



ABLE POWER PRODUCTS

LED Surge Protection & Over/Under Voltage Control Experts



RF-Mesh Communication

FCMS – Full Duplex Communication Mesh System

The idea of combining full duplex transmitter/receiver and protocol structuring means that a much higher number of repeaters/amplifiers can be used in the transmit/receive chain, as only the latency is affected, but the bandwidth remains stable. A distance of typically 100 m and, if necessary, down to 30 m is no problem, as long as the latency/time delay in the installation remains below one second. If absolute synchronicity is needed, this can be achieved via the GPS time and the data could be enhanced by adding an execution time stamp.

Product Portfolio RF-Mesh

- Intelligent luminaire controllers ZHAGA, NEMA, iLC-RS, iPC-RS
- Intelligent edge controllers iDC-SOC
- Infrastructure accessories

Typical Applications

Management of illumination and Smart City applications for

- Streets and car parks
- Bus stops and railway stations
- Industrial facilities and warehouses
- Sports facilities



Edge controller iDC



ARM – RF-Mesh



ZHAGA – RF-Mesh



NEMA – RF-Mesh



iLC/iPC-RS – RF-Mesh



An Introduction

Cables are known to provide high data rates, and robust communication with either electrical or optical data transmission. They must however be planned and installed from the start, since any subsequent installation usually entails enormous expense. Wireless data transmission, on the other hand, provides maximum flexibility, but has limited availability as a frequency range cannot be used twice, and has weaker robustness and security. Outside the world of professionally managed frequency ranges, communication in the so-called license-free ISM frequency bands is only possible through a strict set of rules. Transmission power and duration define the possible data transmission.

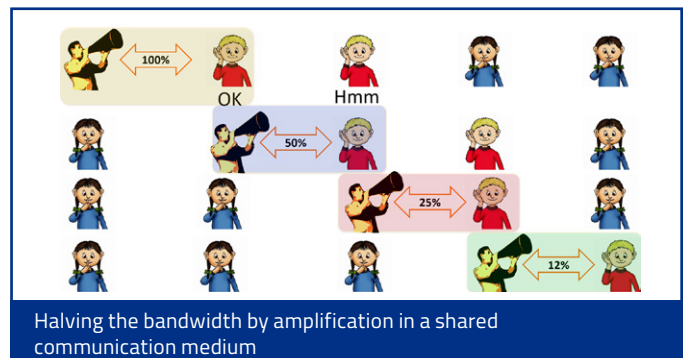
In Europe, the permissible transmission powers in the ISM bands are set much lower than in the USA or the Far East. This is not always a disadvantage, as the range is lower and thus the availability of the transmission channel at neighboring locations is more likely. The consequence, however, is that one needs very different concepts for adequate data transmission depending on the application. So-called Low Power Wide Area Networks (LPWANs such as LoRa®) enable wireless communication over long distances, but only with low bandwidth/data rates. These data rates are not sufficient for more complex applications, and stable communication can only be achieved by generous overlapping of the coverage areas.

Decision makers need to make a thorough list of the requirements for a technology selection at the beginning of a development to avoid a bad investment in time and money. LPWANs with a data bandwidth of a few kBit/s are always sufficient for metering tasks as these are rarely time-critical. However, if the tasks become more complex or it is difficult to foresee what the future applications will require in terms of data throughput, planning should allow more flexibility for long-term investments. The initial product costs are usually only a small part of the project lifetime costs. The costs for installation, maintenance/licensing, replacement or second source as well as the integration of additional applications should play a role as criteria in the decision-making process.



Full duplex communication to solve the bandwidth reduction problem

As the demands on data rates increase, the achievable transmission distances become smaller due to the reduced sensitivity of the receivers. This is generally countered by installing several amplifiers in the signal chain to achieve the required communication distance. Since wireless spectrum is a shared medium, only one transmitter may be active at a time, which means that each amplifier in the chain of transmission halves the available bandwidth. When the first transmitter sends,



all the others must listen. If the data packet is amplified for the first time, logically the original transmitter must also stop its communication because the channel is occupied by the amplification. This means that the bandwidth is halved for the first time. Further halving of the bandwidth occurs with each successive amplification. In the example below with 3 amplifiers only 12.5% of the original bandwidth is available.

Well-known MESH systems such as ZigBee and Thread are used for control applications and struggle with this difficulty. To solve this problem in communication, we need a solution whereby the amplifiers do not interfere with each other. In a traditional hardware installation, one could add a cable to transmit additional information in parallel. The equivalent in wireless communication is to transmit additional data over a different frequency. Typical devices for wireless communication are only equipped with one transceiver and share the transmission channel because they can only receive or transmit. If however an additional transceiver is added, it could receive data in one channel and transmit in another at the same time. This is called **full duplex communication**.

