

## SECTION 230903 - BAS FIELD PANELS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES:

- A. Controllers
- B. ANSI 709.1 Network

#### 1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Section *[\[Insert Applicable Specification Section\]](#)* - Basic Mechanical Requirements
- C. Section 230900 - Building Automation System (BAS) General - (Refer to this section for definitions of terminology)
- D. Section 230901 – Building Automation System (BAS) Basic Materials, Interface Devices, and Sensors
- E. Section 230904 - BAS Communication Devices
- F. Section 230905 - BAS Software and Programming
- G. Section 230993 – Sequences of Operation
- H. Section 230801 –BAS Commissioning

#### 1.3 DESCRIPTION OF WORK:

- A. Furnish and install DDC Control units and/or Smart Devices required to support specified building automation system functions.
- B. Refer to Section 230900 for general requirements.

### PART 2 PRODUCTS

#### 2.1 STAND-ALONE FUNCTIONALITY

- A. **General:** These requirements clarify the requirement for stand-alone functionality relative to packaging I/O devices with a controller. Stand-alone functionality is specified with the controller and for each Application Category specified in Part 3. This item refers to acceptable paradigms for associating the points with the processor.
- B. **Functional Boundary:** Provide controllers so that all points associated with and common to one unit or other complete system/equipment shall reside within a single control unit. The boundaries of a standalone system shall be as dictated in the contract documents. Generally systems specified for the Application Category will dictate the

boundary of the standalone control functionality. See related restrictions below. When referring to the controller as pertains to the standalone functionality, reference is specifically made to the processor. One processor shall execute all the related I/O control logic via one operating system that uses a common programming and configuration tool.

C. The following configurations are considered acceptable with reference to a controller's standalone functionality:

1. Points packaged as integral to the controller such that the point configuration is listed as an essential piece of information for ordering the controller (having a unique ordering number).
2. Controllers with processors and modular back planes that allow plug in point modules as an integral part of the controller.
3. I/O point expander boards, plugged directly into the main controller board to expand the point capacity of the controller.
4. I/O point expansion devices connected to the main controller board via wiring and as such may be remote from the controller and that communicate via a sub LAN protocol. These arrangements to be considered standalone shall have a sub LAN that is dedicated to that controller and include no other controller devices. All wiring to interconnect the I/O expander board shall be:
  - a) Contained in the control panel enclosure;
  - b) Or run in conduit. Wiring shall only be accessible at the terminations.
5. General purpose LonMark I/O devices or Smart Devices racked with a processor module in the same contiguous physical enclosure. All devices needed to execute the sequence shall be on a dedicated 709.1 subnet and shall be managed by the BPOC.. The following are additional requirements of this configuration:
  - a) Configuration must meet the requirements for battery back up.
  - b) If processor fails, the I/O devices shall go to their fail condition.
  - c) Contractor shall provide a network bandwidth analysis of the controller segment or subnet. The analysis shall document network bandwidth utilization does not exceed 30% for a continuous one hour period.
  - d) Logic must provide for orderly sequencing of I/O during a power interruption and restart of program logic upon restoration of power.

Note that this configuration may be used by the contractor even when not required to meet the requirements of a stand-alone system. In particular, this installation configuration may be used when the application(s) require "High Bandwidth Communication" between controllers as defined in paragraph 3.3.D.4.b below under minimum send time.

D. Alternate Configuration:

1. Multiple controllers may be provided to control a single unit or other complete system if the provided Building Automation System manufacturer does not have a single controller (with or without expansion modules) that can be provided to meet the single unit/system point count.

2. In this instance, multiple controllers may be provided as long as each controller is still "stand-alone". All points required to execute any subroutine or PID Loop type control shall be contained in a single controller.
3. When multiple controllers are utilized to control a single system, that network segment shall contain no more than 12 nodes if controlling primary equipment such as AHUs, Exhaust systems, Chilled water systems, Hot Water systems, etc. (i.e. 4 AHUs with 3 controllers each maximum on a single network). For terminal unit systems (i.e. tracking VAV box zones), a maximum of 32 controllers shall exist on a network segment. If a system requires more than 12 controllers for a single system, all required controllers shall be connected on a dedicated network segment utilizing appropriate LON routers.
4. Each Open Lab shall be treated as a single system and shall be on a dedicated network segment such that only network traffic necessary for the control of the terminal units in a specific open lab will be present on that network segment. (i.e. provide at least 1 LON router for each open LAB system).

