

## SECTION [26 09 43.19]

### WIRELESS NETWORK LIGHTING CONTROLS

**This section includes editing notes to assist the user in editing the section to suit project requirements. These notes are included as hidden text, and can be revealed or hidden by one of the following methods:**

Microsoft Word: From the pull-down menu, select “Tools”, then “Options”. Under the tab labeled “View”, select or deselect the “hidden Text” option. Microsoft’s ¶ button (located in the toolbar) can also be utilized to show all non-printing characters, which also reveals the hidden text.

#### PART 1 – GENERAL

##### 1.01. SUMMARY

###### A. Related Documents:

1. Drawings and general provisions of the Subcontract apply to this Section.
2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

###### B. Section Includes:

1. Wired and Wireless Vacancy/Occupancy Sensors
2. Wired and Wireless Daylight sensors
3. Wired and Wireless wall dimmers and switches
4. Wireless Controllers and Radios
5. Smart Luminaires and Smart LED Lamps
6. Networked Management Appliance
7. Networked Lighting Controllers
8. Networked Plug Load Controllers
9. Networked Meters.

##### 1.02. RELATED SECTIONS

- A. [01 00 00] General Requirements
- B. [23 09 00] Instrumentation and Control for HVAC
- C. [23 09 13] Instrumentation and Control Devices for HVAC
- D. [25 11 13] Integrated Automation Network Servers
- E. [25 15 16] Integrated Automation Software for Control and Monitoring Networks
- F. [26 05 00] Common Work Results for Electrical
- G. [26 06 50.13] Lighting Panelboard Schedule
- H. [26 06 50.16] Lighting Fixture Schedule

- I. [26 01 50] Operation and Maintenance of Lighting
- J. [26 08 00] Commissioning of Electrical Systems
- K. [26 09 00] Instrumentation and Control for Electrical Systems
- L. [26 09 13] Electrical Power Monitoring
- M. [26 09 23] Lighting Control Devices
- N. [26 24 00] Switchboards and Panelboards
- O. [26 25 00] Low-voltage Enclosed Bus Assemblies
- P. [26 27 00] Low-voltage Distribution Equipment
- Q. [26 27 13] Electricity Metering
- R. [26 28 00] Low-voltage Circuit Protective Devices
- S. [26 35 00] Power Filters and Conditioners
- T. [26 50 00] Lighting
- U. [26 51 19] LED Interior Lighting
- V. [27 00 00] Communications

#### 1.03. REFERENCES

[NECA 1 describes industry best practices for good workmanship in electrical construction. NECA 1 is approved as an American National Standard \(ANS\). For additional information, please see the NECA website:](#)

- A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2000

[Two types of design tests for relays and relay systems that relate to the immunity of this equipment to repetitive electrical transients are specified. Test generator characteristics, test waveforms, selection of equipment terminals on which tests are to be conducted, test procedures, criteria for acceptance and documentation of test results are described. This standard has been harmonized with IEC standards where consensus could be reached.](#)

- B. IEEE C37.90.1-2012 IEEE Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

[Adopted in all 50 states, the NEC is the benchmark for safe electrical design, installation, and inspection to protect people and property from electrical hazards.](#)

- C. NFPA 70 (2017) - National Electrical Code.

[NFPA 70B details preventive maintenance for electrical, electronic, and communication systems and equipment -- such as those used in industrial plants, institutional and commercial buildings, and large multi-family residential complexes -- to prevent equipment failures and worker injuries.](#)

- D. NFPA 70b (2016) - Recommended Practice for Electrical Equipment Maintenance.

NFPA 70E requirements for safe work practices to protect personnel by reducing exposure to major electrical hazards. Originally developed at OSHA's request, NFPA 70E helps companies and employees avoid workplace injuries and fatalities due to shock, electrocution, arc flash, and arc blast, and assists in complying with OSHA 1910 Subpart S and OSHA 1926 Subpart K.

E. NFPA 70e (2018) - Standard for Electrical Safety in the Workplace.

<https://www.ecfr.gov/cgibin/textidx?SID=82d023cfee18532354eef8df7d30a443&mc=true&node=pt47.1.15&rgn=div5>

F. Electronic Code of Federal Regulations Title 47 → Chapter I → Subchapter A → Part 15

<https://www.nema.org/Products/Pages/Lighting-Controls.aspx>

G. NEMA Section Lighting Systems | Lighting Controls – National Electrical Manufacturers Association

This standard assures that tested electrical equipment and systems are operational, are within applicable standards and manufacturer's tolerances, and are installed in accordance with design specifications. These specifications cover the suggested field tests and inspections that are available to assess the suitability for initial energization and final acceptance of electrical power equipment and systems.

NETA has developed the ANSI/NETA ATS to assist in the pre-energization inspection and startup of power equipment and systems. Electrical testing firms, architects, engineers, equipment owners, inspection authorities, and others should reference this document when inspecting power equipment after it is installed in the field. This type of testing identifies any damage that occurred during shipping, checks to assure that installation occurred in accordance with designs, and that all components are connected and function as part of a system as well as individually.

Acceptance tests are not manufacturers' factory tests. They comprise those tests necessary to determine that the electrical equipment has been selected in accordance with the engineer's requirements, installed in accordance with applicable codes and installation standards, and perform in accordance with their design and setting parameters. The ANSI/NETA Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems assists designers, specifiers, architects, and users of electrical equipment and systems in specifying required tests on newly-installed power systems and apparatus, before energizing, to ensure that the installation and equipment comply with specifications and intended use as well as with regulatory and safety requirements.

H. NETA ATS (2017) - Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

I. DLC Qualified Systems – DesignLights Consortium Networked Lighting Control System Technical Requirements V3.0

J. UL 916 – Underwriters' Laboratories Standard for Energy Management Equipment

K. UL 8750 – Underwriters' Laboratories Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products

- L. UL 773 – Underwriters' Laboratories Standard for Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting
- M. UL 60950-1 – Underwriters' Laboratories Standard for Information Technology Equipment - Safety - Part 1: General Requirements
- N. CSA C22.2
- O. UL 514C – Underwriters' Laboratories Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
- P. UL 1363 – Underwriters' Laboratories Standard for Relocatable Power Taps
- Q. UL 1449 – Underwriters' Laboratories Standard for Surge Protective Devices
- R. UL 2043 – Underwriters' Laboratories Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces

OSHA's standards contain requirements for NRTL product testing and certification for 39 product types. For example, in 29 CFR 1910.303, OSHA requires NRTL approval for many kinds of electrical equipment when they are used in the workplace. OSHA's website contains a listing of the type of products requiring NRTL approval.

[https://www.osha.gov/dts/otpca/nrtl/nrtl\\_faq.html](https://www.osha.gov/dts/otpca/nrtl/nrtl_faq.html)

ETL-US Electrical Testing Labs and UL - Underwriters Laboratories are examples

- S. NRTL Certified – Nationally Recognized Testing Laboratories

<https://www.zigbee.org/zigbee-for-developers/applicationstandards/zigbeehomeautomation/>

- T. ZigBee HA

- U. [2016 State of California Building Energy Efficiency Program Title 24 Requirements]

#### 1.04. SUBMITTALS

- A. Submit under provision of Section [01 22 00].
- B. Certificates: Certify that submitted equipment either meets specification as stated or meets specification through an alternate means and indicate the specific methodology used.
  - 1. Meets specification as stated.
  - 2. Meets specification through an alternate means and indicate the specific methodology used.
- C. Shop Drawings: The Subcontractor shall submit for approval Shop Drawings prepared in accordance with Section [01 33 00] "Submittal Procedures", and as required by other sections of the Specifications. Provide [five (5)] printed copies of:
  - 1. Product data sheets, installation and operation manuals, setup instructions on equipment, component devices, and accessories on manufactured system network devices. Include dimensions, colors, power requirements, and configurations.
  - 2. Schematic (one-line diagram) of system indicating planned locations and relationships of electrical components, network devices, and accessories in manufactured system.

