Mark* VIeS

A SIL 2 and SIL 3 functional safety system for today's connected world

Mark VIeS
Functional Safety System

In today's world of brilliant machines, operators require high-performance automation solutions that seamlessly connect their machines, data, and people while ensuring the safety and integrity of their process and equipment. This convergence of connectivity and safety is occurring just as a generation of skilled workers is retiring, and risks to infrastructure and processes are increasing. This combination of factors has resulted in more stringent safety regulations and system certification requirements as well as greater scrutiny of program and operator integrity.

To help meet the ever-evolving safety challenges of today's connected world, GE combines its leadership of the Industrial Internet with its rich history of process safety to deliver the Mark VIeS Functional Safety System.

The Mark VIeS Functional Safety System is born from a decades-long heritage of turbine protection and control. The Mark VIeS system is a cost-effective, complete, flexible, and reliable functional safety system with enhanced cyber security for critical processes such as plant emergency shutdown, burner management, critical process control, and fire and gas detection applications.

The Mark VIeS Functional Safety System is designed to perform in the extreme conditions found in industries such as:

- Oil & Gas
- Power Generation
- Chemical and Process
- Pulp and Paper
- Mining and Minerals Engineering

The Mark VIeS Functional Safety System offers:

- A proven and safe solution
- Flexibility and reliability
- Enhanced productivity and efficiency
- Seamless integration with basic process control system

The Mark VIeS Advantage

The Mark VIeS Functional Safety System reflects GE's experience of three-plus decades, four generations, and over 10,000 installed Triple Modular Redundant (TMR) systems.

The Mark VIeS is certified to IEC 61508 standards to meet the needs of the majority of safety requirements – SIL 2 and SIL 3.

These proven and reliable systems perform mission critical applications worldwide, utilizing flexible Safety Integrity Level (SIL) configuration and qualified manufacturing and solution delivery processes.

A Proven and Safe Solution

GE brings decades of domain expertise to the Mark VIeS Functional Safety System. The Mark series of controllers has earned a reputation for superior running reliability and superior tripping reliability when required in thousands of TMR systems installed in power generation and infrastructure applications globally. These proven philosophies are at the heart of the Mark VIeS Functional Safety System.

The Mark VIeS can be applied as a stand-alone safety application or as part of GE plant-wide control solutions. To help protect your infrastructure, the Mark VIeS system's enhanced cyber security features integrate with GE plant-wide security management systems, providing perimeter defense and intrusion detection and protection against denial of service (DOS) attacks and buffer overrun.

The proven and reliable Mark VIeS system helps keep operations safe and secure through:

• Branded and locked application code

• Dedicated security process and response

• Limited data access

• Improved passwords

• Achilles Certification – Level 1

• User authentication and access control

• Security logs

• Hardened protocols

Flexibility and Reliability

Flexible Redundancy

Redundancy is a critical feature in safety control system design, enabling continuous process operation during system maintenance or repair. The Ethernet backbone of the Mark VIeS

Functional Safety System allows each segment of the system to be configured with different levels of redundancy.

• Controllers can be: Simplex, Dual, or TMR

• I/O network (IONet) Communications can

be: Simplex, Dual, or TMR

• I/O modules can be: Simplex or TMR

This flexibility enables customers to design to the exact needs of their SIL application reducing system costs. Customize your level of redundancy to meet your safety and running reliability needs.

Reliability in Harsh Environments

GE understands that safety systems don't just reside in clean rooms. That's why the Mark VIeS Functional safety provides high performance in the extreme conditions found in many process environments. The processors, network switches, and I/O components are approved for Class 1, Division 2 and are G3 compliant. That means less downtime for your operations.

Enhanced Productivity and Efficiency

Sophisticated application automation tools and seamless data integration between the control system and HMI enable process efficiencies during project execution to reduce delivered cost and improve quality. Enhanced software reusability features allow users to create and maintain logic standards that can then be efficiently deployed over and over again. This reduces project costs, increases integrity of software, and reduces risk of human error. All critical considerations when deploying safety related systems.

Integration with Existing Control Systems

GE Automation & Controls understands the importance of seamless integration between your safety and existing control solutions. The Mark VIeS offers flexibility, scalability, and standards-based operational interfaces to integrate securely with your existing process control systems. This allows world-class safety functionality to securely connect to existing processes, creating a seamless safety program.

