

LONWORKS® COMPLIANCE ASSESSMENT TOOL

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Overview

- UFGS 25 10 10 (UMCS) and 23 09 23 (DDC) require Open LonWorks
- The specs are intended to be used together but independently
- Army installations procure DDC systems on a regular basis, but do not always immediately interface them to a UMCS
- DDC system compliance with the specs needs to be verified/accepted prior to interface with UMCS
- DDC system compliance assessment mechanism/methodology/tool is needed
- Goal: Obtain a high degree of confidence that DDC system is ready for interface to a UMCS



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DDC/UMCS Interface Objectives/Goals

- SNVTs available for display of points
- SNVTs available to monitor (poll) buildings and to generate alarms
- SNVTs available to perform trending
- SNVTs available to perform system Scheduling (SNVT_occupancy)
- SNVTs available to perform load management (i.e. Load Shed application)



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Summary of Requirements for an Open DDC System

- LNS Database
- Building Control Network: TP/FT-10
- Standard protocol: ANSI/CEA-709.1B
- SNVTs
- No gateways
- Points Schedule drawing
- Building Scheduler
- Software and licenses
- LONMARK certified ASCs
- LNS Plug-ins



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Building Level LON System UFGS 23 09 23

- System Scheduler – Most important **component** in a LON system with regards to system integration
 - Contains the SNVTs for Occupancy commands from UMCS
 - Contains logic functions to determine if UMCS is communicating to the building level controllers
 - Provides alternate scheduling should communications with the UMCS M&C server be disrupted
 - Can be incorporated into a GPPC or another device on the building LON network



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Other Building Level LON System Components UFGS 23 09 23

- Local Display Panel (LDP)
 - Provides maintenance technicians access to system points without the need to provide Laptops or local workstations (i.e. Fort Hood, Fort Bragg and Fort Sill)
 - Remember – the LNS database exists in only one computer! Service laptop issues with LNS
 - LDP may contain System Scheduler functions (Loytec L-Vis)
- Building Point of Connection – LON to IP Router
 - ILON-600 (Echelon) and LIP-3 (Loytec)



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Design Build Contract Documents

- Request for Proposal
 - Include UFGS 23 09 23
 - Include UFGS 25 10 10
- Project Review
 - Check project specifications to ensure key elements of model RFP are included
- Controls Contractor Submittal – 23 09 23
 - Equipment Submittal – Lonmark Certified
 - Network type – FT-10
 - Points Schedule
 - Network Riser diagram
 - Software licenses (As-Built)
 - LNS Database (As-Built)
 - GPPC application and source files
 - LNS Plugins



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Sample Equipment Datasheet

TEC2245-2 LONWORKS® Network Thermostat with Single Proportional Output and One-Speed Fan Control Installation Instructions

Part No. 24-9890-390, Rev. —
Issued May 16, 2006

Applications

The TEC2245-2 Thermostat is a LONWORKS® network device that provides control of two-pipe fan coils, cabinet unit heaters, or other equipment using a proportional 0 to 10 VDC control input and one-speed fan control. The technologically advanced TEC2245-2 Thermostat features a Building Automation System (BAS) LONWORKS network communication capability that enables remote monitoring and programmability for efficient space temperature control. The TEC2245-2 Thermostat features an intuitive user interface with backlit display that makes setup and operation quick and easy. The thermostat also employs a unique, proportional control algorithm that virtually eliminates temperature offset associated with traditional, differential-based thermostats.

IMPORTANT: The TEC2245-2 Thermostat is intended to provide an input to equipment under normal operating conditions. Where failure or

North American Emissions Compliance

United States

This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when this equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his/her own expense.

Canada

This Class (A) digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulations.



TAC Xenta 102-AX
VAV Controller with Actuator and
Airflow Transducer

6 Mar 2002

Sample Equipment Datasheet



TAC Xenta® 102-AX is a zone controller intended for VAV heating and cooling applications with one or two stages of reheating. The controller keeps a constant temperature in the zone by controlling the air flow and heating stages. By using a carbon dioxide sensor, the air quality can be controlled in the zone.

