIN	Plant Information Network
PRM	Plant Resource Manager
PROJECT	HOLLANDSE KUST NOORD WIND PARK Project
PV FARM	Photo Voltaic
PURCHASER	The organisation placing a purchase order for the supply of equipment or services for the Project. The Purchaser could be the COMPANY or the Contractor or some other party appointed by the COMPANY or Contractor.
SCADA	Supervisory Control and Data Acquisition
SHALL	An absolute requirement.
SHOULD	This word indicates a recommendation that whilst preferred may not be implemented provided some equivalent is proposed and agreed by COMPANY. The full implications must be understood and carefully weighed before choosing a different course.
SIF	Safety Instrumented Function
SIL	Safety Instrumented Level
SIS	Safety Instrumented System
SQL	Structured Query Language
TCP/IP	Transmission Control Protocol/Internet Protocol
TQ	Technical Query
UCP	Unit Control Panel
UPS	Uninterruptible Power Supply

VENDOR	Manufacturer/Supplier of equipment and services to perform the duties specified by the Purchaser.
Vnet/IP	Yokogawa Virtual Network
WSUS	Window Security Update Services

Table 3 – Definitions and Abbreviations

3 APPLICABLE CODES, STANDARDS, AND REGULATIONS

3.1 GENERAL

The equipment shall be designed, manufactured, tested, and delivered in accordance with this philosophy and the Project documents, codes, standards, and regulations listed below. It is the MACs responsibility to ensure complete compliance in their design, inclusive of all sub-suppliers. The normative documents listed below contain requirements that, through reference in this text, constitute the requirements of this Project. Latest editions of all referenced documents shall apply.

SYSTEM SECURITY REQUIREMENTS (CWHKN-PMT-PJA-PLN-00009) shall be referred as CW specification document to protect Operational Technology (OT) against unauthorized access or modification and to ensure availability of operational processes. It defines provides core practices for implementing controls and requirements for Suppliers and Third Parties to be used during procurement and contracting of new services as well as during ongoing execution of services in the OT environment are defined in requirements. In SYSTEM SECURITY REQUIREMENTS (CWHKN-PMT-PJA-PLN-00009) document are based on the ISA / IEC 62443 (formerly known as ISA - 99) Series of Standards on Industrial Automation and Control Systems (IACS) Security.

The following requirements shall apply as a minimum with the design being fit for purpose as detailed in this specification.

The project shall apply relevant standards and codes in the following order:

1. Regulations
2. Selected DEM-1 and DEM-2 requirements.
3. Industry Codes and Standards.

The applicable industry codes and standards are detailed in sections 3.2, 3.3 and 3.4.

3.2 REGULATIONS

Document Name	Document Title
1999/92/EC	ATEX 153 Workplace Directive
2011/65/EU	Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment
2014/30/EU	Electromagnetic Compatibility (EMC) Directive
2014/34/EU	ATEX Directive
2014/35/EU	Low Voltage Directive
94/9/EC	Equipment intended for use in Potentially Explosive Atmospheres
99/92/EC	Minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres

Table 4 – Applicable Regulations

3.3 APPLICABLE DESIGN ENGINEERING PRACTICES

Design Engineering Practices (DEP) have a limited rollout on BLPH.

3.3.1 Fully Applicable DEP

The following DEP are identified as being fully applicable to the project.

Document Name	Document Title
DEP 32.01.20.12	Industrial Automation and Control Systems (IACS) Security
DEP 30.00.60.15	Humans Factors Engineering – Control Room Design
DEP 33.64.10.32	Electrical Network Monitoring and Control System for Global Application
DEP 37.76.10.10	HVAC for Offshore Installations (Amendments/Supplements to ISO 15138)

Table 5 – Applicable DEPs

DEP 32.01.20.12 shall be applied to the project in full, in conjunction with IEC 62443, for the cybersecurity design.

DEP 30.00.60.15 shall be applied to the project for the design of the Control Room.

The functional requirements of DEP 33.64.10.32 shall be adhered to by MAC to ensure safe and effective operation of all relevant electrical equipment.

DEP 37.76.10.10 and ISO 15138 shall apply for offshore equipment rooms, i.e., the ITER.

3.3.2 DEM-1 Process Safety Only DEP

The following DEPs shall have the DEM-1 'Process Safety' requirements applied to the project.

Document Name	Document Title
DEP 32.30.20.11	Fire, Gas and Smoke Detections
DEP 32.80.10.10	Safety Instrumented Systems
DEP 32.80.10.14	Alarm Management (Amendment/Supplements to IEC 62682)
DEP 62.10.08.11	Inspection and Function Testing of Instruments

Table 6 – Applicable DEPs

3.4 INDUSTRY STANDARDS

Document Name	Document Title
EN 1127	Explosive Atmospheres, Explosion Prevention and Protection, Basic Concepts and Methodology

ISO 11801	Information technology – Generic cabling for customer premises
EN 61131	Programmable Controllers
IEC 60079	Installation & Maintenance of Electrical apparatus for use in Potential explosive atmosphere
IEC 60331	Fire resisting characteristics for electrical cables (all parts)
IEC 60332	Tests on electric cables under fire conditions
IEC 60364	Low-voltage Electrical Installations
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)
IEC 61158	Industrial communication networks
IEC 61508	Functional safety of electrical/electronic/programmable electronic safety-related systems
IEC 61511	Functional Safety – Safety Instrumented Systems for the Process Industry Sector – Framework, Definitions, System, Hardware, and Application Programming Requirements
IEC 61850	Communication Networks and Systems for Power Utility Automation
IEC 62305	Protection Against lightning
IEC 62443	Cyber Security for Industrial Automation and Control Systems
IEC 62682	Management of Alarm Systems for the Process Industries
ISO 15138	Petroleum and natural gas industries - Offshore production installations - Heating, ventilation and air-conditioning
ISO 14001	Environmental Management System
ISO 9001	Certifications of Quality Management System

Table 7 – Industry Standards

4 PCS COMPONENTS

4.1 HUMAN INTERFACE STATION (HIS)

HIS is an Operator Workstation computer and it is mainly used for control, operation, and monitoring of the plant process. Aside from displaying process graphics and other related displays, this workstation also shows process variables, control parameters and equipment status per System. HIS alerts the operator with necessary alarms with capability to acknowledge and receive messages required for plant operation.

In this project EWS shall have HIS functionality with necessary license. Centum VP screens shall not be provided, whereas SCADA OWS shall have Graphics for Operation and Monitoring. PCS/SIS standard function blocks Faceplates shall be accessible in CentumVP HIS (in this project EWS).

4.2 PCS ENGINEERING WORKSTATION (EWS)

PCS EWS is mainly used for system engineering activities via AD Suite such as configuration and building functions, overall system component definition, building control strategies and graphic displays as well as for system maintenance.

Module less Engineering shall be followed.

4.3 FIELD CONTROL STATION (FCS)

The Field Control Station (FCS) is where the control configuration of the system is downloaded and running. The FCS has its F-IO that interface to the process. F-IO gathers I/O signals and measurements from the field and processes these inputs and subsequently perform control functions based on approved and downloaded control strategies. The online configuration residing in the FCS sends desired outputs to the field final control elements such as valves, relays, etc. based on control algorithm performed or as an input to another control strategy within the database for further processing.

In addition to the control functions, FCS also provides the required interface to another subsystem through FIO MODBUS TCP/IP and PROFINET.

5 PROCESS CONTROL FUNCTIONS

Process control functions for this project shall be listed below with category of control functions (typical & complex control loop, process interlock/shutdown, equipment module, unit supervision and others).

Process Unit/Area	Control Function	Assigned FCS	Category						Remark
			Typical Control Loop	Complex Control Loop	Interlock or PSD	Equipment Module	Unit Supervision	Others	
PCS	x	FCS0101	x	x				x	Safety System for Emergency Shutdwon, EMCS for Electrical Monitoring and Control

Table 8 – List of Process Control Functions

5.1 COMMON SPECIFICATIONS FOR CONTROL FUNCTIONS AND SETTINGS

Shall be defined the common specifications for FCS common properties, I/O modules properties, input processing, output processing, alarm processing, control calculation processing, parameter settings, etc.

5.2 CATEGORY OF FCS FUNCTIONS USED FOR CONTROL

Control functions will be designed and implemented by using various functions (function blocks, programs, etc.) in FCS.

5.2.1 Typical Control Loop

Typical control loops are commonly used for regulatory control functions where applicable and Yokogawa I/O list relates the type of typical control loops with tags.

5.2.2 Complex Control Loop

Complex control loops that are not part of Software Typical shall be designed by referring to customer design inputs such as control narratives.

5.2.3 Interlock or Process Shutdown (PSD) Logic

If interlock or process shutdown logic is implemented in FCS, it shall be designed by referring to customer design inputs such as control narratives.

5.2.4 Equipment Module and Unit Supervision

Process units or equipment requiring unit control may involve sequential control in addition to regulatory control. Unit control may include start-up / shutdown sequence for unit or equipment. It shall be designed by referring to customer design inputs such as control narratives.

5.2.5 Others

Custom function blocks may be required to meet the customer specifications. However, use of custom function blocks should be minimized due to maintenance reason. Custom function blocks may not be functioning when the system version of FCS is upgraded, and re-engineering may be required in this case. If custom function blocks are used, sufficient documentation shall be available in the project to ensure proper support.

5.3 PROJECT I/O LICENSE

A Project IO license is required from CENTUM VP R6 to determine the number of logical I/O points that can be used in a single project. The number of usable logical I/O points in a project is determined by the number of Project I/O licenses assigned to that project. Project I/O License is required for all types of I/O such as process I/O, fieldbus I/O, and communication I/O.

Types of I/O	Counting	Remarks
Process I/O	1 point = 1 channel of one I/O Module or one redundant pair of I/O Modules defined in the project database	Points are counted per I/O Module (or redundant pair of I/O Modules). e.g. An I/O Module with 16 Channels = 16 points.
Communication I/O	Ehternet TCP/IP, Profibus-DP, Profinet-250	In this project 1 no. Modbus TCP/IP and 1 no. Profinet module is used = IO points 500.

Table 9 – Counting the number of I/O

A Project I/O License (VP6F3100) is required for every 200 logical I/O points. Place an order for the number of licenses to match the number of logical I/O points to be used in a project.

The number of logical I/O points is checked at creating an I/O module, downloading communication I/O builder, FCS offline downloading.

Software Packages are standard packages available to configure a PCS control system as per project requirement.

S.No	PCS Software Description	Model	Make	ITER	OER	CCR	Total
1	Software Media for Centum VP R6	VP6CKM-V11	Yokogawa	1	0	0	1
2	Product Maintenance License	SV2CPML-V1107-S1112	Yokogawa	1	0	0	1
3	Certificate of Product Maintenance License	SS2CPMLM-V1107-S1112	Yokogawa	1	0	0	1
4	Project ID License	VP6CPJT-V11N01	Yokogawa	1	0	0	1
5	Standard Operation/Monitoring Function (For New installation)	VP6H1100-V11N01	Yokogawa	1	0	0	1
6	Control Drawing Status Display Package (For New installation)	VP6H4410-V11N01	Yokogawa	1	0	0	1

7	Logic Chart Status Display Package	VP6H4420-V11N01	Yokogawa	1	0	0	1
8	Automatic Design Suite & Standard Engineering Function	VP6E51AD-V11N01	Yokogawa	1	0	0	1
9	Graphic Builder	VP6E5150-V11	Yokogawa	1	0	0	1
10	Self-documentation Package (For New installation)	VP6E5490-V11N01	Yokogawa	1	0	0	1
11	Centum VP Instruction Manual	VP6C5495-V11	Yokogawa	1	0	0	1
12	Project I/O License	VP6F3100-V11	Yokogawa	4	0	0	4
13	Microsoft Excel Software	MS Excel	Microsoft	1	1	0	2
14	PRM License	PM4SSET-V11N1000	Yokogawa	1	0	0	1
15	Project ID License for PRM R4	PM4CPJT-V11	Yokogawa	1	0	0	1
16	CI Server Software Media	CS2CKM-D11	Yokogawa	1	0	0	1
17	CI Server User's Manual Media	CS2CKM2-C11	Yokogawa	1	0	0	1
18	CI Server Software License	CS2CLC-L11/FCA02/SCA02/CB02/CD02/PTL03/VER01/DEP02/ADH02	Yokogawa	1	0	0	1
19	Product Maintenance License - CI Server	SV2CPMLC-V1100-S1112/C01	Yokogawa	1	0	0	1
20	End Point Security License (Initial) - For applicable products	LS1SN001-E01/AV	Yokogawa	4	3	3	10
21	End Point Security License (Initial) - For other products	LS1SN001-E01/AVX	Yokogawa	0	7	0	7

Table 10 –PCS Software List

5.4 CENTUM VP SOFTWARE LICENSE INSTALLATION AND VALIDATION

This section explains license management process when building license project for first time. License installation and validation task is performed on Engineering workstation and on all the other workstation only validation and acceptance of license is performed where Centum software is installed.

Following are the steps to be performed on engineering workstation and operator workstation.

- Create a license project. When creating a license project, specify the name of the project.
- Read the license key file from the license key media and register the available licenses.
- Add and specify the stations whose licenses need to be distributed.
- Assign available licenses to each station i.e. EWS, OWS, FCS etc.
- Distribute licenses to assigned stations through network.
- After successful distribution accept the licenses to activate respective software packages

6 COMMON CONTROL FUNCTIONS

6.1 COMMON PROJECT PROPERTIES

There are a set of common properties that need to be defined for the project. These properties need to be assigned from the System View while creating a new CENTUM VP project.

Setting Item	Yokogawa Default	*Project Setting*	Remarks
	Name and Position Tab		
Project	PJT01	BLPH-CW1	Name of the project. Max. of 8 alphanumeric characters.
Position	C:\CENTUMVP\ENG\BkProject/	C:\CENTUMVP\ENG\BkProject/	Project Position in the Hard Disk.
Project Comment	Null	BLPH CROSSWIND	Comment on project. Max. of 32 alphanumeric characters.
Alias of Project	Null	-	Optional. Max. of 8 alphanumeric characters.
User Authentication : Use Windows user names as HIS user names	Unchecked	Checked	Check for single sign-in. Otherwise Uncheck.
	Outline		
Model	Read-only	Read-only	CENTUM VP
User	Null	BLPH	
Organization	Null	Crosswind	
Project Information	Null	BLPH	
	Constant		
Domain Number	01	01	It just shows the default domain number. Actual domain number of a new station shall be manually set according to the project system configuration when creating the station.
	Detailed Setting		
Manually Register Engineering Unit Symbol	Unchecked	Checked	EU symbol shall be registered manually. Automatic registration is not possible.
Manually Register Switch Position Label	Unchecked	Checked	Switch Position Label shall be registered manually. Automatic registration is not possible.

Setting Item	Yokogawa Default	*Project Setting*	Remarks
Plant Hierarchy : Start Number	1	See Remarks	Use the default value unless it is already used by another project. For example, this value is required to change when CENTUM CS is at upper level and CENTUM VP is at lower level.
Plant Hierarchy : Maximum Number of Use	32767	See Remarks	Use the default value.
Plant Hierarchy : Number of in use (Number of custom facilities)	Read-only	Read-only	Number of plant hierarchies that are running in project (Number of plant hierarchies displayed in the plant hierarchy viewer)
Display FF-PID in same style as PID.	Unchecked	Unchecked	Gain, Reset, and Rate for FF-PID shall be represented as P, I and D respectively.
Do not allow online change of alarm detection setting.	Unchecked	Unchecked	Online change of alarm detection setting is allowed.
Enable Advanced Features of Editing Header & Footer for Self-Documentation	Checked	Checked	
Show Guideline for aligning I/O area on FCS builder	Unchecked	Unchecked	
Define Tag Name Hierarchies.	Unchecked	Unchecked	For Hierarchically Handling Tag Name, this option is Checked
Enable Sheet link on HIS	Unchecked	Checked	
Apply same permission level of PV to CPV	Checked	Checked	To apply same operation and monitoring authorities for CPV and PV, this option is Checked
Prohibit setting SV to a value beyond the range of SVL and SVH	Unchecked	Checked	When this option is checked, the value of SV can be prohibited beyond the range of SVL and SVH
Hide the information related to disabled alarms on HIS	Unchecked	Unchecked	
Change the shape of tag marks and alarm marks for each alarm priority	Unchecked	Unchecked	

Table 11 – Common Project Database Properties

6.2 FCS COMMON CONFIGURATION SUMMARY

The following table summarizes the common settings that decide the FCS behavior. All FCSs in this project shall use the settings below:

Configuration Builder	Setting Item	Yokogawa Default	Project Setting	Comment
STNDEF	FCS Start Condition	MAN	TIME	
	Momentary Power Failure Tolerant Time	2 Sec	2 Sec	
	Node Momentary Power Failure Tolerant Time	2 Sec	2 Sec	
	Digital Filter Coefficient 1	0.5	0.5	
	Digital Filter Coefficient 2	0.75	0.75	
	Digital Filter Coefficient 3	0.875	0.875	
	Self-Station : Buffer Size	0	1024	
	Station Scan Transmission	No Scan Transmission	See Comment column	Shall be enabled based on the inter FCS transmission requirement.
	Wind Up Time	60 Sec	60 Sec	
	SEBOL/User-C Ratio	100 %	100 %	
	Interval of Repeated Warning Alarm	600 Sec	600 Sec	
	Alarm Mask for Initial Cold Start	Yes	Yes	
	Inter-station data link communication period	1 Sec	1 Sec	
	Re-transmission skip when inter-station data link error occurs	60 Sec	60 Sec	
	Switch ALF111 modules upon communication errors	Valid	Valid	
	Notification message for status change of batch operations	No	No	
	Function block tracks output module during OOP	Yes	No	
	Color to indicate abnormal subsystem communication	Green/Yellow	Red	
	Enable XL-HKU for Cabinet Address (2) to (4)	No	No	

Configuration Builder	Setting Item	Yokogawa Default	Project Setting	Comment
	I/O Communication Bandwidth Limit Value (SOE)	500	500	
	I/O Communication Bandwidth Limit Value (Device Data Communication)	1000	1000	
CONSTANT tab in FCS Properties	Fast Scan	Not applied	Apply by checking Box (For set value, see Comment)	200 msec
	Medium-Speed Scan Period	Not applied	Apply by checking Box & set value at 500 msec	500 msec
	MC Block Pulse Width	2 Sec	3 Sec	The default value may be too small for e.g. a pulse output used for subsystem communication output.
	MC Block Serial Startup Interval	0 Sec	2 Sec	
	MLD-SW AUT/CAS	CAS	AUT	
	SEBOL "Drive" Statement Action Type	1	3	
	Options	None selected	Add DIOENH (For other options, see Comment)	
	IOM Online updating	"IOP occurs in connected blocks" not applied	"IOP occurs in connected blocks" not applied	
	PID Pulse Width Output: CENTUM-V Compatible MV Display	Unchecked	Unchecked	Used only for CENTUM-V to CENTUM VP migration projects
	PI-HLD Action after hold – CENTUM-XL Compatible	Unchecked	Checked	Used only for CENTUM-XL to CENTUM VP migration projects

Configuration Builder	Setting Item	Yokogawa Default	Project Setting	Comment
	CENTUM-XL Compatible Sequence Tables	Unchecked	Checked	Used only for CENTUM-XL to CENTUM VP migration projects
	Then/Else has Higher Precedence	Unchecked	Checked	Used only for CENTUM-XL to CENTUM VP migration projects
	dPV/dCPV O/P from SUB becomes 0 after IOP	Not applied	Apply by checking the box	
	Accept Batch-End during EMST	Checked	Checked	
CONSTANT2 tab in FCS Properties	SS-DUAL PV update during deviation alarm	Not applied	Not applied	
	Alarm Notify Action when all AOF released	Not applied	Not applied	
	Specify Reference Station Tag List	None selected	See Comment	Required only in case of Multiple Project Connection
	Annunciator Message with Data	Annunciator Message Head Number : 0 Printing Message Head Number : 0	Annunciator Message Head Number : 0 Printing Message Head Number : 0	
	Increase Number of System Common Switches	Enabled	Enabled	Increases number of system common switches from 200 to 400.
	Preset MV Valid Immediately	Preset MV valid at next scan	Preset MV valid at next scan	Options : 1, Preset MV valid by Preset Switch(for systems compliant to CENTUM-V & CENTUM-XL) 2, Preset MV valid at next scan
	MV of Switch/MC Instrument follows its CSV change	Not applied	Not applied	

Configuration Builder	Setting Item	Yokogawa Default	Project Setting	Comment
CONSTANT3 tab in FCS Properties	TM/CTS/CTP blocks hold PALM after CTUP	Not applied	Not applied	
	Raised %AN sends out alarm when AOF released	Not applied	Apply by checking the box	
	Suppress OOP alarms during online maintenance of ALP121 and dual redundant ALP111	Not applied	Not applied	
	CENTUM-XL compatible IOP reactions	Not applied	Apply by checking the box	
	Suppress system alarm when CALCU error occurs	Not applied	Apply by checking the box	
	Use HKU of System Cabinet	Not applied	Not applied	
	Initiate process alarm when CAL is set or released	Not applied	Not applied	
	Allow to change function block to PRD mode while CAL is on (XL compatible)	Not applied	Apply by checking the box	Used only for CENTUM-XL to CENTUM VP migration projects
	LC64-E Starts with its internal status interact when FCS performs an initial start [Except Offline download]	Not applied	Apply by checking the box	
	Enable output limiter in PRD mode (XL compatible)	Not applied	Not applied	Used only for CENTUM-XL to CENTUM VP migration projects
	Pass calculation block's input QST status to CPV	Not applied	Not applied	
	CENTUM-XL compatible IOP reactions: Main input	Unchecked	Unchecked	Used only for CENTUM-XL to CENTUM VP migration projects
	CENTUM-XL compatible IOP reactions: Sub inputs and tag data referenced in the expressions of CALCU	Not applied	Apply by checking the box	
	Set PV of %Z to zero upon failure of a DI module	Unchecked	Unchecked	Used only for CENTUM-XL to CENTUM VP migration projects

Configuration Builder	Setting Item	Yokogawa Default	Project Setting	Comment
	Sebol Group Assignment Statement- Adhere to the order specified in the variable list during data setting	Not applied	Apply by checking the box	

Table 12 – FCS Common Configuration

6.3 FIO NODE PROPERTIES

All FIO nodes in this project shall use the settings below:

Setting Item	Yokogawa Default	*Project Setting*	Comment
Node Type	ESB Bus/Optical ESB Bus	ESB Bus/Optical ESB Bus	ER Bus option not available for FFCS-C/V type FCS.
Node number	1	See Comment column	Select node number as per the system configuration
Power supply unit	Dual redundant power supply with 80W	Dual redundant power supply with 80W	
Optical ESB Bus: Use Optical ESB Bus	No	No	Select Yes when optical ESB bus repeater is used.
Optical ESB Bus: Distance from FCU	5km	See Comment column	Select the maximum distance between FCU and the Node unit in the range of 0km to 50km.
Optical ESB Bus: Slave Module	ANT5x2	See Comment column	Select ANT5x2 or SB401 as per the system configuration
Component Number	Blank	Blank	Optional Entry : Component Number of the node unit
Node Comment	Blank	Blank	Optional Entry: Comment of the node unit

Table 13 – FIO Node Properties

6.4 FCS FUNCTION BLOCKS INITIALIZATION

When the FCS starts up, as a standard, the block mode of function blocks is initialized as follows:

Function block with output to the field or subsystem: MAN

Other function blocks: Last Saved Values

6.5 INPUT PROCESSING

6.5.1 Input Signal Conversion

The input signal conversion shall be configured in accordance with each applicable typical.

Linearization shall be performed either in smart transmitter or PCS as per the project specification. In accordance with this guideline, the input signal conversion can be defined as shown in the following tables.

Transmitter Type	Description	Input Signal Processing	Comments
Flow	DP Flowmeter	SQRT with x% for low flow cut off	Transmitter or PCS, as defined in project specification. Both Square root and low cut-off shall be performed in the same location
	Mechanical Flowmeter	BTHPUL	With Pulse Rate
	Vortex Flowmeter	LINEAR	
	Magnetic Flowmeter	LINEAR	
	Coriolis Flowmeter	LINEAR	With Density
	Ultrasonic Flowmeter	LINEAR	
	Others	As per the transmitter vendor's specification	
Level		LINEAR	If not sure, refer line chart
Pressure		LINEAR	
Temperature		LINEAR	Depends on sensor type, but linearization shall be done in transmitter / I/O module.
Analyzer		LINEAR	
Electric Current		LINEAR	

Table 14 – Input Signal Conversion Table for Conventional I/O

In case of input from a subsystem using an interface such as Modbus, input signal conversion may be required when using 16-bit integer data format. Input signal conversion is configured as SUBSYS in the function block with appropriate data conversion bias and data conversion gain. For a subsystem interface using 32-bit floating data type format, input signal conversion may not be required.

The computational expression for the communication input conversion is shown below.

- PV = GAIN * IN + BIAS
- Where, IN – Subsystem input value
- GAIN – Data conversion gain
- BIAS – Data conversion bias

Data Item	Yokogawa Default	*Project Setting*	Comments
Data Conversion Gain	1.000	Depends on PCS display scale and subsystem communication data value range	
Data Conversion Bias	0.000		

Data Item	Yokogawa Default	*Project Setting*	Comments
Input High Limit Detection Set Value	106.25		Equivalent to 21 mA for detecting IOP+, Subject to change as per project requirement.
Input Low Limit Detection Set Value	-6.25		Equivalent to 3 mA for detecting IOP-, Subject to change as per project requirement.

Table 15 – Input Signal Conversion Table for Subsystem I/O Communication:

6.5.2 Input filtering.

Digital Filter is a function to remove the noise from the process input signal.

The digital filter is defined for each regulatory control block or calculation block connected to analog input in "Input Signal Filtering" on the Control Logic Editor (*1). Input Signal Filtering: None, Auto, 1, 2, and 3. Default is Auto.

Auto: If the IN terminal is connected to I/O module including communication module, "Digital Filter Coefficient 1" is used. If the IN terminal is connected to neither communication module nor I/O module, no filtering process is performed.

None: No Filtering process is performed.

1, 2, and 3: Selected respective Digital Filter Coefficient is used; Digital Filter Coefficient can be set in FCS constant.

Note *1: If you don't use AD Suite, use Function Block Detail Builder.

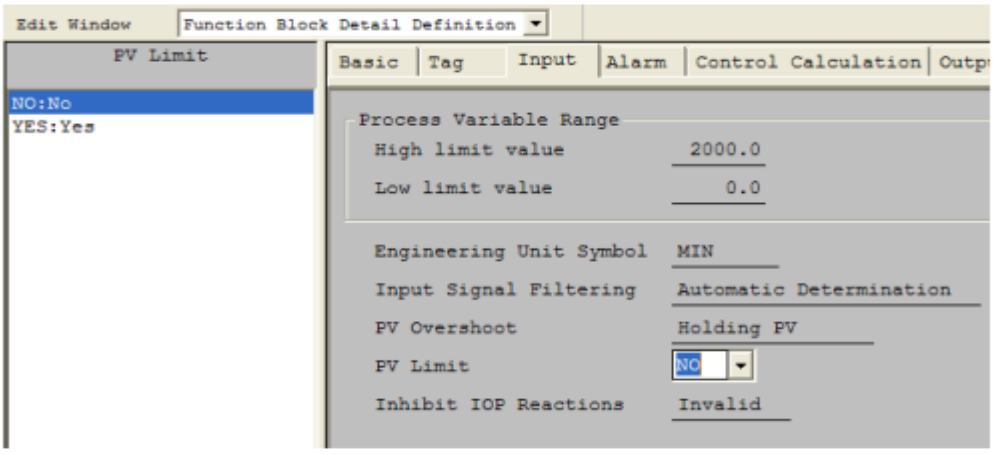


Figure 4 – Example of an Input filtering.

6.5.3 Bad Data Status Detection

The behaviour of function blocks when bad status is detected is described below:

1. Input open (IOP) alarm is generated when this alarm is enabled.

2. Analog input processes such as square root extraction, pulse input conversion, digital filters and totalizer functions are disabled.
3. The process value before IOP alarm occurrence is latched as a process variable (PV) according to the settings for holding last good value in the function blocks. The presence of an IOP alarm is the operator's indication that this value is to be unreliable.
4. In regulatory control blocks that have the MAN fallback function, MAN fallback is activated, and the block mode is switched to "MAN" mode.

The input open detection check for analog signals determines whether the input values read by an I/O module are out of the range of high and low limit input open detection setpoint values. The high and low limit input open detection setpoint values are configured in the IO module. Refer to the section 6.11.1

The input open detection for calculated input values in arithmetic calculation blocks shall be configured with the general principle that an IOP condition is propagated throughout the connected tags unless otherwise specified.

In the case of subsystem communication inputs, bad data status detection is based on the communication healthiness between the subsystem and PCS & based on the data values read from the subsystem.

Note: The calculation block's input QST status is passed to CPV. This feature can be enabled in FCS Properties.

6.5.4 Totalization

Input totalization shall be disabled unless otherwise specified- (e.g., presence of a P&ID tag with function code FQ). For regulatory control blocks, totalization is specified. In case of a bad PV status or IOP+, IOP- alarm detection by the function block, the totalizer function is stopped. Below a configurable low input cut value, totalization is not executed. The totalizer can be reset with or without operator intervention.

6.5.5 Decimal Point Settings

Scale high/low limit value can be set maximum 7 digits including sign and decimal point. Table below lists the general rule for the decimal point setting for this project.

Span	Decimal Point	Example
0 to <10	X.XXX	0.200 KPA
10 to <100	XX.XX	50.00 °C
100 to <1000	XXX.X	100.0 %
>=1000	XXXX	2000 M3/H
Totalizer	XXXXX	50000 t

Table 16 – Decimal Point Settings

6.6 OUTPUT PROCESSING

6.6.1 AFO versus AFC Control Valves

To provide the operator with a consistent display and operation, all control valves will be represented in the same way. Therefore, the closed valve position as MV=0% is indicated at the bottom of the faceplate scale, whereas the open position as MV=100% is indicated at the top of the faceplate scale.

To follow this guideline, hard-wired analog outputs shall be configured in the IOM settings depending on AFC or AFO with disabling MV Reverse Display in the function block.

The setting in IOM for AFC/AFO control valves is as follows:

Control Valve Type	IOM Set Details	Output Current
AFC	Direct Output (1*)	100% MV: 20mA, 0% MV:4mA
AFO	Reverse Output	100% MV: 4mA, 0% MV:20mA

Table 17 – IOM Setting for Non-FF Control Valves

Note *1: Direct output is the default system settings.

For hardwired valve positioner, fully open/Tightly-shut setting in the function block shall be enabled in order to close the valve fully and tightly. If the valve positioner is HART smart type, sufficient mA output at low scale for HART communication shall be set.

Table 18 – Fully-open/Tightly-shut setting

Data Item	Default Setting	Project Setting (for HART smart positioner)
Output Signal Conversion: Output Value for Full-open	106.25 (%)	101.00 (%)
Output Signal Conversion: Output Value for Tight-Shut	-17.19 (%)	-1.00 (%)
Output Signal Conversion: Fully-open/Tightly-shut	Yes	Yes

6.6.2 Output Conversion

The output signal conversion shall be configured depending upon the requirement.

In case of output to a subsystem using an interface such as Modbus, output signal conversion may be required when using 16-bit integer data format. Output signal conversion is configured as SUBSYS in the PCS output block with appropriate data conversion bias and data conversion gain, thus converting the PCS 0 to 100% output to Modbus counts. For a subsystem interface using 32-bit floating data type format, output signal conversion may not be required.

The computational expression for the communication output conversion is shown below.

- OUT = (1/GAIN) * (MV-BIAS)
- Where, OUT – Subsystem output value
- GAIN – Data conversion gain
- BIAS – Data conversion bias

6.6.3 Output Clamp

The positional-type control output actions are always applied to PID control computation. This will cause the occurrence of reset windup (integral saturation) by setting limits to the integral term in PID control computation. To mitigate reset windup during the clamped state, reset limit functions shall be configured to react appropriately in taking account of tracking the output clamp status to the upstream function block.

" Limit Output in Direction when clamped" shall be turned off in all blocks immediately upstream of MLD-SW blocks. This prevents clamping on the upstream blocks when the downstream MLD-SW block is clamped, a situation which would lead to a state in which the output would be limited to a value above 0% or below 100%. For other function blocks, this setting is enabled or disabled based on the application.

6.6.4 Output Tracking

This function is standard for cascaded PID controllers and does not need any special configuration. If a calculation block is used between the primary and the secondary controllers, a back calculation (for bump less transfer) must be implemented unless specified otherwise in the control narrative.

Note: The function block output (MV) tracks the output module during OOP. The enabling of this feature is done in the FCS Constants of the FCS Builder in System View.

6.7 ALARM PROCESSING

All PCS function block alarms are configured as active and set as per alarm setpoints in I/O database. If alarm setpoints are not specified in I/O database, those alarms are set to high/low PV range limits to preventing unnecessary alarms.

The hysteresis of every alarm detection function shall be configured as the following table.

Transmitter Type	Hysteresis Settings
Flow	2 %
Level	2 %
Pressure (Liquid)	2 %
Pressure (Gas)	2 %
Temperature	2% or 4 °F (2 °C) whichever is less

Table 19 – Alarm Hysteresis Setting

The deviation alarm thresholds shall be configured as the following table:

Transmitter Type	Deviation Alarm Settings
Flow	10 % of span
Level	5 % of span
Pressure	2 % of span
Temperature	2 °C or 4 °F

Table 20 – Deviation Alarm Setting

6.8 CONTROL CALCULATION PROCESSING

Control calculation processing is the collection of functions associated with function block execution timing and calculation algorithms.

6.8.1 Scan Period

For all function blocks, the scan period shall be selected as Basic scan (1000 msec) except specified otherwise.

In case of fast scan (50 or 100 msec) applications such as compressor surge control, speed control, etc., High Speed-Read option of the related I/O modules shall also be enabled in I/O module properties. To reduce the load in the FCS these fast scan I/O points are put together in the same I/O modules as much as possible.

6.8.2 Control Period

By default, the regulatory control blocks in the FCS shall be configured to employ the control period of 1000 msec. Therefore, the fixed control period shall be selected, and its period shall be set to 1000 msec except the blocks that are defined as high-speed or medium-speed scan.

Blocks configured with high-speed or medium-speed scan should be configured with control period set to “automatic determination” so that the control period is set to the scan period.

6.8.3 PID Controller Control Action

The EPC Contractor shall provide the control action of the PID controllers in the instrument database or the control narrative.

6.8.4 PID Control Algorithm

By default, the PID controller block shall use the algorithm of "PV derivative type PID control (PI-D)". In case of an override controller in the auto selector control typical, the PID controller shall use the "PV proportional and derivative type PID control (I-PD)" algorithm. Any other exceptions are specified within the typical loop description of control narratives.

6.8.5 Measurement Tracking

Measurement tracking shall be enabled for “MAN mode”, “AUT and CND mode” and “CAS and CND mode” by default. Exceptions will be specified per typical, or by the EPC for classes of controllers.

6.8.6 Reset Limit Function (Anti-Reset Windup)

In PID control computation, the integral action is represented by integrated value of deviation time, When the output is already limited (control computation exceeded the manipulated high-limit or low-limit setpoint (MH, ML) and deviation prolongs, the integral term in PID control computation becomes saturated due to continuous integral action. This condition resulted to “reset windup (integral saturation).” When this situation happens, the control result tends to overshoot thus, process becomes unstable. In order to avoid such condition, the PID output must be set to positional-type in the PID block details and use the reset limit function.

The reset limit values via RLV1 and RLV2 terminal are input data having the same engineering unit and scale range as those of the manipulated output value (MV). These limit values exert directly on the integral term

of the output value (MV). By correcting the computational Manipulated Output Value of the PID, its final output is limited to "RLV1-RLV2" thus, providing anti-reset windup functionality to the PID.

6.9 SETPOINT VALUE LIMITER

The setpoint value limiter function limits the setpoint value (SV) within a range between the setpoint high limit (SVH) and setpoint low limit (SVL).

The action of the setpoint value limiter in automatic (AUT) or manual (MAN) mode varies depending on whether the setpoint value (SV) can be set to a value beyond the range between SVH and SVL or not. This setting can be changed from the option of [Prohibit setting SV to a value beyond the range of SVL and SVH] on the properties sheet of the project.

When the option of [Prohibit setting SV to a value beyond the range of SVL and SVH] is checked, the setpoint value limiter performs the following actions:

1. When try to set a setpoint value (SV) greater than the setpoint high limit (SVH):

   An error message will be displayed and the value beyond the setpoint high limit becomes invalid, the previous setpoint value will be held.

2. When try to set a setpoint value (SV) smaller than the setpoint low limit (SVL):

   An error message will be displayed and the value beyond the setpoint low limit becomes invalid, the previous setpoint value will be held.

When the option of [Prohibit setting SV to a value beyond the range of SVL and SVH] is not checked, the setpoint value limiter performs the following actions:

1. When a setpoint value (SV) greater than the setpoint high limit (SVH) is set:

   An acknowledgment dialog box appears to prompt for the operator's confirmation. When confirms, the operator can set a value greater than the setpoint high limit (SVH) as the setpoint value.

2. When a setpoint value (SV) smaller than the setpoint low limit (SVL) is set:

   An acknowledgment dialog box appears to prompt for the operator's confirmation. When confirms, the operator can set a value smaller than the setpoint low limit (SVL) as the setpoint value.

However, when try to set a setpoint value (SV) to a value beyond the range between the process high alarm setpoint (PH) and the process low alarm setpoint (PL), the setpoint value limiter performs the following actions regardless of if the option of [Prohibit setting SV to a value beyond the range of SVL and SVH] is checked or unchecked:

1. When try to set a setpoint value (SV) greater than the process high alarm setpoint (PH):

   An acknowledgment dialog box appears to prompt for the operator's confirmation. When confirmed, the operator can set a value greater than the process high alarm setpoint (PH) as the setpoint value.

2. When try to set a setpoint value (SV) smaller than the process low alarm setpoint (PL):

   An acknowledgment dialog box appears to prompt for the operator's confirmation. When confirmed, the operator can set a value smaller than the process low alarm setpoint (PL) as the setpoint value.

When the function block is in remote cascade (RCAS) mode and the setpoint value (SV) is defined to automatically follow the remote setpoint value (RSV) received from the supervisory system computer and the option of [Prohibit setting SV to a value beyond the range of SVL and SVH] is checked, the setpoint value limiter performs the following actions:

1. The value exceeds the setpoint high limit (SVH) is forced to be equal to the setpoint high limit (SVH).
2. The value smaller than the setpoint low limit (SVL) is forced to be equal to the setpoint low limit (SVL).

Note1: When integrated to the multiple projects and these setting are different from the project, the operation of the setting SV on HIS follow to the setting of the project belonging to FCS.

6.10 P, I AND D PARAMETER SETTINGS

The set parameters of the PID control algorithms in CENTUM VP:

- Proportional band (P): 0 to 1000 %.
- Integral time (I): 0.1 to 10000 seconds.
- Derivative time (D): 0 to 10000 seconds.

For each individual controller the P, I, and D default tuning parameters are specified to make startup easier. The recommended P, I, and D parameter settings are defined as follows:

PID controller type	P (%)	I (Sec)	D (Sec)
Flow	333	30	0
Pressure (Liquid)	143	30	0
Pressure (Gas)	50	300	0
Level	100	600	0
Temperature	33	600	0
Analyzer	333	2400	0
Others	250	20	0

Table 21 – PID Parameter Setting

Note: These above are the standard tuning parameter settings. Actual tuning values will be configured during commissioning only.

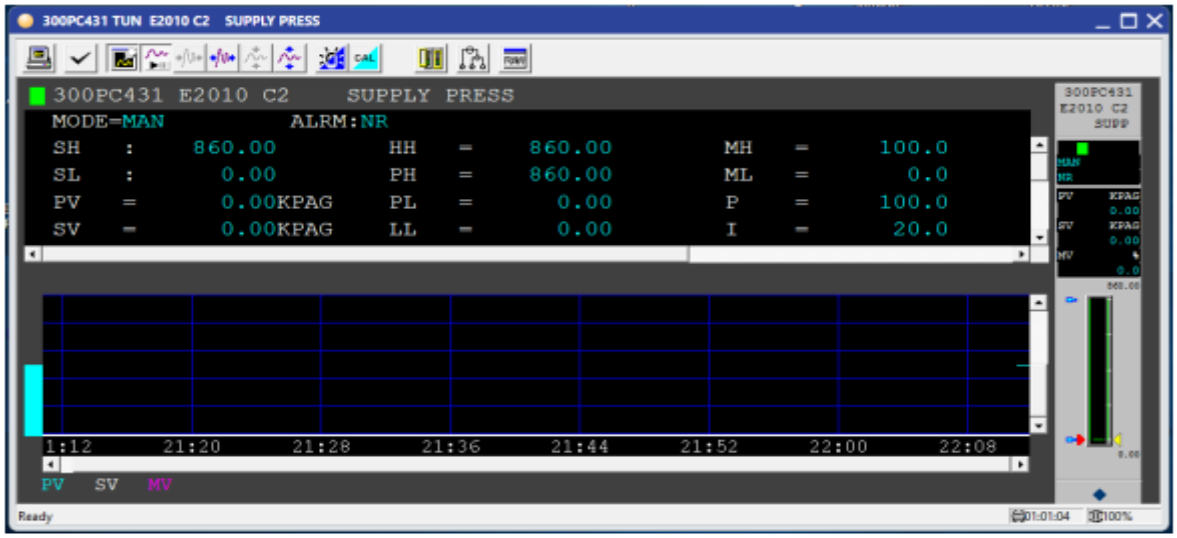


Figure 5 – P, I AND D PARAMETER SETTINGS.

6.11 I/O MODULE SETTINGS

To perform the process input/output function, it is necessary to define process inputs/outputs in I/O Modules. Settings vary with different types of I/O modules. The following sections only explain the main settings applicable to this project.

All settings are generated according to the I/O database unless otherwise specified.

Note: Enable "High Speed Read" for reading data of I/O units at high speed, if an I/O module contains I/O channels connected to high-speed scan control loops. By default, this setting is disabled.

6.11.1 Analog I/O Settings

In case of conventional (4-20mA) analog inputs, high and low input open detection setpoints shall be configured based on the transmitter type. If the transmitter conforms to NAMUR NE 43 standards, then, the input open detection high & low limits shall be set as per transmitter manufacturer specifications between saturation and fault limits. By default, these settings are specified as 3.7 mA (-1.875%) and 20.8 mA (105.0%). In case of non-NAMUR transmitters, the input open detection low limit shall be set as 3 mA (-6.25%) and the input open detection high limit shall be set as 21 mA (106.25 %), that are Yokogawa Default Settings, except as directed otherwise by the EPC.

Setting Item	Selectable Parameter	Remarks
Service comment	A string of up to 40 alphanumeric characters	
Details setting	Pulse Input: No terminal resistance, 200, 500, 1000 Ohm.	Default "No Terminal resistance". To be defined as per input device requirements.
	Output: Direct / Reverse	Default "Direct". Select "Reverse" for AFO valve
P&ID tag name	A string of up to 16 alphanumeric characters	

Setting Item	Selectable Parameter	Remarks
Label	Up to 13 user defined alphanumeric characters	
IOP detection (IOPE)	Yes/No	Default "Yes" [High limit: 106.3, Low limit: -6.3]
Transmitter power supply (VTTSEL)	12 or 24 VDC	For pulse input modules. Default "12"
OOP detection (OOPE)	Yes/No	Default "Yes
Burnout specification (BOEN)	Yes/No. If Yes, Upscale/Downscale	Only "Yes" for Thermocouple signals. Default burnout is "Upscale

Table 22 – Analog I/O Setting

Thermocouple or RTD type shall be configured as a part of the IO Settings. No additional configuration is required in the function blocks for signal conversion since the detailed settings in thermocouple or RTD IO module provide the conversion from physical measurement to temperature.

HART I/O Settings

Setting Item	Selectable Parameter	Remarks
Channel	01 to 16 or 01 to 08 (depend on I/O model)	Set the physical channel number of the I/O module
Data Type	PV, SV, TV or FV	
Polling Address	1 to 63	If multi-drop connections

Table 23 – HART I/O Settings

6.11.2 Digital I/O Settings

Setting Item	Selectable Parameter	Remarks
P&ID tag name	A string of up to 16 alphanumeric characters	
Tag Name	A string of up to 12 alphanumeric characters	
Tag comment	A string of up to 12X2 alphanumeric characters	This is used for service description
Switch position label	As per HMI definition	Default "ON/OFF"
Tag mark	As per HMI definition	Default "2"
Security level	As per HMI definition	Default "4"

Table 24 – Digital I/O Setting

Signal Status Definition

The hardwired digital I/O signal status to PCS system shall generally follow the following definition unless specified otherwise:

Process Status	Relay Contact for Status	Relay Contact for Command	PCS I/O Signal Status	Annunciator Signal Status
Alarm / Normal	CO / CC	N/A	0 / 1	1 / 0
Open / Close Command	N/A	CC / CO	1 / 0	N/A
Open / Not Open State	CC / CO	N/A	1 / 0	N/A
Close / Not Close State	CC / CO	N/A	1 / 0	N/A
Run / Stop State	CC / CO	N/A	1 / 0	N/A
Start / Not Start Command	N/A	CC / CO on energization of relay	1 / 0	N/A
Stop / Not Stop Command	N/A	CC / CO on energization of relay	1 / 0	N/A

Table 25 – Signal Status Definition

Note: CO – Contact Open; CC – Contact Closed

6.11.3 Subsystem Communication I/O Settings

In BLPH project MODBUS TCP-IP and Profinet communication protocol are being used for subsystem integration with PCS.

6.12 SYSTEM FUNCTION BLOCKS

The System diagnostics related function blocks are available from controller type FFCS-C/V. The system function blocks can be used by projects for displaying FCS running status and internal resources on HIS graphic views.

The system function blocks provide the following information.

- CPU Load Information
- Communication Load Information
- IO Load Information
- SEBOL related information

The data of the system function blocks can be configured to view on graphic or trend views on HIS. The system function blocks will be automatically generated when an FCS is created on System View. Users defined tag names cannot be configured for system function blocks.

For displaying the data of the system function blocks on HIS, the syntax for designating the data item is as follows.

- BLnnnnSddmm01.<DataItem>

Where, nnnn is block number, "S" is fixed text, dd is domain number and mm is station number.

The block numbering of system function blocks is as follows;

- %BL0001 – CPU Load Information
- %BL0002 – Communication Load Information
- %BL0003 – I/O Load Information
- %BL0004 – SEBOL Related Information

The system function blocks can be used in the same manner as using the other types of function blocks for displaying the FCS running statuses and internal resource information.

6.12.1 Overview of function blocks

The following table contains a list of the commonly used function blocks in the system.

Note: Following table shall be updated during detailed engineering.

BLOCK NAME	FUNCTION	DESCRIPTION
AS-H	Auto-selector High (Output)	Selects the higher value from 2 or 3 inputs and transfers it to the output.
AS-L	Auto-selector Low (Output)	Selects the lower value from 2 or 3 inputs and transfers it to the output.
AVE	Averaging	Calculate average value for certain input value
CALCU	Calculation	Perform calculation, change alarm levels, etc.
CI	Code input	The CI block is used to read the contact input or internal switch as a binary code or binary coded decimal and display the integer value indicated by the code as the input code value
CO	Code output	The CO block is used to convert the integer value which is set as the setting code value (PV) from the operation and monitoring functions or other function block into the code pattern for output to the contact output or internal switch.
LC64-E	Logic chart	Provides implementation of logic in a logic chart format.
MC-2/3 MC-2E/3E	Motor Control Unit	Contains within one function block most of the functions used in relation with motors and/or motorized valves. MC-2 for 2 position motor control (Stop/Run) and MC-3 for 3 position motor control (Forward/Stop/Reverse)
MLD	Manual Loader	Output an analogue value as set by the operator to the field.
MLD-SW	Cascade/Auto/Manual Station	Basically, same as MLD, but can be cascaded with other function blocks, where it then provides tracking functions. Used for output to valves in a split range configuration and to provide SV ramping in cascade configurations.
NOT	Negation	Negates the input.
PID-STC	PID Controller with Self Tuning Function	This function block is used to automatically adjust PID parameters (P, I, D)

BLOCK NAME	FUNCTION	DESCRIPTION
FF-AI, FF-AO	Foundation Fieldbus Function blocks	These function blocks are used to connect the FF instruments to FCS.
PVI	Input Indicator	Displays an analogue value received from the field directly via I/O modules, from subsystems, or calculation variables within the system.
PVI-DV	Input Indicator with Deviation Alarm	Same as PVI. The additional set point value enables deviations to be monitored and alarmed.
RL	Relational Expression	The RL block is used to judge the numerical relationship or the logical product of two data.
SEBOL	Sequence and Batch Oriented Language	Programming language for process control. Use for sequence control or complex calculation.
S(I)(O)-XX	Switch Instrument	Indication of digital inputs in combination with digital outputs to control discrete devices like valves and motors. Various types are available to support up to 2 inputs and 2 outputs.
SPLIT	Split Range	Split the output of a controller into two outputs with a range conversion function
SS-M	Medium Selector (Process value)	Select the medium value from 3 inputs.
ST16	Sequence table	Provides implementation of logic functions in a table format.
SW-33	3 poles, 3 position switch	3 poles selection between 3 positions.
TM	Timer	It measures time in the unit of seconds or minutes.
VELLIM	Velocity Limiter block	The VELLIM outputs a change per unit time by limiting it within the velocity limits

Table 26 – Function blocks

6.12.2 Data Items

The following table contains a list of common data items that exist in the Yokogawa CENTUM VP system. Most function blocks contain only a limited selection of these data items. On the other hand, some function blocks contain specific data items that are not identified in this table.

DATA ITEM	FUNCTION	DESCRIPTION
PV	Process Value	Input value to the function block. Can be from the field or from another block.
MV	Manipulated Value	Output value from the function block. Can go to the field or to another block.
SV	Set Value	Set-point value indicating the required/expected process value.
FV	Feedback Value	Analogue input value to the MC-2/3 function block.
MODE	Block mode	Functioning mode of the function block: can be MAN, AUT, CAS, etc.
ALM	Alarm status	Alarm status of the function block: NR, HI, LO, IOP, OOP, etc.
DV	Deviation Value	Deviation between SV and PV.

DATA ITEM	FUNCTION	DESCRIPTION
HH	High-high alarm limit	When PV goes over the HH value, a high-high alarm (HH) is triggered.
PH	High alarm limit	When PV goes over the PH value, a high alarm (HI) is triggered.
LL	Low-low alarm limit	When PV goes under the LL value, a low-low (LL) alarm is triggered.
PL	Low alarm limit	When PV goes under the PL value, a low (LO) alarm is triggered.
VL	Velocity alarm limit	When the PV rate of change goes over the VL alarm, a velocity alarm (VEL+, VEL-) is triggered.
DL	Deviation alarm limit	When DV goes over the DL value, a deviation (DV+, DV-) alarm is triggered.
MH	MV high alarm limit	When MV goes over the MH value, an output high alarm (MHI) alarm is triggered.
ML	MV low alarm limit	When MV goes under the ML value, an output low alarm (MLO) alarm is triggered.
P	Proportional band	P setting for the PID algorithm (%).
I	Integral time	I setting for the PID algorithm (s).
D	Derivative time	D setting for the PID algorithm (s).
SH	Scale high	High value of the PV scale.
SL	Scale low	Low value of the PV scale.
ANSP	Answerback set point	When for an MC-2/3 function block with analogue input only, if FV is less than ANSP, PV is set to 0. Else PV is set to 2.
MTM	Answerback timer	If the answerback does not follow the output within the period specified by MTM,

Table 27 – Data Item

6.12.3 Alarm Status

The following table contains a list of the most common alarm status which is available in the Yokogawa CENTUM VP control system. Most function blocks contain only a limited selection of these alarms. On the other hand, some function blocks contain specific alarms that are not identified in this table.

SYMBOL	NAME	DESCRIPTION
ANS+	ON Answerback Error	Answerback does not match the command in time (open/start)
ANS-	OFF Answerback Error	Answerback does not match the command in time (close/stop)
DV+	Deviation Alarm +	The deviation between PV and SV has exceeded the deviation alarm limit (DL) in the positive direction (PV-SV > DL). For MVC, this alarm occurs when the CUSUM value exceeds the limit. DV+ stands for "high deviation" because this alarm results when CUSUM value exceeds the alarm limit.
DV-	Deviation Alarm -	The deviation between PV and SV has exceeded the deviation alarm limit (DL) in the negative direction (SV-PV > DL).
HH	High-high Alarm	The PV has risen above the high-high alarm limit (HH).
LL	Low-low Alarm	The PV has fallen below the low-low alarm limit (LL).
HI	High Alarm	The PV has risen above the high alarm limit (PH).
INT	Interlock Alarm	The interlock input of the function block has become active.
IOP	High Input Open Alarm	The input value to the function block cannot be read due to a failure or connection error at the input module (high input).
IOP-	Low Input Open Alarm	The input value to the function block cannot be read due to a failure or connection error at the input module (low input).

SYMBOL	NAME	DESCRIPTION
LO	Low Alarm	The PV has fallen below the low alarm limit (PL).
MHI	Output High Alarm	The output has almost risen above the output high alarm limit (MH). The actual value is limited to MH.
MLO	Output Low Alarm	The output has almost fallen below the output low alarm limit (ML). The actual value is limited to ML.
NR	Normal	No alarm conditions exist.
OOP	Output Open Alarm	Output value from the function block cannot be transferred to the field due to failure or connection error at the output module.
PERR	Undefined Answerback	Both open/close feedback inputs are active at the same time.
TRIP	Thermal Trip Alarm	The trip input of the function block has become active.
VEL+	Velocity Alarm +	The PV rate of change over a certain period has exceeded the velocity alarm limit (VL) in positive direction (ΔPV > DL) is triggered.
VEL-	Velocity Alarm -	The PV rate of change over a certain period has exceeded the velocity alarm limit (VL) in negative direction (ΔPV < -DL) is triggered.
CNF	Connection Status Failure Alarm	Data status is bad due to device or Card I/O abnormality.

Table 28 – Alarm Status

6.13 SIGNAL ISOLATION METHODS FOR MAINTENANCE

As a part of standard maintenance procedure, the following steps should be followed to isolate I/O signals from the control system when they are invalid (e.g., during calibration). The objectives of this signal isolation exercise are:

- Prevent a faulty signal from adversely affecting closed loop control, operator decision making, and reporting functions on the business network.
- Allow technicians to view the affected transmitter values for troubleshooting purposes.
- Allow the operator access to final control elements.

For both Fieldbus and conventional (4~20mA) devices:

An individual with supervisor or engineering authority places the field-connected function block in "CAL" (Calibration) mode.

In CAL mode, the block's PV holds its last value until manually changed by an operator. If that block is a controller, any control mode other than MAN is disallowed. An operator can adjust final control elements in manual mode, and a technician can view the raw process value by clicking on the RAW button in the tuning window of that block.

Because ExaOPC is configured to mark function blocks in CAL mode with UNCERTAIN data quality, any advanced control or business user is made aware that the function block's data quality is degraded. However,

be aware that CAL status is not automatically propagated to other downstream PCS blocks, such as calculations or selectors. For example, a compensated flow controller will not be forced to manual mode when the raw flow signal is placed in CAL mode. Also, a signal selector could select a block in CAL mode.

If it is necessary to mark a transmitter signal as BAD, then the related function block must be placed in O/S mode, thus causing an IOP condition within all downstream blocks. Please note that, with the function block in O/S mode, it is not possible to read the raw transmitter value in the PCS, and it is not possible to adjust that block's output.

6.14 MISCELLANEOUS ENGINEERING PRACTICES

6.14.1 Engineering Units

In case of incomplete engineering ranges and/or engineering units, the engineering unit of that function blocks shall be assigned to "TBA". This helps in filtering all incomplete tags.

6.14.2 Operator Switches

Common switches have no upper equipment name. Without the upper equipment name, it is not possible to restrict the operation range of the common switches. Either all the operators will get access to all of the common switches in an FCS, or no operators will get access to the common switches. Therefore Common switches (%SW) are NOT used for any operator soft switches (e.g., interlock bypass switches, selection between operating modes, alarm suppression enable/disable switches).

Instead, annunciator tags or function blocks (SO-1, SO-2, PBS5C, etc.) can be used for operator soft switches. The choice of annunciator tag vs. function block depends upon the required status on FCS restart: an annunciator tag always starts up in state 0, while a function block retains its last position.

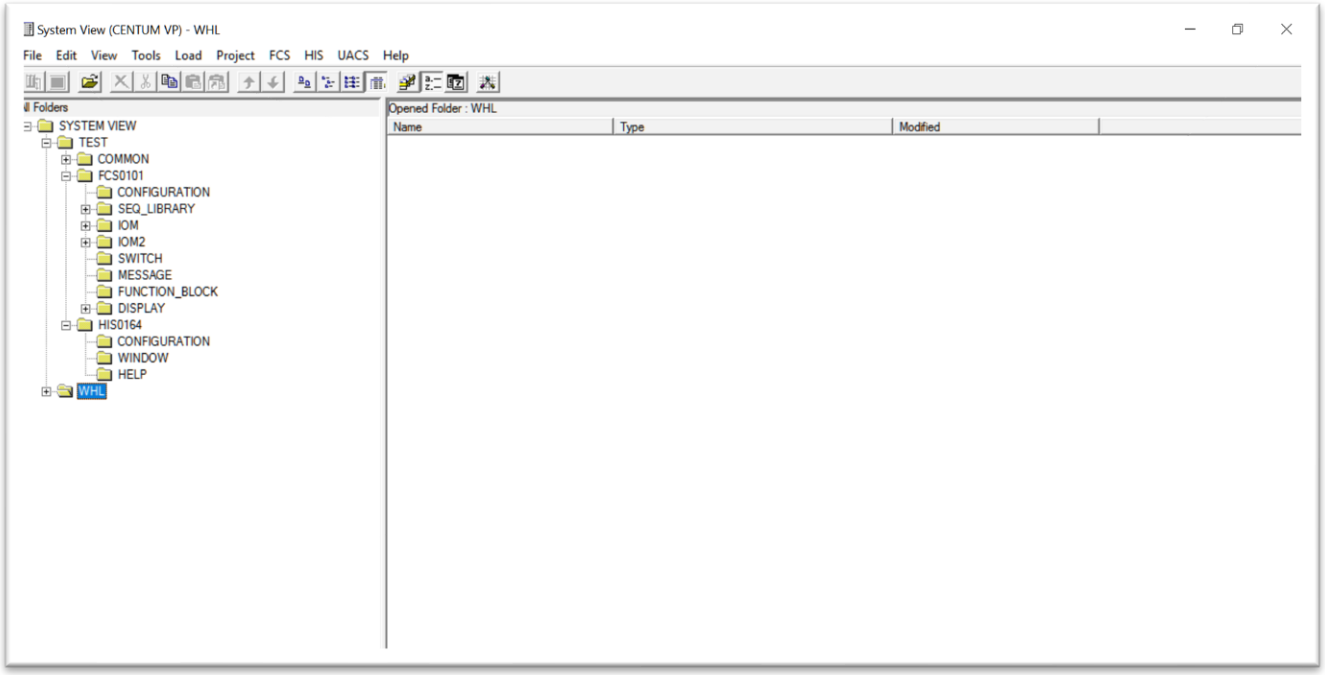


Figure 6 – VP Builder.

7 PCS CONTROL APPLICATIONS

This section describes the design philosophy for PCS control applications.

7.1 GENERAL FCS CONFIGURATION GUIDELINE

7.1.1 FCS Template Database

The FCS template database defines a maximum configurable quantity for each category of function blocks, tags, SFC sequences, etc.

Note: In this project, based on Project requirement general purpose FFCS-V: VP6F1700-V11C01 is used.

There are the following standard FCS (for FFCS-C/V) template databases.

- General-Purpose (Default)
  FFCS-C : VP6F1800-V11C01 (FCS model with Standard Type suffix code) is required.
  FFCS-V : VP6F1700-V11C01 (FCS model with Standard Type suffix code) is required.
- Extended Type
  FFCS-C : VP6F1800-V11C02 (FCS model with Extended Type suffix code) is required.
  FFCS-V : VP6F1700-V11C02 (FCS model with Extended Type suffix code) is required.
- Large Type
  FFCS-C : VP6F1800-V11C03 (FCS model with Large Type suffix code) is required.
  FFCS-V : VP6F1700-V11C03 (FCS model with Large Type suffix code) is required.

Care should be taken that the function block quantity within each category does not exceed the maximum number when assigning I/O tags in a control station.

7.1.2 FCS Resource Information

Using General Purpose FCS template for this project and it is located in Custom Folder of CentumVP Project Database.

Station Common

Category	Maximum Number	Used	Maximum Amount	Capacity	Load Ratio(%)
SEBOL User Function	210	0	430080B	0B	0
SFC Sequence	630	6	5160960B	125184B	2
Unit Procedure	60	0	122880B	0B	0
Tag-List(I/O,Switch)	18000	927	-----	-----	5
FCS-C/Option Area	-----	-----	320KB	64KB	20

Function Block

Category	Maximum Number	Used	Load Ratio(%)
Regulatory Control Blocks / Calculation Blocks	1500	295	19
Sequence	150	53	35
General-Purpose Calculations	310	19	6
SFC Blocks	40	6	15
Operation	200	0	0
Switch Instruments	800	34	4
Sequence Elements 1	500	45	9
Faceplate Blocks	120	10	8
Logic Operation Blocks	100	0	0
Sequence Elements 2	100	10	10
Batch Data	100	0	0
Sequence [M-Size]	100	0	0
Sequence [L-Size]	100	0	0
Unit Operation	0	0	0
Unit Instruments	10	0	0
Total Number of Function Blocks	4130	472	11
Tag-List(Block,Annunciator)	7000	660	9
Inter-station data links	512	1	1
Foundation Fieldbus faceplate	1500	0	0

I/O point
Logical I/O Calculation:Method-2

Category	Number of I/O	Number of logical I/O
Process I/O	256	256
Communication I/O		750
Total		1006

I/O license usage
Standard Engineering Function : 906/Unlimited
Project I/O License : 906/ 20000

Table 29 – FCS Resource Information.

7.1.3 Estimating Required Quantity of Functional Blocks

The quantity of each category of function blocks should be counted to select the required number of FCSs. Once the hard and soft I/O assignment has been finished, the FCS loading calculation will be done during the design, implementation, and testing phases. The FCS loading calculation (depending on CPU load calculation and the maximum number of blocks.

7.1.4 Controller I/O Cards

A PCS field controller (FCS) with model AFV30D is capable of handling multiple I/O types by using universal type I/O module. It consists of redundant Field Control Unit (FCU) and maximum of 32 local/remote nodes. Each node allows install up to 8 N-ESB bus coupler module or communication cards. Each N-ESB bus

coupler module allows install up to 16 Node Interface Unit (NIU) and each NIU allows install up to 6 universal type I/O module. Each universal type I/O module could connect to 16 I/O points.

7.1.5 FCS Application Capacity

The following table lists the application capacity of FCS (AFV30D) with different types of databases:

Note: In this project, we are using Model C01 Standard type.

Item		AFV30□/AFV40□		
		VP6F1700-V1□C01 (Standard)	VP6F1700-V1□C02 (Expanded)	VP6F1700-V1□C03 (Large)
No. of Tags	Elements per FCS (*1)	18000	18000	18000
	Function blocks (*2)	3500	3500	7000
Process I/O	Analog I/O points	1760	1760	1760
	Contact I/O points	4096	4096	4096
Communication I/O (*3)	Data volume (in 16-bit units)	8000	8000	8000
Internal Switches	Common switches	9000	9000	9000
	Global switches	256	256	256
Message Outputs	Annunciator messages	2000	2000	2000
	Print messages	2000	2000	2000
	Operator guide messages	1000	1000	1000
	Sequence message request	200	200	200
	Event messages	1000	1000	1000
Control Functions	Control drawings	200	200 (300/400/500) (*4)	
1 second Trend	Acquisition points	1024	1024	1024
ADL Points	Number of accesses to other stations	512	512	512

Table 30 – Application Capacity

7.1.6 CPU Idle Time

An FCS performs many tasks which include Message Sending, Trend Communication, I/O processing, Control function, System Diagnostic, External communication, and external communication with HIS and ExaOPC which are consuming CPU processing time.

The performance of FCS is measured by the idle time (non-processing time) in seconds in one-minute period. The load will be measured during FAT.

The FCS load is affected by the number of I/O cards installed, function blocks used, trend points and external communication points. FCS CPU load will be estimated / calculated based on the above factors.

7.1.7 Control Drawing Assignment

The application software within an FCS is organized in control drawings. Each FCS contains 200 control drawings, in which all function blocks are defined, as default. The control drawings shall follow the structure below and should only be modified when additional space is required for a specific area:

- DR0001 initialization
- DR0005 inter-FCS communication inputs

- DR0010 ~ DR0020 used for alarm suppression (if any)
- DR0021 ~ DR0100 used for control functions for typical loops generation.
- DR0101 ~ DR0140 used for Subsystem communication (if any)
- DR0141 ~ DR0160 used for control functions for complex loops.
- DR0161 ~ DR0198 used for sequences (if any)
- DR0199 inter-FCS communication outputs
- DR0200 used for idle time measurement.

Control drawings will be sorted by unit number, typical loop and loop name with, as a default, two empty control drawings between different typical loops. In case more drawings are needed the number of empty drawings between the different typical loops can be reduced.

Note: Control drawings in FCS (FFCS-C/V) can be expanded up to 500 with Node Expansion Package, but it is recommended to keep 200 (default), If numbers of control drawings in FCSs are increased, maximum number of FCSs are decreased due to limitation of Plant Hierarchy names.

7.1.8 Control Drawing General Settings

The control drawings contain function blocks and process I/O references, which together form a specific control function. The I/O references or PIO block shall contain either a label (for analogue signals) or a tag name (for digital signals).

General Control Drawing Setting

The setting for each control drawing shall be as indicated in the following table:

Setting Item	Remarks
Control drawing format	1600 x 1072
Control drawing grid size	4

Table 31 – Control Drawing General Settings

7.1.9 Software I/O Definition

Software inputs/outputs are virtual inputs/outputs provided by the FCS system software. They are often referred as "Internal switches" used for the purpose of data exchange and software manipulation between function blocks and control stations in the process control network. Two types of internal switches are defined namely: Common and Global switches.

Common Switches

Common switches are internal switches defined by the configuration design engineer to aid and develop the FCS application software efficiently. The logical state of these switches is used exclusively in the FCS which owns them and cannot be shared by other FCSs in the process control network.

9000 common switches are available in one FCS (FFCS-V) ranging from element number %SW0001 to %SW9000. 9999 common switches are available in one FCS (FFCS-C) ranging from element number

%SW0001 to %SW9999. For ease of maintenance and software trouble shooting the design engineer allocates the switches in a structured manner. A typical structured common switch allocation is shown in Table below.

Common Switch Range	Function
%SW0001 - 1000	FCS Common
%SW1001 - 2000	Unit #1
%SW2001 - 3000	Unit #2
%SW3001 - 4000	Unit #3
%SW4001 - 8000	Reserved for future
%SW8001 - 9000	Reserved by system

Table 32 – Typical Common Switch Allocation in a FCS (FFCS-V)

Common Switch Range	Function
%SW0001 - 1000	FCS Common
%SW1001 - 2000	FCS Common
%SW2001 - 3000	Reserved for future
%SW3001 - 4000	Reserved for future
%SW4001 - 8000	Reserved for future
%SW8001 - 9999	Reserved by system

Table 33 – Typical Common Switch Allocation in a FCS (FFCS-C)

Global Switches

Global switches are internal switches used to transfer signals from SCS to PCS and vice versa. It is defined by the configuration design engineer to share logical data generated in one FCS with other FCSs in the same domain.

256 global switches are defined in one FCS ranging from element number %GS001 to %GS256. For ease of maintenance and software trouble shooting the design engineer will choose to allocate the switches in a structured manner as common switches.

When a global switch is used in logic, its data status should be also monitored in logic for handling the abnormal situation. If the data status of the global switch is "BAD", the PV value of the global switch will stay at the last received value.

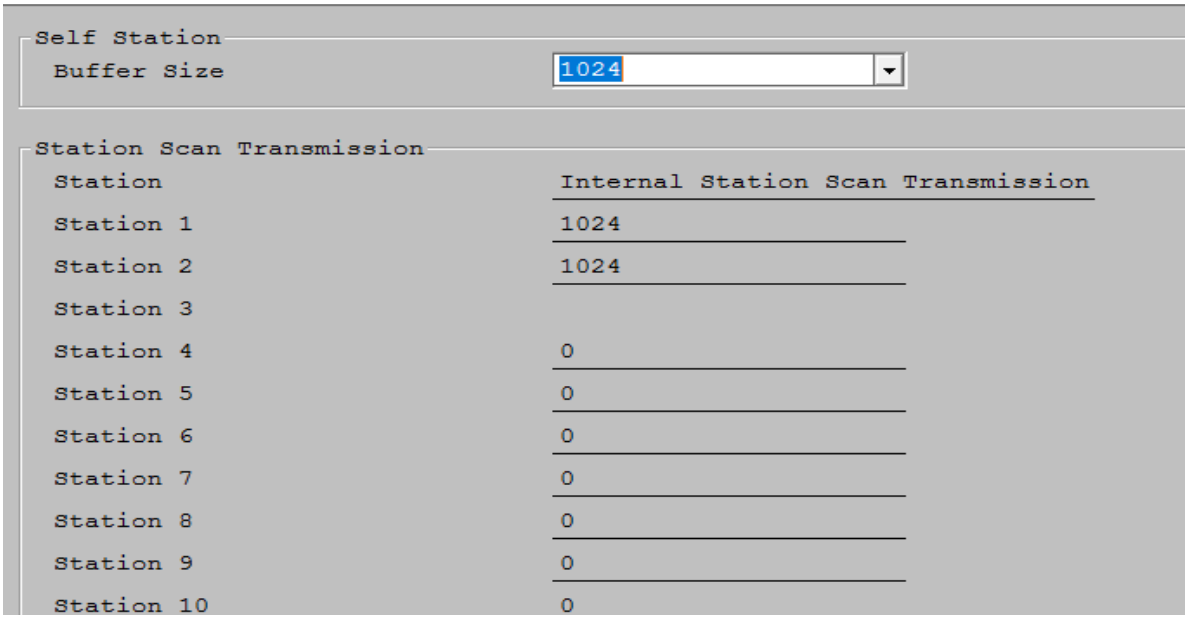


Figure 7 – Scan Transmission Settings

Annunciator Message

These are custom messages generated in one FCS configured by the control design engineer for the purpose of alarm annunciation to alert the operator. 2000 Annunciator Messages can be defined in one FCS (FFCS-C/V) and they are assigned from %AN0001 to %AN2000.

Operator Guidance Message

Operator guidance message outputs an alert to an operator in real-time situations. The operator guidance message is normally used by sequence or batch control.

Printer Message

Printout message outputs the data corresponding to an event that occurred in the process. This is mainly used to record the event that occurred in a process by printing them on paper as well as logging them into a file. The printout message cannot be displayed in the process alarm view.

The printout message is generally not used unless otherwise specified.

7.2 PHILOSOPHY OF DESIGNING CONTROL APPLICATIONS

Module-based engineering should be used when designing control application, and Global Class Module shall be used as many as possible to establish implementation standardization within the project to achieve consistency of deliverables created by project members.

7.2.1 Module-based engineering

Module-based engineering is an approach that subdivides a system into smaller parts (modules) which can be independently created, tested, and accepted before they are used to drive multiple functionalities.

There are two types of modules for control application design: Class module and application module.

Note: Module based engineering is not applicable for this project.

7.2.2 Complex Control Loop Design

When complex control loops are newly designed for the project, the following items need to be taken into consideration in addition to the general guidelines described earlier in this document.

- How to deal with alarm & data status propagation, including other station data.
- Output tracking & bumpless transfer.
- Connecting user-defined data items (SFC & Unit) with regulatory control function blocks.
- Possible modes of operation including crippled mode.
- Block number order (scan order).
- Loop dynamics including terminal-to-terminal response time, reset limiter, etc.

7.2.3 Sequence Control Design

Philosophy of Sequence Design

A policy to design the sequence control should be defined with regard to usage of various function blocks. There are the following two areas where the policy shall apply.

1. To define the structure of the sequence
   - States transition
   - Procedure
2. To configure the execution sequence
   - Condition and action for devices and/or equipment (pump, valve, flow, pressure, temperature, etc.)

Structure of the sequence

There are two methods to define the structure of the sequence as follows.

A. Using SFC block (_SFCPB)

   The standard states transition matrix is only available. If it cannot meet the project requirement, use the method 1A).

B. Using sequence table (ST16)

There is no standard states transition. It shall be manually designed always.

The following table provides a decision matrix to select the method.

Structure of Sequence	1A) SFC block (_SFCPB)	1B) Sequence table
Viewing format	SFC (Sequential Function Chart)	Sequence Table

Structure of Sequence	1A) SFC block (_SFCPB)	1B) Sequence table
Sequence consisting of multiple operations (used for batch sequence)	Not Recommended	Not Recommended
Sequence consisting of multiple operations (used for continuous control)	Not Recommended	Not Recommended
Sequence consisting of single operation	*Recommended*	Applicable

Table 34 – Decision Matrix to Select Function Blocks in Sequence Structure

Execution sequence

To configure the execution sequence, there are three methods.

Using SEBOL

Using sequence table (ST16)

Using logic chart (LC64)

The following table provides a decision matrix to select the method.

Type of Sequence	SEBOL	Sequence table	Logic chart
Step sequence	Recommended	Applicable	Not recommended
Monitoring sequence used as status change such as stopping the sequence	Applicable	Applicable	*Recommended*
Monitoring sequence used for other purposes	Recommended	Applicable	Applicable
(Other FCS data access)	No additional blocks*1	Global switch or Area out connection block required	Global switch or Area out connection block required

Table 35 – Decision Matrix to Select Function Blocks/Programs in Execution Sequence

*1: Performance shall be considered.

Initialization Sequence Design

Initialization for function blocks needs to be properly designed for proper functioning of continuous and sequence control functions. The following items shall be considered as minimum.

- Desired block mode and switch position of the connected function blocks
- Stating of specific SFC blocks
- MV preset value of the function blocks that are connected to field outputs
- Start mode of unit instrument
- Block mode of ST16
- Step number of ST16

7.2.4 Interlock or Process Shutdown Logic Design

Consistent implementation within the project shall also apply to interlock or process shutdown (PSD) logic design.

Recommended Function Block

Recommended function block to implement an interlock or process shutdown logic is LC64-E.

Interlock Condition Signal

When a digital status or an analog value comparison is used as a condition in the logic diagram, use the following guideline.

Digital status

An annunciator message (%AN) is used for a digital alarm and an SI-1 block is used for a non-alarm digital status. Use these as the condition in the logic diagram.

Analog value comparison

When an analog value comparison is required, prepare an additional PVI block where the comparison value is entered in its PH or PL, and use ALRM of the PVI block as the condition in the logic diagram. This is for considering the ease of testing, reviewing, and maintenance. This additional PVI block will have the Logging alarm priority because this does not require an alarm notification.

Point of Design for Interlock Logic

Interlock (PSD) logic may affect the other control functions and it may be used as a start condition, halt condition, unit shutdown condition, etc.

The following table summarizes a point of design for such logic.

Point of view	Method	Point of design
How to reset	Auto reset by process condition	Need to decide how to reset the output from the logic.
	Manual reset	
Action from/to the main sequence	Action to the main sequence	When the interlock logic stops or halts the main sequence, consider how to restart the sequence. • Restarting the sequence is possible anytime regardless of interlock status • Restarting the sequence is only possible when the interlock is reset
	Action from the main sequence	Avoid a situation of simultaneous device manipulation by both the main sequence and interlock logic. • The interlock logic overrides an action from the main sequence by e.g., connecting the output of the interlock logic with the standard interlock connection terminal of a function block. • The main sequence manipulates the function block only when it is not interlocked.
Action type of interlock logic to the main sequence	One-shot action	This is the case that the interlock acts on the main sequence one-shot. This pattern is recommended.
	One-shot action + Operation prohibition	This is the case of the above pattern plus operation prohibition. As a means of operation prohibition, an operation mark may be used.
	Always	This is the case that the interlock always acts on the main sequence. This pattern shall not be used.
Notification to operator	Annunciator message (This may be implemented only when the requirement permits.)	Need to decide if it is held until recovery or automatically reset after a few seconds.
	Operation guidance message (This may be implemented only when the requirement permits.)	Must be always one-shot notification.
	Display	Graphic link parts shall be designed to show the interlock state.

Table 36 – Point of Design for Interlock Logic

7.2.5 SEBOL

SEBOL is useful to configure the process data access, sequence control and calculation processing. There are two types of SEBOL from the execution timing point of view.

- Periodic SEBOL (for FFCS-C/V only)

  Periodic SEBOL executes the codes in one second unless interrupted by codes or system.

- Timeshare SEBOL

  Timeshare SEBOL executes the maximum 20 lines * N times in 1 second when CPU idle time allows.

The following table provides a decision matrix to select the method.

Usage or process	Periodic	Timeshare	Remarks
Calculation processing exceeding CALCU capability	Recommended	Not Recommended	Remark-A)
Other station data access	Recommended	Applicable	Remark-B)
Monitoring (Every second execution)	Recommended	Not Recommended	Remarks-A,B,)
Monitoring (every few second execution)	Recommended	Applicable	Remarks-A,B,)
High speed execution (less than 1sec)	N/A	N/A	Use ST16, LC64, or CALCU

Table 37 – Decision Matrix to Select SEBOL Types

Some limitations and considerations will apply in each case.

A) Periodic SEBOL is executed in 1 second for all processing until interrupted by the system (e.g., wait until, drive, delay statement). Timeshare SEBOL is executed in CPU idle time. When there is not enough CPU idle time in the basic scan period, timeshare SEBOL will be executed in the next basic scan if CPU idle time allows.

B) Periodic SEBOL may affect the CPU load when the quantity of execution lines is too many. Do not create an infinite looping program.

C) Accessing the other FCS data is treated as interruption in periodic SEBOL. Some coding technique (e.g., using a group assignment statement for reading data and copying them to local variables) may be required.

Use the System Function Block to monitor SEBOL information. (For FFCS-C/V only).

7.3 PEER-TO-PEER COMMUNICATION

The peer-to-peer communication among FCSs shall be limited as much as possible. Therefore, FCSs and I/O in them shall be allocated to avoid the peer-to-peer communication as much as possible. In case that this is required, loading estimation shall be made more carefully.

7.3.1 Peer-to-peer Communication Methods

There are following three methods to implement peer-to-peer communication among FCSs; global switch, area data link (ADL) function block, and SEBOL program.

Global switches are effective for digital data communication (up to 256 bits for each FCS) with easy configuration requiring no function blocks. Data transmission delay can be ignored because global switches are exchanged among FCSs at every 100msec, but it can only be used within the same Vnet/IP domain.

ADL's can be used for both the digital and analog data communication and can be used across the different Vnet/IP domains, but additional function blocks are required in receiving FCS. ADL's communication is executed at every second as default setting.

SEBOL programs in SFC or Operation blocks can provide the similar function as the ADL's, using a controller model FFCS-C/V, a periodic SEBOL program is available that is executed in the basic function block scan (one second) and it thus provides every second communication cycle.

In the ADL method, all communication tags and loop connections shall be manually configured on control drawings, but connection can be easily identified on control drawings.

SEBOL programs can be a sequence library so that easy configuration (re-usability) will be available. SEBOL program codes can be re-used in FCSs as they are where program code changes are not required at all.

If many inter-station communications is required, use of the periodic SEBOL method will provide a more value than the ADL method from a perspective of implementation time.

Peer to peer communication between FCS and SCS (safety controller) is also possible by the same methods if safety system (ProSafe-RS System) is integrated with PCS (CENTUM VP System). In this project PCS system & Safety systems are integrated (integrated control and safety system)

7.4 TIME SYNCHRONIZATION

Time Synchronization is required for accurate and consistent time stamping for all event occurrences. Network time synchronization is accomplished by using Network Time Protocol (NTP).

The Vnet/IP Network Time synchronization sets the clock time on every Vnet/IP stations. To ensure consistent time stamping all over the plant, all stations including PCS, ESD and FGS connected to Vnet/IP will be utilizing the Simple Network Time Protocol (SNTP) connected to NTP server.

In a Vnet/IP system, the Vnet/IP clock is the standard. All the stations within a domain allow the time synchronization service program to check for time difference between the Vnet/IP master clock and the computer's clock and adjust the computer's clock when necessary.

7.5 PHILOSOPHY OF APPLICATION TESTING

7.5.1 Application Testing

Application testing is to ensure that the implemented applications function in accordance with the master design document; project functional design documents that have been developed during basic design phase for typical loops and detailed design phase for complex loops/logics/sequences. Those documents shall be approved by a customer prior to the tests.

General Workflow

Testing of project-specific typical software loops

Since the modular design approach is one of the key aspects of the project execution and test strategy, Yokogawa will aim to maximize utilization of the global class module as they do not require dynamic check. When the project-specific typical software loops are designed and implemented, they are subject to rigorous testing, to minimize the probability of errors being propagated. The test includes:

- Full functional test, including all normal and abnormal operating scenarios
- Alarm and event generation
- I/O parameter settings
- Validation of interface with other function blocks
- Verification of the function block documentation, including all the above aspects and any constraints that may apply to the application of the function block

After sign-off by the customer, the approved "typical software loops" become the basis for bulk generation of software configuration, are stored in the project's typical loops library and are subject to rigorous and systematic change management. Replicated typical software loops do not need further dynamic functional testing. During the internal tests and FAT the focus is on correct tag names and interconnections.

Verification of software configuration replicated from typical software loops

Software configuration which can be replicated from the approved typical software loops can be generated in bulk. Testing of such software configuration includes verification of function block parameter settings against I/O definition. The correctness of the software typical used by Yokogawa from the approved typical loops library shall be verified first if in line with control narratives and then with I/O definition supplied by customer.

Next, the tag-specific function block parameter definition shall be verified. Common tag parameter derived from customer, such as Tag name, Service Description, Instrument Range and Engineering Unit etc., will be verified visually through the faceplate or printed system configuration (PCS Self-Documents). Depending on typical loop used, specific function block parameters will additionally be verified (e.g., Alarm Settings, Control Action Direction for PID controllers).

Testing of software configuration for specific loops

Logic, control sequence and algorithm that are specifically defined in the control narrative will be fully tested. Where specified, test of inter-system trips/interlocks will be carried out in an integrated method (e.g., integrated test of ESD trip with the PCS Motor Trip functionality). In general, test procedures shall prescribe all perceived loop-specific tests.

All defects or inconsistencies identified during testing of the sequences or identified with the associated project documentation are entered into Punch-list. The resolution activities are also recorded such that a full audit trail from the original fault through the subsequent recovery actions is established.

Testing Method

Depending upon situations (re-using GES modules, project-specific modules, complexity, etc.), a type of testing method, i.e., static (paper) check or dynamic check, will be selected.

The static (paper) check is used for verifying the static configurations such as tag name, tag comment, instrument range, engineering unit, etc.

The dynamic check is used for verifying complex control functions, project-specific re-usable modules, and/or GES re-usable modules modified by the project.

Application testing will be categorized as below:

1. Individual test

- Control applications that are implemented by re-using the GES typical control loops.
  - In case that GES typical control loops are re-used as they are
    Perform the static (paper) check for static configurations.

  In case that GES typical control loops are used with functional modifications
    Perform the thorough dynamic check using actual FCS hardware or simulator, including abnormal situation testing.
- Project-specific control applications
  - Perform the thorough dynamic check using actual FCS hardware or simulator, including abnormal situation testing.
  - If the same control application is used for the other loops, perform the static (paper) check for replicated objects.

2. Integrated test

Perform the following dynamic checks.

- With using the test function or dynamic process simulation models (if available), verify PCS control functions, OWS (CI Portal view) and alarm solutions, and Safety functions for a selected process unit including abnormal situation testing.
- Controller tuning may be performed where appropriate.
- With following the plant operation procedure (if available), verify that plant start-up and shutdown or other sequential operations are executed as per the master design document, and check effects caused by abnormal situation, e.g. equipment or device failures and recovery from them.
- Verify integration with 3rd-party systems (including response time)
- Verify other hardware and/or system if applicable.
- Verify that spare capacity for application resources for each FCS meets project specification.
- Verify FCS performance and network loading.

Testing method is summarized as below:

Type	Objects suitable for this testing	General procedure
Static (Paper) check	Objects of which their correctness can be verified through static comparison of objects with master documents. • Detailed specification data for function blocks	Check definitions or gaps between test objects and the master document by self-documentation or any other electronic files.
Dynamic check	Objects that require dynamic verifications by simulating process inputs, changing operation modes, changing values of function blocks, and confirming expected outputs and/or results.	Run the application and check functionality based on the master document.

Table 38 – Type of Testing Method Table

For static & dynamic checks follow project FAT test procedures.

Dynamic check is further classified as below:

Test case	Point of view	Objects suitable for this testing
Normal path testing	Verify that test objects behave as described in the design document.	All objects such as • Complex loop • Calculation • Sequence control • Logic
Abnormal situation testing	List abnormal situations as many as possible and verify that test objects behave as described in the test procedure per listed abnormal situation cases.	• All objects listed above • Internal and external interfaces.
Operation and interface testing (Integrated test)	• With executing several functional components at the same time, verify that test objects behave as described in the test procedure. • Perform irregular operations such as trying illegal operations, repeatedly pushing keyboards, repeating opening/closing many views, and so on, and confirm the system still functions as expected.	Testing is focused on • Executing several modules, complex loop, logic, and sequence control at the same time. • Operator interaction from HMI. • Internal communications from HMI, OPC, and other FCS/SCS. • Interfaces with external components.

Table 39 – Test Cases in Dynamic Check

7.5.2 Criteria for Design

The following criteria of testing will apply.

Static (Paper) Check

Test criteria for static (paper) check are summarized in the table below:

Test object	Criteria
Simple property data defined in I/O database • Tag name, • Comment or description, • Instrument range, • Engineering unit, • Input/output processing spec, • Alarm level, security level, • Control parameters, • etc.	Verify that configured data are identical with those in the master I/O database.
Replicated loop / module / sequence / logic	Verify the replicated configurations are identical with those in the original configurations. Exceptions apply to tag names, descriptions, ranges, etc. Extract such gaps between replicated object and original one, and verify gaps are acceptable.

Table 40 – Test Cases in Dynamic Check

Dynamic Check

Dynamic tests are the functional tests performed to meet the functional requirements specified in the control narratives supplied by the EPC, FAT Procedure document shall BE used for testing the complex/sequence logics generated based on design inputs supplied by EPC (Control narratives, IO List and C&E).

7.5.3 Test Plan

Note- Refer Doc No 1724000594-QC-ITP-00002 (Inspection and Test Plan Structure) for detailed plan.

8 VNET/IP CONTROL NETWORK

The network directly related to Process Control is Vnet/IP.

8.1 VNET/IP COMMUNICATION SPECIFICATIONS

The Vnet/IP control network protocol for process automation, developed by Yokogawa has been unanimously accepted by the International Electro Technical Commission (IEC) as a part of international standard IEC 61784-2 Ed.1.0.

The Vnet/IP plant control network protocol is based on 1 Gbps high-speed Ethernet and features both the openness of Ethernet and the reliability/real-time capability required in plant control, concurrent with Yokogawa's development of the Vnet/IP control network protocol.

Vnet/IP was accepted by the IEC for publication as Publicly Available Specification (PAS) No. IEC/PCS 62405/Ed.1 in April 2005. This was an important step in the direction of being accepted as an international standard. PAS is a mechanism for popularizing new technologies in fields where technological advances occur quite rapidly, allowing for the public disclosure of specifications before the IEC officially certifies the technologies as international standards.

General specifications:

- Topology: Star topology
- Transmission speed: 1 Gbps for Yokogawa Hardware, 100 Mbps for general Ethernet equipment.
- Access control: Full duplex
- Scale: 64 stations per domain
- Bus configuration: Redundant
- Control communication: Functionally compatible with Vnet
- Open communication: TCP/IP
- Network equipment: Commercially available & with proven high reliability switching hubs and routers.
- Cables: CAT6 or higher UTP cables or single-mode fiber optic cables

8.2 VNET/IP ADDRESS

The following Vnet/IP address assignment philosophy has taken into consideration for future expansion and to ensure numbering and design consistency.

8.2.1 IP Address for Control Communications

An IP address for control communications can be automatically set, ranging from 1 to 129 from domain and station numbers. Domain and station numbers are set with a DIP switch for each device. Domain numbers should not overlap in Vnet/IP system. In addition, the time server host address is fixed at 254. Class C private address is used for V-Net/IP communication.

8.2.2 IP Address for Open Communications

IP addresses for open communications in a Vnet/IP station, as well as for general-purpose, open- based communications devices and network devices, are not automatically set. Network addresses should be set

in conformity with an address system for control communications. Addresses 1 to 128 and 254 are set aside for control communications, select from 130 to 253 as the host address for open communications.

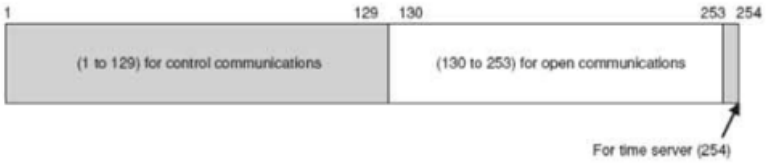


Figure 8 – IP Address Segregation

The following Vnet/IP address assignment philosophy has taken into consideration for future expansion and to ensure numbering and design consistency:

- Vnet/IP Bus1 is used for control purposes (herein called control communication) and Bus2 can connect the general-purpose Ethernet equipment (herein called open communication).
- When IP address is set on Bus1, IP address on Bus2 for control purpose is automatically set.

8.3 STATION NAMING

For stations with Vnet/IP connection, their naming convention will be as following:

Station Type	Station Name	Vnet IP BUS 1 Address	Vnet IP BUS 2 Address	Example
Station Name for EWS (PCS, SIS+FGS)	EWS ddss	Refer table 42	Refer table 42	EWS0164
Station Name for FCS	FCS ddss	*	*	FCS0101
Station Name for Others (PCS, SIS+FGS, EMCS)	STN ddss	Refer table 42	Refer table 42	EWS0163

Table 41 – Vnet/IP Station Naming

Where:

dd: is the Vnet/IP domain (01 to 16)

ss: is the Vnet/IP station number (01 to 64)

"*": Refer to 1724000594-IN-RE-00043 -Cyber Security Settings document.

8.4 IP ADDRESS ASSIGNMENT

Refer to 1724000594-IN-RE-00043 -Cyber Security Settings document.

9 TAG NAMING PHILOSOPHY

ICSS Tag Naming Philosophy Tag name in ICSS refers to the user defined character string that used to call up various control elements such as function block, I/O data, Internal Switch, etc. Each tag name will have an instrument faceplate associated to it when it is called up from the HIS. The ICSS tag name for operation shall be limited to a maximum length of 12 characters for proper display of tag name on the instrument faceplate. However, a maximum length of 16 characters will be used for internal tags. The tag name (including window name) in the whole project database shall be unique. The tag numbering convention shall consider this constraint so that it will not cause any possible duplication of tag name or window name.

9.1 PCS IO TAG

The PCS (CENTUM VP) tag here refers to tags created in PCS stations such as FCS.

1	2	3	4	5	6	7	8	9	10
P	P	M	M	M	-	N	N	N	X

- PP = Process Unit Code:
- MMM = Measured Variable Code
- NNN = Sequence number (Process : 001-499, Package: 501-999)
- X = Identical Equipment No, (A,B,C)

Examples –

IO Type	P&ID Tag Name	IOM Tag	Equipment
Analog Input	25FT-031	%%I25FT-031	Flow Transmitter
Analog Output	25FY-036	%%O25FY-036	Positioner
Digital Input	25ZSH-033	25ZSH-033	Limit Switch
Digital Input	B100TIR-001	B100TIR-001	SWGR HV/MV
Digital Output	25XY-021	25XY-021	Solenoid Valve

Table 42 – Naming Philosophy for PCS IO Tag.

9.1.1 Operator Faceplate Tag

Operator faceplate Tags are defined in P&ID, Instrument Index which are generally too long to fit into PCS system. Reduction (by removing '-'and less important characters from the tag) or conversion of the tag names is required to keep the tag name within the PCS system faceplate constraint of 12 characters. This maintains a consistent and concise tag name philosophy.

PCS Operator Faceplate Tag Name Format that is applied for the project is:

Note: For Digital alarm tag, refer to section 10.2.2

Where:

- PP = Process Unit Code:

- MM = Measured Variable Code
- NNN = Sequence number (As per design input)
- X = Identical Equipment

Examples:

P&ID Tag Name	Function Block	Operator Faceplate Tag
25PT-031B	PVI	25PI-031B
25FIC-032	PID	25FIC-032
25FY-036	MLD	25FY036-ML
25PY-055A	MLD-SW	25PY055A-ML1
25PY-055B	MLD-SW	25PY055B-ML2
B100TIR-001	Digital Input	B100TIR-001
25XY-011	MC2E-PumpA	25XY-011
25XY-012	MC2E-PumpB	25XY-012

Table 43 – Naming Philosophy for Operator Faceplate Tag.

9.1.2 PCS Internal Tag

When function blocks described on P&ID, Instrument Index cannot be directly one to one mapped to PCS function blocks, additional tags in PCS may be required to realize the control function. These tags are directly related to the loop configuration. For example, a split range function block is not shown on P&ID but PCS will configure a SPLIT function block for loop configuration. Normally tags under this category do not need operation access. Therefore, a maximum length of 16 characters will be used

PCS Tag Name Format:

MAIN LOOP TAG	–	S	S	N	N

Where:

- SS = Suffix for Internal Tag identification of function block type
- NN = Sequential Number (Always start from 01).

Examples:

P&ID Tag Name	Suffix	Function Block	PCS Internal Tag
25FIC-032	ST-16	ST16	25FIC032-ST
25FIC-032	RL	RL	25FIC032-RL
25PT-040	AN	%AN	25PI040AN
25ZSL-043	GS	%GS	25ZSL043-GS

25ZSH-043	SW	%SW	25ZSH043-SW
25ZSH-011	IL	%SW	25ZSH011-IL
50TI-002	LC	LC64	50TI002-LC
43FIC-001	CL	CALCU	43FIC001-CL
50TI-001	ADD	50TI001-AD	50TI001-AD
25PIC-040	AS	AS-H/M/L	25PIC040-AS

Table 44 – Naming Philosophy for PCS Internal Tag.

These tags are used to realize the control functions not directly described on the P&ID or in the control narrative. They may also be used for common control functions shared by multiple loops, process units or for PCS internal administrative functions.

PCS Tag Name Format

1	2	3	4	5	6	7	8	9	10	11	12	13
S	D	D	D	D	C	C	C	-	S	S	N	N

Where:

- SDDDD = S + FCS domain and station number
- CCC = Control Drawing No number
- SSNN = For Internal Tag identification of function block type.

Examples:

Controller number	Function Block	PCS Internal Tag
FCS0101	ST16	S0101ST001
FCS0101	RL	S0101RL001
FCS0101	LC	S0101LC001
FCS0101	%GS	S0101GS001
FCS0101	%SW	S0101SW001

Table 45 – Naming Philosophy for PCS Internal Tag for FCS.

9.2 THIRD PARTY COMMUNICATION TAG NAMING

ALE111 Modbus communication cards shall be used for Modbus TCP communication with PCS. CI Server shall be communicating with EMCS Server using OPC UA communication protocol. In few cases vendors provided tag names in mapping lists then same shall be used. In some of the communication packages Tag names shall be configured to meet CentumVP/CI Server HMI/Logic implementation. The following Naming philosophy shall be followed to create unique tag names.

Area	Service1	Separator	Sequence Number 1	Sequence Number 2	E.g. Tag Name	Description (24 Char)
AA	CCCC	-	MM	NN		
Area	Service	Separator		Sequence Number		
20	F3	-	0		20US-5301	Normal Mode
20	F4	-	0		20US-5302	Bypass mode

Service	Service1			Sequence Number1
	CCCC= (1) +(2) +(3)			
Type of service	(1)	(2)	(3)	MM (SEQ NUMBER NN <99) Exclude01/02/03/04/06/08/10
Tripped	XS			
Safety Fault	XZA			
Process Fault	XA			
Unspecified	U			
Analog Indicator			I	
Temperature	T			
status		S		
Flow		F		
Control/Command/ Setpoint			C	
Power	J			
LOCAL	LOC			
REMOTE	REM			
READY	RDY			
CURRENT	C			
VOLTAGE	V			
OPEN	ZSH			
CLOSE	ZSL			
SYNCH	SYN			
TEST	TST			
COUNTER	CNT			

Service	Service1			Sequence Number1
	CCCC= (1) +(2) +(3)			
ERROR CODE	ERR			
FREQUENCY	FRQ			
SPEED	SPD			
SELECT	HS			
HIGH LIMIT	HI			
HIGH LIMIT 2	HH			
LOW LIMIT	LO			
LOW LIMIT 2	LL			
START	ST			
STOP	SP			
STANDBY	STBY			
AUTO/MANUAL	AM			
AUTO	A			
MESSAGE	MSG			
Alarm/Angle			A	
CHARGE	CH			
OVERLOAD	OL			
27-1				28
27-2				29
50-1				50
50-2				52
51				51
51-1				11
51N				14
51G				15
59-1				60
59-2				61
59N				59
59N-1				58
59N-2				57
67-1				68

Service	Service1			Sequence Number1
	CCCC= (1) +(2) +(3)			
67-2				69
A1				71
A2				72
A3				73
A4				74
A5				75
A6				76
A7				77
APPARENT POWER (kVA)				16
BUCHHOLZ				32
BESS STATUS1				91
BESS STATUS2				92
BESS STATUS3				93
CT				33
FC/BATTERY1				81
FC/BATTERY2				82
FC/BATTERY3				83
FC/BATTERY4				84
FC/BATTERY5				85
FC/BATTERY6				86
General alarm				34
GPC				78
TR1/GIS1				21
TR2/GIS2				22
INTERTRIP				87
K86				86
L1				41
L1-L2				12
L2				42
L2-L3				23
L3				43

Service	Service1 CCCC= (1) +(2) +(3)			Sequence Number1
L3-L1				31
magnitude				37
MAINTENANCE				38
OIL PRESSURE				35
OIL TEMPERATURE				36
Phase A				44
Phase B				45
Phase C				46
Phase N				47
POWER FACTOR				19
REACTIVE POWER (kVAR)				17
REAL POWER (kW)				18
V.T. HEALTLY CIRCUIT				48
VT				49
WATCHDOG PROTECTION RELAY				39
WINDING TEMPERATURE				40
UP-200F3				53
UP-200F4				54

Table 46 – Naming Philosophy for Communication Packages where Tag names generated

Area: E.g. A2000 Electrolyzer 20

NN: Sequence Number

9.3 TAG COMMENTS

PCS/SIS/FGS Faceplates can have maximum 24 Character length Service descriptions. To achieve meaning full-Service descriptions Service comments are abbreviated in PCS/SIS and SCADA. SCADA HMI Faceplates are in line in PCS/SIS/FGS faceplates in CentumVP HMI.

Abbreviations	Descriptions
ABND	abandon

Abbreviations	Descriptions
ACK	ACKNOWLEDGE
ACT	Activation
ALM	Alarm
BAT	Battery
BRK	BREAKER
CB	Circuit Breaker
CEL	CELL
CF	CONFIRMED
CHG	CHARGING
CKT	CIRCUIT
CMD	Command
CNTRL	Control
DEPR	DEPRESSURIZATION
DEPRS	Depress.
DISC	DISCONNECT
DISTB	Distribution
DPT	DIFFERENTIAL PRESSURE TRANSMITTER
ER	Equipment ROOM
ELEC	Electrolyser
Emg.	Emergency
EQUIP	Equipment
FC	FUEL CELL
FB	Feedback
FGS	Fire and Gas System
FLT	FAULT
FLTR	FILTERS
FR	from
FRM	FARM
FT	Flow Transmitter
HDR	Header
HI	High
HI HI	HIGH HIGH
HV	High Voltage
H2	HYDROGEN
IA	INSTRUMENT AIR
IL	Inlet
IN	INSIDE
IN.	Inhibit

Abbreviations	Descriptions
INC	INCOMING
INST	Instrument
INT	INTEGER
ISOL	ISOLATION
LO	Low
LS	Limit Switch
LT	Level transmitter
LV	Low Voltage
MOB	Man over board
MV	Medium Voltage
N2	NITROGEN
NW	Network
OL	Outlet
OPN	OPEN
PARA	PARAMETER
PCS	Process Control System
PKG	Package
PMP	Pump
POS	Position
POWER	PWR
PR	Pressure
PT	Pressure Transmitter
PV	PROCESS VALUE
PVS	Package Vent System
PWR	POWER
REC	RECIEVER
REDO	Room Emergency Door Open
RM	ROOM
RMD	Room Motion Detection
RPDO	Room Primary Door Open
RUNN	RUNNING
SR	Switchgear Room
SD	shut down
SERV	SERVICES
SIS	Safety instrumented System
SM CONF	Smoke confirmed
ST	START
STO	storage
SUP	Supply
SURG ARST	SURGE Arrester
SW	SEA WETER

Abbreviations	Descriptions
SW	Switch
SWGR	Switchgear
SWT	SEA WATER TREATMENT
SYS	System
TREAT	Treatment
TT	Temperature transmitter
TWR	Tower
Tx	Transmitter
VLV	VALVE
VNT	VENT
VSL	Vessel
WS	Wired Spare
WTR	WATER
ZSH	Open limit Switch
ZSL	Close limit Switch

Table 47 – Service description Abbreviations

10 PROJECT COMMON SETTINGS

10.1 SWITCH LABEL

The switch position labels refer to character strings displayed as labels for switches on the Motor Control instruments, the Switch instruments, the digital I/O, the Annunciator, the internal switches, the SFC blocks, the selector switch instruments, and the logic operation blocks.

128 switch position labels can be used for one project. One set consists of three labels (Label 1, Label 2 and Label 3). The label 4-character string is not displayed on the instruments with up to three switches, and also define a unique character string for each set. The switch position label can be defined with up to eight (8) alphanumeric characters.

The following table shows CENTUM VP label sets. Labels 1 and 2 cannot be changed or deleted, No.3~13 are system default. These switch labels are common across PCS and SIS so changes in switch labels are not recommended post design freeze.

No.	Label 1	Label 2	Label 3	Label 4
1				
2	ON	OFF	ON	
3	RUN	STOP	RUN	
4	OPEN	CLOSE	OPEN	
5	HIGH	MIDDLE	LOW	HIGH
6	RIGHT	MIDDLE	LEFT	RIGHT
7	DIRECT	STOP	REVERS	DIRECT
8	START	HOLD	STOP	START
9	3	2	1	0
10	STOP	PAUSE	START	STOP
11	RAISE	LOWER	RAISE	
12	RUN	PAUSE	STOP	RUN2
13	START	PAUSE	RESTART	START2
14	START	STOP	START	
15	RESET	NORMAL	RESET	
16	ALARM	NORMAL	ALARM	
17	NORMAL	FAULT	NORMAL	
18	REMOTE	LOCAL	REMOTE	
19	N_AVBL	AVBL	AVBL	
20				
21	NORMAL	TRIP	NORMAL	

No.	Label 1	Label 2	Label 3	Label 4
22				
23	SHUTDOWN	NORMAL	SHUTDOWN	
24	CLOSED	N_CLOSED	CLOSED	
25	OPENED	N_OPENED	OPENED	
26				
27				
28	START	N_START	START	
29	STOP	N_STOP	STOP	
30	MOS ON	MOS OFF	MOS ON	
31	RUN	N_RUN	RUN	
32	RESET	OFF	RESET	
33	AUTO	-	AUTO	
34	OPEN	N_OPEN	OPEN	
35	CLOSE	N_CLOSE	CLOSE	
36	RUNNING	STOPPED	RUNNING	
37	MANUAL	-	MANUAL	
38	ERROR	NORMAL	ERROR	
39	NORMAL	LOW	NORMAL	
40	N_READY	-	N_READY	
41	READY	-	READY	
42	DISABLE	ENABLE	DISABLE	
43				
44				
45				
46				
47				
48	CLOSE	NORMAL	CLOSE	
49	OPEN	NORMAL	OPEN	
50	TRIP	NORMAL	TRIP	
51	ACTIVE	NORMAL	ACTIVE	
52	CLOSE	OPEN	CLOSE	
53	BAD	GOOD	BAD	
54	LOCKED	UNLOCKED	LOCKED	
55	MUTE	UNMUTE	MUTE	

No.	Label 1	Label 2	Label 3	Label 4
56				
57	HEALTHY	BAD	HEALTHY	
58				
59	DISABLE	OFF	DISABLE	
60	BYPASS	NORMAL	BYPASS	
61	MOVING	STOP		
62				
63				
64	ACTIVE	INACTIVE	ACTIVE	
65				
66	NORMAL	SHUTDOWN	NORMAL	
67	MANUAL	MANUAL		
68	AUTO	AUTO		
69				
70	RETURN	RETURN		
71	SUPPLY	SUPPLY		
72	RET-RET	RET-RET		
73	SUP-SUP	SUP-SUP		
74	RET-SUP	RET-SUP		
75	SUP-RET	SUP-RET		
76	YES	NO		
77	MANUAL	MCS	MANUAL	

Table 48 – Switch Label configuration Tab

Standard switch labels shall be used across the project. Few Switches label for ON status sample shown below.

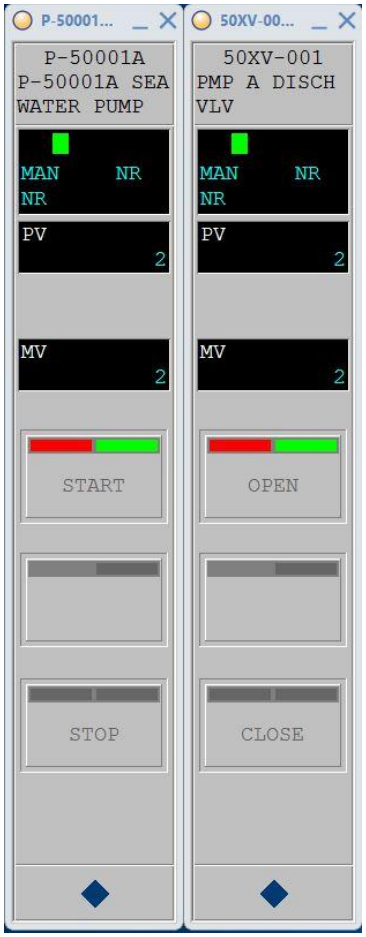


Figure 9 – Motor and Valve Faceplate Label in ON condition.



Figure 10 – Motor and Valve Faceplate Label in OFF condition.



Figure 11 – Switch Label Sample in ON condition.



Figure 12 – Switch Label Sample in OFF condition.

10.2 OPERATION MARK

Note: In this project Operation mark is not envisaged.

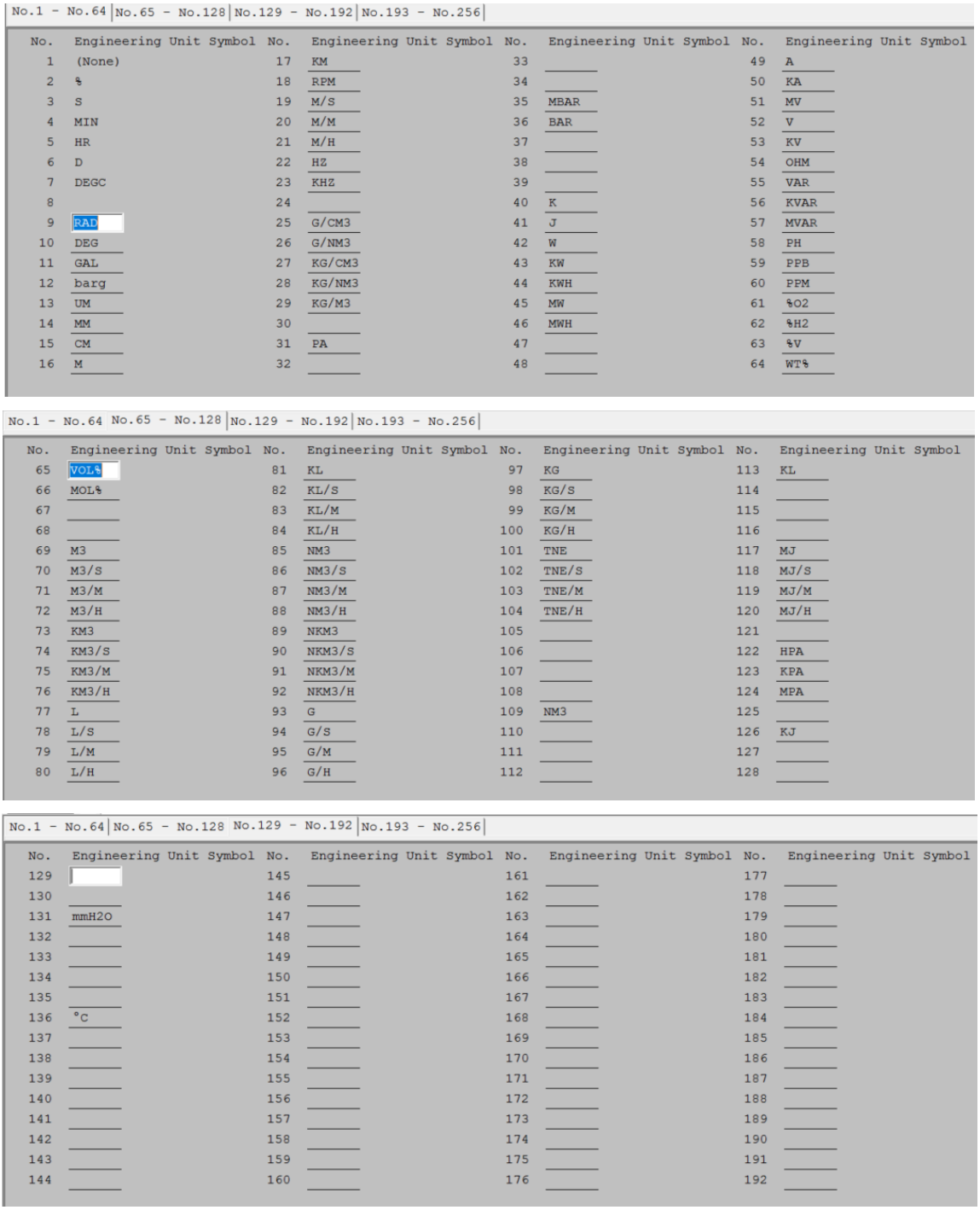
The label of the operation mark can be set using the Operation Mark Builder. Up to 8 characters can be entered as the text on the label (string). The non-defined operation mark label may be temporarily changed during the operation on the HIS Setup window. The following table defines the operation marks to be used. No. 33 thru 64 is reserved for operation mark install/remove by application software. No. 1 thru 32 is reserved for install/remove by user. The table below shows operation mark definitions. Individual projects can revise the definition to suit the project requirements.

No.	Tag Label	Color	Tag Level	Install/Remove
1	OPMARK01	White	Comment Type	All Privileges
2	OPMARK02	White	Comment Type	All Privileges
3	OPMARK03	White	Comment Type	All Privileges
4	OPMARK04	White	Comment Type	All Privileges
5	OPMARK05	White	Comment Type	All Privileges
6	OPMARK06	White	Comment Type	All Privileges
7	OPMARK07	White	Comment Type	All Privileges
8	OPMARK08	White	Comment Type	All Privileges
9	OPMARK09	White	Comment Type	All Privileges
10	OPMARK10	White	Comment Type	All Privileges

Figure 13 – Operation Mark Definitions Tab

10.3 ENGINEERING UNIT

The Engineering Unit is a unit symbol attached to a process data value used within the project. Up to 256 engineering unit symbols can be used for one project. Among the 256 symbols, the first 8 are system fixed. The rest can be user defined. One engineering unit symbol can be defined with up to six alphanumeric characters. The table below shows engineering unit definitions. Individual projects can revise the definition to suit the project requirements.



No.1 - No.64 | No.65 - No.128 | No.129 - No.192 | No.193 - No.256

No.	Engineering Unit Symbol	No.	Engineering Unit Symbol	No.	Engineering Unit Symbol	No.	Engineering Unit Symbol
1	(None)	17	KM	33		49	A
2	%	18	RPM	34		50	KA
3	S	19	M/S	35	MBAR	51	MV
4	MIN	20	M/M	36	BAR	52	V
5	HR	21	M/H	37		53	KV
6	D	22	HZ	38		54	OHM
7	DEGC	23	KHZ	39		55	VAR
8		24		40	K	56	KVAR
9	RAD	25	G/CM3	41	J	57	MVAR
10	DEG	26	G/NM3	42	W	58	PH
11	GAL	27	KG/CM3	43	KW	59	PPB
12	barg	28	KG/NM3	44	KWH	60	PPM
13	UM	29	KG/M3	45	MW	61	%O2
14	MM	30		46	MWH	62	%H2
15	CM	31	PA	47		63	%V
16	M	32		48		64	WT%

No.1 - No.64 | No.65 - No.128 | No.129 - No.192 | No.193 - No.256

No.	Engineering Unit Symbol	No.	Engineering Unit Symbol	No.	Engineering Unit Symbol	No.	Engineering Unit Symbol
65	VOL%	81	KL	97	KG	113	KL
66	MOL%	82	KL/S	98	KG/S	114	
67		83	KL/M	99	KG/M	115	
68		84	KL/H	100	KG/H	116	
69	M3	85	NM3	101	TNE	117	MJ
70	M3/S	86	NM3/S	102	TNE/S	118	MJ/S
71	M3/M	87	NM3/M	103	TNE/M	119	MJ/M
72	M3/H	88	NM3/H	104	TNE/H	120	MJ/H
73	KM3	89	NKM3	105		121	
74	KM3/S	90	NKM3/S	106		122	HPA
75	KM3/M	91	NKM3/M	107		123	KPA
76	KM3/H	92	NKM3/H	108		124	MPA
77	L	93	G	109	NM3	125	
78	L/S	94	G/S	110		126	KJ
79	L/M	95	G/M	111		127	
80	L/H	96	G/H	112		128	

No.1 - No.64 | No.65 - No.128 | No.129 - No.192 | No.193 - No.256

No.	Engineering Unit Symbol	No.	Engineering Unit Symbol	No.	Engineering Unit Symbol	No.	Engineering Unit Symbol
129		145		161		177	
130		146		162		178	
131	mmH2O	147		163		179	
132		148		164		180	
133		149		165		181	
134		150		166		182	
135		151		167		183	
136	°C	152		168		184	
137		153		169		185	
138		154		170		186	
139		155		171		187	
140		156		172		188	
141		157		173		189	
142		158		174		190	
143		159		175		191	
144		160		176		192	

Figure 14 – Engineering Unit Configuration Tab

10.4 PROJECT COMMON PROPERTIES - SETTINGS FOR GRAPHICS

Note: In this project, CI Portal View shall have graphics. PCS has capability of Graphics but shall not be used.

It is recommended for the engineer to follow these settings as shown below on the Project common properties during Brown filed project execution for better graphics display functions.

Graphics tab in the new project creation dialog box consists below three options for the graphic actions.

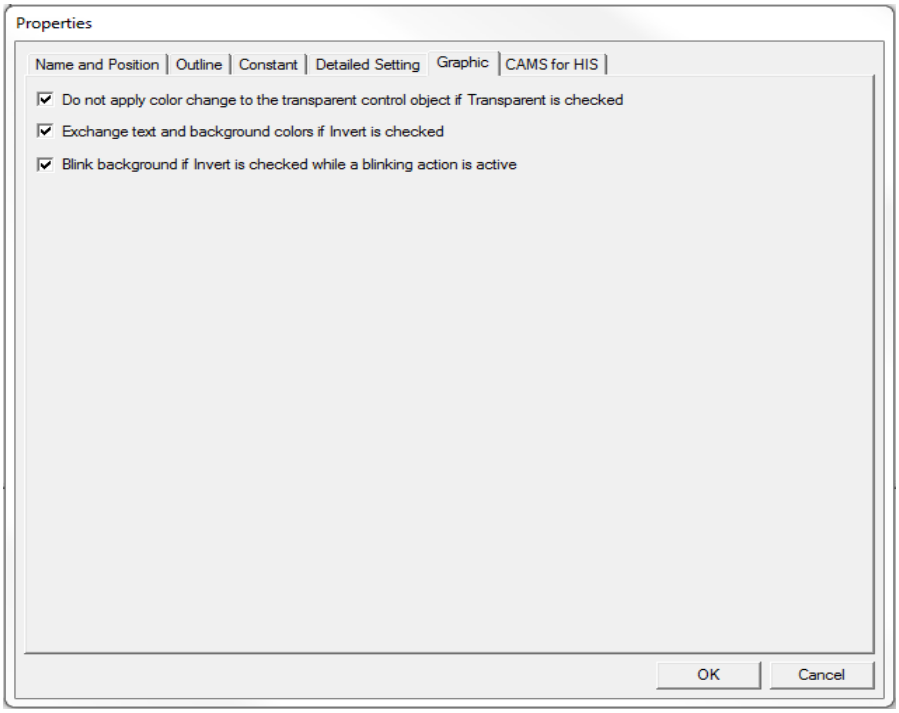


Figure 15 – Project Common Properties - Settings for Graphics

- Do not apply colour change to the transparent object if Transparent is checked.

By checking the above check box, the control with "Transparent" option specified remains transparent even if the modifier condition is met.

- Exchange text and background colours if Invert is checked.

By checking the above check box, the text and the background colours of the following are switched if the modifier condition is met.

- Text control with "Transparent" specified for its background and "Invert" specified as a modifier action.
- Data character control with "Transparent" specified for its background and "Invert" specified as a modifier action.
- Blink background if Invert is checked while a blinking action is active.

By checking the above check box, the background of the following controls blinks if the modifier condition is met.

- Text control with "Blinking" and "Invert" specified together as modifier actions.

- Data character control with “Blinking” and “Invert” specified together as modifier actions.

11 SUBSYSTEM COMMUNICATION- MODBUS TCP/IP

The Ethernet communication module communicates with subsystems at the specified intervals and stores the subsystem data in the communication modules' I/O image. FCS accesses the communication module asynchronously from them and refers to or sets the I/O image. This enables FCS to use the subsystem data through the I/O terminals of the function block in the same way as the general analog and digital I/O signals.

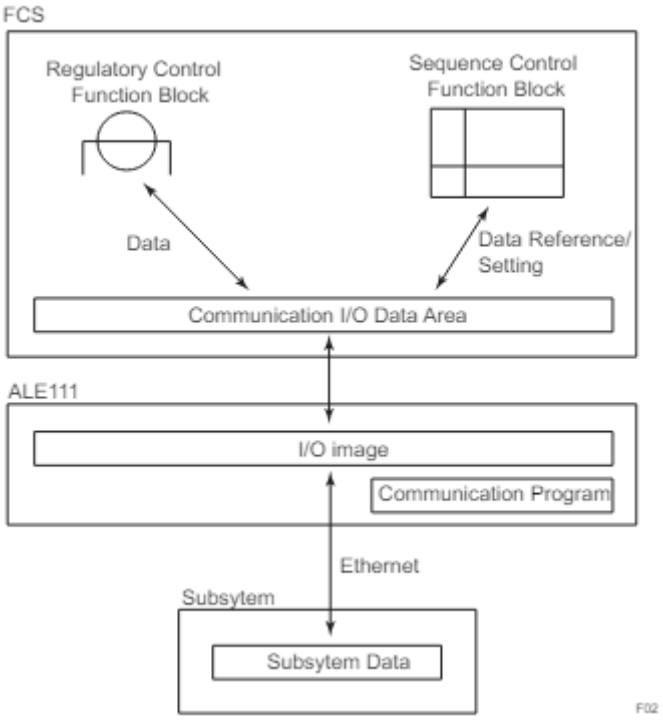


Figure 16 – Flow of data in a Subsystem.

11.1 MODBUS COMMUNICATION CARDS

FCS can communicate with a subsystem by using Ethernet TCP/IP protocol via ALE111 communication module that can be installed on Field Control Unit, ESB Bus Node Unit and Optical ESB Bus Node Unit.

11.2 OVERVIEW

For the CENTUM VP, subsystem communication package for Modbus TCP protocol is offered to allow the basic control function of the FCS to access the subsystem's data via an Ethernet communication module, in the same way as handling signals through other process input/output modules.

11.3 PCS COMMUNICATION CAPACITIES

The capacity specific to Modbus TCP interface when performing subsystem communication with Modbus TCP PLC is indicated below:

Sr. No	Item	Max Amount (For AFV30x / AFV40x / A2FV50X / A2FV70X)	Remark
1	No of Communication modules	Max 32 [16 pairs] per FCS	
2	No. of Communication I/O data	Max 8000 words / FCS	1 word = 16 bits
3	Amount of data those can be communicated with one module	Max 1000 words / Module	ALE111
4	No. of Communication ports / Module	1 port	
5	No of Subsystem for communication	Max 30 Subsystems	Total number of TCP and UDP connections
6	No. of Words per transmission	Max 125 Words (AI/O) Max 8 Words (DI/O)	
7	No of Communication definitions	Max 128 definitions / Module	

Table 49 – PCS Communication Capacity for Modbus TCP/IP

11.4 COMMUNICATION PERFORMANCE

The Communication performance for Modbus TCP protocol is dependent on the following factors:

- Number of words per transmission frame
- Number of communication definitions

Yokogawa recommends that the subsystem Communication data be with contiguous addresses & packed in units of words, to improve the efficiency of communication data acquired and set by the FCS.

Note: When more than 2 Subsystem PLC is communicating with 1 ALE Card, the network cable from each PLC COM port should directly connect to the Modbus L2 switch (PCS side) without any intermediate routers or gateways. To verify this, subsystem vendor to provide the system architecture along with subsystem design inputs.

11.5 COMMUNICATION INTERFACE

ALE111 is an Ethernet communication module that can be installed on Field Control Unit, ESB Bus Node Unit and Optical ESB Bus Node Unit.

11.6 COMMUNICATION SPECIFICATION OF ALE111

The communication specification specific to Modbus/TCP PLCs is listed in the table below:

Item	Description
Data Encoding Setting	Binary
Error Control	NA
Stations that can be communicated with	Modbus/TCP PLC Stations

Table 50 – Modbus TCP/IP Communication Specification

11.7 REDUNDANCY OF COMMUNICATION

11.7.1 Functional Overview

The Ethernet communication module, ALE111, can be made dual-redundant by setting two modules in the adjacent (odd- and even-numbered) slots of the same node unit.

Note: For this project, refer to Section 11.9 for the Interface Package List.

Note: In this Project Redundant and Non-Redundant communication is considered

11.7.2 Data Input Flow

Each of the two ALE111 modules communicates with the subsystem and reads the subsystem input data into the module. An FCS accesses the control communication module to read and use these data; however, it does not access the standby communication module. When the FCS detects a control communication module error or subsystem communication failure, the FCS switches its control to the standby module from which to read data.

11.7.3 Data Output Flow

A control communication module outputs data to a subsystem. The control communication module writes data to the subsystem at the specified intervals when an FCS sets the data in it. Meanwhile, the standby communication module re-reads and retains the output image data when it accesses the subsystem at the specified interval. This equalizes the data between the control and standby communication modules.

When an error is detected, the FCS switches its control to the stand-by module through which the FCS continues to output data to the subsystem.

11.8 CONFIGURATION SETTINGS

For this configuration, the following settings are required:

1. Set IP addresses for the ALE111 modules (Both) in the same network domain.
2. Check “Automatically Set Communication Details” in ALE111 properties.
3. Set IP addresses of the subsystems in the same network domain.

The following example shows the definition of redundant ALE modules in CENTUM VP system.

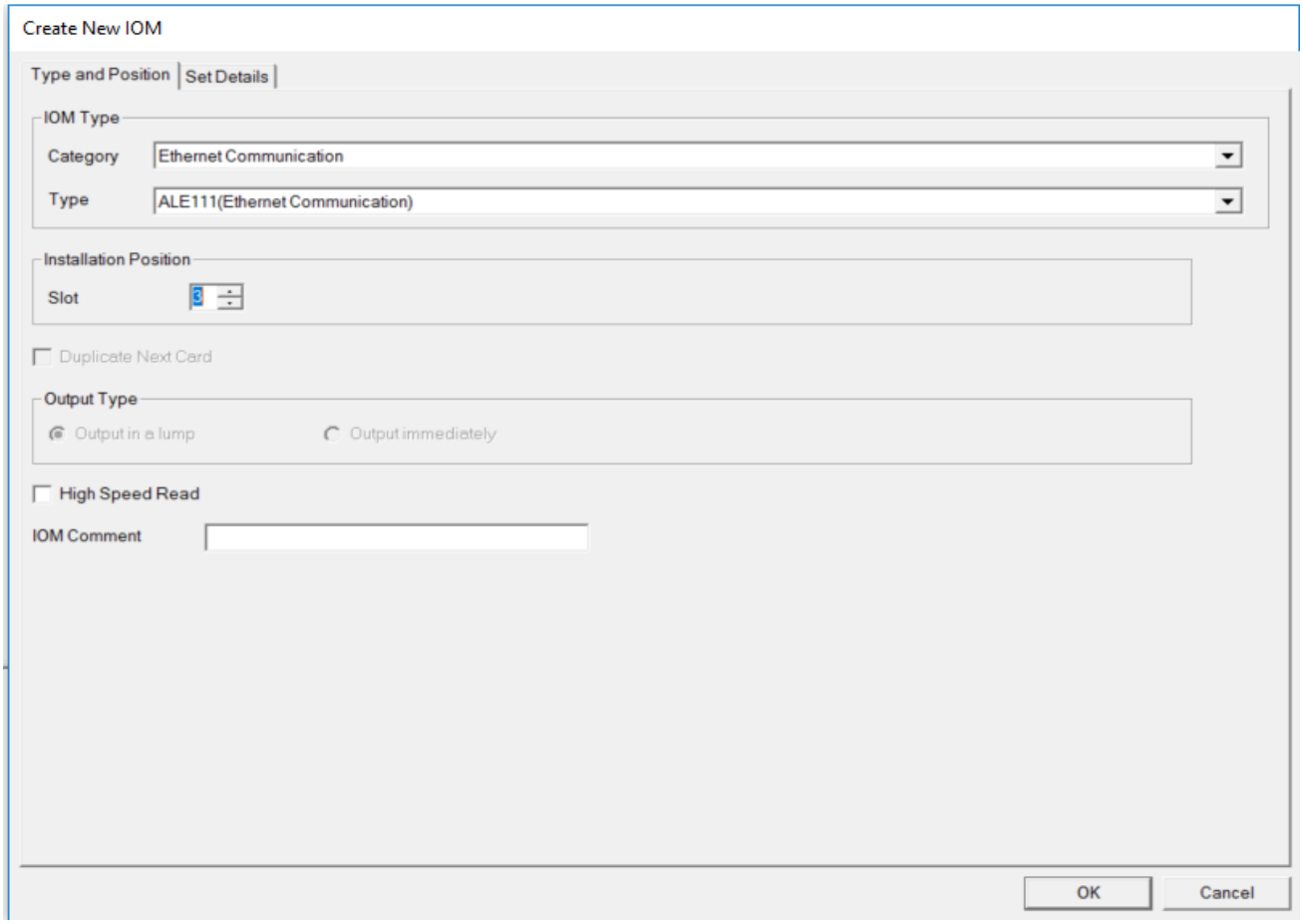


Figure 17 – Non-redundant Communication Module ALE 111 Configuration

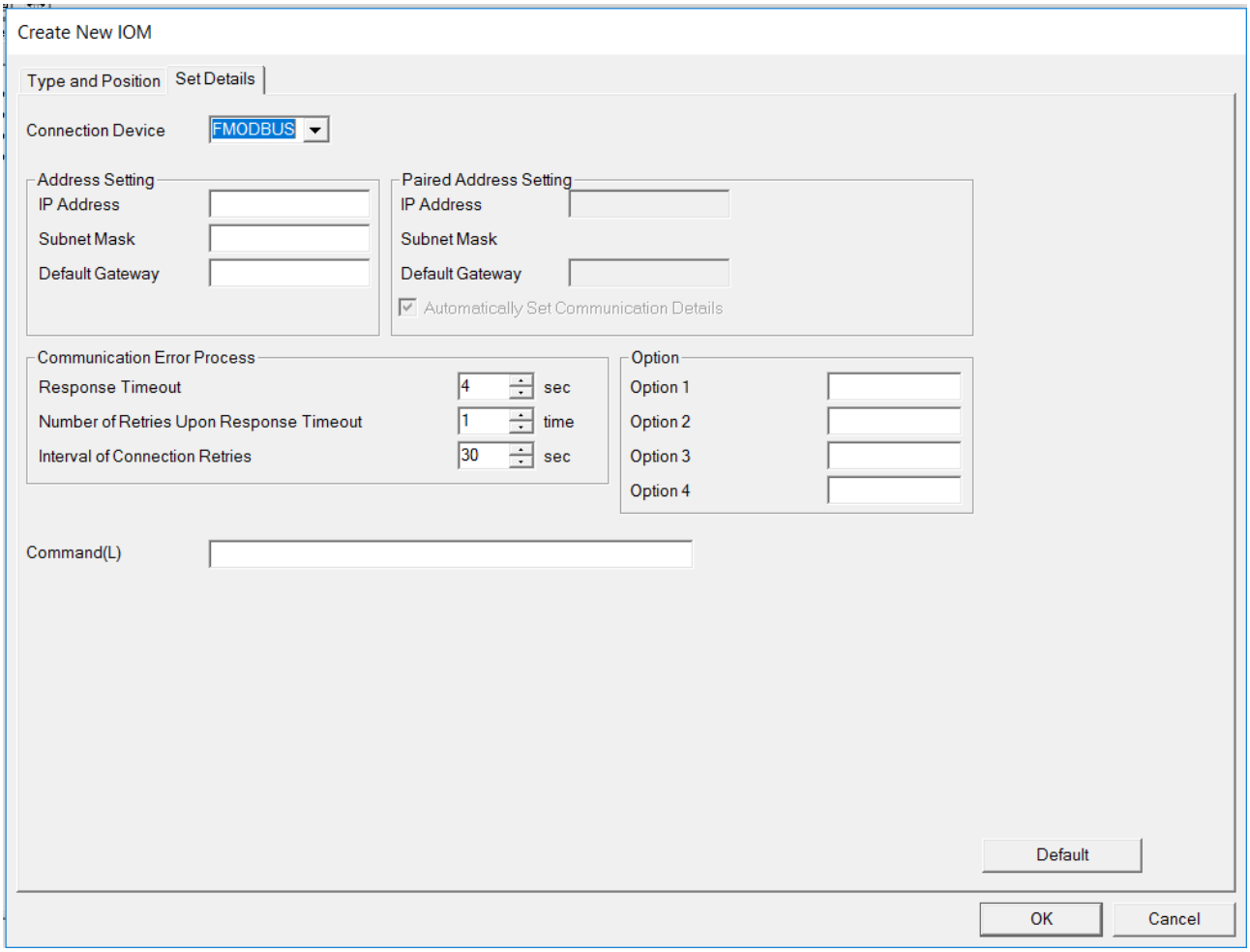


Figure 18 – Non-redundant Communication Module ALE 111 IP Setting

11.9 INTERFACE PACKAGE LIST

Modbus module shall be connected to Network switch which in turn connected will all Package PLCs

S. NO	Package Name	FCS	NODE	SLOT	PORT	Redundancy	Protocol
1	Water Treatment UCP	FCS0101	4	3	1	Non-Redundant	ALE111
2	LV Switchgear	FCS0101	3	7		Non-Redundant	ALE111
3	HVAC	FCS0101	4	3		Non-Redundant	ALE111
4	UPS	FCS0101	4	1		Redundant	ALE111
5	EMCS	FCS0101	4	1		Redundant	ALE111

Table 51 – Interface Package List- ALE111

12 SUBSYSTEM COMMUNICATION- PROFINET

This document describes Model A2LP131 PROFINET Communication Module which performs as the PROFINET IO-Controller to communicate and exchange data with PROFINET IO-Devices.

A2LP131 can be mounted on the following field control units (FCU). It can also be mounted on the ESB bus node unit (ANB10D) and the optical ESB bus node unit (ANB11D) which are connected to the FCU.

List of Applicable FCS: AFV30S, AFV30D, AFV40S, AFV40D, A2FV50S, A2FV50D, A2FV70S, A2FV70D

Note: For this project, refer to Section 12.5 for the Interface Package List.

12.1 HARDWARE SPECIFICATION

Hardware specifications for A2LP131 PROFINET communication module are as shown below.

Item	A2LP131 Specifications
Physical layer interface	IEEE 802.3 100BASE-TX
Connector	RJ-45
Transmission Speed	100 Mbps
Transmission route	2x2 twisted-pair shielded cable (symmetrical)
Transmission distance	1 segment, 100 m
No. of physical ports	One Port
Maximum current consumption	0.8 A
Weight	Approx. 0.31 kg

Table 52 – Communication Module Hardware Specifications

12.2 PROFINET COMMUNICATION SPECIFICATIONS

12.2.1 Communication with Profinet IO-Devices

A2LP131 exchanges data with PROFINET IO-Devices and receives the alarms from PROFINET IO-Devices. The PROFINET I/O-Devices data is stored in the communication modules' I/O Image area. FCU accesses this module, refers to the data stored in the I/O Image of the module, and stores the data in the communication I/O data area. Also, FCU accesses this module and sets the data set in the communication I/O data area by the functional block to this module's I/O Image area.

