Intelligent luminaire controller with a Zhaga socket (iZHAGA)

1. Brief description

Interoperable, radio-linked luminaire controller for controlling street lights with electronic ballasts and a D4i-compliant DALI2 interface. The controller is mounted without tools using a standardised Zhaga Book 18 socket and communicates via a self-configuring full-duplex RF mesh in the licence-free 2.4 GHz ISM band. It can operate either as a single light point in stand-alone mode or as part of a network with other luminaire controllers, an edge controller and a higher-level SCADA or lighting management system.

2. Detailed description (system description)

Configuration of an open, interoperable lighting management system for street and building-adjacent lighting, car parks, bus stops, railway stations, company premises, warehouses and sports facilities. The iZHAGA luminaire controller controls DALI2- or D4i-compliant ballasts and enables automated, astronomical and brightness-dependent lighting functions, as well as adaptive, demand-based lighting control via internal or external sensors.

Communication takes place via an RF mesh full-duplex connection in the frequency range from 2,400 to 2,480 MHz. Standardised data transmission is based on the LON protocol in accordance with ANSI/CTA 709.1 and 709.11, as well as EN 14908-1 and EN 14908-11 (in preparation). The controller is compatible with the LonMark® OLC profile, supports unicast, broadcast and groupcast, and can receive firmware updates and parameter changes via OTA (over-the-air) communication.

The DALI2/D4i interface can be used to switch and dim luminaires, as well as to control RGBW, Tunable White and light distributions. Electrical measurements such as voltage, current, power factor, power, energy and temperature are recorded depending on the DALI2/D4i-compatible ballast used. An integrated brightness sensor, GPS/GNSS for localisation and a satellite-synchronised real-time clock support control based on weather, season and location.

The luminaires can be operated autonomously with predefined lighting profiles, within a mesh network, or in conjunction with an edge controller and a SCADA system. The maintenance factor function compensates for LED degradation over the lifetime of the luminaire and helps maintain a constant luminous flux whilst reducing energy consumption. The robust, UV-resistant design with twist-lock contacts ensures a reliable electrical connection in outdoor environments.

3. Technical Specifications (Specification Items)

Item 1: High-level system description & communication architecture

Technical Specification:

Intelligent luminaire controller with a standardised Zhaga Book 18 connection for cross-manufacturer control of street and outdoor luminaires with DALI2/D4i-compliant ballasts. The system must be designed as an interoperable, self-configuring wireless mesh platform and support stand-alone operation, the networking of multiple light points, and integration into edge controller and SCADA architectures.

Radio communications and interoperability:

- RF Mesh Full-duplex: simultaneous transmission and reception on two channels with dynamic selection from up to 80 channels.
- Frequency range: 2.4 GHz; supported ISM band: 2,400 to 2,480 MHz.
- Transmission power: 10 dBm.
- Modulation: LoRa in accordance with ISO-OSI Layers 1 and 2.
- Data transmission in accordance with the LON protocol, ANSI/CTA 709.1 and 709.11, as well as EN 14908-1 and EN 14908-11 (in preparation), corresponding to ISO-OSI Layers 1 to 6.
- Communication organisation: CDMA/FDMA (Collision/Frequency Detection Multiple Access).
- Net data rate for wireless communication: up to 100 kB/s.
- Communication types: unicast, broadcast and groupcast.
- Encrypted data transmission: XTEA and AES; expandable via software update.
- Mesh network with up to 100 hops; latency less than 1 second; consistent data rate of up to 100 kbit/s.
- Network organisation in accordance with the ISO OSI layer model, layers 1 to 3; self-configuring.
- Software interface compatible with the LonMark® OLC profile.

Lighting, DALI and sensor integration:

- Control and dimming via DALI2, D4i-compliant in accordance with IEC 62386.
- DALI2/D4i Multi-Manager-compatible; supplies connected DALI devices such as sensors and ballasts up to a maximum total current consumption of 30 mA.
- Short-circuit-proof control output to the control gear via the DALI2 interface.
- Support for internal and external brightness, motion, presence and luminance sensors in accordance with DALI2 and D4i.
- Integrated brightness sensor with a measuring range from 0 to 120 kLux.
- Integrated GPS/GNSS receiver and integrated antennas.
- Galvanic isolation provided.
- Firmware updates and parameter configuration via OTA wireless transmission.

Item 2: Functional requirements / Device software functions

The lighting controllers on offer must provide the following control, networking, sensor and maintenance functions either directly at the light point or in conjunction with an edge controller and a higher-level management system:

Basic functions of lighting control:

- Switching on and off, as well as dimming, via the integrated lighting schedule.
- Brightness-dependent control with an adjustable hysteresis threshold for unpredictable weather phenomena.
- Seasonal and location-dependent lighting control via GPS/GNSS and astronomical functions.
- Stand-alone operation with an integrated dimming level for night-time dimming; multi-stage version available on request.
- Fading with a predefined time in stand-alone mode.
- Freely configurable dimming levels when operated with an Edge Controller or management system.
- Separate switching of safety and architectural lighting points, such as pedestrian crossings or monuments.
- Support for RGBW when operated with an Edge Controller or SCADA system via 10 DALI short addresses.
- Support for ‘Tunable White’ technology and adjustable lighting distribution via DALI2 or D4i.

- Replacement of sound-wave or long-wave remote control systems, for example in conjunction with a Switch Cabinet controller.