TAC Xenta 102-AX is equipped with an integrated, static air velocity transducer and a motorized bidirectional actuator in a single package.

The differential pressure air velocity transducer requires a minimum of maintenance. Thus it is also well suited to be placed in the zone return air duct.

The controller is a LonMark® compliant device aimed at communicating on a LonTalk® TP/FT-10 network via a twisted-pair, unpolarized cable. It is able to operate both as a stand-alone unit and as part of a system. All relevant network variables can be monitored and configured via the Network Plug-in or, locally, via the intelligent thermostat device I/STAT or the commissioning device M/STAT.

TECHNICAL DATA	
Supply voltage, single class two source	24 V AC ±10%, 50-60 Hz
Power consumption:	Controller: 8 VA
Digital outputs, each	max. 18 VA
Total, all outputs	max. 48 VA
Ambient temperature:	Operation: 0 °C to +50 °C (32 °F to 122 °F)
Storage	-20 °C to +50 °C (-4 °F to 122 °F)
Humidity	10 to 90% RH, non-condensing
Enclosure:	Dimensions: 197x152x63 mm (7.75"x8.25"x2.50")
Enclosure rating	NEMA 1 and IP 10
Meets	UL94-V0 UL flammability for plenum applications
Weight	1.04 kg (2.30 lb.)
Inputs - Digital:	Dry Contact: excitation: 5 V DC at 0.5 mA
Terminations	Removable screw terminal connectors
Damper linkage	round shaft extending a minimum of 25 mm (1") from the box, diameter: 12.7 mm (1/2")
Application program:	Cycle time: 1 s
Indication LED colors:	Power On: green
LON network activity transmission	amber
LON network activity receive	green
Not in service	amber
Interoperability standard conforms to:	LonMark Interoperability Guidelines and LonMark Functional Profile: VAV Controller
Communication protocol	LonTalk
Physical channel	TP/FT-10, 78 kbps
Network type	2450*, 10 MHz



Points Schedule

- Most useful document detailing the aspects of an open LON system
- Documents controller points: hardware inputs/outputs and network variable inputs/outputs
 - Networked points (SNVTs) have their name and type identified
 - Networked points have their trending, alarming, and local display options identified
- Controls Contractor may have his own method for identifying this information
- COE has a standard format that should be used for the construction submittal and the As-Built drawings



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ALL AIR SMALL PACKAGE UNITARY SYSTEM						
NODE: <DDC#> NODE LOCATION: < > NODE ADDRESS: Domain = < >, Subnet = < >, Node = < > NODE ID: < >						
FUNCTION	NAME	DESCRIPTION	SETTING (WITH UNITS)	RANGE (WITH UNITS)	nci/CPT NAME	IO TYPE
PROOFS & SAFETIES		<UNIT MANUFACTURER'S SAFETIES> (SEE NOTES)	< >	ALM/NORMAL	< >	<BI>
	RST-BUT	SYSTEM RESET BUTTON	-	-	< >	[]
START/STOP	< >	HEAT-OFF-COOL SWITCH INPUT	-	HEAT/OFF/COOL/ <EMERG>	< >	< >
	SYS-OCC	OCCUPANCY INPUT (FROM SYSTEM SCHEDULER)	-	< >	< >	NI
	ZN-OCC	ZONE OCCUPANCY INPUT (OCCUPANCY SENSOR)	-	OCC/UNOCC	< >	BI
	SF-ON/AUTO	SUPPLY FAN ON/AUTO SWITCH	-	ON/AUTO	< >	BI
	UNIT STATUS	UNIT STATUS (SEE NOTES)	-	HVAC_COOL/ HVAC_HEAT/ HVAC_OFF	< >	NVO
ZONE TEMPERATURE CONTROL	ZN-T	ZONE TEMPERATURE	-	< >	< >	AI
	ZN-T-SP	ZONE TEMPERATURE SETPOINT	OCCUPANT ADJUSTABLE	[68-77 DEG F]	< >	AI
	ZN-T-SP-UNOCC	ZONE TEMPERATURE SETPOINT FOR UNOCC MODE			< >	
	SF-SS	SUPPLY FAN START/STOP COMMAND	-	ON/OFF	< >	BO
	COMP-CLG/HTG	COMPRESSOR (PKG UNIT) COOLING/HEATING MODE	-	CLG/HTG	< >	BO
	COMP-SS	COMPRESSOR (PKG UNIT) START/STOP	-	ON/OFF	< >	BO
	EMERG-HTG-2P	EMERG HEATING COMMAND (2-POS)	-	ON/OFF	< >	AO
		HEATING COIL VALVE PID LOOP SETTINGS	< >	-	< >	-
	COOLING COIL VALVE PID LOOP SETTINGS	< >	-	< >	-	



