# Table of Contents

# 1 Controllers

## 1.1 UCSC Controllers

UCSC controllers are compact, stand-alone controllers that run application-specific control system logic used in a diverse range of applications, such as wind turbines, gas and steam turbines, and combined-cycle power plants.

The UCSC controller offers the following advantages:

- Single module
- No battery
- No fan
- No jumper settings required
- Flash memory can be conveniently updated
- Can be expanded to include seven additional I/O ports

The UCSC controller mounts in a panel and communicates with I/O modules through on-board I/O network (IONet), PROFINET, EtherCAT, High-speed Serial Link (HSSL) and/or other interfaces.


***UCSC Controller Data Nameplate***

---

***Note*** For additional information, refer to the following documents:

• *Mark VIe and Mark VIeS Control Systems, Volume I System Guide* (GEH-6721_Vol_I)

• *ToolboxST User Guide for Mark Controls Platform* (GEH-6700 or GEH-6703)

• *UCSC Installation and Maintenance Requirements (IMR)* (GFK-3006)

• *ControlST Software Suite Release Notes* (GEI-100746)

---

## 1.1.1 UCSCH1x Controllers

The UCSCH1x controller is available in the standard three I/O port configuration and a 10 I/O port configuration. The 10 I/O port configuration, UCECH1x, consists of a standard UCSCH1x controller coupled with a seven I/O port expansion board.

### 1.1.1.1 Mark* VIe UCSCH1x Controller

The Mark VIe UCSCH1x quad core controller uses real-time hypervisor technology and QNX® Neutrino, a real-time, multi-tasking operating system (OS), to run the following virtual machines, depending on the platform configuration:

- The UCSCH1B controller is designed for high-speed, high-reliability industrial applications.
- The UCSCH1A Embedded PROFINET® Gateway (Embedded PPNG) module allows communication with PROFINET I/O devices, including RSTi-EP Slice I/O.
- The UCSCH1C Embedded EtherCAT® controller enables communications with EtherCAT I/O devices, including RSTi-EP Slice I/O. Line and Ring topologies are supported.
- Embedded Field Agent (EFA) technology is used to apply Predix™ cloud-based applications and/or locally hosted web applications over a secure connection and deliver real-time data.

The UCSCH1x controller is loaded with software specific to its application. As a turbine or balance of plant (BoP) controller, it runs the Mark VIe firmware and applications and utilizes IONet interfaces. IONet is a private special-purpose Ethernet that only supports Mark controls I/O packs and controllers. IEEE 1588 protocol is used through the IONet interfaces to synchronize the clock of the I/O modules and controllers to within ±100 microseconds. External data is transferred to and from the control system database in the controller over the IONet interfaces. This includes process inputs/outputs to the I/O modules. Unlike traditional controllers where I/O is on a backplane, the UCSC controller does not host any application I/O. In a redundant set, all I/O networks are attached to each controller, providing them with all input data. This hardware and software architecture guarantees that no single point of application input is lost if a controller is powered down for maintenance or repair.

The UCSCH1x is available beginning with ControlST V07.01, and supports Simplex, Dual, and Triple Modular Redundant (TMR) redundancy.

The UCSCH1C is available beginning with ControlST V07.03, and supports Simplex redundancy only.

***UCSCH1 Platform Configuration Supported Features***

| Platform | Embedded PPNG | Embedded EtherCAT | EFA |
|---|---|---|---|
| UCSCH1A | ✓ | X | ✓ |
| UCSCH1B | X | X | ✓ |
| UCSCH1C | X | ✓ | ✓ |


***Mark VIe UCSCH1x Controller***

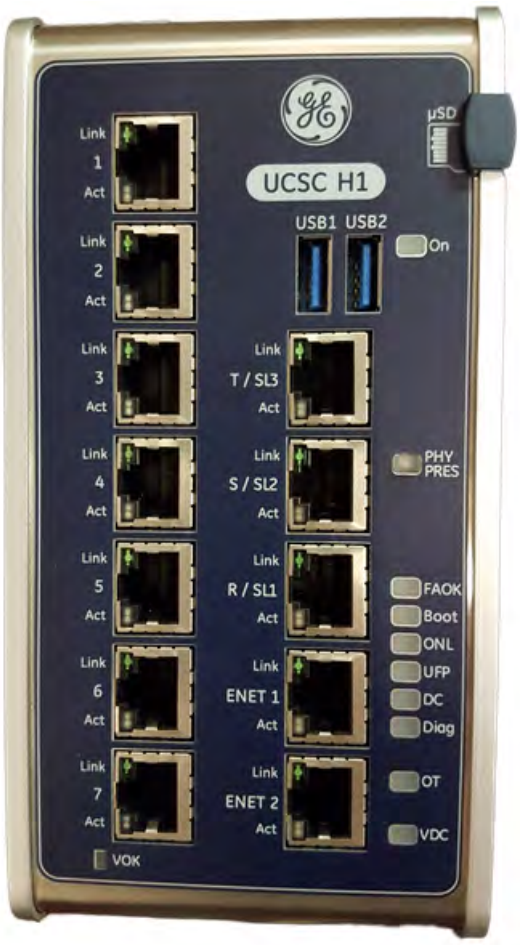
### 1.1.1.2 UCECH1x I/O Port Expansion Module

The UCECH1x module is a UCSCH1x controller coupled with a seven I/O port expansion board. The UCSCH1x controller contained within the UCECH1x module has the same features and benefits as the stand-alone UCSCH1x controller. The controller is loaded with software specific to its application.

The UCECH1x is available beginning with ControlST V07.03, and supports Excitation control applications.

***UCECH1x Module and Platform Configuration Supported Features***

| Module | Platform | Expansion I/O Ports | Embedded PPNG | Embedded EtherCAT | EFA |
|---|---|---|---|---|---|
| UCECH1B | UCSCH1x | 7, RJ-45 | X | X | ✓ |




*UCECH1x Module*


*Example UCEC Data Nameplate*

### 1.1.2 UCSCH2x Controllers

The UCSCH2 dual core controller is available in the standard three I/O port configuration.


***UCSCH2x Controller***

#### 1.1.2.1 Mark VIe UCSCH2x Controller

The Mark VIe UCSCH2A dual core controller running on QNX Neutrino, a real-time, multi-tasking operating system (OS), is designed for high-speed, high-reliability industrial applications.

The controller is loaded with software specific to its application. As a turbine or balance of plant (BoP) controller, it runs the Mark VIe firmware and applications and utilizes IONet interfaces. IONet is a private special-purpose Ethernet that only supports Mark controls I/O packs and controllers. IEEE 1588 protocol is used through the IONet interfaces to synchronize the clock of the I/O modules and controllers to within ±100 microseconds. External data is transferred to and from the control system database in the controller over the IONet interfaces. This includes process inputs/outputs to the I/O modules. Unlike traditional controllers where I/O is on a backplane, the UCSC controller does not host any application I/O. In a redundant set, all I/O networks are attached to each controller, providing them with all input data. This hardware and software architecture guarantees that no single point of application input is lost if a controller is powered down for maintenance or repair.

The UCSCH2A controller is available beginning with ControlST V07.04, and supports Simplex, Dual, and TMR redundancy.

***UCSCH2 Platform Configuration Supported Features***

| Platform | Embedded PPNG | Embedded EtherCAT | EFA |
|---|---|---|---|
| UCSCH2A | X | X | X |

### 1.1.2.2 MarkStat UCSCH2x Controller

The MarkStat UCSCH2A dual core controller running on QNX Neutrino, a real-time, multi-tasking operating system (OS), runs the MarkStat Power Conversion applications. It is loaded with software specific to its applications.

The UCSCH2A controller communicates with the wind turbine control system and applications through the IONet interface. External data is transferred to and from the control system database in the controller over the IONet interface. The MarkStat UCSC communicates with the bridge interface modules through three high-speed serial link (HSSL) connections, and communicates with the ToolboxST application over UDH.

The UCSCH2A controller is available beginning with ControlST V07.01, and supports only the Simplex configuration.

***UCSCH2 Platform Configuration Supported Features***

| Platform | Embedded PPNG | Embedded EtherCAT | EFA |
|---|---|---|---|
| UCSCH2A | X | X | X |

### 1.1.3 UCSCS2x Controllers

The UCSCS2 dual core controller runs the Mark VIeS Safety control applications used for functional safety loops to achieve SIL 2 and 3 capabilities. Mark VIeS Safety equipment is used by operators that are knowledgeable in safety-instrumented system (SIS) applications to reduce risk in critical safety functions. Safety controllers and distributed I/O modules are specifically programmed for safety control use, and this specific control hardware and software is compliant with the IEC 61508 certification. The Mark VIeS Safety controller runs on QNX Neutrino, a real-time, multi-tasking operating system (OS).

The UCSCS2A is available beginning with ControlST V07.02, and supports Simplex, Dual, and TMR redundancy.


***Mark VIeS Safety UCSCS2x Controller***

## 1.1.4 Specifications

### 1.1.4.1 UCSC Specifications

| Item | UCSC Specification |
|---|---|
| Microprocessor | IS420UCSCH1: quad core, 1.2 GHz AMD G-Series |
| | IS420UCSCH2: dual core, 1.6 GHz AMD G-Series |
| | IS420UCSCS2: dual core, 1.6 GHz AMD G-Series |
| Memory | IS420UCSCH1: 4 GB DDR3-1333 SDRAM |
| | IS420UCSCH2: 2 GB DDR3-1066 SDRAM |
| | IS420UCSCS2: 2 GB DDR3-1066 SDRAM |
| NVRAM | ControlST V07.05 and higher supports 6139 non-volatile program variables, 338 forces, and 128 totalizers<br>ControlST V07.04 and lower supports 3067 non-volatile program variables, 338 forces, and 64 totalizers<br>*Not supported by Mark VIeS Safety control* |
| Ports | • 5 Ethernet ports on front panel (Refer to the section *Interface Details*.)<br>• 1 Ethernet port on bottom used for connectivity to Predix<br>• 2 USB ports only used to initially set up UDH network IP address or for restore function<br>• 1 COM port is 115200 bit/s, 8N1, RJ-45 connector, no Flow-Control, serial redirection of UEFI-setup, and typically used by GE for troubleshooting in field<br>• 1 Display Port (disabled after startup)<br>• 1 microSD (not currently supported) |
| LEDs | Refer to the section *LEDs*. |
| Input Power | Refer to the section *Power Requirements*. |
| HMI | ControlST* Software Suite V07.00.00C or later |
| Programming | Control block language with analog and discrete blocks; Boolean logic represented in relay ladder diagram format.<br>Supported data types include:<br>• Boolean<br>• 16-bit signed integer<br>• 16-bit unsigned integer<br>• 32-bit signed integer<br>• 32-bit unsigned integer<br>• 32-bit floating point<br>• 64-bit long floating point |
| Dimensions | UCSC: 168 x 150 x 55 mm (6.61 x 5.90 x 2.17 in) (H x D x W) |
| | UCSC with mounting: 204 x 152 x 55 mm (8.03 x 5.99 x 2.17 in) (H x D x W) |
| Weight | 1,327 g (46.8 oz) |
| Mounting | Refer to the section *Mounting Requirements*. |
| Cooling | Convection |
| Operating temperature | -40 to 70 °C (-40 to 158 °F), ambient 25 mm (0.98 in) from any point on UCSC |
| Storage Temperature | -40 to 85 °C (-40 to 185 °F) |
| Humidity | 95% non-condensing |
| Altitude | Normal Operation: 0 to 1,000 m (0 to 3281 ft) at 101.3 to 89.8 kPa<br>Extended Operation: 1,000 to 3,000 m (3281 to 9,843 ft) at 89.8 to 69.7 kPa; requires temperature derating up to 3000 m (9,843 ft) = 65°C (149 °F) max |
| Reliability MTBF at 30°C (86 °F) | IS420UCSCH1: 414,248 hours |
| | IS420UCSCH2: 417,821 hours |
| | IS420UCSCS2: 417,821 hours |
| ECCN US Classification | Can be supplied upon request |
| Certifications | Refer to the section *Agency Certifications and Standards*. |

### 1.1.4.2 UCEC Module Specifications

***Note*** All specifications provided in the table *UCSC Specifications* are also applicable to the UCEC module, with the following exceptions.

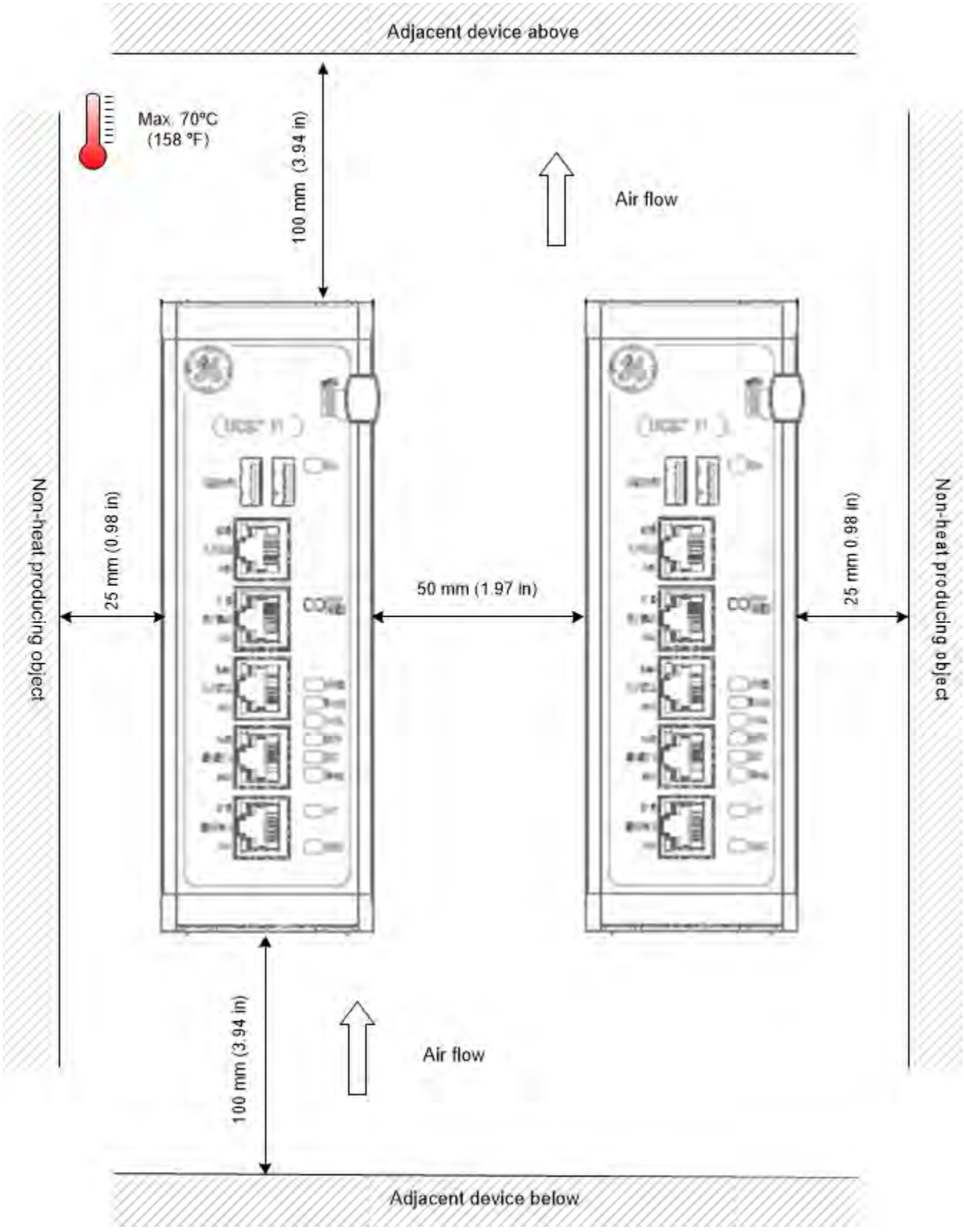
| Item | UCEC Module Specification |
|---|---|
| Ports | 7 expansion I/O ports<br>(in addition to all UCSCH1x ports listed in *UCSC Specifications* table) Refer to the section *Interface Details*. |
| LEDs | Refer to the section *LEDs*. |
| Input Power | Refer to the section *Power Requirements*. |
| HMI | ControlST V07.03.00C or later |
| Dimensions | UCEC: 168 x 150 x 85 mm (6.61 x 5.91 x 3.35 in) (H x D x W) |
| | UCEC with mounting: 204 x 153 x 85 mm (8.03 x 6.02 x 3.35 in) (H x D x W) |
| Weight | 2,060 g (72.7 oz) |
| Mounting | Refer to the section *UCEC Module Mounting Requirements*. |
| Cooling | Convection |
| Operating temperature | -40 to 70 °C (-40 to 158 °F), ambient 25 mm (0.98 in) from any point on UCEC |
| Storage Temperature | -40 to 85 °C (-40 to 185 °F) |
| Humidity | 95% non-condensing |
| Altitude | Normal Operation: 0 to 1,000 m (0 to 3281 ft) at 101.3 to 89.8 kPa<br>Extended Operation: 1,000 to 3,000 m (3281 to 9,843 ft) at 89.8 to 69.7 kPa; requires temperature derating up to 3000 m (9,843 ft) = 65°C (149 °F) max |
| Reliability MTBF at 30°C (86 °F) | IS420UCECH1: 329,615 hours |
| Certifications | Refer to the section *Agency Certifications and Standards*. |