This enables FCU to use the PROFINET IO-Devices data through the I/O terminals of the function block in the same way as the general analog and digital I/O signals.

The following PROFINET data types can be assigned directly to the CENTUM VP functional block when using A2LP131. Boolean, Integer16, Integer32, Unsigned16, Unsigned32, Float32 In addition, A2LP131 receives the alarm from PROFINET IO-Devices and sends notifications to FCU.

Note: GSD (General Station Description) files shall be supplied by EPC.

12.2.2 Communication Path Dual Redundancy

In CENTUM VP, PROFINET network communication path dual redundancy is facilitated by connecting managed switches that have the Media Redundancy Manager (MRM) function, which is compliant with Media Redundancy Protocol (MRP), and the PROFINET IO-Devices that are the media redundancy clients (MRC) in a ring topology.

Media redundancy is a redundancy specification of PROFINET. For details, refer to the PROFIBUS Organization website. In CENTUM VP, dual redundancy of the communication path is achieved by making the PROFINET network a ring configuration. Consequently, even if communication with one communication path becomes impossible, communication can be continued by using the other communication path.

A2LP131 is placed outside of the media redundancy ring topology.

Note: In this project Dual Path Redundancy is not considered.

12.3 INSTALLATION ENVIRONMENT

No. of ALR111, ALR121, ALE111, ALP111, ALP121, A2LP131, and A2LP141 modules	Max. 32 units/FCS (Max. 16 pairs for dual-redundant operation) (*1)
No. of ALF111 modules	Max. 64 units/FCS (Max. 32 pairs for dual-redundant operation)
No. of all the communication modules	Max. 64 modules/FCS (*1) (*2)
No. of ports	1 port/A2LP131
No. of connectable PROFINET IO-Devices	Max. 128 devices/A2LP131
I/O data capacity for communication	1000 words/A2LP131
No. of communication definitions	200 definitions/A2LP131
No. of communication functions	Max. 8 types/FCS (*1) (*3)
Communication I/O data capacity	Max. 8000 words/FCS (incl. data from other communication functions)

*1: ALP111 and ALP121 cannot be mounted on the same FCS together.
*2: This is the sum of ALR111, ALR121, ALE111, ALF111, ALP111, ALP121, A2LP131, A2LP141, AGS813, and AGP813 modules.
*3: This is the sum of communication functions of ALR111, ALR121, ALE111, ALP111, ALP121, A2LP131, and A2LP141.

Table 53 – Communication Module Installation Environment.

12.4 CONFIGURATION SETTINGS

The following example shows the definition of redundant A2LP131 module in CENTUM VP system.

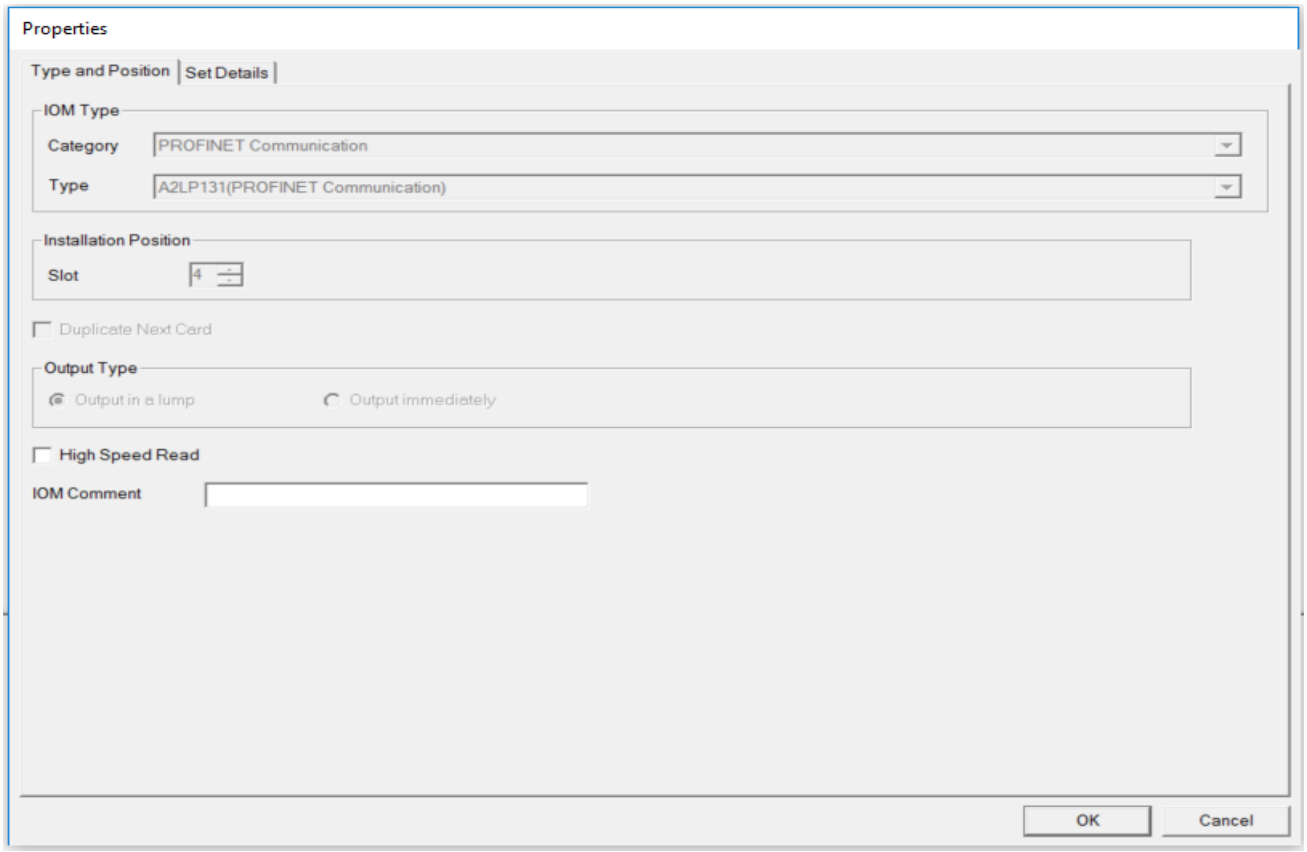


Figure 19 – Communication Module A2LP131 Configuration

12.5 INTERFACE PACKAGE LIST

PROFINET module shall be connected with Network switch and network shall be connected with PROFINET devices.

S. NO	Package Name	FCS	NODE	SLOT	PORT	Redundancy	Protocol
1	Instrument Air UCP	FCS0101	4	4	1	Non-Redundant	A2LP131
2	Nitrogen UCP	FCS0101	4	4		Non-Redundant	A2LP131

Table 54 – Interface Package List- Profinet

13 FUNCTIONAL OVERVIEW OF IAMS (PRM)

13.1 SYSTEM OVERVIEW OF IAMS

Plant Resource Manager (PRM) is Instrument Asset Management System (IAMS) in Yokogawa PCS.

Here after "IAMS" shall be referred as PRM in this Document.

PRM is a key component of YOKOGAWA Asset Excellence initiative, is a centralized asset management system that helps to reduce plant down-time and maintenance costs throughout the plant life cycle.

Being installed as part of Yokogawa ICSS (e.g. CENTUM VP, ProSafe-RS), PRM provides users with the capability to effectively configure and manage intelligent field devices such as Foundation Fieldbus H1 devices, HART devices, PROFIBUS DP and PA devices, ISA100 wireless devices and other FDT compliant devices (herein after referred to as field devices). It also provides users with various diagnostic information from field devices to help identify faults of plant assets in a proactive manner and to maximize production out of assets in the plant life cycle.

13.1.1 System Configuration

PRM consists of following software components, which have the potential to be installed on the same or separate machines. The details of the actual installation and architecture are depicted in System Architecture Drawing Doc.No.1724000594-IN-DD-00015.

Standard (required for all installations)

- PRM Client

PRM Client is a graphical user interface application used to view device information, monitor device status, and perform various operations related to device management throughout the plant life cycle. The PRM Client can be installed alone in one dedicated machine or can be installed along with the other components in the PRM system described in this section or can be installed in the HISs in CENTUM VP system. In this project PRM Server shall have PRM Client.

- PRM Server

PRM Server serves as a centralized repository which stores information collected from the field devices such as parameters, alarms and events, and diagnostic information. It also provides various tools and configuration templates to allow users to effectively manage the devices.

- PRM Field Communication Server

PRM Field Communication Server serves as a gateway to access fieldbus devices connected to Yokogawa ICSS through Control System Network. It also supports a serial link interface to HART devices through a HART multiplexer and linking/communication devices to interface with field devices such as PROFIBUS devices ISA100 wireless devices, etc. through Ethernet network. The PRM Field Communication Server dedicatedly serves one corresponding PRM Server which has the potential to be installed in the same machine or a separate machine depending on the sizing of whole PRM system.

13.1.2 Network Architecture

The following network architecture diagram shows an example of the PRM related components placed in the plant control network. Refer to System Architecture Drawing Doc. No.1724000594-IN-DD-00015 for the actual PRM software and hardware installation in this project.

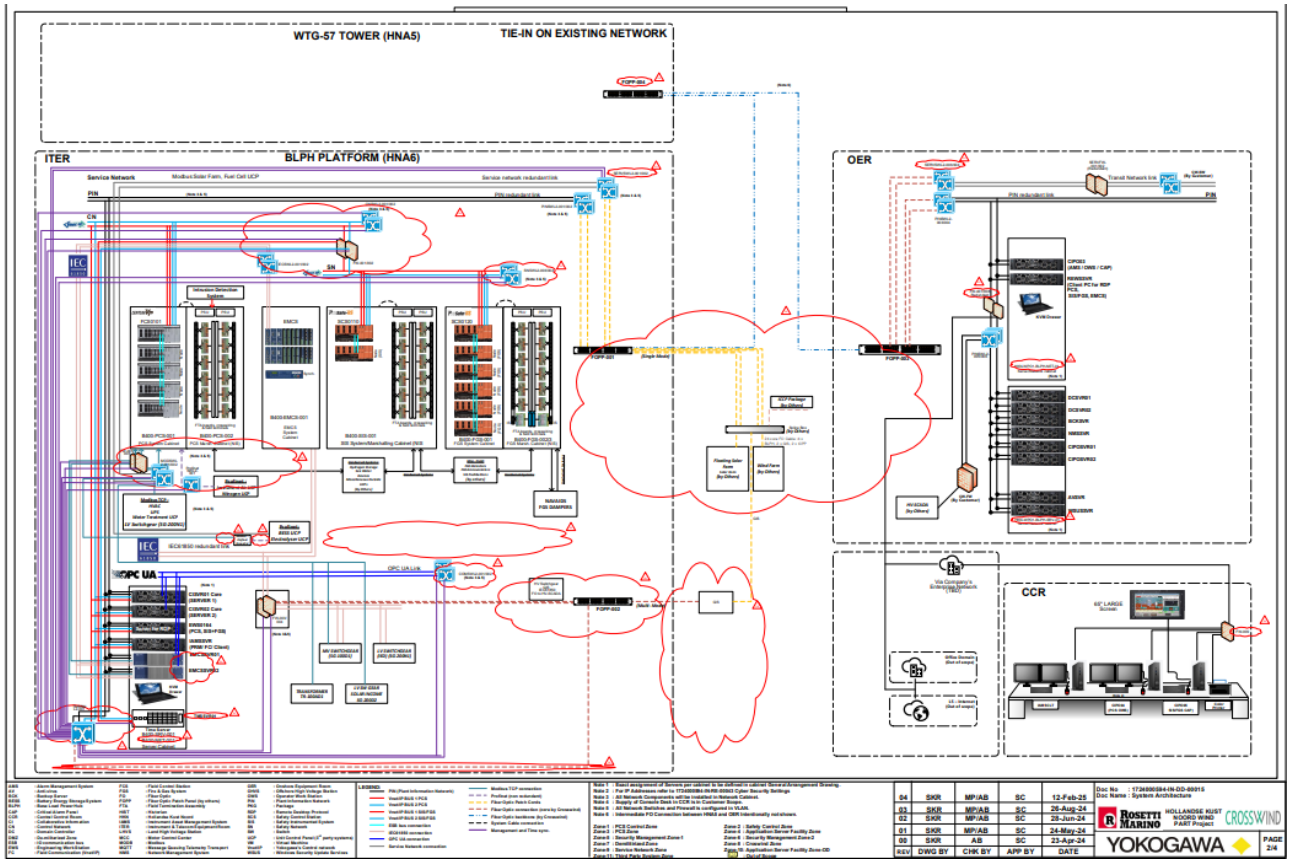


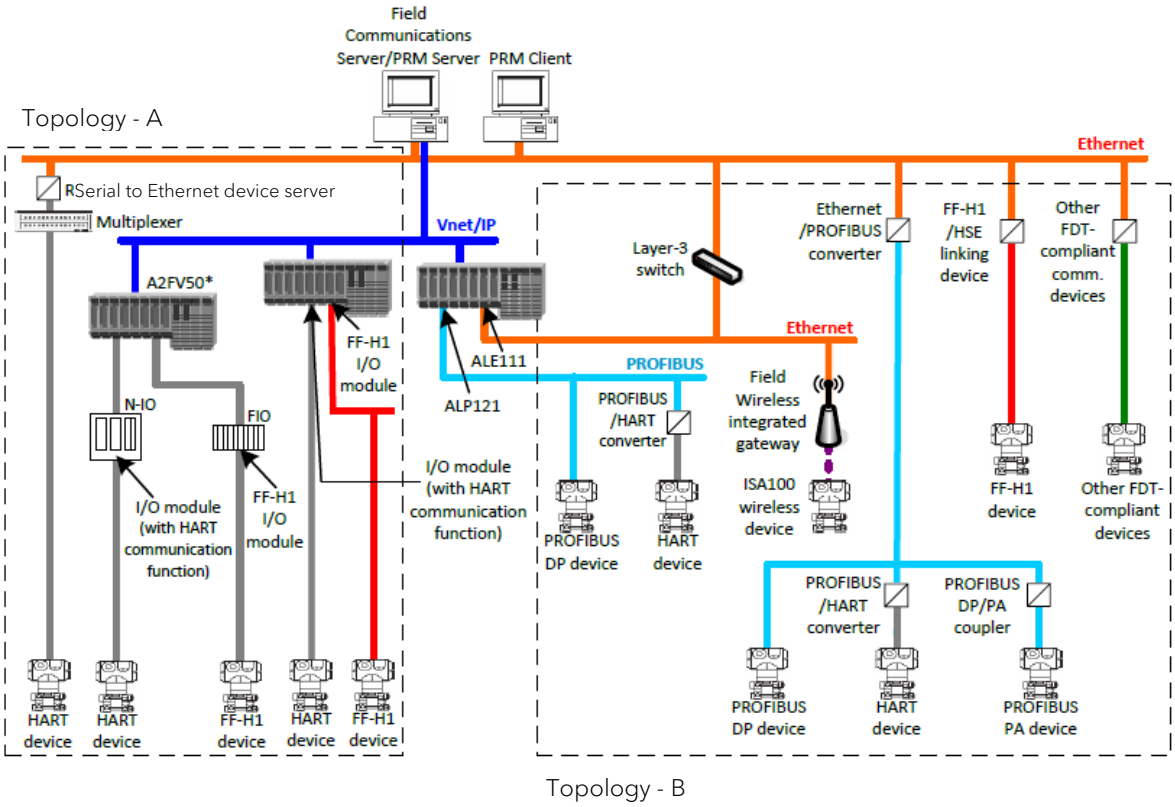
Figure 20 – Example of PRM Network Architecture

13.1.3 Field Device Network Topologies

Various types of field devices can be supported on the PRM:

- FF-H1 devices
- HART devices
- PROFIBUS PA and DP devices
- ISA100.11a devices
- Other FDT compliant devices

The topologies used for the device types above are shown in the following figure as an example:



Topology - A: PRM system collects information from devices through the control bus via host controllers or Multiplexer.

Topology - B: PRM system collects information from devices through Ethernet network.

Figure 21 – Example of Field Device Network Topologies

14 PRM STANDARD FUNCTIONS

The following table shows the main standard functions of PRM available in relation to types of supported devices. The section details the functions.

Categories	Functions	Topology - A *		Topology - B *			
		FF-H1(*5)	HART (*1)	FF-H1 on Linking Device (*5)	HART on PROFIBUS	PROFIBUS (*2)	ISA 100.11a
Basic Setup	Plug & Play	xx	xx	xx	xx	x (*3)	xx
	Device Template	xx	xx	xx	xx	xx	xx
Device Navigation	Plant View	xx	xx	xx	xx	xx	xx
	Network View	xx	xx	xx	xx	xx	xx
	Class View	xx	xx	xx	xx	xx	xx
	Signal View	xx	xx	xx	xx	xx	xx
	Custom View	xx	xx	xx	xx	xx	xx
Maintenance Alarm	Indication on Device Navigation Views	xx	xx	xx	xx	xx	xx
	Message Notification	xx	xx	xx	xx	xx	xx
Diagnosis and Adjustment	Device Viewer	xx	xx	xx	xx	NA	xx
	Parameter Manager	xx	xx	xx	xx	NA	NA
	DTM Works	xx	xx	xx	xx	xx	xx
	DD Menu	xx	NA	xx	NA	NA	NA
Maintenance Operation Assistance	Maintenance Mark	xx	xx	x	xx	xx	xx
Maintenance Information Management	Device Details	xx	xx	xx	xx	xx	xx
	Inspection Memo	xx	xx	xx	xx	xx	xx
	Inspection Schedule	xx	xx	xx	xx	xx	xx
	Parts List	xx	xx	xx	xx	xx	xx
Document Management Assistance	Document Links	xx	xx	xx	xx	xx	xx
Audit Trail Management	Parameter History	xx	xx	xx	xx	xx	xx
	Operation History	xx	xx	xx	xx	xx	xx
	Device Event Message	xx	xx	xx	xx	xx(*4)	NA
Security	PRM Groups and User Management	xx	xx	xx	xx	xx	xx
FieldMate Integration	Synchronization with FieldMate	xx	xx	xx	xx	xx	xx

Table 55 – PRM Standard Functions in relation with Types of Field Devices

xx: supported. x: partially supported. NA: not supported.

*: See section 13.1.3 for the topology of each device type.

*1: HART 5, 6, and 7 are supported on PRM.

*2: To gain full-fledged feature of each function below, it is recommended to follow the designated guideline.

Function	Guideline	Consequence of not following the Guideline
Plug & Play	The device must: • Support both DP V0 and DP V1 • Conform to PA Profile V3.02 or later	Loss of device static information (Device Details) on Plug & Play. This issue may be worked around by manually entering the same information.
Indication on Device Navigation Views	The device must: • Support both DP V0 and DP V1 • Conform to PA Profile V3.02 or later	The associated device icon always displays the "Uncertain" status shown in white.
DTM Works	The device must support both DP V0 and DP V1.	DTM Works not functional.
Device Event Message	A GSD file must be available for the device.	Loss of partial diagnostic information on Maintenance Alarm message.
	The device must: • Support both DP V0 and DP V1 • Conform to PA Profile V3.02 or later, and A GSD file of revision 3 or later must be available for the device.	Loss of partial or whole diagnostic information on Maintenance Alarm message.

Table 56 – Guideline for Profibus related functions on PRM

*3: For PROFIBUS DP (with Non-PA profile), device needs to be manually added to a FDT project before Plug & Play.

*4: PROFIBUS device event message is acquired via ALP111 or ALP121 PROFIBUS-DP Communication Module.

*5: FF Devices are not used in this project.

For general guidance on Profibus technology, visit the web site of PROFIBUS international.

14.1 BASIC SETUP FUNCTIONS

14.1.1 Plug & Play

Plug & Play is an initial setup for the PRM to recognize the devices through the PRM Field Communication Server and register them in its database. A device becomes available for the various PRM functions when it is complete with Plug & Play. In order to perform Plug & Play for the devices, communication must be established between the devices and the host system (e.g. CENTUM VP, ProSafe-RS) or associated gateway devices in advance. Also, the following setup must be completed for the PRM Field Communication Server before Plug & Play:

- Device path configuration for HART devices.
- FDT project configuration for FDT based devices.
- Installation of proper DD/CFF files and DTM files in the designated folder in the PRM.

14.1.2 Manual registration

If User need to prepare the devices before plant commissioning, then manually register the devices in PRM even if they are not connected to the field network. User also can manually register devices that cannot be registered by the other registration methods.

- The devices that you can register manually are as follows:
- Devices that use connection methods not supported by PRM.
- Conventional and static devices.

Devices that can represent and manage an asset on the site, area, process cell, or unit of the plant hierarchy

Offline devices to be connected later using device path configuration.

Manual Registration through PRM Client

Registers devices by adding it manually in the PRM Client.

Supported communication type: FF-H1, HART, ISA100, PROFIBUS, BRAIN, Modbus, Conventional device, Static device and Other.

Manual Registration through Bulk Device Import tool

- Registers multiple devices that belong to YOKOGAWA systems by importing a device registration file.

  Supported communication type: FF-H1, HART.
- Registers multiple devices that belong to Generic systems by importing a device registration file.

  Supported communication type: Conventional device.

14.1.3 Device Template

A PRM device template gives the user a static configuration template that can eliminate manual work for configuring some of the PRM features during the commissioning or maintenance activities. The template allows the user to reuse the following configuration for the field devices of the same make, model and revision:

- Device Details
- Link to the associated Plug-in applications.
- Link to the associated Parts list.
- Document link.

Once a template is configured, it will appear on the Class View as shown in Figure 25.

It should be noted that the PRM device template does not contain configurations of the device itself, i.e. device parameters.

As Number of devices are small so Device Template usage is not envisaged in this project.

14.1.4 Template for Device Parameter

Functionality:

1) Multiple device template can be created for specific vendor, device type and revision for HART device.
2) User is able to configure parameters which are related to template
3) Template can be applied and downloaded to multiple devices.

Key Benefit:

Reduce device commissioning time by preparing the common device parameter template, then bulk download to devices.

As Number of devices are small in number so Device parameter usage is not envisaged in this project.

14.1.5 Device Tag Display Extension

The device tag display extension provides with the user a means to identify a field device by an additional string in addition to its device tag or a string other than its device tag on the PRM. When duplicated device tags are expected in similar process units, this feature allows the user to register those devices by the other means in order to avoid duplicated tags in the PRM Server.

The following configuration options are available. These configurations should be determined during the basic design phase to bring consistency in configurations between the system and field devices.

- Device Tag Display Extension for HART devices

One of the following configuration options can be selected for HART devices. The additional string if used as well as the device tag should be set in each HART device prior to the commissioning phase.

- Tag (Default): Displays the physical device tag.
- Tag + Descriptor: Displays the physical device tag and the descriptor information of the device.
- Descriptor: Displays the user-defined descriptor information for the device.
- Message: Displays the user-defined message information for the device.
- Long Tag (for HART 6 and later): Displays the Long Tag parameter value for HART 6 and later devices.

The following figure shows Device Tag Display Extension Configuration dialog box on the PRM Client window.

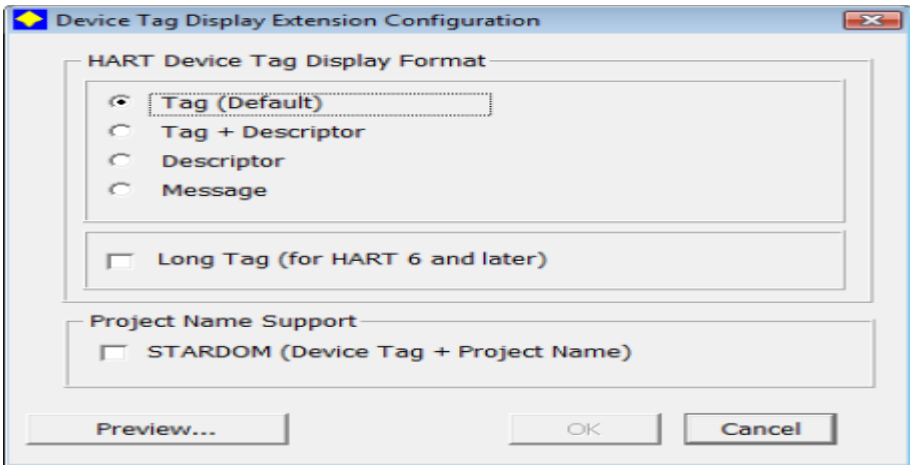


Figure 22 – Device Tag Display Extension Configuration dialog box

14.2 DEVICE NAVIGATION FUNCTIONS

The PRM Client provides the user with the following views for navigating field devices:

- Plant View
- Network View
- Class View
- Signal View
- Custom View

Once a device is complete with Plug & Play, it will appear on the views above as the device status icon and will be shown in the pre-defined color depending on its operating status (e.g. green if normal and red if abnormal). Refer to section 14.3.2 for the color-coding scheme in the PRM.

14.2.1 Plant View

The Plant view displays the devices and equipment modules of the plant in the form of a plant hierarchy structure that may include Site, Area, Process cell, Unit, Equipment modules and Control modules layers as shown in Figure 26.

Devices that are newly created, and those detected by Plug & Play initially appear in the Spare folder. User can customize the structure of the plant hierarchy tree according to the actual structure of your plant. This view also enables user to create new devices manually and delete existing devices.

The devices which are not on service will be under Out of Service folder.

PRM will allow import and export of plant hierarchy for Ease of Engineering.

Refer to section 14.16 for configuration of the plant hierarchy for this project.

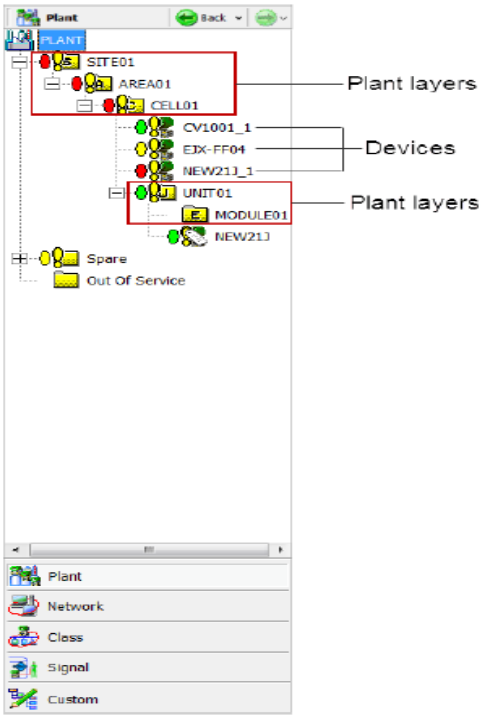


Figure 23 – Example of the Plant View

14.2.2 Network View

The Network View displays the field devices in a hierarchy determined by the location of the devices in relation with the actual hardware architecture of the system. As shown in Figure 27. The field device is shown in the relevant folder at the bottom of the hierarchy under the concerned controller and I/O module.

The initial set up for registering a field device in the PRM will be performed by executing Plug & Play on the Network View.

The information of the actual hardware architecture will be fed by configuring the device path or FDT project depending on the field device types using the PRM Setup Tool. Refer to section 14.15.4.3 for configuration of the device path and FDT project for this project.

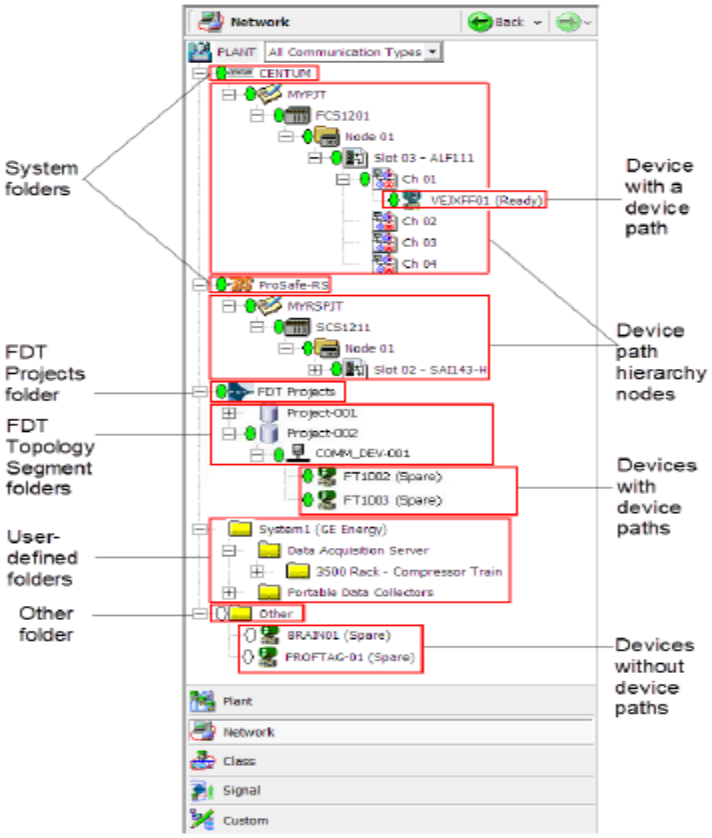


Figure 24 – Example of the Network View

14.2.3 Class View

The Class View displays the field devices in a hierarchy determined by the fixed attributes of the devices such as the communication type (Foundation Fieldbus, HART, PROFIBUS …etc.), category, vendor, model, revision and status of the devices. Each of the attributes is represented by a respective folder in a tree-like view and a field device is located at the bottom of the hierarchy as shown in figure 28.

The status of the devices falls into the following three depending on the operating status of the device on the PRM.

- On-Service
- Spare
- Off-Service

No configuration is required for the Class View.

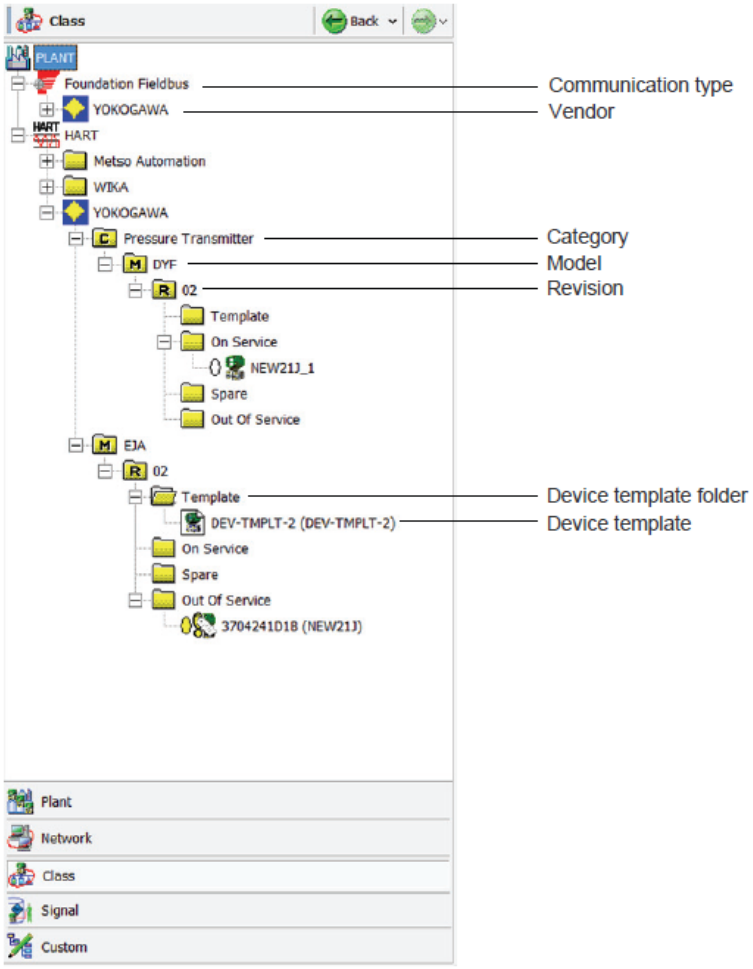


Figure 25 – Example of the Class View

14.2.4 Signal View

The Signal View displays the field devices that require the user's attention for a corrective action in certain priorities determined by NAMUR NE107. The NAMUR NE107 gives a consistent and structured approach to enable delivery of diagnostic information from an individual field device to the asset management system and allows the user to quickly respond to a failure with more meaning full information available.

The field devices are arranged on the signal view per priorities shown below.

Status Signal	Priority	Status Signal Icon	Description	Remark
Failure	1		The device is malfunctioning and must be replaced.	Sensor break, electronics failure..etc.

Check Function	2		The device has incomplete calibration or tuning.	Device not fully configured, calibrated or tuned …etc.
Out of Specification	3		The device is not operating within the specified measurement range.	Bubble formation in flow metering, Valve sticking …etc.
Maintenance Required	4		The device requires short-term or midterm maintenance because it is about to stop functioning.	Build-up of deposits …etc.
(Normal)	N/A	N/A	There is no NAMUR status applicable for field devices in Normal status.	The field devices in this status are not shown on the display.

Table 57 – NAMUR NE107 Status Classification and Description

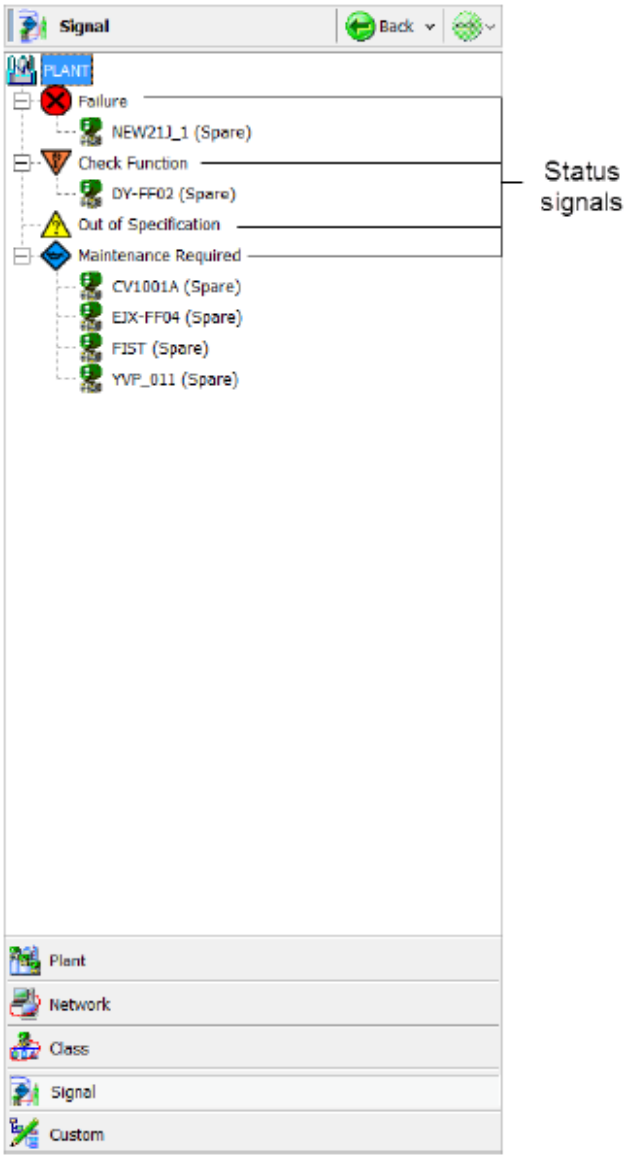


Figure 26 – Example of the Signal View

The NAMUR status signal of a field device is also displayed on other windows such as Device List window, Device Viewer window and History window.

14.2.5 Custom View

The Custom View allows the user to create folders and allocate the field devices to these folders as needed. For instance, the user can create "Need Attention" folder in Custom View and put faulty devices there for the instrument engineer for investigation.

14.3 MAINTENANCE ALARMS

The PRM receives alarms and events from various sources and process them to the meaningful asset related information, which are displayed on History window of the PRM Client and stored in the PRM database. Maintenance Alarms and events are shall not be configured to receive in OWS.

This section describes the following functions:

- Message Acquisition
- Device Patrol
- Message Notification

14.3.1 Message Acquisition

The message acquisition function is an OPC-AE client based standard function. By default, it works to receive alarms and events associated with the field devices through the host systems such as CENTUM VP, ProSafe-RS. Message Acquisition function shall not be configured in this project.

14.3.2 Device Patrol

The Device Patrol function is a means to poll status of the field devices via the host systems such as CENTUM VP, ProSafe-RS or via the gateway devices on the device network. The current status of each field device will be reflected to the respective device status icon with the pre-defined color as shown in the following figure.

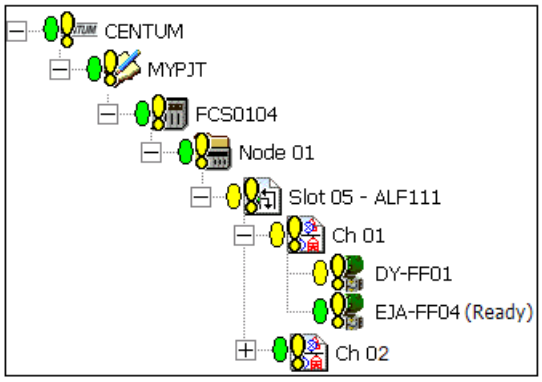


Figure 27 – Example of the Device Status Icon on the Network View

When the Device Patrol detects faulty status within a field device, it will generate an alarm (or an event depending on its criticality) and store it in the PRM database with the time stamp. History window on the PRM Client allows the user to view all logged alarms and events in the PRM database. Refer to section 14.8.2 for details of the History window.

The following table shows the color coding scheme for the device status icon:

Color	Status Value	Results	Description
White	10	Uncertain	Indicates that the device status is unknown. This status may be assigned to newly registered devices, which have not yet been scanned by Device Patrol, or to devices that use a communication type not supported by PRM.
Green	20	Normal	Indicates that the device has no errors.
Grey	30	Communication Error	Indicates an error in a communication between the Field Communications Server and the field device. This includes cases of communication errors caused by device failure.
Yellow	40	Warning	Indicates that the device is in a warning state.
Red	50	Abnormal	Indicates that the device has errors.

Table 58 – Device Status Icon Color Coding Scheme

Note: The status value indicates the priority level of each status with a larger number for higher priority. It is internally used within the PRM system.

The polling cycle for the device patrol (device patrol period) can be specified to each of the following object criticality levels that are assigned to the field devices (Note: The default object criticality for all field devices is "Low".):

- Low
- Medium
- High
- High+

The default patrol period is one hour for all criticality levels. Refer to section 7.5.1.1 for configuration of the device patrol period for this project.

14.3.3 Alarm Management Rules

The alarm management rules allow the user to add meaningful information such as a cause of the problem, corrective actions …etc. to the alarm of a particular device or suppress particular alarms based on pre-configured criteria. Configuration for the alarm management rules can be done using the Alarm Management tool. By default, no alarm management rules are implemented so that the information provided for each alarm is based on the default of each type of the fieldbus devices and that suppression is not applicable to all field devices.

14.3.4 Alarm Notification Rules

The alarm notification rules allow the user to route a particular alarm to the HIS station Configuration for the alarm notification rules can be done using the Notification Configuration tool. By default, no alarm notification rules are implemented so that alarms will not be routed to outside of the PRM system.

14.4 DIAGNOSIS AND ADJUSTMENT

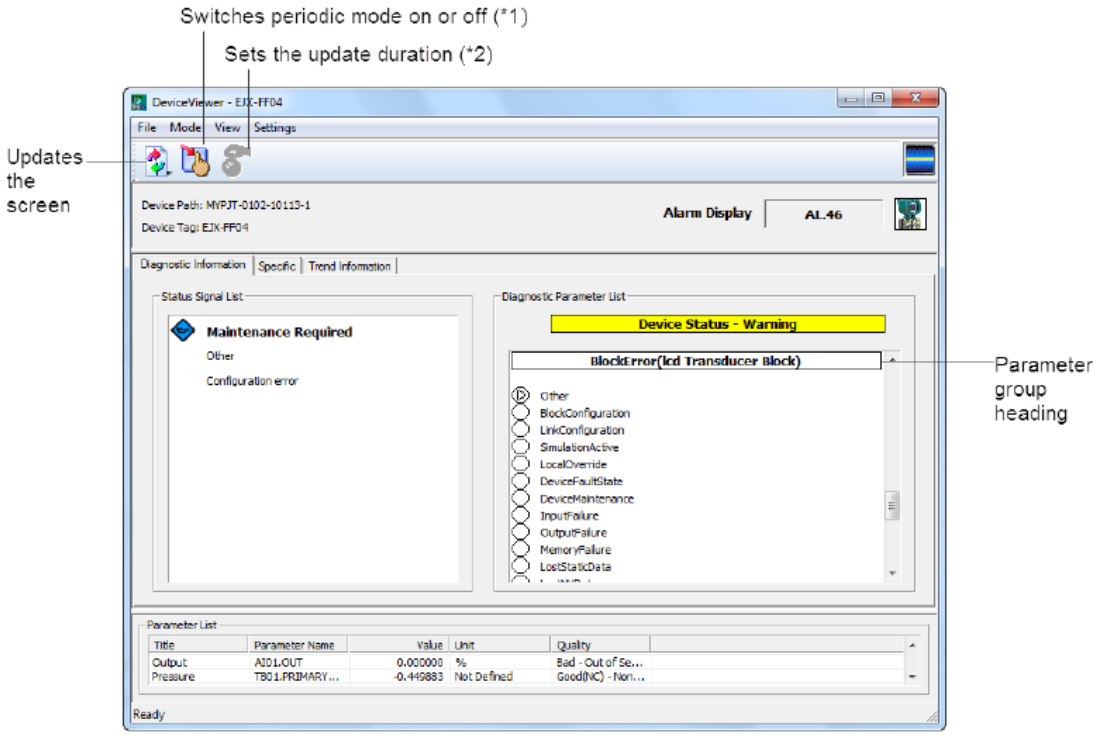
This section describes the following functions used for adjustment and diagnosis for the field devices:

- DeviceViewer
- Parameter Manager
- DTM Works
- DD Menu

14.4.1 DeviceViewer

The DeviceViewer provides the user with a means to display diagnostic alarms and key values of the field devices. The DeviceViewer may display either instrument specific diagnostic information using the associated DD file or common information depending on the DeviceViewer configuration file (xxx.cfg) provided along with the PRM software packages. Refer to Appendix-3 for details of the DeviceViewer configuration files provided for this project.

The following figures show examples of the DeviceViewer windows provided for Yokogawa EJX transmitter. Depending on how it is set up, it retrieves the information on demand or continuously in the specified update duration. If the continuous mode is selected, the values can be displayed in a form of trend graph.



1: A check mark appears next to Periodic mode in the menu bar if it is on.
2: This is only available when Periodic mode is on.

Figure 28 – Example of DeviceViewer (Diagnostic Information tab)

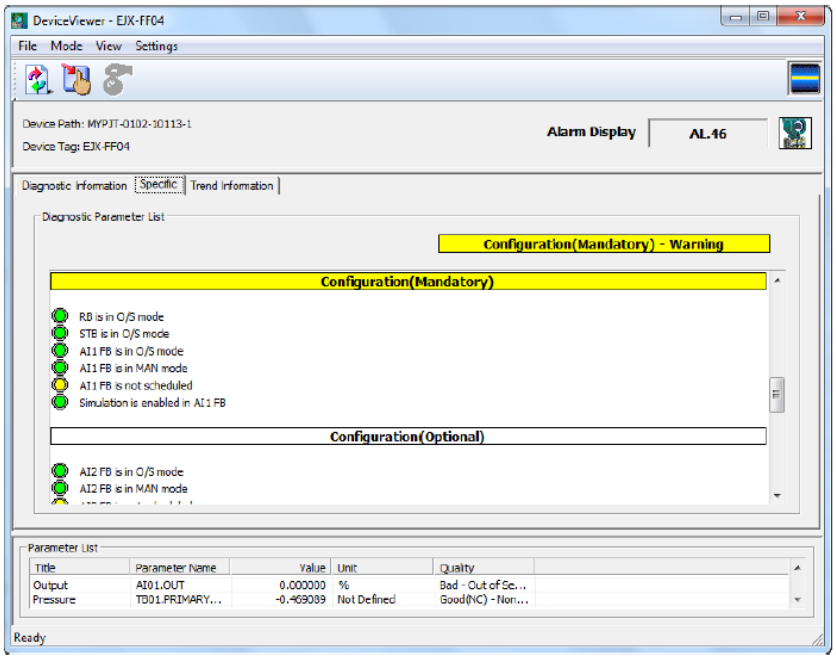


Figure 29 – Example of DeviceViewer (Specific tab)

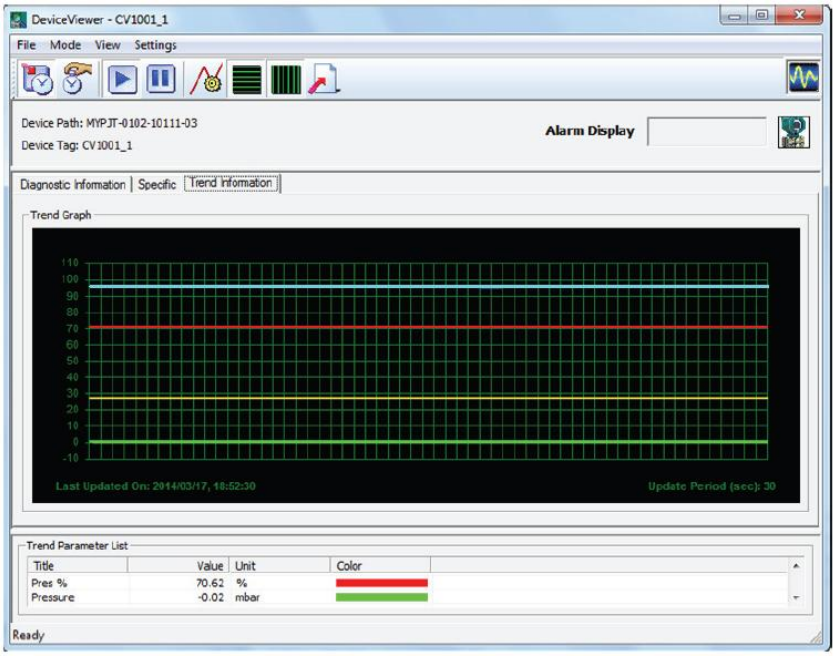


Figure 30 – Example of DeviceViewer (Trend Information tab)

The trend data shown on Trend Information tab can be saved in a CSV file with date/time stamp.

14.4.2 Parameter manager

The Parameter Manager provides the user with a means to display device parameters and adjust them through the dedicated window of the PRM Client using DD files. It allows the user to only browse a specific parameter or a group(s) of the parameters depending on the selected tab.

It also allows the user to historized the parameters captured at a certain time by saving them into the PRM database and compare them with the latest parameters retrieved from the device on the same window. The following figure shows an example of Parameter Manager Window.

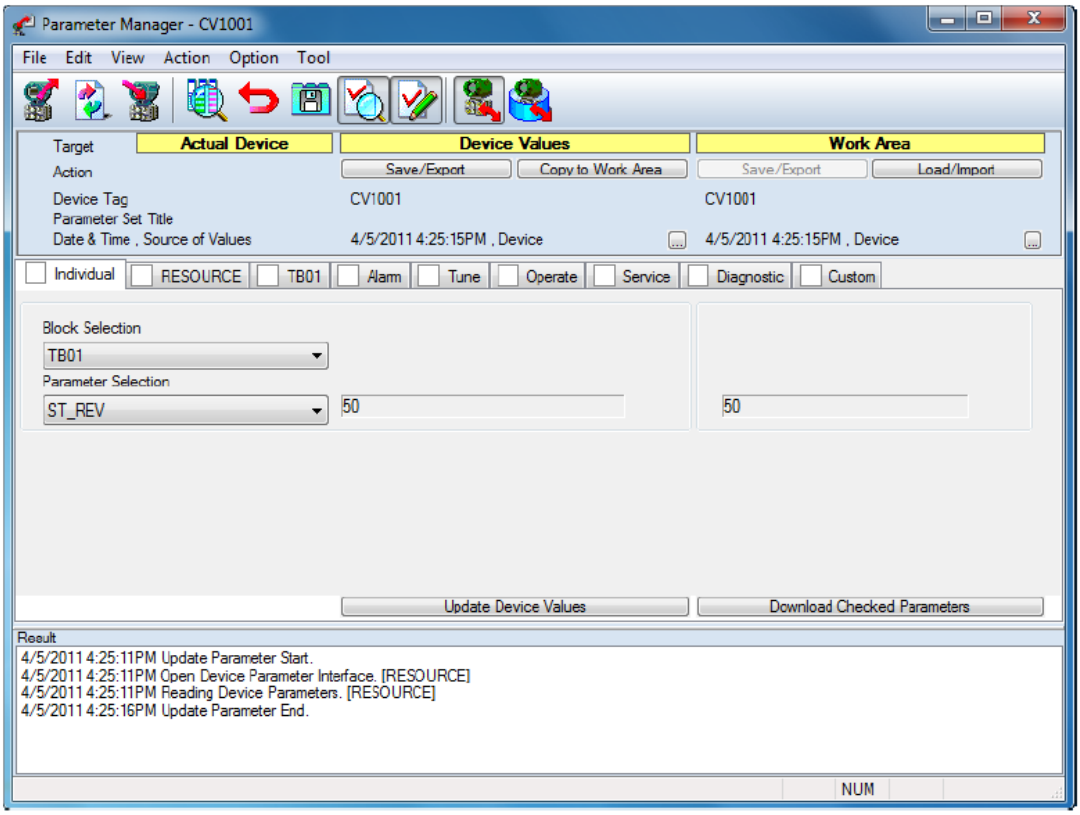


Figure 31 – Example of Parameter Manager

The user has an option to choose the Parameter Manager or the DTM Works described in the next section as the default parameter management tool on the PRM Client.

14.4.3 DTM Works

The DTM Works provides the user with the equivalent function as the Parameter Manager described in the earlier section.

The DTM Works functions based on either the device DTM files provided by the respective device vendor for a particular type of devices or the universal DTM. With the device DTM files installed, the DTM Works gives the user a comprehensive way of configuring, diagnosing and trouble-shooting a particular type of the

devices through the dedicated graphical user interface while it only gives a generic interface with the universal DTM installed.

Note: DTM files supply is not part of Yokogawa Supply.

By following the standard installation procedure, the device DTM for some of Yokogawa instruments will be available in the PRM while the universal DTM will be used instead for the remaining devices.

The user can obtain the device DTM specific to a particular device type from the respective vendor and make use of it by installing it in the specific folder.

Refer to Appendix-3 for details of the List of supported devices and Yokogawa specific DTM files and universal DTM for other vendors provided for this project.

The user has an option to choose the Parameter Manager or the DTM Works as the default parameter management tool on the PRM Client.

The following figure shows an example of the DTM Works for Yokogawa EJA (a pressure transmitter).

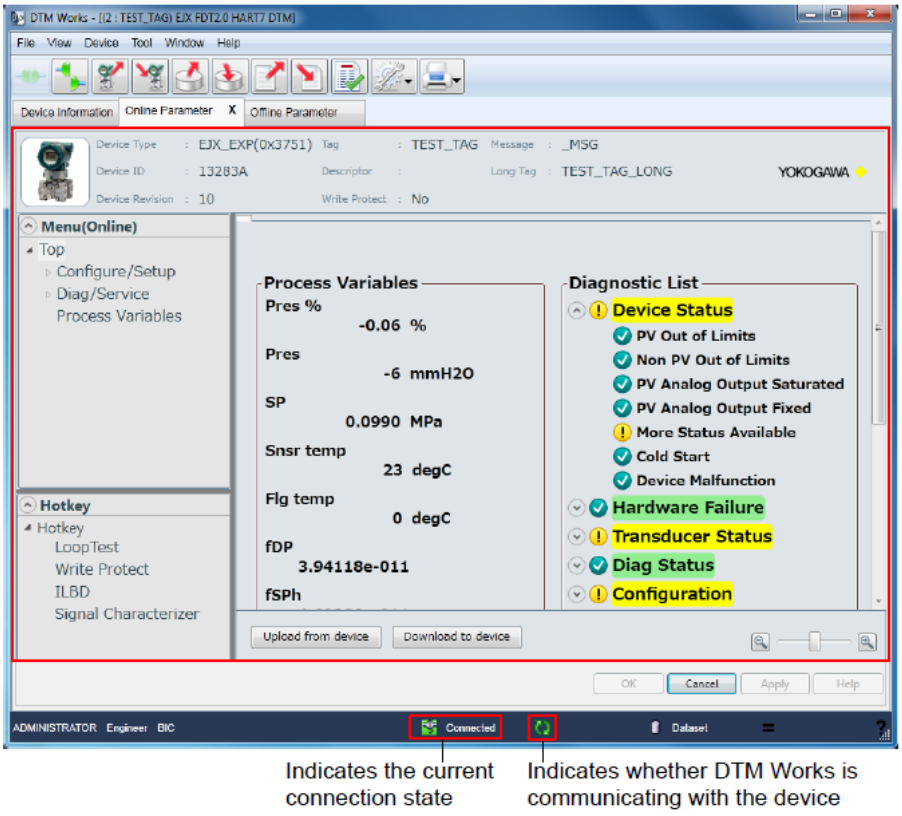


Figure 32 – Example of DTM Works

14.4.4 DD Menu

Aside from the Parameter Manager and DTM Works, the PRM also provides the DD menu for the FF devices to perform the similar function through its text-based user interface. The following figure shows an example of the DD menu for Yokogawa EJA pressure transmitter.

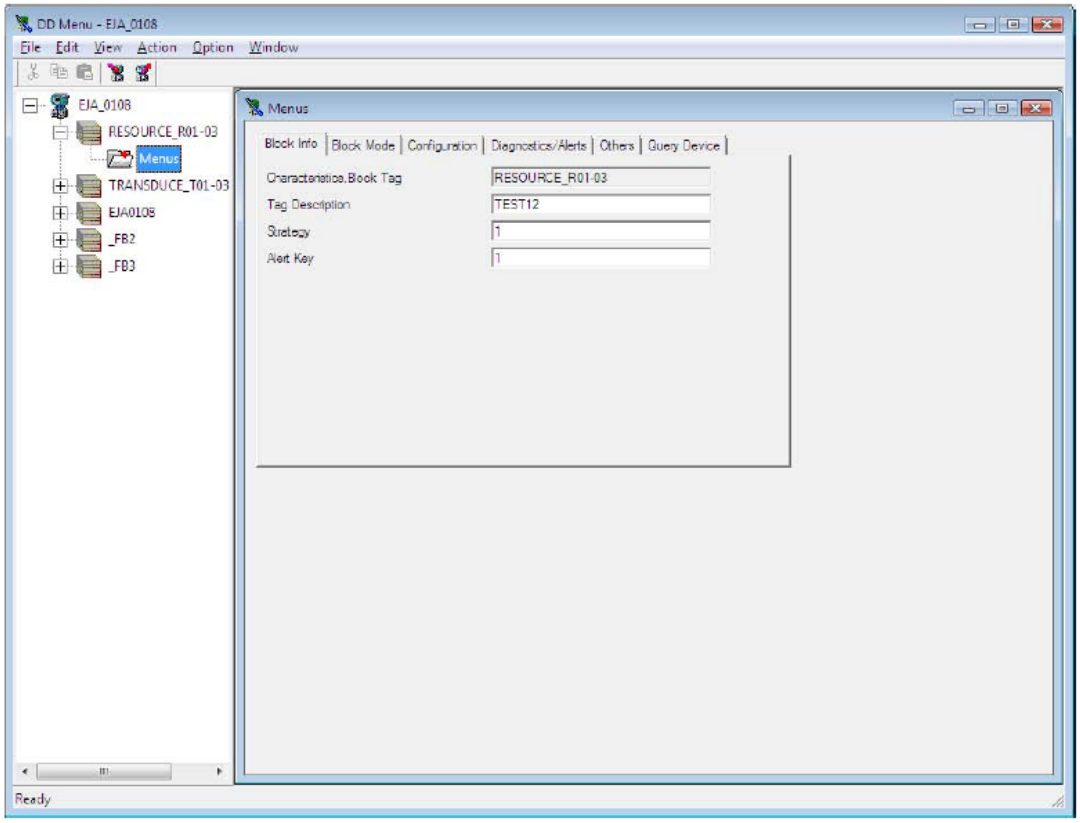


Figure 33 – Example of DD Menu

14.5 MAINTENANCE OPERATION ASSISTANCE

14.5.1 Maintenance Marks

Note: In this project Operation Mark usage is not envisaged.

As a means to assist maintenance activities for the field devices, PRM can provide the user to indicate the maintenance status of a device on the PRM Client, so called the Maintenance Mark. The Maintenance Mark allows the user to share status of the activity undergoing for a particular device with other users on the PRM Clients by having an MTMK icon overlaid on the device status icon as shown in the following example. (The red tag mark shown in the following figure is a maintenance mark.)

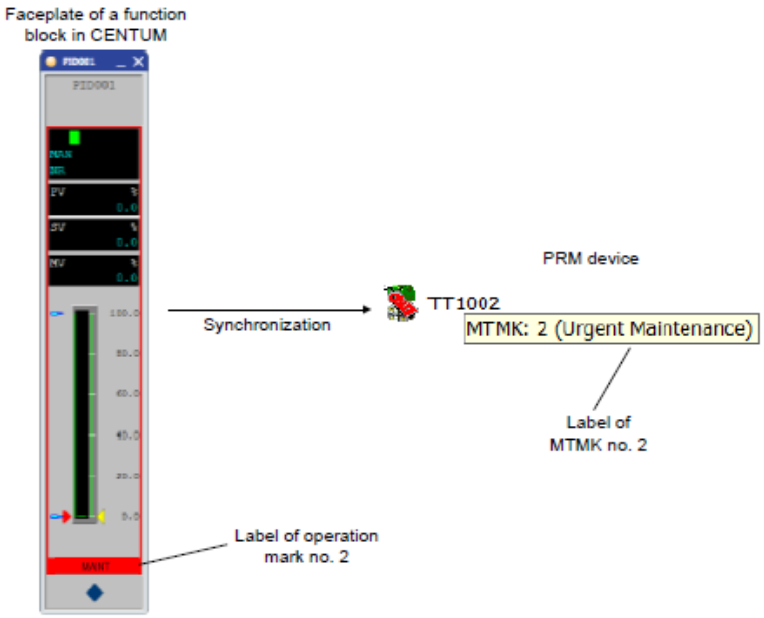


Figure 34 – Example of the Maintenance Mark

Once a Maintenance Mark is attached to a device, it either gives the user access rights to perform adjustment of the parameters for the device, or revokes the access rights or retains the access rights provided when the Maintenance Mark is not attached depending on the configuration of the maintenance mark. When the Maintenance Mark is removed, the access rights pre-defined on the PRM will be retained.

When it is configured to synchronize with a particular Operation Mark on the CENTUM VP system, the operator can initiate an action to automatically assign a pre-defined Maintenance Mark to a device on the PRM Client by attaching the Operation Mark to the respective faceplate of the control loop on the HIS in CENTUM VP system.

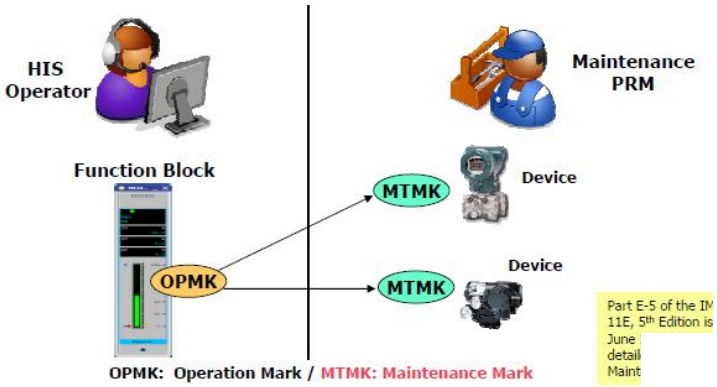


Figure 35 – Example of Operation Mark and Maintenance

14.6 MAINTENANCE INFORMATION MANAGEMENT

The PRM provides the user with the following functions to maintain the devices effectively:

- Device Details (Device Master Information)
- Inspection Memo

- Inspection Schedule
- Parts List

Configuration of the above will be left at the system default.

14.7 DOCUMENT MANAGEMENT ASSISTANCE

14.7.1 Document Links

The PRM provides the user with a means to quickly access the documents associated with the field devices (e.g. manuals, P&IDs, data sheet ...etc.) through the PRM Client using the Document Links. The documents can be stored either in the pre-defined folder in its local hard drive or centralized location over the network. The Document Links can be configured by specifying the location of folders or URL. The PRM supports PDF file format as system default document software.

14.8 AUDIT TRAIL MANAGEMENT

The PRM provides the user with a means to manage and keep track of the asset related information such as historized (saved) parameters, alarms and events of the devices and operation logs on the PRM Client. This section describes the followings available on the PRM Client as the Audit Trail Management functions:

- Parameter History
- History Window

14.8.1 Parameter History

The functions such as the Parameter Manager, DTM Works, and DD Menu (Refer to section 14.4 for details.) allow the user to save the current set of parameters in the field devices in the PRM database. It is saved with the time stamp so that the user can keep track of the changes made at any time and compare one set of the saved parameters with the other or the current set in the devices using these functions.

The saved parameters can be exported in the form of XML format.

Comparing parameter data of multiple devices

User can compare the parameters of multiple devices by using the Audit Device Parameter tool. The tool enables you to perform the following types of comparisons:

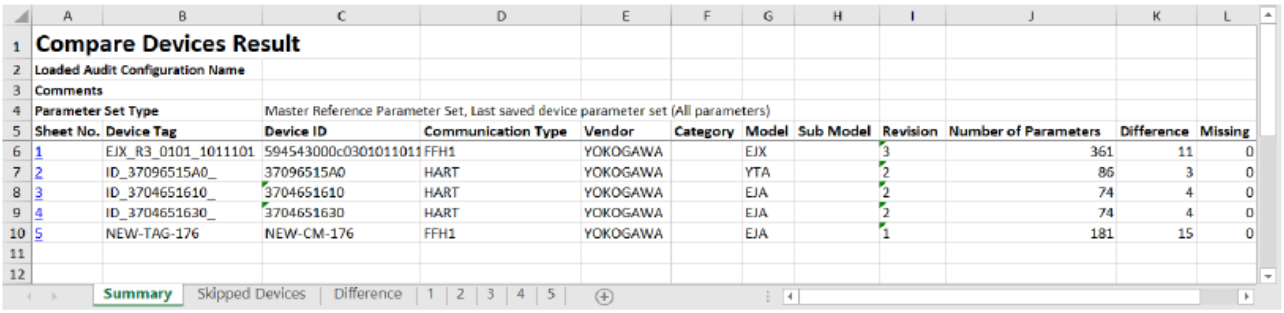
- Compare devices

This comparison enables you to compare the actual parameter data or last saved parameter set with the baseline parameter set of a device. The baseline parameter set is either the parameter set assigned with the Master Reference key, or the saved parameter set with an earlier time stamp, depending on the comparison mode that user is using. Multiple devices can be compared at the same time.

- Compare with templates

This comparison enables user to compare the actual parameter data or the last saved parameter set of multiple devices with the baseline parameter set of a device template in the same device class. The baseline parameter set is the last saved parameter set of the device template.

User can use the Audit Device Parameter tool to validate incorrect parameter values in scenarios such as setting up of a new plant, replacing of devices, or shutting down of a plant for maintenance purposes.



Compare Devices Result

Loaded Audit Configuration Name	
Comments	
Parameter Set Type	Master Reference Parameter Set, Last saved device parameter set (All parameters)

Sheet No.	Device Tag	Device ID	Communication Type	Vendor	Category	Model	Sub Model	Revision	Number of Parameters	Difference	Missing
1	EJX_R3_0101_1011101	594543000c0301011011	FFH1	YOKOGAWA		EJX		3	361	11	0
2	ID_37096515A0_	37096515A0	HART	YOKOGAWA		YTA		2	86	3	0
3	ID_3704651610_	3704651610	HART	YOKOGAWA		EJA		2	74	4	0
4	ID_3704651630_	3704651630	HART	YOKOGAWA		EJA		2	74	4	0
5	NEW-TAG-176	NEW-CM-176	FFH1	YOKOGAWA		EJA		1	181	15	0

Summary | Skipped Devices | Difference | 1 | 2 | 3 | 4 | 5

Figure 36 – Example of the comparison summary sheet

14.8.2 History Window

The History Window allows the user to browse alarms and events of the devices, events generated from the user actions, and system events logged in the PRM database. It comes with various tabs for the user to browse the alarms and events of a particular category of his/her interest. The Maintenance tab displays the alarms and events along with the detailed information such as the cause of the individual problems and corrective actions required. It also allows the user to acknowledge standing alarms for managing alarms on the PRM Client.

The logged alarms and events can be exported in the form of XML format.

The following figure shows an example the History Window:

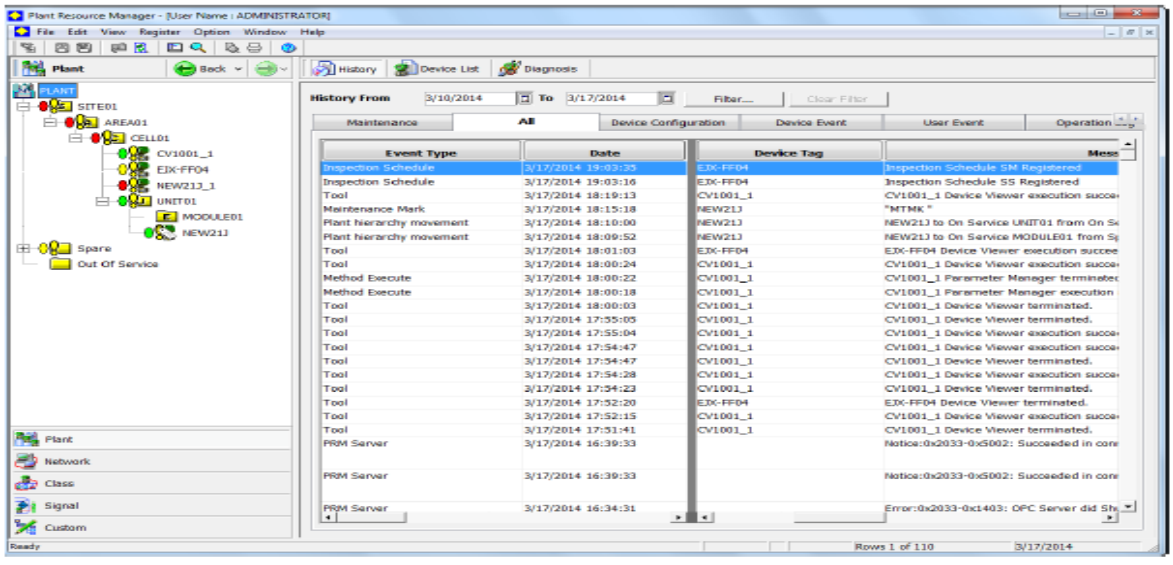


Figure 37 – Example of the History Window

14.9 SECURITY

The PRM provides the user, who performs administrative tasks, with a capability to configure user groups and accounts on the PRM applications with proper access rights depending on users' rolls and responsibilities. Once logging on a specific user account of the PRM applications, the user is granted to perform only the functions allowed under the user account.

The PRM provides two different authentication methods, namely, PRM authentication and Windows authentication. Once a user account is created in the PRM applications with the PRM authentication in use, the respective user will go through two separate authentication process of both Windows system and PRM applications by typing the respective user name and password at each authentication.

With the Windows authentication in use, on the other hand, a user account name created in the Windows environment (e.g. a user account on the domain controller on PIN or on the local computer) can be copied in the PRM applications and assigned to any PRM user group. This provides the user with only the granted access rights to the PRM applications under the Windows user name, allowing for a single sign-in process by the Windows system to meet various password complexity and expiration requirements implemented in the user's network environment.

Refer to section 14.17 for configuration of the user groups and accounts for this project.

14.10 LICENSE MANAGEMENT

PRM applies common license management to provide consistent lifecycle maintenance service for all Yokogawa System Products

PRM adopts license manager and individual Project ID the same as CENTUM VP and Prosafe-RS.

PRM requires product maintenance License (PML) to get standard software support the same as Centum VP and Prosafe -RS.

14.11 SOFTWARE REQUIREMENTS

14.11.1 Software Requirements

PRM Server- Windows Server 2016 Standard Edition (64-bit version)/ Windows Server 2019 Standard Edition (64-bit version)/ Windows Server 2022 Standard Edition (64-bit version).

PRM Client- Windows 10 IoT Enterprise Edition 2021 LTSC (64-bit version)/ Windows Server 2019 Standard Edition (64-bit version)/ Windows 10 Enterprise Edition 2021 LTSC (64-bit version)/ Windows 10 Enterprise Edition 2019 LTSC (64-bit version).

14.12 OTHER PRM OPTIONAL FUNCTIONS

This section describes optional functions available on PRM system. The use of each optional function should be considered by the individual projects. The proper licenses must be purchased depending on the necessities. Refer to the project Bill of Materials Doc No.1724000594-IN-LIS-00003 for the licenses provided for this project.

14.13 PLUG-IN APPLICATIONS

A Plug-in application is a software product that is provided by a third party device vendor to configure, adjust and diagnose a particular device type.

Note: Plug-in applications are not part of Yokogawa Supply.

14.14 FDT/DTM BASED APPLICATIONS

Field Device Tool/Device Type Manager (FDT/DTM) is a standardized program in order to reinforce the interoperability between Yokogawa FDT Frame application supported on the PRM and the DTM of third

party vendors. Recently, device vendors have developed various applications based on the FDT/DTM technology that work for their specific device types to effectively configure, adjust and diagnose the devices. Once installed, these applications allow the PRM to take advantage of those vendor specific features through the PRM Client.

PRM supports FDT/DTM applications developed in compliance with FDT 1.2 and 2.0.

Visit the website <https://www.yokogawa.com/library/documents-downloads/software/list-of-fist-completed-devices/> for the FDT/DTM applications that has been proved operable with the PRM.

Note: FDT/DTM is not part of Yokogawa supply.

14.15 PRM AND GENERIC THIRD-PARTY SYSTEMS INTEGRATION

Integrating PRM with a Generic third-party system enables user to monitor the status and view event messages of third-party devices that are registered in PRM system.

PRM environment

- An existing working installation of PRM R4.03 or later
- License for Interface Package for Generic System

Generic third-party system environment

- The generic third-party system
- OPC Data Acquisition (DA) 3.0 server
- OPC Alarms and Events (A&E) 1.10 server

Note: In this project not envisaged Generic third-party system integration to IAMS.

14.16 PROJECT SCOPE AND CONFIGURATIONS

In this project 1 PRM Server including 1 PRM Client shall be supplied and remote access to PRM Server shall be provided. The PRM Server will be installed in the Server/Network cabinet in the OER and includes KVM extender to 24" LCD screen.

Refer to the project system architecture drawing number 1724000594-IN-DD-00015 for details.

14.16.1 Minimum Hardware Requirements

PRM Server- Minimum Memory requirement is 7 GB and Minimum disk space requirement is 18 GB.

PRM Client- Minimum Memory requirement is 1 GB and Minimum disk space requirement is 2 GB.

14.16.2 Software License and Medium

Refer to the project Bill of Materials Doc. No. 1724000594-IN-LIS-00003 for the software licenses and medium provided to this project.

14.16.3 Supported Devices and Protocols

A DVD, Device Files Media (Model: PM4CDM), provided along with all PRM software packages, includes the DD, DTM and DeviceViewer configuration files for the field devices listed in Appendix-3

. These files are installed in the PRM system for this project.

The following fieldbus protocols are used in this project:

- HART protocol in CENTUM VP
- HART protocol in ProSafe-RS

14.16.4 Configurations for the Project

In projects configuration and testing of sample devices will be done during the FAT phase whereas configuration and thorough testing for all the devices will be done during SAT/Commissioning phase. Refer to the following sections for details of the configurations.

PRM Server

IAMSSVR, domain 1 and station 60 shall be located in ITER.

- Server Set (This item specifies the computer name of PRM Server components in the PRM system.)

  Plant Area: ITER

  PRM Server: IAMSSVR

  Field Communication Server: IAMSSVR

  Advanced Diagnostic Server: IAMSSVR

  Diagnosis Historian Server: IAMSSVR

  No of Field Devices: 1000
- Device Patrol (Device Patrol Period)

  Low: 1 Hour

  Medium: 1 Hour

  High: 1 Hour

  High +: 1 Hour
- Message Acquisition

  CENTUM VP/ProSafe-RS Computer Name: EWS0164

  Message Selection: Default *

  Enable event notification for HART 7 (or later) devices: Not selected

  STARDOM Computer Name: Not Applicable

  Message Selection: Default *

  * Refer to A-3 for details of this configuration.

  (Note: In order to enable the Event Notification method or Polling method described in section 14.3.1, the message number 3401 or 3403 must be selected in the Message Selection window, respectively.)
- Maintenance Mark:

  Enable Synchronization with CENTUM VP: Disabled (Default)

  Maintenance Mark configuration shall not be used.
- Alarm Management: Not configured
- Alarm Notification Configuration: Not configured
- Third-party System: Not configured

PRM Client

IAMSSVR in ITER and remote access from CCR.

- Connection (This item specifies PRM Server computer name(s) that the PRM Client can have access to.)

  Use One PRM Server: IAMSSVR

PRM Server: IAMSSVR

User Multiple PRM Servers: Not selected (Not Applicable)

- **Appearance** (This item specifies size of fonts and icons used on the PRM Client)

  Font Size: Medium (10 points; Default)

  Icon Size: Medium (24x24 pixels: Default)

  Use Bold characters in Device Navigator: Selected (Default)
- **DTM Setup:** Default (See Appendix-3 for details.)

Field Communication

IAMSSVR in ITER and remote access from CCR.

- **Device Path:** Configured based on the project I/O information for the CENTUM VP and ProSafe-RS systems.
- **FDT Project Management:** Not configured
- **DD Copy Tools** (This utility specifies location of the folders that contain DD/CFF files for the FF devices and DD files for HART devices.)

  C:\PRM\DD\ (for FF)

  C:\PRM\DD\HART\ (for HART)

Configuration for PST Scheduler (PST Server)

- **Connection (PST Scheduler Server):** Not Applicable

14.17 OTHER CONFIGURATION FOR PRM OPERATION ENVIRONMENT

- **Plant Hierarchy on Plant View:** Hydrogen, BESS, F&G
- **Custom View:** Not configured
- **Parameter Tab of Customize Window (Preferred parameter tool):** Always Parameter Manager
- **Block setting for each type of Devices:** FF devices not used
- **Document Links:** FF devices not used

14.18 SECURITY SETTING UTILITY

Yokogawa IT security tool provides three types of security models, Legacy model, Standard model, and Strengthened model, according to the required security strength, in order to flexibly accommodate system configuration and operation.

Security for Domain Management (Standard Model) is used.

Standard model places importance on operation of the product and collaboration with other systems (Exaopc, ProSafe-RS, and so on) to guard against "attacks over the network" and "direct attack to a system by operating on an HIS or on a computer with system builders." The Standard model does not guard against "Theft of HIS or computer with system builders or theft of data" because its threat is considered minor due to the characteristics of the product.

For more details on security models refer to IM 33J01C30-01EN CENTUM VP Security Guide.

14.19 USER GROUPS AND ACCOUNTS

Refer to Appendix-4 for PRM User groups and Account configuration template.

Baseed on opertation and maintenance requirements User groups with specified previlages shall be configured during commissioning, user list shall be accessed from Domain controller.

14.20 DEVICE TAG DISPLAY EXTENSION SETTINGS

- HART Device Tag Display Format:

  Tag (Default)

  Long tag for HART 6 and later: Not selected

- Project Name Support (for STARDOM system only):

  Device Tag + Project Name: Not selected

A. List of Supported Devices

Refer to Appendix-3 for List of Supported Devices.

B. PRM user groups and Account configuration

Refer to Appendix-4 for PRM User groups and Account configuration template.

C. PRM Message Acquisition Configuration

The following tables show default alarms and events routed from the host systems to the PRM.

Note: Following table shall be updated during detail engineering

Message Number	Description
0089	Subsystem Communication Error (SS-COM Error)
0090	Subsystem Communication Recovery
0491	HART Device Status
3001	Fieldbus Device Failure
3002	Recovery of Fieldbus Device to Normal
3101	Occurrence of a Fieldbus Device Alarm
3102	Recovery of a Fieldbus Device to Normal
3111	Occurrence of process alarm from Fieldbus Devices
3112	Recovery of Fieldbus Device from process alarm
3150	Update of Fieldbus Devices
3160	Change in Write Protection of Fieldbus Device
3171	Fieldbus Device Abnormal
3172	Fieldbus Device Recovered to Normal
3173	Fieldbus Device Detected a process alarm
3174	The process alarm detected by the Fieldbus Device recovered
3175	Fieldbus Device Update Event

Message Number	Description
3176	Enable/Disable Write Protection of Fieldbus Device
3181	Fieldbus Device Failure
3182	Fieldbus Device Recovery
3183	Error Detected by ALF111 Self-diagnosis
3401	HART device event notification
3403	I/O module detected a HART device status change
3405	Communication error when acquiring HART device status (No response)
3407	Communication error when acquiring HART device status
3408	Recovery of communication when acquiring HART device status
4031	HART Device Error
4032	HART Device Recovery
4033	HART Communication Error
4034	HART Communication Recovery
4035	HART Communication Command Error
4036	HART Communication Command Recover
4056	Switching the control rights of a PROFIBUS redundant slave device
4125	I/O module channel error occurred
4126	Recovery from I/O module channel error

Table 59 – Alarms and Events routed from CENTUM VP (ProSafe-RS) to the PRM (Default)

15 PCS SOFTWARE TYPICAL

Note: Equipments those not covered in typical logics shall be configured based in process/operational logic requirments

15.1 TYPICAL LOOP INDEX

No.	Typical Loop No	Functional Description
1	TYP001	Indication of Analog Input and Alarm
2	TYP002	Indication of Subsystem Analog Input and Alarm
3	TYP003	On/Off valve control function block
4	TYP004	Output to subsystem
5	TYP005	Indication of on/off valves of subsystem.

Table 60 – Typical Loop Index

15.2 TYP001- INDICATION OF ANALOG INPUT AND ALARM

15.2.1 Sample P&ID Image

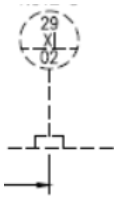


Figure 38 – P&ID representation of Analog Input and Alarm

15.2.2 Description

The Analogue input is indicated on OWS using faceplate/Graphics/Trend using the PVI function block. The value of the process variable is received from the field via FCS analog input module.

15.2.3 PCS Control Drawing

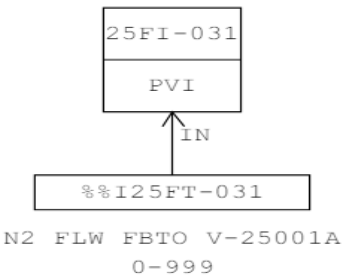


Figure 39 – Control Drawing of Analog input and Alarm.

15.2.4 Alarming Function

In the event of Input Open (IOP), the alarm "IOP" is generated by this block. All other alarms in this block are disabled by default. Alarms are enabled when associated set point values are specified in the IO List.

15.2.5 HMI Items

The following default HMI items are defined for this typical:

Access level PVI function block: 3

15.2.6 Tag Name Structure

Description	P&ID Tag name	IO Tag Name	PCS Tag Name
Input	26FT-031	%%I26FT-031	NA
Indicator Block	NA	NA	26FI-031

Table 61 – Tag Name Structure

15.3 TYP002- INDICATION OF SUBSYSTEM ANALOG INPUT AND ALARM

15.3.1 Sample P&ID Image

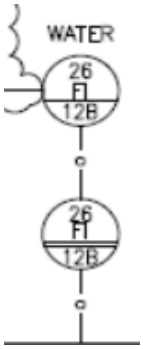


Figure 40 – P&ID representation of Subsystem Analog input and Alarm

15.3.2 Description

The value of the process variable is received from the field via Subsystem to FCS Subsystem input module. The analog input is indicated on HIS using faceplate/Graphics/Trend using the PVI function block.

15.3.3 PCS Control Drawing

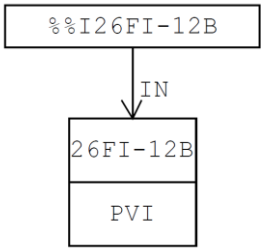


Figure 41 – Control Drawing of Subsystem Analog input and Alarm
Table 62 – Tag Name Structure

15.3.4 HMI Items

The following default HMI items are defined for this typical:

Access level PVI function block: 3

15.3.5 Tag Name Structure

Description	P&ID Tag name	IO Tag Name	PCS Tag Name
Input	26FT-12B	%%I26FT-12B	NA
Indicator Block	NA	NA	26FI-12B

Table 63 – Tag Name Structure

Note: For Gain Bias Setting, refer section 6.5.1

15.4 TYP003- ON/OFF VALVE CONTROL FUNCTION BLOCK

15.4.1 Sample P&ID Image

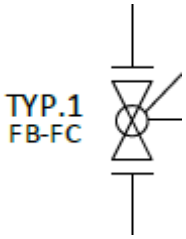


Figure 42 – P&ID representation of ON/OFF Valves

15.4.2 Description

Opened & Closed feedback are received through two different digital inputs and one digital output is used to extend open & close command. SIO-21E function block is used for PCS engineering.

15.4.3 PCS Control Drawing

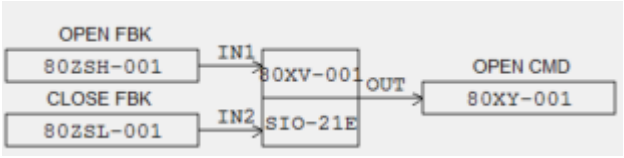


Figure 43 – Control Drawing of ON/OFF valve

Table 64 – Tag Name Structure

15.4.4 Operation & Alarming Function

Opened (IN1) & Closed (IN2) feedback, two different digital inputs are connected with the input terminals of the function block. A digital output is connected with output terminal. SIO-21E function block generates "ANS+" (Failed to Open),"ANS-"(Failed to close) & "PERR"(Concurrency alarm-both opened & closed feedback received together) alarms along with normal operation of the valve.

i) "ANS +": Open command issued but feedback is not received within a specified time, time can be set in the tunning window, parameter is "MTM".

ii) "ANS -": Close command issued but feedback is not received within a specified time, time can be set in the tunning window, parameter is "MTM".

iii) "PERR": Concurrency alarm-both opened & closed feedbacks are received together.

15.4.5 HMI Items

The following default HMI items are defined for this typical:

Access level SIO-21E function block: 3

15.4.6 Tag Name Structure

Description	P&ID Tag name	IO Tag Name	PCS Tag Name
On/Off Valve	25-XV-004	NA	25XV-004
Input	25-ZSH-004	NA	25ZSH-004
	25-ZSL-004	NA	25ZSL-004
Output	25-XY-004	NA	25XY-004

Table 65 – Tag Name Structure

15.5 TYP004-OUTPUT TO SUBSYSTEM

15.5.1 PCS Control Drawing

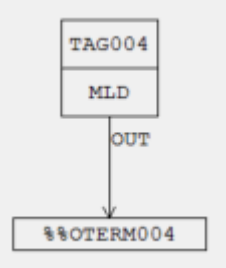


Figure 44 – Control Drawing of Subsystem Analog input and Alarm

15.5.2 Operation & Alarming Function

The function block "MLD" is used to send the Setpoint or any kind of integer/double integer or a real value to the connected subsystem. The out terminal is connected with a specific register address. In case of communication failure "OOP" alarm is generated on the function block faceplate.

15.6 TYP005- INDIACTION OF ON/OFF VALVES OF SUBSYSTEMS

15.6.1 PCS Control Drawing

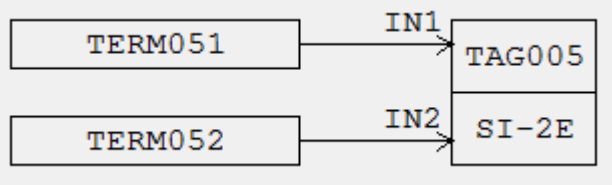


Figure 45 – Control Drawing of Subsystem Analog input and Alarm

15.6.2 Indication & Alarming Function

The function block is used for the indication of manual valves connected with subsystem. Open feedback is connected to IN1 input terminal and Closed feedback to IN2. "PERR" alarm is generated when both Opened & Closed feedbacks are received together.

16 PROCESS CONTROL LOGICS

BLPH Connection Modes logic is configured using SFC function blocks. In SFC(Sequence Flow Chart) are used for process control logics in different Modes, the outputs are issued as conditional logic mentioned the control philosophy.

16.1.1 SNAP OF SFC STEP

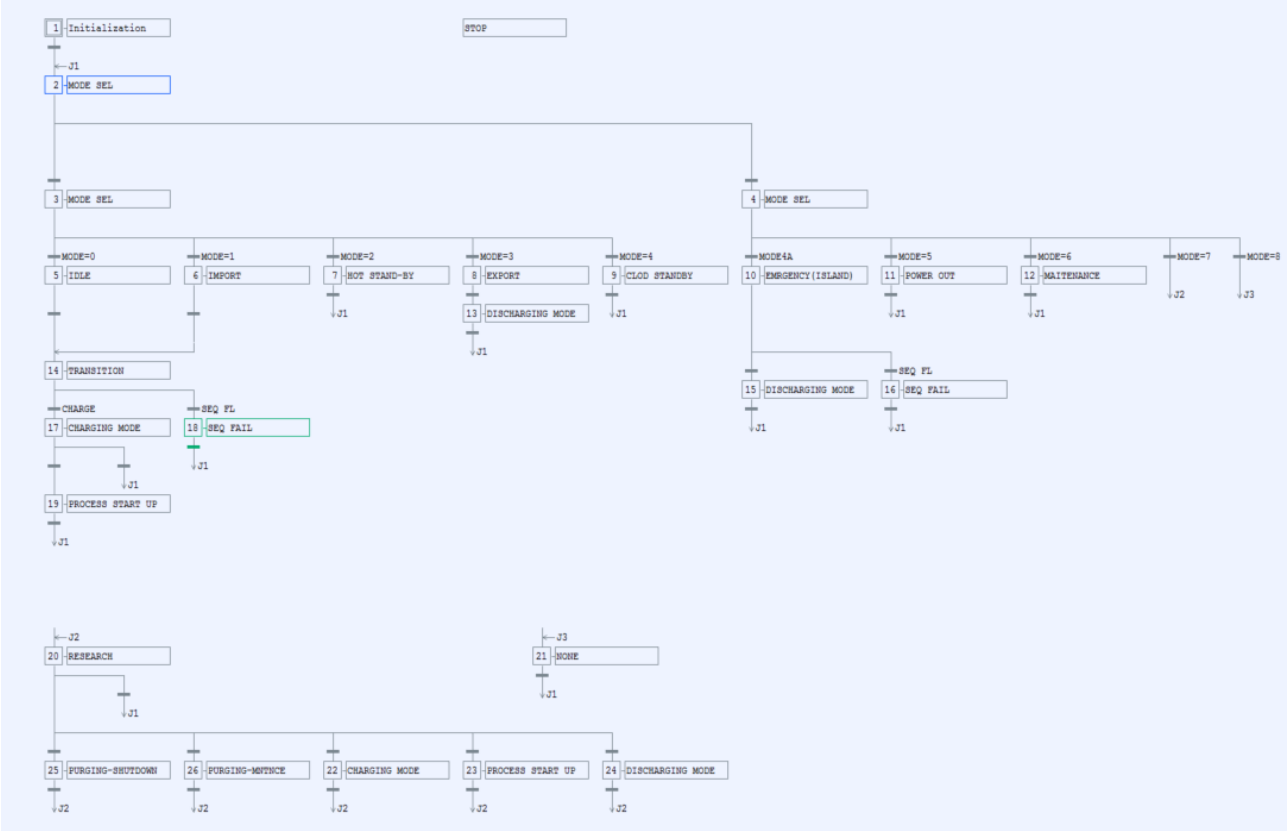


Figure 46 – Control Drawing of Subsystem Analog input and Alarm

16.1.2 SNAP OF SFC LOGIC

```
%.STATE="IDLE            "
k=0
SEQFL=0
[INTSW[1].PV,INTSW[2].PV,INTSW[3].PV=0,0,0]
INIT:
if  (TM01.BSTS=="CTUP")    then
SEQFL=1
quit
end if

!Checking permissive for staring electrolizer package-------------------------------------------------

if (%.STATUS[12]==0)   [%.OPMSG[1],%.OPMSG[2],%.OPMSG[3],%.OPMSG[4]="PERMISSIVE CONDI","TIONS FOR IDLE M","ODE IS NOT MET  ",""]
wait until (%.STATUS[12]==1)
[%.OPMSG[1],%.OPMSG[2],%.OPMSG[3],%.OPMSG[4]="PERMISSIVE CONDI","TIONS FOR IDLE  ","MODE IS SATISFIE","D              "]

!-----PCS commands to start the Main Sea water Pump (see par. 4.1)-----------------------------------

INTSW[1].PV=1         !GROUP START COMMAND TO SEA WATER INTAKE PUMP

[%.OPMSG[1],%.OPMSG[2],%.OPMSG[3],%.OPMSG[4]="GROUP START COMM","AND INITIATED TO","SEA WATER INTAKE"," PUMP          "]

t[1].PH=%.DLY[1]
t[1].OP=TMSTAT
wait until    (SWP[1].PV==2 | SWP[2].PV==2 | t[1].BSTS=="CTUP")

if (SWP[1].PV==0 & SWP[2].PV==0) then
   if (TM01.BSTS<>"NR" & k==0)    TM01.OP=TMSTAT
       k=1
    goto INIT
end if
INTSW[1].PV=0
!----PCS commands to start the Water system Treatment package (delay xxx sec) (see. 4.2.4).------------

INTSW[2].PV=1
t[2].PH=%.DLY[2]
t[2].OP=TMSTAT
wait until (XV[3].PV==2 | t[2].BSTS=="CTUP")              !50-XV-031 OPEN FEEDBACK

INTSW[2].PV=0
```

Figure 47 – Control Drawing of Subsystem Analog input and Alarm

17 SIS/FGS DESIGN REQUIREMENTS

17.1 SYSTEM DESCRIPTION

The requirements for SIS / F&G must be considered as part of the overall health, safety, and environmental protection facilities for a plant installation. The fundamental requirements for SIS/F&G are specified in IEC 61508 and IEC 61511. The concepts within the standard are equally applicable where the consequences include asset or environmental loss.

17.2 GENERAL SYSTEM DESIGN REQUIREMENTS

Following general system requirements are specified for the SIS/FGS:

- The SIS/FGS is fed from dual 230Vac 50Hz UPS with a 30 minutes and 8 hours backup capacity.
- The SIS/FGS power supply unit includes 20% spare capacity.
- The SIS/FGS contains as minimum 10% installed spare IO capacity. Installed spare capacity shall include wiring between termination boards and IO modules.
- The final configuration loadings of the CPU's shall not exceed 60%. This means that the actual SCS loading shall not exceed 36 seconds during FAT and the idle time shall not be less than 60-36=24 seconds.
- The SIS/FGS system is suitable for the following environmental conditions; Temperature between -20°C and 45°C. Humidity between 5% and 95% RH Non condensing.
- The SIS/FGS time synchronization resolution is within +/- 25msec.
- The SIS/FGS design is based upon de-energize to trip(SIS) & energize to trip(FGS) principle.
- The SIS system is suited for SIL 3 applications.
- The SIS/FGS system will be designed such to meet an availability of 99.99%.
- The SIS/FGS has as a (maximum) scan rate of 300msec (SIS) and 500msec (FGS)..
- The SIS/FGS analogue IO modules are HART compatible.
- All IO modules are redundant.

The following general functions for the application are specified for the SIS/FGS PLC:

- SIS/FGS system alarms and messages at the CI view to identifying all system faults and failures.
- SIS/FGS PLC system alarms and messages at the CI view are tag based.
- SIS/FGS process alarms at the CI View are tag based.
- First failure alarms are indicated at the CI View

17.3 SAFETY CONTROL SYSTEM (SCS) SIZING REQUIREMENTS

The number and allocation of the ProSafe-RS SCS for a project is based on many factors, some of which are listed below:

SCS physical installation locations in the facility.

- Requirements for local and remote I/O nodes.
- HART functionality.
- Installed spare I/O.
- Installed spare slots.
- Number of I/O's.
- Module redundancy.
- FTA selection, location, and distribution.

Limitations:

- A maximum of 13 I/O nodes shall be installed per SCS. (along with Node extension software package).
- A maximum of 64 stations can be set up in one domain including 16 HISs.
- I/O Modules (redundant) shall be allocated depending on the summation value for each SCS/SNU.
- Ambient temperature conditions need to be considered while installing I/O nodes and the SCS in the same cabinet.
- A maximum of 2000 annunciator blocks can be programmed into one SCS. (Note 2)

18 IEC 61508

The international standard IEC 61508 defines safety integrity levels (SIL) 1 to 4. In order for a safety system to achieve a certain SIL, it has to be shown quantitatively (calculations) in various phases of a project and follow procedures. The quantitatively (calculations) and procedures will be described in a Safety Validation Plan. In here it is shown that the system will achieve the quantitative requirements associated with the relevant SIL. Furthermore, certain application specific system architectural constraints must be taken into account (e.g. redundant configuration for high availability). The complete safety loops, from sensor up to and including the final elements, must be verified this way. The ProSafe-RS in single configuration is approved for use in SIL 3 applications, hence redundancy in CPU & I/O cards is only provided for availability reasons.

Parts of the IEC 61508 requirements used for this document are the steps to be taken for the realization of the project. The relevant steps of section 2 of the IEC standard for EPC phases are shown in Error! Reference source not found.. In this figure it is assumed that Company and Contractor are responsible for step9.1 (safety requirement specification). The TYPICALS, C&E diagrams, DEP's and the IPF requirements will cover step 9.1. The other steps shall be executed during EPC Phase and are described in the Project Implementation Plan.

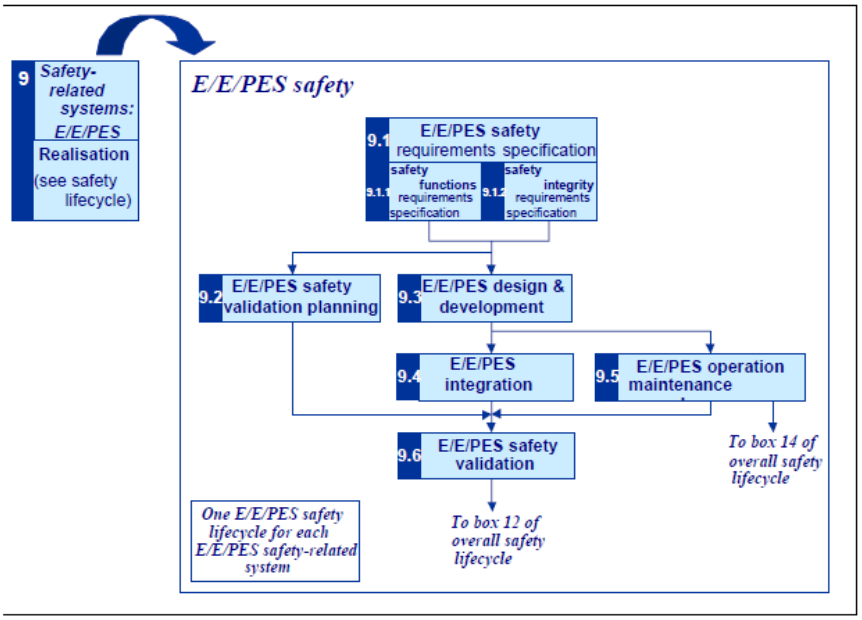


Figure 48 – Example directory.

The steps as mentioned in Figure 44 are included in the Quality Management System (QMS) of Yokogawa. Verification of all steps is done after each design phase.

19 PROSAFE-RS PROJECT CONFIGURATION

A ProSafe-RS project is a set of configuration files accessible from the Workbench Software. The files are organized in a set of folders for each SCS controller.

19.1 RS PROJECT FOLDER STRUCTURE

The project shall be stored on the EWS in the designated folder: C:\RS-Projects.

Under this folder create a folder with the project name. This folder is where the SCS controllers will be created using the Workbench Software. Additional levels of folders can be created to separate units or plants if so desired.

The Project Name folder must be given a valid name with 8 characters maximum. The following naming restrictions apply:

Folder name: Up to 8 characters, starting with an upper case alphabet character. Characters that can be used: Upper case alphabet characters, numerals, underscore, and hyphen.

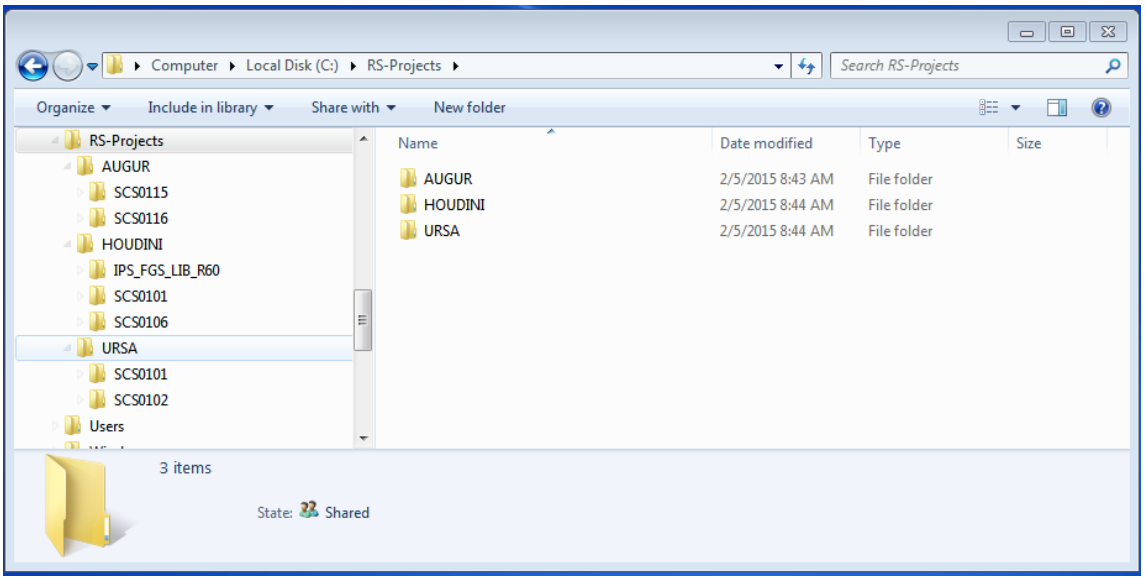


Figure 49 – Example directory

In the example, "AUGUR", "HOUDINI" and "URSA" are the project folders, "SCS0115" and "SCS0116" are folders for each SCS shown for completeness. The controller folders will be created automatically when the controller is created in the Workbench software.

NOTE: The Safety Control Station (SCS) system folder will take the format "SCSddss" where dd = domain number and ss = station number.

19.2 SCS SETUP

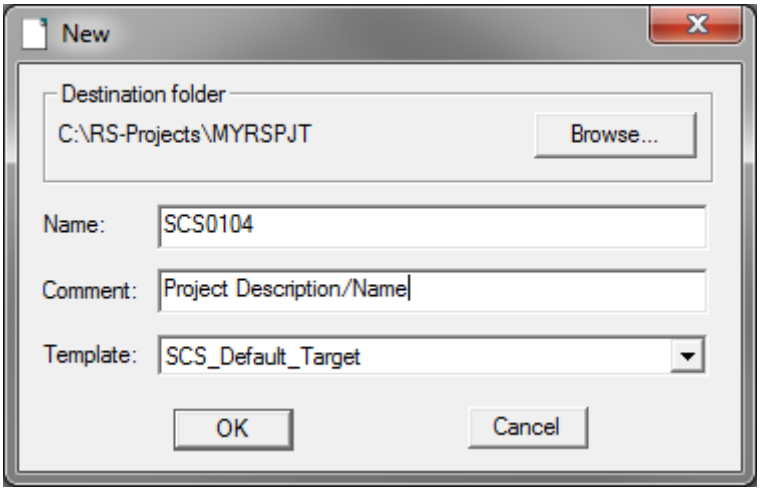


Figure 50 – New Controller Window

Use the Browse button to select the directory in which to create the SCS controller i.e. the correct project.

Name: "SCSddss" as defined in the architecture diagram.

Comment: Project name with a maximum of 24 characters. The project name appears as the caption of the workbench of the currently open project.

Template: Select SCS_Default_Target.

Select OK.

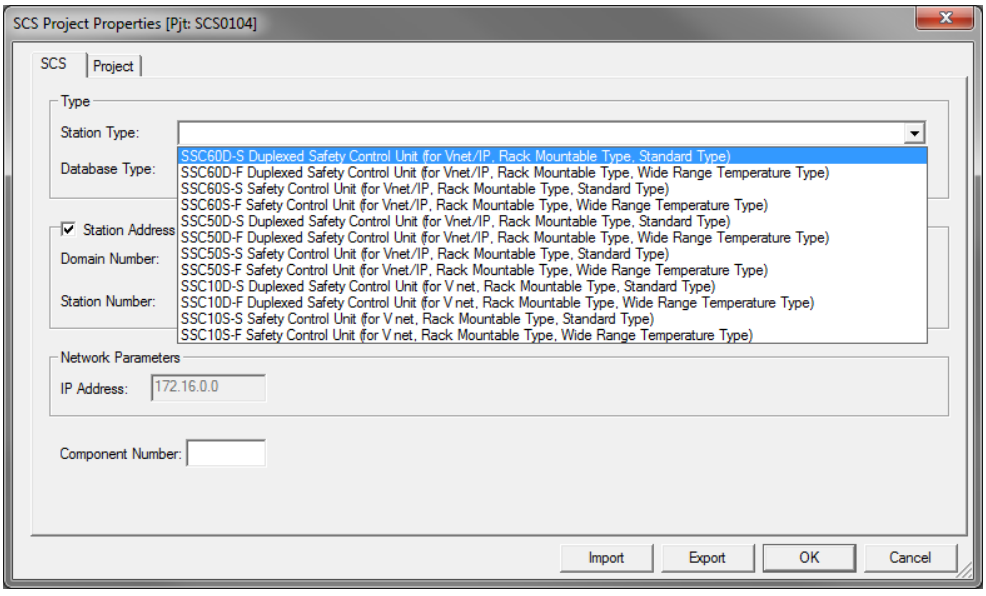


Figure 51 – SCS Project Properties Window – SCS selection.

Select the correct SCS type.

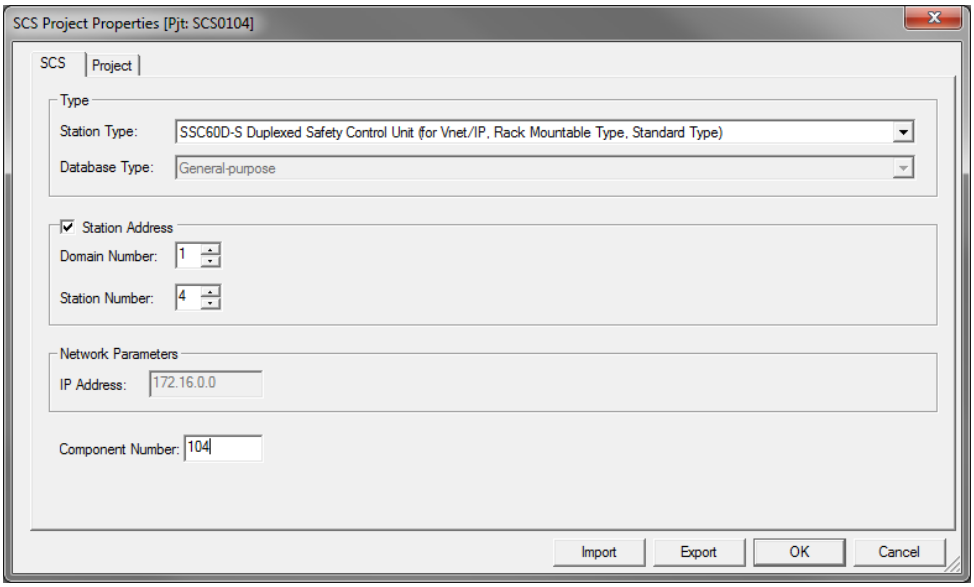


Figure 52 – SCS Project Properties Window – Station Address

Enter the correct Domain and Station Number.

The Component Number is ddss with no leading zeros.

19.3 PROJECT ARCHITECTURE SETUP

The Project architecture will be set-up by selecting the title bar on Link Architecture View (the default view after creation) and then choosing the [Properties] from the Edit menu to display the Resource Properties dialog box. The resource name and the resource number are defined through the General tab.

19.3.1 Link Architecture

Name: Same as project name folder. 8 characters maximum.

Comment: Same as Project Comment. 24 characters maximum.

Resource number: "ddss" (dd: domain number, ss: station number with no leading zeros on the domain).

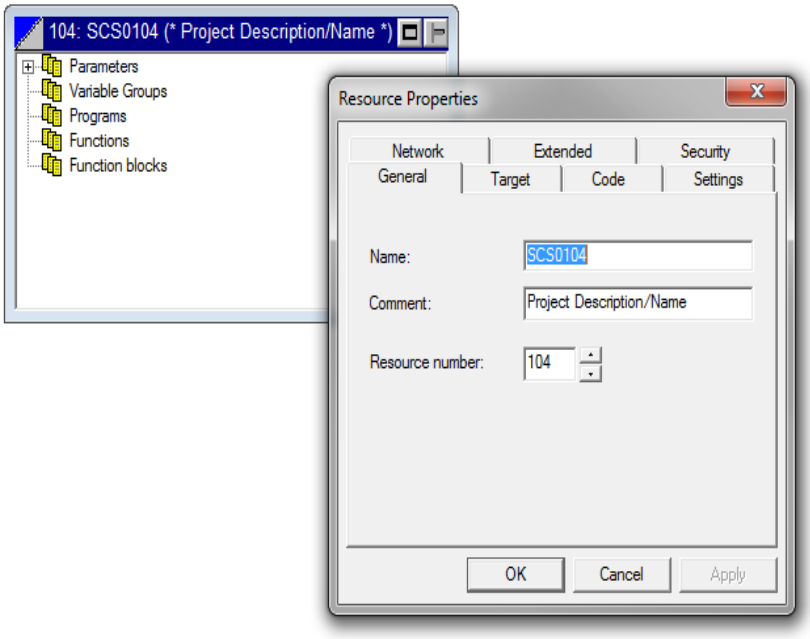


Figure 53 – Resource Properties

19.3.2 Scan Rate

The Scan Rate shall be configured through the settings Tab in the Resource properties window as shown below. The Minimum Scan Rate that can be entered in the Cycle time box is 50 milliseconds. The required Scan rate entered in the Cycle Timing box in milliseconds, depends on Safety Requirement Specification which will meet the required process safety time. The setting for the other tabs will be left at the default values. Refer the online help for additional information.

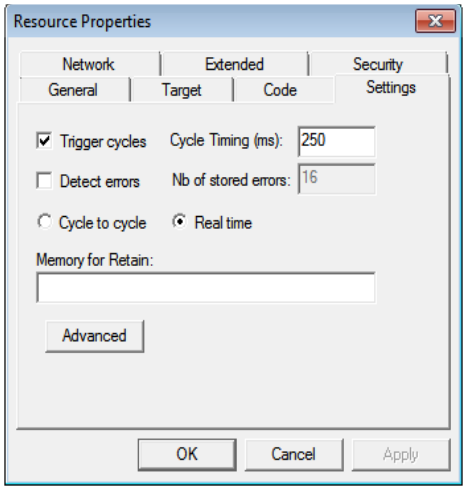


Figure 54 – Scan Rate Setting

19.3.3 Network Parameter

The IP address shall be defined on Hardware Architecture View. From the Windows button toolbar, select the Hardware Architecture view. Double click "Connection" (the line connecting the SCS box to the network line) so as to display Connection - Properties dialog box. The IP address needs to be set for "Value" item.

The IP address sets: 172.16.dd.ss

dd: domain number

ss: station number

E.g.:

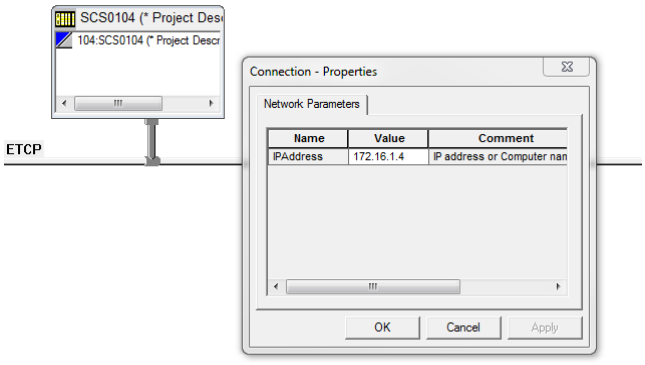


Figure 55 – Network Parameters

Use the Windows menu to return to the Link Architecture view.

19.3.4 ESB Bus Repeater Configuration

If Optical ESB Bus Repeater node is used, Repeater parameters must be configured in SCS Constants Builder and I/O Parameter Builder.

Select SCS Constants Builder from Workbench's Engineering menu

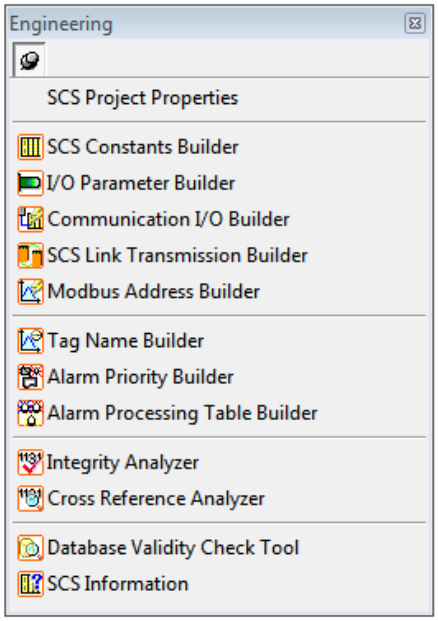


Figure 56 – SCS Engineering Menu Window

Select 1 (Yes) option and Maximum Extension Distance for Optical ESB Bus Repeater from SCS Constants Builder window. This distance value is the maximum distance from processor to the last extended node.

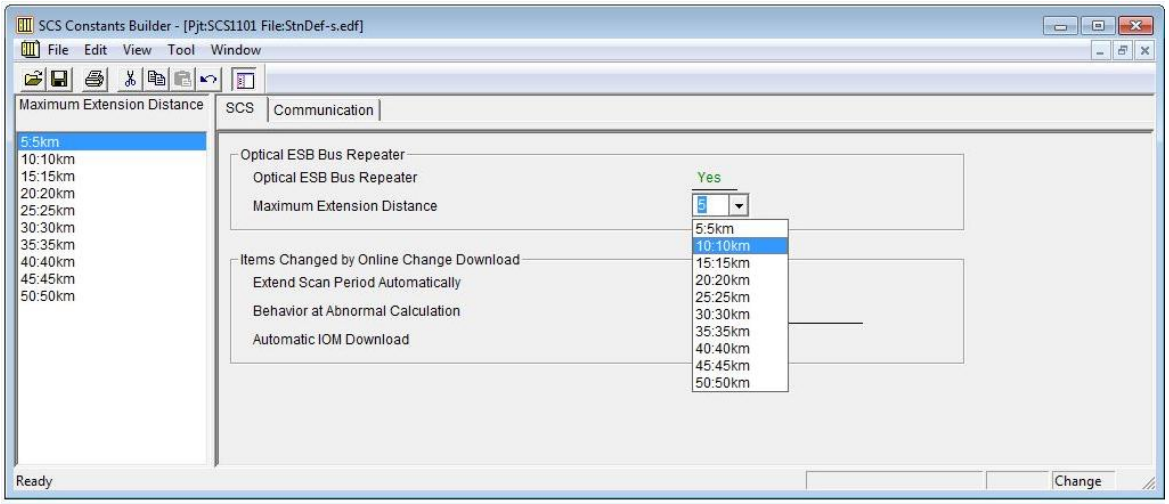


Figure 57 – SCS Constants Builder Window

Once SCS Constants Builder options has been selected and saved, Open I/O Parameter Builder from Engineering menu. Select node number on the left then select 1 (Yes) option and specify repeater node distance.

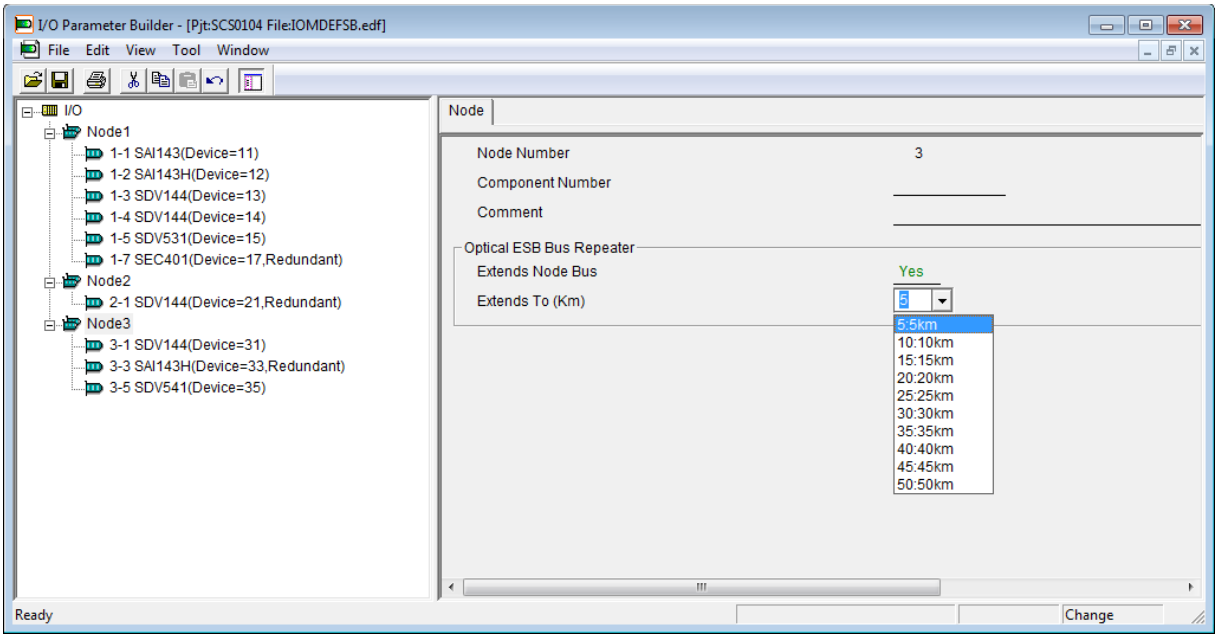


Figure 58 – I/O Parameter Builder Window

19.3.5 Additional SCS Configuration Options

Extend Scan Period Automatically – This function automatically extends the scan period of application logic execution function when the load on SCS becomes high. It is not recommended to enable this option because it can affect the system safety time.

Behavior at Abnormal Calculation – if there is an error in the application logic (i.e. divide by 0) that causes overflow and other abnormal calculations during logic execution, SCS will stop because correct control cannot be continued. Enabling this option (select 'SCS Continues') will allow SCS processor to resume operations and system alarms will be generated. It is recommended to have this option enabled.

Automatic IOM Download – This function will allow automatic execution of IOM download. When a redundant module on standby side is replaced for maintenance, the configuration information is automatically downloaded from the module on control side to the replaced module. It is recommended to enable this option.

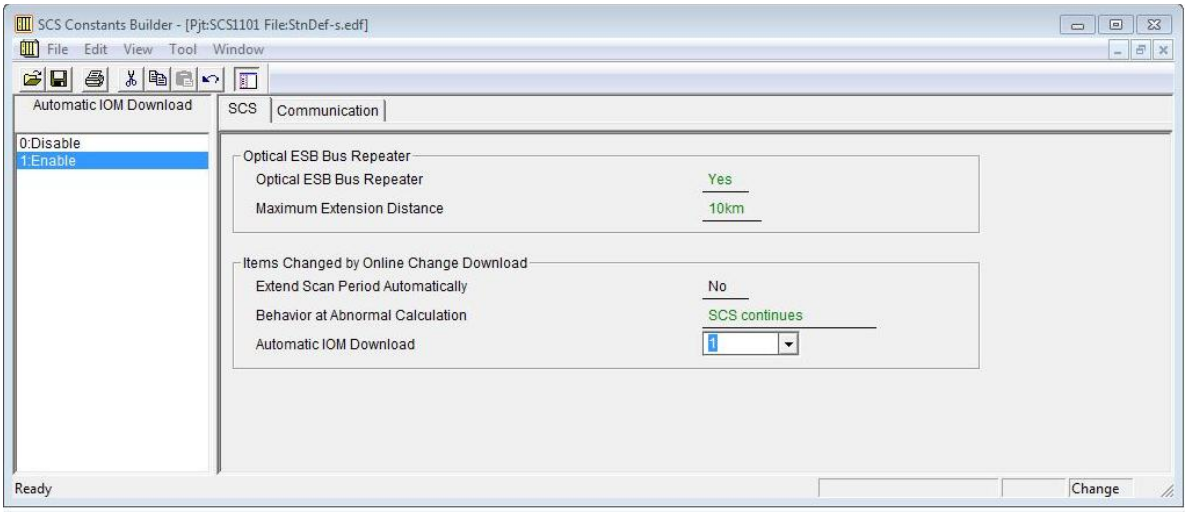


Figure 59 – SCS Engineering Menu Window

20 PROGRAMMING AND INSTRUMENTATION CONVENTION

The following convention shall be used throughout the project:

- SIS Outputs typically de-energize to trip & FGS Outputs typically energize to trip.
- Input trip signals shall occur when de-energized (0 or OFF) for SIS & energized(1 or ON) for FGS.
- Transmitter fault signals shall occur when de-energized (0 or OFF). A fault may or may not be a trip depending on the voting scheme and the actual transmitter configuration.
- FGS detector fault signals shall occur when energized (1 or ON). A fault may or may not be a trip depending on the voting scheme and the actual detector configuration.
- Overrides shall be active when energized.
- Alarms and first outs are indicated as energized when active.
- Constant values shall be used for setting alarm limits and trip set points. These constants shall be accessible only to authorized personnel through the Workbench software and require coding changes.
- SIS Logic shall be programmed to be negative: TRUE is the normal condition; FALSE reflects the tripped state. [De-energize to safe]
- FGS Logic shall be programmed to be positive: FALSE is the normal condition; TRUE reflects the tripped state. [energize to safe]

20.1 DEFAULT CONSTANTS SETTING

- Repeated warning alarms: Project Specific.
- Synchronous mode: Vnet/IP.
- Scan period for external system: one second.
- MODBUS word order: blank (filled in when subsystem defined).

The above SCS communication behaviour can be specified in SCS constants builder independently and the same is explained below in detail.



Figure 60 – SCS Constant Builder-Communication Behavior.

20.2 I/O PARAMETER BUILDER

Set all channel parameters according to the hardware design. Parameters of I/O modules and channels include the specification of action on error detection.

20.2.1 Digital Input Line Monitoring

Line monitoring configuration can detect short circuits, open circuits or both. Provided below are the options and their settings. Exceptions will be justified on a case-by-case basis. The SCB110 is a 5.6V Zener Diode and the SCB100 is a 36kohm, 1%, 25W resistor.

Short & Open Circuit:

SCB110 & SCB100 EOL Device are required for short & open circuit line monitoring.

Open Circuit:

SCB100 EOL Device is required for open circuit line monitoring.

Short Circuit:

SCB110 EOL Device is required for short circuit line monitoring.

No Monitoring :

Shall have all diagnostics removed.

Trip signal item specifies whether or not to regard an event as a trip occurrence. This setting is only enabled if [Yes] is set for [SOER].

- No (0): Changes are not regarded as a trip signal (default).
  However these are recorded in SOE as event changes.
- OFF TRIP (1):
  A change to OFF is regarded as a trip signal and SOE data before and after a trip is stored in an SCS.
- ON TRIP (2):
  A change to ON is regarded as a trip signal and SOE data before and after a trip is stored in an SCS.

The default background color for trip trigger events in SOE viewer is yellow.

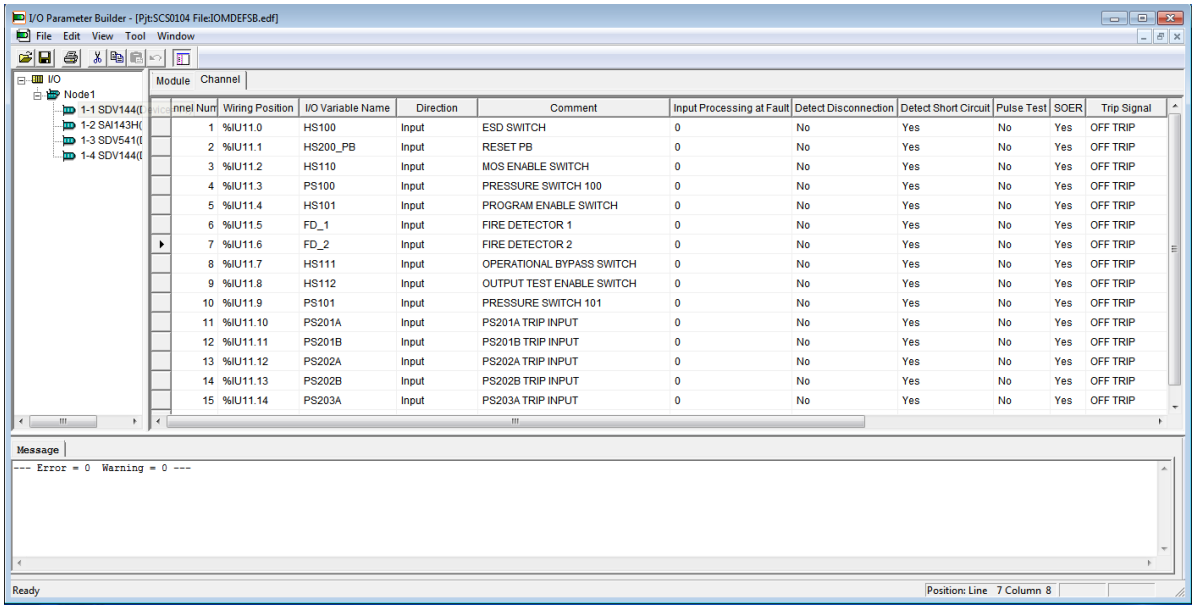
I/O Parameter	Options	Project Setting	
		SIS Setting	FGS Setting
Input Value at Fault :	0, 1, HOLD	0	0
Disconnection Detection:	NO, YES	YES (NOTE 1)	YES (NOTE 1)
Short Circuit Detection:	NO, YES	YES (NOTE 1)	YES (NOTE 1)
Pulse Test:	NO, YES	NO	NO
SOER:	NO, YES	YES	YES
Trip Signal:	NONE, OFF TRIP, ON TRIP	[Trip direction of Point]	[Trip direction of Point]

Table 66 – Discrete Input card settings

Note 1: To be Configured based on IO Lists.

I/O Parameter Builder settings for all wired spare/unwire spare tags shall be disabled for signal/transmitter fault detection to avoid nuisance alarms Example Configuration

Example Configuration



nnel Num	Wiring Position	I/O Variable Name	Direction	Comment	Input Processing at Fault	Detect Disconnection	Detect Short Circuit	Pulse Test	SOER	Trip Signal
1	%IU11.0	HS100	Input	ESD SWITCH	0	No	Yes	No	Yes	OFF TRIP
2	%IU11.1	HS200_PB	Input	RESET PB	0	No	Yes	No	Yes	OFF TRIP
3	%IU11.2	HS110	Input	MOS ENABLE SWITCH	0	No	Yes	No	Yes	OFF TRIP
4	%IU11.3	PS100	Input	PRESSURE SWITCH 100	0	No	Yes	No	Yes	OFF TRIP
5	%IU11.4	HS101	Input	PROGRAM ENABLE SWITCH	0	No	Yes	No	Yes	OFF TRIP
6	%IU11.5	FD_1	Input	FIRE DETECTOR 1	0	No	Yes	No	Yes	OFF TRIP
7	%IU11.6	FD_2	Input	FIRE DETECTOR 2	0	No	Yes	No	Yes	OFF TRIP
8	%IU11.7	HS111	Input	OPERATIONAL BYPASS SWITCH	0	No	Yes	No	Yes	OFF TRIP
9	%IU11.8	HS112	Input	OUTPUT TEST ENABLE SWITCH	0	No	Yes	No	Yes	OFF TRIP
10	%IU11.9	PS101	Input	PRESSURE SWITCH 101	0	No	Yes	No	Yes	OFF TRIP
11	%IU11.10	PS201A	Input	PS201A TRIP INPUT	0	No	Yes	No	Yes	OFF TRIP
12	%IU11.11	PS201B	Input	PS201B TRIP INPUT	0	No	Yes	No	Yes	OFF TRIP
13	%IU11.12	PS202A	Input	PS202A TRIP INPUT	0	No	Yes	No	Yes	OFF TRIP
14	%IU11.13	PS202B	Input	PS202B TRIP INPUT	0	No	Yes	No	Yes	OFF TRIP
15	%IU11.14	PS203A	Input	PS203A TRIP INPUT	0	No	Yes	No	Yes	OFF TRIP

Figure 61 – Discrete Input Parameter Builder

Short and Open Circuit Line Monitoring Wiring Diagram

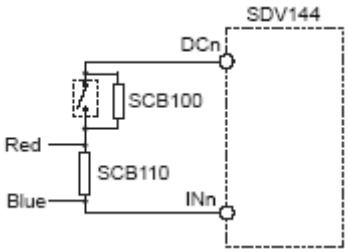


Figure 62 – Short & Open Circuit

Open Circuit Line Monitoring Wiring Diagram

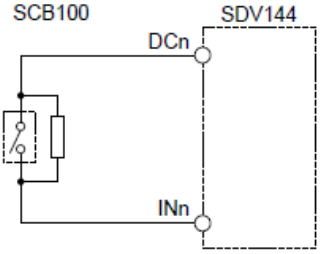


Figure 63 – Open Circuit

Short Circuit Line Monitoring Wiring Diagram

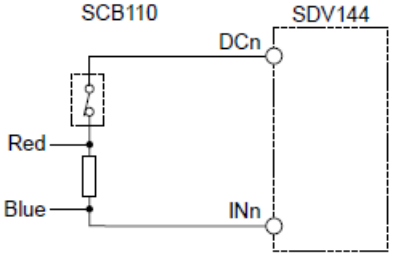


Figure 64 – Short Circuit

20.2.2 Digital Output Line Monitoring

Line monitoring for DO is available. Prosafe RS outputs shall be configured with the following diagnostics configuration:

IO Parameter	Options	SIS Setting	FGS Setting
Output Shutoff Switch:	DISABLE, ENABLE	ENABLE (Note 1)	ENABLE (Note 1)
Output Processing at Fault:	0, 1, HOLD	0 (1 for BDV)	0
Detect Disconnection:	NO, YES	NO (Note 2)	YES (Note 2)
Pulse Test (OFF):	NO, YES	NO (Note 2)	NO
Pulse Test (ON):	NO, YES	NO	Yes (Note 2)
SOER:	NO, YES	YES	YES
Trip Signal:	NONE, OFF TRIP, ON TRIP	OFF TRIP (ON TRIP for BDV)	ON TRIP

Table 67 – Discrete Output card settings

Note 1: The Output Shutoff Switch should be set to ENABLED. Spares and non-critical points should have Output Shutoff Switch DISABLED. When set to ENABLED, the whole digital output card will be de-energised when a critical fault is detected.

If the project selects the settings to ENABLED, engineering attention shall be given to IO allocation such that when the complete IO card is shut down no dangerous situation shall occur.

Note 2: To be Configured based on IO Lists.

For Lamp outputs & buzzer, disconnection connection and pulse test options will be set to NO.

For relay the line monitoring diagnostics available until coil supply.

For the monitoring to function properly, the normal load must exceed 35mA. If the end device draws less, resistors shall be installed to support the monitoring function.

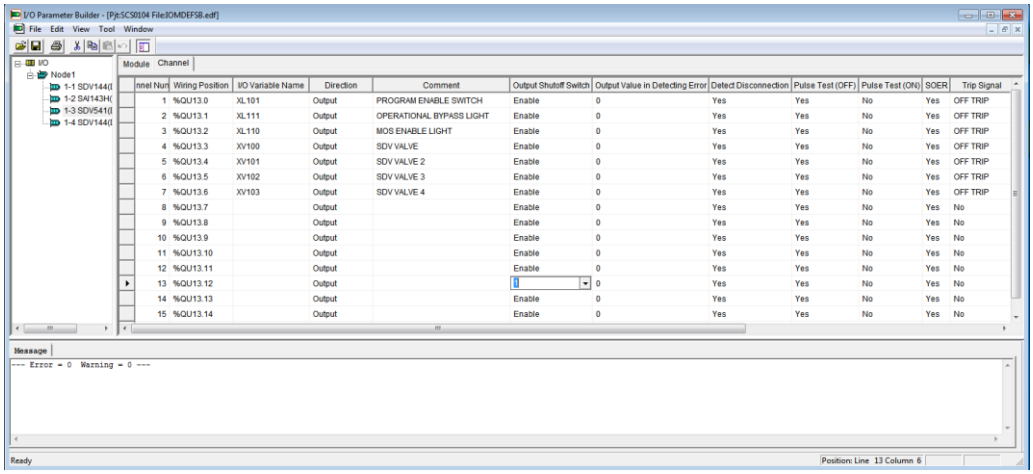


Figure 65 – Discrete Output Parameter Builder

20.2.3 Transmitter Failure Detection

Transmitter failure detection shall be at the channel level producing a system alarm with node slot channel and fault type displayed on the HIS. Diagnostics shall be configured as follows:

IO Parameter	Options	SIS Setting	FGS Setting
Input Processing at Fault:	HOLD, FIXED VALUE	FIXED VALUE Note 1	HOLD Note 4
Input Value at Fault:	-25.0%(0mA) TO 125.0%(24mA)	(Refer IO list for Fail safe value) Note 5	0.0%
Input Processing at Transmitter Fault	Input Processing at Fault, Raw Data	0-Input Processing at Fault	1-Raw data
Signal Conversion	LINEAR, SQRT	LINEAR	LINEAR
IOP Detection (High):	NO, YES	YES (Note 1)	YES (Note 1)
IOP Detection (Low):	NO, YES	YES (Note 1)	YES (Note 1)
Transmitter Fault Detection (High):	NO, YES	YES (Note 1)	NO
Transmitter Fault Detection (Low):	NO, YES	YES (Note 1)	NO
Field Power Diagnosis	None, 2-Wire, 4-Wire	2-Wire or 4 Wire	2-Wire or 4 Wire

Table 68 – Analog Input card settings

Note 1: Fixed value, either high trip or low trip, shall be set based upon project requirements. Correct settings must be evaluated for each individual channels.

The following default set points shall be used to detect faults (The values below are the defaults and need to be verified for the specific field instrument):

Parameter Note 3	High	Low
Transmitter Fault (Note 2)	103.125% (20.5 mA)	-1.25% (3.8mA)
IOP	106.25% (21 mA)	-2.5% (3.6mA)

Table 69 – Analog Input card settings

Note 1: 2-wire and 4-wire signals should be separated when possible for clarity.

Note 2: Setting at instrument in field should be 3.6mA and/or 21.0 mA.

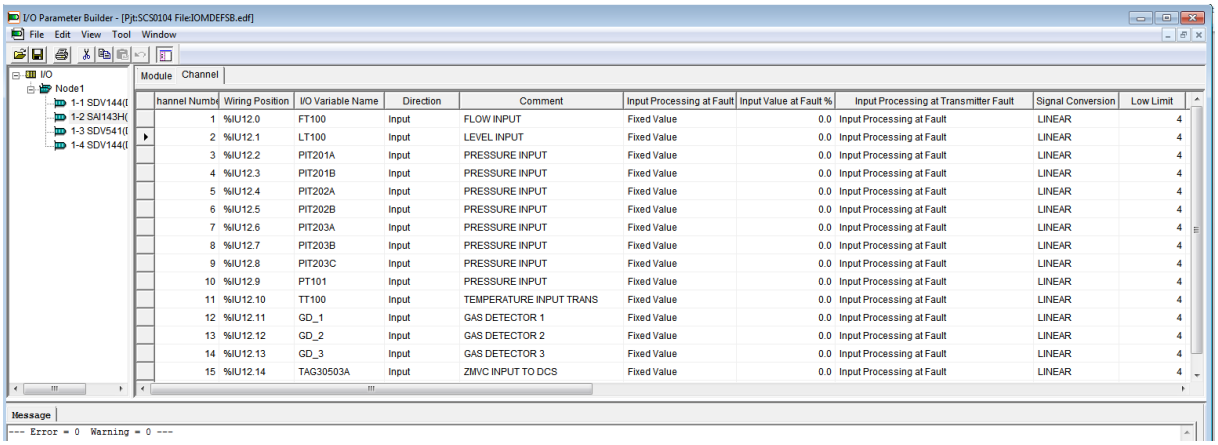
Note 3: Both transmitter fault and Input Open, create IOP on HMI.

Note 4: General fault for various devices shall be generated as per device data sheet and same is summarized in below table of each detector (HOLD-1).