Sample Points Schedule

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LDP AND M&C DISPLAY					OVERRIDES			
LDP VIEW REQ'D	M&C		SNVT NAME	SNVT TYPE	LDP OVRD REQ'D	M&C OVRD REQ'D	SNVT NAME	SNVT TYPE
	DISP REQ'D	TREND REQ'D						
[~]	[~]	[~]	< >	< >	-	-	-	-
[~]	[~]	[~]	< >	< >	[]	[]	< >	< >
[~]	[~]	[~]	< >	< >	[~]	[~]	< >	< >
[~]	[~]	[~]	< >	< >	-	-	-	-
[~]	[~]	[~]	< >	< >	-	[~]	< >	< >
[~]	[X]	[~]	< >	HVAC_STATUS	-	-	-	-
[~]	X	X	< >	TEMP_P	-	-	-	-
[~]	X	X	< >	< >	[~]	X	< >	< >
[~]	[~]	[~]	< >	< >	[~]	X	< >	< >
[~]	[~]	[~]	< >	< >	[~]	X	< >	< >
[~]	[~]	[~]	< >	< >	[~]	X	< >	< >
[~]	[~]	[~]	< >	< >	[~]	X	< >	< >
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

Sample Points Schedule Continued



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Compliance Tool Objectives

- Provide reviewing personnel with a checklist of items that compose an open LON system with respect to UFGS 23 09 23 and 25 10 10
- Two test methods described
 - Detailed Test: To be performed by a person with advanced knowledge of LONWORKS® systems and access to a network configuration tool
 - Limited Test: To be performed by a person without access to a network configuration tool or limited experience with the LONWORKS® system



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Compliance Tool

Item	Priority	Category	Section	Requirement
1	High	General	1.4.1.a	Control system shall be an open implementation of the CEA-709.1B communications protocol using LonMark Standard Network Variable Types

Assessment

Review point schedules, inspect devices for SNVT variables with SNVT type identified. Look for any UNVTs on the Points Schedule (or any UNVTs for points that are used on the controller). UNVTs are not in compliance with the intent of the specification.



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Compliance Tool

Item	Priority	Category	Section	Requirement
2	High	General	1.4.1.b	LNS services shall be used for all network management. A copy of the LNS database shall be submitted to the project site.

Assessment

Ensure LNS database submitted as part of record-drawings.



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Compliance Tool

Item	Priority	Category	Section	Requirement
3	High	General	1.4.1.f	All necessary documentation, configuration information, configuration tools, programs, drivers, and other software shall be licensed to and otherwise remain with the Government such that the Government or their agents are able to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the Contractor.

Assessment

Review submitted As-Built documentation and software provided by contractor. Ensure that plug-in and programming software is provided for all controllers detailed in Record Drawings and point schedules. Ensure that proof of software licensing listing Govt as owner exists in the submittal package.



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Item	Priority	Category	Section	Requirement
4	Med	Other/Misc	1.8.f	The HVAC control System Operation and Maintenance Instructions shall include printouts of configuration settings for all devices.
5	Med	DDC Hardware	1.12.1.b	The Building control network backbone shall be a TP-FT10 network if a backbone is utilized.

Assessment

Review record drawings for controller printouts
Review network riser diagram. Ensure that only FT-10 routers and devices exist in the riser diagram except the BPOC, which should be a IP to FT-10 network device.



