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UCV Controller

Controller Overview

The Mark* VI UCV_ controller is a 6U high, single or double slot, single board computer (SBC) that operates the turbine application code. The controller mounts in a VME rack called the control module and communicates with the turbine I/O boards through the VME bus. The controller operating system is QNX[®], a real time, multitasking OS designed for high-speed, high-reliability industrial applications. Three communication ports provide links to operator and engineering interfaces as follows:

- Ethernet connections to the UDH for communication with HMIs, and other control equipment
- RS-232C connection for setup using the COM1 port
- RS-232C connection for communication with distributed control systems (DCS) using the COM2 port (such as Modbus[®] slave)

Operation

The controller is loaded with software specific to its application to steam, gas, and land-marine aeroderivative (LM), or balance of plant (BOP) products. It can execute up to 100,000 rungs or blocks per second, assuming a typical collection of average size blocks. An external clock interrupt permits the controller to synchronize to the clock on the VCM1 communication board to within ± 100 microseconds.

External data is transferred to and from the control system database (CSDB) in the controller over the VME bus by the VCM1 communication board. In a simplex system, the data consists of the process inputs and outputs from the I/O boards. In a TMR system, the data consists of the voted inputs from the input boards, singular inputs from simplex boards, computed outputs to be voted by the output hardware, and the internal state values that must be exchanged between the controllers.

Note Application software can be modified online without requiring a restart.

Controller Versions

Five controller versions are in use:

- The single-slot UCVE is the current generation controller used in most new systems.
- The double-slot UCVF is the high-end current generation controller used in only the systems that require it.
- The single-slot UCVG features performance between the UCVE and the UCVF and may be used as a direct replacement for any previous controller version without necessitating a backplane upgrade.

Note The double-slot UCVB and UCVD are no longer shipped with new systems, but are still in use in older systems.

The UCVE and UCVF may also be used to replace earlier revision controllers, but require a backplane upgrade. If replacing a UCVB, an Ethernet cabling upgrade from 10Base2 to 10Base-T is also required.

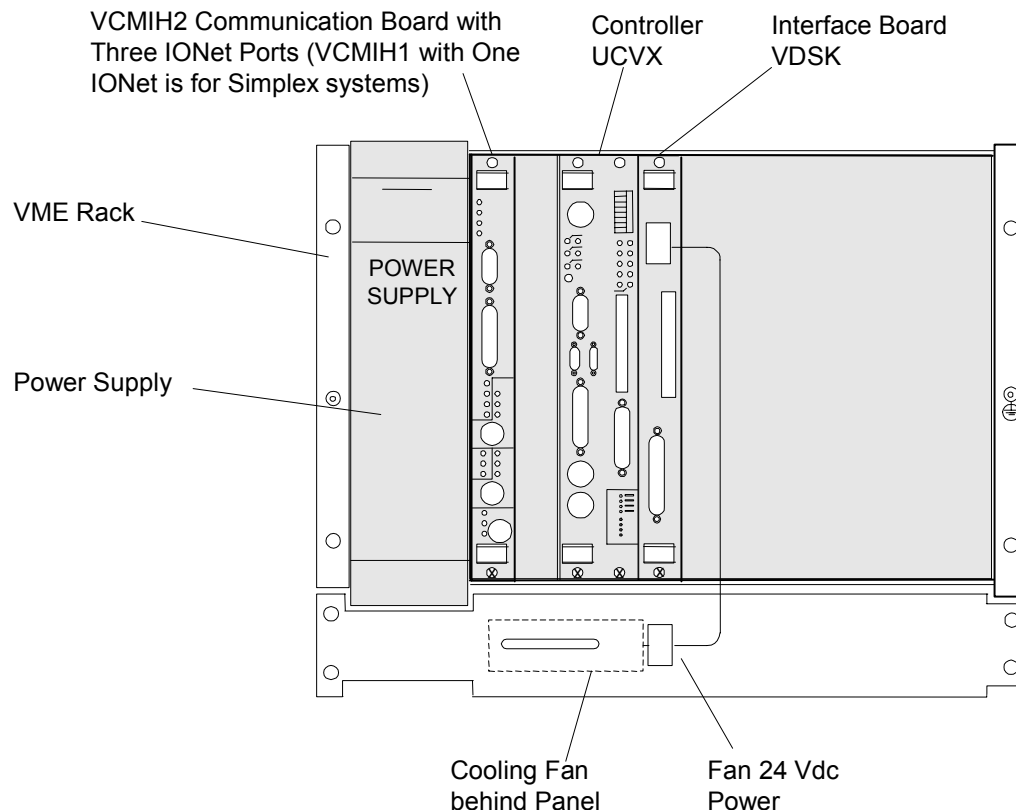
Diagnostics

If a failure occurs in the Mark VI controller while it is running application code, the rotating status LEDs (if supported) on the front panel stop and an internal fault code is generated.

If a failure occurs in the Mark VI controller, a diagnostic alarm is generated that can be read from the toolbox. In the UCVB and UCVD, these diagnostics are also encoded by flashing LEDs on the front panel. The error numbers and descriptions are available on the toolbox help screen. Additional information can also be obtained from the controller COM1 serial port. For further information, refer to *GEH-6421, Vol. I Mark VI System Guide, Chapter 7, Troubleshooting and Diagnostics*.

Installation

A control module contains (at a minimum) the controller and a VCM. Three rack types can be used: the GE Fanuc integrator's rack shown in the following figure and two sizes of Mark VI racks shown in the section, VCM - Bus Master Controller. The GE Fanuc rack is shorter and is used for stand-alone modules with remote I/O only. The Mark VI racks are longer and can be used for local or remote I/O. Whichever rack is used, a cooling fan is mounted either above or below the controller. The stand-alone control module implemented with a GE Fanuc integrator's rack also requires a VDSK board to supply fan power and provide the rack identification through an ID plug.



