LIGHTGRID+

DIGITAL NETWORK LIGHTING CONTROL DEVICES Guide Specification

The LightGRID+ Wireless Outdoor Lighting Control System offers lighting control solutions for virtually any outdoor application. From parking lots to smart cities, LightGRID+'s proven robustness and scalability provides cost-effective and flexible solutions that meet application requirements and energy codes, maximizes energy savings and simplifies outdoor lighting operations.

LightGRID+ provides a seamless, code compliant lighting control solution using wireless technology. Wireless modules control the luminaires and communicate over the air to a LightGRID+ Gateway. The LightGRID+ Gateways monitor the health of the modules and retrieve metering information. The LightGRID+ Enterprise Server retrieves information from the Gateways over a standard Ethernet/Cellular network and presents that information in a customized dashboard.

LightGRID+ software efficiently meets stringent energy codes and improves safety and performance over time. Using visual tools, including site maps, icons, and navigation tools, LightGRID+ can remotely and securely manage multiple sites from anywhere.

Section 260943 DIGITAL NETWORK LIGHTING CONTROLS (this section)
System Architecture
Wireless Relay Fixture Modules
Wireless Gateway
Software
Low Voltage Switch Stations
Low Voltage Motion Sensors
External Photocell Module

SECTION 26 09 43
DIGITAL NETWORK LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1   SUMMARY

A.   The lighting control system specified herein shall provide a wireless, distributed, secure, self-organizing and self-healing peer to peer mesh network of fixture control modules, motion sensors, daylight sensors and switch stations for outdoor lighting applications.

B.   The system shall be capable of turning lighting loads on/off as well as full range dimming of lights (if lighting load is capable of being dimmed).

C.   Wireless devices shall provide both Sink and Source 0-10V control within the module. Dimming shall not be done via a separate or external control module.

D.   All wireless devices shall communicate utilizing long range 2.4GHz or 900MHz ISM band. Systems which use other frequencies shall provide documentation insuring range and performances equal to that of the specified system. Wireless devices shall be capable of supporting distances up to 1000'.

E.   Wireless devices shall be capable of being installed inside of fixtures or externally. External wireless devices shall utilize the standardized ANSI C136.41-2013 (7 & 5 pin) receptacles. Receptacles that do not meet ANSI standards shall not be supported.

F.   Wireless devices shall have a programmable power-up state.

G.   Wireless devices shall be capable of supporting 3 digital inputs (e.g. Occupancy Sensor, Photocell, Luxmeter, and Low-voltage Switch) and 2 outputs.

H.   Device firmware shall be updateable securely from anywhere via an Internet connection. Firmware updates shall not require a serial or patch cable.

I.   System shall be accessible remotely from the local IP network or the Internet. If a wired network connection is not possible, system shall support the use of cellular modems for network connectivity.

J.   System shall support non-proprietary mapping services. System shall also support cartography using satellite imagery.

K.   Wireless device locations shall use Geographic Coordinates.

L.   System shall support enterprise multiple site control via a single user interface.

M.   System shall provide optional support for BACnet IP.

N.   System shall not require a third-party 24/7 manned network operations center for systems monitoring.

O.   The system shall provide a 5-year warranty for all components.

1.2   DEFINITIONS

A.   AES-128 – Advanced Encryption Standard 128-bit encryption key

B.   DHCP – Dynamic Host Configuration Protocol

C.   DNS – Domain Name Server

D.   FCC – Federal Communications Commission

E.   HTTPS – Hypertext Transfer Protocol Secure

F.   IC – Industry Canada

G.   ISM Band – Industrial, Scientific and Medical radio frequency band

H.   RF – Radio Frequency

I.   SPST – Single Pole, Single Throw

J.   SSL – Secure Sockets Layer

K.   TCP/IP – Transmission Control Protocol / Internet Protocol

1.3   SUBMITTALS

A.   Prior to fabrication and shipment of lighting control components, manufacturer shall provide submittal documentation for approval.