## 1.1.5 UCSC Mounting and Installation Requirements

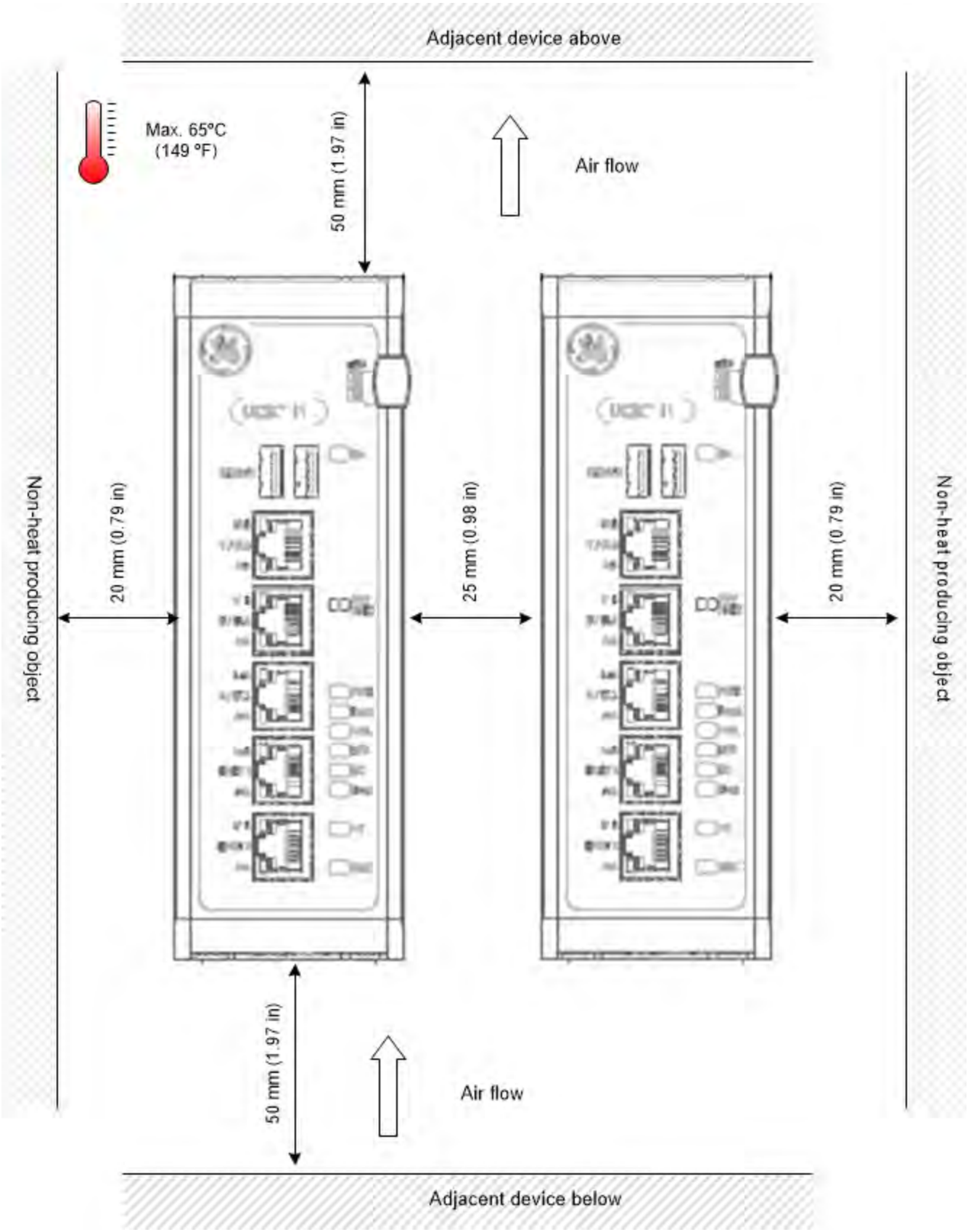
### 1.1.5.1 UCSC Mounting Requirements

The following are requirements for mounting the UCSC controller:

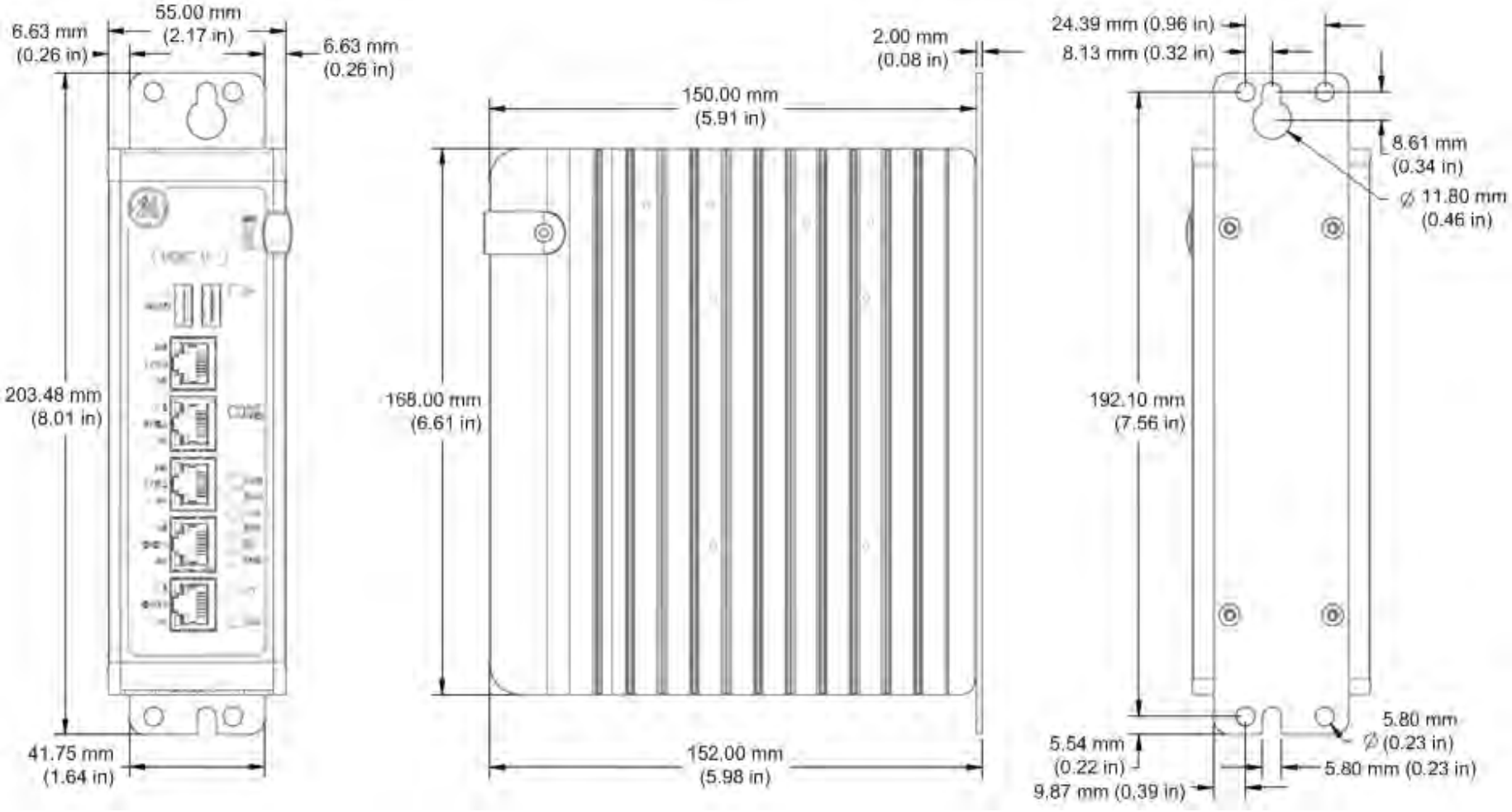
- Directly mount the UCSC to the mounting base using the two mounting screws.
- Vertical mount with unobstructed air flow through fins.
- Leave a minimal 100 mm (3.94 in) air gap above and below the UCSC.
- Parallel mount UCSC to UCSC requires a minimal 50 mm (1.97 in) spacing to achieve full temperature rating.
- The *operating temperature* envelope is 25 mm (0.98 in) from any point on UCSC.




***UCSC Mounting Requirements to Achieve 70ºC Operating Temperature***




***UCSC Mounting Requirements to Achieve 65ºC Operating Temperature***

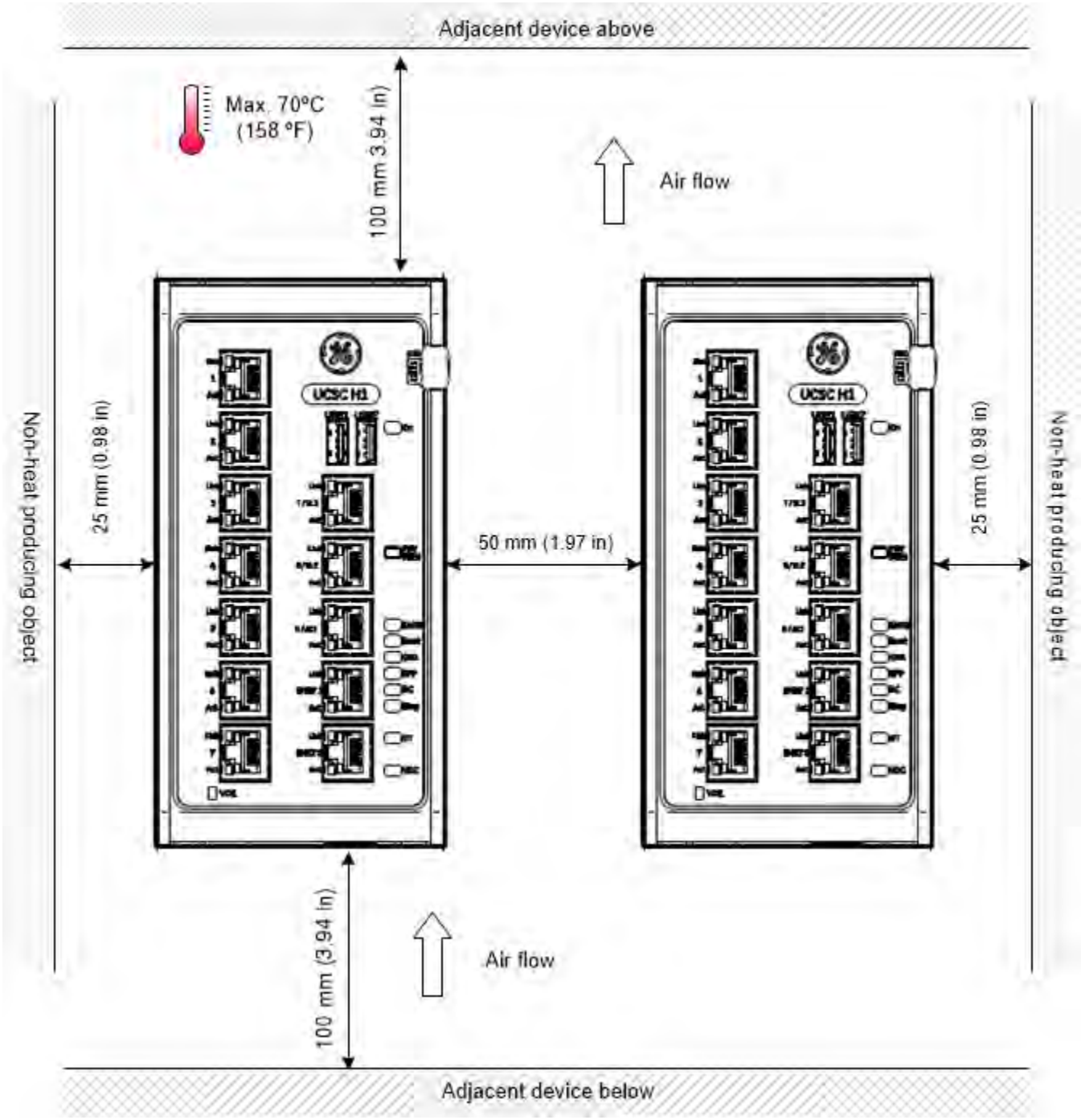



***UCSC Controller Mounting Dimensions***

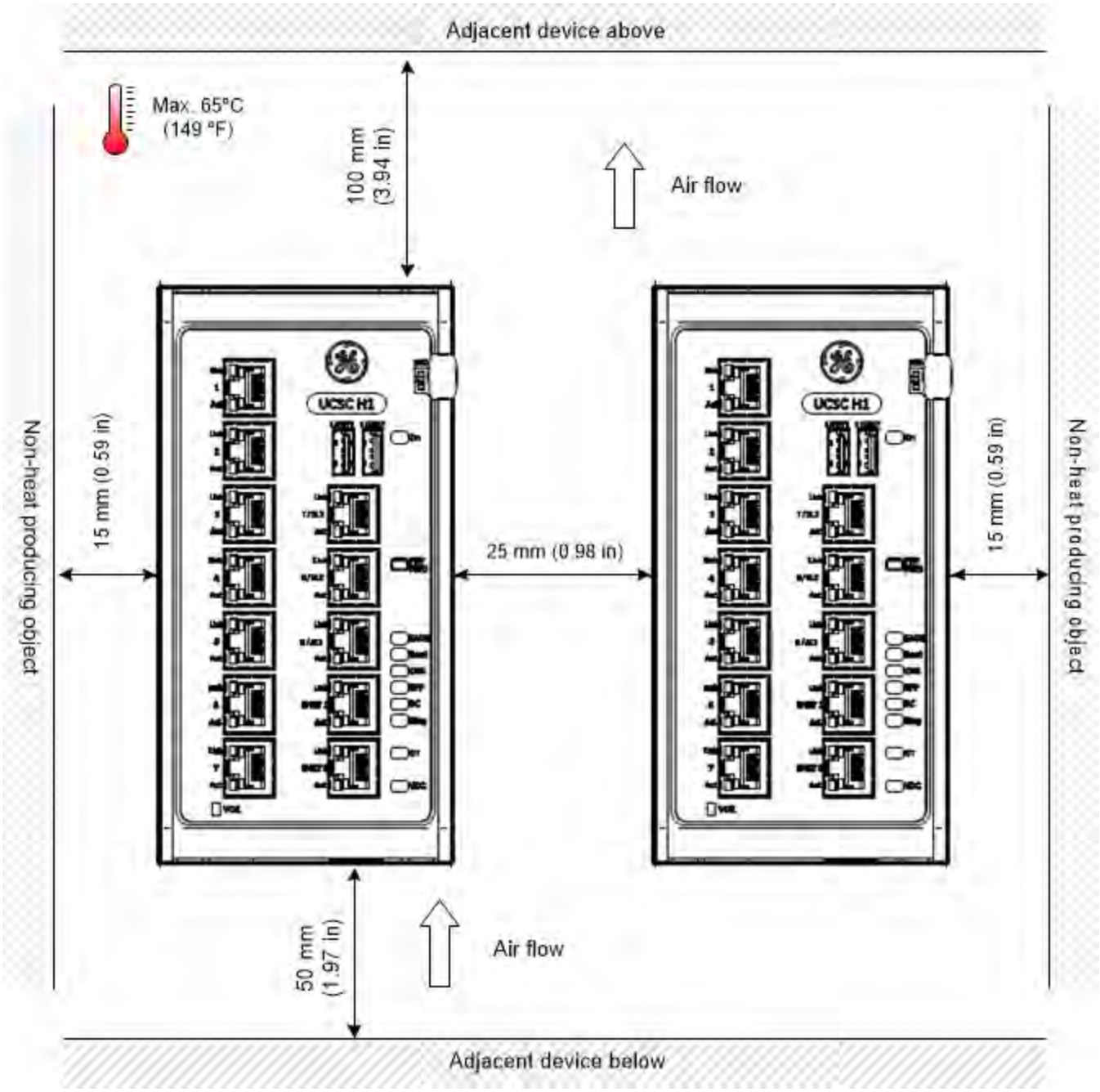
### 1.1.5.2 UCEC Module Mounting Requirements

The following are requirements for mounting the UCEC module:

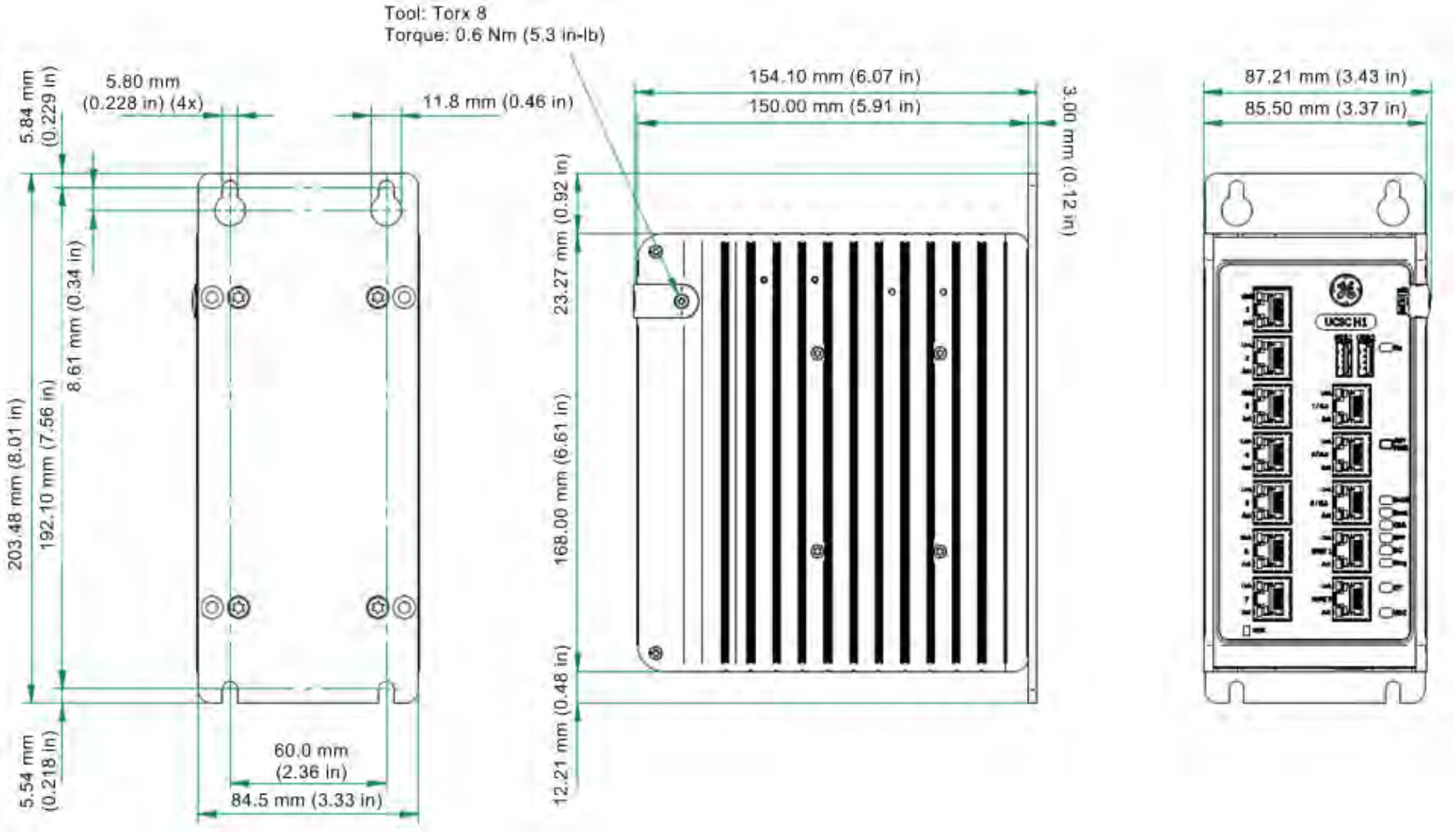
- Directly mount the UCEC to the mounting base using the four mounting screws.
- Vertical mount with unobstructed air flow through fins.
- Leave a minimal 100 mm (3.94 in) air gap above and below the UCEC module.
- Parallel mount UCEC to UCEC requires a minimal 50 mm (1.97 in) spacing to achieve full temperature rating
- The *operating temperature* envelope is 25 mm (0.98 in) from any point on UCEC.




