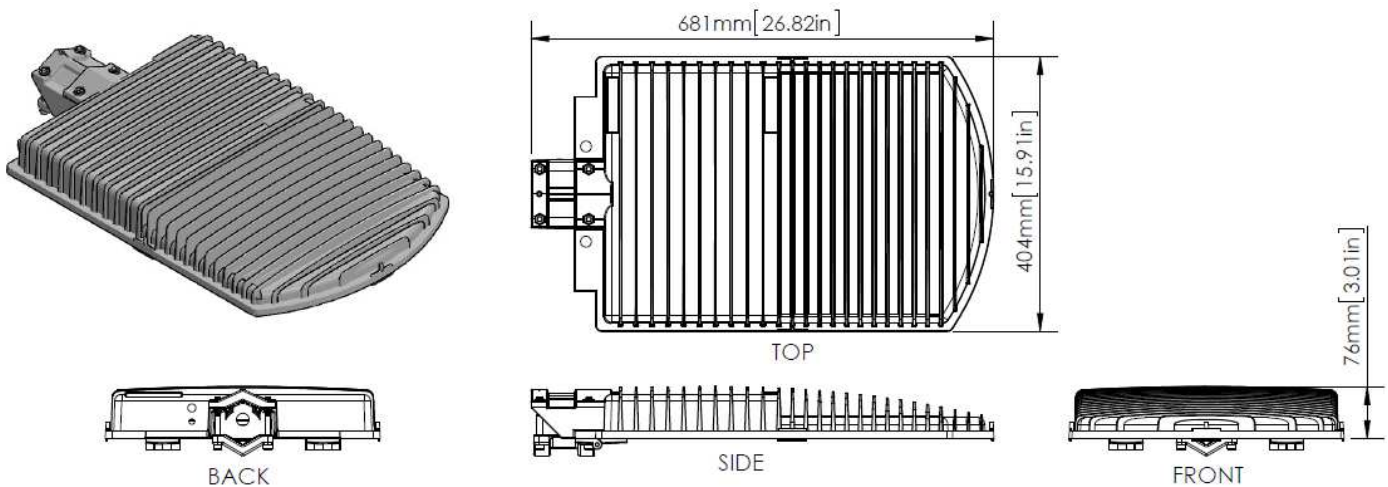


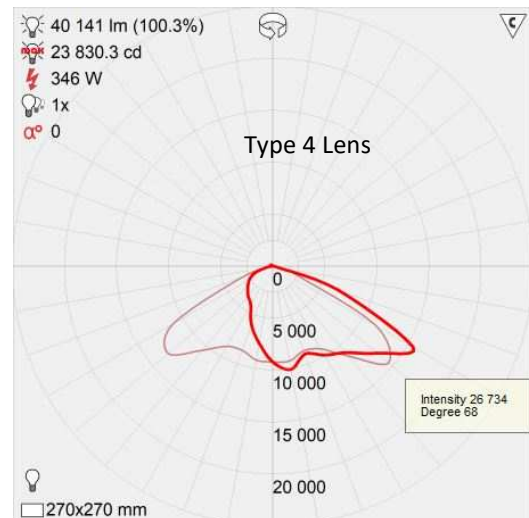
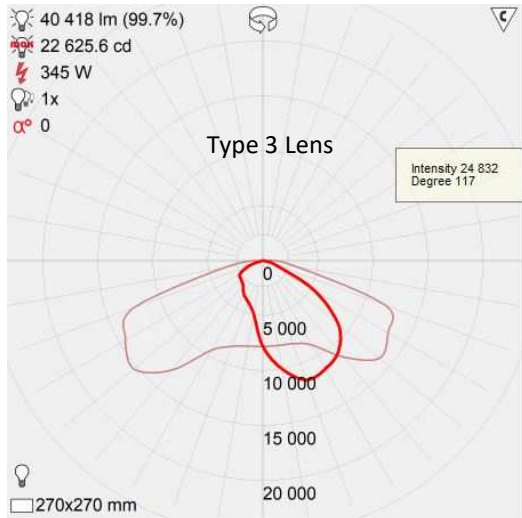


Apollo SL5 medium – The ideal LED lamp for outdoor use that is highly cost-effective. The robust die cast aluminum housing with its finned surface guarantees excellent heat management. The light is ETL listed and conforms to UL STD 1598.

- for street, roadway and parking lot lighting applications
- heat management system assures long LED life and minimal lumen depreciation
- tool-less entry for ease of maintenance
- modular LED design with the ability to easily replace LEDs in the field
- universal mounting design
- best lumens per watt/lumen per dollar in the industry
- mil-spec components to withstand the hottest and coldest climates
- wireless control, UHF or 900 MHz
- optional: Camera, WiFi, LTE, and DVR

Number of LEDs	16/24
Lumen@4000k	35000/40000/60000
Lumen per Watt	116
Typical Power Consumption (W)	280/350/480





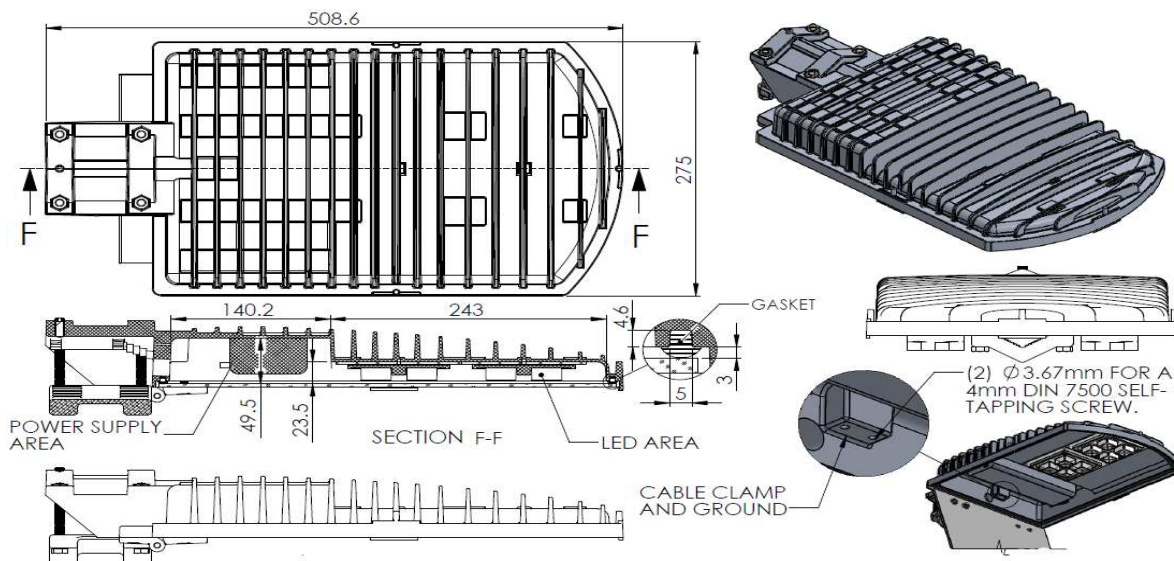
Electrical	
Input Voltage	100-277 V AC
Frequency Range	50/60 Hz
Surge Spike Protection	Compliance to EN61000-4-5 6 kV, 10 kV line to ground
Power Factor	0.99
Optical	
Light Source	CREE XHP 70-2
Color Temperature	4000 K
Custom Design Lens Source	LEDIL
Beam Pattern	Type III, IV or V, others on request
Lumen/Watt	116
Environmental	
Operating Temperature	-40 to +85C
Mechanical	
Dimensions	681 x 404 x 76 mm
Weight	18.8 Lbs. (8.5 kg)
Material	Aluminum Alloy / Glass
Wind Load	0.056 m ² = 0.557 sqft
Mounting	Diameter 2.6"/63 mm

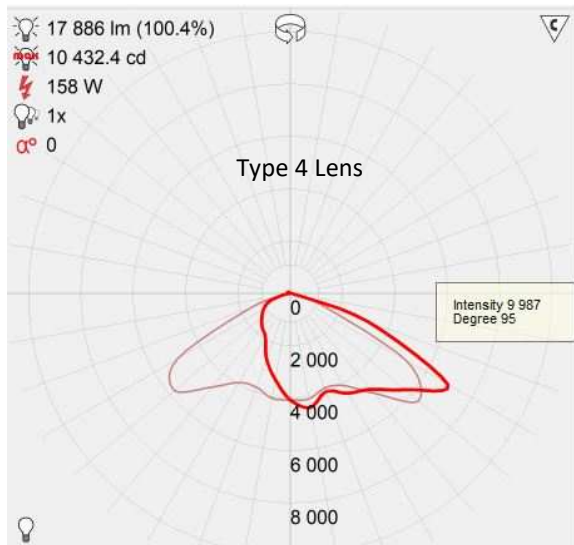
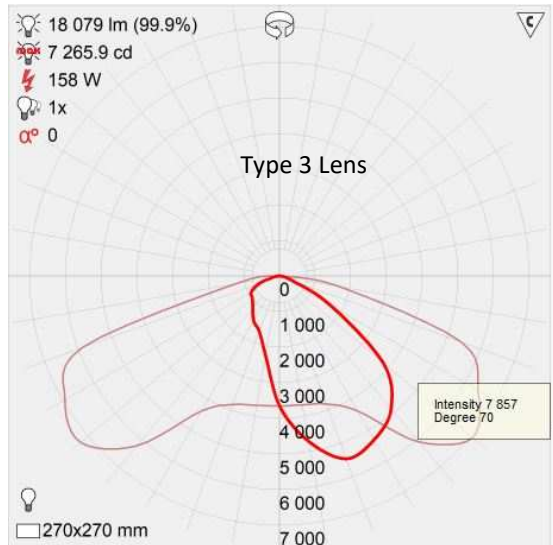


Apollo SL5 mini – The ideal LED lamp for outdoor use that is highly cost-effective. The robust die cast aluminum housing with its finned surface guarantees excellent heat management. The light is ETL listed and conforms to UL STD 1598.

- for street, roadway and parking lot lighting applications
- heat management system assures long LED life and minimal lumen depreciation
- tool-less entry for ease of maintenance
- modular LED design with the ability to easily replace LEDs in the field
- universal mounting design
- best lumens per watt/lumen per dollar in the industry
- mil-spec components to withstand the hottest and coldest climates
- wireless control on UHF and 900 MHz
- adjustable elevation in mounting bracket

Number of LEDs	8
Lumen@4000k	17900
Typical Power Consumption (W)	150





Electrical	
Input Voltage	100-277 V AC or 480 V AC or 48 V DC
Frequency Range	50/60 Hz
Surge Spike Protection	Compliance to EN61000-4-5 6 kV, 10 kV line to ground
Optical	
Light Source	CREE XHP 70-2
Color Temperature	4000 K – others on request
Custom Design Lens Source	LEDIL
Beam Pattern	Type III or type IV, others on request
Environmental	
Operating Temperature	-40 to +85C
Mechanical	
Dimensions	520 x 280 x 75 mm
Weight	12.8 Lbs. (5.8kg)
Material	Aluminum Alloy / Glass
Wind Load	0.0336 m ² = 0.362 sqft
Mounting	2.6"/63 mm

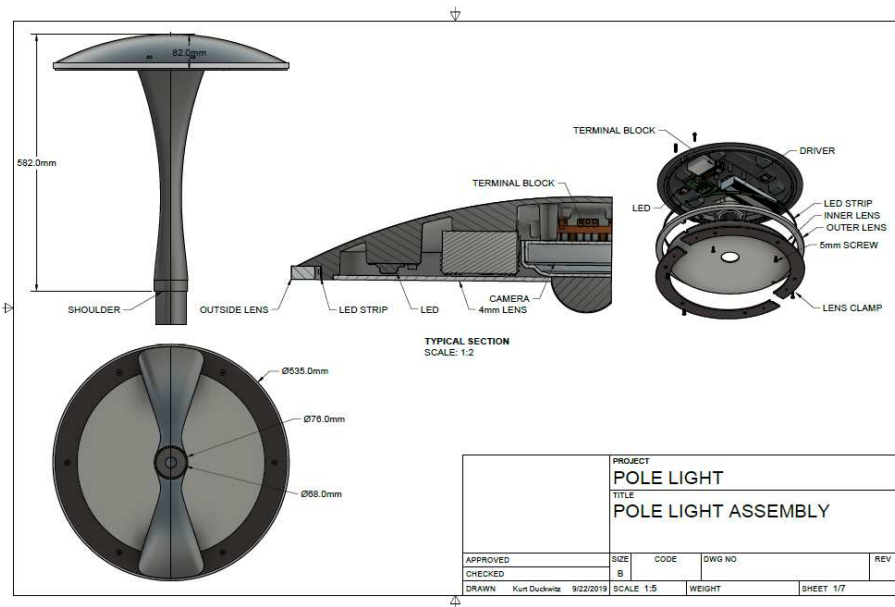


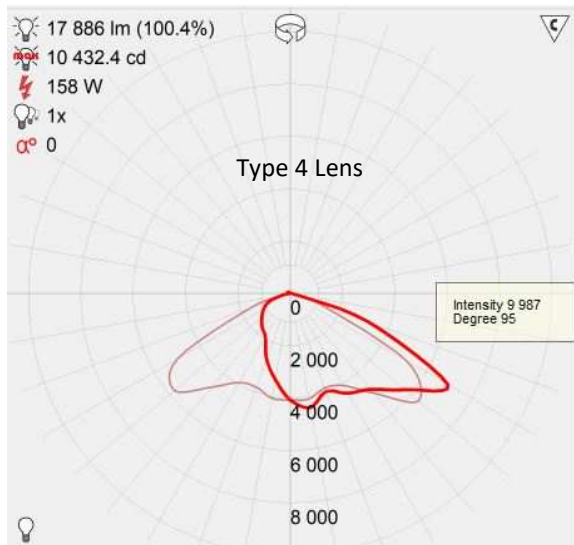
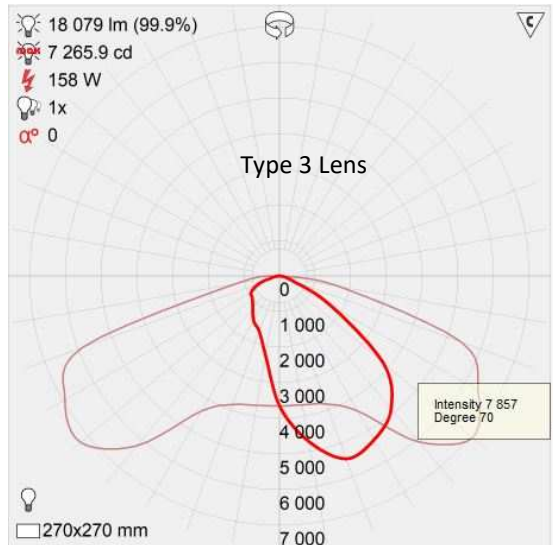
Apollo Smart Poletop – This elegant luminaire for outdoor use combines beauty and function. It was especially designed for pedestrian areas on campuses, in cities, or in parking lots. The robust die cast aluminum housing guarantees excellent heat management, assuring long LED life, and minimal lumen depreciation. Poletop and mast can be powder coated in any RAL color for a seamless design.

- Options Available
 - 100 RGB LEDs in the outside ring can be used for decoration or information purposes
 - 4K ONVIF camera with 5 GHz radio
 - Speaker for PA capabilities
 - Wireless control on UHF and WIFI



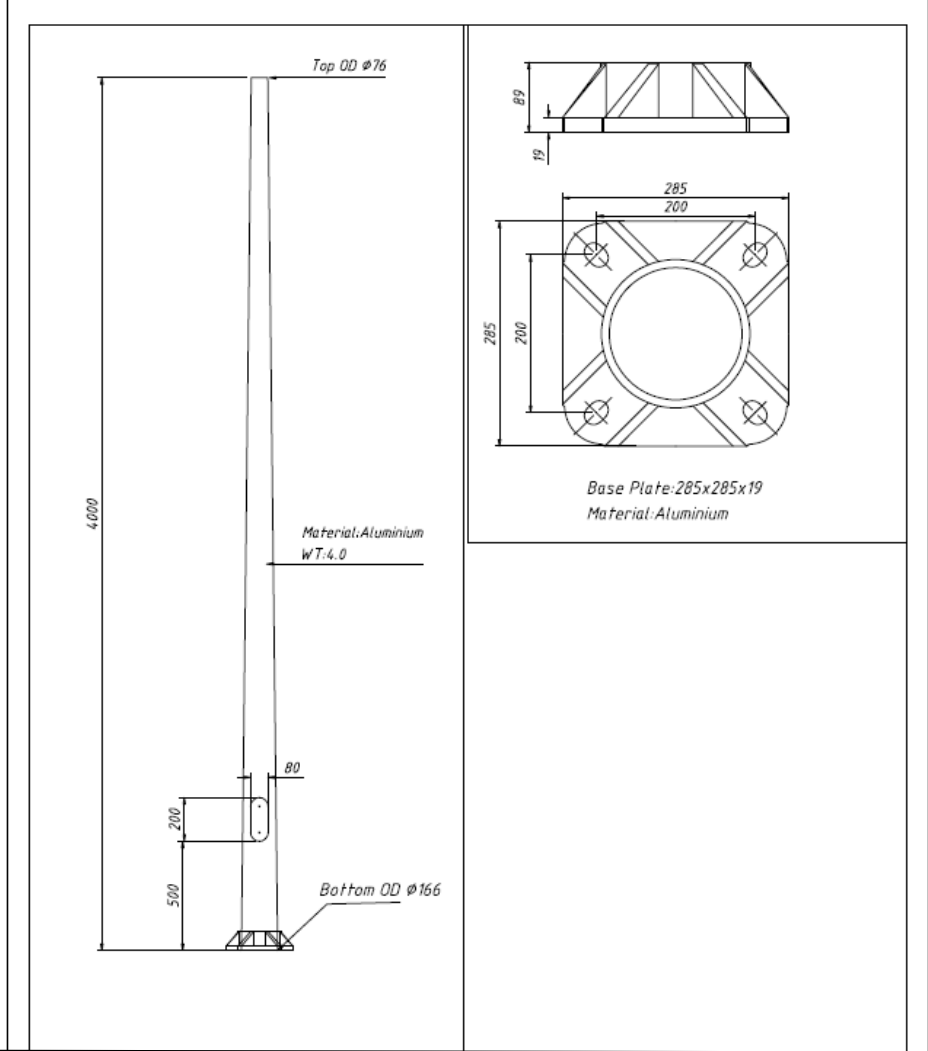
Number of LEDs	6
Lumen@4000k	17900
Typical Power Consumption (W)	150





Electrical	
Input Voltage	100-277 V AC, 480 V AC, 48 V DC
Frequency Range	50/60 Hz
Surge Spike Protection	Compliance to EN61000-4-5 6 kV, 10 kV line to ground
Optical	
Light Source	CREE XHP 70-2 (6)
Color Temperature	4000 K – others on request
Custom Design Lens Source	LEDIL
Beam Pattern	Type III, IV, or V, others on request
Environmental	
Operating Temperature	-40 to +85C
Mechanical	
Dimensions	See drawing
Weight	8kg
Material	Aluminum Alloy/Acrylic Ring and Cover
Wind Load	0.0336 m ² = 0.362 sqft
Mounting	68 mm OD

Optional matching mast for a seamless design. Poletop light and mast are available in any RAL color. Height of mast can be 4, 5, or 6 meters.