Network Communication Management

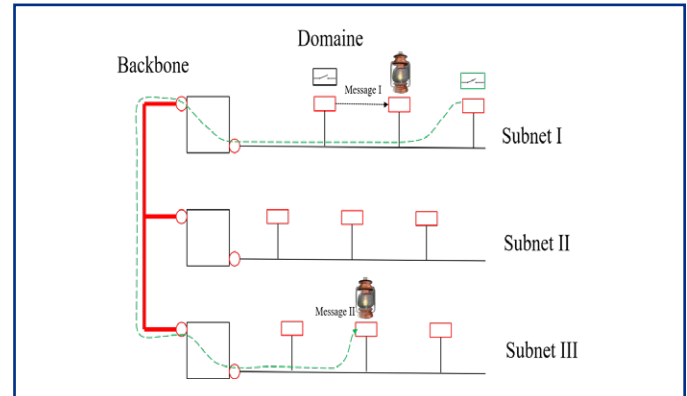
Widely differing requirements have led to the development of various communication protocols. Lean protocols carry hardly any overhead, are quick and efficient but are only tailored to a limited area of application. Others, such as the IP protocol, are designed so universally that there are virtually no restrictions but bring a high overhead. The LON protocol, which was developed in the 1990's provides a suitable combination of efficiency (not much overhead), universal applicability, routability and various services. Everything that is necessary is available and is also covered by an EN / ANSI standard, so that it is open and available to anyone. When comparing the IP and LON protocols, there are many welcome similarities, but certain non-vital features have been left out for the sake of efficiency.

The following vital features are available with the LON® protocol:

- Subdivision into Domain, Subnet, Node-ID
- Services: Uni cast, Group cast, Broad cast
- Unacknowledge / Acknowledge
- Routability
- Different transmission speeds and transmission media
- Payload 1 31 byte
- Interoperable through optional standardised definitions of the payload and device profiles
- Standardised according to ANSI CTA 709.1 (709.n) and EN 14908-1 (14908-n)
- A general tool base for commissioning

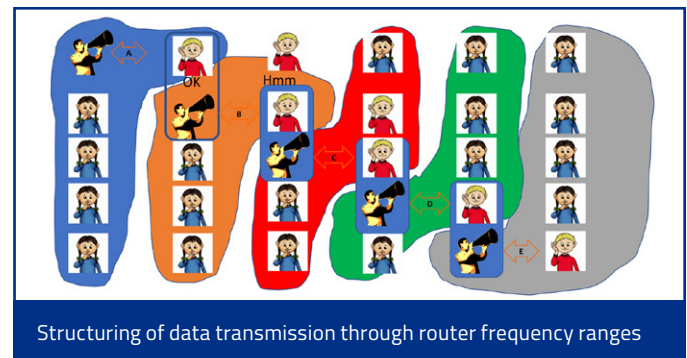
The LON protocol allows structures to be built that can transmit and filter/route data very efficiently, so that only those network segments are loaded in which

communication is happening. In the following picture we find two messages. The message (I) which only exists in the same segment because it is filtered out by the router as well as the message (II) from the 1st subnet via the router (I) into the backbone and then via the router (III) into subnet 3 to reach its destination.



If we now bring together both ideas of full duplex data transmission and a suitable protocol that allows structuring, the result is a new technical solution that goes far beyond what is available today in the field of wireless communication.

Considering the LON specification and its limitations, it is theoretically possible to build networks in a domain with 255 subnets and 127 controllers per subnet.



When factoring in reserves for communication availability we find that up to 100 subnets in a row with 15 to 30 controllers per subnet are feasible without problems. This assumption would result in interconnected network islands of 1500 to 3000 controllers. The first confirmed measurements in field tests proved that stable communication with net 100 kBit/s can be achieved via 80 hops/repeaters and the latency between sending the information and reaching the destination via 80 routers is only approx. 300 ms.

Street lighting infrastructure, poles and cables are omnipresent assets typically owned by municipalities or other public owners. Extending the functionality from simply switching on and off or dimming a street light to a ubiquitous network, under public control and ownership, gives municipalities the opportunity to improve the safety, attractiveness and quality of life of the city.

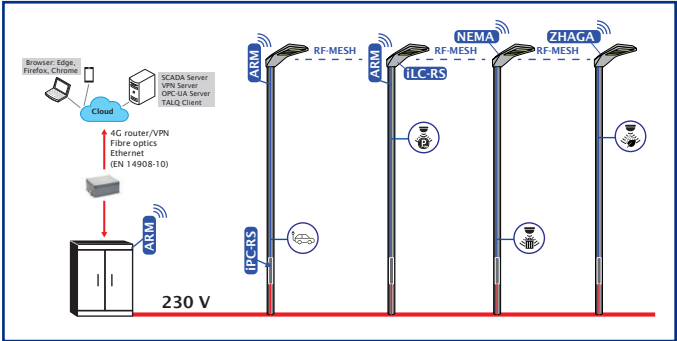


The measured latency of the data transmission length depends, among other things, on the channel occupancy, and must be determined in later field tests with different payload lengths and according to Wifi activity in order to obtain a basis for reserves that must be included in when dimensioning the networks.