*UCECH1 Mounting Requirements to Achieve 70ºC Operating Temperature*




***UCECH1 Mounting Requirements to Achieve 65ºC Operating Temperature***




***UCEC Module Mounting Dimensions***

### 1.1.5.3 Power Requirements

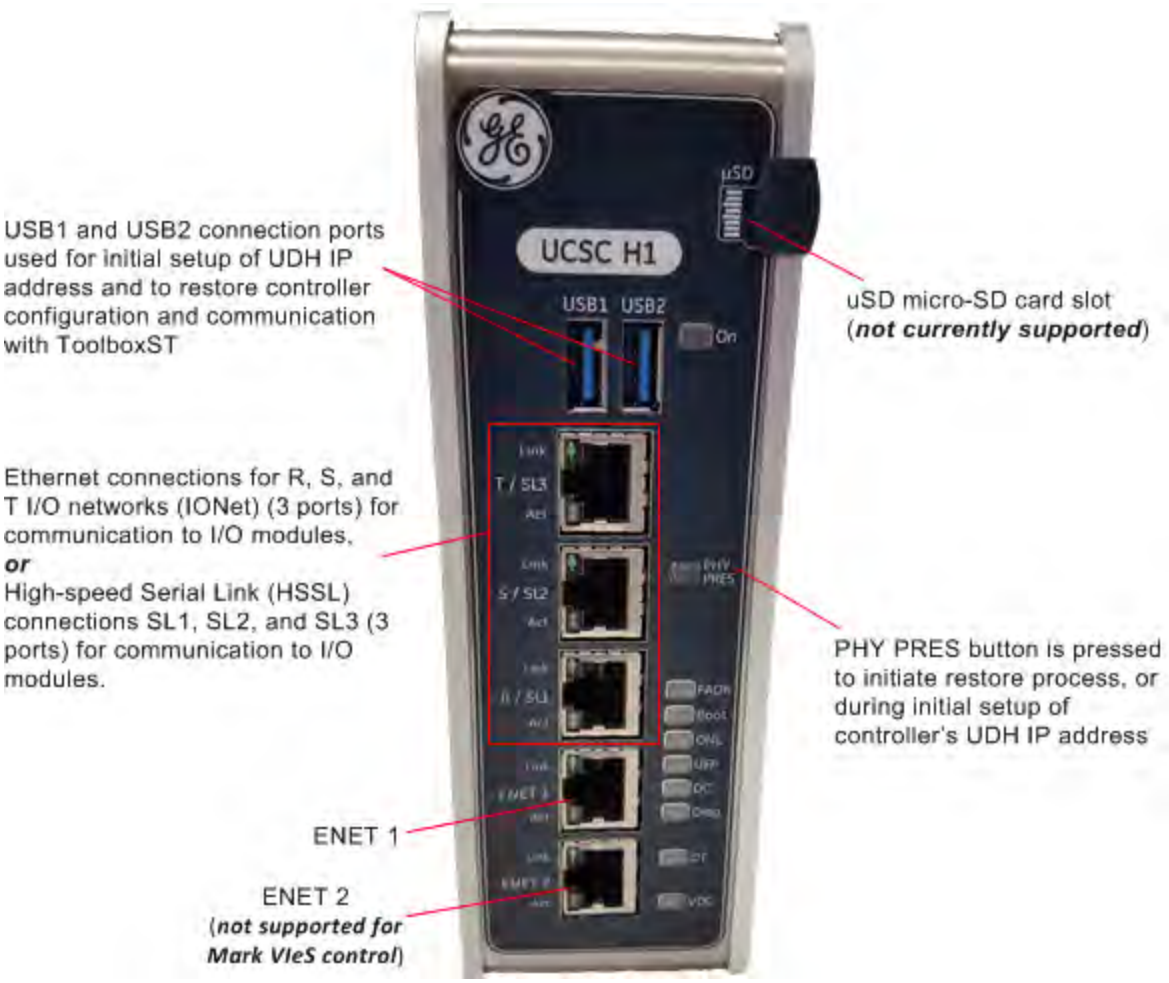
***Power Requirements***

| Item | Min | Nom | Max | Units |
|---|---|---|---|---|
| UCSC Controller Input Power | — | 18 | 30.8 | Watts |
| UCEC Module Input Power | — | 28 | 42 | Watts |
| Voltage | 18 | 24/28 | 30 | V dc |
| Input Capacitance | — | 25 | — | uF |
| Surge Protection | Non-replaceable 4 A 125 V dc rated fuse<br>Nominal melting: 26 A squared seconds ($A^2$ sec) | | | |
| Reverse Polarity Protection | Provided<br>*Reversing the + and - input will not damage the UCSC, nor will it power up.* | | | |

***3-pin Power Plug***

| Item | Description |
|---|---|
| Pin 1 | Ground |
| Pin 2 | Negative<br>*The UCSC case is bonded to power supply negative.* |
| Pin 3 | Positive |
| Wire Sizes | 28 to 16 AWG |
| Screw Torque | 0.23 Nm (2 in-lb) |
| Part Number | Phoenix Contact MC 1,5/ 3-STF-3,81 - 1827716 |

### 1.1.5.4 Interface Details




***UCSC Connection Ports (Front View)***

---

***Note*** For further information, refer to the *ToolboxST User Guide for Mark Controls Platform* (GEH-6700 or GEH-6703), the section *System Controller Platforms*.

---

† **COM** serial port can be used as an alternate way to set up controller IP address instead of using a flash device

**DisplayPort** provides signals for connecting a display monitor or video adapter (***not currently supported***)

**IICS Cloud Port** (Ethernet port) is used to configure the EFA and to communicate with the Predix cloud environment (***not supported for Mark VIeS or MarkStat control***)

**Energy Pack / 1-wire EEPROM** allows energy pack connection to enable the controller to save its current state in the event of power loss (***not currently supported***)

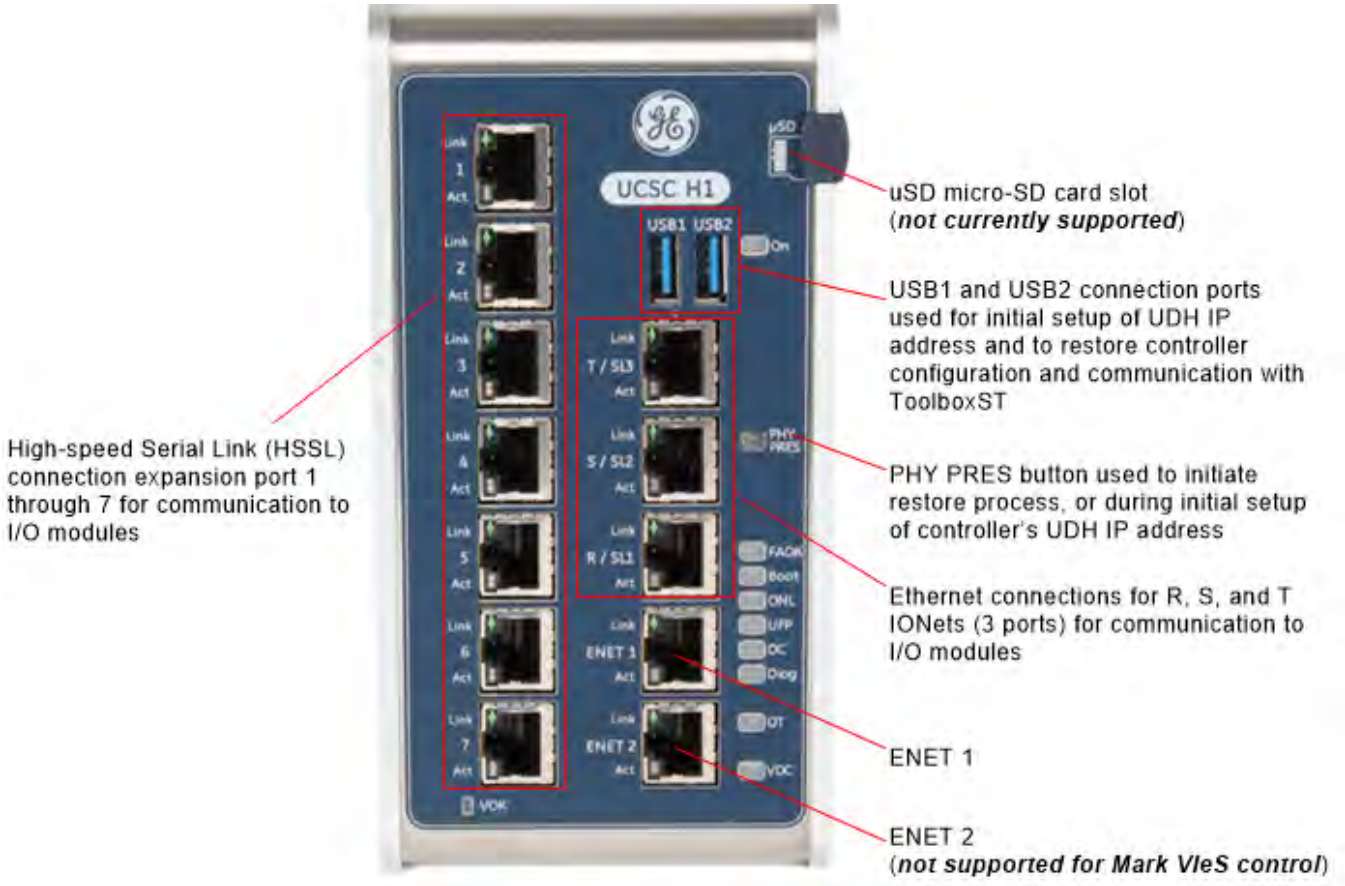
**24/28 V DC IN** input power connection


***UCSC Connection Ports (Bottom View)***

---

***Note*** † For instructions to set up the controller Internet Protocol (IP) address using the COM port, refer to the *ToolboxST User Guide for Mark Controls Platform* (GEH-6700 or GEH-6703), the section *Configure and Transfer IP Address to UCSB / UCSC Controller*.

---




***UCEC Connection Ports (Front View)***

---

***Note*** For further information, refer to the *ToolboxST User Guide for Mark Controls Platform* (GEH-6700 or GEH-6703), the section *System Controller Platforms*.

---

† **COM** serial port can be used as an alternate way to set up controller IP address instead of using a flash device

**DisplayPort** provides signals for connecting a display monitor or video adapter (***not currently supported***)

**IICS Cloud Port** (Ethernet port) is used to configure the EFA and to communicate with the Predix cloud environment (***not supported for Mark VIeS or MarkStat control***)

**24/28 V DC IN** input power connection

***UCEC Connection Ports (Bottom View)***

***Note*** † For instructions to set up the controller Internet Protocol (IP) address using the COM port, refer to the *ToolboxST User Guide for Mark Controls Platform* (GEH-6700 or GEH-6703), the section *Configure and Transfer IP Address to UCSB / UCSC Controller.*

***Mark VIe UCSCH1x Ethernet Ports***

| Ethernet Port | Description |
|---|---|
| IONet Ethernet Interface (3 Ports) | UCSCH1A / UCSCH1B:<br>T/SL3 is <T> network for TMR (using all three ports).<br>S/SL2 is <S> network for Dual redundancy (used with R/SL1).<br>R/SL1 is <R> network for Simplex redundancy.<br>*Twisted pair 10Base-TX/100Base-TX, RJ-45 connector is used.*<br>*TCP/IP protocols is used to communicate between controllers and I/O modules.*<br>*For TMR and Dual configurations, IONet redundancy is equal to controller redundancy.*<br>*For Simplex configurations, both Simplex and TMR IONet redundancy are supported.* |
| | UCSCH1C:<br>T/SL3 is EtherCAT redundant (Ring topology).<br>S/SL2 is not supported.<br>R/SL1 is <R> IONet network<br>*Twisted pair 100Base-TX, RJ-45 connector is used.*<br>*TCP/IP protocols is used to communicate between controllers and I/O modules.*<br>*Simplex IONet redundancy is the only supported configuration.* |
| ENET 1 Primary Ethernet Interface to LAN | UDH<br>*Twisted pair 10Base-T/100Base-TX, RJ-45 connector is used.*<br>*TCP/IP protocol is used for communication between controller and ToolboxST application.*<br>*TCP/IP protocol is used for alarm communication to HMIs.*<br>*Modbus TCP Slave and/or OPC UA*<br>*EGD protocol is used for application variable communication to HMIs.* |
| ENET 2 | UCSCH1A:<br>*PROFINET*<br>*Twisted pair 10Base-T/100Base-TX, RJ-45 connector is used.* |
| | UCSCH1B:<br>Secondary plant network<br>*Twisted pair 10Base-T/100Base-TX, RJ-45 connector is used.*<br>*Modbus TCP Slave, OPC UA, and/or EGD* |
| | UCSCH1C:<br>EtherCAT Primary (Line and Ring topologies)<br>*Twisted pair 100Base-TX, RJ-45 connector is used.* |

***UCECH1B Ethernet Ports***

| Ethernet Port | Description |
|---|---|
| High-speed Serial Link (HSSL) Interface (10 Ports) | GE Proprietary protocol that provides high-speed point-to-point synchronous communication between a controller and any HSSL–enabled I/O module.<br>R/SL1, S/SL3, T/SL3, expansion ports 1 through 7 are 10 independent serial link interfaces.<br>*Twisted pair 10Base-TX/100Base-TX, RJ-45 connector is used.*<br>*HSSL I/O module support is defined by the controller firmware.* |
| ENET 1 Primary Ethernet Interface to LAN | UDH<br>*Twisted pair 10Base-T/100Base-TX, RJ-45 connector is used.*<br>*TCP/IP protocol is used for communication between controller and ToolboxST application.*<br>*TCP/IP protocol is used for alarm communication to HMIs.*<br>*Modbus TCP Slave and/or OPC UA*<br>*EGD protocol is used for application variable communication to HMIs.* |
| ENET 2 | Secondary plant network<br>*Twisted pair 10Base-T/100Base-TX, RJ-45 connector is used.*<br>*Modbus TCP Slave, OPC UA, and/or EGD* |

***Mark VIe UCSCH2x Ethernet Ports***

| Ethernet Port | Description |
|---|---|
| IONet Ethernet Interface (3 Ports) | T/SL3 is <T> network for TMR (using all three ports).<br>S/SL2 is <S> network for Dual redundancy (used with R/SL1).<br>R/SL1 is <R> network for Simplex redundancy.<br>*Twisted pair 10Base-TX/100Base-TX, RJ-45 connector is used.*<br>*TCP/IP protocols is used to communicate between controllers and I/O modules.*<br>*For TMR and Dual configurations, IONet redundancy is equal to controller redundancy.*<br>*For Simplex configurations, both Simplex and TMR IONet redundancy are supported.* |
| ENET 1 Primary Ethernet Interface to LAN | UDH<br>*Twisted pair 10Base-T/100Base-TX, RJ-45 connector is used.*<br>*TCP/IP protocol is used for communication between controller and ToolboxST application.*<br>*TCP/IP protocol is used for alarm communication to HMIs.*<br>*Modbus TCP Slave*<br>*EGD protocol is used for application variable communication to HMIs.* |
| ENET 2 | Secondary plant network<br>*Twisted pair 10Base-T/100Base-TX, RJ-45 connector is used.*<br>*Modbus TCP Slave, OPC UA, and/or EGD* |

***MarkStat UCSCH2x Ethernet Ports***

| Ethernet Port | Description |
|---|---|
| High-speed Serial Link (HSSL) Interface (3 Ports) | GE Proprietary protocol that provides high-speed point-to-point synchronous communication between a controller and any HSSL–enabled I/O module.<br>R/SL1, S/SL3, T/SL3 are three independent serial link interfaces.<br>*Twisted pair 10Base-TX/100Base-TX, RJ-45 connector is used.*<br>*HSSL I/O module support is defined by the controller firmware.* |
| ENET 1 Primary Ethernet Interface to LAN | UDH<br>*Twisted pair 10Base-T/100Base-TX, RJ-45 connector is used.*<br>*TCP/IP protocol is used for communication between controller and the ToolboxST application.*<br>*TCP/IP protocol is used for alarm communication to HMIs.*<br>*EGD protocol is used for application variable communication to HMIs.* |
| ENET 2 | IONet Interface<br>*Twisted pair 10Base-T/100Base-TX, RJ-45 connector is used.* |

***Mark VIeS UCSCS2x Ethernet Ports***

| Ethernet Port | Description |
|---|---|
| IONet Ethernet Interface (3 Ports) | T/SL3 is <T> network for TMR (using all three ports).<br>S/SL2 is <S> network for Dual redundancy (used with R/SL1).<br>R/SL1 is <R> network for Simplex redundancy.<br>*Twisted pair 10Base-TX/100Base-TX, RJ-45 connector is used.*<br>*TCP/IP protocols is used to communicate between controllers and I/O modules.*<br>*For TMR and Dual configurations, IONet redundancy is equal to controller redundancy.*<br>*For Simplex configurations, both Simplex and TMR IONet redundancy are supported.* |
| ENET 1 Primary Ethernet Interface to LAN | UDH<br>*Twisted pair 10Base-T/100Base-TX, RJ-45 connector is used.*<br>*TCP/IP protocol is used for communication between controller and the ToolboxST application.*<br>*TCP/IP protocol is used for alarm communication to HMIs.*<br>*Modbus TCP Slave*<br>*EGD protocol is used for application variable communication to HMIs.* |
| ENET 2 | Not supported |

## 1.1.6 UCSC Operation

### 1.1.6.1 UDH Network Configuration

The UCSC is typically set up for communications on the UDH network using an unencrypted minimum 4 GB flash drive that is configured with the ToolboxST application. The factory default IP address is 192.168.101.111. The correct UDH IP address must be properly set up so that the controller can communicate to the site HMIs.