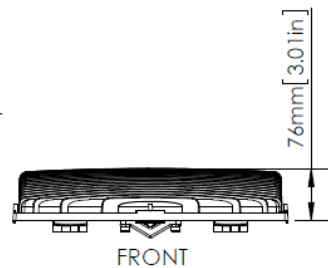
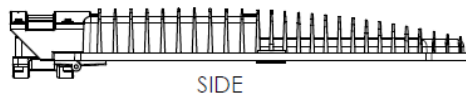
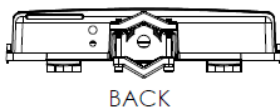
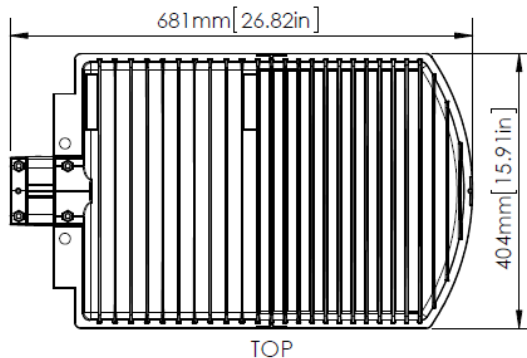
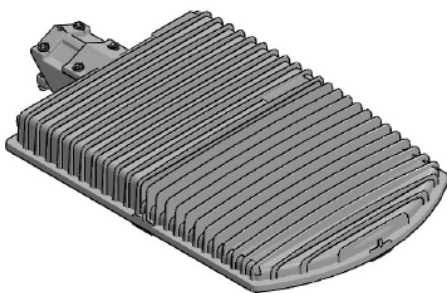


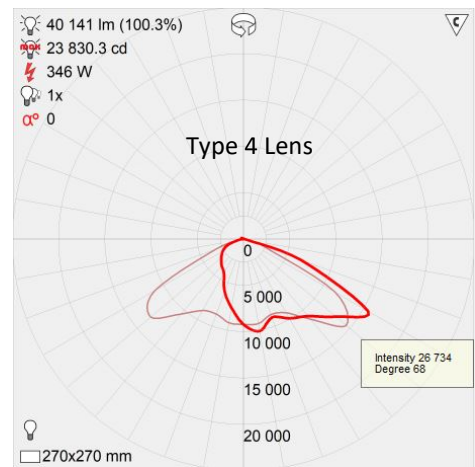
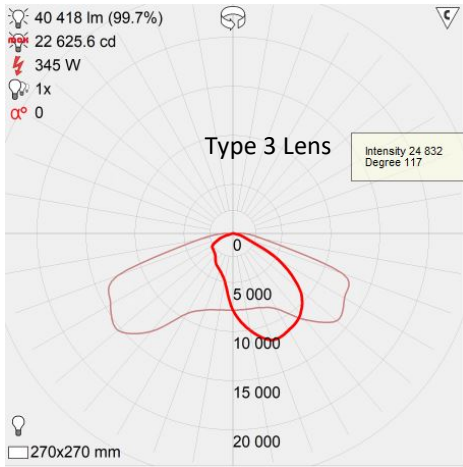


Apollo SL5 medium AMBER – This is the AMBER version of our standard medium traffic light for applications close to the coast. The robust die cast aluminum housing with its finned surface guarantees excellent heat management. The light is ETL listed and conforms to UL STD 1598.

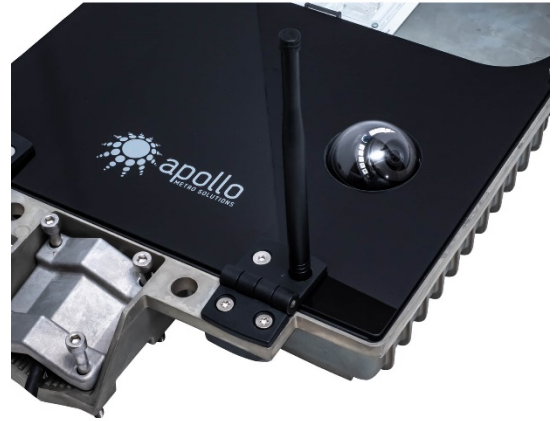
- for street, roadway and parking lot lighting applications
- heat management system assures long LED life and minimal lumen depreciation
- tool-less entry for ease of maintenance
- modular LED design with the ability to easily replace LEDs in the field
- universal mounting design
- best lumens per watt/lumen per dollar in the industry
- mil-spec components to withstand the hottest and coldest climates
- wireless control, UHF or 900 MHz
- optional: Camera, WiFi, LTE, and DVR

Number of LEDs	8/16/24
Lumen@623nm	6000/12000/18000
Lumen per Watt	114
Typical Power Consumption (W)	62/124/220





Electrical	
Input Voltage	100-277 V AC or 480 V AC
Frequency Range	50/60 Hz
Driver	Inventronics
Surge Spike Protection	Inventronics PS-20KS10KHT Imax 20 kA, In 10 kA, UL1449 recognized
Electrical Rating	UL1598/ETL
Power Factor	0.99
Optical	
Light Source	OSRAM LZ4-00R108
Color Temperature	623 nm
Custom Design Lens Source	LEDIL
Beam Pattern	Type III, IV or V, others on request
Lumen/Watt	114
Environmental	
Operating Temperature	-40 to +85C
Rating	IP66
Mechanical	
Dimensions	681 x 404 x 76 mm
Weight	18.8 Lbs. (8.5 kg)
Material	Aluminum Alloy / Glass
Coating	Polyester Powder Coating Light grey RAL7035
Wind Load	0.056 m ² = 0.557 sqft
Mounting	Diameter 2.6"/63 mm



Apollo SL5 medium camera option – The ideal LED lamp to include an inconspicuous camera for heightened security.

- Ethernet PoE 12V
- Fiber (external converter)
- WiFi: 2.4 or 5GHz
- LTE
- Built-in recorder with GPS

Technical Specifications

Camera	
Image Sensor	1/2.8" Sony IMX335 CMOS
Effective Pixels	2592(H)×1944 (V)
Electronic Shutter	AUTO, 1/25s ~ 1/100000s
Min. Illumination	0.01Lux@F1.2(AGC ON), 0Lux IR on
Day/Night	Auto/Color/(B/W)/Timing
WDR	Digital WDR
White Balance	Auto
Other	AGC,2/3 DNR,Motion Detection, Privacy Mask, Mirror, Flip
Encode	
Embedded Solution	Mstar MSC316DM



apollo
METRO SOLUTIONS

Video Standard	H.265/H.264
Video Resolution	MainStream:15fps@5MP(2592x1944),25fps@4MP/3MP,30fps@1080P/720P
	Sub stream: D1/VGA(640x480)/360P/QVGA@25fps
Video Bitrates	512Kbps - 6Mbps, VBR/CBR
Audio Standard	G.711-u/G.711-a
IR LED	
IR LED	10 Array IR LED
IR Distance	10-15 meters
Lens	
Focal Length	3.6 mm fixed lens
Optional Function	
POE, Audio	
Network Services	
Protocol	RTSP/FTP/DHCP/DDNS/NTP/SMTP/NFS
P2P	YES
Web	IE , firefox 32bit ESR
Media	CMS, Android, IOS
ONVIF	17.06 compatible
General	
Network Port	1-RJ45, 100Mbps, POE optional
Power Supply	12 VDC \pm 10%
Power Consumption	< 5 W
Operating Temperature	-30°C-(+60)°C, 10%-90%RH

OSRAM

Our Brand

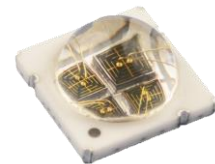
LED ENGIN



Light is OSRAM

Amber LED Emitter

LZ4-00A108



Key Features

- High Luminous Efficacy 6.3W Amber LED
- Ultra-small foot print – 7.0mm x 7.0mm
- Surface mount ceramic package with integrated glass lens
- Very low Thermal Resistance (2.8°C/W)
- Individually addressable die
- Very high Luminous Flux density
- JEDEC Level 1 for Moisture Sensitivity Level
- Autoclave compliant (JEDEC JESD22-A102-C)
- Lead (Pb) free and RoHS compliant
- Reflow solderable (up to 6 cycles)
- Emitter available on Serially Connected MCPCB (optional)

Typical Applications

- Emergency vehicle lighting
- Strobe and warning lights
- Marine and buoy lighting
- Aviation and obstruction lighting
- Roadway beacons and traffic signaling
- Architectural lighting
- Automotive signal and marker lights

LZ4-00A108

Part number options

Base part number

Part number	Description
LZ4-00A108-xxxx	LZ4 emitter
LZ4-40A108-xxxx	LZ4 emitter on 1 channel Standard Star MCPCB

Bin kit option codes

A1, Amber (590nm)

Kit number suffix	Min flux bin	Color bin range	Description
0000	R	A3 – A6	full distribution flux; full distribution wavelength

Luminous Flux Bins

Table 1:

Bin Code	Minimum	Maximum
	Luminous Flux (Φ_V) @ $I_F = 700\text{mA}$ ^[1,2] (lm)	Luminous Flux (Φ_V) @ $I_F = 700\text{mA}$ ^[1,2] (lm)
R	285	356
S	356	445
T	445	556
U	556	695

Notes for Table 1:

- Luminous flux performance guaranteed within published operating conditions. LED Engin maintains a tolerance of $\pm 10\%$ on flux measurements.
- Future products will have even higher levels of luminous flux performance. Contact LED Engin Sales for updated information.

Dominant Wavelength Bins

Table 2:

Bin Code	Minimum	Maximum
	Dominant Wavelength (λ_P) @ $I_F = 700\text{mA}$ ^[1,2] (nm)	Dominant Wavelength (λ_P) @ $I_F = 700\text{mA}$ ^[1,2] (nm)
A3	587.5	590
A4	590	592.5
A5	592.5	595
A6	595	597.5

Notes for Table 2:

- Dominant wavelength is derived from the CIE 1931 Chromaticity Diagram and represents the perceived hue.
- LED Engin maintains a tolerance of $\pm 1.0\text{nm}$ on dominant wavelength measurements.

Forward Voltage Bins

Table 3:

Bin Code	Minimum	Maximum
	Forward Voltage (V_F) @ $I_F = 700\text{mA}$ ^[1,2] (V)	Forward Voltage (V_F) @ $I_F = 700\text{mA}$ ^[1,2] (V)
0	8.96	11.60

Notes for Table 3:

- LED Engin maintains a tolerance of $\pm 0.04\text{V}$ for forward voltage measurements.
- Forward Voltage is binned with all four LED dies connected in series.

Absolute Maximum Ratings

Table 4:

Parameter	Symbol	Value	Unit
DC Forward Current ^[1]	I_F	1000	mA
Peak Pulsed Forward Current ^[2]	I_{FP}	1500	mA
Reverse Voltage	V_R	See Note 3	V
Storage Temperature	T_{stg}	-40 ~ +125	°C
Junction Temperature	T_J	125	°C
Soldering Temperature ^[4]	T_{sol}	260	°C
Allowable Reflow Cycles		6	
Autoclave Conditions ^[5]		121°C at 2 ATM, 100% RH for 168 hours	
ESD Sensitivity ^[6]		ESD Sensitive Device Class 0 ANSI/ ESDA/ JEDEC JS-001 HBM	

Notes for Table 4:

- Maximum DC forward current (per die) is determined by the overall thermal resistance and ambient temperature. Follow the curves in Figure 10 for current derating.
- Pulse forward current conditions: Pulse Width \leq 10msec and Duty Cycle \leq 10%.
- LEDs are not designed to be reverse biased.
- Solder conditions per JEDEC 020D. See Reflow Soldering Profile Figure 3.
- Autoclave Conditions per JEDEC JESD22-A102-C.
- LED Engin recommends taking reasonable precautions towards possible ESD damages and handling the LZ4-00A108 in an electrostatic protected area (EPA). An EPA may be adequately protected by ESD controls as outlined in ANSI/ESD S6.1.

Optical Characteristics @ $T_C = 25^\circ\text{C}$

Table 5:

Parameter	Symbol	Typical	Unit
Luminous Flux (@ $I_F = 700\text{mA}$) ^[1]	Φ_V	400	lm
Luminous Flux (@ $I_F = 1000\text{mA}$) ^[1]	Φ_V	520	lm
Dominant Wavelength ^[2]	λ_P	590	nm
Viewing Angle ^[3]	$2\Theta_{1/2}$	100	Degrees
Total Included Angle ^[4]	$\Theta_{0.9V}$	120	Degrees

Notes for Table 5:

- Luminous flux typical value is for all four LED dies operating concurrently at rated current.
- Amber LEDs have a significant shift in wavelength over temperature; please refer to Figure 6 for details. Caution must be exercised if designing to meet a regulated color space due to this behavior as product may shift out of legal color space under elevated temperatures.
- Viewing Angle is the off axis angle from emitter centerline where the luminous intensity is $\frac{1}{2}$ of the peak value.
- Total Included Angle is the total angle that includes 90% of the total luminous flux.

Electrical Characteristics @ T_C = 25°C

Table 6:

Parameter	Symbol	Typical	Unit
Forward Voltage (@ I _F = 700mA) ^[1]	V _F	10.0	V
Forward Voltage (@ I _F = 1000mA) ^[1]	V _F	10.4	V
Temperature Coefficient of Forward Voltage ^[1]	ΔV _F /ΔT _J	-11.2	mV/°C
Thermal Resistance, electrical (Junction to Case)	RΘ _{J-C}	2.8	°C/W

Note for Table 6:

- Forward Voltage typical value is for all four LED dies connected in series.

IPC/JEDEC Moisture Sensitivity Level

Table 7 - IPC/JEDEC J-STD-20D.1 MSL Classification:

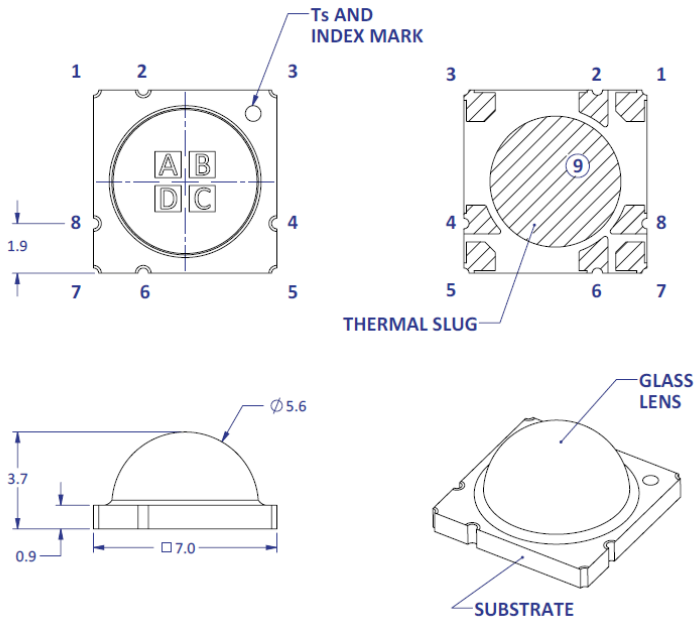
Level	Soak Requirements					
	Floor Life		Standard		Accelerated	
	Time	Conditions	Time (hrs)	Conditions	Time (hrs)	Conditions
1	Unlimited	≤ 30°C/ 85% RH	168 +5/-0	85°C/ 85% RH	n/a	n/a

Note for Table 7:

- The standard soak time is the sum of the default value of 24 hours for the semiconductor manufacturer’s exposure time (MET) between bake and bag and the floor life of maximum time allowed out of the bag at the end user of distributor’s facility.