Overall, these results provide a significant improvement to the network size limitation of 70 to 100 controllers of competing technologies. The combination of LON's typical multi-master capability and the event-driven behavior results in further advantages with regard to the organization of the network.

CDMA (Collision Detection Multiple Access), with LON's preferentially implemented event-driven behaviour, ensures low network utilisation. Thus, due to the full duplex capability in each subnet, costly synchronisation via TDMA (Time Division Multiple Access) as well as the waste of time slots can be avoided. The formation of a communication infrastructure via the backbone must be carried out using full duplex capability, but simple participants such as (sensors/actuators) without full duplex capability can be connected/integrated into the respective subnet at any time. As a result, it is still possible to use very energy-efficient devices that are only equipped with one transceiver and need only be upgraded by expanding the protocol stack.

If we return to the topic of simple mesh systems, it is now understandable that the goal is to position as few amplifiers as possible in the transmission channel so that the bandwidth remains as large as possible. Thus,



the transmission power and the sensitivity determine the communication distance. In an open space (line of sight) the communication distance is about five times greater than in the built environment. If you reach 1 km in an open space, it is about 200 m in the city. Many causes are responsible for this, such as signal attenuation, interference or the overlapping of products with higher transmission power, such as Wifi-based communication networks.

The idea of combining full duplex transmitter/receiver and protocol structuring means that a much higher number of amplifiers can be used in the transmit/receive chain, as only the latency is affected, but the bandwidth remains stable. A distance of typically 100 m and, if necessary, down to 30 m is no problem, as long as the latency/time delay in the installation remains below one second. If absolute synchronicity is needed, this can be achieved via the GPS time and the data could be enhanced by adding an execution time stamp.



Intelligent Active Radio Module (ARM)

The interoperable ISM-RF-MESH communication module ARM is suitable for mounting on a luminaire pole and communicates with the iLC-RS and iPC-RS luminaire controllers via RS485 (half-duplex) using the Modbus protocol, thus ensuring integration into the standardised 2.4 GHz frequency band.

The ARM in combination with the RS Luminaire controllers allows the simple conversion or supplementation of existing powerline streetlighting systems to radio controls. The ARM also serves as an RF MESH interface for the iDC-SOC edge controller.

Data transmission is in accordance with ANSI/CTA 709.11 and EN 14908-11. It is possible to operate either as part of a lighting management system using the LonMark OLC profile or as a stand-alone system with predefined lighting profiles.

The ARM takes over the function of wireless transmission of information from controller to controller and each unit can be programmed and updated OTA (over-the-air)

Typical Applications

- Radio-controlled data transmission
- In combination with RS luminaire controllers for controlling the lighting of:
 - Streets
 - Car parks
 - Bus stops and railway stations
 - Industrial facilities and warehouses
 - Sports facilities



Key Features

- Integrated light sensor
- Location positioning and synchronisation via GPS/GNSS
- LON node with OLC profile
- Mesh repeater/LON router on demand
- RS485(half-duplex) interface with termination
- Management functions
- Power consumption: 500 mW
- Connection of Modbus devices from other manufacturers possible
- 2 years warranty