## 2.2 CONTROLLERS

### A. General Requirements for all Controllers:

1. It shall incorporate a "service pin" which, when pressed will cause controller to broadcast its 48-bit NodeID and its ProgramID over the network. The service pin shall be distinguishable and accessible.
2. It shall incorporate a light to indicate the device is receiving power.
3. It shall incorporate a TP/FT-10 transceiver in accordance with ANSI 709.3 and connections for TP/FT-10 control network wiring.
4. It shall incorporate self-test diagnostics capable of indicating controller failure via SNVT output. All outputs shall go to their specified fail position.
5. Application programs and configuration settings shall be stored in a manner such that a loss of power does not result in a loss of the application program or configuration. Upon restoration of power, controller shall resume operation without manual intervention.
6. It shall contain sufficient memory, I/O, and processing capability to execute application programs, calculations, and commands as required by the sequence of operation.
7. It shall be capable of performing stand-alone control in the absence of the control network.
8. All controllers incorporating a real time clock shall installed such that the clock can be set from the BPOC. This event shall be capable of being initiated from the BPOC.
9. All controllers shall be fully configurable (with the exception of hardware switch settings on the controller and downloading of programs to PCs) from anywhere on the ANSI 709.1 control network. Use of SCPTs or SNVTs for configuration is preferred, but use of UCPTs is allowed.

10. All point data, algorithms and application software shall be modifiable from the LCS.
11. All data and software other than firmware (including application programs and data, configuration information, etc.) shall be capable of being uploaded from the controller to the LCS computer.
12. Controller shall have hardware I/O to support the application. Controller's hardware I/O shall meet the following requirements:
  - a) Digital Outputs (DO): Outputs shall be rated for a minimum 24 VAC or VDC, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output and [a manual hand off or auto switch to allow for override], [If these HOA switches are not provided on the main board they shall be provided via isolation relays within the control enclosure,] excluding terminal equipment. Each DO shall be discrete outputs from the controller board (multiplexing to a separate manufacturer's board is unacceptable). Provide suppression to limit transients to acceptable levels.
  - b) Analog Inputs (AI): AI shall be 0-5 Vdc, 0-10Vdc, 0-20Vdc, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the controller board (multiplexing to a separate manufacturers board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 8-10 bits depending on application.
  - c) Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the controller and shall be isolated from the main board.
  - d) Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
  - e) Electronic Analog Outputs (AO) as required by application: voltage mode, 0-5VDC and 0-10VDC; current mode (4-20 mA). Provide zero and span calibration and circuit protection. Where floating control is allowed, transducer/actuator shall be programmable for normally open, normally closed, or hold last position and shall allow adjustable timing. In addition, use of floating control without any feedback of actual output device position requires the capability to periodically re-zero the output device as detailed below in 3.4 RE-ZERO FUNCTION FOR FLOATING CONTROL. Pulse Width Modulated (PWM) analog via a DO and transducer is acceptable only with Owner approval (Generally these will not be allowed on loops with a short time constant such as discharge temperature loops, economizer loops, pressure control loops and the like. They are generally acceptable for standard room temperature control loops.). Where these are allowed, transducer/actuator shall be programmable for normally open, normally closed, or hold last position and shall allow adjustable timing. Each AO shall be discrete outputs from the controller board (multiplexing to a separate manufacturers board is unacceptable). D/A converters shall have a minimum resolution of 8 bits.

