IR-LED ILLUMINATORS FOR CCTV SYSTEMS

INTRODUCTION

For further information on light features and on the possible use of illuminators, please refer to the tutorial "Illumination for CCTV Systems".

From that tutorial we just would like to quote a few sentences (on page 3) as introduction to the following analysis, since great technological advances have recently contributed to the making of a new type of high-performance LEDs, including high-power models that, as for lighting systems, make it possible to design/create new illuminators replacing traditional lamp, filament or halogen lamp illuminators:

*"...IR illuminators with traditional halogen lamps normally use a cut-off filter which determines the output wavelength. These types of illuminators are subject to an average 2.000 rated hours lamp life. As an alternative, it is possible to use **LED** illuminators. It is not our intention to deal with the subject in full, but anyway we can indicate that, considering the **low** power of LEDs, this type of illuminator is generally applied for **short** illumination range (8/10 meters, mainly indoor). LEDs also have a **decreased performance** when the operating temperature increases and if no adequate measures are taken, the more the illuminator is on (warming up), the more the light gets weaker."*

LEDs

LEDs (Light Emitting Diodes) are made of semiconductor "chips"* (or semiconductor alloys) that, whenever voltage is applied to them, emit light (e.g.: GaAs-gallium arsenide, GaP-gallium phosphide, GaAsP-gallium arsenide phosphide, SiC-silicon carbide, GaInN-gallium and indium nitride, etc..). All is needed is that two thin layers of material are put together: one has an excessive level of electrons, while the other lacks negative electric charges but positive ones are numerous. When voltage is applied to the semiconductor, electrons are pushed to rejoin with positive charges, thus emitting light.

These are just a few millimetre big, that is why they are considered as a good alternative to traditional light sources. The choice of semiconductors affects the wavelength of peak photon emission, the efficiency of electrooptics conversion, thus the output light intensity. Considering that the power of each LED is just few tenth of Watt, one or three Watts more for the most performing versions, it is clear that in order to obtain the same light intensity of a traditional lamp, a large number of properly connected LEDs is needed. In various applications, the use of LEDs is widely justified and **enables original and convenient solutions**. Thanks to their reduced dimensions, both individually and in groups, LEDs make it possible to design compact systems with reduced width. For applications whereby it is cost-saving, difficult or dangerous to frequently replace light source, the LED long service life **guarantees an obvious and significant maintenance cost reduction**. LEDs are particularly resistant to crashes and mechanical stress and are therefore suitable for extremely difficult environments.

(*due to the extremely technical subject, the case is not thoroughly dealt with in this article)

HIGH-POWER LEDs

On the world market there is a variety of LEDs, from standard 3/5 diameter LEDs, Piraha version up to the latest high-performing light-emitting devices (in different forms and measures). Just a few years ago, due to LED low power, IR illuminators for CCTV Systems were made using a certain number of LEDs in cases (of different forms and materials) for indoor use or sealed for outdoor environments. Light ranges were not particularly wide and the main problem was related to heat dispersion. **Whenever temperature increases, LEDs actually lose power** (light gets weaker and service life is reduced). Nowadays, thanks to increased performances, a series of new versions are sold on the market, from IR illuminators made with traditional LED matrixes up to 500/600 pieces (but with quite big dimensions) or the Piraha 30 LED type or similar (with reduced spaces), according to the indicated illumination range*.

(* see chapter "Illumination Range/Angle")

Semiconductor technology has recently achieved major performances and state-of-the-art LEDs are already used for the Automotive sector to produce illuminating bodies for Cars, Motorbikes, Trains, and so on. Thanks to the latest versions, it will soon be possible to use these products also for car's driving or passing beams. In lighting engineering, LEDs **are increasingly replacing traditional light bulbs**.