***Note*** The UCSC, as shipped from the factory, does not include the software on the controller to support communication from the PHY PRES button to the EFA. The user needs to download to the controller at least once (using ToolboxST) to enable this.

➢ **To change the UDH network IP address for the UCSC**

1. Verify that the HMI computer running the ToolboxST application has been configured (through Windows OS) with the correct IP address for the UDH network.
2. From the ToolboxST Component Editor, verify that the controller Platform is set as UCSCxxx.
3. From the Component Editor **General** tab Property Editor **Network Adapter 0**, configure the appropriate controller IP address as a relative subnet to the HMI's UDH IP address from Step 1.
4. Insert a non-encrypted, USB 2.0 only flash drive with a minimum 4 GB capacity into a USB port of the computer that is running the ToolboxST application.
5. From the ToolboxST Component Editor, select **Device**, **Download**, and **Controller Setup** to launch the Controller Setup Wizard.
6. Follow the on-screen instructions to load the flash drive. Refer to the *ToolboxST User Guide for Mark Controls Platform* (GEH-6700 or GEH-6703), the section *Configure and Transfer IP Address to UCSB / UCSC Controller* for further instructions.

➢ **To set the controller's network address using the COM port**

***Attention***

**Use a UCSC COM port *adapter*, a standard serial to USB cable, and/or a Cat5e or better Ethernet cable for this connection.**

1. Connect the UCSC COM port adapter to the Ethernet cable and the other end of the cable to the UCSC COM port.
2. Connect the UCSC COM port adapter to the serial to USB cable, then to the computer that runs the ToolboxST application.
3. From the ToolboxST Component Editor **General** tab, select **Device**, **Download**, and **Controller Setup** to launch the *Controller Setup Wizard*.
4. Follow the on-screen instructions to transfer the UDH network address to the controller. Refer to the *ToolboxST User Guide for Mark Controls Platform* (GEH-6700 or GEH-6703), the section *Configure and Transfer IP Address to UCSB / UCSC Controller* for further instructions.

### 1.1.6.2 LEDs

The locations and descriptions of the LED indicators that are located on the front panel of the UCSC controller and the UCEC module are as follows.


*UCSCH1 Controller*

**Link LED** (RJ-45 connector) (qty 5):
Solid green = connection has been established
Solid green ***plus*** **Boot LED solid red** = startup in progress

**Act LED** (RJ-45 connector) (qty 5):
Solid green = packet traffic
Solid green ***plus*** **Boot LED solid red** = startup in progress

**On LED**:
Solid green = one of the USB drives is running the restore process
Flashing green = restore process failure

**FAOK LED** indicates status of Embedded Field Agent (EFA)
Solid green = EFA connected to cloud.
Flashing green = refer to *CPE400 Quick Start Guide* (GFK-3002)
(***not supported for Mark VIeS or MarkStat control)***

**Boot LED:**
Solid red = startup in progress
Off = startup completed
Flashing red = controller firmware failed to load properly
Flashing once every 3 seconds = Baseload signature verification failure

**ONL LED:**
Solid green = controller is online and running the application

**UFP LED** indicates status of FPGA program updates:
Off = normal operation
Solid amber† = internal software update in progress
Solid green = controller is online and running the application

**DC LED:**
Solid green = controller is designated controller
(***always on for Simplex configurations***)

**Diag LED:**
Flashing red = active diagnostic alarm

**OT LED:**
Solid amber ‡ = temperature of internal components exceeds recommended limit

**VDC LED:**
Solid red = stand-by power on board in soft-off or suspend to disk mode
Solid amber = suspend to RAM, memory power on
Solid green = full power on
Flashing red = Missing internal voltage
Flashing amber = all voltages asserted but system reset in progress

† *An internal software update may take several minutes. Do not cycle controller power during this update because this could cause potential damage to the controller.*

‡ *A diagnostic alarm for temperature is also annunciated. When the temperature exceeds the max threshold, the controller automatically shuts down to prevent damage.*

**Link LED** (RJ-45 connector) (qty 12):
Solid green = connection has been established
Solid green ***plus*** **Boot LED** solid red = startup in progress

**Act LED** (RJ-45 connector) (qty 12):
Solid green = packet traffic
Solid green ***plus*** **Boot LED** solid red = startup in progress

**VOK LED:**
Solid green = All voltages are operating correctly
Flashing green = internal voltage has failed
Off = input voltage or primary internal voltage has failed

***Note:*** *All other LED functionality is as described for the UCSC controller.*


*UCECH1 Module*

#### 1.1.6.3 Over-temperature Protection

The UCSC controller uses internal temperature readings and logic to protect its internal electronics. Internal circuitry generates a warning at 85°C (185 °F) and shuts down at 95°C (203 °F). The UCSC will reboot once the internal circuitry detects the temperature has dropped below 75°C (167 °F). Independently, the microprocessor monitors its operating temperature and generates a warning at 105°C (221 °F) and shuts down at 107°C (225 °F). A power cycle is required to recover from a microprocessor over-temperature shut down. Both of these warnings drive the OT LED and are annunciated as diagnostic alarms.

#### 1.1.6.4 UCSC COM Port

Typically used by GE to troubleshoot in the field, the UCSC COM port accepts a UCSC COM port *adapter* and a standard serial to USB cable is used to connect to another computer. Use Cat5e or better Ethernet cable for this connection. The COM port can also be used to set the controller's UDH network address. For these instructions, refer to the *ToolboxST User Guide for Mark Controls Platform* (GEH-6700 or GEH-6703), the section *Configure and Transfer IP Address to UCSB / UCSC Controller*.

### 1.1.7 UCSC Embedded Field Agent (EFA)

The Embedded Field Agent (EFA) provides connectivity to GE Predix* cloud-hosted applications and datastores through a local Predix machine interface that runs within a Linux virtual machine on the UCSCH1. The EFA has two primary functions:

- Collecting and transmitting machine data securely
- A platform for running Predix apps on the Edge directly on the machine

Once a Field Agent is up and running, data is transferred from the plant to the cloud over encrypted channels, preserving its time stamp, quality, and fidelity. It also provides a rich domain application environment for edge processing, so logic can be executed at the most appropriate place in the architecture — locally on the machine or in the cloud.

---

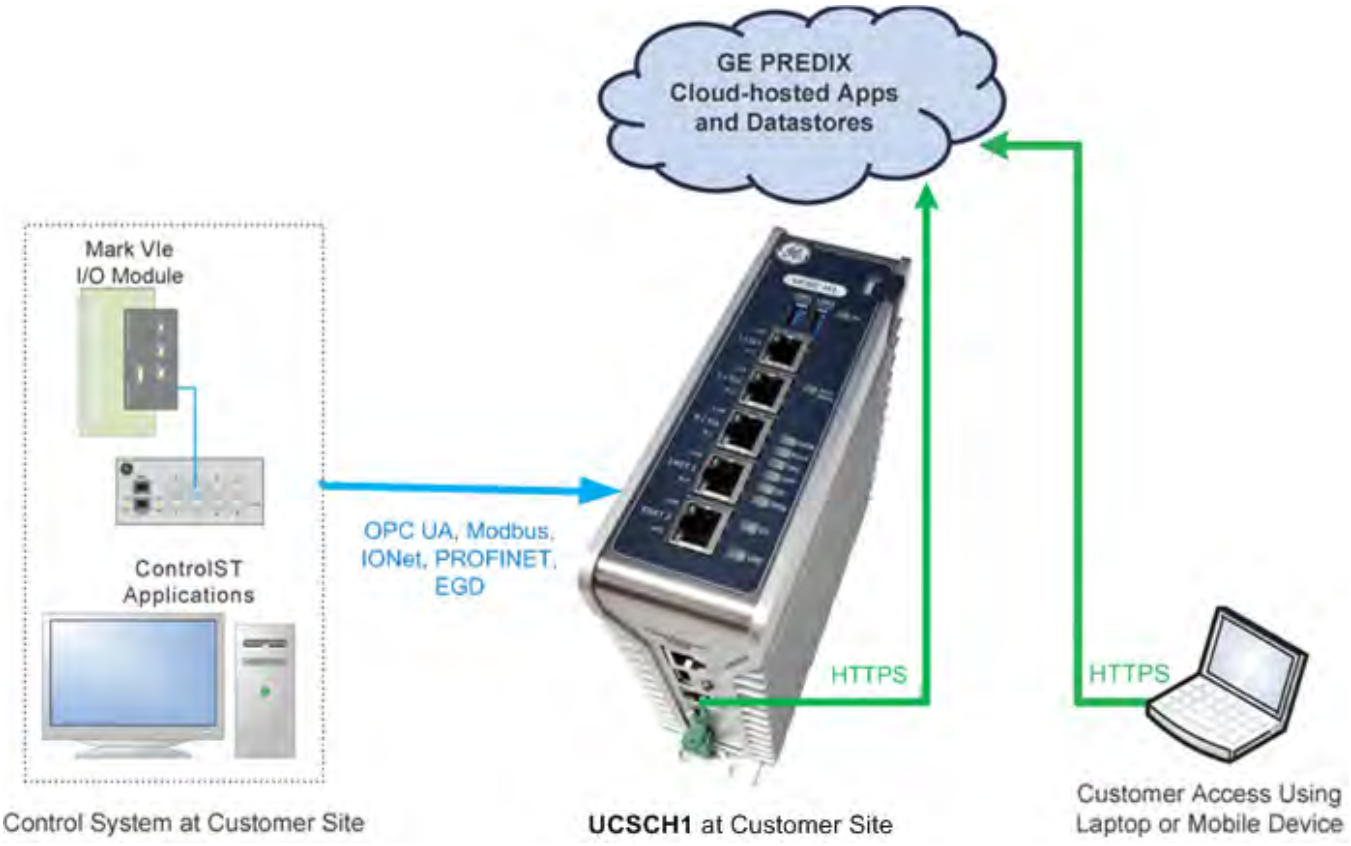
***Note*** For more information, refer to the following documentation:

• *Field Agents User Guide* (GFK-2993)

• *Field Agent Secure Deployment Guide* (GFK-3009)

• *Field Agents Upgrade Guide* (GFK-3017)

---




## 1.1.8 UCSC Virtual Network

The virtual network is a feature of the hypervisor used in UCSCH1 controllers. The virtual network transfers data between the virtual machines (VMs) in the UCSCH1 controller like an Ethernet network transfers data between physical machines over a physical network. The virtual network in the UCSCH1 controller is used to transfer data between the Mark VIe control running in one VM, and the Embedded Field Agent (*EFA*) running in another VM. The EFA requires a connection to the Mark VIe control and a connection to the cloud. However, the Mark VIe control must not have a connection to the cloud, so a physical managed switch must be used to segment the networks. To resolve this issue, data is passed through the virtual network so the EFA can connect directly to the cloud and eliminate the need of a managed switch.

The virtual network transfers data through memory shared between the VMs instead of the wires of a physical network. The Mark VIe control uses a network firewall to prevent all other traffic.

Like a physical network, the virtual network must be configured with an IP address and subnet mask. The VMs in the UCSCH1 controller must be on the same subnet to function properly. The Mark VIe virtual network is configured using the ToolboxST application. The default configurations for the Mark VIe control and the EFA provide a working virtual network. However, changing the configuration in one VM may interrupt communication over the virtual network until a corresponding change is made to the other VM.

---

***Note*** To configure virtual network adapters, refer to the *ToolboxST User Guide for Mark Controls Platform* (GEH-6700), the section *Virtual Network Adapters*. To configure the virtual network in the EFA, refer to the *Field Agents User Guide* (GFK-2993).

---

## 1.1.9 UCSC Embedded PROFINET Gateway (Embedded PPNG) Module

**Attention**

**The information provided in this section is only applicable beginning with ControlST V07.04 / PPNG V05.11 and higher.**

**This information does not apply to the stand-alone PPNG PROFINET Gateway (PPNG) module. For information on the PPNG module, refer to the chapter *PPNG PROFINET Gateway Module*.**

The UCSCH1A Embedded PROFINET Gateway (Embedded PPNG) module is a virtual machine that maps I/O from PROFINET Slave devices to the Mark VIe controller. It connects to a high-speed PROFINET local area network (LAN), enabling communication with PROFINET I/O devices. The Embedded PPNG module provides the functionality, services, and protocols required for certification as a PROFINET RT Version 2.2 I/O controller, running 100 Mbps Ethernet interfaces.

Embedded PPNG features include:

- One RJ-45 shielded-twisted pair 10/100 Mbps port for PROFINET communication
- Simplex or Hot Backup module redundancy (Hot Backup configuration supports PROFINET system redundancy)
- Support for star (connect to switch), line/bus (connect directly to I/O device), or mixed network topologies on the PROFINET network, and Ring topology with MRP devices
- PROFINET I/O device configuration
- Cyclic exchange of input and output data from PROFINET I/O devices, asynchronous with Mark VIe controller frame
- Input and output values displayed in the ToolboxST application
- Device diagnostic messages for troubleshooting

From the ToolboxST application, users can add and configure PROFINET I/O devices and smart sensors in a typical Mark VIe control system architecture. Any change made to the configuration of attached PROFINET devices requires a new configuration file to be downloaded to the Embedded PPNG, which reboots the virtual machine. Connecting an existing variable to a PROFINET I/O Point does not require a reboot.

### 1.1.9.1 Compatibility

The following table lists the available Embedded PPNG configurations. For details on switching between configurations, refer to the *ToolboxST User Guide for Mark Controls Platform* (GEH-6700 or GEH-6703), the section *Embedded PPNG Hot Backup and Simplex Configuration*.

***Supported Embedded PPNG Configurations***

| UCSCH1A Controller Redundancy | Simplex Embedded PPNG | Hot Backup Embedded PPNG |
|---|---|---|
| Simplex | Supported; 1 Embedded PPNG | Not supported |
| Dual | Supported; 1-2 Embedded PPNGs | Supported |
| Triple Modular Redundancy (TMR) | Supported; 1-3 Embedded PPNGs | Supported |

The following is an explanation of redundancy options:

- Dual UCSCH1A controller redundancy supports up to two Simplex Embedded PPNGs or a Hot Backup configuration
- TMR UCSCH1A controller redundancy supports up to three Simplex Embedded PPNGs or a Hot Backup configuration. In the Hot Backup configuration, R and S Embedded PPNGs are used; the T Embedded PPNG is not used.

### Migration from Prior Embedded PPNG Version

Prior to ControlST V07.04 (which includes PPNG V05.11 firmware), the only supported Embedded PPNG configuration was a Simplex Embedded PPNG in the R UCSCH1A controller, regardless of controller redundancy. Also, the R IONet and PROFINET networks had to be combined because the Embedded PPNG's only available network connection was the ENET2 port (this port was required for communication over IONet to the Mark VIe controller(s) and PROFINET devices).

Beginning with ControlST V07.04, PROFINET system redundancy support has been added, as well as the support for multiple Simplex Embedded PPNGs. IONet communication between the Embedded PPNG and the Mark VIe controller(s) travels through internal IONet switches, which enables separation of the IONet and PROFINET external networks.

No re-wiring or configuration change is required during an upgrade from an older Embedded PPNG version (prior to ControlST V07.04). The I/O and configuration compatibility codes for the Embedded PPNG have changed, which drives an offline download to the system. Additionally, the variable name **PROFI_BACKUP_ PPNG_R** has been changed to **PRIMARY_PPNG_R/PRIMARY_PPNG_S** to indicate the Primary Embedded PPNG in a Hot Backup configuration. Therefore, any variable connected to **PROFI_BACKUP_PPNG_R** is intentionally dropped.

After upgrade, users can separate the IONet and PROFINET networks if needed, but it is not required to maintain existing functionality.

### PROFINET Device Support in Hot Backup Configuration

The Hot Backup configuration provides the ability to have both Embedded PPNG redundancy (via two Embedded PPNGs working together) and network redundancy (via MRP ring). This is achieved by implementing the PROFINET system redundancy feature of the standard PROFINET version. The Mark VIe Embedded PPNG implements and supports S2 system redundancy in Legacy mode and supports the PROFINET scanner devices listed in the following table.

***Supported PROFINET Scanner Devices in Hot Backup Configuration***

| PROFINET Slave Device | Part Number |
|---|---|
| RX3i CEP PROFINET Scanner | IC695CEP001 |
| RX3i PROFINET Scanner | IC695PNS001 |
| PAC8000 PROFINET Scanner | 8515-BI-PN |
| VersaMax PROFINET Scanner | IC200PNS001 |
| GLM064 MRP Switch | IC086GLM064 |
| *The latest GSDML files for these devices are distributed with the ControlST Software Suite.* | |

### 1.1.9.2 Dataflow

The UCSCH1A Embedded PPNG exchanges data with the control system at standard Mark VIe controller frame rates (10 ms, 20 ms, 40 ms and so forth). Actual PROFINET data size depends on the data transmitted by the PROFINET I/O devices. The Embedded PPNG limits this to a maximum of 8 KB of data in either direction. The ToolboxST application has rules in place to check for the maximum allowable amount of PROFINET data in terms of Ethernet packets.