LZ4-00A108

Mechanical Dimensions (mm)

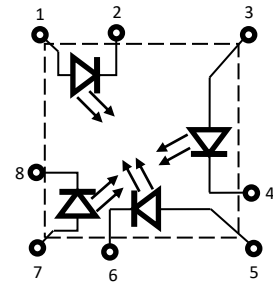


Pin Out		
Pad	Die	Function
1	A	Anode
2	A	Cathode
3	B	Anode
4	B	Cathode
5	C	Anode
6	C	Cathode
7	D	Anode
8	D	Cathode
9 [2]	n/a	Thermal

Figure 1: Package outline drawing

Notes for Figure 1:

1. Unless otherwise noted, the tolerance = ± 0.20 mm.
2. Thermal contact, Pad 9, is electrically neutral.



Recommended Solder Pad Layout (mm)

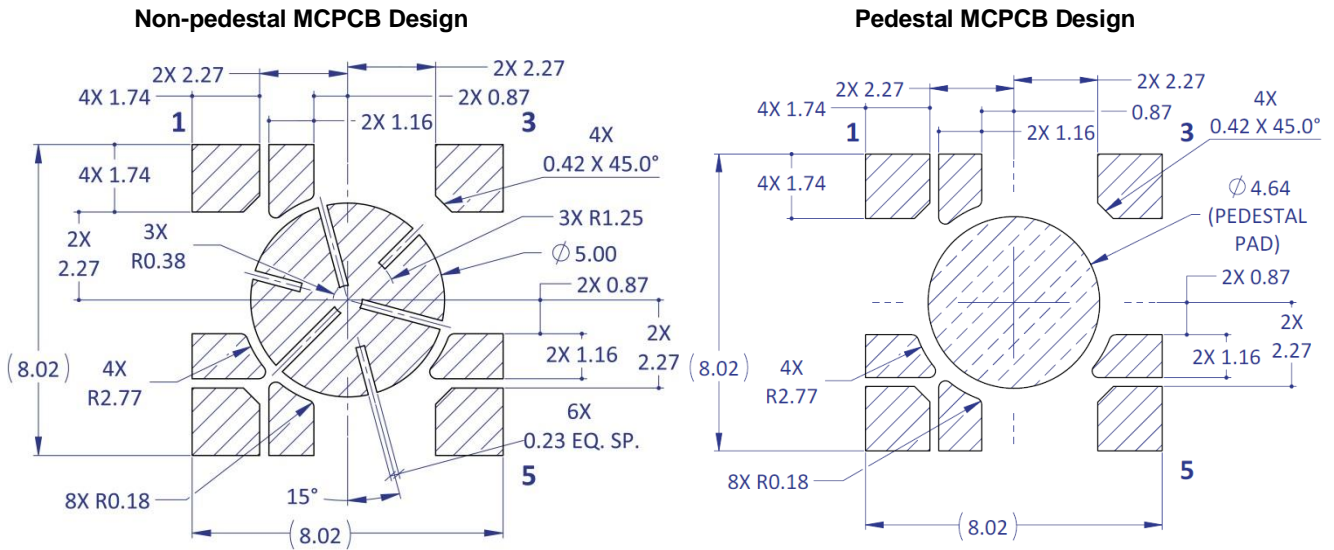


Figure 2a: Recommended solder pad layout for anode, cathode, and thermal pad for non-pedestal and pedestal design

Notes for Figure 2a:

1. Unless otherwise noted, the tolerance = ± 0.20 mm.
2. Pedestal MCPCB allows the emitter thermal slug to be soldered directly to the metal core of the MCPCB. Such MCPCB eliminate the high thermal resistance dielectric layer that standard MCPCB technologies use in between the emitter thermal slug and the metal core of the MCPCB, thus lowering the overall system thermal resistance.
3. LED Engin recommends x-ray sample monitoring for solder voids underneath the emitter thermal slug. The total area covered by solder voids should be less than 20% of the total emitter thermal slug area. Excessive solder voids will increase the emitter to MCPCB thermal resistance and may lead to higher failure rates due to thermal over stress.

Recommended Solder Mask Layout (mm)

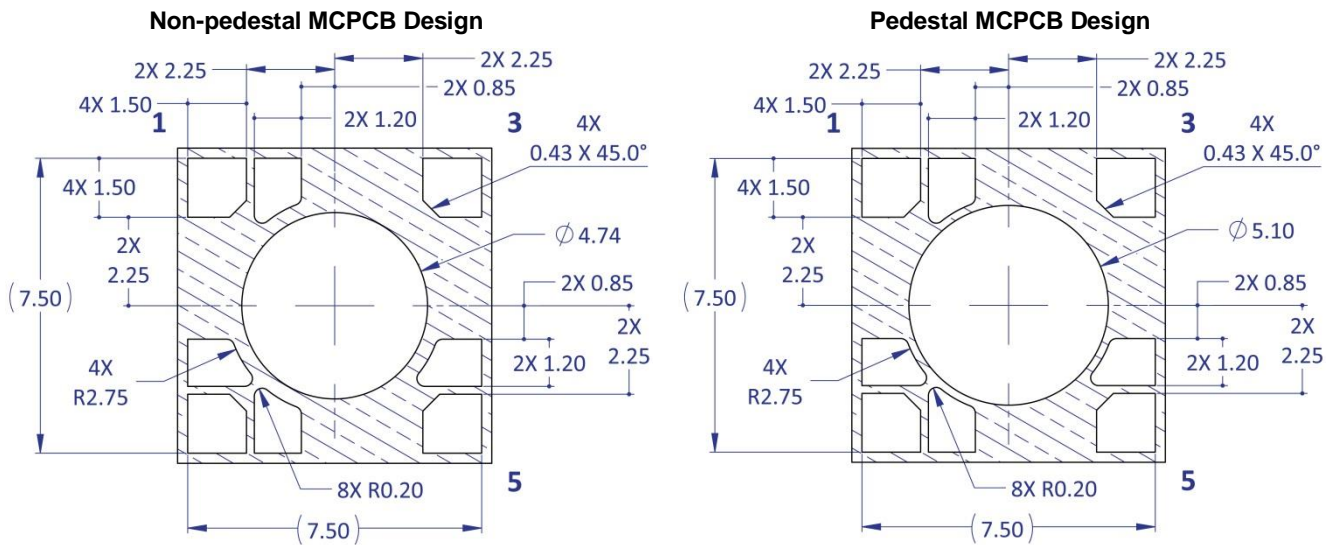


Figure 2b: Recommended solder mask opening for anode, cathode, and thermal pad for non-pedestal and pedestal design

Note for Figure 2b:

1. Unless otherwise noted, the tolerance = ± 0.20 mm.

Recommended 8mil Stencil Apertures Layout (mm)

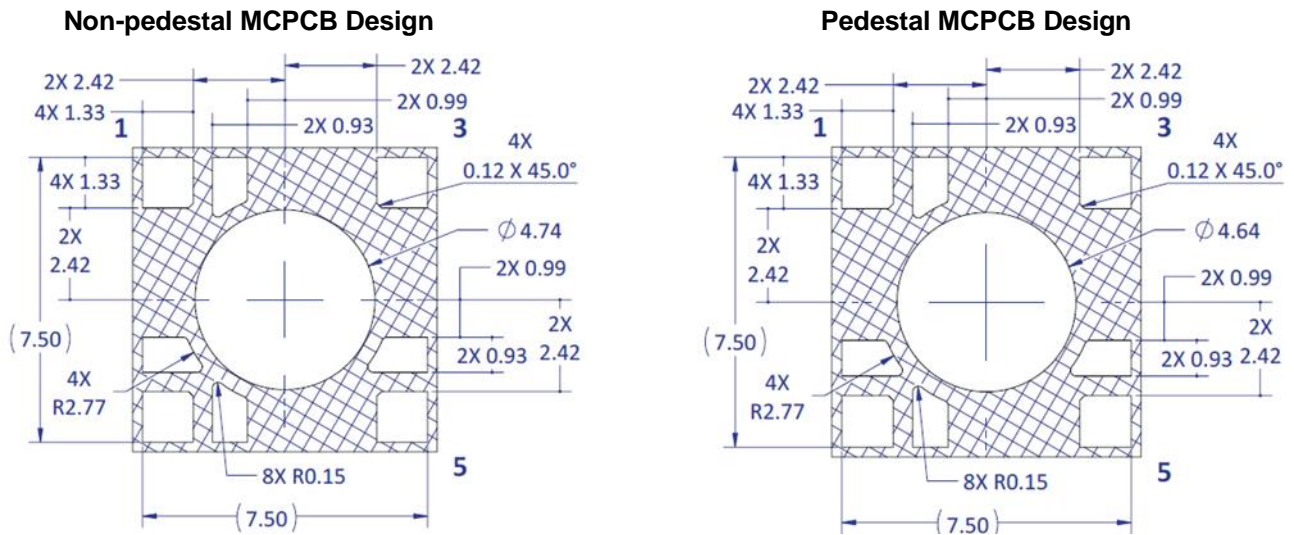


Figure 2c: Recommended 8mil stencil apertures for anode, cathode, and thermal pad for non-pedestal and pedestal design

Note for Figure 2c:

- 1. Unless otherwise noted, the tolerance = ± 0.20 mm.

Reflow Soldering Profile

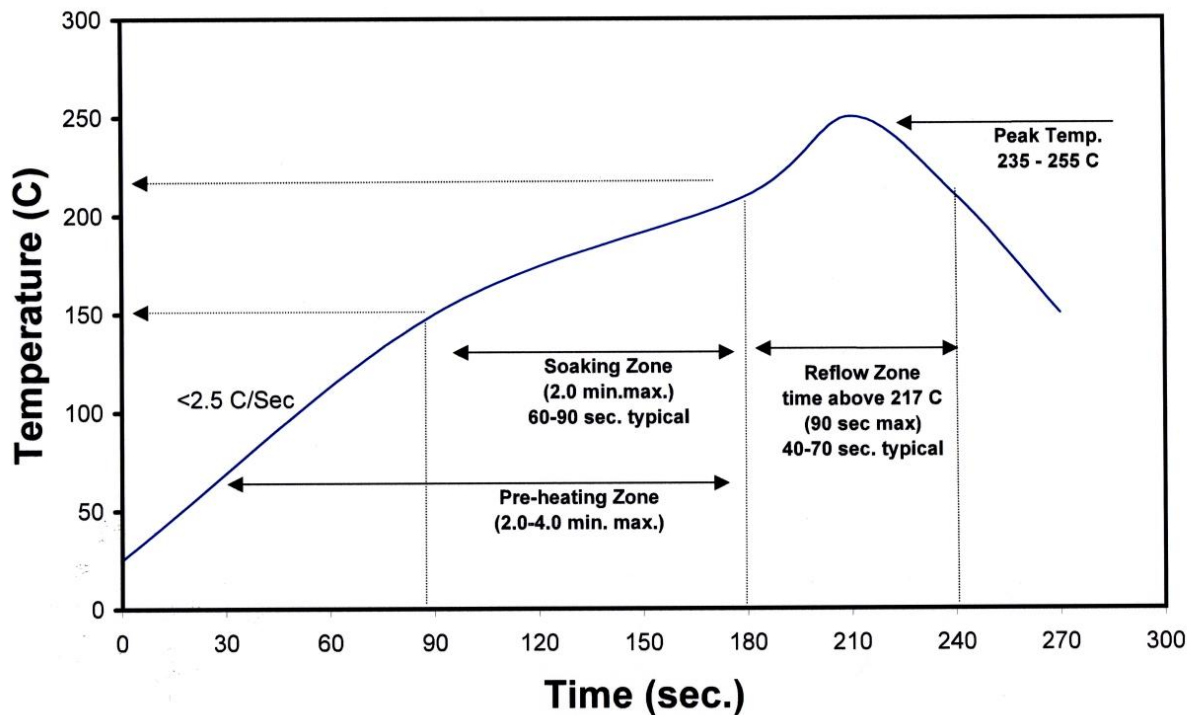


Figure 3: Reflow soldering profile for lead free soldering

Typical Radiation Pattern

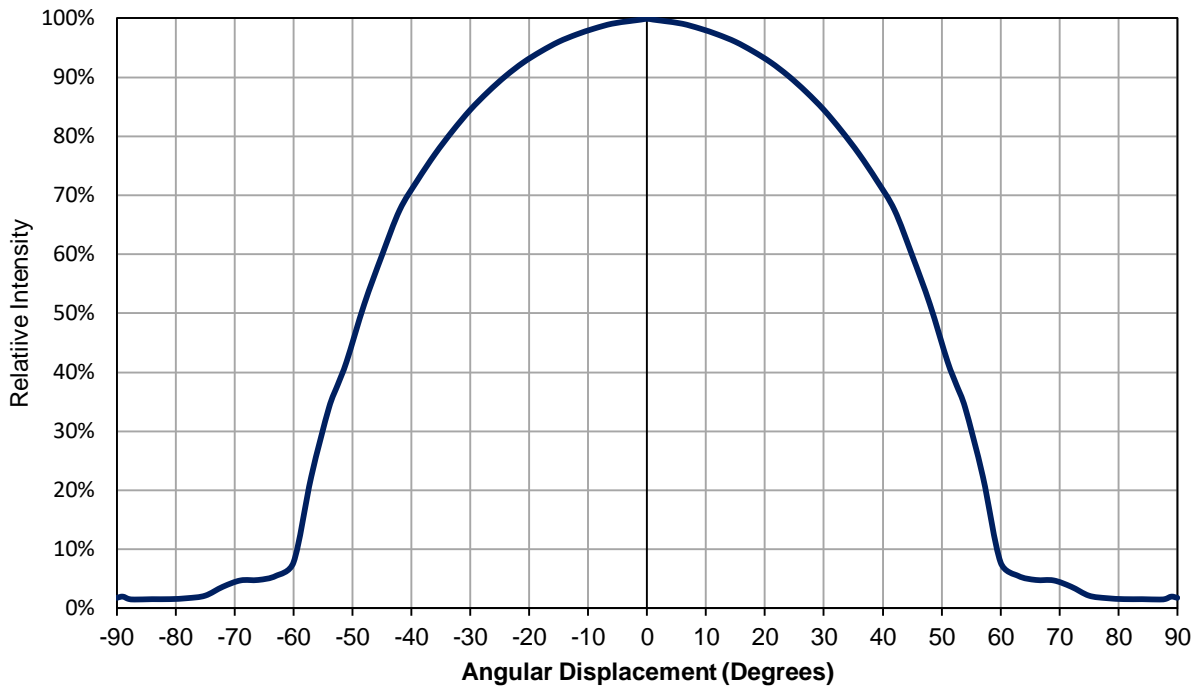


Figure 4: Typical representative spatial radiation pattern

Typical Relative Spectral Power Distribution

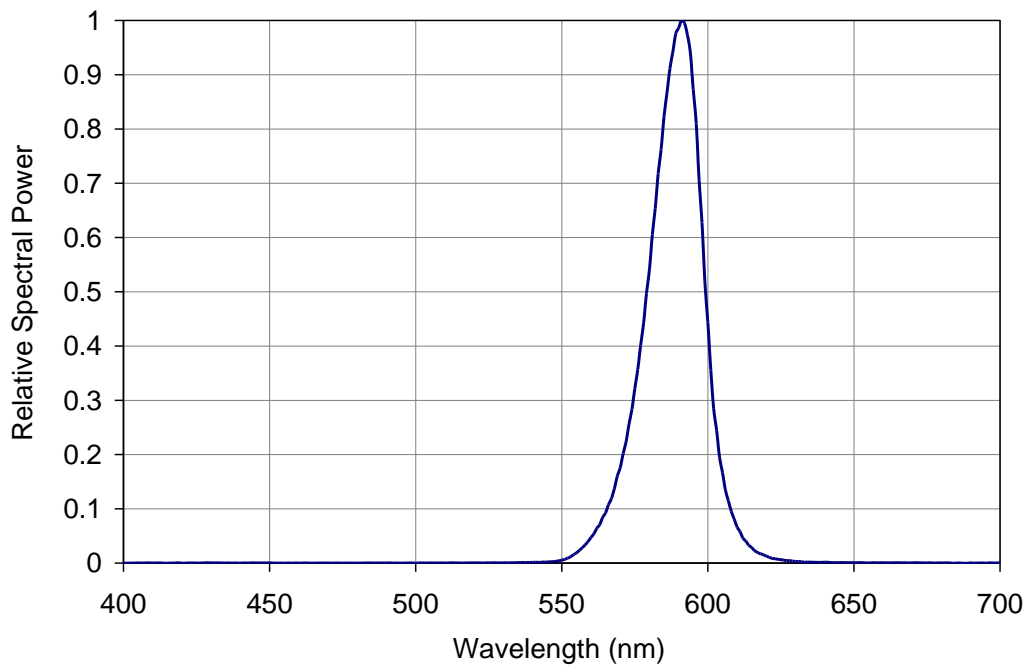


Figure 5: Typical relative spectral power vs. wavelength @ $T_c = 25^\circ\text{C}$