Note 5: Fail Safe Value (input value at fault) Setting for SIS follow below

Voted Configuration	Fail Safe Setting	Remarks
1ooN (1oo1, 1oo2) High Trip Transmitter	100%	Towards the direction of high trip
1ooN (1oo1, 1oo2) Low Trip Transmitter	0%	Towards the direction of low trip
1ooN (1oo1, 1oo2) High/Low Trip Transmitter	0% or 100%	Selection of fault value is toward the higher SIL rated function

Table 70 – Fail safe Value



hannel Numbe	Wiring Position	I/O Variable Name	Direction	Comment	Input Processing at Fault	Input Value at Fault %	Input Processing at Transmitter Fault	Signal Conversion	Low Limit
1	%IU12.0	FT100	Input	FLOW INPUT	Fixed Value	0.0	Input Processing at Fault	LINEAR	4
2	%IU12.1	LT100	Input	LEVEL INPUT	Fixed Value	0.0	Input Processing at Fault	LINEAR	4
3	%IU12.2	PIT201A	Input	PRESSURE INPUT	Fixed Value	0.0	Input Processing at Fault	LINEAR	4
4	%IU12.3	PIT201B	Input	PRESSURE INPUT	Fixed Value	0.0	Input Processing at Fault	LINEAR	4
5	%IU12.4	PIT202A	Input	PRESSURE INPUT	Fixed Value	0.0	Input Processing at Fault	LINEAR	4
6	%IU12.5	PIT202B	Input	PRESSURE INPUT	Fixed Value	0.0	Input Processing at Fault	LINEAR	4
7	%IU12.6	PIT203A	Input	PRESSURE INPUT	Fixed Value	0.0	Input Processing at Fault	LINEAR	4
8	%IU12.7	PIT203B	Input	PRESSURE INPUT	Fixed Value	0.0	Input Processing at Fault	LINEAR	4
9	%IU12.8	PIT203C	Input	PRESSURE INPUT	Fixed Value	0.0	Input Processing at Fault	LINEAR	4
10	%IU12.9	PT101	Input	PRESSURE INPUT	Fixed Value	0.0	Input Processing at Fault	LINEAR	4
11	%IU12.10	TT100	Input	TEMPERATURE INPUT TRANS	Fixed Value	0.0	Input Processing at Fault	LINEAR	4
12	%IU12.11	GD_1	Input	GAS DETECTOR 1	Fixed Value	0.0	Input Processing at Fault	LINEAR	4
13	%IU12.12	GD_2	Input	GAS DETECTOR 2	Fixed Value	0.0	Input Processing at Fault	LINEAR	4
14	%IU12.13	GD_3	Input	GAS DETECTOR 3	Fixed Value	0.0	Input Processing at Fault	LINEAR	4
15	%IU12.14	TAG30503A	Input	ZMVC INPUT TO DCS	Fixed Value	0.0	Input Processing at Fault	LINEAR	4

Figure 66 – Analog Input Parameter Builder

20.3 I/O WIRING CONFIGURATION

Configure the I/O modules according to the hardware design.

20.3.1 Device Selection

ESB Bus Coupler Module SEC402 connects safety control units and safety node units via an ESB bus cable.

An SEC401 bus coupler module is required if Safety Node Units (I/O racks) are installed.

The device index shall be numbered as follows:

First two characters are the node number, and the second character is the slot number.

The I/O parameter Builder shall show the actual configuration in the correct order, using the node/slot numbers.

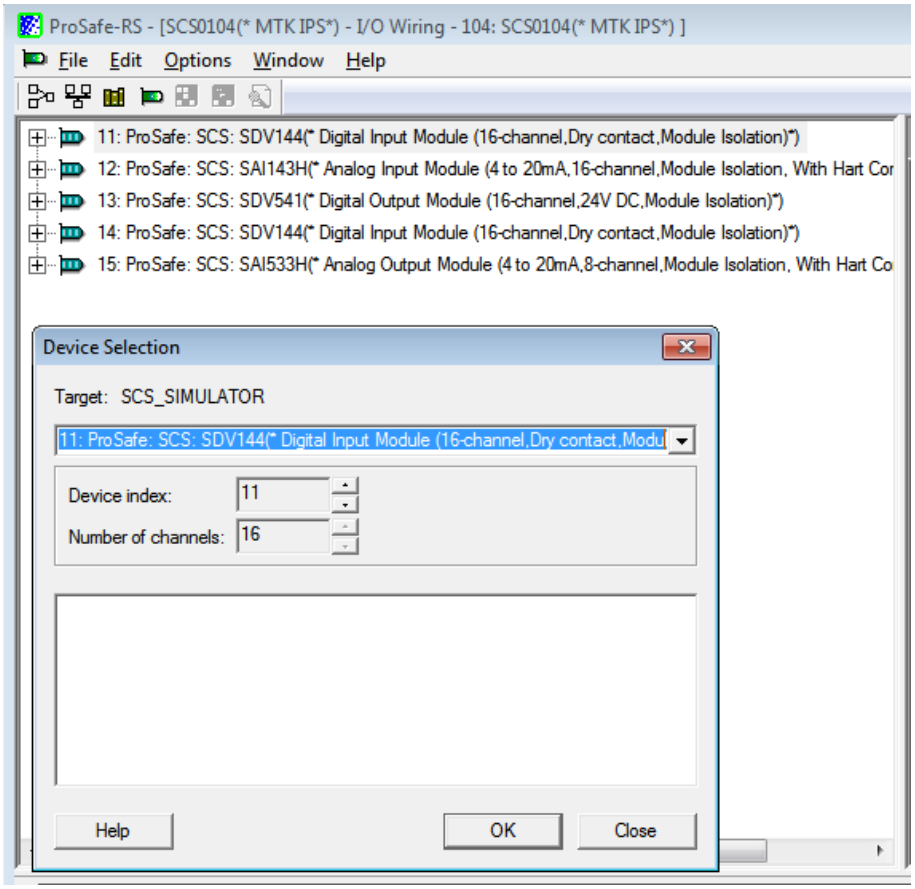


Figure 67 – I/O Module Selection

20.3.2 I/O Parameters

Each module's node and slot numbers shall be entered, and TRUE shall be entered in the Is Redundant field. Non-critical loops such as indication lamps may be assigned to non-redundant modules; in this case the Is Redundant field will be FALSE.

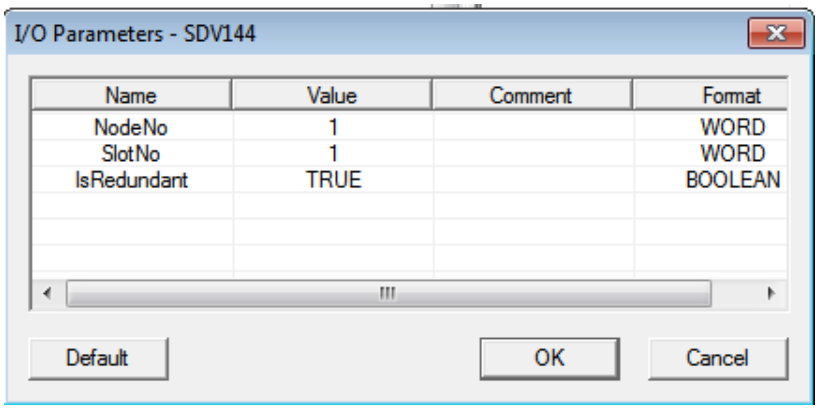


Figure 68 – I/O Module Parameters

Once variables declared as I/O have been created in the dictionary, they shall be listed in the unwired variables table. Only variables of the correct type for the selected I/O module are listed in the unwired variable table, a variable can then be wired to the selected channel.

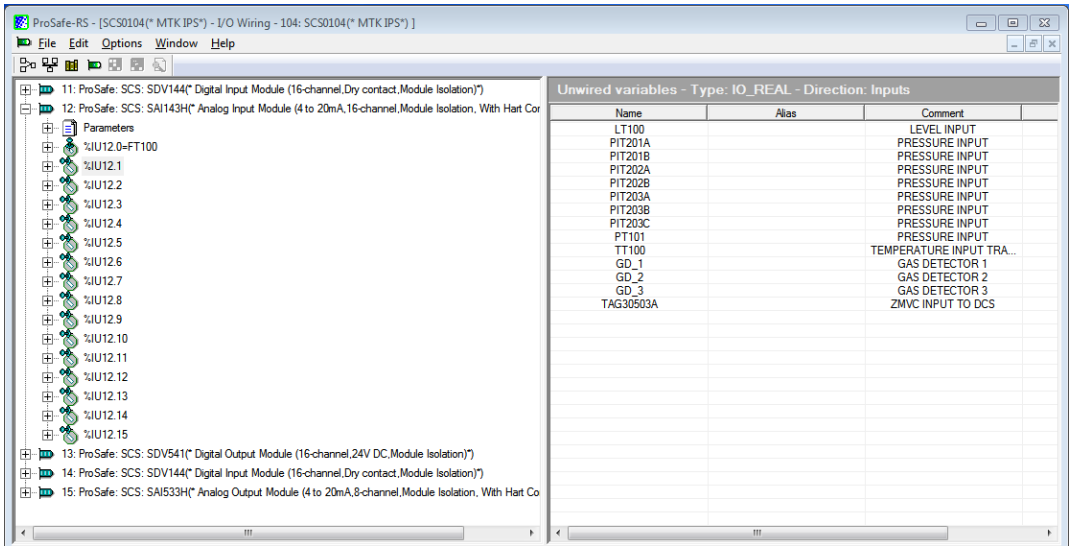


Figure 69 – I/O Wiring

20.4 DEFINED WORDS FOR SOE BLOCKS

Only default words shall be used and are in the Dictionary under the 'Open - True' Tab.

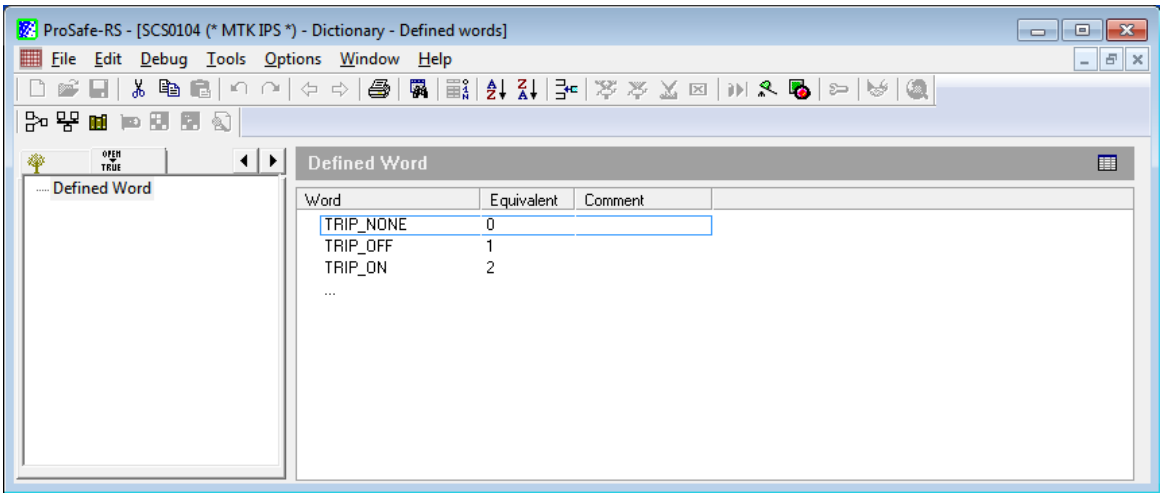


Figure 70 – Defined Words

The Defined Words are used on the SOE block input nubs:

TRIP_NONE is used to signify that a point or event is not a trip.

TRIP_OFF is used to signify that a point or event trip in the OFF or 0 position.

TRIP_ON is used to signify that a point or event trip in the ON or 1 position.

20.4.1 Variable Dictionary

The following fields are required for every I/O point or internal variable:

Field	Description
Name	Variable Name
Type	Variable Type
Group	Variable Group
Attribute	Variable Attribute (Read, Write, or Free)
Scope	Variable Global or Local to Program
Direction	Variable Direction (Input, Output, or Internal)
Comment	Variable Comment (24 character limit)

Figure 71 – Variable Dictionary

Most of these fields shall be imported from the project database.

Name	Alias	Type	[]	Init. value	Dimensi...	Group	Attribute	Scope	Direction	Retain	Wiring	Address	Comment
PPA10200		BOOL				None	Free	Global	Internal	No			PRESSURE PRE ALARM
PPA10300		BOOL				None	Free	Global	Internal	No			PRESSURE PRE ALARM
⊞ PPA10400		ANN				None	Free	Global	Internal	No			PRESSURE PRE ALARM
PPA10400A		BOOL				None	Free	Global	Internal	No			PRESSURE PRE ALARM
PPA10400B		BOOL				None	Free	Global	Internal	No			PRESSURE PRE ALARM
⊞ PPA10500		ANN				None	Free	Global	Internal	No			PRESSURE PRE ALARM
PPA10500A		BOOL				None	Free	Global	Internal	No			PRESSURE PRE ALARM
PPA10500B		BOOL				None	Free	Global	Internal	No			PRESSURE PRE ALARM

Figure 72 – Variable Dictionary

20.4.2 Variable Name

The Variable Name will be the tag from the project database.

20.4.3 Variable Type

This is a drop-down menu with the available I/O types.

20.4.4 Variable group declaration

Variable Groups provide a method of managing variables and logically sorting them within a SCS. The variable groups are shown in the Variables Tree. Their contents are defined within the Dictionary Variables grid. Define the following variable groups:

Name	Functionality
AI_Proc	Analog Input Proc UDFB & Points
AO_Proc	Analog Output Proc UDFB & Points
DI_Proc	Discrete Input Proc UDFB & Points
DO_Proc	Discrete Output Proc UDFB & Points
COMM	Inter SCS UDFB & Points

SYS	System Alarms & Diagnostics

Table 71 – Variable group declaration

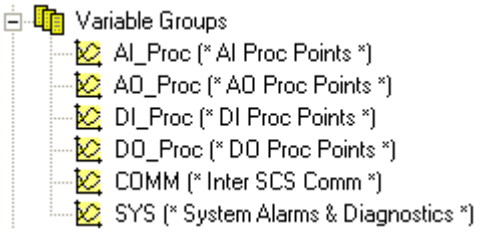


Figure 73 – Variable Groups

20.4.5 Variable Attribute

The Variable Attribute can be one of three settings:

1) Read – used for Inputs.
2) Write – used for Outputs.
3) Free – used for internal variables which are read and write capable.

20.4.6 Variable Scope

The Variable Scope may be one of two values: Global, and Local to Program. A Global Variable may be used and seen by all areas of programming within the SCS. A Local to Program Variable is confined to use within a subprogram or Function Block.

20.4.7 Variable Direction

The Variable Direction can be one of three settings:

1) Input – used for Inputs.
2) Output – used for Outputs.
3) Internal – used for internal variable which are read and write capable.

20.4.8 Variable Comment

Comment field for all points shall be filled with a description of the service and function of the tag.

21 APPLICATION PROGRAMS

21.1 ORGANIZATION / STRUCTURE

21.1.1 Setup

When starting a new controller configuration, certain initial settings for Workbench need to be verified.

In the logic editor:

- Under the options menu ensure that Show I/O Variable Comments and Show Internal Variable Comments are checked.
- In the Tools menu, select Show/Hide Guidelines Area and check that all guidelines are checked.
- In the working area space, the guidelines such that the Inputs area is five "dots" wide, the From area is five "dots" wide, the Logic area is Twenty Five "dots" wide, the To area is five "dots" wide and the Outputs area is five "dots" wide.

21.1.2 Program Sheet Format

The Program shall include a title block as described above. The title block shall be positioned at the top of the page properly sized with extra space for future additional commenting.

Program functionality shall be divided as follows:

Functionality	Program Naming Convention
Auxiliary Alarms such as power supply and fan failure	AUX_ALM
Link Transmission Received from other SCS and FCS	COM_FROM_SCS[Domain][Station] COM_FROM_FCS[Domain][Station]
Serial Communications Blocks	COM_SER
Unit Processing	UNIT_xx[Group or Equipment]
Special Logic Processing such as sequences or trip that span multiple C&Es	SCLxx_[Group or Equipment]
Link Transmission Leaving to other SCS or FCS	COM_OUT

Table 72 – Types of Program Functionality

Further divisions shall be created as needed on a per project basis. The program flow is as follows:

1. The inputs from other systems are read.
2. All of the inputs are processed including scaling and override, creating the appropriate trip flags.
3. The output logic is processed using the trip flags created in the current or previous sheets.
4. Outputs to other systems are sent.
5. The first out (if needed) is generated.

The configuration will be grouped based on Units. Each group of sheets will start with an input processing section (one sheet or more if necessary) a logic section containing the UZ trip and resetting logic and an output processing sheet (one sheet or more if necessary).

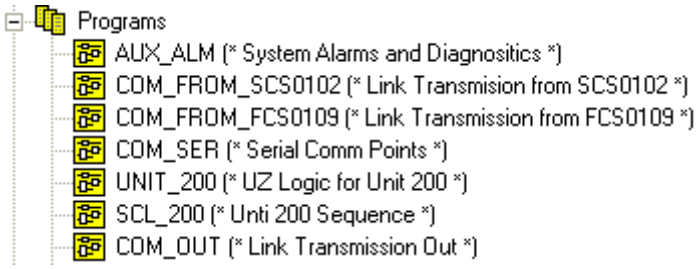


Figure 74 –Program Layout Example

21.1.3 Trip Principle

The trip principle for Safety Instrumented Systems is typically de-energize to trip; exceptions shall be identified in the Project's Safety Requirements Specification. When an SIS/FGS output is tripped, a signal will be sent to the PCS to place any associated loops into manual with a 0% output.

The trip principle for Fire & Gas Systems Shall follow typically energize to trip. Firefighting related system outputs, fire water pump start signals and horn/beacon outputs which are designated energise-to-activate, and for which line monitoring shall be provided. Other requirements shall be identified in the Projects Fire & Gas Safety Requirements Specification. The FGS trip signal sent to SIS to initiate shutdown as required shall be designed fail-safe.

21.1.4 Inter SCS Communication

Communication between different SCS's is possible in following 2 methods.

- Across domains using Inter SCS Safety communication.
- Within same domain using Link transmission function.

Link Transmission

Only BOOL communications will be performed using Link Transmission within a single Domain. This allows each controller to broadcast 128 bits of data to all the other controllers in the domain. Each controller can receive up to 1000 bits from a mix of SCSs and FCSs. The response to loss of communications can be set individually to true, false or hold for each bit in the receiving SCS. Link Transmission allows BOOL type data communication only if the SCS are in the same domain.

Reaction for Link transmission

The three factors that determine response times for link transmission between two controllers are:

- Data execution by the SCS system program for receiving (consumer) controller and transmitting (producer) controller.
- Link transmission repeat time.
- V-net/IP transmission delay.

The data execution by the SCS is maximal two times the scan period for handling the input and output and logic execution. The V-net/IP transmission delay is 10ms (including 2ms switch over time, between bus1 and bus2), for communication within the same domain. The link transmission data is broadcast in a fixed time interval of 100ms. So, the worst-case scenario (theoretical maximum response time) for the response time between two controllers can be determined by applying the following formula;

RTDMAX (Reaction Time on Demand) = 2 x scan periods (producer) + 2 x scan periods (consumer) + 2 x link transmission repeat periods + V-net/IP delay + Link transmission repeat time.

The minimal data execution time is the scan period plus the input handling time plus the output handling time. As a result, the minimum (optimal) response time between two controllers can be determined by applying the following formula.

RTDOPT (Reaction Time on Demand) = 1 x scan period (producer) + 1 x scan period (consumer) + Vnet/IP delay + Link transmission repeat time

The average response time can be calculated by the following formula.

RTDAVG (Reaction Time on Demand) = (RTDMAX + RTDOPT) / 2.

Inter-SCS Safety Communication

If large amounts of data must be communicated between domains, one SCS in each domain will be selected to concentrate the data to be sent/received from the other domain. Consumer and Producer blocks will be used to send the data between these two SCSs. Link Transmission will be used to distribute the received data to other SCSs in the domain.

Reaction for safety communication

The two factors that determine response times for safety communication between two controllers are:

- Data execution by the SCS system program for receiving (consumer) controller and transmitting (producer) controller.
- V-net/IP transmission delay.

The data execution by the SCS is maximal two times the scan period for handling the input and maximal three times for the output handling and logic execution. The V-net/IP transmission delay is 50ms (including 2ms switch over time, between bus1 and bus2), for communication within the different domains. The worst-case scenario (theoretical maximum response time) for the response time between two controllers can be determined by applying the following formula.

RTDMAX (Reaction Time on Demand) = 2 x scan periods (producer) + 3 x scan periods (consumer) + Vnet/IP delay.

The minimal data execution time is the scan period plus the input handling time plus the output handling time. As a result, the minimum (optimal) response time between two controllers can be determined by applying the following formula.

RTDOPT (Reaction Time on Demand) = 1 x scan period (producer) + 1 x scan period (consumer) + Vnet/IP delay.

It is possible to program consumer and producer blocks for REAL or BOOL points, but usage requires Shell approval. System Producer Block (PROD_B for BOOL, PROD_I for DINT, or PROD_R for Real) and Consumer Block (CONS_B for BOOL, CONS_I for DINT, or CONS_R for Real) are used when configuring Inter SCS Communications. The response to loss of communications can be set individually to a preset value for each consumer block.

21.1.5 Analog Input processing

Analog input processing will be performed using one of the analog input typical depending on the voting requirements of the point.

- Scaling: An analog input 4-20 mA signal is normalized to a 0-100% value at the Analog Input card. The percentage is then scaled into engineering units from scale high and low value input nubs at the ANLG_S block.
- Analog Trip Points: There are input nubs for SDL, SDH, high-high, high, low and low-low trip. Pre-trip and trip setpoints are to be documented in the project's Safety Requirements Specification. When a setpoint is not required, the setpoint shall be set to value (99999.0 or -99999.0) to ensure that trip or alarm does not occur.

21.1.6 Discrete Input Processing

Discrete input processing will be performed using one of the discrete input typicals depending on the voting requirements of the point.

21.1.7 Interlock Logic Processing

The logic shall be grouped into UZ (or trip) groups. When one of the input devices associated with a UZ group enters its trip state, the UZ group is tripped, and all of the outputs affected by the group will be driven to their safe state. If the device was the first device in that group to trip, the first out flag for that point will be set true and all subsequent first out flags will be masked. The UZ group can only be reset when all of the input devices have been cleared or overridden. Once the group has been reset the outputs for that group will return to their normal state. If an output is driven by more than one UZ group, it will only return to its normal state if none of the UZ groups are tripped.

21.1.8 Fire and Gas Logic Processing

Fire and gas trip logic shall be grouped in per cause and effect or logic descriptions. Each group normally includes all fire and gas detectors in one unit zone or area. Each trip input is latched and must be reset individually. Once all initiating inputs have been reset the outputs for that zone will return to their normal state automatically. Single input trip or multiple input faults or overrides will initiate fire and gas vote to trip.

21.1.9 Resets

SIS logic and FGS logic has manuals reset only. Resets are initiated from the CI-View by the operator. Only when related trip input is recovered the reset signal will be accepted by the logic.

21.1.10 Output Processing

Output processing is performed by a standard template. Basic operation of the template is as follows:

- SIS Process & FGS manual trip shall cause an output to shut down to a fail-safe position.
- Shutdown outputs shall return to normal state once all trip conditions are cleared, all permissive conditions are satisfied, and the proper reset procedure has been completed.

The inputs for the output processing function block are generic in nature and can be used for many different types of outputs. Multiple outputs can be triggered by one block as long as all outputs share trip, permissive, and reset requirements.

21.1.11 Auxiliary Alarms

The following are cabinet alarms.

Part Alarm-1 : Fan Failure.

Part Alarm-2 : MCB tripped alarm

Part Alarm-3 : PSU Power Failure

Part-Alarm-4 : Earth Fault.

Part-Alarm-5 : Thermostat Alarm

The signals shall be wired fail safe. System alarms shall be configured on a per project basis. All system diagnosis alarms shall be brought to the CI-View alarm banner.

21.1.12 Annunciators

Discrete Alarms shall be programmed with the use of ANN function block. They shall exist throughout the application's function blocks or where process alarms are required. Annunciator messages will be composed of the Tag and the Tag Description for proper display in the alarm window.

21.1.13 Sequence of Events (SOE)

All DI and DO signals that require SOE shall be configured at the channel level of the IO module. Analog input signals shall be configured for SOE in the ANLG_S block. Any other points requiring SOE shall be programmed with the SOE function blocks. Only BOOL points shall be used for SOE. An example would be voted trip. They shall exist throughout the application's user defined function blocks or where the points are programmed. Points configured in the SOE application shall be per project requirements. Time stamping for SOE events shall be within 2 ms of event for Digital IO modules and at system scan rate for all others. Refer section 19.2 for SOE setting for digital inputs and outputs.

21.2 TAG NAME BUILDER

21.2.1 Tag Name Parameter Setting

BOOL / DINT / REAL / ECW TABS:

Points created in the dictionary shall have the Tag Name field the same as the Variable Name field and Tag Comment field the same as the Comment field.

Points from instanced user defined function block outputs shall have the Tag Name field follow the tag naming convention. The Tag Comment shall have as clear a description of the service and description of the point as possible with 24 characters maximum with a space at 12th character. Variable Naming Convention shall have the Tag Name field follow the expanded tag naming convention on a per project basis.

BOOL/ECW_B | DINT/REAL/ECW_I/ECW_R | ANLGI/ANLG_S | VEL | ANN | IO_REAL | IO_BOOL | GOV_B/GOV_IB/OVR_B/OVR_IB | OVR_I/OVR_R/OVR_IR | PASSWD | SCI_B/SCO_B | SCI_I/SCO_

Variable Name	Tag Name	Type	Tag Comment	Comment
HAS10300	HAS10300	BOOL	PST10300 STARTUP BYPASS	PST10300 STARTUP BYPASS
HAS10600	HAS10600	BOOL	PST10600 STARTUP BYPASS	PST10600 STARTUP BYPASS
HAS10700	HAS10700	BOOL	PST10700 STARTUP BYPASS	PST10700 STARTUP BYPASS
HAS10800	HAS10800	BOOL	PST10800 STARTUP BYPASS	PST10800 STARTUP BYPASS
SDV10850_PST.CONFIRM	SDV10850_CONF	BOOL	CONFIRM REQUEST TO OP	CONFIRM REQUEST TO OP
SDV10850_PST.FBO_PROGRESS	SDV10850_PROG	BOOL	PST IN PROGRESS	PST IN PROGRESS
SDV10850_PST.FBO_COMPLETE	SDV10850_COMP	BOOL	PST COMPLETE FLAG	PST COMPLETE FLAG

Table 73 –Tag Name Builder Example

ANLGI / ANLG_S TAB:

The Tag Name field shall be the transmitter (root) instrument name with the "T" replaced with an "I", i.e. the ANLG_S for analog input PT10300 will be PI10300.

The Tag Comment shall have as clear a description of the service and description of the point as possible with 24 characters maximum in accordance with the customer IO database. The faceplate will display the comment in two 12-character rows so care should be taken to try to generate a comment that can be understood when split.

The Low Limit and High Limit fields shall be the low and high scale ranges associated with the transmitter.

The Unit field shall be the engineering units associated with the transmitter following the engineering units table from the integrated PCS (CENTUM VP) project.

BOOL/ECW_B | DINT/REAL/ECW_I/ECW_R | ANLGI/ANLG_S | VEL | ANN | IO_REAL | IO_BOOL | GOV_B/GOV_IB/OVR_B/OVR_IB | OVR_I/OVR_R/OVR_IR | PASSWD | SCI_B/SCO_B | SCI_I/SCO_I/SCI_F

Variable Name	Tag Name	Tag Comment	Comment	Low Limit	High Limit	Unit
PI10100	PI10100	TANK PRESSURE	TANK PRESSURE	0.0	200.0	BAR
PI10200	PI10200	TANK PRESSURE	TANK PRESSURE	0.0	200.0	BAR
PI10300	PI10300	TANK PRESSURE	TANK PRESSURE	0.0	200.0	BAR
PI10400A	PI10400A	TANK PRESSURE	TANK PRESSURE	0.0	200.0	BAR
PI10400B	PI10400B	TANK PRESSURE	TANK PRESSURE	0.0	200.0	BAR
PI10500A	PI10500A	TANK PRESSURE	TANK PRESSURE	0.0	200.0	BAR
PI10500B	PI10500B	TANK PRESSURE	TANK PRESSURE	0.0	200.0	BAR
PI10500C	PI10500C	TANK PRESSURE	TANK PRESSURE	0.0	200.0	BAR

Figure 75 -ANLGI / ANLG_S Tab Example

ANN TAB

Points created in the dictionary shall have the Tag Name field the same as the Variable Name field.

Points from instanced user defined function block outputs shall have the Tag Name field follow the tag naming convention. Variable Naming Convention shall have the Tag Name field follow the expanded tagging convention on a per project basis.

Annunciator Message field shall include the tag name, equipment or group, and description with 80 characters maximum.

BOOL/ECW_B | DINT/REAL/ECW_I/ECW_R | ANLGI/ANLG_S | VEL | ANN | IO_REAL | IO_BOOL | GOV_B/GOV_IB/OVR_B/OVR_IB | OVR_I/OVR_R/OVR_IR | PASSWD | SCI_B/SCO_B

Element Name	Variable Name	Tag Name	Annunciator Message
%AN0016	PXA10400	PXA10400	PST10400 High High Alarm
%AN0017	PXA10500	PXA10500	PST10500 High High Alarm
%AN0018	PI10400.DEV	PDA10400	PST10400 Deviation Alarm
%AN0019	PI10400.PRETRIP	PPA10400	PST10400 High Alarm
%AN0020	PI10400.TRIP	PXA10400	PST10400 High High Alarm

Figure 76 -Annunciator Tab Example

ALL OTHER TABS

Points created in the dictionary shall have the Tag Name field the same as the Variable Name field and Tag Comment field the same as the Comment field.

Points from instanced user defined function block outputs shall have the Tag Name field follow the tag naming convention. The Tag Comment shall have as clear a description of the service and description of the point as possible with 24 characters maximum. If the point has a faceplate, the faceplate will display the comment in two 12-character rows so care should be taken to try to generate a comment that can be understood when split. Variable Naming Convention shall have the Tag Name field follow the expanded tagging convention on a per project basis.

21.2.2 CENTUM VP/ ProSafe-RS integration

ProSafe-RS shall provide all signals required by the CENTUM VP graphics through the Tag Name Builder. These signals shall include analog ANLG_S blocks, trip/shutdown signals, maintenance, startup override feedback, SIS/FGS process alarms, transmitter fault signals and timers included in logic.

21.2.3 Alarm priority building

Alarm Priority Builder setting must match the alarm priority setting in CENTUM VP PCS. If a mismatch occurs a warning shall occur when the program is built or compiled.

21.2.4 Alarm Processing Table Builder

SIS/FGS(SCS)/PCS(FCS) integration, the Alarm Processing Table is used to determine the Alarm Priority of process alarms raised by function blocks (FBs) or mapping blocks. Each block will have the same alarm priority in the Tag Name Builder, but the individual alarms associated with each block can be assigned different priorities in the builder based on that overall priority. The Alarm Processing Table Builder is edited in the CENTUM VP EWS and then imported into Workbench.

The Alarm Processing Table Builder is used to import the 'Alarm Processing Table' defined on CENTUM VP to the SCS project. In the CENTUM VP integration structure, the application of ProSafe-RS needs to be defined with those builders. Furthermore, engineering of CENTUM VP including SCS definition and configuration, and tag list generation needs to be executed on the CENTUM VP EWS.

The following figure shows the outline of CENTUM VP integration application definition.

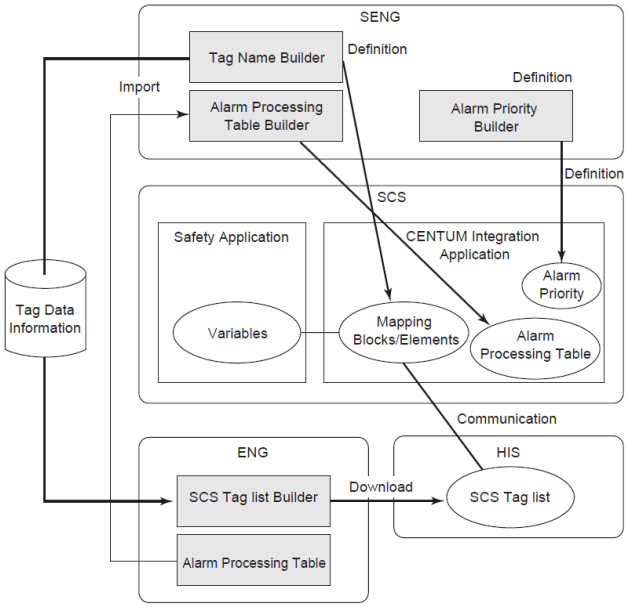


Figure 77 – CENTUM VP Integration

21.3 SECURITY AND PASSWORDS SETTING

21.3.1 Security

All security levels must have passwords configured as per site requirements. Passwords shall be configured during pre-FAT. The security level of SCS indicates how much the memory of SCS is protected from the setting of data from outside. An overview of SCS security level is as follows:

- One SCS has one security level. At any moment of time, the controller can only be in one particular state.
- The security level can be confirmed from an LED on the CPU module and the SCS State Management screen of SCS Maintenance Support Tool.

STATUS lamps	Display	Description
1, 2	Operating Mode	• Running mode: 1 and 2 on • Waiting mode: 1 off, 2 on • Others: 1 and 2 off
3	Security level	Turns on only for security level 2. (*1)
4	Safety control station error (*2)	• Error occurred: off • Normal: on
5, 6, 7	Unused	Always on
8	Writing to flash memories	Writing: off, Otherwise: on

*1: Security level 0 corresponds to offline level and security levels 1 and 2 correspond to online level.
*2: This lamp may be linked to the SYS_DIAG output.

Table 74 – Status Lamps Display Operating Mode and Error Status

- SCS limits changes made online depending on the security level.
- The security level can be referred to by applicable logic.
- The security level can only be changed by an authorized user.
- The system function block (SYS_SEC_CTL) allows control of whether or not security level change operations from a EWS with an external hardware program Enable/Disable key switch.
- The security level can be changed under the following conditions:
  - The SCS is either in the Waiting or Running mode
  - SYS_SEC_CTL is set to allow security level changes or is not used.

There are two classifications of security levels: Online and Offline.

- The Online level is used when the SCS is in normal operation. It can be separated into two levels according to the limits of functions which can be used.
  - Level 2: The highest security level. The SCS runs at this level in normal operation.
  - Level 1: A temporary security level used by authorized users for maintenance of equipment and changing SCS applications online.

- The Offline level is used when SCS is not in normal operation. This is displayed as "Level 0" on the Status Display Window of SCS and EWS. In the Offline Level, the SCS does not limit access to system parameters. Information which was used at test may be stored in SCS databases depending on operations performed by those tools.

Write Operation to SCS	Security Level (*)			Operation
	Level 2	Level 1	Level 0	
Override from OWS	OK	OK	OK	OWS
Operation on password block from OWS	OK	OK	OK	OWS
Operation on manual operation block	OK	OK	OK	OWS
Confirmation of Process alarm	OK	OK	OK	OWS
Setting operation mark on mapping element/mapping block	OK	OK	OK	OWS
Confirmation and Deletion of Diagnostic information	OK	OK	OK	EWS
Setting of system time	OK	OK	OK	OWS /EWS
Change of security level	OK	OK	Error	EWS
IOM Download (**)	OK	OK	OK	EWS
Resetting of Trip signal file	OK	OK	OK	EWS
Change of password for security level	OK	OK	OK	EWS
Lock/unlock variables	Error	OK	OK	EWS
On-demand communication for device management	OK	OK	OK	PRM
Change of variable with forcing function	Error	OK	OK	EWS
Online change download of applications	Error	OK	OK	EWS
I/O lock function	Error	OK	OK	EWS
Communication I/O lock function	Error	OK	OK	EWS
Switching Control right for dual-redundant AIO/DIO modules	Error	OK	OK	EWS
Offline download	Error	Error	OK	EWS
Application Debug function	Error	Error	OK	EWS
Restart of SCS from EWS	Error	Error	OK	EWS
Output Enabled Operation	OK	OK	OK	EWS
Save/Download Operation Marks	OK	OK	OK	EWS
Output module starting operation	OK	OK	OK	EWS

Table 75 – Operations Performed to SCS and Required Security Levels

21.3.2 System Program Enable Switch

System Program Enable Switch is a hard-wired switch and shall be in applicable system cabinet. This Key provides protections against unauthorized access and modification to system logic.

- System key is normally set to REMOTE position. The ProSafe-RS logic security level is set and locked at level 2, which is read only mode.
- When System key is set to PROGRAM position, security level remains at 2 but is allowed to be changed to 1 or 0 for online and offline download.
- When System key is switched from PROGRAM to REMOTE position, the logic will enable all locked or disabled variables then set security level back to 2. Enabling disabled variables is necessary to ensure that System key input will not be kept in locked state, which will cause security level and variable enable feature locked down.

21.3.3 Passwords

- Passwords for the security level are controlled in SCS.
- A password for the security level is set for each security level. Passwords are required to be set for changing to Level 1 and Level 0. A password is not necessary to change to Level 2.
- A password is a maximum of 16 alphanumeric characters and is upper/lower case sensitive.
- Passwords are maintained during a power cut and restart of SCS.
- Security Level Passwords are deleted when SCS Off-line Download is performed. Security level passwords shall be set upon start up.

21.3.4 Setting and Changing Passwords

- Authorized users may change passwords on the SCS Manager in EWS.
- Passwords can be changed when the SCS is online.
- When a password is changed, the person who changes it must enter the old password before it is changed.
- When a password has been changed, the SCS notifies its change with a Diagnostic Information Message.

21.4 SPECIFICATIONS AT STARTUP

A SCS always performs the initial cold start processing when it starts up. It does not have a function that allows it to resume the operating mode as it was before stopping. The operating mode at startup is always the Stop mode. An SCS can start up in one of the following three ways:

- After Power Recovery Start. An SCS starts up in this way when the power supply is resumed after a power failure.
- Start after Off-line Download. An SCS starts up in this way when the user performs off-line download from the EWS. Security Level Passwords are deleted when SCS Off-line Download is performed. Security level passwords shall be set upon start up. Refer IM32P01B10-01EN ProSafe-RS User Guide for detailed configuration.

- Manual Restart. An SCS restarts when the restart switch of the CPU module is pressed, or the user performs SCS restart operation from SCS Manager of the EWS.
- Output Enable. An output enable shall be performed once SCS is Active. The Output Enable Operation will enable the output channels to output the application logic results, initiates inter-SCS safety communication, SCS link transmission and subsystem communication.

21.5 SYSTEM ACTIONS DUE TO ERROR OCCURRENCE

If an error occurs in the system, operations corresponding to the error level must be executed. The following three error levels are specified: fatal error, major error and minor error.

A fatal error disables hardware and/or software so that operation cannot be continued. Both sides of a redundant CPU module stop, and all channels of all output modules will go to the fail-safe state.

A (system) error does not affect the application logic execution function itself. In a redundant hardware device, if an error occurs in one of the devices, the control right is switched to the standby side to continue the processing. Such errors are regarded as minor. The fact that a switch over occurred due to a failure is notified via a diagnostic information message. Since the SCS can continue controlling in this case, the data status is not changed nor is any error status notification to system function blocks performed.

21.6 SOFTWARE AND I/O FORCING

It is possible to force individual inputs and outputs to the logic '0' or '1' state or manipulate analogue and time values or any other types via SCS Manager on the EWS. This is a facility to support off-line field device test and maintenance. The SCS must be in non-secure mode to enable the I/O forcing function. All forces are disabled (removed) if the SCS is switched back to the secure mode. This function can be used to cancel all the forces (locking statuses) in such an emergency as the unavailability of SCS Manager due to a EWS fault.

The presence and total number of forced variables shall be reported to PCS. If variables in the system are forced for more than 4 hours an alarm will be generated every 4 hours, these facts are notified as diagnostic system status information.

21.7 ON-LINE AND OFF-LINE MODIFICATIONS

ProSafe-RS allows both the application to be modified and specific I/O module settings to be changed on-line. The SCS Manager on the EWS is used for editing the work database. The edited work database, when being downloaded to SCS with On-line Change Download, is automatically saved in the master database.

The Master Database Restoration Function deletes the SCS database which is being edited in the work database and replaces it with the master database. Do not Set/Reset Maintenance overrides from HIS while executing an on-line download to SCS.

List of applicable online changes as follows.

Corrected item	Description
Adding/deleting a variable	-
Deleting variables and adding variables with the same names as the deleted variables	-
Changing the types of variables	-
Changing attributes of variables	-
Adding/deleting I/O variables	-
Adding/deleting the standard FB instances	-
Adding/deleting the user-defined FB instances	Including FB defined in the library. A project that is created with the revision earlier than R3.02.00 will be in the same condition as R3.02.00 when clean project is executed. Therefore, you can perform online change download.
Deleting FB instances and adding FB instances with the same names as the deleted ones	
Changing the types of FB instances	

Table 76 – Operations that Can be Changed Online for Variables and Instances Used in Program

Modification	Description
Adding/deleting a variable	-
Deleting variables and adding variables with the same names as the deleted variables	-
Changing the types of variables	-
Changing the attributes of variables	-
Adding/deleting the standard FB instances	-
Adding/deleting the user-defined FB instances	Including FB defined in the library. A project that is created with the revision earlier than R3.02.00 will be in the same condition as R3.02.00 when clean project is executed. Therefore, you can perform online change download. When adding user-defined FU/FB, the added user-defined FU/FB must be tested. When adding pre-validated user-defined FB, testing of the FB itself is not required.
Deleting FB instances and adding FB instances with the same names as the deleted ones	Including FB defined in the library. A project that is created with the revision earlier than R3.02.00 is in the same state as R3.02.00 when clean project is executed. Therefore, it can perform online change download.
Changing the types of FB instances	

Table 77 – Online Changes of User –Defined FB and FU

Modification	Online Change (*1)
Adding nodes	Yes
Deleting nodes	Yes
Changing parameters of nodes	Yes
Adding I/O modules	Yes
Deleting I/O modules	Yes
Changing redundant I/O modules	Yes
Changing parameters of I/O modules	Yes
Changing parameters of channels	Yes
Changing parameters of serial communication modules	Yes
Defining wiring between a variable and an idle channel	Yes
Deleting wiring between a channel and a variable	Yes
Changing wiring between a channel and a variable	Yes
Adding, changing or deleting subsystem communication definitions	Yes
Changing wiring of communication input/output FBs	Yes
Adding or deleting ESB bus coupler modules	Yes

*1: Yes: Online change download is possible.

Table 78 – I/O Module Information that is Changeable Online

Classification	Modification	Online Change (*1)
Configuration	Name	No
	Password	No (*2)
Resource	Name	No
	Resource Number	No
	Cycle Timing	Yes
	Memory size for online changes	No
	Memory size for temporary variable	No
Network	IP address	No
	Station address	No
	Inter-SCS safety Communication (Binding)	No

*1: Yes: Online change download is possible.
No: Offline download is required.
*2: Setting and changing passwords is ignored.

Table 79 – Constants and Network Information Changeable Online

Items	Online Change (*1)
SCS Constants Builder	Yes (*2)
I/O Parameter Builder	Yes
Communication I/O Builder	Yes
SCS Link Transmission Builder	Yes
Modbus Address Builder	Yes
DNP3 Communication Builder (*3)	Yes (*4)
Tag Name Builder	Yes
Alarm Priority Builder	No
Alarm Processing Table Builder	No

*1: Yes: Online change download is possible.
No: Offline download is required.
*2: Some items are enabled. A breakdown showing which items are and are not enabled is provided in "Table of SCS Constants Builder online change."
*3: Usable only when the version of SCSU1 is R3.02.20 or later
*4: Some items are enabled. A breakdown showing which items are and are not enabled is provided in "Table of DNP3 Communication Builder online change."

Table 80 – Builder Definitions Changeable Online

Items	Online Change (*1)
Interval of Repeated Warning Alarms	No
Synchronous Mode	No
Scan Period for External System	No
Modbus Word Order	No
16-bit Modbus master support mode	No
Alarm Notify Action when AOF Released	No
PV Status of S_ANLG_S	No
DNP3 Slave Function (*2)	No
Optical ESB Bus Repeater	No
Maximum Extension Distance	No
Extend Scan Period Automatically	Yes
Behavior at Abnormal Calculation	Yes
Locking of Internal Variables (*3)	Yes
Automatic IOM Download	Yes

*1: Yes: Online change download is possible.
No: Offline download is required.
*2: Displayable only when the version of SCSU1 is R3.02.20 or later
*3: Only for SCSP2

Table 81 – SCS Constants Builder Changeable Online

22 OVERRIDES

The various types of overrides that shall be used in the project are: Operational Override (OOS) and Maintenance(MOS). Overrides are utilized during startup, maintenance, construction and equipment testing. The following is a general description for initiating the overrides and their effects.

22.1 OPERATIONAL OVERRIDE SWITCH (OOS)

To be able to start equipment or sections of process, it shall be necessary to override some inputs of the safety system, as sensor signal may be in an abnormal state prior to start-up and could cause a shutdown. Such overrides are designated as "Start-Up Overrides".

Activation of OOS shall be carried out automatically as far as possible by the SIS system during a start-up sequence, but some OOS may have to be set manually by the operator from the SIS Console. (e.g. automatic = pump discharge low pressure and manual = high level in a compressor scrubber).

Each OOS function shall be reset automatically either by the sensor signal reverting to the normal or healthy status, after a dedicated step of the equipment start-up sequence or after a predetermined time delay, or by a set of process conditions. If cancelled automatically by the sensor signal, the input logic shall prevent spurious trips being caused by oscillation of the input around the reset value.

Indication of the raw statuses of the sensors overridden by automatic start-up shall be shown into the OWS graphic displays and recorded on the event log.

22.2 MAINTENANCE/TESTING DEVICE OVERRIDE (MOS)

During normal unit operating conditions, maintenance and operations personnel shall be required to perform maintenance and testing procedures on safety devices and equipment. During these procedures, the shutdown logic for each device shall be overridden but shall allow the audible and visual alarms for each device to be fully functional. This shall include devices in the SIS/FGS Systems. This shall allow maintenance or operations personnel to complete all testing procedures under safe working conditions.

The MOS will be enabled by signal from SCADA (MOS enable switch) located on CAP. The override signal shall be used in the analog input processing templates to inhibit trip. Return of the MOS enable switch will disable and remove all active Maintenance Overrides. MOS function will override both trip and fault signals of an input.

In the case of 1oo1, the override will inhibit the trip. In the case of 1oo2 and 2oo2, the override will be treated as a negative override to force the logic to 1oo (N-1) or 1oo1. Override logic will be handled in voting logic.

If an overridden transmitter remains in faulty condition while its override function is removed, UZ logic trip will occur. This logic only applies to non-redundant transmitters since override and fault logics for voting transmitters are handled by voting logics.

The Project's SRS shall specify which sensor types will not be provided with a MOS (e.g. manual trip switches and flame sensors).

23 PROSAFE-RS VERSION CONTROL MANAGEMENT

The ProSafe-RS application software comes with a version control tool. It allows progressive tracking through version control of the user application logic at various stages of development and implementation. The version control function is intended for controlling the version History of SCS projects to support users' system update.

The version control tool function serves the following purposes:

Name	Description
Version control of project Data	Save engineering data at a project milestone or at the end of engineering in different hard disks (check-in). Refer section 23.2 of this document for version control procedure which shall be followed for this project.
Backing-up project data	Checked-in data can be used as backup data. Checked-in project data can be checked out and restored
Replacing by revised project with large-scale changes	When making large-scale changes to an SCS project, it is recommended to perform engineering tasks on temporarily copied project data, rather than editing the active project data directly; this way, the active project data can be replaced with the new project data at the end of engineering.

Table 82 – List of ProSafe-RS Version Control Tool Function Overview

23.1 VERSION CONTROL TOOL

The version control tool performs the following functions:

1. Check-in and check-out of project data
2. Deletion of versions and check-in projects
3. Reading and printing of version information
4. Designation of check-in folders and SCS projects to be version controlled

A typical ProSafe-RS version control tool function is described as below.

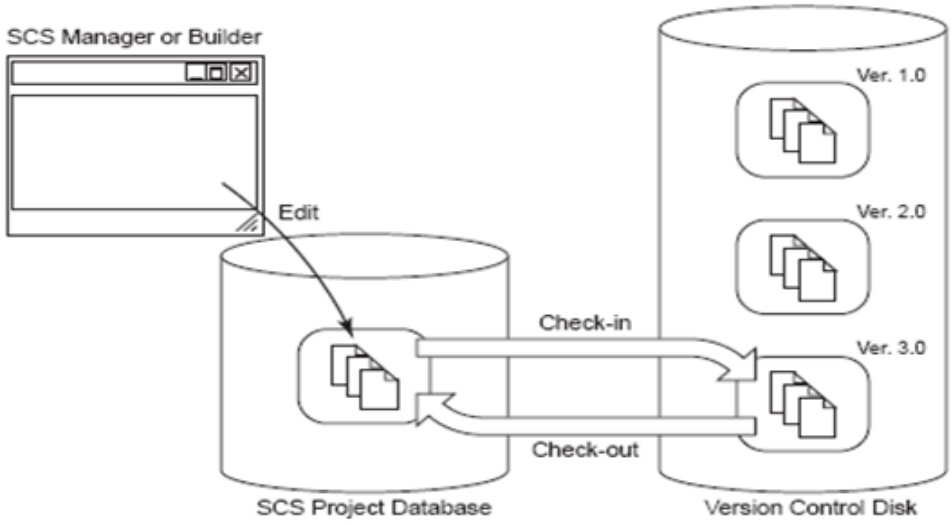


Figure 78 – Version Control Tool Function.

23.2 VERSION CONTROL NUMBERING

This section describes the version control numbering to be applied throughout the code development lifecycle of the application software from the engineering stage to FAT for this project. Beyond SAT and throughout the operational lifetime of the asset, the end-user's version and disaster recovery procedures shall be applied.

Item	Check in Timing	Version Control Number
During Detailed Engineering	Initial SCS Project Creation	-
	Changes in database	-
	End of Detailed Engineering	1.00
	Check-in path	Note 1
During Internal Test	Initial SCS project save during int. test starts	1.00
	Changes in database	Increment second decimal (e.g., 1.01, 1.02 etc.)
	End of Internal FAT	2.0
	Check-in path	Note 1
During FAT	Initial SCS project save during FAT starts	2.00
	Changes in database	Increment second decimal (e.g., 2.01, 2.02 etc.)
	End of FAT	3.00
	Check-in path	Note 1

Item	Check in Timing	Version Control Number
During SAT	Initial SCS project save during SAT starts	3.00
	Changes in database	Increment second decimal (e.g., 3.01, 3.02 etc.)
	End of SAT	4.00
	Check-in path	Note 1

Table 83 – Version Control Numbering

Note 1: The version-controlled databases are to be copied to other location in local EWS immediately after the project check-in activity completion as per the above schedule. The path to maintain the version data in the local EWS shall be

- D:\BLPH\VERSIONCONTROL\SCR XX\SCSddss

  BLPH – Project Name

  SCR XX – SCR Number (E.g., 01, 03…)

  SCSddss – SCS version control backup

This path shall contain the respective Unit's / System's SCS version control backup. The version control path shall be a different folder path than RS Projects.

The check in settings will include 'Engineer Name', 'Comment' and 'Note'. The 'Note' shall refer to the 'Punch List' during internal FAT and FAT phase.

The Punch List shall include the 'Safety Impact Review', 'application version number before modification' and 'application version number after modification' for the respective design change due to the test incidents.

24 TAG NAMING PHILOSOPHY

24.1 PHYSICAL IO VARIABLE NAMING

This section details the naming convention as applied to variables assigned to AI, DI, AO and DO channels and used in the application logic.

All input and output variables such as Analog Inputs (AI), Digital Inputs (DI), Analog Output (AO) and Digital Outputs (DO) shall adopt the same variable naming philosophy as detailed in the following table.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
_	U	U	U	X	X	X	X	X	S1	S2	S3	Y1	Y2	Y3

Were,

_	Used in the beginning of SIS field signal
UUU	Unit Code (ex: 01, 90)
XXXXX	Instrument type, Minimum 2 characters, and Maximum 5 characters
S1S2S3	Component Number, Minimum 2 characters, and Maximum 3 characters
Y1Y2Y3	Sequence Number

Each physical IO variable will contain a maximum of 16 characters.

Type	Field IO Tag name	ProSafe-RS Variable name	In builder Tag Name
Analog Input	01-FT-012AA	_01FT012AA	01FT-012AA
Digital Input	01-BSL-501A	_01BSL501A	01BSL-501A
Digital Output	114HY0002	_114HY0002	114HY-0002

Table 84 – Physical IO Variable Naming

If the total length exceeds 16 characters, certain portions of the name must be truncated, and a unique identifier added to differentiate them.

The "Unique Identifier" shall be determined in consultation with the Contractor with respect to their acceptable naming format. This is only necessary if the existing tag names in the IO database exceeds 16 characters.

24.2 TAG COMMENTS NAMING

A tag comment can be defined using up to 24 single-byte or 12 double-byte characters. On each faceplate, the Tag Comment will occupy 2x rows of 12-single byte or 6-double byte characters.

Tag Comment Convention shall be: "XXXXXXXXXXXX" (first row) + "YYYYYYYYYYY" (second row)

where:

XXXXXXXXXXXX	12-Single byte / 6-double byte to describe Equipment Name / Process Area of related tag (TGCOMM)
YYYYYYYYYYYY	12-Single byte / 6-double byte to describe Tag Function (e.g., TGCOMM2, Reset, Shutdown, Override, etc.)

It is suggested to consider use of appropriate spacing and alignment of words to avoid breaking up of descriptions between the two rows to ensure readability. For example,

1. When all the characters are used in the first row, then between the first row and second row characters, there should not be any empty spaces as the faceplate will automatically start the display for the 13th character on the second row.
2. In case the last word on the first row does not end on the last character of the first row, then empty spaces must be added to ensure the first word of the second row starts on the first character of the second row.

The tag comment must be defined as part of the design and engineering inputs for physical I/O tags by CONTRACTORS.

24.3 INTERNAL VARIABLE NAMING

Internal Variables are the most common type of variables or tags to be declared in the Workbench application environment. This section describes the naming convention as applied to any variables used in the application logic for intermediate logic states or temporary storage of calculation results, which maybe independent or related to the Input and Output variables.

Below naming philosophy is used for internal variables used in applications such as SIS C&E, F&G C&E:

Type	ProSafe-RS Variable name	Internal Variable name	In builder Tag Name
Analog Input	_01FT012AA	_01FT012AA+FB PIN	01FT012AA+ FB PIN
Digital Input	_01BSL501A	_01BSL501A+ FB PIN	01BSL-501A+ FB PIN
Digital Output	_114HY0002	_114HY0002+ FB PIN	114HY0002+ FB PIN

Tag names shall be adjusted due to limitation of 18 characters for internal tag names & 16 characters for HIS tag names in ProSafe-RS.

24.4 FUNCTION BLOCK INSTANCE NAMING

Function blocks are commonly used for specific logical operations and generating intermediate variables for use in the application logic.

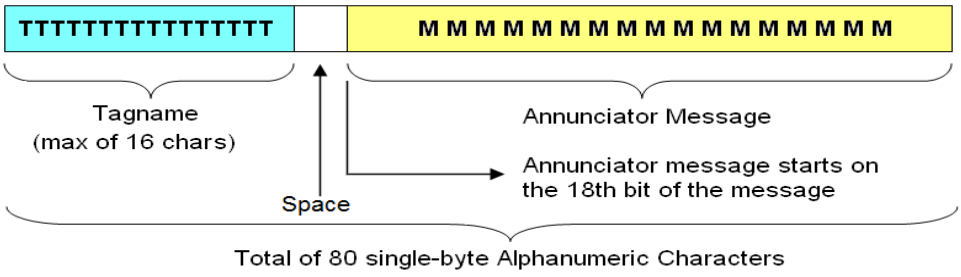
Function Block	Prosafe – RS IO Variables	Prefix	Suffix	Instance Name
Analog input UDFB	_01FT012AA	AI	-	AI_01FT012A

Function Block	Prosafe – RS IO Variables	Prefix	Suffix	Instance Name
Digital input UDFB	_01BSL501A	DI	-	DI_01BSL501A
Digital output UDFB	_114HY0002	DO	-	DO_114HY0002
Safeguarding UDFB (per Interlock)	Interlock 01-IS-001 for Unit 01	UZ	-	UZ_01IS001_01
Fire Zone UDFB (per Interlock)	Interlock 04-IF-501 for Unit 04	UZ	-	UZ_04IF501_01
Voting UDFB	02-GD-021-A / B / C	VT23 VT13	HH HI	VT23_02GD021HH (For, HH-2oo3) VT13_02GD021HI (For, HI-1oo3)

Table 85 – Function Block Instance Naming

24.5 ANNUNCIATOR MESSAGE DESIGN

This defines a message notifying a process error. An annunciator message can be defined using an arbitrary character string consisting of up to 80 single-byte characters or 40 double-byte characters. The General message structure is described below in figure.



Pzi

Figure 79 – Annunciator Message Structure.

TTTTTTTTTTTTTT : Tag name

MMMMMMMMMMM : Annunciator message (Tag comments and functions)

The annunciator is usually taken from the IO List (Service Description).

Notes:

1. Tag names are derived from the Tag names defined in IODB & Centum VP Integration Tag name.
2. The abbreviation for instance name defined for ANN function block in UDFB is described subsequently.

SIS:

Type	I/O Type	Annunciation Type	Annunciation Philosophy
Trip Initiator	Digital Input	Trip state (except limit switch)	TAGNAME+ SERVICE +TRP
		Trip state (limit switch)	TAGNAME+SERVICE+OPN (for Open limit switch)
			TAGNAME+SERVICE+CLS (for Close limit switch)
	Analog Input	Trip state	TAGNAME + SERVICE +TRP
Final Control Element	Digital Output	Trip state	TAGNAME + SERVICE
Operation Override		OOS activated warning	TAGNAME + SERVICE + OOS ACT
First Out		First – Out Alarm	TAGNAME + SERVICE + FO

Table 86 – SIS Annunciation Philosophy

FGS:

Type	I/O Type	Annunciation Type	Annunciation Philosophy
Detector / Sensor	Digital Input	Active state	TAGNAME+ SERVICE+TRP
		Signal Fault	TAGNAME+ SERVICE + FLT
	Analog Input	Alarm state	TAGNAME + SERVICE + HH/HI/LO/LL
		Open Loop Fault	TAGNAME + SERVICE + IOP
		Over Range Fault	TAGNAME + SERVICE + OVR
		Dirty Optics	TAGNAME + SERVICE + DIRTY OPTICS
		Beam Block	TAGNAME + SERVICE + BB
		Fault	TAGNAME + SERVICE + FLT
Final Control Element	Digital Output	Active state	TAGNAME + SERVICE
		Signal Fault	TAGNAME + SERVICE + FLT
First Out		First – Out Alarm	TAGNAME + SERVICE + FO
Voting Activation Alarm		Voting Trip Alarm	TAGNAME + ALM(HI/HH/LO/LL) + VOT + TRP
Voting Degradation Alarm		Voting Degradation Alarm	TAGNAME + ALM(HI/HH/LO/LL) + VOT + DEG
Voting All Fault		Voting All Fault Alarm	TAGNAME + ALM(HI/HH/LO/LL) + ALL DET FLT

Table 87 – F&G Annunciation Philosophy

24.6 SEQUENCE OF EVENTS (SOE) MESSAGE PHILOSOPHY

The SOE message for each user-configurable event shall be defined according to the following convention for this project:

1. Maximum of 32-single byte or 16-double byte alphanumeric characters

Event ID to comprise of 3 portions (with empty space in between) and based on:

- Tag name
- Abbreviated equipment name / location

- Functionality

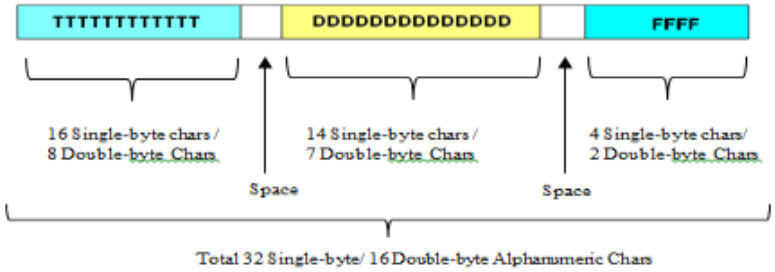


Figure 80 – SOE Message Structure.

- TTTTTTTTTTTT : Tag name
- DDDDDDDDDDDDD : Description (equipment name / tag comment/ location)
- FFFF : Function (maximum of 4 chars)

Note: The abbreviated equipment name / tag comment / location is defined by the CONTRACTOR as part of the design and engineering inputs.

Type	SOE Type	SOE Philosophy
SIS Analog Input	Analog input trip initiator	Tag Name + Description + "TRP"
F&G Analog Input	Analog input alarm initiator	TAGNAME + SERVICE + HH/HI/LO/LL
F&G Analog Input (Detector)	Analog input open loop fault	TAGNAME + SERVICE + IOP
	Analog input over range fault	TAGNAME + SERVICE + OVR
	Analog input dirty optics	TAGNAME + SERVICE + DIRTY OPTICS
	Analog input beam block	TAGNAME + SERVICE + BB
	Fault	TAGNAME + SERVICE + FLT
Maintenance Override	Maintenance Override activation status	TAGNAME + SERVICE + MOS
Operation Override	Operation Override activation status	TAGNAME + SERVICE + OOS
First-out	First-out alarm events (Trip)	TAGNAME + SERVICE + FO
Voting Activation	Voting Trip activated	TAGNAME + ALM(HI/HH/LO/LL) + VOT + TRP
Voting Degradation	Voting degraded	TAGNAME + ALM(HI/HH/LO/LL) + VOT + DEG
Voting All Fault	All detectors in voting fault	TAGNAME + ALM(HI/HH/LO/LL) + ALL DET FLT

Table 88 – Sequence of Events Message Philosophy

Notes:

SOE for digital I/O's will be module based and not in the function block level. Hence, tag comment in the workbench dictionary will become the SOE for digital I/O's. The SOE philosophy for digital I/O's is as follows:

1. Message should be defined in Dictionary Tag comment for IO_BOOL variables.
2. The abbreviation for SOE instance name defined in UDFB is described subsequently.

The path to maintain the SOE configuration files in the local EWS shall be:

- D:\BLHPREF\SOE

24.7 COMMUNICATION BETWEEN (FCS - SCS) / (SCS – FCS):

In this project, signal sent from SCS to PCS shall be via Vnet/IP using SCS Tag name Builder. Communication naming convention

1. Sending Variable Names
2. Receiving Variable Names

Sending Variable Names:

Sending variables can be IO Variable or Internal Variable and their respective variable naming conventions shall be observed if customer not provided.

The tagging philosophy for the sending tags will be as below:

SddssFddss_DIYY

S – Constant (S – SCS)

F – Constant (F – FCS)

dd – Domain Number

ss – Station Number

DI– DINT

YY – Sequence number

For example – SCS0101 sending set of 16 bits with pack function to FCS0103 with sequence no. 1 is configured as S0101F0103_DI1 in SCS0101. In this case Instance name will be 'P_S0101F0103_DI1'.

Receiving Variable Names:

Receiving variables can be IO Variable or Internal Variable and their respective variable naming conventions shall be observed if customer not provided.

The tagging philosophy for the receiving tags will be as below:

FddssSddss_ECYY

F – Constant (F – FCS)

S – Constant (S – SCS)

dd – Domain Number

ss – Station Number

EC– ECW_I

YY – Sequence number

For example – FCS0104 sending set of 16 bits with pack function to SCS0103 with sequence no. 1 is configured as F0104S0103_EC1 in SCS0104. If 5th bit of this signal must be used in logic, F0104S0103_EC1.5 is to be used. In this case Instance name will be 'U_F0104S0103_EC1'

25 SCS SYSTEM SOFTWARE LICENSE

The following are the software license shall be used for this project.

Description	Software License
Project ID License	RS4CPJT-V11
Safety System Engineering and Maintenance Function & Server Function	RS4E5100-V11
Electronic Instruction Manual	RS4C5400-V11
Software Media	RS4CKM-V11
Project I/O License	RS4F3100-V11
CENTUM VP Integration Package	RS4E5600-V11
Safety Control Function (for S2SC70x)	RS4F1500-V11

Table 89 – ProSafe-RS SCS System Software License

Note:

The Project ID license must be unique for ProSafe-RS system for this project and will be different from PCS.

26 PROSAFE-RS ENGINEERING PROCEDURE FOR CENTUM VP INTEGRATION

In this project, signal sent from safety systems to PCS shall be via Vnet/IP using SCS Tag name Builder.

Signal sent from PCS to safety systems shall be using SEBOL (Periodic Execution).

The CENTUM integration function of ProSafe-RS provides a seamless interface for accessing SCS by Centum VP system. Accessing of SCS data from PCS is also treated the same as the PCS to access other PCS.

In the Centum VP Integration Configuration, engineering needs to be performed both by the EWS functions and the Centum VP Engineering Functions. The figure shows the engineering procedure in the Centum VP Integration Configuration.

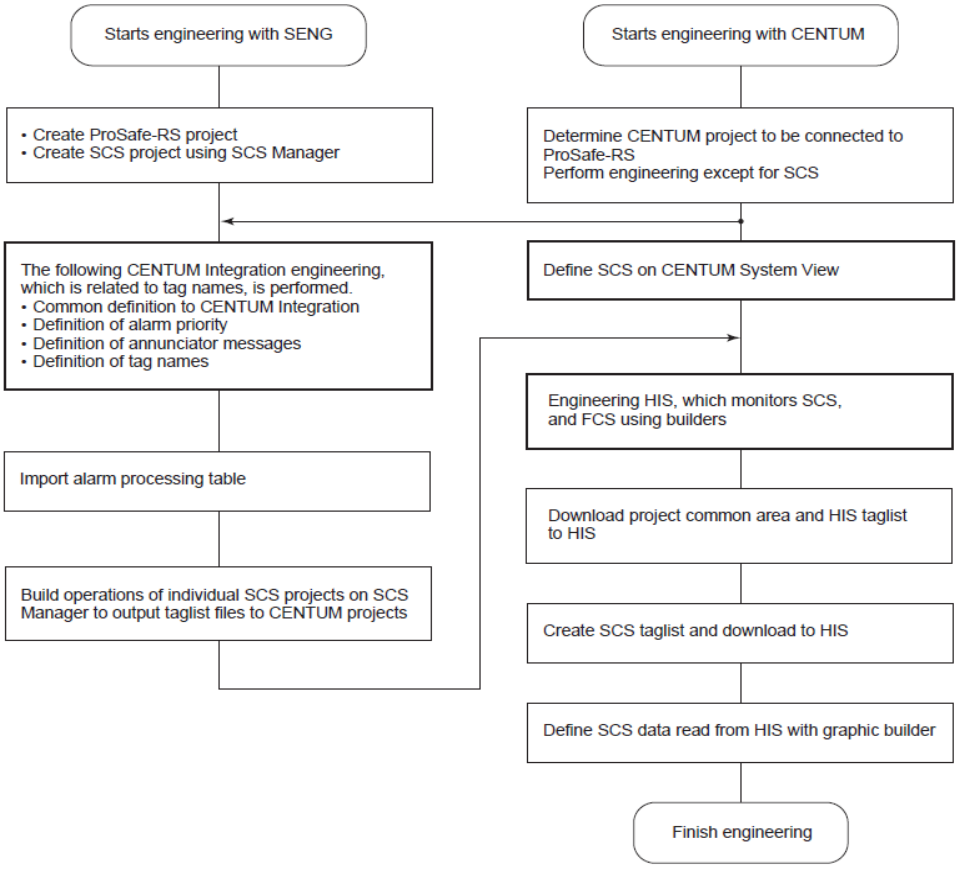


Figure 81 – ProSafe-RS & Centum Integration Engineering Procedure

Engineering Function	Description	ProSafe-RS Builder	Project Definition
Common definition of Centum PV Integration	Defines the top folder of the Centum VP project	SCS project property	Will be finalized during detailed engineering. Refer Functional Design Specifications – PCS Software

Engineering Function	Description	ProSafe-RS Builder	Project Definition
Definition of alarm priority	Defines the handling of SCS process alarms, which appear on OWS	Alarm priority builder	The SIS / F&G alarms are defined as high priority alarm. Refer Functional Design Specifications – PCS Software
Definition of alarm processing table	Import the alarm processing table, which is defined on Centum VP	Alarm processing builder	The definition of alarm processing table in CENTUM database is to be imported to ProSafe-RS Refer Functional Design Specifications – PCS Software
Definition of annunciator messages	Defines the contents of process alarms, which appear on OWS	Tag name builder	Refer section 15.2 for Annunciation Design of this FDS.
Definition of tag names	Allows Centum VP to access the variables of application logic by assigning tag names	Tag name builder	Refer section 15.2 Centum VP Mapping Block/Element Naming of this FDS.
Engg Unit	Import the engineering unit, which is defined on Centum VP	Tag name builder	Refer Functional Design Specifications – PCS Software
Switch Position Label	Import the label, which is defined on Centum VP	Tag name builder	Refer Functional Design Specifications – PCS Software

Table 90 – ProSafe-RS & Centum Integration Settings

27 USER DEFINED FUNCTION BLOCKS

27.1 SIS TYPICALS

27.1.1 General

The following sections will describe the User Defined Functions and Function Blocks that will be used to build the Logic Typicals. The blocks in this section are specifically designed to meet the Shell requirements.

Refer attached Typical test reports for the detailed functionalities.

27.1.2 EDI

Digital input signal for normally open type of inputs without Line Monitoring (EDI)

Purpose

This function is used to process the normally open digital input signal without Line Monitoring.

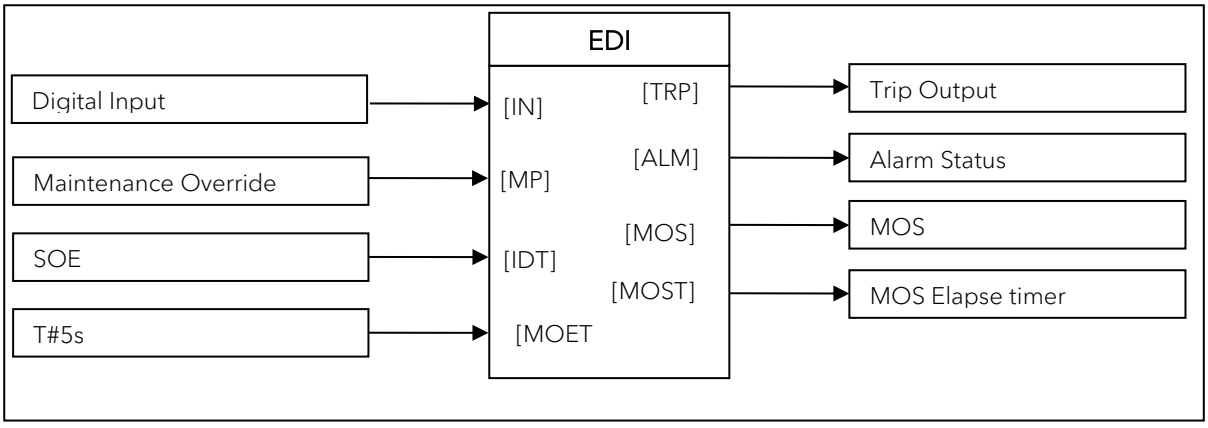
Functionality:

The EDI function block has the following main functions:

- Trip management with alarming function.
- Optional maintenance override functionality.

The functions of the EDI typical are shown below. This typical is used for normally open digital trip initiator inputs based upon energize to trip function without line monitoring function. The typical has optional maintenance override functionality to override the trip function. The alarm output is independent of the MOS functionality.

The field signal for the typical is a digital input. The typical has an alarm and trip output. When the input becomes energized the output will be tripped and will remain tripped until the input value becomes de-energized again. The trip output will be used in the SIS application logic and the status will be indicated on the OWS. MOS shall be enabled from the OWS.



27.1.3 EDI_LM

Digital input signal for normally open type of inputs with Line Monitoring (EDI_LM)

Purpose

This function is used to process the normally open digital input signal with Line Monitoring.

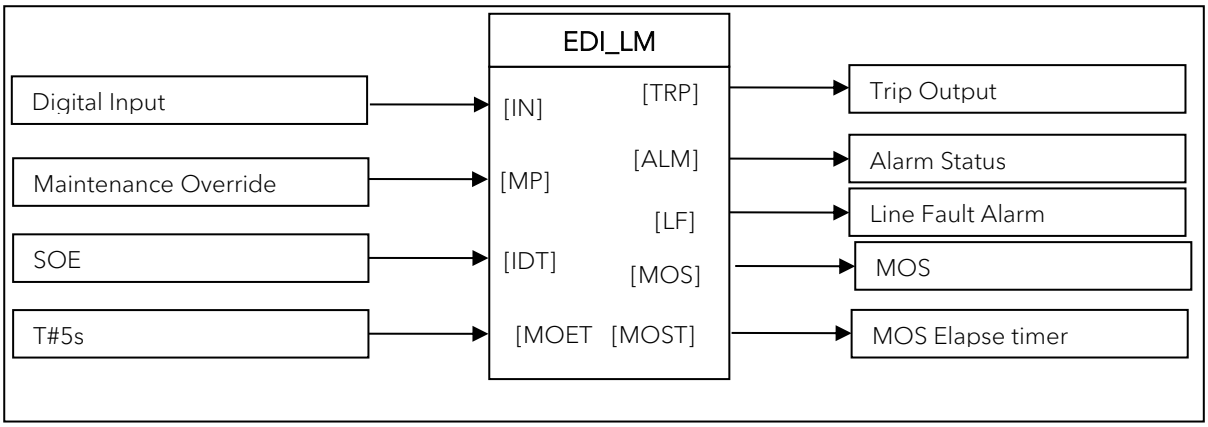
Functionality:

The EDI_LM function block has the following main functions:

- Trip management with alarming function.
- Optional maintenance override functionality.
- Line fault detection.

The functions of the EDI typical are shown below. This typical is used for normally open digital trip initiator inputs based upon energize to trip function with line monitoring function. The typical has optional maintenance override functionality to override the trip function. The alarm output is independent of the MOS functionality.

The field signal for the typical is a digital input. The typical has an alarm and trip output. When the input becomes energized the output will be tripped and will remain tripped until the input value becomes de-energized again. The trip output will be used in the SIS application logic and the status will be indicated on the OWS. MOS shall be enabled from the OWS.



27.1.4 DDI

Digital input signal for normally close type of inputs without Line Monitoring (DDI)

Purpose

This function is used to process the normally close digital input signal without Line Monitoring.

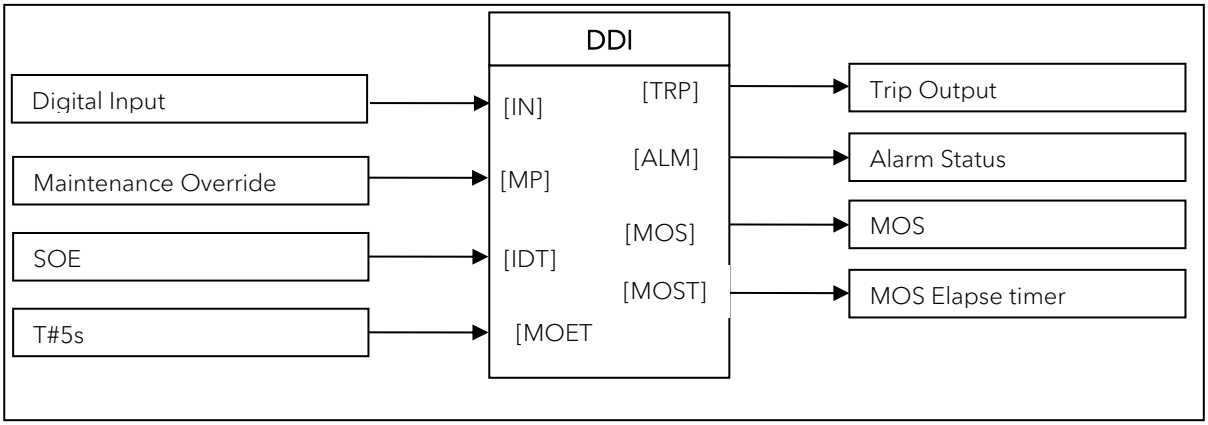
Functionality:

The DDI function block has the following main functions:

- Trip management.
- Optional maintenance override function.

The functions of the DDI typical are shown below. This typical is used for digital inputs based upon de-energize to trip function. The typical has optional maintenance override functionality to override the trip function. The alarm output is independent of the MOS functionality.

The field signal for the typical is a digital input. This typical is applicable for normally closed field contact. The typical has a trip output. In case the input becomes de-energized the output will be tripped and will remain de-activated until the input value becomes energized again. The trip output status alarm will be indicated on OWS. MOS shall be enabled from the OWS.



27.1.5 DDI_LM

Digital input signal for normally close type of inputs with Line Monitoring (DDI_LM)

Purpose

This function is used to process the normally close digital input signal with Line Monitoring.

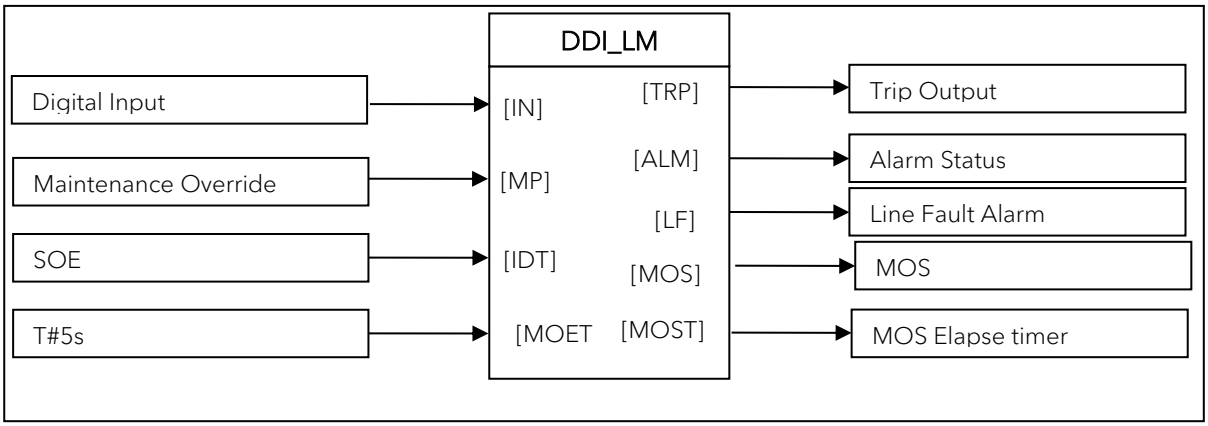
Functionality:

The DDI function block has the following main functions:

- Trip management.
- Line fault detection.
- Optional maintenance override function.

The functions of the DDI typical are shown below. This typical is used for digital inputs based upon de-energize to trip function which require line monitoring. The typical has optional maintenance override functionality to override the trip function. The alarm output is independent of the MOS functionality.

The field signal for the typical is a digital input. This typical is applicable for normally closed field contact. The typical has a line fault alarm and trip output. In case the input becomes de-energized the output will be tripped and will remain de-activated until the input value becomes energized again. The trip output status and line fault alarm will be indicated on OWS. MOS shall be enabled from the OWS.



27.1.6 SAI

SAI Function block is used to scale the Input signal to the Engineering value

Purpose

SAI Function block is used to scale the Input signal to the Engineering value and will generate trip signal when input value exceeds the Set points of LOW, LOW LOW, HIGH & HIGH HIGH.

Functionality:

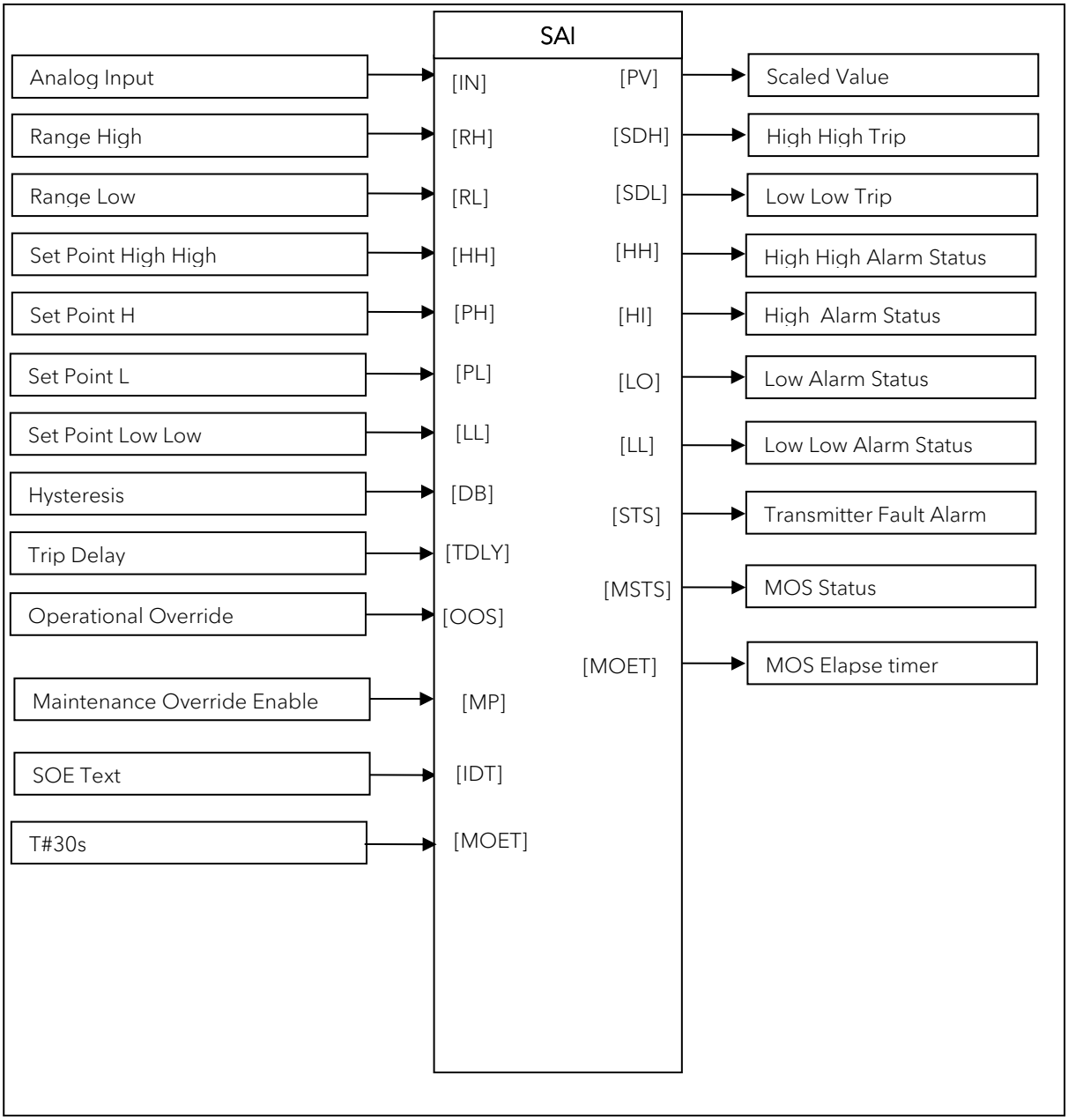
The SAI function block has the following main functions:

- Validity check of the signal.
- Process threshold management.
- Optional functions are maintenance override and operational override functionality

This function block is used in logic applications in order to decide whether the input signal is below the Low, or above the High threshold setting. The image below gives the model for the functions specified for the SAI function block. For the threshold, an optional dead-band DB will be available (hysteresis) when changing from a trip state to a normal state.

When the input value drops below the Low Low set-point, the (LL) alarm and trip (SDL) will be set, and will remain latched until the input value rises above the Low Low set-point plus the dead-band. When the input value exceeds the High High set-point, the (HH) alarm and trip (SDH) will be set, and will remain latched until the input value falls below the High High set-point minus the dead-band.

The trip function can be overridden by the maintenance override. The alarm function is independent of the status of the maintenance override. The trip status and line fault alarm will be indicated on OWS. MOS shall be enabled from the OWS.


SAI
Analog Input
[IN]
Range High
[RH]
Range Low
[RL]
Set Point High High
[HH]
Set Point H
[PH]
Set Point L
[PL]
Set Point Low Low
[LL]
Hysteresis
[DB]
Trip Delay
[TDLY]
Operational Override
[OOS]
Maintenance Override Enable
[MP]
SOE Text
[IDT]
T#30s
[MOET]
[PV]
Scaled Value
[SDH]
High High Trip
[SDL]
Low Low Trip
[HH]
High High Alarm Status
[HI]
High Alarm Status
[LO]
Low Alarm Status
[LL]
Low Low Alarm Status
[STS]
Transmitter Fault Alarm
[MSTS]
MOS Status
[MOET]
MOS Elapse timer

27.1.7 UZGRP

UZGRP typical provides the common functionality for UZ groups in the SIS.

PURPOSE

UZGRP typical provides the common functionality for UZ groups in the SIS. The functions of the typical are trip latching, alarming and first failure identification.

Functionality:

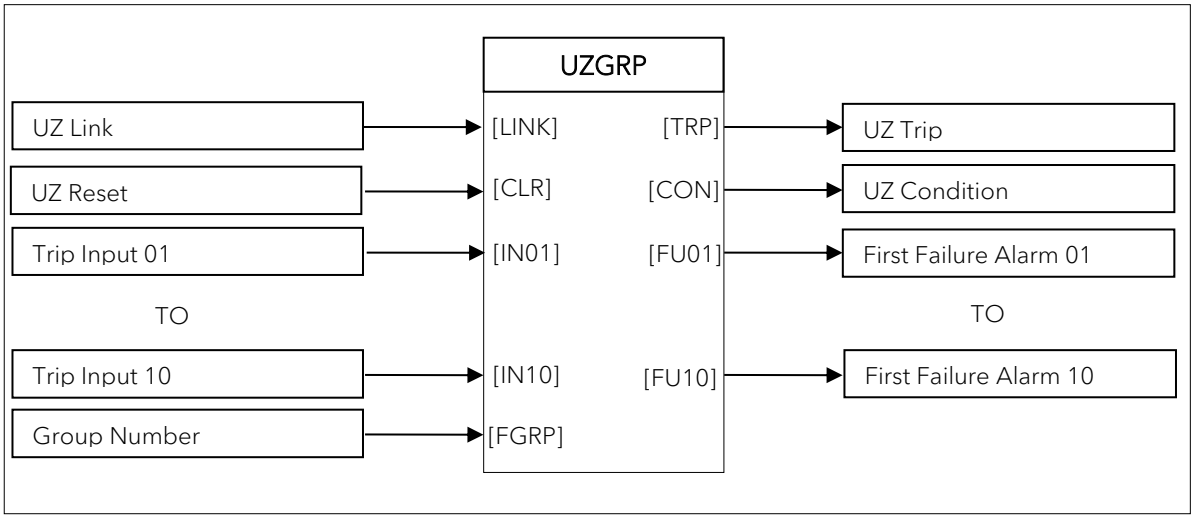
The UZGRP function block has the following main functions:

- Trip the UZ group if one of the inputs is tripped.
- Initiate a First Failure alarm to indicate which trip came first.
- Latch the UZ trip if a trip condition is active and no reset has been applied.

For every process group in the system at least one UZ block is used. The typical UZ block is designed for 10 inputs. Depending on the number of inputs to the group, more UZ blocks may be used for a process group. The UZ block can be linked together in a chain by linking the UZ Link and UZ Condition of the next UZ block together. If only one UZ block is used to trip a UZ group the UZ Link input shall be set to TRUE.

The trip outputs of input typical and/or voting typical in a UZ group are connected to the inputs of the UZ block. A trip condition on an input of the UZ block will trip the UZ group. This will latch the UZ block, further trips on the inputs will be ignored for failure indication, but still affect the UZ group trip. The output of the UZ block will be used in the application logic to the trip related field outputs. The trip alarm and the first failure flag of the tripped input will be shown in the OWS. The Tripped Outputs Latched status will be shown in the OWS until UZGRP is reset.

After all trip conditions are cleared the UZ typical can be reset via the optional UZRST application typical, by a reset signal from SCS. If the UZ group requires an auto-reset function, then the UZ Condition output has to be connected to the Clear input. The Clear input will only react on a positive trigger. The Clear will not only reset the UZ group but also clears the first failure flag, a reset will only have affected if all trip input conditions are normalized (not tripped).



27.1.8 UZRST

UZRST typical will be used to reset UZ safety groups which require a manual reset (from OWS) after a trip.

Purpose

This typical will be used to reset UZ safety groups which require a manual reset (from OWS) after a trip. The UZRST block has an input to indicate UZ trip status and an output to reset UZGRP logic.

Functionality:

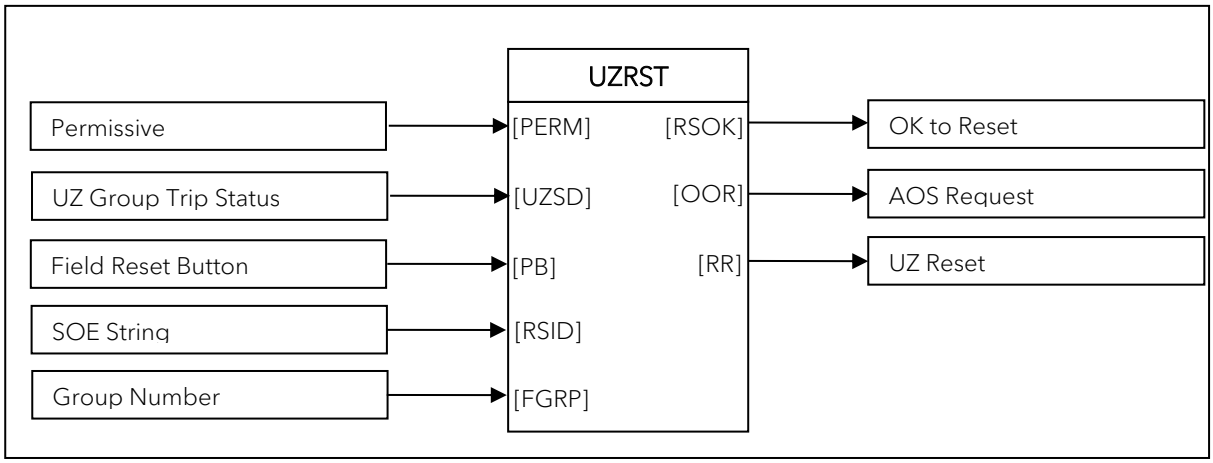
The UZRST function block has the following main functions:

- Reset UZ groups only when SCS Reset operated from OWS or field reset switch has been applied
- Indicate that SCS reset is allowed.

This typical will be used to reset UZ safety groups which require a manual reset (from OWS) after a trip. The UZRST block has an input to indicate UZ trip status and an output to reset UZGRP logic.

To indicate that a SCS reset is allowed (i.e. Permissive is 'TRUE') the status (Ok to Reset) is sent to OWS. After the reset from OWS, the Ok to Reset status will go off.

Push button field input reset is designed for normally open-momentary closed contacts to reset.



27.1.9 SDV_1

SDV_1 function is used for the Fail to Close Valves with limit switch Feedback

Purpose

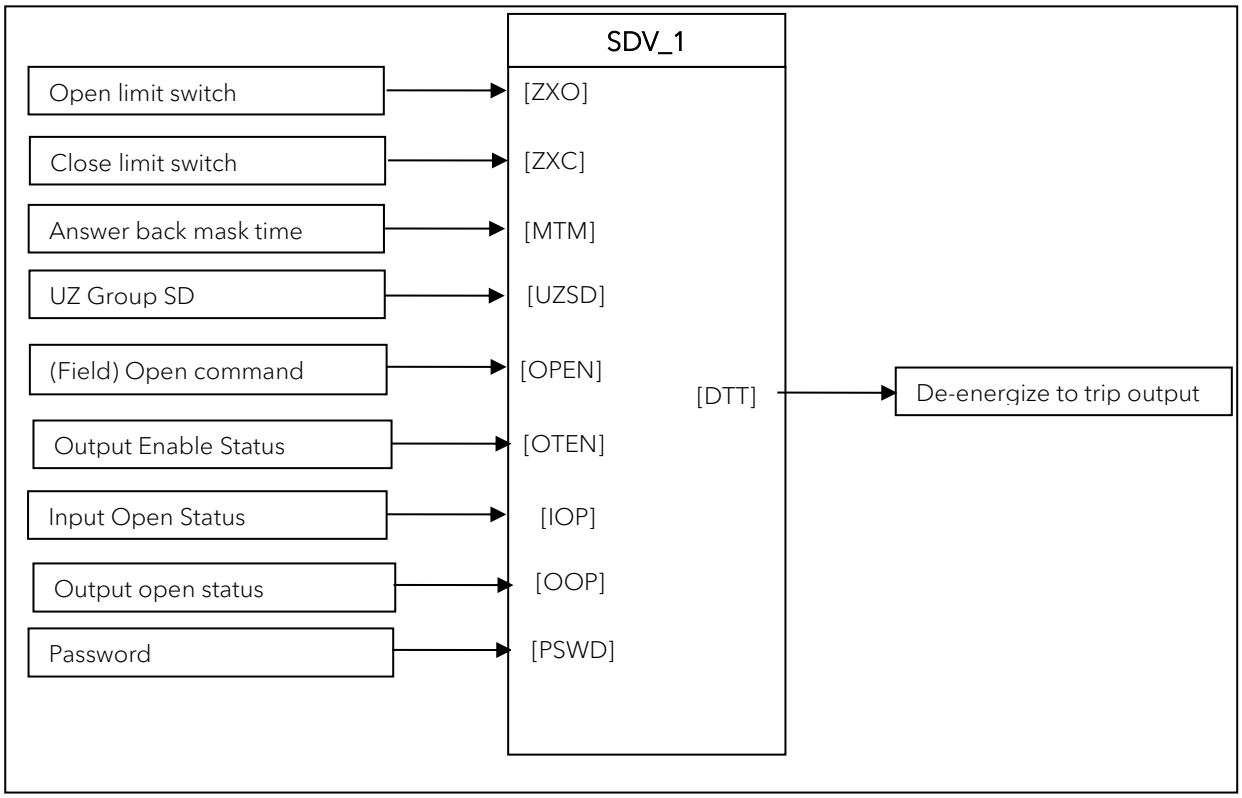
This typical, drives the output to safe-state when the UZSD input trips.

Functionality:

The SDV_1 typical has the following features:

- Valve operation.
- Limit switch feedback (one or two limit switches)

This typical, drives the output to safe-state when the UZSD input trips. When the UZGRP is normal, then open command can be given from the OWS / AUTO open (OPEN nub).



27.1.10 BDV

BDV function is used for the Fail to Open Valves with limit switch Feedback

Purpose

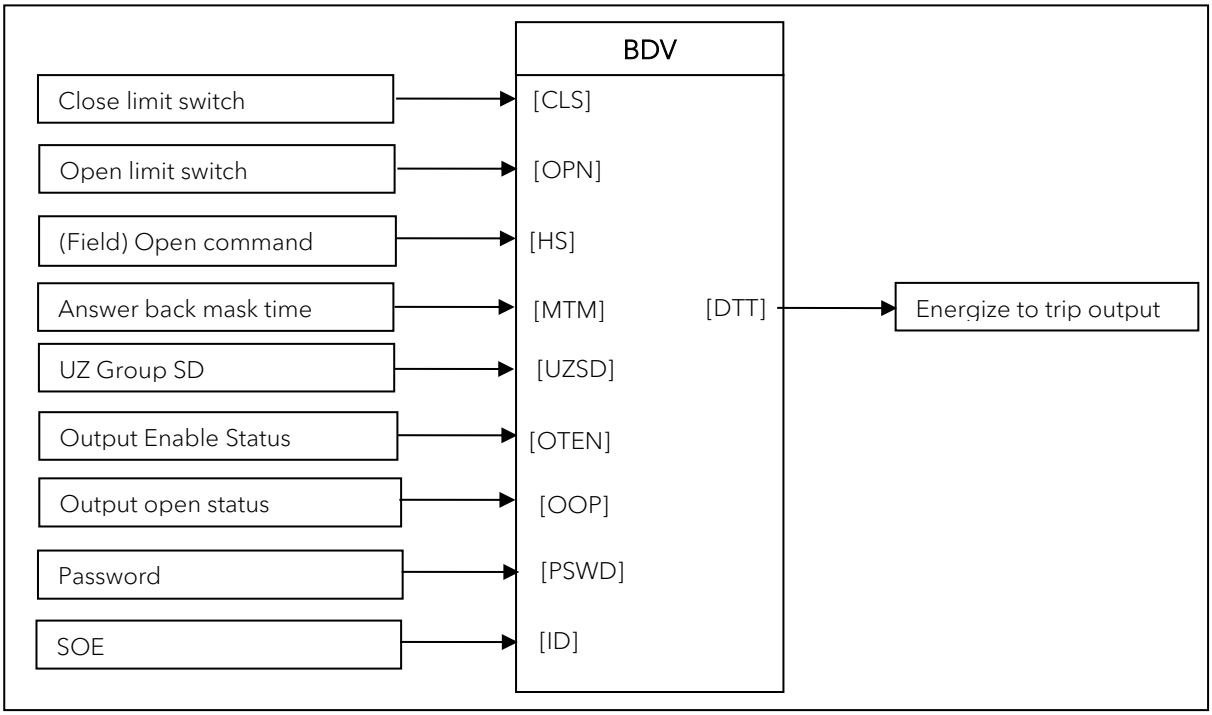
This typical, drives the output to safe-state when the UZSD input trips.

Functionality:

The BDV typical has the following features:

- Valve operation.
- Limit switch feedback (one or two limit switches).

This typical, drives the output to safe-state when the UZSD input trips. Design of the typical is energize to trip (or activate) the output hence line monitoring of the output is essential. MANUAL operations to the Valve from the OWS are prohibited at all times except in a state when the associated UZ group acting on the BDV recovers from trip state and UZ group is reset. CLOSE command shall be issued from the OWS. Field Hand Switch allows opening of the Valve locally when the valve is in CLOSE condition.



27.1.11 TOF

Trip Delay Timer (TOF) timer is used to provide delayed actions or alarms in response to a specific condition.

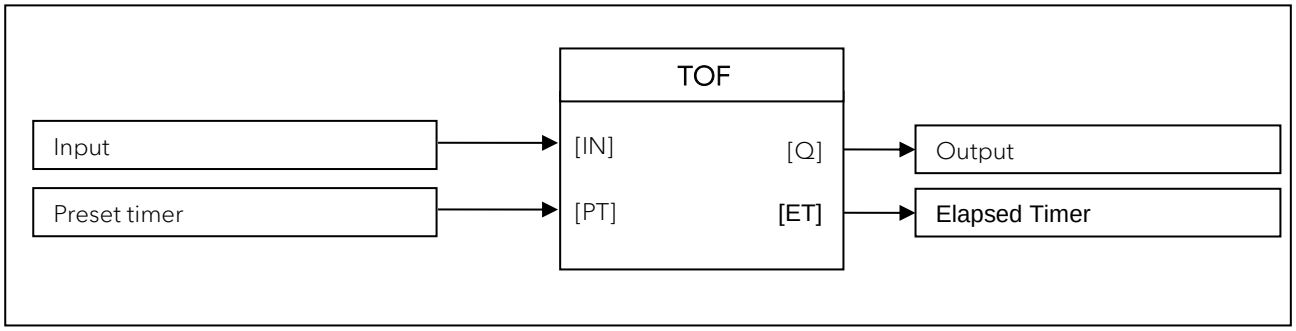
Purpose

Trip delay timer (TOF) timer is often used to provide delayed actions or alarms in response to a specific condition.

Functionality:

The TOF function block has the following main functions:

1. Activation on Condition: The TOF timer is triggered when a specific condition is met, such as an abnormal process variable exceeding its safe limit (e.g., high pressure, high temperature).
2. Timing Period: Once the condition is met, the TOF timer starts counting. This period is preset and can vary depending on the application. During this time, the condition is monitored continuously.
3. Condition Sustains Beyond the Timer:
    1. If the condition persists beyond the timer period, the SIS initiates the corresponding safety action, such as:
        1. Activating an alarm
        2. Triggering an emergency shutdown (ESD)



27.2 FGS TYPICALS

27.2.1 General

The following sections will describe the User Defined Functions and Function Blocks that will be used to build the Logic Typicals. The blocks in this section are specifically designed to meet the Shell requirements.

Refer attached Typical test reports for the detailed functionalities.

27.2.2 FG_MAN_REL_NC

This typical is used for discrete inputs that are de-energized to trip.

Purpose

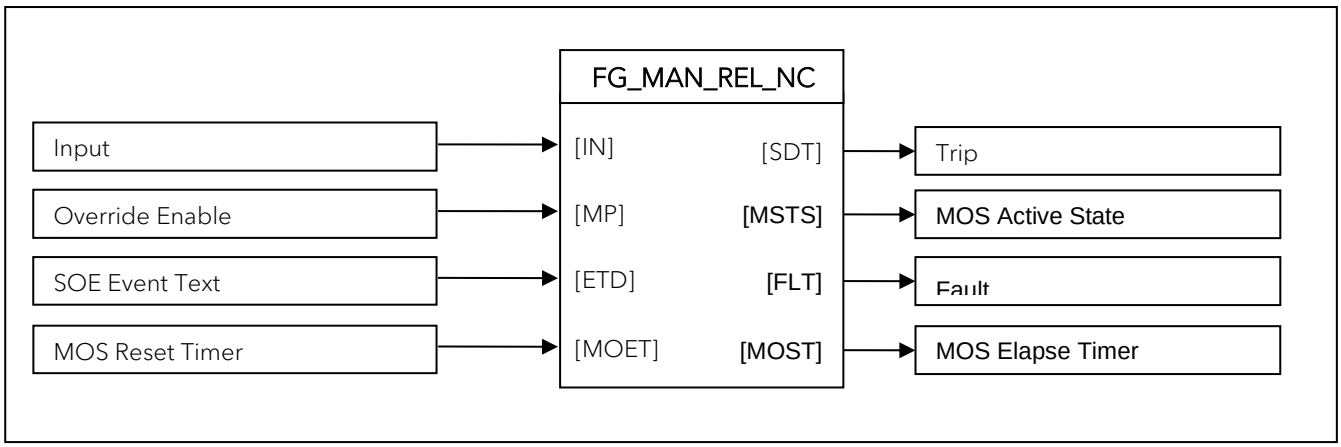
This typical is used for discrete inputs that are de-energized to trip such as Heat, Smoke detectors, ESD or Blowdown switches.

Functionality:

- Process Normally Closed digital input
- Manage the maintenance override function (MOS) for each MAN_REL_NC input
- Manage input trip, diagnostic and I/O fault logics
- Manage input trip alarm reset logics
- Optional line monitoring and fault detection
- All diagnostic and I/O alarms will trigger individual Annunciator alarms.

Note: The MOS override function is included inside the function block

MOS function can be disabled by forcing the MOS enable key switch permanently to FALSE.



27.2.3 FG_MAN_REL_NO

This typical is used for discrete inputs that are energized to trip.

Purpose

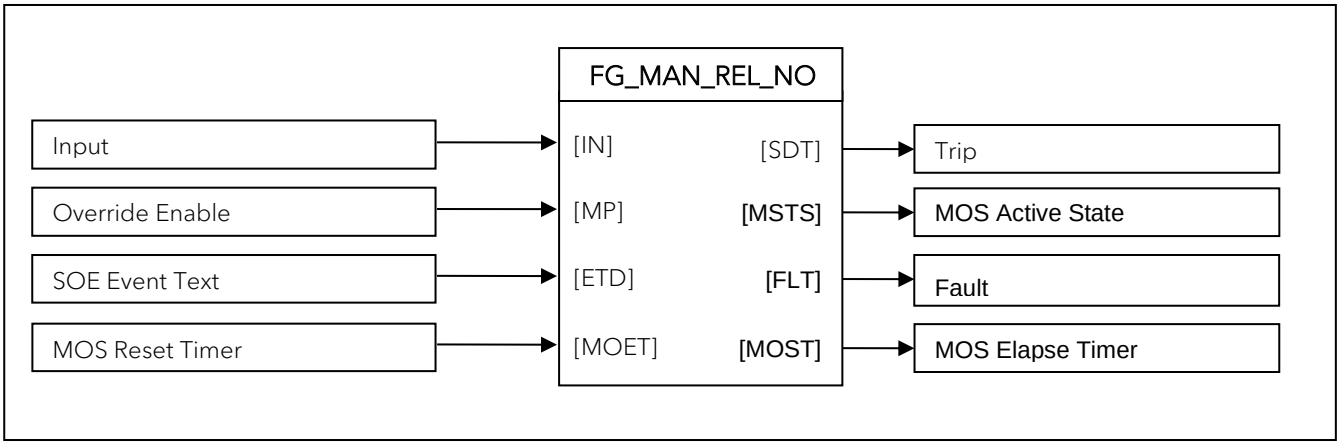
This typical is used for discrete inputs that are energized to trip such as manual alarm call points.

Functionality:

- Process Normally Open digital input
- Manage the maintenance override function (MOS) for each MAN_REL_NO input
- Manage input trip, diagnostic and I/O fault logics
- Manage input trip alarm reset logics
- Optional line monitoring and fault detection
- All diagnostic and I/O alarms will trigger individual Annunciator alarms.

Note: The MOS override function is included inside the function block

MOS function can be disabled by forcing the MOS enable key switch permanently to FALSE.



27.2.4 FG_FLAME_IR

This typical is used for Flame detector

Purpose

This typical is used for Ultrasonic Flame detector

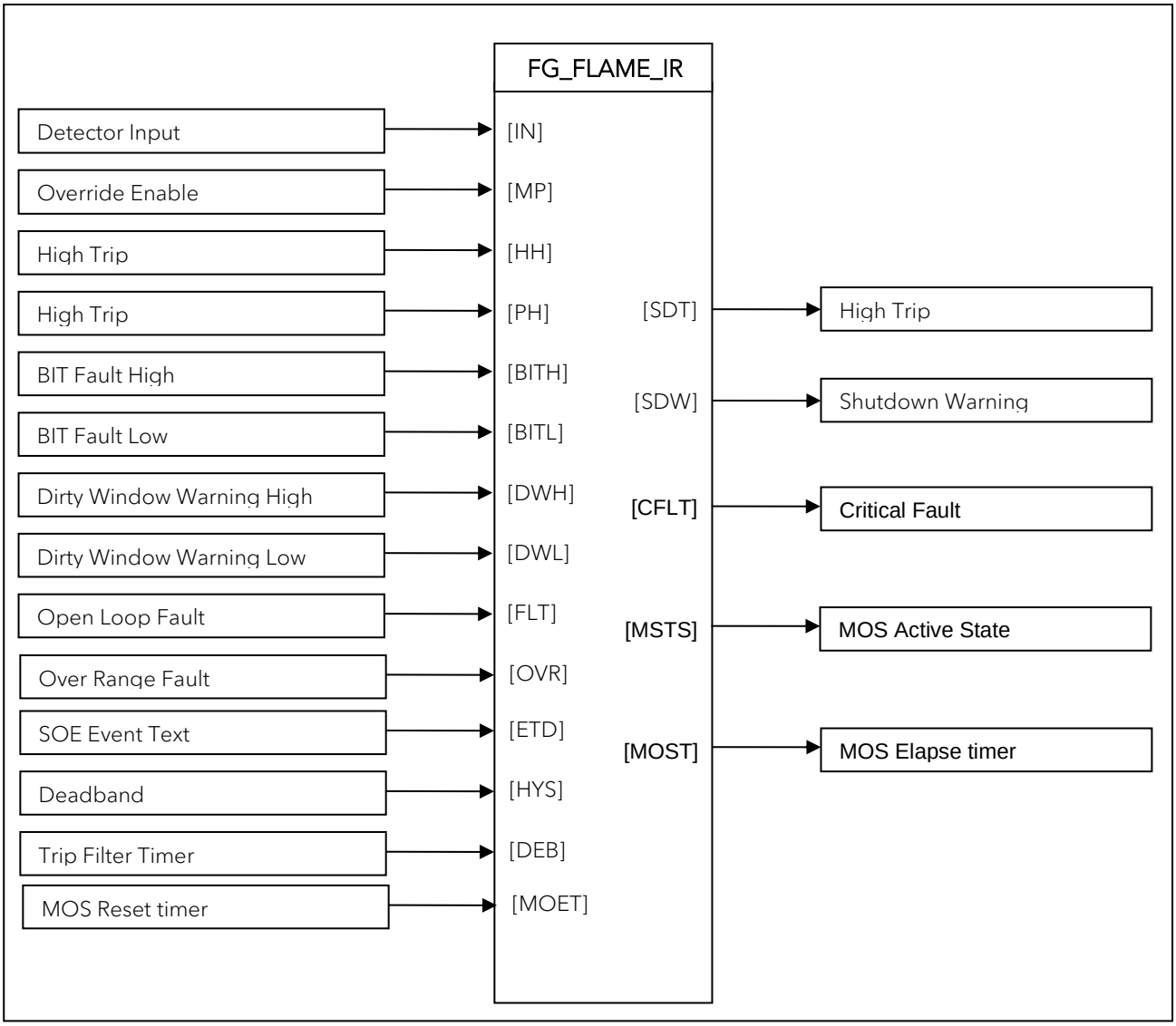
Functionality:

- Process Flame Ultrasonic type Flame analog gas detectors
- Manage the maintenance override function (MOS) for each FLAME IR detector
- Manage detector trip, diagnostic and I/O fault logics

Note: The MOS override function is included inside the function block.
MOS function can be disabled by forcing the MOS enable key switch permanently to FALSE.

Flame_IR input processing block:

- Trip and general diagnostic setpoints are hardcoded outside the User Defined Function Block (UDFB).
- Scaling setpoints are inside UDFB.
- LL and LTRP values are masked as these provide no function for flame detection.
- HHH value & HTRP values is used for warning and trip.
- All faults are considered critical and result in degraded voting logic.


FG_FLAME_IR
Detector Input
Override Enable
High Trip
High Trip
BIT Fault High
BIT Fault Low
Dirty Window Warning High
Dirty Window Warning Low
Open Loop Fault
Over Range Fault
SOE Event Text
Deadband
Trip Filter Timer
MOS Reset timer
[IN]
[MP]
[HH]
[PH]
[BITH]
[BITL]
[DWH]
[DWL]
[FLT]
[OVR]
[ETD]
[HYS]
[DEB]
[MOET]
[SDT]
[SDW]
[CFLT]
[MSTS]
[MOST]
High Trip
Shutdown Warning
Critical Fault
MOS Active State
MOS Elapse timer

27.2.5 FG_LD/FG_GD

This typical is used for Leak and gas detector.

Purpose

This typical is used for H2 Leak and H2/O2 gas detectors.

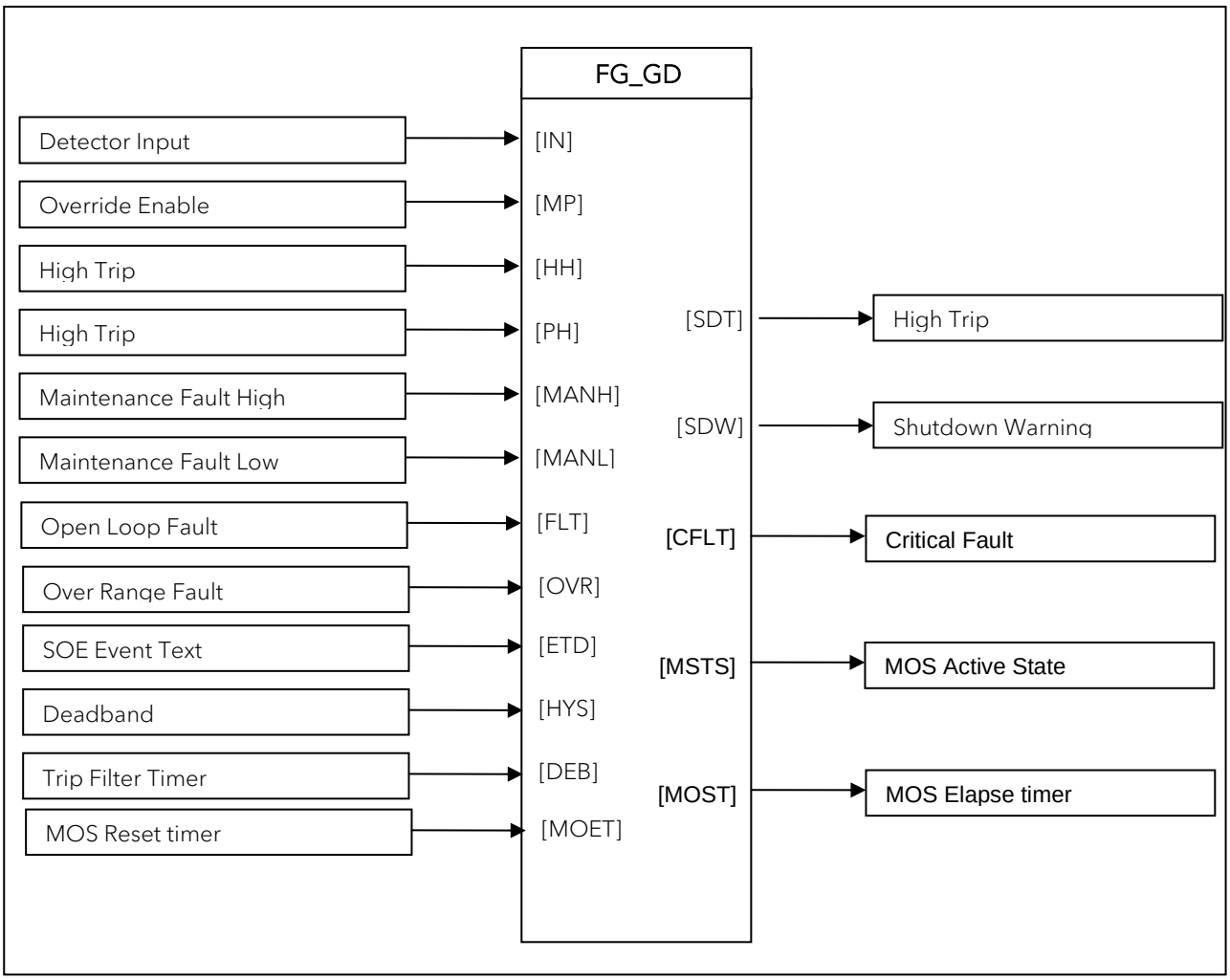
Functionality:

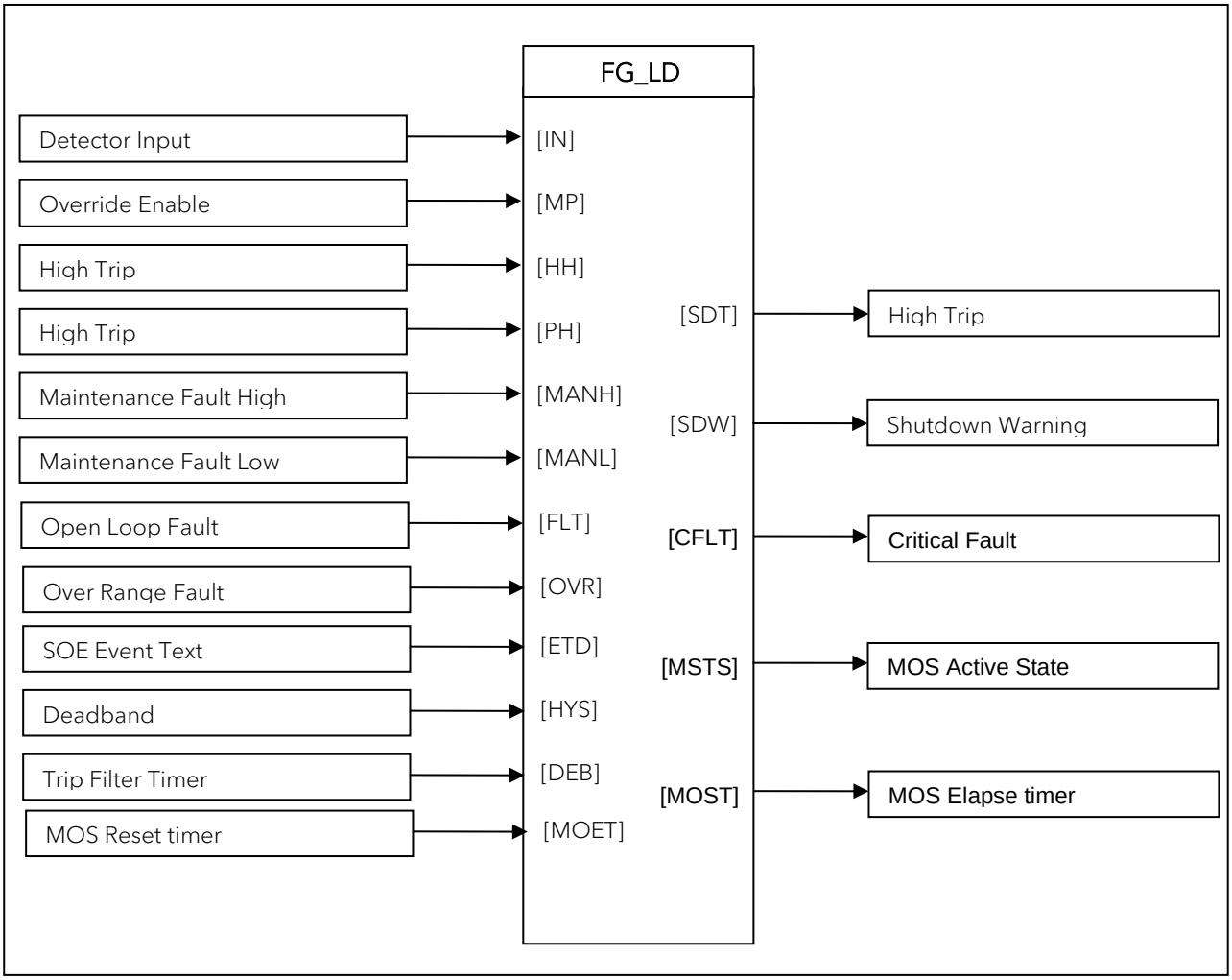
- Process Point type gas detectors
- Manage the maintenance override function (MOS) for gas point detector
- Manage detector trip, diagnostic and I/O fault logics

Note: The MOS override function is included inside the function block
MOS function can be disabled by forcing the MOS enable key switch permanently to FALSE.

Gas Point type input processing block:

- Trip and general diagnostic setpoints are hardcoded outside the User Defined Function Block (UDFB).
- Scaling setpoints are inside UDFB.
- LL and LTRP values are masked as these provide no function for flame detection.
- HHH and HTRP values is used for warning and to trip.
- All faults are considered critical and result in degraded voting logic.


FG_GD
Detector Input
Override Enable
High Trip
High Trip
Maintenance Fault High
Maintenance Fault Low
Open Loop Fault
Over Range Fault
SOE Event Text
Deadband
Trip Filter Timer
MOS Reset timer
[IN]
[MP]
[HH]
[PH]
[MANH]
[MANL]
[FLT]
[OVR]
[ETD]
[HYS]
[DEB]
[MOET]
[SDT]
[SDW]
[CFLT]
[MSTS]
[MOST]
High Trip
Shutdown Warning
Critical Fault
MOS Active State
MOS Elapse timer


FG_LD
Detector Input
Override Enable
High Trip
High Trip
Maintenance Fault High
Maintenance Fault Low
Open Loop Fault
Over Range Fault
SOE Event Text
Deadband
Trip Filter Timer
MOS Reset timer
[IN]
[MP]
[HH]
[PH]
[MANH]
[MANL]
[FLT]
[OVR]
[ETD]
[HYS]
[DEB]
[MOET]
[SDT]
[SDW]
[CFLT]
[MSTS]
[MOST]
High Trip
Shutdown Warning
Critical Fault
MOS Active State
MOS Elapse timer

27.2.6 FG_SD

This typical is used for Smoke detector.

Purpose

This typical is used for Smoke detectors.

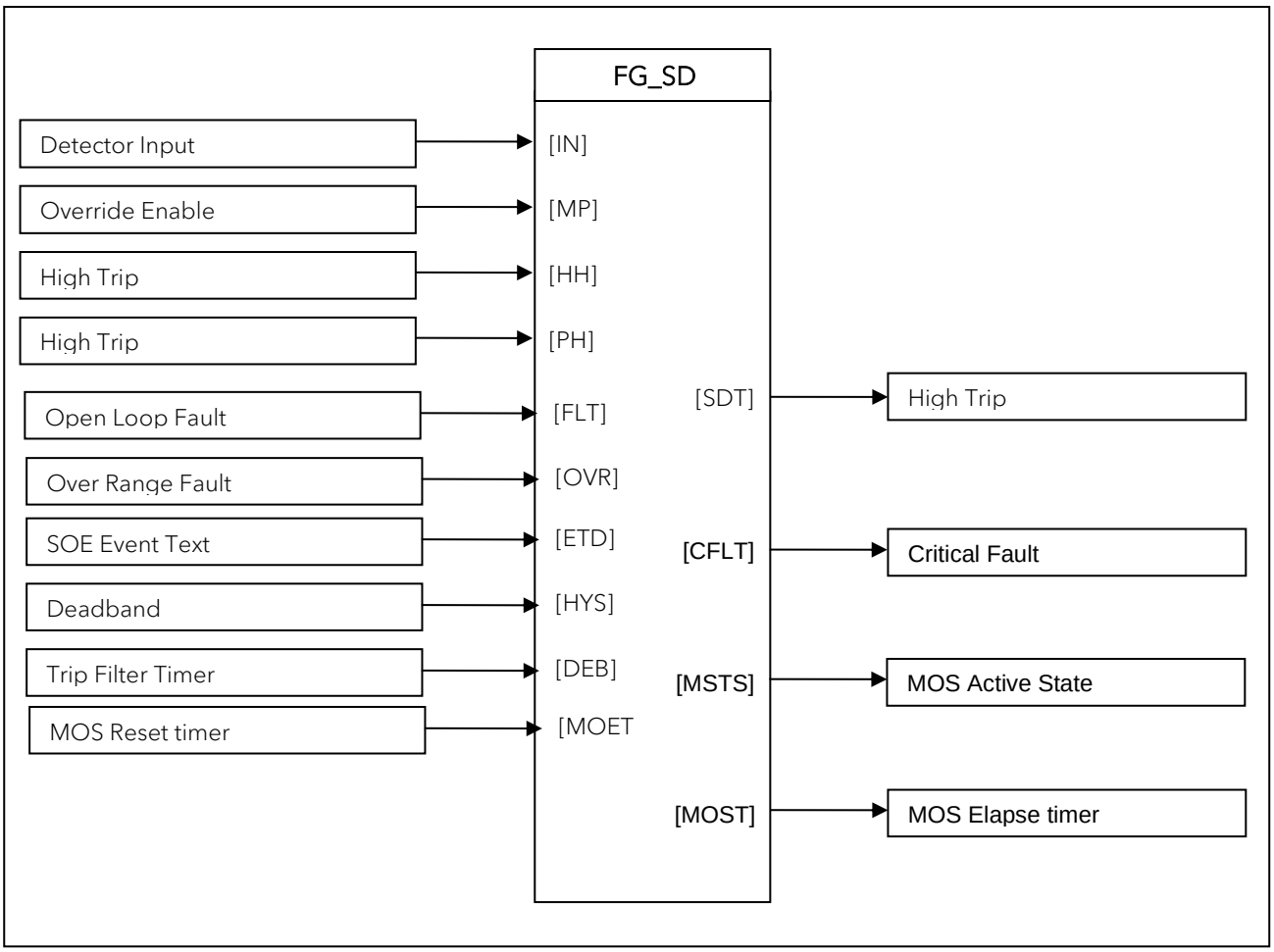
Functionality:

- Process smoke detectors
- Manage the maintenance override function (MOS) for gas point detector
- Manage detector trip, diagnostic and I/O fault logics

Note: The MOS override function is included inside the function block
MOS function can be disabled by forcing the MOS enable key switch permanently to FALSE.

Smoke Detector input processing block:

- Trip and general diagnostic setpoints are hardcoded outside the User Defined Function Block (UDFB).
- Scaling setpoints are inside UDFB.
- LL and LTRP values are masked as these provide no function for flame detection.
- HTRP values is used to trip.
- All faults are considered critical and result in degraded voting logic.


FG_SD
Detector Input
Override Enable
High Trip
High Trip
Open Loop Fault
Over Range Fault
SOE Event Text
Deadband
Trip Filter Timer
MOS Reset timer
[IN]
[MP]
[HH]
[PH]
[FLT]
[OVR]
[ETD]
[HYS]
[DEB]
[MOET
[SDT]
[CFLT]
[MSTS]
[MOST]
High Trip
Critical Fault
MOS Active State
MOS Elapse timer

27.2.7 UZGRP

UZGRP typical provides the common functionality for UZ groups in the SIS.

Purpose

UZGRP typical provides the common functionality for UZ groups in the FGS. The functions of the typical are trip latching, alarming and first failure identification.

Functionality:

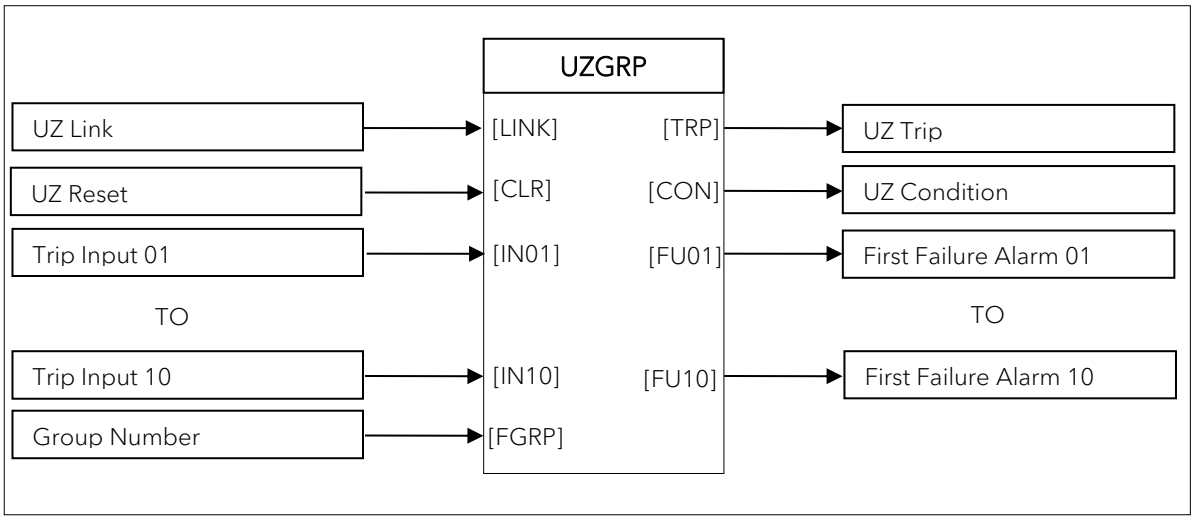
The UZGRP function block has the following main functions:

- Trip the UZ group if one of the inputs is tripped.
- Initiate a First Failure alarm to indicate which trip came first.
- Latch the UZ trip if a trip condition is active and no reset has been applied.

For every process group in the system at least one UZ block is used. The typical UZ block is designed for 10 inputs. Depending on the number of inputs to the group, more UZ blocks may be used for a process group. The UZ block can be linked together in a chain by linking the UZ Link and UZ Condition of the next UZ block together. If only one UZ block is used to trip a UZ group the UZ Link input shall be set to FALSE.

The trip outputs of input typical and/or voting typical in a UZ group are connected to the inputs of the UZ block. A trip condition on an input of the UZ block will trip the UZ group. This will latch the UZ block, further trips on the inputs will be ignored for failure indication, but still affect the UZ group trip. The output of the UZ block will be used in the application logic to the trip related field outputs. The trip alarm and the first failure flag of the tripped input will be shown in the OWS. The Tripped Outputs Latched status will be shown in the OWS until UZGRP is reset.

After all trip conditions are cleared the UZ typical can be reset via the optional UZRST application typical, by a reset signal from SCS. If the UZ group requires an auto-reset function, then the UZ Condition output has to be connected to the Clear input. The Clear input will only react on a positive trigger. The Clear will not only reset the UZ group but also clears the first failure flag, a reset will only have affected if all trip input conditions are normalized (not tripped).



27.2.8 UZRST

UZRST typical will be used to reset UZ safety groups which require a manual reset (from OWS) after a trip.

Purpose

This typical will be used to reset UZ safety groups which require a manual reset (from OWS) after a trip. The UZRST block has an input to indicate UZ trip status and an output to reset UZGRP logic.

Functionality:

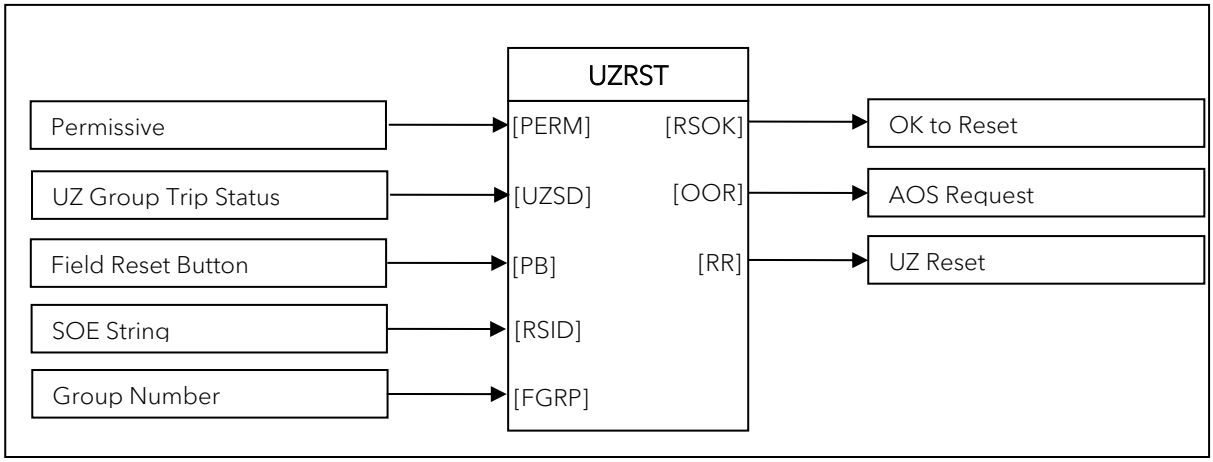
The UZRST function block has the following main functions:

- Reset UZ groups only when SCS Reset operated from OWS or field reset switch has been applied
- Indicate that SCS reset is allowed.

This typical will be used to reset UZ safety groups which require a manual reset (from OWS) after a trip. The UZRST block has an input to indicate UZ trip status and an output to reset UZGRP logic.

To indicate that a SCS reset is allowed (i.e. Permissive is 'TRUE') the status (Ok to Reset) is sent to OWS. After the reset from OWS, the Ok to Reset status will go off.

Push button field input reset is designed for normally open-momentary closed contacts to reset.



27.2.9 F23

2oo3 Voting typical will be used for Fire and Gas application.

Purpose

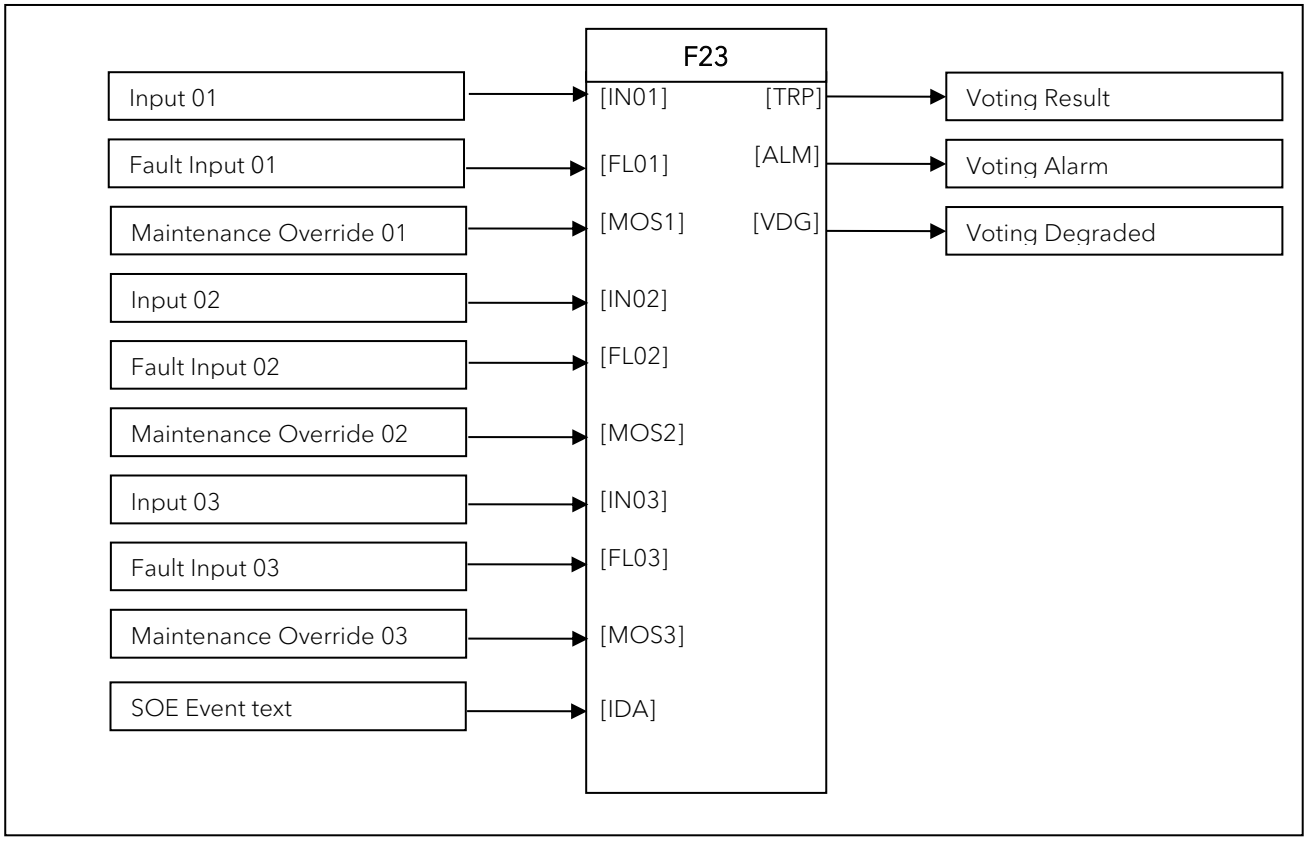
This typical is used to Initiate a trip if two of the three inputs are in trip.