Typical Controller Mounted in Rack with Communication Board

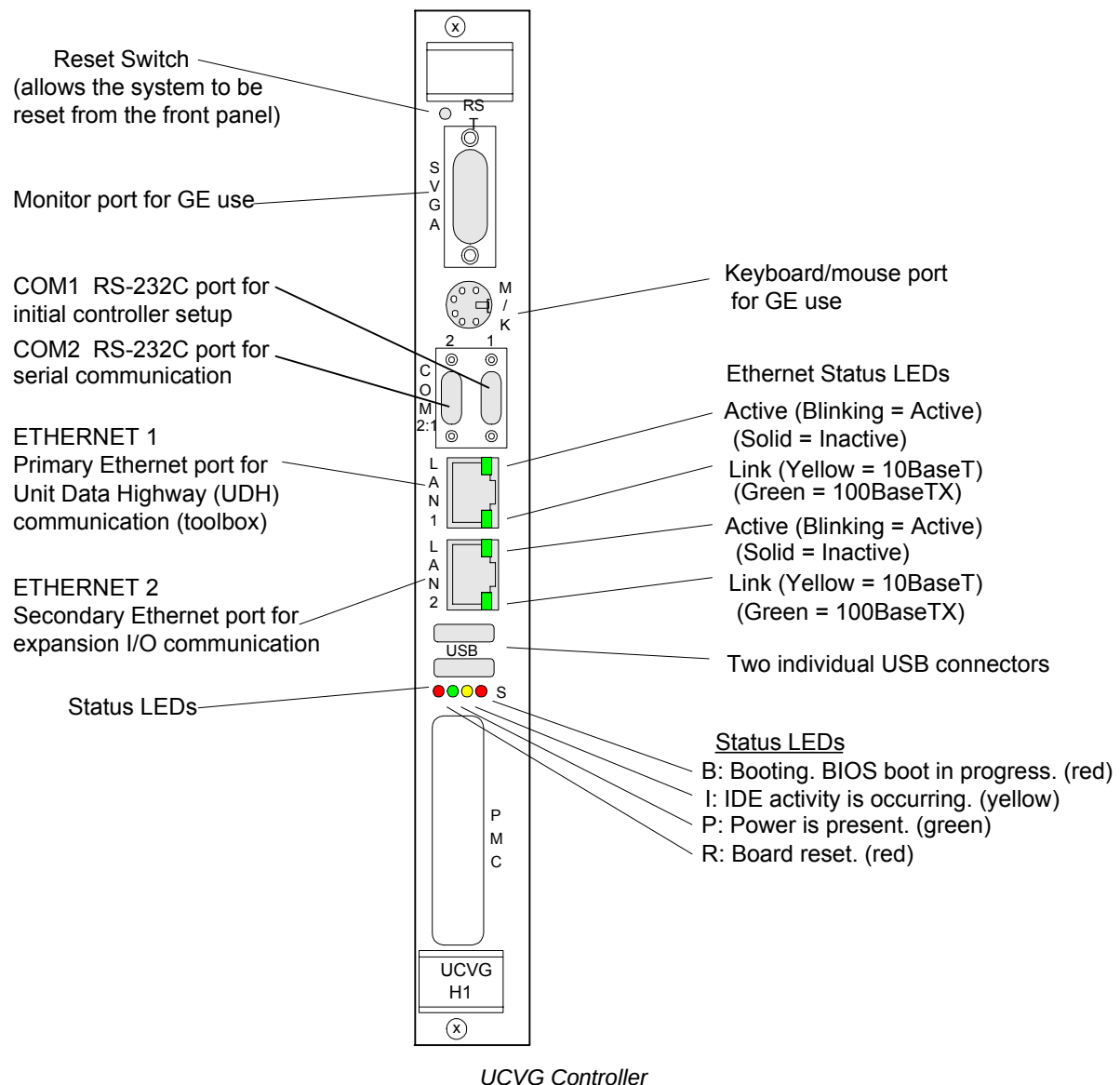
UCVG Controller

The UCVG is a single-slot board using an Intel[®] Ultra Low Voltage Celeron[™] 650 MHz processor with 128 MB of flash memory and 128 MB of SDRAM. Two 10BaseT/100BaseTX (RJ-45 connector) Ethernet ports provide connectivity. The first Ethernet port allows connectivity to the UDH for configuration and peer-to-peer communication.

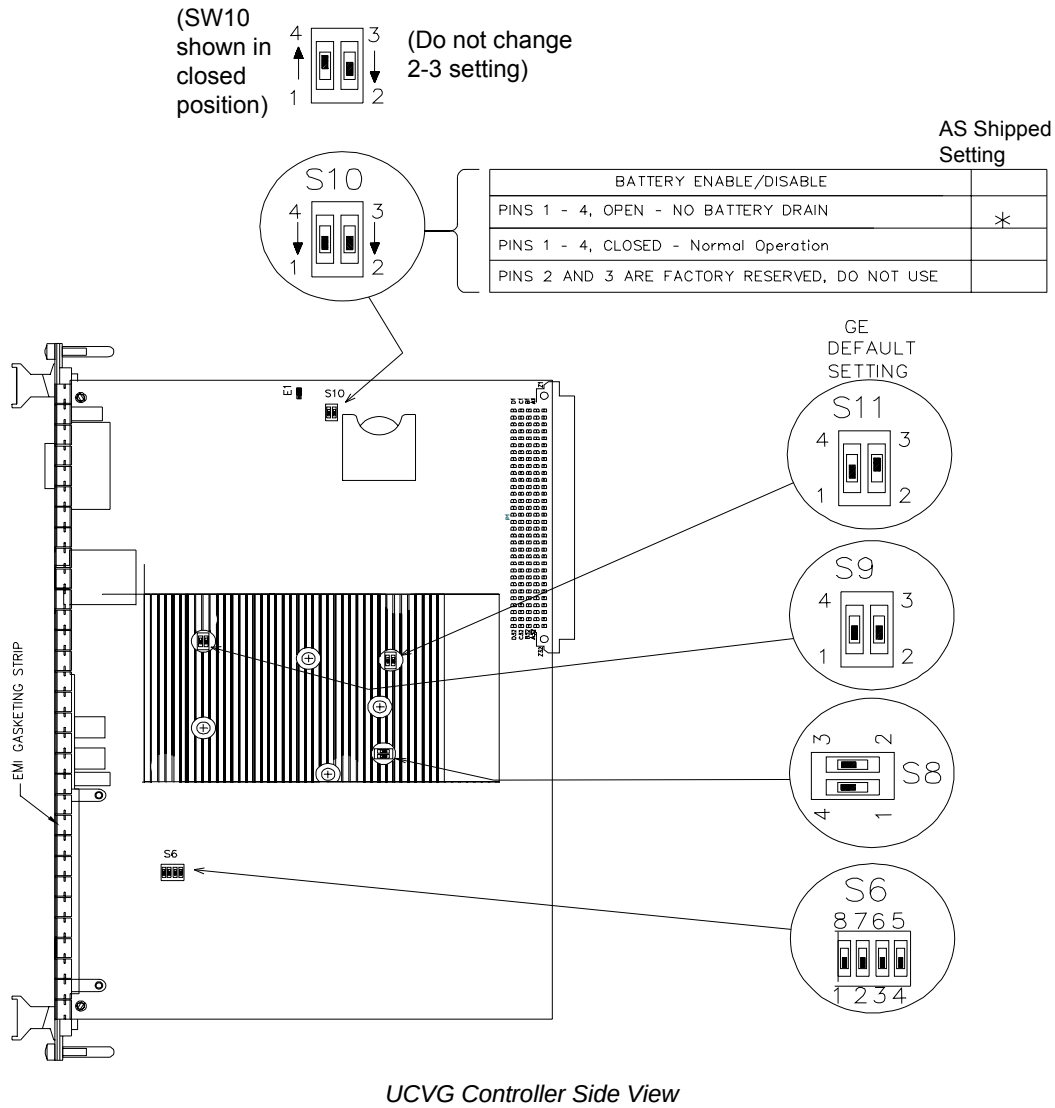
The second Ethernet port is for use on a separate IP logical subnet and can be used for Modbus or private Ethernet Global Data (EGD) network. This Ethernet port is configured through the toolbox. The controller validates its toolbox configuration against the existing hardware each time the rack is powered up.

Note A separate subnet address allows the controller to uniquely identify an Ethernet port. IP subnet addresses are obtained from the Ethernet network administrator (for example, 192.168.1.0, 192.168.2.0).

Mark VI Controller UCVGH1



Note The factory setting of the battery is in the disabled position. To enable the battery, set SW10 to the closed position as shown in the following drawing.



UCVG Controller Specifications

Item	Specification
Microprocessor	Intel Ultra Low Voltage Celeron 650 MHz
Memory	128 MB SDRAM 128 MB Compact Flash Module 256 KB Advanced Transfer Cache
Operating System	QNX
Programming	Control block language with analog and discrete blocks; Boolean logic represented in relay ladder diagram format. Supported data types include: Boolean 16-bit signed integer 32-bit signed integer 32-bit floating point 64-bit long floating point
Primary Ethernet Interface (Ethernet 1)	Twisted pair 10BaseT/100BaseTX, RJ-45 connector: TCP/IP protocol used for communication between controller and toolbox EGD protocol for communication with CIMPLICITY [®] HMI, and Series 90-70 programmable logic controllers (PLCs) Ethernet Modbus protocol supported for communication between controller and third-party DCS
Secondary Ethernet Interface (Ethernet 2)	Twisted pair 10BaseT/100BaseTX, RJ-45 connector: EGD protocol Ethernet Modbus protocol supported for communication between controller and third-party DCS
COM Ports	Two micro-miniature 9-pin D connectors: COM1 Reserved for diagnostics, 9600 baud, 8 data bits, no parity, 1 stop bit COM2 Used for serial Modbus [®] communication, 9600 or 19200 baud
Power Requirements UCVGH1	+5 V dc, 4 A typical, 5.4 A maximum +12 V dc, less than 1 mA typical - 12 V dc, less than 1 mA typical
Expansion site	PMC expansion site available, IEEE [®] 1386.1 5V PCI
Environment	Operating temperature: 0°C to 70°C (32 °F to 158 °F) Storage temperature: -40°C to 80°C (-40 °F to 176 °F)
Note The UCVG controller contains a Type 1 Lithium battery. Replace only with equivalent battery type, rated 3.3 V, 200 mA.	