B.   Submittal documentation shall include:

1.   Bill of Material including a list of components to be supplied,
2.   Device specification sheets indicating device features, certifications, dimensions, construction specifications, electrical specifications, wiring diagrams, nomenclature, and related products,
3.   Component schedules: Indicating lighting control device types and locations
4.   Lighting panel schedules,
5.   Wiring diagrams,
6.   Control cable type and routing requirements,
7.   System riser drawings of sufficient detail to indicate relative placement of major system components and the required connections between each,

8. Contractor Startup Request Form – to be completed prior to factory startup,
9. Operating and maintenance instructions, manuals and/or videos.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualification: Manufacturer of lighting control devices with minimum five years record of satisfactory manufacturing and support of components comparable to basis of design system.
1. Approval of Comparable Products: Submit the following at least 10 days prior to submission of a proposal package. Substitution submitted without the below shall be rejected.
a. Submit line-by-line comparison that describes differences, if any, between each lighting control device specified and those being proposed. Comparison shall include differences in size, quantity, quality, method of control, features and functions, control software functions, and installation requirements.
b. Product data, including certified independent test data indicating compliance with requirements.
c. Samples of each component.
d. Project references: Minimum of 3 installations not less than 3 years old, with Owner and Architect contact information.
e. Sample warranty.
2. Substitutions following award of contract are not allowed except as stipulated in Division 01 General Requirements.

B. Factory Assembly: All system components shall arrive at the job site completely pre-wired and ready for installation, requiring only the connection of lighting circuits and network terminations. All connections shall be made to clearly and permanently labeled termination points or by connectorized cable. Systems that required field assembly shall not be acceptable.

C. Component Testing: All system components and assemblies shall be individually tested prior to assembly. Once assembled, all finished products shall be tested for proper operation of all control functions per specifications prior to shipment.

1.5 SYSTEM COMPLIANCE

A. Compliance: Where indicated, individual components shall comply with the following requirements:
1. NEC Compliance: All system components shall comply with all applicable sections of the National Electrical Code (NEC) NFPA 70 as required.
2. NEMA Compliance: All system components shall comply with all applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

3. UL Approval: All applicable equipment shall be tested to and listed under UL standard 508, UL standard 916 or UL924 and shall bare labels to indicate compliance. Lighting control relays shall be tested to UL standard 508 for both safety and endurance. Systems listed under ETL or other UL sections shall provide documentation proving compliance with UL standards as listed above.

4. FCC Emissions: All applicable equipment shall comply with FCC emissions standards specified in Part 15, sub-part j for commercial and residential applications and shall bear labels indicating compliance testing. Equipment that does not meet these standards shall not be acceptable.

1.6   WARRANTY

A.   Manufacturer shall warrant the lighting control system components to be free from defects in material and workmanship for a period of five (5) years from the date of the certificate of building occupancy or proof of installation, whichever occurs first ("Warranty Period"). If the certificate of building occupancy is not available or there is no proof of installation, the Warranty Period shall begin with the Product ship date.

B.   Manufacturer's warranty shall include the repair or replacement product(s) with the same or a functionally equivalent product(s) or component part(s).

C.   Manufacturer shall provide telephone technical support and remote diagnostics where applicable during normal business hours excluding manufacturer holidays.

D.   Upon request, Manufacturer shall provide quotation for manufacturer service contract option(s) which include on-site technician visits for service and repair.

PART 2 - PRODUCTS

2.1   MANUFACTURERS

A.   Acceptable Manufacturer:

1.   Current

B.   Basis-of-Design: LightGRID+ Wireless Outdoor Lighting Controls System provided by HLI Solutions, a division of Current, Greenville SC.

2.2   SYSTEM ARCHITECTURE

A.   System shall consist of wireless, distributed and intelligent lighting control devices consisting of but not limited to control modules with ON/OFF and 0-10VDC full range dimming capabilities,

and system input devices including but not limited to motion sensors, daylight sensors and manual switch stations.

B.   Control modules shall be capable of measuring and monitoring the loads they control and report alarms for out of range values.

C.   System shall have an architecture that creates a self-organizing and self-healing mesh network infrastructure.

D.   Device Firmware and radio firmware shall be upgradable over the air via the gateway without having to go physically on site and without human intervention. During the upgrade process, the device shall continue to operate normally.