Functionality:

The F23 function block has the following main functions:

- Initiate a trip if two of the three inputs are in trip state.
- Degrade voting function.

If two of the three inputs are tripped the output TRP of the F23 block will trip. If either one of the three inputs is not valid (detector fault) or a maintenance override is applied the voting function will degrade to 1oo2 and VDG of F23 will become true. If all transmitters are in fault, or if one maintenance override is applied while the other two transmitters are in fault the voting function is disabled.



27.2.10 FG_V2N_Voting

2-out-of-N voting is commonly used in fire and gas system to initiate trip, Process shutdown interlocks and other safety functions. This voting logic requires any two detectors to be in Alarm condition.

Purpose

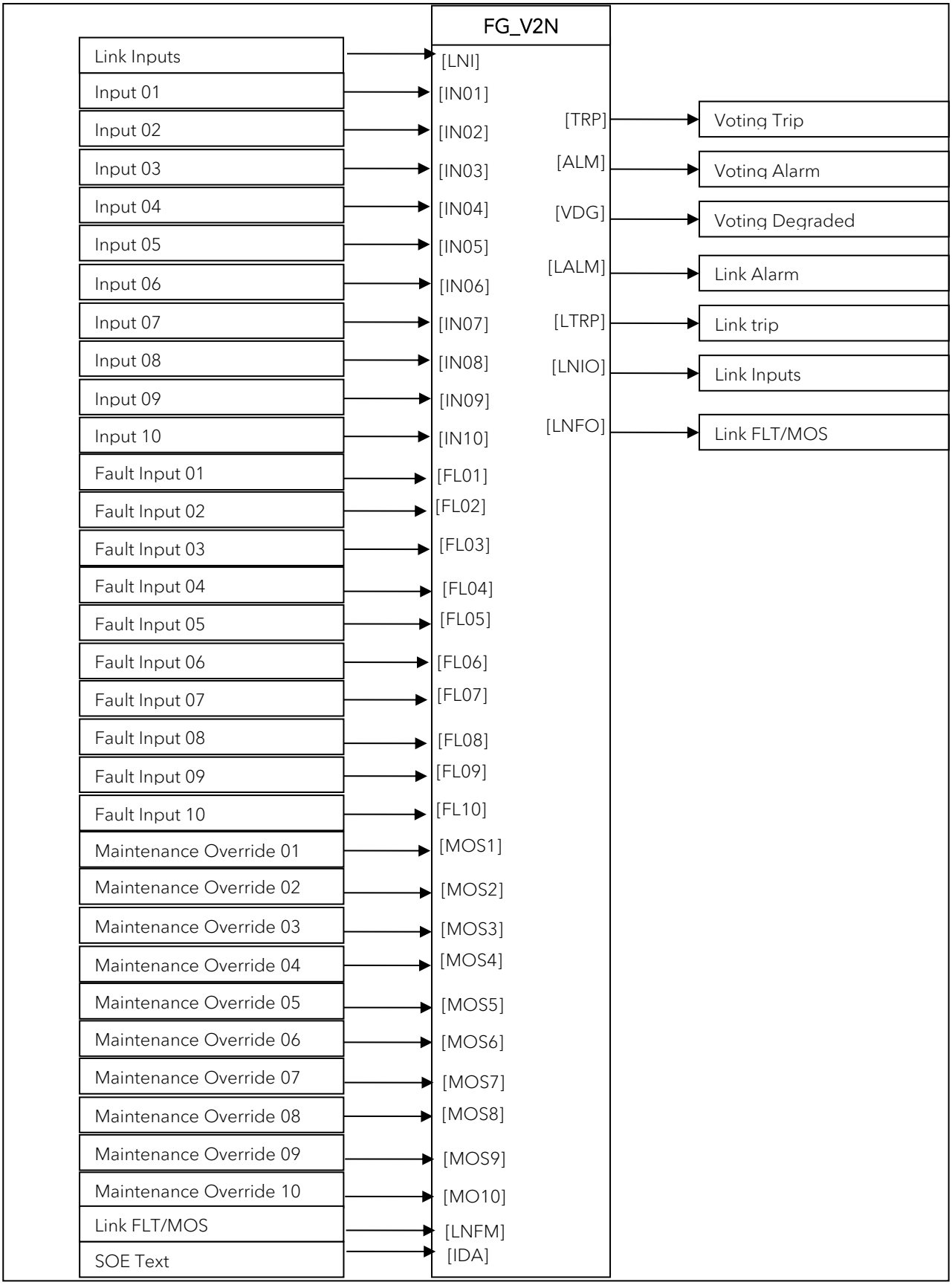
This typical is used to Initiate a trip if two of the N inputs are in trip.

Functionality:

The FG_V2N function block has the following main functions:

- Initiate a trip if two of the three inputs are in trip state.
- Degrade voting function.

If two of the N inputs are tripped the output TRP of the FG_V2N block will trip. If any one of the N inputs is not valid (detector critical fault) or a maintenance override is applied the voting function will degrade and VDG of FG_V2N will become true. If all transmitters are in fault, or if one maintenance override is applied while the N transmitters are in fault the voting function is disabled.


FG_V2N
Link Inputs
[LNI]
Input 01
[IN01]
Input 02
[IN02]
Input 03
[IN03]
Input 04
[IN04]
Input 05
[IN05]
Input 06
[IN06]
Input 07
[IN07]
Input 08
[IN08]
Input 09
[IN09]
Input 10
[IN10]
Fault Input 01
[FL01]
Fault Input 02
[FL02]
Fault Input 03
[FL03]
Fault Input 04
[FL04]
Fault Input 05
[FL05]
Fault Input 06
[FL06]
Fault Input 07
[FL07]
Fault Input 08
[FL08]
Fault Input 09
[FL09]
Fault Input 10
[FL10]
Maintenance Override 01
[MOS1]
Maintenance Override 02
[MOS2]
Maintenance Override 03
[MOS3]
Maintenance Override 04
[MOS4]
Maintenance Override 05
[MOS5]
Maintenance Override 06
[MOS6]
Maintenance Override 07
[MOS7]
Maintenance Override 08
[MOS8]
Maintenance Override 09
[MOS9]
Maintenance Override 10
[MO10]
Link FLT/MOS
[LNFM]
SOE Text
[IDA]
[TRP]
Voting Trip
[ALM]
Voting Alarm
[VDG]
Voting Degraded
[LALM]
Link Alarm
[LTRP]
Link trip
[LNIO]
Link Inputs
[LNFO]
Link FLT/MOS

28 CI SERVER FUNCTION DESIGN

28.1 CI SERVER

28.1.1 CI Server Configuration

CI Server can be flexibly configured according to the plant architecture and business style from standalone configuration, in which single computer provides environment of data collection in real time processes alarms and stores it in the historical database.

- CI Server consists of three functional components. The system configuration is determined by allocating these components on the server computers and client computers.
- CI Core: Collects, stores, and calculates plant operation data, and links data with other CI Core and other systems.
- CI Portal: Provides the data collected and stored by CI Core and predefined screens to CI View.
- CI View: HMI for operation and monitoring

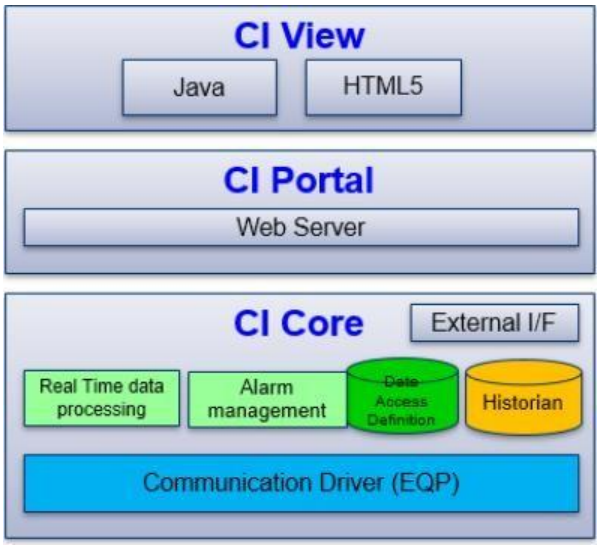


Figure 82 – Functional Component of CI Server

Detailed system design is as follows:

Location	Station	License	Node	Redundancy	Virtualized	Vnet/IP
ITER	CI Core	1	1	YES	NA	YES
ITER	CI Core	1	1	YES	NA	YES
OER	CI Portal VIEW	3	21,22,23	NA	NA	NA
CCR	CI View	2		NA	NA	NA

Table 91 – List of CIX Modules

These components can be installed in computers using the functional component unit. Each of the functional components can be installed in a single computer or can be distributed across computers based on the

plant structure. Therefore, CI Server supports both standalone structure in which data collection and operation maintenance is carried out in a single computer as well as wide area system structure in which multiple servers are installed in a wide area and are integrated.

The system design architecture has 2 Server Modules installed in ITER location and shall have CI -Core redundancy.

28.1.2 Redundancy

CI SERVER comes with several built-in features for supporting high Availability solutions. The purpose of these features is to support redundant Server configuration to reduce down-time.

The high availability features include:

- Redundant server support
- Monitoring CPU levels, queue levels and activity of CI SERVER Processes
- Synchronizing data between redundant servers
- Journaling of changes to CI SERVER databases

In the rest of the document, the CI SERVER High Availability features will be abbreviated to HAC.

Configuring the high availability is performed primarily through the HAC setup file. This file can be accessed from the CI server Setup File Editor.

28.1.3 CI-Core HAC Servers

The CI-Core in the CCR will be configured as a dual-redundant High Availability Computing (HAC).

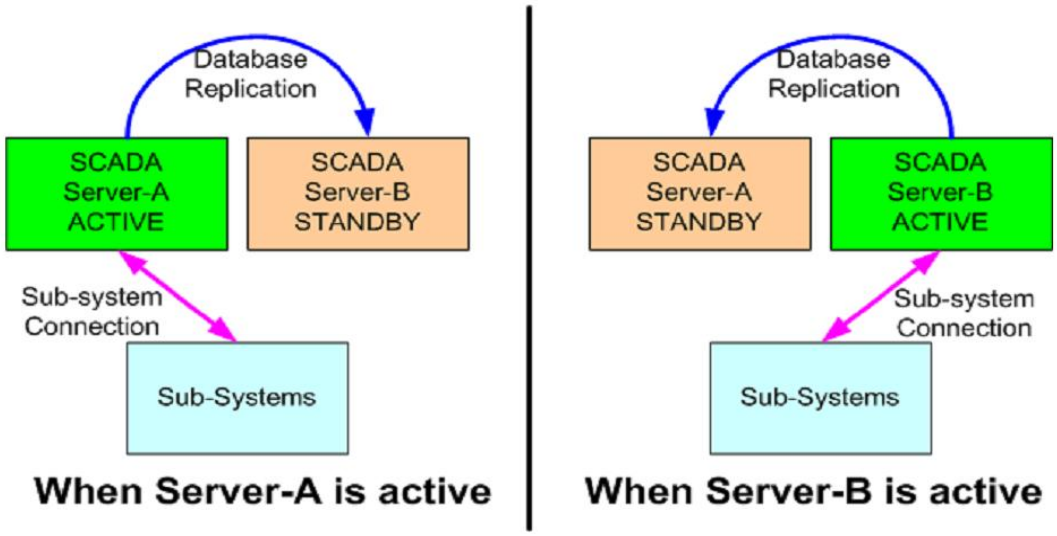


Figure 83 – CI-Core HAC Concept

At start-up, Primary server will become the active server, while the secondary server will take role as the hot standby server. Then HAC module will synchronize the content (files) of the active server to the standby server. Only the differences of the files (delta) will be replicated.

Initial replication to get in sync will take time from a minute to hours depending on network speed and the size of files. After that, the databases are synchronized in real-time.

Whenever there is an abnormality in the active server (such as hardware failure) the standby side will be activated within ~15 seconds (depends on hardware and system size and configuration).

CI-Core HAC system is to synchronize the CI-Core database only.

28.2 FIELD DATA ACQUISITION

28.2.1 Field Controller

28.2.2 Field Data Acquisition

The list of communication line between the field controllers and CI Server (CI-Core) are as follows:

#	Controller	Protocols	Scan rate*	Master / Slave	Communication Link
1	FCS	Vnet/IP	> 1 second	Slave	Vnet/IP bus
2	SCS_SIS	Vnet/IP	> 1 second	Slave	Vnet/IP bus
3	SCS_FGS	Vnet/IP	> 1 second	Slave	Vnet/IP bus
4	EMCS	OPC UA/ Modbus TCP/IP	> 1 second	Slave	Ethernet

Table 92 – Communication Lines

*Actual Scan rates to be finalized once Master Tag list is available.

28.3 FIELD CONTROL

28.3.1 Control Philosophy

CI Server shall be designed to continuously monitor/ access data on real time basis from PCS, SIS & EMCS and operate the entire integrated system on day-to-day basis.

28.4 CI SERVER NETWORK

For Network design overview, network names and subnet, routing and firewall rules, time synchronization (NTP) refer to 1724000594-IN-RE-00043 - Cyber Security Settings.

28.5 CI SERVER SOFTWARE CONFIGURATION

CI Server software configuration covers the main aspect of CI-Server engineering (Database, Visualization, and Interfacing).

28.5.1 CI Server Database (CI-Core)

Real Time Database

The CI Server (CI-Core) collects data from the field through the controllers (FCSs, SCSs, EMCSs, etc.) and stores it in the real-time database and shown in HMI. The data are also simultaneously processed for alarming and stored in the historian database.

The data refresh rate is entirely based on the scan rate (data polling) from CI-Core to field controllers as defined in section 3.2.2.

Tag-set	Tag	I/O	Function Description	Scan Rate
	All AO/DO	Output	All output are sent immediately	1 sec.
PVI	PV	Input	The transmitter value (measured value)	1 sec.
PVI	HH	Feedback Input	Alarm HH limit set-point Also, for HI, LO and LL	5 secs.

Table 93 – Scan rate settings for I/Os example

Historical Data Recording

Historical data from the field are collected as follows

Typically, every AI data (process-value) from transmitters is recorded in every 1 second, while status data are recorded in the event of value change.

The target of historian data storage life cycle is to be kept for up to 1 year. Final settings to be defined after MTL is received.

Historical Data Storage group

History Group	Scan Rate	Avg. (1)	Agg.(2)	Life Cycle	Description
EVENT	Event	-	-	1 year	For all status (DI / DO) tags and event-based AI.
0001_FCS1_EI	Event	-	-	1 year	For AI tags which are involved for process control such as PID-control-loop (PV and MV).
0001_FCS1_ST1	5 sec	60 sec	-	1 Year	For AI tags which are involved for monitoring from PCS Controller
0001_SCS1_EI	Event	-	-	1 year	For DI tags which are related to FO alarms and annunciator
0001_SCS1_ST1	5 sec	60 sec	-	1 year	For AI tags which included timers
TEN_MINUTES	600 sec	-		1 year	For AI tags related to EMCS

Table 94 – History groups

Archiving and De-Archiving

The archive and de-archive functionality is the backup and restore functionality.

There are two types of archiving procedures.

- Automatic Archive: This method archives the history files automatically from the storage groups at a specified time each day.

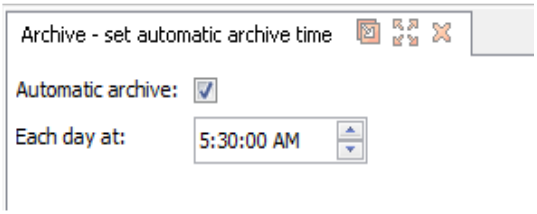


Figure 84 – Automatic Archive

- Manual Archive: This method archives the history files from the storage groups from the start of archive period to end of archive period specified by the user at the time of archiving.

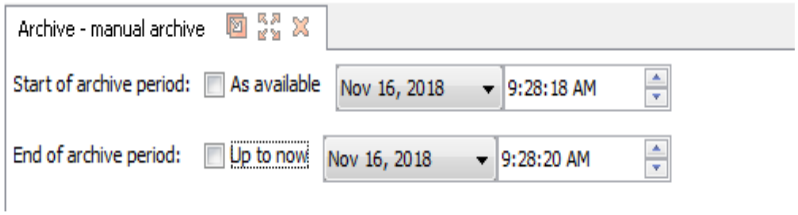


Figure 85 – Manual Archive

The archive supports disk drive, that are accessible via a directory path, and it can be used for archiving purposes on Windows. This means that all read/write storage mediums that are accessible via a directory path can be used by the archive functionality. This includes:

- Local Disk drives.
- Drive access over the network.
- USB Storage devices.
- CD and DVD writers that support Universal Disk Format (UDF) and are loaded with a UDF formatted CD-R, CD-RW, DVD-RAM (or compatible systems).

For disk drives the disk is the archive medium and for CD and DVD drives the CD's and DVD's are the archive mediums.

Drive access over the network shall be configured in backup recovery server and Mass storage devices shall not be used.

CI-Core has its own historical database (online historical) for reporting and trending, then such data will be archived to the specified location.

This method retrieves the information from the archived folders from the storage medium by specifying the start of retrieval period and end of retrieval period time.

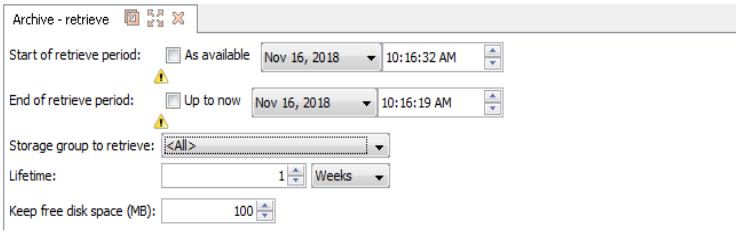


Figure 86 – De-Archive

Refer 1724000594-IN-RE-00043 - Cyber Security Settings for detailed settings of backup recovery server.

28.5.2 Item Naming Convention

In CI SERVER, items are the main definition within the CI Core database. They are the real-time tags that can be configured via points to receive real-time data from the PCS blocks tags, generate alarms, be used in graphics, stored in history, and used in reports.

The items can be placed under Sections and Objects which will define a plant hierarchy structure within the CI Server database.

The layout of an item name is as follows:

SECTION.SECTION..... OBJECT.ITEM

SECTION: can be the location, plant area, subsystem.

- OBJECT: the equipment tag name, usually the PCS block name as well.
- ITEM: the sub tag which relates to the parameter of the PCS block (e.g. PV, ALRM)

When an item is referred to within the CI server database, its name will include the sections and object name and can contain a maximum of 252 characters.

An item is also uniquely identified by an item ID which is automatically generated when the item is defined.

Item Name – 1st layer sections

The following 1st layer sections are defined:

1st Layer Section	Description
BLPH	Base Load Power Hub

Table 95 – 1st layer section example

Item Name – 2nd layer sections

The following 2nd layer sections are defined:

1st Layer Section	2nd Layer Section	Description
BLPH	FCS0110	FCS Controller
	SCS0110	SIS Controller 1
	SCS0120	F&G Controller 2
EMCS		Electrical Monitoring and Control System

Table 96 – 2nd layer section example

Item Name – 2nd layer sections

Item names will change based on the block used for generating the object.

Tag names will be defined in Master Tag List (MTL).

28.5.3 HMI Server (CI-Portal)

CI-Portal role can be as:

CI Portal Function	Description
HMI Web-Server	Serving the HMI request from CI-View clients.
Engineering Workstation (EWS for CI-Server)	In this EWS (desktop), engineer can do: • Configures CI-Core database (with Engineering module) • Creates / modify Graphics HMI (with Edit Module)

Table 97 – CI Portal Roles

CI Portal software is installed on a target machine. The application makes a native CI Server connection to CI Core. Users can open the operator interfaces directly from the target machine.

The lists of CI Portal are:

CI	Node#	Device Type	Location
CI VIEW(OWS)	NA	CIPO04	CCR
CI VIEW (CAP)	NA	CIPO05	CCR
CI PORTAL/VIEW (EWS)	21,22,23	CIPO03	OER

Table 98 – List of CI Portals

28.5.4 HMI Client (CI-View)

CI-View (HMI Client) connection is:

CI View type	Description
Remote-Connect	The Java based CI-View suites which covers the functionality of Engineering, HMI Editing and HMI Viewing.

Table 99 – List of CI Portals

CI View solution is a web-based user interface of CI Server. It can be opened by opening a web browser and connecting either to a CI Portal machine or CI Core. A user license is required to open the operator interface. E.g. if CI Portal is equipped with 2 user licenses, on the native CI Portal machine the operator interface can be opened and via a web browser on the same or another machine a second Operators interface can be

opened as well. This can be useful to give additional users access to the operator interface, e.g. during commissioning or e.g. to provide information to remote users.

Both HMI1 and HMI2 are equipped with an additional CI View license for this purpose.

The functionality as EWS or OWS is only determined by user's right, whereas the engineering capabilities is only available to the specific users in the "system-manager" group of CIX user database.

Machine	Function	# Additional CI View License
HMI 1	Operator Working Station	1
HMI 2	Operator Working Station	1
CI EWS	Engineering Working Station	0

Table 100 – List of CI View Machines

The maximum number of monitors that can be connected to one CI View is 4.

28.5.5 CI Server Presentation

The acquired field data in CI Server database will be presented to the operator in the following forms as:

- Process Schematic HMI
- Trending Chart

Please refer to section 30 for graphics HMI design.

Process Schematic

Reference to section 30.2.

Trending Chart

Trending chart is available for all analog values from sensors or transmitters, for digital signals and for software items.

The "value-display" in HMI can be clicked to show the fluctuation of the historical value in the trending-chart pop-up window.

Reference to section 30.2.5.

28.5.6 Reporting Definitions

NOTE: No inputs received during Development and FAT.

Report Conventions

The layout of a report is configurable. The following figure shows what parameters can be set:

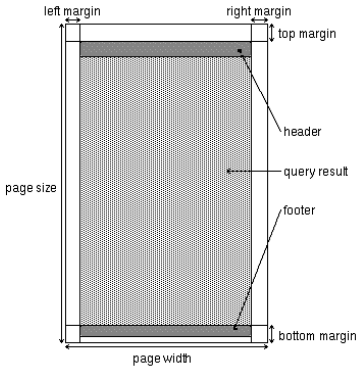


Figure 87 – *Report layout Parameters*

For this project the parameters are defined as follows:

- Page size 72 lines
- Top margin 3 lines
- Bottom margin 6 lines
- Page width 80 characters
- Left margin 3
- Right margin 3

The header of each report will look as follows:

REPORT DESCRIPTION

Date 7-MAY-2022 PAGE NUMBER

The header shows the date when the report was generated. Furthermore, it shows a report description. Finally, it shows the report page number.

The footer of the report looks as follows:

TOT_PROD page 1

On the left side the CI SERVER name of the report is shown and on the right side the page number.

Report Destinations

The following report destinations are available:

Destination	Device	Output type	Description
REPORT	CI_Core Server	Hardcopy	For all add-hoc generated reports

FILE	< none >	File	For all automatically generated reports

Table 101 – Report Destination

Report Handling

Reports can be generated in the following ways:

- Time based; meaning the report is generated at specific time, such as daily or monthly.
- Event based; meaning the report is generated after it was triggered by tag's events such as a pressure crosses a certain limit, or a digital input signal state was changed.
- Ad-hoc: meaning that the user must press a button to start the generation of the report.

The following table gives an overview of all default delivered reports. The below reports can be ad-hoc generated. Custom reports can be defined as well but require customer input.

Report Name	Report Description
ALARM_COUNT	Alarm counting report
ALARM_CURRENT	Current alarms report
ALARM_HISTORY	Alarm history report
AUDIT_TRAIL	Audit trail of user activity and item/object/class modification
AUTH_GROUP	Authorization groups
ITEM_ACK	Items and related acknowledgement type
ITEM_ALM	Items and related alarm info
ITEM_EQP	Items and related equipment info
ITEM_FO	Items and related first out groups
ITEM_HISTORY	Historical values of an item
ITEM_ID	Items and related item ids
ITEM_ITM	Items with related item table info
ITEM_OTH	Items and related miscellaneous info
ITEM_TYPE	Items in order of item type
ITEM_VAL_STA	Item value and status report
ITEM_VAL_CSV	Export CI SERVER data in csv format.

STATION	Station definitions
SYSTEM_LOG	The contents of the system log
USER	User definitions

Table 102 – Report Destination

Generated reports are stored in history and retained for a certain period (lifetime).

28.5.7 Audit Trail

Audit Trail is a function for recording a log for each action by the CIX users which affecting the CI-Core database. This optional feature was added for this project.

There is no special configuration required; and by default, the following action by CIX users will be logged:

CIX DB Tables	User's Action
CIX System (Engineering, Edit and Operator Interface)	Login and Logout.
Equipment (sub-system) scan (polling) properties	Modify
Station (sub-system) connection	Modify (Scan / Off-scan)
Item (Tag) structures (Installation, Unit, Section)	Insert and delete
Item's properties	Modify
Item's value (manual)	Modify
Class	Insert, Modify and Delete
Class's Objects	Insert, Modify and Delete
Class's Trigger Group	Modify
Users	Insert, Modify and Delete
User's Profiles	Modify

Table 103 – Audit Trails actions and affected objects

28.5.8 System Monitoring

CI Server system components health status and parameters will be monitored, and it will be displayed in HMI.

Device status / Parameters monitoring by PLC

The list of devices and its parameters which are connected and monitored in SCADA:

Device name	Monitored Parameters (MP)			
	MP-1	MP-2	MP-3	MP-4
FCS	Communication	Node and CPU	Battery	BUS Line
SCS_SIS	Communication	Node and CPU	Battery	BUS Line
SCS_FGS	Communication	Node and CPU	Battery	BUS Line
EMCS	Communication	-	-	

Table 104 – List of Monitored Device's Status

Network Device Monitoring

CI Server by means of the utility called INTTCPMON can periodically ping network devices and capture the response and connect this to a tag. The tag can be used for visualization and alarm.

28.5.9 CI Server Licenses

The list of CI Server licenses that being used in this project are:

Software name	Version	Quantity	Computer name
CI Core with FCS Connections: 1 SCS Connections: 2 Number of licensed items: 64000	v.1.03 *	1	CI_Core
CI Portal	v.1.03 *	3	HMI1, HMI2, CI_EWS
CI View	v.1.03*	5	HMI1, HMI2, CI_EWS + 2-browser-based connections
Product Maintenance License (PML)			

Table 105 – CI Server Licenses

*Note: In the project the latest version available will be used (R1.03). Post Integration of all packages item-based license shall be procured to meet the requirements as per project scope.

28.6 SYSTEM ALARMING

CI Server acts as an overall integration package where Operators control the plant on a day-to-day basis. A key element of control are alarms and alarm management.

From a high-level perspective to integrate alarms there are 2 approaches possible:

- Centrally: Alarm management is organized centrally in CI Server: All alarm definitions, alarm generation and acknowledgement are centrally defined and managed.

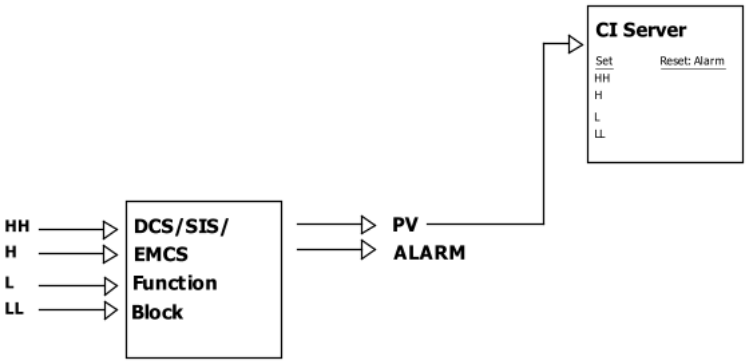


Figure 88 – Central alarm management

- Integrated: Alarm settings and alarm generation are defined in lower system(s), CI Server connects and displays these alarms. Acknowledgement of alarms happens in CI Server, refer to below picture. Typically, it is possible to update alarm limits in CI Server and write those back to the lower system.

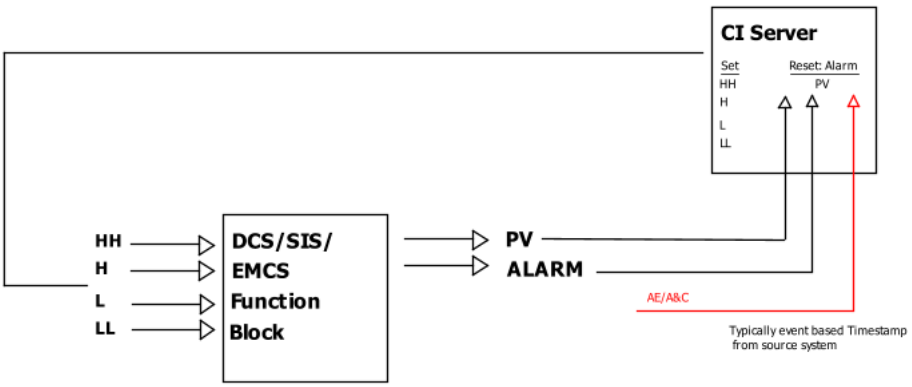


Figure 89 – Integrated alarm management

The process values and alarm status of e.g. Function blocks are polled by CI Server scan based and typically get the timestamp of CI Server. Exception to this rule are systems which use protocols which provide the timestamp as well.

To get alarm information with lower system timestamp either OPC AE or OPCUA A&C is required. Often a combination of scan-based data and the OPC based data are used, which will result in a slight offset in time on Function block status and alarm status in the alarm banner, due to the different moment the information enters CI Server. This typically is not a problem if the difference in time is limited.

Alarm limits and definitions will all be set and maintained in the lower systems.

28.6.1 Alarm concept and features in CI Server

The alarm concept in CI Server can be summarized as follows:

Each tag can be enabled/ disabled for alarming. When a tag is enabled for alarming the status change of the tag is the primary driver for alarming. A status change can be for example from High High to High, or Boolean 1 to Boolean 0, Offline to Normal, etc. In total 255 statuses can be defined in CI Server. With status

e.g. the alarm state & acknowledgement approach, priorities, coloring, etc. can be set. Alarm related features (see below) make use of these settings as well.

	Item status	Description	Status number	Alarm state	Alarm prio...	Alarm color	Mnemonic	Shelve enable
0	CALCULATE	calculate status	1	Normal	0	WH	CALC	☑
1	USE OLD	use old status	2	Normal	0	GR	OLD	☑
2	BLOCKED	BLOCKED	3	Alarm 3	3	BL	BLKD	☑
3	BOOLEAN 0	FALSE	4	Normal	15	WH	FALSE	☑
4	BOOLEAN 1	TRUE	5	Normal	15	WH	TRUE	☑
5	UNDERRANGED	underranged	6	Alarm 1	0	CY	UNDERR	☑
6	LOW LOW	LOW LOW	7	Alarm 3	1	RE	LL	☑
7	LOW	LOW	8	Alarm 2	2	YE	LO	☑
8	NORMAL	NORMAL	9	Normal	15	GR	NR	☑
9	HIGH	HIGH	10	Alarm 2	2	YE	HI	☑
10	HIGH HIGH	HIGH HIGH	11	Alarm 3	1	RE	HH	☑

Figure 90 – Item Status

These status dependent settings can be set project wide, however each individual tag has the possibility for max 6 individual status to override defaults.

Alarm related features within CI Server are for example:

- Alarm acknowledgement: to acknowledge an alarm.
- First out groups: A mechanism for a group of tags with alarms related to each other.
- Alarm collections: a grouping function.
- Alarm Selection Areas: Filters which can be programmed and used in other features, e.g. to filter on an alarm banner, for audible alarms, etc.
- Acknowledgement types: mechanism which supports automatic or manual alarm acknowledgement definitions.
- Area of interest: To create alarm filtering, more info is given in this chapter.
- Alarm link display: Link a particular tag with alarming to a particular display.
- Alarm notifications: Alarm to email.
- Alarm shelving: Temporarily shelving of alarms.
- Alarm repeat: Alarm repeat if not acknowledged with a certain time.
- Alarm delay: Delay an alarm event after e.g. to limit nuisance alarms.
- Audible alarms: to create audible sounds when a particular alarm becomes active.
- Priority change of alarms: Change alarm priority over time.
- Alarm Trend linkage: based on a tag in alarm, show the related trend.

28.6.2 Alarm Priorities

NOTE: Default priorities are followed.

Alarm priority is a numeric grading for the alarming condition (hence the priority); defined as integer number series from 0 to 15. The grading can be as descending (0 as the highest risk) or ascending (15 as the highest risk).

In this project descending grades is used with the interpretation as (example, to be finalized):

Priority	Interpretation
0	Emergency alarm identifying threat to life and environment.
1	High priority alarm indicating plant trip within 10 minutes
2	Medium priority alarm indicating area trip within 10 minutes.
3	Low priority alarm indicating degradation of product quality.
15	Unconcerned status, Normal

Table 106 – Alarm Priorities Example

28.6.3 Alarm State Transition

Alarm-states are the transition boundary of an evolving condition, defined as:

State	Interpretation
Normal	A condition which considered as a safe or normal event.
Alarm-1	The early stage of an alarming condition, or Low priority Boolean alarm.
Alarm-2	The next higher stage of an alarming condition, or medium priority Boolean alarm.
Alarm-3	The terminal stage of an alarming condition which supposed to be as the tripping point for shut down, or high priority Boolean alarm.

Table 107 – Alarm State Transitions

28.6.4 Alarm Configuration

28.6.5 Operator's action for Alarm

Two actions can be taken by Operator:

- Acknowledge: It's a conscious action by operator to admit that alarm situation has happened, and his team should know it and act accordingly to rectify the problem.
- Shelve: Alarm shelving is provided to prevent distraction from a repeating alarm from some "under repair" or maintenance.

28.6.6 Alarm Acknowledgement

Alarms can be manually or automatically acknowledged. For each type of acknowledgement rule an acknowledgement type is defined. Each tag can be assigned one of these acknowledgement types. For this project there are three acknowledgement types defined:

- Full Manual: Each change in alarm state must be manually acknowledged by the user.

  NORMAL to ALARM<x>, ALARM<x> to ALARM<y> as well as ALARM<x> to NORMAL
- Manual: When there is a change in alarm state from NORMAL to ALARM, the user must acknowledge this alarm. When the tag changes from ALARM to NORMAL, this will be automatically acknowledged.
- Automatic: Any change in alarm state will be acknowledged automatically.

The following tables show the acknowledgement matrices for the three types. The table should be read as follows: select from the left column the current alarm state and for that state the current acknowledgement

state. Then select the column with the new alarm state. On the intersection it shows either "auto" or "manual", specifying how this new alarm should be acknowledged:

Current alarm state \ Next alarm state		No Alarm (N)	Alarm1 (A1)	Alarm2 (A2)	Alarm3 (A3)
No Alarm	Ack	Manual	Manual	Manual	Manual
	Nack	Manual	Manual	Manual	Manual
Alarm1	Ack	Manual	Manual	Manual	Manual
	Nack	Manual	Manual	Manual	Manual
Alarm2	Ack	Manual	Manual	Manual	Manual
	Nack	Manual	Manual	Manual	Manual
Alarm3	Ack	Manual	Manual	Manual	Manual
	Nack	Manual	Manual	Manual	Manual

Table 108 – Full Manual Acknowledge type

Current alarm state \ Next alarm state		No Alarm (N)	Alarm1 (A1)	Alarm2 (A2)	Alarm3 (A3)
No Alarm	Ack	Auto	Manual	Manual	Manual
	Nack	Manual	Manual	Manual	Manual
Alarm1	Ack	Auto	Manual	Manual	Manual
	Nack	Manual	Manual	Manual	Manual
Alarm2	Ack	Auto	Manual	Manual	Manual
	Nack	Manual	Manual	Manual	Manual
Alarm3	Ack	Auto	Manual	Manual	Manual
	Nack	Manual	Manual	Manual	Manual

Table 109 – Manual Acknowledge type

Current alarm state \ Next alarm state		No Alarm (N)	Alarm1 (A1)	Alarm2 (A2)	Alarm3 (A3)
No Alarm	Ack	Auto	Auto	Auto	Auto
	Nack	Auto	Auto	Auto	Auto
Alarm1	Ack	Auto	Auto	Auto	Auto
	Nack	Auto	Auto	Auto	Auto
Alarm2	Ack	Auto	Auto	Auto	Auto
	Nack	Auto	Auto	Auto	Auto
Alarm3	Ack	Auto	Auto	Auto	Auto
	Nack	Auto	Auto	Auto	Auto

Table 110 – Automatic Acknowledge type

Alarm acknowledge types for the project shall be decided/ finalised during FAT. Until then all alarms will be configured with manual type acknowledgment.

28.6.7 Audible Alarm Annunciation

Alarm can be made audible in HMI workstation (CI-View).

For each priority level a different sound is generated: low, medium, and high tone. Furthermore, a horn silence command is available. This will cease the tone until a new alarm event is received.

Please note that the horn silence command will NOT acknowledge the alarm. The horn silence command is available under function key < F10 >.

The following table shows what will be the result when a new alarm event occurs (example, to be finalized):

Previous situation	New event	New situation
No alarm active	Low priority alarm	Audible annunciation (low tone)
No alarm active	High priority alarm	Audible annunciation (high tone)
Low priority alarm active (low tone audible)	Low priority alarm	No change
High priority alarm active (high tone audible)	High priority alarm	No change
Low priority alarm active (low tone)	High priority alarm	Audible annunciation (high tone)
High priority alarm active (high tone)	Low priority alarm	No change
Low priority alarm active (low tone)	Horn silence command	Cease audible annunciation
High priority alarm active (high tone)	Horn silence command	Cease audible annunciation
Alarms are active, no audible because silence command	Low priority alarm	Audible annunciation (low tone)
Alarms are active, no audible because silence command	High priority alarm	Audible annunciation (high tone)

Table 111 – Alarm Event Example

28.6.8 Alarm Selection Area

Alarm selection areas (ASA) are used to filter the output of alarms destinations such as alarm-display or printers. The ASA naming philosophy supports a maximum of 15 characters.

ASA is a logical expression to select alarm / events. Various attributes of the item (tag) can be used to make the ASA filter such as Section, tag-name, alarm-priority.

ASA created for this project is based on Master Alarm Database (123A90-DDL-IN-LIS-40027).

Name	Priority Level
Station/Subsystem NAMES	Alarms can be filtered individually based on Station/Subsystem using AOI filter.
SYSTEM	System based alarms can be grouped as station names

Table 112 – Alarm Selection Area

28.6.9 Area of Interest (AOI)

An area of interest is a name, which represents a specific region. Areas of interest are used to specify what region an Item operates in. By defining area of interest and connecting items to area of interests, it is possible that an operator obtains only relevant alarms. If, however, no areas of interest are used, the operator will receive all possible alarms. To filter and group the relevant alarms for users AOI are used. A Tag can be associated to 16 areas. The following AOI grouping is suggested.

Name	Priority Level
Station/Subsystem NAMES	Alarms can be filtered individually based on Station/Subsystem using AOI filter.
SYSTEM	System based alarms can be grouped as SCS names.

Table 113 – Alarm of Interest

28.6.10 Alarm Collection

Alarm collection group is a mechanism to manage alarms of all items (group items) registered in the group.

The status of each alarm collection group (group status) indicates the arising status, acknowledgement status, and reset status of alarms that are arising in the group items. The group status is represented by a combination of three information:

1. No alarm/Alarm is arising
2. Waiting for Acknowledgement/Acknowledged completed
3. Waiting for reset operation/Reset completed

These are the combination of groups and are independent.

If the group status is "Alarm State," it means that one or more alarms have occurred in all group items. If at least one of the group items has an alarm, the group status indicates an alarm state.

If the group status is "Acknowledgment required," it means that there is one or more Nack alarms in arising alarms in all group items. Only when all the alarms are acknowledged, it indicates the group status is the acknowledged status.

When the group status is "Reset operation," it means that the reset operation is done for the alarm collection group.

Refer Master Alarm Database -123A90-DDL-IN-LIS-40027.

28.7 SYSTEM INTERFACING

From external application (3rd party system), CI-Core data can be accessed via protocols such as OPC-UA. CI-Core acts as data-provider (Client); while 3rd party application acts as data-consumer (Server). This section describes this function.

28.7.1 OPC Interface

OPC-UA Client

CI-Core has an in-built OPC-UA client. The specification as follows:

Specified parameter	Parameters configuration value (options)
Endpoint URL	*
Security policy	*
Message security mode	Sign (only) Sign and encrypt
Login	Username and password

Table 114 – OPC-UA server access parameters

"*": Refer to Cybersecurity Document for the details of IP address and Security policy

28.8 CI SERVER USER MANAGEMENT

Note: Details to be aligned with customer.

In most cases, there are three essential "Authorization Groups" (user level):

- View only group
- Remote
- Operator
- Admin / Engineer

28.8.1 Authorization Group

Five user levels are defined:

- Level 0: View Only

This will be the default level for all workstations, view only level allows the user to view all process values, process displays, system status displays, trends and alarm acceptance. He is not allowed to manipulate any data or Process parameters.

- Level 1: Operation

The process operator can change control set points, outputs, operation modes and acknowledge process & system alarms of certain areas.

- Level 2: Process Operations Supervisor

The process operator can change alarm parameters, Enable / Disable alarms, Enable / Disable point scan and assignment of AOI's, also manual overwrite process values.

- Level 3: Engineer

The engineer has access to system management functions like tag definition (add, modify, and delete), building graphics or changing software.

- Level 4: Administrator

This is the highest level. This user can change/delete user rights, set file permissions and attributes.

Each level can be configured with selectable privileges. Each higher level includes all the lower-level privileges.

System function	System user level				
	0	1	2	3	4
Display process variables	X	X	X	X	X
Change process variables		X	X	X	X
Acknowledge alarms		X	X	X	X
System function	**System user level**				
	0	1	2	3	4
Manually override input process variables			X	X	X
Modify alarm parameters			X	X	X
Assignment of plant areas, view only terminals			X	X	X
USER/FAST system management				X	X
Modify/add displays				X	X
Change passwords					X
Add/delete users					X
Install/modify CI Server software					X
Managing system backup					X
Stop/Start CI Server or Operator Console					X
Restrict file access					X
Setting file attributes					X
Restrict any system resources					X

Table 115 – User level and access rights

Authorization groups have been created for each of the above levels with respective privileges. The Central and Station Controls will have separate authorization groups for each of the above levels.

Note: Authorization group will be modified inline to customer requirements.

28.8.2 User Profiles

The following users are defined for an example, actual users to be received from customer:

Authorization Group	General definitions: - user name (1) - password (2) - Process area	Operator interface: - layout - initial display	Alarming: - alarm selection area - Shelving group
System Administrator	admin ***** 1-999	default system_start_sa	administrator USER_SELF_GROUP
Engineer	Eng ***** 1-999	engineer system_start_en	system USER_SELF_GROUP
Operations Supervisor	super ***** 1-800	opersv system_start_sv	process USER_SELF_GROUP
Operator	oper ***** 1-500	oper system_start_op	oper USER_SELF_GROUP
View only	View ***** <none>	View system_start_vi	View <none>

Table 116 – Defined user profiles Example

Notes:

- The real usernames to be added on production deployment.
- All passwords are temporary; it is to be changed on production deployment.

28.8.3 Active Directory (AD) on CI Server

The following AD functions are available on CI Server:

- Users and user policies can be maintained in one place and are used everywhere in the system that makes up an automated system. No need to log on to the CI Server after logging on to Windows.
- Users are identified by name or password (or other authentication such as fingerprints). No one can access your system without a valid username and password. In addition, strong password rules can be applied at the Windows level without relying on potentially weak authentication of the application.
- Many companies standardize Windows technology, and external software is required to use these standards. Kerberos is a protocol available on Windows and other platforms supported by CI Server. AD is a technology of Microsoft.
- Even if a CI Server system is isolated from the network and has no access to the Windows domain controller, it is still possible to log on and access the application.
- Whether the CI Server uses AD integration can be configured for individual machines.
- The following widely accepted standard mechanisms are used:
- Kerberos - a ticket-based computer network authentication protocol that allows nodes communicating over an insecure network to prove each other's identities in a secure manner.
- Microsoft Active Directory (AD) - an AD domain controller assigns and enforces security policies to all computers, installs and updates software, and authenticates and authorizes all users and computers within a Windows domain type network. For example, when a user logs on to a computer that is part of a Windows domain, AD checks the password sent to determine if the user is a system administrator or a regular user.

CI Server supports a secondary logon mechanism to temporarily elevate the privilege level of users whereas AD and single sign-on do not support a secondary logon mechanism.

The AD integration function of CI Server has priority over the logon method (Login method) configured for each application using the following Authentication and authorization setup file (dssana.sup).

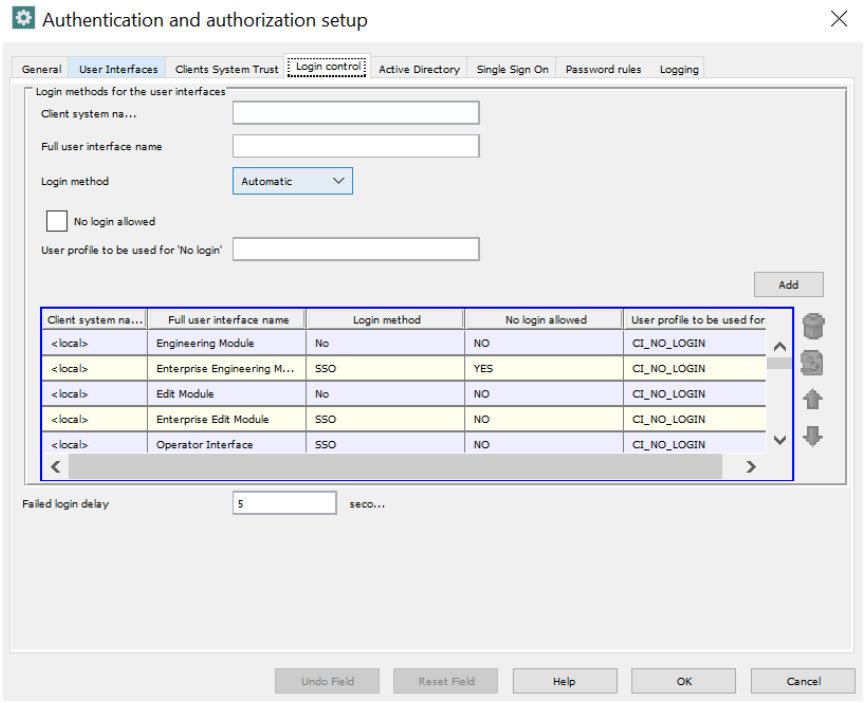


Figure 91 – Authentication and authorization setup

AD will be used for this project.

28.9 CI SERVER SYSTEM SECURITY

CI Server System security holistic approach covers the design, hardware, software component and the network. Refer to 1724000594-IN-RE-00043 - Cyber Security Settings document.

28.9.1 PC access Security

Active Directory

Reference to 1724000594-IN-RE-00043 - Cyber Security Settings document.

28.9.2 Network Security

Reference to 1724000594-IN-RE-00043 - Cyber Security Settings document.

28.9.3 Application security

Reference to 1724000594-IN-RE-00043 - Cyber Security Settings document.

28.9.4 Database security

In general, the field historian data is not considered as sensitive data in CI Server, however the process control set-point is sensitive for some industries. Therefore, it is recommended not to include the set-point value tags into RDBMS exposure.

28.10 SYSTEM BACKUP

28.10.1 System Backup

For a system back-up the software Windows Native Back up tool is used. All systems that are configured for back-up will store the image to the CI Core Machine.

For CI Core the backup is scheduled automatically using Backup recovery Server

All CI Portal are considered as non-critical machines and scheduled automatic back-up shall be taken. For these stations a back-up can be initiated on demand.

28.10.2 Restore

Whenever a system needs to be restored it must be booted with the Back-up Exec recovery CD. From the recovery utility one can select the image to restore. After the image has been restored, the machine must be rebooted. After reboot the system is up and running again.

Restore individual files

The backup software as described in the previous section provides the possibility to retrieve individual files and/or folders from a system back-up.

Note: When a CI server folder structure is retrieved, the CI server software on that machine must be stopped beforehand.

Reference to 1724000594-IN-RE-00043 - Cyber Security Settings document.

28.11 SYSTEM TOOLS

28.11.1 Quickload

A unique functionality of the CI Server engineering environment is loading and exporting the entire application configuration through the "quick load engineering utility".

This enables the user to "quick load" applications and modifications online without stopping the system from its real-time duties. While loading the application CI Server continuously checks the "quick load" data. An error in the configuration will be reported instantly, stopping the loading process or prompting the user for rejection or acceptance.

The advantages of preparing the applications configuration database this way is:

- Preparation of configuration data can be done off-line
- Data can be pre-checked on: Consistency, Format/Syntax and Completeness
- Re-use for other applications
- Easy and fast configuration of backup-systems

The following configuration data can be prepared off-line:

- Items
- Displays
- I/O-driver configurations
- Alarm collections

- History groups
- User-profiles
- Objects and classes

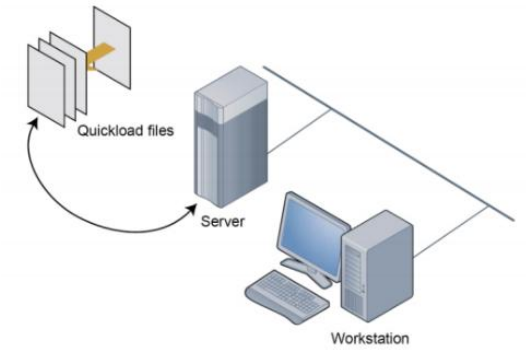


Figure 92 – Quickload Configuration

28.11.2 Report Editor

NOTE: No input received during Development or FAT.

Using the standard tool REPORT, the system manager is able to define and generate reports.

REPORT can be used to:

- Define a report
- Generate a report
- Inspect a report
- List the database field names corresponding to the real-time database

This utility is available through several USER forms.

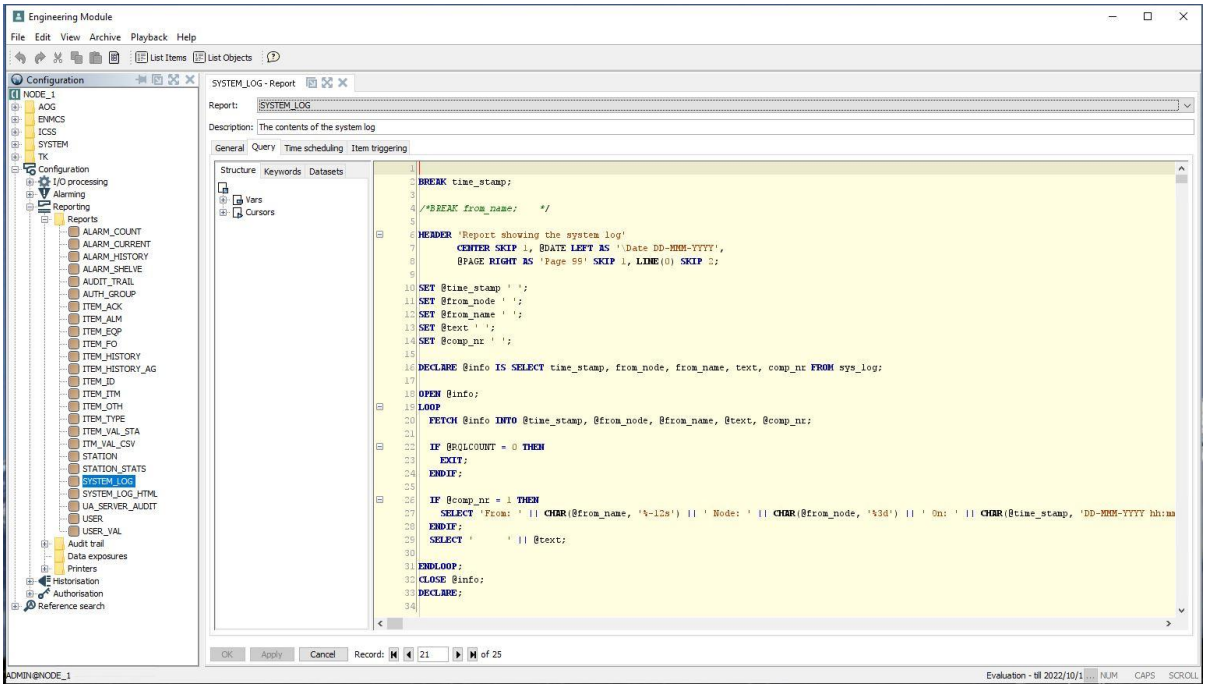


Figure 93 – Report Editor

28.11.3 Diagnostic Tools

CI SERVER provide an extensive set of diagnostic tools allowing online monitoring of:

- Configuration settings
- Real-time values of items, communication statistics, process-load
- Time related issues
- Status values
- Module specific parameters

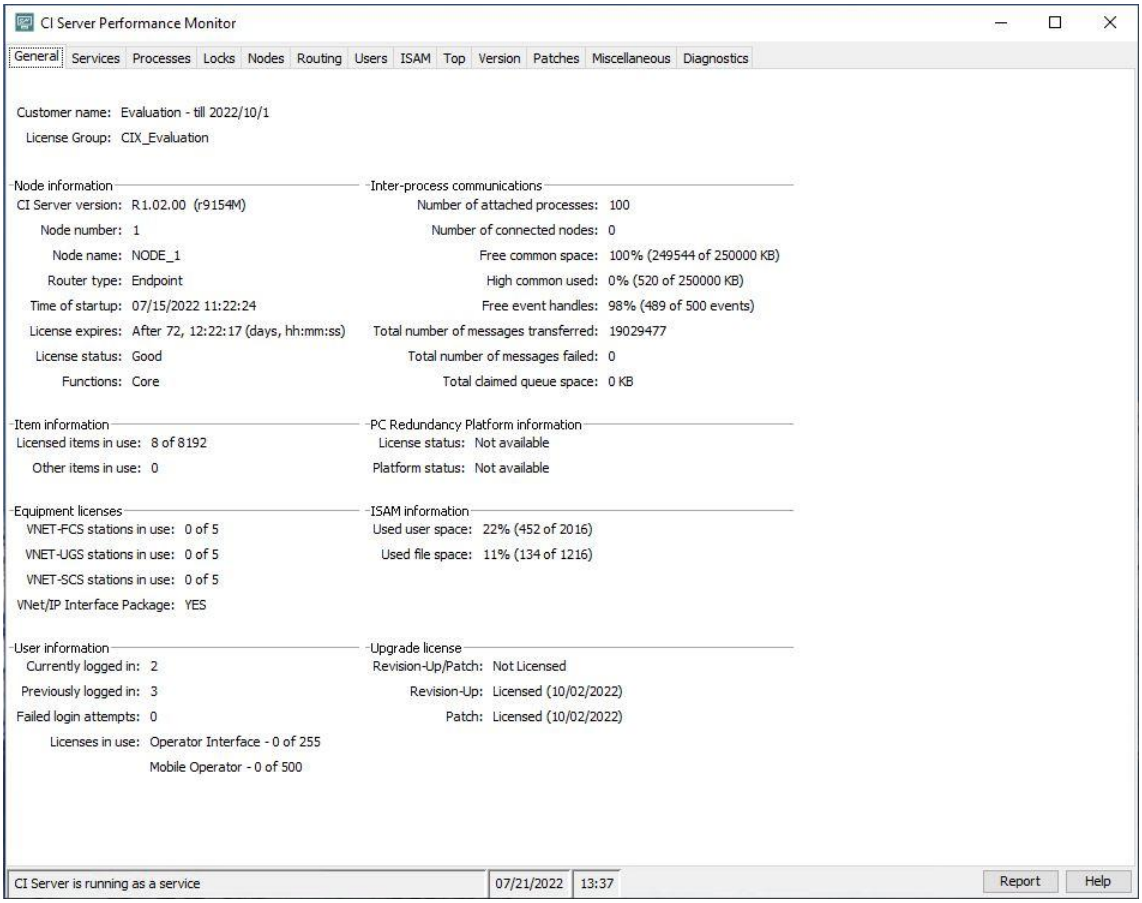


Figure 94 – Performance Monitor

These diagnostic tools are used to locate suspicious faulty situations and to optimize the performance of the CI Server system. Performance optimization can be done by:

- Balancing network traffic between e.g., a server and workstation in a redundant network
- Preventing queue overflows by defining larger queue sizes of CI Server processes that are consuming more than others.
- Perfecting scan times of external process variables in addition some diagnostic tools allow logging diagnostic data to a file on disk, which can be used for analyses later. The diagnostic features are impressive and go as far as byte and bit information.

The following diagnostic tools are available within CI Server:

Internal data traffic diagnostic tool

A lot of information can be gathered related to the internal data traffic in a CI Server based system. Looking into the main data streams will provide the user with information on how to tune the system. By examining the data traffic between processes, a problem can easily be broken down into a single process. Some of the optimization possibilities are:

- Overview of total message traffic.
- Overview of message traffic per process.

- Show outstanding number of messages per process.
- Overview of all time-related actions (clock queue).
- Overview of traffic to other systems.
- Logging of the data contents of messages transferred.
- Block a message queue.
- Influence the order of messages in a queue.
- Selective flush messages from a queue.
- Overview of maximum queue use since system start-up

Process variable related diagnostics

- On process variable level the following information can be collected:
- Statistics about all actions related to process variables since system startup.
- Overview of event streams between process variables and processes.
- Detailed information about all historical samples stored.

29 HARDWARE SPECIFICATION

For hardware configuration (performance) and features of the server cabinet, PC servers, firewalls, console desks, operator workstations and engineering workstation. Reference to be PAS Hardware Functional Design Specification (FDS-HW) 1724000594-IN-SP-00017.

30 HMI / GRAPHIC SPECIFICATION

This chapter describes the graphical user interface for the CI Server System. First, an overview of the mimics itself is given, thereafter an overview of all symbols being used to build the mimics. This graphical user interface is mainly to be used by the operator.

The following definitions are being used in this chapter:

- Screen: Applies to what is shown on the whole physical screen
- Mimic/display: Applies to a part of the screen representing a function which is logically grouped together.

This chapter will be updated accordingly.

30.1 GRAPHIC CONVENTIONS

30.1.1 Framework

Screen Layout

The startup display is automatically activated when the user logs on to the system. It consists of a framework which is always visible:

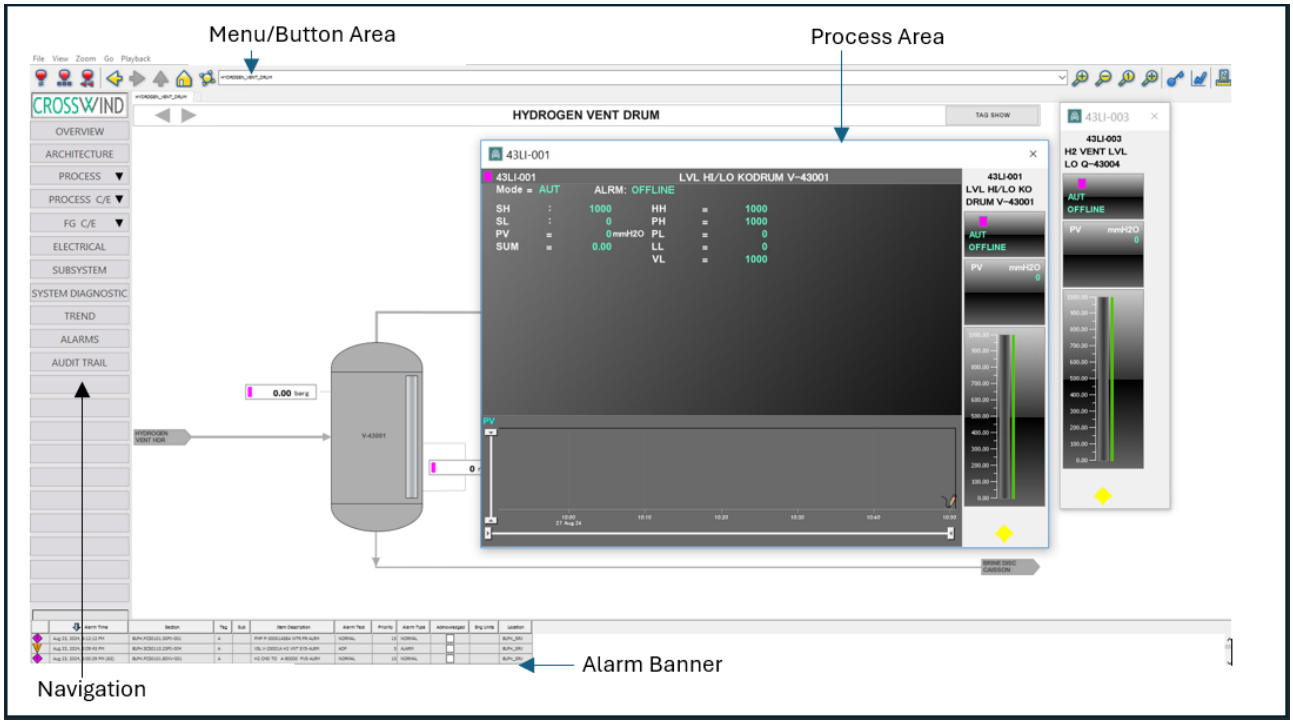


Figure 95 – General Display Layout

The displays resolution for the graphics of this project is 1920 x 1080 pixels (ratio 16:9).

Within this area the following sections are identify

Menu/button area

The menu and button area are always visible and as shown in the below figure, the following options are available for the operator:



Figure 22: Header menu

The menu and button area are always visible on the top part of each display unless a popup display is opened. Buttons will also provide a shortcut to basic HMI functions. Below table shows a summary of buttons and their functions:

Button	Function
	Go to current alarm list
	Go to Shelved alarm list
	Go to historical alarm list
	Go to system alarm list
	Go back to main display
	Reload main display
	Go to previous display or forward
	Zoom in
	Zoom out
	Reset to 100%
	Fit Display
	Login
	Go to Trending
	Print Screen

Table 117 – Header Buttons

Navigation

The left side of the displays is the navigation area. This area is always visible. Via buttons in this area the user can quickly navigate through the displays. The navigation area is designed in such a way to move through the displays efficiently and effectively.

Alarm banner

At the bottom of the display the alarm banner is shown. This part is always visible and shows the 3 most recent high priority alarms.

Process area

In this area the process displays are shown. It is possible to open more process displays and show each display in a separate tab. The tab indication is visible at the top of the process area.

Function Keys

Within the operator interface function keys are available for quick access to certain functions. The keys are accessible regardless of what display is shown. The following table gives an overview of the function keys:

Action	Result
F1	Shows help menu
F2	Horn silence
F3	Print screen

Table 118 – Function Key definition Example

30.1.2 General Conventions

Screen Size

Note: To be aligned & finalized.

The screen size of the project is defined as 1920 x 1080 pixels, the following areas are defined as:

- Navigation menu : 160 x 992 pixels
- Process area : 1760 x 992 pixels
- Alarm banner : 1920 x 80 pixels

Display Titles

The display title helps the user recognize the display objective quickly and should be immediately visible to the user. All main displays shall have a top text line and shall appear in the top left corner of the screen.

Screen Name

Screen shall be derived from P&IDs or SLDs in case of multiple sheets shall be suffixed by" _XX""

XX-Sheet Number.

Text

The visual specification for the Graphic Title, Equipment and tag names is as per the table below.

Display Object	Specification	Example
Equipment label/description	Gray (RGB 64,64,64) Arial, Bold, 12 pt	TK-0024
Tag names/EGUT	Black, Arial, Bold, 12 pt	TAG2401B
Graphic Title	Black, Arial, Bold, 24 pt	Subsystem Overview

Table 119 – Text

Lines

The visual specification for the Process/Instrument/Control lines is listed in the table below:

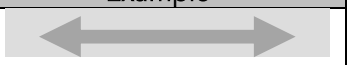
Display Object	Specification	Example
Main process Lines	Gray (RGB 165,165,165) Solid Line 5 pt.	
Instrument/Control Lines	Gray (RGB 128,128,128) Dashed Line 1 pt. (no arrows)	
Minor process lines	Gray (RGB 165,165,165) Solid Line 3 pt.	
Utility lines	Gray (RGB 165,165,165) Solid Line 1 pt.	

Table 120 – Lines

Arrow indicating process flow direction shall only be used where pipe enters equipment, at pipe corners or where lines leave the page.

2–way process lines will show same as process lines, but with at least one pair of double arrows ½ inch apart, spaced along line to make flow direction to and from connect equipment visually obvious.

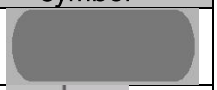
For crossing lines, the horizontal one will be in the front and the vertical one will be in the background.

Static Equipment

Representation of static equipment shall be as simple (without extra detail) as possible. Static equipment shall be filled on Gray (RGB 165,165,165) color. Static equipment shapes shall not show any edge colors. Static equipment shall not show any internals.

The equipment name will be shown within the equipment symbol as Gray, Arial, Bold, 12pt. The layout will follow the P&ID representation.

Samples static equipment shapes are shown below:

Equipment Type	Symbol
Vessels	
Tube Exchangers	
Furnace and Heaters	
Pumps	

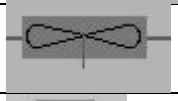
Positive displacement pumps	
Fin Fan exchangers	
Filters	
Compressors	

Table 121 – Static Equipment Example

Grid Settings

The grid is set to 4x4.

Actions

The following action conventions apply to the project:

Single left-click - Initiate an action on any dynamic symbol.

30.2 DISPLAY OVERVIEW

This section lists all displays that are available for the project. It will describe the contents/purpose of the screen, navigation options to/from the screen and any further details if available. Please note that not all screens are shown. Only for a few types of displays a screenshot is provided to give an overall representation.

30.2.1 Main Overview Display

The below display is an example of the Main Overview display.

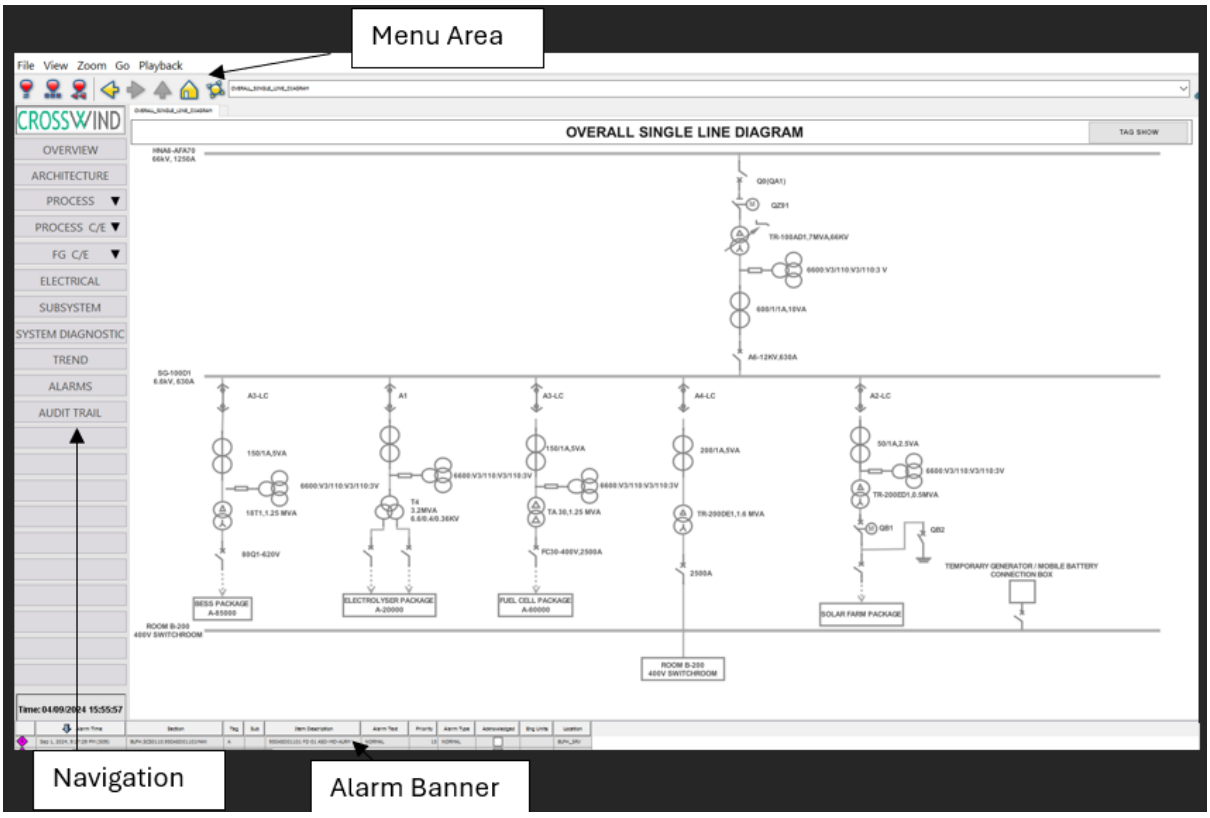


Figure 96 – Main Overview Display Example

30.2.2 System monitoring display

This display is a schematic layout of the cabinets with the CI servers, the local area network with the workstations, and the VNET/IP network. It displays the status of the CI servers, workstations, the local area network, and the cabinet alarms. For status of PIN network, a dedication navigation link shall be provided for accessing the NMS status webpage.

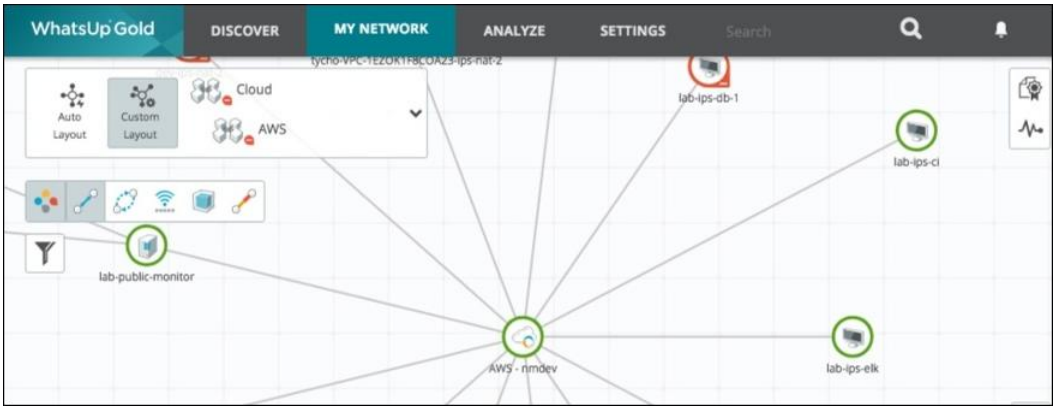


Figure 97 – System monitoring example

Navigation

This display is accessible from the navigation panel on the left side of the screen with the System Monitoring button.

30.2.3 Current Alarm Overview

The current alarm overview shows the alarms that are currently active. All the alarms are displayed in the Alarm overview, which can be accessed by the most left icon from the Header menu. Alarms are aligned in chronological order and operators can sort the alarms the way they want to. All new alarms are currently unacknowledged and must be acknowledged manually. Alarms also have the possibility that they do not need confirmation from the operator.

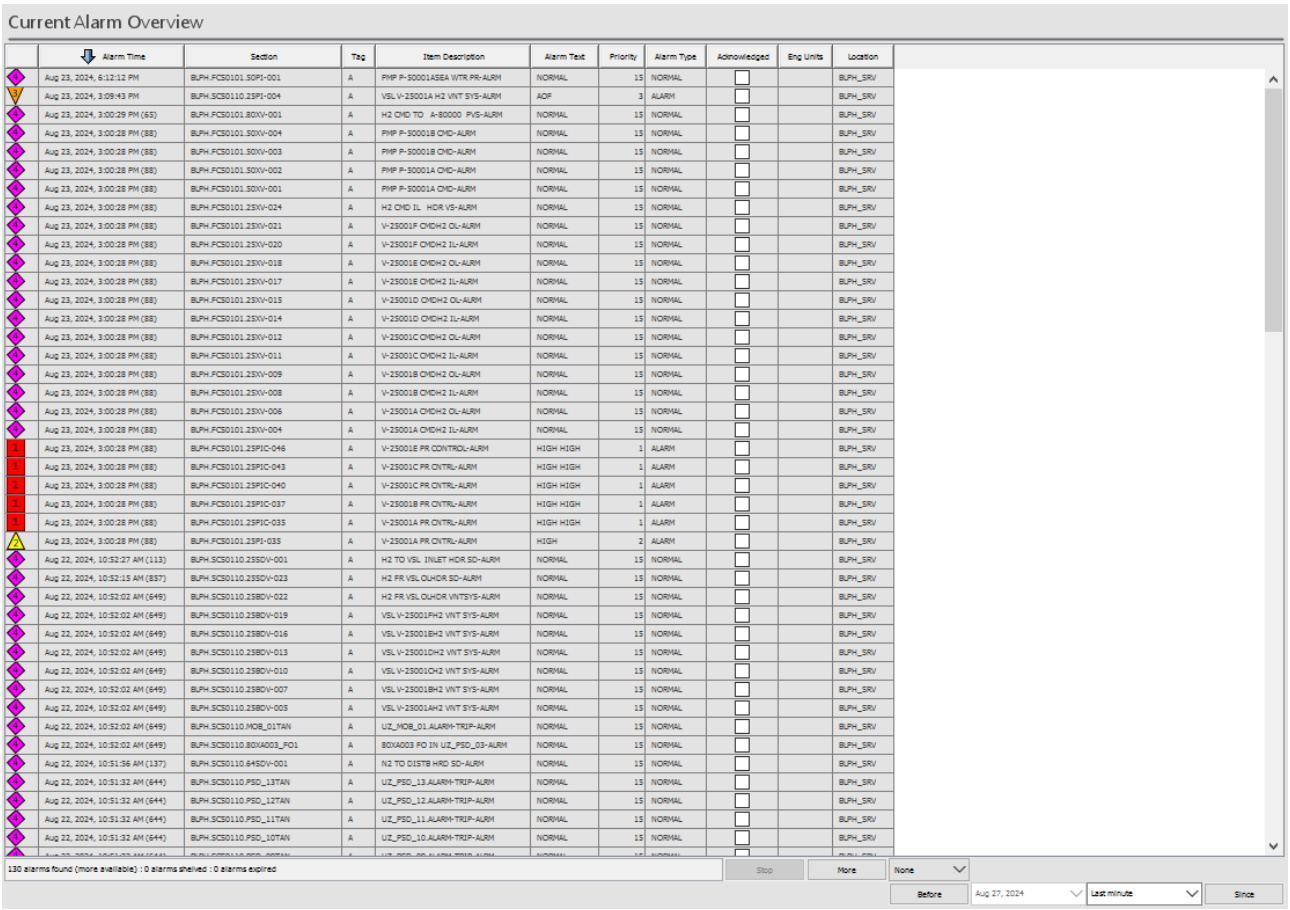


Figure 98 – Current alarm overview example

Alarm Indicator Icon

The alarm indicator icon in the alarm overviews refers to colour and numeric priority of item status. The color of the alarm indicator icon can be changed from system wide definition of item status or overridden by item definitions. See the below figures:

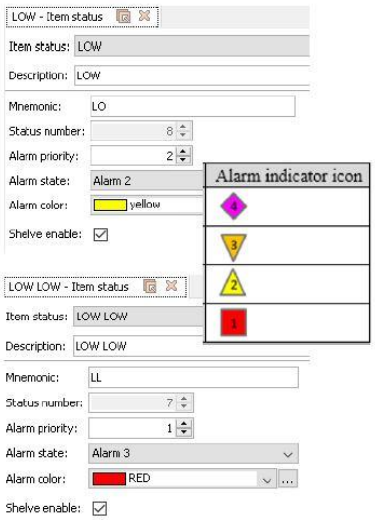


Figure 99 – System Wide Definition example

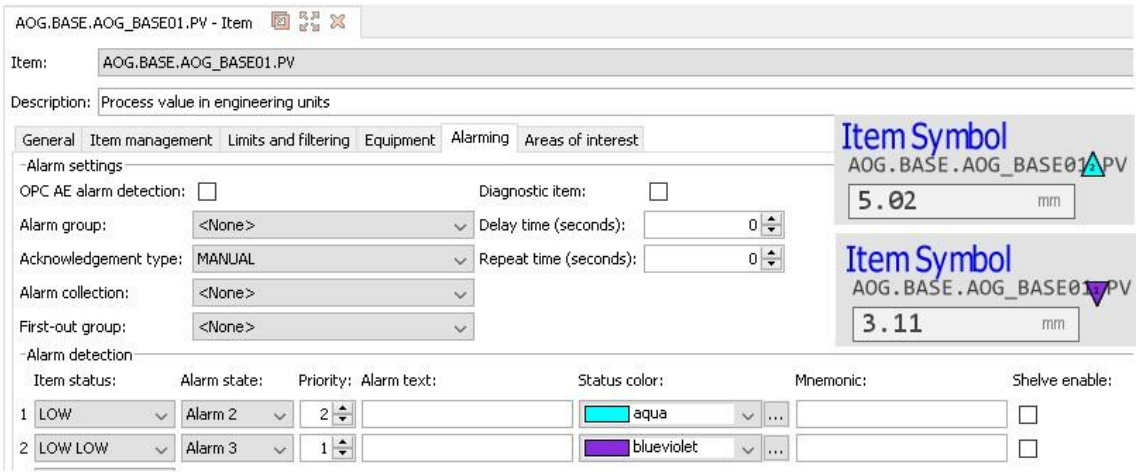


Figure 100 – Item Definition example

Navigation

This display is accessible from the navigation pane on the left side of the screen.

No specific navigation is available from this display.

Actions

Action	Object	Result
Left Mouse-click	Individual alarm line	Acknowledge of the alarm
Right Mouse-click	Any alarm line	Pop-up of a context menu: Acknowledge all visible alarms. Go to related display.

Table 122 – Actions in current alarm overview

30.2.4 Historical Alarm Overview

The historical alarm overview shows the alarms that have occurred in chronological order.

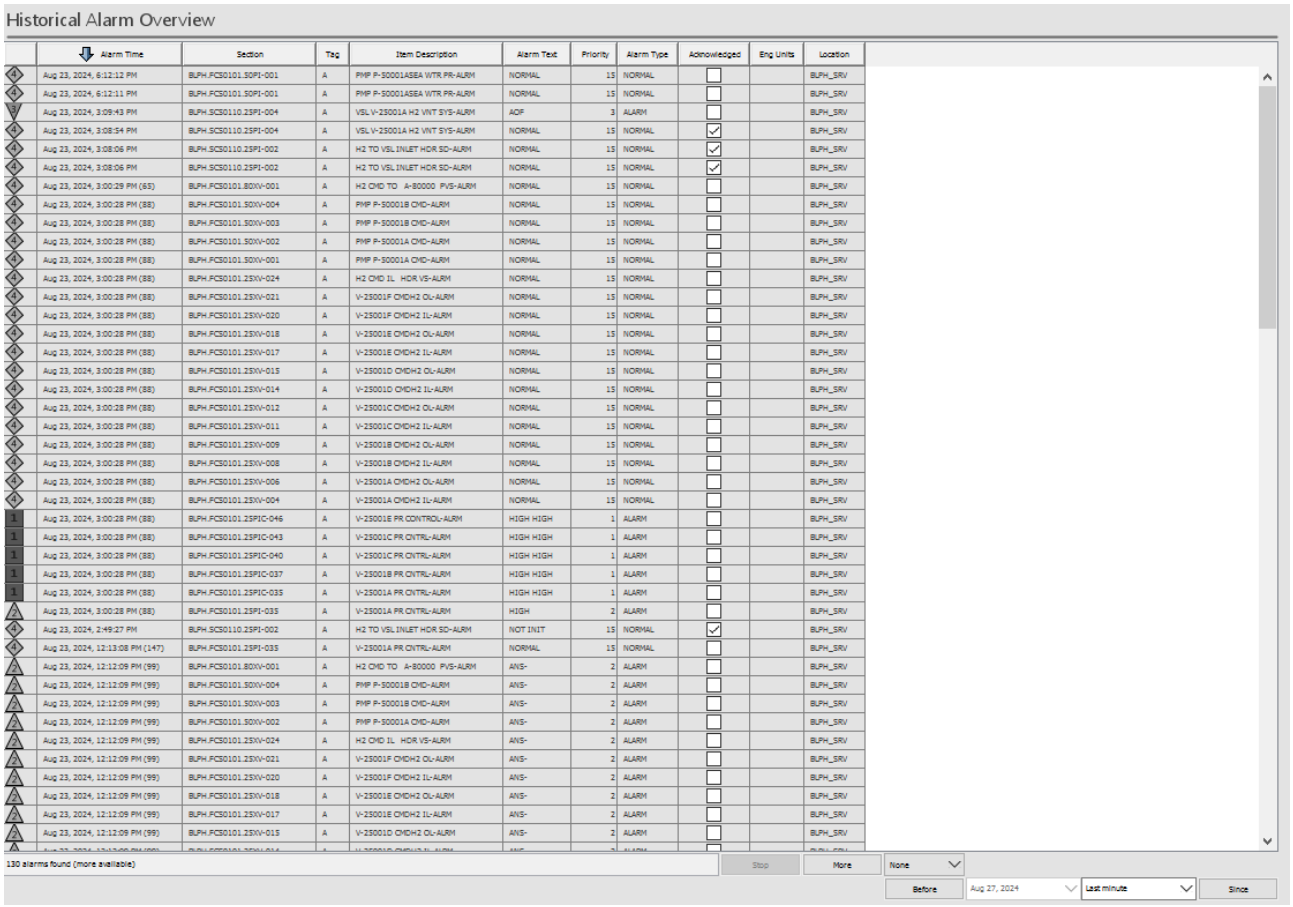


Figure 101 – Historical alarm overview example

Navigation

This display is accessible from the navigation pane on the left side of the screen.

No specific navigation is available from this display.

Actions

In the historical alarm overview no actions are defined.

30.2.5 Trend Display

The "Trend" display allows the user to generate plots of the desired process tag(s) as a function of time. Options for trend generation include multiple tag selection, date/time selection, date/time scroll, zoom in/out functionality, print functionality. The "Trend" display navigation has to defined in accordance with the other process graphics screen.

Layout

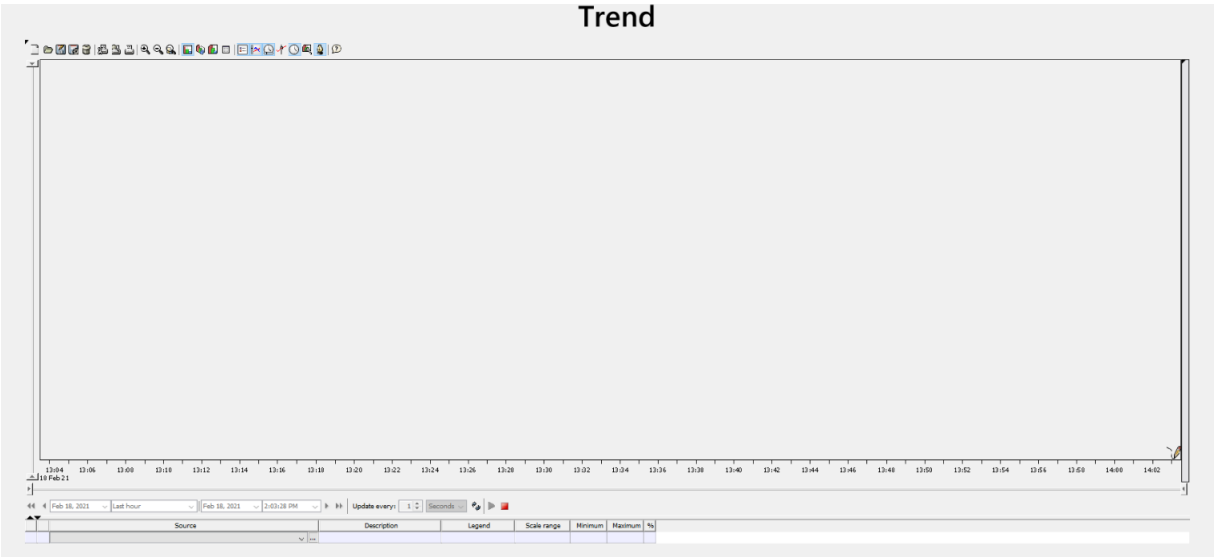


Figure 102 – Trend layout example

Settings

The trend display consists of the following sections:

- Toolbar
- Time/date settings control buttons
- Pen panel

Toolbar

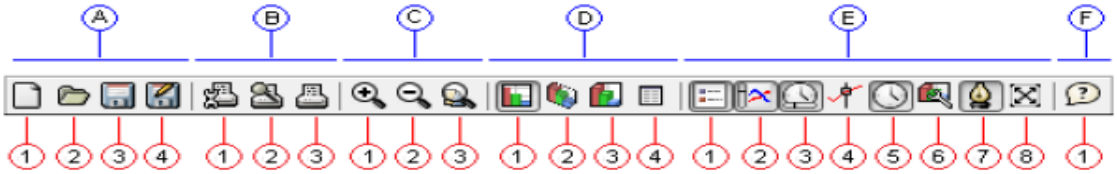


Figure 103 – Toolbar Buttons

Item	Description
A: Create and save trends	
1	Create a new trend
2	Open a trend
3	Save a trend
4	Save a trend as
B: Print	
1	Print page setup

2	Print preview
3	Print
C: Zoom	
1	Zoom in
2	Zoom out
3	Fit in window (to show complete trend contents)
D: Appearance	
1	Switch to 2d rendering
2	Switch to 3d orthographic rendering
3	Switch to 3d oblique rendering
4	Switch to table rendering
E: Show or hide user interface components	
1	Show or hide legend
2	Show or hide value slider
3	Show or hide time slider
4	Show or hide Hairline
5	Show or hide time control
6	Show or hide 3d control panel
7	Show or hide pen selection panel
8	Maximize current trend
F: Help	
1	Help

Table 123 – Trend Toolbar

Time/date settings control buttons

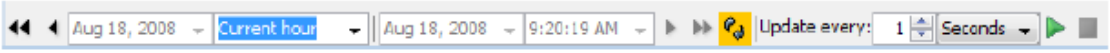


Figure 104 – Time/date settings control buttons

Time interval:

- Last minute
- Last hour
- Last day
- Last week

With one of these options, you select a "Last" period. If you click the "trend refresh" button the data of this "Last" period will be retrieved and shown.

- Current minute
- Current hour
- Current day
- Current week
- Current month
- Current year

With one of these options, you select a "Current" period. If you click the "trend refresh" button the data of this "Current" period will be retrieved and shown.

Example:

- 12:00 AM
- 12:30 AM
- 13:00 AM
- ...
- ...
- 10:30 PM
- 11:00 PM
- 11:30 PM

With one of these time settings, you can set a period from which you want to retrieve the data. If you click the "trend refresh" button the data of this period will be retrieved and shown. You cannot use the play button.

Pen Panel

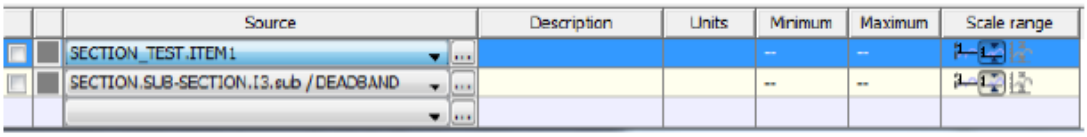


Figure 105 – Pen Panel Controls example

In the pen-panel (the area at the bottom of the application main frame), click in the table cell containing the text "…". The table-cell will change contents and a small button with dots on it, will be rendered at the right side of the table cell.

Click on this small button in the table cell. This will cause the item selection dialog to appear, in which all currently defined FAST/TOOLS items or sub-items, attributes and history storage groups are rendered in a tree-like hierarchical structure.

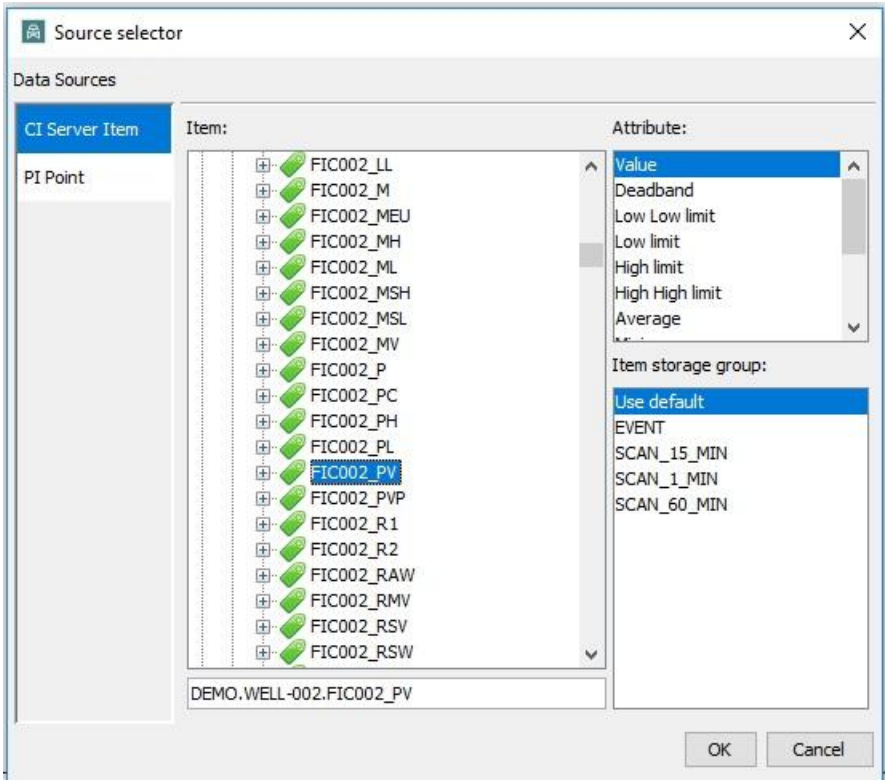


Figure 106 – Pen Selection pop-up example

Navigate in this tree to find the item that has been configured. Once found, click on the item, and press the OK button to select it (a short-cut for doing this is double-clicking on the item). The item selection dialog disappears, and the name of the selected item is depicted in the pen-panel. You can also select attributes or history storage groups.

30.2.6 Alarm Display Relations

From the alarm display the user can select an alarm and open the (process)display related to that item. In CI Server this is so-called alarm-jump functionality. In the Master Tag List, the display can be specified per item.

30.2.7 HMI Graphic Symbols

Refer Appendix-5 HMI Graphic Symbols

Appendix -1 SIS Typical test Report

Appendix -2 FGS Typical test Report

Appendix -3 List of Supported Devices

Appendix -4 PRM user groups and Account configuration

Appendix -5 HMI Graphic Objects

TEST REPORT FOR SIS TYPICALS

Revision	**:**	**02**
Date	**:**	**06-JAN-2025**
Test Specification Prepared by	**:**	**DAMINI.D**
Tested by	**:**	**NANDAGOPALK.S.**
Verified by	**:**	**MANOJKUMAR.P**

Revision History

Rev	Date	Revision Details / Remarks
00	05-JULY-2024	First Issue after Typical Test
01	08-OCT-2024	Accepted for Construction
02	06-JAN-2025	Accepted for Construction

List of SIS Software Typical

SYSTEM	SL. NO	Typical Name	Description	Revision			
				00	01	02	03
SIS	1	EDI	Energize to trip without LM	X	X		
	2	EDI_LM	Energize to trip with LM	X	X		
	3	DDI	De-energize to trip without LM	X	X		
	4	DDI_LM	De-energize to trip with LM	X	X		
	5	SAI	SIS Analog input with HH/LL trip	X	X		
	6	UZGRP	SIS UZ group with 10 inputs with First Out	X			
	7	UZRST	SIS Reset for UZ group	X			
	8	SDV_1	SDV VLV Position FB	X			
	9	BDV	BDV VLV Position FB	X	X	X	
	10	AOS	SIS Auto Override function	X			
	11	TOF	Timer Over Function		X		

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1 EDI

Digital input signal for normally open type of inputs without Line Monitoring (EDI)

1.1 PURPOSE

This function is used to process the normally open digital input signal without Line Monitoring.

Functionality:

The EDI function block has the following main functions:

- Trip management with alarming function.
- Optional maintenance override functionality.

The functions of the EDI typical are shown below. This typical is used for normally open digital trip initiator inputs based upon energize to trip function without line monitoring function. The typical has optional maintenance override functionality to override the trip function. The alarm output is independent of the MOS functionality.

The field signal for the typical is a digital input. The typical has an alarm and trip output. When the input becomes energized the output will be tripped and will remain tripped until the input value becomes de-energized again. The trip output will be used in the SIS application logic and the status will be indicated on the OWS. MOS shall be enabled from the OWS.

1.2 LOGIC DIAGRAMS

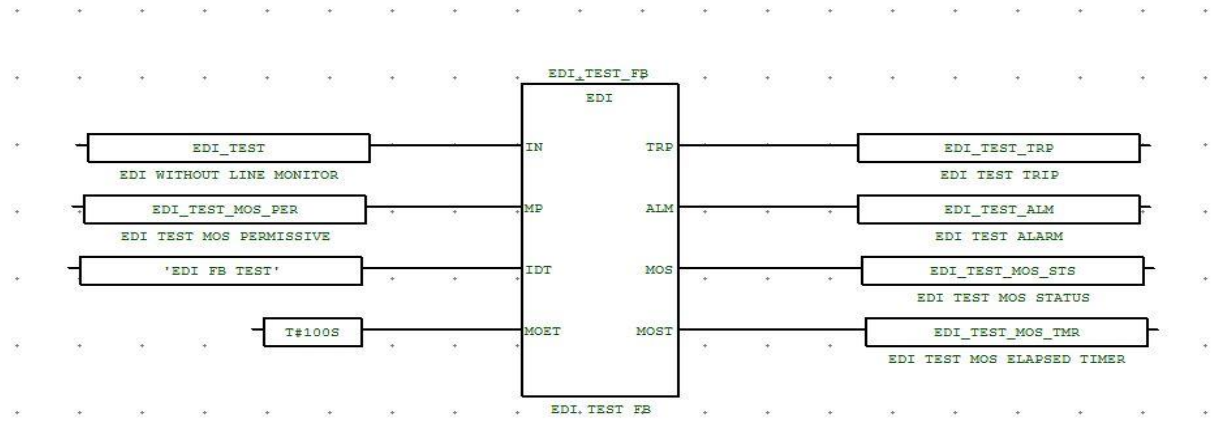


Fig 1 User Defined Function Block EDI

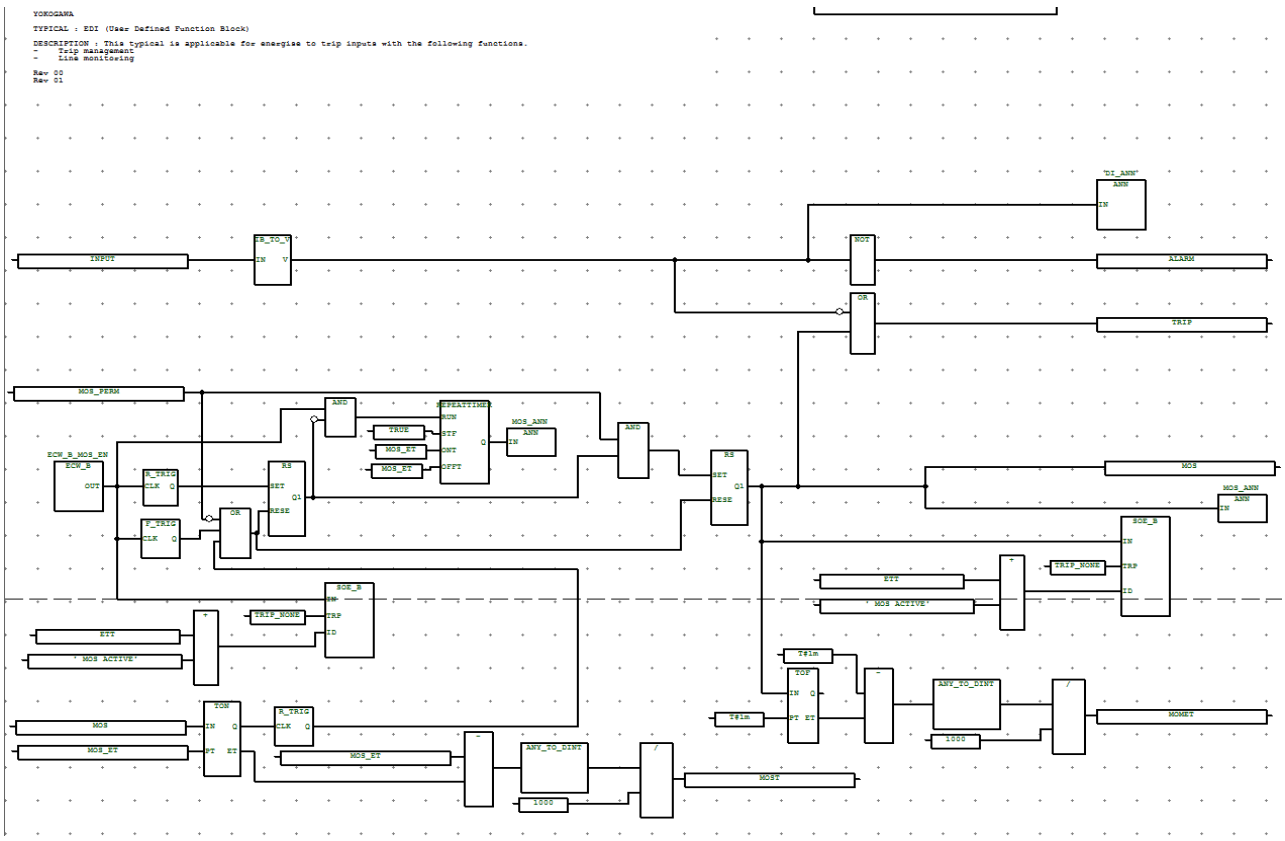


Fig 2 Logic Diagram for Typical EDI

1.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
IN	IN is the Field Digital Input	FALSE
MP	MP is the Maintenance Override Enable	FALSE
IDT	IDT is the comment for the “SOE”	"XXXXXXXXX"
MOET	MOET is the MOS Elapse Time	T#100s

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
TRP	TRP is the Trip Output	TRUE
ALM	ALM is the Alarm Status	TRUE
MOS	MOS is the MOS status	FALSE
MOST	MOST is the MOS Elapsed Time	100

1.4 TEST CASES VS EXPECTED RESULTS

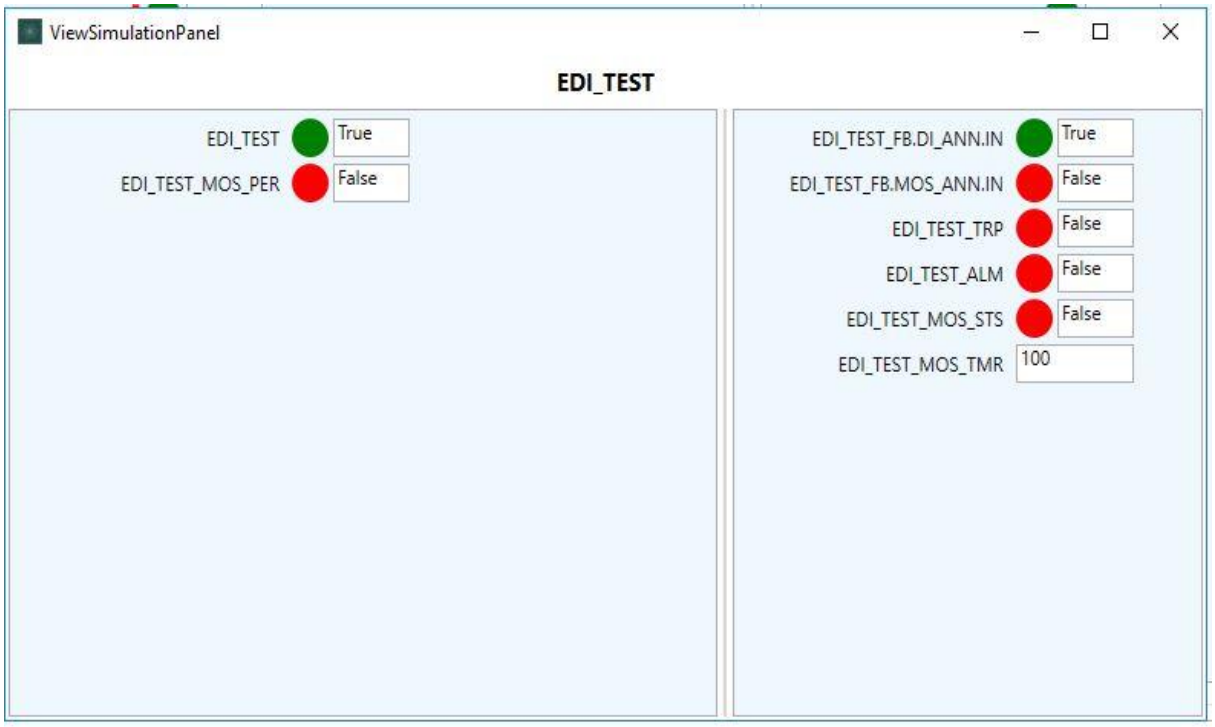
The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

Test Case Number	Test Cases	Input Parameter /Values	Expected Results		
			Trip Output TRP	Logic Alarm ALM	MOS Status MOS
TC#1	IN.Value = TRUE, MP = FALSE	IN.Value = TRUE, MP = FALSE	FALSE	FALSE	N/A
TC#2	IN.Value = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time not Elapsed	IN.Value = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time not Elapsed	TRUE	FALSE	TRUE
TC#3	IN.Value = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time Elapsed	IN.Value = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time Elapsed	FALSE	FALSE	FALSE
TC#4	IN.Value = TRUE, MP = FALSE, MOS ENABLE = TRUE	IN.Value = TRUE, MP = FALSE, MOS ENABLE = TRUE	FALSE	FALSE	FALSE

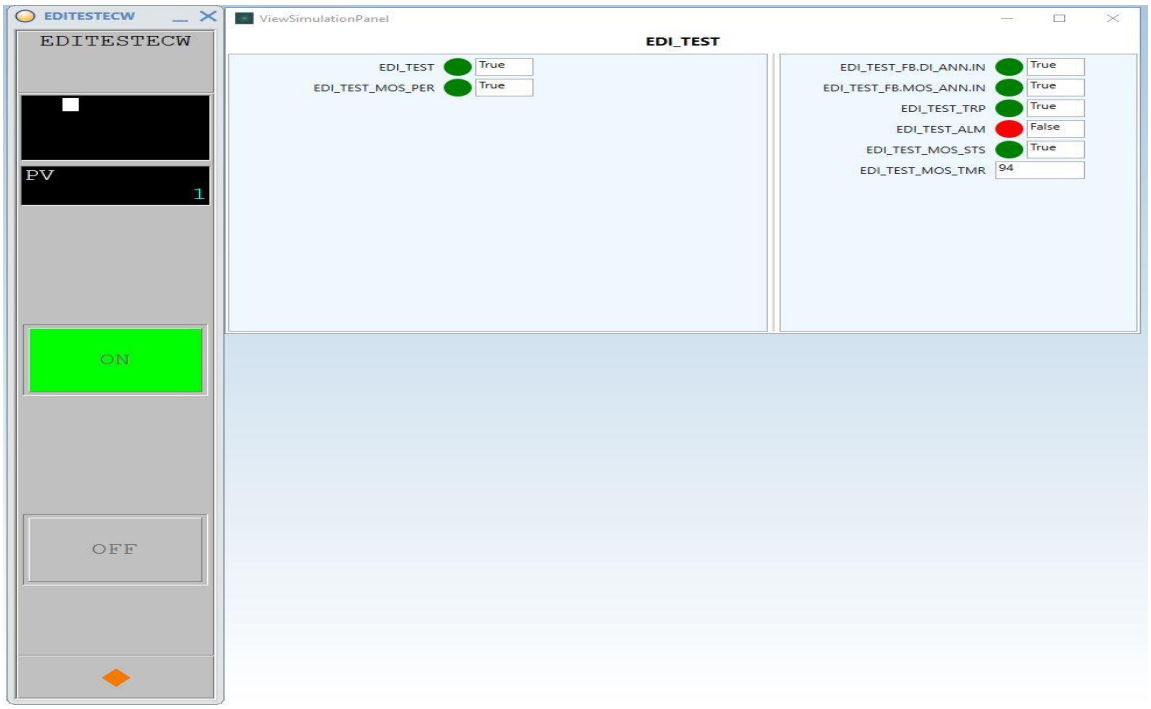
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from "True' to 'False'.

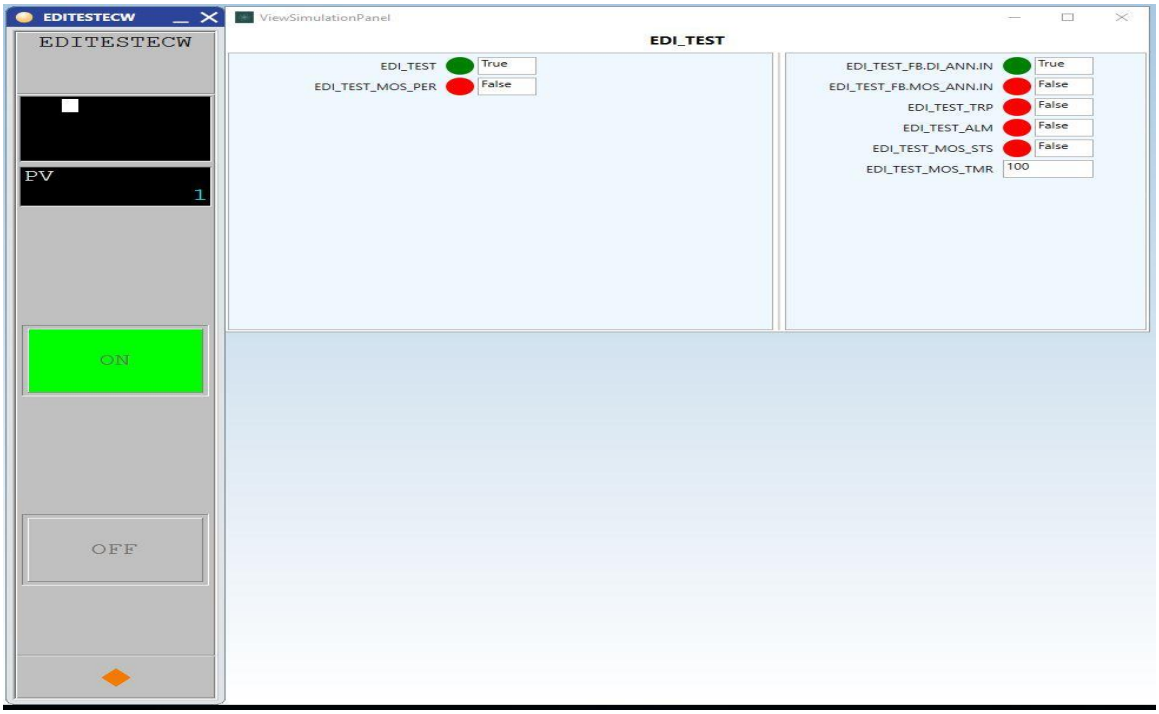
1.5 TEST RESULTS:



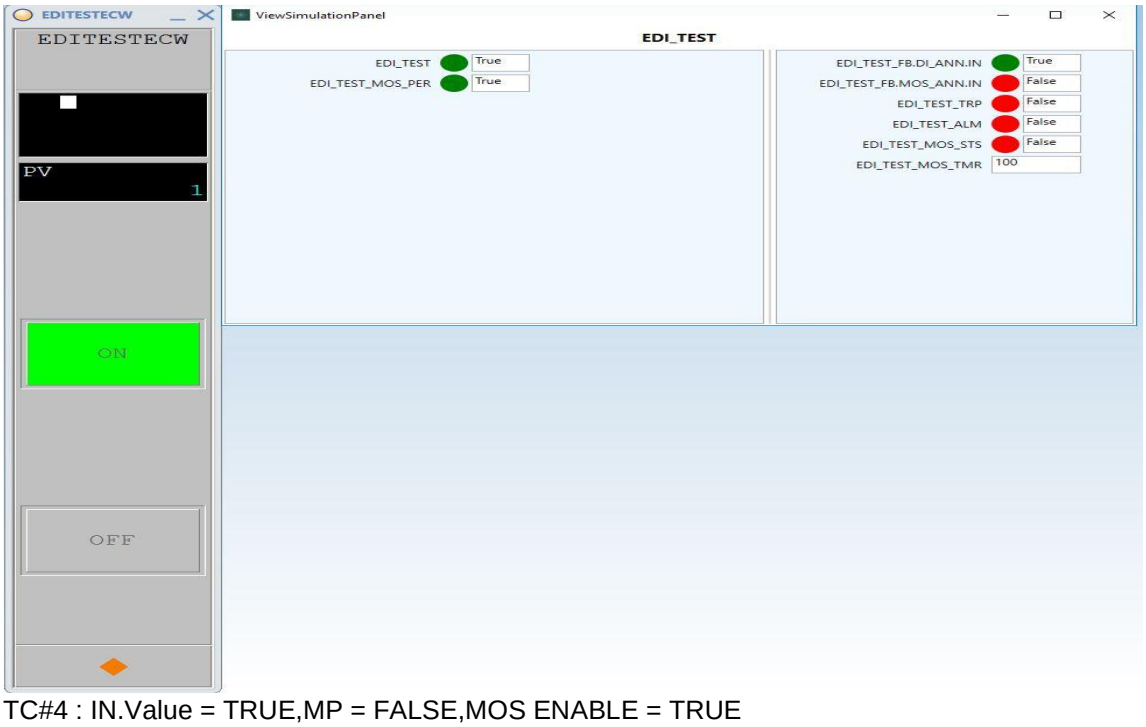
TC#1 : IN.Value = TRUE,MP = FALSE



TC#2 : IN.Value = TRUE,MP = TRUE,MOS ENABLE = TRUE,MOS Elapse time not Elapsed

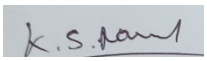


TC#3 : IN.Value = TRUE,MP = TRUE,MOS ENABLE = TRUE,MOS Elapse time Elapsed



TC#4 : IN.Value = TRUE,MP = FALSE,MOS ENABLE = TRUE

1.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	08-OCT-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

2 EDI_LM

Digital input signal for normally open type of inputs with Line Monitoring (EDI_LM)

2.1 PURPOSE

This function is used to process the normally open digital input signal with Line Monitoring.

Functionality:

The EDI_LM function block has the following main functions:

- Trip management with alarming function.
- Optional maintenance override functionality.
- Line fault detection.

The functions of the EDI typical are shown below. This typical is used for normally open digital trip initiator inputs based upon energize to trip function with line monitoring function. The typical has optional maintenance override functionality to override the trip function. The alarm output is independent of the MOS functionality.

The field signal for the typical is a digital input. The typical has an alarm and trip output. When the input becomes energized the output will be tripped and will remain tripped until the input value becomes de-energized again. The trip output will be used in the SIS application logic and the status will be indicated on the OWS. MOS shall be enabled from the OWS.

2.2 LOGIC DIAGRAMS

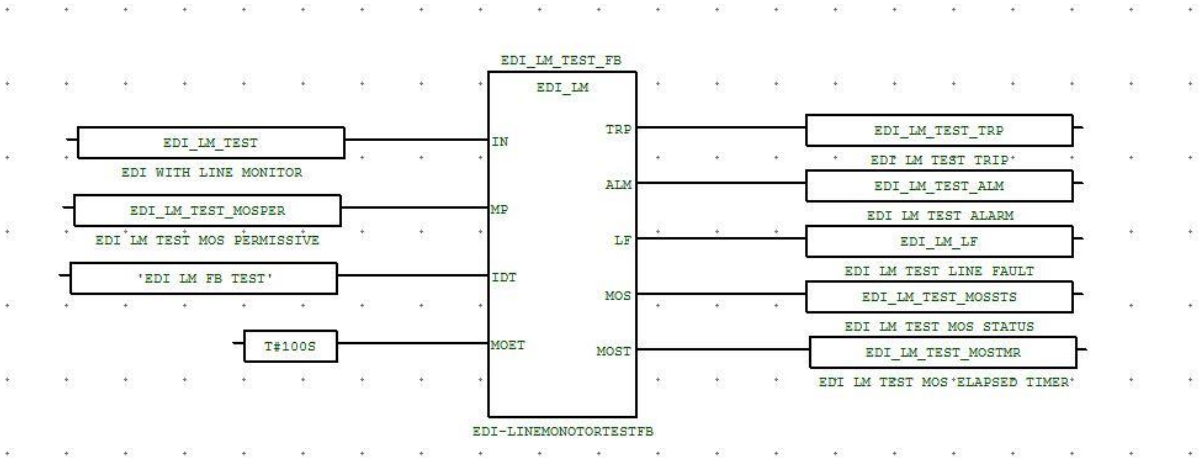


Fig 3 User Defined Function Block EDI_LM

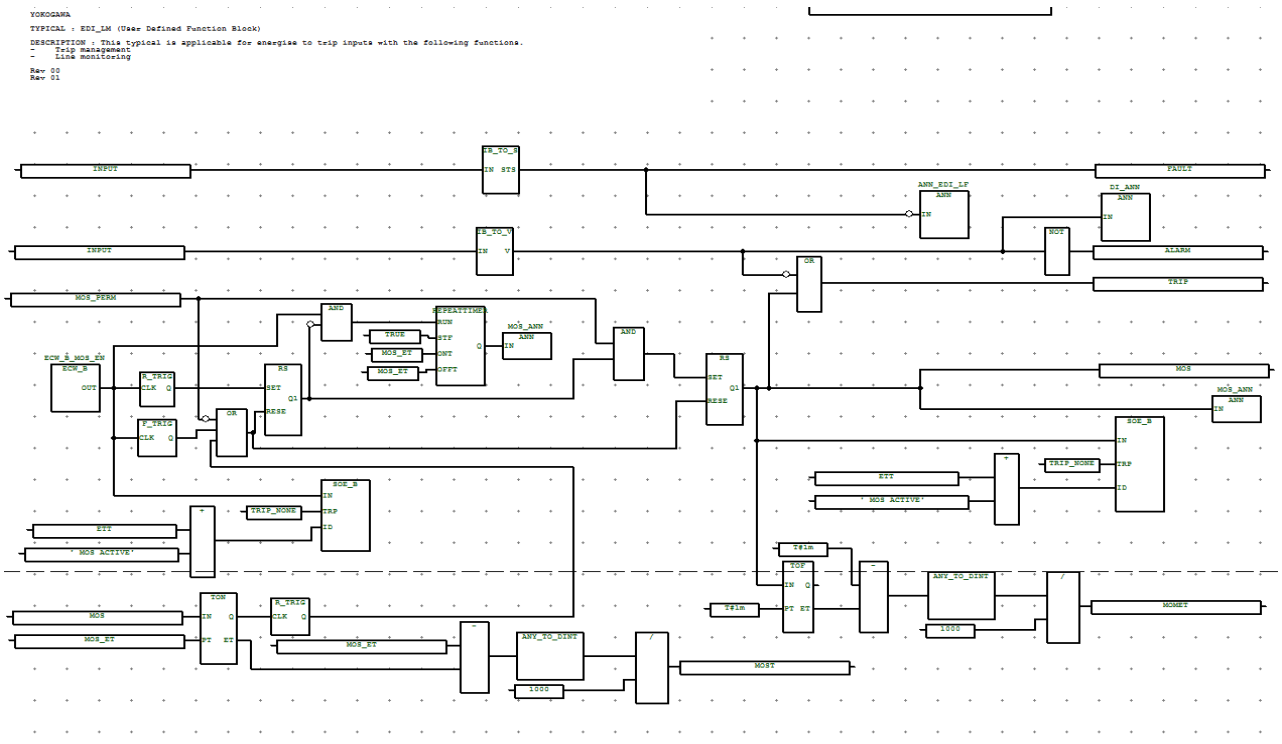


Fig 4 Logic Diagram for Typical EDI_LM

2.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
IN	IN is the Field Digital Input	FALSE
MP	MP is the Maintenance Override Enable	FALSE
IDT	IDT is the comment for the “SOE”	"XXXXXXXXX"
MOET	MOET is the MOS Elapse Time	T#100s

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
TRP	TRP is the Trip Output	TRUE
ALM	ALM is the Alarm Status	TRUE
LF	LF is the Line Fault Alarm	TRUE
MOS	MOS is the MOS status	FALSE
MOST	MOST is the MOS Elapsed Time	100

2.4 TEST CASES VS EXPECTED RESULTS

The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

Test Case Number	Test Cases	Input Parameter /Values	Expected Results			
			Trip Output TRP	Logic Alarm ALM	MOS Status MOS	Line Fault LF
TC#1	IN.Value = FALSE, IN.Status = FALSE, MP = FALSE	IN.Value = FALSE, IN.Status = FALSE, MP = FALSE	N/A	N/A	N/A	FALSE
TC#2	IN.Value = TRUE, IN.Status = TRUE, MP = FALSE	IN.Value = TRUE, IN.Status = TRUE, MP = FALSE	FALSE	FALSE	N/A	N/A
TC#3	IN.Value = TRUE, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time not Elapsed	IN.Value = TRUE, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time not Elapsed	TRUE	FALSE	TRUE	N/A
TC#4	IN.Value = TRUE, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time Elapsed	IN.Value = TRUE, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time Elapsed	FALSE	FALSE	FALSE	N/A
TC#5	IN.Value = TRUE, IN.Status = TRUE, IN.Status = TRUE, MP = FALSE, MOS ENABLE = TRUE	IN.Value = TRUE, IN.Status = TRUE, IN.Status = TRUE, MP = FALSE, MOS ENABLE = TRUE	FALSE	FALSE	FALSE	N/A

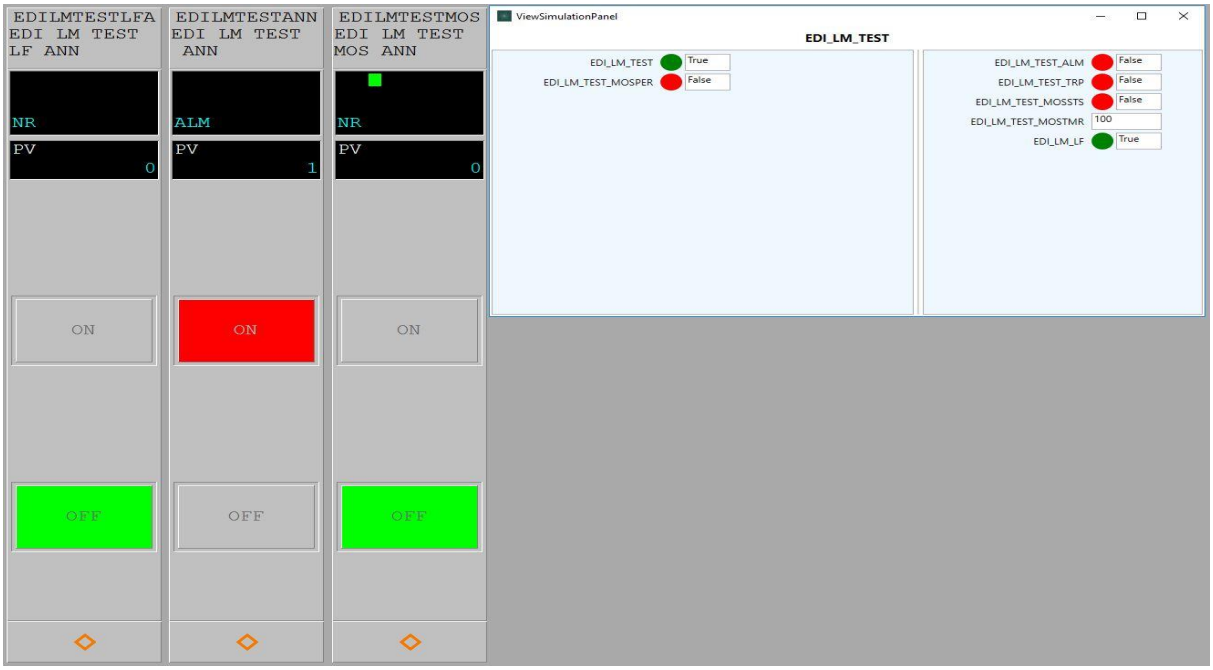
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from "True' to 'False'.

2.5 TEST RESULTS:



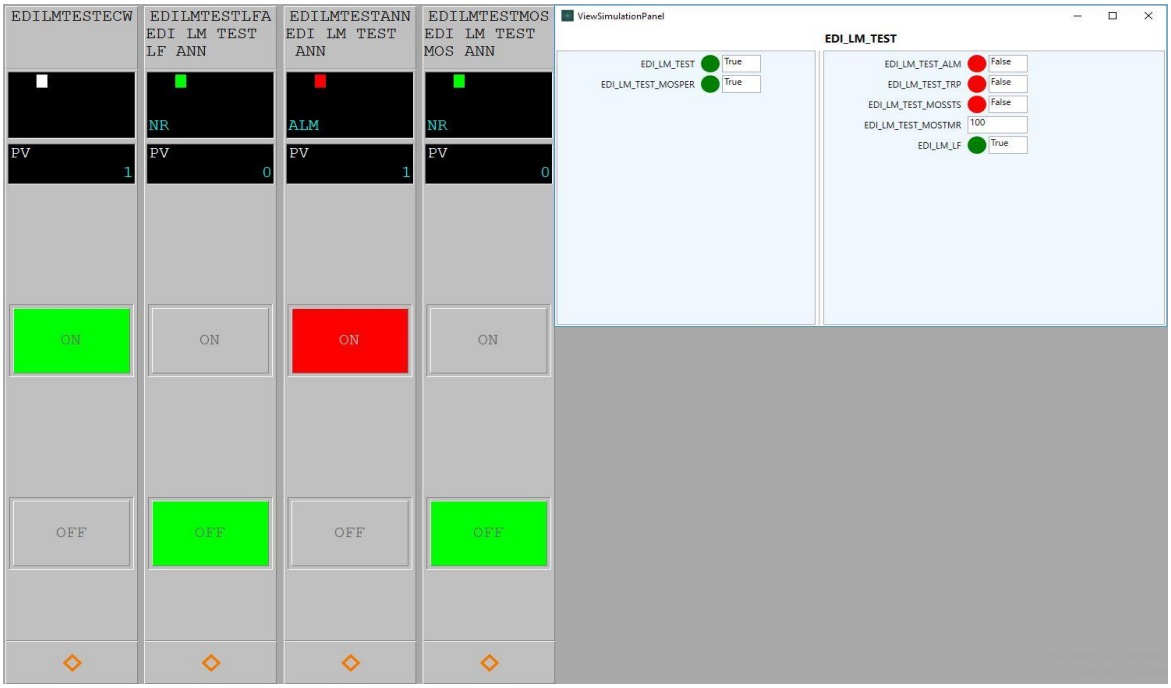
TC#1 : IN.Value = FALSE, IN.Status = FALSE,MP = FALSE



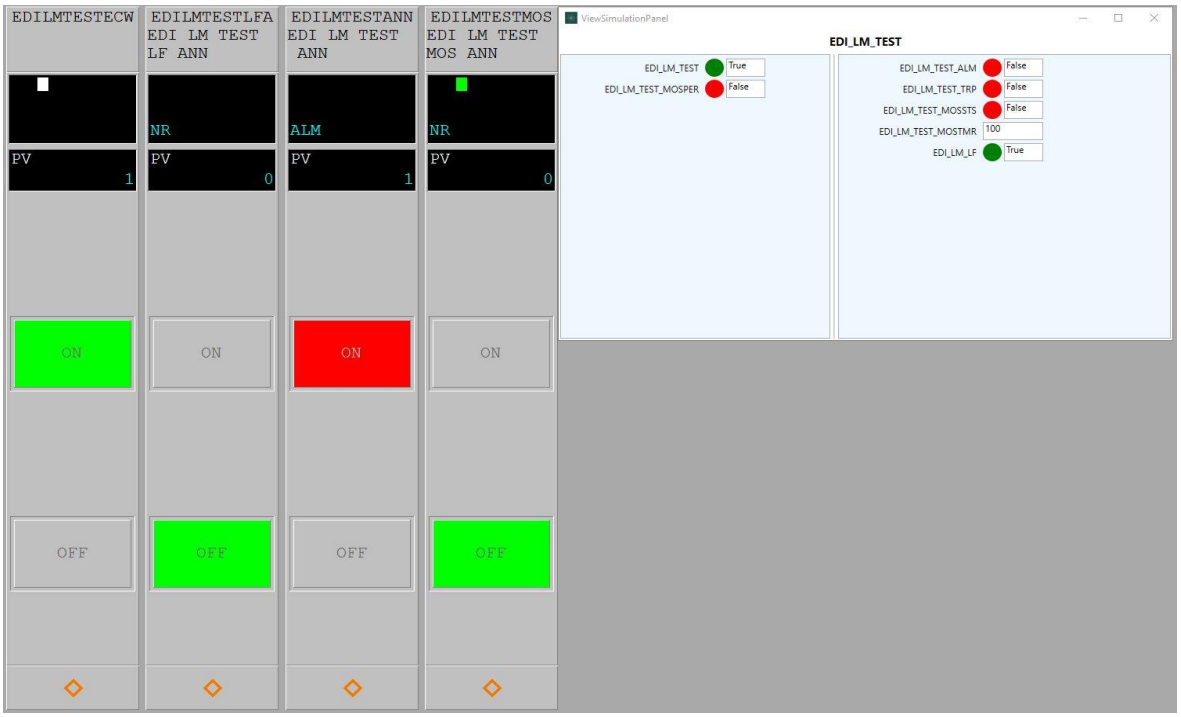
TC#2 : IN.Value = TRUE, IN.Status = TRUE, MP = FALSE



TC#3 : IN.Value = TRUE, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE,
MOS Elapse time not Elapsed

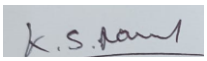


TC#4 : IN.Value = TRUE, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE,
MOS Elapse time Elapsed



TC#5 : IN.Value = TRUE, IN.Status = TRUE, IN.Status = TRUE, MP = FALSE,
MOS ENABLE = TRUE

2.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	08-OCT-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

3 DDI

Digital input signal for normally close type of inputs without Line Monitoring (DDI)

3.1 PURPOSE

This function is used to process the normally close digital input signal without Line Monitoring.

Functionality:

The DDI function block has the following main functions:

- Trip management.
- Optional maintenance override function.

The functions of the DDI typical are shown below. This typical is used for digital inputs based upon de-energize to trip function. The typical has optional maintenance override functionality to override the trip function. The alarm output is independent of the MOS functionality.

The field signal for the typical is a digital input. This typical is applicable for normally closed field contact. The typical has a trip output. In case the input becomes de-energized the output will be tripped and will remain de-activated until the input value becomes energized again. The trip output status alarm will be indicated on OWS. MOS shall be enabled from the OWS.