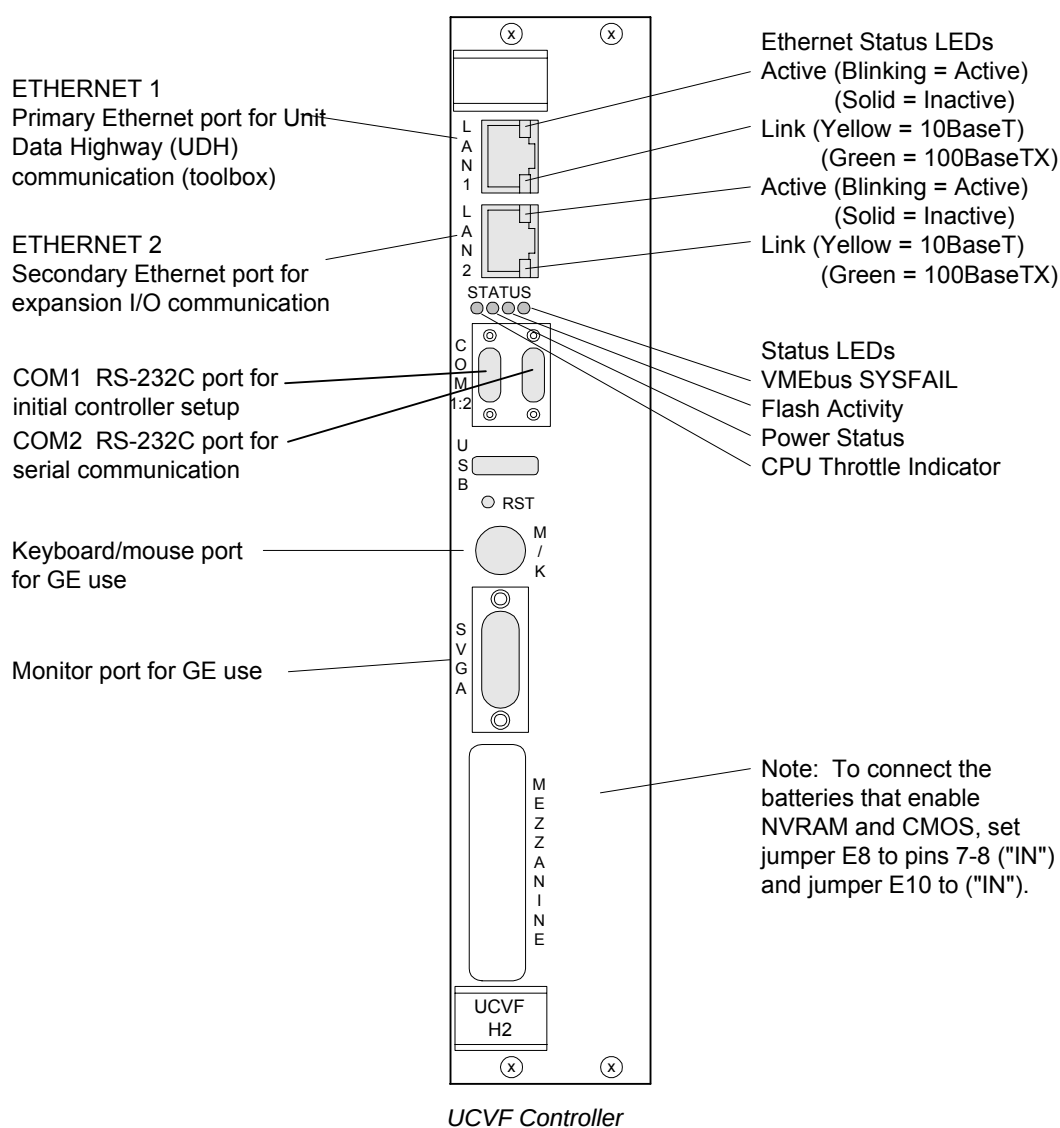
UCVF Controller

The UCVF is a double-slot board using an 850 MHz Intel Pentium® III processor with 16 or 128 MB of flash memory and 32 MB of DRAM. Two 10BaseT/100BaseTX (RJ-45 connector) Ethernet ports provide connectivity. The first Ethernet port allows connectivity to the UDH for configuration and peer-to-peer communication.

The second Ethernet port is for use on a separate IP logical subnet. This Ethernet port is configured through the toolbox. The controller validates its toolbox configuration against the existing hardware each time the rack is powered up.

Note A separate subnet address allows the controller to uniquely identify an Ethernet port. IP subnet addresses are obtained from the Ethernet network administrator (for example, 192.168.1.0, 192.168.2.0).

Mark VI Controller UCVFH2



UCVF Controller Specifications

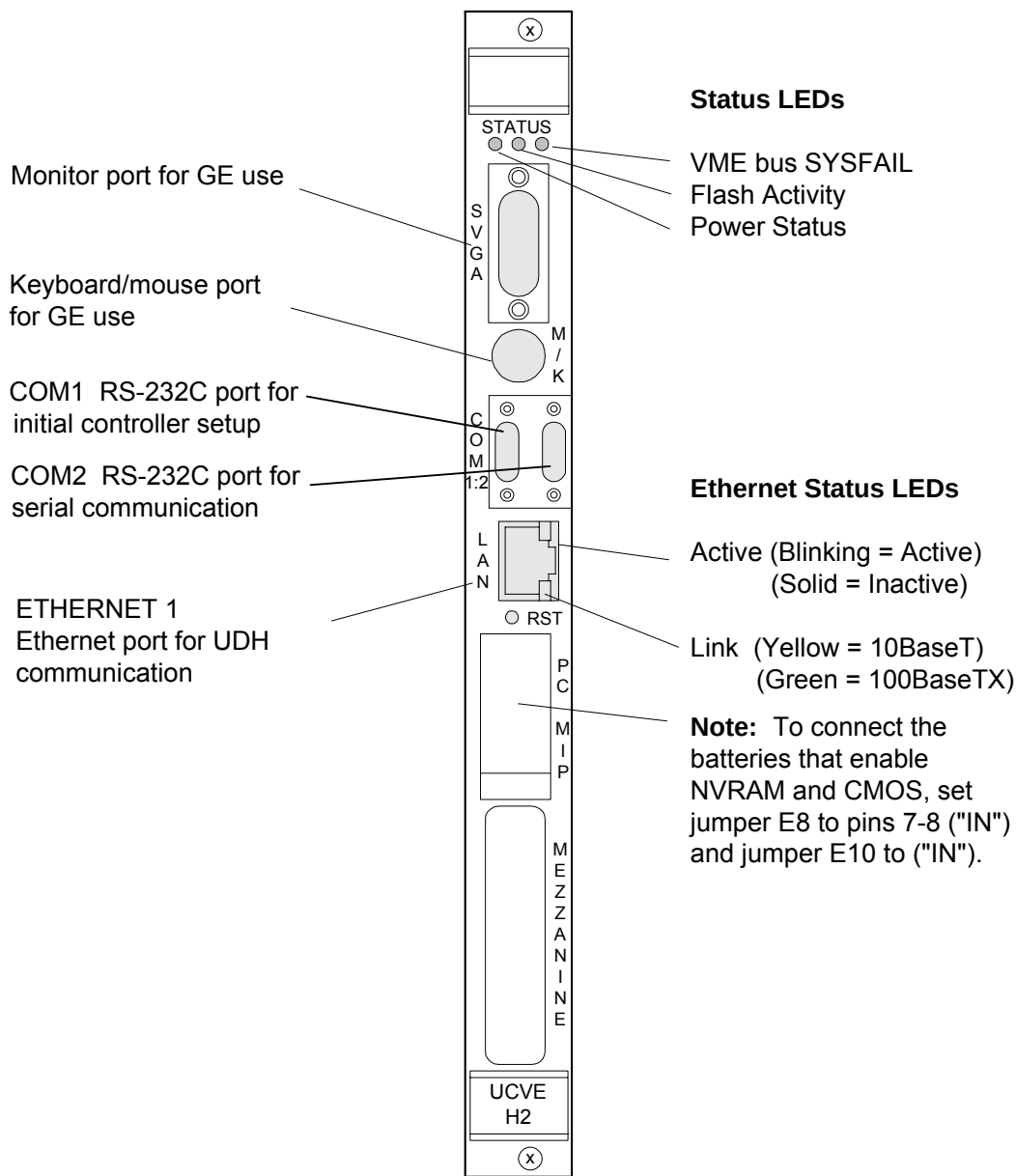
Item	Specification
Microprocessor	Intel Pentium III 850 MHz
Memory	32 MB DRAM 16 or 128 MB Compact Flash Module 256 KB Advanced Transfer Cache Battery-backed SRAM - 8K allocated as NVRAM for controller functions
Operating System	QNX
Programming	Control block language with analog and discrete blocks; Boolean logic represented in relay ladder diagram format. Supported data types include: Boolean 16-bit signed integer 32-bit signed integer 32-bit floating point 64-bit long floating point
Primary Ethernet Interface (Ethernet 1)	Twisted pair 10BaseT/100BaseTX, RJ-45 connector: TCP/IP protocol used for communication between controller and toolbox EGD protocol for communication with CIMPLICITY HMI, and Series 90-70 PLCs Ethernet Modbus protocol supported for communication between controller and third-party DCS
Secondary Ethernet Interface (Ethernet 2)	Twisted pair 10BaseT/100BaseTX, RJ-45 connector: EGD protocol Ethernet Modbus protocol supported for communication between controller and third-party DCS
COM Ports	Two micro-miniature 9-pin D connectors: COM1 Reserved for diagnostics, 9600 baud, 8 data bits, no parity, 1 stop bit COM2 Used for serial Modbus communication, 9600 or 19200 baud
Power Requirements UCVFH2	+5 V dc, 6 A typical, 7 A maximum +12 V dc, 200 mA typical, 400 mA maximum -12 V dc, 2.5 mA typical