Mark VIeS Offers Numerous Benefits

Increased Availability

Mark VIeS offers redundant controllers, power supplies and local area networks to increase availability of the SIL 2 or SIL 3 safety function while assuring tripping reliability for safety related functions.

HART® Capability

Smart HART field instrumentation has enabled new control and asset maintenance programs, and Mark VIeS gives access to these powerful tools.

Normally Energized and De-energized

Mark VIeS digital output channels are certified for both normally energized and normally de-energized applications, and can be configured channel by channel.

Integrated 1ms Sequence of Events

Every digital input and digital output can be enabled to record 1ms SOE events with a simple check box. Captured SOEs can be combined in the live or historical trender to analyze process disruptions and aid in the rapid recovery to normal process conditions.

Rapid Application Development

The safety applications are developed in the ControlST, Function Block Diagrams (FBD), Cause and Effect Matrix, and Ladder Diagrams (LD). Integrated Library capability with advanced replication tools allow OEMs to build trusted algorithms and rapidly deploy them to project-specific configuration with ease.

Security and Access Control

The Mark VIeS security measures include password-protected user accounts, a Trusted Host table of authorized computers, "Controller Locked" mode to prevent unplanned changes, application branding to assure approved code is in use, and a controller password to prevent unauthorized access. Black Channel communications allow safe and secure communications across large plants with multiple safety controllers. It is Achilles Level 1 certified, verifying the network robustness of the Mark VIeS.

Validation and Verification Software

ControlST provides tools to test and monitor any changes to the application program.

Advanced Diagnostics and Alarms

Mark VIeS provides detailed diagnostics across all IO, network, controllers, and power distribution controllers so that you can be confident that all safety loops are operational and ready to perform when needed. Diagnostics and Alarms are maintained in the controller and will not be lost in the event of lost communications.

Universal I/O Capability

Mark VIeS supports Universal Analog I/O modules that allow configuration of analog inputs and outputs at the point level on a module, resulting in lower requisition engineering, spare parts, and panel space.

Management Support

Mark VIeS utilizes exSILentia Safety Lifecycle Management Tool to analyze safety instrumented functions (SIFs) and calculate the safety parameters they require for specific applications. This software helps customers achieve a new level of consistency and productivity in the design of their safety systems.

When analyzing a Safety Instrumented Function with the exSILentia tools, the entire SIF is evaluated, encompassing:

• Sensors

• Logic solver

• Final element

The functional safety parameters for Mark VIeS components are incorporated into the logic solver portion of the Exida safety equipment database, enabling the tools to include these components in calculating the safety and operational characteristics for a SIF.

Solution Components

Mark VIeS Controller

At the heart of the Mark VIeS system is the controller that includes the main processor and redundant Ethernet drivers to communicate with networked I/O, and additional Ethernet drivers for the control network. A set of two or three controllers can be used to provide dual or TMR control. The Mark VIeS control logic can be programmed in a combination of function block diagrams (FBD), Cause and Effect matrix, and relay ladder logic (RLD). A real-time operating system executes this control logic and interfaces with the I/O system.

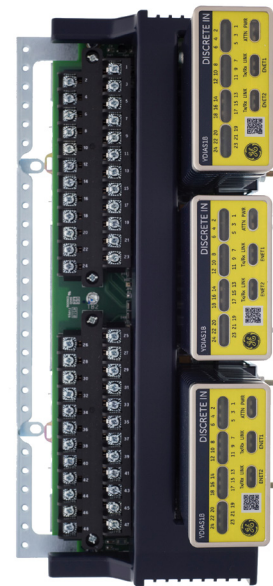**TMR**   **Dual**   **Simplex**
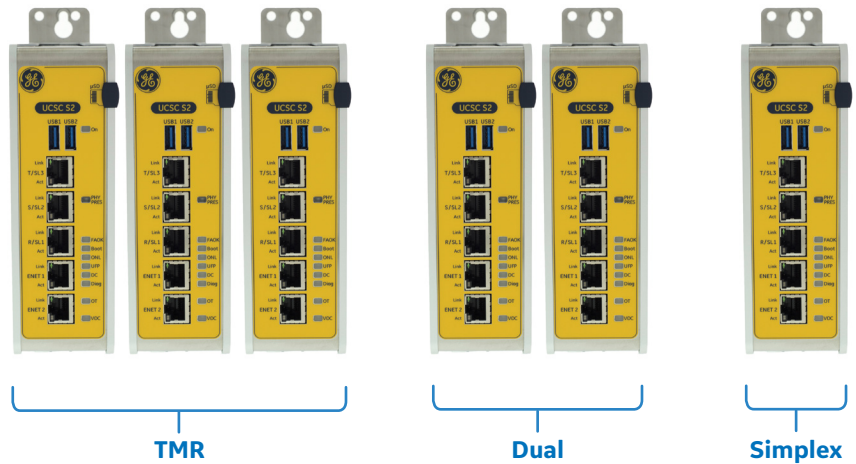
Mark VIeS I/O Modules (I/O Card & Pack)