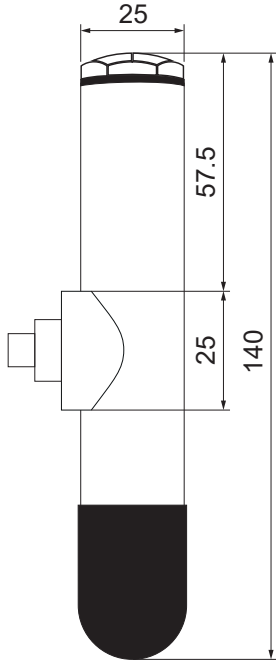
Specifications

Active Radio Module for RF-Mesh	For Luminaire Controller iLC-RS or iPC-RS	For Edge Controller iDC
Type	ARM	ARM-I
Ref. No.	TBD	TBD
Input voltage	9–24 V DC via the connected RS luminaire controller or a separate 12 V/24 V power supply unit – both not included in the scope of delivery	
Power consumption	500 mW	
Communication	<ul style="list-style-type: none"> • RF mesh full duplex (simultaneous transmission and reception on two channels by means of dynamic selection of up to 80 channels) • Frequency range: 2.4 GHz • Power range: 10 dBm • Modulation: FLRC (Fast Long Range Communication) according to ISO-OSI Layer 1 and 2 • Data transmission: according to LON protocol and ANSI/CTA 709.1/11 and EN 14908-1/-11 (in preparation) according to ISO-OSI Layer 1 and 2 • Organisation of communication: CDMA/FDMA (Collision/Frequency Detection Multiple Access) • Data rate: 100 kB/s net • Communication types: Unicast, Broadcast, Groupcast • Communication services: un- / soft- / -acknowledged • Encrypted data transmission: AES 128 	
Supported frequencies	2400-2480 MHz ISM band	
Mesh network	Up to 100 hops; latency: < 1 second, constant data rate of 100 kBit/s	
Network organisation	According to ISO-OSI layer model Layer 2 or 3, self-configuring	
Software interfaces / Control output electronic operating device	RS-485 (half-duplex), compatible with the LonMark® OLC profile	
Light sensor	Integrated, 0-64 k lux	
External sensors	Connection of any wired Modbus sensors/actuators	
GPS/GNSS receiver	Integrated	
Antennas	Integrated	
Firmware update / parameter configuration	OTA (over-the-air) via radio	OTA (over-the-air) via radio and via Modbus
Capture of measured data	Brightness	
Connection	4-pin bayonet connector, male	
Operating temperature range to	–25 to +85 °C	
Storage temperature range	–25 to +85 °C	
Humidity	5 to 95% non-condensing	
Degree of protection	IP67, UV resistant material	
Impact resistance	IK09 (vertical) / IK07 (lateral)	
Compliant standards	CE, RoHS 2011/65/EU, EN 61547, EN 55015, EN 61000-6-2/6-3/4-2/4-3/4-4/4-5/4-6/4-11, EN 301489-1/3, EN 300328	
Casing material	PVC tube, acrylic sight glass, silicone cover, nylon saddle washer	
Dimensions (ØxH)	Ø 25 x 140 mm (PVC tube incl. sight glass and silicone cover); with lateral connection plug, fixed centrally on PVC tube: 40 mm x 140 mm; mounting distance to luminaire pole: min. 15-40 mm depending on mounting type	
Weight	70 g	
Custom tariff number	t.b.d.	
Certification	CE	

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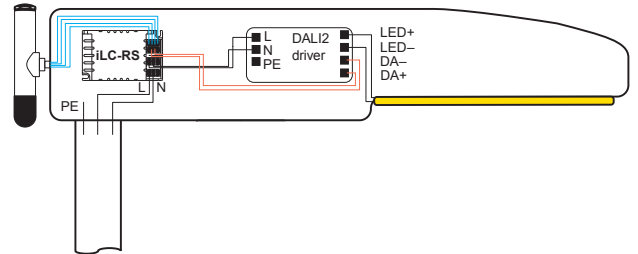


Dimensional Drawing (mm)

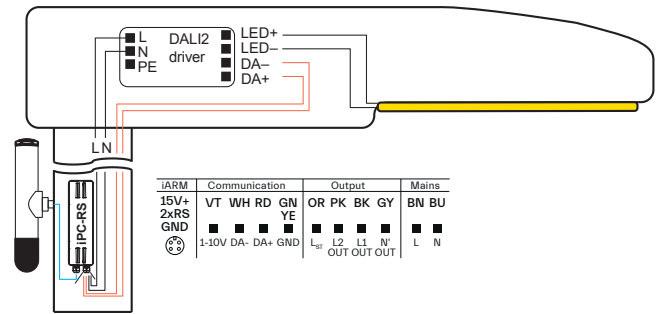


Circuit Diagrams

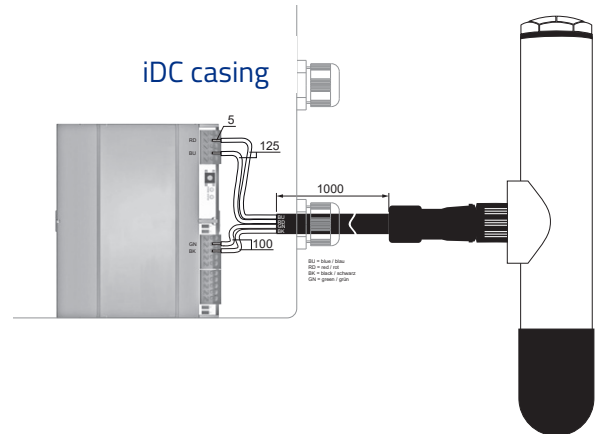
ARM – With luminaire controller iLC-RS



ARM – With luminaire controller iPC-RS



ARM-I – For edge controller iDC-SOC





Intelligent Luminaire Controller with Zhaga Socket (ZHAGA)

The interoperable ZHAGA controller controls street luminaires with electronic control gear and D4i-compliant DALI2 interface.

For this purpose, the luminaire controller with OLC-LonMark® profile uses standardised radio mesh communication in the licence-free 2.4 GHz band.

Data transmission is in accordance with ANSI/CTA 709.11 and EN 14908.11. It is possible to operate either as part of a lighting management system using the LonMark OLC profile or as a stand-alone system with predefined lighting profiles.