UCVE Controllers

The UCVE is available in multiple forms: UCVEH2 and UCVEM01 to UCVMEM05. The UCVEH2 is the standard Mark VI controller. It is a single-slot board using a 300 MHz Intel Celeron processor with 16 or 128 MB of flash memory and 32 MB of DRAM. A single 10BaseT/100BaseTX (RJ-45) Ethernet port provides connectivity to the UDH.

The UCVEM_ _ modules have all the features of the UCVEH2 with the addition of supporting additional Ethernet ports and Profibus. Some UCVEM_ _ modules support secondary 10BaseT/100BaseTX Ethernet ports for use on a separate IP logical subnet. The secondary Ethernet port is configured through the toolbox. The controller validates its toolbox configuration against the existing hardware each time the rack is powered up. A separate subnet address allows the controller to uniquely identify an Ethernet port.

Mark VI Controller UCVEH2



UCVE Controller

UCVE Controller Specifications

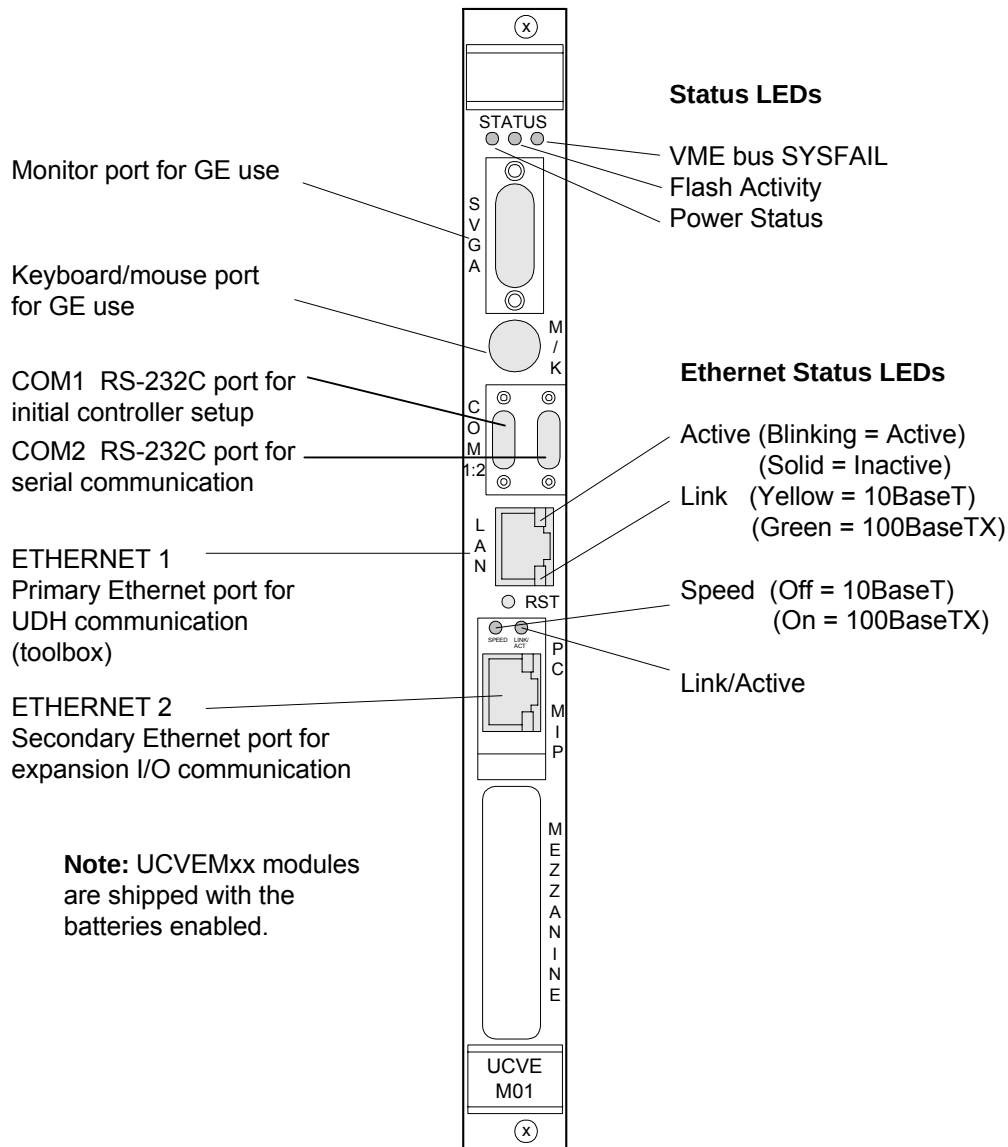
Item	Specification
Microprocessor	Intel Celeron 300 MHz
Memory	32 MB DRAM 16 or 128 MB Compact Flash Module 128 KB L2 cache Battery-backed SRAM - 8K allocated as NVRAM for controller functions
Operating System	QNX
Programming	Control block language with analog and discrete blocks; Boolean logic represented in relay ladder diagram format. Supported data types include: Boolean 16-bit signed integer 32-bit signed integer 32-bit floating point 64-bit long floating point
Primary Ethernet Interface (Ethernet 1)	Twisted pair 10BaseT/100BaseTX, RJ-45 connector: TCP/IP protocol used for communication between controller and toolbox EGD protocol for communication with CIMPLICITY HMI and Series 90-70 PLCs Ethernet Modbus protocol supported for communication between controller and third-party DCS
COM Ports	Two micro-miniature 9-pin D connectors: COM1 Reserved for diagnostics, 9600 baud, 8 data bits, no parity, 1 stop bit COM2 Used for serial Modbus communication, 9600 or 19200 baud
Power Requirements UCVEH2	+5 V dc, 6 A typical, 8 A maximum +12 V dc, 180 mA typical, 250 mA maximum -12 V dc, 180 mA typical, 250 mA maximum

UCVEM01 Controller Specifications

Item	Specification
Secondary Ethernet Interface (Ethernet 2)	Twisted pair 10BaseT/100BaseTX, RJ-45 connector: EGD protocol Ethernet Modbus protocol supported for communication between controller and third party DCS
Power Requirements	+5 V dc, 6.2 A typical, 8.2 A maximum +12 V dc, 180 mA typical, 250 mA maximum -12 V dc, 180 mA typical, 250 mA maximum

Note For specifications common to all UCVE modules, refer to *UCVEH2 Controller Specifications*.