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Compliance Tool

Item	Priority	Category	Section	Requirement
6	Med	DDC Hardware	1.12.2.a	The backbone shall have no control devices connected to it. Only CEA-709.1B Routers
7	Low	DDC Hardware	1.12.2.b	The backbone shall be installed such that a router at the Building Point of Connection (BPOC) location may be connected to the backbone.

Assessment

Review riser diagram and verify no control devices exist on the backbone
Review record drawings and verify that backbone is located in the BPOC location



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Item	Priority	Category	Section	Requirement
8	Med	DDC Hardware	1.12.2.c	The local control bus shall use CEA-709.1B over a TP/FT-10 network doubly-terminated bus topology in accordance with CEA-709.3

Assessment

Review record drawings and verify that local control bus has network layout documented with location of terminators identified. The TP/FT-10 network should be a single strait bus with no single drops exceeding 3 feet. Termination should occur at each end of the TP/FT-10 network wire. Branch wiring from the network bus is forbidden.



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Compliance Tool

Item	Priority	Category	Section	Requirement
9	Med	DDC Hardware	1.12.2.d	The local control busses shall be installed such that no node(device connected to the control network) has more than two CEA-709.1B Routers and CEA-709.3 Repeaters (in any combination) between it and the backbone, including the router connected to the backbone.
10	High	DDC Hardware	2.4.1.1	CEA-709.1B Routers (including routers configured as repeaters) shall meet the requirements of CEA-709.1B and shall provide connection between two or more CEA-709.3 TP/FT-10 channels.

Assessment

Review riser diagram and ensure that no channel is configured in such a fashion that more than two CEA-709.1B routers and repeaters exist between the backbone and the nodes

Review product data sheets and ensure that all installed routers are CEA-709.1B certified



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Item	Priority	Category	Section	Requirement
11	High	DDC Hardware	2.4.1.2	CEA-709.3 Repeaters shall be physical layer repeaters in accordance with CEA-709.3
12	High	DDC Hardware	2.4.2	Gateways shall perform bi-directional protocol translation from one non CEA-709.1B protocol to CEA-709.1B. Gateways shall incorporate exactly two network connections: one shall be for connection to a TP/FT-10 network in accordance with CEA-709.3 and the second shall be as required to communicate with the non-CEA-709.1B network.

Assessment

Review product data sheets and ensure that all installed repeaters are physical layer repeaters

Review product data sheets and ensure that all installed gateways incorporate one TP/FT10 network port and one proprietary network port



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Item	Priority	Category	Section	Requirement
13	High	DDC Hardware	2.14.1.c	All DDC hardware shall incorporate a TP/FT-10 transceiver in accordance with CEA-709.3 and connections for TP/FT-10 control network wiring. It shall not have connections to any other network media type and it shall communicate via the CEA-709.3 protocol only.

Assessment

Review product data sheets and ensure that all installed nodes incorporate a TP/FT10 transceiver. Review Record drawings device details to determine the TP/FT10 transceiver is set for operation if jumper settings are required. Note: Transceiver designation may be TP/FT-10, FT-10, FTT-10, or FTT-10A depending upon manufacturer.



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Item	Priority	Category	Section	Requirement
14	High	DDC Hardware	2.14.1.h	It shall have all functionality specified and required to support the application (Sequence of Operation or portion thereof) in which it is used, including but not limited to: (1) It shall provide input and output SNVTs as specified and required to support the sequence and application in which it is used. (2) It shall be configurable via standard or user-defined configuration parameters (SCPT or UCPT), SNVT network configuration inputs (nci), or hardware settings on the controller itself as specified and as required to support the sequence and application in which it is used.

Assessment

Review point schedules and product data sheets. Inspect nodes for SCPT configuration parameters and SNVT variables. Verify that points defined in sequence and points list are represented by SNVT variables in the point schedules. Verify that configuration parameters as required for sequence of operation are present in the controller data sheets.