- f) Analog Output Pneumatic (AOP), 0-20 psi: Pneumatic outputs via an I/P transducer, PWM/P transducer, or digital to pneumatic transducer are acceptable. Multiplexed digital to pneumatic transducers are acceptable provided they are supplied as a standard product and part of the controller and provide individual feedback. Multiplexed pneumatic outputs of a separate manufacturer are unacceptable.
- 13. An external interface file (\*.XIF) shall be provided describing network variables, configuration parameters and other parameters supported.
- 14. Shall be mounted on equipment, in packaged equipment enclosures, or wall mounted in a locking NEMA 1 enclosure, as specified elsewhere

**B. Additional Requirements for Primary Control Units (PCU)**

- 1. In addition to all general controller requirements, Primary Control Units are subject to the following additional requirements. Where these PCU specific requirements conflict with the general controller requirements, the more stringent requirement shall apply.
- 2. Application programs, data, and configuration settings shall be stored in a manner such that a loss of power does not result in a loss of the application program, data, or configuration. Should PCU memory be lost for any reason, the PCU shall automatically report the condition and be capable of receiving a download from the LCS via the network.
- 3. The PCU(s) shall provide fully distributed control independent of the operational status of the LCS or BPOC. All control strategies performed by the PCU (s) shall be both operator definable and modifiable through the LCS.
- 4. PCUs shall be programmable from a LCS, portable operator's terminal, or hand held operating device.
- 5. In the event of a control network failure, all control functions shall continue with the global values programmable to either last value or a specified value.
- 6. PCUs shall accept control programs, perform automated HVAC functions, control peripheral devices and perform all necessary mathematical and logical functions. Each unit shall have its own internal RAM, non-volatile memory, microprocessor, battery backup, regulated power supply, power conditioning equipment, ports for connection of operating interface devices, and control enclosure PCU shall contain sufficient memory for all specified global control strategies and communication programs.
- 7. In addition PCUs may provide intelligent, standalone control of HVAC functions. Each PCU may be capable of standalone direct digital operation utilizing its own processor, non-volatile memory, input/output, wiring terminal strips, A/D converters, real-time clock/calendar and voltage transient and lightning protection devices. Refer to standalone functionality specified above.
- 8. The PCU may provide for point mix flexibility and expandability. This requirement may be met via either a family of expander boards, modular input/output configuration, or a combination thereof. Refer to stand alone functionality specified above.

9. Each PCU shall contain software to perform full DDC/PID control loops. Each PCU shall be equipped with loop tuning algorithm for precise proportional, integral, derivative (PID) control. Tools to support loop tuning must be provided such that P, I, and D gains are automatically calculated.
10. PCU hardware I/O shall meet the following (in addition to all requirements under general controller hardware I/O):
  - a) Digital Outputs (DO): Outputs shall have a manual hand off or auto switch to allow for override. Provide feedback to remotely indicate the HOA is not in the Auto position. If these HOA switches are not provided on the main board they shall be provided via isolation relays within the control enclosure
  - b) Analog Inputs (AI): A/D converters shall have a minimum resolution of 12 bits. Inputs shall have diagnostic capability to indicate a failed or out-of-range input. Slope intercepts and gain adjustments shall be available on a per-point basis.
  - c) Electronic Analog Outputs (AO): Voltage mode: 0-5 Vdc and 0-10 Vdc; Current mode: 4-20 mA D/A converters shall have a minimum resolution of 10 bits. AO points shall have a selectable failure setpoint. The PCU shall be capable of maintaining this failure setpoint in the event of a system malfunction, which causes loss of PCU control, or loss of output signal, as long as power is available at the PCU. The failure setpoint shall be selectable on a per point basis.
  - d) Pulsed Inputs: Capable of counting up to 8 pulses per second with buffer to accumulate pulse count. Pulses shall be counted at all times.
11. A minimum of four levels of password protection shall be provided at each PCU.
12. Documented and commented source code for all application programs shall be submitted for every program resident in the PCU.
13. PCU hardware can be provided which utilizes an alternate protocol where required for integrations, smoke control, or stand-alone functionality. These controllers are exempted from the general requirements specific to ANSI 709.3 controllers but must meet the hardware I/O requirements as defined in 2.2 A 12 above.