Mark VI Controller UCVEM01



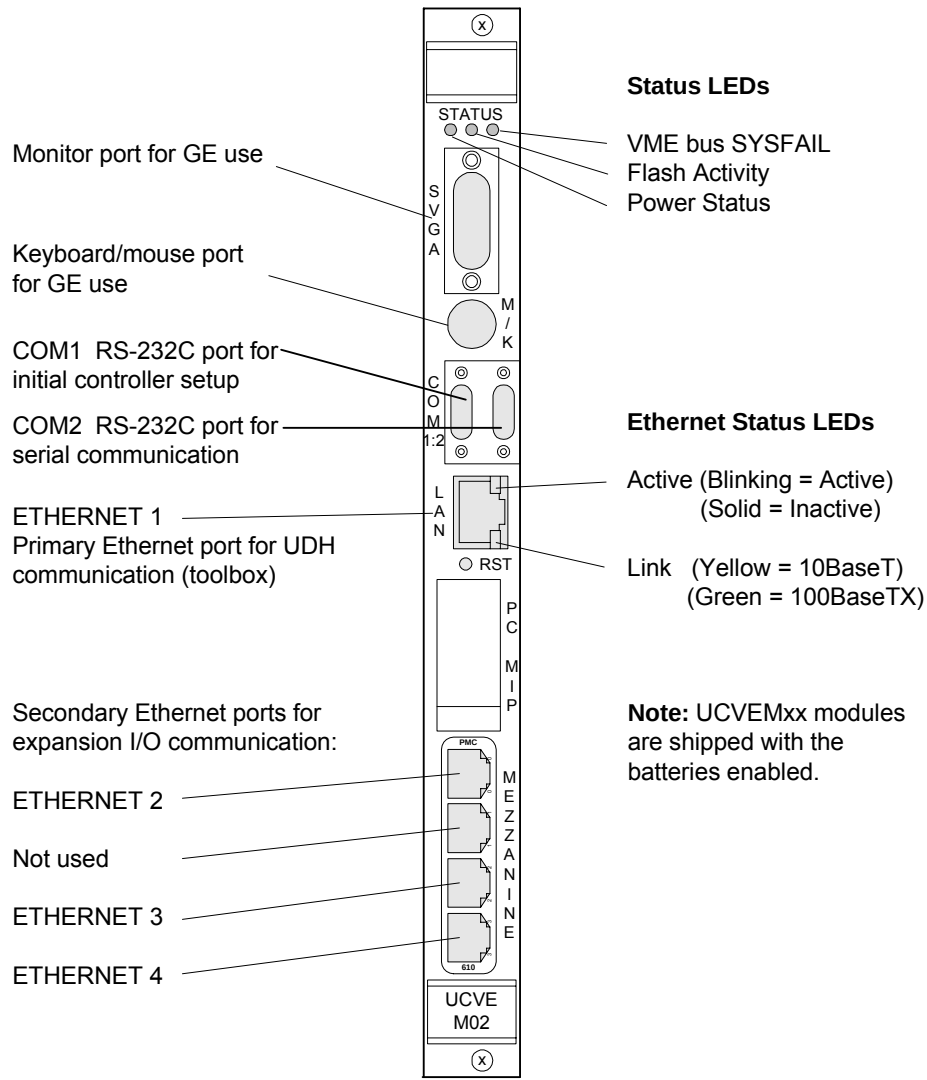
UCVEM01 Front Panel

UCVEM02 Controller Specifications

Item	Specification
Secondary Ethernet Interfaces (Ethernet 2-4)	Twisted pair 10BaseT/100BaseTX, RJ-45 connector: EGD protocol Ethernet Modbus protocol supported for communication between controller and third-party DCS
Power Requirements	+5 V dc, 8.3 A typical, 10.3 A maximum +12 V dc, 180 mA typical, 250 mA maximum -12 V dc, 180 mA typical, 250 mA maximum

Note For specifications common to all UCVE modules, refer to *UCVEH2 Controller Specifications*.

Mark VI Controller UCVEM02



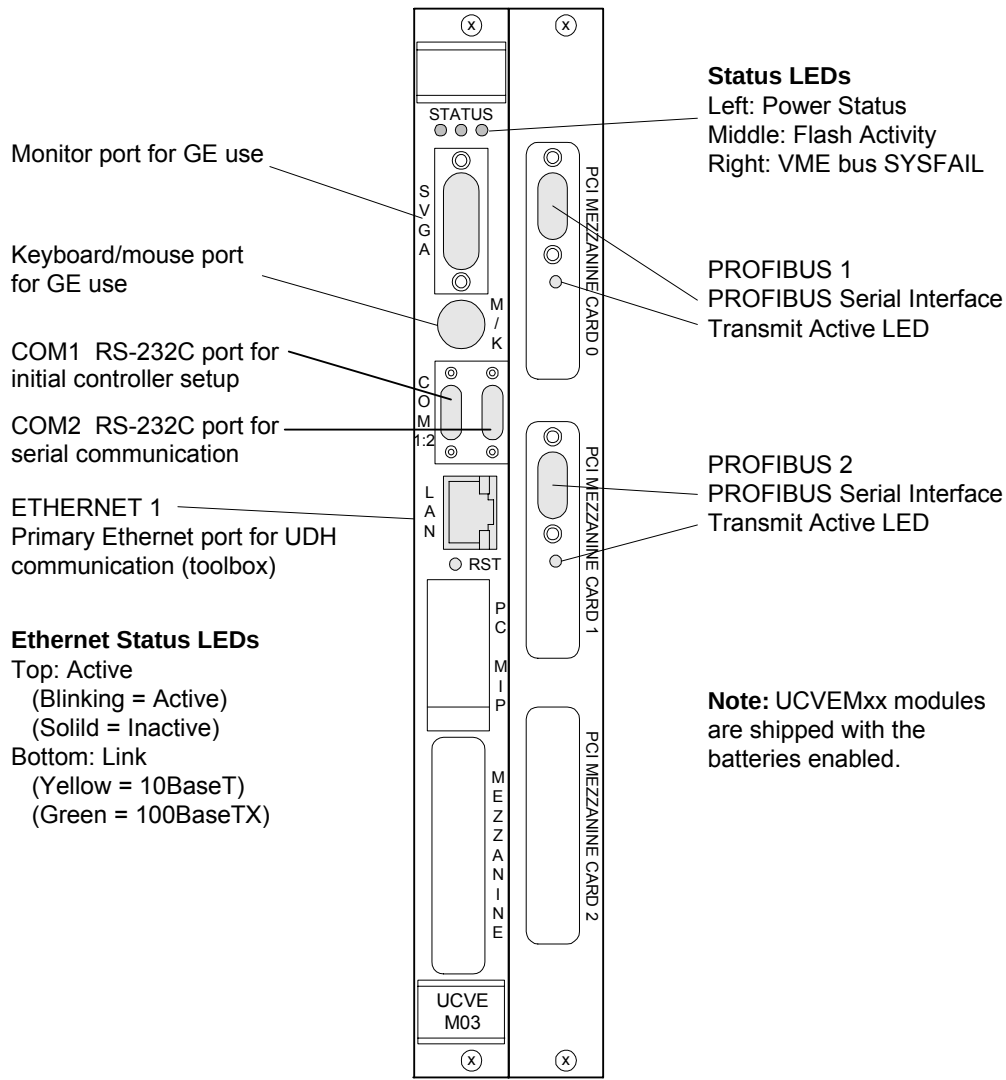
UCVEM02 Front Panel

UCVEM03 Controller Specifications

Item	Specification
PROFIBUS Interface (PROFIBUS 1-2)	PROFIBUS DP master class 1
Power Requirements	+5 V dc, 8.2 A typical, 10.2 A maximum
	+12 V dc, 180 mA typical, 250 mA maximum
	-12 V dc, 180 mA typical, 250 mA maximum

Note For specifications common to all UCVE modules, refer to *UCVEH2 Controller Specifications*.