Typical Dominant Wavelength Shift over Case Temperature

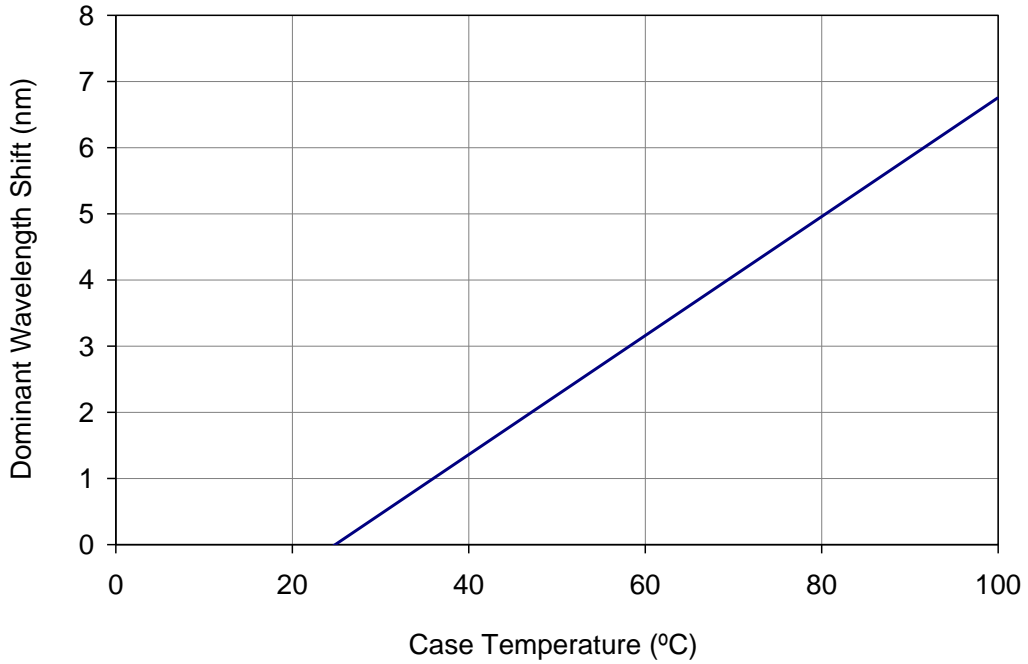


Figure 6: Typical dominant wavelength shift vs. case temperature

Typical Relative Light Output over Current

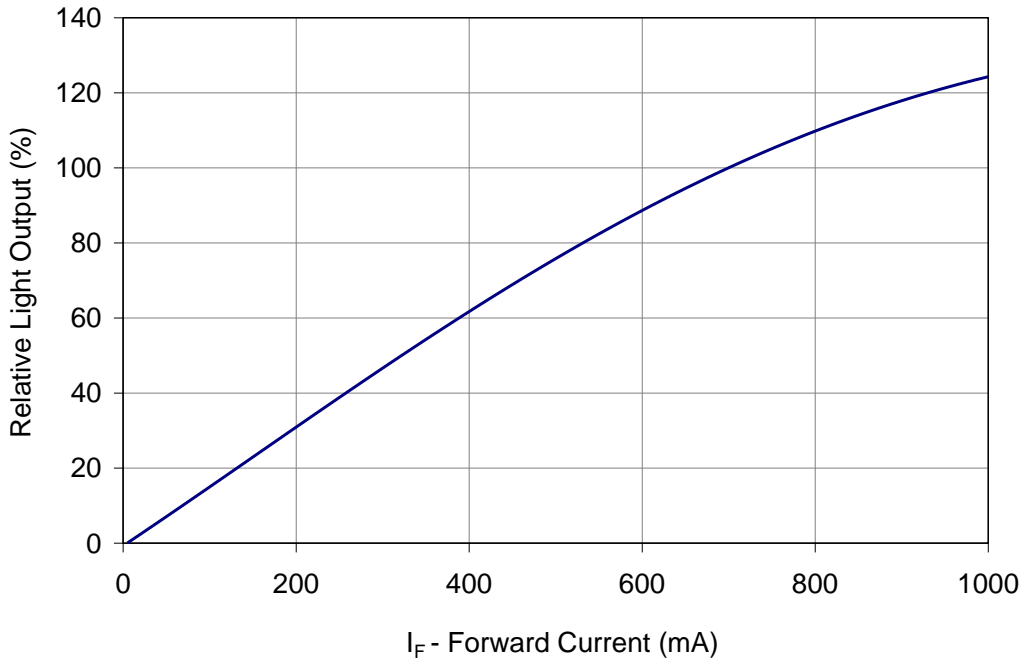


Figure 7: Typical relative light output vs. forward current @ T_C = 25°C

Typical Relative Light Output over Case Temperature

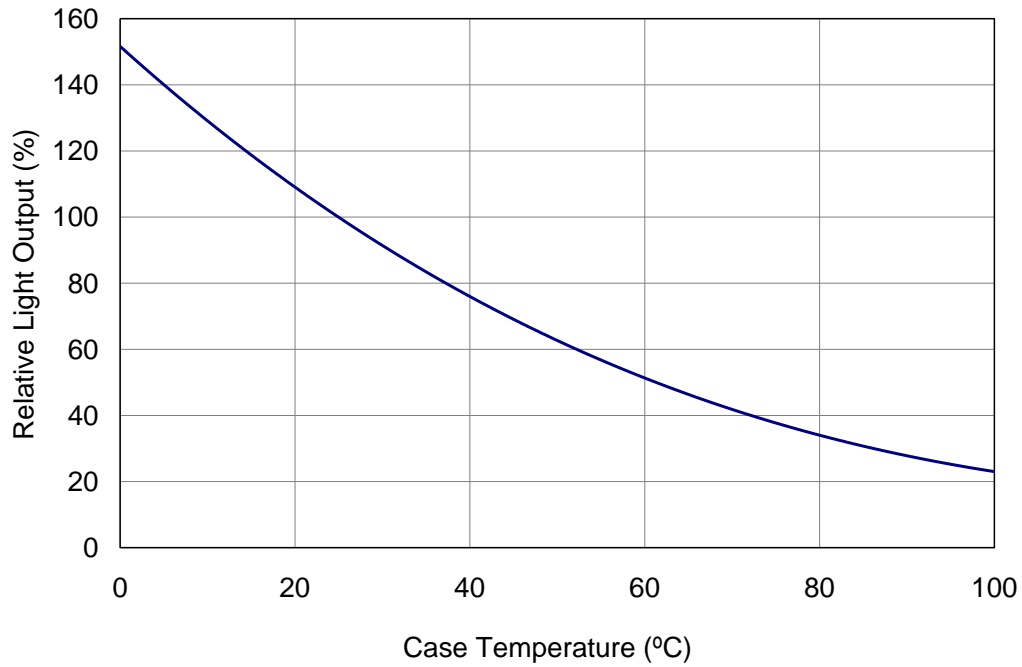


Figure 8: Typical relative light output vs. case temperature

Typical Forward Current Characteristics

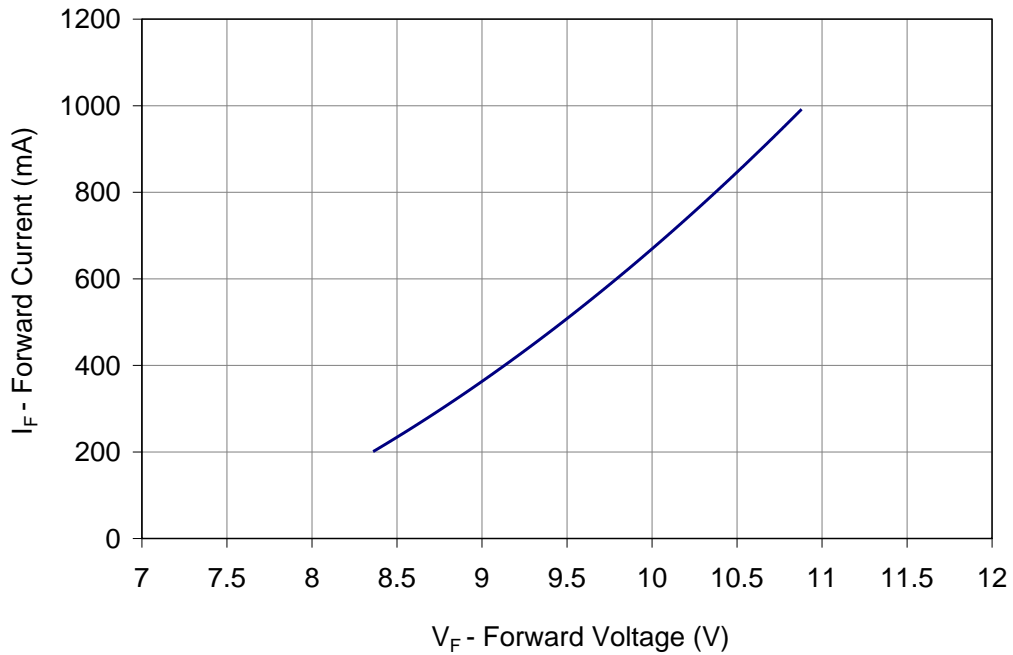


Figure 9: Typical forward current vs. forward voltage @ T_C = 25°C

Note for Figure 9:

- 1. Forward Voltage curve assumes that all four LED dies are connected in series.

Current De-rating

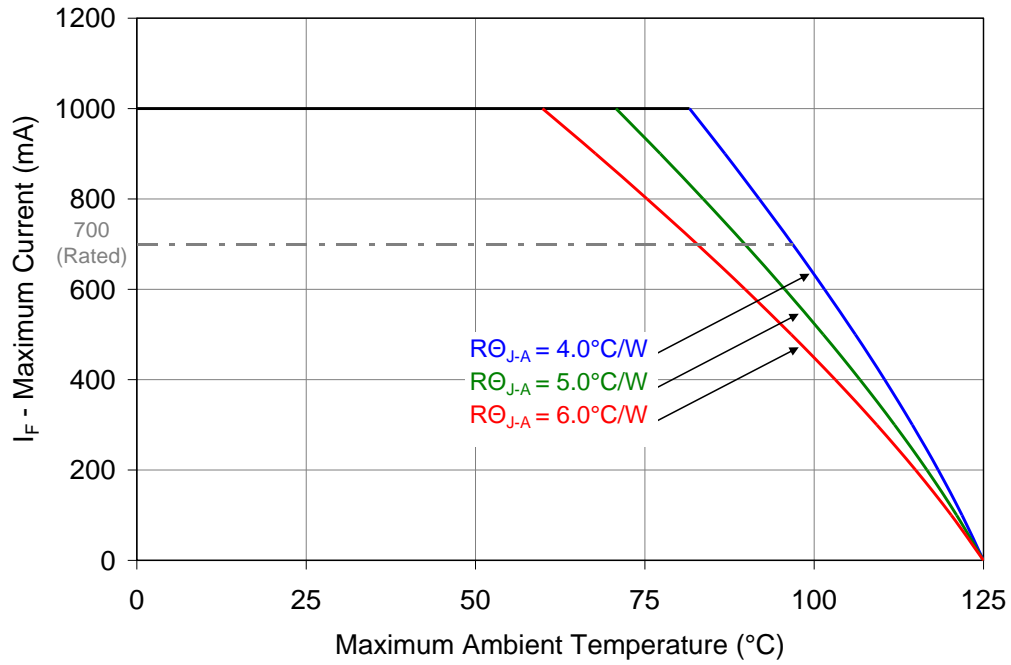


Figure 10: Maximum forward current vs. ambient temperature based on $T_{J(MAX)} = 125^\circ\text{C}$

Notes for Figure 10:

1. Maximum current assumes that all four LED dies are operating concurrently at the same current.
2. $R\Theta_{J-C}$ [Junction to Case Thermal Resistance] for the LZ4-00A108 is typically 2.8°C/W .
3. $R\Theta_{J-A}$ [Junction to Ambient Thermal Resistance] = $R\Theta_{J-C} + R\Theta_{C-A}$ [Case to Ambient Thermal Resistance].

Emitter Tape and Reel Specifications (mm)

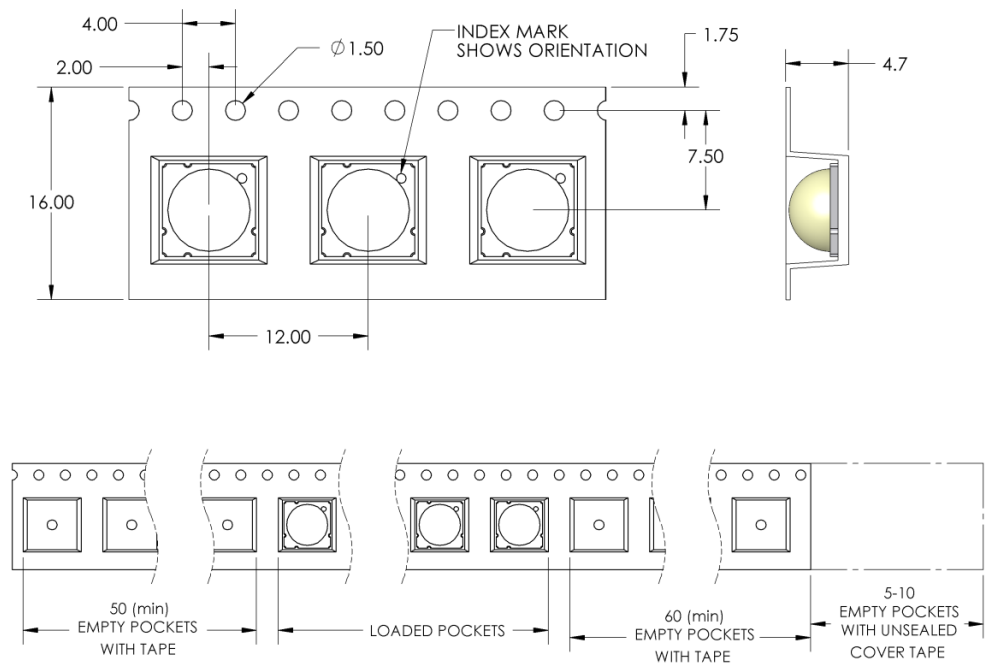


Figure 11: Emitter carrier tape specifications (mm)

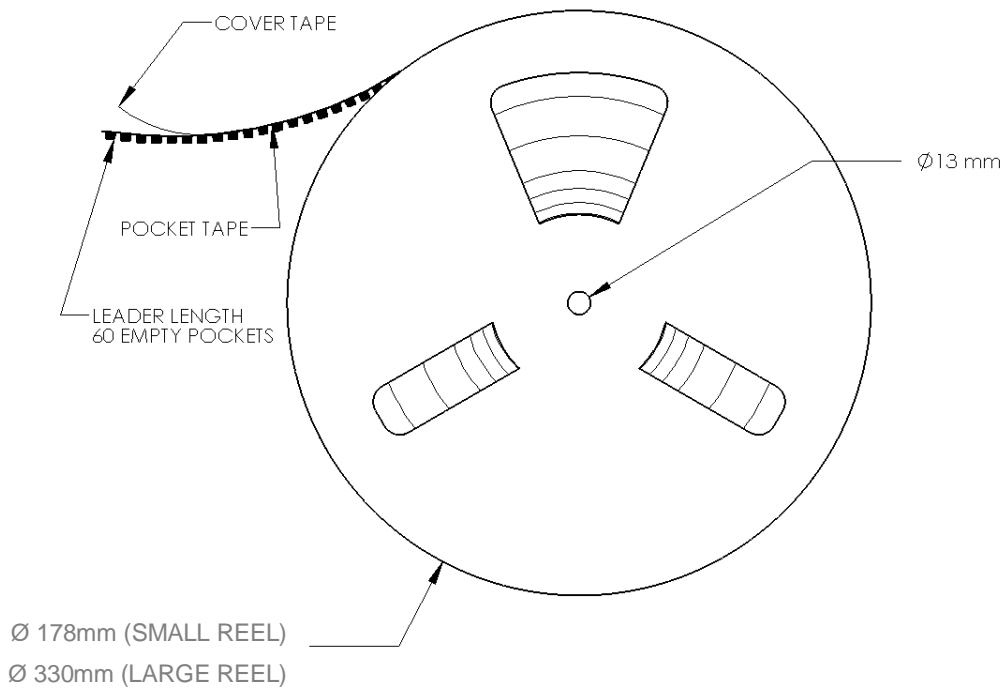


Figure 12: Emitter reel specifications (mm)

Notes for Figure 12:

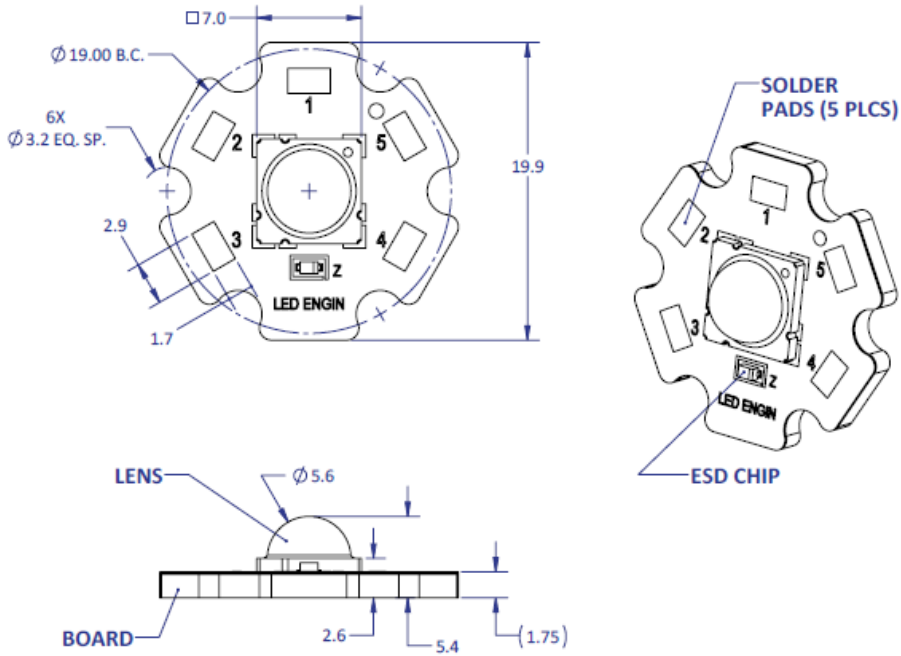
1. Small reel quantity: up to 250 emitters
2. Large reel quantity: 250-1200 emitters.
3. Single flux bin and single wavelength bin per reel.