The controller takes over all tasks of a modern light management system and thus ensures a high degree of investment security with the ecological benefits of reduced energy consumption and CO2 emissions. Each unit can be programmed and updated OTA (over-the-air).

Typical Applications

- Street lighting and lighting in the vicinity of buildings
- Car parks, bus stops and railway stations
- Industrial facilities and warehouses
- Sports facilities



Key Features

- Lighting control via radio signal or automatically through predefined parameters (astronomical clock, light sensor)
- Adaptive need-based lighting via internal and external sensors
- Dimming, RGBW control, Tunable White, light distribution via DALI2, D4i
- Location positioning and synchronisation via GPS/GNSS
- With satellite-synchronised real-time clock and integrated light sensor for weather dependent control
- Monitoring of electrical parameters via DALI2- or D4i-compliant D4i-compliant drivers
- Power consumption: < 2 W
- Robust twist-lock contacts for reliable electrical connection
- Tool-free mounting due to standardised Zhaga Book 18 base
- 2 years warranty



Specifications

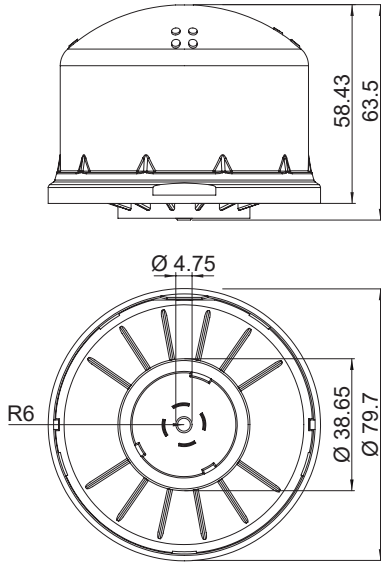
Electronic Luminaire Controller		with PIR sensor
Type	ZHAGA	ZHAGA-S
Ref. No.	TBD	TBD
Input voltage	24 V DC	
Power consumption	2 W	t.b.d.
Communication	<ul style="list-style-type: none"> • RF mesh full duplex (simultaneous transmission and reception on two channels by means of dynamic selection of up to 80 channels) • Frequency range: 2.4 GHz • Power range: 10 dBm • Modulation: FLRC (Fast Long Range Communication) according to ISO-OSI Layer 1 and 2 • Data transmission: according to LON protocol and ANSI/CTA 709.1/11 and EN 14908-1/-11 (in preparation) according to ISO-OSI Layer 3 to 6 • Organisation of communication: CDMA/FDMA (Collision/Frequency Detection Multiple Access) • Data rate: 100 kB/s net • Communication types: Unicast, Broadcast, Groupcast • Encrypted data transmission: AES 128 	
Supported frequencies	2400-2480 MHz ISM band	
Software interfaces	Compatible with the LonMark® OLC profile	
Mesh network	Up to 100 hops; latency: < 1 second, constant data rate of 100 kBit/s	
Network organisation	According to ISO-OSI layer model Layer 2 or 3, self-configuring	
Galvanic isolation	Yes	
Control / Dimming	Via DALI2, D4i-compliant (IEC 62386)	
DALI	DALI2, D4i-compliant Multi-manager capable, supply of DALI devices (sensors and drivers) up to max. 30 mA total consumption	
Control output electronic operating device	Short-circuit proof, DALI2 interface	
Light sensor	Integrated, 0-64 k lux	
PIR sensor	—	Pyroelectric infrared sensor for motion detection
External sensors	Connection of any wired DALI2, D4i-compliant sensors for e.g. motion and presence detection, luminance	
GPS/GNSS receiver	Integrated	
Antennas	Integrated	
Firmware update / parameter configuration	OTA (over-the-air) via radio	
Capture of measured data	Voltage, current, power factor, power, energy, temperature only by means of DALI2-D4i compatible control gear	
Connection	Via ZHAGA socket (Book 18)	
Operating temperature range tc	-25 to +80 °C	-25 to +60 °C
Storage temperature range	-25 to +85 °C	-25 to +70 °C
Humidity	5 to 95% non-condensing	15 to 75% non-condensing
Degree of protection	IP66, UV resistant cap	
Impact resistance	IK09 (vertical) / IK07 (lateral)	
Compliant standards	CE, RoHS 2011/65/EU, Radio Equipment Directive (RED) 2014/53/EU, EN 301489-1/3, EN 61547, EN 55015, EN 300328, EN 60950	
Casing material	Cap: PC, Socket: PBT UV-f1 certified plastic materials (UL 94 5-VA) for outdoor use	
Dimensions (ØxH)	Ø 80 x 58,43 mm	Ø 80 x 67,9 mm
Weight	120 g	140 g
Custom tariff number	8543 7090	
Certification	CE	