Mark VI Controller UCVEM03



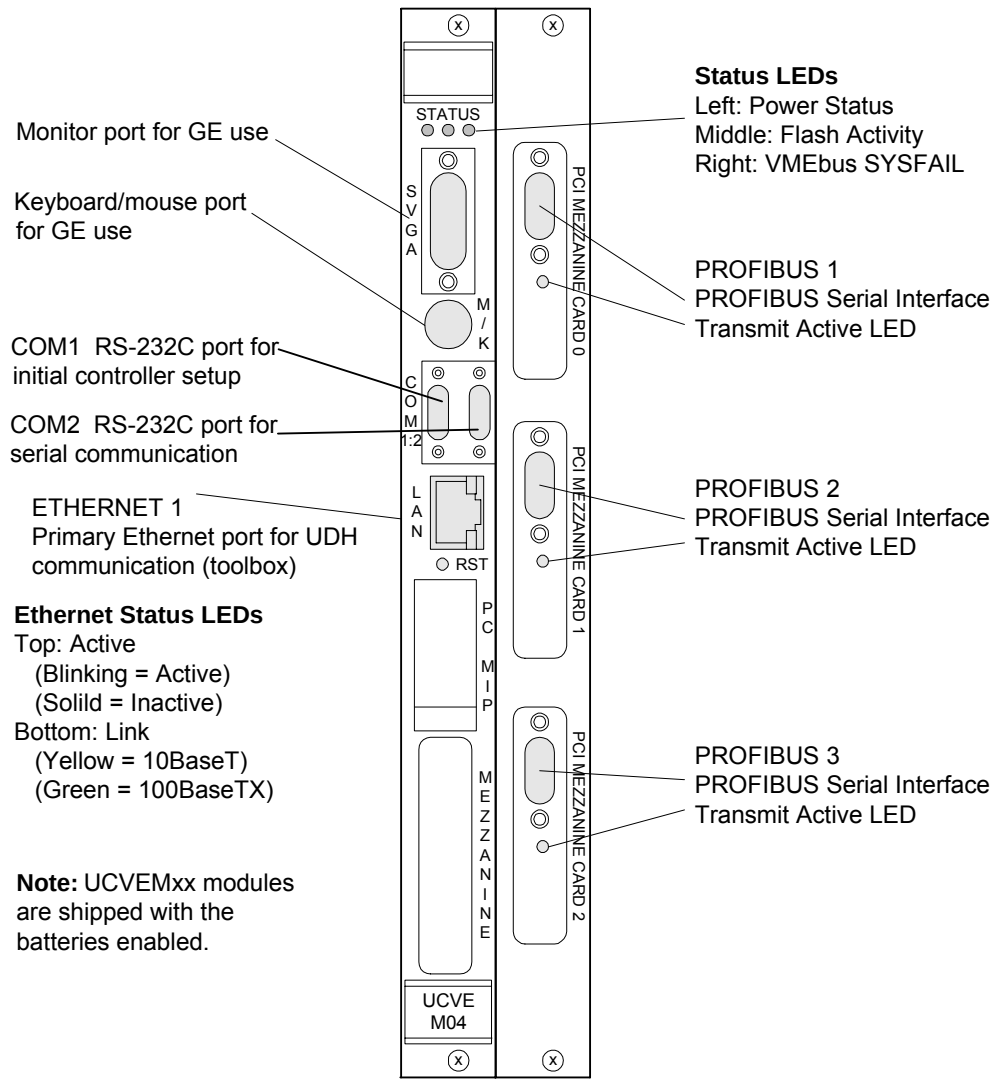
UCVEM03 Front Panel

UCVEM04 Controller Specifications

Item	Specification
PROFIBUS Interface (PROFIBUS 1-3)	PROFIBUS DP master class 1
Power Requirements	+5 V dc, 9.2 A typical, 11.2 A maximum +12 V dc, 180 mA typical, 250 mA maximum -12 V dc, 180 mA typical, 250 mA maximum

Note For specifications common to all UCVE modules, refer to *UCVEH2 Controller Specifications*.

Mark VI Controller UCVEM04



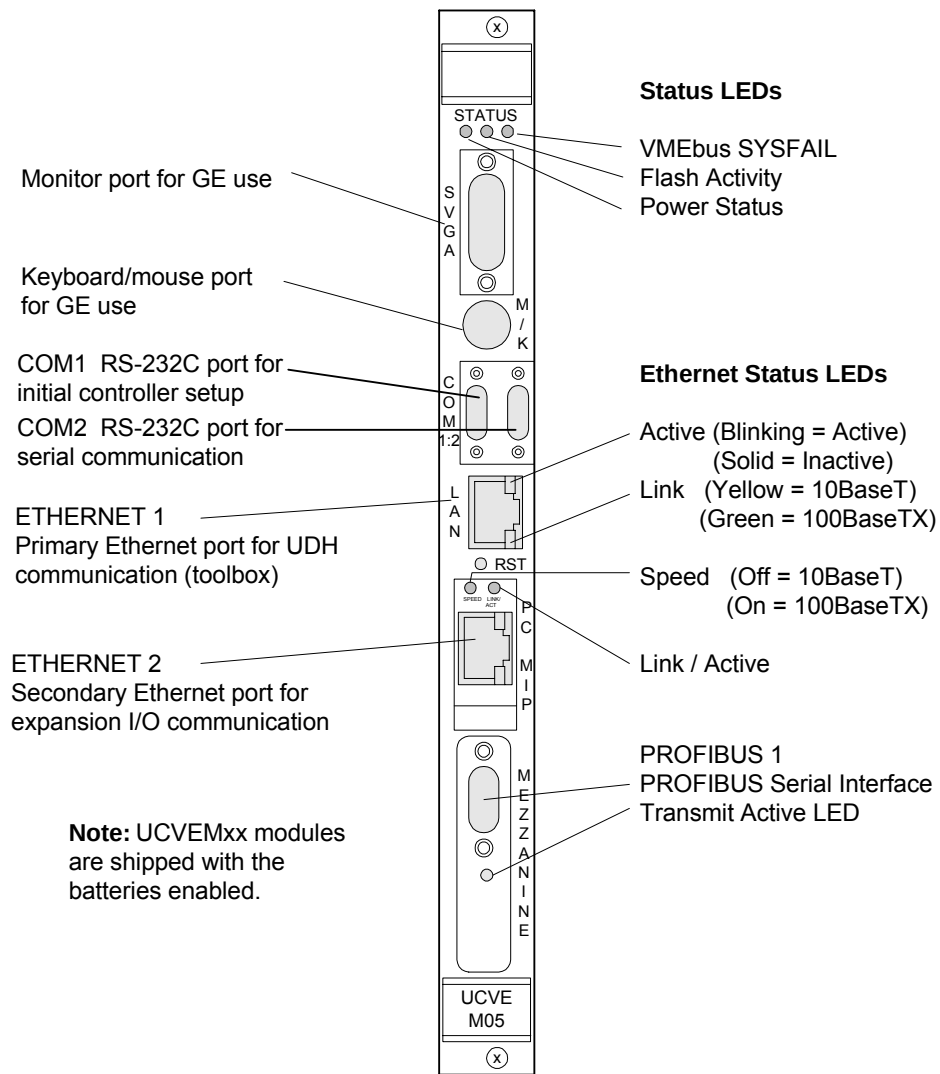
UCVEM04 Front Panel

UCVEM05 Controller Specifications

Item	Specification
Secondary Ethernet Interface (Ethernet 2)	Twisted pair 10BaseT/100BaseTX, RJ-45 connector: EGD protocol Ethernet Modbus protocol supported for communication between controller and third-party DCS
PROFIBUS Interface (PROFIBUS 1)	PROFIBUS DP master class 1
Power Requirements	+5 V dc, 7.2 A typical, 9.2 A maximum +12 V dc, 180 mA typical, 250 mA maximum -12 V dc, 180 mA typical, 250 mA maximum

Note For specifications common to all UCVE modules, refer to *UCVEH2 Controller Specifications*.