E.   System shall use a gateway controller for proper system operation. Each gateway shall support up to 500 nodes.

F.   System shall be self-organizing. The mesh network of devices shall build automatically without the need to manually set device addresses via dials, DIP switches or other means.

G.   System shall be self-healing. System shall be capable to accept a failed node without compromising message delivery.

H.   System nodes shall comprise user configurable fail safe and fault recovery mechanisms that will execute commands in case of lost communication such as default to photocell on/off control in case of failure or to the execution of internal schedules

I.   System nodes shall be able to maintain accurate date time while powered

J.   Each system node shall be capable of storing their Geographic Coordinates in nonvolatile memory

K.   System shall be capable of storing diagnostic logs for troubleshooting purposes

L.   System architecture shall facilitate data transmission between each wireless device over the 2.4GHz or 900MHz ISM radio frequency (RF) bands with a supported and outdoor unobstructed RF range of 1000ft between each radio module.

M.   System architecture shall allow for up to 32 hops (levels) of propagation in any direction and from any transmitter.

N.   System shall secure all messages. When transmitting over the air, each wireless device shall use the strong and secure AES-128 (Advanced Encryption Standard) or AES-256 security cipher to encrypt and decrypt messages. System input devices shall be to monitor and broadcast changes such as Motion, daylight levels and manual switch input.

O.   System shall be capable of being accessed from a local network or the Internet using LightGRID+ Express or LightGRID+ Enterprise software.

P.   System shall have an intuitive and easy to use Graphical User Interface (GUI) to configure, control, monitor and schedule individual devices or groups of devices.

Q.   System shall feature a mobile scanning app enabling quick, simple and economical commissioning of wireless modules. Upon module installation, mobile app shall perform both an instant device test and store geo location information.

R.   System shall remain fully functional during the programming process. Lighting control systems that must be taken "OFFLINE" for programming are not acceptable. All programming changes shall take effect immediately as they are programmed.

S.   System shall belong to the customer and installed on the customer's own computer infrastructure or can be hosted by a cloud-based service.

T.   Available reports shall include, but are not limited to:

    1.   List of devices for a given site

    2.   List of scenarios for a given group

    3.   List of current alarms in the last X hours (the number of hours is selectable). You can select the alarm types that will appear in the report otherwise all alarm types will be displayed by default

    4.   List of alarms history in the last X period (the period is selectable with calendar fields). You can select the alarm types that will appear in the report otherwise all alarm types will be displayed by default

    5.   Energy Log in Report Form

    6.   Energy Log in Chart Form

    7.   Energy log detailed in report form. This report provides a list of each device for a given site with their KWH, KVAH, BURN TIME. The period covered is selectable with calendar fields

    8.   All reports may be generated in PDF, XLS or XLSX file formats.

U.   System shall provide client-based or web-based applications for accessing the lighting controls network.

V.   System shall offer installation tools allowing for automatic GPS location positioning (when outdoor) as well as installation validation while on site.

W.   System shall allow for additional metadata to be stored and associated to each node.

X.   System shall allow both map and architectural (images) views alternative with devices overlaid on either type of views. Maps shall be sourced from multiple free providers.

2.3   WIRELESS RELAY FIXTURE MODULES

A.   Basis of Design Product: LightGRID+ Wireless Lighting Control System, Wireless Relay Fixture Modules.

B.   Internal and External Wireless Relay Modules shall provide universal voltage support from 110V to 480V.

C.   Internal and External Wireless Relay Modules shall include protection against surges and transients per ANSI 62.41-2002 category C low (6kV, 1.2/50µS & 3kA, 8/20µS) standard Combo waves and (6kV, 100kHz) Ring wave.

D.   External Relay Modules shall utilize the standardized ANSI C136.41-2013 (7 & 5 pin) receptacles.

E.   Relay Modules shall be capable of controlling fluorescent ballasts (T8 – T5 – T5HO), induction, MH, HPS, LPS, and LED drivers.

F.   Relay Modules shall be fully programmable and capable of storing and autonomously execute commands and scenarios with the following minimum functionalities. The operating scenarios described below shall reside within each addressable intelligent relays even in case of power outage. Systems which rely on the operator to develop these scenarios using a programming language will not be allowed.