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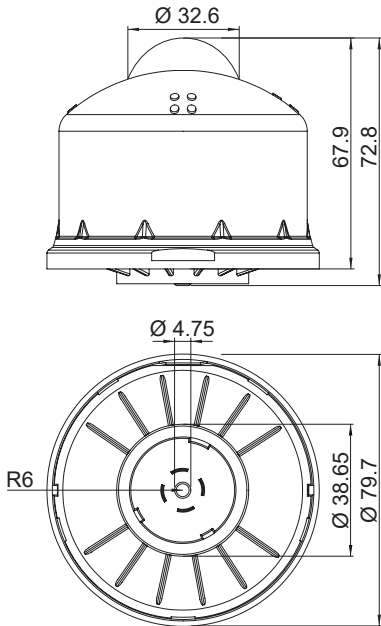


Dimensional Drawing (mm)

ZHAGA

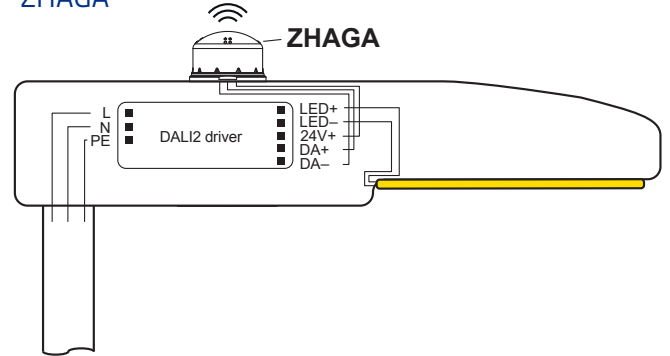


ZHAGA-S
With integrated PIR sensor

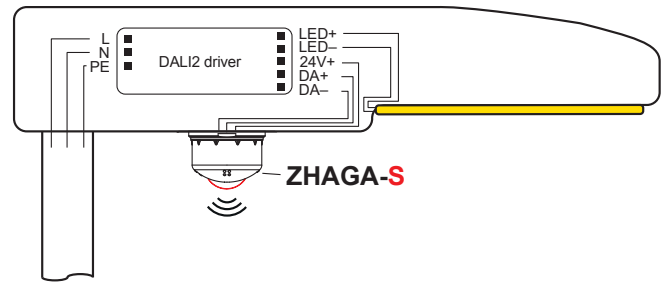


Circuit Diagrams

ZHAGA



ZHAGA-S
With integrated PIR sensor



PIR Sensor for ZHAGA-S

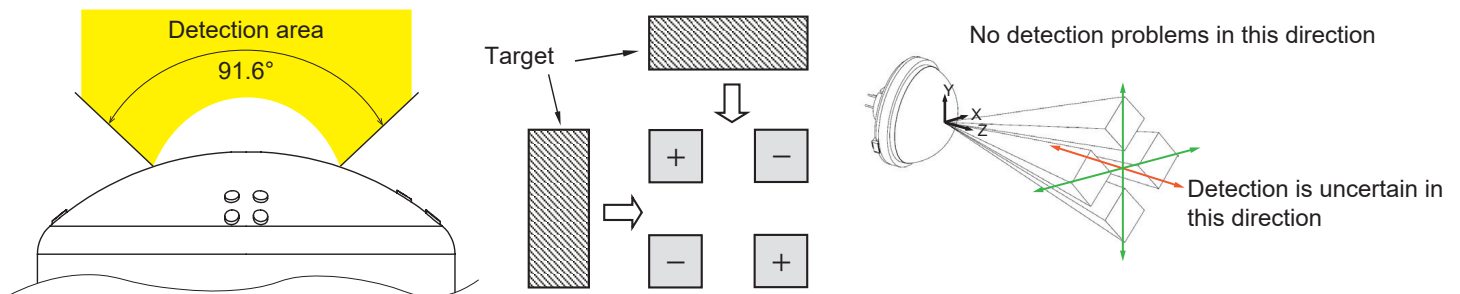
The PIR sensor used is a pyroelectric infrared sensor that detects fluctuations in infrared radiation (model no.: EKMC 1611111 from Panasonic).

Electronic Luminaire Controller	with PIR Sensor
Type	ZHAGA-S
Ref. No.	TBD
Capturing performance (measured at ambient temperature 25 °C)	
Detection area, polarised	<ul style="list-style-type: none"> • Up to 15 m (at a temperature difference of 8 °C) • Up to 10 m (at a temperature difference of 4 °C) • The detection range is dependent on the temperature difference between the target and the environment.
Movement speed	1 m/s
Object size	700x250 mm
Area	vertical: 45° / horizontal: 92°
Detection zones	176
Air pressure	86–106 kPa
Detection of heat sources other than the human body	<ul style="list-style-type: none"> • If small animals enter the detection area. • When a heat source, e.g. sunlight, incandescent lamps, car headlights, etc., or a strong beam of light hits the sensor, whether inside or outside the detection zone. • Sudden temperature changes inside or in the vicinity of the detection area.
Difficulty in detecting the heat source	<ul style="list-style-type: none"> • Glass, acrylic or similar materials located between the target object and the sensor may not allow correct transmission of the infrared rays. • No movement or rapid movement of the heat source within the detection area.
Extension of the detection area	If there are significant differences between the ambient temperature and the human body temperature, the detection area can be extended beyond the configured detection area.
Dimensions (ØxH)	Ø 32.6 x H 12.2 mm (outside the Zhaga cap)

This data can change without notice.