LZ4 MCPCB Option

Part number	Type of MCPCB	Dimension (mm)	Emitter + MCPCB Thermal Resistance (°C/W)	Typical V _f (V)	Typical I _f (mA)
LZ4-4xxxxx	1-channel	19.9	2.8 + 1.1 = 3.9	9.0	700

LZ4-4xxxxx

1 channel, Standard Star MCPCB (1x4) Dimensions (mm)



Notes:

1. Unless otherwise noted, the tolerance = ± 0.2 mm.
2. Slots in MCPCB are for M3 or #4-40 mounting screws.
3. LED Engin recommends plastic washers to electrically insulate screws from solder pads and electrical traces.
4. LED Engin recommends thermal interface material when attaching the MCPCB to a heatsink
5. The thermal resistance of the MCPCB is: $RO_{C-B} 1.1^{\circ}C/W$

Components used

MCPCB: HT04503 (Bergquist)
 ESD chips: BZX585-C30 (NXP, for 4 LED dies in series)

Pad layout			
Ch.	MCPCB Pad	String/die	Function
1	1, 2, 3	1/ABCD	Cathode -
	4, 5		Anode +

Application Guidelines

MCPCB Assembly Recommendations

A good thermal design requires an efficient heat transfer from the MCPCB to the heat sink. In order to minimize air gaps in between the MCPCB and the heat sink, it is common practice to use thermal interface materials such as thermal pastes, thermal pads, phase change materials and thermal epoxies. Each material has its pros and cons depending on the design. Thermal interface materials are most efficient when the mating surfaces of the MCPCB and the heat sink are flat and smooth. Rough and uneven surfaces may cause gaps with higher thermal resistances, increasing the overall thermal resistance of this interface. It is critical that the thermal resistance of the interface is low, allowing for an efficient heat transfer to the heat sink and keeping MCPCB temperatures low. When optimizing the thermal performance, attention must also be paid to the amount of stress that is applied on the MCPCB. Too much stress can cause the ceramic emitter to crack. To relax some of the stress, it is advisable to use plastic washers between the screw head and the MCPCB and to follow the torque range listed below. For applications where the heat sink temperature can be above 50°C, it is recommended to use high temperature and rigid plastic washers, such as polycarbonate or glass-filled nylon.

LED Engin recommends the use of the following thermal interface materials:

- Bergquist's Gap Pad 5000S35, 0.020in thick
 - Part Number: Gap Pad® 5000S35 0.020in/0.508mm
 - Thickness: 0.020in/0.508mm
 - Thermal conductivity: 5 W/m-K
 - Continuous use max temperature: 200°C
 - Using M3 Screw (or #4 screw), with polycarbonate or glass-filled nylon washer (#4) the recommended torque range is: 20 to 25 oz-in (1.25 to 1.56 lbf-in or 0.14 to 0.18 N-m)

- 3M's Acrylic Interface Pad 5590H
 - Part number: 5590H @ 0.5mm
 - Thickness: 0.020in/0.508mm
 - Thermal conductivity: 3 W/m-K
 - Continuous use max temperature: 100°C
 - Using M3 Screw (or #4 screw), with polycarbonate or glass-filled nylon washer (#4) the recommended torque range is: 20 to 25 oz-in (1.25 to 1.56 lbf-in or 0.14 to 0.18 N-m)

Mechanical Mounting Considerations

The mounting of MCPCB assembly is a critical process step. Excessive mechanical stress build up in the MCPCB can cause the MCPCB to warp which can lead to emitter substrate cracking and subsequent cracking of the LED dies

LED Engin recommends the following steps to avoid mechanical stress build up in the MCPCB:

- Inspect MCPCB and heat sink for flatness and smoothness.
- Select appropriate torque for mounting screws. Screw torque depends on the MCPCB mounting method (thermal interface materials, screws, and washer).
- Always use three M3 or #4-40 screws with #4 washers.
- When fastening the three screws, it is recommended to tighten the screws in multiple small steps. This method avoids building stress by tilting the MCPCB when one screw is tightened in a single step.
- Always use plastic washers in combinations with the three screws. This avoids high point contact stress on the screw head to MCPCB interface, in case the screw is not seated perpendicular.
- In designs with non-tapped holes using self-tapping screws, it is common practice to follow a method of three turns tapping a hole clockwise, followed by half a turn anti-clockwise, until the appropriate torque is reached.

Wire Soldering

- To ease soldering wire to MCPCB process, it is advised to preheat the MCPCB on a hot plate of 125-150°C. Subsequently, apply the solder and additional heat from the solder iron will initiate a good solder reflow. It is recommended to use a solder iron of more than 60W.
- It is advised to use lead-free, no-clean solder. For example: SN-96.5 AG-3.0 CU 0.5 #58/275 from Kester (pn: 24-7068-7601)

LZ4-00A108

About LED Engin

LED Engin, an OSRAM brand based in California's Silicon Valley, develops, manufactures, and sells advanced LED emitters, optics and light engines to create uncompromised lighting experiences for a wide range of entertainment, architectural, general lighting and specialty applications. LuxiGen™ multi-die emitter and secondary lens combinations reliably deliver industry-leading flux density, upwards of 5000 quality lumens to a target, in a wide spectrum of colors including whites, tunable whites, multi-color and UV LEDs in a unique patented compact ceramic package. Our LuxiTune™ series of tunable white lighting modules leverage our LuxiGen emitters and lenses to deliver quality, control, freedom and high density tunable white light solutions for a broad range of new recessed and downlighting applications. The small size, yet remarkably powerful beam output and superior in-source color mixing, allows for a previously unobtainable freedom of design wherever high-flux density, directional light is required. LED Engin is committed to providing products that conserve natural resources and reduce greenhouse emissions; and reserves the right to make changes to improve performance without notice.

For more information, please contact LEDE-Sales@osram.com or +1 408 922-7200.

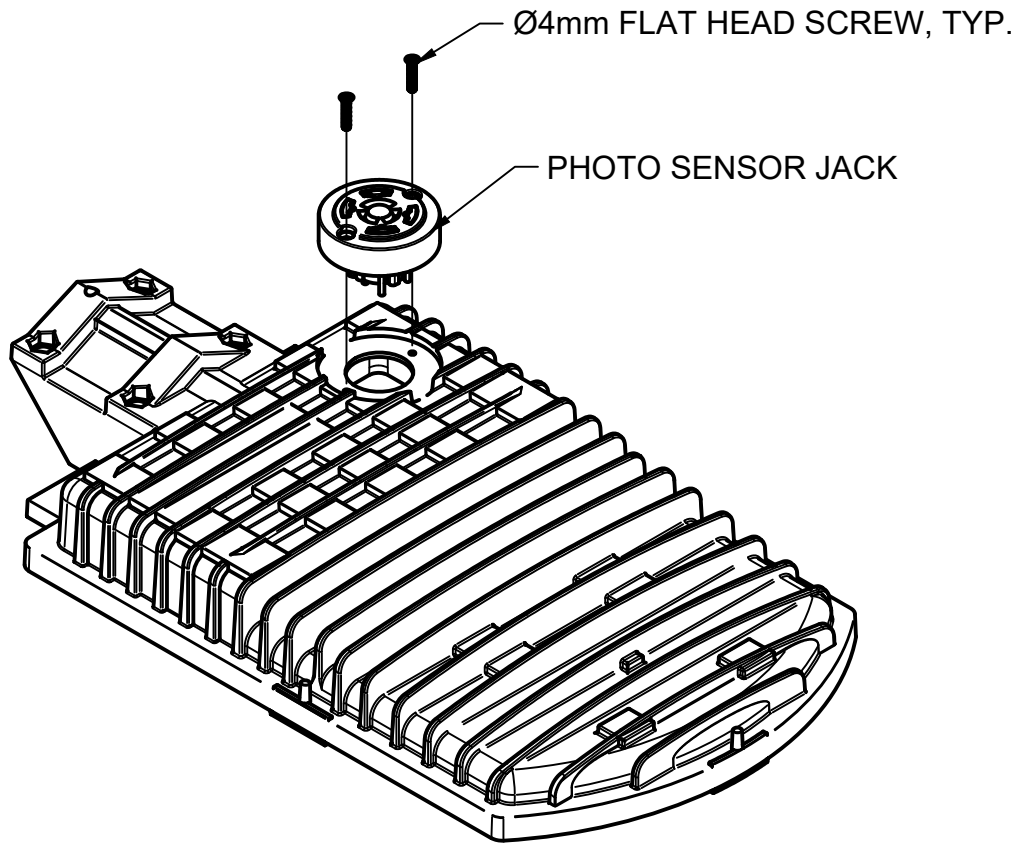
LED Engin office:
651 River Oaks Parkway
San Jose, CA 95134
USA
408 922-7200
LEDE-Sales@osram.com
www.osram.us/ledengin

Our Brand

LED ENGIN



OSRAM



PROJECT

Apollo

TITLE

MINI PHOTO SENSOR ASSEM.

APPROVED

SIZE

CODE

DWG NO

REV

CHECKED

A

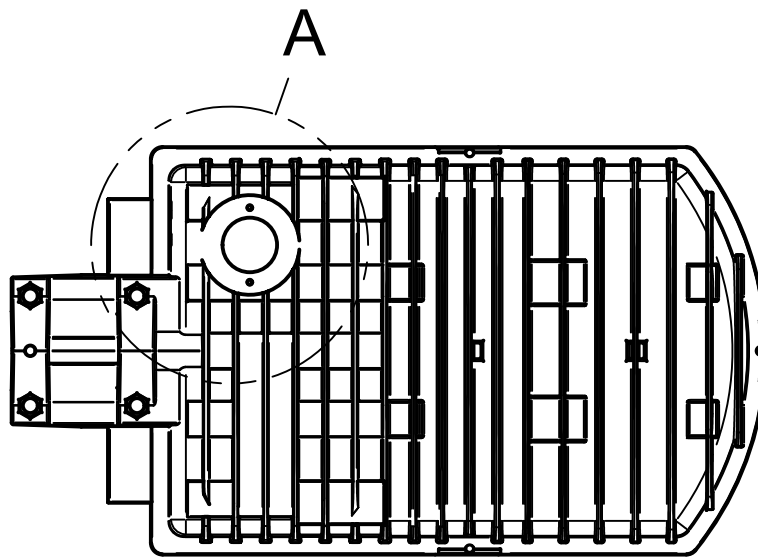
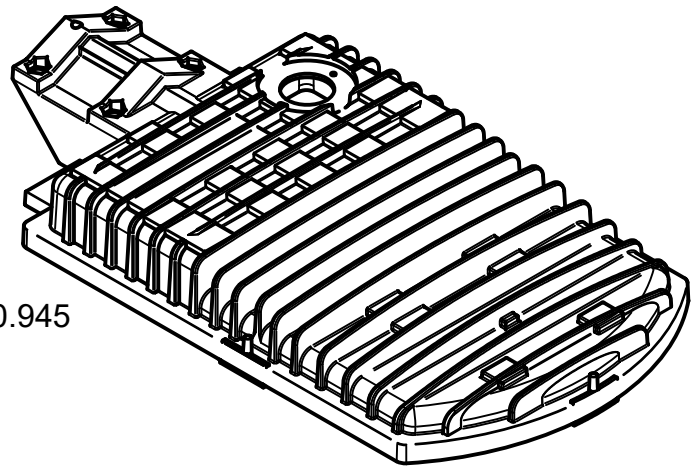
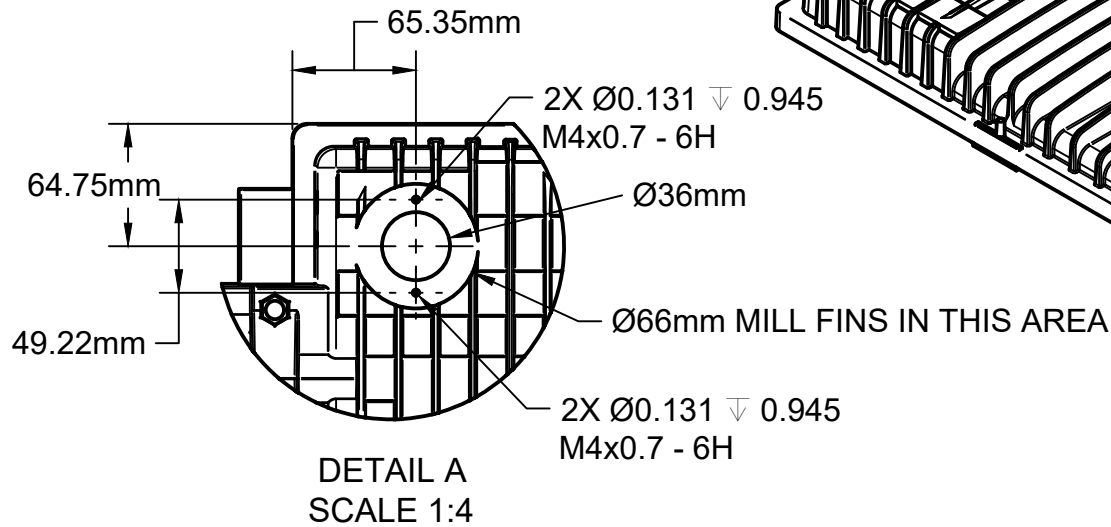
DRAWN KD

1/21/2021

SCALE 1:4

WEIGHT

SHEET 1/2



PROJECT

Apollo

TITLE

**MINI PHOTO SENSOR
MODIFICATION**

APPROVED

SIZE

CODE

DWG NO

REV

CHECKED

A

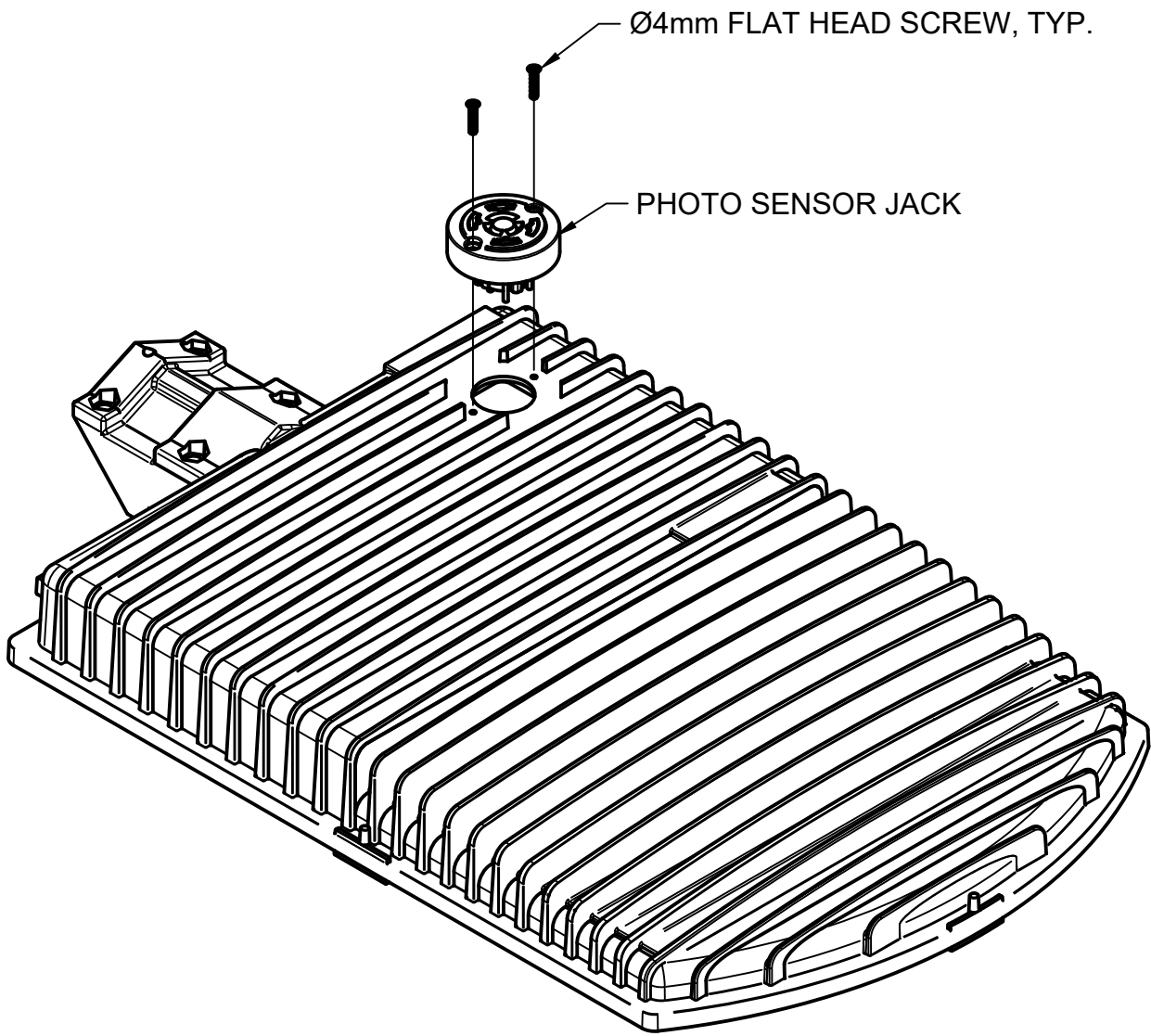
DRAWN KD

1/21/2021

SCALE 1:5

WEIGHT

SHEET 2/2



Ø4mm FLAT HEAD SCREW, TYP.