The exchange of data between the PROFINET I/O device and the UCSC controller is a configurable I/O device data update rate (refer to the applicable *Embedded PPNG Specifications* table for these values). The frame rate of the Mark VIe controller is also a configurable scan rate. Be aware that the transfer of data occurs asynchronously.

IONet communication between the Embedded PPNG and the Mark VIe firmware is routed through internal IONet switches on the UCSCH1A controller(s). Thus, the Embedded PPNG and the Mark VIe firmware share the internal R and S IONet ports in the UCSCH1A controller.

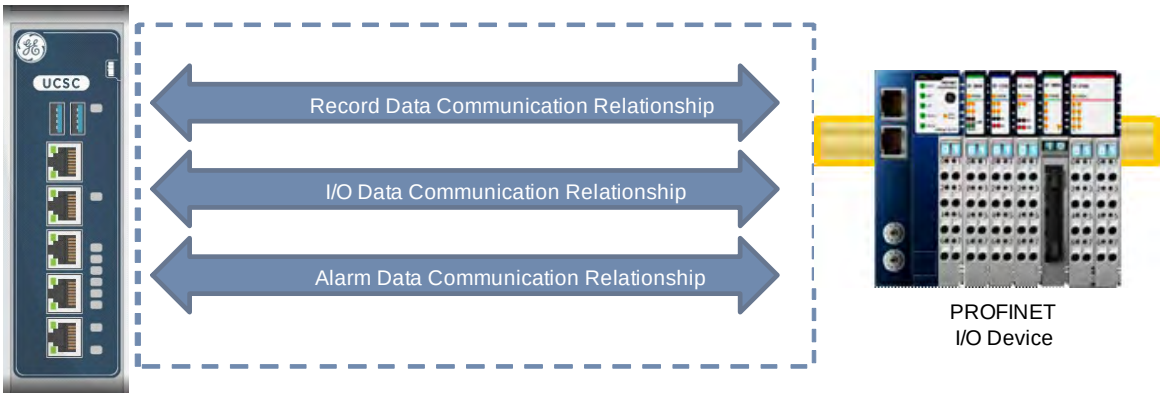
### 1.1.9.3 PROFINET Network Communication

A typical PROFINET network includes the following components:

- **PROFINET I/O controller** is the UCSC Embedded PPNG virtual machine that acts as a PROFINET I/O controller. It controls one or more PROFINET I/O devices through Read/Write of the associated data.
- **Ethernet switch** is either the GE-qualified, general-purpose, unmanaged Ethernet switch or the GE-qualified MRP managed Ethernet switch. Either switch is used to route data from multiple PROFINET I/O devices to the Embedded PPNG.
- **PROFINET I/O devices** are distributed I/O devices hosting various data types that communicate with the Embedded PPNG.

Before the UCSC controller can exchange data with a PROFINET I/O device, an application relationship (connection) must be established between the devices. The UCSC controller automatically sets up the correct number and types of Communication Relationships (CRs) based on its ControlST configuration. The following CR types are established between the UCSC controller and I/O devices:

- **Record Data CRs** are always the first to be established within an application relationship. They are used for non real-time transfers of data records such as startup parameters, diagnostics, identifications, and configurations.
- **IO Data CRs** are used for real-time, cyclic transfer of I/O data.
- **Alarm Data CR** is used for real-time, acyclic transfer of alarms and events.




***Typical PROFINET Network Communication***

### 1.1.9.4 Embedded PPNG Specifications

***Simplex Embedded PPNG Specifications***

| Item | Specification |
|---|---|
| Conformance class version | PROFINET IO-RT V2.2 Class A I/O controller |
| Ethernet cabling supported | Cat 5e STP for PROFINET |
| I/O device data update rates | Configurable: 1 ms, 2 ms, 4 ms, 8 ms, 16 ms, 32 ms, 64 ms, 128 ms, 256 ms, and 512 ms |
| Number of PROFINET MAC addresses | One |
| Maximum I/O memory | 8 KB of input and 8 KB of output memory |
| Max number of PROFINET I/O devices attached to UCSC | Limited to eight devices with update rates of 1 ms |
| Network topology supported | Star (typical), Line (daisy-chain with UCSC at one end of the bus), or a combination |
| Maximum PROFINET data rate | 6 KB per millisecond |
| PROFINET Network Speed | 100 Mbps full duplex on dedicated PROFINET network |
| Media Redundancy Protocol (MRP) | Not supported |
| Auto-Reconfiguration | Not supported |

***Simplex Embedded PPNG with MRP Specifications***

| Item | Specification |
|---|---|
| Conformance class version | PROFINET IO-RT V2.2 Class A I/O controller |
| Ethernet cabling supported | Cat 5e STP for PROFINET |
| I/O device data update rates | Configurable: 8 ms, 16 ms, 32 ms, 64 ms, 128 ms, 256 ms, and 512 ms |
| Number of PROFINET MAC addresses | One |
| Maximum I/O memory | 8 KB of input and 8 KB of output memory |
| Max number of PROFINET I/O devices attached to UCSC | Refer to the table in the section *Device Update Rate versus Number of Devices* |
| Network topology supported | Ring |
| Maximum PROFINET data rate | 6 KB per millisecond |
| PROFINET Network Speed | 100 Mbps full duplex on dedicated PROFINET network |
| Media Redundancy Protocol (MRP) | Supported using the GE-qualified MRP switch serving as the Media Redundancy Manager (MRM) |
| Auto-Reconfiguration | Not supported |

***Hot Backup Embedded PPNG with MRP Specifications***

| Item | Specification |
|---|---|
| Conformance class version | PROFINET IO-RT V2.2 Class A I/O controller |
| Ethernet cabling supported | Cat 5e STP for PROFINET |
| I/O device data update rates | Configurable: 8 ms, 16 ms, 32 ms, 64 ms, 128 ms, 256 ms, and 512 ms |
| Number of PROFINET MAC addresses | One |
| Maximum I/O memory | 8 KB of input and 8 KB of output memory |
| Max number of PROFINET I/O devices attached to UCSC | Refer to the table in the section *Device Update Rate versus Number of Devices* |
| Network topology supported | Ring using MRP |
| Maximum PROFINET data rate | 6 KB per millisecond |
| PROFINET Network Speed | 100 Mbps full duplex on dedicated PROFINET network |
| Media Redundancy Protocol (MRP) | Supported using the GE-qualified MRP switches, with one serving as the Media Redundancy Manager (MRM) |

*Hot Backup Embedded PPNG with MRP Specifications (continued)*

| Item | Specification |
|---|---|
| Maximum Primary Switch-over time (time it takes to switch Embedded PPNG Master) | Refer to the section *Primary Switch-over Time in Hot Backup Configuration* |
| Auto-Reconfiguration | Not supported |

### 1.1.9.5 Embedded PPNG Network Configuration

The Embedded PPNG UCSCH1A controller communicates with a PROFINET scanner (also commonly known as a bus coupler or head module, depending on the manufacturer), which then enables PROFINET communication to I/O devices. By default, the ToolboxST application supports the configuration of several GE PROFINET scanners. For third-party or new PROFINET scanners, users can import the vendor-supplied PROFINET device configuration file (GSDML) into their ToolboxST configuration. For further details on supported PROFINET devices in a Hot Backup configuration, refer to the *Compatibility* section *PROFINET Device Support in Hot Backup Configuration*.

#### Simplex Embedded PPNG without MRP Configuration

➢ **To set up the Simplex Embedded PPNG without MRP**

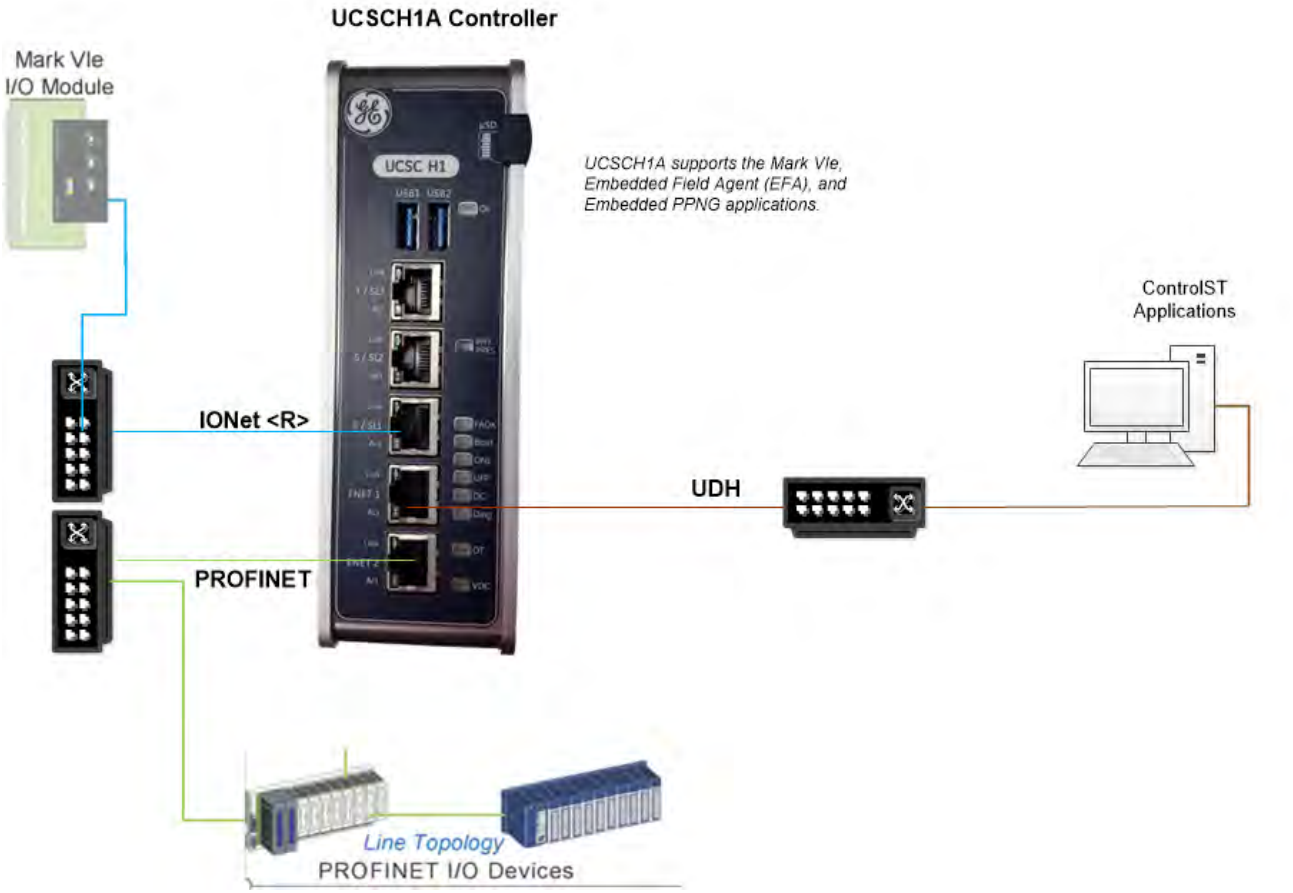
1. Connect a Cat 5e shielded-twisted pair Ethernet cable to a GE-qualified unmanaged switch and the other end of the Ethernet cable to the UCSCH1A *ENET 2 port*. Refer to the PROFINET device-specific technical manuals for more information on requirements for connecting those devices to the GE-qualified unmanaged switch.
2. From the ToolboxST application, configure the Embedded PPNG. For instructions, refer to the *ToolboxST User Guide for Mark Controls Platform* (GEH-6700), the section *PPNG PROFINET Module Configuration*.
   a. Configure the PROFINET network data rate.
   b. Attach and configure the PROFINET I/O devices.

***Note*** The I/O device host names must match the names in the ToolboxST configuration. The ToolboxST DCP configuration feature can be used to set the I/O device host names. Right-click the PPNGE1A module and select **Identify PROFINET Devices**.

3. From the ToolboxST application, perform a series of Builds and Downloads (similar to a standard I/O pack).

***Attention***

**Versions prior to ControlST V07.04 / PPNG V05.11 required that the IONet and PROFINET networks be combined. Beginning with ControlST V07.04 / PPNG V05.11, the UCSCH1A controller supports network separation between the R IONet and PROFINET networks (through internal IONet switches). Combining the IONet and PROFINET networks should only be used in Legacy installed systems. All new designs should separate the networks as illustrated in the following figure.**




***Simplex Embedded PPNG Network Topology without MRP***

### Simplex Embedded PPNG with MRP Configuration

➢ **To set up the Simplex Embedded PPNG with MRP**

1. Connect a Cat 5e shielded-twisted pair Ethernet cable to a GE-qualified MRP switch (non-Ring port in accordance with MRP switch configuration) and the other end of the Ethernet cable to the UCSCH1A *ENET 2 port*. Refer to the PROFINET device-specific technical manuals for more information on requirements for connecting those devices to the GE-qualified MRP switch.
2. Configure the MRP switch as a Media Redundancy Manager (MRM). In the MRM configuration, two ports are configured as Ring ports. The PROFINET devices are connected to the Ring ports as illustrated in the following figure, *Simplex Embedded PPNG Network Topology with MRP*.

---

***Note*** The MRP ring should be kept open (do not close the loop) until the MRM switch has been configured to avoid a situation where there is no ring manager present to prevent a network storm. Once the MRM switch has been configured in its role as ring manager, the ring can be closed to provide the expected network redundancy.

---

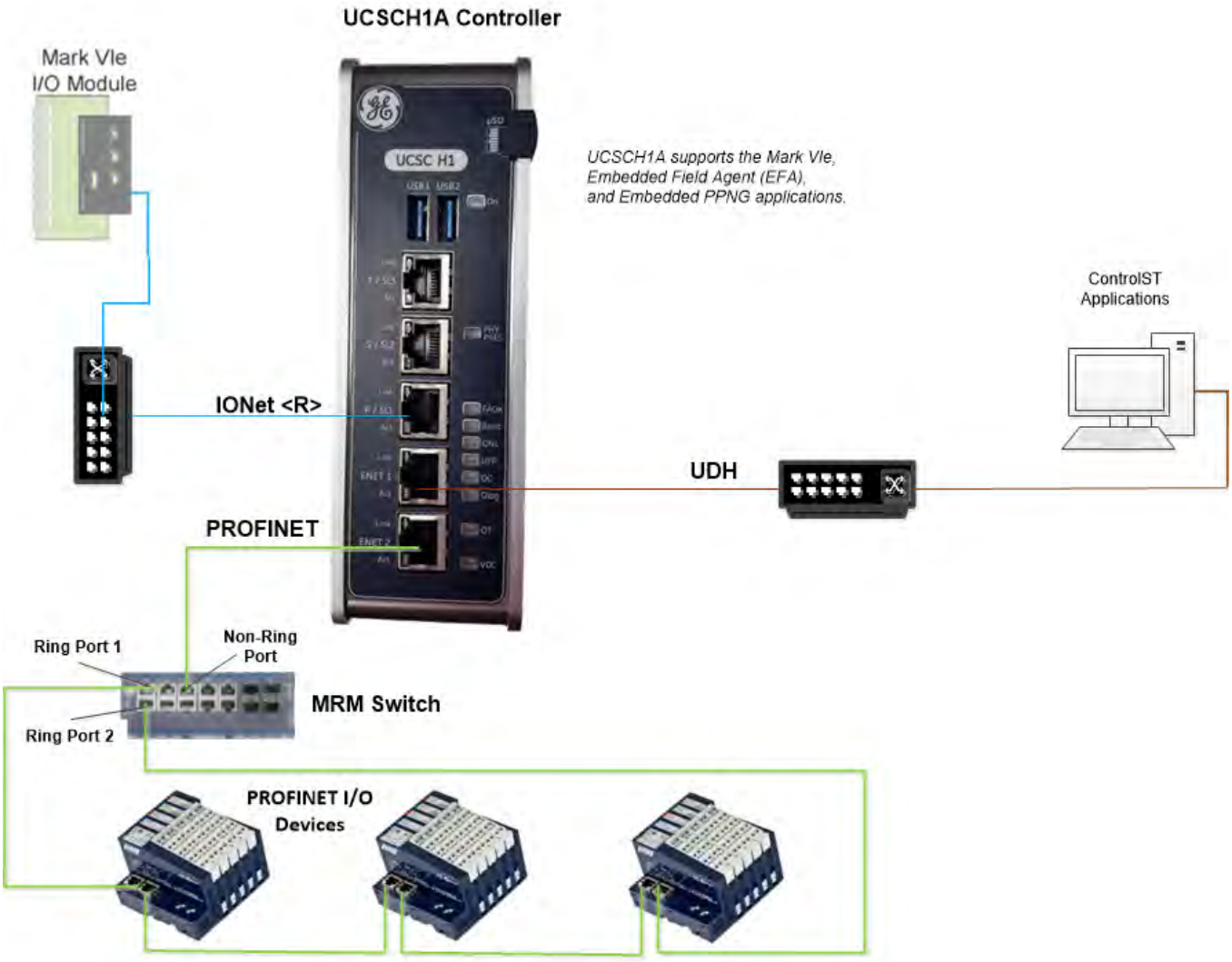
3. From the ToolboxST application, configure the Embedded PPNG module. For instructions, refer to the *ToolboxST User Guide for Mark Controls Platform* (GEH-6700), the section *PPNG PROFINET Module Configuration*.
   a. Add the MRP switch as a PROFINET device to the Embedded PPNG configuration. Configure the MRP switch as an MRM.
   b. Attach and configure the PROFINET I/O devices.
   c. Configure the Media Redundancy Client (MRC) parameters for the PROFINET devices.

---

***Note*** The I/O device host names must match the names in the ToolboxST configuration. The ToolboxST DCP configuration feature can be used to set the I/O device host names. Right-click the **PPNG-E21CR** module and select **Identify PROFINET Devices**.