**C. Additional Requirements for Application Specific Controllers (ASC)**

1. In addition to all general controller requirements, Application Specific Controllers are subject to the following additional requirements. Where these ASC specific requirements conflict with the general controller requirements, the more stringent requirement shall apply.
2. All ASCs shall be LonMark certified to an appropriate LonMark functional profile, and shall be designed according to the LonMark Interoperability Guidelines. Product documentation and devices shall display the LonMark symbol, indicating conformance to the LonMark Interoperability Standards. The only exception is ASCs where no functional profile exists for the application, in which case the ASC may be used with the prior approval of UNC. In this case,

contractor shall fill out the LonMark International self-certification process and submit that documentation along with a request to use a non-certified controller.

3. All ASCs shall be supplied with a LNS plugin. The ASC shall be fully configurable for the application via either hardware switches on the controller and/or the LNS plugin. Use of devices without a LNS plugin is prohibited without prior approval of UNC. In this case, contractor shall provide as a submittal a table containing the following information for each configuration parameter:
  - 1) Configuration property type (float, integer, structure, etc.)
  - 2) Configuration property identifier
  - 3) Use/description of configuration property
  - 4) Allowable range of values for the configuration property

## **2.3 NETWORK MANAGEMENT**

- A. The network services for the BAS shall be the latest version of LonWorks Network Services (LNS) or the network management tool utilized by an approved existing BAS Vendor.
- B. The Network Management Application shall be fully compatible with the latest version of LNS or the network management tool utilized by an approved existing BAS Vendor. . The network management application is to be used for commissioning and management of the LonTalk control architecture, no exceptions allowed. The network management service tool shall remain on the project as the property of UNC. A copy of the Database shall be archived on the service tool and LCS, documenting system bindings and node addressing. In addition all system variables shall have a plain English language description for each variable. This service tool shall be used for all system maintenance and expansion, so that the network database backup remains current.

## **PART 3 EXECUTION**

### **3.1 INSPECTION:**

- A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

### **3.2 INSTALLATION OF CONTROL SYSTEMS:**

- A. General: Install systems and materials in accordance with manufacturer's instructions, specifications roughing-in drawings and details shown on drawings. Contractor shall install all controllers in accordance with manufacturer's installation procedures and practices.

### 3.3 ANSI 709.1 CONTROL NETWORK CONFIGURATION:

- A. Provide LonTalk routers (ANSI 709.1) and/or repeaters as required to segment groups of LonTalk devices to meet maximum network bandwidth usage limits if an existing approved BAS vendor's BPOC is not used for this function.
- B. Configure ANSI 709.1 network so that network bandwidth utilization does not exceed 30% for any one hour period. Configure ANSI 709.1 network so that network error rate does not exceed 1% for any one hour period.
- C. Provide all necessary routers in order to connect TP/FT-10 devices to the BPOC(s) and LCS. *Exception: With the prior approval of UNC (as detailed in section 230900), in addition provide routers as required to connect BPOC(s) and LCS to TP/XF-1250 and routers to connect TP/FT-10 network to TP/XF-1250 network.*
- D. All controllers, BPOC(s), and LCS shall be connected to the ANSI 709.1 control network.
- E. Controller addressing shall conform to the Domain / Subnet / Node addressing method. Coordinate Domain address with UNC.
- F. An ANSI 709.1 communications jack shall be provided at each controller. It shall be possible to perform all program and database back-up, system monitoring, control functions, and controller diagnostics through this port. This jack shall allow temporary use of portable devices without interrupting the normal operation of devices permanently to the control network.
- G. All communication between controllers, between controllers and the BPOC(s), and between controllers and the LCS shall use the ANSI 709.1 protocol exclusively except in those situations where an alternate protocol is required for integrations, smoke control, or stand-alone functionality and written approval from the owner is provided.
- H. Except for communication between the LCS and a controller specifically for the purpose of device configuration or programming, all communication is subject to the following requirements:
  - 1. All data exchange shall use SNVTs exclusively. No UNVTs or explicit messaging is allowed.
  - 2. SNVT types shall be as shown on control drawings. If specific types are not shown, the following SNVT types shall be used (where options are shown, the first one is preferred):
    - a) Temperature: temp\_p, temp\_diff\_p, temp
    - b) Analog Output Percentages: Switch, lev\_cont, lev\_cont\_f  
(valve, damper, etc. outputs)
    - c) Occupancy: occupancy
    - d) Pressure: press\_p, press\_f, press
    - e) System Mode: HVAC\_mode, HVAC\_emerg
    - f) System Status: HVAC\_status, chlr\_status, dev\_status
    - g) Flow: flow\_p, flow\_f