PHOTO SENSOR JACK

PROJECT

Apollo

TITLE

MID PHOTO SENSOR ASSEM.

APPROVED

SIZE

CODE

DWG NO

REV

CHECKED

A

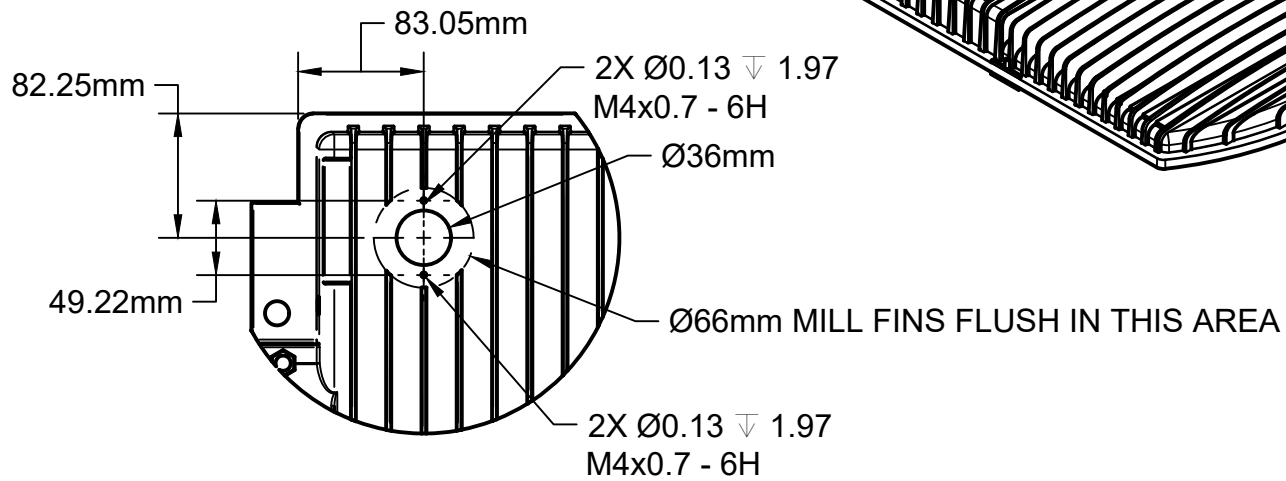
DRAWN KD

1/21/2021

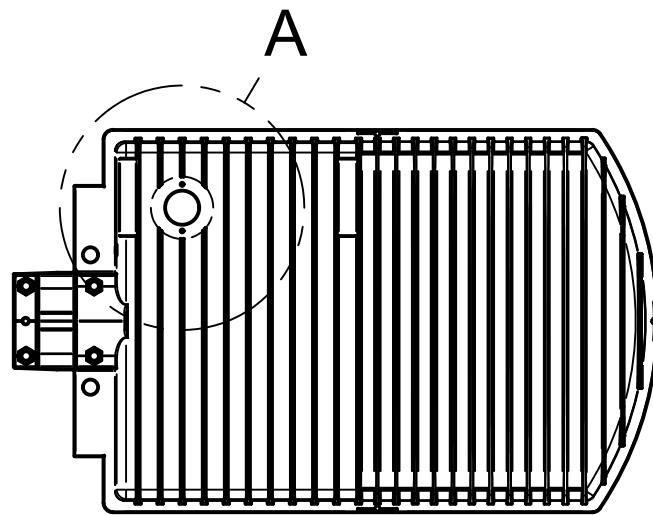
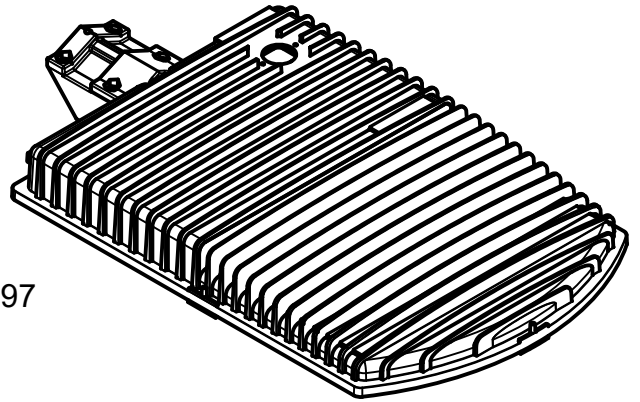
SCALE 1:4

WEIGHT

SHEET 1/2



DETAIL A
SCALE 1:5



PROJECT

Apollo

TITLE

**SL MID PHOTO SENSOR
MODIFICATION**

APPROVED

CHECKED

DRAWN KD

SIZE

A

CODE

1/21/2021

SCALE 1:8

DWG NO

WEIGHT

REV

SHEET 2/2

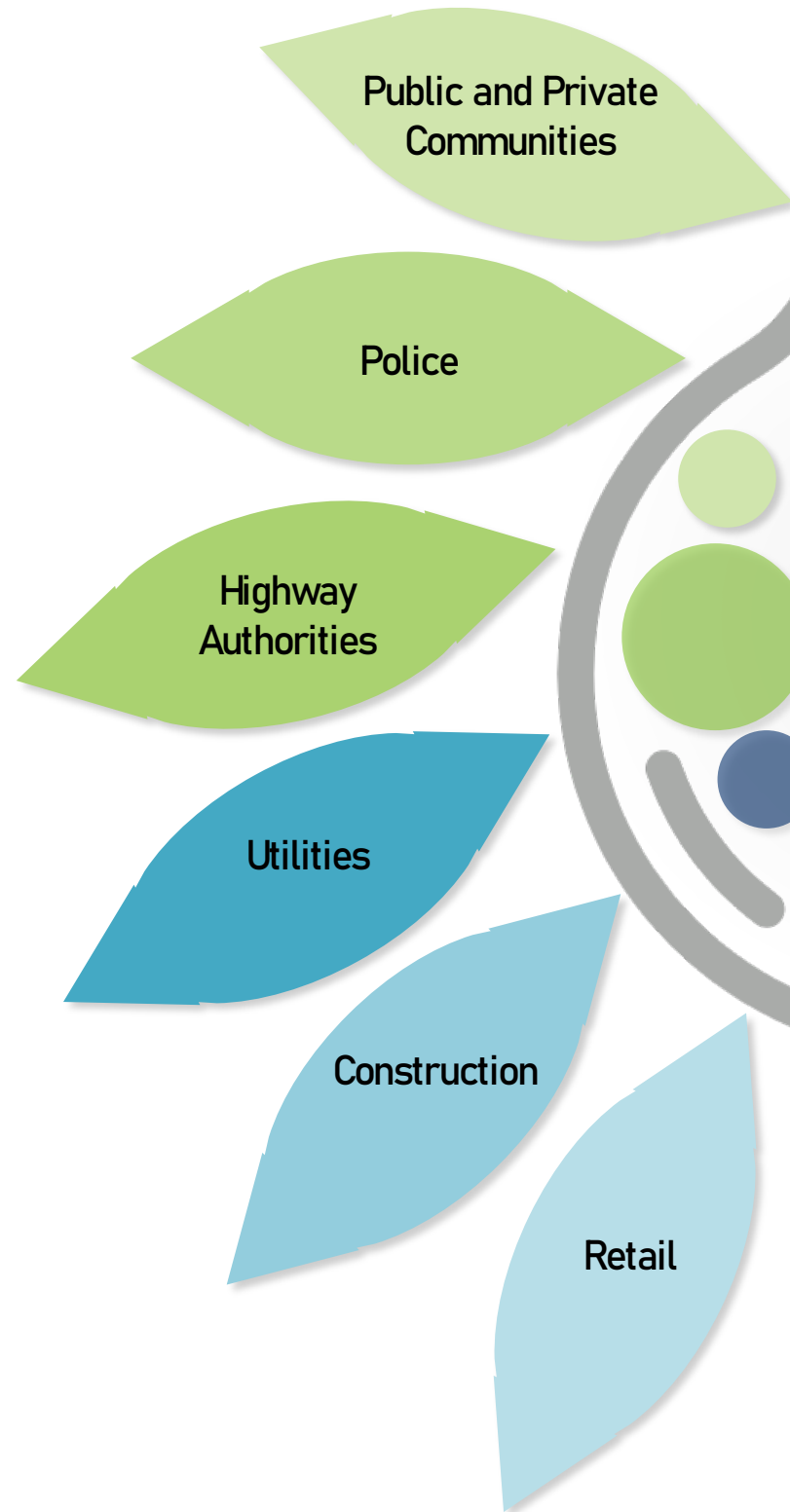


Lighting the Way

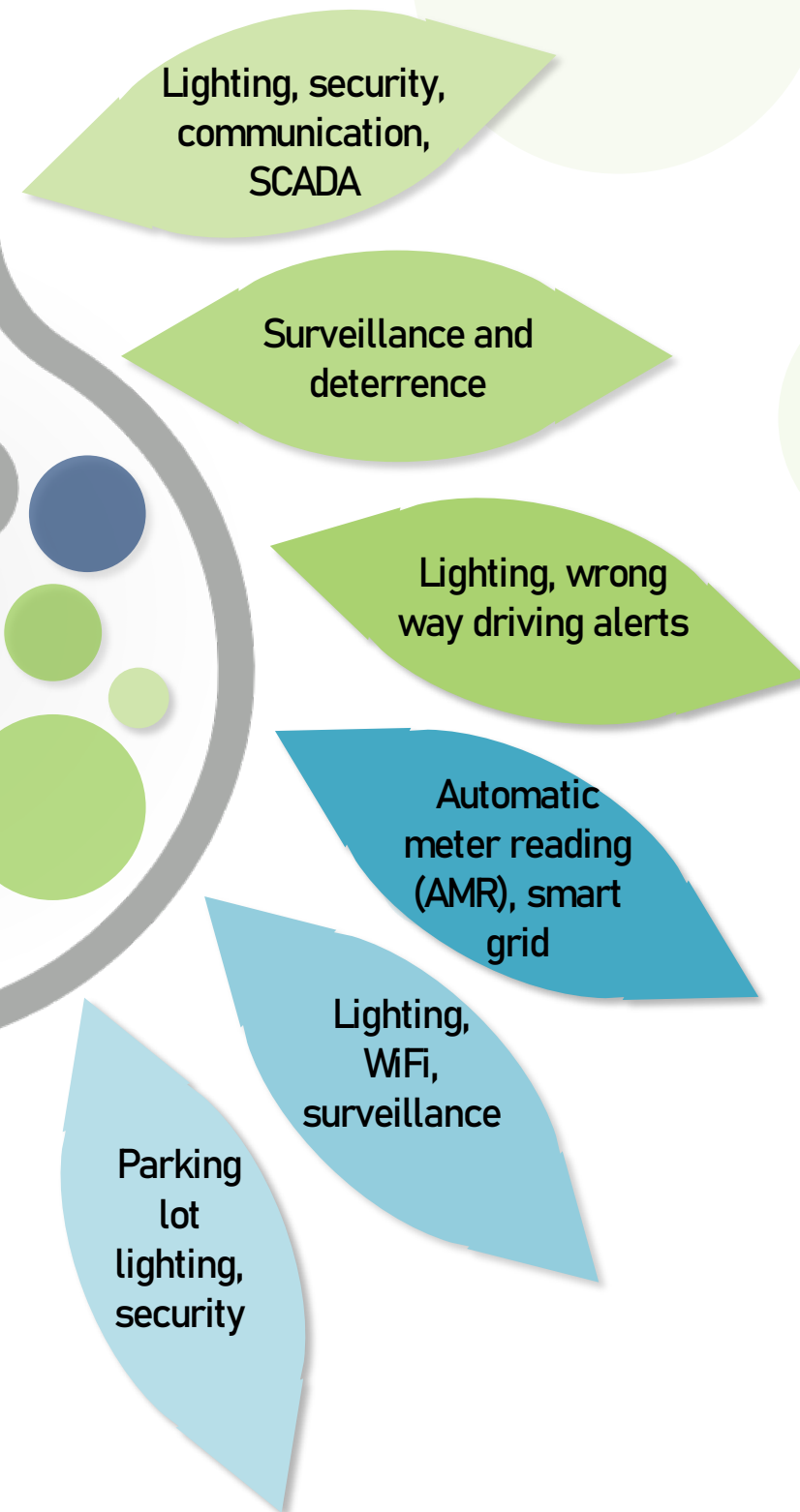
November, 3rd 2020

Applications

Customers



Applications



Apollo Communication Options

Using street lights as ubiquitous universal technology platform



Light Control

- 150/220/450/900MHz direct ISM/LMR
- WiFi/Bluetooth



Cameras

- Ethernet
- Fiber
- WiFi
- LTE
- DVR/LTE



Gateway

- Ethernet/fiber
- WiFi



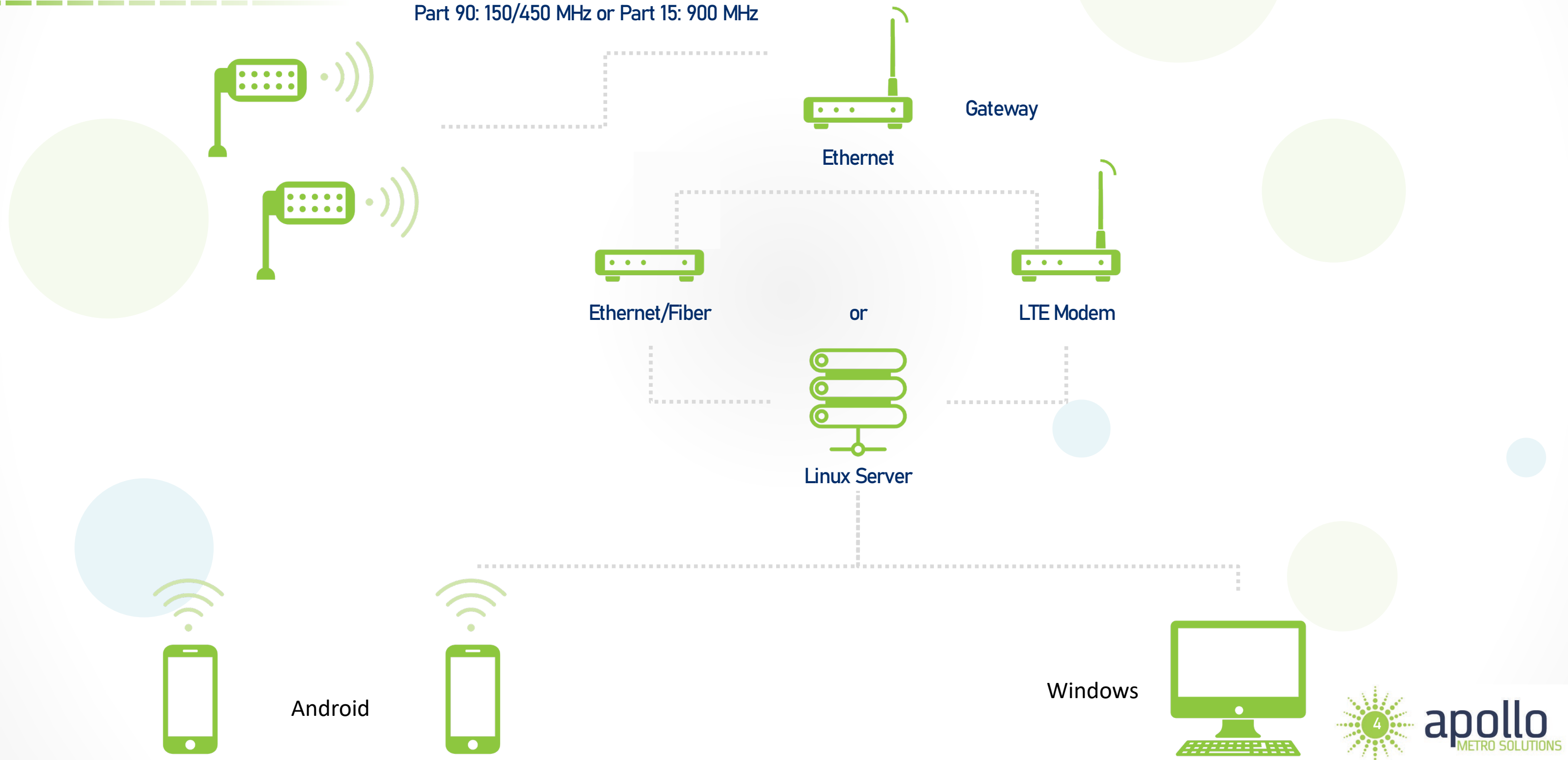
Software

- Gateway dashboard
- Lighting server Dashboard (Browser/Android app)
- Radio configuration (Windows/Android App)
- Video dashboard



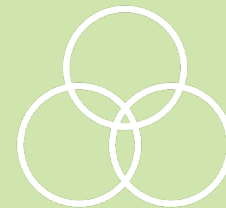
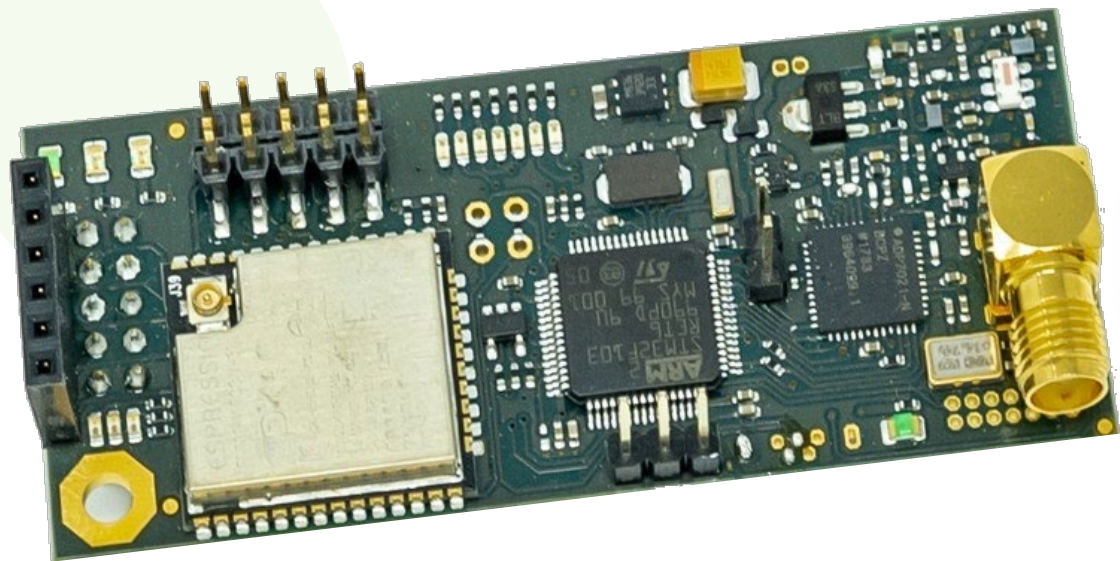
Using Street Lights as Ubiquitous Universal Technology Platform

Part 90: 150/450 MHz or Part 15: 900 MHz



Light Control

The Apollo lights contain a microcontroller which controls the LED driver, reads LED temperature, voltage and current and distributes power to the LED boards.