---

4. From the ToolboxST application, perform a series of Builds and Downloads (similar to a standard I/O pack).




***Simplex Embedded PPNG Network Topology with MRP***

### Hot Backup Embedded PPNG with MRP Configuration

➢ **To set up the Hot Backup Embedded PPNG**

1. Connect a Cat 5e shielded-twisted pair Ethernet cable to a GE-qualified MRP switch (non-Ring port in accordance with MRP switch configuration) and the other end of the Ethernet cable to the UCSCH1A *ENET 2 port*. Refer to the PROFINET device-specific technical manuals for more information on requirements for connecting those devices to the GE-qualified MRP switch.
2. For a Hot Backup configuration, two MRP switches are used. In all PROFINET devices (including MRP switches), two ports are configured as Ring ports and the PROFINET devices are connected to the Ring ports as illustrated in the figure *Hot Backup Embedded PPNG with MRP Network Topology*.
   Also, the Media Redundancy Manager (MRM) switch and the Media Redundancy Client (MRC) switch are looped through the other ring port as illustrated in the figure.

   ***Note*** The MRP ring should be kept open (do not close the loop) until the MRM switch has been configured to avoid a situation where there is no ring manager present to prevent a network storm. Once the MRM switch has been configured in its role as ring manager, the ring can be closed to provide the expected network redundancy.

3. From the ToolboxST application, configure the Embedded PPNG module. For instructions, refer to the *ToolboxST User Guide for Mark Controls Platform* (GEH-6700), the section *PPNG PROFINET Module Configuration*.
   a. Add the MRP switch as a PROFINET device to the Embedded PPNG configuration. Configure the MRP switch as an MRM and configure the other MRP switch as an MRC.
   b. Attach and configure the PROFINET I/O devices.
   c. Configure the MRC parameters for the PROFINET devices.

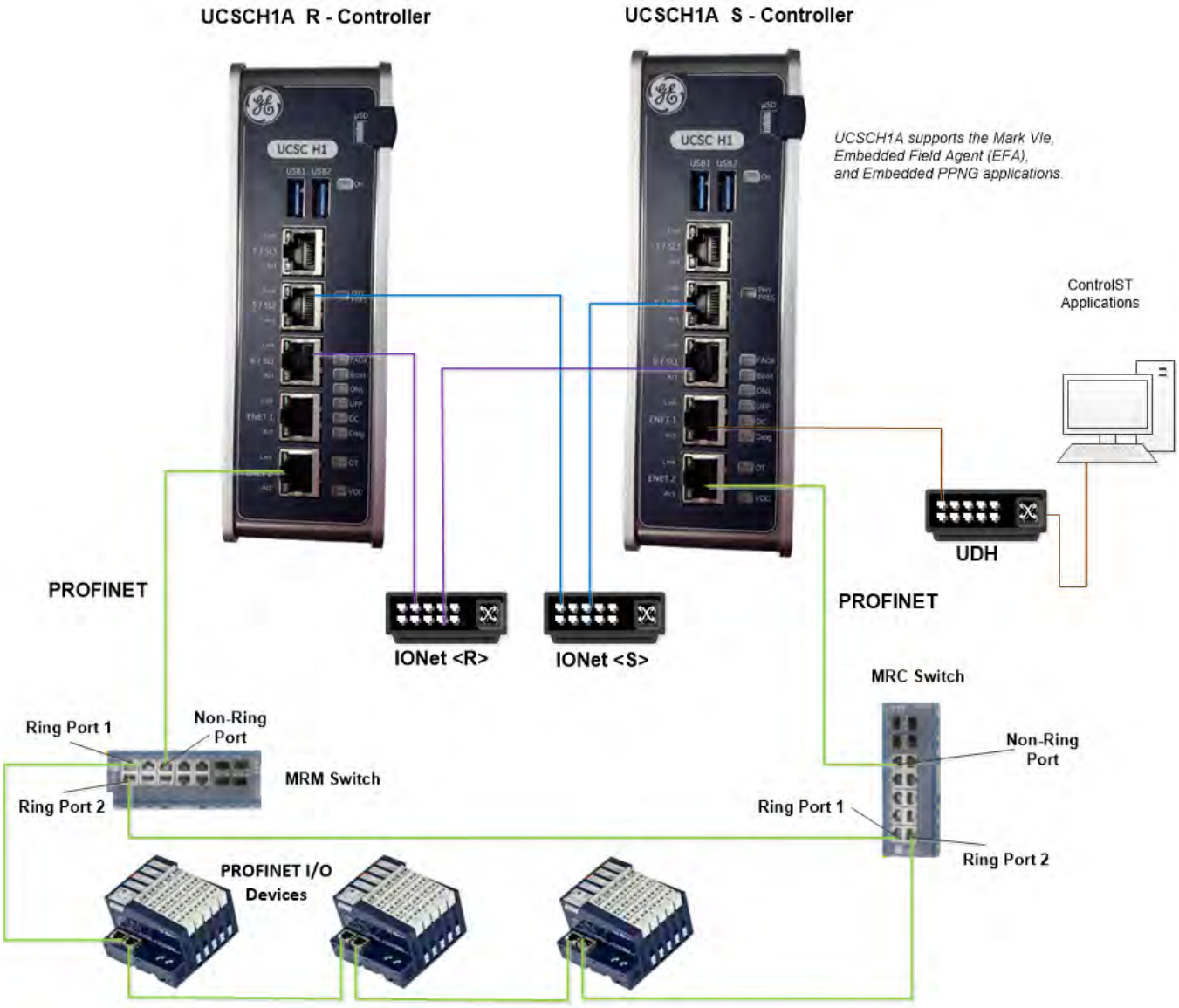
***Note*** The I/O device host names must match the names in the ToolboxST configuration. The ToolboxST DCP configuration feature can be used to set the I/O device host names. Right-click the **PPNG-E21CR** module and select **Identify PROFINET Devices**.

4. From the ToolboxST application, perform a series of Builds and Downloads (similar to a standard I/O pack).

Additional configuration details:

- The MRM switch or the MRC switch can be connected to either the R or S Embedded PPNGs in the configuration. (The T Embedded PPNG is not used.)
- The UCSC ENET2 port can be connected to any of the available non-Ring ports in the MRP switch.
- Ring ports are configured using the ToolboxST application.
- The MRM and MRC switches can be looped through Ring Port 1 and Ring Port 2.

***Note*** The network configuration represented in the following figure is the only GE-qualified network configuration for Hot Backup. You must use the GE-qualified PROFINET MRP switch as specified in this illustration.




***Hot Backup Embedded PPNG with MRP Network Topology***

### Device Update Rate Based on Number of Devices

The following table provides the device update rate based on the number of PROFINET devices depending on the configuration.

In order to have an MRP configuration, you must use either one (Simplex with MRP) or two (Hot Backup with MRP) GLM switches in the system. In order to configure and monitor these switches, you must add them to your configuration as PROFINET devices themselves. Therefore, they must be included in the count when assessing the number of PROFINET devices supported per cyclic rate when MRP is used.

***Device Cyclic Update Rate per Number of Devices***

| Cyclic Rate (ms) | Number of PROFINET Devices | | |
|---|---|---|---|
| | Simplex | Simplex with MRP | Hot Backup with MRP |
| 1 | 8 | 0 | 0 |
| 2 | 16 | 0 | 0 |
| 4 | 32 | 0 | 0 |
| 8 | 64 | 18 | 18 |
| 16 | 64 | 34 | 34 |
| 32 | 64 | 64 | 64 |
| 64 | 64 | 64 | 64 |
| 128 | 64 | 64 | 64 |
| 256 | 64 | 64 | 64 |
| 512 | 64 | 64 | 64 |

### Primary Switch-over Time in Hot Backup Configuration

Primary switch-over time is the time that the I/O points will hold input values and not update until Primary switch-over is complete.

A theoretical maximum switch-over time can be computed using a formula. However, GE has also identified typical maximum switch-over times. The following table shows both of these times (typical maximum based on GE test results and the theoretical maximum). The table lists the supported device cyclic rates and respective Primary switch-over times in a Hot Backup configuration, assuming a configuration with PROFINET devices with a maximum MSOT of 100 ms, which is the maximum switch-over time for the RX3i-CEP PROFINET device, and a controller frame rate of 10 ms.

***Device Cyclic Rates and Primary Switch-over Times Supported in Hot Backup Configuration***

| Cyclic Rate (ms) | Max Switch-over Times (ms) (Typical) | Max Switch-over Times (ms) (Theoretical) |
|---|---|---|
| 8 | 140 | 236 |
| 16 | 200 | 332 |
| 32 | 330 | 524 |
| 64 | 600 | 908 |
| 128 | 1150 | 1676 |
| 256 | 2350 | 3212 |
| 512 | 3670 | 5260 |

***Note*** The maximum switch-over time reduces if the MSOT is lower for all PROFINET devices configured and connected in the system.

The theoretical switch-over time is dependent on the following factors:

- Output update rate (excluding GLM switch update rates) — This is the maximum output update rate of all configured PROFINET devices except the GLM PROFINET device switches.
- Input update rate (excluding GLM switch update rates) — This is the maximum input update rate of all configured PROFINET devices except the GLM configured device switches.
- MSOT — Maximum switch-over time for a PROFINET device. This information must be available in the PROFINET device GSDML file.
- Network transit time — Time taken for the packet to traverse in the network. This time is equal to number of configured PROFINET devices multiplied by 0.14 ms.
- PROFINET controller processing time — Time taken by the PROFINET controller for the switch-over (20 ms).
- Controller frame rate
- Maximum time for all PROFINET devices to be disconnected (maximum all device disconnect time [MDDT]).
  - This is the maximum time that can be taken by all PROFINET devices to be disconnected.
  - The maximum input update rate of all configured PROFINET devices is used for time calculation (excluding GLM switch input update rate).
  - For input update rates of 8, 16, 32, 64, 128, 256 ms, this time is equal to 6 x maximum input update rate.
  - For input update rate of 512 ms, this time is equal to 4 x 512.

The formula to calculate the theoretical maximum primary switch-over time is as follows:

MaxTime =
3 * Longest Output update rate
+ 3 * Longest Input update rate
+ MSOT
+ Network transit time
+ Profinet Controller processing time
+ 2 * Controller Frame Rate
+ MDDT

Refer to the table *Device Cyclic Rates and Primary Switch-over Times Supported in Hot Backup Configuration* for an example of maximum switch-over times (theoretical) calculated using this formula.

### GE-qualified PROFINET Switches (for Simplex Use in non-MRP Networks)

GE has qualified the following unmanaged switches for use on the PROFINET communication network, between the UCSC and the Slave devices:

- ESWA 8–port industrial unmanaged switch
- ESWB 16–port industrial unmanaged switch

### GE-qualified PROFINET MRP Switches

GE has qualified the following managed switch for use as MRP switches on the PROFINET communication network between the Slave devices: IC086GLM064-AAAB or later revision.

An older version of the GLM064 switch may be used, but the firmware for the switch must be upgraded to V00.00.06 or later. Refer to the *PACSystems PROFINET Managed Industrial Ethernet Switches User Manual* (GFK-3030) for the procedures to update the GLM switch firmware.

### Network Cabling

Users should order green-colored Ethernet cables for connections between the UCSC and all PROFINET devices on the PROFINET network (cable color distinguishes this network from the IONet). The following table lists the available green network cables.

***Green-colored PROFINET Ethernet Cables***

| GE Part # | Length |
|---|---|
| 336A4940DTP3GN | 0.91 m (3 ft) |
| 336A4940DTP5GN | 1.52 m (5 ft) |
| 336A4940DTP8GN | 2.44 m (8 ft) |
| 336A4940DTP10GN | 3.05 m (10 ft) |
| 336A4940DTP12GN | 3.66 m (12 ft) |
| 336A4940DTP15GN | 4.57 m (15 ft) |
| 336A4940DTP18GN | 5.49 m (18 ft) |

## *1.1.9.6 Embedded PPNG Variables*

| Variable Name | Type | Description |
|---|---|---|
| L3DIAG_PPNG_R | Input BOOL | True indicates at least one diagnostic alarm is in the queue (active or normal state) |
| LINK_OK_PPNG_R | Input BOOL | True indicates the IONet communication link is okay |
| ATTN_PPNG_R | Input BOOL | True indicates at least one active diagnostic alarm |
| PRIMARY_PPNG_R | Input BOOL | This signal should be True for a Simplex Embedded PPNG configuration.<br>In a Hot Backup configuration, if R Embedded PPNG is Primary, this variable remains True. If R is Backup Embedded PPNG, this variable remains False. |
| PRIMARY_PPNG_S | Input BOOL | This signal should be False in a Simplex Embedded PPNG configuration.<br>In a Hot Backup configuration, if S Embedded PPNG is Primary, this variable remains True. If S is Backup Embedded PPNG, this variable remains False. |
| CPU_HOT_PPNG_R | Input BOOL | This signal is True if the processor temperature has exceeded 97°C (207 °F). |
| BoardTmpr_PPNG_R | AnalogInput REAL | Thermal sensors are not available in the Embedded PPNG, therefore value this will always be zero. |
| AuxTmpr_PPNG_R | AnalogInput REAL | Thermal sensors are not available in the Embedded PPNG, therefore this value will always be zero. |
| PrimarySwitchCmd | Output BOOL | User Primary switch-over command. On the rising edge of this variable going to True, the Primary Embedded PPNG is changed to Backup Embedded PPNG. |

### 1.1.9.7 Hot Backup Configuration (PROFINET System Redundancy)

In a Hot Backup configuration, two UCSCH1A controllers are used, which results in two Embedded PPNGs. These two Embedded PPNGs communicate with each other (Peer-to-Peer Communication, P2P) through the R and S IONets.

P2P communication can fail due to the following reasons:

**1.** Either one of the Embedded PPNGs is not booted up or has not passed the SEQUENCING state.

**2.** The Embedded PPNGs are not communicating on both R and S IONets due to IONet failure.

If P2P communication fails, the Embedded PPNG diagnostic alarm 165, *Redundant PPNG Peer-to-Peer Communication Timeout*, is generated. (For more information, refer to alarm 165 in the section *PPNG Specific Alarms*).

Of the two Embedded PPNGs, one Embedded PPNG is designated as the Primary and the other is designated as the Backup.

During Primary and Backup switch-over, MRP switch devices are not considered.

During primary switch-over, the PROFINET Device Status in ToolboxST may indicate *Primary Not Available* for the devices.

For an Embedded PPNG to be designated as Primary, one of the following conditions must be met:

- The Embedded PPNG is in CONTROLLING state, P2P is healthy, and at least one PROFINET device is connected to it.
- The Embedded PPNG is in CONTROLLING state, P2P is un-healthy, and all configured PROFINET devices are connected to it.

For an Embedded PPNG to be designated as Backup, one of the following conditions must be met:

- The Embedded PPNG has no PROFINET devices connected to it.
- The Peer Embedded PPNG is in Primary state.

For an Embedded PPNG to be designated as Primary Switch-over, one of the following conditions must be met:

- The Embedded PPNG has received the Primary Switch-over command from the user through ToolboxST.

---

***Note*** Prior to issuing a Primary Switch-over command, the user must ensure that the Backup Embedded PPNG has devices connected to it.

---

- The Embedded PPNG has lost all PROFINET devices and the Peer Embedded PPNG has PROFINET devices connected to it.
- The Embedded PPNG has lost all PROFINET devices and P2P is un-healthy.

### 1.1.9.8 PROFINET I/O Device Diagnostics

PROFINET I/O devices (Slaves) provide alarm and event messages to the Embedded PPNG. After they are viewed, these Slave device messages can be reset from the ToolboxST application. However, PROFINET Slave device alarms and events are not forwarded to the Mark VIe controller or the WorkstationST Alarm Viewer. The following table defines the Slave device message types supported by the Embedded PPNG.

***Supported Slave Device Alarm Types***

| Alarm | Type |
|---|---|
| 0x0001 | Diagnosis |
| 0x0003 | Pull |
| 0x0004 | Plug |
| 0x0005 | Status |
| 0x0006 | Update |
| 0x0008 | Controlled by Supervisor (Logical Pull) |
| 0x0009 | Released (Logical Plug) |
| 0x000A | Plug Wrong Sub-module |
| 0x000B | Return of Sub-module |
| 0x000C | Diagnosis Disappears |
| 0x000E | Port data change notification |
| 0x0011 | Network component problem notification |
| 0x0013 | Dynamic frame packing problem indication |
| 0x0016 | Multiple Interface mismatch notification |

***Note*** Beginning with ControlST V07.05 (PPNG V05.12), the I/O device diagnostics list is cleared using the SYS_OUTPUTS block RSTDIAG pin. On a rising edge on the RSTDIAG pin, the I/O device diagnostic list is cleared along with the standard Mark VIe control diagnostic alarm list. Refer to the *Mark VIe Controller Standard Block Library* (GEI-100682), the chapter *System Outputs (SYS_OUTPUTS)* for more information on the usage of the SYS_OUTPUTS block.

### 1.1.9.9 Embedded PPNG Diagnostics

#### Ring Break Diagnostic Alarm

In a Ring configuration (with MRP), the ring may be broken due to PROFINET device failures or Ethernet cable faults. However, there is no specific diagnostic generated for this event. To receive notification of a Ring Break status, the user can attach an application variable to the Ring Break status enabled for alarm.

➢ **To attach an alarm variable to the Ring Break status**

1. From the Embedded PPNG configuration, navigate to the GLM PROFINET device configured as Media Redundancy Manager (MRM).
2. Click Slot 4 (MRP Group 1) for the GLM PROFINET device.
3. Attach an application variable to the variable **Input-0001_3**. If the ring is broken, this variable value becomes False. If the ring is connected, the variable value is True.
4. Set the application variable property to *Alarmed* and set the property **Alarm On Zero** to *True*.

#### Hot Backup Embedded PPNG Diagnostic Alarm

When the Embedded PPNG in a Hot Backup configuration is unable to communicate with the Peer Embedded PPNG, diagnostic alarm 165, *Redundant PPNG Peer-to-Peer Communication Timeout*, is generated. For possible causes and solutions to resolve this issue, refer to alarm 165 in the section *PPNG Specific Alarms*.

#### Common Diagnostic Alarms

For diagnostic alarms that are shared between the Embedded PPNG module and the PPNG module, refer to the section *PPNG Specific Alarms*.

