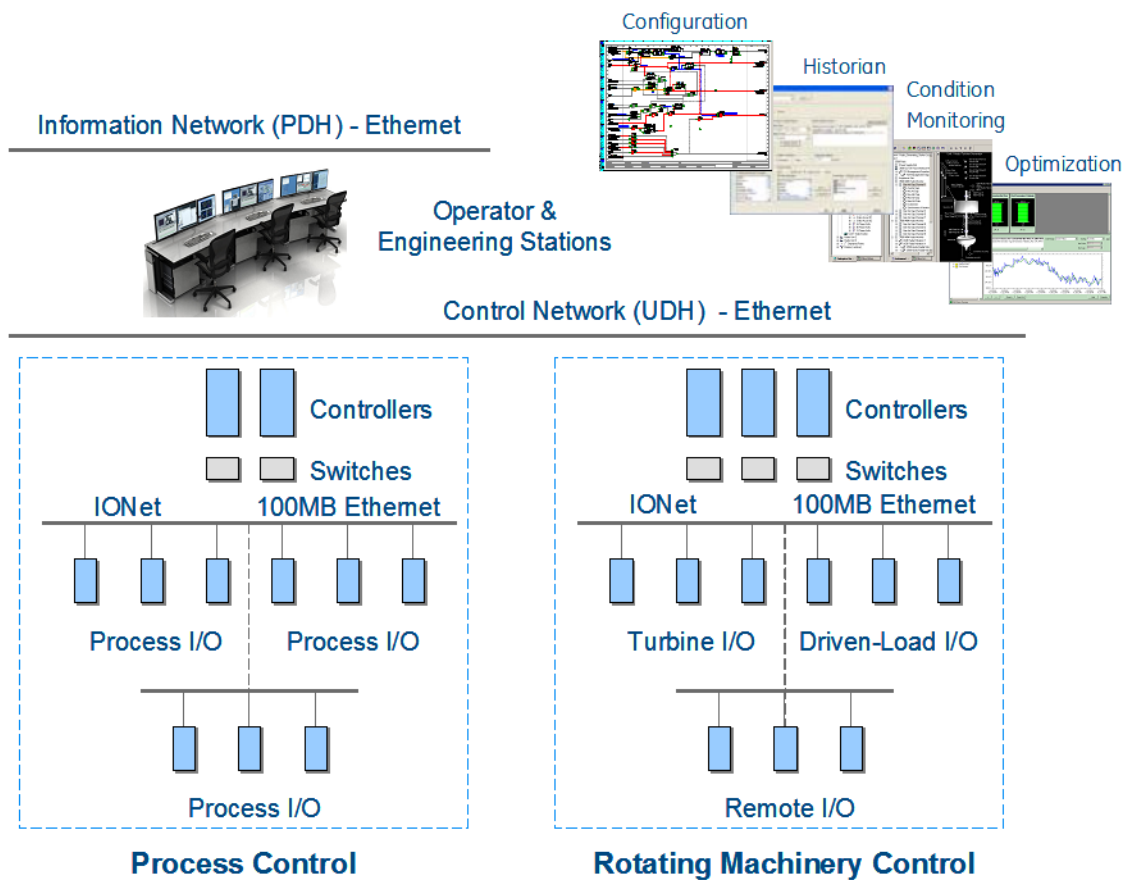


Introduction

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.



Typical Architecture for Plant and Turbine Control Systems

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.

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

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 controller(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.

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.

Redundancy Options

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.

Analog Input (AI) and Analog Output (AO) Modules

- V/I designates a voltage / current input
- TC designates thermocouples
- RTD designates resistance temperature device

Qty.	Input Type	Input Isolation	Output Type	Output Isolation	TB Type	Removable Term. Block	I/O Packs Per Module	Safety Version Available	Hazardous Location Approval
†10 AI 2 AO	V / I	Group	0-20ma	Group	Barrier	Yes	1 or 3	Yes	Yes
			0-20ma	Group	Box	Yes or No	1	Yes	Yes
			0-20/0-200ma	Group	Barrier	Yes	1 or 3	No	No
			0-20/0-200ma	Group	Box	Yes or No	1	No	No
10 AI 2 AO	V / I	Point	0-20ma	Group	Box	Yes or No	1	No	No
			0-20/0-200ma	Group	Box	Yes or No	1	No	No
16 AO 8 AO			0-20ma	Group	Barrier	Yes	1 or 3††	No	Yes
			0-20ma	Group	Box	Yes or No	1	No	Yes
12	TC	Group	N/A	N/A	Barrier	Yes	1, 2, 3 †††	Yes	Yes
12	TC	Group	N/A	N/A	Box	Yes or No	1	Yes	Yes
24	TC	Group	N/A	N/A	Barrier	Yes	1, 2††††	Yes	Yes
16	RTD	Group	N/A	N/A	Barrier	Yes	1, 2 †††††	No	Yes
					Box	Yes or No	1	No	Yes

† HART Communications is available

†† 8 AO outputs are driven by each of two I/O Packs

††† Each TC is monitored by all 3 I/O Packs. Extended range option available for EPRI compliance.