3. Sequence of Operation to describe how system operates and performs in the building, including control schedules and clock schedules.
4. Manufacturer's Instructions including application conditions and limitations of use. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Provide electronic copies of all shop-drawing submittals utilizing Adobe PDF.

#### 1.05. QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum five (5) years' experience in the manufacturing of power management and control systems.

Companies introduce new products or make changes to existing systems, and having a contractor who is trained and up to date on product capabilities and installation requirements reduces the opportunities for installation issues and debugging issues that do arise.

- B. Installer Qualifications: Company certified and approved by the power monitoring controls equipment manufacturer.
- C. Products shall be tested, approved and labeled/listed by a nationally recognized testing laboratory (NRTL) as listed in [26 05 00] "Common Work Results for Electrical."
- D. Electrical equipment and materials shall be new and within one year of manufacture, complying with the latest codes and standards. No used, re-built, refurbished and/or re-manufactured electrical equipment and materials shall be furnished on this project.

#### 1.06. DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in unopened cartons or bundles as appropriate, clearly identified with manufacturer's name, Underwriter's or other approved label, grade or identifying number.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dust, dirt, water, construction debris, and traffic.

#### 1.07. WARRANTY

DLC requires a full five (5) year manufacturer's warranty for all system components excluding network and IT equipment, which are a standard one (1) year.

- A. Provide manufacturer's full [one (1) year] [three (3)] [five (5) years] warranty covering 100% parts and 100% labor from the date of system startup completion.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

- A. Acceptable Controls Manufacturer: [Autani] [EnOcean]:
- B. Acceptable Device Manufacturers: [EnOcean] Meet the ZigBee HA/3.0 and EnOcean Standards with verifiable compatible firmware

\*\*\*OR\*\*\*

C. Basis of design, and with prior approval including the specified requirements of this section, one of the following:

1. [Autani]
2. [EnOcean]
3. [Insert manufacturer's name]

Delete items 1 through 3 if substitutions are not permitted

D. Substitutions: [Not permitted.] [Under provisions of Division 1.]

1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of [10] working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
2. Any substitutions provided by the contractor shall be reviewed at the contractor's expense by the electrical engineer at a rate of [\$150.00] per hour.
3. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring. The contractor shall provide complete engineered shop drawings (including power wiring) with deviations for the original design highlighted in an alternate color to the engineer for review and approval prior to rough in.

## 2.02 GENERAL

A. Products included in this specification include all Modular Network Components. See Section [26 05 00] for additional Power Delivery Components

## 2.03 ENERGY MANAGEMENT NETWORK HARDWARE

An Autani Manager is a centralized control for the premise. It is the login point, scheduling point, and overall management. This is where the building data is maintained and system management is housed. This is the computer and "brains" of the system. There can only be one manager.

An Autani CORE is localized management and reports everything back to the manager. A CORE is essentially a "stripped down" manager, and multiple COREs can manage multiple zones and aggregate all of the data back to a single manager.

This is the IT and network backbone of the wireless control system. To manage the entire building (premise), you must have a manager. Otherwise, the individual rooms would operate as stand alone systems and unmanaged systems with limited energy savings and control capabilities. With a managed network, the owner would have demand response, advanced time scheduling. Moreover, the owner has visibility into how each room is operating and has documentation on how the individual spaces are operating.

Premise based controls allow for the owner to maintain control over their spaces even when the "cloud" or Internet network goes down. In an on premise controlled system, the control is always maintained locally.

The Autani system has the option to connect to the cloud; however, since the system does not require cloud connectivity, the owner will always have at a minimum access to the management appliance and have control over the lighting system.

A. Provide [Autani Manager] Networked Management Appliance and integrated devices with premises-based industrial control processor that integrates and manages Building Management Systems through an integrated wireless mesh communications network.

1. Mounting: [Wall bracket] [table-top]

Performance data is stored locally on the hard drive. With a 120 GB hard drive, you can typically have 2 to 3 years worth of data. For larger facilities or a need for longer data retention, then specify a larger hard drive.

2 GB RAM is sufficient for system performance. There is not much value to increasing this level unless you have a personal preference. The data can be backed up incrementally to cloud based servers if the owner prefers.

2. Storage: [120GB] with HDD, [2GB RAM]

LAN provides for remote access and control. This allows for authorized personnel to make changes, troubleshoot, and manage from a remote location.

3. Remote Access I/O Support

The LAN allows access to the Autani Manager Networked Management Appliance Device

a. Provide LAN: (1) 10/100/1000 Ethernet, TCP/IP v4

One is required to connect to the transceiver. The second allows for connection to a wired system.

b. Serial: 2-1 dedicated internal, (1) open

The USB allows for unintended system changes to be modified through the insertion of a thumb drive.

c. USB: (2) USB 2.0 host interfaces

Since the system hardware is connected, all access to the system will occur through the primary Network Management Appliance Device. There are slight differences in the specifications from the Autani Manager and Autani CORE.

B. Provide [Autani CORE™] premises-based industrial control processor that integrates with the [Autani Manager] Networked Management Appliance through an integrated [wired network] [wireless mesh communications network].

1. Mounting: [IT Closet] [Ceiling Mount] [Wall Mount]

Performance data is stored locally on the manager's hard drive, so a minimal amount of storage is required on the ancillary devices. Network, schedule for the network, and how to manage the network will be stored on the CORE's hard drive.

Minimal hard drive space is required and 2 GB RAM is sufficient for system performance.

2. Storage: [1 GB] with HDD, [2GB RAM]

Because the Manager is the main system controller, no serial ports or USB reports would be required.

3. Remote Access I/O Support: LAN: (1) 10/100/1000 Ethernet, TCP/IP v4
- C. Hardware power, operational, and system performance for [Autani Manager] [Network Management Appliance Device] [Autani CORE] [premises-based industrial control processor].

Endpoint capacity is the number of control or reportable data points from a radio device. Each device supports approximately 150 radios.

As an example, a multi sensor that reports occupancy and daylight has two end points.

When the endpoint capacity is going to be exceeded, an additional manager or CORE is required. Zigbee protocol (white paper) regulates message traffic and once the node traffic is exceeded, the number of “dropped messages” increases. Once the messages are dropped, then the system will not operate as designed / intended. Lights will not operate as intended.

1. Endpoint Capacity: [2000] endpoints

This is a low power device that does not consume excess energy or add substantially to the building electrical load.

Since the wireless lighting control system is typically connected to the local network, it is typically located in an IT closet. This small additional load would also be connected to the UPS or the owner can have a dedicated UPS depending upon how much up time the owner would want during a power interruption.

2. Power
  - a. Power Supply: 12VDC UL/FCC/CE approved power block
  - b. Estimated Draw: 14W maximum load
3. Radio Network

ZigBee requirement takes the scheduling on the processor and communicates this to all of the devices. Data is also reported back to the manager from the devices.