Mark VI Controller UCVEM05



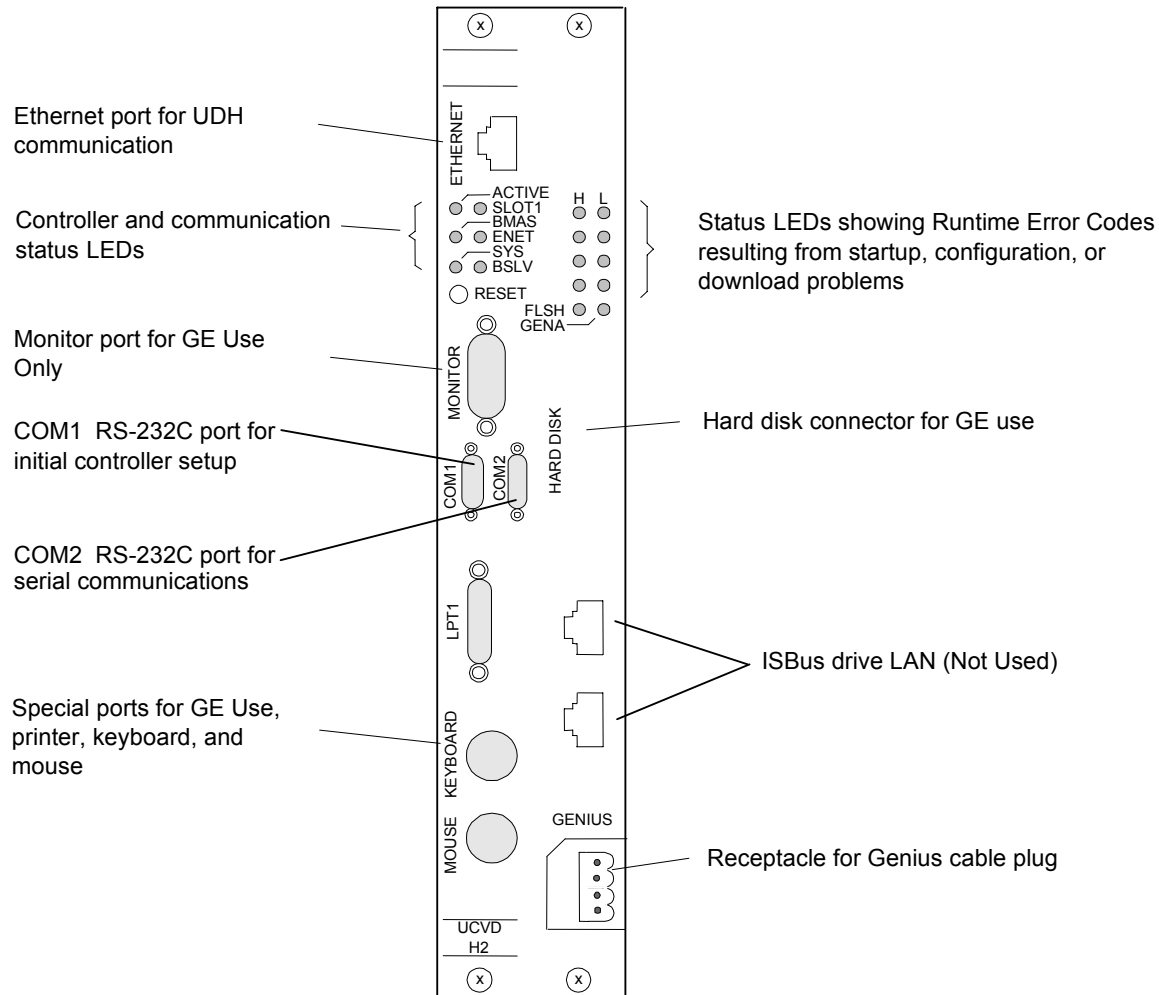
UCVEM05 Front Panel

UCVD Controller

The UCVD is a double-slot board using a 300 MHz AMD K6 processor with 8 MB of flash memory and 16 MB of DRAM. A single 10BaseT (RJ-45 connector) Ethernet port provides connectivity to the UDH.

The UCVD contains a double column of eight status LEDs. These LEDs are sequentially turned on in a rotating pattern when the controller is operating normally. When an error condition occurs, the LEDs display a flashing error code that identifies the problem. For more information, refer to *GEH-6410, Innovation Series Controller System Manual*.

Mark VI Controller UCVDH1, H2



UCVD Controller Front Panel

UCVD Controller Specification

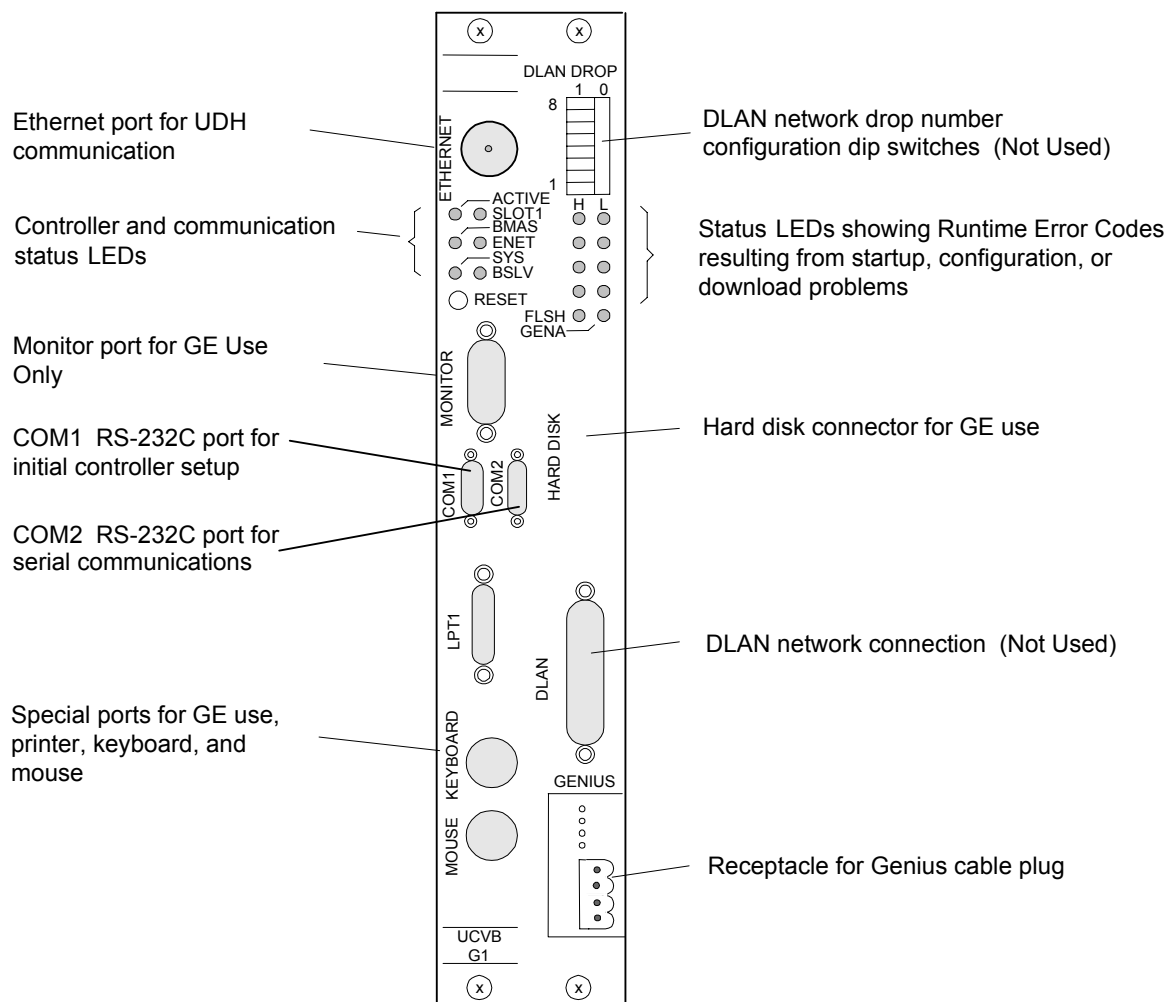
Item	Specification
Microprocessor	AMD-K6 300 MHz
Memory	16 MB DRAM 8 MB Flash Memory in UCVD 256 KB of level 2 cache
Operating System	QNX
LEDs	LEDs on the faceplate provide status information as follows: ACTIVE Processor is active SLOT 1 Controller configured as slot 1 controller in VME rack BMAS VME master access is occurring ENET Ethernet activity BSLV VME slave access is occurring STATUS Display rotating LED pattern when OK Display flashing error code when faulted FLSH Writing to Flash memory GENX Genius I/O is active
Programming	Control block language with analog and discrete blocks; Boolean logic represented in relay ladder diagram format. Supported data types include: Boolean 16-bit signed integer 32-bit signed integer 32-bit floating point 64-bit floating point
Ethernet Interface	Twisted pair 10BaseT, RJ-45 connector TCP/IP protocol used for communication between controller and toolbox Serial Request Transfer Protocol (SRTP) interface between controller and HMI EGD protocol for communication with CIMPLICITY HMI, and Series 90-70 PLCs Ethernet Modbus protocol supported for communication between controller and third-party DCS
COM Ports	Two micro-miniature 9-pin D connectors: COM1 Reserved for diagnostics, 9600 baud, 8 data bits, no parity, 1 stop bit COM2 Used for serial Modbus communication, 9600 or 19200 baud
Power Requirements	+5 V dc, 6 A +12 V dc, 200 mA -12 V dc, 200 mA

UCVB Controller

The UCVB is a double-slot board using a 133 MHz Intel Pentium processor with 4 MB of flash memory and 16 MB of DRAM. A single 10Base2 (BNC connector) Ethernet port provides connectivity to the UDH.