G.   Standard on all relay modules:

1.   On/Off switching and flexible dimming adjustable minimum and maximum levels with 1% steps

2.   Real-Time Operating System (RTOS) that can run multiple simultaneous tasks with minimal latency

3.   Tilt sensor measuring the earth's gravity angle changes

4.   Dynamic level adjustment for daylight harvesting, RP-8 optimal roadway lighting design and similar applications

5.   Programmable delay and dimming level when power is restored following a power outage for peak shaving

6.   Built-in demand response (load shedding) feature

7.   Lumen depreciation compensation over time

8.   Compatible with low-voltage occupancy and lux sensors (daylight harvesting), external photocells and switches enabling energy conservation

9.   Any module with a sensor can be set as a master and control several modules

10.   Each node can be part of 14 different groups and 30 separate scenarios

11.   Generic timers enable execution of a series of instructions at set intervals

12.   Energy consumption data collection

13.   Multiple Configurable Alarms/Alerts: Overload, Over Voltage, Under Voltage, Power Factor, Temperature, 0-10V, Fault When On, Fault When Off, Last Gasp, Restore Power On. Alarm logs shall be stored in non-volatile memory to allow for on demand subsequent retrievals

14.   A scenario broadcasted to a group can represent different commands and setting to different relay modules, enabling complex controls scenarios with a single message

15.   Reporting of status after returning from Black Out shall be user programmable: with the following options: On – Off – Last Level – user defined including a random delay to execute.

16.   Variable Power Up delay, to smooth peak startup demand

17.   Phase-angle and Analog 0-10V dimming relays

18.   Ramping parameters (Brighten-Dim-Ramp up-Ramp Down-Night Mode – Ramp to Levels

19.   Definition of preset levels (min.: 10) with user configurable transition speed

20.   Minimum dimming level, in order to adapt to various brands of dimming ballasts (with the option to Stay On or turn off, below a set minimum level)

21.   Monitoring, metering and reporting

22.   Shall measure the following parameters:
       1)   Power monitoring
           a)   Voltage
           b)   Amperage
           c)   Power
           d)   Power factor

2) *Cumulative Energy with a 2% accuracy*
3) *Cumulative Lamp burn time*
4) *Cumulative Ballast/Driver burn time*

Energy and times shall be stored in non-volatile memory on a regular frequency to prevent loss of information in the event of a loss of power
5) *Number of ON/OFF cycles*

23. Time delay functions:
     1) *(10) Generic timers with the ability to cascade up to (10) timers*
     2) *Selectable individually in each module covering 0-65534 seconds (18h).*

H.   System shall provide repeat capabilities to extend the range beyond normal radio range.

I.   Internal Modules shall provide 5 digital / analog low voltage inputs: 0-30VDC (3mA max at 30VDC), for connection to photocells, motion sensors, switches, lux meters and generic sensors. Two (2) digital outputs shall be provide sink (max: 50mA total) or source 2.4mA (10k pull-up). Power to the accessories shall be provided without requiring the use of an external power pack.

J.   External Modules shall include a built-in photocell for on/off control that will operate immediately upon installation without a need for a network connection. External module shall include an orientation arrow located at the top of the housing.

K.   External Modules shall provide optional GPS technology with GPS accuracy of +/- 4m in clear open sky.

L.   External Modules shall provide multi-purpose input/output: analogic input 0-10V or digital output 24VDC for sensors (e.g. motion sensor).

M.   On detection of Digital contact closed/open, the relay should trigger a programmable Command and/or Scenario.

N.   Relay Modules shall provide acknowledgements to the reception of any configuration changes unless if broadcasted to many relays.

O.   Distributed Control and Distributed Relay Override

    1. Each addressable intelligent relays and sensor-modules shall be capable of autonomous automatic operation. Operating scenarios discussed above shall not depend on the operation of a central panel or computer.

    2. Furthermore, the distributed relay override keypads and motion sensors shall continue to operate should a clock-module or Gateway fail.