- a. IEEE 802.15.4-2003 2.4GHz ISM compliant

This is required to communicate with the EnOcean devices. If you want to talk to an EnOcean device, then you must have an EnOcean gateway or a an Autani WRC (see “WIRELESS NETWORKED SWITCHING AND DIMMING LIGHTING CONTROLLERS” below).

- b. EnOcean 902MHz Compliant through peripheral devices

The radio “helps us” get out of the IT closet. A radio with substantial power can “punch out” of that room to reach the appropriate devices.

- c. Range: Approximately 2000’ line of sight transmit/receive for 2.4GHz and 80’ line of sight transmit/receive for 902MHz peripheral devices

4. Regulatory Approvals

CSA is for Canadian projects



- a. [UL60950-1] [CSA C22.2]

IC is for Canadian projects

- b. [FCC (V8NZRB1000152) Certified Class B Digital Device, FCC Part 15C] [IC (7737A-ZRB1000152)]

DLC requires that different lighting system components and devices are approved. See "Networked Lighting Controls QPL"

<https://www.designlights.org/lighting-controls/download-the-qpl/>

- c. Local Utility Requirement: [DLC]

Electronics need to be handled with care and should be installed indoors in a controlled environment

5. Operating Environment Conditions
  - a. Operating Temperature: 0° to 70°C
  - b. Storage Temperature: -25° to 80°C
6. Protocols

Required for any communication with a BACnet building management system.

- a. Building Management Integration: [BACnet MS/TP] [BACnet/IP] [MODBUS] [Tridium Niagara AX]

ZigBee requirement takes the scheduling on the processor and communicates this to all of the devices. Data is also reported back to the manager from the devices

- b. Wireless: 802.15.4 with mesh networking, including ZigBee HA/3.0
- c. Ethernet: HTTP/HTTPS, FTP
- d. Security: Internal firewall, IPSEC, isolated wireless and internal processors

## 2.04 ENERGY MANAGEMENT SOFTWARE

Local control gives you control even if the Internet goes down. This allows the owner/operator of the building to always have direct control. Remote Access allows the management of multiple sites from one location and allows for remote support.

All ZigBee HA and autaniNet devices are configured, managed, and controlled via HTML (web) pages provided over the [LAN] [WAN] by [Autani EnergyCenter™] Software installed on the [Autani Manager] Networked Management Appliance.

- A. Provide [Autani EnergyCenter™] energy management software installed on the [Autani Manager] Networked Appliance with wireless gateway for [local] [remote] access for programming and monitoring of the lighting system.

Browsers supported are Chrome (preferred) with support immediately available for FireFox and Safari.

- B. Provide browser-based graphic user interface to program, monitor, coordinate, and control the management and control functions, both locally on the device and remotely via connected devices.

As new devices are discovered on the network, those systems are automatically populated into the controls software. BacNet or PRO™ can also be added to the system. PRO™ is an Autani fully customizable control sequence that allows the end user to modify the different controls scenarios to meet most sequences of operations.

To determine if the system is either standard or custom, a sequence of operations must be specified. For example, there can be scenarios where the engineer wants to link a daylight sensor to the HVAC system. In this scenario, the fully customizable software solution would be required. The PRO™ option allows for multiple options to customize sequences of operations that go beyond typical control sequences.

- C. Optimize lighting through the use of [custom] [standard] schedules, occupancy, light level, events, and demand response programs with prioritized load shedding via compatible [EnergyCenter™] software that is [customizable [PRO™]] [standardized] [BacNet enabled] for browser-based management and control of [lighting] [HVAC] [metering] systems that may be connected to the building management control system.

A typical 120GB hard drive will store 2 years of energy data. This should be coordinated with the hard drive system requirement specifications. The end user has immediate access to the energy performance of their systems and devices for the 2-year period. Customer owns and retains all of their data that is housed in their system.

- D. The Networked Management Appliance to retain and store all system events for [two (2) years] so that data can be analyzed to further optimize energy use and savings.

Raw data should be in a format that is easily aggregated to facilitate system management and building performance.

- E. Provide real-time and historical lighting energy usage with real-time consumption data through charts, graphs, and reports.

This allows the customer to view data in a group that makes sense to them and their energy management goals. As an example, a company group systems or areas within building(s) or sites to incentivize and compare energy consumption among different groups to identify energy waste. This also enables the person responsible for the building energy management system to identify manual overrides that may contribute to energy waste or energy usage during unoccupied periods. This information can be used to determine actions necessary to achieve energy usage targets or to better understand the different usage requirements in a space.

- F. Provide reporting for user-defined filters as well as per individual meter for targeted analysis of consumption cost.

This allows for customizable reports to senior management to justify budgets or make decisions on system expansion. This can be utilized as a means to drive additional energy management and capitol improvements from a facilities perspective. *"This is where we can maximize our savings if we make this change."*

- G. Provide comprehensive and actionable information to users in the form of [on-screen displays] [printed reports] [exportable data] [PDF] [CSV].

Real time alerts help the building owner from experience expensive energy consumption, non-system performance, and nuisance issues before they happen. No surprises on next month's utility bill.

- H. Provide real-time alerting for user-defined and system events via [email] [SMS].

This option allows for a real time display show how building operations are aligning with corporate energy policy / goals. Reinforces the need to not waste resources and be a good steward for the environment.

- I. Provide estimated and actual data on [daily cost] [energy consumption kWh] [pounds of CO2 generated].

This is to ensure that only authorized people can login, and that they only have control over specific areas that have been assigned to them. This feature will also log "who" accessed the system, and "what" changes were made. Only the administrator login can create new accounts. It is recommended that the administrator login not be utilized by multiple people so that records can be kept on who, what, why, and when features were modified.

- J. Provide secure, password-protected access with assignable access rights to prevent unauthorized users from logging into the system or effecting changes upon the system.

Over the air updates minimize future upgrade costs by reducing the requirements for physical access to the devices.

- K. Provide over the air mechanism to securely upgrade or change firmware on all connected devices.

ZigBee HA defines functionality for programming endpoints and communication protocols. The system automatically connects different devices from multiple manufactures to "mix and match" to ensure that those products work together.

- L. Interface with Approved Third-Party ZigBee HA devices and fixtures.

Software is adding scheduling and basic associations when the lighting system joins the ZigBee network. The interface and commissioning of the lighting system components will customize the scheduling and sensor associations to meet lighting system performance requirements.

- M. Interface with [Autani's] wireless fixture and room controllers, wired and wireless motion sensors, and third-party motion sensors and photocells.

This specification point is utilized when the lighting system is metered. Metering provides actual data vs. estimated data. Delete if individual metering of the lighting system is not required.

- N. Provide [local] [remote] access to real-time metering of energy consumption, including real energy, reactive energy, apparent energy, voltage, current and power factor for each phase.

WRC should be utilized when you want to control multiple circuits from a single point or looking for semi-autonomous operation in case the network closet has a power failure. If you

are looking to integrate locally with EnOcean controls, then the WRC should be the primary choice.

This is not compliant with a DALI fixture.

## 2.05 WIRELESS NETWORKED SWITCHING AND DIMMING LIGHTING CONTROLLERS [AUTANI WRC]

Conformal coating is required if a device is being installed in a non-conditioned environment (such as outdoors or next to a device where condensation from the HVAC system could occur) to prevent device failure.

The 902 MHz is specific to EnOcean, and this functionality is integrated in every WRC.

- A. Provide [Wall Switch with 902MHz Module A02-01-1160-03] [Wall Switch with 902MHz Module conformal Coated A02-01-1160-04] plenum rated device designed specifically for the control and management of circuit-based loads.

This allows for local control and scheduling. As a fail-safe measure, if the device is unable to communicate with the manager, then the device will operate with a nominal occupancy based schedule.

- B. Provide remote management and control of lighting levels via schedules, sensor inputs, overrides, and curtailments.

This device is configurable to any of the combinations below.

1. Up to two (2) on/off circuits
  2. Up to two (2) dimmable circuits with low end cutoff
  3. One (1) on/off circuit and one (1) dimmable circuit with low end cutoff
  4. Two (2) on/off circuits and (2) dimmable circuits (dimmed to zero)
  5. Two (2) on/off circuits with power pack. 2<sup>nd</sup> circuit requires a powerpack.
- C. Provide switching of up to (2) [120] [277] VAC single pole 20-amp circuits and dimming of up to (2) 0-10V dimmable loads [with power pack].

24V DC is the wired version. EnOcean is the wireless version that is (energy harvested) kinetic or solar powered with a backup battery.

- D. Fully compatible with non-proprietary [occupancy/vacancy sensors] [daylight sensors] [low voltage sensors] [battery backup].

1. [3V DC] [24V DC] [EnOcean] Occupancy/Vacancy Sensors
2. [24V DC] [EnOcean] Daylighting Sensors with 0-10V DC response

- E. Bind local [EnOcean] rocker switch to support:

1. [5] wirelessly linked [EnOcean] rocker switches per circuit for wireless local control.
2. [10] wirelessly linked [EnOcean] occupancy sensors per circuit for wireless local control.

Switches are required for local override. Momentary switches (press and release) can be push button or toggle and will change the state of the lights any time that they are activated. Maintained (Toggle) switches can be configured for on/off or 3-way operation.

F. Provide [momentary] [maintained] contact closure per circuit for local control.

1. Momentary override switches (toggle mode).
2. Standard lighting switches [toggle mode] [switch mode]
3. [EnOcean] wireless wall switch rocker pad

As an example, if you have a closet that you want the light to turn on when the door is opened, then the door switch would be utilized.

4. Door and window contacts (switch mode)

Lights are only turned on/off with a key so no one can override without the key. The keyswitch used here would be an OPEN—CLOSED (OFF-ON) type switch, and would be used in place of a typical ON-OFF switch. This would provide a security feature where only authorized individuals could turn lights ON or OFF by using the key in the switch. Functionality in the software would be a Switch Mode type of switch (defined ON and OFF positions).

5. Keyswitch (switch mode)

G. Provide [AutaniNET Wireless Range Extender with 24VDC Power Supply with parallel blade plug] accessories in quantities and configurations as shown on the Project Drawings.

This is a local override where off overrides the occupancy schedule and sensors in the room until the room is locally turned on (normal operating mode).

H. Provide capability to program a circuit such that the setting of a local control in the “off” position overrides all inputs, sensors, schedules, curtailments, and presets.

1. LED 1 – red LED used to indicate circuit status and stand-alone timeout
2. LED 2 – green LED used to indicate Network or Stand Alone Status
3. SW1 – Local Pushbutton used to join or leave network, or establish stand-alone mode
4. SW2 – Local Pushbutton used to toggle circuits on/ off and to set stand-alone mode timeout

I. Provide local controls and status indicators.

In order to maintain a reliable mesh network, range extenders maybe necessary to reach isolated devices. 600 feet line of sight is the unobstructed range; however, different construction materials and obstacles may reduce the range. The range extender has a 2,000-foot line of sight of unobstructed range.

Sometimes during special construction requirements such as a room with cinder block walls and metal doors, the range extender maybe required to "punch through" to those types of spaces. As a design tip, range extenders can be located in a hallway to reach groups of devices located within dense construction walls and ceilings.

- J. Communicate wirelessly with one another, the Network Management Appliance, and other network devices via a reliable 802.15.4 based mesh network.

This defines the scheduling of the devices. All devices will have a default schedule applied when joined to the manager. It is recommended that the manager device be installed first, and the default schedule modified to meet initial lighting requirements.

Many times the lighting will be installed and utilized before the sensors are installed to facilitate construction. Configuring the default schedule to account for this will prevent delays in construction when lights might be automatically turned off.

Detailed scheduling is usually configured remotely and is included with system training to the customer/end user.

- K. Managed by a user-defined combination of adjustable [schedules] [over-rides] [curtailments] [sensor inputs] [local controls] via a 24-hour x 7 days x 365-day schedule. Behavior of the lighting controller and associated devices responsive to light level, sensors, and timing of automatic shutoffs during vacancy.

As an example, if there is an office at the end of a hallway that is occupied, then the system can ensure that the connected hallway lights are on (dimmed) to make sure the occupant doesn't walk into a dark hallway or has the perception of being isolated.

- L. Sensor devices connected to the wireless controller should be available for other network devices to utilize by mapping the input and data of any sensor connected to a Lighting Controller to any or all other Lighting Controllers and Networked devices in the system.

This can be operated as a standalone network without a manager. This may be intentional if the manager is not in its final location if installation occurs during multiple phases as part of the construction timeline.

- M. Provide ability to operate as a standalone, non-networked device responding to local switch and sensor inputs.

This is the fail-safe mode should the device lose connectivity to the ZigBee network. If the network fails for any reason, the devices will operate until the network is restored. For example, if someone trips the breaker to the IT closet, the system will still operate until power is restored.

- N. In the event of Network failure, the Lighting Controller to operate as a stand-alone device with local control and response to Sensor Inputs.

This defines scheduling and functionality for a non-networked device. This is utilized if there is no manager available for commissioning.

This provides a way for the installer to configure the device manually until the manager is online to control the network. Also, if power is disrupted to the manager, then the pushbuttons would be able to control and operate the lights within the space.

- O. Configurable via local pushbuttons for [10 second] [18 minute] [30 minute] timeout for automatic shutoff of controlled circuits by the Lighting Controller in non-networked mode.

This provides general information on the WRC device, please check the product data sheet for electrical ratings.

The voltage ratings give the system an ability to address the different voltage requirements of different lighting fixtures utilized in typical installations.

P. Device ratings and approvals

1. Input Voltage Range: 85 to 305VAC
2. Recommended Voltage: 100 to 277VAC

The radio network allows for EnOcean devices to be integrated into the ZigBee network. The benefit of having a stronger range allows for a more dispersed network and fewer "hops" to get to an end device, resulting more reliable and stable communication.

3. Radio Network

- a. IEEE 802.15.4-2003 2.4GHz ISM compliant; Range: Approx. 600' LOS transmit/receive.
- b. EnOcean 902MHz; Range: Approx. 80' LOS

4. Regulatory Approvals

- a. UL 916 CSA C22.2 No. 205 (Listing E113003)
- b. UL 2043 Plenum Rated

This is the FCC listing for the ZigBee Radio.

- c. FCC (V8NWAT1000153) & IC (7737A- WAT1000153), Certified Class B Digital Device, FCC Part 15

This is the FCC listing for the EnOcean Radio.

- d. FCC (SZV-TCM320U) & IC (5713A- TCM320U), Certified Class B Digital Device, FCC Part 15

AFC should be utilized when you have a single circuit or an individual fixture or you do not anticipate utilizing EnOcean controls.

Compared to the WRC, the AFC has greater range than the WRC in the same environment. The AFC does not have native integration with EnOcean.