†††† 12 TCs are monitored by each of 2 I/O Packs. Extended range option available for EPRI compliance

††††† 8 3-wire RTDs are monitored by each of 2 I/O Packs

Analog I/O modules typically contain 10 analog inputs and 2 analog outputs. 8 inputs can be configured for 1-5Vdc, ±5Vdc, ±10Vdc, or 0-20ma with jumpers on the module, and the remaining 2 inputs can be configured for 0-20ma or +/-1ma with 250 Ω / 5,000 Ω burden resistors respectively. For applications with a high concentration of analog outputs, dedicated output modules are available for 0-20ma and others for 0-20ma / 0-200ma selection for valve actuators (800 Ω / 50 Ω output loads respectively). Transducers can be externally powered (differential inputs) or internally powered from the I/O module with +24Vdc current limited per point. I/O modules are available with point isolation for externally powered transducers.

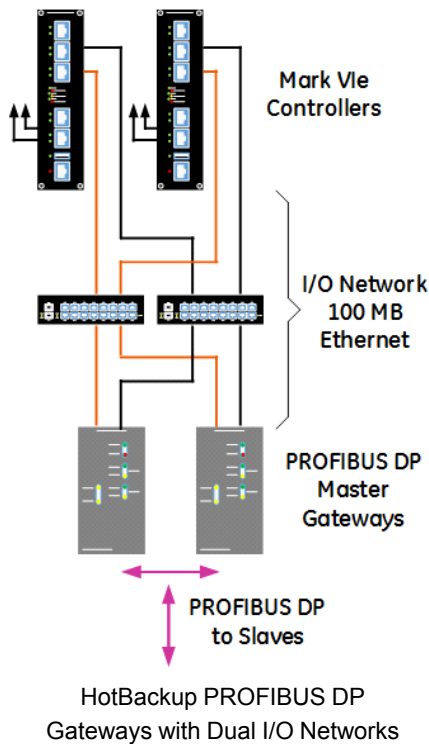
In general, RTDs are useful for precision temperature measurements below 800°C, and thermocouples are cost effective devices for monitoring a wider temperature range. RTD modules provide a 10 ma multiplexed excitation current to each RTD, which can be grounded or ungrounded. They support 100 and 200 Ω platinum, 10 Ω copper, and 120 Ω nickel 3-wire RTDs with software linearization per point. The linearization includes scaling for specific RTD standards such as a MINCO-CA or CU10 10 Ω copper RTDs. RTDs can be located up to 300 meters (984 feet) from the I/O module with a maximum two-way cable resistance of 15 Ω.

Thermocouple modules are available for grounded or ungrounded type E, J, K, S, T, B, N and R thermocouples with linearization per point. A cold junction device is contained in each I/O pack, and modules with two packs average their cold junction readings provided the readings are within normal limits. In addition, remote cold junction compensation is supported. Thermocouples can be located up to 300 meters (984 feet) from the I/O module with a maximum two-way cable resistance of 450 Ω.

Fieldbus Modules

Communication Type	TB Type	Removable Term. Block	I/O Packs Per Module	Safety Version Available	Hazardous Location Approval
PROFIBUS DP-V0 and V1 Master Gateway	N/A	N/A	1	No	Yes
FOUNDATION Fieldbus H1 to HSE Linking Device	N/A	N/A	1	No	Yes
CANopen Master Gateway	N/A	N/A	1	No	Yes
HART Communications: 10 V/I inputs and 2 (0-20ma) outputs	Box	Yes or No	1	Yes	Yes
(6) Serial channels : RS-232, RS-422, RS-485 half-duplex Support 6 Modbus serial and 1 Modbus Ethernet	Box	Yes or No	1	No	Yes

PROFIBUS DP Gateway



Mark VIe offers a PROFIBUS DP-V0 and DP-V1, Class 1 master that maps I/O from slave devices to the controllers.

Bus Performance

The gateway is an I/O module that communicates on the 100 MB Ethernet I/O network to the controllers and on an RS-485 interface to slave devices. It supports 9.6 KB to 12 MB communications for up to 125 nodes with 244 bytes of I/O per slave. Data can be communicated between the controller and the PROFIBUS I/O module as fast as 10 ms. Data is then asynchronously communicated to the slaves at the fastest possible rate, determined by the PROFIBUS network baud rate, slave quantity, I/O quantity, and slave response time. At a 10 ms execution rate (frame rate), 500 inputs and 500 outputs (half Boolean and half analog) can be processed. For input event detection, Boolean inputs can be configured for sequence of events (SOE) logging with 10 ms time tags. Analog data can be configured for point-to-variable data type conversion and scaling. Online downloads of control software are supported.

Redundancy

The gateway can be configured for three types of redundancy: