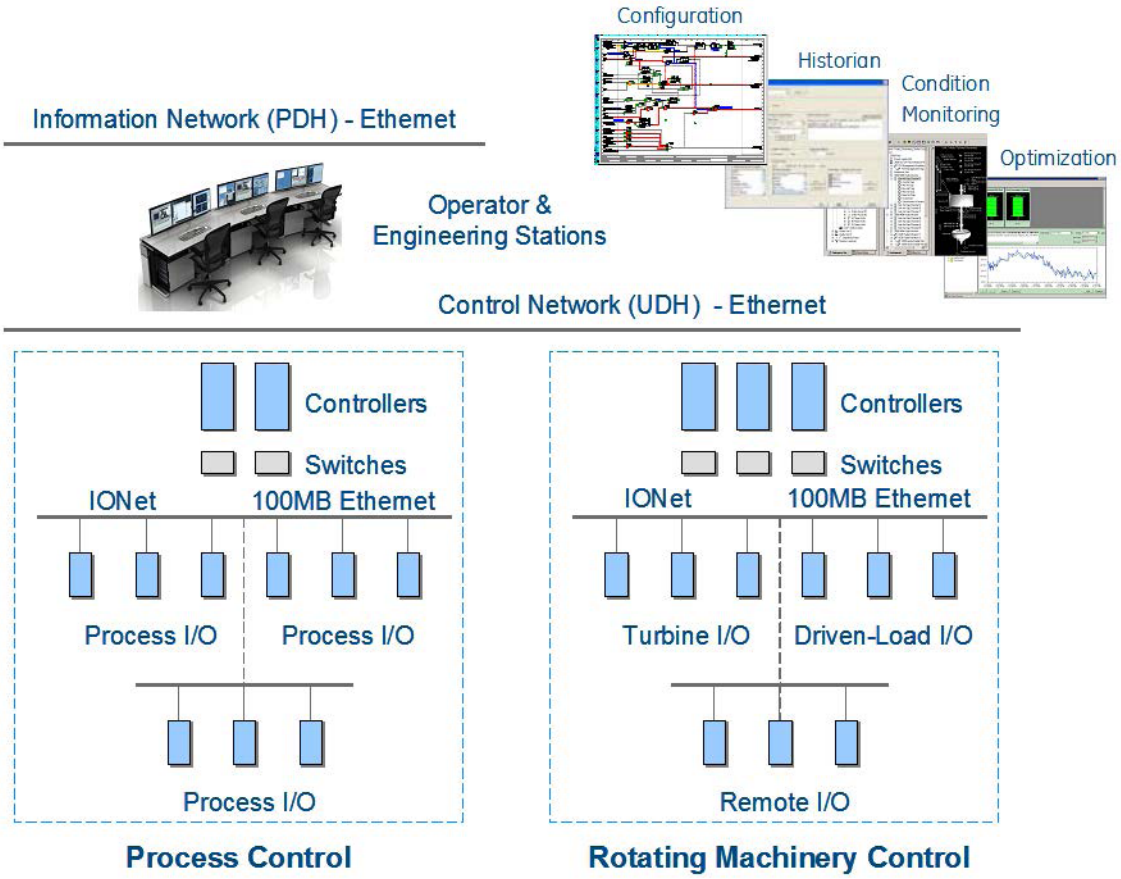
GE VERNOVA

MARK* VIE CONTROL

PRODUCT DESCRIPTION

INTRODUCTION

The Mark* VIe control system is a flexible platform used in multiple applications. It features high-speed, networked input/output (I/O) for simplex, dual, and triple redundant systems. Industry-standard Ethernet communications are used for I/O, controllers, and supervisory interface to operator and maintenance stations, as well as third-party systems. The ControlST* software suite, which contains the ToolboxST* toolset, is used with Mark VIe controls and related systems for programming, configuration, trending, and analyzing diagnostics. It provides quality, time-coherent data in the controllers and at the plant level for effectively managing control system equipment. The Mark VIeS Safety control is a stand-alone safety control system for safety-critical applications that conform to IEC®-61508. It also uses the ControlST software suite to simplify maintenance, but retains a unique set of certified hardware and software blocks. The ToolboxST application provides a means to lock or unlock the Mark VIeS for configuration and safety instrumented function (SIF) programming.



SYSTEM OVERVIEW

A single-board controller is the heart of the system. The controller includes the main processor and redundant Ethernet drivers to communicate with networked I/O, and additional Ethernet drivers for the control network. A real-time, multi-tasking operating system is used for the main processor and I/O modules. Control software is provided in a configurable control block language and stored in non-volatile memory. It is similar to IEEE® 854 32-bit floating-point format, and Sequential Function Charts (SFC) are also available for complex sequencing.