Where the WRC is "bi-lingual" can communicate directly with EnOcean devices, the AFC needs a translator (i.e. the Manager) to interact. The 902 MHz is specific to EnOcean, and this functionality requires an EnOcean Gateway (EnOcean Bridge) or a WRC.

The AFC is a scaled down version of the WRC in terms of functionality. The AFC is only a single circuit, whereas the WRC has 2 circuits of control, and dimming and on/off are linked together.

## 2.06 WIRELESS NETWORKED DIMMING FIXTURE CONTROLLER [AUTANI AFC-A]

The AFC-A is a dimmable fixture controller that does not have an integrated occupancy sensor. The AFC-A can be utilized for circuit control or individual light control.



AFC-A Dimming Fixture Controller, 0-10VDC interface, 120 to 347VAC requires UVPP for power and low-end cutoff.

The AFC-A has a photo sensor input for daylight harvesting.

- A. Provide wireless plenum rated [Autani AFC-A A02-01-0009-01] device designed specifically for the control and management of dimmable lighting circuits and individual lighting fixtures.
- B. Provide remote management and control of lighting levels via schedules, sensors inputs, overrides, and curtailments.

The AFC-A is designed to comply with IEC 60929 (Annex E) and can provide control of up to ten (10) 0-10V DC dimmable fixtures on a single circuit. Maximum numbers of fixtures are controlled by two variables: (1) Circuit load per light (relay limit for on/off), and (2) Dimming current per driver or ballast (maximum 2mA per fixture for 10 fixtures, up to 20mA max per circuit).

Please check local code requirements because some codes will require individually addressable fixtures (one AFC per luminaire).

This is not compliant with a DALI fixture.

- C. Provide control of up to ten (10) 0-10V DC dimmable [fluorescent] [LED] lighting fixtures.
- D. Fully compatible with non-proprietary [occupancy/vacancy sensors] [daylight sensors] [0-10VDC photocells] [low voltage sensors].

AFC-A Dimming Fixture Controller, 0-10VDC interfaces, 120 to 347VAC requires a Universal Voltage Power Pack for power, low-end cutoff.

- E. Provide [Autani AFC-A] Dimming Fixture Controllers and [UVPP Universal Voltage Power Pack] [0-10VDC Local Dimmer Control with On/Off switch] [AutaniNET Wireless Range Extender with 24VDC Power Supply with parallel blade plug] accessories in quantities and configurations as shown on the Project Drawings.
- F. Communicate wirelessly with one another, the Network Management Appliance, and other network devices via a reliable ZigBee based mesh network.

This defines the scheduling of the devices. All devices will have a default schedule applied when joined to the manager. It is recommended that the manager device be installed first, and the default schedule modified to meet initial lighting requirements.

Many times the lighting will be installed and utilized before the sensors are installed to facilitate construction. Configuring the default schedule to account for this will prevent delays in construction when lights might be automatically turned off.

Detailed scheduling is usually configured remotely and is included with system training to the customer/end user

- G. Managed by a user-defined combination of adjustable [schedules] [over-rides] [curtailments] [sensor inputs] [local controls] via a 24-hour x 7 days x 365-day schedule. Behavior of the lighting controller and associated devices responsive to light level, sensors, and timing of automatic shutoffs during vacancy.



This allows a sensor to be able to be connected to multiple devices via software. As an example, if there is an office at the end of a hallway that is occupied, then the system can ensure that the connected hallway lights are on (dimmed) to make sure the occupant doesn't walk into a dark hallway or has the perception of being isolated.

- H. Sensor devices connected to the wireless controller should be available for other network devices to utilize by mapping the input and data of any sensor connected to a Lighting Controller to any or all other Lighting Controllers and Networked devices in the system.

This always provides local control of the device.

- I. Provide ability to operate as a standalone, non-networked device responding to local dimming and sensor inputs.

This is the fail-safe mode should the device lose connectivity to the network. If the network fails for any reason, the devices will operate until the network is restored. For example, if someone trips the breaker to the IT closet, the system will still operate until power is restored.

- J. In the event of Network failure, the Lighting Controller to operate as a stand-alone device with local control and response to Sensor Inputs.

This provides general information on the AFC device, please check the product data sheet for electrical ratings.

The voltage ratings give the system an ability to address the different voltage requirements of different lighting fixtures utilized in typical installations.

K. Device ratings and approvals

1. Input Voltage Range: 12 to 30 VDC
2. Recommended Voltage: 12 to 24 VAC / VDC

The radio network allows for EnOcean devices to be integrated into the ZigBee network. The benefit of having a stronger range allows for a more dispersed network and fewer "hops" to get to an end device, resulting more reliable and stable communication.

3. Radio Network: IEEE 802.15.4-2003 2.4GHz ISM compliant; Range: Approx. 2000' LOS transmit/ receive
4. Regulatory Approvals
  - a. UL 916 CSA C22.2 No. 205 (Listing E113003)
  - b. UL 2043 Plenum Rated

This is the FCC listing for the ZigBee Radio.

- c. FCC (V8NZRB1000152) & IC (7737A- ZRB1000152), Certified Class B Digital Device, FCC Part 15

Wired motion sensors do not require batteries or external sources of power. The wired sensors are either powered from the WRC or the driver/ballast, and provide a direct signal input into the device that is being controlled. Multiple wired sensors can be wired together and will appear as a single sensor on the device.

The wired mini mounts on the “T-rails” in a ceiling grid and discretely blends into the ceiling system.

Specify either passive infrared (PIR) or dual tech if the ultrasonic performance is required. Bathrooms are more likely to utilize dual technology sensors because of PIR blind spots due to the stalls.

## 2.07 WIRED MOTION SENSORS

- A. Provide [Autani MINI] [passive infrared (PIR)] [dual technology (ultrasonic and PIR)] wired motion sensor. Motion sensor mode of operation to be configured with [EnergyCenter™] energy manager software.

Code often specifies when Vacancy mode is required.

### 1. Operation

- a. Smart On/Off Mode: Lights turn on when coverage area is occupied, and turn off when occupancy is no longer detected after a predetermined time delay.
- b. Vacancy Mode: Lights turn on only when an occupant turns on lights using a local switch, and turn off when occupancy is no longer detected after a predetermined time delay.

PIR do not detect through IR obstructions, such as cube walls, bathroom stalls, or windows.

### 2. Detection: PIR sensor detects heat and movement.

As an example, if there is an office at the end of a hallway that is occupied, then the system can ensure that the connected hallway lights are on (dimmed) to make sure the occupant doesn't walk into a dark hallway or has the perception of being isolated.

- a. Sensor Output: Contacts rated to operate the connected relay.
- b. Sensor is powered from the [Autani] wireless room controller.
- c. Mounting: [ceiling] [wall] mounted
  - i. [Ceiling mounted to acoustical ceiling T-grid].
  - ii. [Surface mounted].
- d. Indicator: LED display, to show when motion is detected during testing and normal operation of sensor.

Detection ranges are device specific. Standard sensors have approximately a 32-foot range and high bay sensors can be 45 feet or more depending upon the sensor. Must know the ceiling height and mounting location to select the appropriate sensor.

Use the Autani Mini for normal office conditions of 10 to 12 foot ceilings. Use a high bay type of sensor for high vestibules, open foyers of 2+ stories, etc.

