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