It also controls 3 color LEDs on the LED board which show the status of the light and the radio, visible under the installed light. This board is called the triple power board.

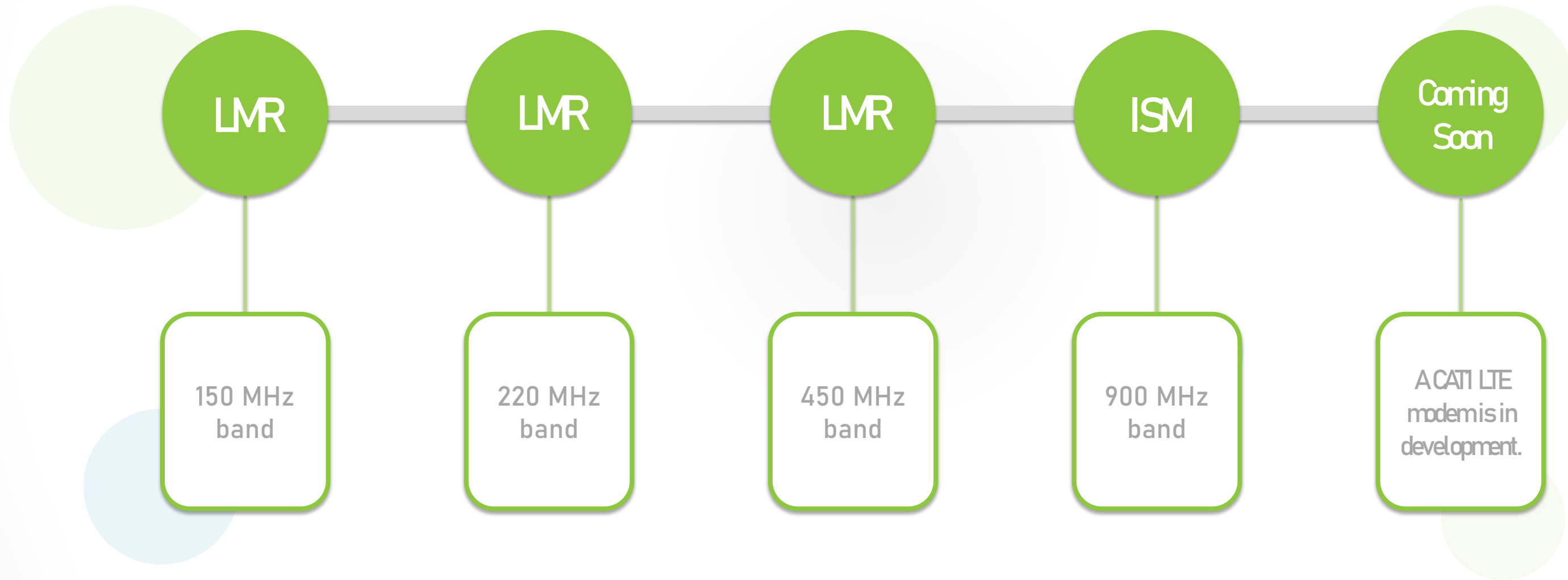


The triple power board can be powered by the aux power of the LED drive or by a separate 5W power supply, depending on the configuration.

The Apollo Metro radio module is plugged into the triple power board which controls all functions of the street light.

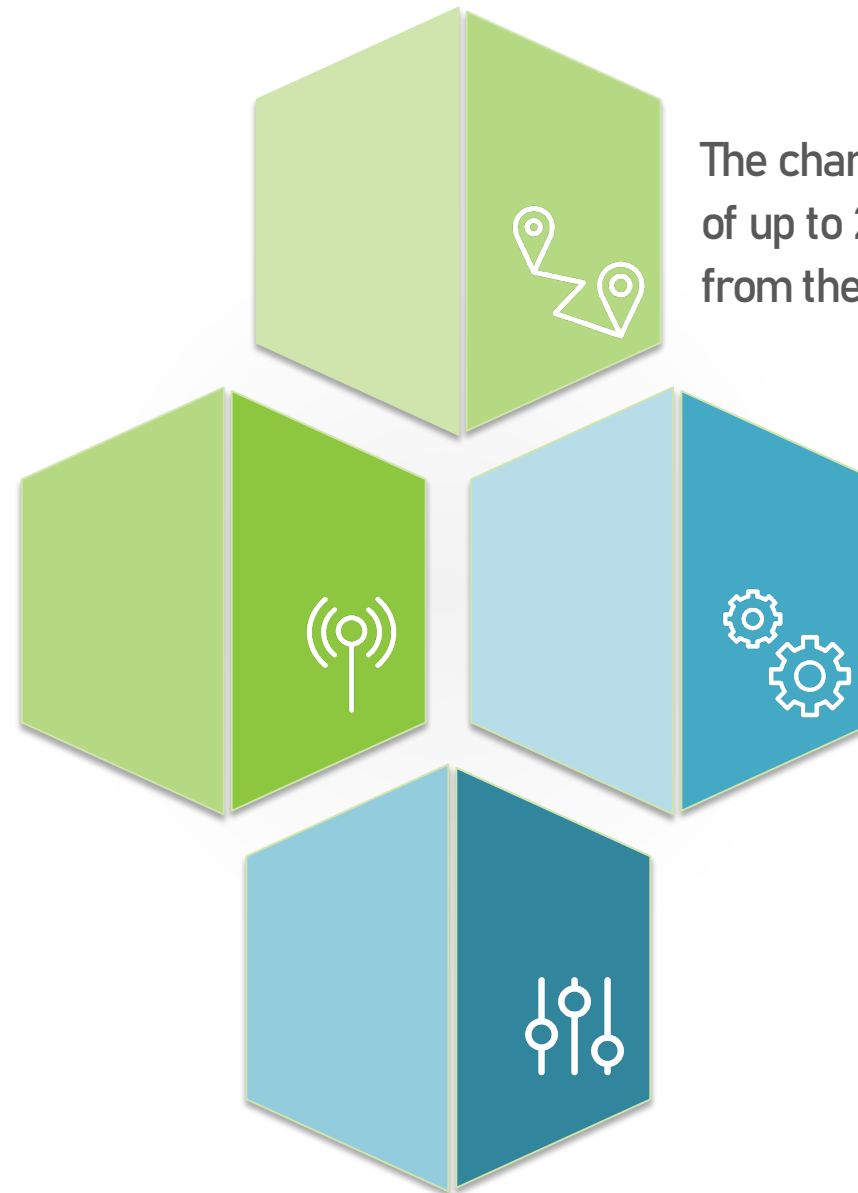
Light Control: Apollo Radio Module

There are 4 versions of the radio module available:



Light Control: Apollo Radio Module Cont'd.

The radio board has an optional serial interface as well as an optional Ethernet interface to communicate with other devices in or around the light. It also has a 2.4 GHz Radio which can be configured as a WiFi access point, a WiFi client or as a bluetooth radio.



The channels can be 6.25 or 12.5 kHz wide, with an output power of up to 2W RF out. This allows a control range of over 10 miles from the control Gateway to the light.

This 2.4 GHz module is used for the initial setup of the light and the radio in the field, using an Android tablet. There are many parameters which can be set. The setup screen has a simplified standard mode and a password protected expert mode.

The radio can also be switched into a digital LMR radio mode, supporting several modes, such as P25 or DMR. The radio connects via Ethernet or WiFi to a central reflector system which in turn connects to the existing base station repeaters of the network.

Gateway



The Apollo Metro Server **collects data from the Gateway**, using an MQTT based protocol. It is running on an Ubuntu server and can be **accessed from Windows and mobile Android devices**.

The Apollo Server uses an **SQL data base** which collects **all collected data**, it also holds a **reference table** which logically links the luminaire addresses to circuit and pole numbers as well as longitude and latitude for a graphical representation of the information collected.

Server

The Apollo Metro Gateway is the interface between the Apollo Metro Radios in the street lights and the central control server.

One Gateway can handle over 1000 lights. With an output power with up to 25W it controls devices up to 20 miles away.



The Gateway has a broadcast mode. In this mode, commands (such as dimming at midnight) can be sent to all lights or group of light simultaneously.



The radio connects either to an Ethernet or Fiber to the central control server or, alternatively through a VPN via a cellular LTE modem.



The other mode is the polling mode, which is used to check on each light sequentially, collecting values such as power, voltage, temperature. Each light is checked multiple times per night.



Multiple Gateways can share one antenna, using duplexers. Typical extended dipole antennas with 4 dipoles are recommended.

Communication Options for Apollo Street Light Cameras

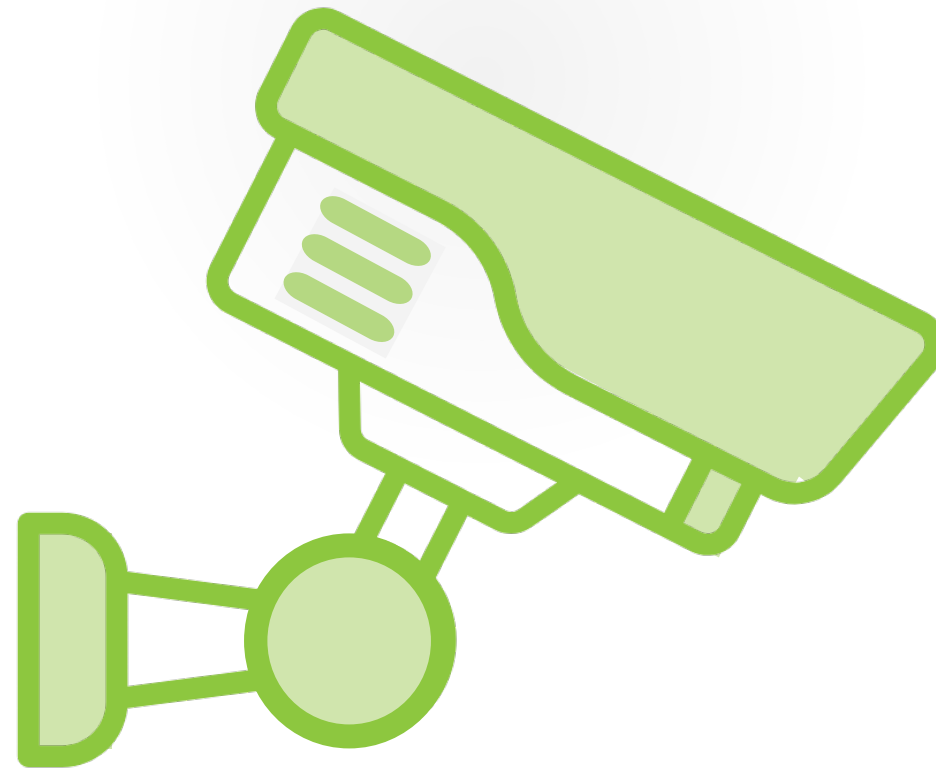
Apollo street light cameras have an Ethernet interface, which supports different video protocols mainly ONVIF and http. As the range of an Ethernet cable is limited to 300ft (100m), other media for backhauling have to be implemented, depending on the topology of the respective project. The following text discusses several options, which are by no means complete, but give an overview of the possibilities.

Ethernet

When the **street lights are within 300ft** of a building, or outdoor NEMA box, they can be **connected to an Ethernet switch which is then connected to a digital DVR**. This is the most simple solution and works very reliably on parking lots, when the Ethernet cable can be routed through an existing conduit.

Cable

When the **camera street lights are near a cable modem** (which can be installed outdoors in a NEMA box) the **Ethernet cables are connected to a VPN router mirrored by another VPN router on the central side**. Keep in mind, the uplink speed of the cable modem is relevant, not the downlink speed! A typical HD stream is 2 Mbit/s, a 4k stream about 4 Mbit/s. To have some reserve, 15MBit/s is a good number.



Wifi

When existing parking lot lights are replaced, it is often not possible to route Ethernet cable to the main building. In this case, the street light cameras can be connected via WiFi. **Apollo offers camera lights with Ubiquiti bullet radios**, which support both 2.4 GHz and 5 GHz bands, with protocols up to 802.11ac. **The street lights can directly connect to the WiFi** of the next building, which often exists, or to an outdoor Ubiquiti AP, which might be installed on the roof for better coverage.

Communication Options for Apollo Street Light Cameras

Apollo street light cameras have an Ethernet interface, which supports different video protocols mainly ONVIF and http. As the range of an Ethernet cable is limited to 300ft (100m), other media for backhauling have to be implemented, depending on the topology of the respective project. The following text discusses several options, which are by no means complete, but give an overview of the possibilities.

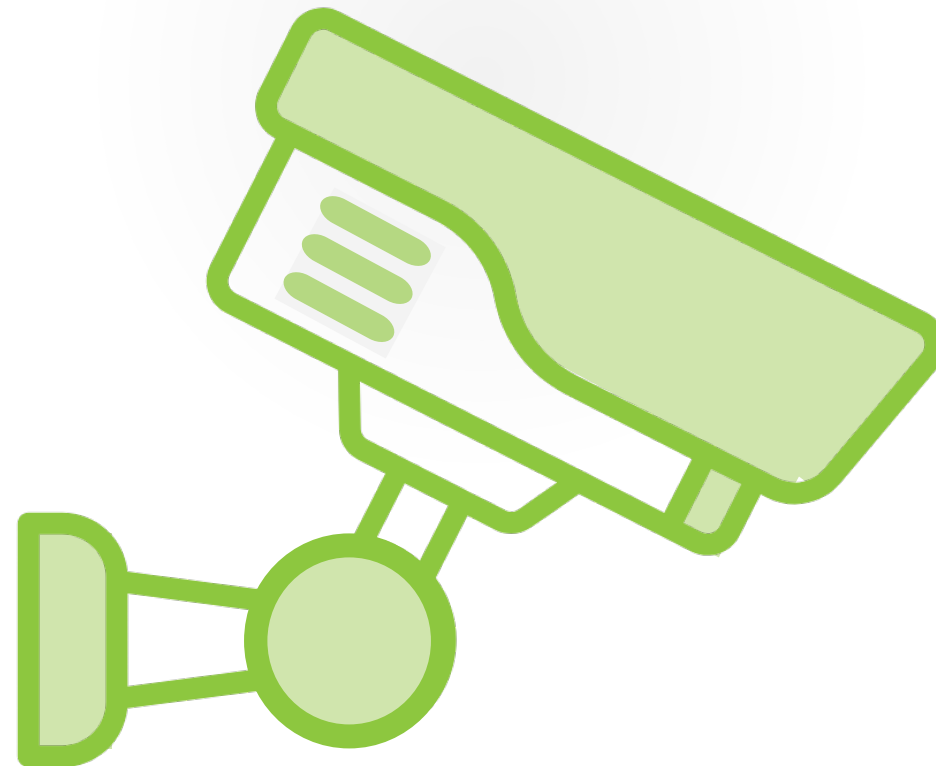
LTE

On remote sites, such as construction sites, there is often no internet link available. Apollo offers camera lights with built in LTE modems which overcome this obstacle by using cellular internet connectivity.

Our sister company, M2M Dynamics (www.m2m-dynamics.com) offers complete VPN solution, including carrier data connectivity, VPN service and maintenance. However, keep in mind that the amount of data in a video stream is very high, which leads to a high monthly cost for such a link.

There are several solutions to manage this:

- Lowering the resolution
- Transmitting the amount of frames per second
- Establishing the VPN on demand only



LTE/DVR

Another way to overcome the problem of cellular overload is to include the DVR in the street light camera. Apollo offers DVRs with 128/256GB memory cards and 4 analog inputs with HD resolution, an LTE modem and a GPS receiver to show the location of the street light camera on a map.

During regular operation, a low resolution frame is transmitted per second, leaving the data stream under 100 kB/s. If an alarm occurs the DVR can be accessed remotely and a high resolution stream of the event can be downloaded.

The DVR can also act as a SIP speaker phone, a microphone and a speaker can be installed in the pole. Additionally, there are digital I/O lines available to be connected to actors and sensors around the camera street light on a project-specific base.