- e. Detection range of [32 feet]. Multiple occupancy sensors may be connected to the [Autani] wireless room controller

As an example, if there is an office at the end of a hallway that is occupied, then the system can ensure that the connected hallway lights are on (dimmed) to make sure the occupant doesn't walk into a dark hallway or has the perception of being isolated.

3. Sensor devices connected to the wireless controller should be available for other network devices to utilize by mapping the input and data of any sensor connected to a Lighting Controller to any or all other Lighting Controllers and Networked devices in the system.

Accessories may be required when connecting multiple sensors to a single device or if there is a large distance between where the sensor is located and the controlled device.

Extension cords have also been utilized when a sensor is located above a hard ceiling or wall, and the contractor locates the controller in a more accessible location.

4. Provide optional accessories [Modular 25ft. RJ-11 Extension Cord] [Modular Splitter] [6 pin modular Coupler (Female RJ-11 to Female RJ-11) for in-line extension] [Sensor Mounting Bracket] to facilitate access for maintenance.

Wireless motion sensors are utilized when pulling wire is difficult or prohibited.

Wireless sensors are also advantageous to use when a single sensor is directly controlling multiple local devices. In an EnOcean configuration, a sensor can trigger an immediate response to those devices located within the range of the wireless sensor.

## 2.08 WIRELESS MOTION SENSOR

- A. Provide [EnOcean] wireless passive infrared (PIR) motion sensors with mode of operation to be configured with [EnergyCenter™] energy manager software.

Code often specifies when Vacancy mode is required.

1. Operation
  - a. Smart On/Off Mode: Lights turn on when coverage area is occupied, and turn off when occupancy is no longer detected after a predetermined time delay.
  - b. Vacancy Mode: Lights turn on only when an occupant turns on lights using a local switch, and turn off when occupancy is no longer detected after a predetermined time delay.

PIR do not detect through IR obstructions, such as cube walls, bathroom stalls, or windows.

2. Detection: PIR sensor detects heat and movement.

Full utilization of the sensor across multiple devices requires the sensor to be discovered and managed by the Autani manager.

3. Sensor Output: Wireless signal is sent via mesh network to the [Autani Manager] Networked Management Appliance.
  - a. Mounting: [Ceiling] [wall] mounted.

For local single room response, utilize a WRC. For multiple device use either the WRC or the EnOcean Gateway to forward the device signal to the Autani manager.

- b. Communicate wirelessly with one another, the Network Management Appliance through the [Autani WRC] [EnOcean Gateway] wireless room controller via a reliable ZigBee based mesh network.

As an example, if there is an office at the end of a hallway that is occupied, then the system can ensure that the connected hallway lights are on (dimmed) to make sure the occupant doesn't walk into a dark hallway or has the perception of being isolated.

4. Sensor devices connected to the wireless controller should be available for other network devices to utilize by mapping the input and data of any sensor connected to a Lighting Controller to any or all other Lighting Controllers and Networked devices in the system.

#### B. Device ratings and approvals

Coin cell is strongly recommended in spaces with periods of no motion or no light, like a janitor closet or a bathroom.

1. Solar powered [with coin cell battery backup] sensor.

The radio network allows for EnOcean devices to be integrated into the ZigBee network. The benefit of having a stronger range allows for a more dispersed network and fewer "hops" to get to an end device, resulting more reliable and stable communication.

2. Radio Network: EnOcean 902MHz with approximate range of 80' LOS transmit/ receive.
3. Regulatory Approvals: FCC (SZV-STM300U) & IC (5713A- STM300U)
4. Detection Range
  - a. Ceiling Mounted: 40' diameter
  - b. Wall Mounted: 50' wide angle lens, 100' long range lens

#### 2.09 WIRED DAYLIGHT/PHOTO SENSORS

See [26 09 23] Lighting Control Devices for Daylight Sensor specifications

- A. Provide [Leviton] automatic [dimming] [zoned switching] control to implement energy saving strategy through the use of wired 0-10V dimming photocell.

Multiple photo sensors in a single zone will cause oscillations, and the controls will not operate properly. Examples of zones include primary side lit, secondary side lit, sky lit, etc.

- B. One photocell per lighting zone.

Wired photo cells should not be wired in parallel and should not be wired to multiple devices.

- C. One wired photocell per [Wireless Networked Switching and Dimming Lighting Controller] [Autani WRC] [Wireless Networked Dimming Fixture Controller] [AUTANI AFC-A]

The delayed response to adjust the fixture light level is configurable via the energy management software. There can be a delayed response to keep the light levels from constantly changing due to things such as cloud cover and temporary "shading". This is ultimately the preference of either the owner or designer of the lighting system.

- D. Provide configurable [delayed] [instantaneous] lighting response [20 seconds] [ ] to account for transient changes.
- E. Mounting: [ceiling] [wall] mounted
  - 1. [Ceiling mounted to acoustical ceiling T-grid].
  - 2. [Surface mounted].

## 2.10 WIRELESS DAYLIGHT/PHOTO SENSORS

See [26 09 23] Lighting Control Devices for Daylight Sensor specifications

- A. Provide [EnOcean] automatic [dimming] [zoned switching] control to implement energy saving strategy through the use of wireless dimming photocell.

Multiple photo sensors in a single zone will cause oscillations, and the controls will not operate properly. Examples of zones include primary side lit, secondary side lit, sky lit, etc.

- B. One photocell per lighting zone.

The delayed response to adjust the fixture light level is configurable via the energy management software. There can be a delayed response to keep the light levels from constantly changing due to things such as cloud cover and temporary “shading”. This is ultimately the preference of either the owner or designer of the lighting system.

- C. Provide configurable [delayed] [instantaneous] lighting response [20 seconds] [ ] to account for transient changes.
- D. Mounting: [ceiling] [wall] mounted
  - 1. [Ceiling mounted to acoustical ceiling T-grid].
  - 2. [Surface mounted].

It may not be practical or permissible to pull wire for a switch.

You may also want a “portable” switch that you can carry an extra switch with you. As an example, the receptionist may hold multiple labeled switches that can turn lights on/off where the primary switch is located in a locked room.

All of these devices can be either wired or wireless. Wireless is specified below.

## 2.11 WIRELESS WALL SWITCHES [ENOCHEAN ROCKER PAD]

- A. Provide self-powered wireless [EnOcean Single Rocker Pad] [EnOcean Double Rocker Pad] standard wall switches to control the [“ON” and “OFF” state] [Dimming Level]. Configure multiple wireless wall switches in [2] [3] [4] way switch configurations.

Functional operations are (1) On/Off, (2) continuous dimming, and (3) step dimming. In step dimming, each press of the paddle changes the light level by a pre-defined percentage. For continuous dimming, when the paddles are pressed and held, the light level dims up/down until the desired light level is reached.

Some codes may require continuous dimming, while some codes require a minimum number of steps.

1. [On/Off Operation: Lights turn on, off when the paddle is touched.] [Dim level when the device is pressed and held]
  2. Sensor Output: Wireless signal is sent via mesh network to the [Autani Manager] Networked Management Appliance.
  3. Kinetic energy powered sensor.
  4. Mounting: Wall [surface] [box] mounted
- B. Device ratings and approvals
1. Electrical: Kinetic energy powered.
  2. Radio Network EnOcean 902MHz with approximate range of 80' LOS transmit/ receive.
  3. Regulatory approval: FCC (SZV-PTM210U) & IC (5713A- PTM210U)

Individual LED lamps and light fixtures can be controlled directly through the energy management system.