That is why, thanks to technical innovations and, in particular, to the related "business" that big manufacturers do not intend to miss, also market segments especially dedicated to sensors and IR transmitters will consequently benefit from the achieved bigger power and performances. These segments/products are e.g. as follows:

- Remote control
- Light intensity measurement
- Remote measurements
- Radio communications
- Sensor engineering
- Pre-crash sensors (for Automotive)
- Security sensor for industrial automation and process control
- Illumination for CCTV video surveillance systems
- Illumination for pictures/motion pictures

It goes without saying that for these latest LEDs, **quality and origin are always fundamental**. Therefore not all LEDs can be suitable for a specific use or, **under the same conditions, performances can dramatically vary.** Generally speaking (but this is not always the case..), manufacturers that can rely on an advanced R&D department, are then able to offer more performing products. Thanks to research, there are now LEDs that can achieve incredible performances.

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An extremely developing technology which is offering incredible results is ThinFilm and ThinGaN. In short, it is defined by: extremely reduced dimensions (although emission area can be up to 1mmq), high power, high efficiency, low heat resistance, very long service life, increased reliability for resistance to humidity and thermal cycles, wavelengths particularly suitable when applied both with CMOS and CCD sensors (850nm and 940nm).

High Power IR-LED Illuminators, made by SERINN, apply these technology to guarantee top performances. Their extremely reduced dimensions, with regards to illumination ranges and angles, make it an excellent product.

These are made by Anticorodal extruded parts, processed through CNC machinery, and electrocolour galvanic processes. These new illuminators apply state-of-the-art **ThinFilm semiconductors with a large energy gap** (energy distance between valence and conduction band) in GaN (Gallium Nitride), considered as one of the most performing materials available from a technological point of view (thus particularly suitable for applications where high power and high operating temperatures are required). Each LED has a **PMMA (polymethyl methacrylate) collimator** that guarantees an extremely highly efficient light beam. The proposed technical solutions guarantee also a great level of resistance to corrosion and weather conditions, including marine environment.

Features:

- Extremely long service life (>50.000 hours)
- Wide temperature range (from –20°C to +50°C)
- Low power consumptions
- Two-way interface for Day&Night cameras (with PS01IR power supply)
- Automatic twilight switch
- Light intensity adjustment (with PS01IR power supply)
- Stainless steel bolts and screws
- IP66 protection rate
- Cable with PVC Compound sheath for outdoor use
- Vandal resistant polycarbonate front glass

The updated product range is made up of three versions:

LX345IR: n° LEDs: 3, 12V AC/DC power supply, range 20mt*, illumination angle 45°
LX325IR: as above except for range 35mt* and 25° collimators

LX945IR: n° LEDs: 9, specific power supply PS01IR, range 35mt*, illumination angle 45°
LX925IR: as above except for range 60mt* and 25° collimators

LX1845IR: n° LEDs: 18 (2x 9), two power supply PS01IR, range. 60mt*, illumination angle 45°

LX1825IR: as above except for range 105mt* and 25° collimators

(* see chapter "Illumination Range/Angle")

The specific PS01IR power supply is power-stabilized, is supplied with Input/Output terminal blocks (connection with Day&Night or interface with other equipment), enables light intensity adjustment and is supplied with automatic twilight switch. Die cast Aluminium box, IP65.

The function "light intensity adjustment" is extremely useful, since, in case the illuminator is placed too close to the area/subject to be shot, light intensity can be adjusted accordingly **in order to achieve the right light always** (otherwise the image would be too bright and consequently details would be lost or, in case of plate reading systems, the software wouldn't be able to correctly read the information).

ILLUMINATION RANGE/ANGLE

How an IR illuminator performs depends not only on the scene/subject reflection index, but **also on the type of camera and lenses used** (CCD sensor sensitivity to IR emissions, minimum functional illumination level, reaction of lenses to IR light, focal lengths, and so on..). This is why much attention must be paid to data sheets indicating ranges, shown on various catalogues, as it is often the case that these reference data are not given. **Thus the risk is to find out that the various indicated ranges, 50 mt, 100 mt, or 200 mt, are translated in practice into much shorter ones…**