### 1.1.9.10 PROFINET IO-Link Device Backup and Restore

In IO-Link V1.1, the IO-Link Master and devices support the backup and restore feature (if configured). The IO-Link device parameters can be backed up to the IO-Link Master and the device parameters can be restored when the device is replaced. *(In some IO-Link devices, this feature is also referred to as Upload and Download, respectively.*) Beginning with ControlST V07.06, this feature is integrated in the Embedded PPNG module.

IO-Link devices have indexes and sub-indices from/to which parameters can be Read or Written. These parameters are not accessible from ToolboxST; the IO-Link blocks, IO_LINK_DEVICE_READ and IO_LINK_DEVICE_WRITE, in the Mark VIe Standard Block Library are designed to communicate with a specific IO-Link device index and sub-index. Using the backup feature, device parameters are backed up to the IO-Link Master. AFter calibration of an IO-Link device is complete, the calibration parameters can be backed up to the IO-Link Master.

---

***Note*** For more information on the IO-Link blocks, refer to the *Mark VIe Controller Standard Block Library* (GEI-100682), the chapters *IO-Link Device Read (IO_LINK_DEVICE_READ)* and *IO-Link Device Write (IO_LINK_DEVICE_WRITE)*.

---

An example use-case scenario for the backup and restore feature is when a calibration routine sets specific parameters inside an IO-Link device. The calibration parameters can be backed up (uploaded) to the IO-Link Master. Then, if the IO-Link device is replaced at a later date (such as due to hardware failure of the device), the IO-Link device parameters can be restored (downloaded) from the IO-Link Master.

---

***Note*** The replacement device must be identical or compatible with the failed IO-Link device. When initiating a restore of device parameters, the backed-up calibrated device parameters will be assigned to the newly replaced device automatically. This avoids having to do a re-calibration on the newly replaced device.

---

If an IO-Link Master must be replaced, the new, factory-reset replacement IO-Link Master requires that all IO-Link devices parameters be backed up to be stored in the replacement IO-Link Master.

---

***Note*** All device parameters may or may not be backed up. This is determined by the IO-Link device manufacturer. For further details on IO-Link functionality, including the backup and restore feature, refer to the following location: *https://www.io-link.com/share/Downloads/At-a-glance/IO-Link_System_Description_eng_2018.pdf*, Section 3.3 *Changing and backing up device settings during plant operation*).

---

IO-Link devices must be properly configured for the backup and restore feature to work properly. IO-Link devices are configured for an Embedded PPNG module using the ToolboxST application, then the configuration must be downloaded to the Embedded PPNG module.

---

***Note*** IO-Link device parameters must be backed up using the IO_LINK_DEVICE_WRITE block. For further details and instructions, refer to *Mark VIe Controller Standard Block Library* (GEI-100682), the section *IO-Link Device Backup and Restore*.

---

### ➢ To configure the backup (upload) and restore (download) feature

1. From the ToolboxST Component Editor **Hardware** tab, expand the **Distributed I/O Tree View**, right-click an Embedded PPNG module, and select **Add PROFINET IO Device** to display the *PROFINET GSDML Manager* window.
2. From the *PROFINET GSDML Manager* window, import a GSDML file or browse to and import a GSDML file to add an IO-Link Master.
3. From the *PROFINET GSDML Manager* window, select the IO-Link Master device and click **Add Device**. (For more detailed instructions, refer to the *ToolboxST User Guide for Mark Controls Platform* (GEH–6700), the section *Add PROFINET I/O Devices to Local Area Network (LAN)*.)
4. From the **Distributed I/O Tree View**, select the IO-Link device, then select the **Parameters** tab and set the device parameter configuration values for the IO-Link Masters to properly back up and restore device parameters.

   Depending on the IO-Link Master in use, the following IO-Link device parameter configuration settings may be available to configure the PROFINET IO-Link device: Device Validation, Channel Mode, Data Storage Config, Validation Config, and Data Validation Mode. Users should refer to the manufacturer's documentation for the specific IO-Link Master in use for valid values. Refer to the following tables for a description of parameter values. Examples to illustrate parameter configuration are also provided.

***IO-Link Device Channel Mode and Device Validation Mode Configuration Parameters***

| Device Validation Mode / Channel Mode Parameter | Description |
|---|---|
| No Check | No validation check of proper I/O link device is performed for automatic backup or restore operation. |
| Compatible device | A compatible IO-Link device is connected and the backup and restore operations must be performed manually. |
| Compatible device with Backup and Restore | If a compatible IO-Link device is connected, the backup and restore of IO-Link device parameters is performed automatically.<br>If a compatible IO-Link device is not connected, both backup and restore operations fail. During Embedded PPNG startup, the PROFINET diagnostic alarm *Configuration Mismatch during Profinet Configuration* is annunciated. During a restore command, the PROFINET diagnostic *Profinet Wrong Submodule* is annunciated. |

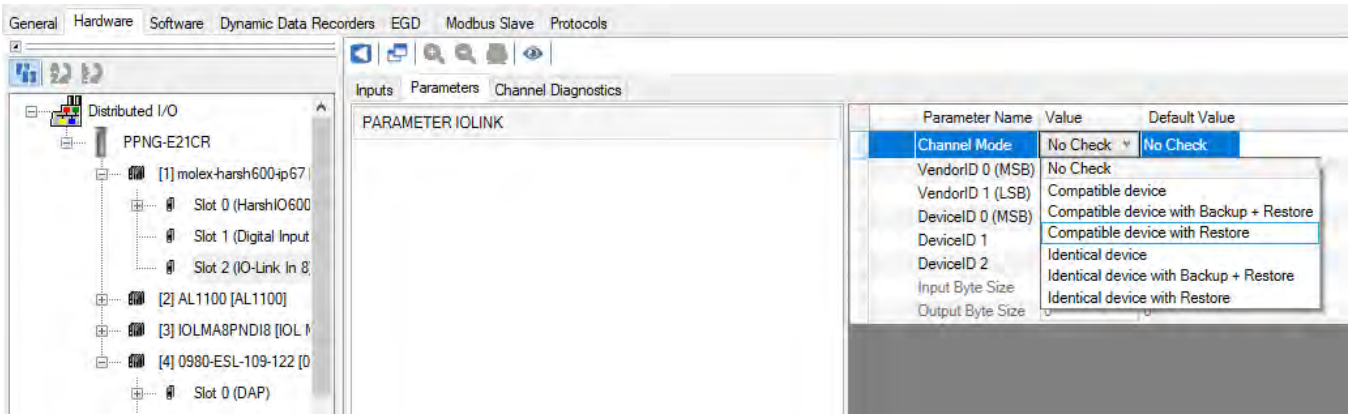
*IO-Link Device Channel Mode and Device Validation Mode Configuration Parameters (continued)*

| Device Validation Mode / Channel Mode Parameter | Description |
|---|---|
| Compatible device with Restore | If a compatible IO-Link device is connected, restore of IO-Link device parameters is performed automatically.<br>If a compatible IO-Link device is not connected, the restore operation fails. During restore, the PROFINET diagnostic *Profinet Wrong Submodule* is annunciated. |
| Identical device | If an identical IO-Link device is connected, the backup and restore operations must be performed manually. |
| Identical device with Backup and Restore | If an identical IO-Link device is connected, the backup and restore of IO-Link device parameters is performed automatically.<br>If an identical IO-Link device is not connected, both backup and restore operations fail. During Embedded PPNG startup, the PROFINET diagnostic message *Configuration Mismatch during Profinet Configuration* is annunciated. During a restore command, the PROFINET diagnostic *Profinet Wrong Submodule* is annunciated. |
| Identical device with Restore | If an identical IO-Link device is connected, restore of IO-Link device parameters is performed automatically.<br>If an identical IO-Link device is not connected, the restore operation fails. During restore, the PROFINET diagnostic *Profinet Wrong Submodule* is annunciated. |

**Attention**

**For Device ID and Vendor ID values, refer to the manufacturer's documentation for the specific IO-Link device. If these values are not valid for the specific IO-Link device, the backup and restore operation will fail and a PROFINET diagnostic alarm similar to those described in the table *IO-Link Device Channel Mode and Device Validation Mode Configuration Parameters* will be generated.**

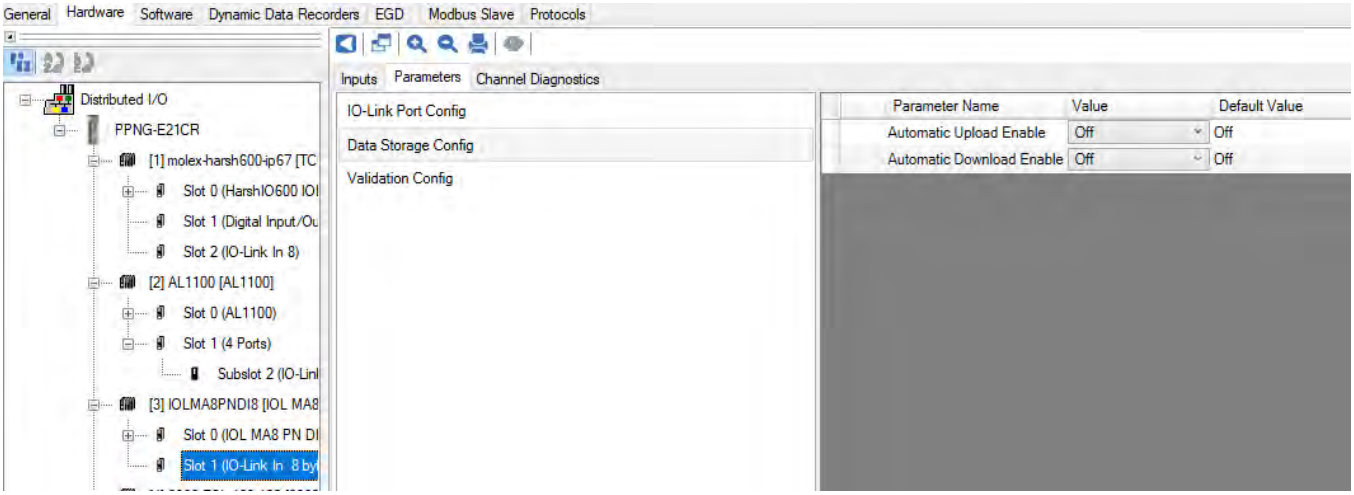
***Note*** If automatic backup is not enabled, IO-Link parameter backup must be done using the IO-Link blocks. For further details and instructions, refer to *Mark VIe Controller Standard Block Library* (GEI-100682), the section *IO-Link Device Backup and Restore*.




***Example Channel Mode Parameter Configuration***

***IO-Link Device Data Storage Config Configuration Parameters***

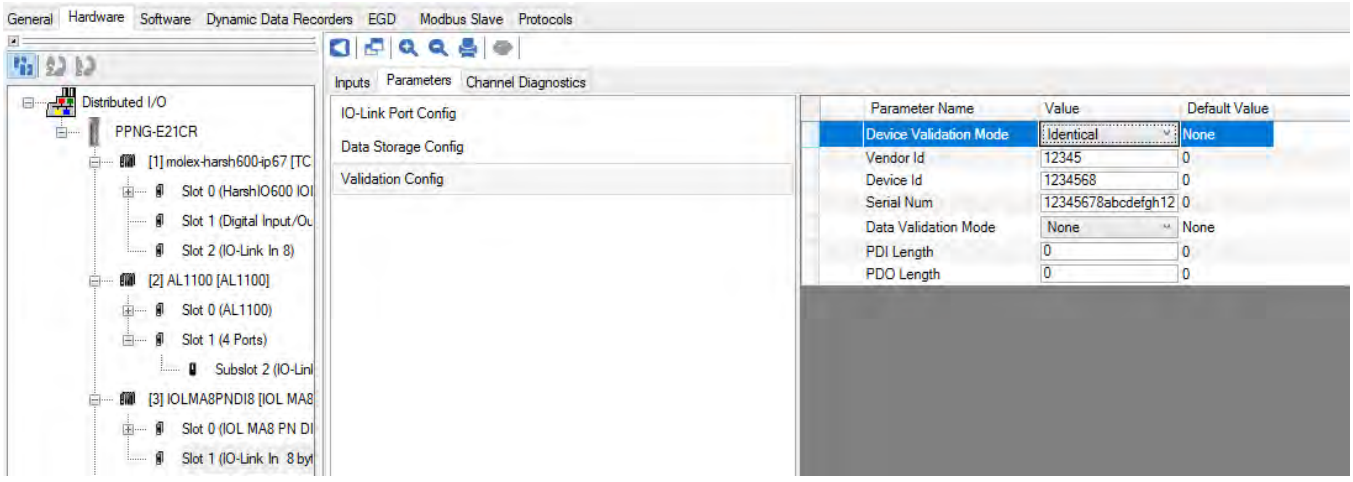
| Data Storage Config Parameter | Description |
|---|---|
| Automatic Upload Enable | When set to On, the backup of device parameters occurs automatically whenever there is a change in device parameters. |
| Automatic Download Enable | When set to On, the device parameters are restored automatically from the IO-Link Master during device restart or device replacement. |




***Example Data Storage Config Parameter Configuration***

***IO-Link Device Validation Mode Configuration Parameters***

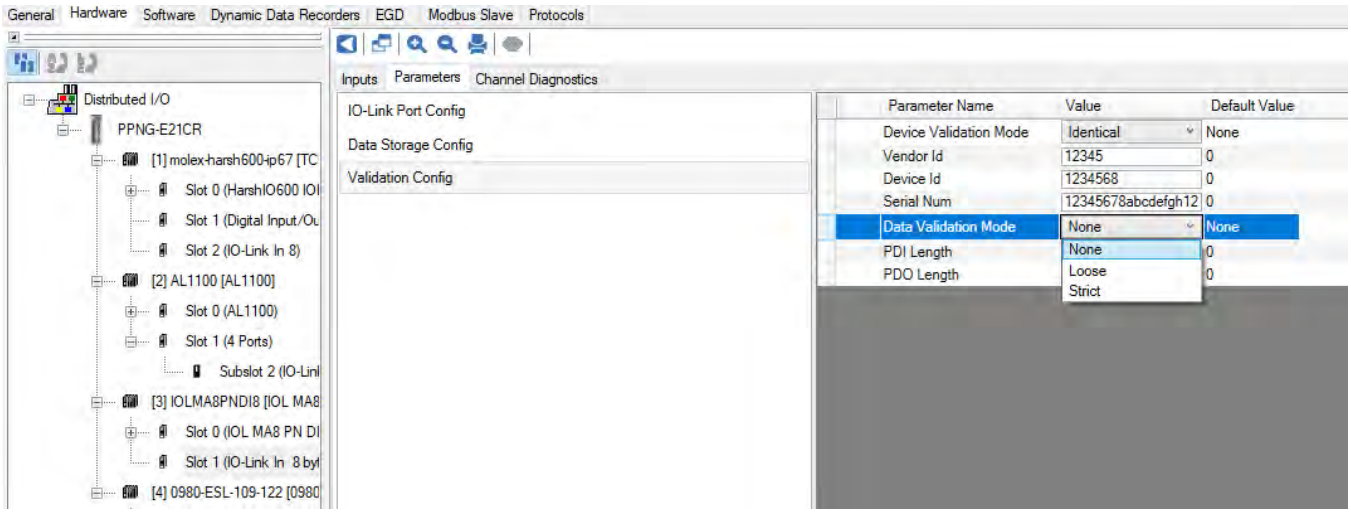
| Device Validation Mode Parameter | Description |
|---|---|
| None | No validation check of proper I/O link device is performed for automatic backup or restore. |
| Compatible | Vendor Id and Device Id should be compatible with the device being restored. |
| Identical | Vendor Id, Device Id, and Serial Num should match the connected device values. If these numbers do not match, the device will not operate properly after startup, and will annunciate a PROFINET diagnostic alarm indicating device loss. |




***Example Device Validation Mode Parameter Configuration***

***IO-Link Device Data Validation Mode Configuration Parameters***

| Data Validation Mode Parameter | Description |
|---|---|
| None | No check for input and output process data. |
| Loose | IO-Link device's input and output process data lengths must be less than or equal to the user configured values. |
| Strict | IO-Link device's input and output process data lengths must be the same as the user configured values. |




***Example Data Validation Mode Parameter Configuration***

## 1.1.10 UCSC Embedded EtherCAT Controller

The UCSCH1C contains an embedded EtherCAT Master, which maps I/O from EtherCAT Slave devices to the Mark VIe controller. It connects to an EtherCAT device network, enabling communication with EtherCAT I/O devices. It provides a mechanism to import EtherCAT Network Information (ENI) files to configure and operate an EtherCAT I/O device network in either Line or Ring topologies.

EtherCAT features include:

- One or two RJ-45 shielded-twisted pair 100 Mbps port(s) for EtherCAT communication
- Support for Line (only one connection to UCSCH1C), Ring (closed loop with two connections to UCSCH1C), or mixed EtherCAT network topologies
- EtherCAT I/O device configuration by importing an existing ENI file
- Cyclic exchange of input and output data from EtherCAT I/O devices, synchronous with Mark VIe controller frame
- I/O values are displayed and modified in the ToolboxST application

TwinCAT®, or another EtherCAT network configuration tool, is required to generate an ENI file. Using the ToolboxST application, this ENI file is imported to create the Mark VIe configuration. Any change made to the configuration of attached EtherCAT devices requires a new configuration file to be imported into ToolboxST. (Refer to the *ToolboxST User Guide for Mark Controls Platform*, GEH-6700 or GEH-6703, the section *EtherCAT Tab*, for ToolboxST configuration details.) After initial configuration, a local variable can be connected to a particular I/O point from EtherCAT device I/O and used in the Mark VIe controller application logic.