3.2 LOGIC DIAGRAMS

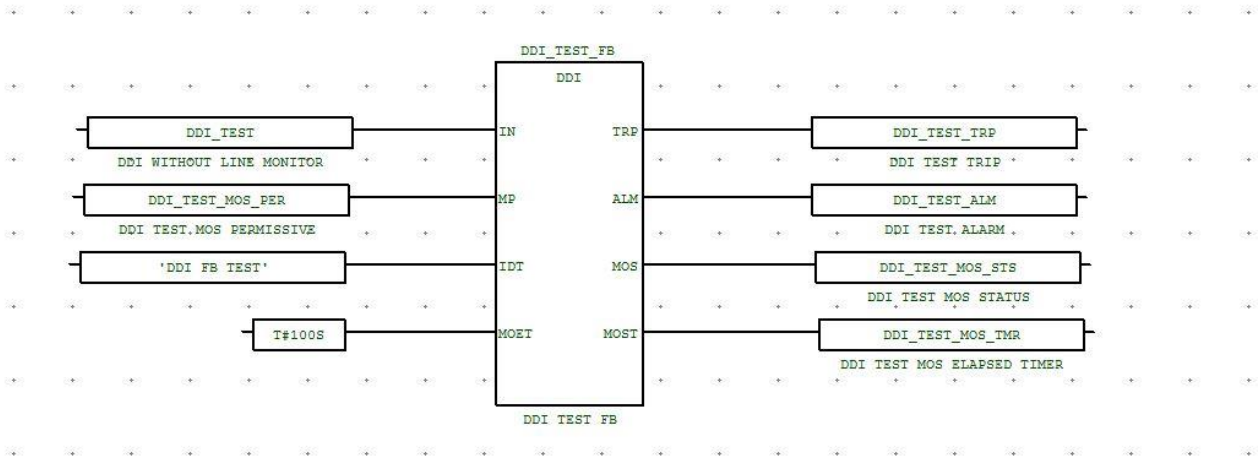


Fig 5 User Defined Function Block DDI

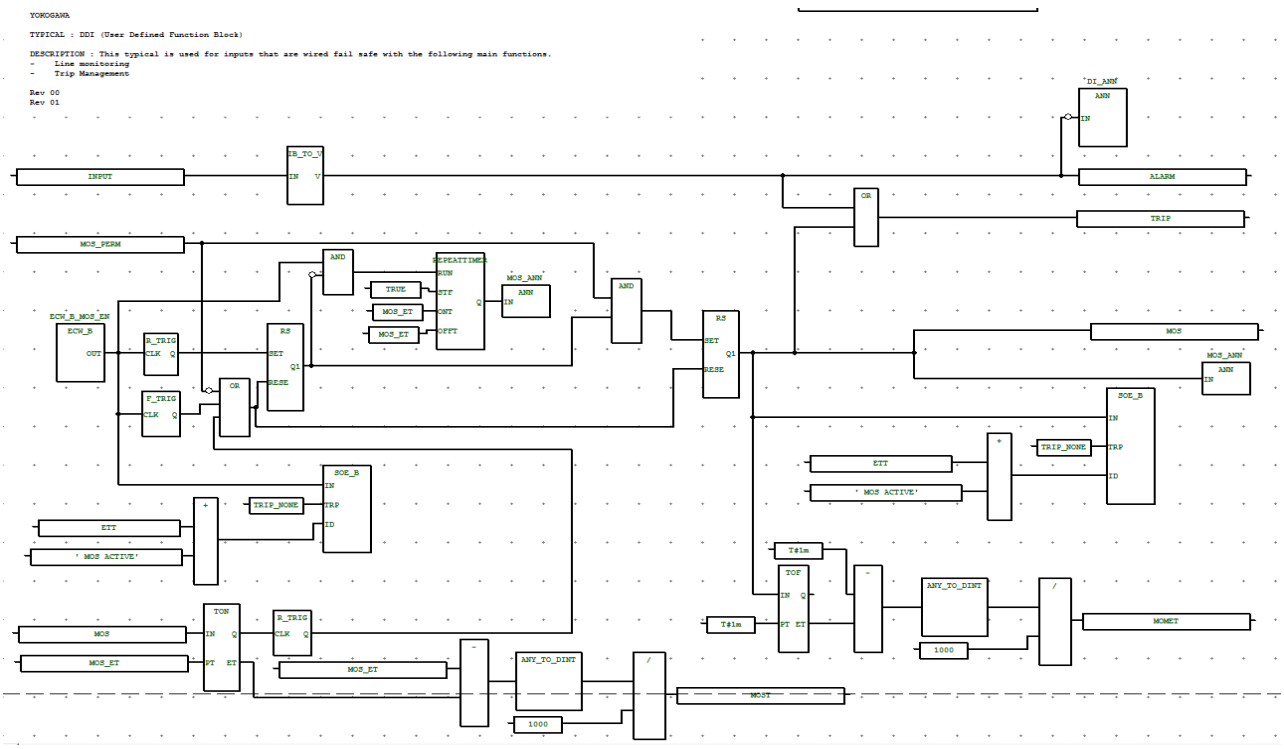


Fig 6 Logic Diagram for Typical DDI

3.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
IN	IN is the Field Digital Input	TRUE
MP	MP is the Maintenance Override Enable	FALSE
IDT	IDT is the comment for the “SOE”	"XXXXXXXXX"
MOET	MOET is the MOS Elapse Time	T#100s

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
TRP	TRP is the Trip Output	TRUE
ALM	ALM is the Alarm Status	TRUE
MOS	MOS is the MOS status	FALSE
MOST	MOST is the MOS Elapsed Time	100

3.4 TEST CASES VS EXPECTED RESULTS

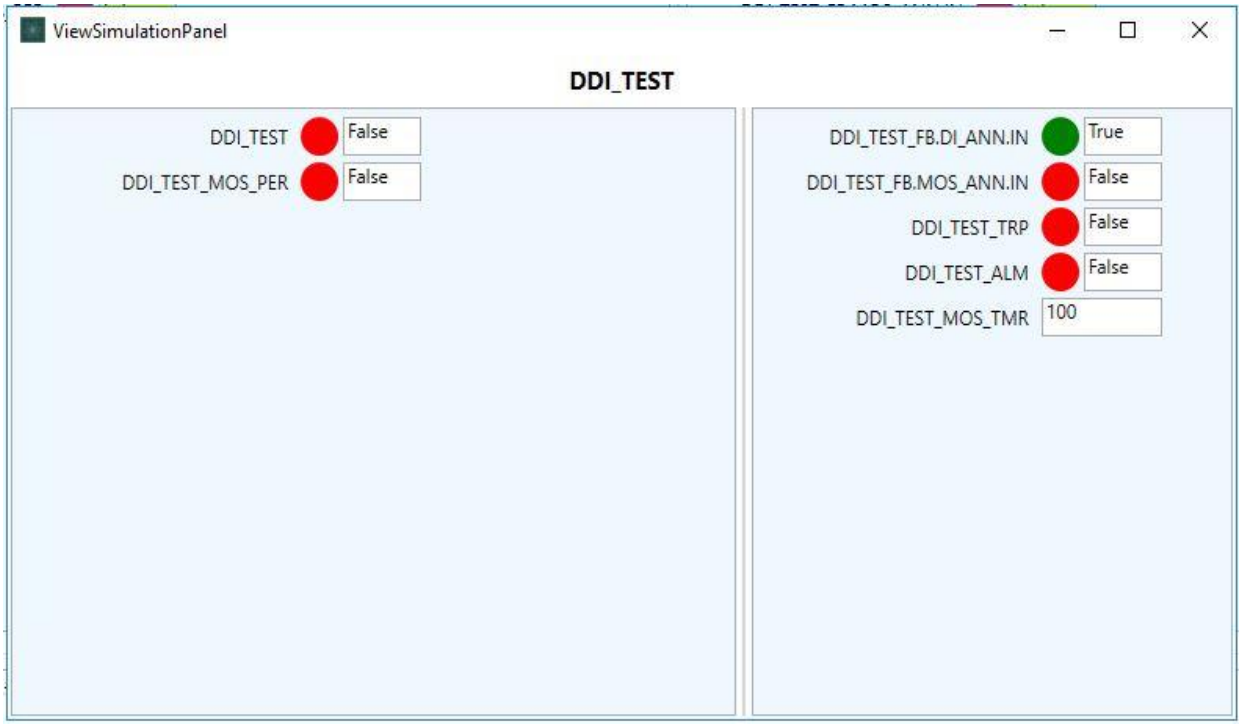
The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

Test Case Number	Test Cases	Input Parameter /Values	Expected Results		
			Trip Output TRP	Logic Alarm ALM	MOS Status MOS
TC#1	IN.Value = FALSE, MP = FALSE	IN.Value = FALSE, MP = FALSE	FALSE	FALSE	N/A
TC#2	IN.Value = FALSE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time not Elapsed	IN.Value = FALSE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time not Elapsed	TRUE	FALSE	TRUE
TC#3	IN.Value = FALSE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time Elapsed	IN.Value = FALSE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time Elapsed	FALSE	FALSE	FALSE
TC#4	IN.Value = FALSE, MP = FALSE, MOS ENABLE = TRUE	IN.Value = FALSE, MP = FALSE, MOS ENABLE = TRUE	FALSE	FALSE	FALSE

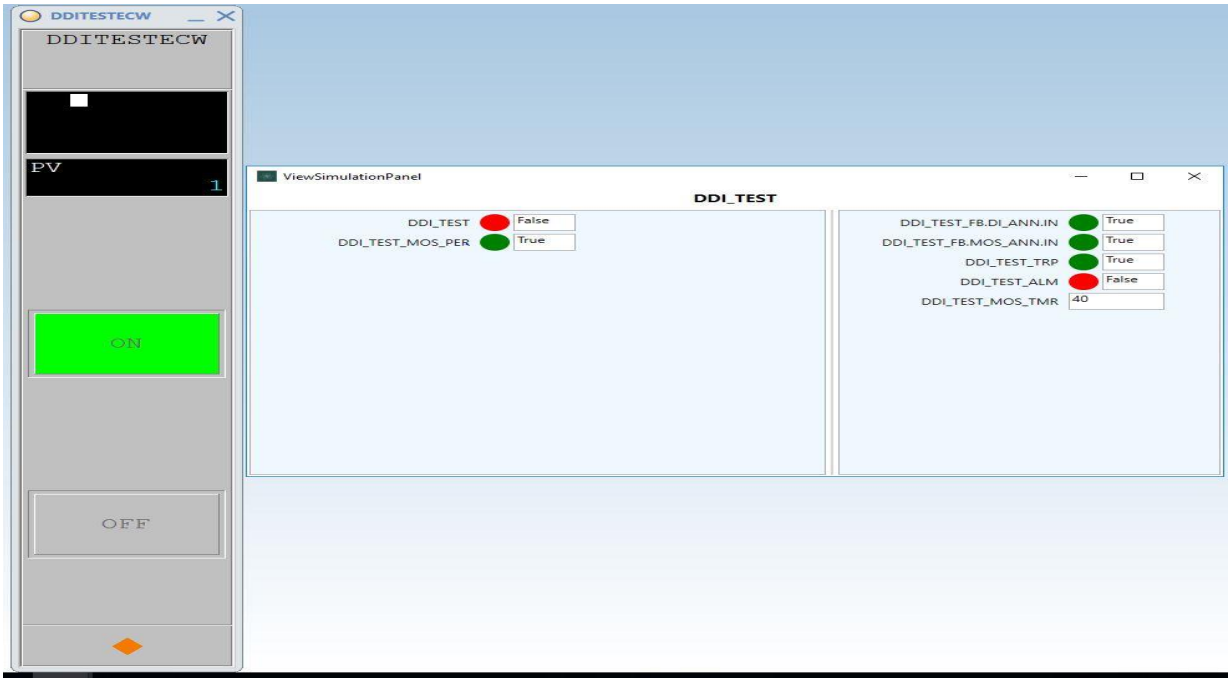
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from "True' to 'False'.

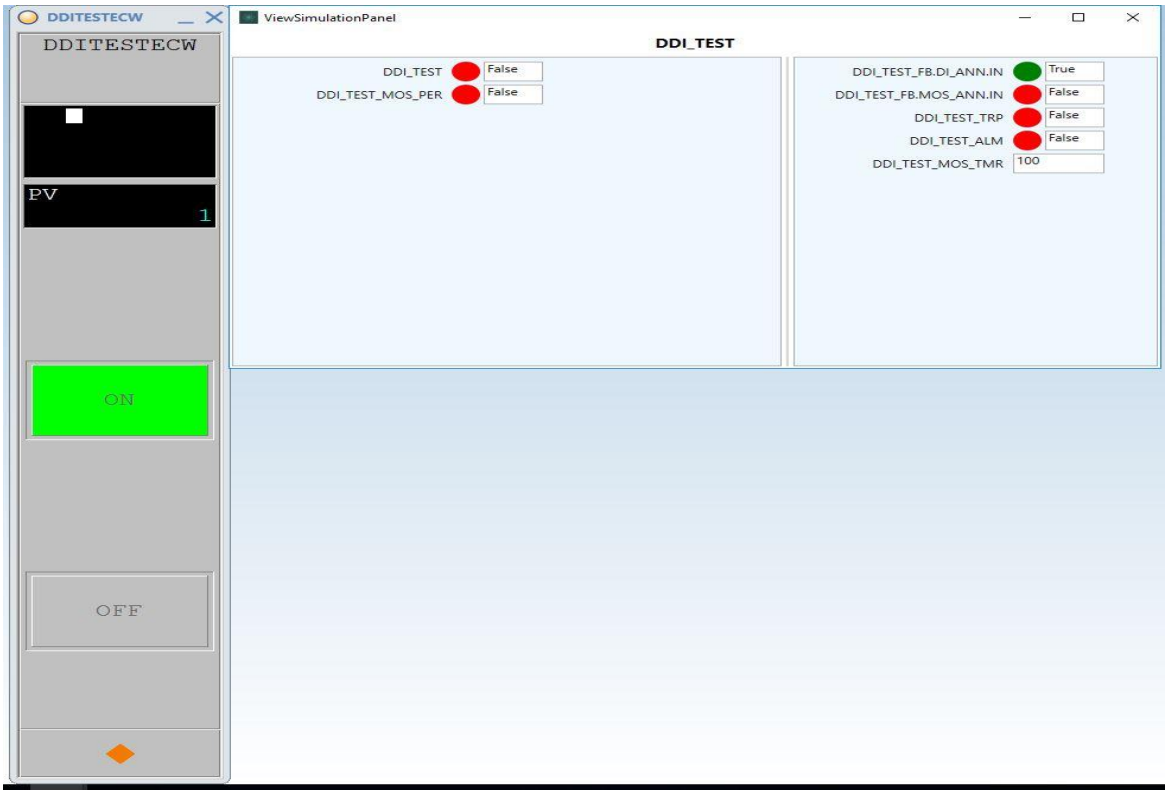
3.5 TEST RESULTS:



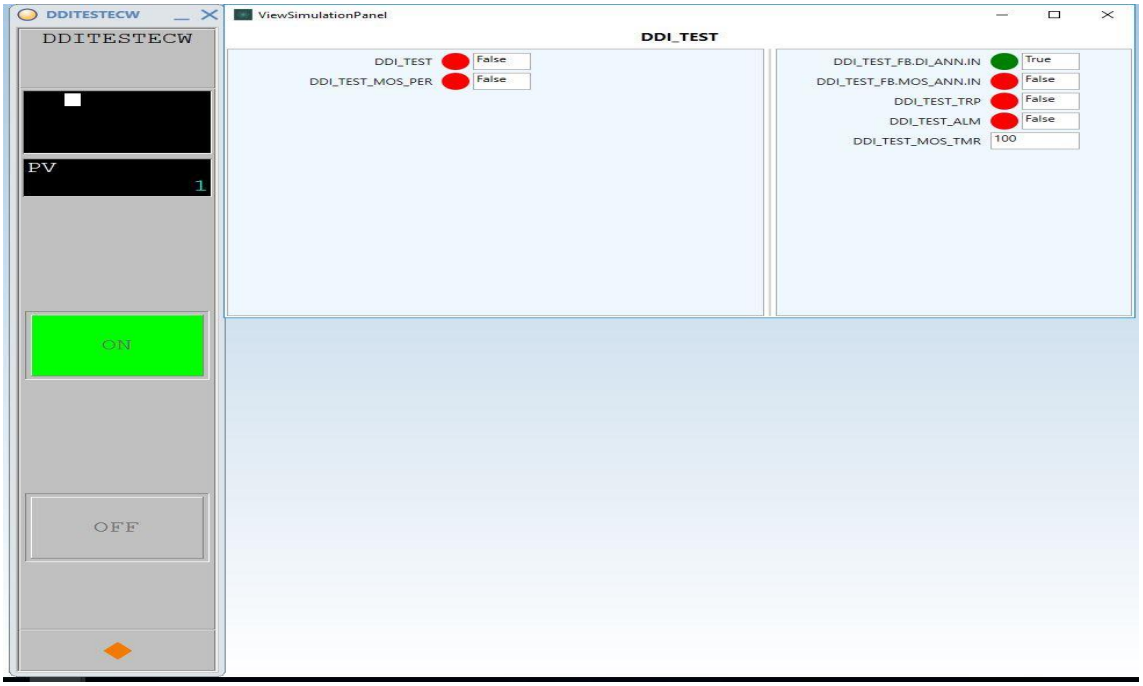
TC#1 : IN.Value = FALSE, MP = FALSE



TC#2 : IN.Value = FALSE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time not Elapsed

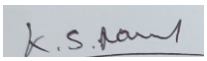


TC#3 : IN.Value = FALSE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time Elapsed



TC#4 : IN.Value = FALSE, MP = FALSE, MOS ENABLE = TRUE

3.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	08-OCT-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

4 DDI_LM

Digital input signal for normally close type of inputs with Line Monitoring (DDI_LM)

4.1 PURPOSE

This function is used to process the normally close digital input signal with Line Monitoring.

Functionality:

The DDI function block has the following main functions:

- Trip management.
- Line fault detection.
- Optional maintenance override function.

The functions of the DDI typical are shown below. This typical is used for digital inputs based upon de-energize to trip function which require line monitoring. The typical has optional maintenance override functionality to override the trip function. The alarm output is independent of the MOS functionality.

The field signal for the typical is a digital input. This typical is applicable for normally closed field contact. The typical has a line fault alarm and trip output. In case the input becomes de-energized the output will be tripped and will remain de-activated until the input value becomes energized again. The trip output status and line fault alarm will be indicated on OWS. MOS shall be enabled from the OWS.

4.2 LOGIC DIAGRAM

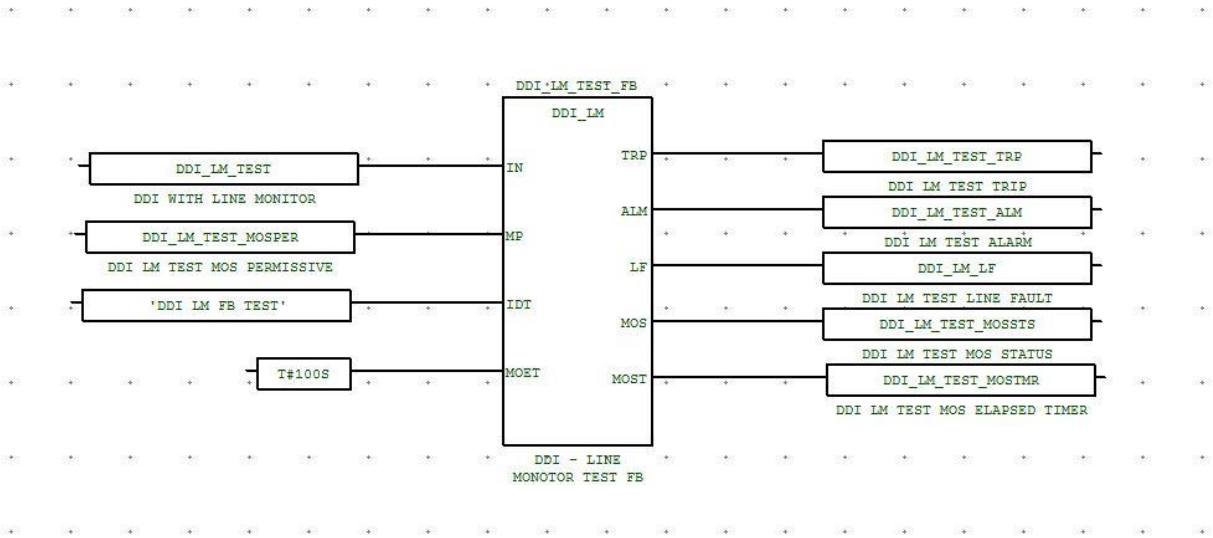


Fig 7 User Defined Function Block DDI_LM

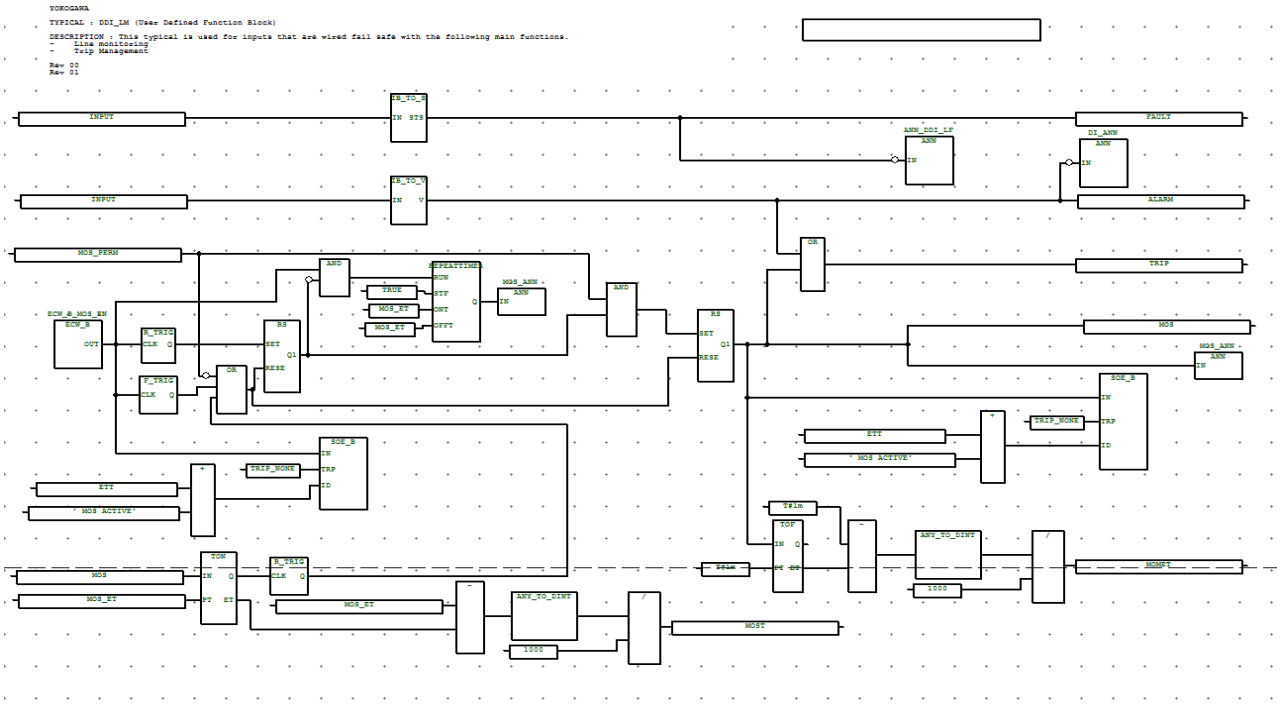


Fig 8 Logic Diagram for Typical DDI_LM

4.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
IN	IN is the Field Digital Input	TRUE
MP	MP is the Maintenance Override Enable	FALSE
IDT	IDT is the comment for the “SOE”	"XXXXXXXXX"
MOET	MOET is the MOS Elapse Time	T#100s

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
TRP	TRP is the Trip Output	TRUE
ALM	ALM is the Alarm Status	TRUE
LF	LF is the Line Fault Alarm	TRUE
MOS	MOS is the MOS status	FALSE
MOST	MOST is the MOS Elapsed Time	100

4.4 TEST CASES VS EXPECTED RESULTS

The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

Test Case Number	Test Cases	Input Parameter /Values	Expected Results			
			Trip Output TRP	Logic Alarm ALM	MOS Status MOS	Line Fault LF
TC#1	IN.Value = TRUE, IN.Status = FALSE, MP = FALSE	IN.Value = TRUE, IN.Status = FALSE, MP = FALSE	N/A	N/A	N/A	FALSE
TC#2	IN.Value = FALSE, IN.Status = TRUE, MP = FALSE	IN.Value = FALSE, IN.Status = TRUE, MP = FALSE	FALSE	FALSE	N/A	N/A
TC#3	IN.Value = FALSE, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time not Elapsed	IN.Value = FALSE, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time not Elapsed	TRUE	FALSE	TRUE	N/A
TC#4	IN.Value = FALSE, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time Elapsed	IN.Value = FALSE, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time Elapsed	FALSE	FALSE	FALSE	N/A
TC#5	IN.Value = FALSE, IN.Status = TRUE, IN.Status = TRUE, MP = FALSE, MOS ENABLE = TRUE	IN.Value = FALSE, IN.Status = TRUE, IN.Status = TRUE, MP = FALSE, MOS ENABLE = TRUE	FALSE	FALSE	FALSE	N/A

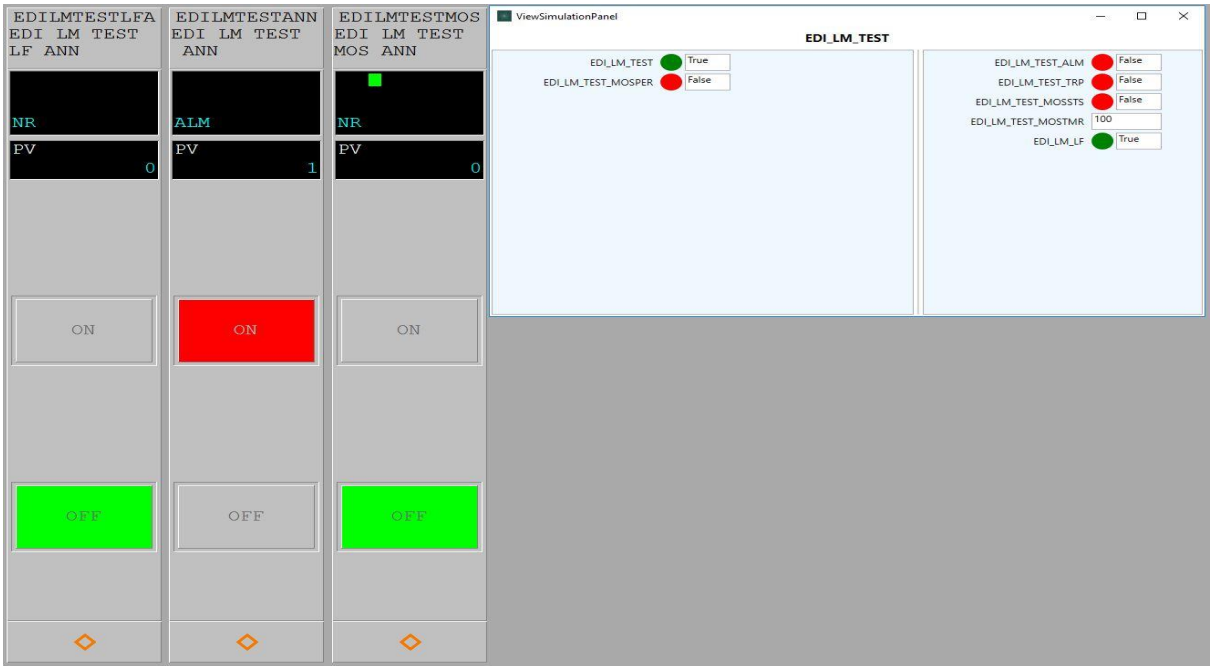
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from "True' to 'False'.

4.5 TEST RESULTS:



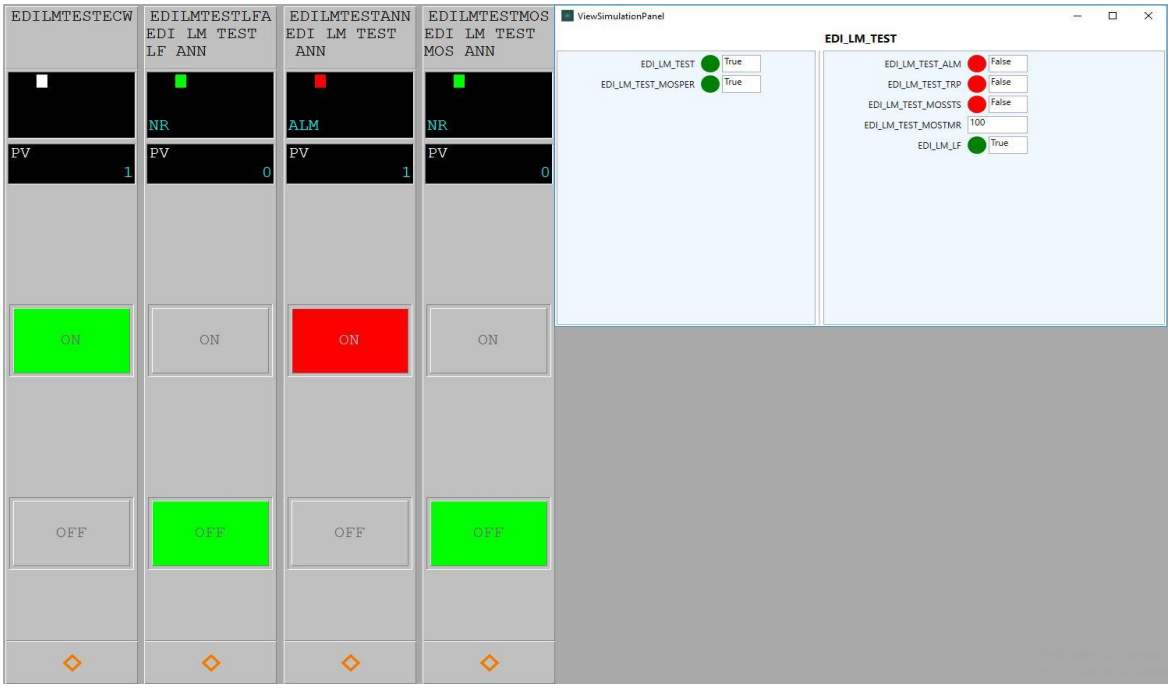
TC#1 : IN.Value = FALSE, IN.Status = FALSE,MP = FALSE



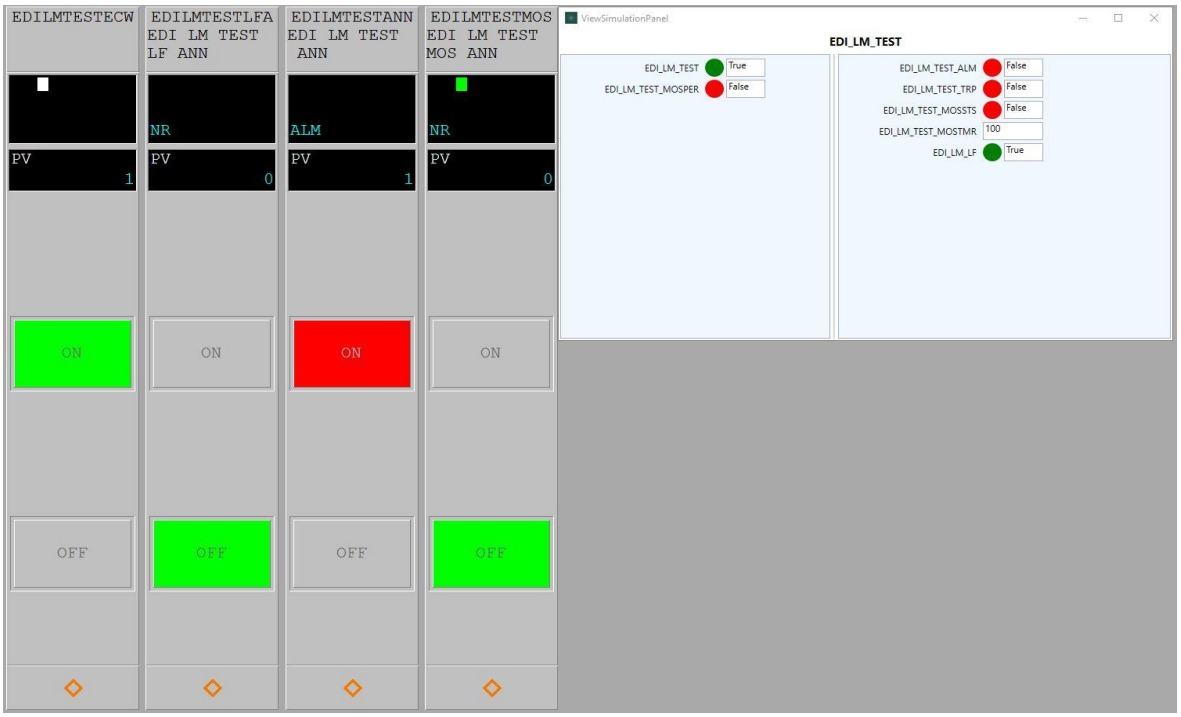
TC#2 : IN.Value = TRUE, IN.Status = TRUE, MP = FALSE



TC#3 : IN.Value = TRUE, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE,
MOS Elapse time not Elapsed

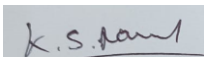


TC#4 : IN.Value = TRUE, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE,
MOS Elapse time Elapsed



TC#5 : IN.Value = TRUE, IN.Status = TRUE, IN.Status = TRUE, MP = FALSE,
MOS ENABLE = TRUE

4.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	08-OCT-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

5 SAI

SAI Function block is used to scale the Input signal to the Engineering value

5.1 PURPOSE

SAI Function block is used to scale the Input signal to the Engineering value and will generate trip signal when input value exceeds the Set points of LOW, LOW LOW, HIGH & HIGH HIGH.

Functionality:

The SAI function block has the following main functions:
• Validity check of the signal.
• Process threshold management.
• Optional functions are maintenance override and operational override functionality

This function block is used in logic applications in order to decide whether the input signal is below the Low, or above the High threshold setting. The image below gives the model for the functions specified for the SAI function block. For the threshold, an optional dead-band DB will be available (hysteresis) when changing from a trip state to a normal state.

When the input value drops below the Low Low set-point, the (LL) alarm and trip (SDL) will be set, and will remain latched until the input value rises above the Low Low set-point plus the dead-band. When the input value exceeds the High High set-point, the (HH) alarm and trip (SDH) will be set, and will remain latched until the input value falls below the High High set-point minus the dead-band.
The trip function can be overridden by the maintenance override. The alarm function is independent of the status of the maintenance override. The trip status and line fault alarm will be indicated on OWS. MOS shall be enabled from the OWS.

5.2 LOGIC DIAGRAMS

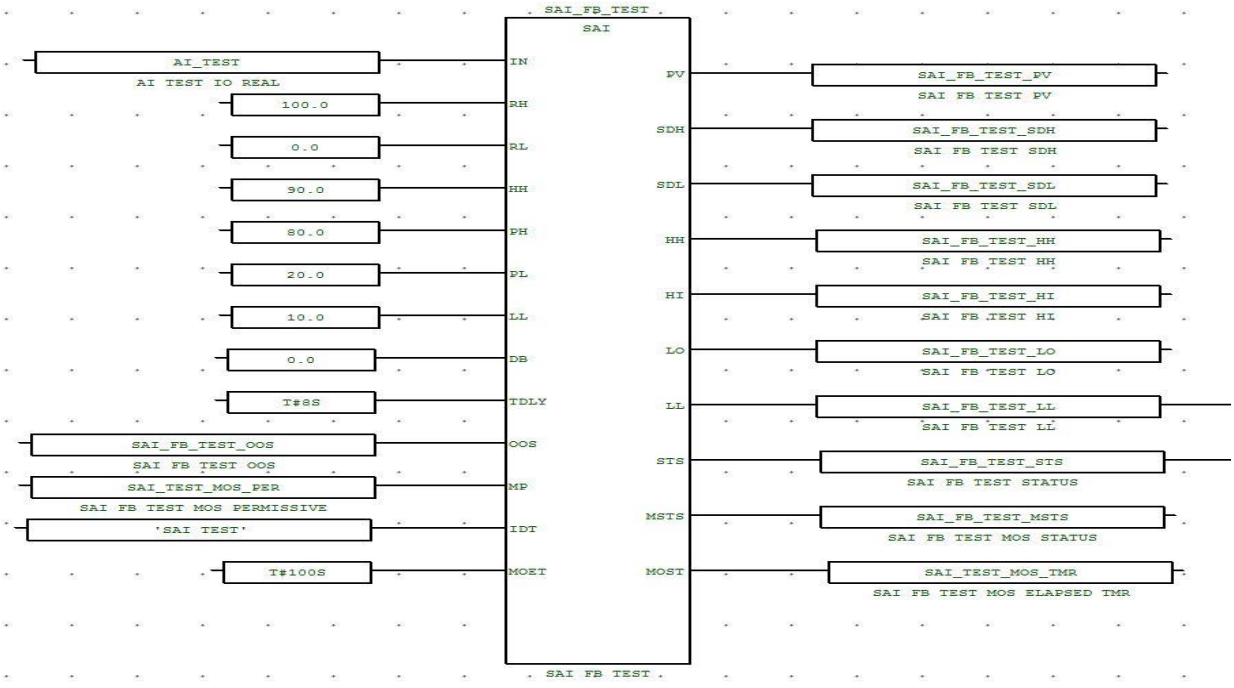


Fig 9 User Defined Function Block SAI

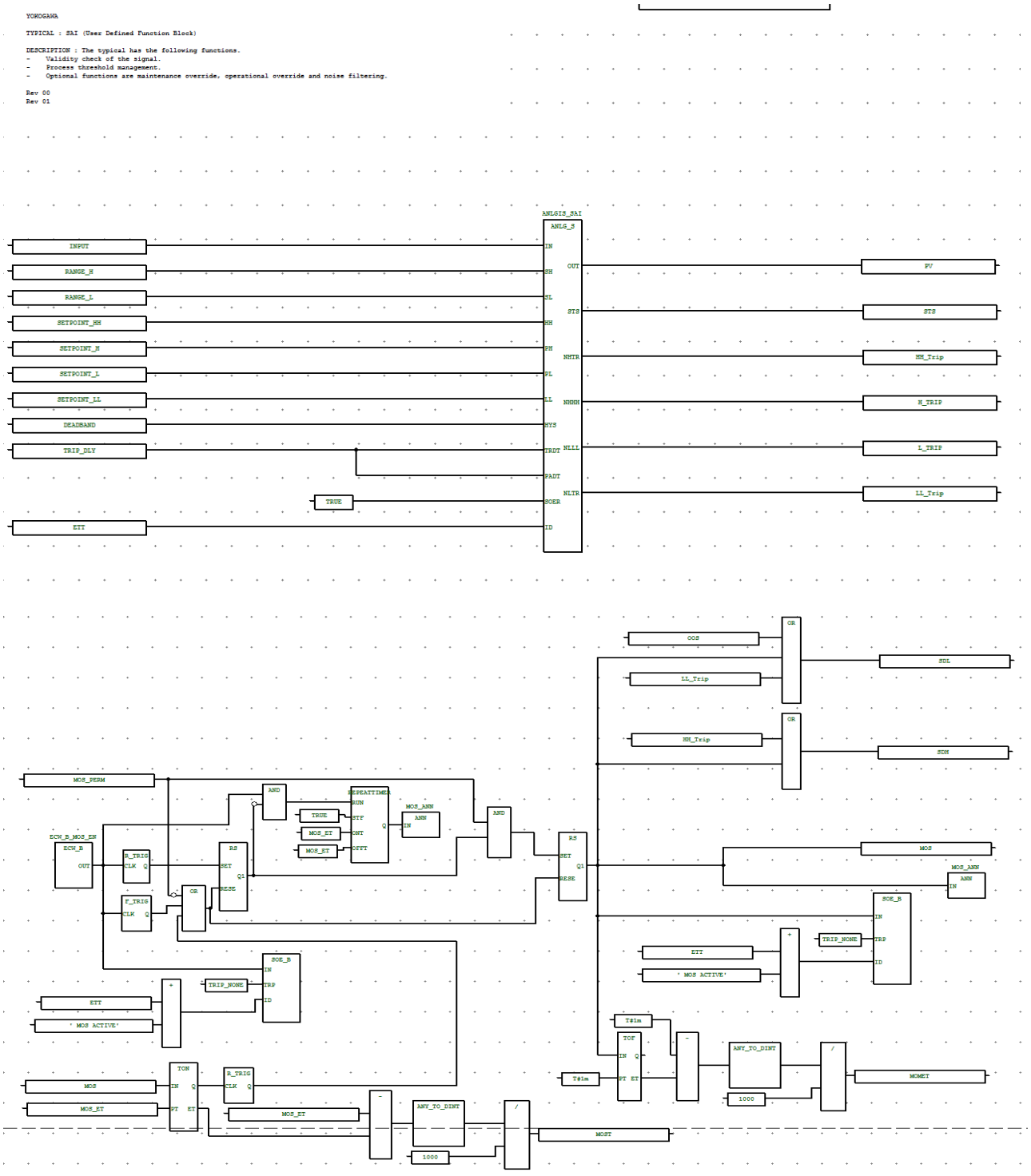


Fig 10 Logic Diagram for Typical SAI

5.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
IN	IN is the Field Analog Input	50.00
RH	RH is the "Range High" Value	100.00
RL	RL is the "Range Low" Value	0.00
HH	HH is the Setpoint Value "High High"	90.00
PH	HH is the Setpoint Value "High "	80.00
PL	HH is the Setpoint Value "Low"	20.00
LL	HH is the Setpoint Value "Low Low"	10.00
DB	DB is the "Hysteresis" Value	0.50
TDLY	TDLY is the Trip Delay Time	T#8s
OOS	OOS is the Operational Override	FALSE
MP	MP is the Maintenance Override Enable	FALSE
IDT	IDT is the comment for the “SOE”	"XXXXXXXXX"
MOET	MOET is the MOS Elapse Time	T#100s

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
PV	TRP is the Processed Digital Input Signal value	50.00
SDH	Shutdown High High Trip	TRUE
SDL	Shutdown Low Low Trip	TRUE
HH	HH is the High High Alarm Status	TRUE
HI	HI is the High Alarm Status	TRUE
LO	LO is the Low Alarm Status	TRUE
LL	LL is the Low Low Alarm Status	TRUE
STS	STS is the Transmitter Fault Alarm	TRUE
MSTS	MOS is the MOS status	FALSE
MOST	MOST is the MOS Elapsed Time	100

5.4 TEST CASES VS EXPECTED RESULTS

The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

	Test Cases	Input Parameter /Values	Expected Results								
Test Case Number			PV	SDH	SDL	HH TRIP	HI ALARM	LO ALARM	LL TRIP	Line Fault STS	MOS Status MSTS
TC#1	IN.Value = 50.0, IN.Status = FALSE, MP = FALSE	IN.Value = 50.0, IN.Status = FALSE, MP = FALSE	50.00	N/A	N/A	N/A	N/A	N/A	N/A	FALSE	N/A
TC#2	IN.Value = 19.0, IN.Status = TRUE, MP = FALSE	IN.Value = 19.0, IN.Status = TRUE, MP = FALSE	19.00	N/A	N/A	N/A	N/A	FALSE	N/A	N/A	N/A
TC#3	IN.Value = 9.0, IN.Status = TRUE, MP = FALSE	IN.Value = 9.0, IN.Status = TRUE, MP = FALSE	9.00	N/A	FALSE	N/A	N/A	FALSE	FALSE	N/A	N/A
TC#4	IN.Value = 81.0, IN.Status = TRUE, MP = FALSE	IN.Value = 81.0, IN.Status = TRUE, MP = FALSE	81.00	N/A	N/A	N/A	FALSE	N/A	N/A	N/A	N/A
TC#5	IN.Value = 91.0, IN.Stat	IN.Value = 91.0, IN.Status =	91.00	FALSE	N/A	FALSE	FALSE	N/A	N/A	N/A	N/A

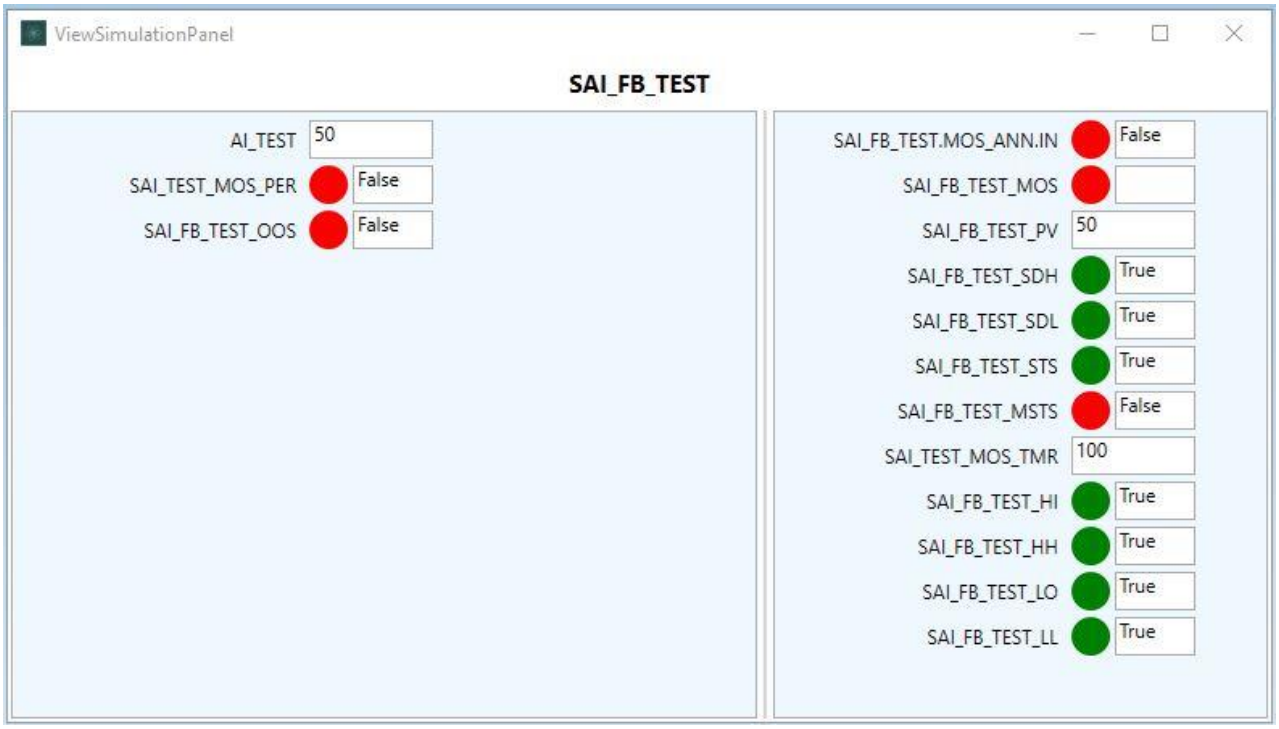
	us = TRUE, MP = FALSE	TRUE, MP = FALSE									
TC#6	IN.Value = 9.0, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time not Elapsed	IN.Value = 9.0, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time not Elapsed	9.00	N/A	TRUE	N/A	N/A	TRUE	TRUE	N/A	TRUE
TC#7	IN.Value = 9.0, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time Elapsed	IN.Value = 9.0, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time Elapsed	9.00	N/A	FALSE	N/A	N/A	FALSE	FALSE	N/A	FALSE
TC#8	IN.Value = 9.0, IN.Status = TRUE, MP = FALSE, MOS ENABLE = TRUE	IN.Value = 9.0, IN.Status = TRUE, MP = FALSE, MOS ENABLE = TRUE	9.00	N/A	FALSE	N/A	N/A	FALSE	FALSE	N/A	N/A

TC#9	IN.Value = 9.0, IN.Status = TRUE, MP = FALSE, OOS = TRUE	IN.Value = 9.0, IN.Status = TRUE, MP = FALSE, OOS = TRUE	9.00	N/A	TRUE	N/A	N/A	FALSE	FALSE	N/A	N/A

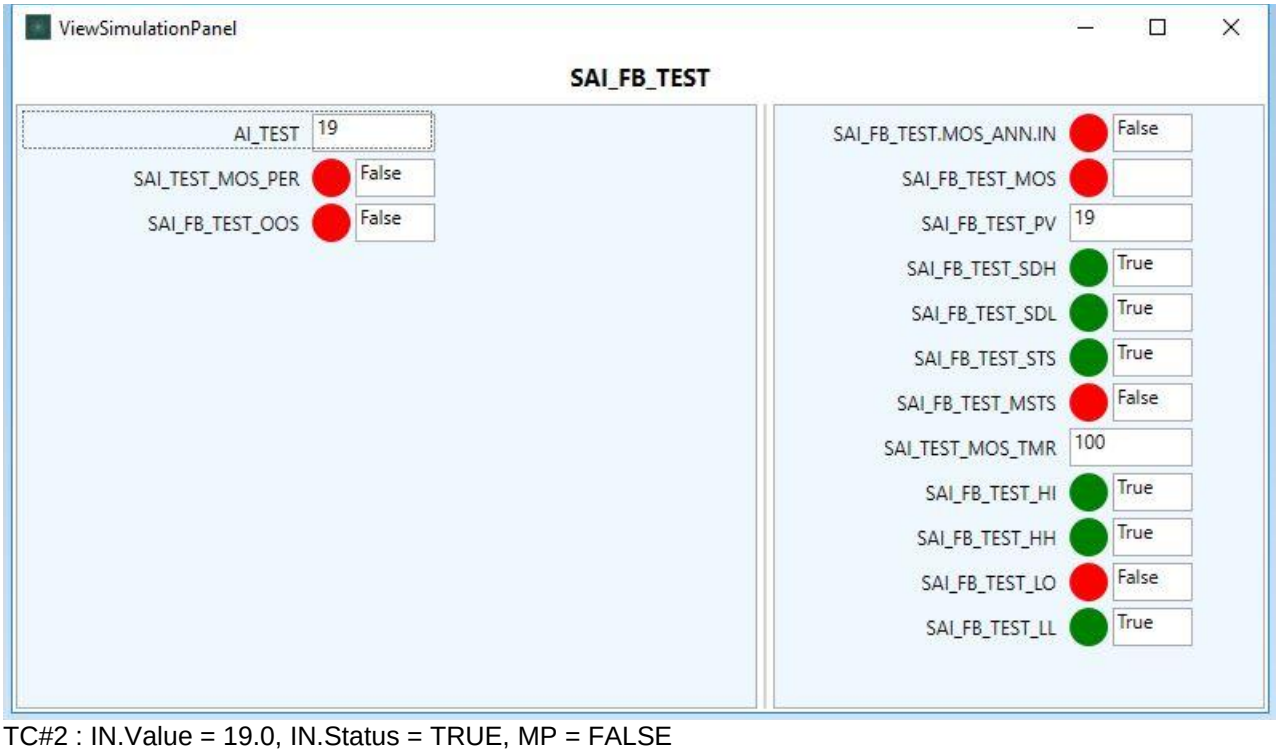
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from “True’ to ‘False’.

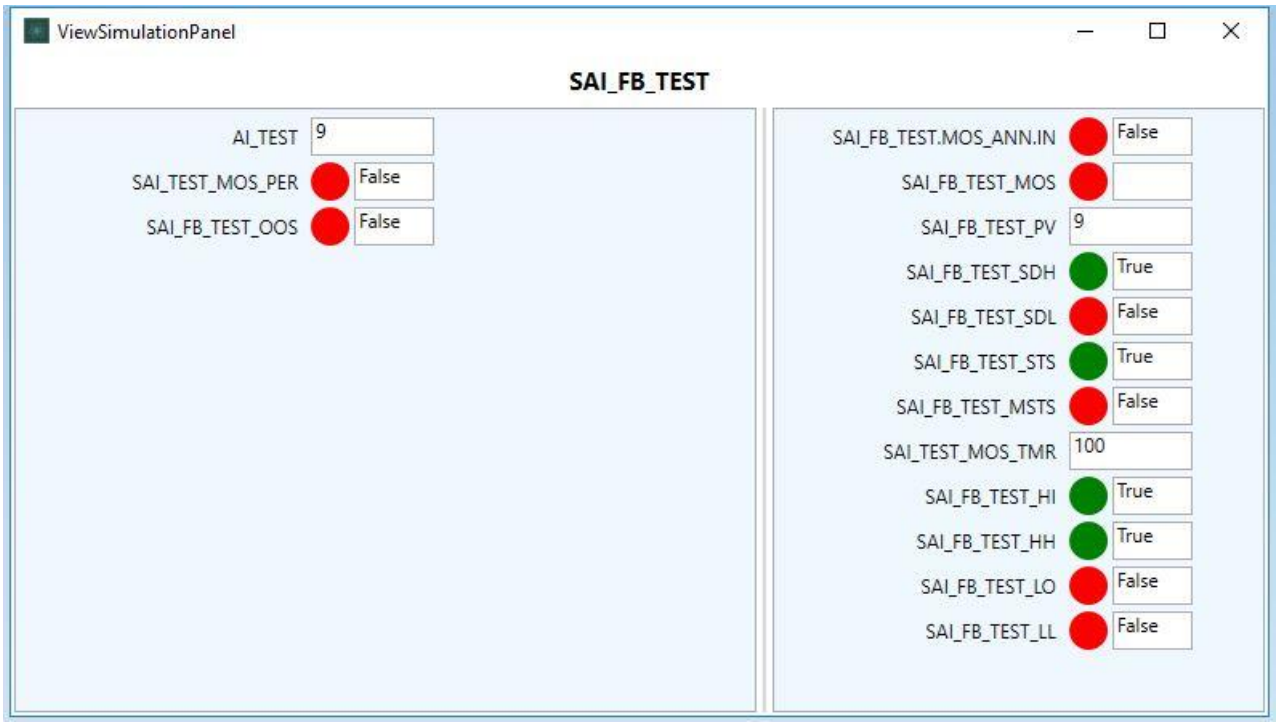
5.5 TEST RESULTS:



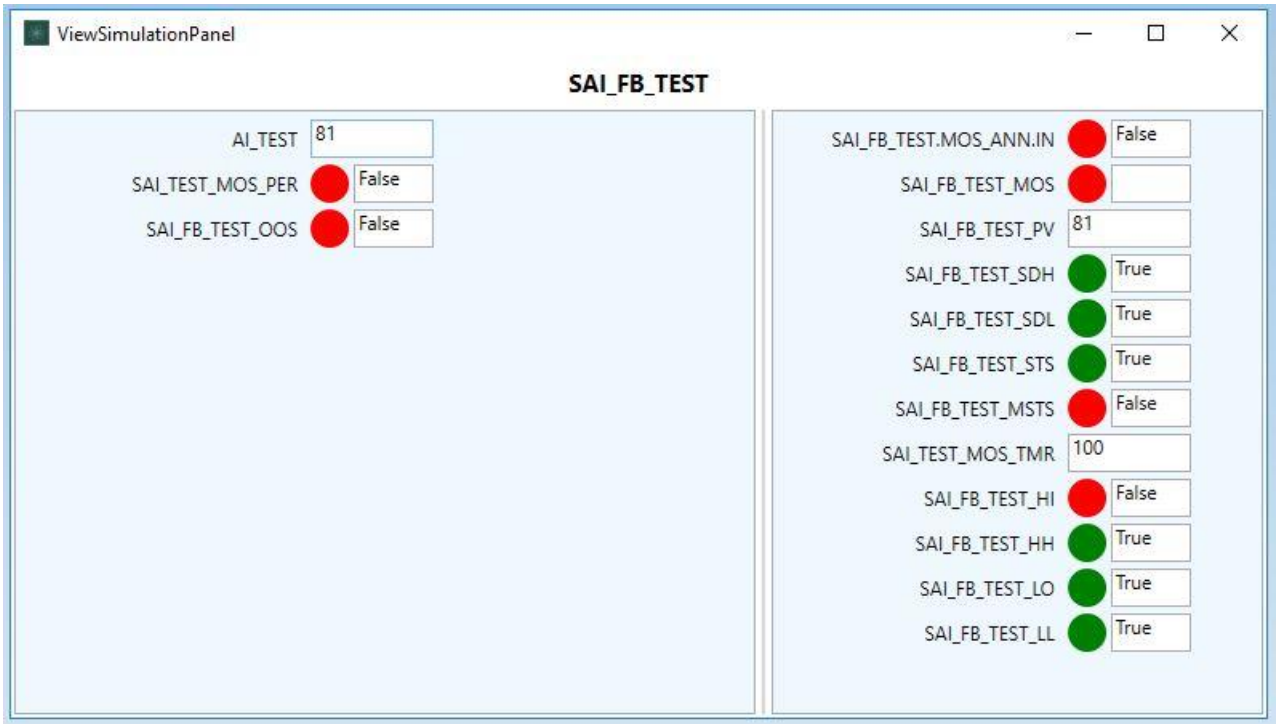
TC#1 : IN.Value = 50.0, IN.Status = FALSE, MP = FALSE



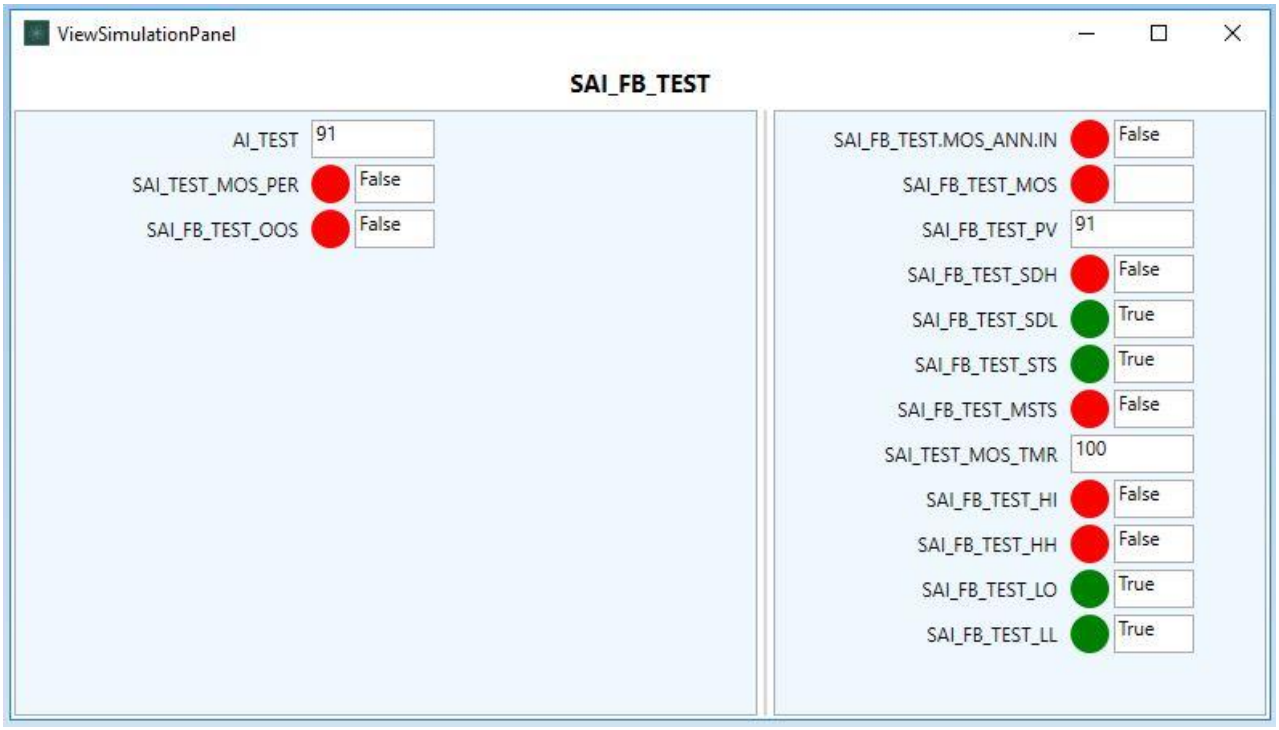
TC#2 : IN.Value = 19.0, IN.Status = TRUE, MP = FALSE



TC#3 : IN.Value = 9.0, IN.Status = TRUE, MP = FALSE



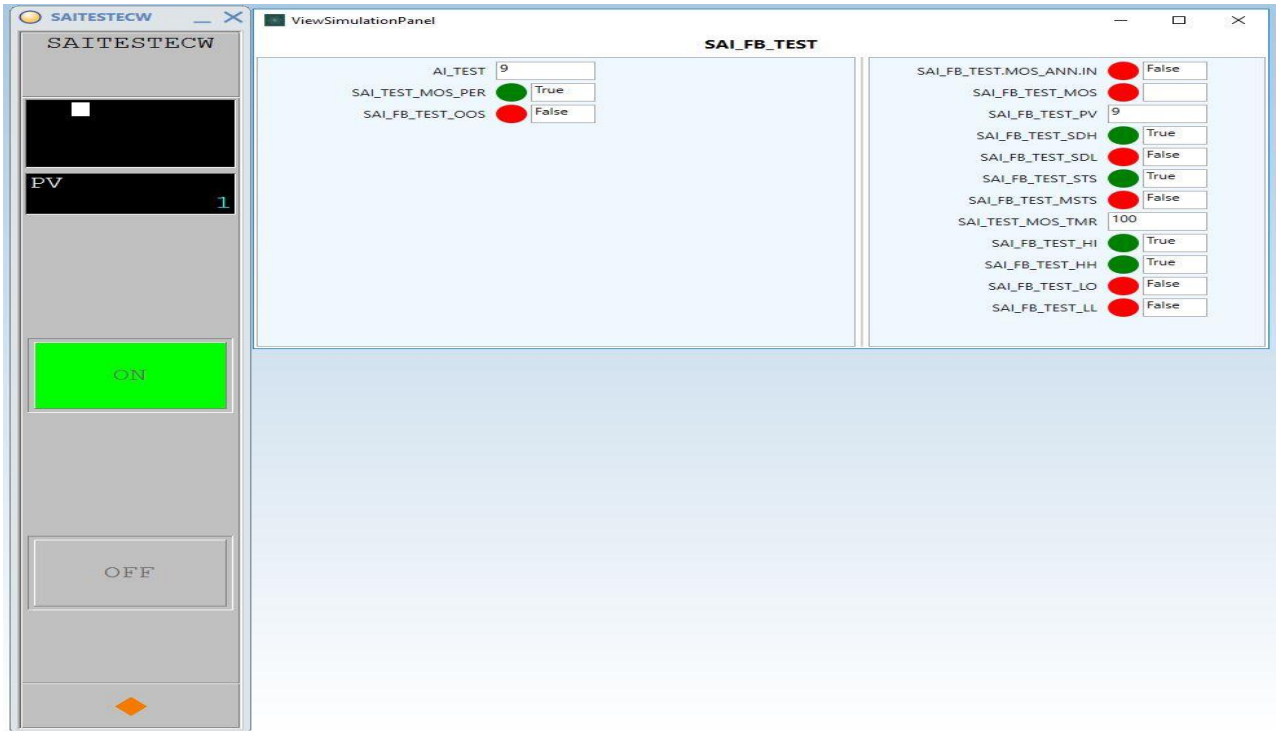
TC#4 : IN.Value = 81.0, IN.Status = TRUE,MP = FALSE



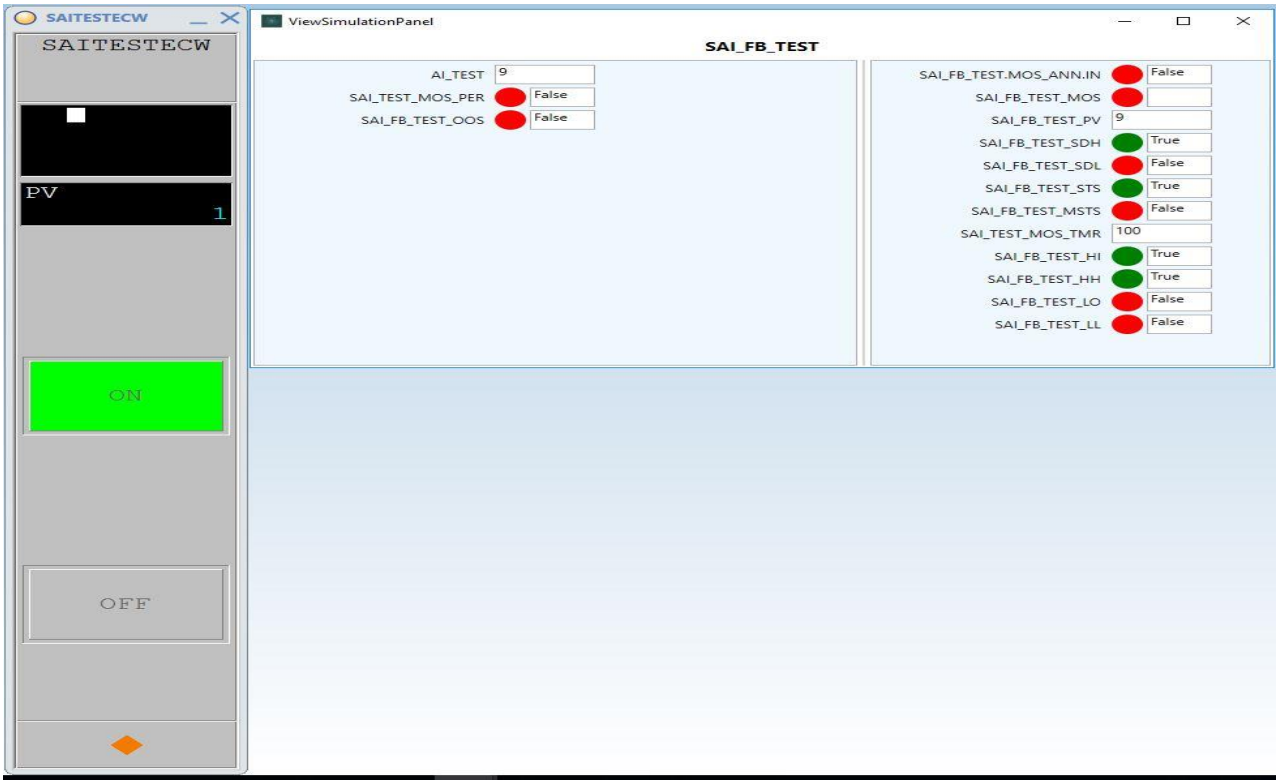
TC#5 : IN.Value = 91.0, IN.Status = TRUE, MP = FALSE



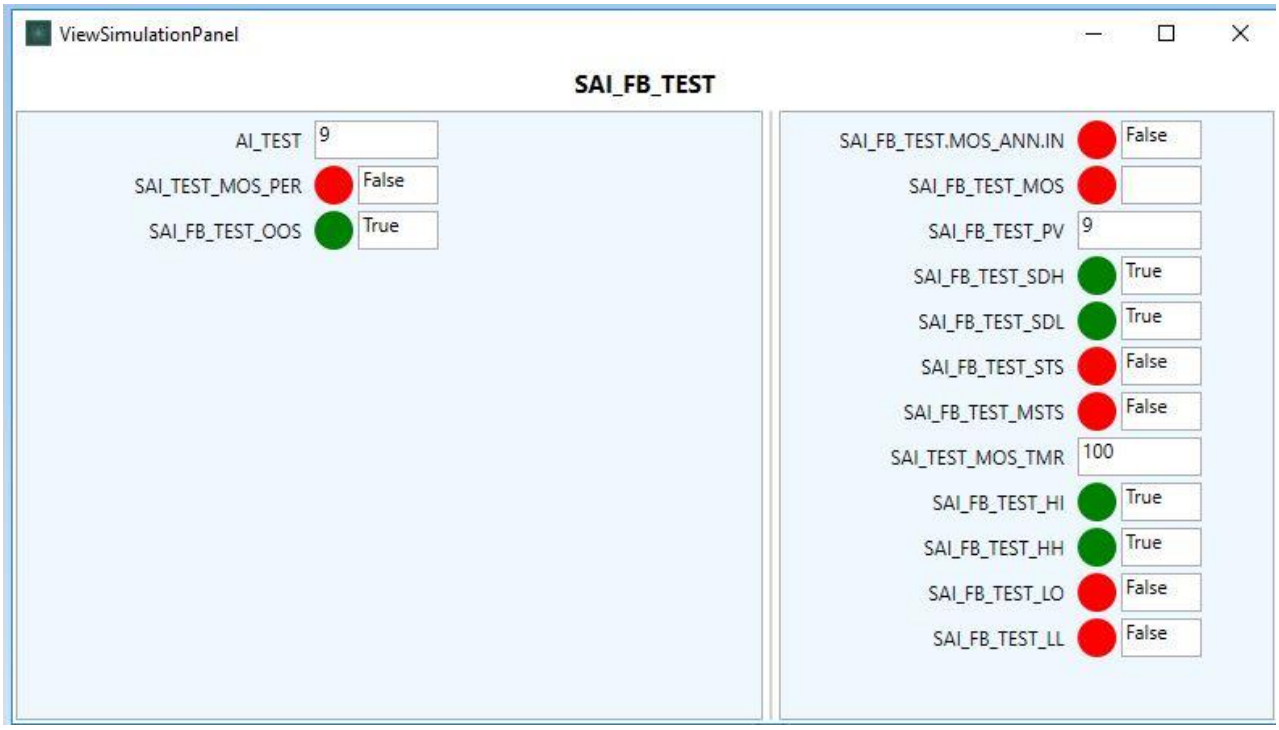
TC#6 : IN.Value = 9.0, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE,
MOS Elapse time not Elapsed



TC#7 : IN.Value = 9.0, IN.Status = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time Elapsed

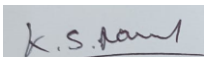


TC#8 : IN.Value = 9.0, IN.Status = TRUE, MP = FALSE, MOS ENABLE = TRUE



TC#9 : IN.Value = 9.0, IN.Status = TRUE, MP = FALSE, OOS = TRUE

5.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	08-OCT-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

6 UZGRP

UZGRP typical provides the common functionality for UZ groups in the SIS.

6.1 PURPOSE

UZGRP typical provides the common functionality for UZ groups in the SIS. The functions of the typical are trip latching, alarming and first failure identification.

Functionality:

The UZGRP function block has the following main functions:

- Trip the UZ group if one of the inputs is tripped.
- Initiate a First Failure alarm to indicate which trip came first.
- Latch the UZ trip if a trip condition is active and no reset has been applied.

For every process group in the system at least one UZ block is used. The typical UZ block is designed for 10 inputs. Depending on the number of inputs to the group, more UZ blocks may be used for a process group. The UZ block can be linked together in a chain by linking the UZ Link and UZ Condition of the next UZ block together. If only one UZ block is used to trip a UZ group the UZ Link input shall be set to TRUE. The trip outputs of input typical and/or voting typical in a UZ group are connected to the inputs of the UZ block. A trip condition on an input of the UZ block will trip the UZ group. This will latch the UZ block, further trips on the inputs will be ignored for failure indication, but still affect the UZ group trip. The output of the UZ block will be used in the application logic to the trip related field outputs. The trip alarm and the first failure flag of the tripped input will be shown in the OWS. The Tripped Outputs Latched status will be shown in the OWS until UZGRP is reset.
After all trip conditions are cleared the UZ typical can be reset via the optional UZRST application typical, by a reset signal from SCS. If the UZ group requires an auto-reset function, then the UZ Condition output has to be connected to the Clear input. The Clear input will only react on a positive trigger. The Clear will not only reset the UZ group but also clears the first failure flag, a reset will only have affect if all trip input conditions are normalized (not tripped).

6.2 LOGIC DIAGRAMS

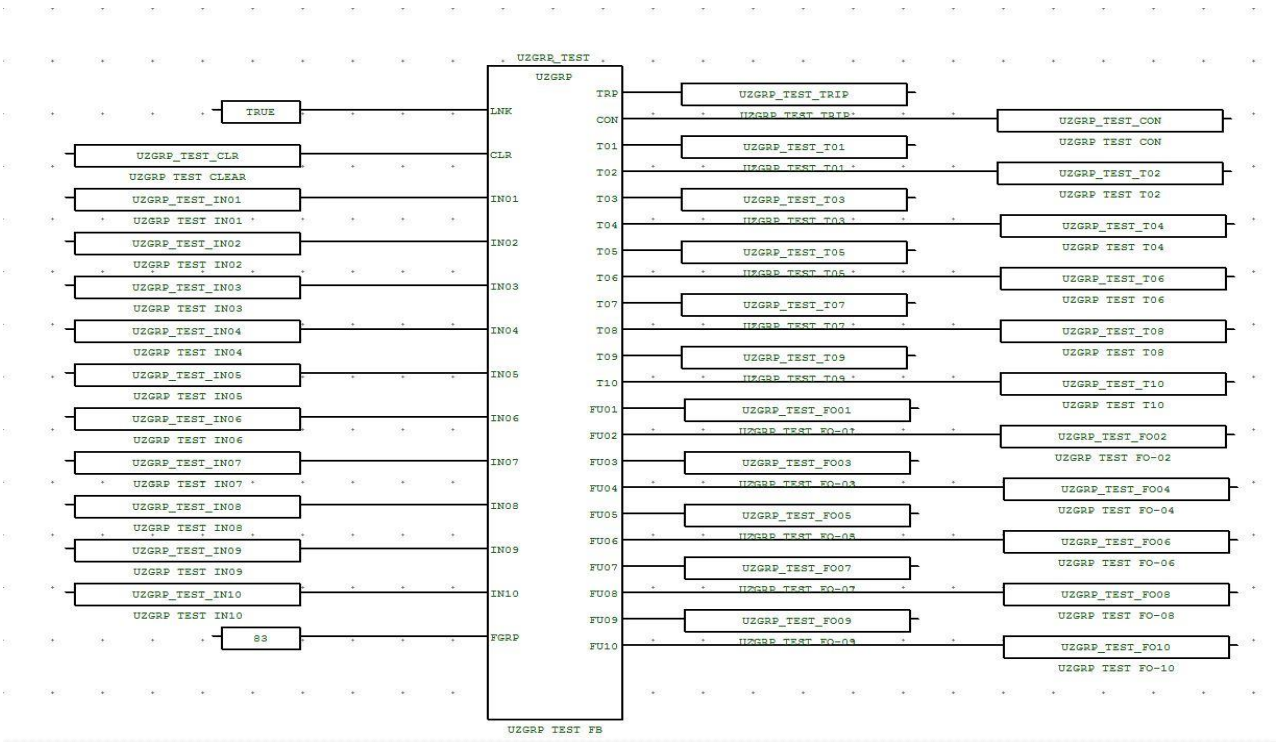
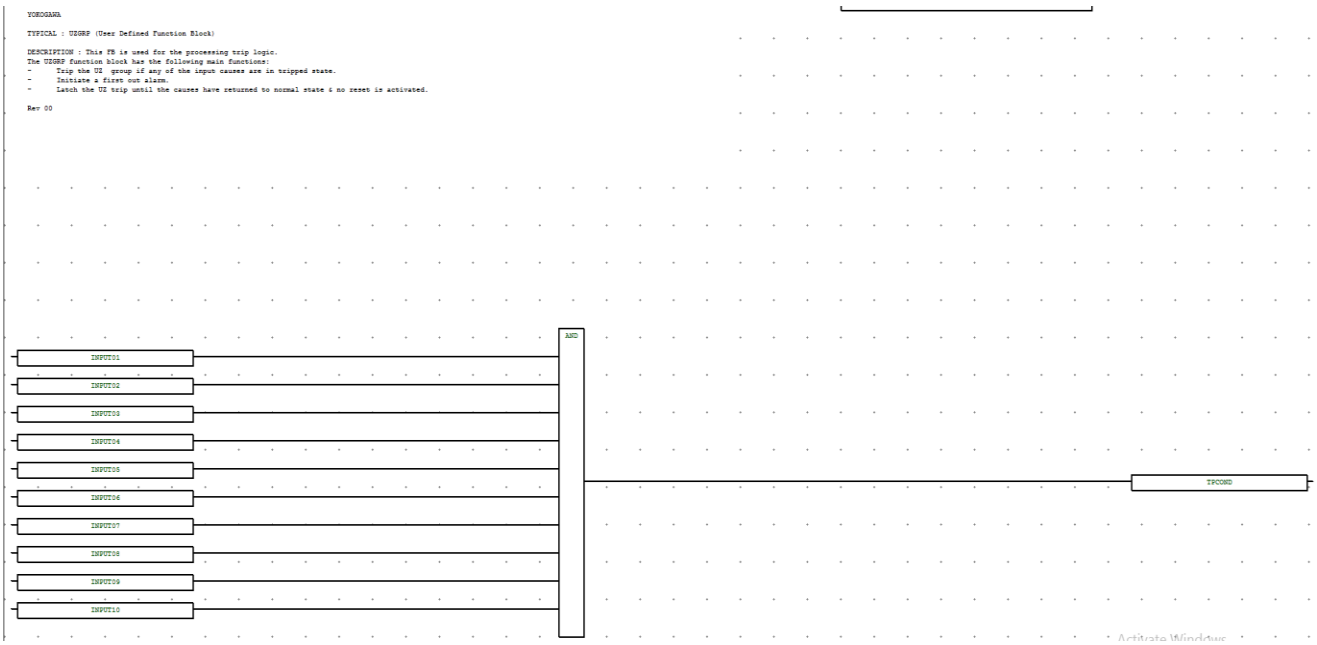


Fig 11 User Defined Function Block UZGRP



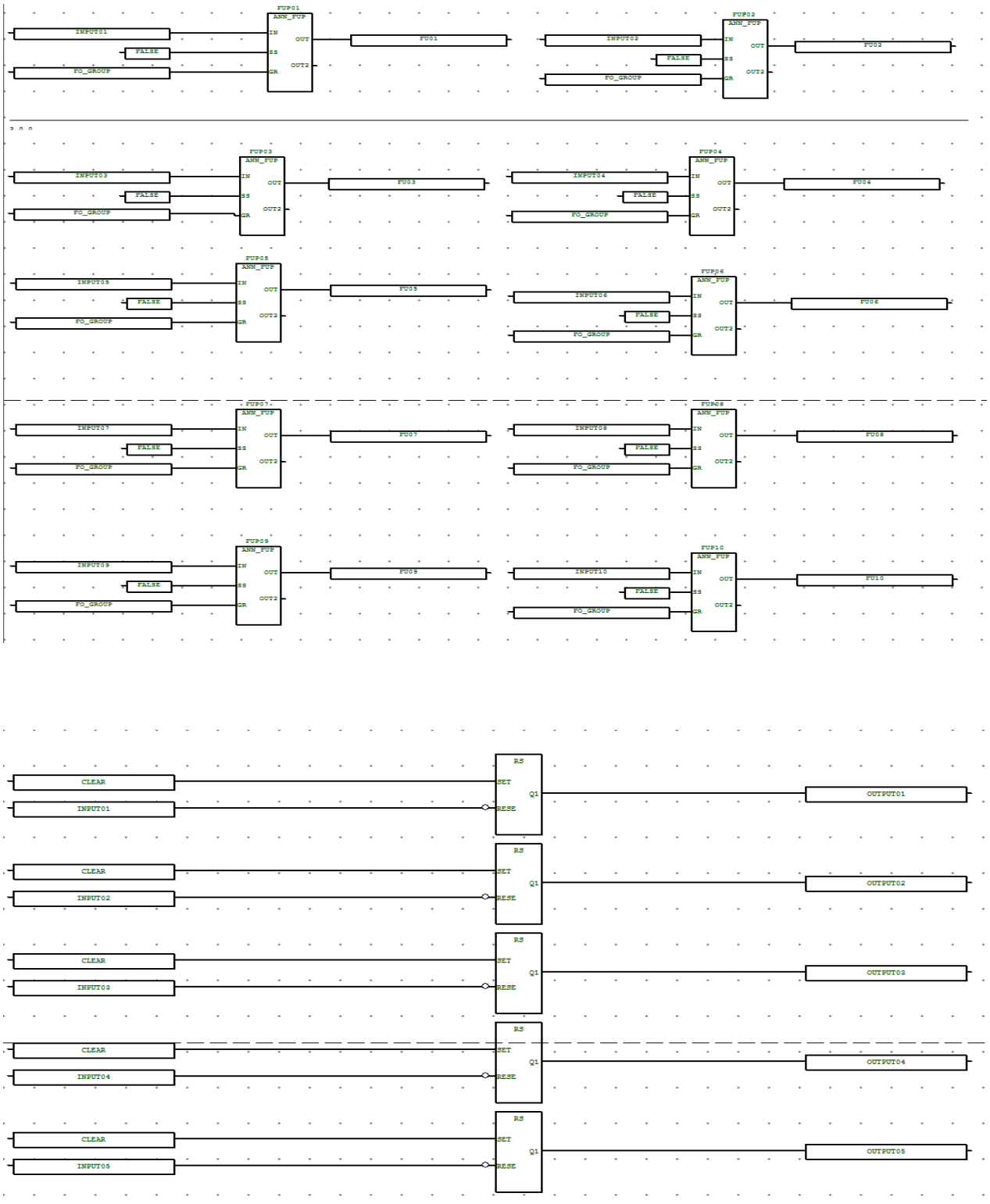


Fig 12 Logic Diagram for Typical UZGRP

6.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
LINK	LINK is the UZ link	TRUE
CLR	CLR is the UZ reset	FALSE
IN01, IN02,…....IN09, IN10	IN01,…IN10 are the Trip Inputs	TRUE
FGRP	FGRP is the Group Number	"83"

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
TRP	TRP is the UZ Trip	TRUE
CON	CON is the UZ Condition	TRUE
T01, T02,…....T09, T10	T01,…T10 are the Trip Output of Inputs IN01,….IN10 respectively	TRUE
FU01, FU02,…....FU09, FU10	FU01,…FU10 are the First Out of Inputs IN01,….IN10 respectively	FALSE

6.4 TEST CASES VS EXPECTED RESULTS

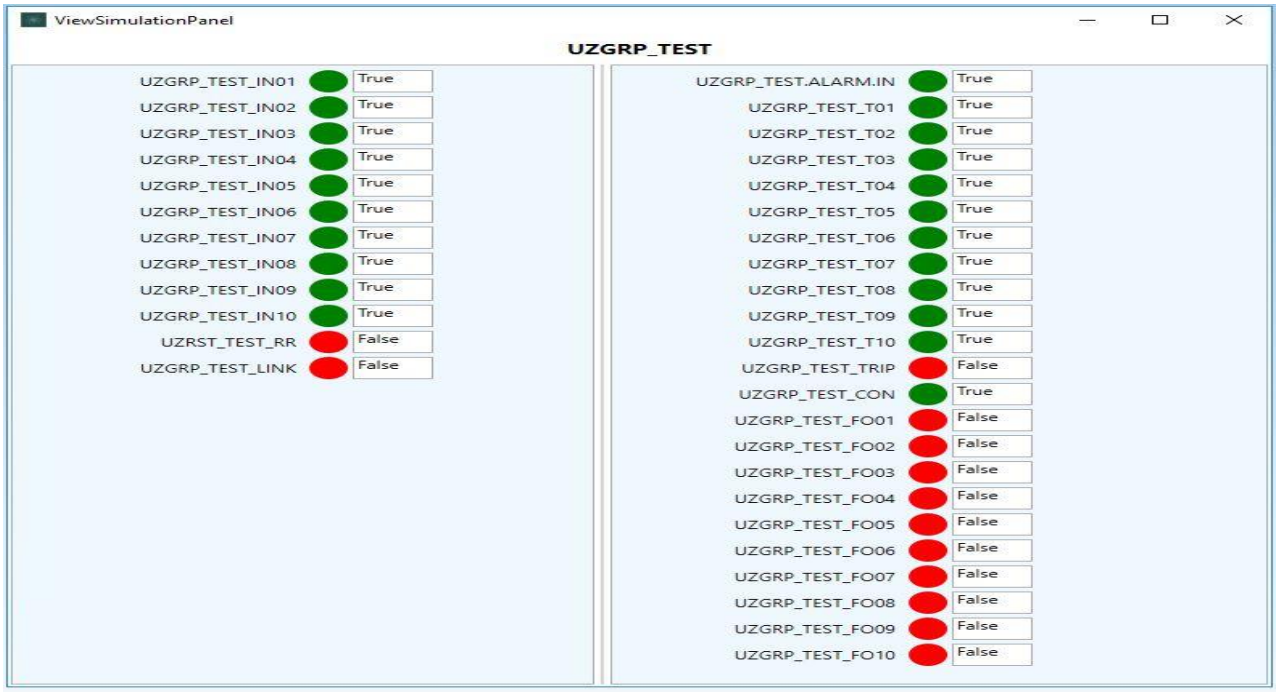
The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

	Test Cases	Input Parameter /Values	Expected Results			
Test Case Number			**Grp Trip TRP**	**All Cause CON**	**Cause TRIP**	**FU**
TC#1	LINK = FALSE, All IN are "TURE"	LINK = FALSE, IN01,IN02,…IN09,IN10 = TRUE	FALSE	TRUE	N/A	N/A
TC#2	LINK = TRUE, Any one IN is "FALSE"	LINK = TRUE, IN01 or IN02 or ..or IN09 or IN10 = FALSE	FALSE	FALSE	FALSE	TRUE
TC#3	LINK = TRUE, All IN are "TURE"	LINK = TRUE, IN01,IN02,…IN09,IN10 = TRUE	FALSE	TRUE	FALSE	TRUE
TC#4	LINK = TRUE, All IN are "TURE", CLR = TRUE	LINK = TRUE, IN01,IN02,…IN09,IN10 = TRUE, CLR = TRUE	TRUE	TRUE	TRUE	FALSE

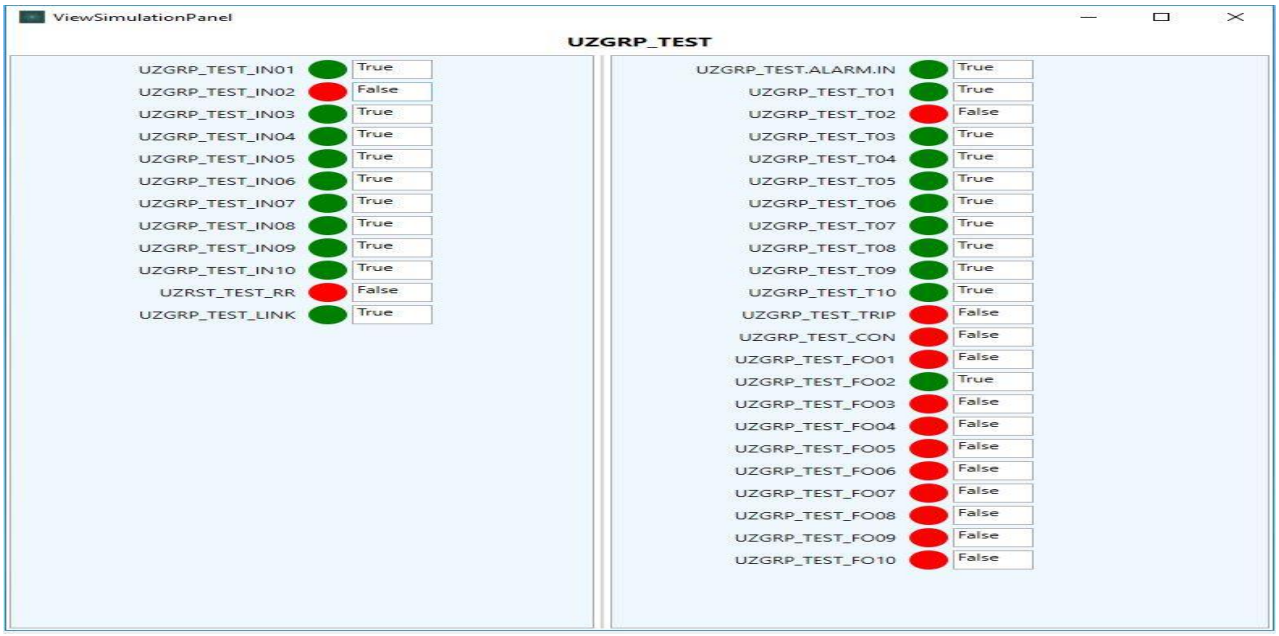
Note:

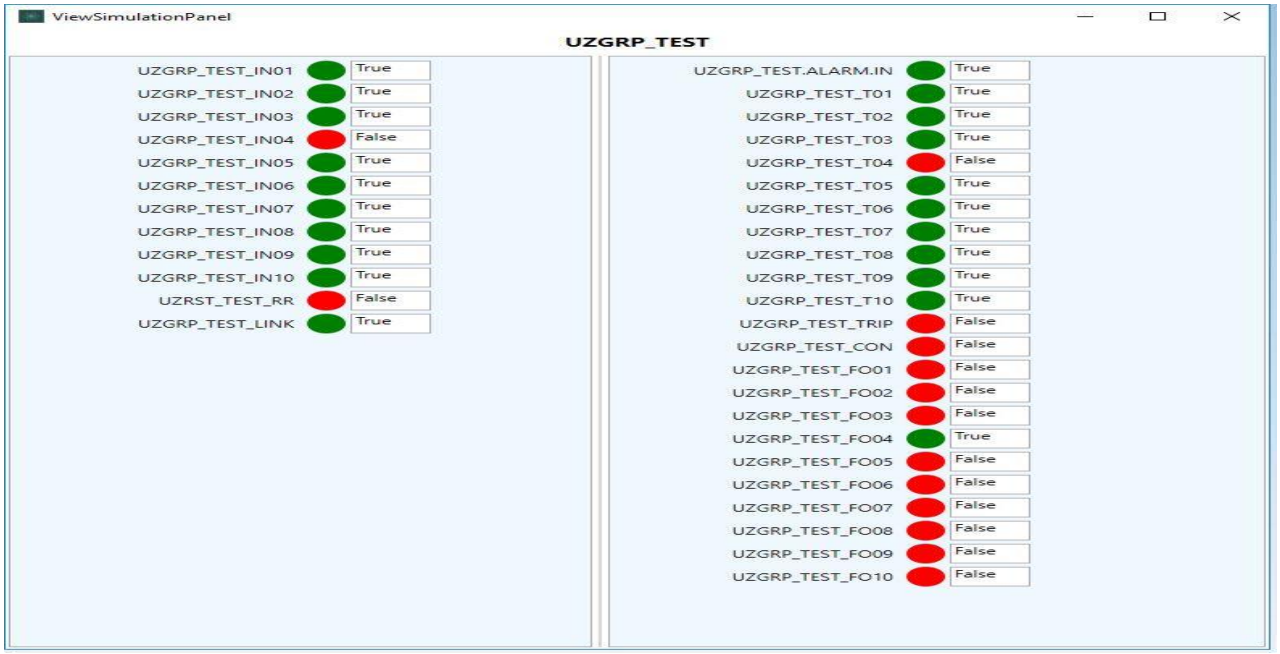
- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from "True' to 'False'.

6.5 TEST RESULTS:

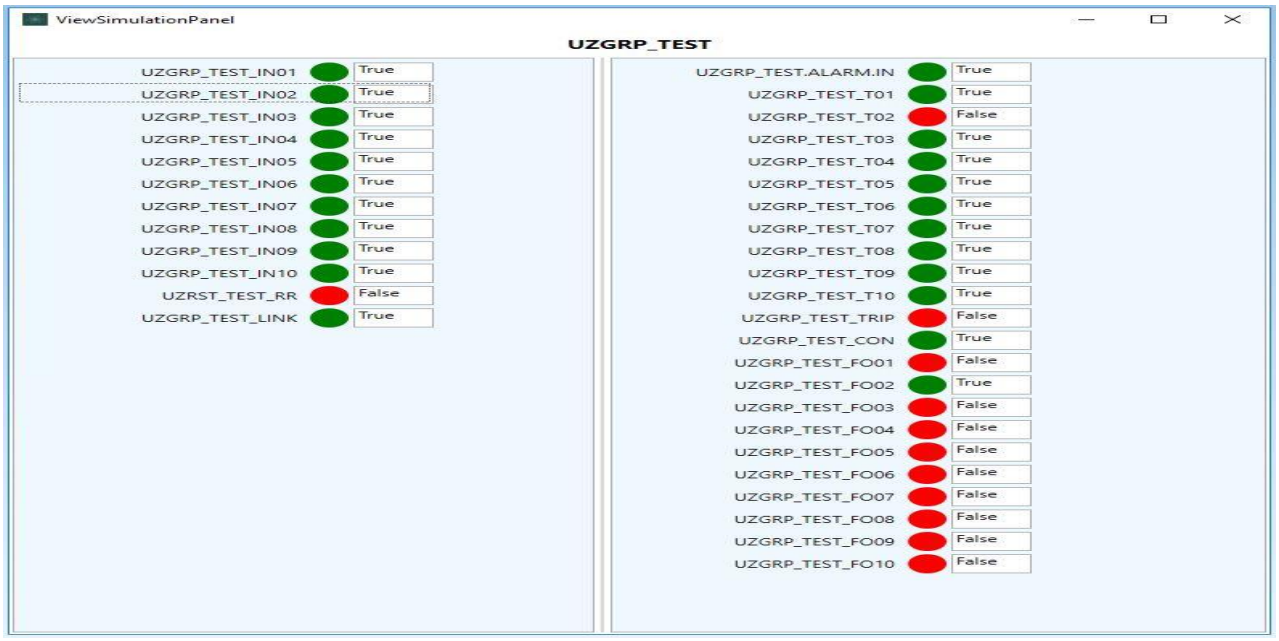


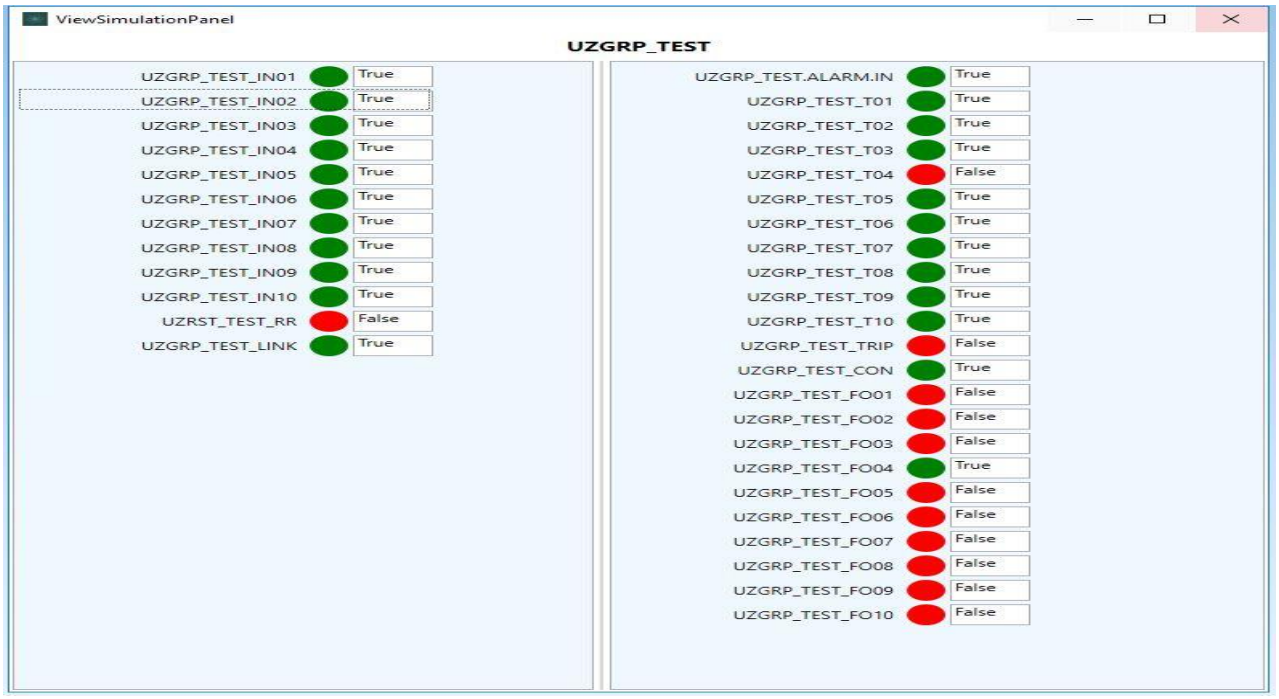
TC#1 : LINK = FALSE, IN01,IN02,…IN09,IN10 = TRUE



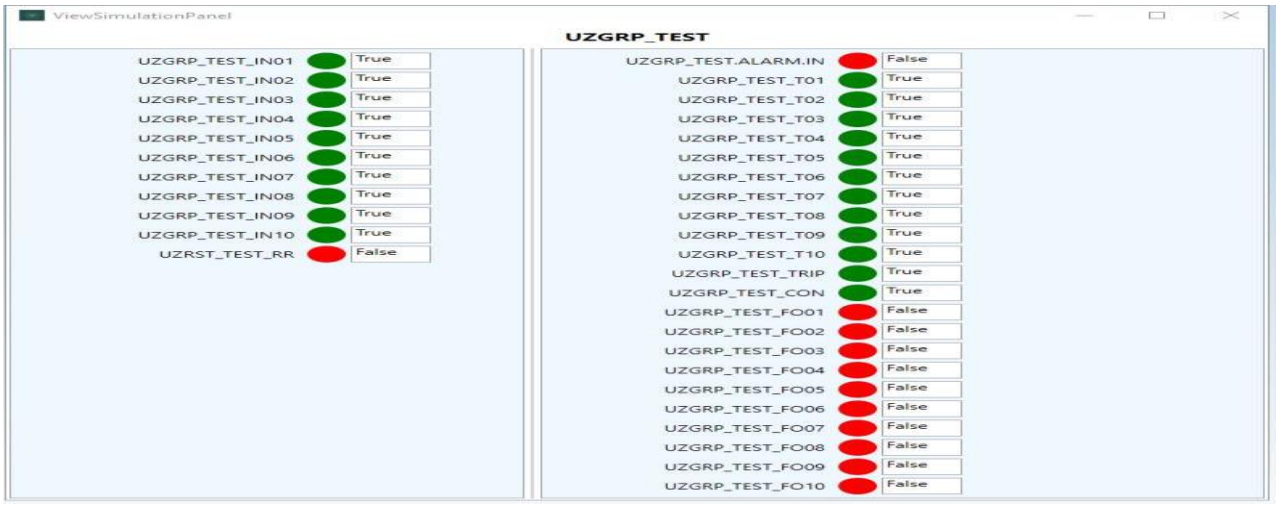


TC#2 : LINK = TRUE, IN01 or IN02 or ..or IN09 or IN10 = FALSE



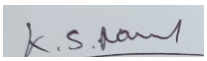


TC#3 : LINK = TRUE, IN01,IN02,…IN09,IN10 = TRUE



TC#4 : LINK = TRUE, IN01,IN02,…IN09,IN10 = TRUE, CLR = TRUE

6.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	05-JUL-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

7 UZRST

UZRST typical will be used to reset UZ safety groups which require a manual reset (from OWS) after a trip.

7.1 PURPOSE

This typical will be used to reset UZ safety groups which require a manual reset (from OWS) after a trip. The UZRST block has an input to indicate UZ trip status and an output to reset UZGRP logic.

Functionality:

The UZRST function block has the following main functions:

- Reset UZ groups only when SCS Reset operated from OWS or field reset switch has been applied
- Indicate that SCS reset is allowed.

This typical will be used to reset UZ safety groups which require a manual reset (from OWS) after a trip. The UZRST block has an input to indicate UZ trip status and an output to reset UZGRP logic.

To indicate that a SCS reset is allowed (i.e. Permissive is ‘TRUE’) the status (Ok to Reset) is sent to OWS. After the reset from OWS, the Ok to Reset status will go off.

Push button field input reset is designed for normally open-momentary closed contacts to reset.

7.2 LOGIC DIAGRAMS

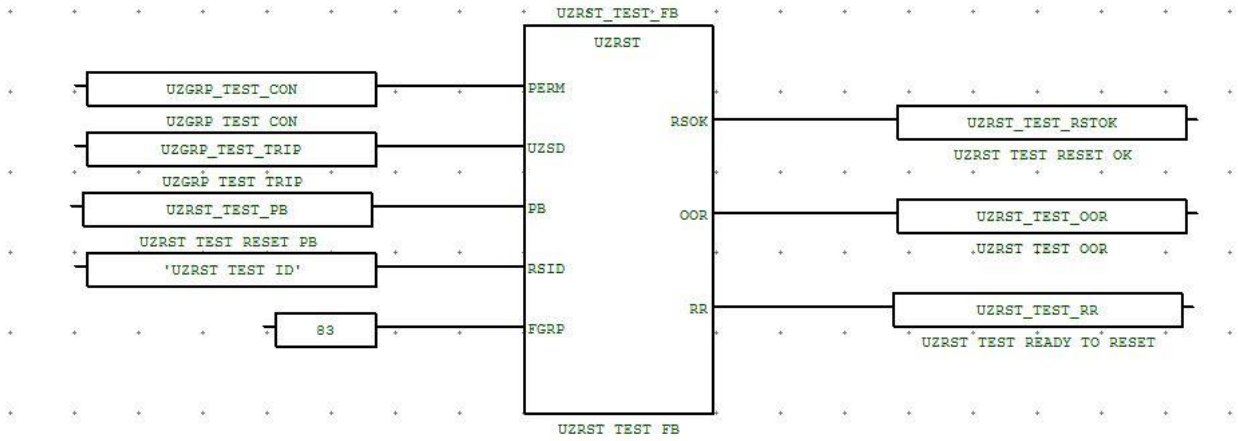


Fig 13 User Defined Function Block UZRST

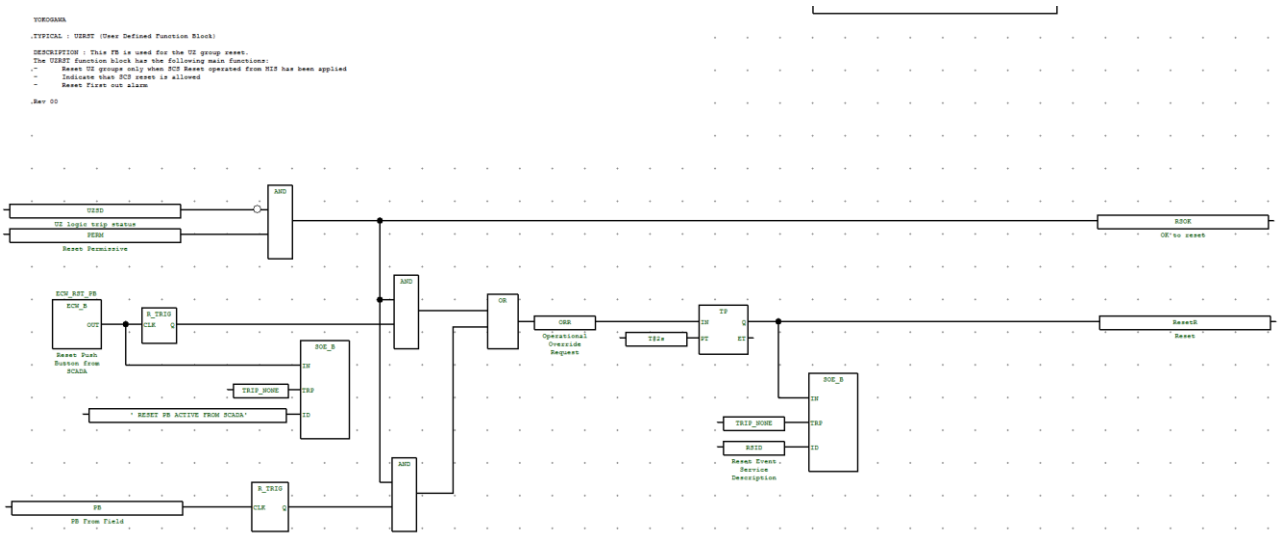


Fig 14 Logic Diagram for Typical UZRST

7.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
PERM	PERM is the Reset Permissive	FALSE
UZSD	UZSD is the UZ Group Trip Status	TRUE
PB	PB is the Field Reset Push Button	FALSE
RSID	RSID is the comment for the “SOE”	"XXXXXXXXX"
FGRP	FGRP is the Group Number	"83"

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
RSOK	RSOK is the OK to Reset	FALSE
OOR	OOR is the AOS Request	FALSE
RR	UZ Reset	FALSE

7.4 TEST CASES VS EXPECTED RESULTS

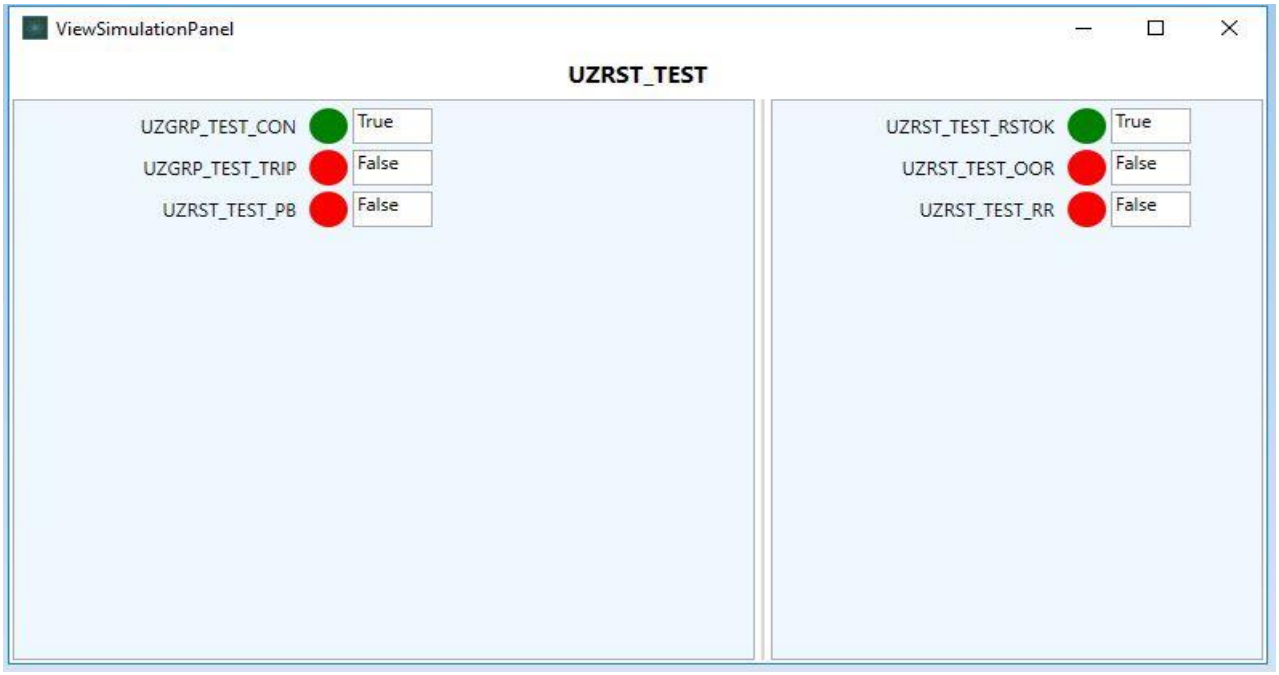
The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

	Test Cases	Input Parameter /Values	Expected Results		
Test Case Number			**OK to Reset RSOK**	**OOR (Pulse OP)**	**Reset Signal RR(2Sec)**
TC#1	PERM = TRUE, UZSD = FALSE, PB = FALSE, OWS RESET = FLASE	PERM = TRUE, UZSD = FALSE, PB = FALSE, OWS RESET = FLASE	TRUE	N/A	N/A
TC#2	PERM = TRUE, UZSD = FALSE, PB = TRUE, OWS RESET = FLASE	PERM = TRUE, UZSD = FALSE, PB = TRUE, OWS RESET = FLASE	FALSE	TRUE	TRUE
TC#3	PERM = TRUE, UZSD = FALSE, PB = FALSE, OWS RESET = TRUE	PERM = TRUE, UZSD = FALSE, PB = FALSE, OWS RESET = TRUE	FALSE	TRUE	TRUE

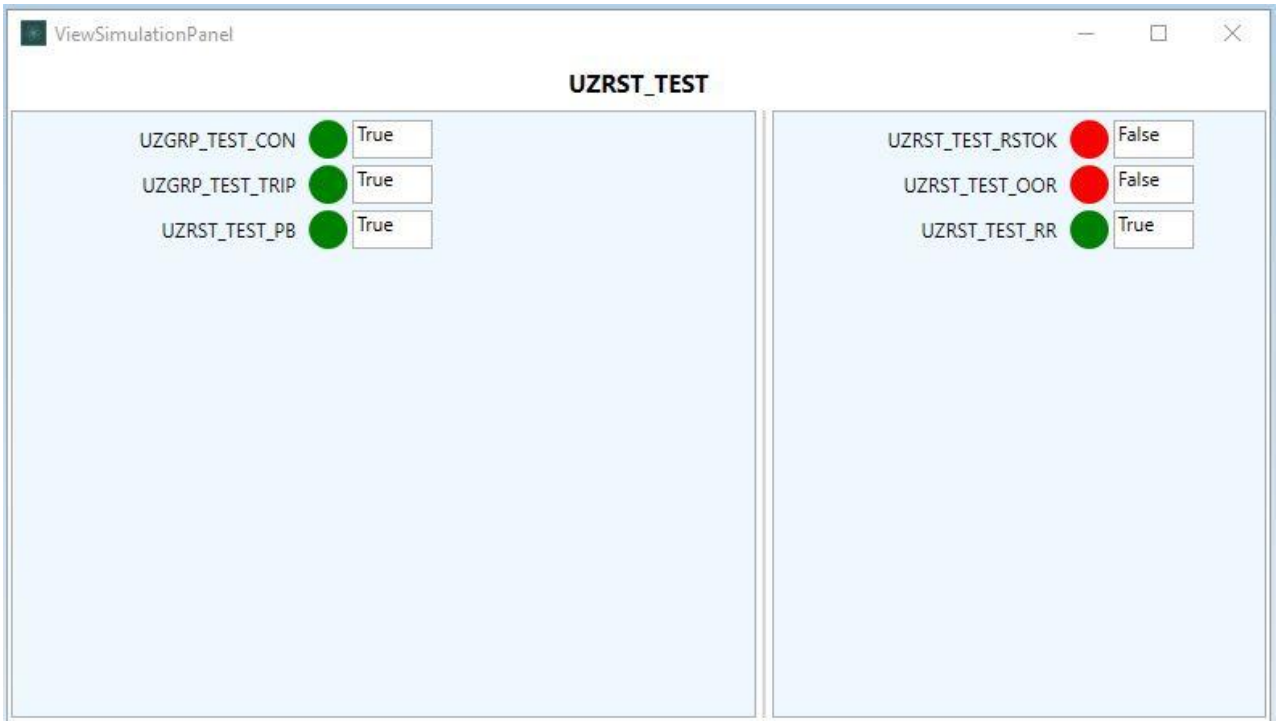
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from "True' to 'False'.

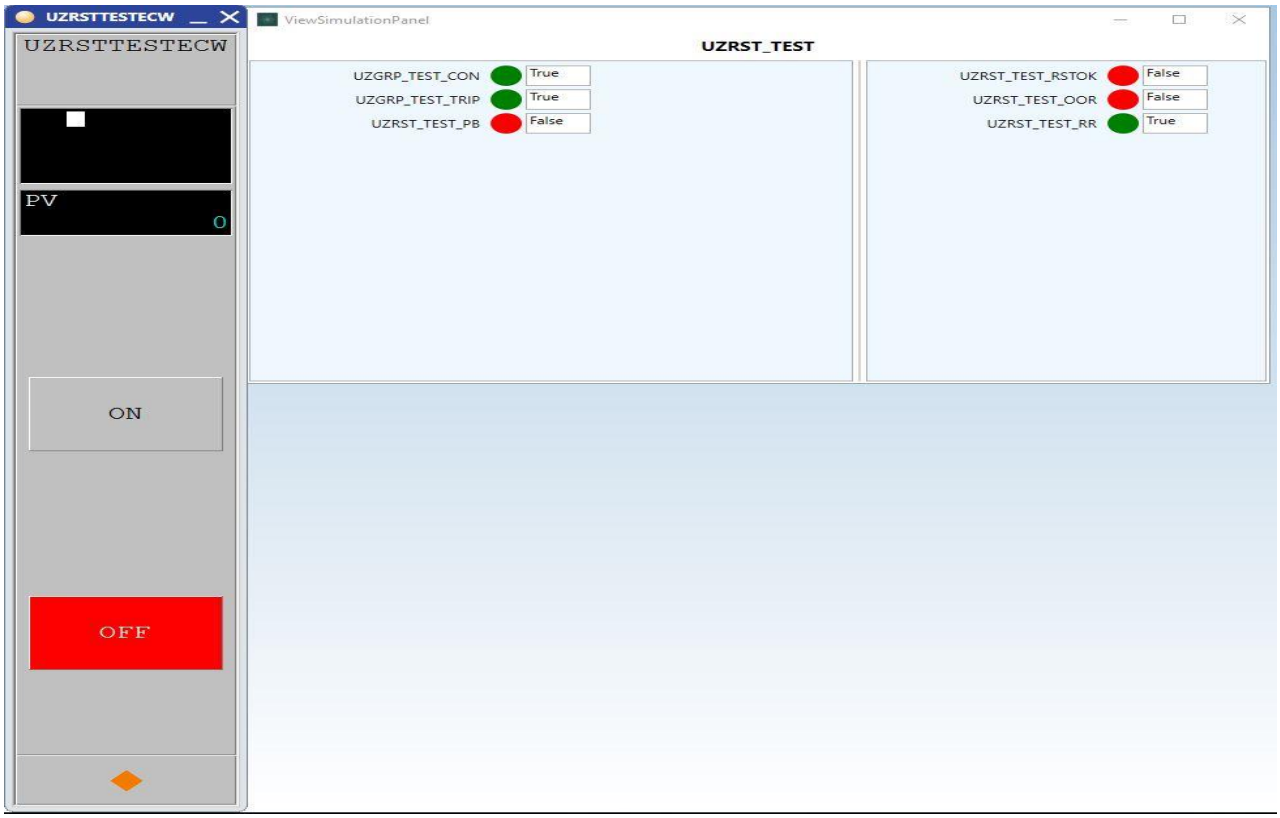
7.5 TEST RESULTS:



TC#1 : PERM = TRUE, UZSD = FALSE, PB = FALSE, OWS RESET = FLASE

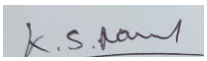


TC#2 : PERM = TRUE, UZSD = FALSE, PB = TRUE, OWS RESET = FLASE



TC#3 : PERM = TRUE, UZSD = FALSE, PB = FALSE, OWS RESET = TRUE

7.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	05-JUL-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

8 SDV_1

SDV_1 function is used for the Fail to Close Valves with limit switch Feedback

8.1 PURPOSE

This typical drives the output to safe-state when the UZSD input trips.

Functionality:

The SDV_1 typical has the following features:

- Valve operation.
- Limit switch feedback (one or two limit switches)

This typical drives the output to safe-state when the UZSD input trips. When the UZGRP is normal ,then open command can be given from the OWS / AUTO open (OPEN nub)

8.2 LOGIC DIAGRAMS

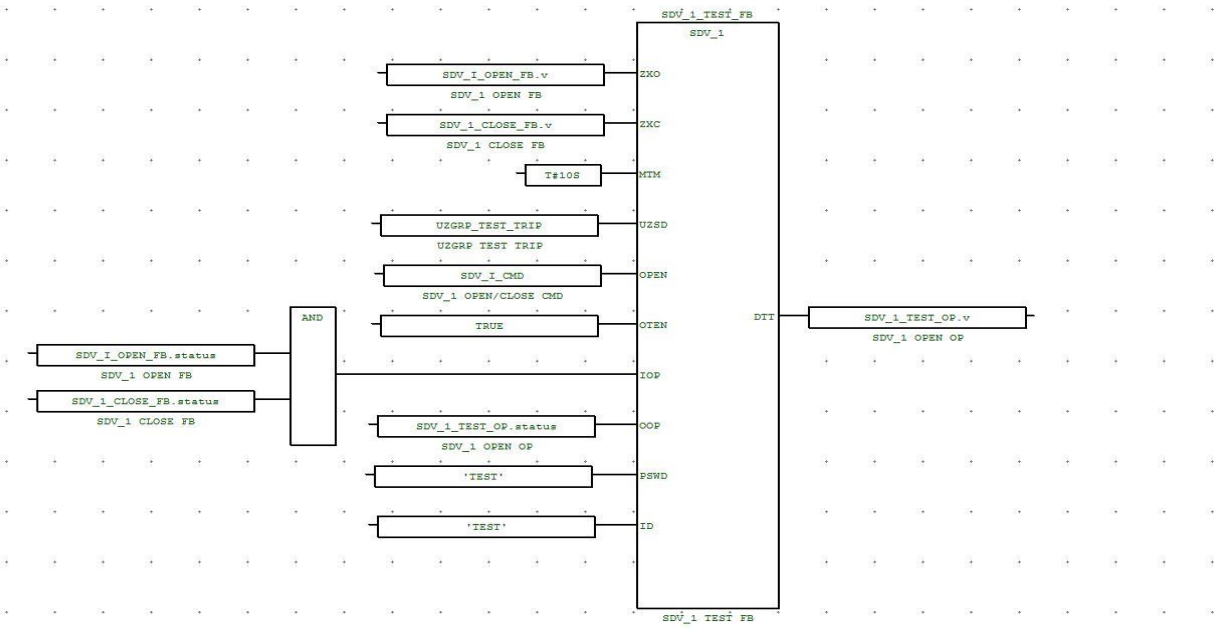


Fig 15 User Defined Function Block SDV_1

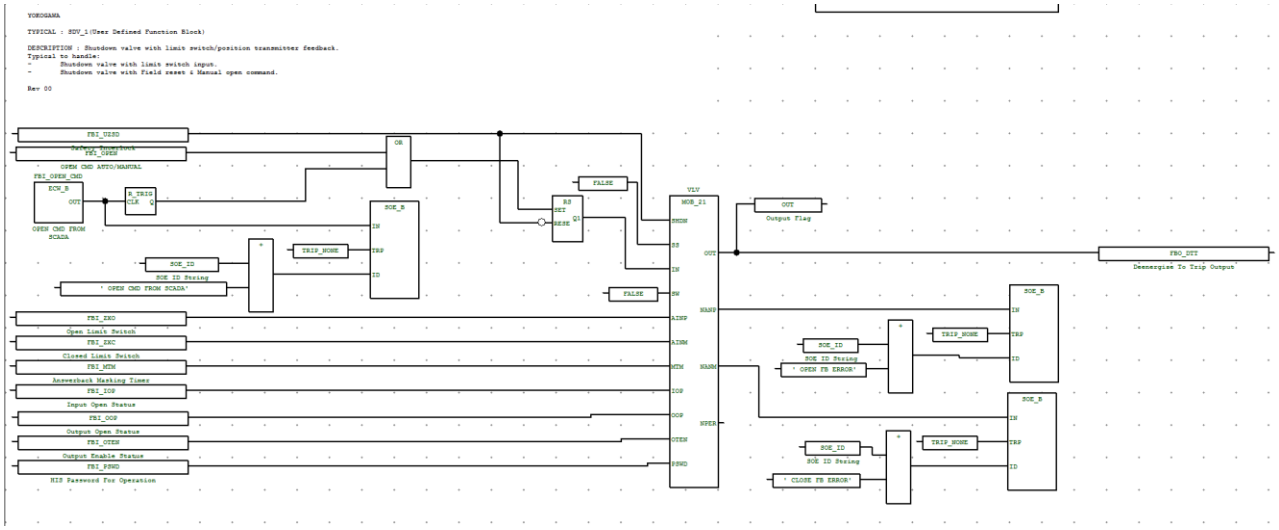


Fig 16 Logic Diagram for AI Typical SDV_1

8.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
ZXO	ZXO is the Open Limit Switch	TRUE
ZXC	ZXC is the Close Limit Switch	FALSE
MTM	MTM is the Answer Back Mask Time	T#10s
UZSD	UZSD is the UZ Group SD	TRUE
OPEN	OPEN is the AUTO/Field Open Command	FALSE
OTEN	OTEN is the Output Enable Status	FALSE
IOP	IOP is the Input Open Status	TRUE
OOP	OOP is the Output Open Status	TRUE
PSWD	PSWD is the Password	"XXXXXXXXX"
ID	RSID is the comment for the “SOE”	"XXXXXXXXX"

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
DTT	DTT is the Output to Valve	TRUE

8.4 TEST CASES VS EXPECTED RESULTS

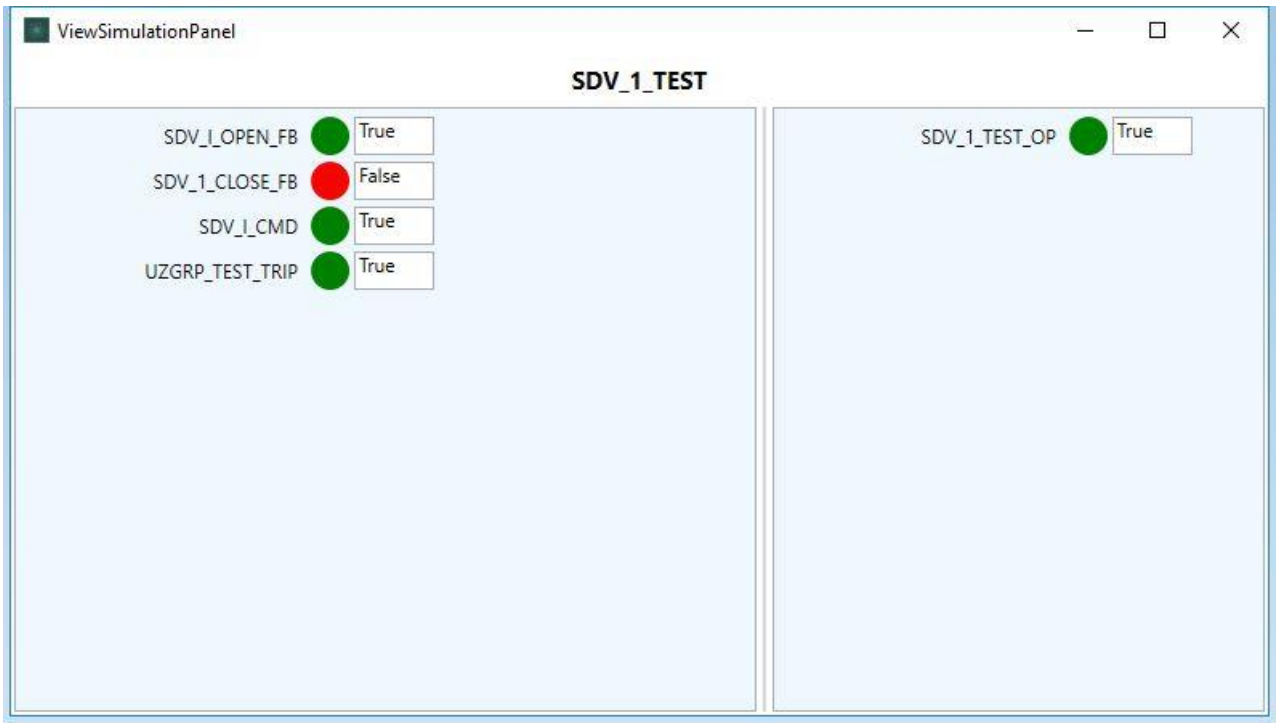
The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

Test Case Number	Test Cases	Input Parameter /Values	Expected Results		
			Output DTT	Open FB SOE Record	Close FB SOE Record
TC#1	ZXO = TRUE, ZXC = FALSE, UZSD = TRUE, CMD = TRUE	ZXO = TRUE, ZXC = FALSE, UZSD = TRUE, CMD = TRUE	TRUE	N/A	N/A
TC#2	ZXO = TRUE, ZXC = FALSE, UZSD = FALSE, CMD = TRUE, MTM time not Elapsed	ZXO = TRUE, ZXC = FALSE, UZSD = FALSE, CMD = TRUE, MTM time not Elapsed	FALSE	N/A	N/A
TC#3	ZXO = TRUE, ZXC = FALSE, UZSD = FALSE, CMD = TRUE, MTM time Elapsed	ZXO = TRUE, ZXC = FALSE, UZSD = FALSE, CMD = TRUE, MTM time Elapsed	FALSE	YES	N/A
TC#4	ZXO = FALSE, ZXC = TRUE, UZSD = TRUE, CMD = FALSE	ZXO = FALSE, ZXC = TRUE, UZSD = TRUE, CMD = FALSE	FALSE	N/A	N/A
TC#5	ZXO = FALSE, ZXC = TRUE, UZSD = TRUE, CMD = TRUE	ZXO = FALSE, ZXC = TRUE, UZSD = TRUE, CMD = TRUE	TRUE	N/A	N/A

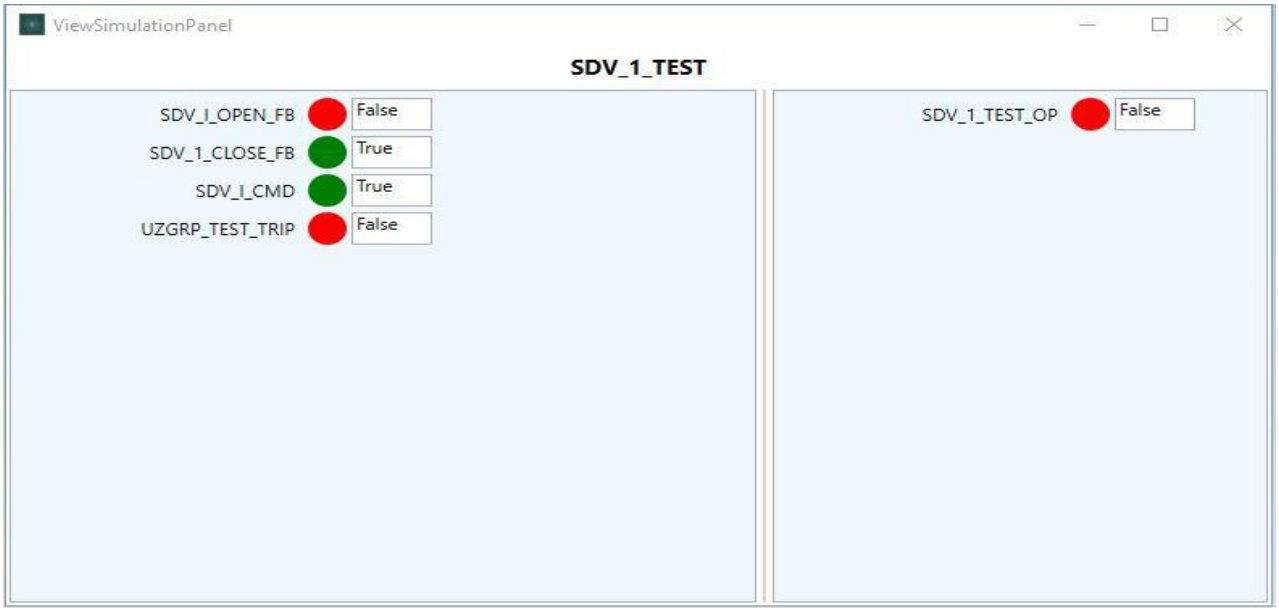
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from "True' to 'False'.

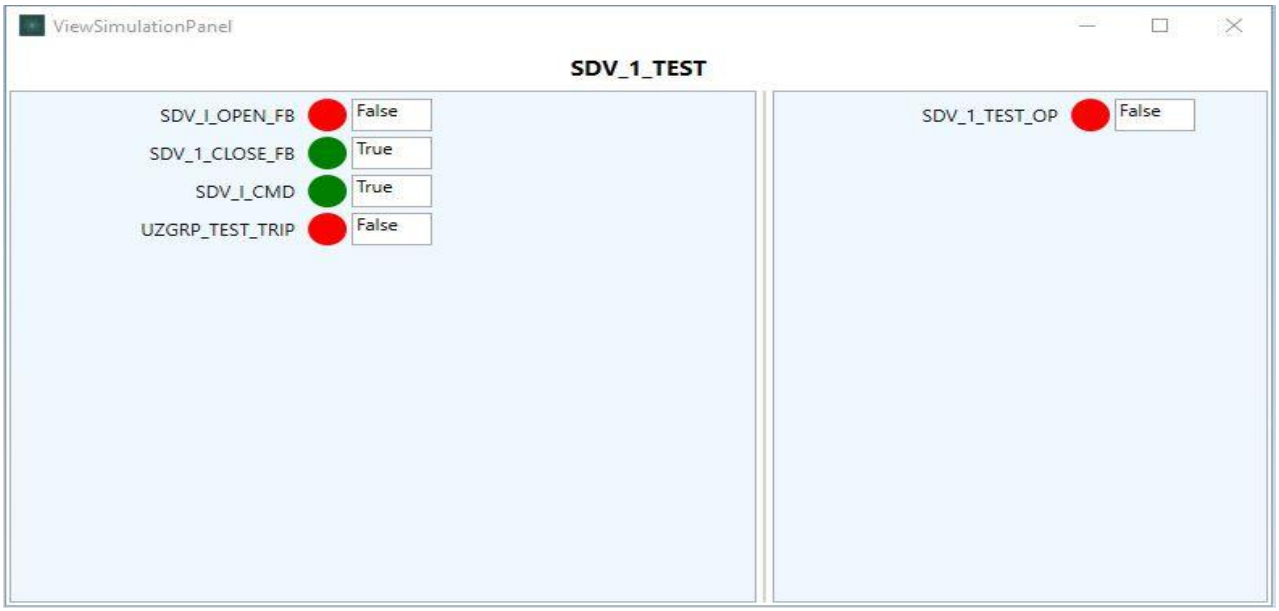
8.5 TEST RESULTS:



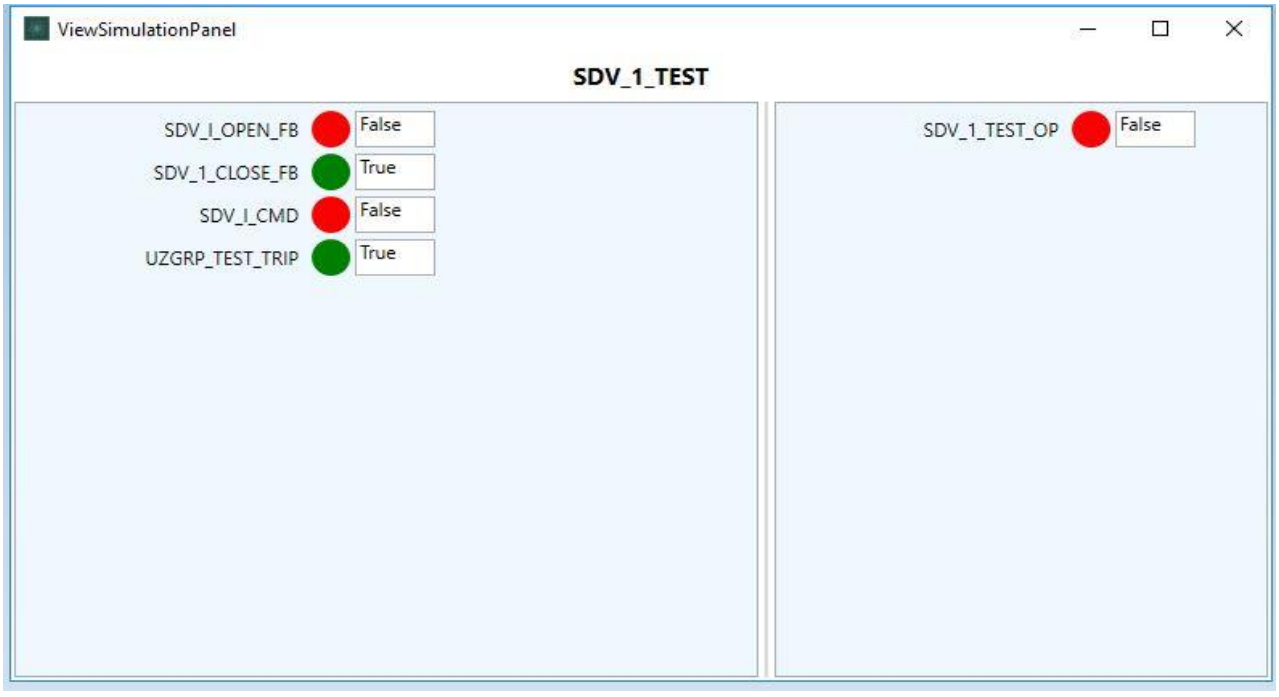
TC#1 : ZXO = TRUE, ZXC = FALSE, UZSD = TRUE, CMD = TRUE



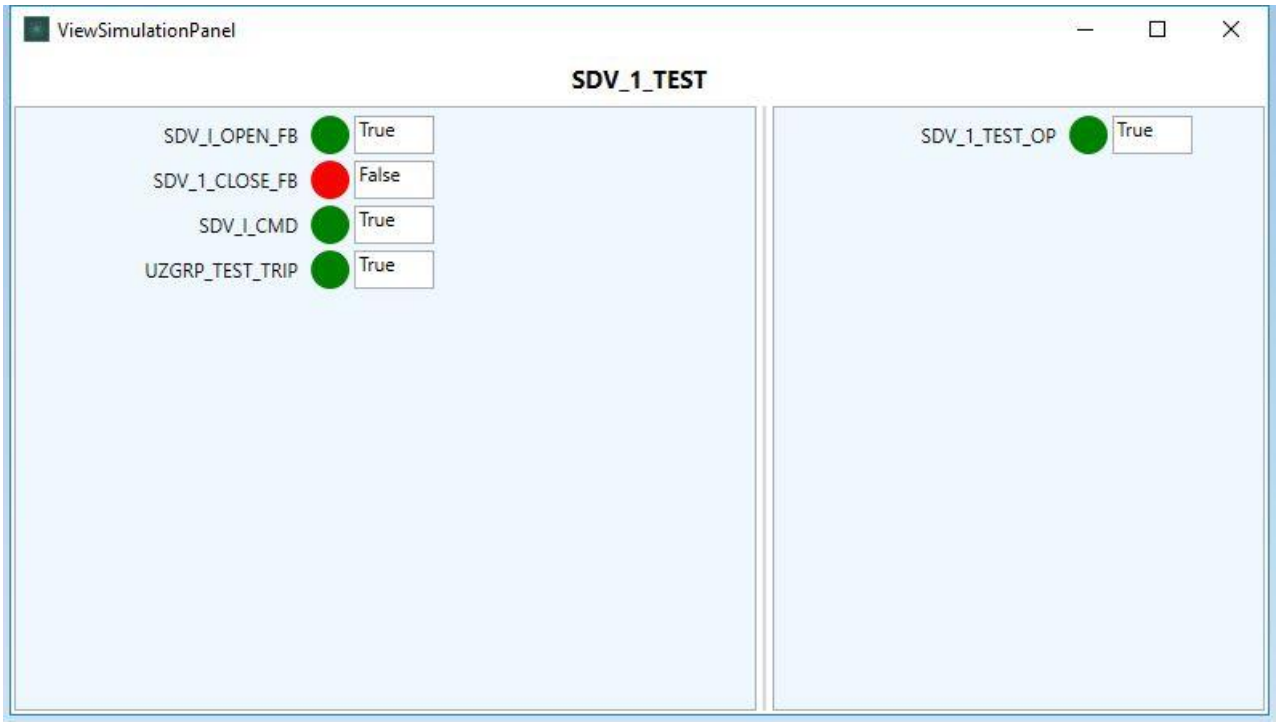
TC#2 : ZXO = TRUE, ZXC = FALSE, UZSD = FALSE, CMD = TRUE, MTM time not Elapsed



TC#3 : ZXO = TRUE, ZXC = FALSE, UZSD = FALSE, CMD = TRUE, MTM time Elapsed

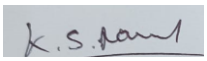


TC#4 : ZXO = FALSE, ZXC = TRUE, UZSD = TRUE, CMD = FALSE



TC#5 : ZXO = FALSE, ZXC = TRUE, UZSD = TRUE, CMD = TRUE

8.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	05-JUL-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

9 BDV

BDV function is used for the Fail to Open Valves with limit switch Feedback

9.1 PURPOSE

This typical drives the output to safe-state when the UZSD input trips.

Functionality:

The BDV typical has the following features:

- Valve operation.
- Limit switch feedback (one or two limit switches).

This typical drives the output to safe-state when the UZSD input trips. Design of the typical is energize to trip (or activate) the output hence line monitoring of the output is essential. MANUAL operations to the Valve from the OWS are prohibited at all times except in a state when the associated UZ group acting on the BDV recovers from trip state and UZ group is reset. CLOSE command shall be issued from the OWS. Field Hand Switch allows opening of the Valve locally when the valve is in CLOSE condition.