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Compliance Tool

Item	Priority	Category	Section	Requirement
15	High	DDC Hardware	2.14.3.a	ASCs shall be LonMark Certified.
16	High	DDC Hardware	2.14.b	Unless otherwise approved, all necessary Configuration Parameters and network configuration inputs (ncis) for the sequence and application in which the ASC is used shall be fully configurable through an LNS plug-in. This plug-in shall be submitted as specified for each type of ASC (manufacturer and model). (Note: configuration accomplished via hardware settings does not require configuration via plug-in)

Assessment

Review product data sheets and ensure LonMark certification status

Ensure plug-in application is provided for each ASC type with software submittal, contact the submitting contractor for file names for clarification if required.



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Item	Priority	Category	Section	Requirement
17	Med	DDC Hardware	2.14.3.c	Local Display Panel (LDP): The Local Display Panel shall be an Application Specific Controller (ASC) with a display and navigation buttons. It shall provide display and adjustment of SNVT inputs and SNVT outputs as shown.

Assessment

Ensure LDP documentation includes networked point schedules. Ensure plug-in and project application(s) are included in software submittal.



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Item	Priority	Category	Section	Requirement
18	High	DDC Hardware	2.14.4.b	All programming software required to program the GPPC shall be delivered to and licensed to the project site as specified. Copies of the installed GPPC application programs as source code compatible with the supplied programming software shall be submitted as specified. The submitted GPPC application program shall be the complete application necessary for the GPPC to function as installed and be sufficient to allow replacement of the installed controller with a GPPC of the same type.

Assessment

Ensure GPPC application and source code files are provided with software submittal. Contact submitting contractor for details concerning applications and source code files if the reviewer is unfamiliar with the vendor's products.



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Item	Priority	Category	Section	Requirement
19	Med	DDC Hardware	3.2.4.a	Each gateway shall communicate with and perform protocol translation for non-CEA-709.1B control hardware controlling one and only one package unit.
20	High	DDC Hardware	3.2.4.b	Non-CEA-709.1B control hardware shall not be used for controlling built-up units.

Assessment

Review record drawings and riser diagrams to ensure third party networks are not employed and gateway communicates with only one unit.

Review record drawings and riser diagrams to ensure that gateway communicates only with package unit controller, not third party external controls



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Compliance Tool

Item	Priority	Category	Section	Requirement
21	High	DDC Hardware	3.2.4.c	Non-CEA-709.1B control hardware shall not perform system scheduling functions.

Assessment

Review device point schedules to ensure scheduling not performed by the Gateway device. Ensure output (nvo) SNVT occupancy and mode are status points for equipment on the proprietary port of the gateway.



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Item	Priority	Category	Section	Requirement
22	High	Scheduling	3.4.2.2	The System Scheduler functionality shall reside in either a piece of DDC Hardware dedicated to this functionality or in the DDC Hardware controlling the system AHU. A single piece of DDC Hardware may contain multiple System Schedulers. A unique System Scheduler shall be provided for: each AHU including it's associated Terminal Units, and each stand-alone Terminal Unit (those not dependent upon AHU service)[or group of stand-alone Terminal Units acting according to a common schedule].

Assessment

Review As-Built Documentation to determine the location(s) of the default scheduler(s). The default scheduler may reside in one or more pieces of dedicated hardware, it may reside in certain brands of ANSI/CEA-852 LON to IP routers, or in a GPPC scheduler module. Once the scheduler is identified, if scheduling is performed in anything other than a GPPC, confirm a different output SNVT of SNVT_occupancy exists for each major system in the facility by reviewing the point schedules.



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Item	Priority	Category	Section	Requirement
23		Scheduling		Each System Scheduler shall provide the following functionality:
24	Med	Scheduling	3.4.2.a	Scheduled Occupancy Input: Accept network variable of type SNVT_occupancy (as defined in the LonMark SNVT List). Input shall support the following possible values: OC_STANDBY, OC_OCCUPIED and OC_UNOCCUPIED.

Assessment

Review Network variable list of the scheduler and identify an input SNVT_occupancy point for each system as defined by the project scope of work.