Operating modes and networking:

- Stand-alone without mesh: single light point; operating schedule, brightness sensor, seasonal/location-dependent control, OTA configuration and maintenance factor function in the controller; no networking or grouping.
- Stand-alone with mesh: multiple light points; automated, direction-dependent, moving light for luminaires on one side of the carriageway; for luminaires on both sides of the carriageway, following manual configuration of the controllers prior to installation (binding); networking and grouping possible.
- With Edge Controller: multiple networked light points; operating time calendar and programmable event calendar in the Edge Controller; any dimming levels; RGBW support; long-term storage of measured values mapped to the OLC profile.
- With Edge Controller and SCADA system: additional visualisation of measured values and operation via the SCADA software.
- External sensors can be connected via DALI2 in all operating modes.
- Certain functions require the street lighting to be continuously powered.

Measurement data acquisition and maintenance factor:

- Measurement data is recorded via the connected DALI2 luminaire driver in accordance with the DALI2/D4i specification; the iZHAGA controller itself records the operating time.
- Measurable values with a compatible ballast: voltage, current, power factor, power, energy and temperature.
- In stand-alone mode, the current measured value is stored in the controller and read out via OTA.
- In edge controller mode, the measurement data is mapped to the OLC profile and stored over a longer period; additional visualisation is available with a SCADA connection.
- Maintenance factor function to compensate for the decline in luminous flux and LED degradation over the lamp's service life, and to limit oversizing in line with the application.

Extensibility for smart city applications:

- Open, interoperable communications infrastructure in accordance with EN 14908-1; radio transmission in accordance with EN 14908-11 is currently being developed.
- Potential integration of additional sensors for environmental and weather data, including particulate matter, nitrogen oxides, CO_2, ozone, temperature, humidity, air pressure, precipitation, wind and road surface conditions.
- Other potential applications: noise measurement, car park management, waste management, traffic control, traffic counting, transmission of pre-processed image data, charging infrastructure for electric vehicles and actuator data for information boards.

Item 3: Base position A – Light controller type: iZHAGA

Technical Specification:

Electronic, interoperable RF mesh luminaire controller with an integrated brightness sensor, GPS/GNSS receiver and Zhaga Book 18 interface for controlling DALI2/D4i-compliant luminaires. The general requirements of items 1 and 2 must be met in full.

- Input voltage:
  24 V DC.
- Power consumption:
  1 to 2.5 W.
- Communication:
  RF mesh full-duplex with dynamic selection of up to 80 channels; 2.4 GHz; 10 dBm; LoRa modulation; LON protocol in accordance with ANSI/CTA 709.1/.11 and EN 14908-1/-11 (EN

14908-11 in preparation); CDMA/FDMA; up to 100 kB/s net; unicast, broadcast and groupcast; encryption using XTEA and AES.

- Supported frequencies:
  2,400 to 2,480 MHz in the licence-free ISM band.
- Mesh network:
  Up to 100 hops; latency less than 1 second; consistent data rate of up to 100 kbit/s; self-configuring network organisation in accordance with ISO-OSI layers 1 to 3.
- Software interface:
  Compatible with the LonMark® OLC profile.
- Electrical isolation:
  Yes.
- Control / dimming:
  Via DALI2, D4i-compliant in accordance with IEC 62386.
- DALI interface:
  DALI2 and D4i-compliant; multi-manager capable; power supply for connected DALI devices up to a maximum total consumption of 30 mA; support for brightness and motion sensors in accordance with DALI2.
- Control output to the ballast:
  Short-circuit-proof DALI2 interface.
- Light sensor:
  Integrated; measurement range 0 to 120 kLux.
- External sensors:
  Connection of any wired DALI2/D4i-compliant sensors, for example for motion and presence detection or luminance measurement.
- GPS/GNSS receiver:
  Integrated.
- Antennas:
  Integrated.
- Firmware update / parameter configuration:
  OTA (over-the-air) via radio.
- Measurement data acquisition:
  Voltage, current, power factor, power, energy and temperature via a DALI2/D4i-compatible ballast; the controller itself records the operating time.
- Connection / Mounting:
  Tool-free via standardised Zhaga socket in accordance with Book 18, with robust twist-lock contacts.
- Operating temperature range tc:
  –25 to +80 °C.
- Storage temperature range:
  –25 to +85 °C.
- Humidity:
  5 to 95 per cent, non-condensing.
- Protection rating:
  IP66 with UV-resistant cover.
- Impact resistance:
  IK09 for vertical impact / IK07 for lateral impact.
- Compliant standards / directives:
  CE; RoHS 2011/65/EU; Radio Equipment Directive (RED) 2014/53/EU; EN 301489-1/3; EN 61547; EN 55015; EN 300328; EN 60950.
- Housing material:
  Polycarbonate (PC) cover, polybutylene terephthalate (PBT) base; UV-f1-certified plastic materials in accordance with UL 94 5-VA for outdoor use.
- Dimensions (Ø x H):
  Nominal dimensions Ø 80 x 58.43 mm. Dimensional drawing: outer diameter 79.7 mm, base area Ø 38.65 mm and total height 63.5 mm.
- Weight:

120 g.
- Customs tariff code:
  8543 7090.
- Certification:
  CE.
- Warranty:
  2 years.
- Brand:
  iCiti iZHAGA, Ref. No. 200067, or equivalent.

Item 4: Planning and installation instructions

- Continuous power supply:
  A continuous power supply to the lighting infrastructure is required for networked, direction-dependent and advanced smart city functions.
- DALI measurement data:
  The type and scope of the available measurement data depend on the DALI2/D4i-compliant luminaire driver used.
- Future developments:
  Further lighting control functions, such as directional running lights for tunnel lighting or traffic-dependent lighting control, are in the pipeline, as per the data sheet.