9.2 LOGIC DIAGRAMS

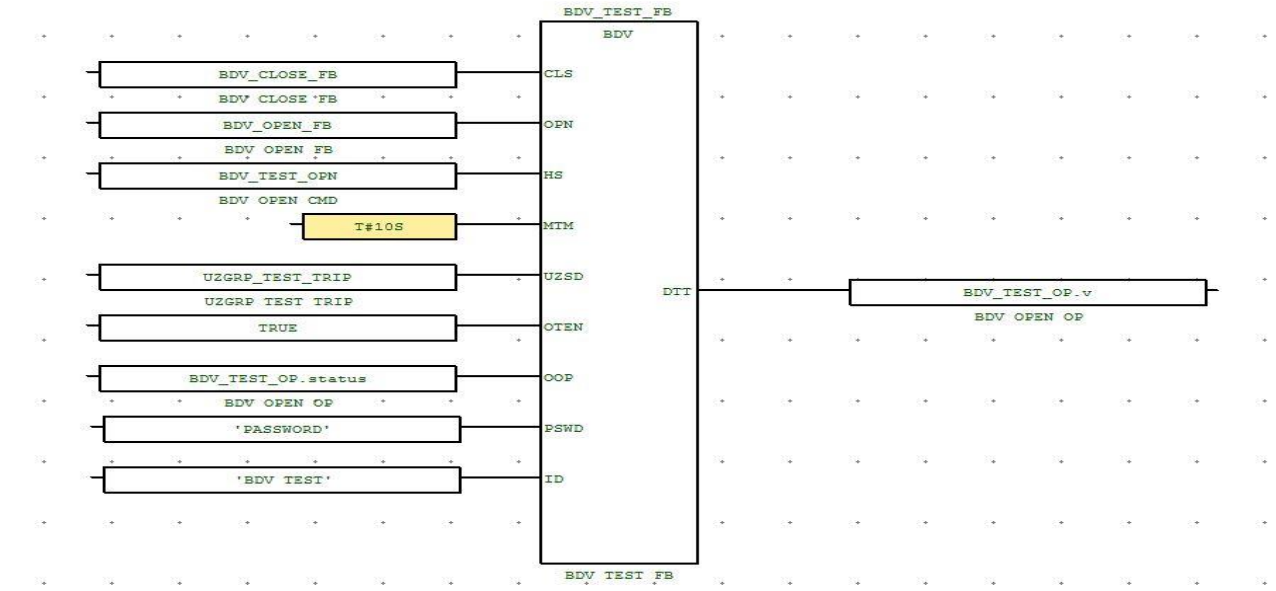


Fig 17 User Defined Function Block BDV

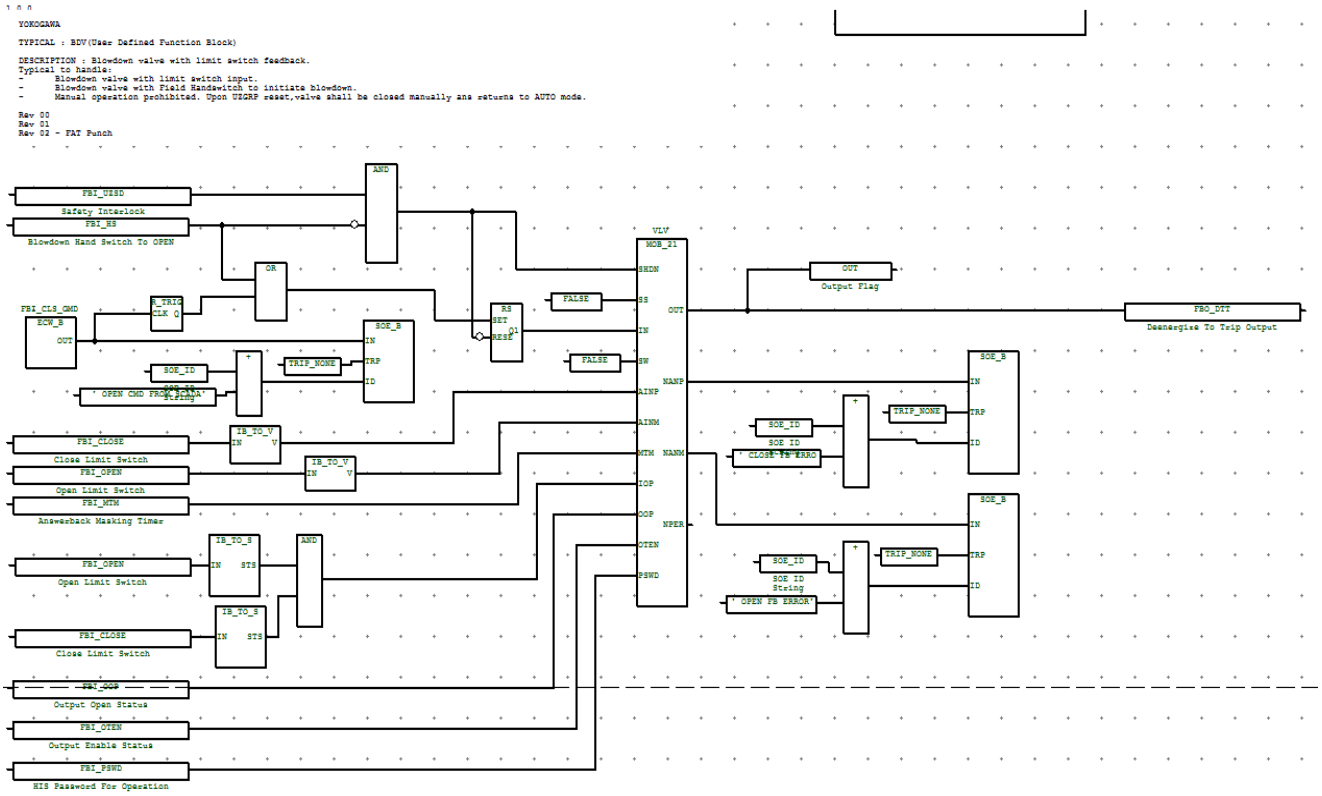


Fig 18 Logic Diagram for Typical BDV

9.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
CLS	CLS is the Close Limit Switch	TRUE
OPN	OPN is the Open Limit Switch	FALSE
HS	HS is the Field Open Command	FALSE
MTM	MTM is the Answer Back Mask Time	T#10s
UZSD	UZSD is the UZ Group SD	TRUE
OTEN	OTEN is the Output Enable Status	FALSE
OOP	OOP is the Output Open Status	TRUE
PSWD	PSWD is the Password	"XXXXXXXXX"
ID	RSID is the comment for the “SOE”	"XXXXXXXXX"

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
DTT	DTT is the Output to Valve	FALSE

9.4 TEST CASES VS EXPECTED RESULTS

The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under ‘Predefined Values’ section.

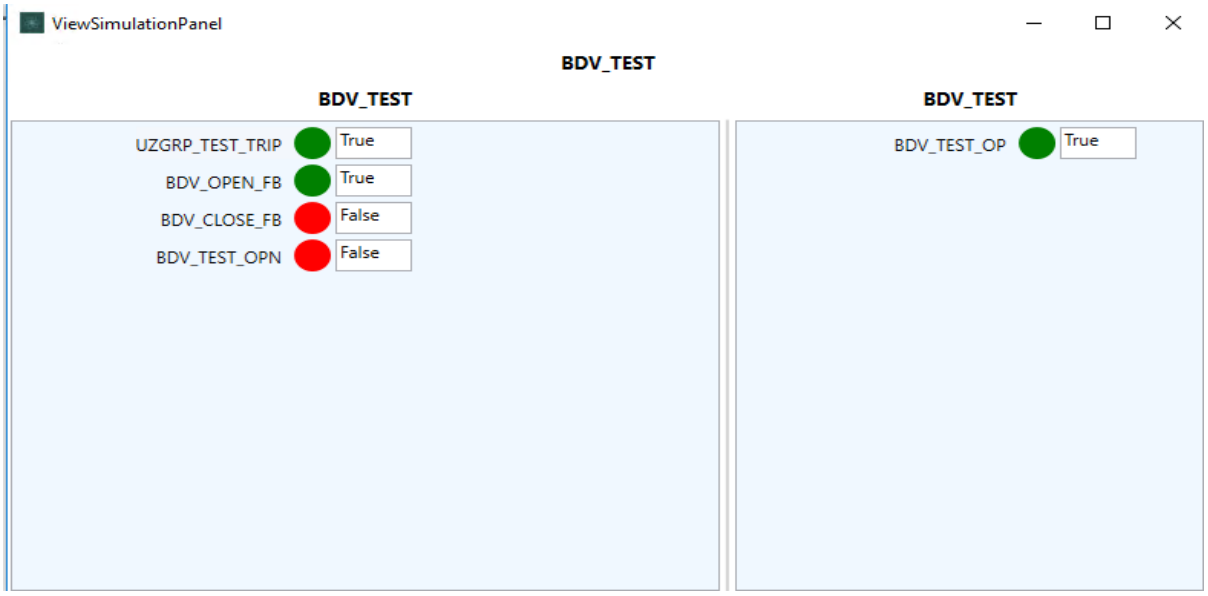
		Input Parameter /Values	**Expected Results**		
Test Case Number	**Test Cases**		**Output DTT**	**Open FB SOE Record**	**Close FB SOE Record**
TC#1	OPN = TRUE, CLS = FALSE, HS = FALSE, UZSD = TRUE	OPN = TRUE, CLS = FALSE, HS = FALSE, UZSD = TRUE	TRUE	N/A	N/A
TC#2	OPN = TRUE, CLS = FALSE, HS = FALSE, UZSD = FALSE, MTM time not Elapsed	OPN = TRUE, CLS = FALSE, HS = FALSE, UZSD = FALSE, MTM time not Elapsed	FALSE	N/A	N/A

TC#3	OPN = TRUE, CLS = FALSE, HS = FALSE, UZSD = FALSE, MTM time Elapsed	OPN = TRUE, CLS = FALSE, HS = FALSE, UZSD = FALSE, MTM time Elapsed	FALSE	YES	N/A
TC#4	OPN = FALSE, CLS = TRUE, HS = FALSE, UZSD = TRUE, DDT = TRUE, OWS CLO CMD = FALSE	OPN = FALSE, CLS = TRUE, HS = FALSE, UZSD = TRUE, DDT = TRUE, OWS CLO CMD = FALSE	FALSE	N/A	N/A
TC#5	OPN = FALSE, CLS = TRUE, HS = FALSE, UZSD = TRUE, OWS CLO CMD = TRUE	OPN = FALSE, CLS = TRUE, HS = FALSE, UZSD = TRUE, OWS CLO CMD =TRUE	TRUE	N/A	N/A

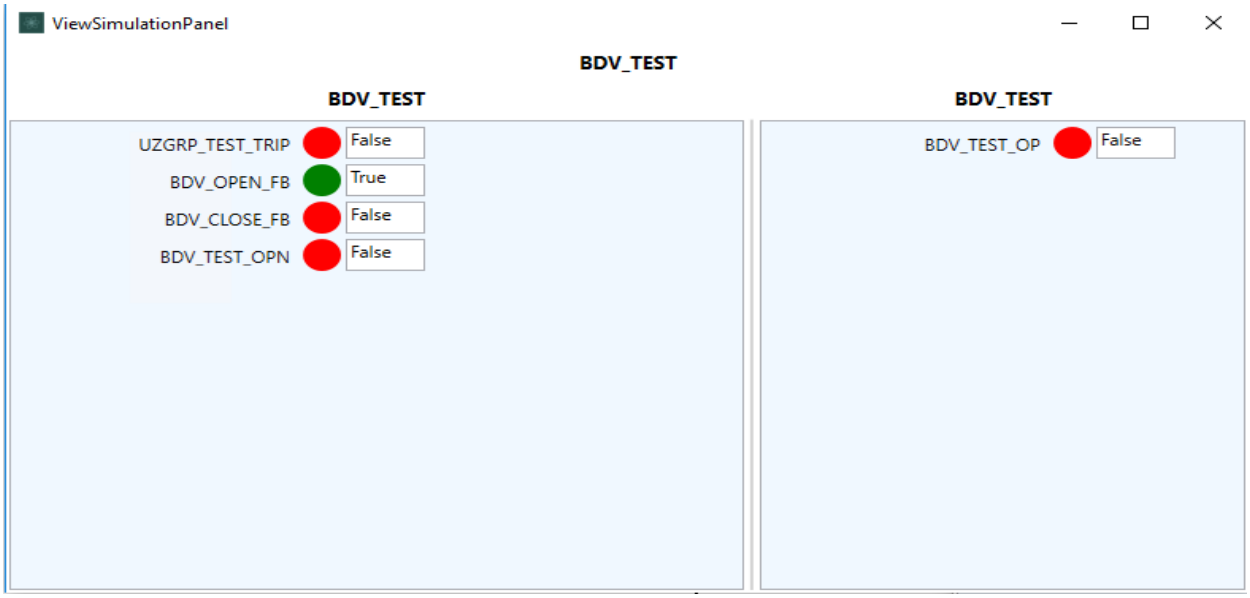
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from “True’ to ‘False’.

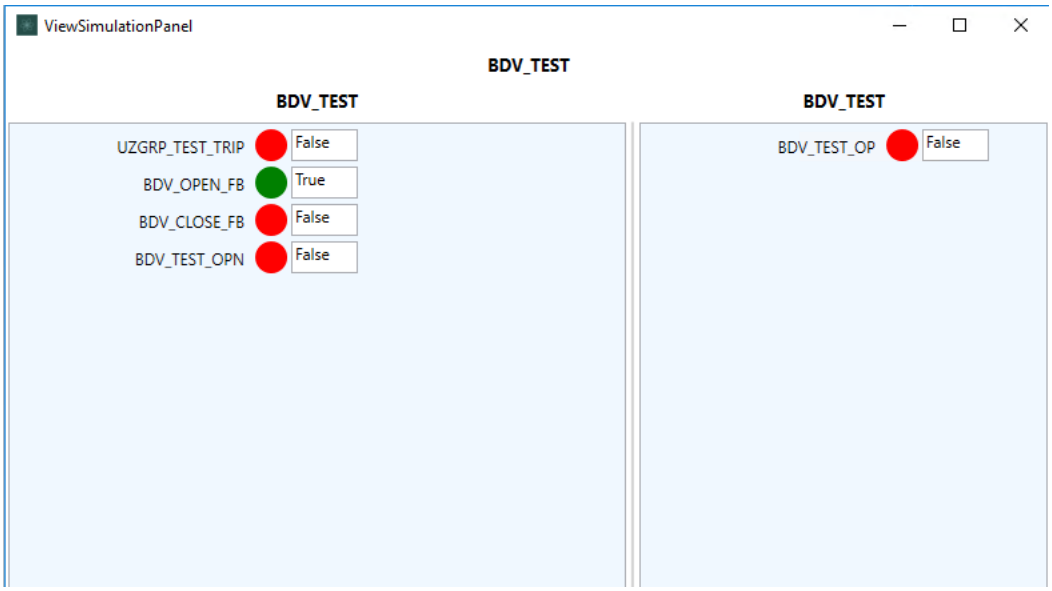
9.5 TEST RESULTS:



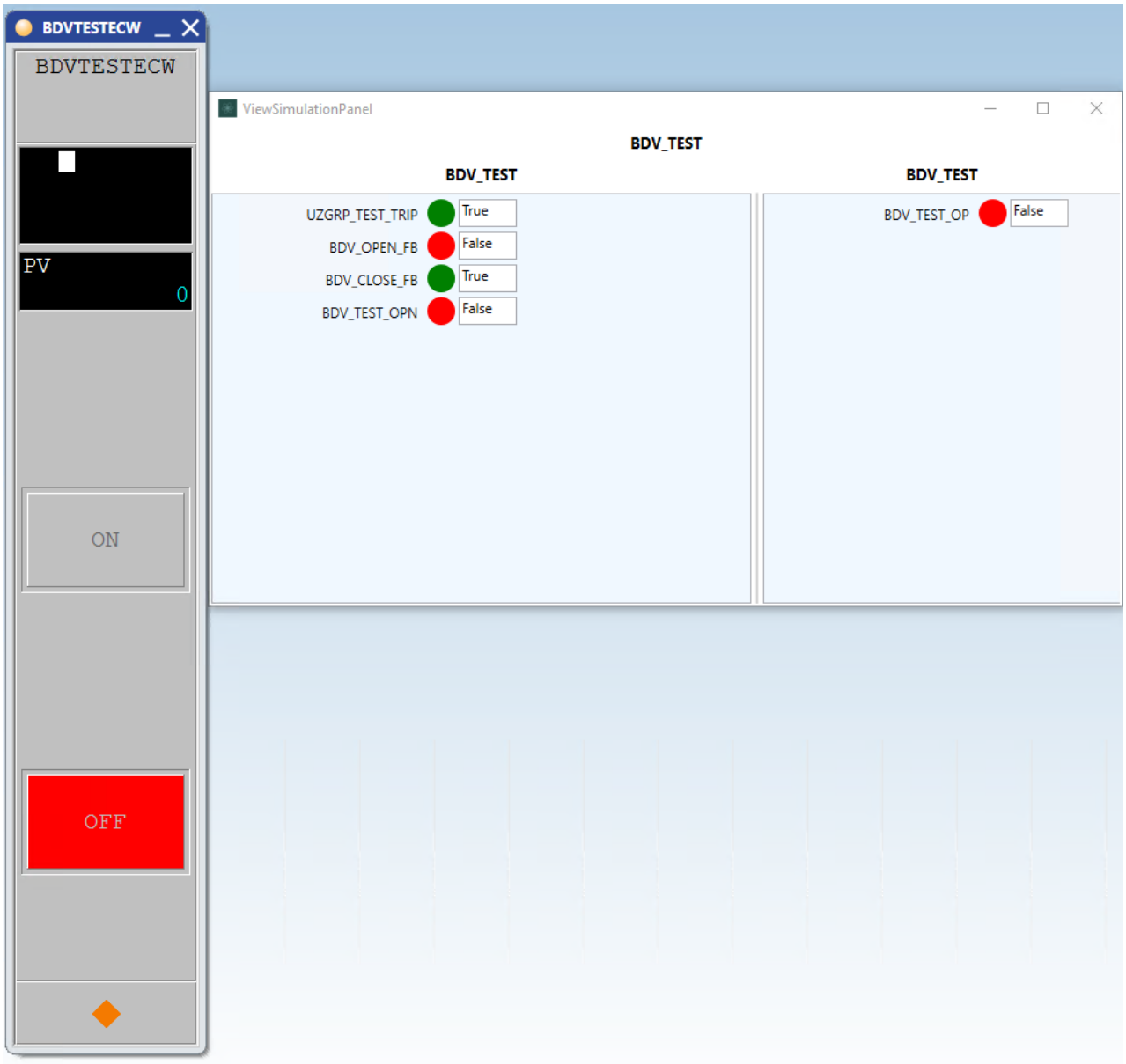
TC#1 : OPN = TRUE, CLS = FALSE, HS = FALSE, UZSD = TRUE



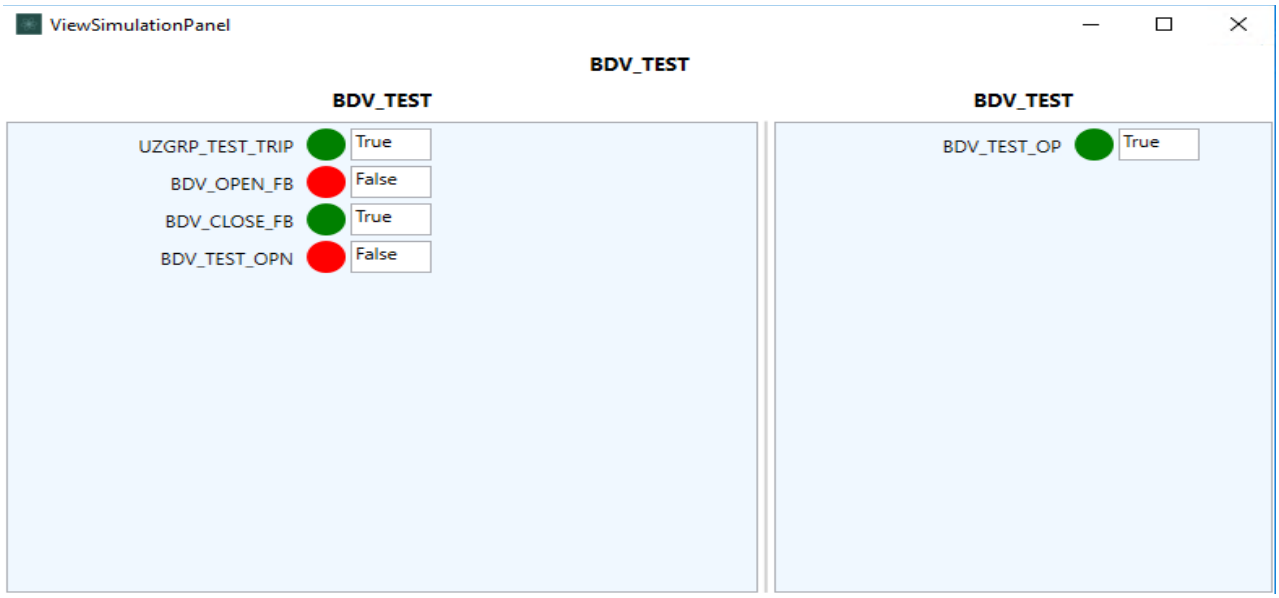
TC#2 : OPN = FALSE, CLS = FALSE, HS = FALSE, UZSD = FALSE,
MTM time not Elapsed



TC#3 : OPN =TRUE, CLS = FALSE, HS = FALSE, UZSD = FALSE,
MTM time Elapsed

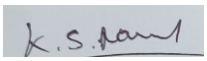


TC#4 : OPN = FALSE, CLS = TRUE, HS = FALSE, UZSD = TRUE, DDT = FALSE,
OWS CLO CMD = FALSE



TC#5 : OPN = FALSE, CLS = TRUE, HS = FALSE, UZSD = TRUE, OWS CLO CMD = TRUE

9.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	06-JAN-2025

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

10 AOS

AOS function is used for the Start-up Override

10.1 PURPOSE

The Automatic Operational Override (also known as startup override) is used during a unit (re)start. During a unit startup, levels, pressures, flows, and temperatures may be in a state of alarm providing a shutdown signal to the SIS. This in turn prevents the continuation of a process startup. The Automatic Operational Override shall be used to override the Lo-Lo and Hi-Hi shutdown signals as specified in the *Project* allowing operations to bring the unit back up.

Functionality:

The AOS function block has the following main functions:

1. Manage the operational override on startup function.
2. Reset the startup override when the override time is elapsed.
3. Reset the startup override when the process value has reached above the Low set point for at least a predefined time (process settling time) within the allowed operational override time.
4. Reset startup override when UZ group logics shutdown.
5. Reset the operational override (AOS) when the transmitter is faulty.

The operational override is activated by a UZ-group reset. The reset signal is connected to the operational override request input. The operational override will be activated on a rising edge of the reset signal if the following conditions are met:

- If the input typical is in trip alarm;
- And if there is no transmitter fault.

The operational override will be active as long as the operational override time is not elapsed. The operational override will be reset if:

- If the operational override time is elapsed;
- Or if the process value has reached normal condition for at least a predefined time (process settling time) within the allowed operational override time,
- Or if the transmitter is faulty; Start-up sequence should be stopped.
- A trip occurs in the applicable UZ group.

10.2 LOGIC DIAGRAMS

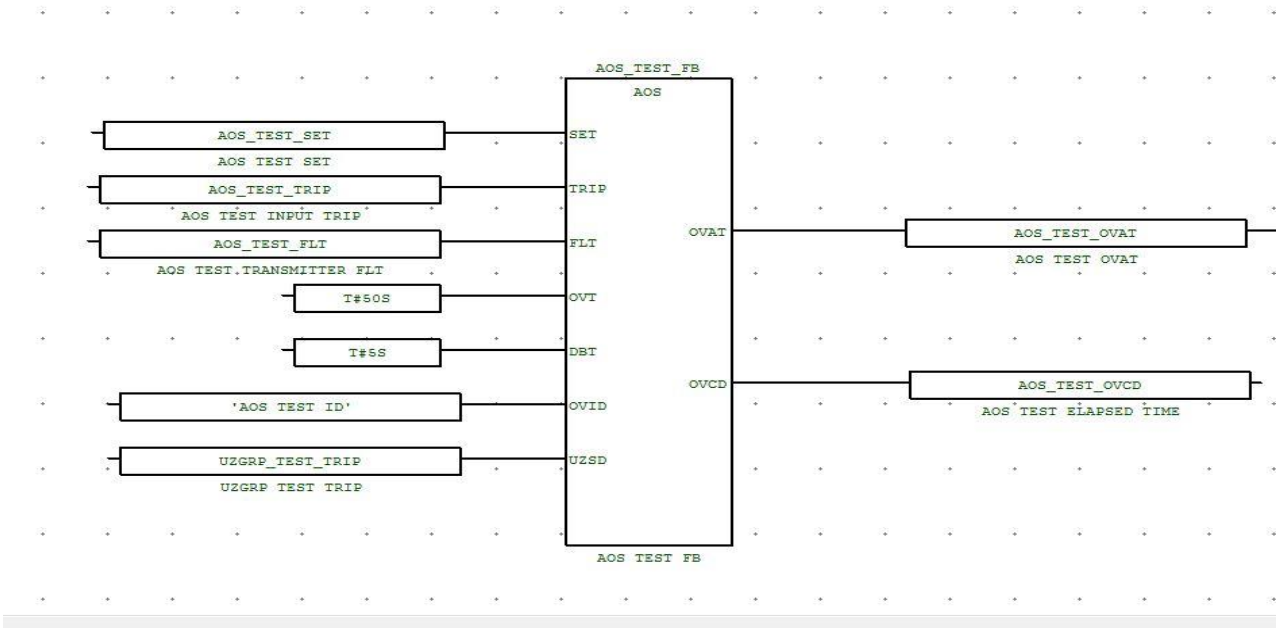


Fig 19 User Defined Function Block AOS

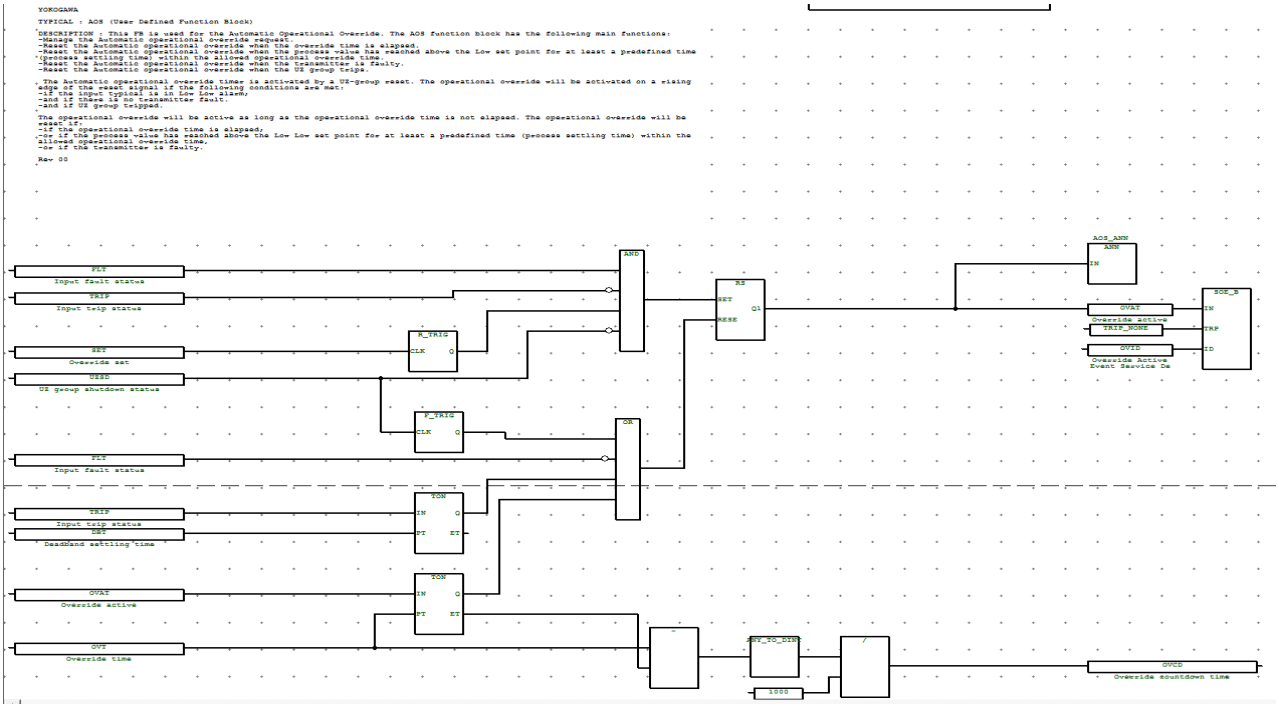


Fig 20 Logic Diagram for Typical AOS

10.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
SET	AOS Set from the UZRST Block	FALSE
TRIP	TRIP is the "LL trip" from the SAI Block	TRUE
FLT	FLT is the "STS" from the SAI Block	TRUE
OVT	OVT is the Override timer	T#50s
DBT	DBT is the Process Settling Time	T#5s
OVID	OVID is the comment for the “SOE”	"XXXXXXXXX"
UZSD	UZSD is the UZ Group Trip Status	TRUE

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
OVAT	OVAT is the Boolean Override bit	FALSE
OVCD	OVCD is the Override Countdown Time	50

10.4 TEST CASES VS EXPECTED RESULTS

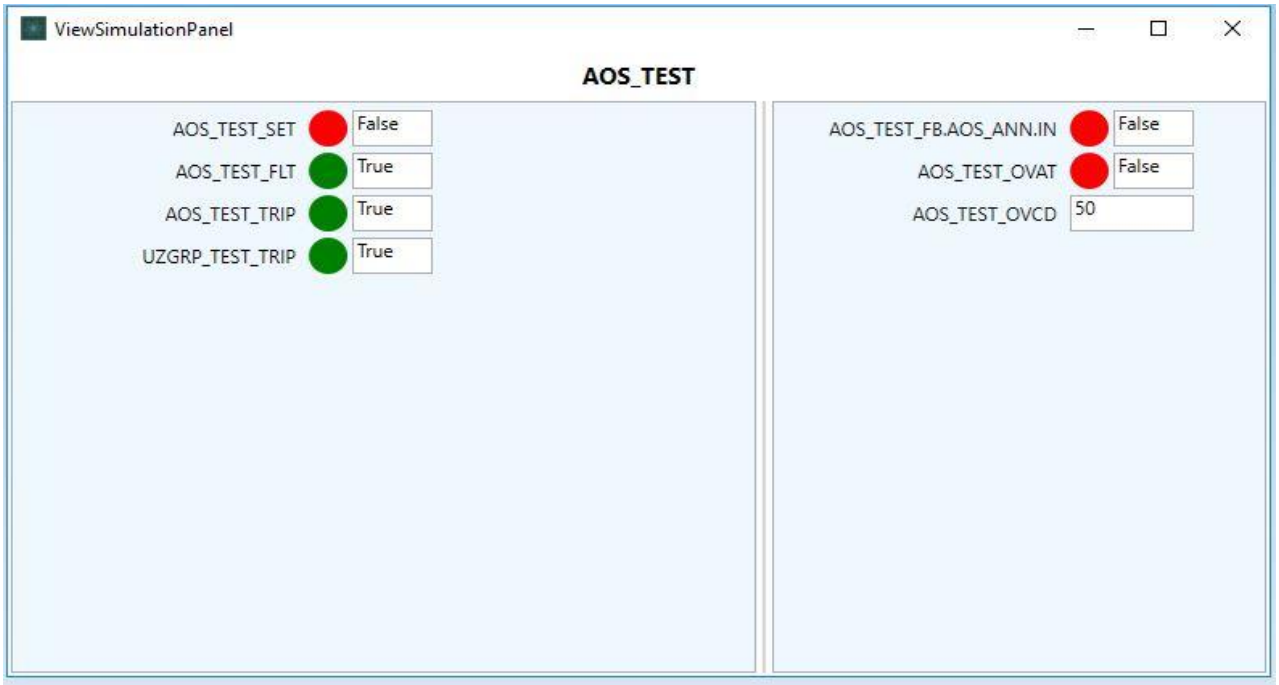
The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

	Test Cases	**Input Parameter /Values**	**Expected Results**
Test Case Number			**OVAT**
TC#1	SET = FALSE, TRIP = TRUE, FLT = TRUE, UZSD = TRUE	SET = FALSE, TRIP = TRUE, FLT = TRUE, UZSD = TRUE	N/A
TC#2	SET = FALSE, TRIP = FALSE, FLT = TRUE, UZSD = FALSE	SET = FALSE, TRIP = FALSE, FLT = TRUE, UZSD = FALSE	N/A
TC#3	SET = TRUE, TRIP = FALSE, FLT = TRUE, UZSD = TRUE	SET = TRUE, TRIP = FALSE, FLT = TRUE, UZSD = TRUE	TRUE
TC#4	SET = FALSE, OVAT = TRUE and TRIP = TRUE or OVAT = TRUE and FLT = FALSE or OVAT = TRUE and UZSD = FALSE or OVAT = TRUE and Countdown time Elapse	SET = FALSE, OVAT = TRUE and TRIP = TRUE or OVAT = TRUE and FLT = FALSE or OVAT = TRUE and UZSD = FALSE or OVAT = TRUE and Countdown time Elapse	FALSE

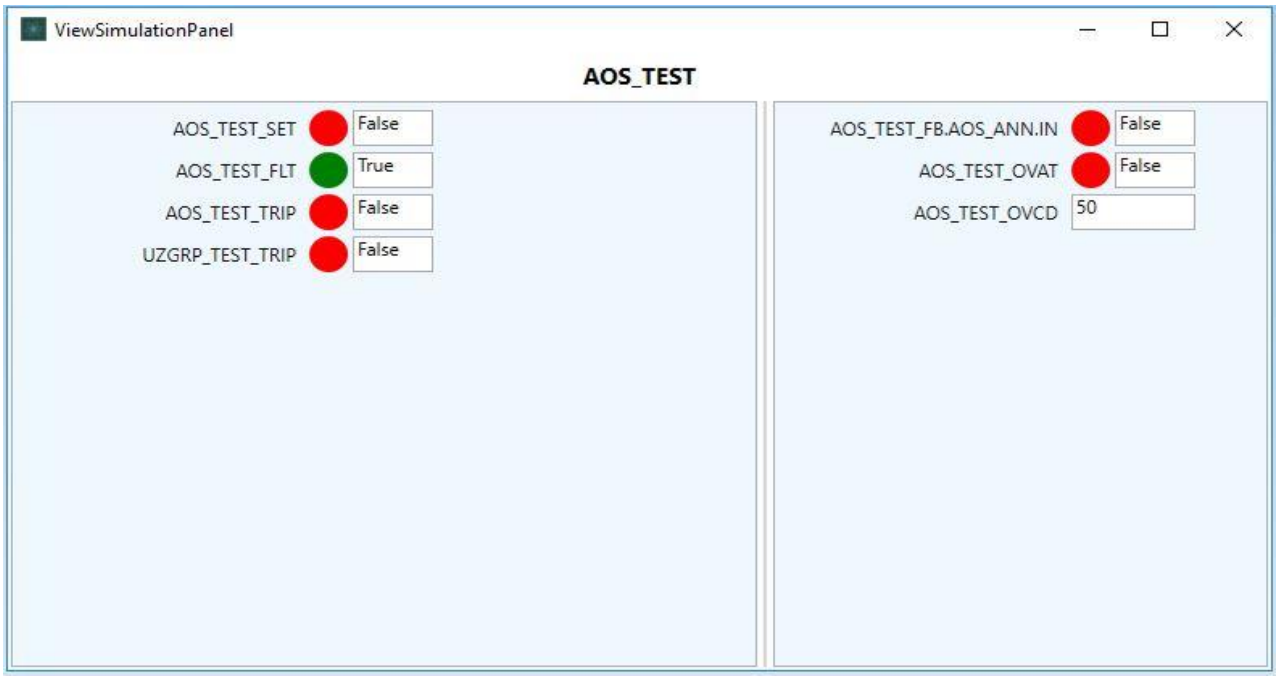
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from "True' to 'False'.

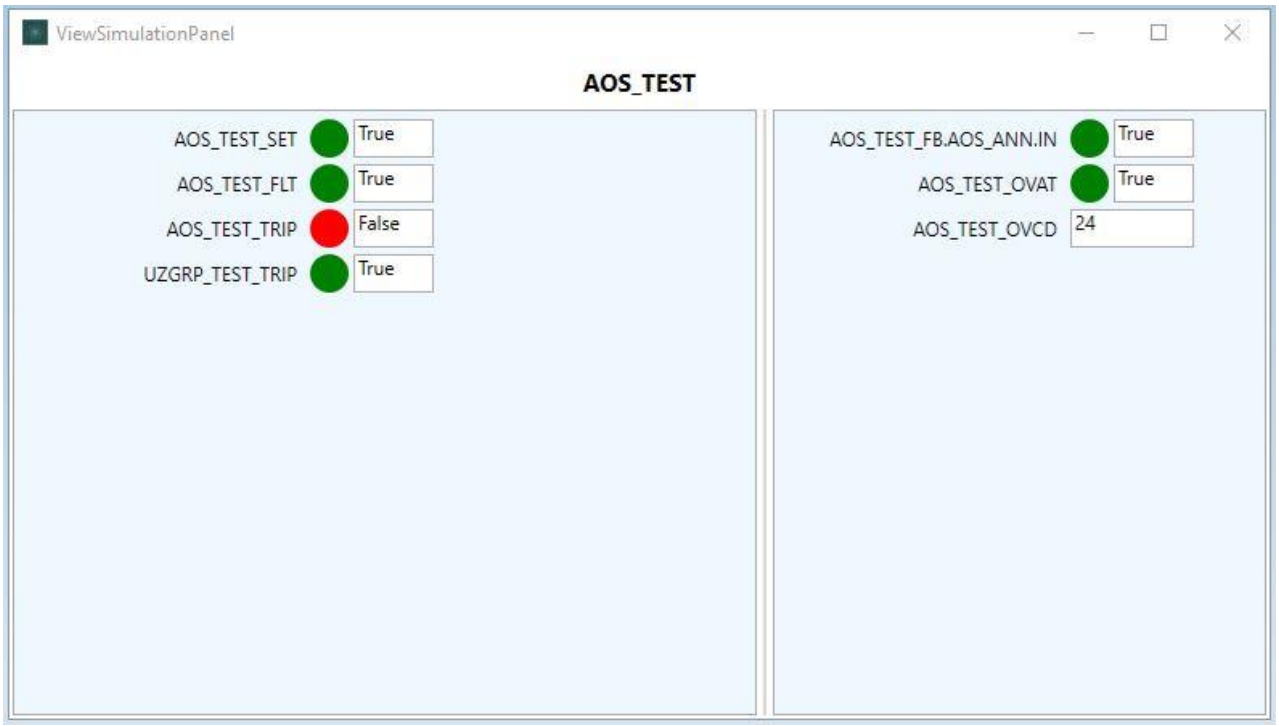
10.5 TEST RESULTS:



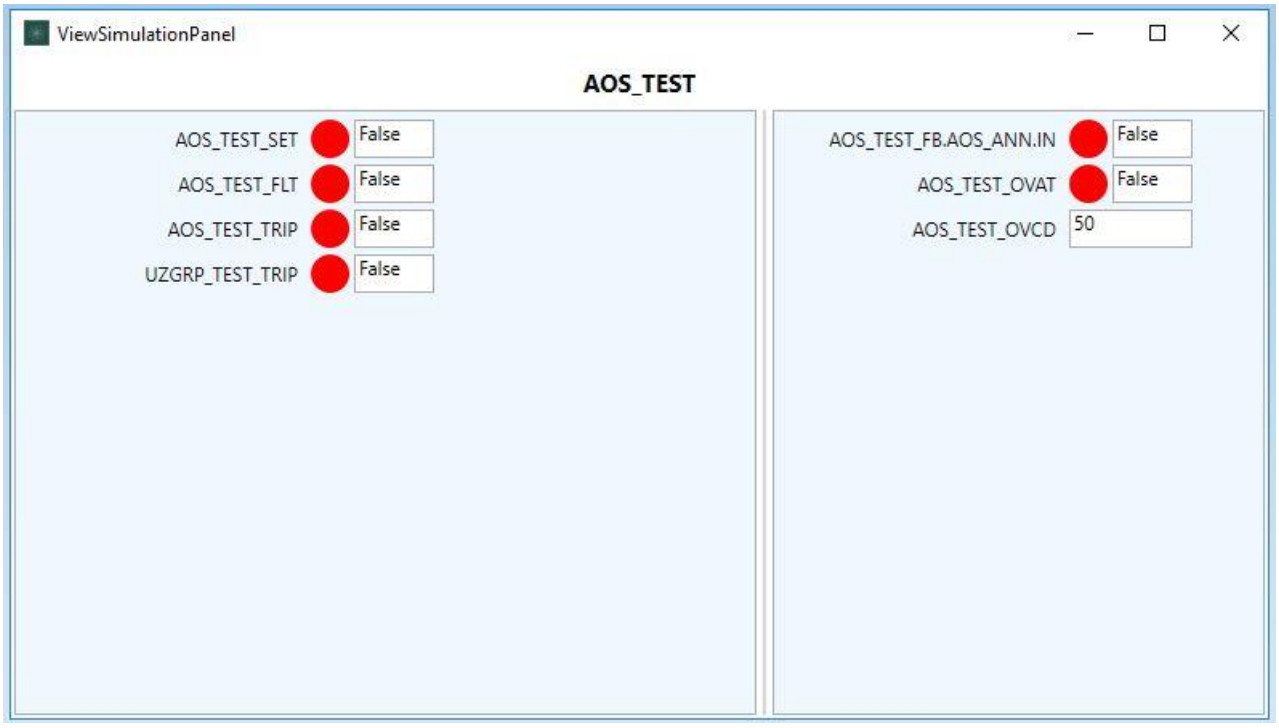
TC#1 : SET = FALSE, TRIP = TRUE, FLT = TRUE, UZSD = TRUE

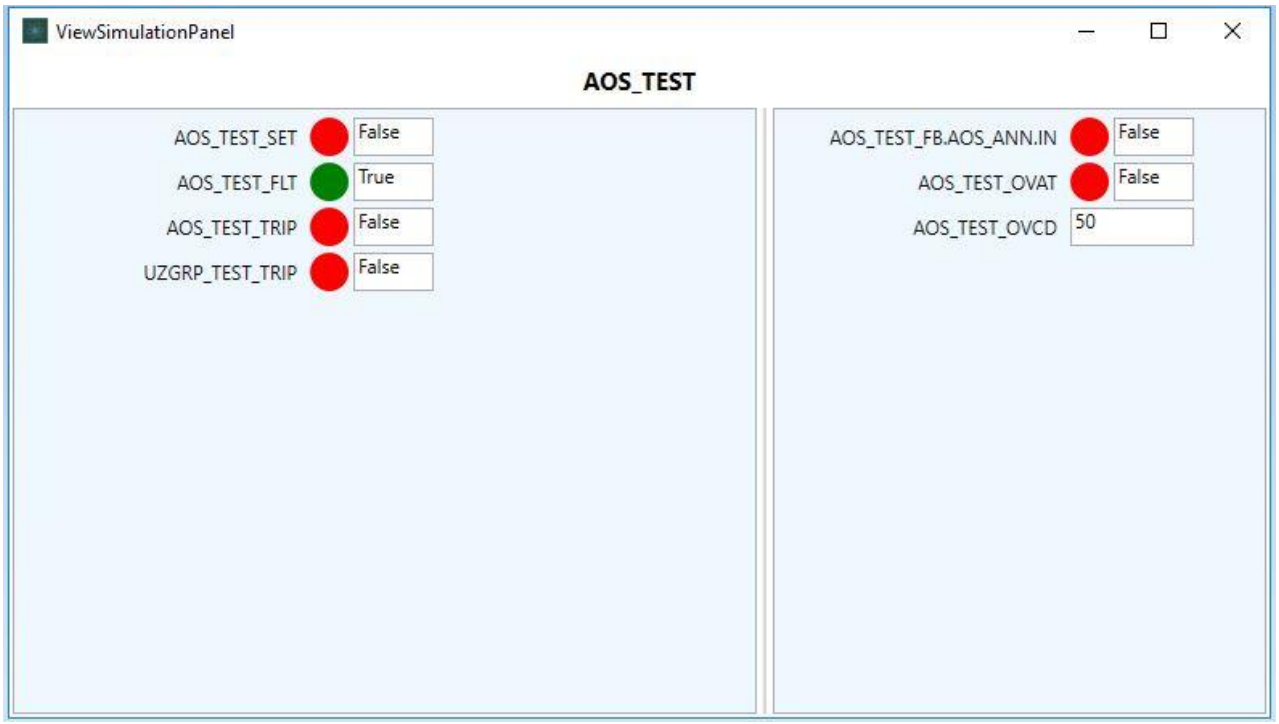


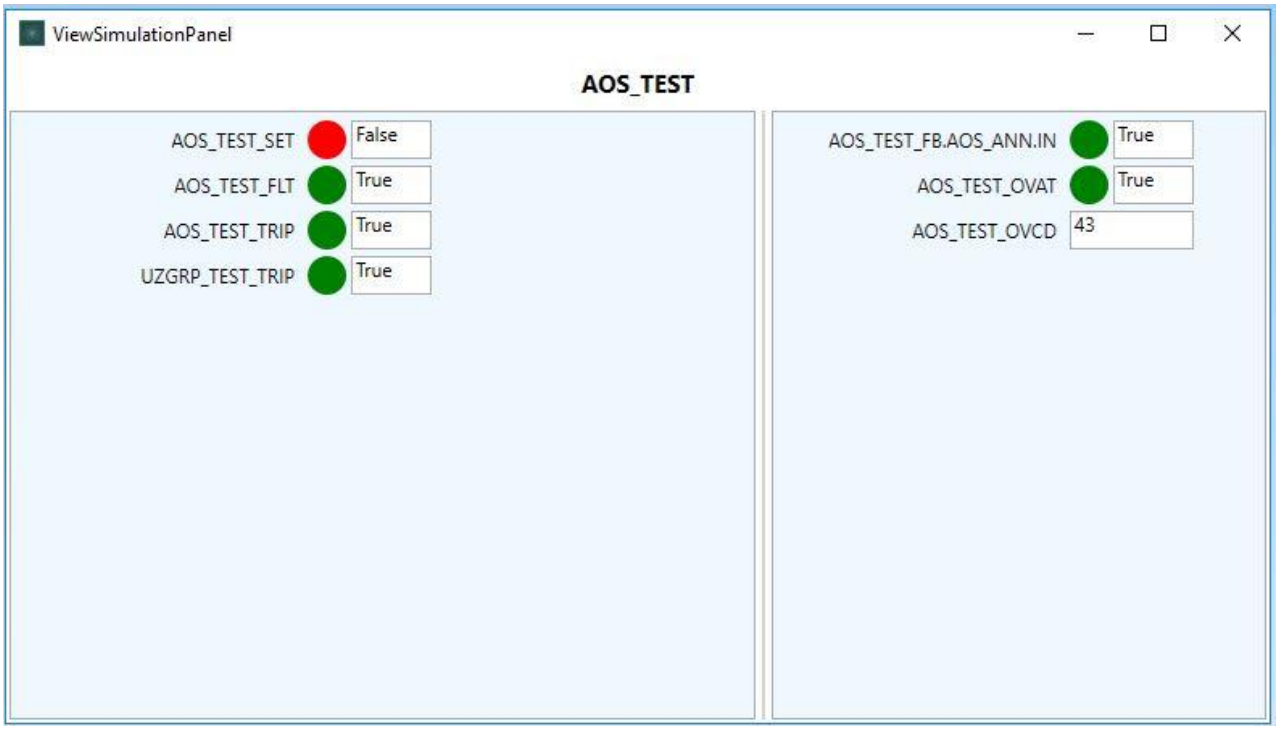
TC#2 : SET = FALSE, TRIP = FALSE, FLT = TRUE, UZSD = FALSE



TC#3 : SET = TRUE, TRIP = FALSE, FLT = TRUE, UZSD = TRUE

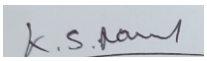






TC#4 : SET = FALSE,
OVAT = TRUE and TRIP = TRUE or
OVAT = TRUE and FLT = FALSE or
OVAT = TRUE and UZSD = FALSE or
OVAT = TRUE and Countdown time Elapse

10.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	05-JUL-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

11 TOF

Trip Delay Timer (TOF) timer is used to provide delayed actions or alarms in response to a specific condition.

11.1 PURPOSE

Trip delay timer (TOF) timer is often used to provide delayed actions or alarms in response to a specific condition.

Functionality:
The TOF function block has the following main functions:

1. **Activation on Condition**: The TOF timer is triggered when a specific condition is met, such as an abnormal process variable exceeding its safe limit (e.g., high pressure, high temperature).
2. **Timing Period**: Once the condition is met, the TOF timer starts counting. This period is preset and can vary depending on the application. During this time, the condition is monitored continuously.
3. **Condition Sustains Beyond the Timer**:
    1. If the condition persists beyond the timer period, the SIS initiates the corresponding safety action, such as:
        1. **Activating an alarm**
        2. **Triggering an emergency shutdown (ESD)**

11.2 LOGIC DIAGRAMS

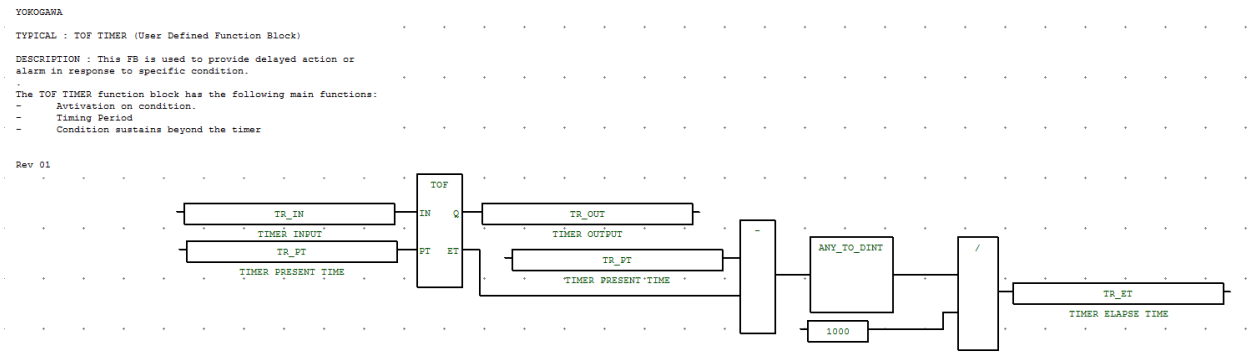


Fig 21 User Defined Function Block TOF

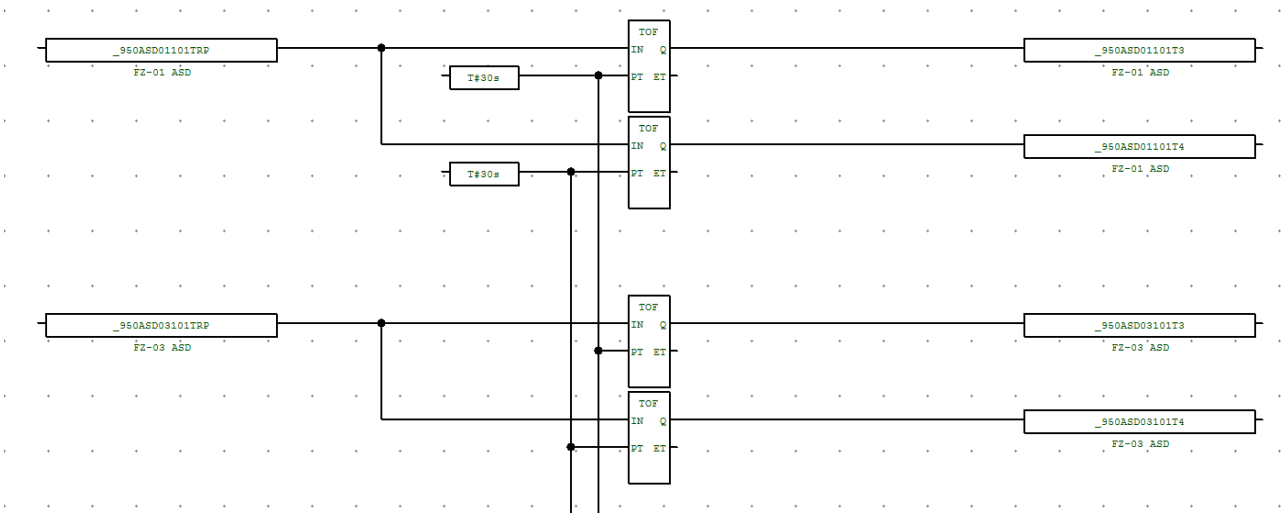


Fig 22 Logic Diagram for Typical TOF

11.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
IN	Input (BOOL)	TRUE
PT	Preset Timer	T#Sec

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
Q	Output (BOOL) If TRUE: total time is not elapsed If FALSE: ET increments till reaches reach PT	TRUE
ET	Elapsed Time	T#Sec

11.4 TEST CASES VS EXPECTED RESULTS

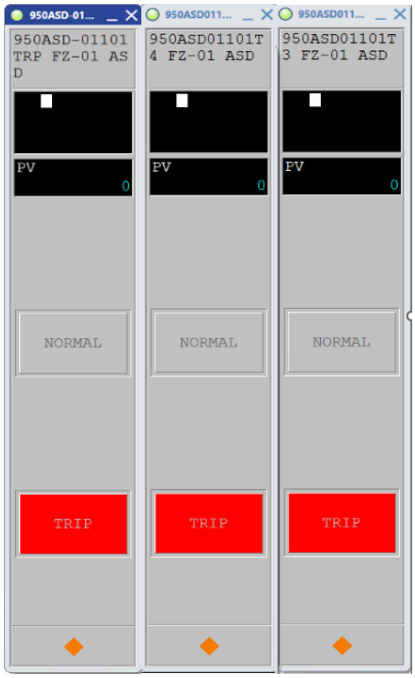
The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

Test Case Number	Test Cases	Input Parameter /Values	Expected Results
			Q (OUTPUT)
TC#1	IN = FALSE, Q = FALSE, PT = 0-2147483648, ET = 0-2147483648	IN = FALSE	FALSE
TC#2	IN = TRUE, Q = TRUE, PT = RESET TO ZERO, ET = RESET TO ZERO	IN = TRUE	TRUE

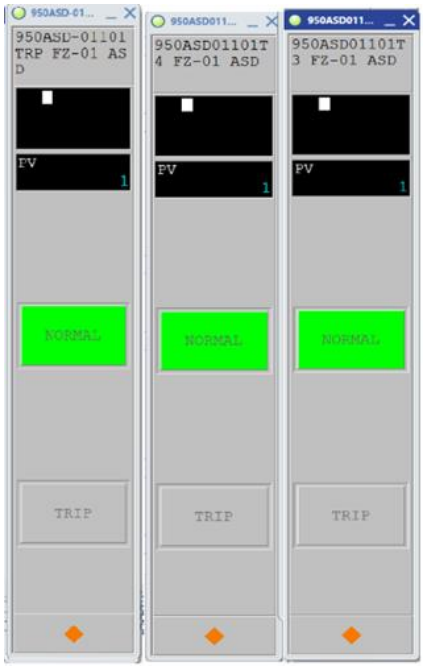
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from "True' to 'False'.

11.5 TEST RESULTS:

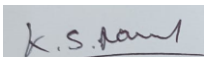


TC#1 : IN = FALSE, Q = FALSE, PT = 0-2147483648, ET = 0-2147483648



TC#1 : IN = TRUE, Q = TRUE, PT =0-2147483648 , ET = RESET TO ZERO

11.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	08-OCT-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

TEST REPORT FOR FGS TYPICALS

Revision	**:**	**01**
Date	**:**	**08-OCT-2024**
Test Specification Prepared by	**:**	**DAMINI.D**
Tested by	**:**	**NANDAGOPALK.S.**
Verified by	**:**	**MANOJKUMAR.P**

Revision History

Rev	Date	Revision Details / Remarks
00	05-AUG-2024	First Issue after Typical Test
01	08-OCT-2024	Accepted for Construction

List of FGS Software Typical

SYSTEM	SL. NO	Typical Name	Description	Revision			
				00	01	02	03
FGS	1	FG_LD	Leak Detector Analog Input	X	X		
	2	FG_GD	Gas Detector Analog Input	X			
	3	FG_SD	Smoke Detector Analog Input	X			
	4	FG_FLAME_IR	Flame Detector Analog Input	X	X		
	5	FG_MAN_REL_NC	FGS NC Type Digital Input	X			
	6	FG_MAN_REL_NO	FGS NO Type Digital Input	X			
	7	F23	FGS Voter 2oo3	X	X		
	8	FG_V2N	FGS 2ooN Voting	X			
	9	UZGRP	IPS UZ group with 10 inputs	X			
	10	UZRST	IPS Reset for UZ group	X			

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1 FG_LD

Leakage Detector for Fire and Gas Applications.

1.1 PURPOSE

This typical is used for H2 Leak detectors.

Functionality:

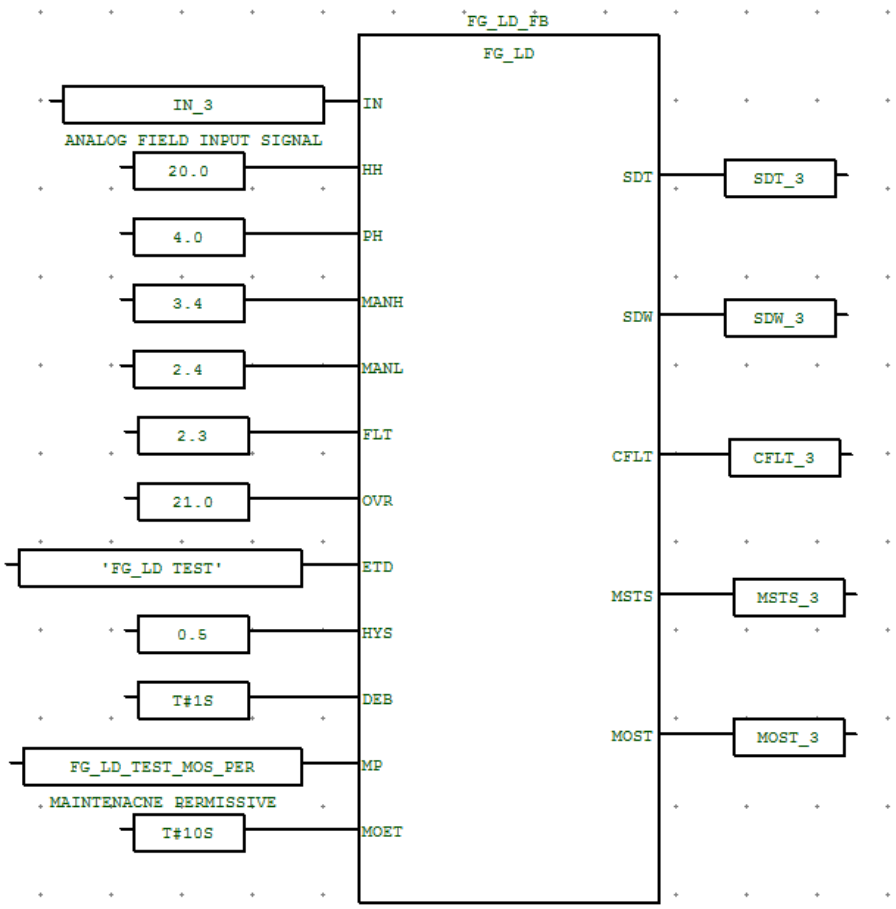
- Process Point type gas detectors
- Manage the maintenance override function (MOS) for gas point detector
- Manage detector trip, diagnostic and I/O fault logics

Note: The MOS override function is included inside the function block
MOS function can be disabled by forcing the MOS enable key switch permanently to FALSE.

Gas Point type input processing block:

- Trip and general diagnostic setpoints are hardcoded outside the User Defined Function Block (UDFB).
- Scaling setpoints are inside UDFB.
- LLLL and LTRP values are masked as these provide no function for flame detection.
- HHH and HTRP values is used warning and trip.
- All faults are considered critical and result in degraded voting logic.

Logic Diagrams



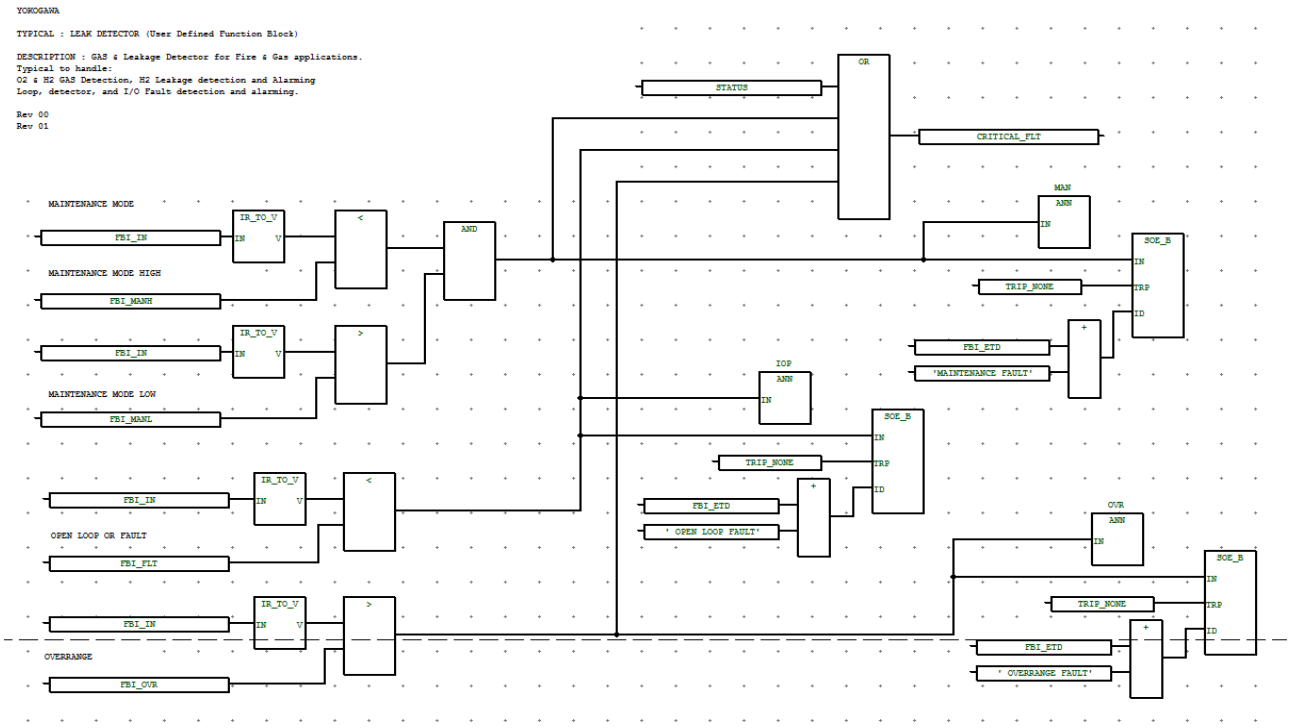


Fig 1 User Defined Function Block FG_LD

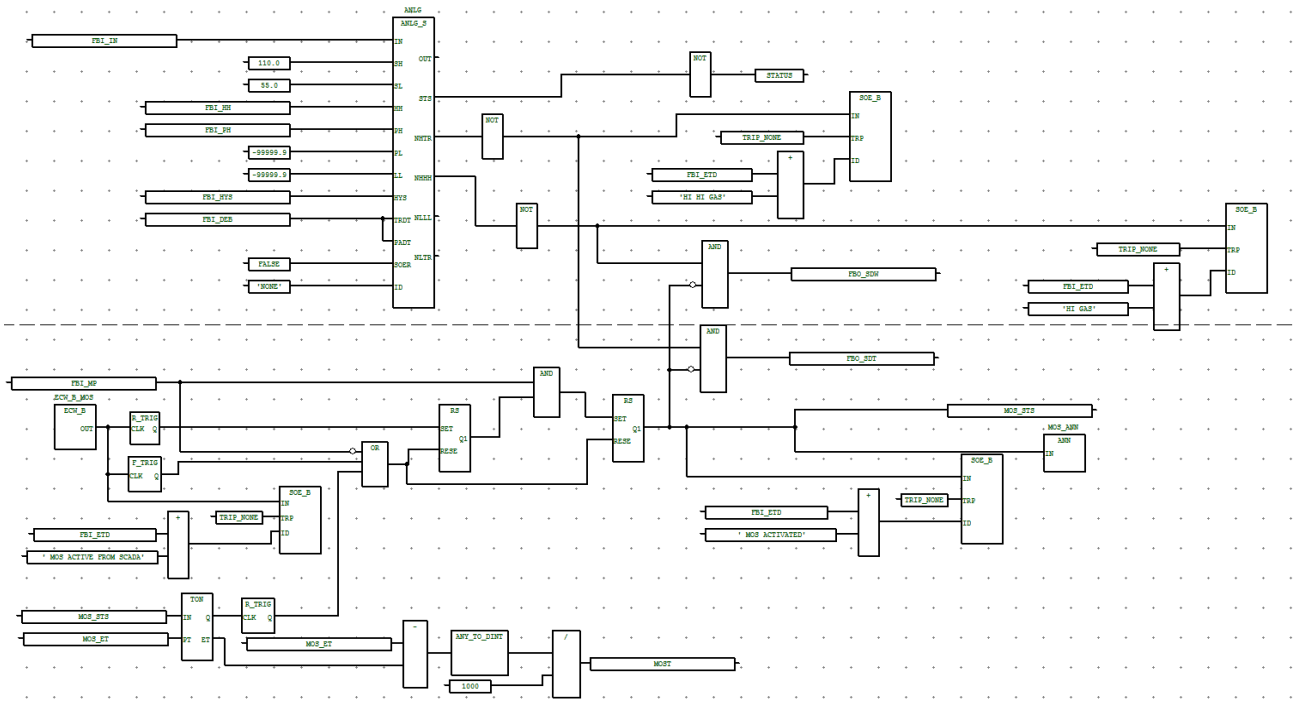


Fig 2 Logic Diagram for Typical FG_LD

1.2 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
IN	ANALOG FIELD INPUT SIGNAL	50
HH	HH SETPOINT	80
PH	PH SETPOINT	70
MANH	MAINTENANCE FAULT THRESHOLD HI	-3.4
MANL	MAINTENANCE FAULT THRESHOLD LO	-6.4
FLT	OPEN LOOP FAULT	-8
OVR	OVERRANGE FAULT	105
ETD	EVENT TEXT FOR DEVICE	XXXXXX
HYS	HYSTERESIS %	0.5
DEB	DEBOUNCE TIME	T#1S
MP	MAINTENACNE PERMISSIVE	FALSE
MOET	MOS RESET TIMER	T#10s

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
SDT	SHUTDOWN TRIP	FALSE
CFLT	CRITICAL FAULT	FALSE
MSTS	MOS STATUS	FALSE
MOST	MOS RESET TIMER	10s

1.3 TEST CASES VS EXPECTED RESULTS

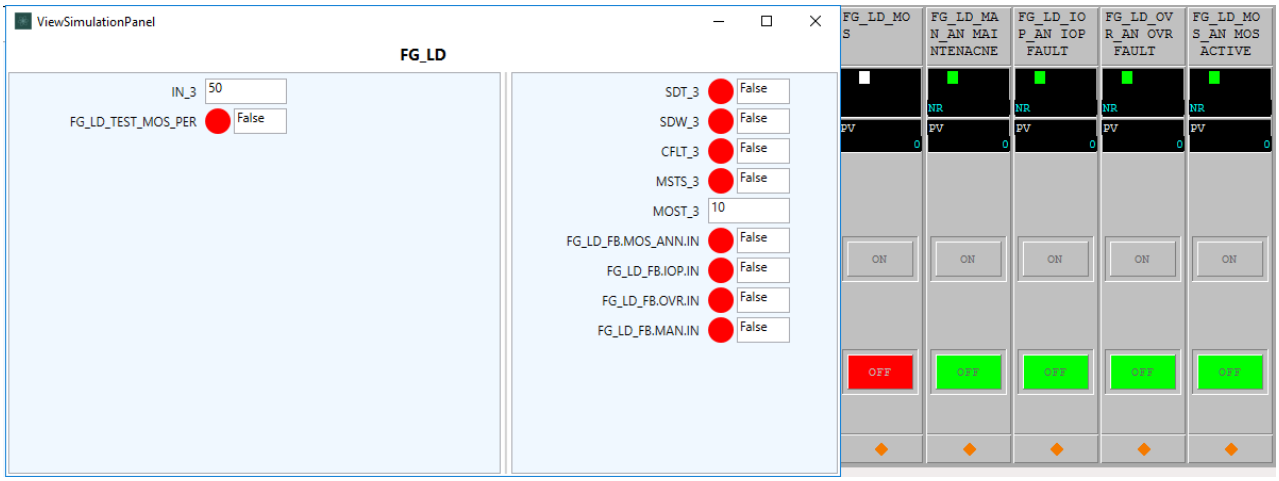
The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

Test Case Number	Test Cases	Input Parameter /Values	Expected Results			
			Shutdown Trip	Shutdown H Trip	Critical Fault	MOS Status
TC#1	IN.Value = 50.0, MP = FALSE	IN.Value = 50.0, MP = FALSE	FALSE	FALSE	FALSE	FALSE
TC#2	IN.Value = 81.0, MP = FALSE,	IN.Value = 81.0, MP = FALSE,	TRUE	TRUE	FALSE	FALSE
TC#3	IN.Value = 81.0, MP = TRUE, @ECW_B_LD = TRUE	IN.Value = 81.0, MP = TRUE, @ECW_B_LD = TRUE	FALSE	FALSE	FALSE	TRUE
TC#4	IN.Value = 81.0, MP = TRUE, MOS ENABLE = TRUE MOS TIME ELAPSED	IN.Value = 81.0, MP = TRUE, MOS ENABLE = TRUE MOS TIME ELAPSED	TRUE	TRUE	FALSE	FALSE
TC#5	IN.Value = -3.5, MP = FALSE,	IN.Value = -3.5 MP = FALSE,	FALSE	FALSE	TRUE	FALSE
TC#6	IN.Value = -8.1, MP = FALSE,	IN.Value = -8.1, MP = FALSE,	FALSE	FALSE	TRUE	FALSE
TC#7	IN.Value = 105.1, MP = FALSE,	IN.Value = 105.1, MP = FALSE,	TRUE	TRUE	TRUE	FALSE
TC#8	IN.Value = 50.0, MP = FALSE, TRANSMITTER FAULT(STS)= TRUE	IN.Value = 50.0, MP = FALSE, TRANSMITTER FAULT(STS)= TRUE	FALSE	FALSE	TRUE	FALSE

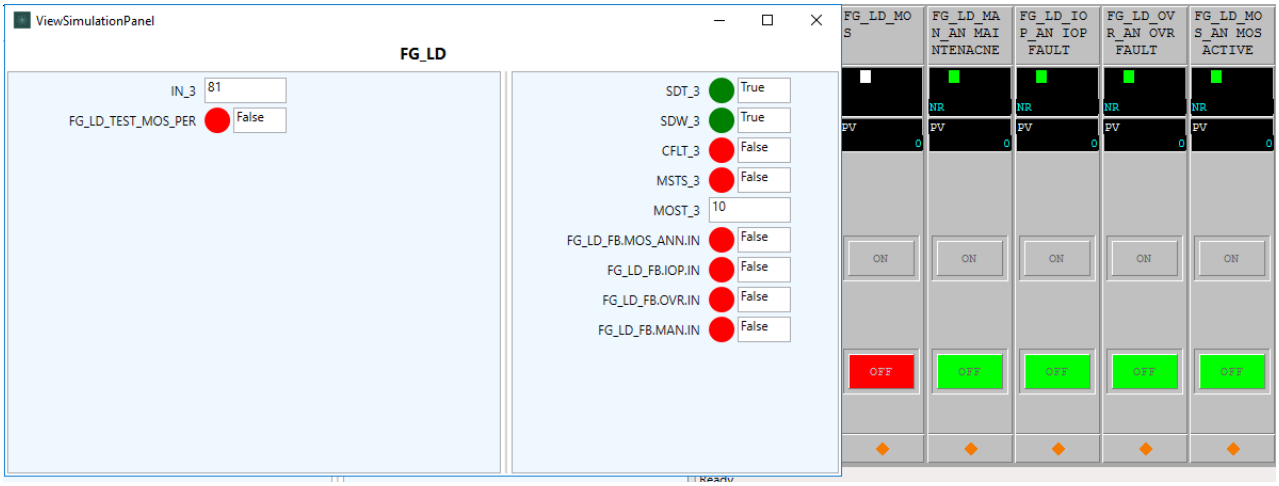
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- TRUE Indicates Alarm / Trip value changes from “False’ to ‘True’.

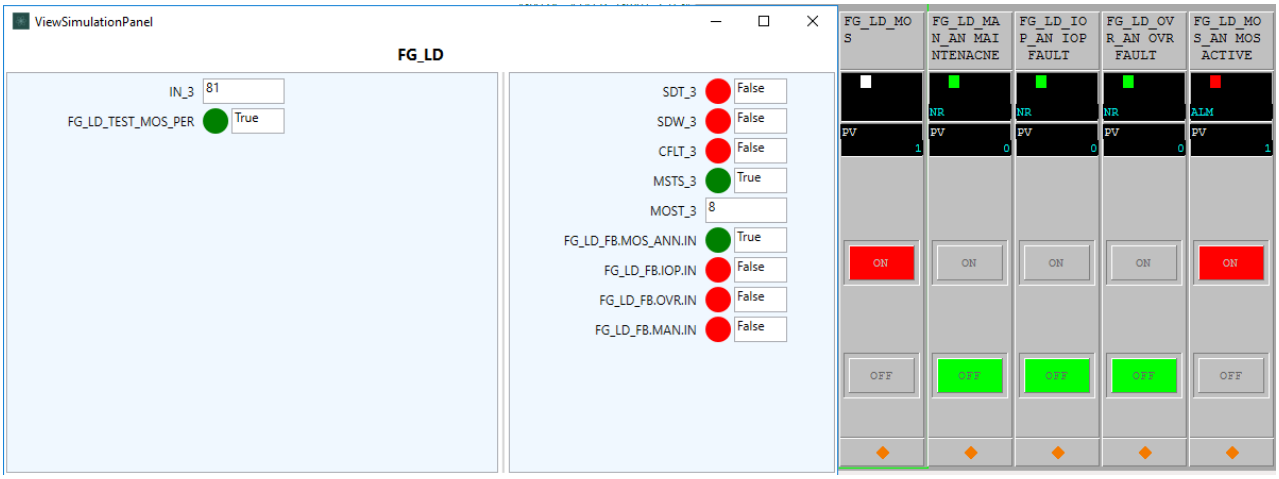
1.4 TEST RESULTS:



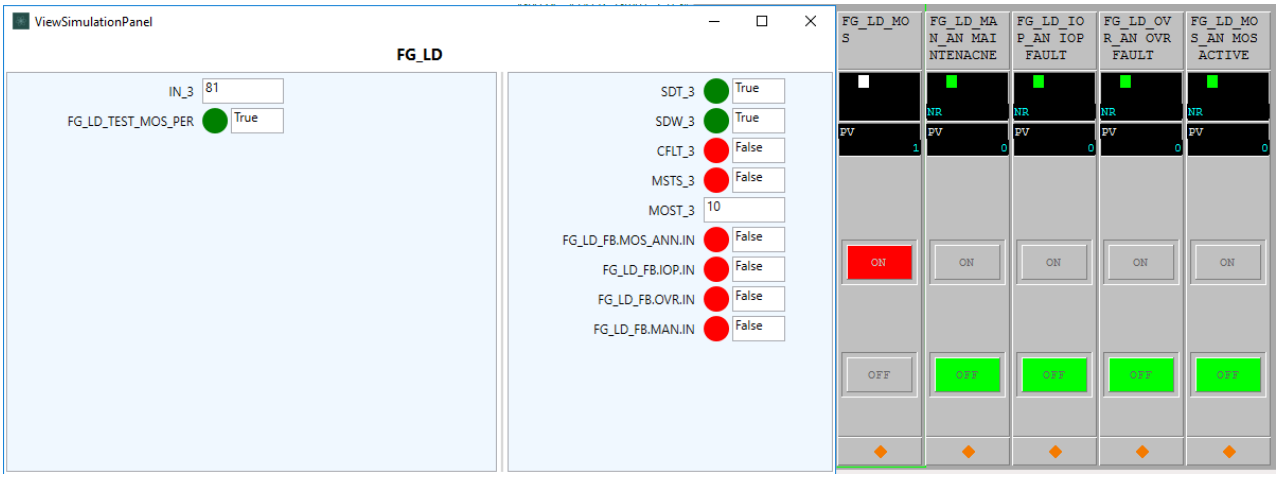
TC#1 : IN.Value = 50.0,MP = FALSE



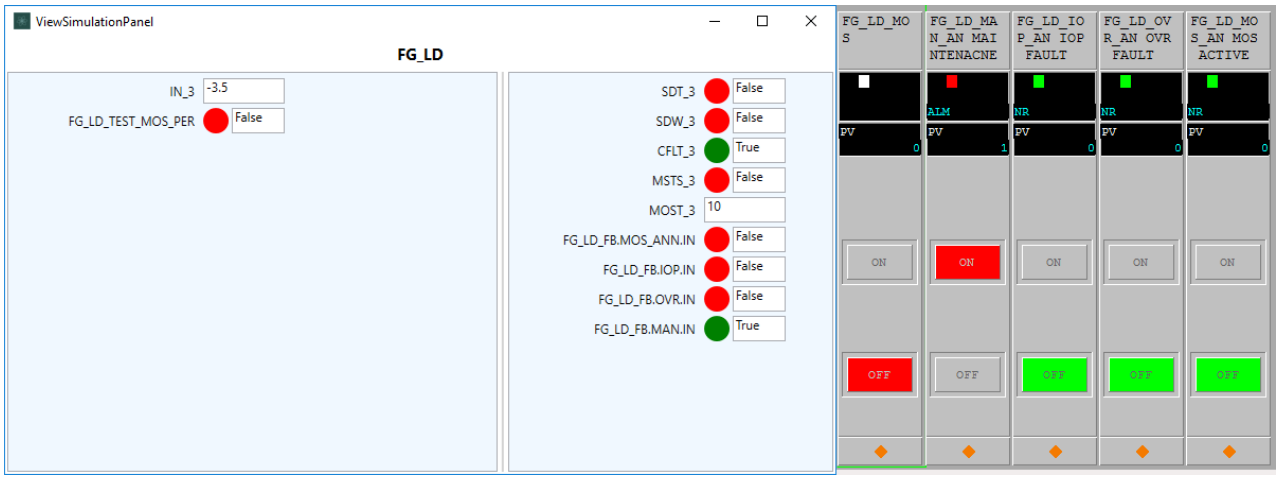
TC#2 : IN.Value = 81.0,MP = FALSE



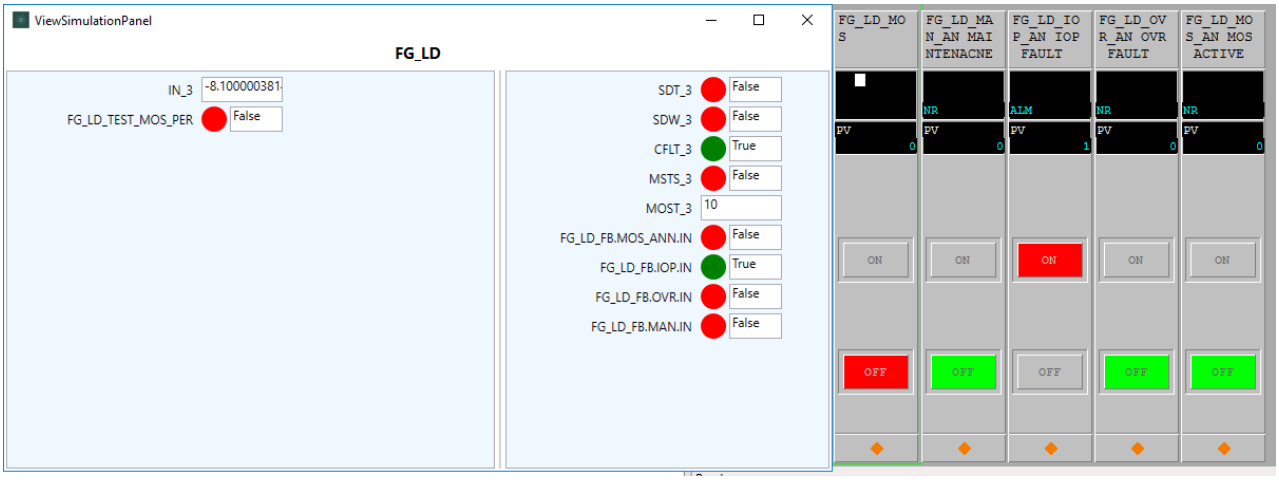
TC#3 : IN.Value = 81.0,MP = TRUE,MOS ENABLE = TRUE



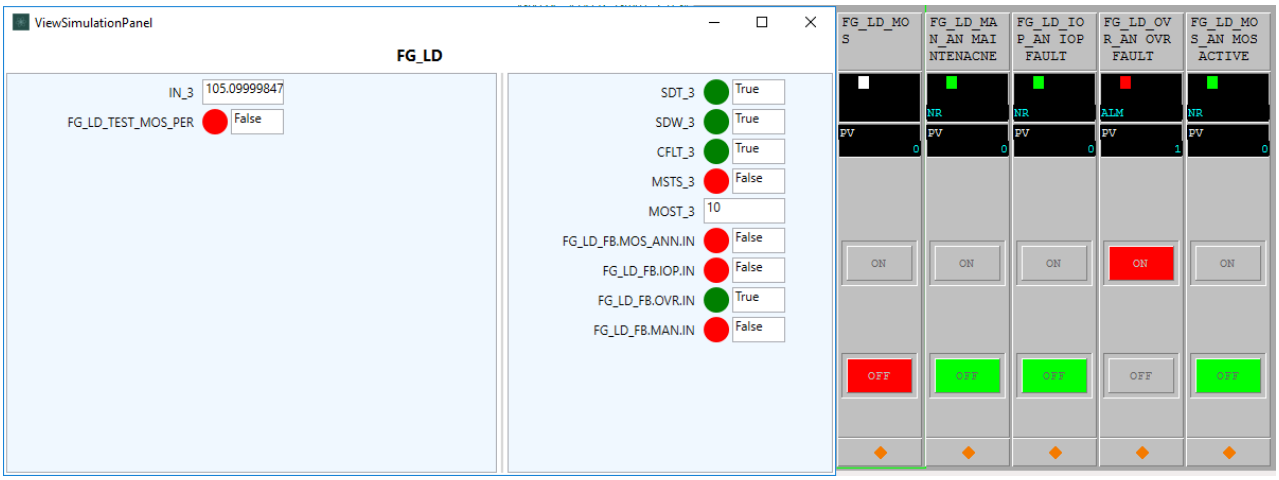
TC#4 : IN.Value = 81.0,MP = TRUE,MOS ENABLE = TRUE, MOS TIME ELAPSED



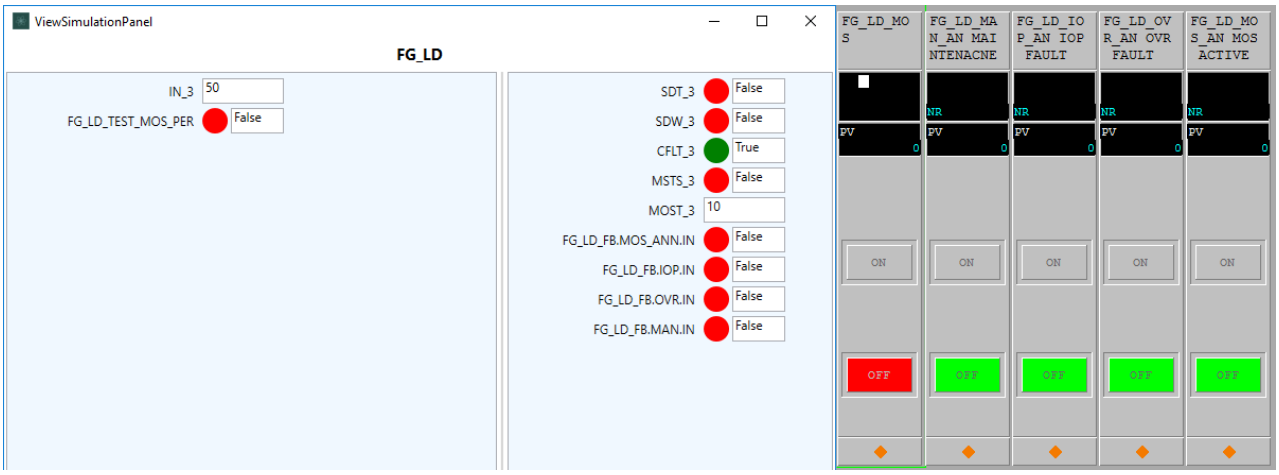
TC#5: IN.Value = -3.5,MP = FALSE



TC#6 : IN.Value = -8.1,MP = FALSE

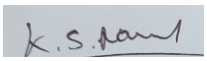


TC#7 : IN.Value = 105.1,MP = FALSE



TC#8 : IN.Value = 50.0,MP = FALSE, TRANSMITTER FAULT(STS) = TRUE

1.5 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	08-OCT-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

2 FG_GD

GAS Detector for Fire & Gas applications.

2.1 PURPOSE

This typical is used for H2 & O2 gas detectors.

Functionality:

- Process Point type gas detectors
- Manage the maintenance override function (MOS) for gas point detector
- Manage detector trip, diagnostic and I/O fault logics

Note: The MOS override function is included inside the function block
MOS function can be disabled by forcing the MOS enable key switch permanently to FALSE.

Gas Point type input processing block:

- Trip and general diagnostic setpoints are hardcoded outside the User Defined Function Block (UDFB).
- Scaling setpoints are inside UDFB.
- LLL and LTRP values are masked as these provide no function for flame detection.
- HHH and HTRP values is used warning and trip.
- All faults are considered critical and result in degraded voting logic.

2.2 LOGIC DIAGRAMS

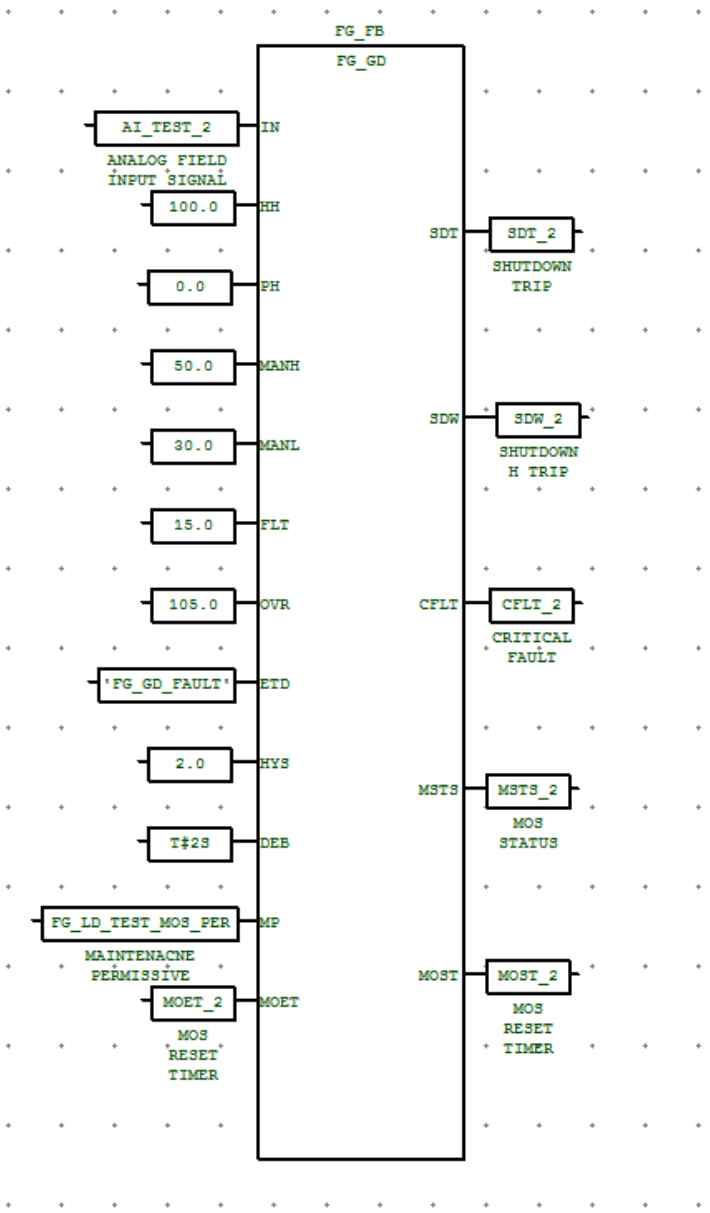


Fig 3 User Defined Function Block FG_GD

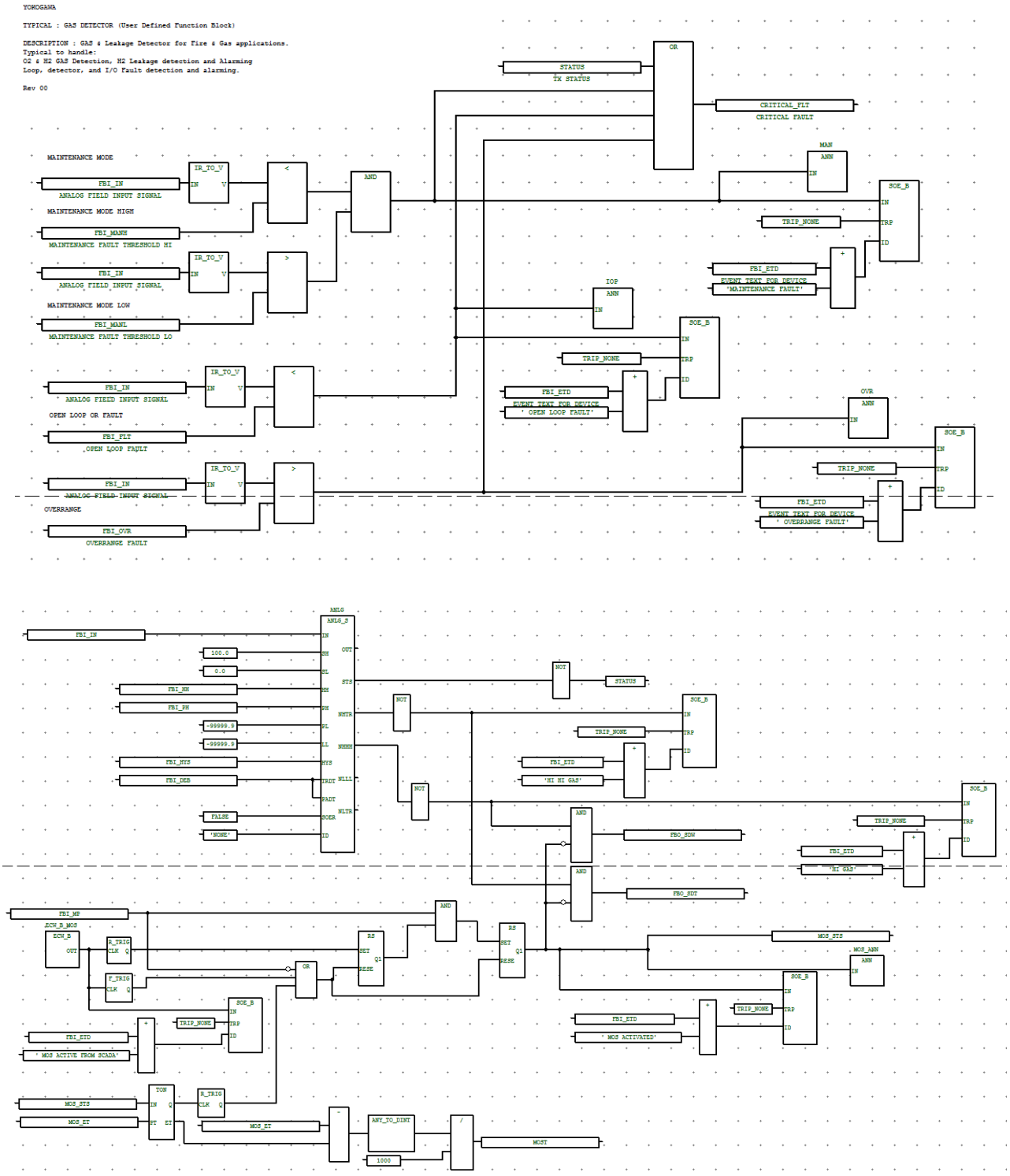


Fig 4 Logic Diagram for Typical FG_GD

2.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
IN	ANALOG FIELD INPUT SIGNAL	50.0
HH	HH SETPOINT	80.0
PH	PH SETPOINT	70.0
MANH	MAINTENANCE FAULT THRESHOLD HI	-3.4
MANL	MAINTENANCE FAULT THRESHOLD LO	-6.4
FLT	OPEN LOOP FAULT	-8.0
OVR	OVERRANGE FAULT	105.0
ETD	EVENT TEXT FOR DEVICE	XXXXXX
HYS	HYSTERESIS %	0.5
DEB	DEBOUNCE TIME	T#1S
MP	MAINTENACNE PERMISSIVE	FALSE
MOET	MOS RESET TIMER	T#10s

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
SDT	SHUTDOWN TRIP	FALSE
CFLT	CRITICAL FAULT	FALSE
MSTS	MOS STATUS	FALSE
MOST	MOS RESET TIMER	10s

2.4 TEST CASES VS EXPECTED RESULTS

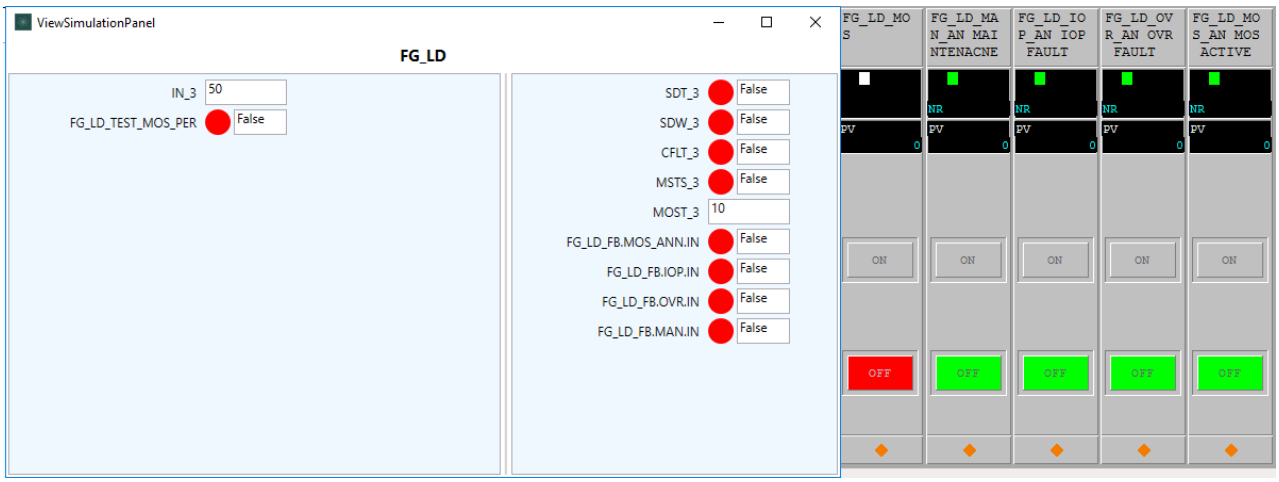
The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

Test Case Number	Test Cases	Input Parameter /Values	Expected Results		
			Shutdown Trip	Critical Fault	MOS Status
TC#1	IN.Value = 50.0, MP = FALSE	IN.Value = 50.0, MP = FALSE	FALSE	FALSE	FALSE
TC#2	IN.Value = 81.0, MP = FALSE,	IN.Value = 81.0, MP = FALSE,	TRUE	FALSE	FALSE
TC#3	IN.Value = 81.0, MP = TRUE, @ECW_B_GD = TRUE	IN.Value = 81.0, MP = TRUE, @ECW_B_GD = TRUE	FALSE	FALSE	TRUE
TC#4	IN.Value = 81.0, MP = TRUE, MOS ENABLE = TRUE MOS TIME ELAPSED	IN.Value = 81.0, MP = TRUE, MOS ENABLE = TRUE MOS TIME ELAPSED	TRUE	FALSE	FALSE
TC#5	IN.Value = -3.5, MP = FALSE,	IN.Value = 81.0, MP = FALSE,	FALSE	TRUE	FALSE
TC#6	IN.Value = -8.1, MP = FALSE,	IN.Value = 81.0, MP = FALSE,	FALSE	TRUE	FALSE
TC#7	IN.Value = 105.1, MP = FALSE,	IN.Value = 81.0, MP = FALSE,	TRUE	TRUE	FALSE
TC#8	IN.Value = 50.0, MP = FALSE, TRANSMITTER FAULT(STS)= TRUE	IN.Value = 81.0, MP = FALSE, TRANSMITTER FAULT(STS)= TRUE	FALSE	TRUE	FALSE

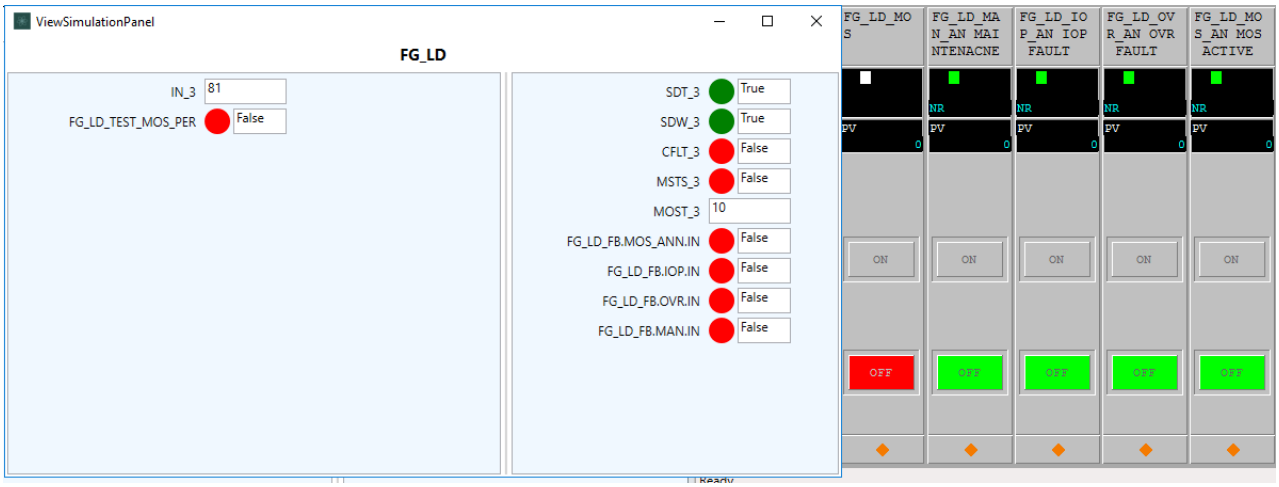
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- TRUE Indicates Alarm / Trip value changes from "False' to 'True'.

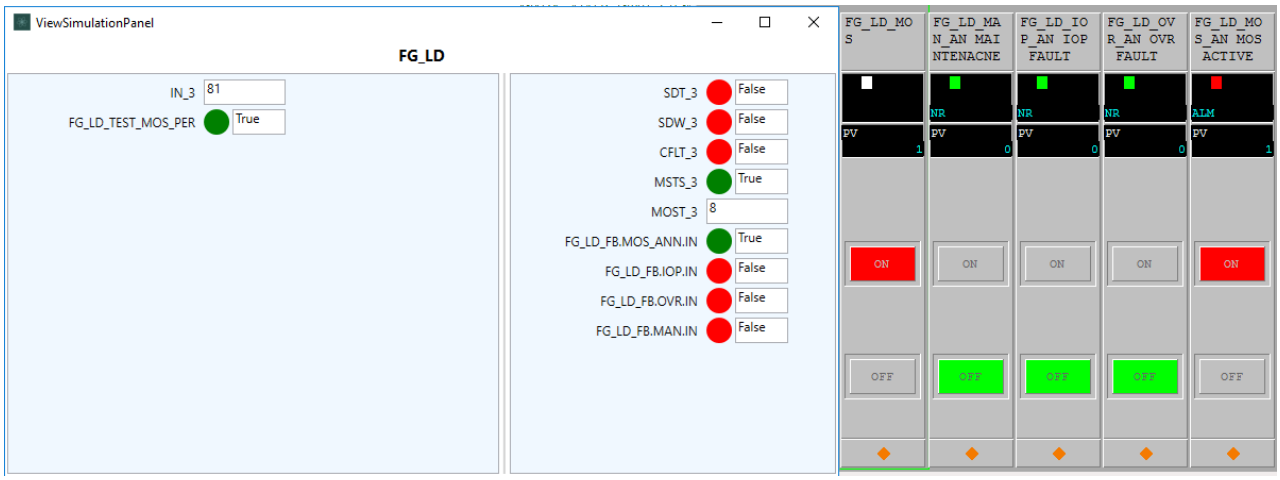
2.5 TEST RESULTS:



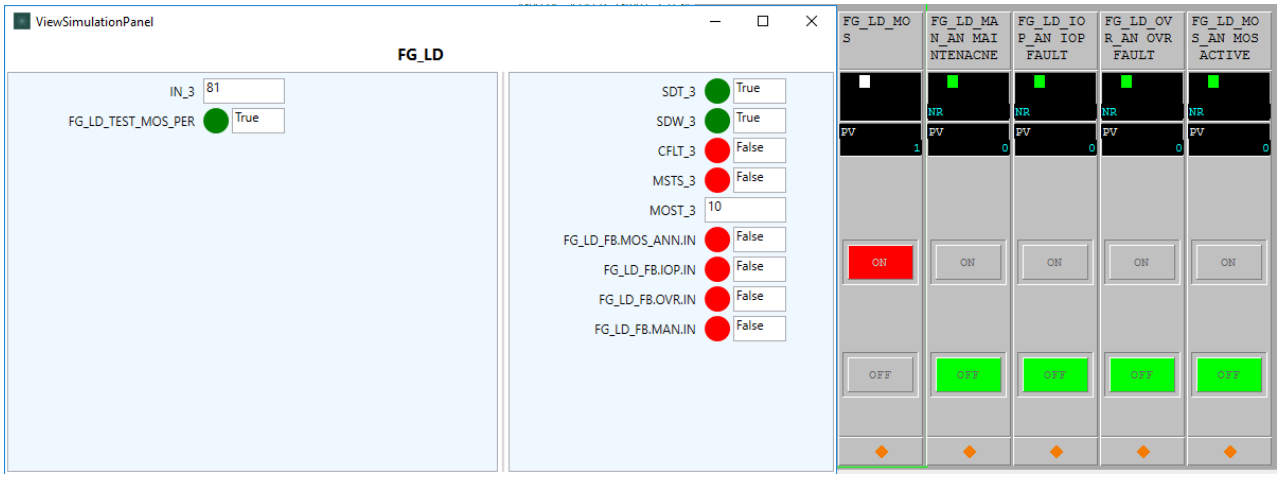
TC#1 : IN.Value = 50.0,MP = FALSE



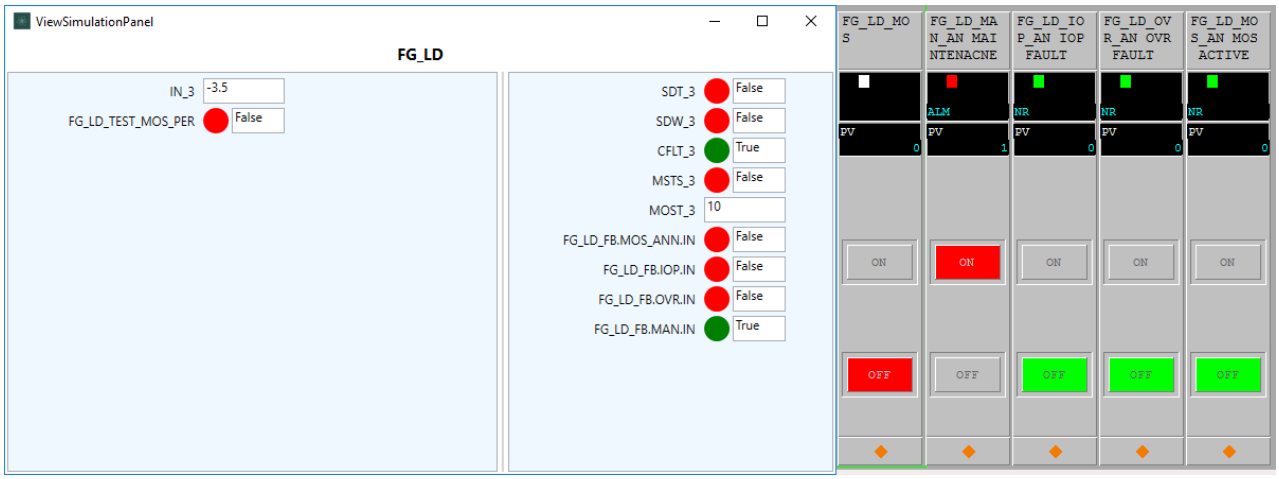
TC#2 : IN.Value = 81.0,MP = FALSE



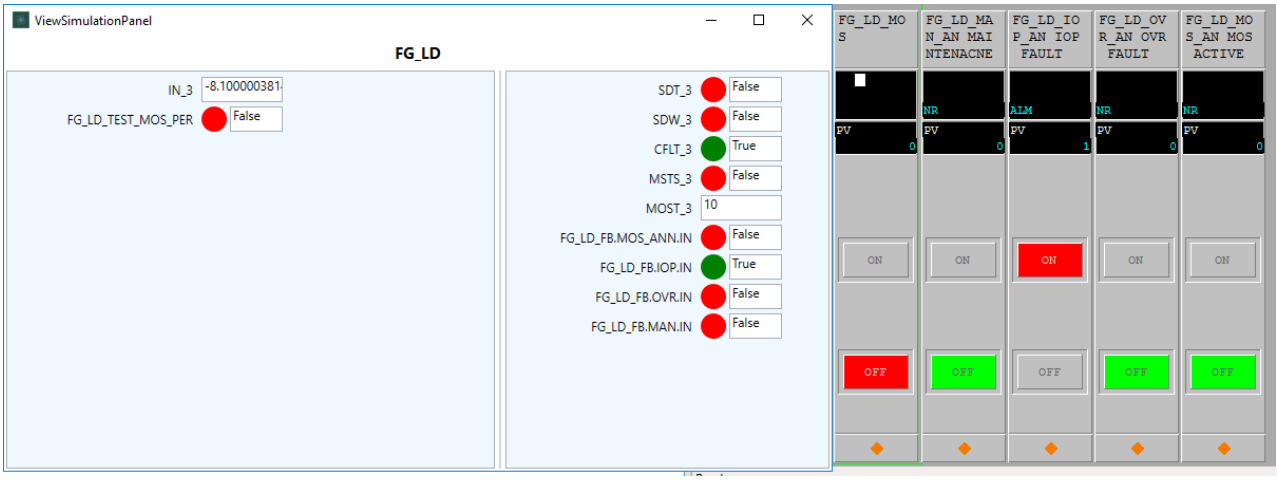
TC#3 : IN.Value = 81.0,MP = TRUE,MOS ENABLE = TRUE



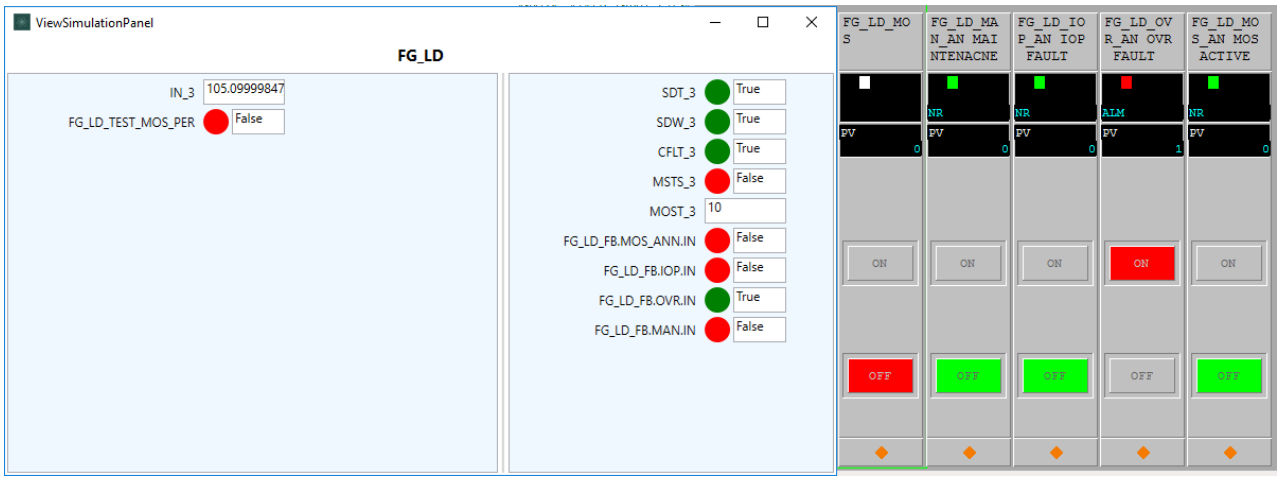
TC#4 : IN.Value = 81.0,MP = TRUE,MOS ENABLE = TRUE, MOS TIME ELAPSED



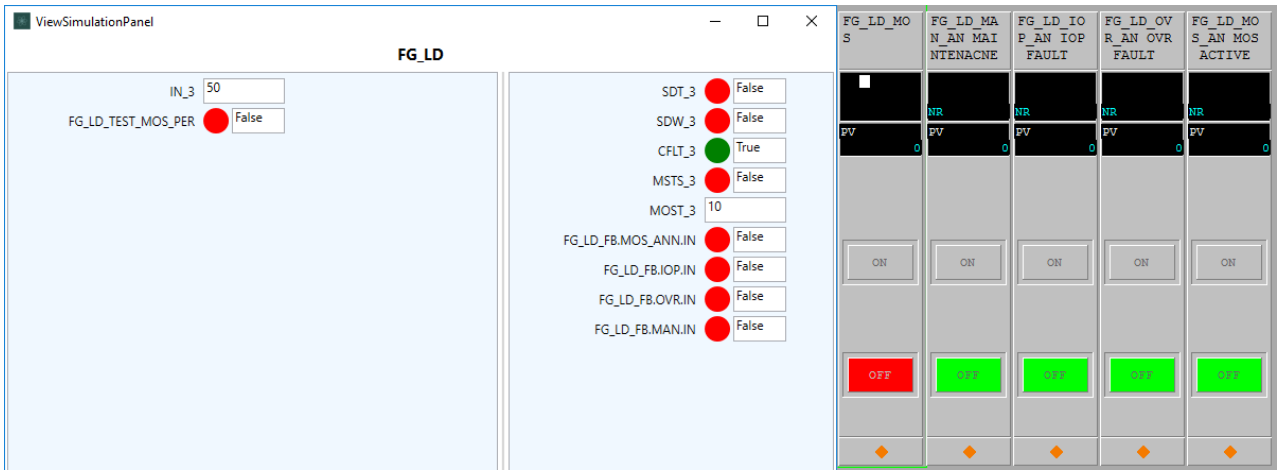
TC#5: IN.Value = -3.5,MP = FALSE



TC#6 : IN.Value = -8.1,MP = FALSE

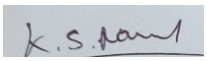


TC#7 : IN.Value = 105.1,MP = FALSE



TC#8 : IN.Value = 50.0,MP = FALSE, TRANSMITTER FAULT(STS) = TRUE

2.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	05-AUG-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

3 FG_SD

Smoke Detector for Fire and Gas Applications.

3.1 PURPOSE

This typical is used for Smoke detectors.

Functionality:

- Process smoke detectors
- Manage the maintenance override function (MOS) for gas point detector
- Manage detector trip, diagnostic and I/O fault logics

Note: The MOS override function is included inside the function block
MOS function can be disabled by forcing the MOS enable key switch permanently to FALSE.

Smoke Detector input processing block:

- Trip and general diagnostic setpoints are hardcoded outside the User Defined Function Block (UDFB).
- Scaling setpoints are inside UDFB.
- LLLL and LTRP values are masked as these provide no function for flame detection.
- HTRP values is used to trip.
- All faults are considered critical and result in degraded voting logic.

3.2 LOGIC DIAGRAMS

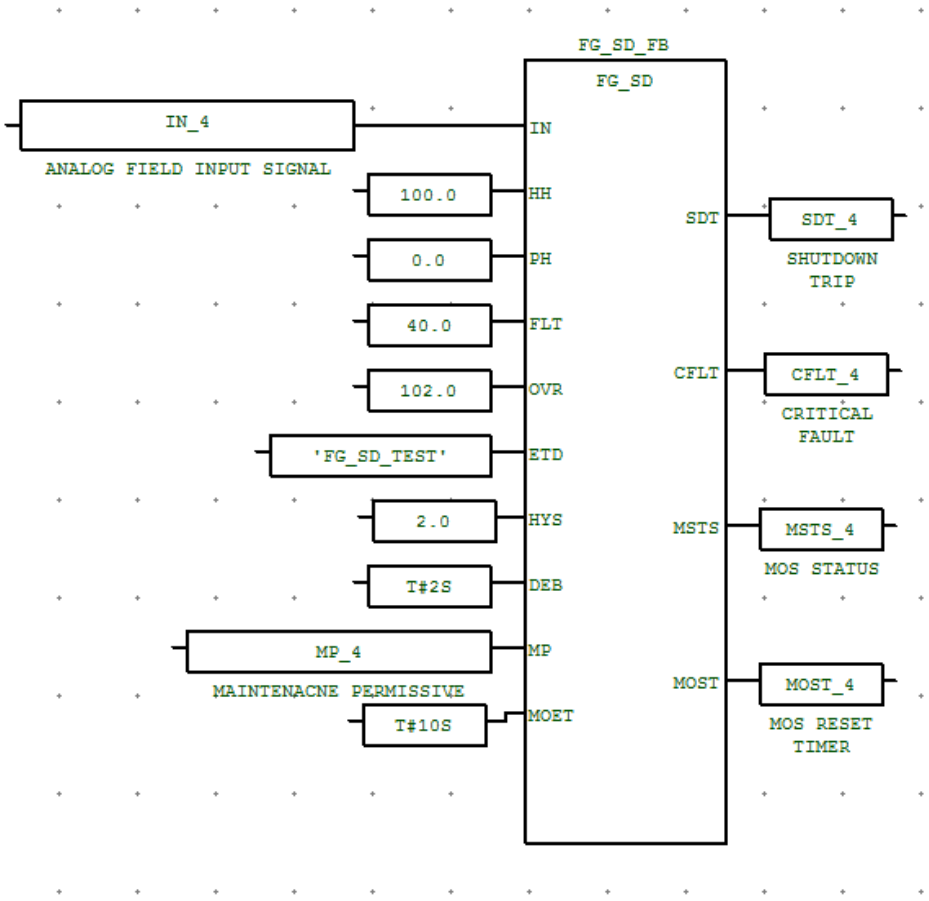


Fig 5 User Defined Function Block FG_SD

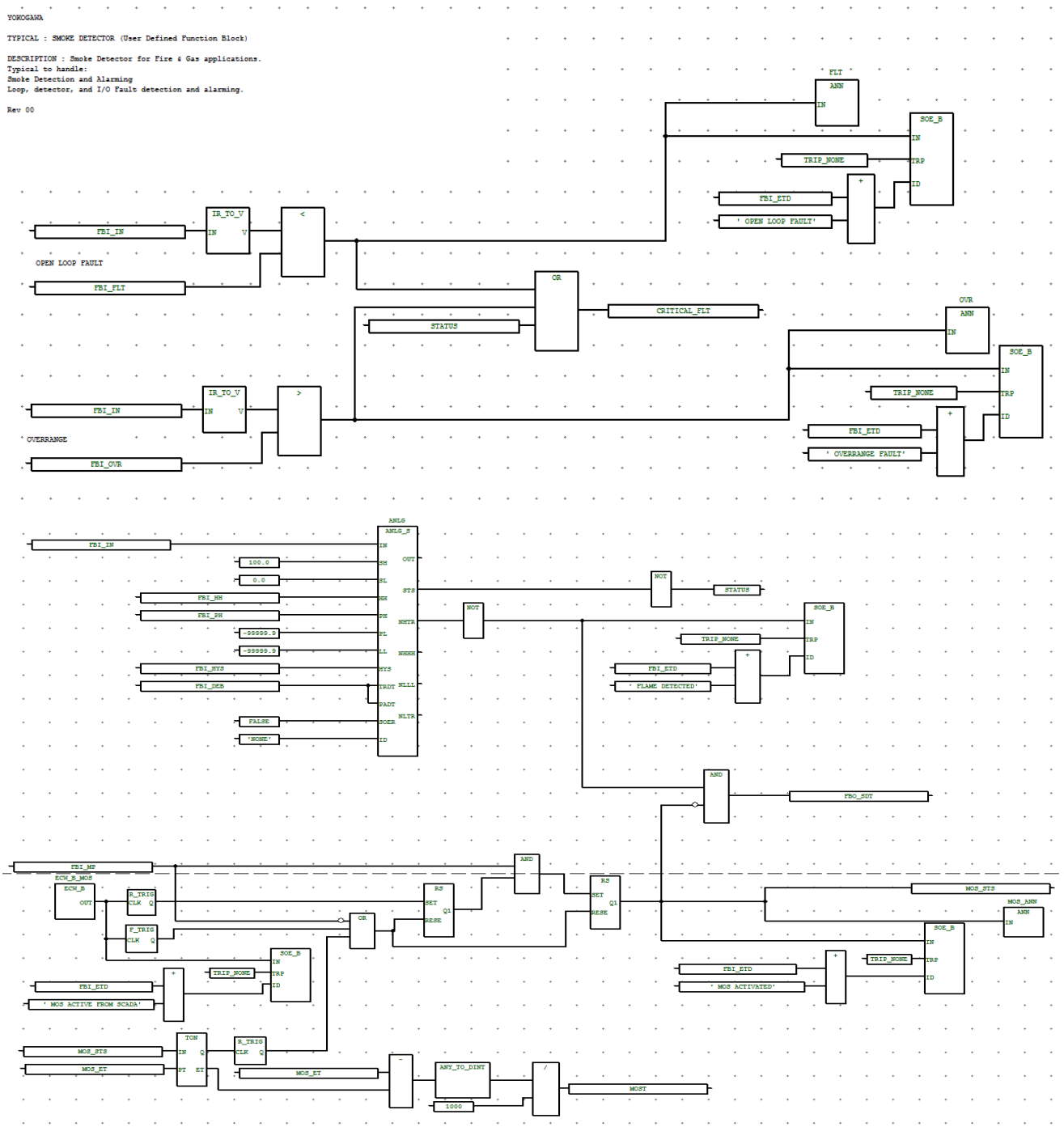


Fig 6 Logic Diagram for Typical FG_SD

3.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
IN	ANALOG FIELD INPUT SIGNAL	50.0
HH	HH SETPOINT	80.0
PH	PH SETPOINT	70.0
FLT	OPEN LOOP FAULT	-8.0
OVR	OVERRANGE FAULT	105.0
ETD	EVENT TEXT FOR DEVICE	XXXXXX
HYS	HYSTERESIS %	0.5
DEB	DEBOUNCE TIME	T#1S
MP	MAINTENACNE PERMISSIVE	FALSE
MOET	MOS RESET TIMER	T#10s

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
SDT	SHUTDOWN TRIP	FALSE
CFLT	CRITICAL FAULT	FALSE
MSTS	MOS STATUS	FALSE
MOST	MOS RESET TIMER	10s

3.4 TEST CASES VS EXPECTED RESULTS

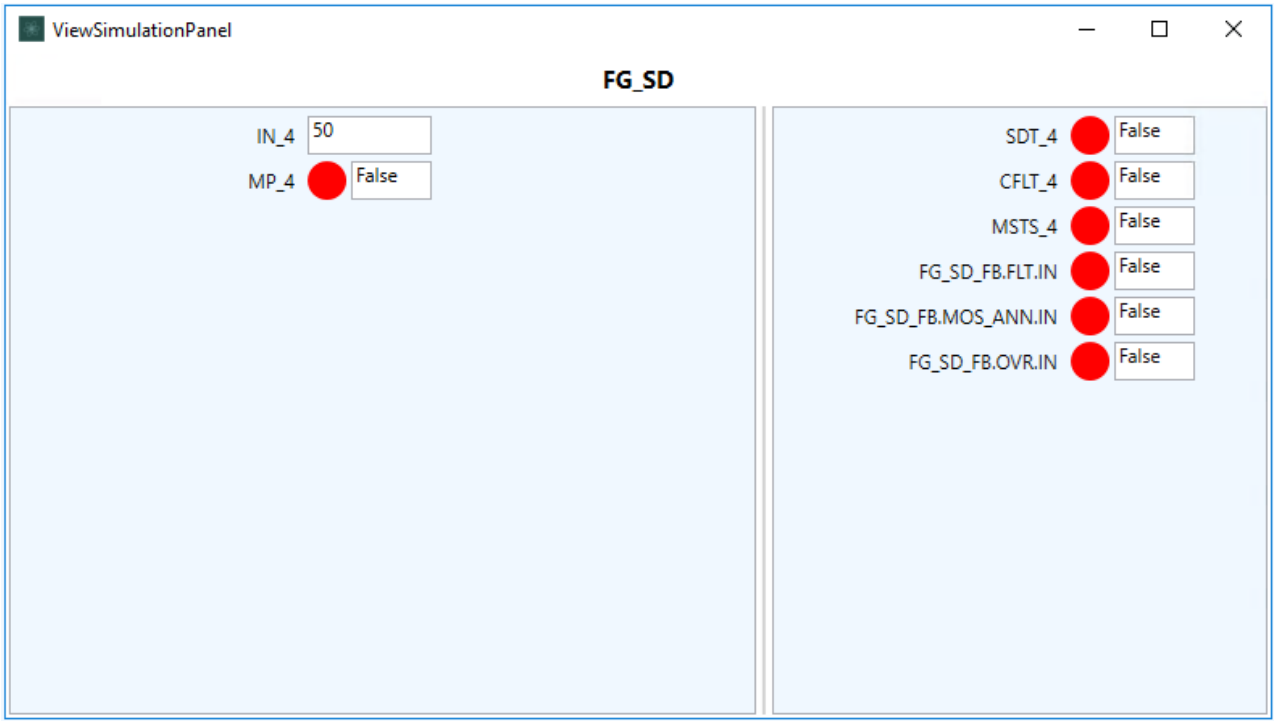
The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

Test Case Number	Test Cases	Input Parameter /Values	Expected Results		
			Shutdown Trip	Critical Fault	MOS Status
TC#1	IN.Value = 50.0, MP = FALSE	IN.Value = 50.0, MP = FALSE	FALSE	FALSE	FALSE
TC#2	IN.Value = 81.0, MP = FALSE,	IN.Value = 81.0, MP = FALSE,	TRUE	FALSE	FALSE
TC#3	IN.Value = 81.0, MP = TRUE, @ECW_B_GD = TRUE	IN.Value = 81.0, MP = TRUE, @ECW_B_GD = TRUE	FALSE	FALSE	TRUE
TC#4	IN.Value = 81.0, MP = TRUE, MOS ENABLE = TRUE MOS TIME ELAPSED	IN.Value = 81.0, MP = TRUE, MOS ENABLE = TRUE MOS TIME ELAPSED	TRUE	FALSE	FALSE
TC#5	IN.Value = -3.5, MP = FALSE,	IN.Value = -3.5, MP = FALSE,	FALSE	TRUE	FALSE
TC#6	IN.Value = 105.1, MP = FALSE,	IN.Value = 105.1, MP = FALSE,	TRUE	TRUE	FALSE
TC#7	IN.Value = 50.0, MP = FALSE, TRANSMITTER FAULT(STS)= TRUE	IN.Value = 50.0, MP = FALSE, TRANSMITTER FAULT(STS)= TRUE	FALSE	TRUE	FALSE

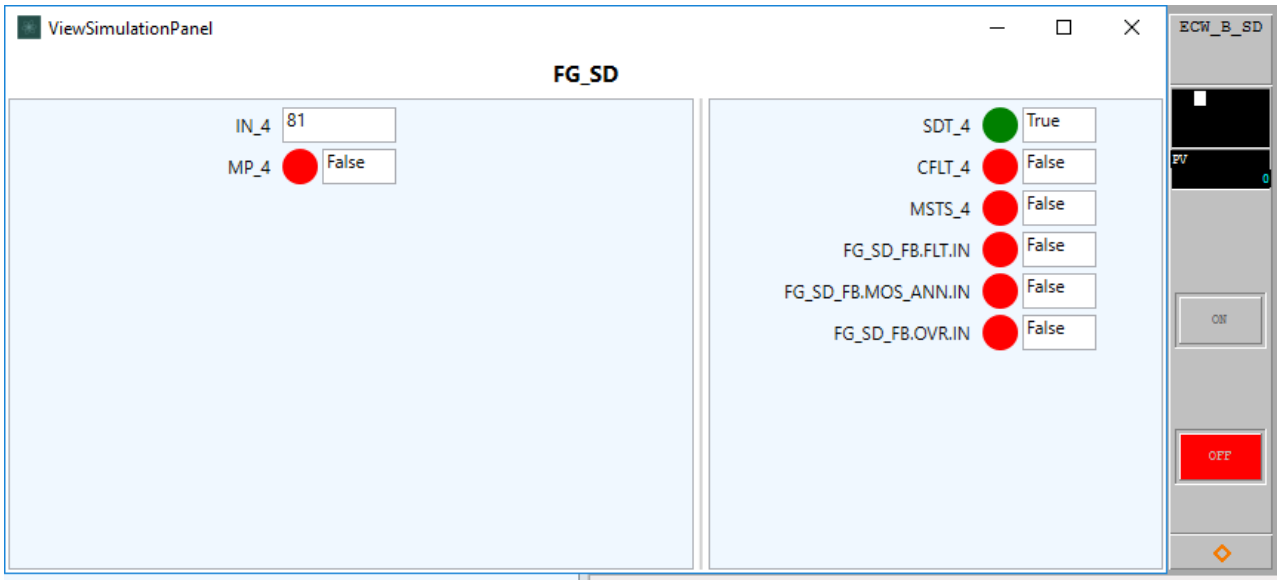
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- TRUE Indicates Alarm / Trip value changes from "False' to 'True'.

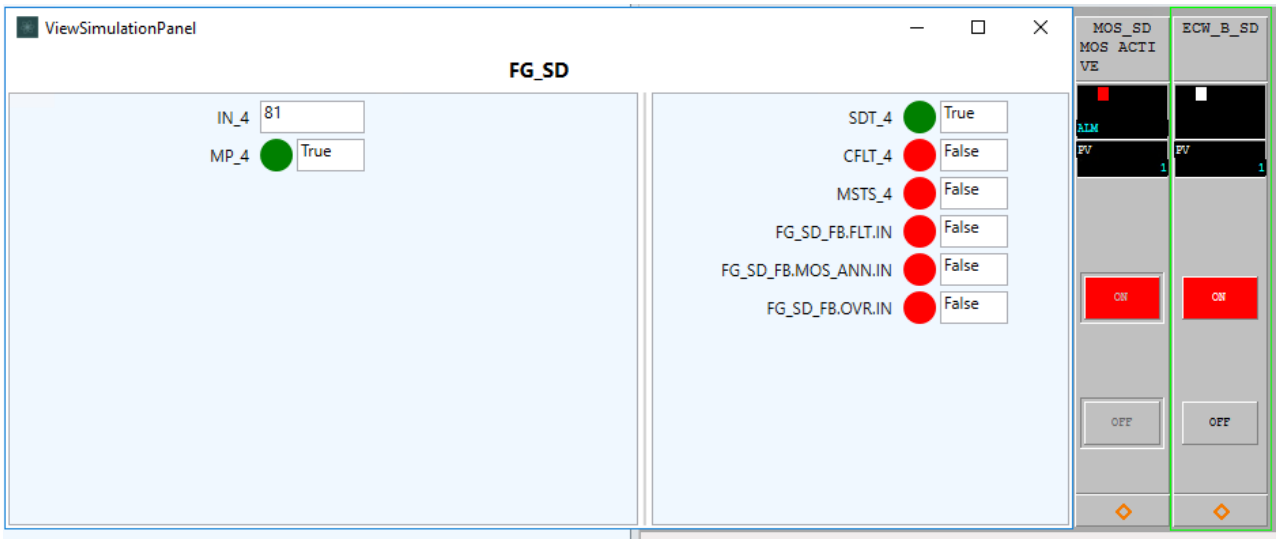
3.5 TEST RESULTS:



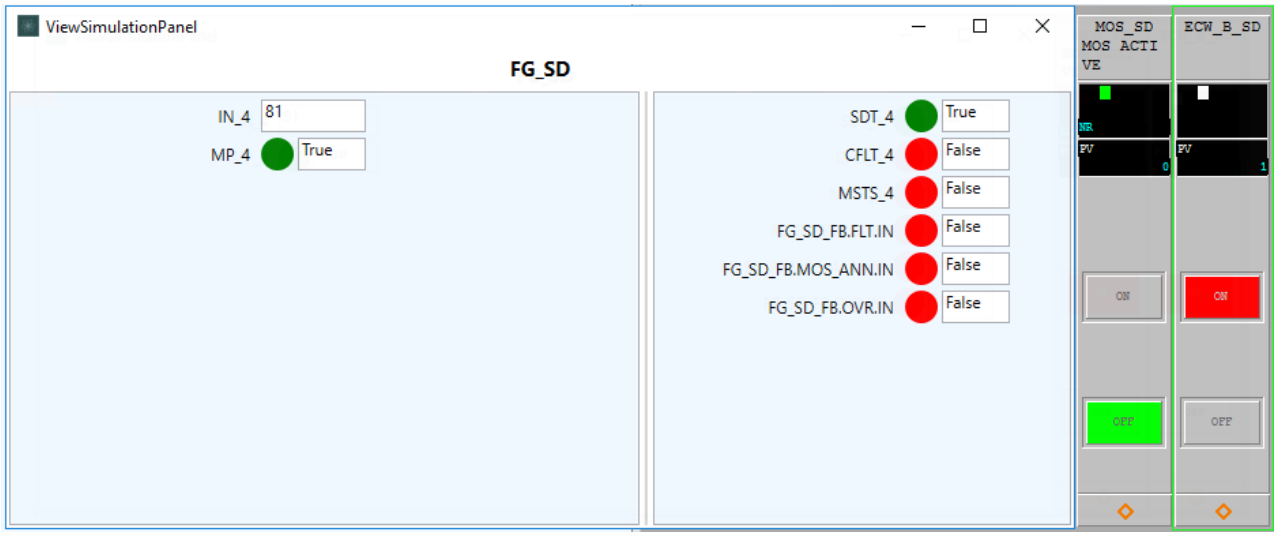
TC#1 : IN.Value = 50.0,MP = FALSE



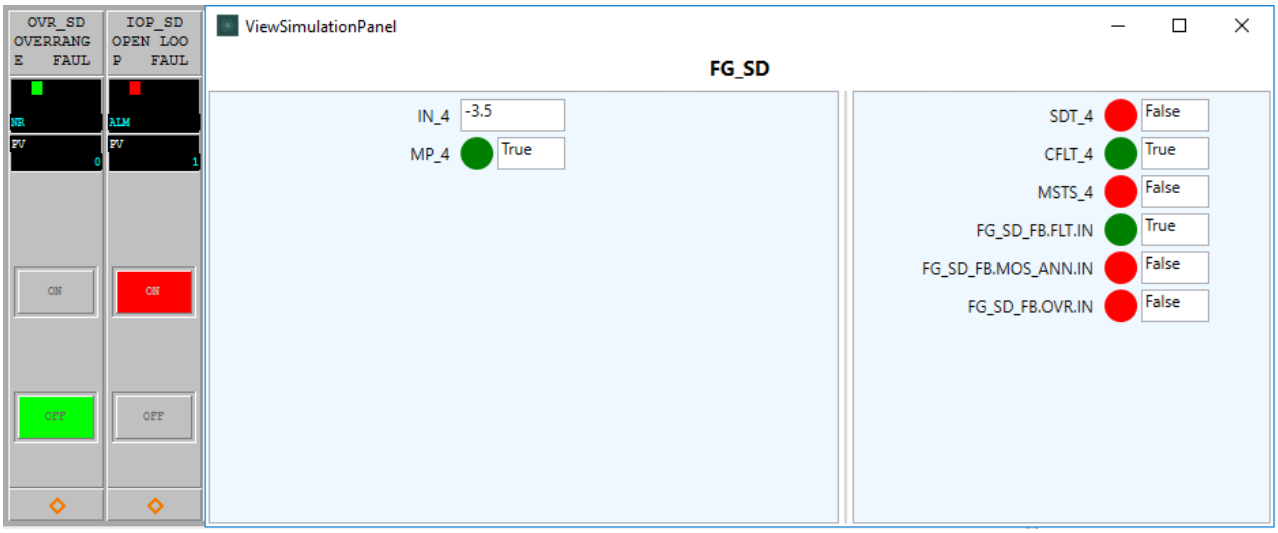
TC#2 : IN.Value = 81.0,MP = FALSE



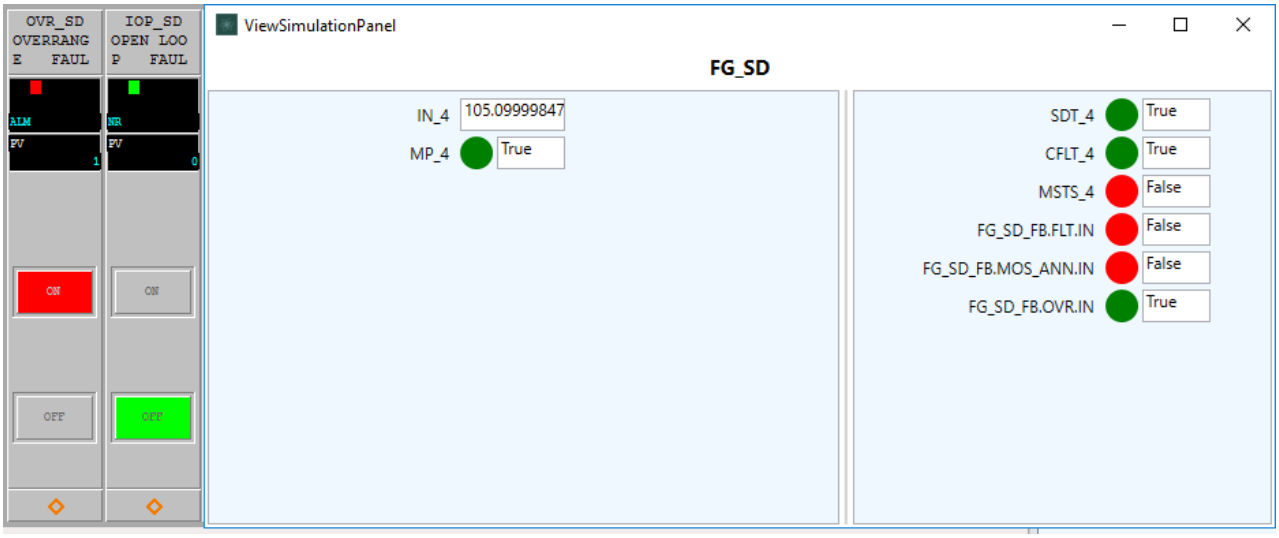
TC#3 : IN.Value = 81.0,MP = TRUE,MOS ENABLE = TRUE



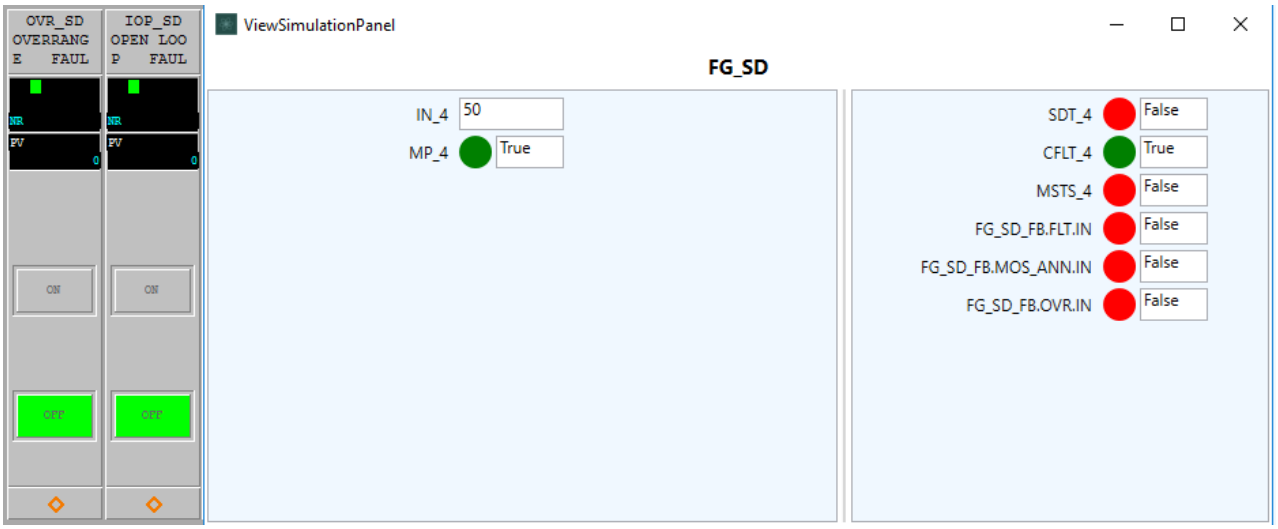
TC#4 : IN.Value = 81.0,MP = TRUE,MOS ENABLE = TRUE, MOS TIME ELAPSED



TC#5: IN.Value = -3.5,MP = FALSE

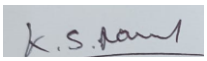


TC#6 : IN.Value = 105.1,MP = FALSE



TC#7 : IN.Value = 50.0,MP = FALSE, TRANSMITTER FAULT(STS) = TRUE

3.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	05-AUG-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

4 FG_FLAME_IR

UV IR Flame Detector for Fire & Gas applications.