Detection Area

The detection range is polarised. If a target enters the + and – detection areas at the same time, the signals will each be cancelled and detection could become impossible at maximum detection range.





Functions

Operation	Stand-alone without Mesh	Stand-alone with Mesh	With Edge Controller	With Edge-Controller and SCADA system
Functions	Single light point with ZHAGA controller	Multiple light points with ZHAGA controller	Multiple light points with ZHAGA controller and edge controller	Multiple light points with ZHAGA controller, edge controller and SCADA software
Runtime calendar	Part of the controller	Part of the controller	Part of the edge controller	Part of the edge controller
Programmable calendar for events	–	–	Yes	Yes
Light sensor	Yes	Yes	Yes	Yes
Seasonal/location-dependent light control	Yes	Yes	Yes	Yes
Integrated motion detector	Only for ZHAGA-S	Only for ZHAGA-S	Only for ZHAGA-S	Only for ZHAGA-S
External sensor	Yes; via DALI2	Yes; via DALI2	Yes; via DALI2	Yes; via DALI2
Direction-dependent, moving light with street luminaires on one side of the carriageway	–	Yes, automated	Yes, automated	Yes, automated
Direction-dependent, moving light with street luminaires on both sides of the carriageway	–	Yes, if controllers are set up manually before installation (binding)	Yes, if controllers are set up manually before installation (binding)	Yes, if controllers are set up manually before installation (binding)
Parameterisation via RF (Over-the-Air)	Yes	Yes	Yes	Yes
Networking	–	Yes	Yes	Yes
Grouping	–	Yes	Yes	Yes
Maintenance factor / LED degradation over service life	Yes	Yes	Yes	Yes
Dimming levels for night-time dimming	1 step integrated; multi-step on request	1 step integrated; multi-step on request	Any dimming levels parameterisable	Any dimming levels parameterisable
Fading	Yes; with predefined time	Yes; with predefined time	–	–
Support of RGBW	–	–	Yes (10 DALI short addresses)	Yes (10 DALI short addresses)
Measurement data via DALI2	Storage of the current value in the controller and readout via OTA	Storage of the current value in the controller and readout via OTA	Measurement data mapped to the OLC profile depending on the DALI2 LED driver used; storage of values over a longer period of time in the edge controller	Measurement data mapped to the OLC profile depending on the DALI2 LED driver used; storage of values over a longer period in the edge controller and visualization via SCADA software

Note: certain functions are only possible with permanent power supply to the street lighting.

Typical Applications

- Control light (switch on/off and dim)
 - by means of a runtime calendar
 - by means of a programmable calendar (in the light management system)
 - by means of light sensor incl. adjustability of a hysteresis threshold for unpredictable weather phenomena
 - by means of GPS location (seasonal)
 - Dimming with freely selectable dimming levels (in the management system) or by means of a predefined dimming level (in stand-alone operation)
- Separate switching of the light at dangerous or

architectural points, e.g. pedestrian crossing, monuments, etc.

- Replacement for audio frequency/long wave ripple control technology (e.g. in combination with Switch Cabinet Controller)

Additional function of the ZHAGA-S

- Motion-controlled light via PIR sensor: when movement is detected it switches the luminaire on.
- Further lighting control functions
- For example, running lights with directional lighting for tunnels or light control depending on traffic volume (e.g. traffic jam warning) in preparation.

Note: No additional components required



Measurement data collection

Measurement data acquisition is carried out via the connected DALI2 luminaire driver (see DALI2/D4i specification). The ZHAGA controller only records the runtime.

Maintenance factor function

A constant luminous flux can be achieved with the lighting controls slowly increasing power to counteract the lumen depreciation over the service life of the lamp. This avoids the need to over specify the luminous output to allow for lumen depreciation and thereby optimizes energy consumption.

Communication infrastructure for smart city applications

Using an open protocol, the existing street lighting infrastructure becomes an intelligent communication platform for further smart city applications.

The technology used is fully interoperable at the protocol and communication level due to the standardised protocol according to EN 14908-1. The transmission channel based on radio is standardised according to EN 14908.11 and is in preparation.

ZHAGA luminaire controllers create a reliable communication structure to which further smart city applications can be added.

ZHAGA allows the lighting to be controlled while maintaining power at the pole which is a prerequisite for adding additional applications.