The I/O network (IONet) is a dedicated, full-duplex, point-to-point protocol. It provides a deterministic, high-speed 100 MB communications network that is suitable for local or distributed I/O devices, and provides communication between the main controllers(s) and networked I/O modules. Online controllers continuously read input data directly from the IONet, which is available in single, dual, and triple redundant configurations. Both copper and fiber interfaces are supported.

100 MB Ethernet is used forcommunication to local and distributed I/O modules.

The Mark VIe I/O modules consist of three basic parts: the terminal board, the terminal block, and an I/O pack. Barrier or box-type terminal blocks are mounted on a terminal board, which mounts on a DIN rail or base in the control cabinet. The I/O pack contains two Ethernet ports, a power supply, a local processor, and a data acquisition board. I/O capability grows as I/O packs are added to the control system, enabling use in a simplex, dual, or triple redundant configuration. Some process sub-systems require even more throughput; therefore, the local processors in each I/O pack run algorithms at higher rates as required for the application.

REDUNDANCY

Every application has different requirements for redundancy depending on the criticality of the process. The Mark VIe control system provides a wide range of redundancy options for local and remote distribution.

Control Components	Redundancy Level		
Power sources	Single	Dual	Triple
Power supplies	Single	Dual	Triple
I/O packs per I/O module	Single	N/A	Triple
Ethernet ports per I/O pack	Single	Dual	N/A
IONet	Single	Dual	Triple
Control Network	Single	Dual	N/A

Dual redundant systems transmit inputs from single or redundant input packs on dual IONets to dual Mark VIe controllers. Controllers then run application software and transmit outputs to output packs. Three output I/O packs may be provided to vote output signals for mission-critical field devices. Dual redundant systems may be configured for single, dual, and triple redundant sensors.

Triple redundant systems protect against soft or partial device failures. A failed component is outvoted with a 2-out-of-3 logical selection (vote) or a median value selection. Control software in all three Mark VIe controllers runs on the voted value of the signal while diagnostics identify the failed device. These sophisticated diagnostics reduce the mean-time-to-repair (MTTR) while the online repair capability increases the mean-time-between-forced-outages (MTBFO). Field sensors for these systems may be single, dual, or triple.

I/O INTERFACE

One or multiple I/O packs are mounted on each module to digitize the sensor signal, run algorithms, and communicate with a separate controller containing the main processor. I/O packs have a local processor board that runs a real-time operating system and a data acquisition board that is unique to the specific I/O application. Local processors run algorithms at faster speeds than the overall control system, such as the regulation of servo valves performed within a servo module.

Each I/O processor has a local temperature sensor accurate to ±2°C (±3.6 °F). Detection of an excessive temperature generates a diagnostic alarm and the logic is available in the database (signal space) to facilitate control action or unique process alarm messages. The temperature is continuously available in the database. I/O module features include:

- Dual 100 MB Ethernet ports
- 100 MB full-duplex ports
- Online repair per I/O pack
- Automatic reconfiguration
- Accuracy is specified over full operating temperature
- Internal temperature sensor
- LEDs:
  - Power status and attention
  - Ethernet link-connected and communication-active
  - Application-specific
- 28 V dc power
- Internal solid-state circuit breaker and soft start

A power supply provides a regulated 28 V dc power feed to each I/O pack. The negative side of the 28 V dc is grounded through the I/O pack metal enclosure and its mounting base. The positive side has solid-state circuit protection built into the I/O pack with a nominal 2 A trip point. Online repair is possible by removing the 28 V dc connector, replacing the I/O pack, and re-inserting the power connector. I/O packs are automatically reconfigured if the Auto-Reconfiguration feature is enabled.

> Every I/O pack communicates directly over the IONet, which enables each I/O pack to be replaced individually without affecting other I/O packs in the system. Additionally, the I/O pack may be replaced without disconnecting any field wiring.