4.1 PURPOSE

This typical is used for Ultrasonic Flame detector

Functionality:

- Process Flame Ultrasonic type Flame analog gas detectors
- Manage the maintenance override function (MOS) for each FLAME IR detector
- Manage detector trip, diagnostic and I/O fault logics

Note: The MOS override function is included inside the function block.
MOS function can be disabled by forcing the MOS enable key switch permanently to FALSE.

Flame_IR input processing block:

- Trip and general diagnostic setpoints are hardcoded outside the User Defined Function Block (UDFB).
- Scaling setpoints are inside UDFB.
- LLL and LTRP values are masked as these provide no function for flame detection.
- HHH value & HTRP values is used for warning and trip.
- All faults are considered critical and result in degraded voting logic.

4.2 LOGIC DIAGRAMS

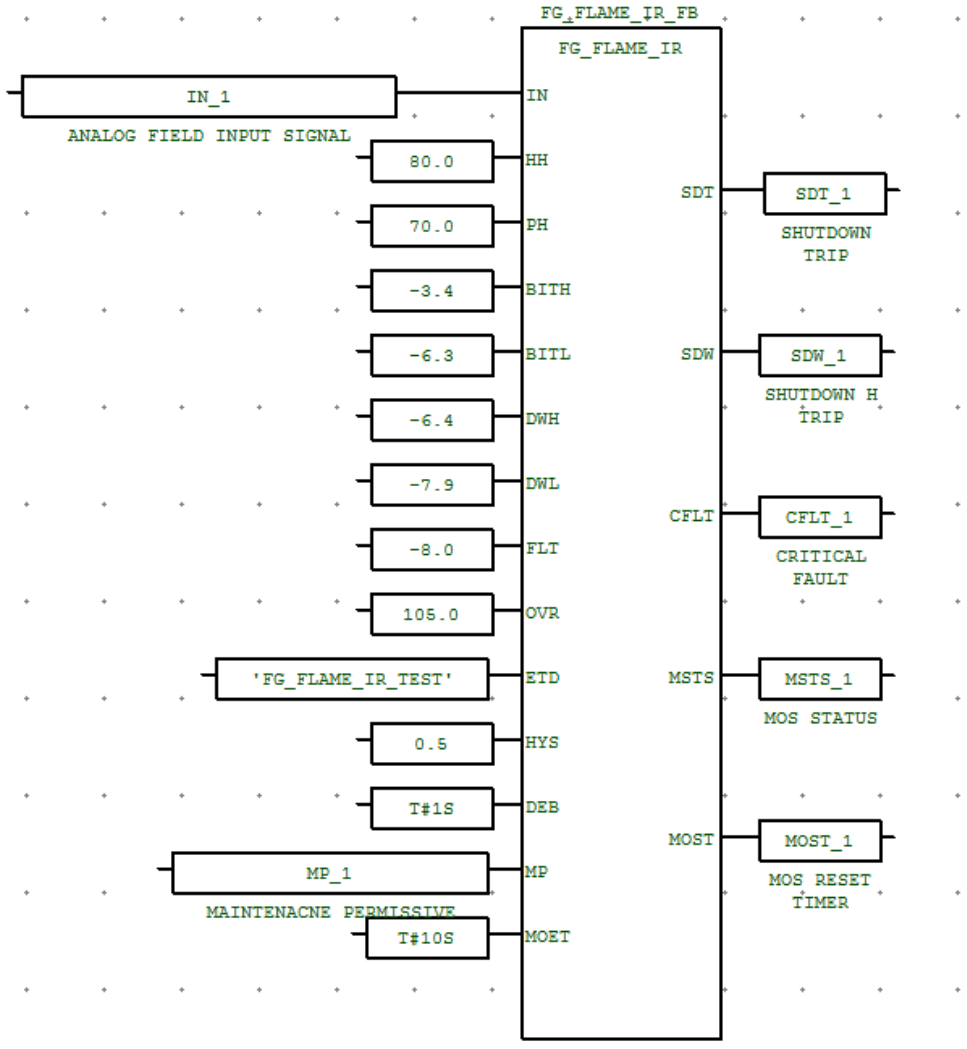


Fig 7 User Defined Function Block FG_FLAME_IR

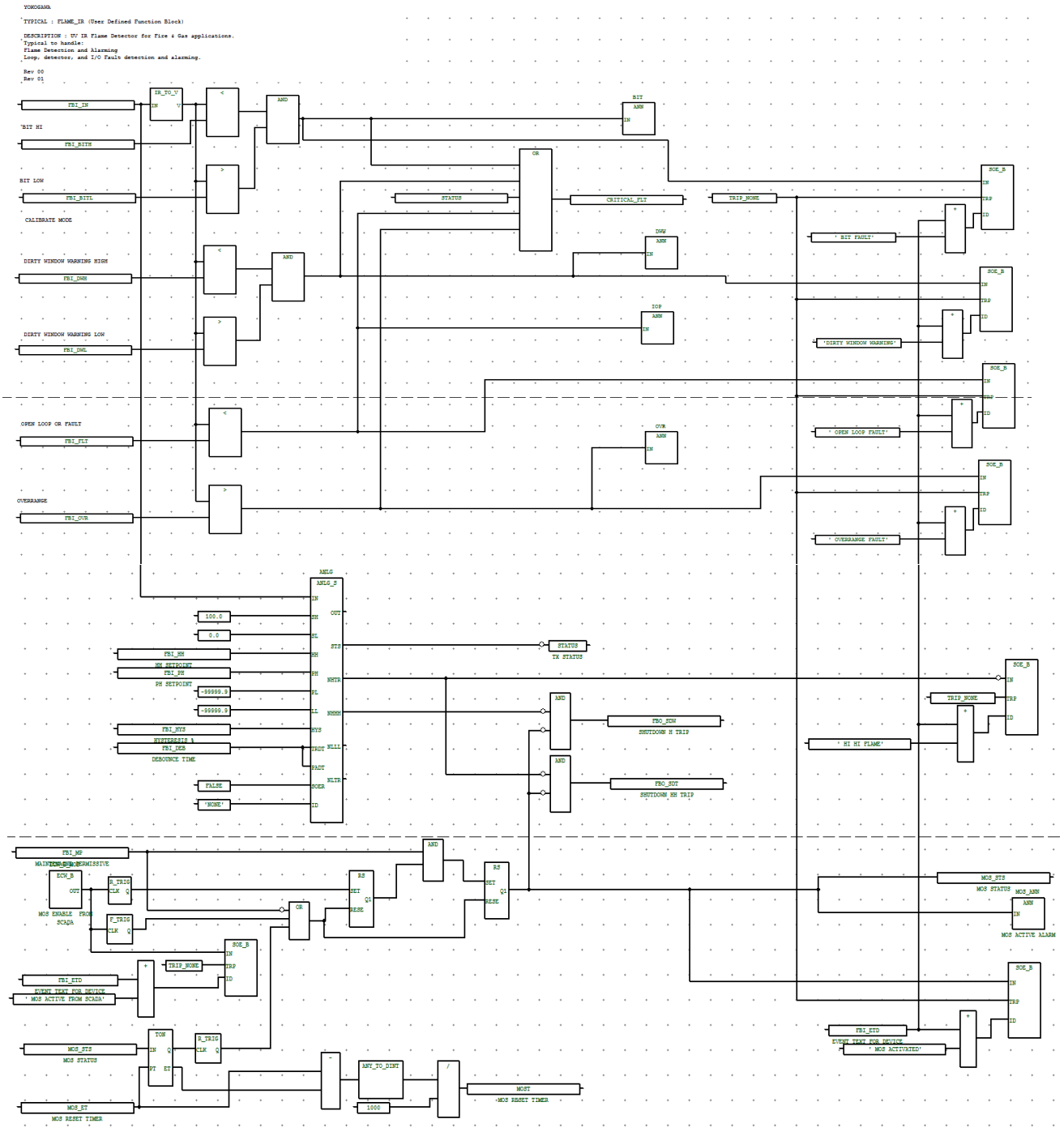


Fig 8 Logic Diagram for Typical FG_FLAME_IR

4.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
IN	ANALOG FIELD INPUT SIGNAL	50.0
HH	HH SETPOINT	80.0
PH	PH SETPOINT	70.0
BITH	BIT FAULT THRESHOLD HI	-3.4
BITL	BIT FAULT THRESHOLD LO	-6.3
DWH	DIRTY WINDOW THRESHOLD HI	-6.4
DWL	DIRTY WINDOW THRESHOLD LO	-7.9
FLT	OPEN LOOP FAULT	-8.0
OVR	OVERRANGE FAULT	105.0
ETD	EVENT TEXT FOR DEVICE	XXXXXX
HYS	HYSTERESIS %	0.5
DEB	DEBOUNCE TIME	T#1S
MP	MAINTENACNE PERMISSIVE	FALSE
MOET	MOS RESET TIMER	T#10s

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
SDT	SHUTDOWN TRIP 2	FALSE
CFLT	CRITICAL FAULT	FALSE
MSTS	MOS STATUS	FALSE
SDW	SHUTDOWN TRIP 1	FALSE
MOST	MOS RESET TIMER	10s

4.4 TEST CASES VS EXPECTED RESULTS

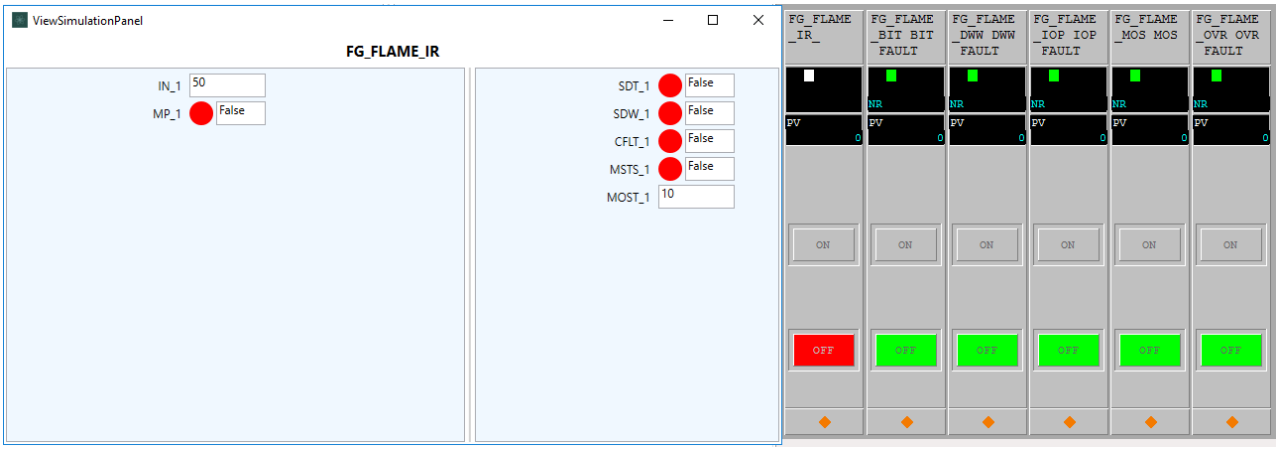
The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

Test Case Number	Test Cases	Input Parameter /Values	Expected Results			
			Shutdown Trip 1	Shutdown H Trip	Critical Fault	MOS Status
TC#1	IN.Value = 50.0, MP = FALSE	IN.Value = 50.0, MP = FALSE	FALSE	FALSE	FALSE	FALSE
TC#2	IN.Value = 81.0, MP = FALSE,	IN.Value = 81.0, MP = FALSE,	TRUE	TRUE	FALSE	FALSE
TC#3	IN.Value = 81.0 or 71.0 MP = TRUE, @ECW_B_GD = TRUE	IN.Value = 81.0 or 71.0 MP = TRUE, @ECW_B_GD = TRUE	FALSE	FALSE	FALSE	TRUE
TC#4	IN.Value = 81.0, MP = TRUE, MOS ENABLE = TRUE MOS TIME ELAPSED	IN.Value = 81.0, MP = TRUE, MOS ENABLE = TRUE MOS TIME ELAPSED	TRUE	TRUE	FALSE	FALSE
TC#5	IN.Value = -3.5, MP = FALSE,	IN.Value = -3.5, MP = FALSE,	FALSE	FALSE	TRUE	FALSE
TC#6	IN.Value = -6.5, MP = FALSE,	IN.Value = -6.5, MP = FALSE,	FALSE	FALSE	TRUE	FALSE
TC#7	IN.Value = -8.1, MP = FALSE,	IN.Value = -8.1, MP = FALSE,	FALSE	FALSE	TRUE	FALSE
TC#8	IN.Value = 105.1, MP = FALSE,	IN.Value = 105.1, MP = FALSE,	TRUE	TRUE	TRUE	FALSE
TC#9	IN.Value = 50.0, MP = FALSE, TRANSMITTER FAULT(STS)= TRUE	IN.Value = 50.0, MP = FALSE, TRANSMITTER FAULT(STS)= TRUE	FALSE	FALSE	TRUE	FALSE

Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- TRUE Indicates Alarm / Trip value changes from “False’ to ‘True’.

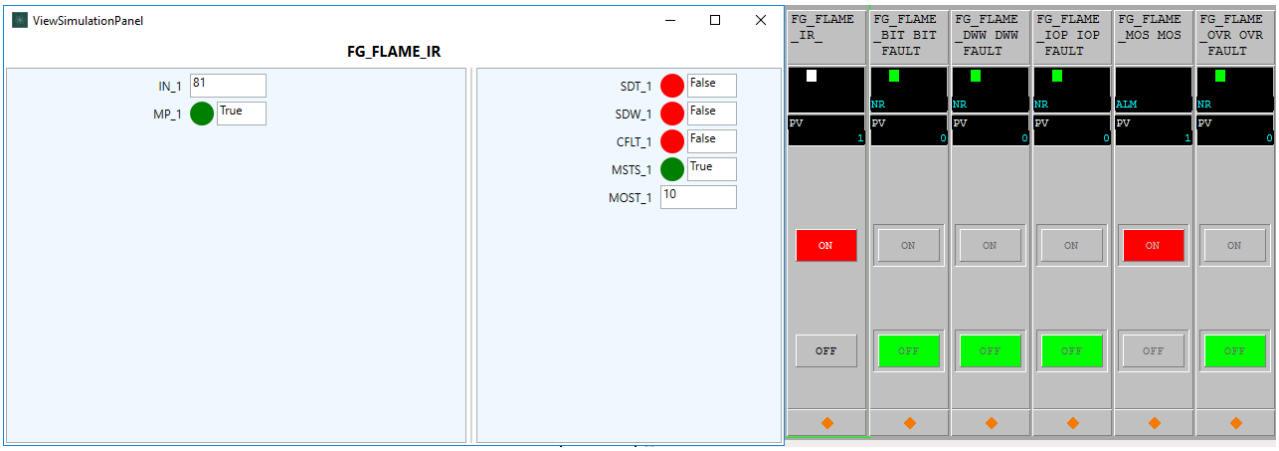
4.5 TEST RESULTS:



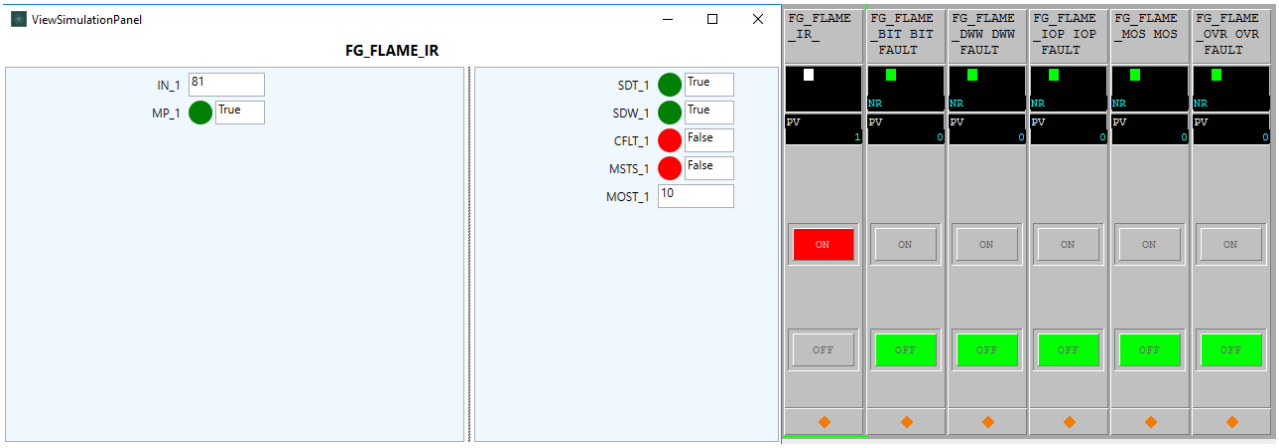
TC#1 : IN.Value = 50.0,MP = FALSE



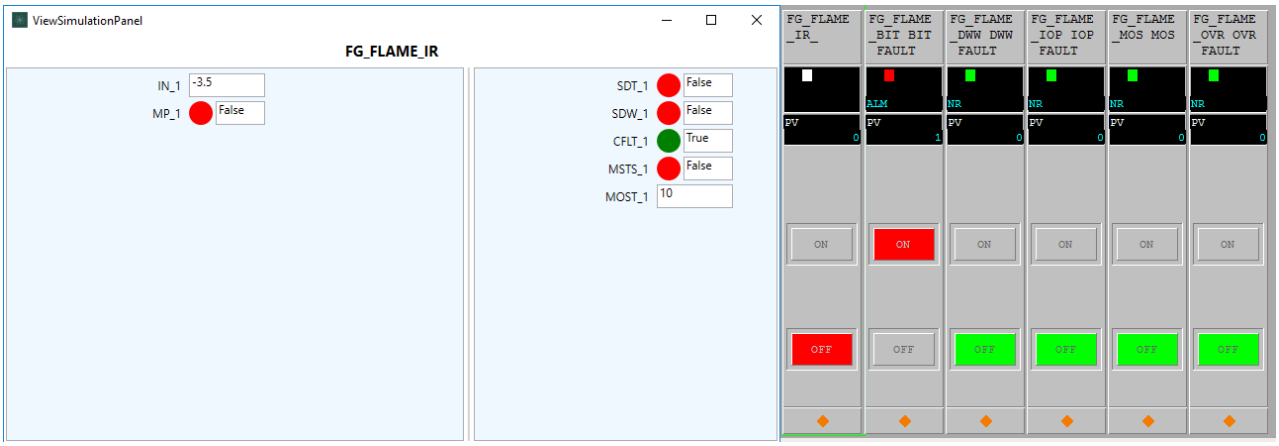
TC#2 : IN.Value = 81.0,MP = FALSE



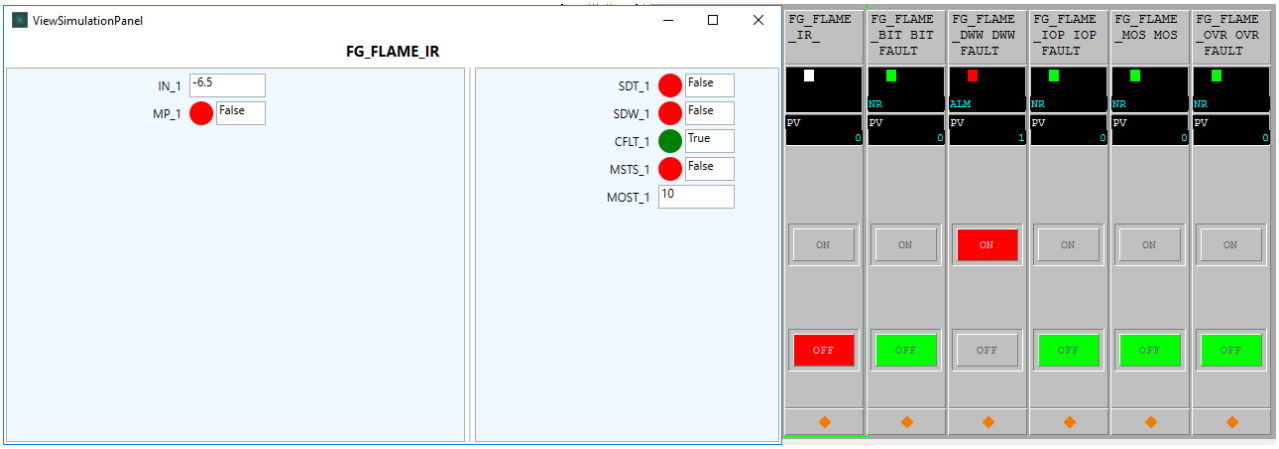
TC#3 : IN.Value = 81.0,MP = TRUE,MOS ENABLE = TRUE



TC#4 : IN.Value = 81.0,MP = TRUE,MOS ENABLE = TRUE, MOS TIME ELAPSED



TC#5: IN.Value = -3.5,MP = FALSE



TC#6 : IN.Value = -6.5,MP = FALSE



TC#7 : IN.Value = -8.1,MP = FALSE

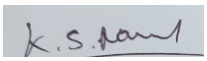


TC#8 : IN.Value = 105.1,MP = FALSE



TC#9 : IN.Value = 50 ,MP = FALSE, TRANSMITTER FAULT(STS)= TRUE

4.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	08-OCT-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

5 FG_MAN_REL_NC

This typical is used for discrete inputs that are de-energized to trip.

5.1 PURPOSE

This typical is used for discrete inputs that are de-energized to trip such as Heat, Smoke detectors, ESD or Blowdown switches.

Functionality:

- Process Normally Closed digital input
- Manage the maintenance override function (MOS) for each MAN_REL_NC input
- Manage input trip, diagnostic and I/O fault logics
- Manage input trip alarm reset logics
- Optional line monitoring and fault detection
- All diagnostic and I/O alarms will trigger individual Annunciator alarms.

Note: The MOS override function is included inside the function block

MOS function can be disabled by forcing the MOS enable key switch permanently to FALSE.

5.2 LOGIC DIAGRAMS

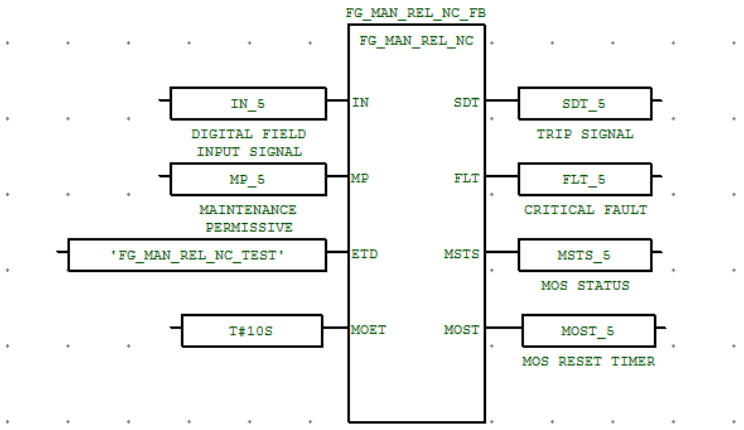


Fig 9 User Defined Function Block FG_MAN_REL_NC

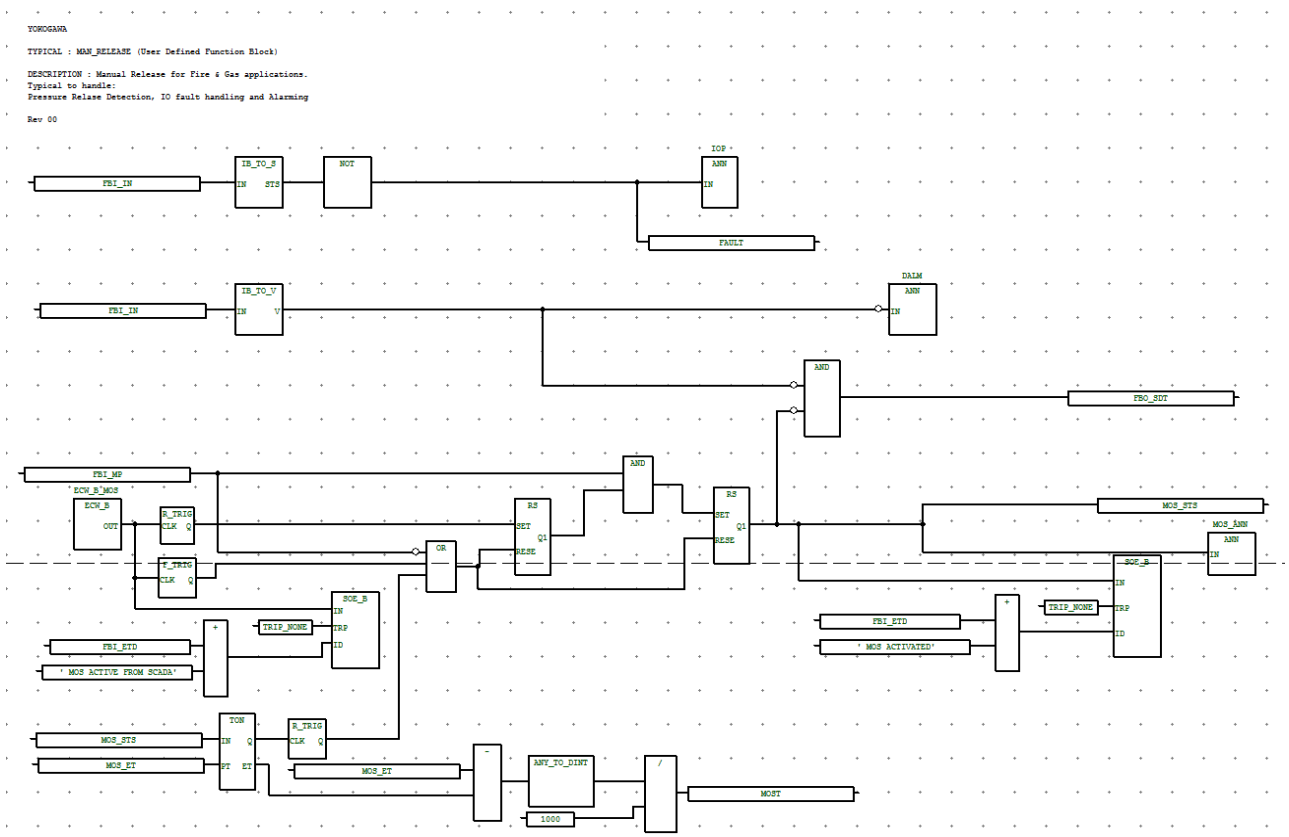


Fig 10 Logic Diagram for Typical FG_MAN_REL_NC

5.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
SDT	TRIP SIGNAL	FALSE
FLT	CRITICAL FAULT	FALSE
MSTS	MOS STATUS	XXXXXX
MOST	MOS RESET TIMER	T#10S

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
SDT	TRIP SIGNAL	FALSE
FLT	CRITICAL FAULT	FALSE
MSTS	MOS STATUS	XXXXXX
MOST	MOS RESET TIMER	10S

5.4 TEST CASES VS EXPECTED RESULTS

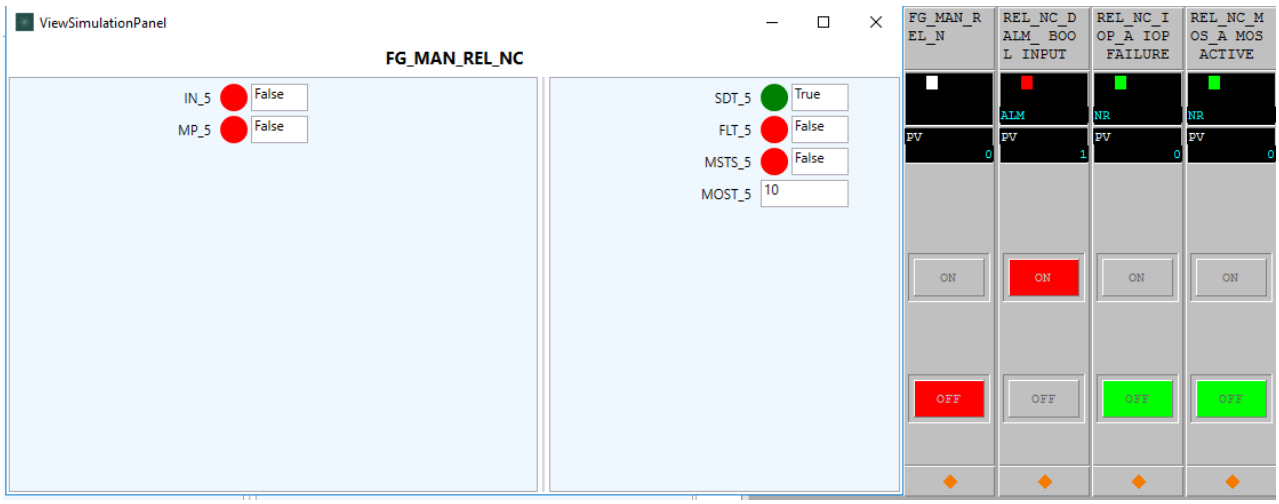
The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

Test Case Number	Test Cases	Input Parameter/Values	Expected Results		
			Trip Signal	Critical Fault	MOS Status
TC#1	IN.Value = FALSE, MP = FALSE	IN.Value = FALSE, MP = FALSE	TRUE	FALSE	FALSE
TC#2	IN.Value = TRUE, MP = FALSE	IN.Value = TRUE, MP = FALSE	FALSE	FALSE	FALSE
TC#3	IN.Value = TRUE, MP = TRUE MOS ENABLE = FALSE MOS Elapse time not Elapsed	IN.Value = TRUE, MP = TRUE MOS ENABLE = FALSE, MOS Elapse time not Elapsed	FALSE	FALSE	FALSE
TC#4	IN.Value.Value = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time not Elapsed	IN.Value.Value = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time not Elapsed	FALSE	FALSE	TRUE
TC#5	IN.Value = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time Elapsed	IN.Value = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time Elapsed	FALSE	FALSE	FALSE
TC#6	IN.Value = TRUE, MP = FALSE, MOS ENABLE = TRUE	IN.Value = TRUE, MP = FALSE, MOS ENABLE = TRUE	FALSE	FALSE	FALSE

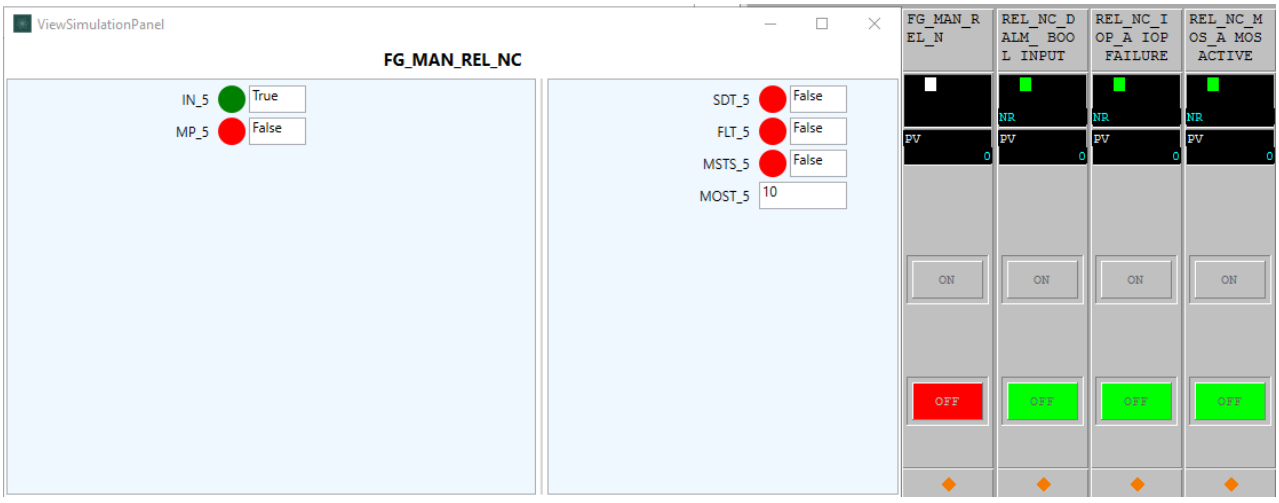
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from "True' to 'False'.

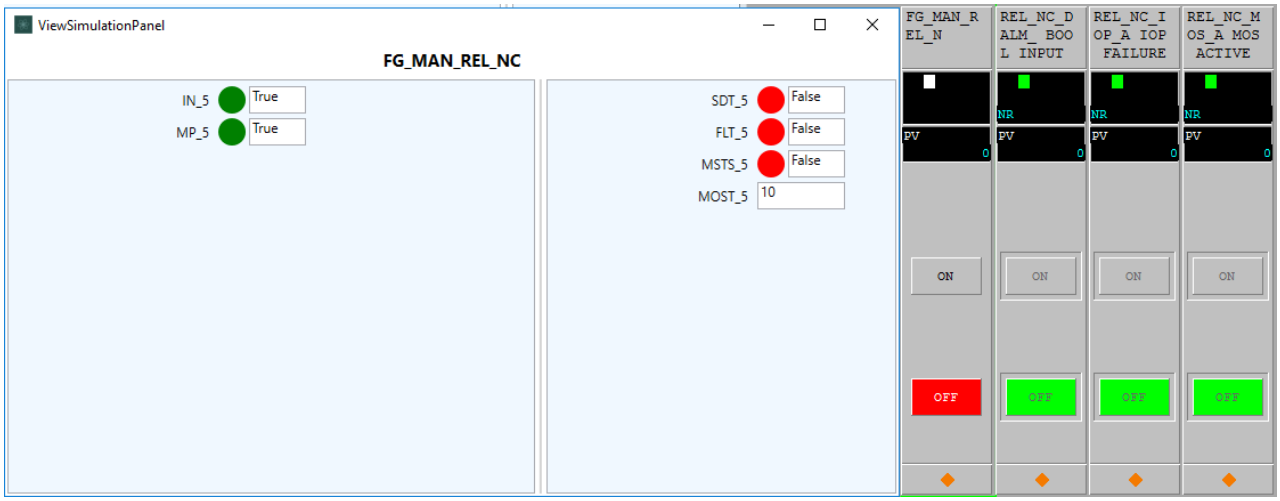
5.5 TEST RESULTS:



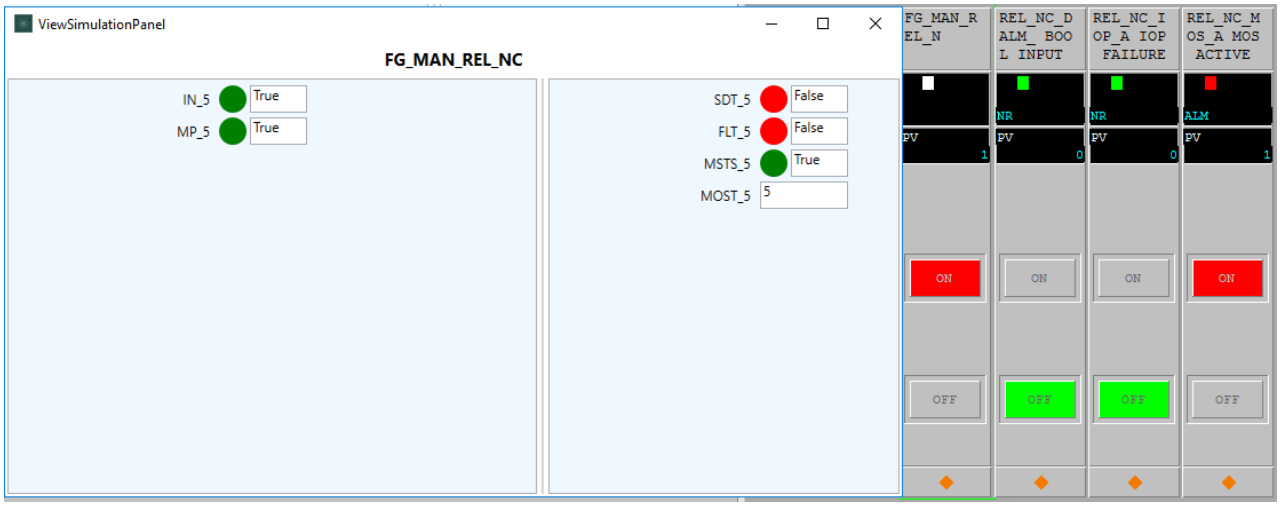
TC#1 : IN _5 = FALSE, MP_5 = FALSE, FG_MAN_REL_N=FALSE



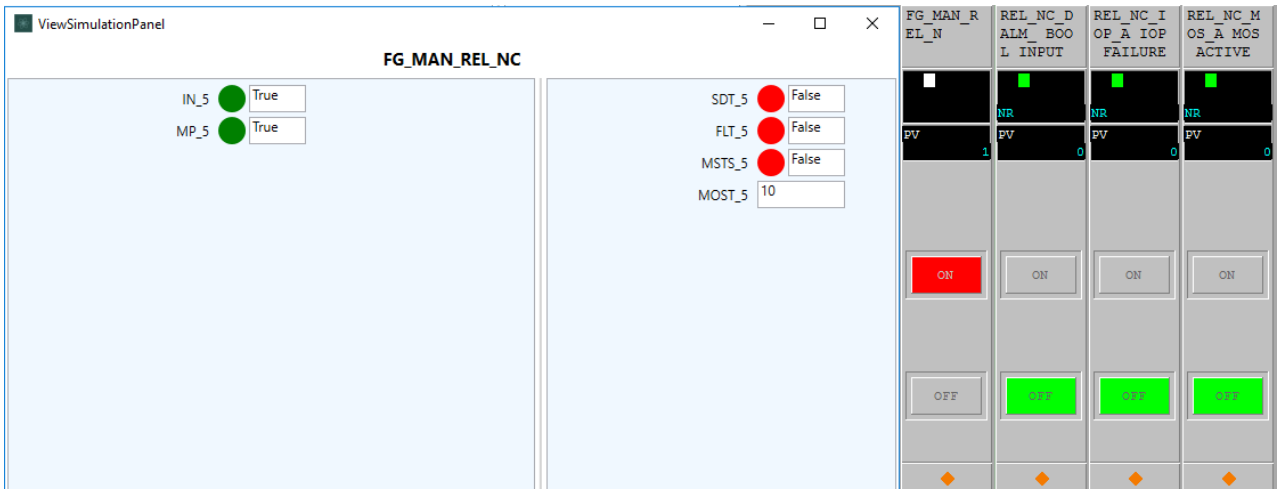
TC#2 : IN_5 = TRUE, MP_5 = FALSE FG_MAN_REL_N=FALSE.



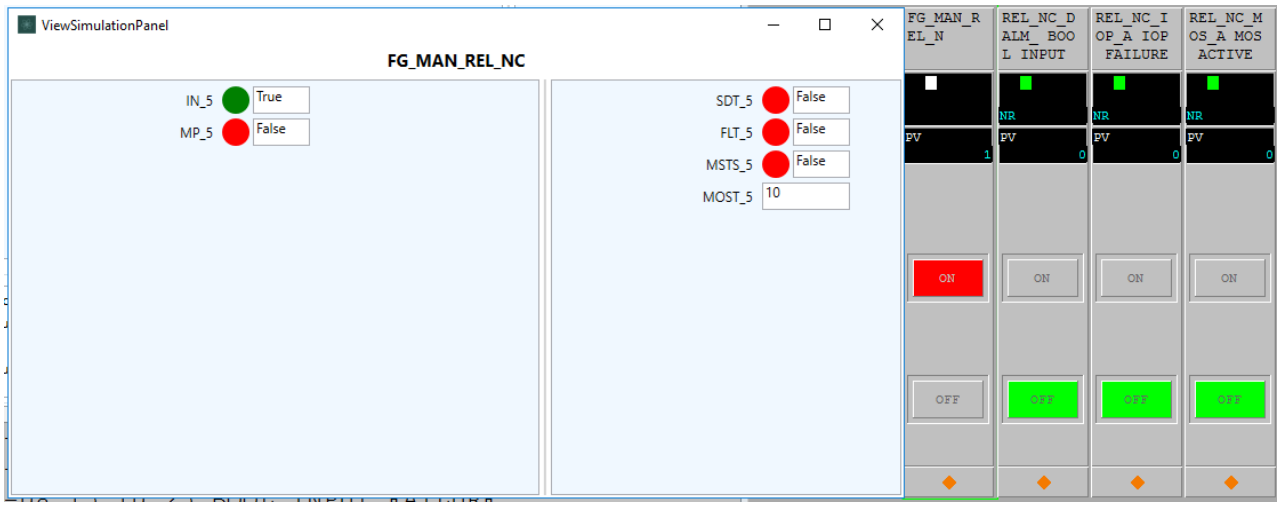
TC#3 : IN_5 = TRUE, MP_5 = TRUE, FG_MAN_REL_N =FALSE.



TC#4 : IN_5 = TRUE, MP_5 = TRUE, FG_MAN_REL_N =TRUE, MOS Elapse time not Elapsed

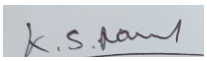


TC#5 : IN_5 = TRUE, MP_5 = TRUE, FG_MAN_REL_N =FALSE, MOS Elapse time Elapsed



TC#6 : IN_5 = TRUE, MP_5 = FALSE, FG_MAN_REL_N =TRUE.

5.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	05-AUG-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

6 FG_MAN_REL_NO

This typical is used for discrete inputs that are energized to trip.

6.1 PURPOSE

This typical is used for discrete inputs that are energized to trip such as manual alarm call points.

Functionality:

- Process Normally Open digital input
- Manage the maintenance override function (MOS) for each MAN_REL_NO input
- Manage input trip, diagnostic and I/O fault logics
- Manage input trip alarm reset logics
- Optional line monitoring and fault detection
- All diagnostic and I/O alarms will trigger individual Annunciator alarms.

Note: The MOS override function is included inside the function block

MOS function can be disabled by forcing the MOS enable key switch permanently to FALSE.

6.2 LOGIC DIAGRAMS

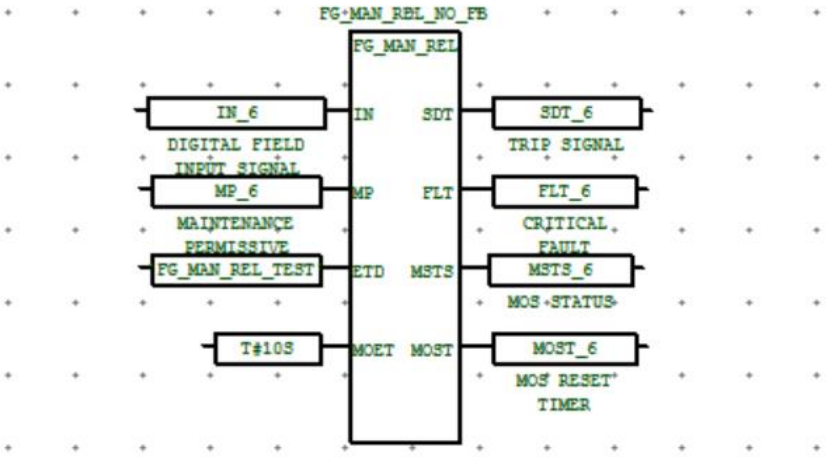


Fig 11 User Defined Function Block FG_MAN_REL_NO

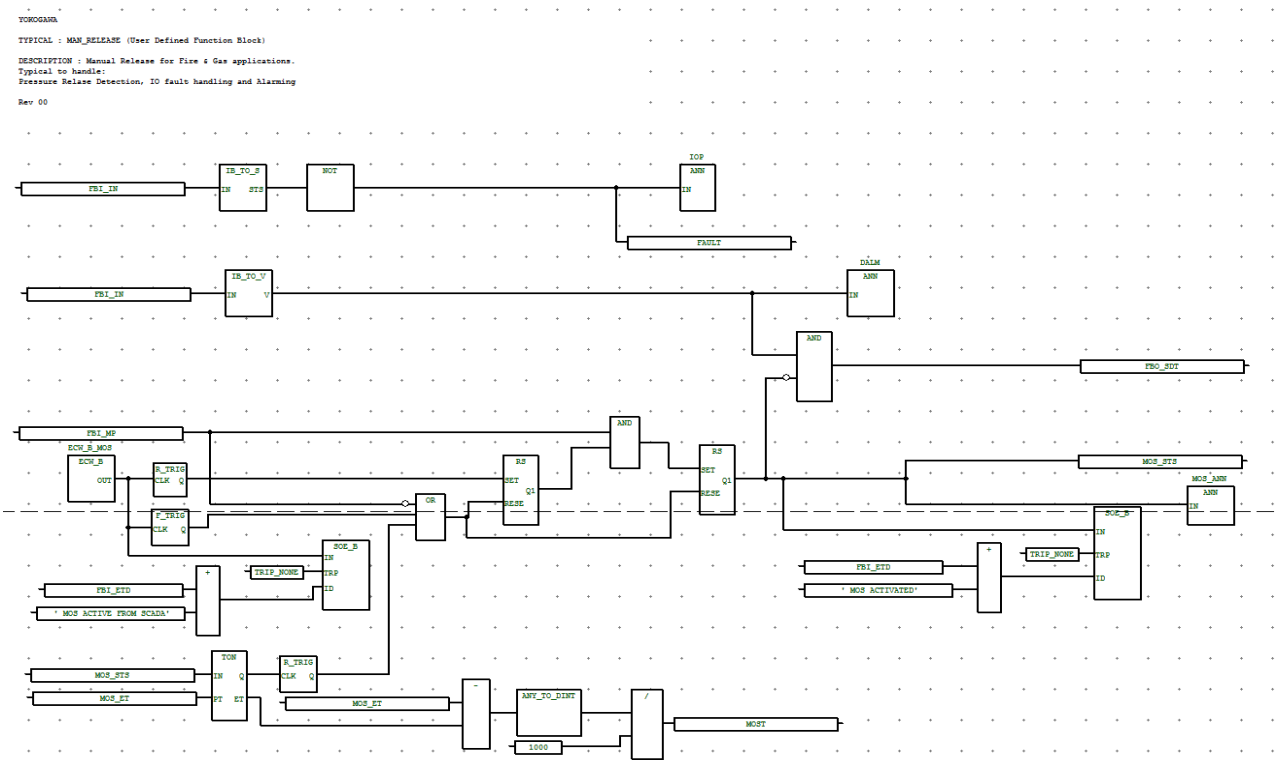


Fig 12 Logic Diagram for Typical FG_MAN_REL_NO

6.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
IN	DIGITAL FIELD INPUT SIGNAL	FALSE
MP	MAINTENANCE PERMISSIVE	FALSE
ETD	EVENT TEXT FOR DEVICE	FALSE
MOET	MOS RESET TIMER	10

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
SDT	TRIP SIGNAL	FALSE
FLT	CRITICAL FAULT	FALSE
MSTS	MOS STATUS	XXXXXX
MOST	MOS RESET TIMER	10S

6.4 TEST CASES VS EXPECTED RESULTS

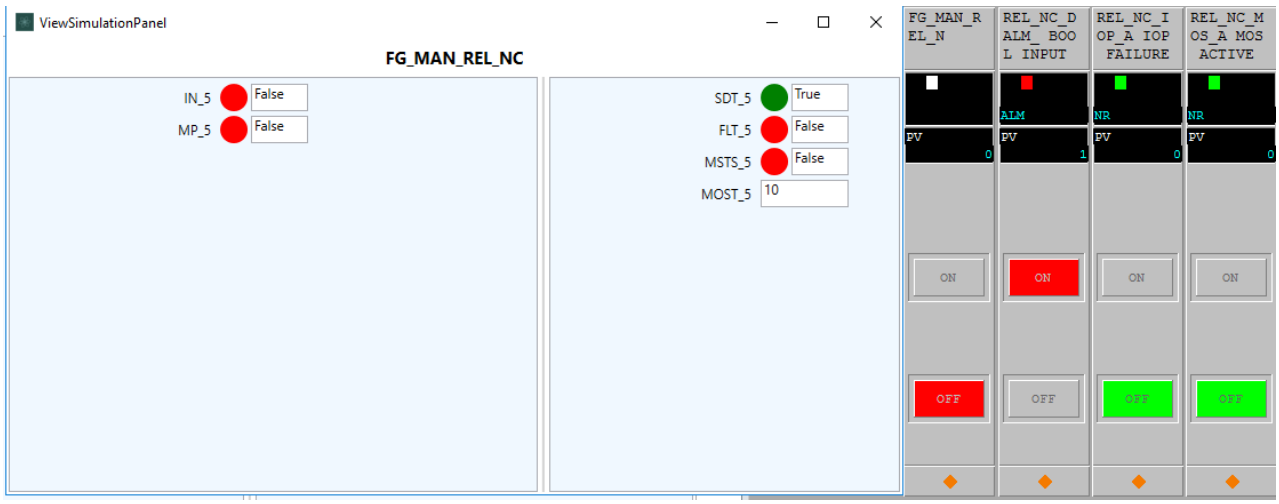
The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

Test Case Number	Test Cases	Input Parameter /Values	Expected Results		
			Trip Signal	Critical Fault	MOS Status
TC#1	IN = FALSE. MP = FALSE	IN = FALSE. MP = FALSE	TRUE	FALSE	FALSE
TC#2	IN = TRUE, MP = FALSE	IN = TRUE, MP = FALSE	FALSE	FALSE	FALSE
TC#3	IN = TRUE, MP = TRUE MOS ENABLE = FALSE MOS Elapse time not Elapsed	IN = TRUE, MP = TRUE MOS ENABLE = FALSE, MOS Elapse time not Elapsed	FALSE	FALSE	TRUE
TC#4	IN.Value = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time not Elapsed	IN.Value = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time not Elapsed	FALSE	FALSE	TRUE
TC#5	IN.Value = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time Elapsed	IN.Value = TRUE, MP = TRUE, MOS ENABLE = TRUE, MOS Elapse time Elapsed	FALSE	FALSE	FALSE
TC#6	IN.Value = TRUE, MP = FALSE, MOS ENABLE = TRUE	IN.Value = TRUE, MP = FALSE, MOS ENABLE = TRUE	FALSE	FALSE	FALSE

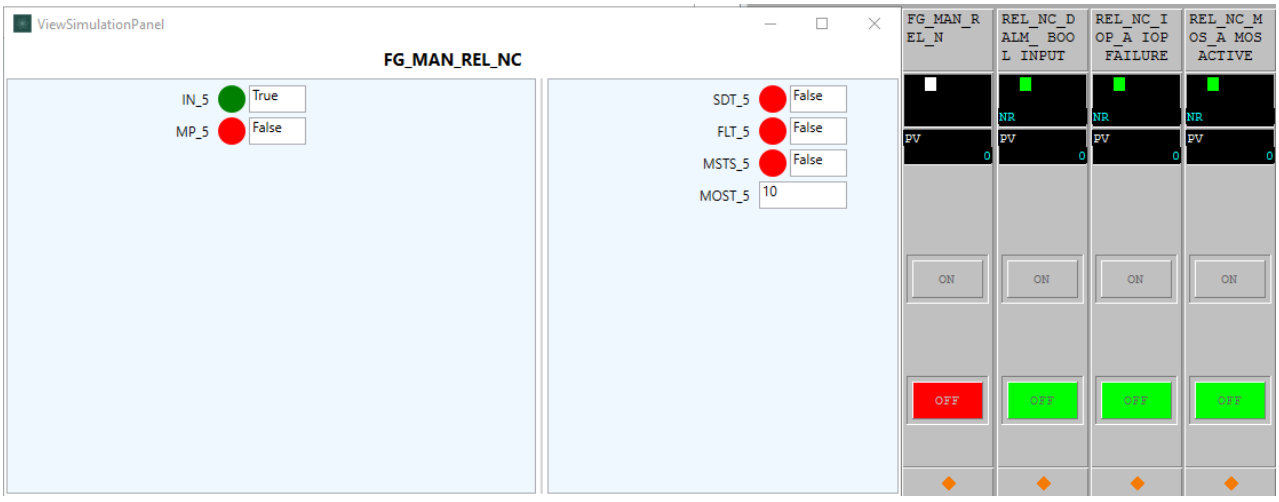
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from "True' to 'False'.

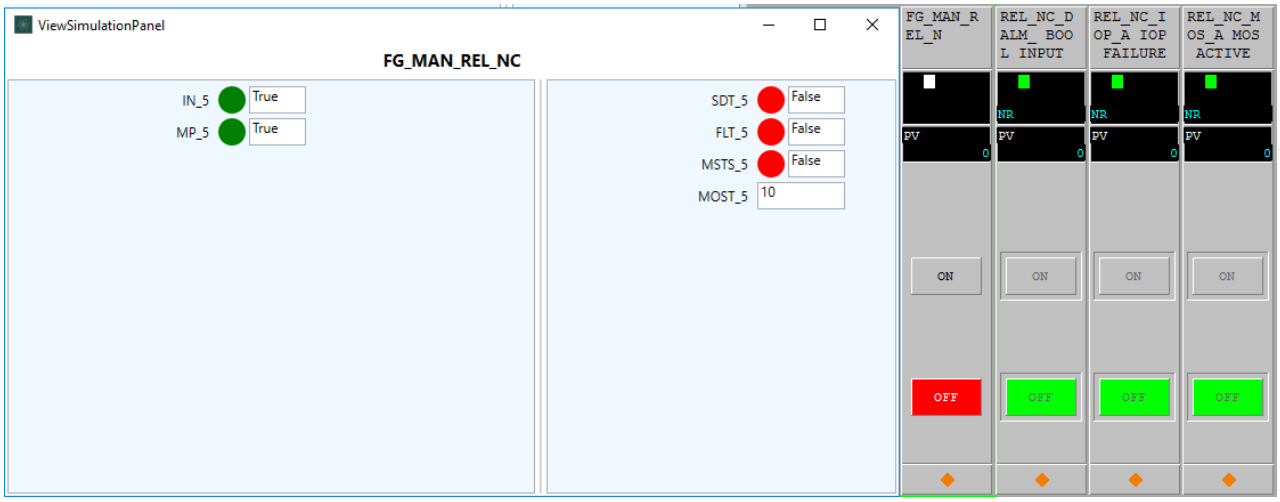
6.5 TEST RESULTS:



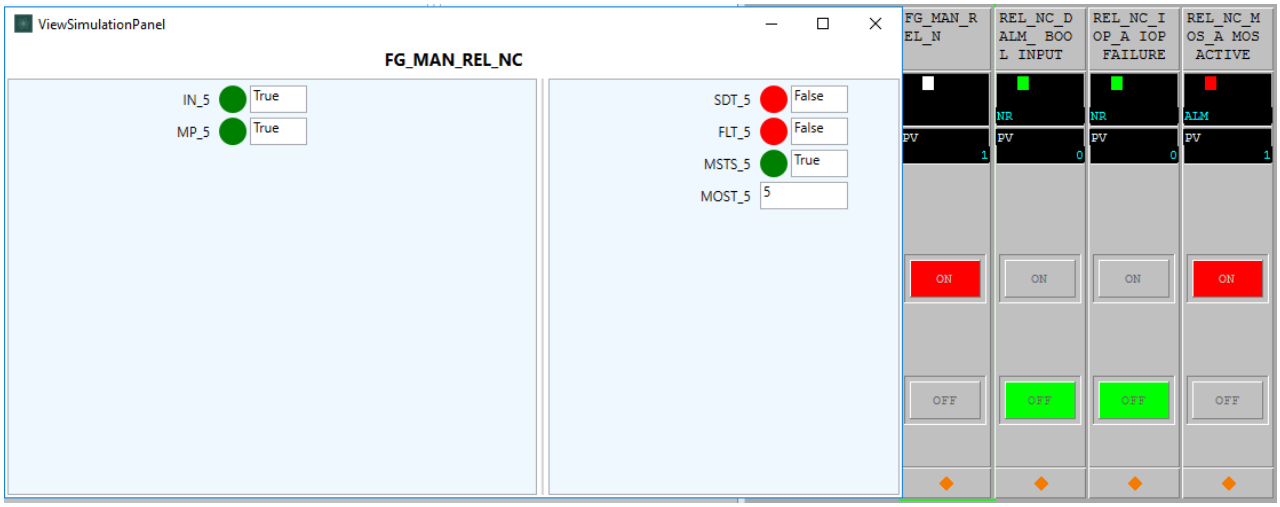
TC#1 : IN_5 = FALSE, MP_5 = FALSE, FG_MAN_REL_N=FALSE



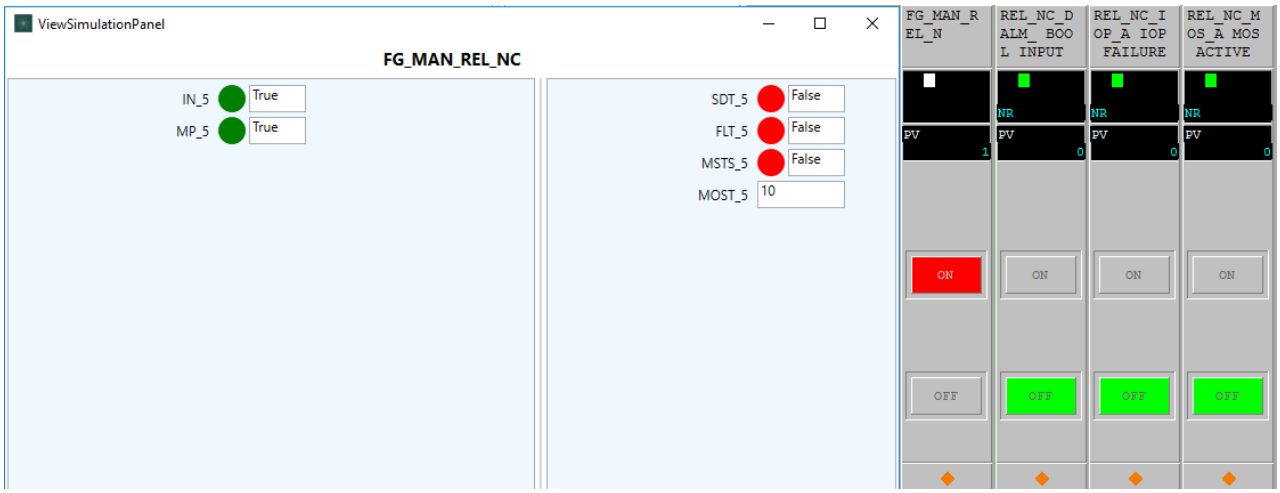
TC#2 : IN_5 = TRUE, MP_5 = FALSE FG_MAN_REL_N=FALSE.



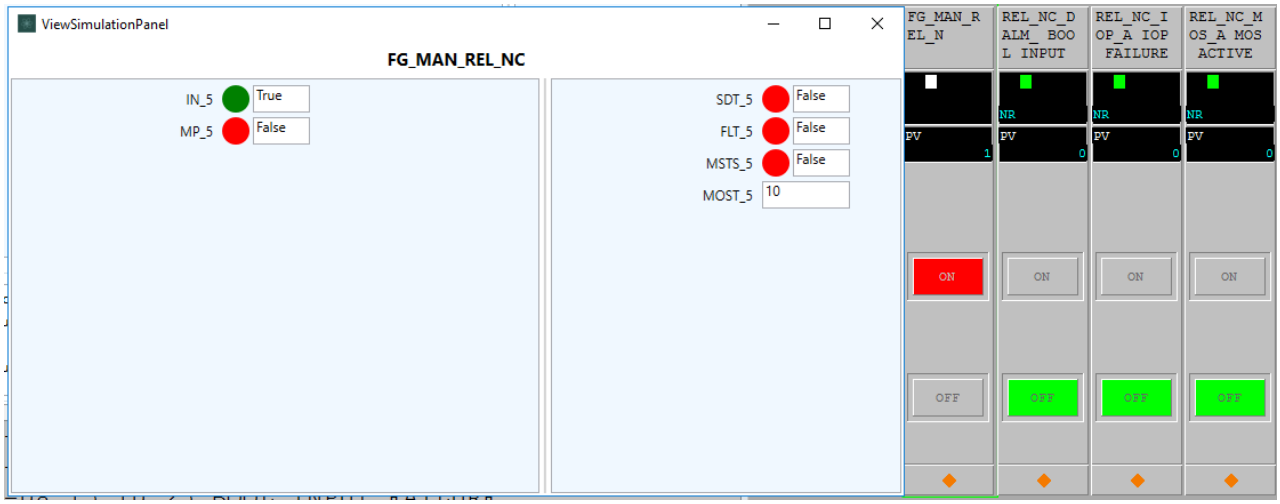
TC#3 : IN_5 = TRUE, MP_5 = TRUE, FG_MAN_REL_N =FALSE.



TC#4 : IN_5 = TRUE, MP_5 = TRUE, FG_MAN_REL_N =TRUE, MOS Elapse time not Elapsed

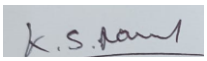


TC#5 : IN_5 = TRUE, MP_5 = TRUE, FG_MAN_REL_N =FALSE, MOS Elapse time Elapsed



TC#6 : IN_5 = TRUE, MP_5 = FALSE, FG_MAN_REL_N =TRUE.

6.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	05-AUG-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

7 F23

2oo3 Voting typical will be used for Fire and Gas application.

7.1 PURPOSE

This typical is used to Initiate a trip if two of the three inputs are in trip.

Functionality:

The F23 function block has the following main functions:

- Initiate a trip if two of the three inputs are in trip state.
- Degrade voting function.

If two of the three inputs are tripped the output TRP of the F23 block will trip. If either one of the three inputs is not valid (detector critical fault) or a maintenance override is applied the voting function will degrade to 1oo2 and VDG of F23 will become true. If all transmitters are in fault, or if one maintenance override is applied while the other two transmitters are in fault the voting function is disabled.

7.2 LOGIC DIAGRAMS

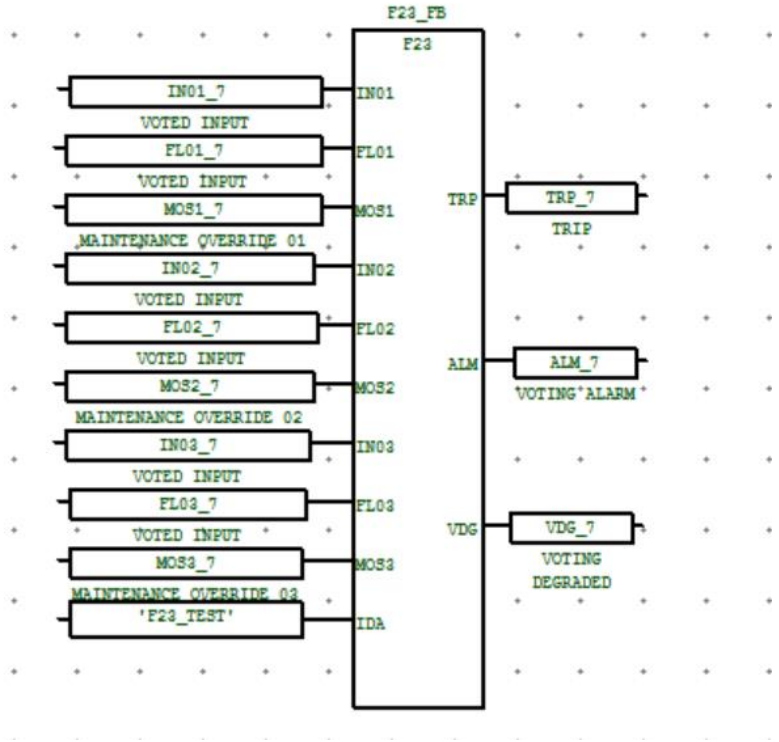


Fig 13 User Defined Function Block F23

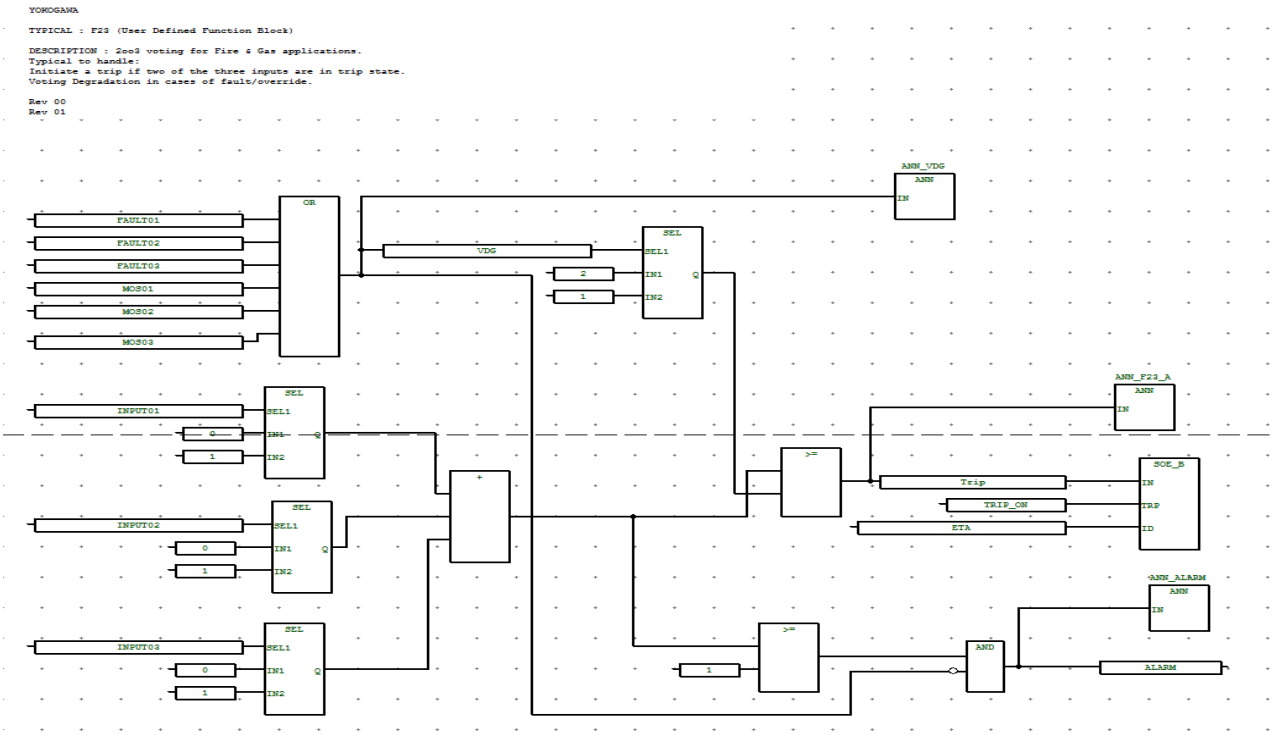


Fig 14 Logic Diagram for Typical F23

7.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
IN01, IN02, IN03	VOTED INPUT	FALSE
FL01, FL02, FL03	VOTED INPUT	FALSE
MOS1, MOS2, MOS3	MAINTENANCE OVERRIDE	FALSE
IDA	TRIP EVENT ID	"XXXXXXXXX"

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
TRP	TRIP	FALSE
ALM	VOTING ALARM	FALSE
VDG	VOTING DEGRADED	FALSE

7.4 TEST CASES VS EXPECTED RESULTS

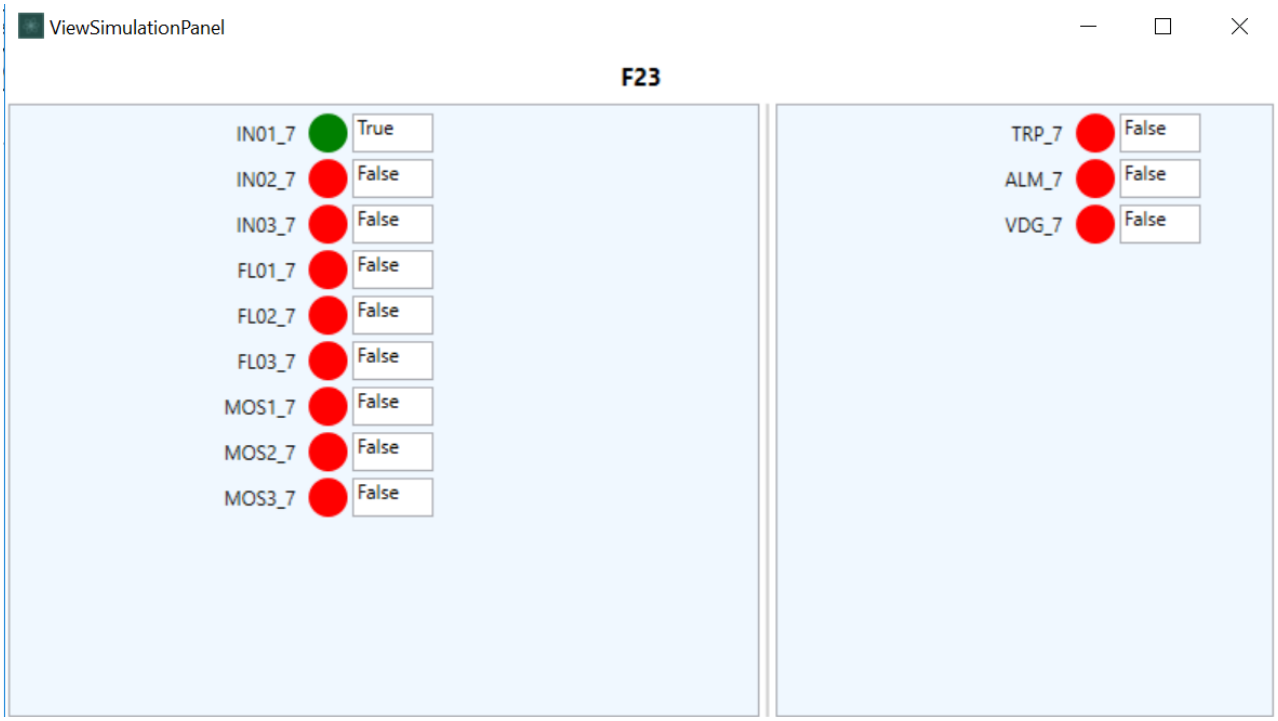
The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

Test Case Number	Test Cases	Input Parameter /Values	Expected Results		
			TRP	ALM	VDG
TC#1	IN01 = TRUE, FL01=FALSE MOS1=FALSE IN02 = FALSE, FL02=FALSE MOS1=FALSE IN03 = FALSE, FL03=FALSE MOS1=FALSE	IN01 = TRUE, FL01=FALSE MOS1=FALSE IN02 = FALSE, FL02=FALSE MOS1=FALSE IN03 = FALSE, FL03=FALSE MOS1=FALSE	FALSE	FALSE	FALSE
TC#2	IN01 = TRUE, FL01=FALSE MOS1=FALSE IN02 = TRUE FL02=FALSE MOS1=FALSE IN03 = FALSE, FL03=FALSE MOS1=FALSE	IN01 = TRUE, FL01=FALSE MOS1=FALSE IN02 = TRUE, FL02=FALSE MOS1=FALSE IN03 = FALSE, FL03=FALSE MOS1=FALSE	TRUE	TRUE	FALSE
TC#3	IN01 = TRUE, FL01=TRUE MOS1=FALSE IN02 = FALSE, FL02=FALSE MOS1=FALSE IN03 = FALSE, FL03=FALSE MOS1=FALSE	IN01 = TRUE, FL01=TRUE MOS1=FALSE IN02 = FALSE, FL02=FALSE MOS1=FALSE IN03 = FALSE, FL03=FALSE MOS1=FALSE	TRUE	TRUE	TRUE
TC#4	IN01 = TRUE, FL01=FALSE MOS1=TRUE IN02 = FALSE, FL02=FALSE MOS1=FALSE IN03 = FALSE, FL03=FALSE MOS1=FALSE	IN01 = TRUE, FL01=FALSE MOS1=TRUE IN02 = FALSE, FL02=FALSE MOS1=FALSE IN03 = FALSE, FL03=FALSE MOS1=FALSE	TRUE	TRUE	TRUE

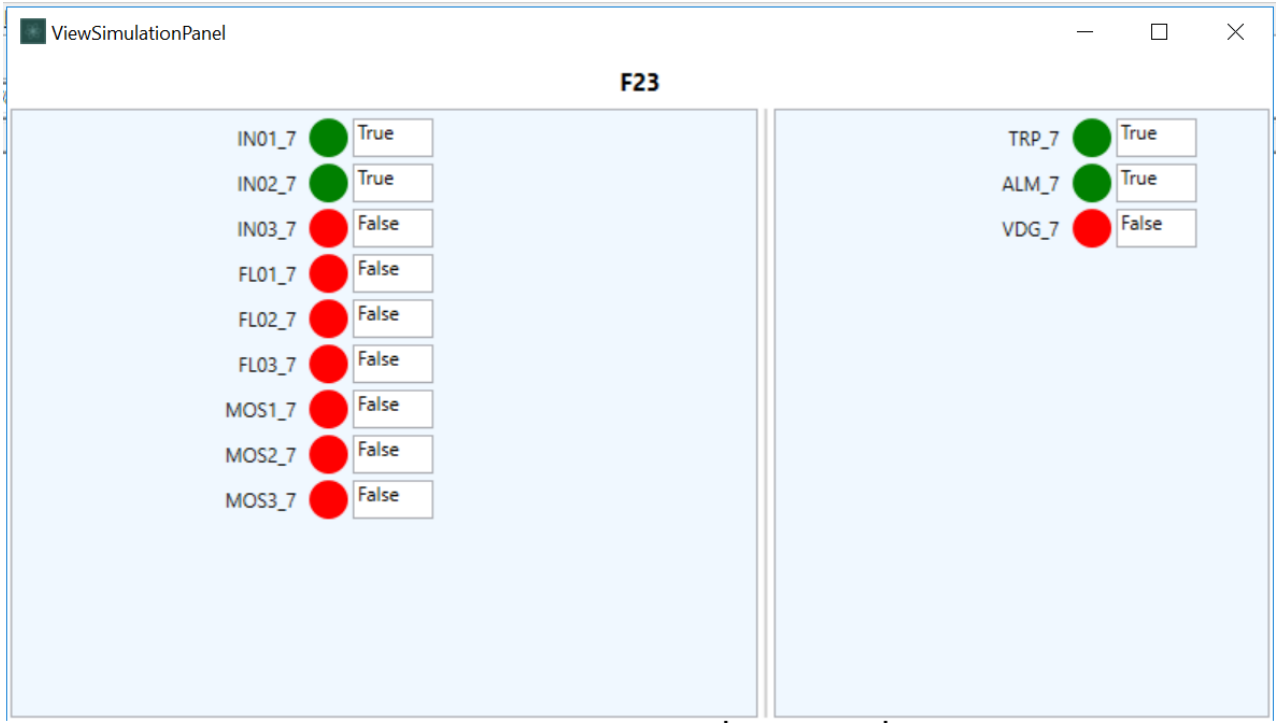
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from “True’ to ‘False’.

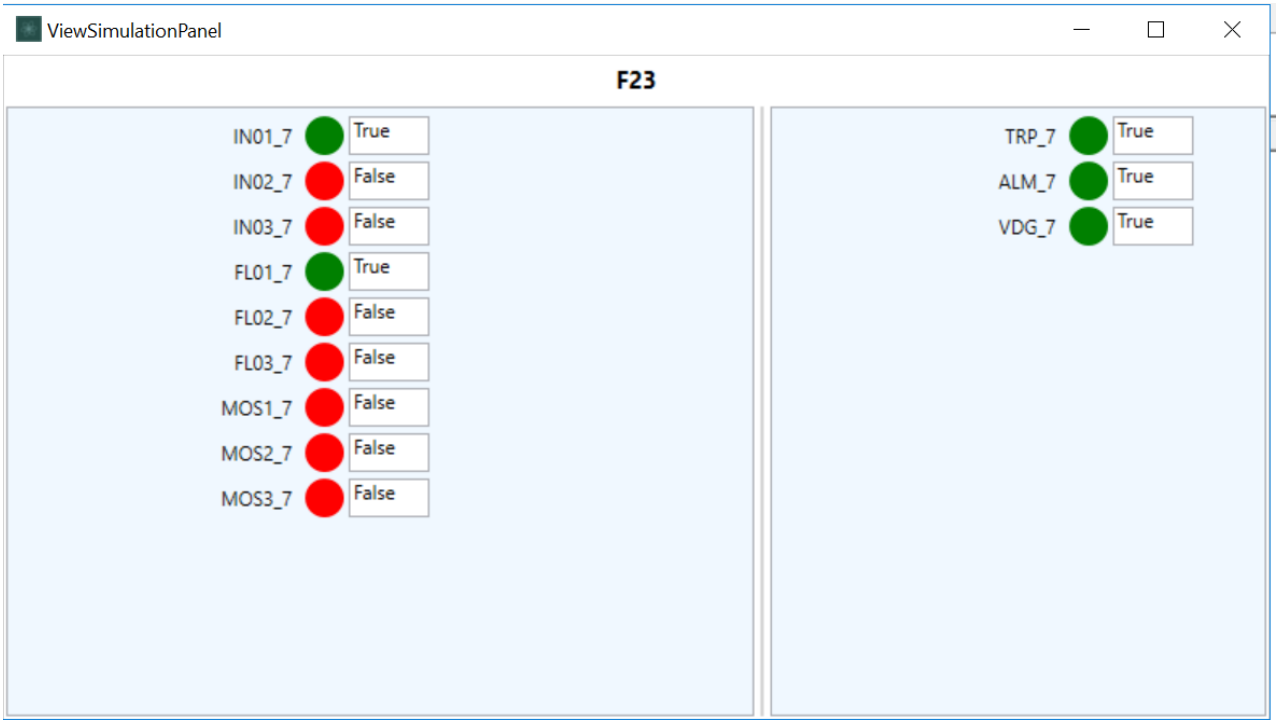
7.5 TEST RESULTS:



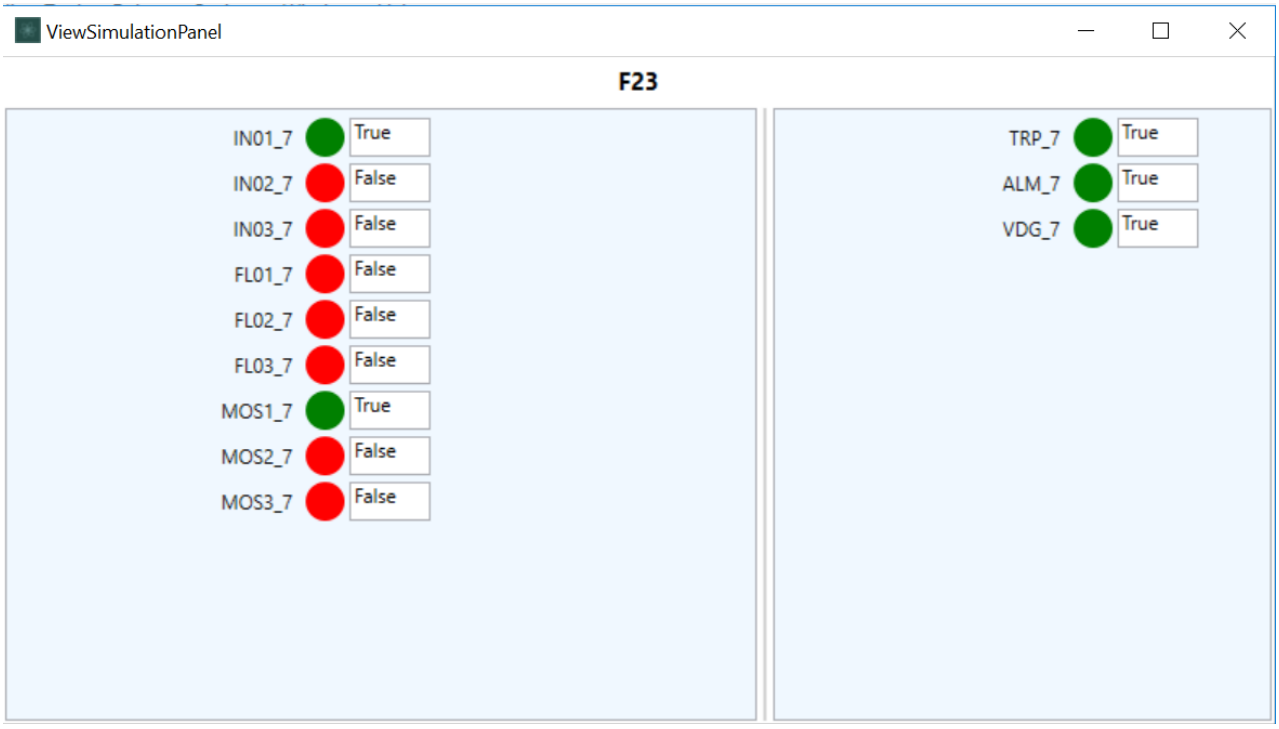
TC#1 : IN01 = TRUE, IN02 = FALSE, IN03 = FALSE,FL01=FALSE, FL02=FALSE, FL03=FALSE, MOS1=FALSE, MOS2=FALSE, MOS3=FALSE



TC#2 : IN01 = TRUE, IN02 = TRUE, IN03 = FALSE,FL01=FALSE, FL02=FALSE, FL03=FALSE, MOS1=FALSE, MOS2=FALSE, MOS3=FALSE

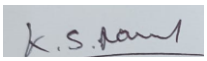


TC#3 : IN01 = TRUE, IN02 = FALSE, IN03 = FALSE,FL01=TRUE, FL02=FALSE, FL03=FALSE, MOS1=FALSE, MOS2=FALSE, MOS3=FALSE



TC#4 : IN01 = TRUE, IN02 = FALSE, IN03 = FALSE,FL01=FALSE, FL02=FALSE, FL03=FALSE, MOS1=TRUE, MOS2=FALSE, MOS3=FALSE

7.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	08-OCT-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

8 FG_V2N

2ooN Voting logic for Fire & Gas applications.

8.1 PURPOSE

2-out-of-N voting is commonly used in fire and gas system to initiate trip, Process shutdown interlocks and other safety functions. This voting logic requires any two detectors to be in Alarm condition.

Functionality:

The FG_V2N function block has the following main functions:

- Initiate a trip if two of the three inputs are in trip state.
- Degrade voting function.

If two of the N inputs are tripped the output TRP of the FG_V2N block will trip. If any one of the N inputs is not valid (detector critical fault) or a maintenance override is applied the voting function will degrade and VDG of FG_V2N will become true. If all transmitters are in fault, or if one maintenance override is applied while the N transmitters are in fault the voting function is disabled.

8.2 LOGIC DIAGRAMS

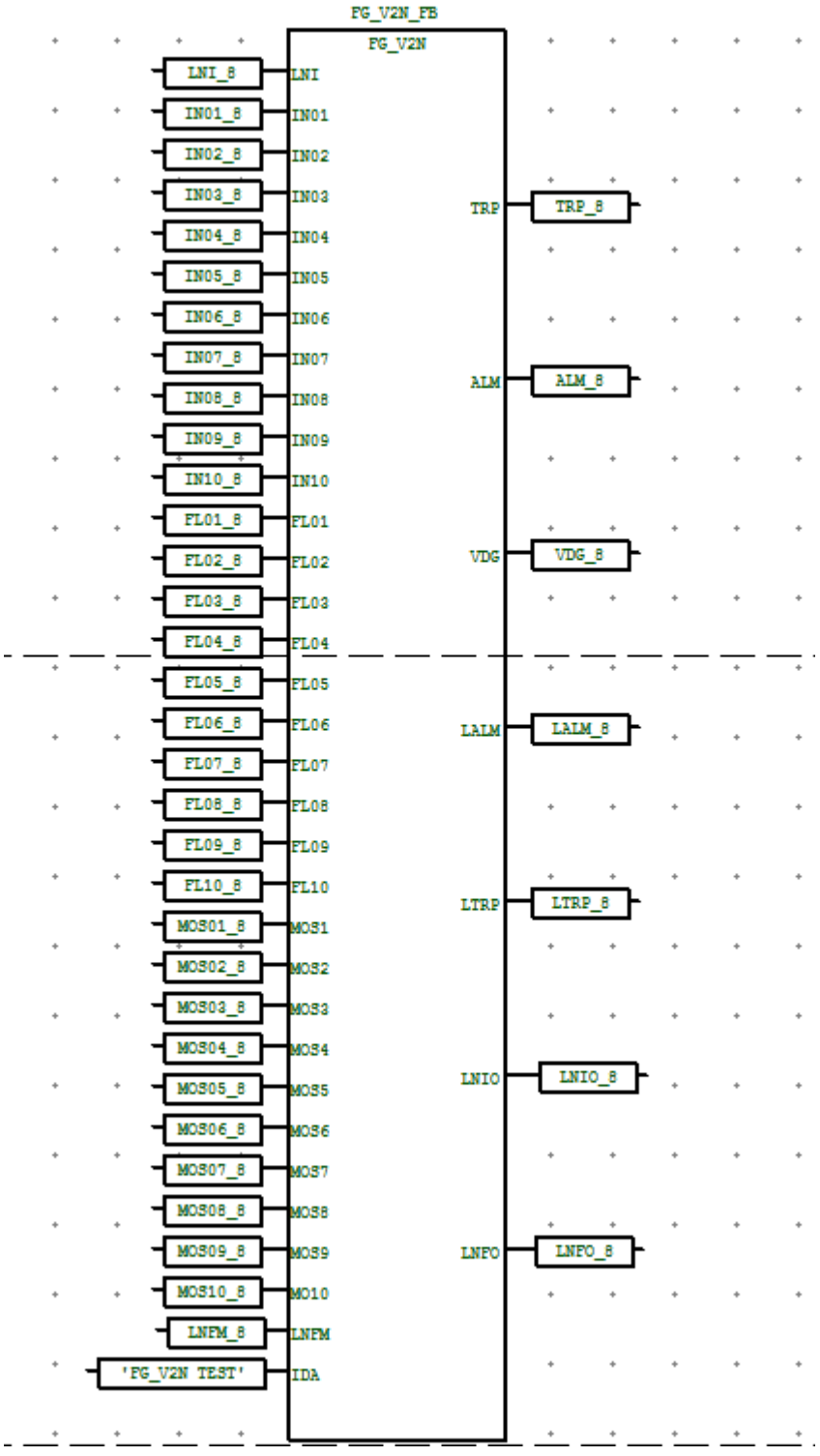
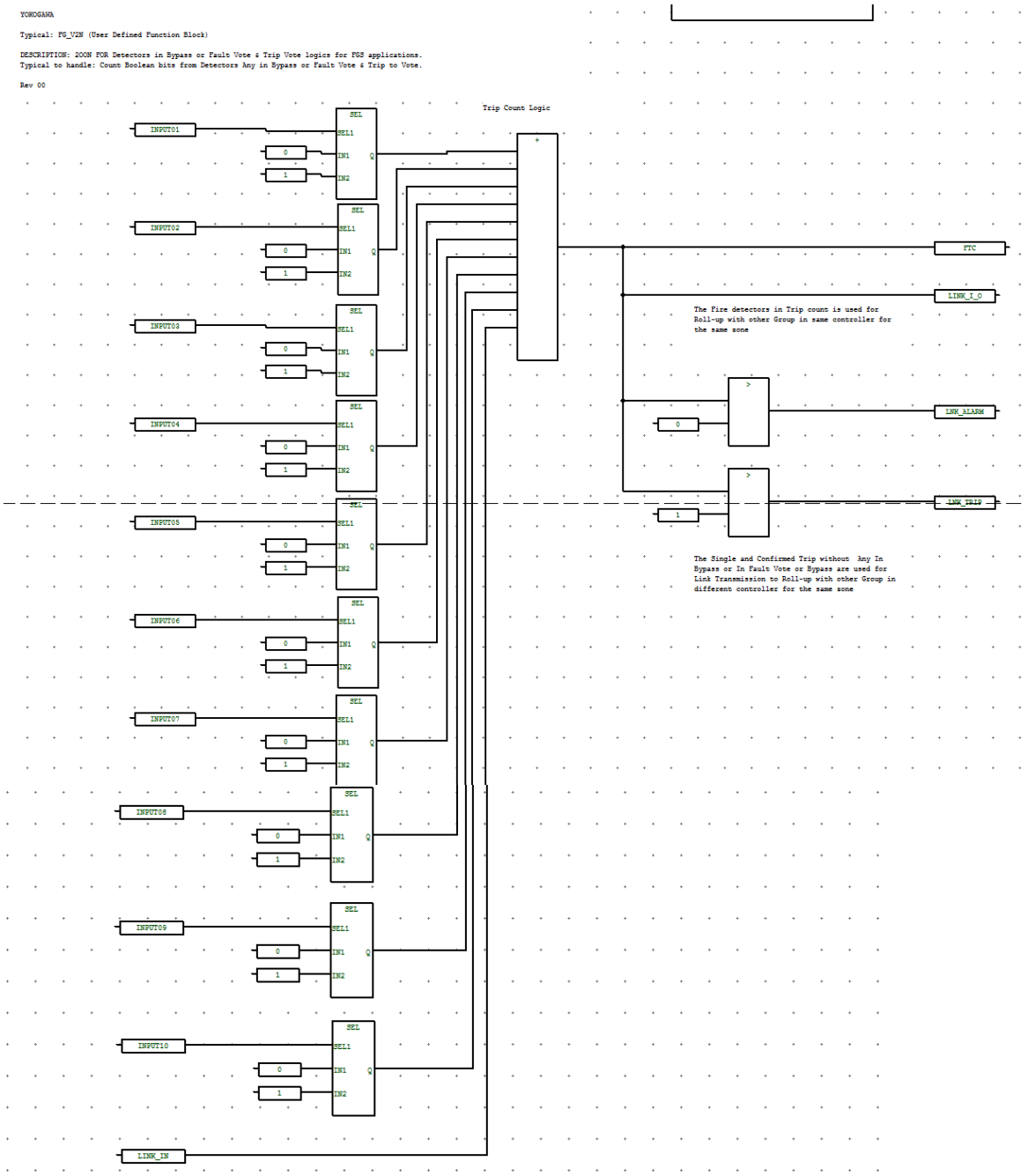


Fig 15 Logic Diagram for Typical FG_V2N


YOKOGAWA
Typical: FG_V2N (User Defined Function Block)
DESCRIPTION: 2OON FOR Detectors in Bypass or Fault Vote & Trip Vote logics for FGS applications.
Typical to handle: Count Boolean bits from Detectors Any in Bypass or Fault Vote & Trip to Vote.
Rev 00
Trip Count Logic
INPUT01
INPUT02
INPUT03
INPUT04
INPUT05
INPUT06
INPUT07
INPUT08
INPUT09
INPUT10
LINK_IN
FTC
LINK_I_O
LNK_ALARM
LNK_TRIP
The Fire detectors in Trip count is used for Roll-up with other Group in same controller for the same zone
The Single and Confirmed Trip without Any In Bypass or In Fault Vote or Bypass are used for Link Transmission to Roll-up with other Group in different controller for the same zone

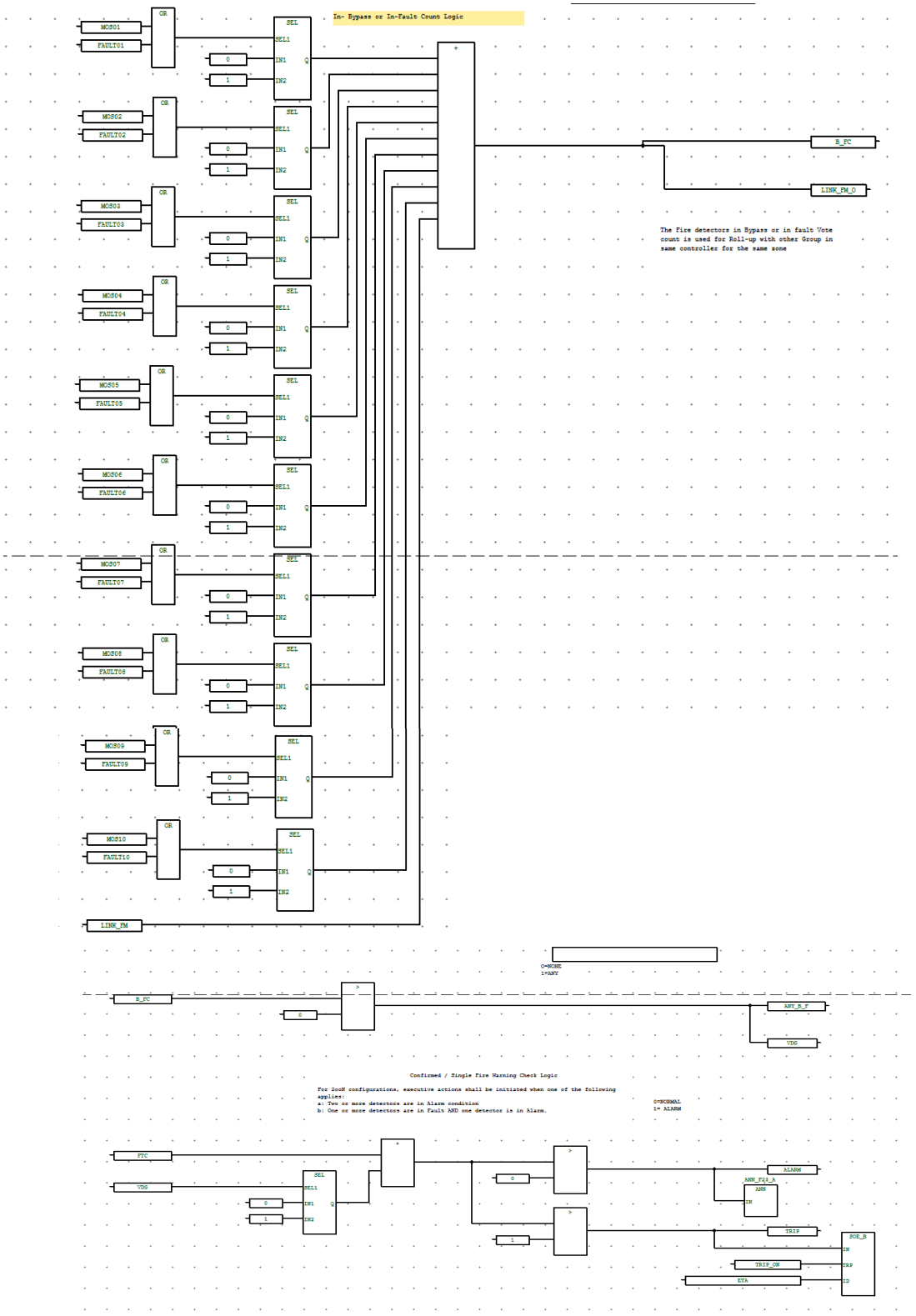


Fig 16 Logic Diagram for Typical FG_V2N

8.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
LNI	Link Input	0
IN01,IN02,IN03,…..IN10	Detector Input	FALSE
FL01, FL02, FL03….FL10	Detector In-Bypass or In-Fault	FALSE
MOS01, MOS02, MOS03,……MOS10	Detector In-Bypass or In-Fault	FALSE
LMFM	LINK FLT & MOS	0
IDA	TRIP EVENT ID	"XXXXXXXXX"

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
TRP	Fire Confirmed Trip Vote	FALSE
ALM	Fire Single Trip Vote	FALSE
VDG	Any Bypass or Fault Vote DEGRADE	FALSE
LALM	Single Trip Warning for Link Tra	FALSE
LTRP	Confirmed Trip Warning for Link	FALSE
LNIO	LINK INPUT TO OTHER VOTING	0
LNFO	LINK FLT& MOS TO OTHER VOTING	0

8.4 TEST CASES VS EXPECTED RESULTS

The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

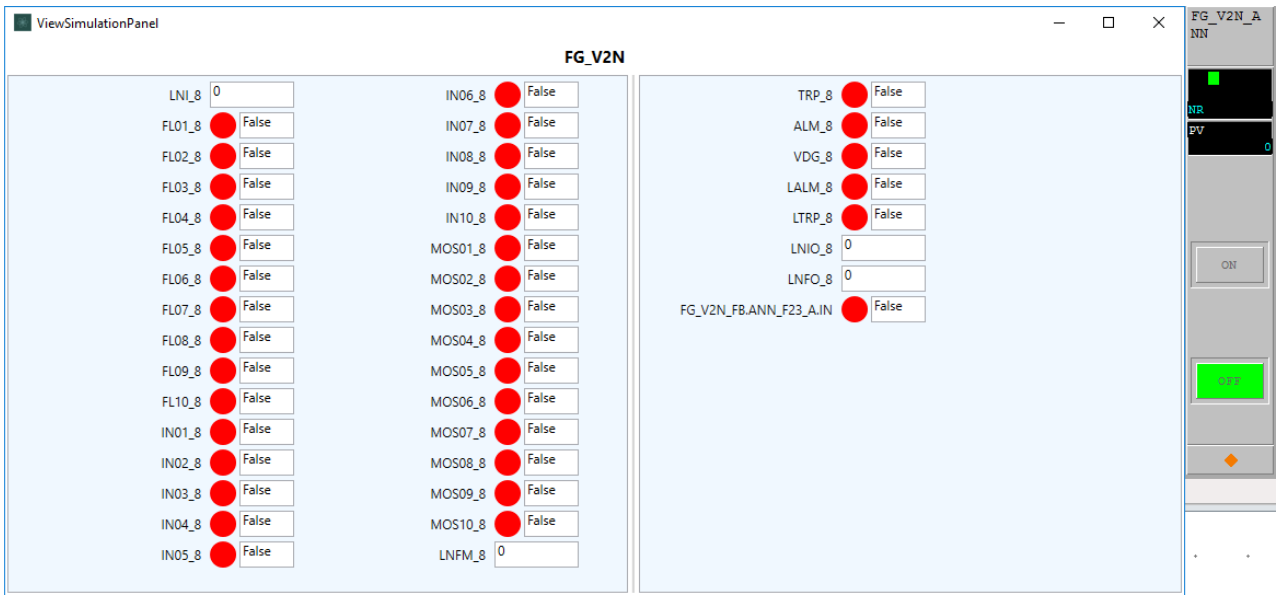
Test Case Number	Test Cases	Input Parameter /Values	Expected Results						
			Trip Signal	ALM	VDG	LALM	LTRP	LNIO	LNFO
TC#1	LNI=0 IN01 TO IN10 = FALSE FL01 TO FL10 = FALSE MOS01 TO MOS10=FALSE LNFM=0	LNI=0 IN01 TO IN10 = FALSE FL01 TO FL10 = FALSE MOS01 TO MOS10=FALSE LNFM=0	FALSE	FALSE	FALSE	FALSE	FALSE	0	0
TC#2	LNI=0 IN01=TRUE IN02=FALSE TO IN10 = FALSE FL01 TO FL10 = FALSE MOS01 TO MOS10=FALSE LNFM=0	LNI=0 IN01=TRUE IN02=FALSE TO IN10 = FALSE FL01 TO FL10 = FALSE MOS01 TO MOS10=FALSE LNFM=0	FALSE	TRUE	FALSE	TRUE	FALSE	1	0
TC#3	LNI=0 IN01=TRUE, IN02=FALSE TO IN10 = FALSE FL01=TRUE FL02 TO FL10 = FALSE MOS01 TO MOS10=FALSE LNFM=0	LNI=0 IN01=TRUE, IN02=TRUE IN03=FALSE TO IN10 = FALSE FL01=TRUE FL02 TO FL10 = FALSE MOS01 TO MOS10=FALSE LNFM=0	TRUE	TRUE	TRUE	TRUE	FALSE	1	10

Test Case Number	Test Cases	Input Parameter /Values	Expected Results						
			Trip Signal	ALM	VDG	LALM	LTRP	LNIO	LNFO
TC#4	LNI=0 IN01=TRUE, IN02=TRUE IN03=FALSE TO IN10 = FALSE FL01 TO FL10 = FALSE MOS01 TO MOS10=FALSE LNFM=0	LNI=0 IN01=TRUE, IN02=TRUE IN03=FALSE TO IN10 = FALSE FL01 TO FL10 = FALSE MOS01 TO MOS10=FALSE LNFM=0	TRUE	TRUE	FALSE	TRUE	TRUE	2	0
TC#5	LNI=0 IN01=TRUE, IN02=FALSE TO IN10 = FALSE FL01 TO FL10 = FALSE MOS01=TRUE, MOS02 TO MOS10=FALSE LNFM=0	LNI=0 IN01=TRUE, IN02=FALSE TO IN10 = FALSE FL01 TO FL10 = FALSE MOS01=TRUE, MOS02 TO MOS10=FALSE LNFM=0	TRUE	TRUE	TRUE	TRUE	FALSE	1	10

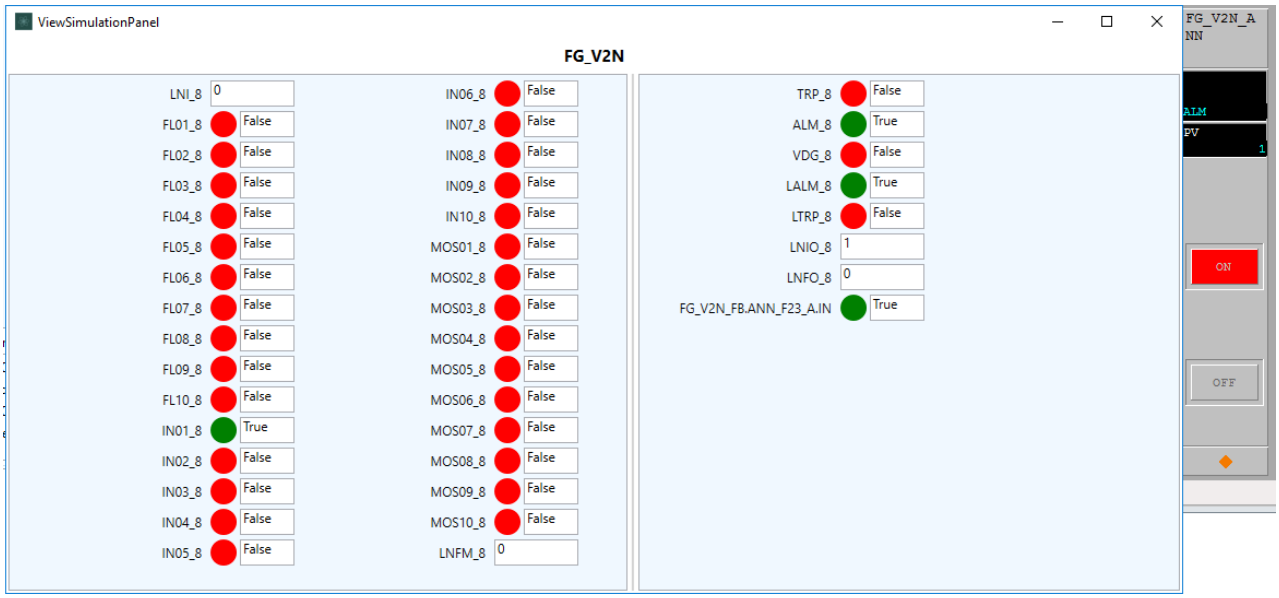
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from “True’ to ‘False’.

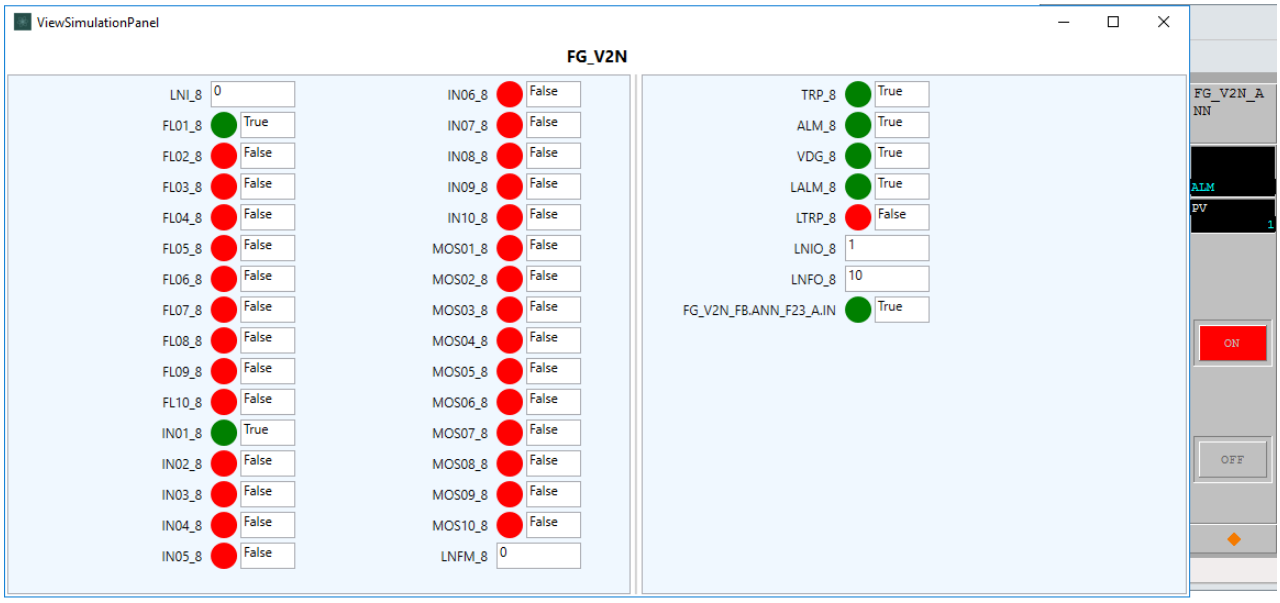
8.5 TEST RESULTS:



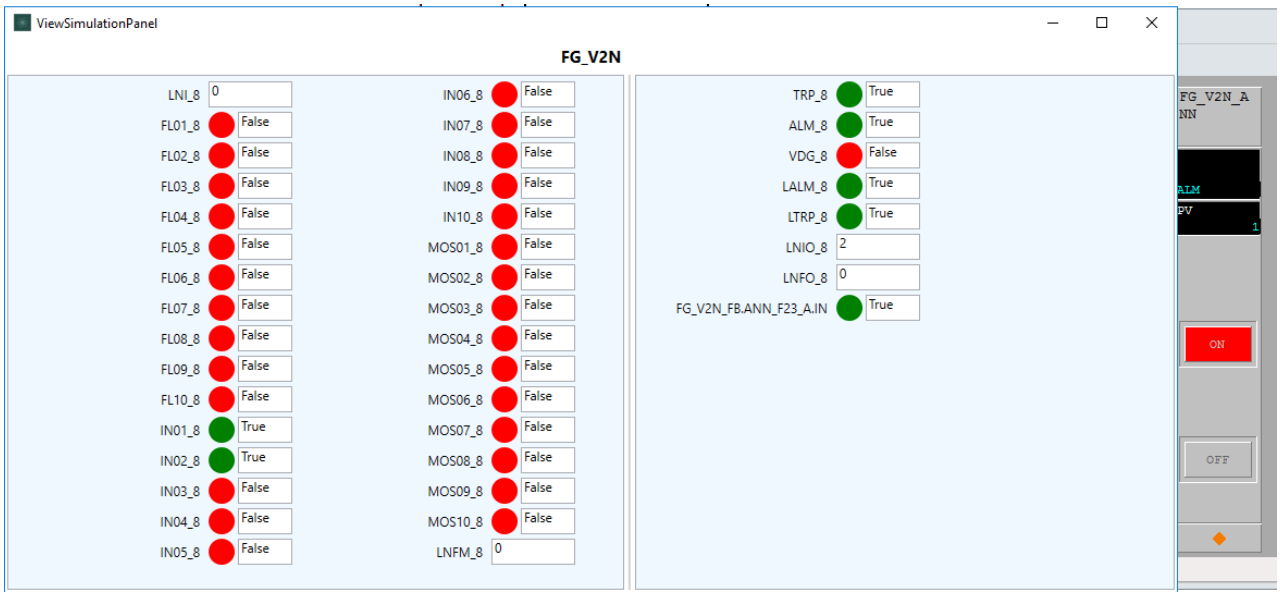
TC#1 : LNI=FALSE, IN01= FALSE TO IN10=FALSE, FL01=FALSE TO FL10=FALSE, MOS01=FALSE TO MOS10=FALSE, LNFM=FALSE,



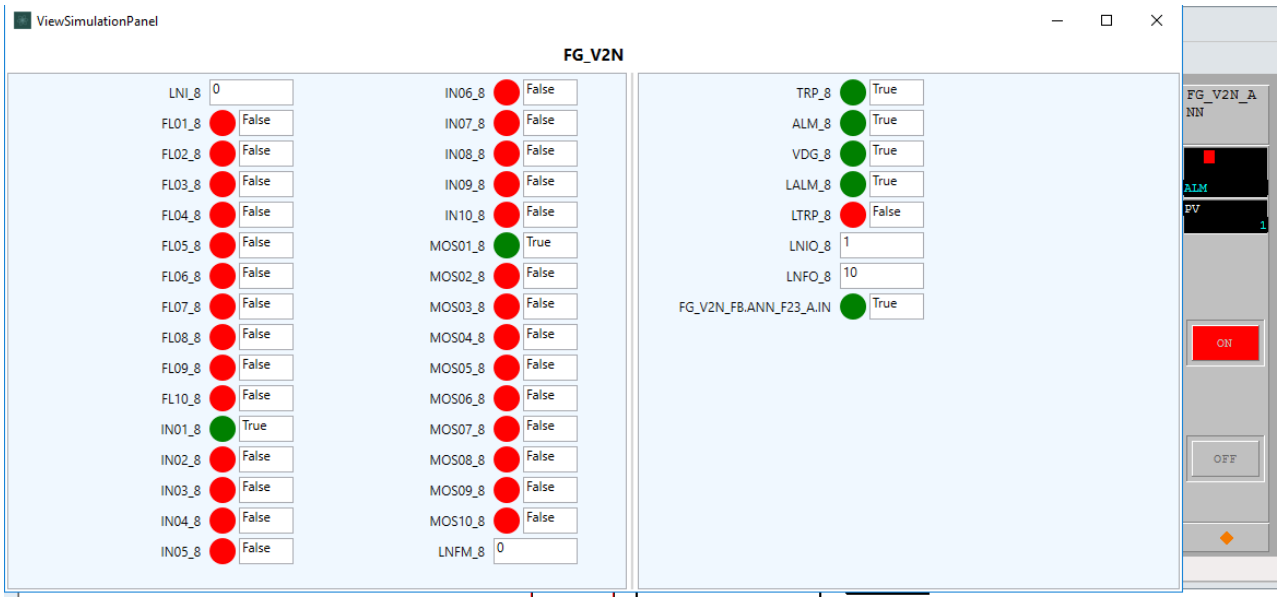
TC#2 : LNI=FALSE, IN01 = TRUE, IN02= FALSE TO IN10=FALSE, FL01=FALSE TO FL10=FALSE, MOS01=FALSE TO MOS10=FALSE, LNFM=FALSE,



TC#3 : LNI=FALSE, IN01 = TRUE, IN02 = FALSE TO IN10=FALSE, FL01=TRUE, FL02=FALSE TO FL10=FALSE, MOS01=FALSE TO MOS10=FALSE, LNFM=FALSE,

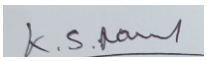


TC#4 : LNI=FALSE, IN01, IN02= TRUE, IN03= FALSE TO IN10=FALSE, FL01=TRUE, FL02=FALSE TO FL10=FALSE, MOS01=FALSE TO MOS10=FALSE, LNFM=FALSE,



TC#5 : LNI=FALSE, IN01= TRUE, IN02= FALSE TO IN10=FALSE, FL01=TRUE, FL02=FALSE TO FL10=FALSE, MOS01=TRUE, MOS02=FALSE TO MOS10=FALSE, LNFM=FALSE,

8.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	05-AUG-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

9 UZGRP

UZGRP typical provides the common functionality for UZ groups in the FGS.

9.1 PURPOSE

UZGRP typical provides the common functionality for UZ groups in the FGS. The functions of the typical are trip latching, alarming and first failure identification.

Functionality:

The UZGRP function block has the following main functions:

- Trip the UZ group if one of the inputs is tripped.
- Initiate a First Failure alarm to indicate which trip came first.
- Latch the UZ trip if a trip condition is active, and no reset has been applied.

For every process group in the system at least one UZ block is used. The typical UZ block is designed for 10 inputs. Depending on the number of inputs to the group, more UZ blocks may be used for a process group. The UZ block can be linked together in a chain by linking the UZ Link and UZ Condition of the next UZ block together. If only one UZ block is used to trip a UZ group the UZ Link input shall be set to TRUE. The trip outputs of input typical and/or voting typical in a UZ group are connected to the inputs of the UZ block. A trip condition on an input of the UZ block will trip the UZ group. This will latch the UZ block, further trips on the inputs will be ignored for failure indication, but still affect the UZ group trip. The output of the UZ block will be used in the application logic to the trip related field outputs. The trip alarm and the first failure flag of the tripped input will be shown in the OWS. The Tripped Outputs Latched status will be shown in the OWS until UZGRP is reset.
After all trip conditions are cleared the UZ typical can be reset via the optional UZRST application typical, by a reset signal from SCS. If the UZ group requires an auto-reset function, then the UZ Condition output has to be connected to the Clear input. The Clear input will only react on a positive trigger. The Clear will not only reset the UZ group but also clears the first failure flag, a reset will only have affect if all trip input conditions are normalized (not tripped).

9.2 LOGIC DIAGRAMS

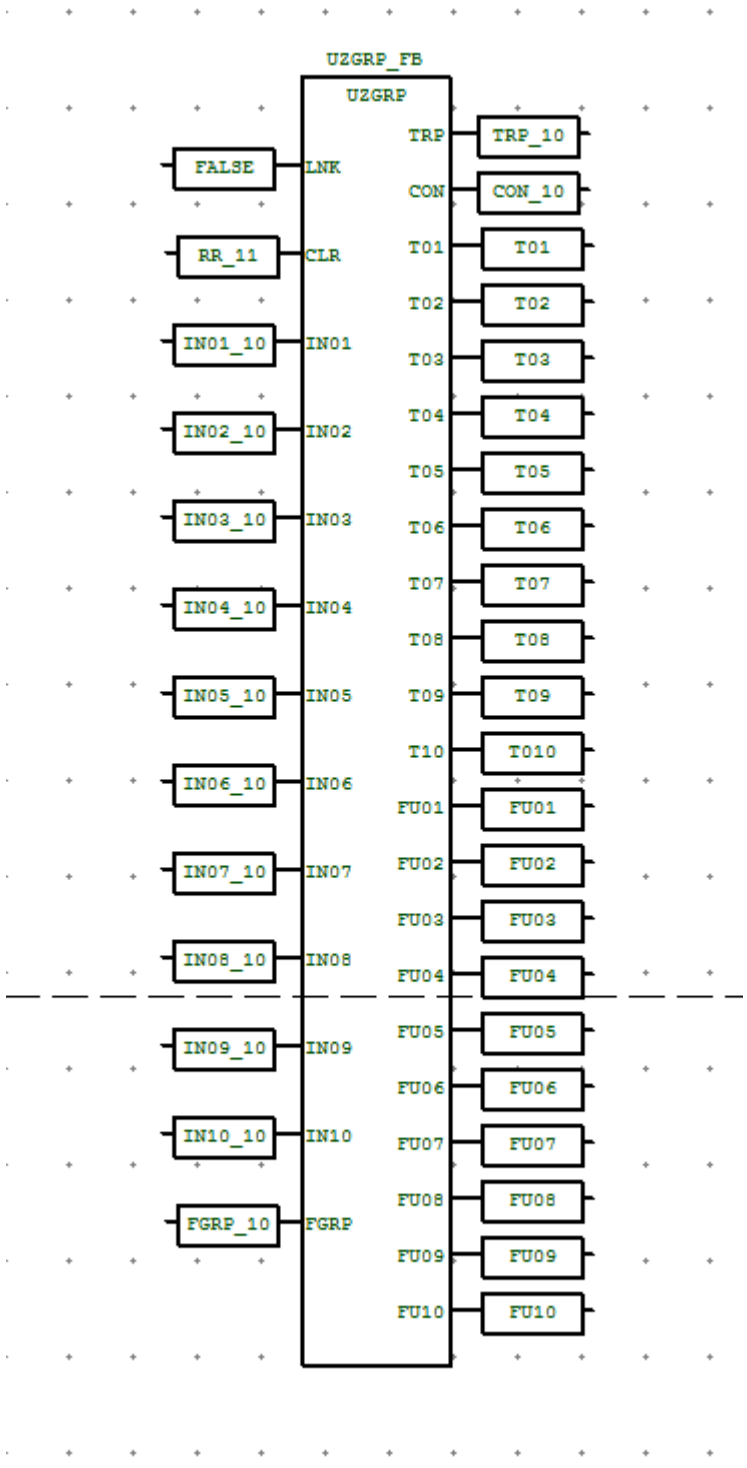
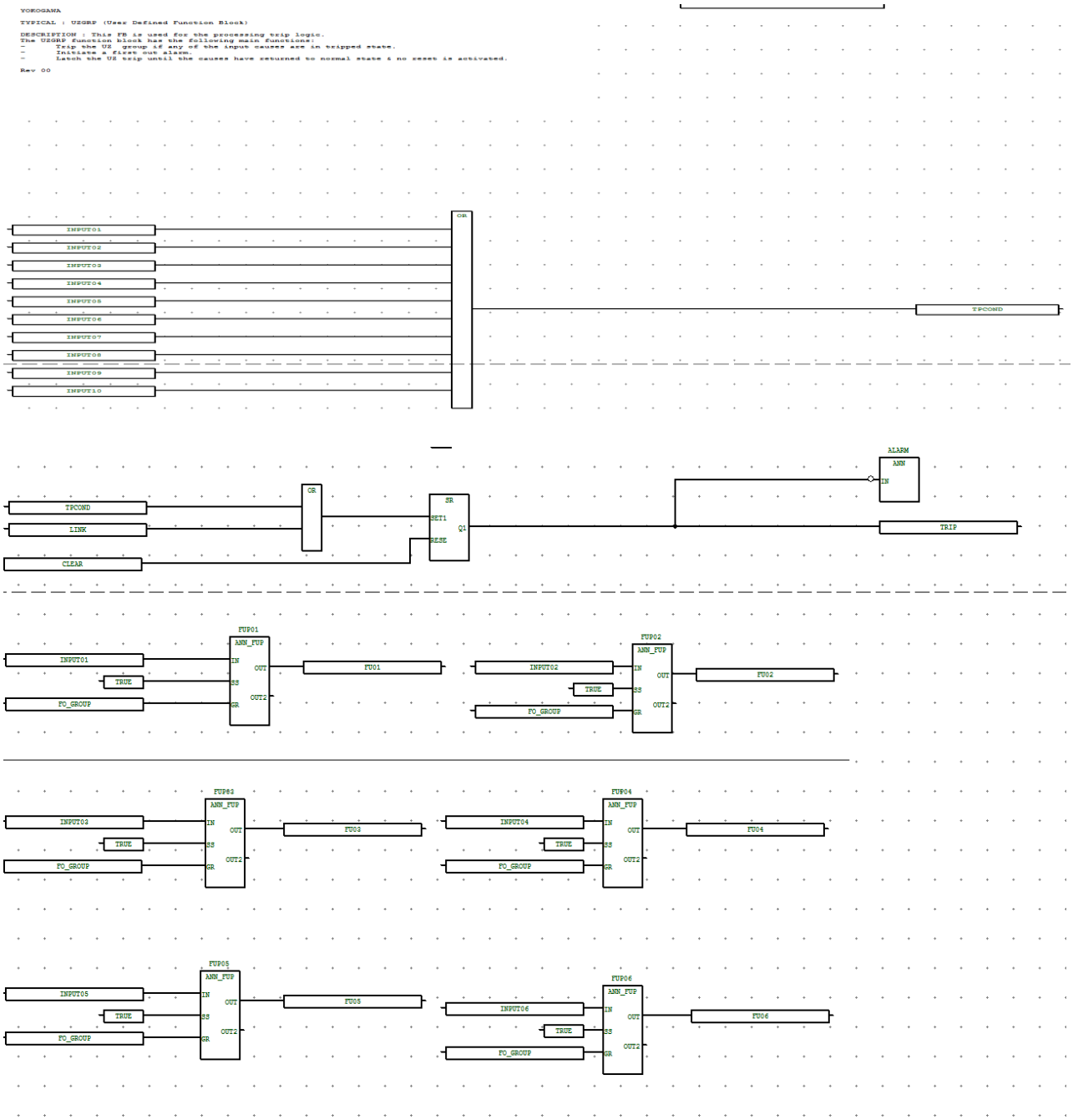
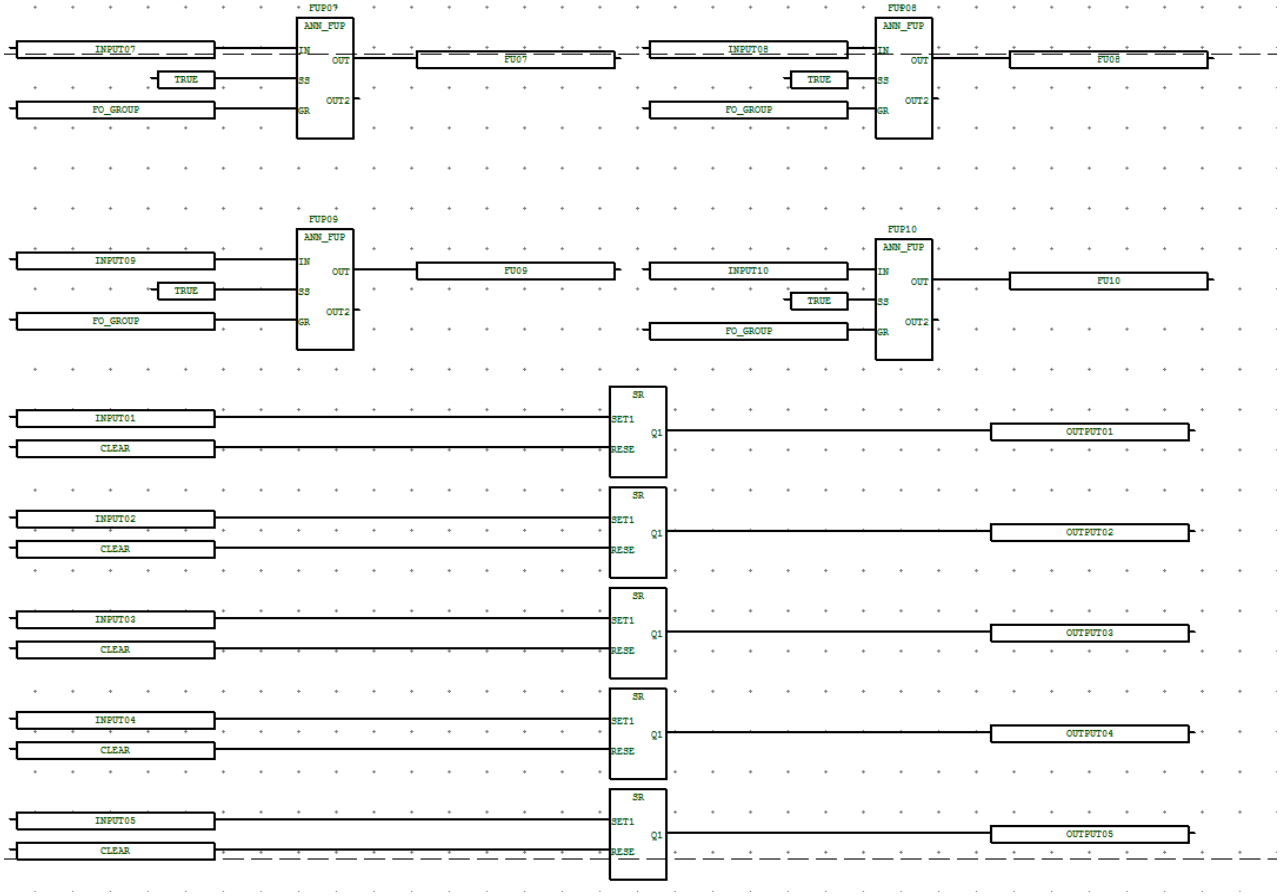


Fig 17 User Defined Function Block UZGRP


YOKOGAWA
TYPICAL : UZGRP (User Defined Function Block)
DESCRIPTION : This FB is used for the processing trip logic.
The UZGRP function block has the following main functions:
- Trip the UZ group if any of the input causes are in tripped state.
- Initiate a first out alarm.
- Latch the UZ trip until the causes have returned to normal state & no reset is activated.
Rev 00
INPUT01
INPUT02
INPUT03
INPUT04
INPUT05
INPUT06
INPUT07
INPUT08
INPUT09
INPUT10
OR
TPCOND
TPCOND
LINK
CLEAR
SR
SET1
RESE
Q1
ALARM
ANN
IN
TRIP
FUP01
ANN_FUP
IN
OUT
SS
OUT2
RR
INPUT01
TRUE
FO_GROUP
FU01
FUP02
INPUT02
FU02
FUP03
INPUT03
FU03
FUP04
INPUT04
FU04
FUP05
INPUT05
FU05
FUP06
INPUT06
FU06


FUP07
ANN_FUP
IN
OUT
FU07
INPUT07
TRUE
SS
OUT2
FO_GROUP
GR
FUP08
ANN_FUP
IN
OUT
FU08
INPUT08
TRUE
SS
OUT2
FO_GROUP
GR
FUP09
ANN_FUP
IN
OUT
FU09
INPUT09
TRUE
SS
OUT2
FO_GROUP
GR
FUP10
ANN_FUP
IN
OUT
FU10
INPUT10
TRUE
SS
OUT2
FO_GROUP
GR
SR
SET1
Q1
INPUT01
CLEAR
RESE
OUTPUT01
SR
SET1
Q1
INPUT02
CLEAR
RESE
OUTPUT02
SR
SET1
Q1
INPUT03
CLEAR
RESE
OUTPUT03
SR
SET1
Q1
INPUT04
CLEAR
RESE
OUTPUT04
SR
SET1
Q1
INPUT05
CLEAR
RESE
OUTPUT05

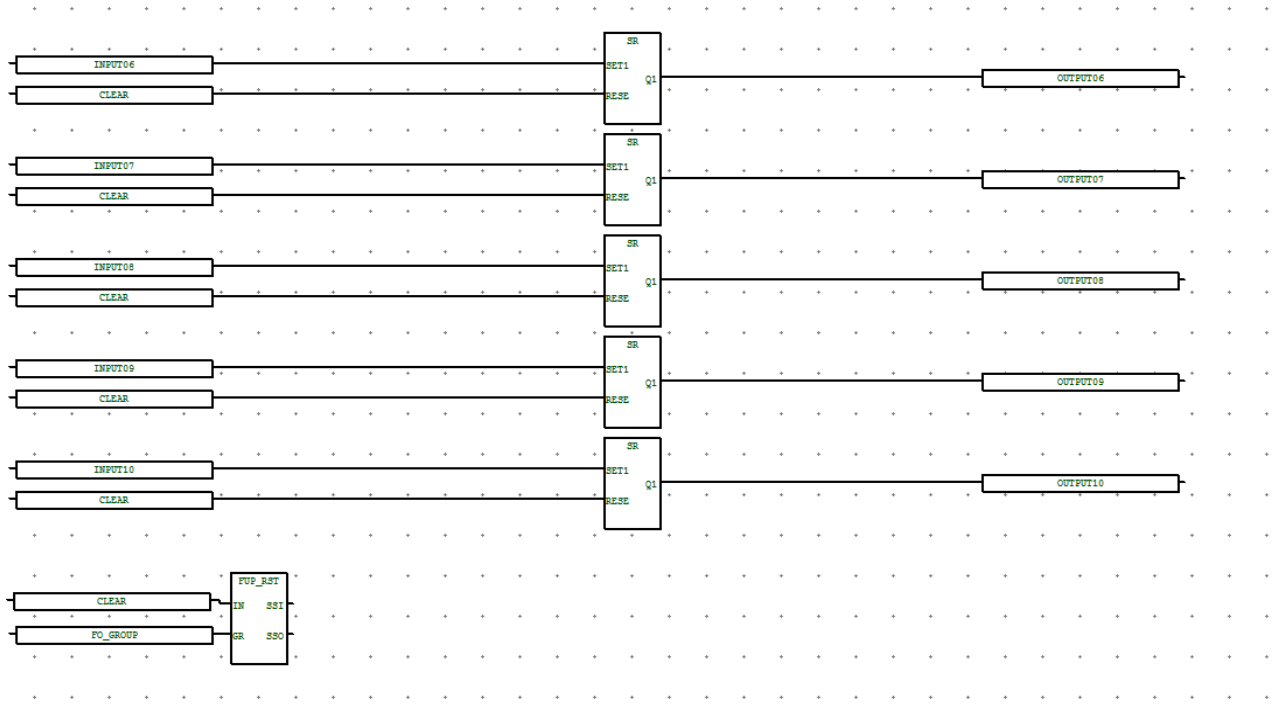


Fig 18 Logic Diagram for Typical UZGRP

9.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
LNK		FALSE
CLR		FALSE
IN01, IN02, IN03….. IN10		FALSE
FGRP		10

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
TRP_10		FALSE
CON_10		FALSE
T01, T02, T03…T10	TRIP OUTPUT	FALSE
FU01, FU02, FU03….FU10		T#10S

9.4 TEST CASES VS EXPECTED RESULTS

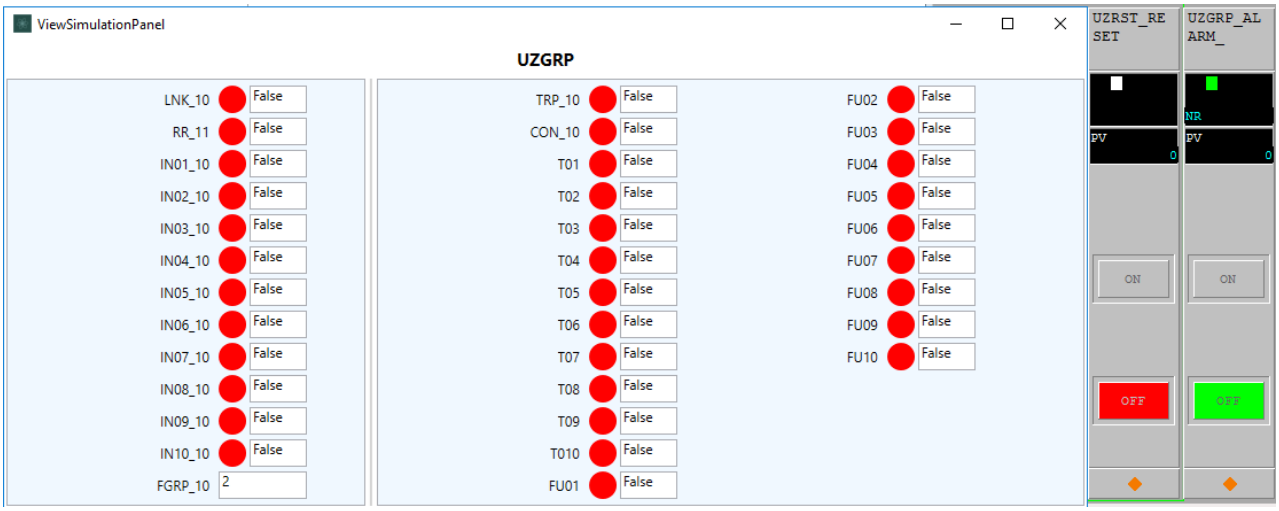
The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

Test Case Number	Test Cases	Input Parameter /Values	Expected Results			
			Trip Signal	Critical Fault	Critical Trip	FU
TC#1	LNK=FALSE CLR = FALSE ALL IN are "FALSE"	LNK=FALSE CLR = FALSE IN01, IN02,…IN09,IN10=FALSE	FALSE	FALSE	FALSE	FALSE
TC#2	LNK=FALSE CLR = FALSE ALL IN are "TRUE"	LNK=FALSE CLR = FALSE IN01 or IN02 or …or IN09 or IN10=TRUE	TRUE	TRUE	TRUE	TRUE
TC#3	LNK=FALSE CLR = FALSE ALL IN are "FALSE"	LNK=FALSE CLR = FALSE IN01, IN02,…IN09,IN10=FALSE	TRUE	FALSE	TRUE	TRUE
TC#4	LNK=FALSE CLR = TRUE ALL IN are "FALSE"	LNK=FALSE CLR = TRUE IN01, IN02,…IN09,IN10=FALSE	FALSE	FALSE	FALSE	FALSE

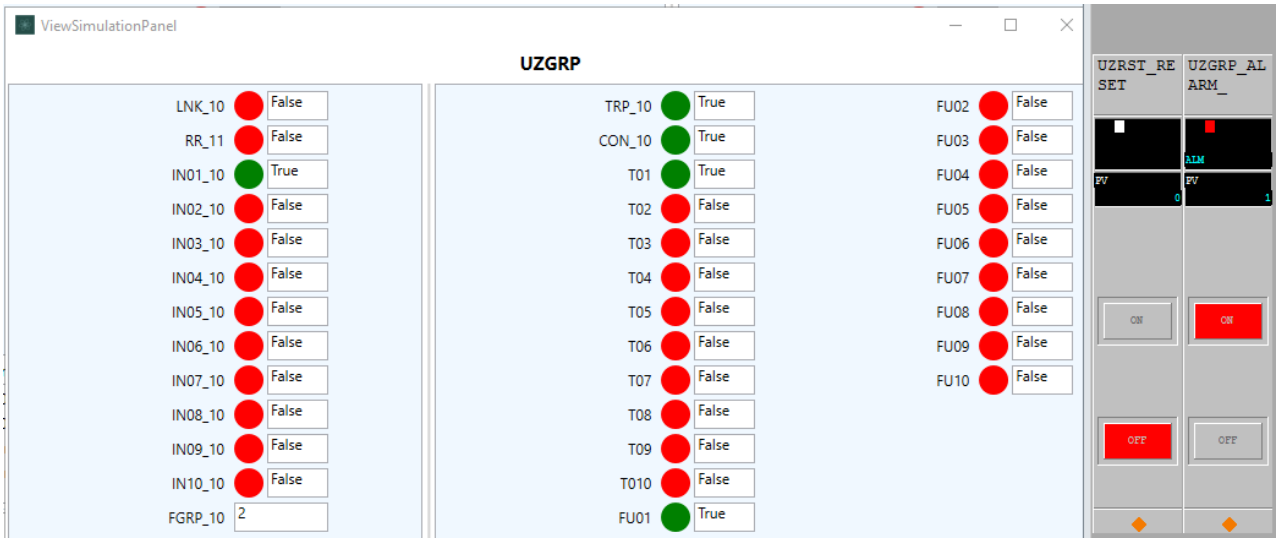
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from "True' to 'False'.