- |                         |                                 |
|-------------------------|---------------------------------|
| h) Speed (fan or pump): | freq_hz, freq_f                 |
| i) Humidity:            | abs_humid, lev_cont, lev_cont_f |
| j) Binary Outputs:      | Switch                          |
| k) Binary Inputs:       | Switch (exception: see below)   |

For Binary Inputs, SNVT\_Switch is the default SNVT type, however in many cases a more specific SNVT should be used, for example, SNVT\_chlr\_status for BIs associated with chiller status.

Where specific types are not shown, use SNVTs appropriate for the data type (i.e. one of the SNVT\_time\_XXX for times). Simple SNVTs and enumerated SNVTs are preferred to structured SNVTs.

3. Bindings shall use either acknowledged send or send 3 times unacknowledged
4. Except where noted elsewhere in these specifications or where approved in advance by UNC, all bindings shall utilize send on change, minimum send time, and maximum send time parameters. Polling shall be avoided.
  - a) Send on delta parameters shall be non-zero values selected to ensure efficient use of the available bandwidth but no greater than the following:
    - Temperatures: 0.2 Degrees Celsius (0.36 Degrees Fahrenheit)
    - Pressures in Air Systems: 4 Pascals (0.025 Inches of Water)
    - Building Static Pressure: 2 Pascals (0.0125 Inches of Water)
    - Flow: 5% of the design maximum flow
    - Relative Humidity: 3%
    - Analog Position: 2%
    - Enthalpy: 0.5 Kilojoules per Kilogram (Approximately 0.2 Btu per Lb)
    - Binary Alarm Data: Change of State
  - b) Minimum send times shall be determined as follows:
    - 1) Determine whether the bindings are considered “High Bandwidth Communications”. Bindings are considered “High Bandwidth Communications” when they are
      - between controllers that meet the installation requirements for “Stand Alone Functionality” (as defined in paragraph 2.1.C.5) and
      - the bindings are part of a single sequence or rapid response time is required by the nature of the application.
    - 2) Using the appropriate table below, determine minimum send times for each binding in the controller:
 

For bindings between controllers meeting “High Bandwidth Communications”

      - Zone Temperatures: 30 seconds

- Pressures: 1 second
- Flows: 2 seconds
- Other: 5 seconds

For other bindings

- Zone Temperatures: 60 seconds
- Pressures: 20 seconds
- Flows: 20 seconds
- Other: 30 seconds

- 3) If the controller supports minimum send times on a per-binding basis, set the minimum send time for each binding. If the minimum send time parameters can only be set on a controller basis, set the controller's minimum send time to the smallest of all the individual minimum send times.

Maximum send times shall be 10 minutes.

### 3.4 RE-ZERO FUNCTION FOR FLOATING CONTROL WITHOUT FEEDBACK

- A. Where floating control is used without actuator feedback, contractor shall program an automatically initiated function that resets the actuator to the fully closed position on a scheduled basis. The controllers shall initially be set up to perform this function once every 24 hours. This function may be either programmed in the individual controllers, or resident elsewhere on the network as a supervisory control program, or some combination of the two. In any case, not more than 5% of the total quantity of controllers in a building shall perform this function at the same time. When possible the controllers shall perform this function when the duct or pipe controlled by the actuator is not operating or is serving unoccupied zones.

### 3.5 HARDWARE APPLICATION REQUIREMENTS

- A. **General:** The functional intent of this specification is to allow cost effective application of manufacturers standard products while maintain the integrity and reliability of the control functions. Specific requirements indicated below are required for the respective application. Manufacturer may apply the most cost-effective unit that meets the requirement of that application.
- B. **Standalone Capability:** Each controller shall be capable of performing the required sequence of operation for the associated equipment. All physical point data and calculated values required to accomplish the sequence of operation shall originate within the associated controller with only the exceptions enumerated below. Refer to Item 2.1 above for physical limitations of standalone functionality. Listed below are functional point data and calculated values that shall be allowed to be obtained from or stored by other controllers via LAN.