    3. Automatic deactivation during scheduled occupancy.

    4. User may choose when to disable the time delay during the night through the relay's schedule.

P.   Full Relay Test Mode

1. The system shall have the capability to automatically exercise every relay in the entire system using a user-defined schedule, controlled from the front-end Gateway. Each relay will be monitored for status, and the user shall have access to the results of this system-wide test from the computer's screen and/or an historical report.

Q. Wireless Relay Modules shall conform to UL-733 & CAN/CSA C22.2 No. 182-2.

R. Wireless Relay Modules shall be FCC Certified and IC Certified.

2.4   WIRELESS GATEWAY

A. Basis of Design Product: LightGRID+ Wireless Lighting Control System, Wireless Gateway.

B. Wireless Gateway shall meet or exceed the following:

1. Power loss memory and clock holdup time: minimum of 6 months

2. Clock: Digital with time, day of week, and date.

3. Automatic leap year compensation.

4. Programmable Daylight Savings Time and Standard Time adjustment.

5. Remote Communications

a. Each Gateway shall support a minimum of two communications ports: a USB port for PLC and/or RF (802.15.4) and an Ethernet port. Either or both may be used for programming, monitoring, and control. The Ethernet port shall allow simultaneous operation of multiple communications access points (Client sessions, Remote Ethernet-PLC modems) to support multiple operator terminals and communications with other building automation systems.

b. All relay changes of state and programmable switch actions shall be communicated over both the local USB/XB network and the Ethernet to support interactive graphics and online status monitoring.

C. Wireless Gateway shall be fan-less, and have 1GHz or faster processor, Ethernet connectors, autoboot on power up, 1 GB RAM, and 500M storage.

D. Wireless Gateway shall be powered by 120VAC 50/60Hz.

E. Wireless Gateway shall provide automatic recovery in case of power failure.

F. Wireless Gateway shall be remotely configurable and upgradable without any on site intervention

G. Wireless Gateway shall provide a cellular modem option.

H.   Wireless Gateway shall utilize Linux Debian.

I.   Wireless Gateway shall support 3rd-party Building Management Systems via an optional BACnet IP Interface.

2.5   SOFTWARE

A.   Basis of Design Product: LightGRID+ Wireless Lighting Control System, LightGRID+ Software

B.   Graphical User Interface (GUI)

1.   Data shall be entered through a simple Graphical User Interface. The operating system shall be Windows 10 or more recent.

2.   Geographical mapping of devices on maps or layouts.

C.   Software shall be capable of creating device groups, scenarios, schedules (time-based/astronomical).

D.   Software shall be able to name devices.

E.   Software shall be able to assign devices to groups and scenarios.

F.   Software shall be able to configure device parameters.

G.   Software shall be able to clone/copy device settings.

H.   Software shall be able to control individual devices and groups of devices.

I.   Schedules

1.   An unlimited number of schedules may be assigned to individual relays or groups of relays.

2.   Each schedule shall allow an unlimited number of events per day, cloning of schedules shall be possible.

3.   Applicable period for individual schedules shall be user-defined, and include concepts of holidays, and special exclusion/inclusion periods

4.   Schedules shall individually be specified to supersede or not Holidays and Special periods.

5.   Unlimited number of Holidays may be defined

6.   "Spring Ahead" and "Fall Back" Dates for daylight savings time changes shall be automatic.

7. Conditional Scheduling & Execution Engine

    a. System shall be capable of building Conditional Scheduling & Execution rules, based on time of day, occupancy statuses, override keypads triggering Scenarios, etc.

    b. Such Conditional Scheduling & Execution Engine enables the user-definition of flexible rules such as:

        1) Blink Warning

        2) Time delay Overrides

        3) Preemptive Override

        4) Master Control

        5) Cleaning Scenarios

J. Software shall be able to program system parameters.

K. Software shall support programming of multiple sites from a single user interface.

L. Software shall allow an unlimited number of different user/passwords per site or per system

M. Software shall be able to create and manage users, user roles, and user rules.

N. Software shall support 3rd party Building Management Systems via a BACnet IP interface:

1. Binary and analog object types

2. Luminaire ON/OFF control

3. Luminaire 0-10V dimming control and feedback

4. Luminaire metering: voltage, current, power, power factor, consumption and lamp burn-time

5. Alarm notifications

6. Run scenarios

7. Set luminaire setpoint levels

8. Run generic timers

2.6 LOW VOLTAGE SWITCH STATIONS

A.   Basis of Design Product: Current Low Voltage Switch Stations.

B.   System shall support switch stations for manual switching of lighting load(s) within a site.

C.   Switches shall be low voltage, momentary switches and shall be available in 1-button, 2-button, and 3-button configurations.