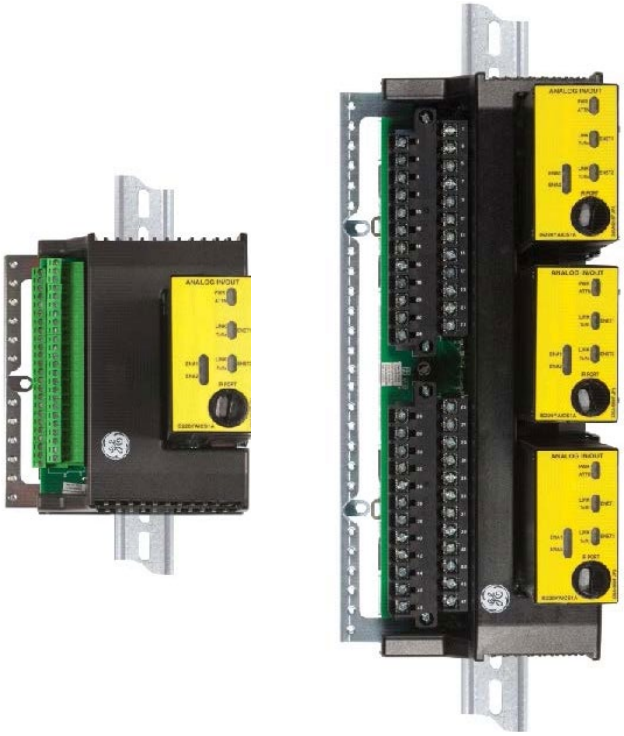
Typical I/O Module with Box-type Terminal Block

TERMINAL BLOCKS

Signal flow begins with a sensor connected to a terminal block on an I/O module. The terminal board mounts to the cabinet and is available in two basic types: T-type and S-type modules.

T-type modules typically fan the inputs to three separate I/O packs. They contain two removable 24-point, barrier-type terminal blocks. Each point can accept two 3.0 mm2 (#12,AWG) wires with 300 V insulation per point and spade or ring-type lugs. Captive clamps are also provided for terminating bare wires. Screw spacing is 9.53 mm (0.375 in) minimum, center-to-center. T-type modules are normally surface mounted, but may also be DIN-rail mounted.

A shield strip is provided next to each block, which is actually the left-hand side of the metal base where the module is mounted. Wide and narrow modules are arranged in vertical columns of high and low-level wiring that can be accessed from top and/or bottom cable entrances. An example of a wide module is a module containing magnetic relays with fused circuits for solenoid drivers.



Box-type and Barrier-type Terminal Blocks in Simplex and Triple Redundant Configuration

S-type modules provide a single set of screws for each I/O point and allows a single I/O pack to condition and digitize the signal. This board is used for simplex, dual, and dedicated triple modular redundant (TMR) inputs by using one, two, or three boards. They are half the size of T-type modules and are DIN-rail or surface mounted. Two versions of the S-type modules are available: fixed terminal blocks and removable terminal blocks.

Fixed box-type terminal blocks accept one 3.0 mm2 (#12 AWG) wire or two 2.0 mm2 (#14 AWG) wires with 300 V insulation per point. Screw spacing is 5.08 mm (0.2 in) minimum, center-to-center. Removable box terminals may be replaced with spring-cage-clamp, insulation displacement, or crimp-and-stab terminals. A shield strip is provided on each terminal block and is tied to functional ground.

TEMPERATURE RATINGS

Mark VIe electronics are packaged in different locations world-wide and customized for a variety of protection classifications with and without ventilation and cooling. Controllers, I/O modules, power supplies, etc. are rated for -30 to 65°C (-22 to 149°F) at the electronics. To compliment the Mark VIe Control's native I/O modules, a variety of fieldbus solutions are available with master communication gateways on the I/O network. These modules have slightly reduced operating temperature ratings:

- PROFIBUS® Master Gateway: -20 to 55°C (-4 to 131°F)
- CANopen® Master Gateway: -20 to 55°C (-4 to 131°F)
- FOUNDATION Fieldbus™ Linking Device: 0 to 55°C (32 to 131°F)

Modules with reduced operating temperatures should be mounted lower in the cabinet to avoid the natural temperature gradient from the bottom to the top of the enclosure. Control room equipment such as operator stations has an operating temperature range of 20 to 30°C (68 to 86°F). For shipping and storage, the controllers, I/O modules, power supplies, etc. are rated -40 to 85°C (-40 to 185°F), and control room equipment is rated 0 to 30°C (32 to 86°F).

I/O modules are mounted in local clusters and distributed remotely for packaging in a variety of protection classifications. Therefore, temperature ratings are provided for the ambient at the electronics.

I/O MODULES

I/O modules can be categorized as generic and application-specific. As an example, discrete inputs (contact inputs) are used in virtually all applications and differ primarily in their voltage rating. Other considerations in selecting a module are its redundancy, isolation (group or point), terminal block type, availability for safety applications (IEC 61508), and approval for hazardous locations.

A typical application-specific module is a servo module that is used for fast closed-loop control of a turbine's servo valve actuator or a complete emergency over-speed trip system for a turbine. These unique modules will not be described in the following tables. However, some application-specific modules such as a vibration module is commonly applied in monitoring radial and axial shaft displacement of rotating machinery in plant distributed control systems and will be described in a separate table.