## 2.12 SMART LUMINAIRES AND SMART LED LAMPS

- A. See Section [26 06 50.16 Lighting Fixture Schedule] [26 50 00 Lighting] [26 51 19 LED Interior Lighting] for ZigBee compliant luminaires and lamp compatibility.
- B. Communicate wirelessly with [LG] [Philips / Signify] [Smart LED Lamps] [Smart Luminaires] [Smart Retrofit Kits] [Smart LED Lamps]

As lighting designs evolve to providing light at the task level and the increasing use of electronic power charging devices, the electric load consumed at the receptacle will further increase. Smart plug load control can be connected to occupancy sensors and master schedules to ensure that electrical equipment with "phantom" loads (draw energy when not in use) can be minimized or eliminated when the building is not in use.

## 2.13 SMARTLET OUTLET PLUG LOAD CONTROLLER [AUTANI SMARTLET]

- A. Provide wirelessly managed device designed specifically for the control and management of Plug Loads, including remote management and control of Plug Loads via schedules, sensors inputs, overrides, and curtailments when used in conjunction with [Autani's EnergyCenter™] energy management software.
- B. Provide control of standard 120VAC, 15 AMP duplex receptacles [two (2) receptacles managed by one (1) relay [Autani A07-01-0151-01](#)] [one (1) receptacle managed by one (1) relay and one (1) constant power receptacle [Autani A07-01-0150-01](#)].
- C. Communicate wirelessly with one another, the Network Management Appliance, and other network devices via a reliable ZigBee based mesh network.
- D. Configured, managed, and controlled via HTML (web) pages provided over the [LAN] [WAN] by [Autani EnergyCenter™] Software installed on the [Autani Manager] Networked Management Appliance.
- E. It shall be possible to map the input and data of any sensor connected any or all other Networked devices in the system.
- F. Device ratings and approvals

1. Load Capacity: 15A @ 120VAC
2. Input Voltage Range: 120VAC
3. Internal Relay
  - a. Max Switching Power: 1800VA
  - b. Max Switching Voltage: 120VAC
  - c. Max. Switching Current: 15A
4. Radio Network
  - a. IEEE 802.15.4-2003 2.4GHz ISM compliant

Because of where outlets are located, there are often obstructions to the radio path that significantly reduce the range of the radio. A "600 foot" line of sight may have a 60-foot actual range.

- b. Range: Approx. 600' LOS transmit/ receive
  5. Regulatory Approvals
    - a. UL
    - b. FCC (V8NWAT1000142) & IC (7737A-WAT1000142), Certified Class B Digital Device, FCC Part 15
  6. Environmental
    - a. Test condition of all ratings 25°C
    - b. Operating Temperature: 0° to 70°C
    - c. Storage Temperature: -25° to 80°C
- G. [Connect to network occupancy sensor.]

When actual consumption data is required in lieu of calculated, then a meter would be required. The meter can either be a pulse counter type (updates in energy intervals) or an actual value (communicate data in real time) from the meter's registry.

For measurement and verification, a pulse meter can usually suffice. If demand response is utilized, then a pulse meter may not provide data sufficiently fast enough to meet demand response requirements.

#### 2.14 NETWORKED METER [AUTANI E50C2 PACKAGED METER]

Revenue meters are 99.5% accurate which are comparable to the accuracy of utility meters. This accuracy generally allows the user to be billed for the actual energy usage.

- A. Provide wirelessly managed electronic revenue grade meter suitable for monitoring energy consumption per [panel] [circuit] [feed].
- B. Provide remote metering of electrical loads when used in conjunction with [Autani's EnergyCenter™] energy management software.

The full functions described below are available when actual data is requested (directly communicated with) from the meter. Pulse meters do not provide all of the information.

“Cheaper” meters may still provide the same information; however, the level of accuracy is much lower.

C. Provide alarm functions, pulse output, and display capable of measuring and reporting:

Accumulated energy aligns with the actual utility bill. Reactive and apparent energy reflect your inductive and capacitive load requirements.

1. Accumulated real energy, reactive energy, and apparent energy

A measure of current electrical demand that can be used to drive Automated Demand Response, lowering the peak energy usage during critical billing phases. Power demand is calculated by dividing the energy accumulated during a specified period by the length of that period. How the power meter performs this calculation depends on the method and time parameters you select (for example, timed rolling block demand with a 15-minute interval).

To be compatible with electric utility billing practices, the power meter provides the following types of power demand calculations:

- Block interval demand
- Synchronized demand
- Thermal demand

2. Net present demand

The maximum values for the kWd, kVARD, kVAD power, and amps (or peak demand) is maintained in the meter’s non-volatile memory.

3. Maximum (peak) demand intervals

Measures instant use. Phase-to-phase and phase-to-neutral measurements are important to measure power faults before equipment is damaged. If one of the phases drops, then the customer receives a warning to prevent equipment being damaged because of the change with the electrical power.

4. Instantaneous power, current, phase-to-phase and phase-to-neutral voltage

Power Factor is directly related to real and apparent energy, and is a measure of electrical efficiency. Power Factor compares real energy vs. apparent energy. If your Power Factor is 0.8, then your real energy is 80% efficient.

5. Power factor

The wrong AC frequency can damage electrical equipment.

6. AC frequency

Managed in the Energy Center software, and email alerts should be set up during commissioning. Email to text can also be configured based on phone carrier, availability, and messages may apply.

D. Provide support warnings for low power factor, current over range, voltage over range, and frequency out of range.



- E. Meters transmit data wirelessly and communicate with other Networked Meters, the [Autani Manager] Networked Management Appliance, and other network devices through a reliable mesh network.

The E50C2 or E50C2A Packaged meter power/energy monitor with wireless communication requires one (1) CT per phase.

Proper CT coil selection is essential to the quality of data collected by the meter.

For example, a 200-amp circuit would require a CT coil that is as close to a 200 amp maximum response WITHOUT going under 200 amps in capacity. If the CT is rated below the circuit capacity, then the meter would not provide accurate information. In the case of a 200-amp circuit, a 300-amp rated CT coil would be an appropriate selection.

Due to instantaneous current draw, allow for the inrush current allowance to “upsized” to the next rated level for the CT coil. A 300-amp CT coil would not be a good selection for a 300-amp circuit. A 400-amp CT would be able to handle the inrush current.

Amp ratings up to 5000 amps supported via Rogowski. coil using E50C2A

- F. Provide [H6810 100A] [H6810 200A] [H6810 300A] [H6811 400A] [H6811 600A] [H6811 800A] [H6812 1,000A] [H6812 1,600A] [H6812 2,000A] [H6812 2,400A] [H6812 3,000A] [H6812 3,500A] [H6812 4,000A] [H6812 5,000A] .3V Split CORE CT.

This provides general information for the meters, please check the product data sheet for electrical ratings.

The voltage ratings give the system an ability to address the different voltage requirements of different lighting fixtures utilized in typical installations.

- G. Device ratings and approvals:

- 1. Inputs

- a. Voltage Input: 100-277VAC
- b. Current input Scaling: 5A to 32,000A
- c. Input Range: 0 to 0.333V or 0 to 1V (selectable)

- 2. Accuracy

- a. Real Power and Energy: 0.5% (ANSI C12.20, IEC 62053-22 Class 0.5S)
- b. Reactive Power and Energy: IEC 62053-23 Class 2, 2% current
- c. Current: 0.4% (+0.015% per °C deviation from 25°C) from 5% to 100% of range; 0.8% (+0.015% per °C deviation from 25°C) from 1% to 5% of range
- d. Voltage: 0.4% (+0.015% per °C deviation from 25°C) from 90VL-N to 600VACL-L
- e. Sample Rate: 2520 samples per second

The update report to the Manager is configurable, and typically occur at 1 to 5-minute intervals.