D.   Switches shall be available in White, Ivory, Light Almond and Gray.

2.7   LOW VOLTAGE MOTION SENSORS

A.   Basis of Design Product: Current Low Voltage Motion Sensors.

B.   Motion Sensors shall provide automatic switching of lighting load(s) within an area/zone based on the presence of human activity.

C.   Motion Sensors shall not require any manual adjustment at the time of installation or during operation.

D.   Motion Sensors shall utilize passive infrared to detect motion.

E.   Motion Sensors with passive infrared technology shall monitor PIR background levels and automatically make corresponding adjustments.

F.   Motion Sensors with passive infrared technology shall incorporate a dual element pyrometer and 144-element cylindrical Fresnel lens

G.   Motion Sensors shall be end or surface mounted (depending on model).

2.8   EXTERNAL PHOTOCELL MODULE

A.   Basis of Design Product: LightGRID+ Wireless Lighting Control System, External Photocell Module.

B.   External Photocell Module shall provide ON/OFF lighting circuit control with 0-10V full-range dimming based on detected light.

C.   External Photocell Module shall be pre-programmed for out-of-the-box photocell operation.

D.   External Photocell Module shall utilize bi-directional wireless RF mesh communications.

E.   External Photocell Module shall use military-grade AES 128-bit (or AES-256 bit) encryption when communicating wirelessly.

F.   External Photocell Module shall have a digital input for motion sensor or switch control.

G.   External Photocell Module shall support multi-level grouping and multiple scenarios.

H.   External Photocell Module shall have adjustable minimum and maximum dimming levels.

I.   External Photocell Module shall be capable of utility-grade metering.

PART 3 - EXECUTION

3.1   EXAMINATION
   A.   Prior to installation, contractor shall examine work area to verify measurements, all wire type and routing requirements, and that commencing installation complies with manufacturer's requirements.
   B.   Where variations from the general specifications or drawings exist, the contractor shall request a clarification prior to rough in or installation

3.2   INSTALLATION
   A.   Lighting controls shall be installed in accordance with manufacturer's instructions, guidelines and submittal documents provided by the lighting control manufacturer.
   B.   Lighting control system components shall only be installed in spaces that meet the following environmental conditions:
       1.   Temperature: 32 – 104 deg F (0 - 40 deg C).
       2.   Relative Humidity: 10 – 90 percent, noncondensing.
   C.   All stored and installed lighting control system components shall be adequately protected from dust and dirt.

3.3   SYSTEM STARTUP
   A.   The system manufacturer shall provide a factory authorized field engineer to the project site after installation has been completed and prior to system energization for the purpose of testing and adjustment of the system.

   B.   Factory field engineer shall test and verify all system functions and ensure proper operation of the system components in accordance with the specifications and on-site conditions. The installing contractor shall notify the system manufacturer in writing that the system is completely wired and ready to be energized and tested 2 weeks prior to scheduling a field engineer for start-up of the system. Should the field engineer arrive on the job site and find the installation incomplete, the installing contractor shall pay the cost of any future visits by the field engineer required to complete the system start-up.

   C.   Factory field engineer shall provide a written report of test and outcomes.

3.4   DEMONSTRATION AND TRAINING

A.   Factory field engineer shall instruct owner's staff on how to adjust, operate and maintain lighting systems; and provide instruction using the system software.
  1.   Allow for up to 4 hours of on-site training on the use and maintenance of the lighting control system to be scheduled at the completion of startup and programming of the system.

3.5   TECHNICAL SUPPORT
  A.   Manufacturer shall provide reasonable access to factory direct telephone technical support during normal business hours.

END OF SECTION

[THIS PAGE INTENTIONALLY LEFT BLANK]