The UCVB contains a double column of eight status LEDs. These LEDs are sequentially turned on in a rotating pattern when the controller is operating normally. When an error condition occurs, the LEDs display a flashing error code that identifies the problem. For more information, refer to *GEH-6410, Innovation Series Controller System Manual*.

Mark VI Controller UCVBG1



UCVB Controller Front Panel

UCVB Controller Specification

Item	Specification
Microprocessor	Intel Pentium 133 MHz
Memory	16 MB DRAM 4 MB Flash Memory in UCVB 256 KB of level 2 cache
Operating System	QNX
LEDs	LEDs on the faceplate provide status information as follows: ACTIVE Processor is active SLOT 1 Controller configured as slot 1 controller in VME rack BMAS VME master access is occurring ENET Ethernet activity BSLV VME slave access is occurring STATUS Display rotating LED pattern when OK Display flashing error code when faulted FLSH Writing to Flash memory GENX Genius I/O is active
Programming	Control block language with analog and discrete blocks; Boolean logic represented in relay ladder diagram format. Supported data types include: Boolean 16-bit signed integer 32-bit signed integer 32-bit floating point 64-bit long floating point
Ethernet Interface	Thinwire™ 10Base2, BNC connector: TCP/IP protocol used for communication between controller and toolbox SRTP interface between controller and HMI EGD protocol for communication with CIMPLICITY HMI, and Series 90-70 PLCs Ethernet Modbus protocol supported for communication between controller and third-party DCS
COM Ports	Two micro-miniature 9-pin D connectors: COM1 Reserved for diagnostics, 9600 baud, 8 data bits, no parity, 1 stop bit COM2 Used for serial Modbus communication, 9600 or 19200 baud
DLAN+ Interface	Interface to DLAN+, a high speed multidrop network based on ARCNET®, using a token passing, peer to peer protocol
Power Requirements	+5 V dc, 5.64 A +12 V dc, 900 mA -12 V dc, 200 mA

Alarms

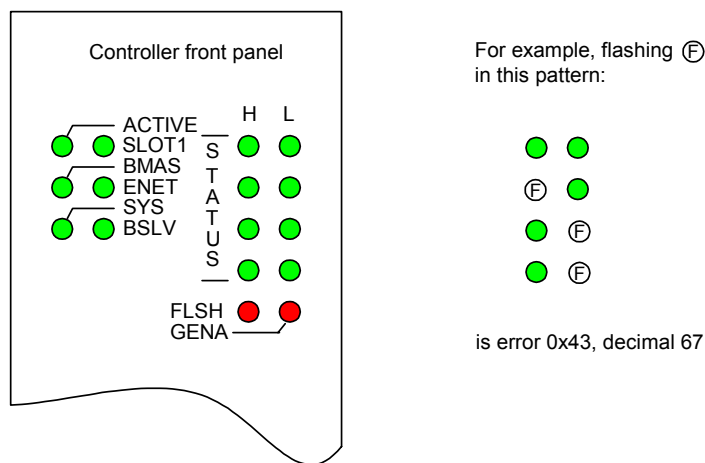
Fault	Fault Description	Possible Cause
31	I/O Compatibility Code Mismatch	Outdated configuration in the VCM
32	Diagnostic Queue Overflow	Too many diagnostics are occurring simultaneously
33	Foreground Process	Outdated runtime version
34	Background Process	Outdated runtime version
37	Idle Process	Outdated runtime version
38	Ambient Air Overt temperature Warning. The rack is beginning to overheat.	The rack fan has failed or the filters are clogged.
39	CPU Over temperature Fault. The controller CPU has overheated and may fail at any time.	The rack fan has failed or the filters are clogged.
40	Genius I/O Driver Process	Outdated runtime version
41	Register I/O Process	Outdated runtime version
42	Modbus Driver Process	Outdated runtime version
43	Ser Process	Outdated runtime version
44	Rcvr Process	Outdated runtime version
45	Trans Process	Outdated runtime version
46	Mapper Process	Outdated runtime version
47	SRTTP Process	Outdated runtime version
48	Heartbeat Process	Outdated runtime version
49	Alarm Process	Outdated runtime version
50	Queue Manager Process	Outdated runtime version
51	EGD Driver Process	Outdated runtime version
52	ADL Dispatcher Process	Outdated runtime version
53	ADL Queue Process	Outdated runtime version
54	DPM Manager Process	Outdated runtime version
68	Genius IOCHRDY Hangup	Outdated runtime version
70	Genius Lock Retry	Outdated runtime version
71	Genius	Outdated runtime version
72	Application Code Online Load Failure	Application code error
74	Application Code Startup Load Failure	Application code error
75	Application Code Expansion Failure	Application code error
76	ADL/BMS Communication Failure with the VCM	The VCM firmware version is too old to work with this controller runtime version.
77	NTP Process	Outdated runtime version
78	Outdated Controller Topology	Download application code and reboot
79	Outdated VCM Topology	Download configuration to VCM and reboot
80	No VCM Topology	Old VCM firmware doesn't support controller/VCM topology checking. Upgrade VCM firmware.
81	Platform Process	Outdated runtime version
82	Hardware Configuration Error	The controller hardware doesn't match the configuration specified by the toolbox. Use the toolbox to view the errors in the controller trace buffer (for example: View General Dump the trace buffer).
83	Register I/O Write/Command Limit Exceeded	Verify that the total command rate of all Modbus interfaces does not exceed the maximum.
84	State Exchange Voter Packet Mismatch	Verify that all three controllers are executing the same application code.
85	Maximum Number of Boolean State Variables Exceeded	The application code is using too many Boolean variables. Move some functions to other controllers.

Fault	Fault Description	Possible Cause
86	Too Many EGD Producers Configured for Fault Tolerant Support	The controller can redirect data over the IONET from a maximum of 16 EGD producers. Data from subsequent producers will be lost in the event of an Ethernet failure.
87	Too Many EGD Points Configured for Fault Tolerant Support	The controller can redirect a maximum of 1400 bytes of data over the IONET. Subsequent EGD points will be lost in the event of an Ethernet failure.
88	Producing Fault Tolerant EGD Data	The controller is redirecting data from the Ethernet to another controller over the IONET.
89	Requesting Fault Tolerant EGD Data	The controller is requesting that Ethernet data be redirected to it over the IONET from another controller.
90	Process Alarm Queue Is Full	Subsequent process alarms will be lost unless the current alarms are acknowledged and cleared by the operator.
91	Hold List Queue Is Full	Subsequent hold alarms will be lost unless the current alarms are acknowledged and cleared by the operator.
92	Data Initialization Failure	Verify that all controllers are executing the same application code. If no VCMI is used (simulation mode), verify that the clock source is set to internal. If a VCMI is used, verify that the clock source is set to external.
93	Pcode mismatch between TMR controllers	Download the same application code to all three controllers
94	Unable to start up Dynamic Data Recorder	Outdated runtime version - download runtime and restart.
95	Dynamic Data Recorder Configuration Fault	Revalidate the application code and then select the Update Dynamic Data Recorder button from the toolbox toolbar
96	Dynamic Data Recorder Process	Outdated runtime version - download runtime and restart

UCV Board UCVD Controller Runtime Errors

In addition to generating diagnostic alarms, the UCVB and the UCVD controller boards display status information on front panel LEDs. The Status LED group on these controllers contains eight segments in a two vertical column layout as shown in the following figure. These LEDs display controller errors if a problem occurs. The right-most column makes up the lower hexadecimal digit and the left-most column makes up the upper digit (the least significant bits on the bottom). Numerical conversions are provided with the fault code definitions.

Note For all controllers, refer to the stats line in the toolbox.



Flashing Controller Status LEDs Indicate Error Codes

If the controller detects certain system errors (typically during boot-up or download), it displays flashing and non-flashing codes on these green status LEDs. These codes correspond to runtime errors listed in the toolbox help file. The following table describes the types of errors displayed by the LEDs.

Controller Runtime Errors

Controller Condition	Status LED Display
Controller successfully completes its boot-up sequence and begins to execute application code	Displays a <i>walking ones</i> pattern consisting of a single lighted green LED rotating through the bank of LEDs.
Error occurs during the BIOS phase of the boot-up sequence	Non-flashing error code is displayed
Error occurs during the application code load	Flashing error codes are displayed until the error has been corrected and either the application code is downloaded again, or the controller is rebooted.
Error occurs while the controller is running	May freeze with only a single LED lighted. No useful information can be interpreted from the LED position. Fault codes are generated internally.