- f. Data Update Rate: [1] minute

- g. Type of Measurement: True RMS up to the 21<sup>st</sup> harmonic 60Hz, one to three phase AC system
3. Radio Network
- a. IEEE 802.15.4-2003 2.4GHz ISM compliant
  - b. Range; Approximately 1000' line of sight transmit/receive
  - c. FCC ID: V8NZRB1000152, IC: 7737A-ZRB1000152
4. Metering Category
- a. US and Canada: CAT III; for distribution systems up to 347VL-N/ 600VACL-L
  - b. Dielectric Withstand: Per UL 508, EN61010
  - c. Conducted and Radiated Emissions: FCC Part 15 Class B, EN55011/ EN61000 Class B (residential and light industrial)
  - d. Conducted and Radiated Immunity: EN61000 Class A (heavy industrial)

Range extenders are utilized to strengthen the wireless ZigBee network when devices are at extreme edges of the communication ranges. They are used to supplement the range of the "CORE" or "Manger" devices. Range extenders can also be utilized to "push" the wireless signal through concrete walls, metal enclosures, etc. that may inhibit a wireless signal from transmitting reliably. Range extenders can also "bounce" the signal around corners when a direct line of sight is not available.

## 2.15 RANGE EXTENDERS

This option is utilized when a standard AC wall outlet is available.

- A. [Provide [AutaniNET A07-01-0403-01] wireless range extender with 24VDC power supply with parallel blade plug.]

This option is utilized with a UVPP for above ceiling installations or tapping into line voltage when an AC wall outlet is not available.

- B. [Provide [AutaniNET A07-01-0403-02] wireless range extender.]
- C. Device ratings and approvals
  - 1. Input Voltage Range: 12 to 30 VDC
  - 2. Recommended Voltage: 12 to 24 VAC / VDC

The radio network allows for EnOcean devices to be integrated into the ZigBee network. The benefit of having a stronger range allows for a more dispersed network and fewer "hops" to get to an end device, resulting more reliable and stable communication.

- D. Radio Network: IEEE 802.15.4-2003 2.4GHz ISM compliant; Range: Approx. 2000' LOS transmit/ receive
- E. Regulatory Approvals
  - 1. UL 916 CSA C22.2 No. 205 (Listing E113003)
  - 2. UL 2043 Plenum Rated

This is the FCC listing for the ZigBee Radio.

3. FCC (V8NZRB1000152) & IC (7737A- ZRB1000152), Certified Class B Digital Device, FCC Part 15

### **PART 3 – EXECUTION**

For system and product installation guides, please see:

<http://www.autani.com/installation-guides/>

#### **3.01 INSTALLATION**

- A. Provide complete installation of the [Autani] Networked Lighting Control Devices in accordance with contract documents and as shown on the Construction Drawings.
- B. Install the energy meter(s) in the control section of switchgear, motor control center, switchboard, and [Panel board] [metering panel] as shown on the Construction Drawings and in accordance with installation documentation.
- C. Potential, control power and current transformers, shorting terminal block, test blocks, fuse blocks and fuses shall be completely installed and wired to the energy meter within the equipment enclosure designated, unless shown otherwise on the Construction Drawings.
- D. Sensors
  1. Coordinate layout and installation of [ceiling-mounted] [wall-mounted] devices with other construction that penetrates [ceilings] [walls] or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
  2. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
  3. Ensure that daylight sensor placement minimizes sensors view of electric light sources; ceiling mounted and fixture-mounted daylight sensors shall not have direct view of luminaires.
- E. Systems integration to be coordinated with owner's representative, [Autani] lighting control system manufacturer and other related equipment manufacturers.
- F. Provide equipment at locations and in quantities indicated on drawings.
- G. Provide any additional equipment required to provide control intent.

#### **3.02 FIELD QUALITY CONTROL**

- A. Perform field inspection, testing, and adjusting in accordance with Section [01 40 00]
- B. Verify that all control devices, components, receptacles; lighting equipment, etc. are powered and energized prior to initiating factory start up and commissioning.
- C. Verify LED driver type and functioning / powered luminaires.

#### **3.03 FACTORY START UP**

- A. Provide both the manufacturer and the electrical engineer with [ten (10)] working days written notice of the Factory Start up.
- B. Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in final testing.
- C. Final programming to be completed by an authorized manufacturer's representative to establish control of the network as required by the specified sequence of operations.
- D. Project Record Documents: Provide five (5) copies of the final results including actual locations of components and accessories to building owner and owner's representatives.
- E. If deficiencies are discovered during the Factory Start Up, the Electrical Contractor to provide reimbursement of all expenses necessary for scheduling additional time and subsequent site visitation for required attendees.
- F. An unsatisfactory condition revealed by these test results, or unsatisfactory methods of tests and/or testing apparatus and instruments, shall be brought to the attention of the [Engineer] [Project Manager] [Factory Representative]. Corrections by the electrical contractor shall be validated by re-tests to the satisfaction of the [Engineer] [Project Manager] [Factory Representative].

### 3.04 ACCEPTANCE AND COMMISSIONING

<https://calctp.org/acceptance-technicians/contractors>

- A. Final acceptance [Per California building Efficiency Standards (Title 24, Parts 1 and 6)] [Per local code requirements] shall depend upon the satisfactory test results as performed in accordance with the verification of the sequence of operations and manufacturer's instructions.
- B. Test and Inspections:
  - 1. Operate the system and its various components to ensure that it is performing properly and in accordance with the sequence of operations.
  - 2. Run a preliminary test for the purpose of:
    - a. Determining whether the equipment is in a suitable condition to conduct the acceptance test.
    - b. Checking and adjusting equipment.
    - c. Training facility personnel.
    - d. Verify that sensors are mapped to appropriate devices.
    - e. Verify that lighting scheduling has been applied.
    - f. Verify drawings are uploaded and viewable within the energy management system software.

Normal mode of operation should be established. Any deviations from normal operations can be communicated back to the customer. For example, rooms occupied during the middle of the night, can let the owner know how the facility is being utilized. Additionally, any energy consumption thresholds from the metering section can also initiate communication.

Who the communication is sent to is usually determined during the customer training, and those email addresses, cell phone numbers, etc. are updated in the system.

- g. Verify that all system alerts and trigger notifications are configured.
- 3. Final system acceptance test: Individually test each networked device and demonstrate that they are operating properly.
- 4. Supply all equipment necessary for system adjustment and testing.
- 5. Verify that the electrical data and information displayed is correct and properly tracking in real time.

### 3.05 COMMISSIONING, TRAINING AND DEMOSTRATION

- A. Commission the system such that all connected devices are operational, reporting accurately and correctly in accordance with the sequence of operations.
- B. Demonstrate the operational use of the system to the Owner.
- C. Upon completion of the system programming, provide [four (4) hours] training to the owner's personnel on the operation and maintenance of the system.
- D. Attendance: [Electrical Contractor] [System Integrator] [Owner] [Owner's Representative] Designated Design Representative(s) for [Architect] [Engineer] [Lighting Designer] [Autani] Manufactured System Representative.
- E. Provide five (5) copies of final acceptance testing and test results.

END OF SECTION