- C. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.
- D. **Application Category Type 0** (Distributed monitoring)
1. Applications in this category include the following:
    - a) Monitoring of variables that are not used in a control loop, sequence logic, or safety.
  2. Any controller may be used in these applications.
  3. Where these points are trended, contractor shall verify and document that the network bandwidth is acceptable for such trends and is still capable of acceptable and timely control function.
  4. **LAN Restrictions:** These points may reside on any controller.

*Delete equipment that is not applicable – do not move equipment types from one category to another.*

E. **Application Category Type 1**

1. Applications in this category include the following:
  - a) Fan Coil Units
  - b) Airflow Control Boxes (VAV and Constant Volume Terminal Units)
  - c) Misc. Heaters
  - d) Unitary equipment <15 tons (Package Terminal AC Units, Package Terminal Heat Pumps, Split-System AC Units, Split-System Heat Pumps, Water-Source Heat Pumps)
  - e) Induction Units
  - f) Dual Duct Zone Dampers
  - g) Chilled Beams
2. Any controller may be used in these applications.
3. **Standalone Capability:** Provide capability to execute control functions for the application for a given setpoint or mode, which shall generally be occupied mode control. Only the following data (as applicable) may be acquired from other controllers via LANs. In the event of a loss of communications with any other controller, or any fault in any system hardware that interrupts the acquisition of any of these values, the controller shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

<u>Physical/Virtual Point</u>	<u>Default Value</u>
Scheduling Period	Normal
Morning Warm-Up	Off (cold discharge air)
Load Shed	Off (no shedding)
Summer/Winter	Winter
Trend Data	N/A

4. **Mounting:**

- a) Controllers that control equipment located above accessible ceilings shall be mounted on the equipment in an accessible enclosure and shall be rated for plenum use. The ceiling grid shall be labeled below the terminal equipment with the unit designation and nameplates shall be provided as an engraved phenolic or micarta material. See Section 230901 for requirements.
  - b) Controllers that control equipment mounted in a mechanical room may either be mounted in, on the equipment, or on the wall of the mechanical room at an adjacent, accessible location.
  - c) Controllers that control equipment mounted outside or in occupied spaces shall either be located in the unit or in a proximate mechanical/utility space.
  - d) Section 230903 contractor may furnish controllers to the terminal unit manufacturer for factory mounting.
5. **LAN Segment Restrictions:** Limit the number of controllers servicing any one of these applications on the LAN Segment up to a maximum of 40. VAV terminals or zone dampers/reheat coils served by a single air handler may be located on the same segment of the LAN with the AHU. Multiple AHUs may reside on a LAN segment if all the associated/served terminal boxes and zone dampers/reheat coils are located on the same LAN segment. Contractor shall provide a network bandwidth analysis of the controller LAN segment or subnet. The analysis shall document network bandwidth utilization does not exceed 30% for a continuous one hour period.

*Delete equipment that is not applicable – do not move equipment types from one category to another.*

**F. Application Category Type 2**

- 1. Applications in this category include the following:
  - a) Constant Volume Air Handlers
  - b) Unitary Equipment  $\geq$  15 tons (Air Conditioners, Heat Pumps, Packaged Heating/Cooling Units, and the like)
  - c) Constant Volume Pump Start/Stop
  - d) Misc. Equipment (Exhaust Fan) Start/Stop
  - e) Misc. Monitoring (not directly associated with a control sequence and where trending is not critical)
  - f) Variable Speed Drive (VSD) controllers not requiring safety shutdowns of the controlled device and not associated with Central Plant equipment.
- 2. Any controller may be used in these applications.
- 3. **Alarm Annunciation Point.** Provide a single normally open dry contact. Configure the application such that the contact closes in response to a critical alarm condition.
- 4. **Standalone Capability:** Only the following data (as applicable) may be acquired from other controllers via LANs without demonstrating good engineering practice per Item 2.1. In the event of a loss of communications with any other controller or any fault in any system hardware that interrupts the acquisition of any

of these values, the controller shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