Software: Gateway Dashboard

The screenshot displays the Apollo Metro Gateway Dashboard in a web browser. The browser address bar shows the URL 192.168.12.70. The dashboard header includes the text "APOLLO METRO" and "19219088". Below the header, there are control elements for "Lum 10 - 100%" (a slider) and "Set Lum" (a button). To the right, there are "ON/OFF" buttons. The main content is a table with 15 columns: NR., Update_Time, My ID, My Gateway, My Group, Temp Board, Temp LED-Board 1, Temp LED-Board 2, Temp LED-Board 3, Current, Voltage, Lum in Percent, RSSI, ON/OFF, Lum 10 - 100%, and SET Lum. The table contains 8 rows of data. At the bottom of the dashboard, there are three buttons: "home", "setup", and "update".

NR.	Update_Time	My ID	My Gateway	My Group	Temp Board	Temp LED-Board 1	Temp LED-Board 2	Temp LED-Board 3	Current	Voltage	Lum in Percent	RSSI	ON/OFF	Lum 10 - 100%	SET Lum
1	0	2	0	1	0	0	0	0	0 A	0 V	0 %	124	ON OFF		SET
2	2.11 11:31	3	0	1	30.2	40.7	0.0	0.0	2.8 A	45.3 V	90 %	68	ON OFF		SET
3	2.11 15:51	4	0	1	28.8	0.0	0.0	0.0	45.6 A	0.0 V	90 %	79	ON OFF		SET
4	2.11 11:31	5	0	1	30.8	39.6	0.0	0.0	3.0 A	45.5 V	90 %	67	ON OFF		SET
5	2.11 11:29	7	0	1	30.6	39.2	0.0	0.0	2.7 A	45.2 V	90 %	70	ON OFF		SET
6	2.11 11:28	10	0	1	31.1	41.8	0.0	0.0	2.8 A	45.4 V	90 %	68	ON OFF		SET
7	2.11 11:29	12	0	1	30.3	43.0	0.0	0.0	2.9 A	45.3 V	90 %	82	ON OFF		SET
8	2.11 13:28	14	0	1	31.9	0.0	0.0	0.0	56.2 A	0.0 V	90 %	83	ON OFF		SET

Software: Lighting Server Dashboard Windows

apollo METRO SOLUTIONS

Apollo Metro Gateway - Server

home master system inventory gateways sLog shell logout

Map 19219088-Naples Gateway apollo

NR	SETALL	Status ₂	My ID	Group	RSSI ₂	Board ₂	LED ₂	Current	Volt	Watt	Percent	soll Percent	pole	V.T	last Update	Lamp ID	Type
1	SetLum	offline ₂	2	1	124/0 ₂	32 F ₂	32 F	0.0 A	0.0 V	0 W	0 %	0 %	87/3113	50	0	19219192	SL5-2
2	SetLum	offline ₂	3	1	68/67 ₂	86.36 F ₂	105.26 F	2.8 A	45.3 V	126.84 W	90 %	90 %	86/3106	50	2.11 11:31	221124072	SL5-2
3	SetLum	online ₂	4	1	82/78 ₂	82.4 F ₂	32 F	25.6 A	0.0 V	0 W	90 %	90 %	85/3112	1	2.11 14:51	28088176	SL5-2
4	SetLum	offline ₂	5	1	67/62 ₂	87.44 F ₂	103.28 F	3.0 A	45.5 V	136.5 W	90 %	90 %	84/3105	50	2.11 11:31	19236052	SL5-2
5	SetLum	offline ₂	7	1	70/68 ₂	87.08 F ₂	102.56 F	2.7 A	45.2 V	122.04 W	90 %	90 %	82/3104	50	2.11 11:29	222183120	SL5-2
6	SetLum	offline ₂	10	1	68/68 ₂	87.98 F ₂	107.24 F	2.8 A	45.4 V	127.12 W	90 %	90 %	79/3109	50	2.11 11:28	223064132	SL5-2
7	SetLum	offline ₂	12	1	82/69 ₂	86.54 F ₂	109.4 F	2.9 A	45.3 V	131.37 W	90 %	90 %	77/3108	50	2.11 11:29	234078128	SL5-2
8	SetLum	offline ₂	14	1	83/78 ₂	89.42 F ₂	32 F	56.2 A	0.0 V	0 W	90 %	90 %	75/3100	50	2.11 13:28	222101132	SL5-2

Map 221152036-Markus Gateway - 1

NR	SETALL	Status ₂	My ID	Group	RSSI ₂	Board ₂	LED ₂	Current	Volt	Watt	Percent	soll Percent	pole	V.T	last Update	Lamp ID	Type
1	SetLum	offline ₂	1	1	50/53 ₂	79.88 F ₂	70.16 F	0.5 A	42.4 V	21.2 W	10 %	10 %	Gartenhaus 1/0	50	2.11 07:00	221213156	SL5-2
2	SetLum	online ₂	2	1	47/47 ₂	79.7 F ₂	67.64 F	0.1 A	0.1 V	0.01 W	0 %	0 %	Gartenhaus 2/0	2	2.11 14:51	223172032	SL5-2
3	SetLum	online ₂	3	1	47/55 ₂	81.14 F ₂	68.54 F	0.1 A	0.1 V	0.01 W	0 %	0 %	Gartenhaus 3/0	4	2.11 14:49	222239212	SL5-2

Map 223032100-Markus_Gateway - 2

NR	SETALL	Status ₂	My ID	Group	RSSI ₂	Board ₂	LED ₂	Current	Volt	Watt	Percent	soll Percent	pole	V.T	last Update	Lamp ID	Type
1	SetLum	offline ₂	1	1	47/47 ₂	83.12 F ₂	71.6 F	0.1 A	0.1 V	0.01 W	0 %	0 %	Labor 1/0	360	2.11 11:23	222177016	SL5-2
2	SetLum	offline ₂	2	1	47/0 ₂	32 F ₂	32 F	0.0 A	0.0 V	0 W	0 %	0 %	Labor 2/0	150	0	222222068	SL4

Gateway Aktive: 3 lights Aktive: 4 11.02.2020 - 09:52 Uhr GW SERVER RUN Version: 20201217

Software: Lighting Server Dashboard Windows

The screenshot displays the Apollo Metro Gateway - Server dashboard. The browser address bar shows `ap.dvrptr.de/gw_server/`. The dashboard header includes the Apollo logo and the title "Apollo Metro Gateway - Server". Below the header is a navigation menu with buttons for "home", "master", "system", "inventory", "gateways", "sLog", "shell", and "logout".

The main content area features a map of an industrial area with "Radio Road" highlighted in yellow. A tooltip for "RADIO RD Pole:84" is visible. Other map labels include "Wells Fargo", "Collier County Tower", "Industrial Boulevard", "Corporate Square", "CR 856", "My Florida Green", "Airport Pulling Road", and "Donna Street".

The dashboard footer contains the following information:

- Gateway Aktive: 3
- lights Aktive: 3
- 11.02.2020 - 10:20 Uhr
- GW SERVER RUN
- Version: 20201217

Software: Lighting Server Dashboard Windows

The screenshot displays the Apollo Metro Gateway - Server dashboard. At the top left is the Apollo logo. The main title is "Apollo Metro Gateway - Server". Below the title is a navigation menu with buttons for "home", "master", "system", "inventory", "gateways", "sLog", "shell", and "logout". The main content area shows "street lamp Profile 221124072". It contains two data tables: "Data" and "technical data". Below the tables is a "Map" section showing an aerial view of a residential area. At the bottom is a status bar with the following information: Gateway Aktive: 3, lights Aktive: 3, 11.02.2020 - 10:25 Uhr, GW SERVER RUN, and Version: 20201217.

apollo
METRO SOLUTIONS

Apollo Metro Gateway - Server

home master system inventory gateways sLog shell logout

street lamp Profile 221124072

Data					
My_ID	Group	Device_ID	pole	type	serialnr
3	1	221124072	86/3106	SL5-2	221124072

technical data					
channel	Gateway	max Temp	max Volt	max Ampere	Percent
0	19219088	73.7	45.4	2.9	93

Map

Leaflet | © Apollo

Gateway Aktive: 3 lights Aktive: 3 11.02.2020 - 10:25 Uhr GW SERVER RUN Version: 20201217

Software: Lighting Server Dashboard Windows


http://ap.dvrptr.de/gw_server/123/lp.php?Light=221124072

street lamp Profile 221124072

Data					
My_ID	Group	Device_ID	pole	type	serialnr
3	1	221124072	86/3106	SL5-2	221124072

technical data					
channel	Gateway	max Temp	max Volt	max Ampere	Percent
0	19219088	73.7	45.4	2.9	93

Map



Leaflet | © Apollo

1 of 1

02-Nov-20, 10:26

Software: Radio Configuration Android

The screenshot shows a web browser window with the URL 192.168.4.1. The page title is "APOLLO METRO" and the version is "2.0.1.8 - 20201069". The interface is titled "local light control" and displays a table with the following data:

MyID	My Group	My Gateway	Temp Board	Temp LED	Voltage	Current
4	1	0	27.22	0.00	0.00	12.49

Below the table, there is a large green slider control set to 90%, with a "SET" button to its right. At the bottom of the interface, there are three buttons: "ON", "OFF", and "flash".

Software: Radio Configuration Android

The screenshot shows a web browser window displaying the APOLLO METRO configuration interface. The browser's address bar shows the URL 192.168.4.1. The page title is "APOLLO METRO". The interface includes a header with the version "2.0.1.8 - 20201069", a MAC address ".80:1F:12:5A:D7:77", and a serial number "222000028". The main content area contains a configuration table with the following fields and values:

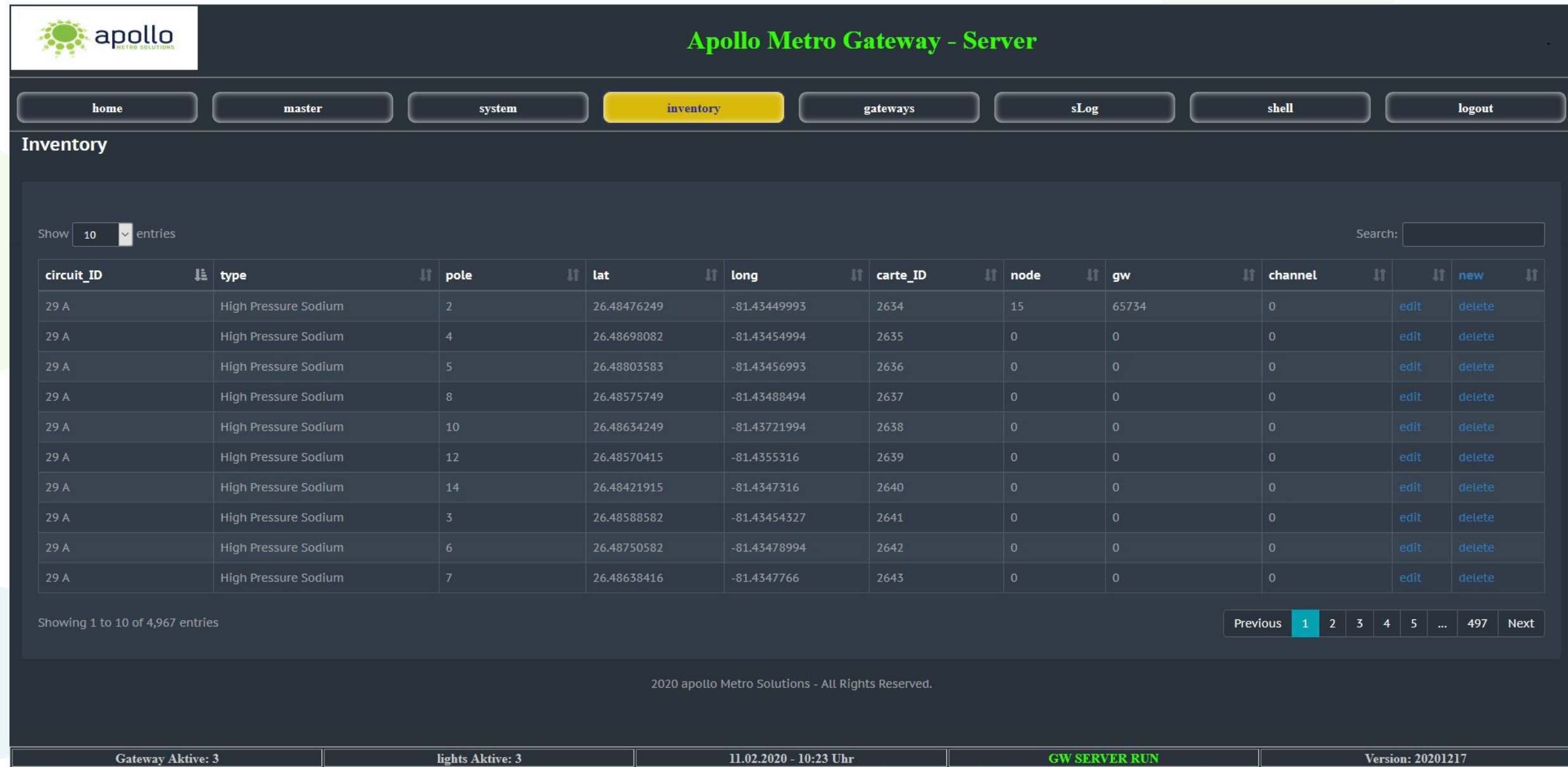
rxFrequency / txFrequency	channel 1 - 451.3625 MHz
RF Power	255
My_ID	4
My_group	1
Server_ID	0
GatewayModus	OFF
LightType	TriplePower
timezones	(GMT) Western Europe Time, London, Lisbon, Casablanca
StartLumination	90

Below the table is a red "SAVE" button and a radio button labeled "Expert". At the bottom of the interface, there are three navigation buttons: "home", "setup" (which is highlighted in yellow), and "update".

Software: Video Dashboard



Software Data Base



The screenshot displays the Apollo Metro Gateway - Server web interface. The top navigation bar includes buttons for home, master, system, inventory (highlighted), gateways, sLog, shell, and logout. The main content area is titled "Inventory" and features a table with columns for circuit_ID, type, pole, lat, long, carte_ID, node, gw, channel, and new. The table lists 10 entries of High Pressure Sodium lights. Below the table, there is a pagination control showing "Showing 1 to 10 of 4,967 entries" and a "Previous" button followed by page numbers 1, 2, 3, 4, 5, ..., 497, and a "Next" button. The footer contains the text "2020 apollo Metro Solutions - All Rights Reserved." and a status bar with "Gateway Aktive: 3", "lights Aktive: 3", "11.02.2020 - 10:23 Uhr", "GW SERVER RUN", and "Version: 20201217".

apollo METRO SOLUTIONS

Apollo Metro Gateway - Server

home master system **inventory** gateways sLog shell logout

Inventory

Show 10 entries Search:

circuit_ID	type	pole	lat	long	carte_ID	node	gw	channel	new
29 A	High Pressure Sodium	2	26.48476249	-81.43449993	2634	15	65734	0	edit delete
29 A	High Pressure Sodium	4	26.48698082	-81.43454994	2635	0	0	0	edit delete
29 A	High Pressure Sodium	5	26.48803583	-81.43456993	2636	0	0	0	edit delete
29 A	High Pressure Sodium	8	26.48575749	-81.43488494	2637	0	0	0	edit delete
29 A	High Pressure Sodium	10	26.48634249	-81.43721994	2638	0	0	0	edit delete
29 A	High Pressure Sodium	12	26.48570415	-81.4355316	2639	0	0	0	edit delete
29 A	High Pressure Sodium	14	26.48421915	-81.4347316	2640	0	0	0	edit delete
29 A	High Pressure Sodium	3	26.48588582	-81.43454327	2641	0	0	0	edit delete
29 A	High Pressure Sodium	6	26.48750582	-81.43478994	2642	0	0	0	edit delete
29 A	High Pressure Sodium	7	26.48638416	-81.4347766	2643	0	0	0	edit delete

Showing 1 to 10 of 4,967 entries

Previous 1 2 3 4 5 ... 497 Next

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Gateway Aktive: 3 lights Aktive: 3 11.02.2020 - 10:23 Uhr GW SERVER RUN Version: 20201217

Sensors

lights in use

MASTER INFO

223032100 - Markus_Gateway - 2

NR	AKTIV	MyID	Group	RSSI	TempBoard	TempLED1	TempLED2	TempLED3	Current	Voltage	LightPercent	sollLightPercent	StartLum	PE	HID	Lamp-ID	V.N2
1	online	1	1	47/47	28.7	27.1	0.0	0.0	0.1	0.1	0	0	0	0	0	222177016	2.11 18:07
2	offline	5	1	47/47	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	288	1	223056096	1.11 12:38
3	offline	2	1	47/0	0	0	0	0	0	0	0	0	0	150	0	222222068	0

SENSOR

NR	AKTIV	MyID	Group	RSSI	TempBoard	pressure	temperatur	humidity	Current	blue_light	ambient_light	red_light	green_light	PE	HID	DS-ID	V.N2
1	online	3	1	47/47	0	1005.71	25.92	46.56	0	10	42	21	15	0	101	223049216	2.11 18:07

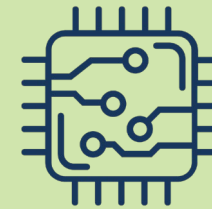


- Temperature
- Humidity
- Illumination
- Gun Shot
- Etc.

Using Street Lights as Ubiquitous Universal Technology Platform



Apollo Metro Solutions
Luminaires can be used as a
“telecom hotel” for all kinds
of sensors, actors, telecom
platforms for any smart city
application.



Apollo Metro can develop
any application in house,
both on the hardware
as well as on the software
side.