### 1.1.10.1 Embedded EtherCAT Controller Specifications

***Attention***

**The UCSCH1C controller and the EtherCAT Master operate at a fixed period of 10 ms. Adjust device timeouts, watchdogs, and state transitions within your EtherCAT network configuration tool accordingly.**

| Item | EtherCAT Specification |
|---|---|
| Conformance class version | EtherCAT Class B I/O controller |
| Supported Ethernet cabling | Cat 5e STP |
| I/O device data update rates | Synchronous updates once per Mark VIe frame (10 ms) |
| Maximum I/O memory | 16 KB |
| Max number of EtherCAT I/O devices attached to UCSC | Limited to 512 devices |
| Supported network topology | Line (daisy-chain with UCSC at one end of the bus), Ring (daisy-chain with UCSC at both ends of the bus), or a combination through junction devices |
| Network speed | 100 Mbps full-duplex on dedicated EtherCAT network |
| Media redundancy | Supported with ports ENET2 and T/SL3 |

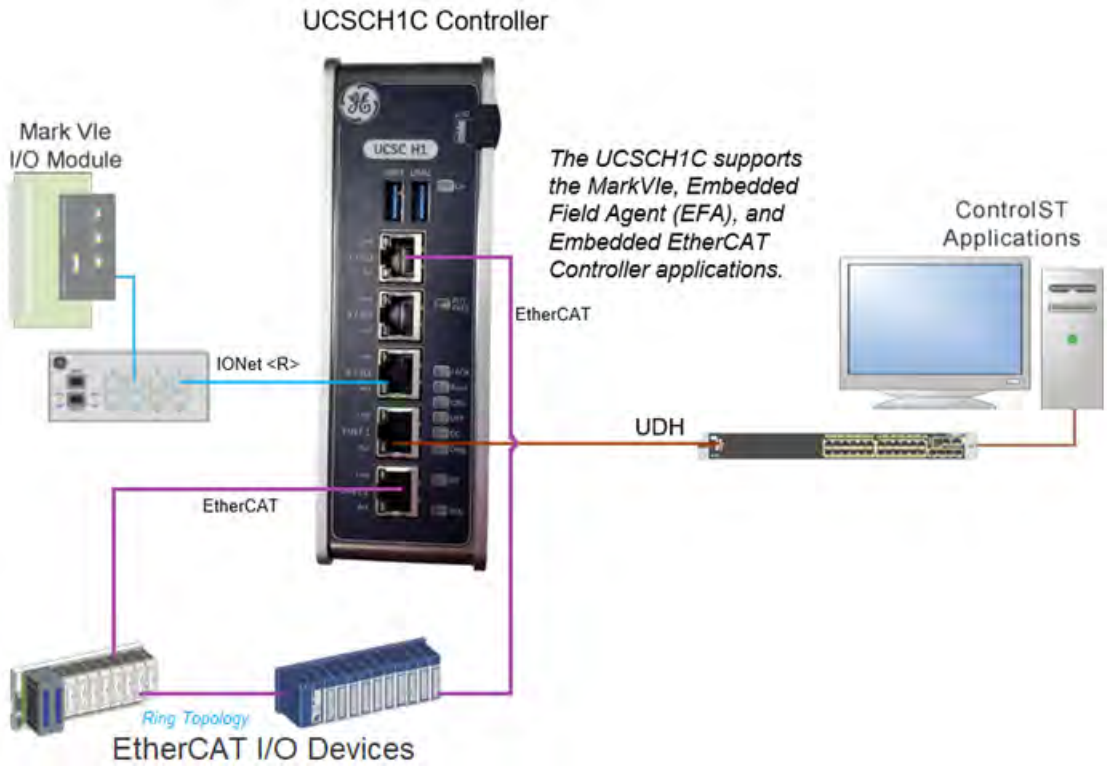
### 1.1.10.2 EtherCAT Network Configuration

The UCSCH1C EtherCAT controller communicates with EtherCAT I/O devices connected through an Cat 5e shielded-twisted pair Ethernet cable. Devices are configured with TwinCAT or a comparable EtherCAT network configuration utility capable of exporting ENI files. The ENI file contains the information required to establish communication with EtherCAT I/O devices, perform configuration and startup, and exchange cyclic data.

➢ **To set up the EtherCAT network**

1. Open TwinCAT, or a comparable EtherCAT network configuration utility.
2. Add all EtherCAT I/O devices that will be connected to this network.
3. Configure the appropriate I/O types, scaling, and sample period for this control application.
4. When the network configuration is complete, export the ENI file.
5. From the ToolboxST application, configure the EtherCAT network. Refer to the *ToolboxST User Guide for Mark Controls Platform* (GEH-6700 or GEH-6703), the section *EtherCAT Tab* for configuration procedures.
   a. Import the ENI file into ToolboxST configuration by right-clicking on the EtherCAT Master node and selecting **Import ENI File**. This imports the network configuration and creates the Mark VIe signal space map required to exchange data with the EtherCAT I/O devices.
   b. Configure Cable Redundancy and Frame Loss Limit for this network.
   c. Perform a Build and Download the configuration to the Mark VIe controller.

**Network Topology**




***Typical Embedded EtherCAT Network Topology (Ring)***

### 1.1.10.3 Dataflow

The UCSCH1C EtherCAT controller exchanges data with the control system at standard Mark VIe controller frame rates in synchronization with the control frame. EtherCAT data exchanges with EtherCAT I/O devices is determined by the ENI file created with the EtherCAT network configuration tool (such as TwinCAT). Refer to the section *EtherCAT Network Configuration* for details.

---

***Note*** EtherCAT network performance is determined by the cyclic data exchanges defined by the EtherCAT network configuration tool. To achieve the highest performance, users should minimize the quantity of packets required to exchange process data.

---

### 1.1.10.4 EtherCAT Network Communication

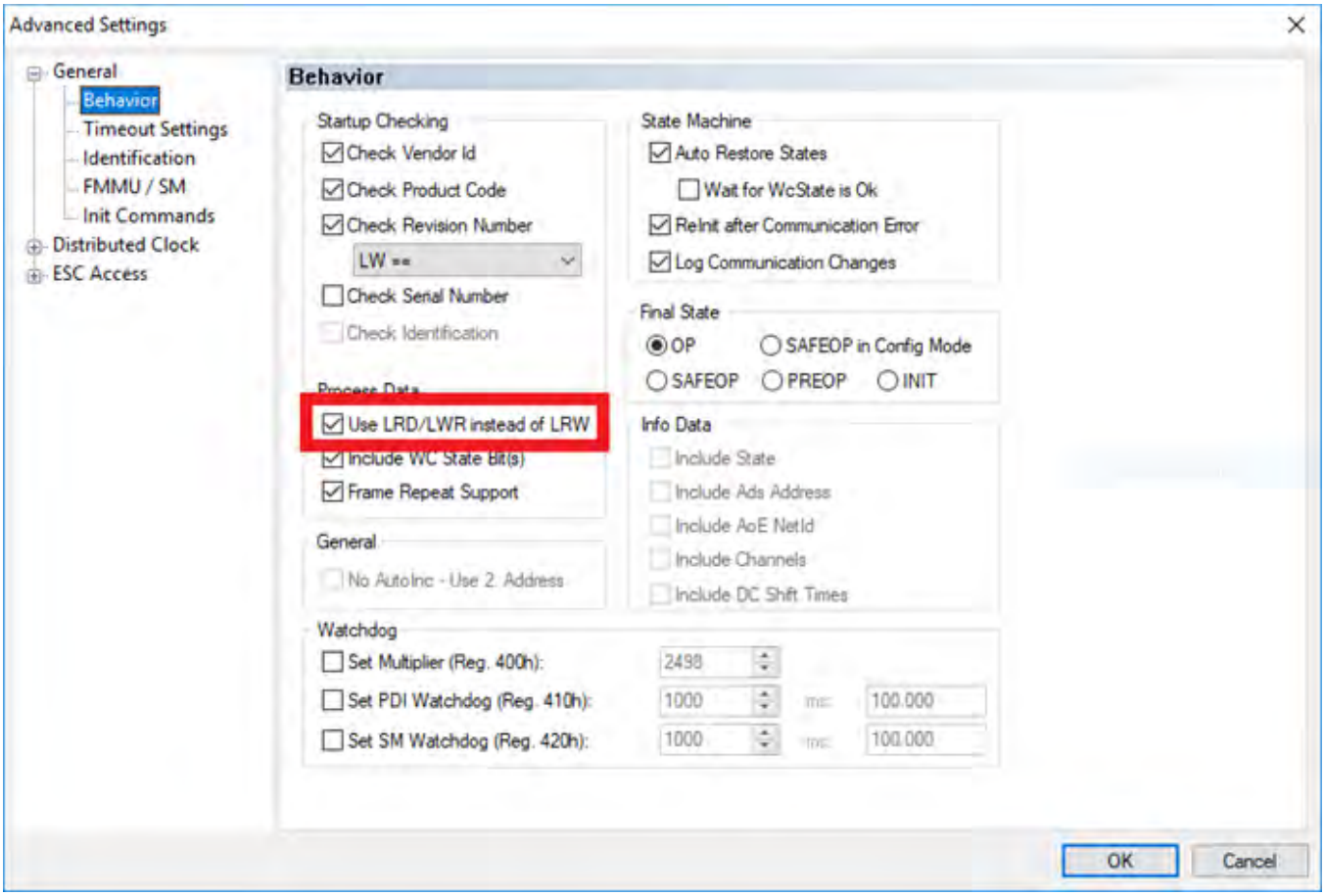
A typical EtherCAT network has the following components:

- **EtherCAT I/O controller** – the UCSCH1C controller establishes communication with EtherCAT I/O devices according to the configured network layout in the ENI file.
- **EtherCAT I/O devices** – are distributed I/O devices hosting various data types that communicate with the Mark VIe controller.

Switches (managed or unmanaged) are not recommended on EtherCAT networks. EtherCAT I/O devices will be advanced from Init (power-on) state to Operational state according to the commands in the ENI file. The EtherCAT I/O devices maintain a current Operating state, which can be read using the OpState variable type. An OpState variable is automatically created for each EtherCAT Slave device and can be read by the Mark VIe application.

The EtherCAT network configuration tool defines the cyclic data exchanges according to customer parameters. Under some conditions, such as utilizing devices with large process data maps, data exchanges can grow larger than standard Ethernet frames or generate a large volume of Ethernet packets. In systems with large applications, users should attempt to minimize the number and size of cyclic data exchanges. This can be accomplished by removing devices, removing unused variables from the process data map, and utilizing Read/Write commands (LRW) if the network topology supports it.

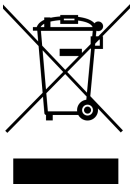
Redundant operation requires that Logical Read/Write (LRW) commands not be used by multiple devices on the same sync unit. It is strongly advised that users that have configurations using cable redundancy replace LRW commands with Logical Read/Logical Write (LRD/LWR). This is accomplished in the Advanced Settings menu for devices in many EtherCAT network configuration tools.



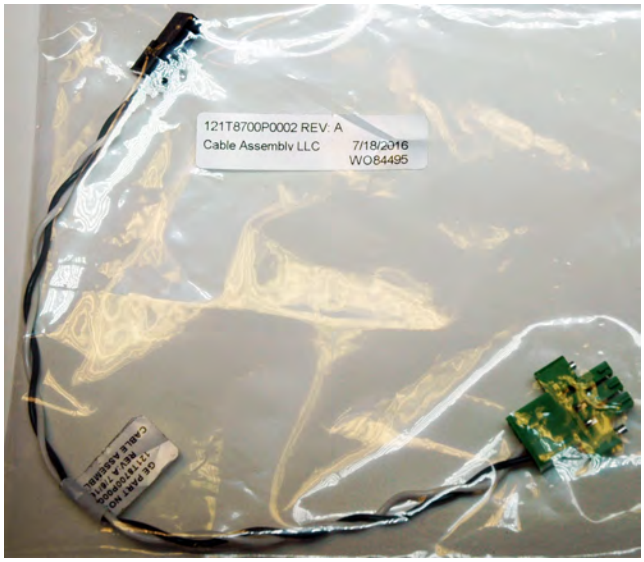

***LRW Command Replacement in Advanced Settings***

### 1.1.11 UCSC and UCEC Agency Certifications and Standards

Refer to the *UCSC Installation and Maintenance Requirements (IMR)* (GFK-3006) for conformance to these standards.

| Description | Marking | Comments |
|---|---|---|
| North America Safety for Programmable Controller for use in Hazardous locations |  | ISA 12.12.01: 2015, Class I Div. 2 Groups ABCD, UL 60079-0 Ed 6.0 (2013), Class I, Zone 2 Gas Group ABCD, UL 60079-15 Edition 4.0 (2013), [Ex nA]<br><br>CSA C22.2 No. 213-15, CAN/CSA-C22.2 NO. 60079-0:15, Class I, Zone 2, CAN/CSA-C22.2 NO. 60079-15:12 |
| EMC Directive<br><br>European Restriction of Hazardous Substances (RoHS) |  | IEC/EN 61131-2: 2007(sections 8-10, Zone B),<br>IEC/EN 61000-6-2: 2005 Ed 2.0,<br>IEC/EN 61000-6-4: 2006 Ed 2.0,<br>CISPR 11:2009 +A1: 2010 / EN 55011: 2009 +A1: 2010,<br>CISPR 22: 2010 / EN55022: 2010/AC:2011 (Class A),<br>CISPR 24: 2010 / EN55024: 2010,<br>IEC/EN 61131-2: 2007 (sections 4 & 6),<br>IEC 61000-4-18: 2006 / EN 61000-4-18: 2007 (refer to IEC61131-2: 2007 Annex D for levels) |
| European Safety for Explosive Atmosphere, ATEX Directive |  | Category 3 equipment - [II 3 G], EN 60079-0: 2012 A+11:2013, EN 60079-7: 2015 [Type of Protection Ex ec] |
| European Waste & Collection |  | Compliance with European WEEE Directive 2012/19/EU |
| China Restriction of Hazardous Substances |  | Compliance with “Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products”.<br>(Jan 21, 2016) Declaration Table provided with equipment. |
| Environmental | No Marking | IEC/EN 61131-2: 2007 (sections 5 & 6)<br>Storage: Dry Heat - IEC 60068-2-2: 1974 test Bb (70°C at 16hrs, unpowered), Cold Temp - IEC 60068-2-1: 2007 test Ab (-40°C at 16hrs, unpowered<br>Sinusoidal Vibration: DIN EN 60068-2-6: (Edition 10/08) (test Fc)<br>Shock: DIN EN 60068-2-27: (Edition 2/10) (test Ea) |

### *1.1.12 Accessories*

| Part Number | Description |
|---|---|
| 121T8700P0002 | UCSB to UCSC Power Cable Adapter<br>  |
| 127T2669P0001 | UCSB/CSLA (151X1235BC01SA##) to UCEC Module Power Cable Adapter<br>  |
| 121T6659P0001 | UCSC COM Port Adapter (RJ-45 to DB9F)<br>  |

### 1.1.13 UCSC Hardware Replacement

Replacement parts may contain static-sensitive components. Therefore, GE ships replacement parts in anti-static bags. When handling electronics, make sure to store them in anti-static bags or boxes and use a grounding strap.

**Caution**

**To prevent component damage caused by static electricity, treat all boards with static-sensitive handling techniques. Wear a wrist grounding strap when handling boards or components, but only after boards or components have been removed from potentially energized equipment and are at a normally grounded workstation.**

**Warning**

**In addition to information provided here, always follow all wiring and safety codes that apply to your area or your type of equipment. For example, in the United States, most areas have adopted the National Electrical Code standard and specify that all wiring conform to its requirements. In other countries, different codes will apply. For maximum safety to personnel and property you must follow these codes. Failure to do so can lead to personal injury or death, property damage or destruction, or both.**

➢ **To replace the UCSC with another UCSC**

1. Loosen the screws holding the power connector in place.
2. Disconnect the power connector from the controller.
3. Disconnect all Ethernet cables (note which cable is connected to which port).
4. Loosen the screws holding the controller in place. The mounting is a keyhole design.
5. Remove the controller by lifting to align the large portion of the keyhole with the mounting screws and pull forward.
6. Verify that the hardware revision of the old UCSC is the same or compatible with the new UCSC for its particular application.
7. Reinstall the new controller by reversing steps 2 through 4. Do not apply power yet.
8. Perform the UCSC Restore procedure to initialize the new controller.
9. If restore was not successful, configure the new controller's UDH network address.
10. Use the ToolboxST application to Build and Download to the controller as needed. Refer to the *ToolboxST User Guide for Mark Controls Platform* (GEH-6700 or GEH-6703), the section *Download to Controller* for instructions.

## 1.1.14 UCSC Restore

After installing a replacement controller, perform the following procedure to apply the configuration to the UCSC controller and allow communication between the UCSC and the ToolboxST application. The Physical Presence (PHY PRES) button located on the front of the controller is used to initiate the procedure.

***Note*** The UCSC, as shipped from the factory, does not include the software on the controller to support communication from the PHY PRES button to the EFA. The user needs to download to the controller at least once (using ToolboxST) to enable this.

➢ **To perform UCSC restore**

1. From the ToolboxST Component Editor **Device** menu, select **Download**, then select **Controller Setup**.
2. When the Controller Setup Wizard *Welcome* window displays, click **Next**.
3. Select **Initialize USB Flash Device**, then click **Next**.
4. Insert a non-encrypted USB 2.0 (only) flash device with a 4 GB minimum capacity into the HMI computer USB port.
5. Click **Scan** and select the listed flash drive.
6. Select the correct **Channel** (R, S, or T if using redundant controllers).
7. Click **Write**, then click **Next**.
8. Complete the controller restore process using the instructions provided on the *Controller Setup Wizard* window or using the remaining steps in this procedure.
9. Remove the USB flash device from the HMI computer.
10. Remove power from the controller.
11. Insert the USB flash device into either USB port of the controller.
12. Press and hold in the **PHY PRES** button, and apply power to the controller. Continue to hold in the PHY PRES button until the USB **On LED** is lit (~ 15 seconds).
13. Release the PHY PRES button and wait for the process to complete. (The USB On LED remains lit to indicate the restore is in progress. The procedure takes one to two minutes.) When the LED turns off, the restore has completed successfully.

    ***Note*** If the LED flashes at a 1 Hz rate, a failure has occurred. Retry or remove the USB flash device.

14. Remove the USB flash device from the controller.
15. Cycle power on the controller.
16. From the ToolboxST *Controller Setup Wizard* window, click **Finish**.
17. Perform a **Download** to bring the controller back online and in the controlling state.