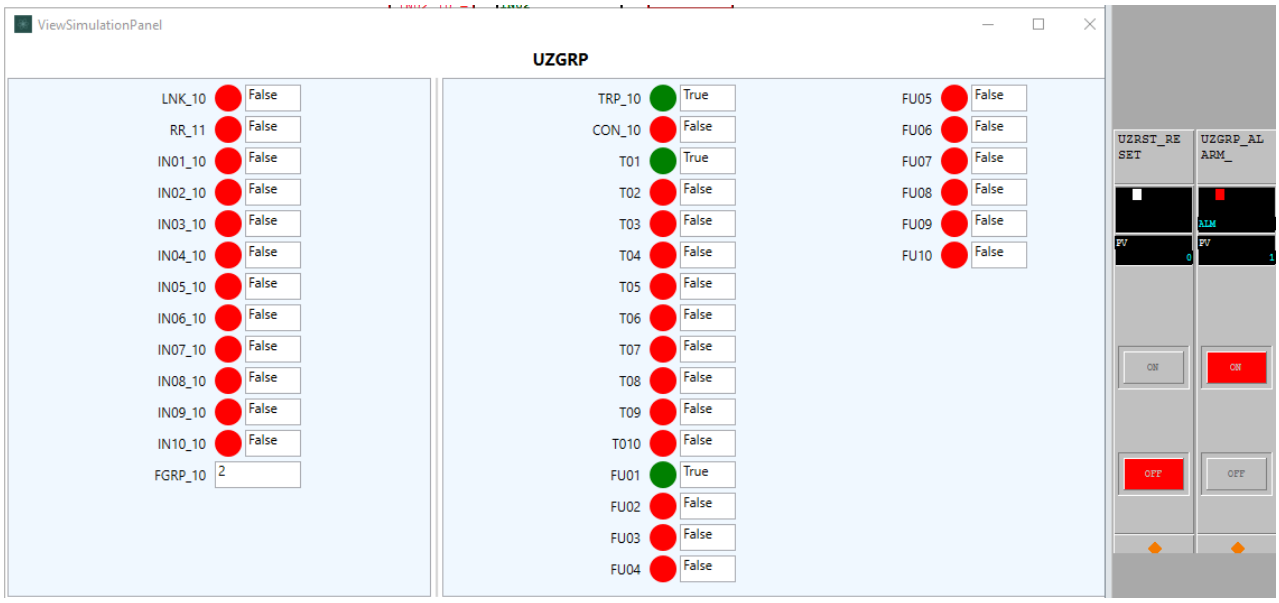
9.5 TEST RESULTS:



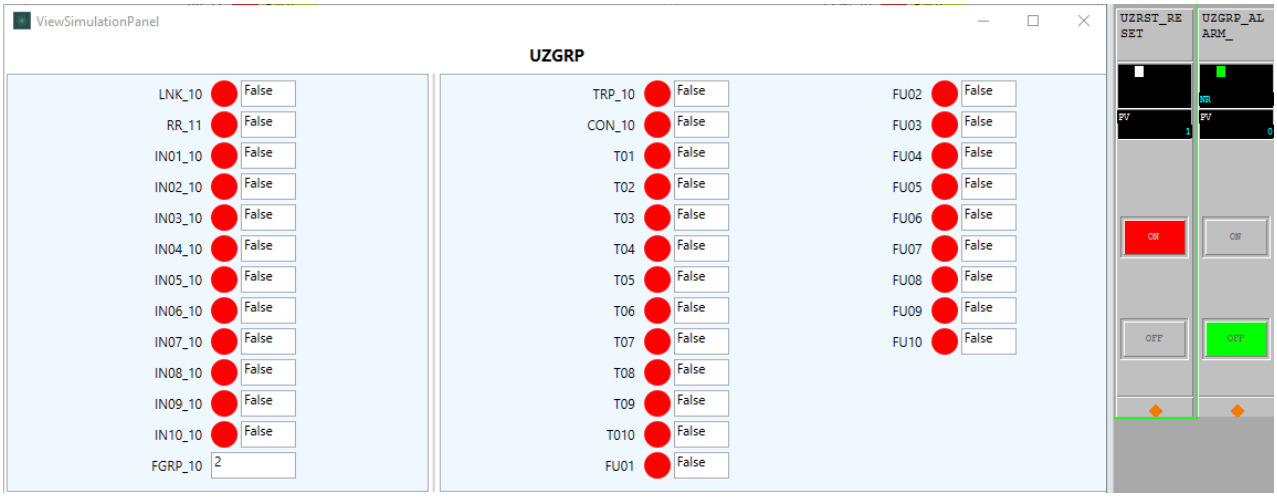
TC#1 : RR=FALSE, IN01 = FALSE, IN02= FALSE, IN03=FALSE, IN04=FALSE, IN05=FALSE, IN06=FALSE, IN07=FALSE, IN08=FALSE, IN09=FALSE, IN10=FALSE, FGRP=2



TC#2 : RR=FALSE, IN01 = TRUE, IN02= FALSE, IN03=FALSE, IN04=FALSE, IN05=FALSE, IN06=FALSE, IN07=FALSE, IN08=FALSE, IN09=FALSE, IN10=FALSE, FGRP=2

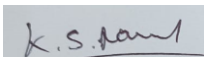


TC#3 : RR=FALSE, IN01 = FALSE, IN02= FALSE, IN03=FALSE, IN04=FALSE, IN05=FALSE, IN06=FALSE, IN07=FALSE, IN08=FALSE, IN09=FALSE, IN10=FALSE, FGRP=2



TC#4 : RR=TRUE, IN01 = FALSE, IN02= FALSE, IN03=FALSE, IN04=FALSE, IN05=FALSE, IN06=FALSE, IN07=FALSE, IN08=FALSE, IN09=FALSE, IN10=FALSE, FGRP=2

9.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	05-AUG-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

10 UZRST

UZRST typical will be used to reset UZ safety groups which require a manual reset (from OWS) after a trip.

10.1 PURPOSE

This typical will be used to reset UZ safety groups which require a manual reset (from OWS) after a trip. The UZRST block has an input to indicate UZ trip status and an output to reset UZGRP logic.

Functionality:

The UZRST function block has the following main functions:

- Reset UZ groups only when SCS Reset operated from OWS or field reset switch has been applied
- Indicate that SCS reset is allowed.

This typical will be used to reset UZ safety groups which require a manual reset (from OWS) after a trip. The UZRST block has an input to indicate UZ trip status and an output to reset UZGRP logic.

To indicate that a SCS reset is allowed (i.e. Permissive is ‘TRUE’) the status (Ok to Reset) is sent to OWS. After the reset from OWS, the Ok to Reset status will go off.

Push button field input reset is designed for normally open-momentary closed contacts to reset.

10.2 LOGIC DIAGRAMS

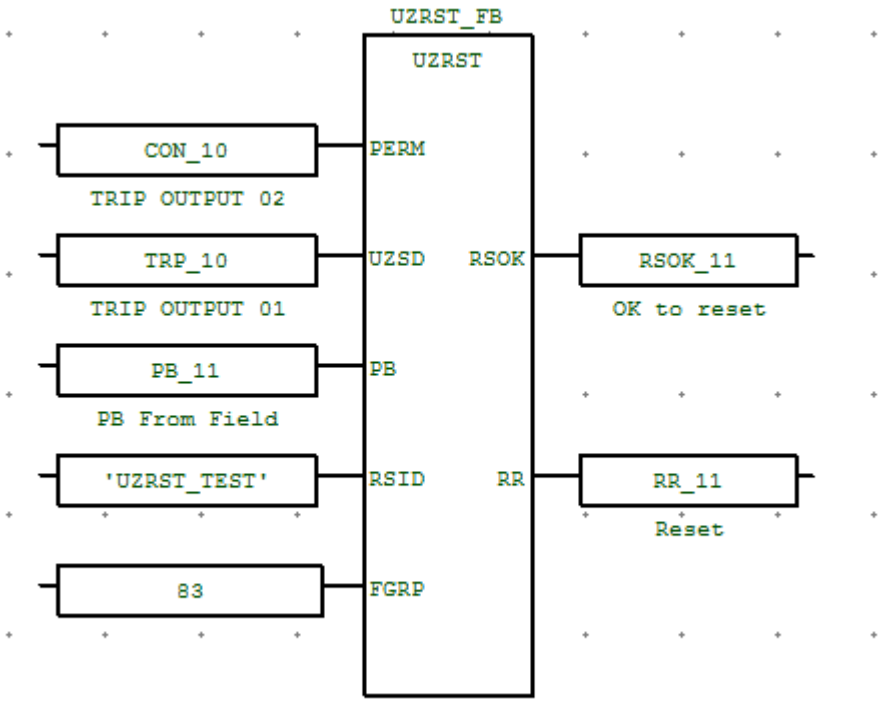


Fig 19 User Defined Function Block UZRST

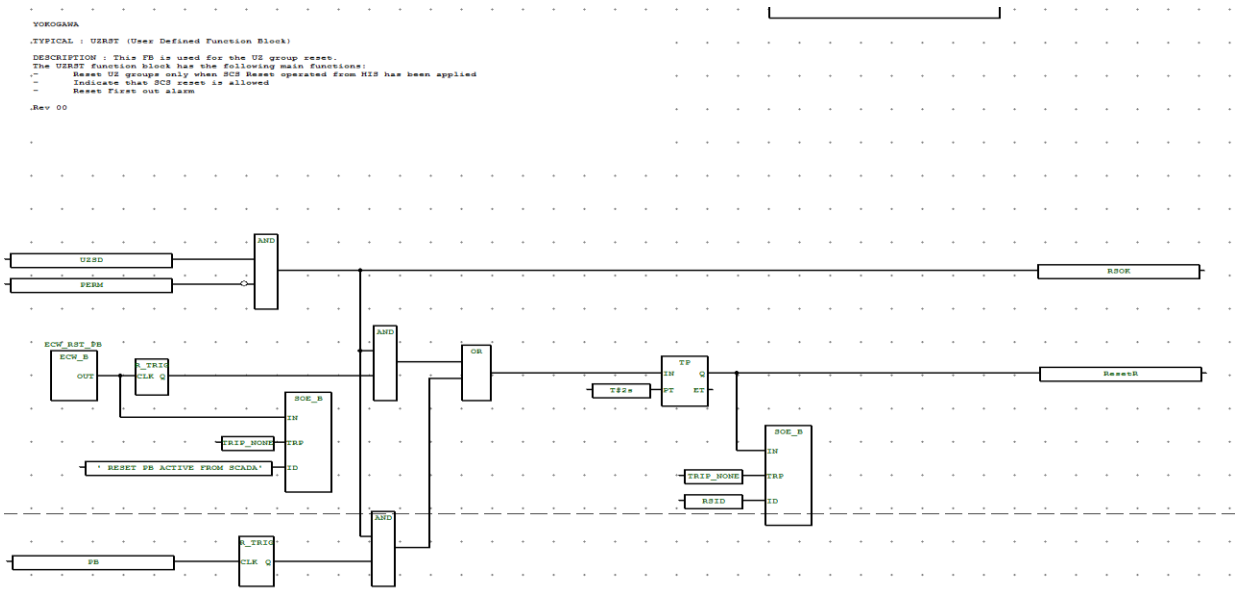


Fig 20 Logic Diagram for Typical UZRST

10.3 PREDEFINED VALUES

Predefined Input Parameter values that are indicated below shall be considered for functional test.

Short Name	Description	Predefined Values
PERM	PERM is the Reset Permissive	FALSE
UZSD	UZSD is the UZ Group Trip Status	FALSE
PB	PB is the Field Reset Push Button	FALSE
RSID	RSID is the comment for the “SOE”	"XXXXXXXXX"
FGRP	FGRP is the Group Number	"83"

Expected output Parameter values that are indicated below shall be verified before start of functional test.

Short Name	Description	Predefined Values
RSOK	RSOK is the OK to Reset	FALSE
RR	UZ Reset	FALSE

10.4 TEST CASES VS EXPECTED RESULTS

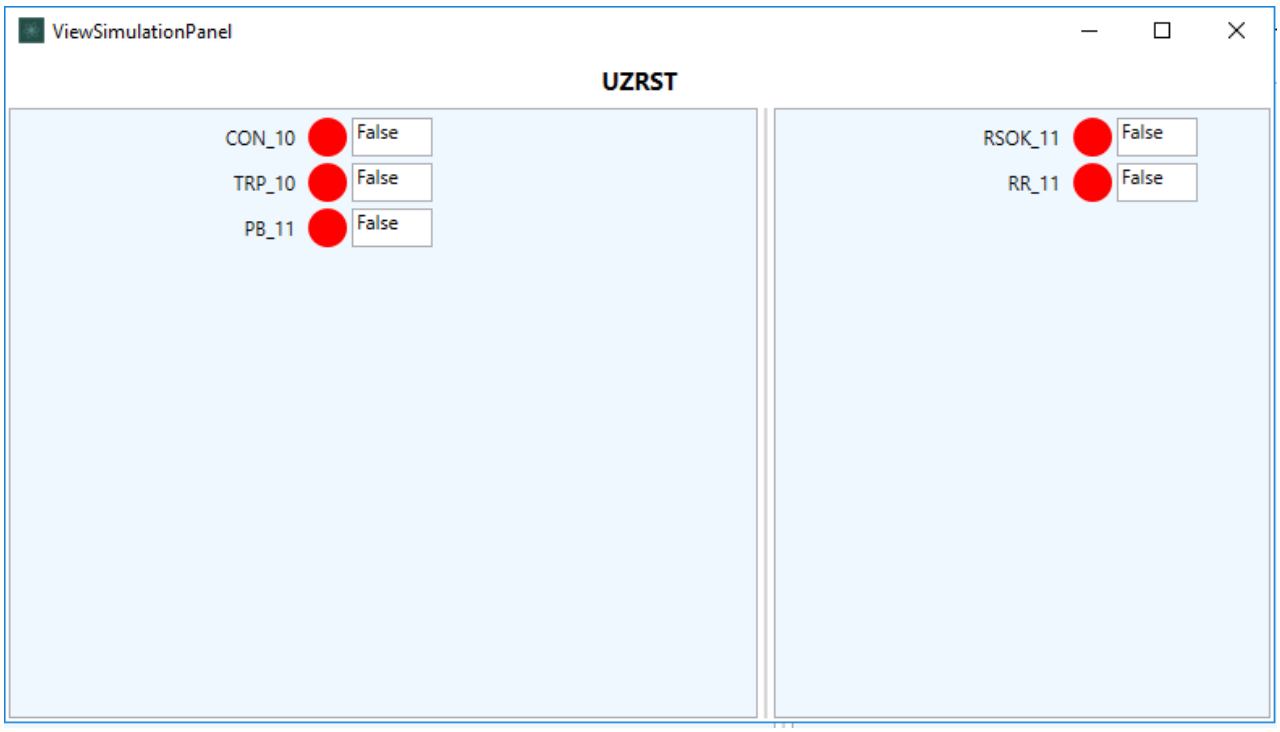
The required input parameters shall be changed from the predefined values based on individual test cases described below to carry out one hundred percent path test. Typical shall be normalized prior to apply the below test cases and make sure typical should read output parameters as stated in the expected output parameter values under 'Predefined Values' section.

Test Case Number	Test Cases	Input Parameter /Values	Expected Results	
			RSOK	RR
TC#1	PERM = FALSE, UZSD = FALSE, PB = FALSE,	PERM = FALSE, UZSD = FALSE, PB = FALSE,	FALSE	FALSE
TC#2	PERM = TRUE, UZSD = TRUE, PB = FALSE,	PERM = TRUE, UZSD = TRUE, PB = FALSE,	FALSE	FALSE
TC#3	PERM = FALSE, UZSD = TRUE, PB = FALSE, UZRST_MOS=FALSE	PERM = FALSE, UZSD = TRUE, PB = FALSE, UZRST_MOS=FALSE	TRUE	FALSE
TC#3	PERM = FALSE, UZSD = TRUE, PB = FALSE, UZRST_MOS=TRUE	PERM = FALSE, UZSD = TRUE, PB = FALSE, UZRST_MOS=TRUE	FALSE	FALSE

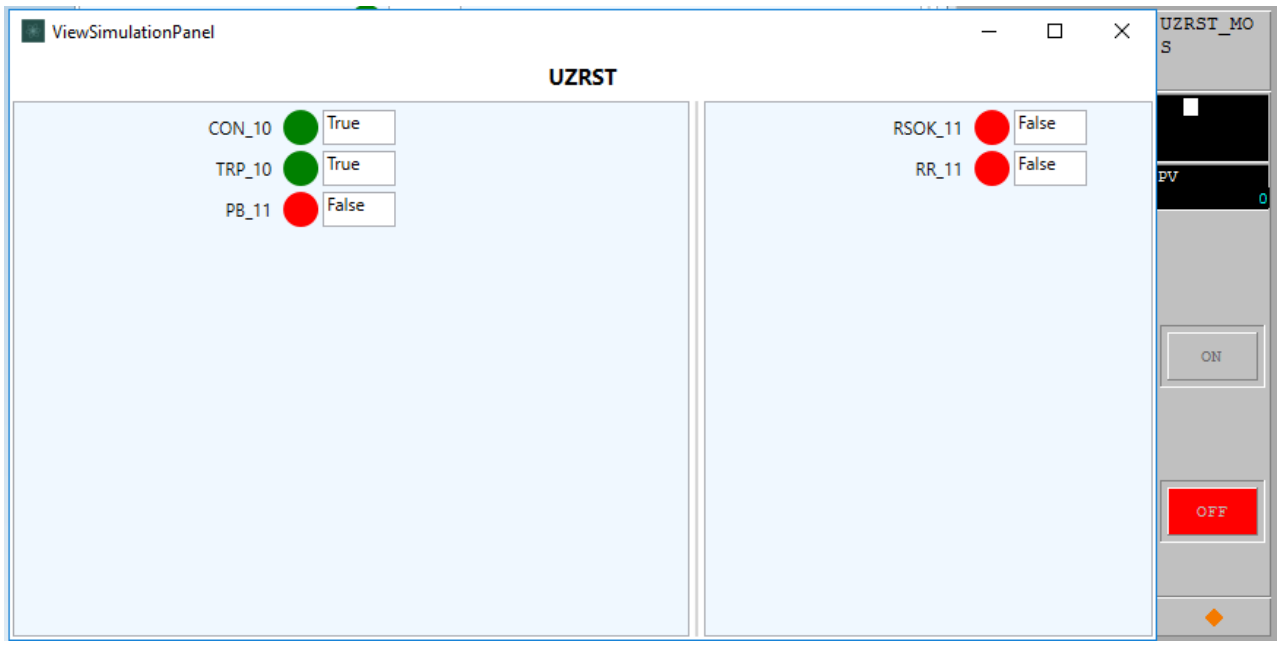
Note:

- N/A which are highlighted grey colour indicates that there is no change in the state. (Change not applicable).
- False Indicates Alarm / Trip value changes from "True' to 'False'.

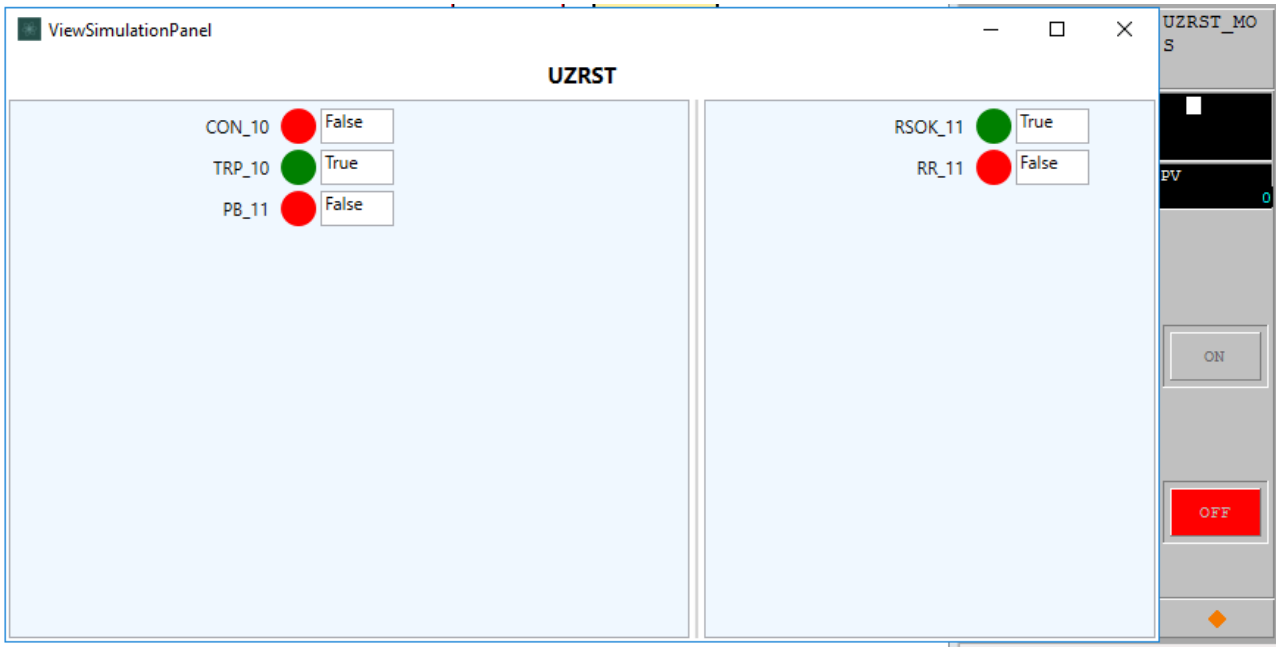
10.5 TEST RESULTS:



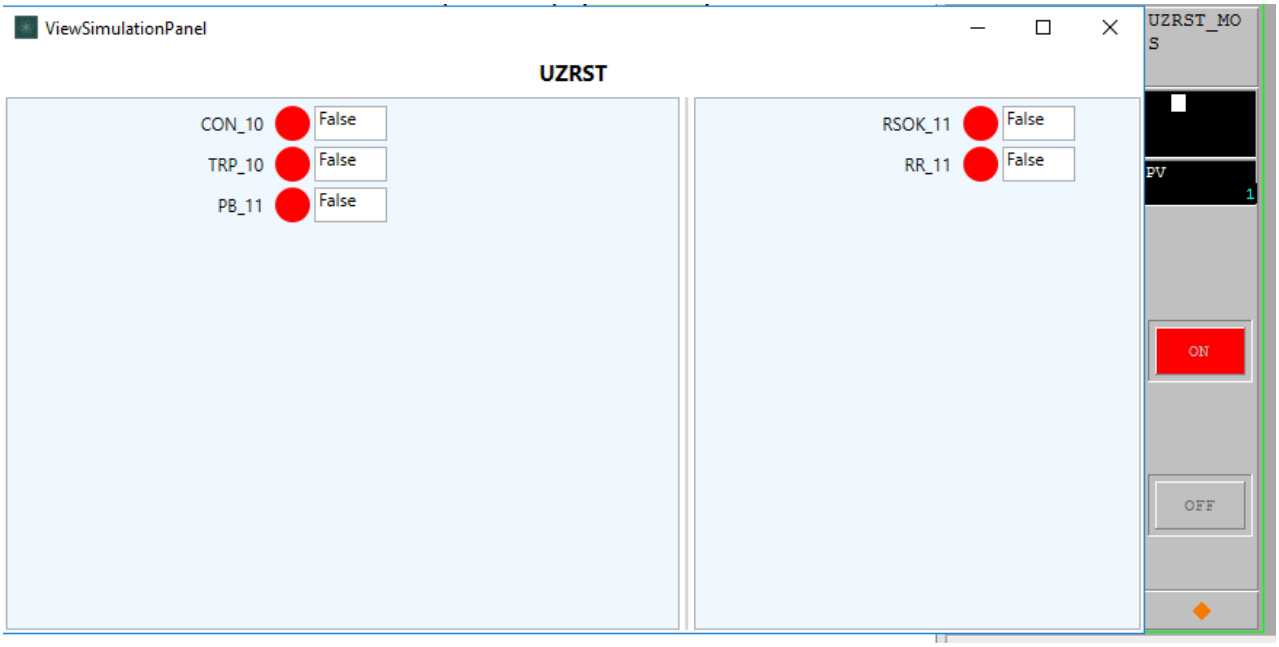
TC#1 : PERM= TRUE, UZSD = FALSE, PB = FALSE



TC#2 : PERM= TRUE, UZSD = TRUE, PB = FALSE



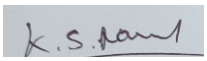
TC#3 : PERM= FALSE, UZSD = TRUE, PB = FALSE



TC#4 : PERM= FALSE, UZSD = TRUE, PB = FALSE, UZRST_MOS= TRUE

Note: (UZSD turns to ‘FALSE’ after timer reaches for 2Sec once the UZRST_MOS is turned ‘ON’)

10.6 SIGNOFF

Functional Check Test Result (**Pass/Fail**)	:	PASS
Test Engineer Name	:	NANDAGOPAL.K.S.
Signature	:	
Date	:	05-AUG-2024

Note:

- Pass / Fail criteria for functional test is based on comparing expected test results with actual test results recorded during simulation environment in IO Simulation Tool.
- Any mismatch observed during manual comparison of expected vs. actual test result then test is considered to be failed. Required logic correction shall be applied and typical to be retested again completely.

Updated on : 09 Jan 2024

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
1.	ABB	264DS	Differential Pressure Transmitter	0004	01/01		
2.	ABB	264DS	Differential Pressure Transmitter	0004	02/01		
3.	ABB	264IB	Multivariable Field Indicator	0006	01/01		
4.	ABB	265DS	Pressure Transmitter	0089	02/01		
5.	ABB	267CS	Multivariable Pressure Transmitter	008A	02/01		
6.	ABB	2600T series-Model 266 P-dP	Differential,Gauge Absolute-Pressure Transmitter	0007	01/01	Firmware Rev :7.01.04	
7.	ABB	2600T Series ・Model 266 P-dP	Differential, Gauge, Absolute Pressure Transmitter	0007	02/03	Enhanced DD	
8.	ABB	FCM2000	Coriolis Mass Flowmeter	0018	01/01		
9.	ABB	ProcessMaster/ HygienicMaster FEX300/FEX 500	Electromangnetic Flowmeter	0124	01/01		
10.	ABB	FSM4000	Magmeter	0017	01/01		
11.	ABB	FXE4000	Magmeter	0016	02/01		
12.	ABB	TB82EC	Four-Electrode Conductivity Transmitter	0051	01/01		
13.	ABB	TB82PH	pH/ORP/pION Transmitter	0050	01/01		
14.	ABB	TB82PH	pH/ORP/pION Transmitter	0050	02/02		
15.	ABB	TB82TC	Toroidal Conductivity Transmitter	0053	01/01		
16.	ABB	TB82TE	Two-Electrode Conductivity Transmitter	0052	01/01		
17.	ABB	TF02(-Ex) / TF202(-Ex)	Temperature Transmitter	001E	01/01		

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
18.	ABB	TRIO-WIRL VT40	Vortex Flowmeter	0015	01/01		
19.	ABB	TRIO-WIRL FV4000/ FS4000	Vortex Flowmeter	0015	02/01		
20.	ABB	TTX300	Temperature Transmitter	001F	01/01	Enhanced DD	
21.	ABB	TZID-C120/220	Valve Positioner	0028	02/02		
22.	ABB	LMT100/200/300	Magnetostrictive Level Transmitters	0096	01/01	Firmware revision 15.05.04	
23.	ASCO	ASCO FF 4449	Valve Controller	4449	01/01		
24.	AUMA	AUMATIC AC 01.2 ACExC 01.2 FF H1	Electric Actuator / Valve Positioner	0001	01/01	Enhanced DD	
25.	AUMA	AUMATIC FF H1	Valve Positioner	01F8	01/01		
26.	AZBIL CORPORATION	AVP303	Valve Positioner	0203	01/01		
27.	AZBIL CORPORATION	AVP303	Valve Positioner	0203	02/01		X: Supported
28.	AZBIL CORPORATION	AVP304	Valve Positioner	1101	02/01		
29.	AZBIL CORPORATION	AVP703	Valve Positioner	1701	01/03		
30.	AZBIL CORPORATION	DSTJ3000, New Ace	Pressure Transmitter	0103	01/02		
31.	AZBIL CORPORATION	MagNew	Magnetic Flow Meter	0001	02/02		
32.	AZBIL CORPORATION	ST3000	Pressure Transmitter	0103	01/02		
33.	AZBIL CORPORATION	Thermonex	Temperature Transmitter	0401	01/02		
34.	AZBIL CORPORATION	MagneW3000 PLUS+/FLEX+	Electromagnetic Flowmeter	1601	01/03	Enhanced DD	
35.	AZBIL CORPORATION	AT9000 Advanced Transmitter Model GTX	Pressure Transmitter	1501	01/01	Enhanced DD	
36.	BEKA	BA414DF (BA414DF Series)	Fieldbus Indicator	0414	01/01		

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
37.	BEKA	BA484DF (BA488CF Series)	Fieldbus Display	0488	01/01		X: Supported
38.	BEKA	BA484DF (BA488CF Series)	Fieldbus Display	0488	02/01		
39.	BIFFI	ICON2000	Valve Positioner	0100	01/02	Obsolete	
40.	BIFFI	ICON2000	Valve Positioner	0100	01/01	Obsolete	
41.	BIFFI	FF2000 v4	Electric Actuator-Valve Positioner	0001	01/01		
42.	BIFFI	FF2000 v4	Electric Actuator-Valve Positioner	0001	02/01	5.71(major) A2.02(minor)	
43.	BIFFI	FF2000 v4	Electric Actuator-Valve Positioner	0001	03/01	Enhanced DD Firmware 6.15	
44.	BIFFI	FF 2000 v4	Electric Actuator-Valve Positioner	0001	03/01	Enhanced DD Firmware 7.00 Tested with STARDOM/CENTUM	
45.	CHONGQING	FlowMaster EM Flow Meter	Electromagnetic Flowmeter	0001	01/01		
46.	CSI	9210	Machinery Health Transmitter	9210	02/01		
47.	DET-TRONICS	FlexVu UD10	Universal Display	0001	01/01		
48.	DRAEGER SAFETY	Polytron7xxx	Gas Detector	00EB	01/01		
49.	DRAEGER SAFETY	Polytron8000	Gas Detector	0001	01/01	Enhanced DD	
50.	DREHMO GMBH	DREHMO i-matic	Electric Actuator	0007	01/01		
51.	DREHMO GMBH	DREHMO i-matic	Electric Actuator	0007	02/01		
52.	DRESSER INC	FVP	Valve Positioner	0001	03/04		X: Supported
53.	DRESSER INC	FVP	Valve Positioner	0001	04/01		X: Supported
54.	DRESSER INC	FVP	Valve Positioner	0001	05/01		
55.	DRESSER INC	FVP (Software Download)	Valve Positioner	0007	02/01		X: Supported
56.	DRESSER INC	FVP (Software Download)	Valve Positioner	0007	03/01		X: Supported

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
57.	EIM CONTROLS INC	DCM Fieldbus Actuator	Electric Valve Actuator	EDC2	01/01	1.11.00 Mon Aug 03 11:13:01 2009by WangPeng	
58.	EIM CONTROLS INC	DCM Fieldbus Actuator	Electric Valve Actuator	EDC2	02/01	1.13.00 Fri Dec 25 14:22:11 2009 by WangPeng	
59.	EMERSON AUTOMATION SOLUTIONS	Magtech LTM-350FF	Magnetostrictive Level Transmitter	0102	01/01		
60.	EMERSON AUTOMATION SOLUTIONS	2051	Pressure Transmitter	2051	01/01		
61.	EMERSON AUTOMATION SOLUTIONS	2051	Pressure Transmitter	2051	02/01	Enhanced DD	
62.	EMERSON AUTOMATION SOLUTIONS	2240	16 Input Temperature Transmitter	2240	02/01		
63.	EMERSON AUTOMATION SOLUTIONS	2230	Graphic Field Display	2230	03/03	Enhanced DD	
64.	EMERSON AUTOMATION SOLUTIONS	3051C	Pressure Transmitter	3051	07/02		
65.	EMERSON AUTOMATION SOLUTIONS	3051C	Pressure Transmitter	3051	08/01	Tested with STARDOM/CENTUM Enhanced DD	
66.	EMERSON AUTOMATION SOLUTIONS	3051S	Pressure Transmitter	3051	14/02		X: Supported
67.	EMERSON AUTOMATION SOLUTIONS	3051S	Pressure Transmitter	3051	17/03		

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
68.	EMERSON AUTOMATION SOLUTIONS	3051S	Pressure Transmitter	3051	18/01	Enhanced DD	
69.	EMERSON AUTOMATION SOLUTIONS	3051S	MultiVariable Transmitter	3151	01/01	Enhanced DD	
70.	EMERSON AUTOMATION SOLUTIONS	3095	Pressure Transmitter	3095	01/01		
71.	EMERSON AUTOMATION SOLUTIONS	3244MV	Temperature Transmitter	3244	05/02		X: Supported
72.	EMERSON AUTOMATION SOLUTIONS	3144P	Temperature Transmitter	3144	01/01		X: Supported
73.	EMERSON AUTOMATION SOLUTIONS	3144P	Temperature Transmitter	3144	01/03	Firmware 001.01.010	
74.	EMERSON AUTOMATION SOLUTIONS	3144P	Temperature Transmitter	3144	02/01		
75.	EMERSON AUTOMATION SOLUTIONS	3144P	Temperature Transmitter	3144	03/03	Enhanced DD	
76.	EMERSON AUTOMATION SOLUTIONS	3900	Radar Level Transmitter	3900	01/01		
77.	EMERSON AUTOMATION SOLUTIONS	5300 Series	Guided Wave Radar Level and Interface Transmitter	5300	01/03		
78.	EMERSON AUTOMATION SOLUTIONS	5300 Series	Guided Wave Radar Level and Interface Transmitter	5300	02/01		

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
79.	EMERSON AUTOMATION SOLUTIONS	5300 Series	Guided Wave Radar Level and Interface Transmitter	5300	03/01		
80.	EMERSON AUTOMATION SOLUTIONS	5300 Series	Guided Wave Radar Level and Interface Transmitter	5300	04/01	Enhanced DD	
81.	EMERSON AUTOMATION SOLUTIONS	5300 Series	Guided Wave Radar Level and Interface Transmitter	5300	04/05	Enhanced DD	
82.	EMERSON AUTOMATION SOLUTIONS	5400 Series	Radar Level Transmitter	5400	02/01		
83.	EMERSON AUTOMATION SOLUTIONS	5400 Series	Radar Level Transmitter	5400	03/01		
84.	EMERSON AUTOMATION SOLUTIONS	5400 Series	Radar Level Transmitter	5400	04/01	Enhanced DD	
85.	EMERSON AUTOMATION SOLUTIONS	5408	Level Transmitter	5408	01/01	Enhanced DD	
86.	EMERSON AUTOMATION SOLUTIONS	5600	Radar Level Transmitter	5600	01/01		
87.	EMERSON AUTOMATION SOLUTIONS	5900	Radar Level Transmitter	5900	02/01		
88.	EMERSON AUTOMATION SOLUTIONS	5900	Radar Level Transmitter	5900	03/01	Enhanced DD	
89.	EMERSON AUTOMATION SOLUTIONS	644	Temperature Transmitter	0644	01/01		X: Supported

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
90.	EMERSON AUTOMATION SOLUTIONS	644	Temperature Transmitter	0644	02/01		
91.	EMERSON AUTOMATION SOLUTIONS	752	Remote Indicator	0752	02/01		X: Supported
92.	EMERSON AUTOMATION SOLUTIONS	752	Remote Indicator	0752	03/01		
93.	EMERSON AUTOMATION SOLUTIONS	752	Remote Indicator	0752	04/01	Enhanced DD	
94.	EMERSON AUTOMATION SOLUTIONS	848L	Discrete IO	848D	01/01		
95.	EMERSON AUTOMATION SOLUTIONS	848T	Eight Input Temperature Transmitter	0848	04/09		X: Supported
96.	EMERSON AUTOMATION SOLUTIONS	848T	Eight Input Temperature Transmitter	0848	05/04		
97.	EMERSON AUTOMATION SOLUTIONS	848T	Eight Input Temperature Transmitter	0848	06/01		
98.	EMERSON AUTOMATION SOLUTIONS	848T	Temperature Transmitter	0848	07/01		
99.	EMERSON AUTOMATION SOLUTIONS	848T	Temperature Transmitter	0848	08/01	Enhanced DD	
100	EMERSON AUTOMATION SOLUTIONS	8732E	Magnetic Flow Transmitter	8732	02/01		

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
101	EMERSON AUTOMATION SOLUTIONS	8732E	Magnetic Flow Transmitter	8732	03/01	Enhanced DD	
102	EMERSON AUTOMATION SOLUTIONS	8742	Mag Flow Meter	8742	04/02		
103	EMERSON AUTOMATION SOLUTIONS	8742	Mag Flow Meter	8742	05/01		
104	EMERSON AUTOMATION SOLUTIONS	8800	Vortex Flowmeter	8800	04/02		
105	EMERSON AUTOMATION SOLUTIONS	8800	Vortex Flowmeter	8800	05/01		X: Supported
106	EMERSON AUTOMATION SOLUTIONS	8800	Vortex Flowmeter	8800	07/01		
107	EMERSON AUTOMATION SOLUTIONS	8800	Vortex Flowmeter	8800	09/01		
108	EMERSON AUTOMATION SOLUTIONS	8800	Vortex Flowmeter	8800	10/03	Enhanced DD	
109	EMERSON AUTOMATION SOLUTIONS	2240S	Multi-Input Temperature Transmitter	2240	03/01	Enhanced DD	
110	EMERSON AUTOMATION SOLUTIONS	700XA	Gas Chromatograph	2001	01/03		
111	EMERSON AUTOMATION SOLUTIONS	1500XA	Gas Chromatograph	2002	01/01		

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
112	EMERSON AUTOMATION SOLUTIONS	5081-A-FF	Amperometric Transmitter	4083	02/01		
113	EMERSON AUTOMATION SOLUTIONS	5081C/T	Conductivity Transmitter	4084	01/01		X: Supported
114	EMERSON AUTOMATION SOLUTIONS	5081-C/T-FF	Conductivity Transmitter	4084	02/01		
115	EMERSON AUTOMATION SOLUTIONS	5081pH/ORP	Conductivity Transmitter	4085	01/01		X: Supported
116	EMERSON AUTOMATION SOLUTIONS	5081-P-FF	pH/ORP Transmitter	4085	02/01		
117	EMERSON AUTOMATION SOLUTIONS	5081-P-FF	pH/ORP Transmitter	4085	03/03	Enhanced DD	
118	EMERSON AUTOMATION SOLUTIONS	Oxymitter 5000	Oxygen Transmitter	4000	03/01		
119	EMERSON AUTOMATION SOLUTIONS	Oxymitter 5000	Oxygen Transmitter	4000	04/01		
120	EMERSON AUTOMATION SOLUTIONS	MLT Analyzer	Multi-Component Continuous Gas Analyzer	1100	01/01		
121	EMERSON AUTOMATION SOLUTIONS	1066-CT-FF	Conductivity Transmitter	4091	01/03	Enhanced DD	
122	EMERSON AUTOMATION SOLUTIONS	1066-P-FF	pH/ORP/Redox Transmitter	4089	01/05	Enhanced DD	

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
123	EMERSON AUTOMATION SOLUTIONS	1066-DO-CL-OZ-FF	Oxygen/Chlorine and Ozone Transmitter	4090	01/03	Enhanced DD	
124	EMERSON AUTOMATION SOLUTIONS	DLC3020F	Digital Level Controller	3020	01/01		
125	EMERSON AUTOMATION SOLUTIONS	DLC3020F	Digital Level Controller	3020	01/05		
126	EMERSON AUTOMATION SOLUTIONS	DVC5000F-SC	Digital Valve Controller	5420	08/03		X:Supported
127	EMERSON AUTOMATION SOLUTIONS	DVC5000F-SC	Digital Valve Controller	5420	09/03		X:Supported
128	EMERSON AUTOMATION SOLUTIONS	DVC6000F	Digital Valve Controller	4601	01/02	SOFTWARE REVISION: 1.0.7.2.1	X:Supported
129	EMERSON AUTOMATION SOLUTIONS	DVC6000F	Digital Valve Controller	4601	01/02	SOFTWARE REVISION: 1.3.2.2.2	X:Supported
130	EMERSON AUTOMATION SOLUTIONS	DVC6000F	Digital Valve Controller	4601	01/02	SOFTWARE REVISION: 1.4.6.2.2	X:Supported
131	EMERSON AUTOMATION SOLUTIONS	DVC6000F	Digital Valve Controller	4601	01/02	SOFTWARE REVISION: 1.5.18.2.2	X:Supported
132	EMERSON AUTOMATION SOLUTIONS	DVC6000F	Digital Valve Controller	4601	01/02	SOFTWARE REVISION: 1.5.19.2.2	
133	EMERSON AUTOMATION SOLUTIONS	DVC6200F/DVC6000F	Digital Valve Controller	4602	02/01	Tested with STARDOM/CENTUM	

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
134	EMERSON AUTOMATION SOLUTIONS	Fisher DVC6200f / DVC6000f	Digital Valve Controller	4602	04/03	Enhanced DD	
135	ENDRESS+HAUSER	Cerabar S	Pressure Transmitter	1007	06/01		
136	ENDRESS+HAUSER	Cerabar S	Pressure Transmitter	1007	06/03		
137	ENDRESS+HAUSER	Cerabar S	Pressure Transmitter	1007	07/02		X: Supported
138	ENDRESS+HAUSER	Cerabar M 5x	Pressure Transmitter	1019	01/01		X: Supported
139	ENDRESS+HAUSER	Cerabar M 5x	Pressure Transmitter	1019	01/03	Enhanced DD	X: Supported
140	ENDRESS+HAUSER	Deltabar M 5x	Differential Pressure Transmitter	1021	01/01		X: Supported
141	ENDRESS+HAUSER	Deltabar M 5x	Differential Pressure Transmitter	1021	01/03	Enhanced DD	X: Supported
142	ENDRESS+HAUSER	Deltabar S	Differential Pressure Transmitter	1009	06/01		
143	ENDRESS+HAUSER	Deltabar S	Differential Pressure Transmitter	1009	06/03	V03.00.08	
144	ENDRESS+HAUSER	Deltabar S	Differential Pressure Transmitter	1009	07/02	Enhanced DD	X: Supported
145	ENDRESS+HAUSER	Deltapilot M 5x	Hydrostatic Level Transmitter	1023	01/01	01.00.01 (Build 1024)	X: Supported
146	ENDRESS+HAUSER	Deltapilot M 5x	Hydrostatic Level Transmitter	1023	01/03	Enhanced DD	X: Supported
147	ENDRESS+HAUSER	Deltapilot S	Hydrostatic Level Transmitter	100B	01/02		
148	ENDRESS+HAUSER	Deltapilot S	Hydrostatic Level Transmitter	100B	06/01		
149	ENDRESS+HAUSER	Deltapilot S	Hydrostatic Level Transmitter	100B	06/01	03.00.04	X: Supported
150	ENDRESS+HAUSER	Deltapilot S	Hydrostatic Level Transmitter	100B	07/02	Enhanced DD	X: Supported
151	ENDRESS+HAUSER	Gammapilot M	Radiometric Density / Level Transmitter	1013	03/01		X: Supported
152	ENDRESS+HAUSER	Levelflex FMP5x	Guided Radar Level Measurement Device	1022	01/01	Enhanced DD	

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
153	ENDRESS+HAUSER	Levelflex FMP5x	Guided Radar Level Measurement Device	1022	02/01	Enhanced DD	
154	ENDRESS+HAUSER	Levelflex FMP5x	Guided Radar Level Measurement Device	1022	02/02	Enhanced DD	X: Supported
155	ENDRESS+HAUSER	Levelflex M	Guided Wave Level Transmitter	1012	03/01	Firmware V01.02.00 (FF)	X: Supported
156	ENDRESS+HAUSER	Levelflex M	Guided Wave Level Transmitter	1012	03/01	Firmware V01.02.06 (FF)	X: Supported
157	ENDRESS+HAUSER	Levelflex M	Guided Wave Level Transmitter	1012	04/01		X: Supported
158	ENDRESS+HAUSER	Levelflex M	Guided Wave Level Transmitter	1012	04/03		
159	ENDRESS+HAUSER	Liquiline M CM42 Cond	Conductivity Transmitter	1090	01/03		
160	ENDRESS+HAUSER	Liquiline M CM42 Doxygen	Dissolved Oxygen Transmitter	109B	01/01	Firmware 20.02.07 - 0008	
161	ENDRESS+HAUSER	Liquiline M CM42 pH/ORP	pH/ORP Transmitter	108F	01/01		
162	ENDRESS+HAUSER	Liquiline Oxygen	Oxygen Transmitter	10A2	01/02	Enhanced DD	X: Supported
163	ENDRESS+HAUSER	Liquiline Oxygen	Oxygen Transmitter	10A2	02/01	Enhanced DD	X: Supported
164	ENDRESS+HAUSER	Liquiline Oxygen	Oxygen Transmitter	10A2	04/01	Enhanced DD	X: Supported
165	ENDRESS+HAUSER	Liquiline Cond	Conductivity Transmitter	10A1	02/02	Enhanced DD	X: Supported
166	ENDRESS+HAUSER	Liquiline Cond	Conductivity Transmitter	10A1	03/01	Enhanced DD	X: Supported
167	ENDRESS+HAUSER	Liquiline Cond	Conductivity Transmitter	10A1	04/01	Enhanced DD	X: Supported
168	ENDRESS+HAUSER	Liquiline pH/ORP	pH/ORP Transmitter	10A0	02/02	Enhanced DD	X: Supported
169	ENDRESS+HAUSER	Liquiline pHORP	pH/ORP Transmitter	10A0	03/01	Enhanced DD	X: Supported
170	ENDRESS+HAUSER	Liquiline pHORP	pH/ORP Transmitter	10A0	04/01	Enhanced DD	X: Supported
171	ENDRESS+HAUSER	Micropilot FMR5x	Radar Level Transmitter	1028	01/01	Enhanced DD	
172	ENDRESS+HAUSER	Micropilot FMR5x	Radar Level Transmitter	1028	02/01	Enhanced DD	
173	ENDRESS+HAUSER	Micropilot FMR5x	Radar Level Transmitter	1028	02/02	Enhanced DD	X: Supported
174	ENDRESS+HAUSER	Micropilot M	Radar Level Transmitter	100F	02/01		
175	ENDRESS+HAUSER	Micropilot M	Radar Level Transmitter	100F	03/01	Firmware V01.02.00 (FF)	X: Supported
176	ENDRESS+HAUSER	Micropilot M	Radar Level Transmitter	100F	03/01	Firmware V01.02.04 (FF)	X: Supported

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
177	ENDRESS+HAUSER	Micropilot M	Radar Level Transmitter	100F	04/01		
178	ENDRESS+HAUSER	Micropilot M	Radar Level Transmitter	100F	05/03		
179	ENDRESS+HAUSER	Micropilot M	Radar Level Transmitter	100F	05/05		
180	ENDRESS+HAUSER	Promag53	Magnetic Flowmeter	1042	02/01		X: Supported
181	ENDRESS+HAUSER	PROline Promag53/55	Electromagnetic Flowmeter	1042	03/01		X: Supported
182	ENDRESS+HAUSER	PROline Promag53/55	Electromagnetic Flowmeter	1042	04/01		X: Supported
183	ENDRESS+HAUSER	PROline Promag53/55	Electromagnetic Flowmeter	1042	05/01	Enhanced DD	X: Supported
184	ENDRESS+HAUSER	Promag 200	2-wire Electromagnetic Flow Meter	1048	01/01	Enhanced DD	X: Supported
185	ENDRESS+HAUSER	Promag 200	2-wire Electromagnetic Flow Meter	1048	01/02	Enhanced DD	X: Supported
186	ENDRESS+HAUSER	Promag 300/500	4-wire Electromagnetic Flowmeter	103C	01/01	Enhanced DD	X: Supported
187	ENDRESS+HAUSER	PROline T-mass 65	Thermal Mass Flowmeter	1065	01/01		
188	ENDRESS+HAUSER	PROline T-mass 65	Thermal Mass Flowmeter	1065	02/01	Enhanced DD	X: Supported
189	ENDRESS+HAUSER	Promass83	Mass Flowmeter	1051	02/01		X: Supported
190	ENDRESS+HAUSER	PROline Promass83	Mass Flowmeter	1051	03/01		X: Supported
191	ENDRESS+HAUSER	PROline Promass83	Mass Flowmeter	1051	04/01		X: Supported
192	ENDRESS+HAUSER	PROline Promass83	Mass Flowmeter	1051	05/01	Enhanced DD	X: Supported
193	ENDRESS+HAUSER	Promass 200	Coriolis Flowmeter	1054	01/01	Enhanced DD	X: Supported
194	ENDRESS+HAUSER	Promass 200	Coriolis Flowmeter	1054	01/02	Enhanced DD	X: Supported
195	ENDRESS+HAUSER	Promass 300/500	4-wire Coriolis Flowmeter	103B	01/01	Enhanced DD	X: Supported
196	ENDRESS+HAUSER	Prosonic Flow92	Ultrasonic Flowmeter	1061	01/01	Firmware V1.00.00D	
197	ENDRESS+HAUSER	Prosonic Flow93	Ultrasonic Flowmeter	1059	01/01		X: Supported
198	ENDRESS+HAUSER	Prosonic Flow93	Ultrasonic Flowmeter	1059	02/01		X: Supported
199	ENDRESS+HAUSER	Prosonic Flow93	Ultrasonic Flowmeter	1059	03/01		X: Supported
200	ENDRESS+HAUSER	Prosonic Flow93	Ultrasonic Flowmeter	1059	04/01	Enhanced DD	X: Supported
201	ENDRESS+HAUSER	Prosonic M	Ultrasonic Level Transmitter	1011	03/01	Firmware V01.02.00 (FF)	X: Supported

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
202	ENDRESS+HAUSER	Prosonic M	Ultrasonic Level Transmitter	1011	03/01	Firmware V01.02.06 (FF)	X: Supported
203	ENDRESS+HAUSER	Prosonic M	Ultrasonic Level Transmitter	1011	04/01		X: Supported
204	ENDRESS+HAUSER	Prosonic M	Ultrasonic Level Transmitter	1011	04/03		X: Supported
205	ENDRESS+HAUSER	Prowirl72	Vortex Flowmeter	1056	01/01		
206	ENDRESS+HAUSER	Prowirl73	Vortex Flowmeter	1057	01/01		
207	ENDRESS+HAUSER	Prowirl200	Vortex Flowmeter	1038	01/01		
208	ENDRESS+HAUSER	Prowirl200	2-wire Vortex Flowmeter	1038	01/02	Enhanced DD	X: Supported
209	ENDRESS+HAUSER	Prowirl200	2-wire Vortex Flowmeter	1038	02/01	Enhanced DD	X: Supported
210	ENDRESS+HAUSER	RID1x (RID14/RID16)	8 Channel Field Indicator	10CF	01/01		X: Supported
211	ENDRESS+HAUSER	RID1x (RID14/RID16)	8 Channel Field Indicator	10CF	02/01		
212	ENDRESS+HAUSER	TMT125	Temperature Multiplexer	10CD	01/06		
213	ENDRESS+HAUSER	TMT162	Temperature Transmitter	10CC	01/01		X: Supported
214	ENDRESS+HAUSER	TMT162	Temperature Transmitter	10CC	02/01		X: Supported
215	ENDRESS+HAUSER	TMT162	Temperature Transmitter	10CC	03/02	Enhanced DD	
216	ENDRESS+HAUSER	TMT162	Temperature Head Transmitter	10CC	03/04	Enhanced DD	
217	ENDRESS+HAUSER	TMT85	Temperature Head Transmitter	10CE	01/01	Firmware 01.00.03	
218	ENDRESS+HAUSER	TMT85	Temperature Head Transmitter	10CE	01/01	Firmware 01.00.04	X: Supported
219	ENDRESS+HAUSER	TMT85	Temperature Head Transmitter	10CE	01/01	Firmware 01.00.07	X: Supported
220	ENDRESS+HAUSER	TMT85	Temperature Head Transmitter	10CE	02/04	Enhanced DD	X: Supported
221	ENOTEC GMBH	COMTEC 6000	Oxygen and COe Analyzer System	0002	01/01		
222	ENOTEC GMBH	OXITEC 5000	Oxygen Analyzer System	0001	01/01		
223	ENRAF	97x SmartRadar Series	Level Gauge	0384	01/01		
224	FCI	ST100/ST80/ST100A	Thermal Mass Flow Meter	0001	01/01		
225	FIELDQ	FieldQ	Pneumatic Valve Actuator	D3A0	02/01		

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
226	FINT	T610/T710	Modbus to Foundation Fieldbus Gateway	0013	01/01	Enhanced DD	
227	FLOWSERVE	Mx Actuator	Valve Actuator	4D58	02/01		
228	FLOWSERVE	LIMITORQUE MX QX	Electric Valve Actuator	4D58	05/01	Tested with STARDOM/CENTUM	
229	FLOWSERVE	LIMITORQUE MX QX	Electric Valve Actuator	4D58	06/05	Enhanced DD	
230	FLOWSERVE	Logix1400	Digital Positioner	0202	05/01		
231	FLOWSERVE	Logix3400IQ/ 1400	Digital Positioner	0202	06/01		
232	FLOWSERVE	Logix 3400MD	Valve Positioner	0203	01/02		
233	FLOWSERVE	Logix 3400MD	Valve Positioner	0203	02/01	Firmware revision 310(1) , 250(2) , 3(3), 0(4)	
234	FLOWSERVE	Logix 3400MD	Valve Positioner	0203	02/01	Firmware revision 310(1) , 250(2) , 3(3), 4(4)	
235	FLOWSERVE	Logix 3400MD	Valve Positioner	0203	02/03	Firmware revision 310(1) , 250(2) , 3(3), 4(4)	
236	FLOWSERVE	Logix 3400MD	Valve Positioner	0203	02/03	Firmware revision 350(1) , 250(2) , 3(3), 4(4)	
237	FLOWSERVE	PMV D3	Digital Valve Positioner	00D3	02/02		
238	FLOWSERVE	Logix 3800	Positioner	0301	01/02	Enhanced DD	
239	FLOWSERVE	Logix 3800	Positioner	0301	01/04	Enhanced DD	
240	FUJI ELECTRIC CORPORATION	FCX-A2	Pressure Transmitter	0032	01/01		
241	FUJI ELECTRIC CORPORATION	FCX-AIII Series	Pressure Transmitter	0033	01/01	Firmware revision V2.20.D.16	
242	FUJI ELECTRIC CORPORATION	FFX-P	Fiber Optic Pressure Transmitter	0001	01/02		
243	GE	XMT868	Ultrasonic Liquid Flowmeter	0001	01/01	GE Flow Liquid 868 Rev 1.2.0	
244	GE	XMT868i	Ultrasonic Liquid Flowmeter	0001	03/01	Enhanced DD	

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
245	GE	XMT910	Ultrasonic Flowmeter	0007	01/01	Enhanced DD	
246	GE	XMT1000	Ultrasonic Flowmeter	0010	01/01	Enhanced DD	
247	GE	GE Flow Gas 868	Gas Flow Transmitter	0002	01/01		
248	GE	SVI FF	Pneumatic Valve Positioner	0008	01/01		
249	GE	SVI FF	Pneumatic Valve Positioner	0008	02/02	Enhanced DD	
250	GE	XGF868I	Ultrasonic Flare Gas Flowmeter	0002	02/06	Enhanced DD	
251	HAWK MEASUREMENT SYSTEM	Hawk FF Level Series - AW-XXXX	Sultan Acoustic Wave Series	0001	01/01	Enhanced DD	
252	HONEYWELL	SmartLine ST700	Pressure Transmitter	0004	01/01	Enhanced DD	
253	HONEYWELL	SmartLine ST700	Pressure Transmitter	0004	04/01	Enhanced DD	
254	HONEYWELL	SmartLine ST800	Pressure Transmitter	0003	01/02	Enhanced DD	
255	HONEYWELL	SmartLine ST800	Pressure Transmitter	0003	04/01	Enhanced DD	
256	HONEYWELL	ST3000FF	Pressure Transmitter	0002	09/01		
257	HONEYWELL	STT35F	Temperature Transmitter	0101	04/01	Enhanced DD	
258	HONEYWELL	SmartLine / STT850	Temperature Transmitter	0006	01/02	Enhanced DD	
259	HONEYWELL	STT650	Temperature Transmitter	0020	01/01		
260	HONEYWELL	STT17F	Temperature Transmitter	1101	01/01		
261	HONEYWELL	SmartLine/RMA 803	Remote Indicator	0005	01/01	Enhanced DD	
262	ISE-MAGTECH	LTM-300FF	Magnetostrictive Level Transmitter	0101	01/01		
263	K-TEK	AT100/ AT100S/ AT200	Magnetostrictive Level Transmitter	0100	02/01	02_FB302- 20080319_ AF080306	
264	K-TEK	AT100/ AT100S/ AT200	Magnetostrictive Level Transmitter	0100	03/01		
265	K-TEK	MT5000/ MT5100/ MT5200	Guided Radar Level Transmitter	5000	01/01	01_FB302- 20080530_ MF080530	
266	K-TEK	MT5000/ MT5100/ MT5200	Guided Radar Level Transmitter	5000	02/01		
267	K-TEK	MT5000/ MT5100/ MT5200	Guided Radar Level Transmitter	5000	03/01		

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
268	KNICK	COMFF 3400 -085	Measuring System for Liquid Analysis	0D48	01/01		
269	KNICK	Stratos FF2231X Cond	Conductivity Transmitter	5728	01/01		
270	KNICK	Stratos FF2231X Oxy	OXY Transmitter	5727	01/01		
271	KNICK	Stratos FF2231X pH	pH Transmitter	08B7	01/01		
272	KNICK	Stratos FF2232X CondI	Torodial Conductivity Transmitter	08B8	01/01		
273	KNICK	Stratos Pro FF A231N/A231X	Measuring System for Liquid Analysis	A231	01/01	Enhanced DD	
274	KROHNE MESSTECHNIK	BM100	Reflex Radar	EE01	02/01		
275	KROHNE MESSTECHNIK	BM70	Radar Level Meter	F901	03/01		
276	KROHNE MESSTECHNIK	IFC090	Electromagnetic Flowmeter	F401	01/01		
277	KROHNE MESSTECHNIK	IFC100	Electromagnetic Flowmeter	0100	01/01	Enhanced DD	
278	KROHNE MESSTECHNIK	IFC300	Electromagnetic Flowmeter	0300	01/01		
279	KROHNE MESSTECHNIK	M40 ESK4-FF	Variable Area Flowmeter, Level Meter	0700	01/01	Enhanced DD	
280	KROHNE MESSTECHNIK	Optiflux IFC300	Electromagnetic Flowmeter	0300	03/01	Enhanced DD	
281	KROHNE MESSTECHNIK	Optimass MFC300	Coriolis Mass Flowmeter	0320	03/01	Enhanced DD	
282	KROHNE MESSTECHNIK	M40 ESK4-FF	Variable Area Flowmeter and Level Meter	0700	02/01	Enhanced DD	
283	KROHNE MESSTECHNIK	OptiSwirl 4200	Vortex Flowmeter	0200	01/03	Enhanced DD	
284	KROHNE MESSTECHNIK	OptiWave_x400/x500	FMCW Radar Level Transmitter	0280	01/01	Enhanced DD	
285	KROHNE MESSTECHNIK	Optimass MFC400	Coriolis Mass Flowmeter	0330	02/02	Enhanced DD	

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
286	KROHNE MESSTECHNIK	OptiFlex 2200 C/F	TDR Level Meter	0220	01/01	Enhanced DD	
287	KROHNE MESSTECHNIK	OptiSonic UFC 400	Ultrasonic Flowmeter	0370	01/02	Enhanced DD	
288	L. BERNARD S.A	BERNARD_ ACTUATOR	Actuator	0001	01/01	M1.3 TI.1H 4.5	
289	L. BERNARD S.A	Intelli+ FF Interface	Actuator Communication Interface	0002	01/03	Enhanced DD	
290	MAGNETROL	705	Guided Wave Radar Level	0705	01/01	Obsolete	
291	MAGNETROL	E3 Modulevel	Displacer Level Transmitter	0003	01/01		
292	MAGNETROL	Eclipse Enhanced Model 705 3X	Guided Wave Radar Level	0001	01/01		
293	MAGNETROL	Eclipse Enhanced Model 705 3X	Guided Wave Radar Level	0001	01/01	Mdl705FF Ver3.0k	
294	MAGNETROL	Eclipse Enhanced Model 705 3X	Guided Wave Radar Level	0001	02/01		
295	MAGNETROL	Eclipse Model 706	Guided Wave Radar Level Transmitter	0005	01/01	Enhanced DD	
296	MAGNETROL	Eclipse Model 706	Guided Wave Radar Level Transmitter	0005	02/01	Enhanced DD	
297	MAGNETROL	Orion Jupiter Model 2xx	Magnetostrictive Level Transmitter	0002	01/01		
298	MAGNETROL	Thermatel Enhanced Model TA2 2x	Magnetostrictive Level Transmitter	0004	01/01	Enhanced DD	
299	MAGNETROL	Orion Jupiter Model JM4	Magnetostrictive Level Transmitter	0006	01/01	Enhanced DD	
300	MAGNETROL	Orion Jupiter Model JM4	Magnetostrictive Level Transmitter	0006	01/02	Enhanced DD	
301	MAGNETROL	Pulsar Model R96	Non-Contact Radar Level Transmitter	0007	01/01	Enhanced DD	
302	MAGNETROL	Pulsar Model R86	Non-Contact Radar Level Transmitter	0008	01/01	Enhanced DD	

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
303	MAGNETROL	Model R86	Non-Contact Radar Level Transmitter	0008	02/01	Enhanced DD	
304	MICROMOTION	MVD2700	Mass Flow Sensor	2000	03/02		
305	MICROMOTION	MVD2700	Coriolis Mass Flowmeter	2000	04/01		
306	MICROMOTION	MVD2700	Coriolis Mass Flowmeter	2000	05/01	Tested with STARDOM/CENTUM	
307	MICROMOTION	MVD2700	Coriolis Mass Flowmeter	2000	06/01		
308	MICROMOTION	MVD2700	Coriolis Mass Flowmeter	2000	07/01	Enhanced DD	
309	MICROMOTION	MVD2700	Coriolis Mass Flowmeter	2000	08/01	Enhanced DD	
310	MICROMOTION	Micro Motion MVD 2700	Coriolis Mass Flowmeter	2000	09/01	Enhanced DD	
311	MICROMOTION	Micro Motion MVD 5700	Advanced Coriolis Flow / Density Transmitter	5700	01/01	Enhanced DD	
312	MICROMOTION	Micro Motion MVD 5700	Advanced Coriolis Flow / Density Transmitter	5700	01/02	Enhanced DD	
313	METTLER TOLEDO	Cond 7100e FF	Conductivity Meter	1BBC	01/01		
314	METTLER TOLEDO	Cond Ind 7100e FF	Torodial Conductivity Transmitter	1BBD	01/01		
315	METTLER TOLEDO	M400(G) FF	Multi-parameter transmitter	0400	01/01	Enhanced DD	
316	METTLER TOLEDO	M700 FF700	Measuring System for Liquid Analysis	00F0	01/01		
317	METTLER TOLEDO	O2 4100eFF	O2 Transmitter	1004	01/01		
318	METTLER TOLEDO	pH2100e FF	pH Transmitter	0834	01/01		
319	MTL	9331-TI	Temperature Transmitter	9331	01/01		
320	MTL	F809F	Fieldbus Diagnostic Module	0001	01/01		
321	MTL	F809F	Fieldbus Diagnostic Module	0001	02/01		
322	MTL	F809F-Plus	Fieldbus Diagnostic Module	0001	03/01	Enhanced DD	
323	OHMART	GEN2000	Nuclear Level Gauge	0003	02/01		
324	OHMART	GEN2000	Nuclear Density Gauge	0003	03/02		
325	OHMART	GEN2000 Density	Nuclear Density Gauge	0004	03/01		

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
326	ORANGE INSTRUMENTS BIFOLD	IS210F FISCO	Actuator Positioner	F210	01/01	Enhanced DD	
327	OVAL CORPORATION	ALTImass	Coriolis Mass Flowmeter	0DD9	01/01	Enhanced DD	
328	OVAL CORPORATION	EX-DELTA	Vortex Flowmeter	0065	01/02		
329	OVAL CORPORATION	EX-DELTA Electrical	Vortex Flowmeter	0065	02/01		
330	OVAL CORPORATION	ULTRAmass MKII	Flowmeter	24B9	01/01		
331	OVAL CORPORATION	CT9401	Flowmeter	24B9	02/01		
332	PEPPERL+FUCHS	F2D0-TI-Ex8.FF	Temperature Multiplexer	0003	01/01		
333	PEPPERL+FUCHS	F2D0-TI-Ex8.FF	Temperature Multiplexer	0003	01/07		
334	PEPPERL+FUCHS	F2D0-TI-Ex8.FF	Temperature Multiplexer	0003	02/01	Enhanced DD	
335	PEPPERL+FUCHS	F2D0-TI-Ex8.FF	Temperature Multiplexer	0003	02/02	Enhanced DD	
336	PEPPERL+FUCHS	D0-MIO-Ex12.FF	Multi-Input/Output Device	0007	01/03	Enhanced DD	
337	PEPPERL+FUCHS	FD0-VC-Ex4.FF	Valve Coupler Fieldbox	0001	01/01		
338	PEPPERL+FUCHS	FD0-VC-Ex.4FF	Valve Coupler Fieldbox	0001	02/01		
339	PEPPERL+FUCHS	HD2-GT-2AD.FFIO	Diagnostic Gateway	0005	01/02		
340	PEPPERL+FUCHS	LB 8110-FB 8210	FF Remote IO	8010	02/01		
341	PHOENIX CONTACT	FB-DIAG/FF/LI & FB-DIAG/FF/NC	Field Diagnostics Module	0321	01/01	Enhanced DD	
342	POWER GENEX LTD	SS	Smart Valve Positioner	0001	01/01	Enhanced DD Tested as Basic device	X: Supported
343	PR ELECTRONICS	PRetop5350	Temperature Transmitter	0080	01/01		
344	PR ELECTRONICS	PRetop5350	Temperature Transmitter	0080	02/01		
345	PR ELECTRONICS	PR6350	Temperature Transmitter	0081	01/01		
346	R STAHL SCHALTGERATE GMBH	9413	Digital I/O Coupler 9413/21 (4-wire)	24C5	01/01		

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
347	R STAHL SCHALTGERATE GMBH	9413 (4-wire version)	Digital I/O Coupler	24C5	03/01		
348	R STAHL SCHALTGERATE GMBH	DCM 9415	Diagnosis Communication Module	0001	01/01		
349	ROTORK CONTROLS LTD	FF-01	Valve Actuator	0001	02/01		
350	ROTORK CONTROLS LTD	FF01 MK2	Valve Positioner	0002	01/01	SW_REV: M1.2T1.1 H1.0	
351	ROTORK CONTROLS LTD	FF01 MK2 Network Interface	Valve Positioner	0002	02/01	Tested with STARDOM/CENTUM	
352	ROTORK CONTROLS LTD	IQ3	Multi-Turn Electric Valve Actuator	0003	01/01	Enhanced DD	
353	ROTORK YTC LIMITED	YT-3300	Smart Positioner	0009	01/01	Enhanced DD	
354	SAMSON AG	Positioner 3787	Valve Positioner	0001	02/01		
355	SAMSON AG	Positioner 3730-5	Valve Positioner	0002	01/01		
356	SAMSON AG	3738-50	SMART Discrete Valve Controller	0003	01/01	Enhanced DD	
357	SAMSON AG	373x-5	Valve Positioner / Final Control Element	0002	02/01	Enhanced DD	
358	SAMSON AG	373x-5	Valve Positioner / Final Control Element	0002	03/01	Enhanced DD	
359	SCHNEIDER ELECTRIC	240FF	Intelligent Transmitter	2506	01/01		
360	SCHNEIDER ELECTRIC	240FF	Intelligent Transmitter	2506	08/01	Enhanced DD	
361	SCHNEIDER ELECTRIC	SRD960	Intelligent Positioner	2481	12/01	Enhanced DD	
362	SCHNEIDER ELECTRIC	SRD991	Intelligent Valve Positioner	2401	10/01		
363	SCHNEIDER ELECTRIC	SRD991	Intelligent Positioner	2401	12/01	Enhanced DD	

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
364	SCHNEIDER ELECTRIC	83	Vortex Flow Transmitter	BD33	03/01	REV_INFO: 3.55/3.2	
365	SCHNEIDER ELECTRIC	IAP10	Single Variable Pressure Transmitter	BA30	30/01		
366	SCHNEIDER ELECTRIC	IMT25	Magnetic Flowmeter	BC29	02/01	REV_INFO: 3.10/3.2	
367	SCHNEIDER ELECTRIC	RTT15-F	Temperature Transmitter	1036	01/01		
368	SCHNEIDER ELECTRIC	RTT30	2 Channel Temperature Transmitter	C034	02/01	Enhanced DD	
369	SCHNEIDER ELECTRIC	RTT80	2 Channel Temperature Transmitter	C035	02/03	Enhanced DD	
370	SCHNEIDER ELECTRIC	IGP10S	Series S Single Pressure Transmitter	BA30	32/02	Enhanced DD	
371	SCHNEIDER ELECTRIC	IDP50S-F Premium Performance	Pressure Transmitter	BA40	01/01	Enhanced DD	
372	SIEMENS AG	SIPART PS2 FF	Valve Positioner	0015	01/01		
373	SIEMENS AG	SIPART PS2 FF	Valve Positioner	0015	02/01		
374	SIEMENS AG	SIPART PS2 FF	Valve Positioner	0015	02/02	Enhanced DD	
375	SIEMENS AG	SIPART PS2 FF	Valve Positioner	0015	04/01	Enhanced DD	
376	SIEMENS AG	SITRANS F M MAG6000	Electromagnetic Flowmeter	0018	01/01		
377	SIEMENS AG	SITRANS F C MASS6000	Coriolis Mass Flowmeter	0019	01/01		
378	SIEMENS AG	SITRANS LR250	Radar Level Transmitter	1954	01/01		
379	SMAR	FI302	Fieldbus to Current Converter	0005	04/01		
380	SMAR	FP302	Fieldbus-Pneumatic Signal Converter	0004	04/01		X: Supported
381	SMAR	FY302	Fieldbus Positioner	0006	04/07		
382	SMAR	IF302	Current to Fieldbus Converter	0003	04/01		
383	SMAR	TT302	Universal Temperature Transmitter	0002	04/01		

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
384	STONEL	461052	Discrete IO (Bus Powered Outputs)	0052	01/01		
385	STONEL	461088	Analog I/O (Externally powered outputs)	00F2	01/01		
386	STONEL	Function Option 93 Discrete VCT	Discrete VCT (Bus Powered Outputs)	0051	02/01		
387	STONEL	I/O module (2DI, 2DO, 1AI, 1AO)	Discrete and Analog I/O Block	00F2	02/01		
388	STONEL	VCT/I/O Module (2DI, 2DO)	VCT/Univ. Discrete I/O Block	0052	02/01		
389	TLV CO LTD	iTrapSensor	Sensor for Steam Trap	0001	01/01	Enhanced DD	
390	TOKYO KEISO	FST4000FB	Torque Tube Displacement Level Transmitter	0002	03/01		
391	TOKYO KEISO	FST4000FB	Torque Tube Displacement Level Transmitter	0002	04/01	Enhanced DD	
392	TOPWORX	D2-FF	Valve Controller	0200	02/03	Enhanced DD	X: Supported
393	TOPWORX	TopWorx D2-FF	Discrete Valve Controller/Positioner	0200	03/01	Enhanced DD	
394	TOPWORX	Valvetop DXP/DVC-FF	Lumitech Discrete Valve Controller (On/Off)	0100	02/01	Topworx Rev 1.2.7	X: Supported
395	TOPWORX	Valvetop DXP/DVC-FF	Lumitech Discrete Valve Controller (On/Off)	0100	02/03	Topworx Rev 1.3.4	
396	TURCK	KMU-40Ex/1GD	Temperature Transmitter	FF9C	01/01		
397	VALMET FLOW CONTROL OY	LCP9000F	Local Control Panel	232A	01/01		
398	VALMET FLOW CONTROL OY	ND800FF	Digital Valve Positioner	0320	03/02		
399	VALMET FLOW CONTROL OY	ND9000F	Digital Valve Positioner	2328	01/02		
400	VALMET FLOW CONTROL OY	ND9000F	Digital Valve Positioner	2328	02/01	F09424-1. 31	

No.	Vendor	Model	Description	Device Type	Dev/DD REV	Remarks	Device Viewer
401	VALMET FLOW CONTROL OY	ND9000F	Digital Valve Positioner	2328	02/01	F09424-1. 492	
402	VALMET FLOW CONTROL OY	ND9000F	Digital Valve Positioner	2328	03/01	F09424-1. 55	
403	VALMET FLOW CONTROL OY	ND9000F	Digital Valve Positioner	2328	03/01	F09424-1. 57	
404	VALMET FLOW CONTROL OY	ND9000F	Digital Valve Positioner	2328	05/01		
405	VALMET FLOW CONTROL OY	ND9000F	Intelligent Valve Positioner	2328	06/01	Enhanced DD	
406	VALMET FLOW CONTROL OY	VG9000F	Smart Valve Controller	2329	01/01		
407	VALMET FLOW CONTROL OY	VG9000F	Intelligent Safety Solenoid with PST	2329	03/01	Enhanced DD	
408	VALMET FLOW CONTROL OY	VG9000F	Intelligent Safety Solenoid with PST	2329	03/02	Enhanced DD	
409	VALVE AUTOMATION	CAM228/CAM28 FF	Electric Actuator	EDC3	01/01	Enhanced DD	X: Supported
410	VEGA	FIBERTRAC 31	Radiation-based Sensor for Continuous Level Measurement	0CF2	02/01	Enhanced DD	
411	VEGA	FIBERTRAC 31	Radiation-based Sensor for Continuous Level Measurement	0CF2	03/01	Enhanced DD	
412	VEGA	FIBERTRAC 32	Radiation-based Sensor for Continuous Level Measurement	0CF3	02/01	Enhanced DD	
413	VEGA	MINITRAC 31	Radiation-based Sensor for Density Measurement and Level Detection	0CF5	02/01	Enhanced DD	
414	VEGA	MINITRAC 31	Radiation-based Sensor for Density Measurement and Level Detection	0CF5	03/01	Enhanced DD	

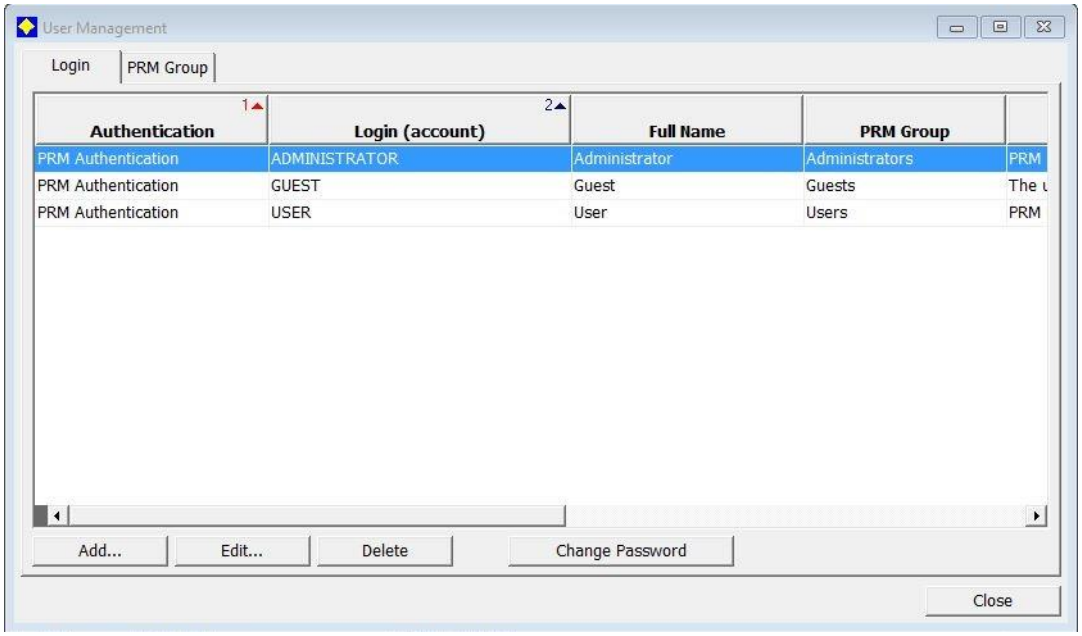
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415	VEGA	POINTRAC 31	Radiation-based Sensor for Level Detection	0D48	02/01	Enhanced DD	
416	VEGA	POINTRAC 31	Radiation-based Sensor for Level Detection	0D48	03/01	Enhanced DD	
417	VEGA	SOLITRAC 31	PreRadiation-based Sensor for Continuous Level Measurement	0CF4	02/01	Enhanced DD	
418	VEGA	SOLITRAC 31	Radiation-based Sensor for Continuous Level Measurement	0CF4	03/01	Enhanced DD	
419	VEGA	VEGABAR	Pressure Transmitter	076F	01/01	Firmware R3.07	
420	VEGA	VEGABAR	Pressure Transmitter	076F	01/01	Firmware R3.11.01	
421	VEGA	VEGABAR	Pressure Transmitter	076F	03/01		
422	VEGA	VEGABAR	Pressure Transmitter	076F	04/01		
423	VEGA	VEGABAR 80 Series FF	Pressure Transmitter	0BF9	01/01	Enhanced DD	
424	VEGA	VEGABAR 80 Series FF	Pressure Transmitter	0BF9	02/02	Enhanced DD	
425	VEGA	VEGABAR 80 Series FF	Pressure Transmitter	0BF9	03/01	Enhanced DD	
426	VEGA	VEGACAL	Admittance Level Transmitter	076E	03/01		
427	VEGA	VEGACAL	Admittance Level Transmitter	076E	04/01		
428	VEGA	VEGAFLEX	Guided Microwave Level Transmitter	0771	01/01	Firmware R3.07	
429	VEGA	VEGAFLEX	Guided Microwave Level Transmitter	0771	01/01	Firmware R3.11.01	
430	VEGA	VEGAFLEX	Guided Microwave Level Transmitter	0771	03/01		
431	VEGA	VEGAFLEX	Guided Microwave Level Transmitter	0771	04/01		
432	VEGA	VEGAFLEX 80 Series	Guided Wave Radar Level Transmitter	0BF5	01/01	Enhanced DD	

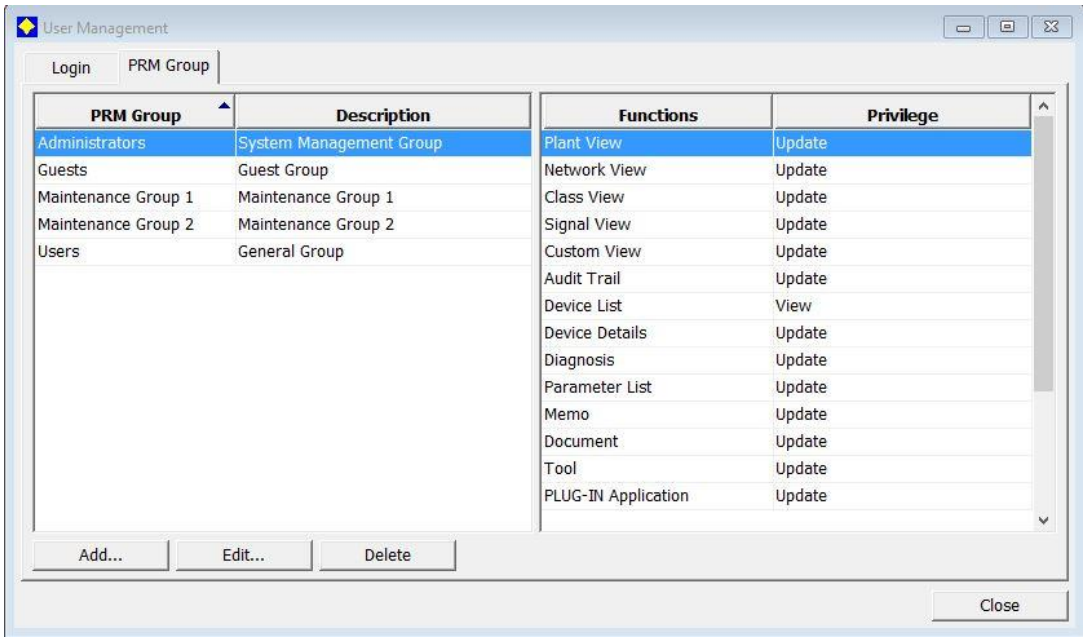
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433	VEGA	VEGAFLEX 80 Series	Guided Wave Radar Level Transmitter	0BF5	02/01	Enhanced DD	
434	VEGA	VEGAFLEX 80 Series	Guided Microwave Transmitter	0BF5	03/01	Enhanced DD	
435	VEGA	VEGAPULS	RADAR Level Transmitter	0772	01/01	Firmware R3.07	
436	VEGA	VEGAPULS	RADAR Level Transmitter	0772	01/01	Firmware R3.11.01	
437	VEGA	VEGAPULS	RADAR Level Transmitter	0772	03/01		
438	VEGA	VEGAPULS	RADAR Level Transmitter	0772	04/01		
439	VEGA	VEGAPULS 61	RADAR Level Transmitter	0BFC	06/01	Firmware R4.5.0 Build 7	
440	VEGA	VEGAPULS 62	RADAR Level Transmitter	0BFD	06/01	Firmware R4.5.0 Build 7	
441	VEGA	VEGAPULS 63	RADAR Level Transmitter	0BFE	06/01	Firmware R4.5.0 Build 7	
442	VEGA	VEGAPULS 65	RADAR Level Transmitter	0BFF	06/01	Firmware R4.5.0 Build 7	
443	VEGA	VEGAPULS 66	RADAR Level Transmitter	0C00	06/01	Firmware R4.5.0 Build 7	
444	VEGA	VEGAPULS 67	RADAR Level Transmitter	0C01	06/01	Firmware R4.5.0 Build 7	
445	VEGA	VEGAPULS 68	RADAR Level Transmitter	0C02	06/01	Firmware R4.5.0 Build 7	
446	VEGA	VEGAPULS 69	RADAR Level Transmitter	0BFA	01/01	Enhanced DD	
447	VEGA	VEGAPULS 69	RADAR Level Transmitter	0BFA	02/01	Enhanced DD	
448	VEGA	VEGAPULS WL 61	RADAR Level Transmitter	0CDB	06/01	Firmware R4.5.0 Build 7	
449	VEGA	VEGAPULS SR 68	RADAR Level Transmitter	0CDC	06/01	Firmware R4.5.0 Build 7	

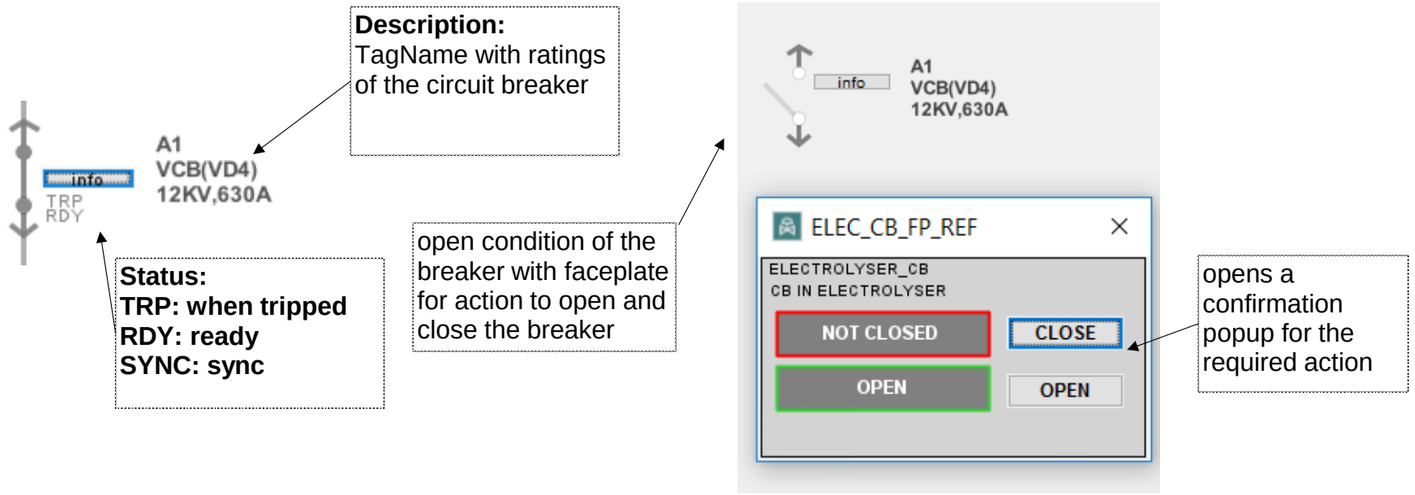
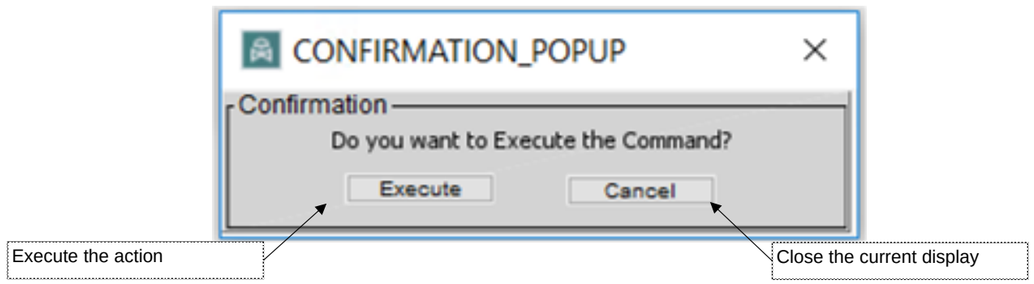
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451	VEGA	VEGASON	Ultrasonic Level Transmitter	0770	01/01	Firmware R3.11.01	
452	VEGA	VEGASON	Ultrasonic Level Transmitter	0770	03/01		
453	VEGA	VEGASON	Ultrasonic Level Transmitter	0770	04/01		
454	VEGA	WEIGHTRAC 31	Radiation-based Sensor for Mass Flow Detection	0CF8	02/01	Enhanced DD	
455	VEGA	VEGADIF 85	Differential Pressure Transmitter	0BF6	03/02	Enhanced DD	
456	WESTLOCK CONTROLS	EL40106	FPAC Valve Controller	0001	01/01		
457	WESTLOCK CONTROLS	Intellis ICoT FF	IS Pneumatic Positioner	1100	01/01		
458	WIKA	IPT-1x-4	Pressure Transmitter	00EC	03/01		
459	WIKA	T53.10	Temperature Transmitter	5310	01/01		

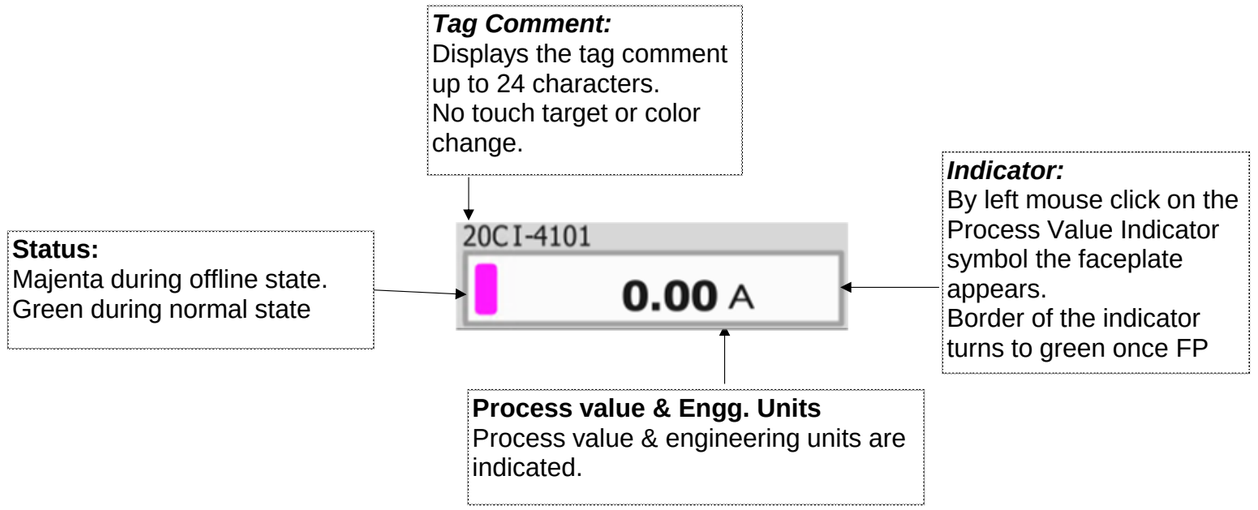
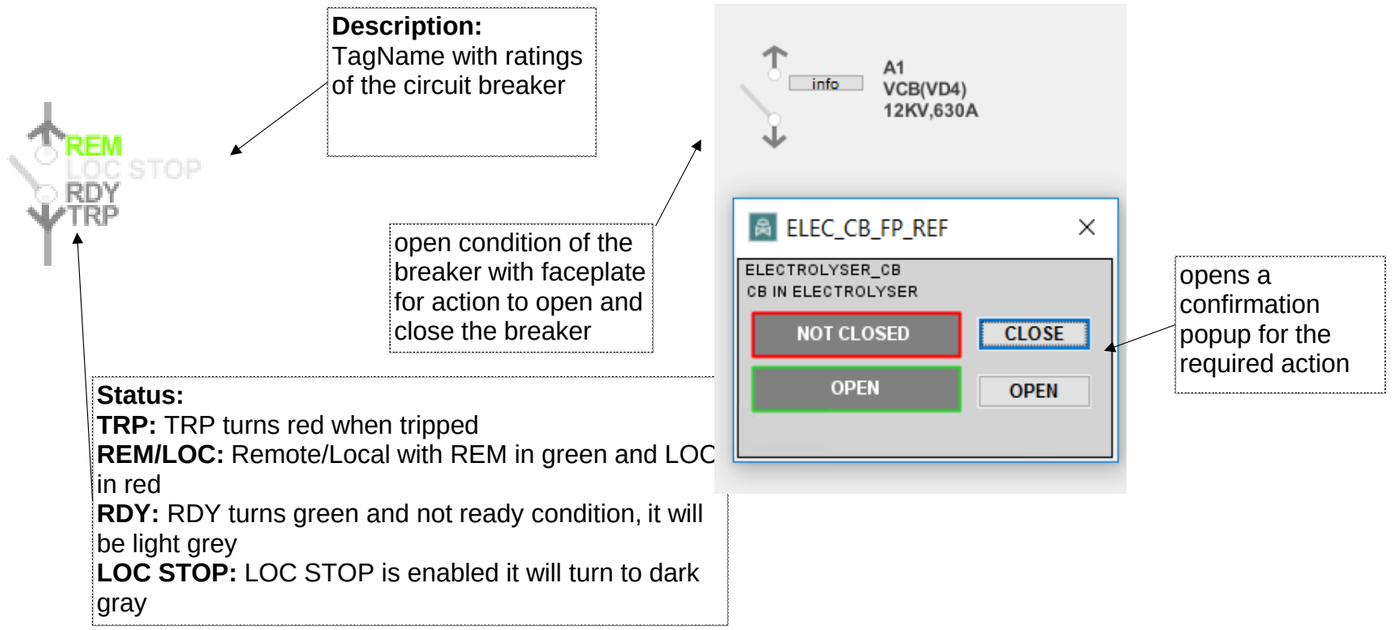
Appendix-4 PRM user groups and Account configuration

PRM User groups and Account configuration details are given below



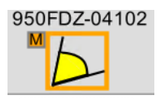
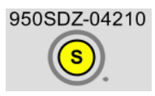


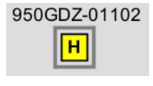
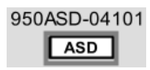
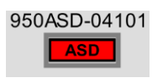
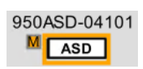
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<tr><td>2</td><td>CONFIRMATION_POPUP</td><td>REV 0</td><td>
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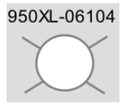
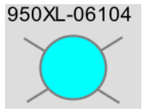
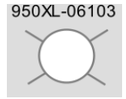
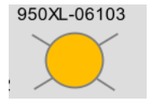
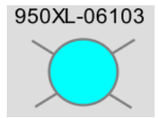
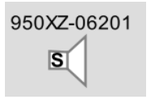
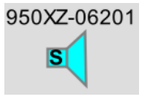
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4	BLPH_UPS_MTR	REV 0			

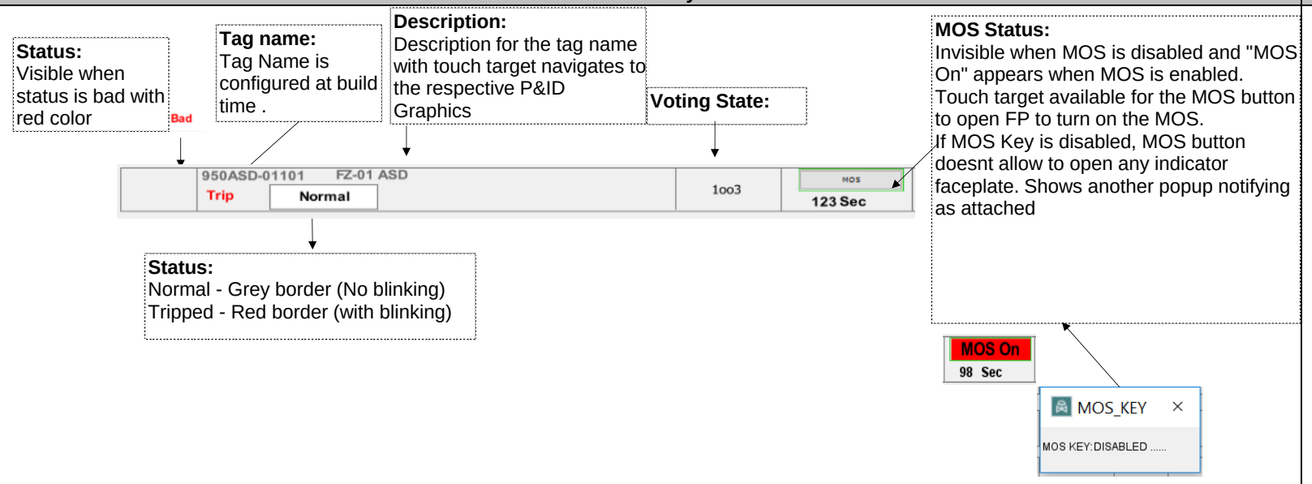
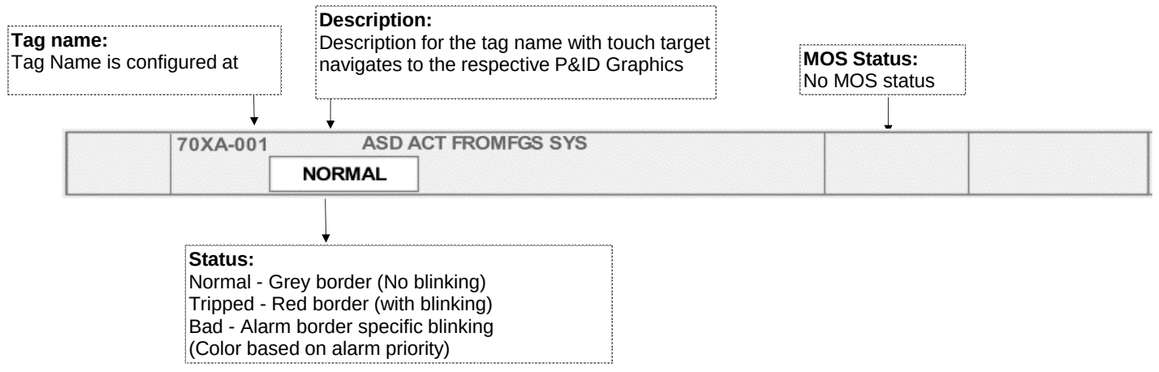
Color Philosphy

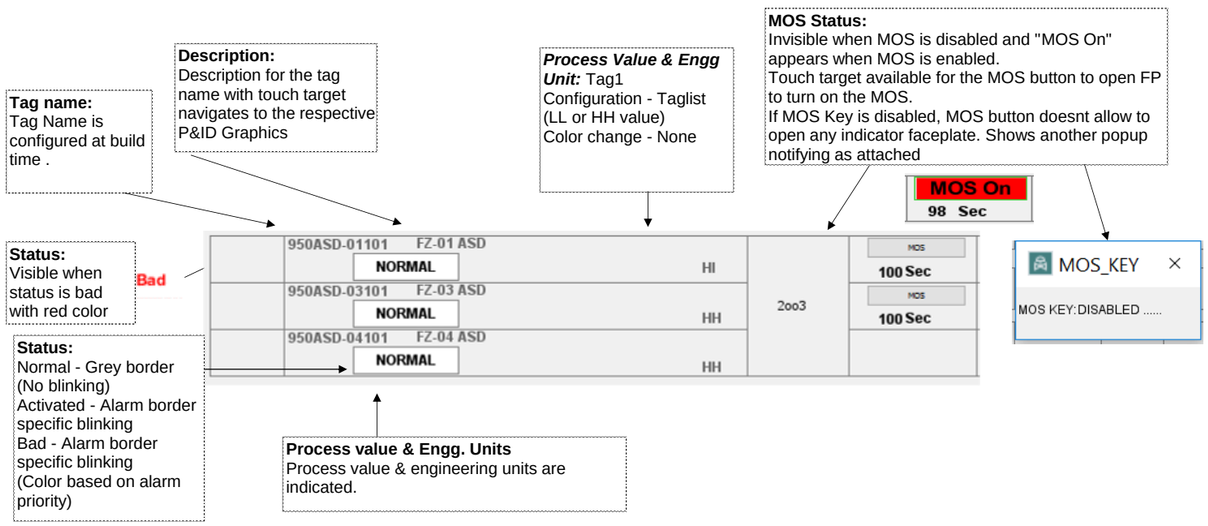
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1	Trip 27-67	Normal	Trip
2	buckholz alarm	Normal	Alarm
3	buckholz Trip	Normal	Trip
4	General alarm	Normal	Alarm
5	General fault	Normal	Fault
6	Level low very low alarm	Normal	Alarm
7	oil temp/pres Alarm	Normal	Alarm
8	oil temp/pres Trip	Normal	Trip
9	protection tripped oil level	Normal	Trip
10	protection relay healthy	Unhealthy	Healthy
11	protection- watchdog	Normal	Fail
12	INTERTRIP SEND TO L.V. SWITCHBOARD	Normal	Intertrip
13	K86 TRIPPED	Normal	Trip
14	C.B. CLOSED AND INSERTED	not closed	close
15	C.B. OPENED OR ISOLATED	not open	open
16	MCB'S CLOSED	close	open
17	C.B. READY (TCS)	not ready	Ready
18	C.B. READY TO CLOSE	Not Ready	ready to close
19	Synchro	not in sync	sync
20	earth open	close	open
21	LOCAL		LOCAL
22	REMOTE	REMOTE	

S.NO	Linkparts	Rev No	Functionality	Graphics level	Comments
1	BLPH-FGS-FLAME-IR	REV 2	 **Normal**  **HH Alarm** As per alarm specific color code  **H Alarm** As per alarm specific color code  **MOS** MOS is indicated by the border.  **MOS & alarm** As per alarm specific color code - No blinking. MOS is indicated by the border.  **Fault alarm**	Level 2 and higher	-
3	RMP-FGS-GAS-PNT-DET	REV 2	 **Normal** S - SMOKE detector .O - OXYGEN detector H - HYDROGEN detector  **HH Alarm** As per alarm specific color code  **H Alarm** As per alarm specific color code  **MOS** MOS is indicated by the border.  **MOS & alarm** As per alarm specific color code - No blinking. MOS is indicated by the border.  **Fault alarm**	Level 2 and higher	This typical is applicable for smoke, hydorgen and oxygen detector.

S.NO	Linkparts	Rev No	Functionality	Graphics level	Comments
4	BLPH_FGS_USH2_DET	REV 2	 **Normal** MCP - Represents Manual call point.  **HH Alarm** As per alarm specific color code  **H Alarm** As per alarm specific color code  **MOS** MOS is indicated by the border.  **MOS & alarm** As per alarm specific color code - No blinking. MOS is indicated by the border.  **Fault alarm**	Level 2 and higher	
5	BLPH_MFA	REV 2	 **Normal** S - Represents Smoke detector.  **Alarm** As per alarm specific color code  **Fault alarm** As per alarm specific color code	Level 2 and higher	MOS is not applicable to manual call point.
6	BLPH_ASDMOB	REV 2	 **Normal**  **alarm** As per alarm specific color code  **MOS** MOS is indicated by the border.  **FAULT** As per alarm specific color code	Level 2 and higher	Applicable for ASD,ESD,ESD-1D,MOB

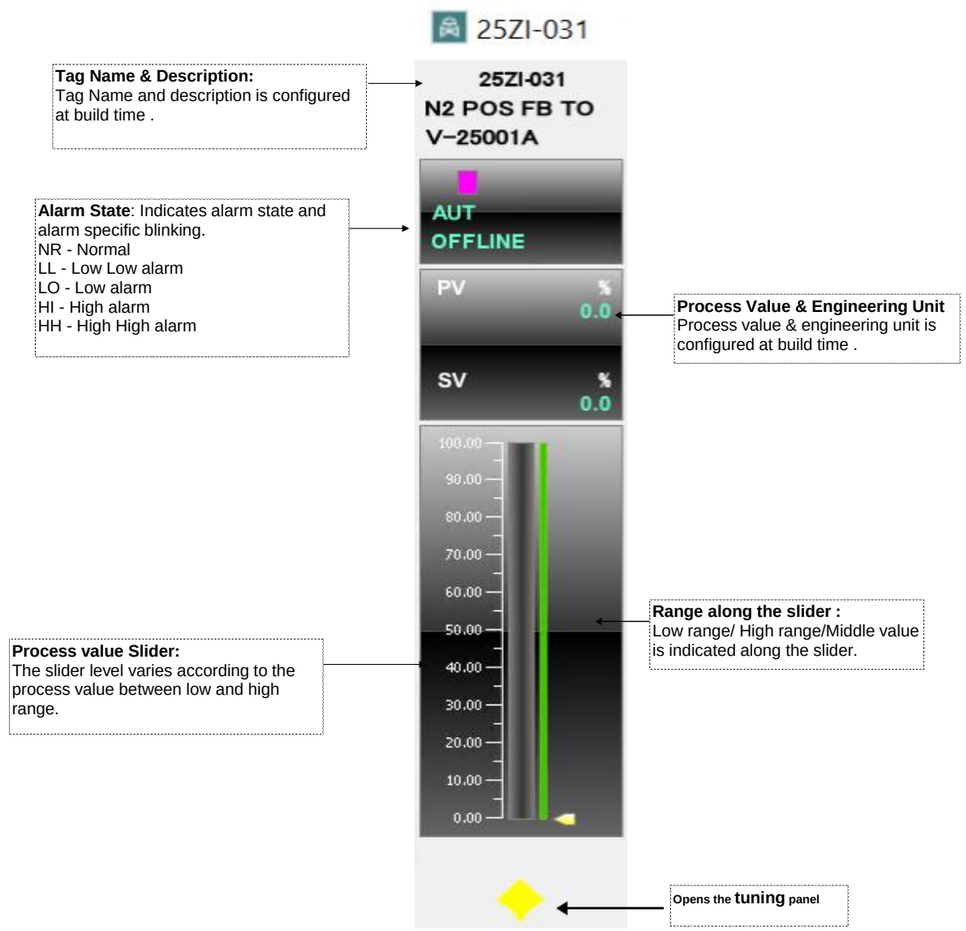
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7	BLPH-FGS-BEACON	REV 2	 **Normal**	 **Alarm** As per alarm specific color code	 **Fault** As per alarm specific color code	Level 2 and higher	-
	BLPH_FGS_GAS_BEACON	REV 2	 **Normal**	 **Alarm** As per alarm specific color code	 **Fault** As per alarm specific color code		
8	BLPH-FGS-SOUNDER	REV 2	 **Normal** S - Represents Sounder	 **Alarm** As per alarm specific color code .	 **Fault** As per alarm specific color code	Level 2 and higher	-

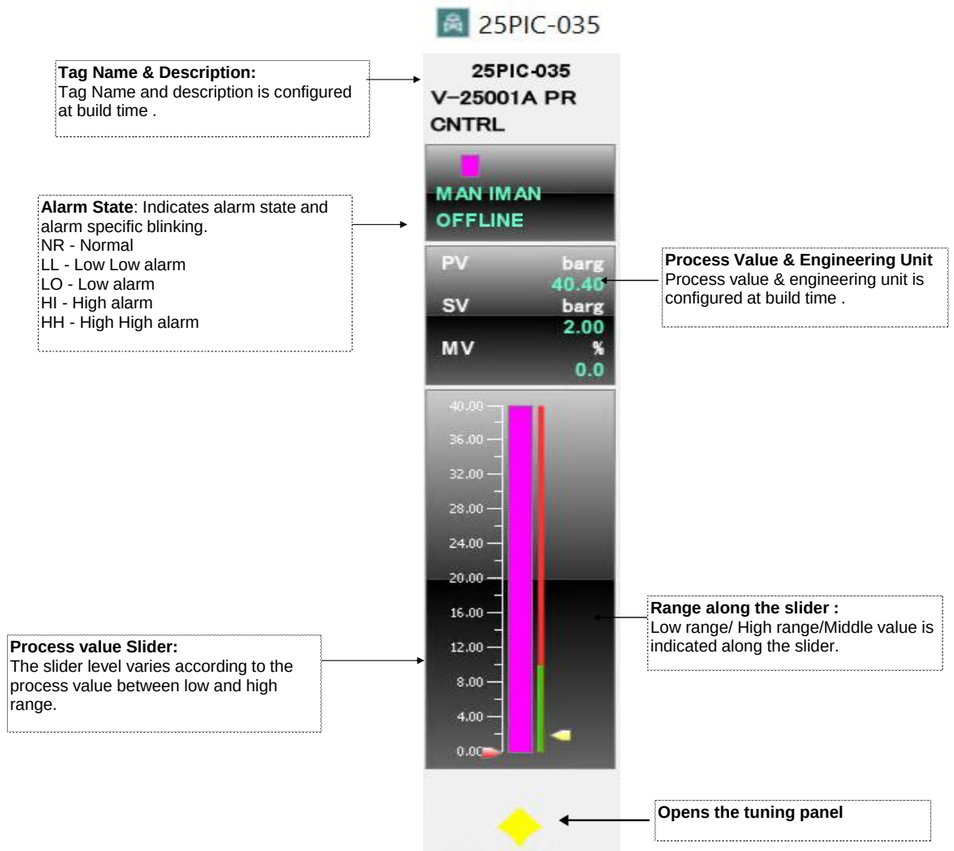
S.NO	Linkparts	Rev No	Functionality	Graphics level	Comments
9	FG_CE_BLPH_DI	REV 0		Level 2 and higher	-
10	FG_CE_BLPH_FGS	REV 0		Level 2 and higher	Used to show the communication status with the field devices

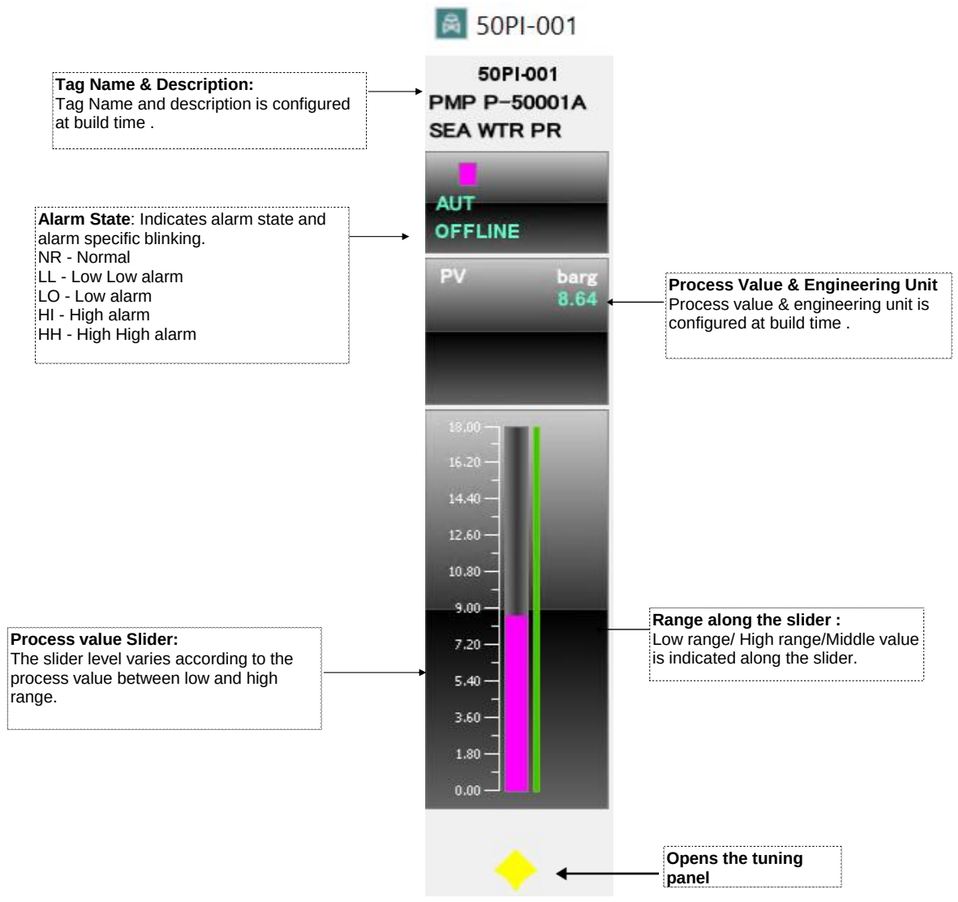
S.NO	Linkparts	Rev No	Functionality	Graphics level	Comments
11	CE_BLPH_AI	REV 0		Level 2 and higher	-

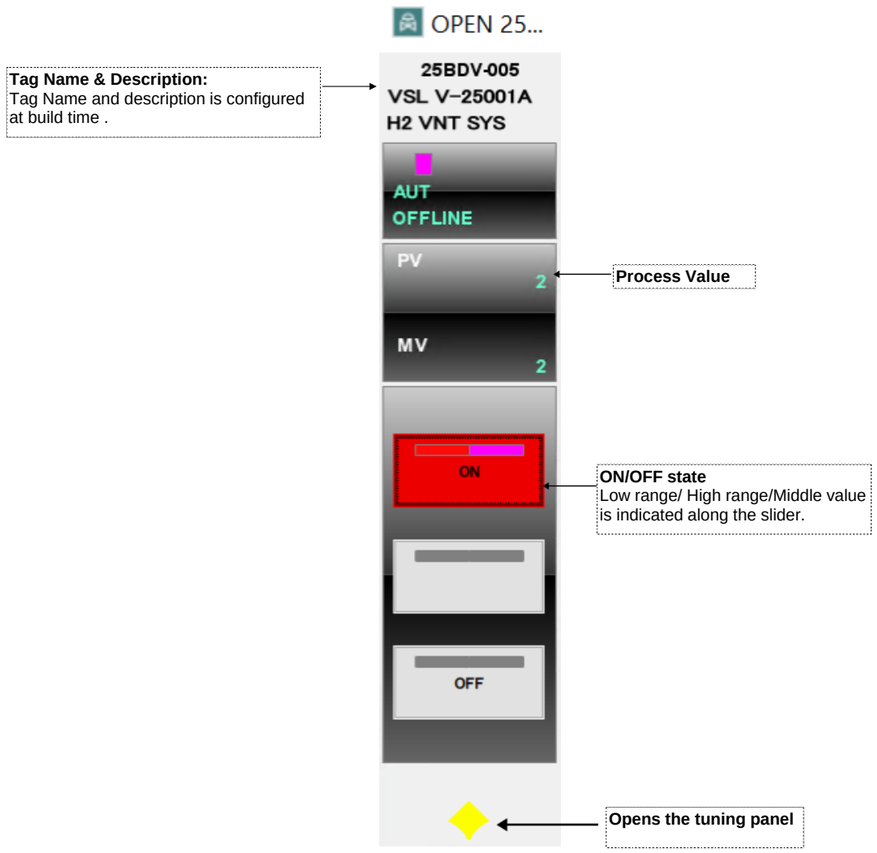
S.NO	Linkparts	Rev No	Functionality	Graphics level	Comments
12	CE_BLPH_DO_2CMNT	REV 0	**Tag name:** Tag Name is configured at build time with a touch target for opening the faceplate. Red when respective effect is tripped. Grey in normal condition. **Description:** Description for the tag name with touch target navigates to the respective P&ID Graphics **Status:** Shows the status of the tag 84XS-007A DISCONNECT AC UPS UP-200F3 BATTERIES A/B (B-300 CONTAINER) Bad	Level 2 and higher	-
13	CE_BLPH_MATRIX_2R	REV 0	**Trip Staus:** Normal Condition - Grey text & Grey alarm border Note: "TR" text is as per Cause & Effect TR TR **Trip Staus:** Trip Condition - Red text & Grey alarm border (No blinking)	Level 2 and higher	-

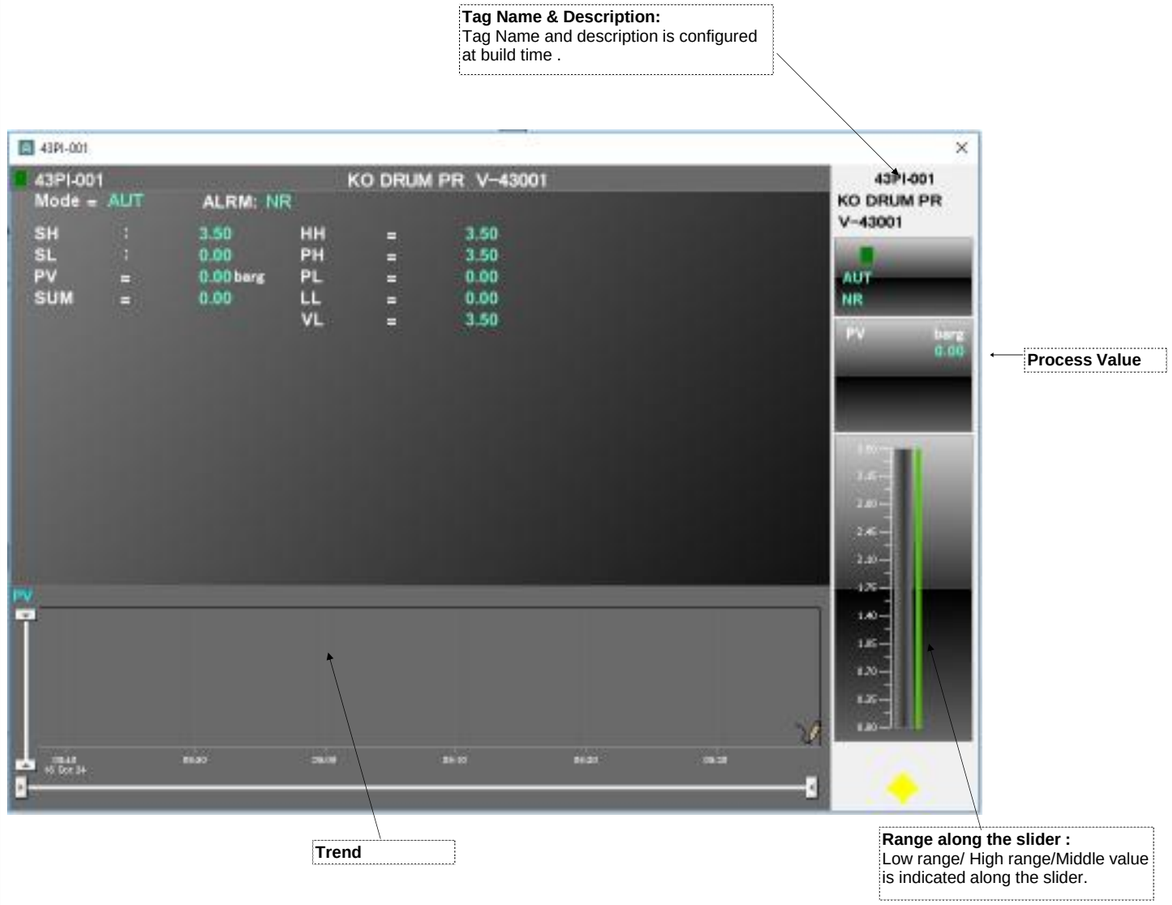
FACEPLATES

S.NO	Linkparts	Rev No	Functionality	Graphic Level	Comments
1	PVI Indicator	REV-1		Level 2 and higher	Applicable for all Analog indicators of SIS system

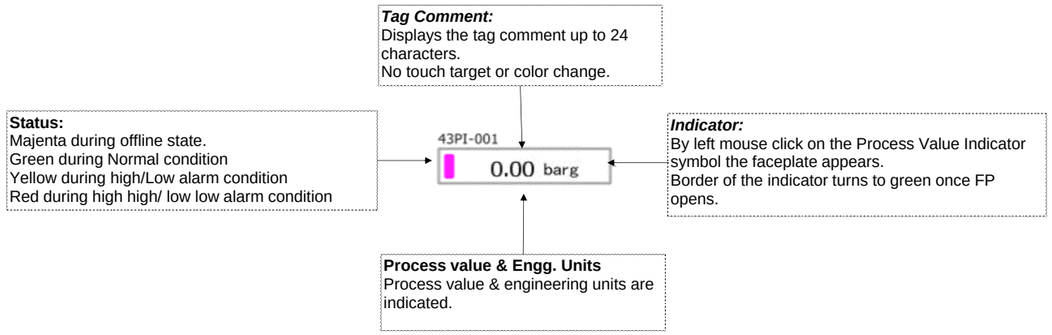
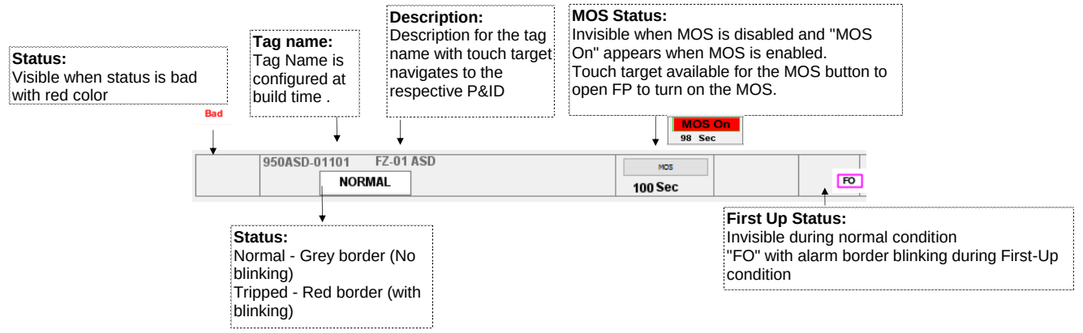
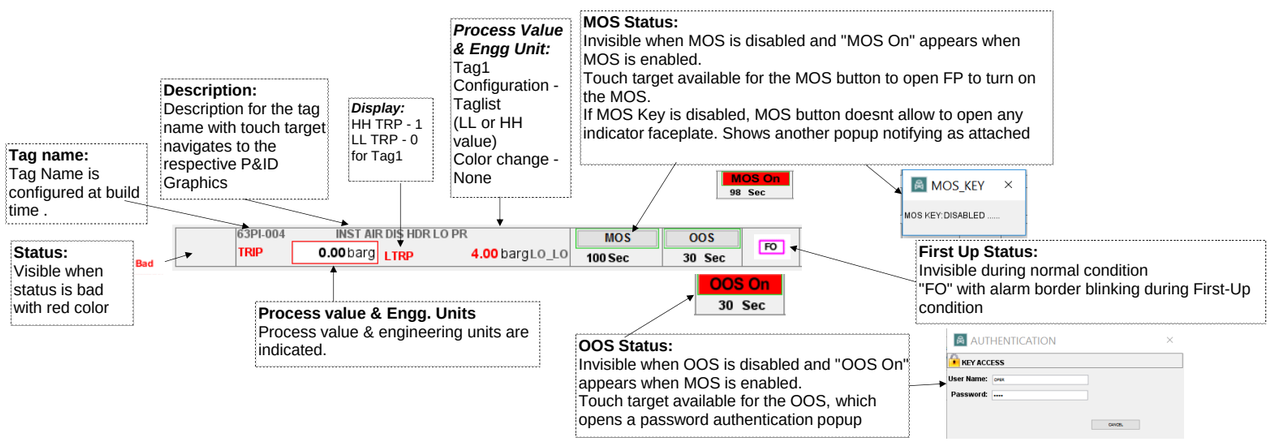
S.NO	Linkparts	Rev No	Functionality	Graphic Level	Comments
2	PID Indicator	REV-1		Level 2 and higher	Applicable for all Analog indicators of SIS system

S.NO	Linkparts	Rev No	Functionality	Graphic Level	Comments
3	SIS PVI Indicator	REV-1		Level 2 and higher	Applicable for all Analog indicators of SIS system

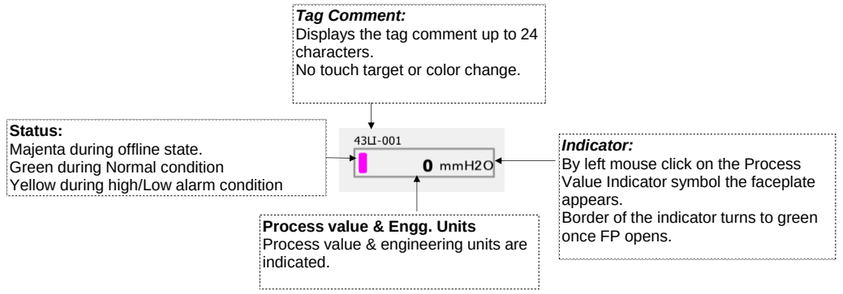
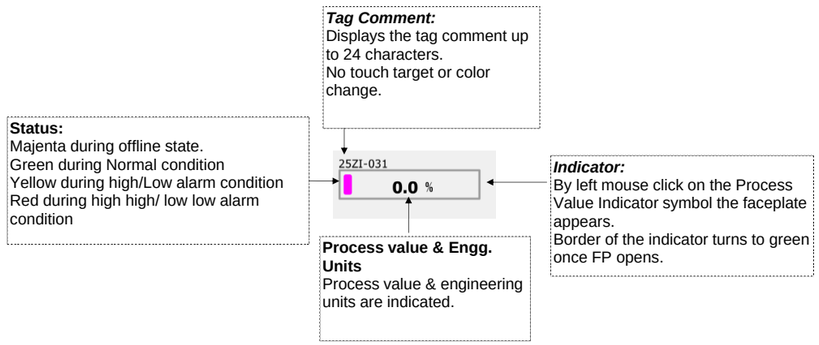
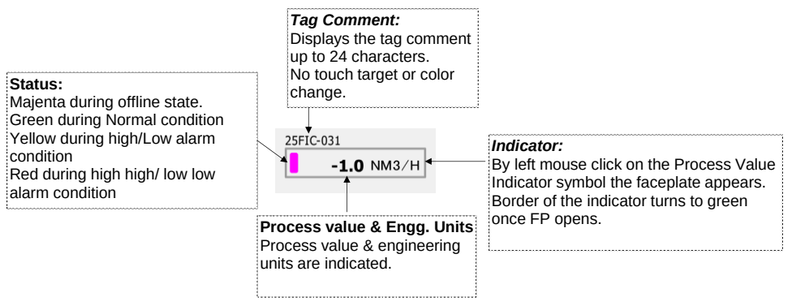
S.NO	Linkparts	Rev No	Functionality	Graphic Level	Comments
4	SIS PVI Indicator	REV-1		Level 2 and higher	Applicable for all Analog indicators of SIS system

S.NO	Linkparts	Rev No	Functionality	Graphic Level	Comments
5	Tuning Panel	REV-1		Level 2 and higher	The Tuning panel parameter will change according to the functional block

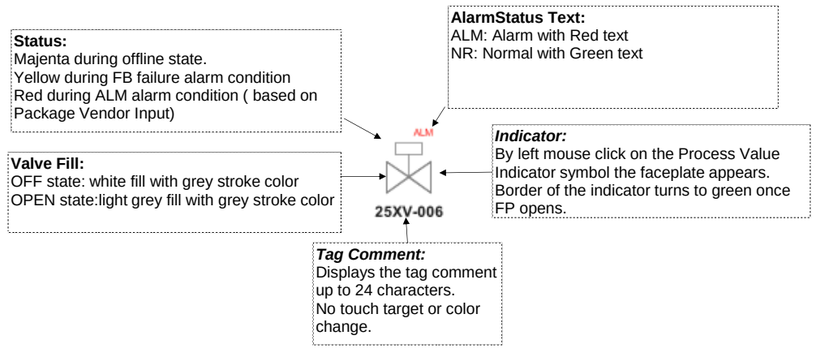
S.NO	Linkparts	Rev No	Functionality	Graphics level	Comments
1	DCS_LINK_R	REV 0		-	-
2	DCS_LINK_L	REV 0		-	-

SAFETY - GRAPHIC TYPICALS					
S.NO	**Linkparts**	**Rev No**	**Functionality**	**Graphics level**	**Comments**
1	SCS_ECW_B	REV 0		ALL LEVEL	-
2	CE_BLPH_DI	REV 0		Level 2 and higher	-
3	CE_BLPH_AI	REV 0		Level 2 and higher	-

S.NO	Linkparts	Rev No	Functionality	Graphics level	Comments
4	CE_BLPH_DO_2CMNT	REV 0	**Tag name:** Tag Name is configured at build time with a touch target for opening the faceplate. Red when respective effect is tripped. Grey in normal condition. **Description:** Description for the tag name with touch target navigates to the respective P&ID Graphics 84XS-007A DISCONNECT AC UPS UP-200F3 BATTERIES A/B (B-300 CONTAINER)	Level 2 and higher	-
5	CE_BLPH_MATRIX_2R	REV 0	T2 **Trip Staus:** Normal Condition - Grey text & Grey alarm border Note: "TR" text is as per Cause & Effect TR TR **Trip Staus:** Trip Condition - Red text & Grey alarm border (No blinking)	Level 2 and higher	-
6	SCS_ANLG	REV 1	***Tag Comment:*** Displays the tag comment up to 24 characters. No touch target or color change. **Status:** Majenta during offline state. Green during Normal condition Yellow during high/Low alarm condition Red during high high/ low low alarm condition 25PI-004 0.0 barg ***Indicator:*** By left mouse click on the Process Value Indicator symbol the faceplate appears. Border of the indicator turns to green once FP opens. **Process value & Engg. Units** Process value & engineering units are indicated.	ALL LEVEL	-
4	SCS_MOB21_BLPH_L	REV 1	**Status:** Majenta during offline state. Yellow during FB failure alarm condition Red during ALM alarm condition (based on Package Vendor Input) ***Tag Comment:*** Displays the tag comment up to 24 characters. No touch target or color change. **Valve Fill:** OFF state: white fill with grey stroke color INTERMEDIATE state: Half grey filled with grey stroke color OPEN state:light grey fill with grey stroke color 25BDV-005 ***Indicator:*** By left mouse click on the Process Value Indicator symbol the faceplate appears. Border of the indicator turns to green once FP opens.	All	-

S.NO	Linkparts	Rev No	Functionality	Graphics level	Comments	FAT COMMENTS
1	DCS_PVI_MOD	REV 0		All	-	
2	DCS_PVI_DV	REV 0		All	-	
3	DCS_PID	REV 0		All	-	

S.NO	Linkparts	Rev No	Functionality	Graphics level	Comments	FAT COMMENTS
4	SIO_21E_VALVE_ON_OFF2	REV 0	**Status:** Majenta during offline state. Yellow during FB failure alarm condition Red during ALM alarm condition (based on Package Vendor Input) **Valve Fill:** OFF state: white fill with grey stroke color OPEN state:light grey fill with grey stroke color 25XV-004 ***Indicator:*** By left mouse click on the Process Value Indicator symbol the faceplate appears. Border of the indicator turns to green once FP opens. ***Tag Comment:*** Displays the tag comment up to 24 characters. No touch target or color change.	All	-	
5	DCS_CONTROL_VALVE3	REV 0	**Status:** Majenta during offline state. ***Mode Status:*** Indicates auto/manual mode M: Manual mode A: Auto mode M 0 % 25FV-031 ***Indicator:*** By left mouse click on the Process Value Indicator symbol the faceplate appears. Border of the indicator turns to green once FP ***Tag Comment:*** Displays the tag comment up to 24 characters. No touch target or color change.	All	-	
6	DCS_PID_IND_VAL	REV 1	***Tag Comment:*** Displays the tag comment up to 24 characters. No touch target or color change. **Status:** Majenta during offline state. 25FIC-031 AUT MAN PV 5.6 NM3/H SV 42.0 NM3/H ***Mode Status:*** Indicates auto/manual mode M: Manual mode A: Auto mode ***Indicator:*** By left mouse click on the Process Value Indicator symbol the faceplate appears. Border of the indicator turns to green once FP **Status:** Majenta during offline state. Green during Normal condition Yellow during high/Low alarm condition Red during high high/ low low alarm condition	All	-	Change the background color, maintain same as that of engineering station

S.NO	Linkparts	Rev No	Functionality	Graphics level	Comments	FAT COMMENTS
7	SIO_21E_VALVE_ON_OFF2_ANN	REV 1		All	-	