Physical/Virtual Point	Default Delay Time	Default Value
Outside Air Temperature	3 minutes	80°F
Outside Air Humidity	3 minutes	60%RH
Outside Air Enthalpy	3 minutes	30 Btu/lb
Trend Data		N/A
Cooling/Heating Requests	3 minutes	None

5. **Mounting:**

- a) Controllers that control equipment located above accessible ceilings shall be mounted on the equipment in an accessible enclosure and shall be rated for plenum use. The ceiling grid shall be labeled below the equipment with the unit designation and nameplates shall be provided as an engraved phenolic or micarta material. See Section 230901 for requirements.
- b) Controllers that control equipment mounted in a mechanical room may either be mounted in, on the equipment, or on the wall of the mechanical room at an adjacent, accessible location.
- c) Controllers that control equipment mounted outside or in occupied spaces shall either be located in the unit or in a proximate mechanical/utility space.

6. **LAN Segment Restrictions:** Limit the number of nodes servicing any one of these applications on the LAN Segment up to a maximum of 40. Contractor shall provide a network bandwidth analysis of the controller LAN segment or subnet. The analysis shall document network bandwidth utilization does not exceed 30% for a continuous one hour period.

*Delete equipment that is not applicable – do not move equipment types from one category to another.*

**G. Application Category Type 3**

1. Applications in this category include the following:
  - a) VAV Air Handlers
  - b) Dual Duct Air Handlers
  - c) Multizone Air Handlers
  - d) Self Contained VAV Units
2. These applications shall be reside in a PCU.
3. **Alarm Annunciation Point.** Provide a single normally open dry contact. Configure the application such that the contact closes in response to a critical alarm condition.
4. **Standalone Capability:** Only the following data (as applicable) may be acquired from other PCUs via LANs without demonstrating good engineering practice per Item 2.1. In the event of a loss of communications with any other

PCUs, or any fault in any system hardware that interrupts the acquisition of any of these values, the PCU shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

Physical/virtual point	default delay time	default value
Outside Air Temperature	3 minutes	80°F
Outside Air Humidity	3 minutes	60%RH
Outside Air Enthalpy	3 minutes	30 Btu/lb
Enable Local Operation	Last Value	
Cooling/Heating Requests	3 minutes	None

5. **Mounting:**

- a) PCUs that control equipment located above accessible ceilings shall be mounted on the equipment in an accessible enclosure and shall be rated for plenum use.
- b) PCUs that control equipment mounted in a mechanical room may either be mounted in, on the equipment, or on the wall of the mechanical room at an adjacent, accessible location.
- c) PCUs that control equipment mounted outside or in occupied spaces shall either be located in the unit or in a proximate mechanical/utility space.

6. **LAN Segment Restrictions:** Limit the number of PCUs servicing any one of these applications on the LAN Segment up to a maximum of 32. Contractor shall provide a network bandwidth analysis of the controller LAN segment or subnet. The analysis shall document network bandwidth utilization does not exceed 30% for a continuous one hour period.

*Delete equipment that is not applicable – do not move equipment types from one category to another.*

**H. Application Category Type 4**

1. Applications in this category include the following:
  - a) Central Cooling Monitoring
  - b) Central Heating Plant
  - c) Sequenced or Variable Speed Pump Control
  - d) Miscellaneous Heat Exchangers
  - e) Specialized Central Plant Equipment
2. These applications shall be reside in a PCU.
3. **Alarm Annunciation Point.** Provide a single normally open dry contact. Configure the application such that the contact closes in response to a critical alarm condition.
4. **LAN Segment Restrictions:** Limit the number of PCUs servicing any one of these applications on the LAN Segment up to a maximum of 20. Only PCUs associated with equipment for the applications in this category may reside on the LAN segment of this application category type, with the exception of Application

Category Type 0 points. Contractor shall provide a network bandwidth analysis of the controller LAN segment or subnet. The analysis shall document network bandwidth utilization does not exceed 30% for a continuous one hour period.

### **3.6 CONTROL UNIT REQUIREMENTS**

- A. Refer to Section 230900 for requirements pertaining to control unit quantity and location.

END OF SECTION 230903