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Item	Priority	Category	Section	Requirement
25	Med	Scheduling	3.4.2.b	Occupancy Override Input: Accept network variable of type SNVT_occupancy (as defined in the LonMark SNVT List). Input shall support the following possible values: OC_STANDBY, OC_OCCUPIED, OC_UNOCCUPIED, and OC_NUL.

Assessment

Review Network variable list of the scheduler and identify an override input SNVT_occupancy point for each system as defined by the project scope of work.



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Item	Priority	Category	Section	Requirement
26	Med	Scheduling	3.4.2.c	Space Occupancy Inputs: For systems with multiple occupancy sensors, accept multiple inputs of network variable type SNVT_Occupancy (as defined in the LonMark SNVT List). Input shall support the following possible values: OC_OCCUPIED, OC_UNOCCUPIED, and OC_NUL. For systems with a single occupancy sensor, accept a network variable input of type SNVT_Occupancy or a hardware binary input (BI) indicating the space occupancy status as Occupied or Unoccupied.

Assessment

Review Network variable list of the system controller and identify Sensor(s) input(s) SNVT_occupancy point for each occupancy sensor as defined by the project scope of work.



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Item	Priority	Category	Section	Requirement
27	High	Scheduling	3.4.2.d	Air Handler Occupancy Output: For a System Scheduler for a system containing an air handler, output one or more SNVTs indicating the desired occupancy status as one of the following possible values: Warm-Up-Cool-Down (when required by the AHU Sequence of Operation), Occupied and Unoccupied.

Assessment

Review Scheduler Output Network variable list. Ensure output SNVT_occupancy point exists for each controlled system. Ensure Range of variable includes only the following values: OC_STANDBY, OC_OCCUPIED, and OC_UNOCCUPIED



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Item	Priority	Category	Section	Requirement
28	High	Scheduling	3.4.2.d	Terminal Unit Occupancy Output: For a System Scheduler for a stand-alone terminal unit, [a group of stand-alone terminal units acting according to a common schedule,] or a group of terminal units served by a single air handler, output one or more SNVTs indicating the desired occupancy status as one of the following possible values: Occupied and Unoccupied.

Assessment

Review Scheduler Output Network variable list. Ensure output SNVT_occupancy point exists for each controlled system. Ensure Range of variable includes only the following values: OCC_OCCUPIED and OC_UNOCCUPIED. Note: The possibility exists that the air handler will pass the occupancy command to the terminal units.



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Item	Priority	Category	Section	Requirement
29	High	Scheduling	3.4.2.e	Default Schedule: Incorporate a 24-hour 7-day default schedule as shown on the drawings which may be activated and deactivated by the System Scheduler Logic.

Assessment

Review Scheduler default schedule parameters in as-built documentation and verify that the default schedule is set for 24-hour 7-day operation.



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Compliance Tool – High Priority Items

- SNVTs used for network communications
- LNS database provided with As-Builts
- All software for controllers provided with licenses in As-Built documentation
- Gateway devices communicate with a single packaged unit only
- Gateway devices to other control system components are not allowed
- LON network utilizes only TP/FT-10 transceivers
- ASCs are LONMARK certified
- GPPC application programming software and source code provided in As-Builts
- LNS plug-ins provided in As-Builts
- System scheduler provided in building



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Summary of Requirements for an Open DDC System

- LNS Database
- Building Control Network: TP/FT-10
- Standard protocol: ANSI/CEA-709.1B
- SNVTs
- No gateways
- Points Schedule drawing
- Building Scheduler
- Software and licenses
- LONMARK certified ASCs
- LNS Plug-ins



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Lessons Learned

- LNS database submittal is a potential problem
- Fort Bragg – Success Story – use of tool identified 8 buildings installed under UFGS 23 09 23 that were not able to be integrated. Discussions with contractor (Bironas, Inc) resulted in repair of all databases at no cost to Fort Bragg.
- Post Installation Design Guides need to include items from model RFP with respect to controls systems
- Design Build projects require close scrutiny of control specifications to ensure UFGS intent is met with respect to LON controls.
- JACE, NAE, XL-15B - Beware! Only IP-852 routers.



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Questions & Answers



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