Mark VIeS I/O modules have been designed to connect direct to field devices with no need for interposing terminals reducing the cost of installation and eliminating a potential failure point. Modules have three common components: a terminal block for field wiring, a terminal board, and I/O pack(s). Two-piece barrier or box-type terminal blocks are mounted on the terminal board which has a DIN rail mounting bracket. Each I/O pack contains two IONet ports and a local processor with a real-time clock synchronized for time-stamping in the sequence- of-events (SOE) function available on all discrete inputs and outputs. This feature allows customers to select SOE with the click of a button, without the complexity and expense of dedicated SOE hardware.

Simplex I/O modules have one I/O pack mounted on the terminal board, TMR I/O modules have three I/O packs mounted to a common terminal board. I/O redundancy is a single selection during hardware configuration, and is transparent to application code.

Simplex Module Configuration (Typical)

TMR Module Configuration (Typical)

I/O Network (IO Net)

The I/O network is a dedicated, full duplex, point-to-point protocol. It supports a deterministic, 100 MB communications network suitable for local and/or distributed I/O modules. In each frame, the online controllers read data from the input modules, write data to the output modules, and synchronize variables between

controllers in a dual or TMR configuration. IOnet switches are a GE design, incorporating extreme environmental capability with superior performance.

Virtual Mark VIeS Controller

For training and validation, simulation of the process and associated control can be invaluable.

The Virtual Mark VIeS provides a virtual, PC-based form of the controller supporting:

• Execution of application program
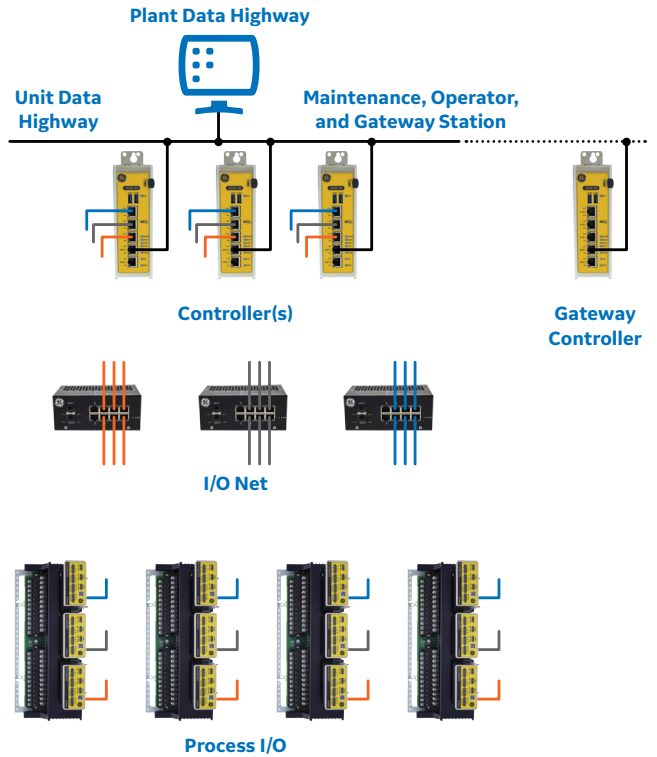
• Communication interface with ToolboxST