Possible fields of application with additional sensors can be:

- Environmental technology (real-time measurement)
 - Nitrogen oxides
 - CO₂
 - Ozone
- Weather data (real-time measurement)
 - Temperature
 - Humidity
 - Air pressure
 - Precipitation
 - Wind
 - Road ice detection
- Noise measurement
- Parking management
 - Detection and display of free/occupied parking spaces
 - Display on information boards
- Waste management (only possible in management mode)
 - Reporting of fill level to central location via e-mail or SMS
- Traffic management
 - Traffic counting (type and quantity)
 - Provision of data for traffic control
 - Pre-processed image data transmission for traffic measurement, blind spot assistant via signal light display
- Charging electric vehicles
 - Single-phase or multi-phase charging of electric vehicles with alternating current incl. energy consumption measurement
 - Different access options to the charging point (ad-hoc charging, app, RFID card)
 - Free/occupied message via street light and transmission to information systems
- Actuator data (e.g. information boards)



Intelligent Luminaire Controller with NEMA Socket (NEMA)

The interoperable NEMA controller controls street luminaires with electronic control gear with either 0-10V or DALI2 (D4i compliant) interfaces.

For this purpose, the luminaire controller with OLC-LonMark® profile uses standardised radio mesh communication in the licence-free 2.4 GHz band.

Data transmission is in accordance with ANSI/CTA 709.11 and EN 14908.11. It is possible to operate either as part of a lighting management system using the LonMark OLC profile or as a stand-alone system with predefined lighting profiles.

The controller takes over all tasks of a modern light management system and thus ensures a high degree of investment security with the ecological benefits of reduced energy consumption and CO2 emissions. Each unit can be programmed and updated OTA (over-the-air).

Typical Applications

- Street lighting and lighting in the vicinity of buildings
- Car parks, bus stops and railway stations
- Industrial facilities and warehouses
- Sports facilities



Key Features

- Lighting control via radio signal or automatically through predefined parameters (astronomical clock, light sensor)
- Adaptive need-based lighting via internal and external sensors
- Dimming, RGBW control, Tunable White, light distribution via DALI2, D4i
- Location positioning and synchronisation via GPS/GNSS
- With satellite-synchronised real-time clock and integrated light sensor for weather dependent control
- Monitoring of electrical parameters via DALI2- or D4i-compliant D4i-compliant drivers
- Power consumption: < 2 W
- Robust twist-lock contacts for reliable electrical connection
- Tool-free mounting due to standardised NEMA solid base
- 2 years warranty



Specifications

General	Version A: 0-10V, 24V Sensor supply	Version B: 0-10V, DALI2
Input voltage	90 .. 305 VAC (50/60Hz)	
Power consumption	2 W	
Switching current	8 A (bi-stable relay)	
Switching cycles	50,000 operations with $\lambda = 0,8$	
Terminals	3+4 according ANSI C136.41 (NEMA)	
Working temperature	-25°C to +80°C	
Storage temperature	-25°C to +80°C	
Air Humidity	5% to 85%	
Type of protection	IP65	
Surge protection	10 KV	
Control output	1-10V Shortcircuit proof	
DALI-2 output	N/A	Compliant to IEC 62386, DALI2 and D4i compliant
Light sensor	Built-in, 0-130,000 lux	
Power measurement	Voltage, Current, Power, Energy, Power Factor, operating hours	
Galvanic isolation	0-10V 24V and sensor input	0-10V, DALI interface
GPS/GNSS receiver	Integrated for location, time, calculation of sunset and sunrise	
Pin out		
1 (LIVE)	L	
2 (NEUTRAL)	N	
3 (LOAD)	LOAD	
4 (DIM+)	1-10V	
5 (DIM-)	GND	
6 (AUX+)	24V, 10 mA load	
6 (AUX-)	Sensor input, digital signal (dry contact)	
Communication	<ul style="list-style-type: none"> • RF mesh full duplex (simultaneous transmission and reception on two channels by means of dynamic selection of up to 80 channels) • Frequency range: 2.4 GHz • Power range: 10 dBm • Modulation: FLRC (Fast Long Range Communication) according to ISO-OSI Layer 1 and 2 data transmission: according to LON protocol and ANSI/CTA709.1/1.11 and EN 14908-1/-11 (in preparation) according to ISO-OSI layer 3 to 6 • Organization of communication: CDMA/FDMA (Collision/Frequency Detection Multiple Access) • Data rate: 100 kB/s net • Communication types: Unicast, Broadcast, Groupcast • Encrypted data transmission: AES 128 	
Frequencies	2400-2480 MHz ISM band	
Software interfaces	Compatible with the LonMark® OLC profile	
Network operation	Up to 100 hops; latency: < 1 second, constant data rate of 100 kBit/s	
Network organisation	According to ISO-OSI layer model Layer 2 or 3, self-configuring	
Impact resistance	OTA (over-the-air) via radio	

This data can change without notice.