application

• Ethernet Global Data (EGD) services
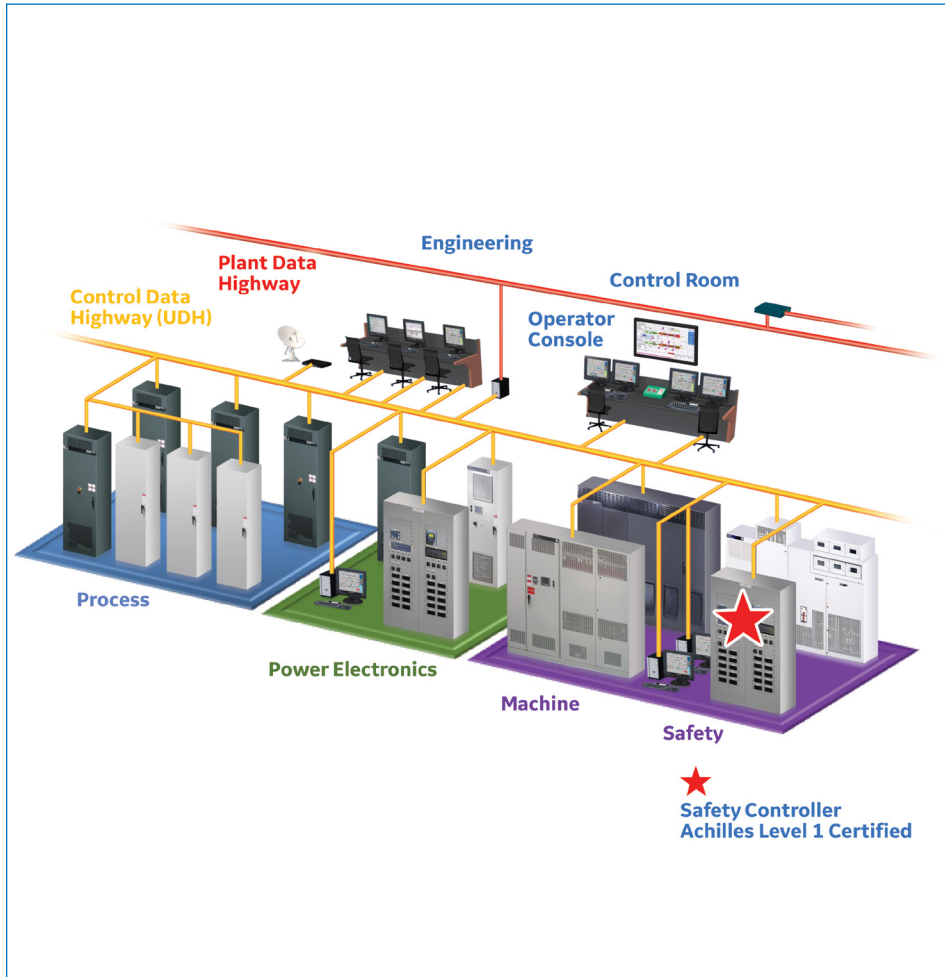
• Process alarm management

Scalable Safety and Availability

The combination of a single board controller and Ethernet-based I/O network has enabled the Mark VIeS to support numerous control modes for Safety Instrumented Functions (SIFs). Customize the system that's right for your operation, selecting redundancy options in seconds with no impact to application code. An example of TMR redundancy across the Mark VIeS components is shown in the illustration at the right. Mark VIeS can be applied in the following configurations to meet various applications:

- TMR 2oo3 SIL3 high/low demand for de-energize-to-trip
- TMR 2oo3 SIL2 low demand for energize-to-trip
- TMR degraded 1oo2 SIL3 high/low demand for de-energize-to-trip
- TMR degradation sequence 2oo3 to 1oo2 to fail-safe
- Dual 1oo2 SIL3 high /low demand for de-energize-to-trip
- Dual 2oo2 SIL2 low demand or energize and de-energize-to-trip
- Simplex 1oo1 SIL2 low demand for de-energize-to-trip

Plant Data Highway

Unit Data Highway

Maintenance, Operator, and Gateway Station

Controller(s)

Gateway Controller

I/O Net

Process I/O

Mark VIeS & Achilles Level 1 Certification

Engineering

Plant Data Highway

Control Room

Control Data Highway (UDH)

Operator Console

Process

Power Electronics

Machine

Safety

Safety Controller
Achilles Level 1 Certified

Certifications

Safety systems must meet international codes and standards. The proven and certified Mark VIeS Functional safety conforms to a variety of industry standards.

Industry Codes and Standards

Code – Standard	Mark
CAN/CSA-C22.2 No. 61010-1-12	
UL Std. No. 61010-1 (3rd Edition)	CSA c us 165588 CE
EN 61010-1 (3rd edition)	
Achilles Level 1 certification, controller security	wurldtech
DEMKO 12 ATEX, application dependent	Ex
ISO 9000	ISO

Safety System Related Codes and Standards

Code – Standard	Mark
IEC 61508 : 2010 Parts 1-7 through Exida	CERTIFIED SIL 3 CAPABLE
EN50402: 2005+A1: 2008 Logic Solver	