Note: A CCD sensor reaction to various wavelengths differ from sensor to sensor, according to its general manufacturing features. It is therefore essential to know how CCD works, especially at frequencies beyond 800nm (these data are given by the camera manufacturer). This reaction is called "Quantum Efficiency*" and can be explained by means of a chart that indicates, through a curve, the ratio between the number of freed electrons transforming into signals and the number of photons that hit the CCD sensor, to various wavelengths (e.g.: a 50% ratio at a specific wavelength indicates that out of the two photons that hit CCD, just one helps freeing an electron). Nowadays the most advanced technology (not for CCTV applications) apply Germanium sensors instead of traditional Silicium ones that offer an EQ of over 70% at wavelengths of approximately 850nm; cooled sensors up to –35°C compared to room temperature, or backlit sensors that achieve an EQ of around 90%.

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Minimum indicated ranges (see also picture on pag.5) refer to the results obtained **in various practical testing sessions** carried out in an urban environment (presence of walls and concrete) and must be considered as wide indications, referred to low-quality cameras with standard lenses and with the following characteristics:

B/W CCD 1/3" Interline 512Hx582V Pixels; 380TVL Resolution; Sensitivity 0,5LUX (F 1.2-Full Video, AGC 30dB); S/N 50dB; Shutter 1/50sec. Lenses applied: manual varifocal 3,5-8mm/F1.4 and 10-25mm/F1.4.

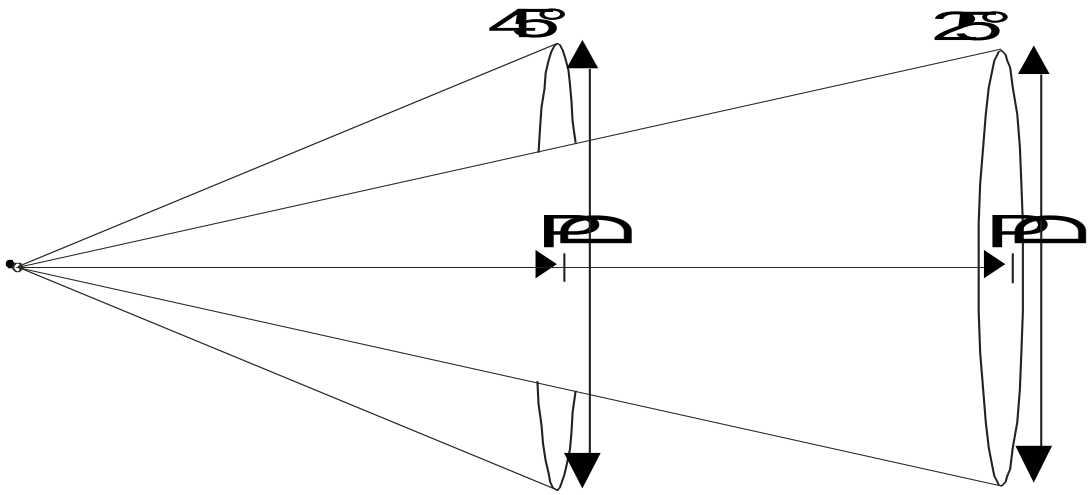
Tests were carried out also on more performing cameras and clearly indicated **an**

extremely high efficiency of these new illuminators (CCD B/W both 1/3" and 1/2"). As general indications (since the specific camera/lense features are unknown), it is stated as follows:

1) **Using B/W CCD 1/3" cameras with an average 0,05LUX Sensitivity and a good reaction to IR emission, multiply the indicated ranges up to 1,5**
2) **Using high-sensitivity cameras optimized for IR emission (e.g.: B/W CCD 1/2"; 752Hx582V Pixels; 570TVL Resolution; Sensitivity 0,0037LUX; etc..), multiply the indicated ranges up to 3**

NOTE: **Best performance is always obtained with B/W only cameras**, regardless the type of IR illuminator and the camera/lenses used. In case of Day&Night cameras, **versions with removable mechanical filter** are indicated **(NOT electronic)**.

High-sensitivity cameras make it possible to shoot also in conditions whereby standard cameras wouldn't show anything. These models seem therefore not to require the use of artificial light sources. It must be nevertheless made clear that image is **little bright and extremely distorted** (snow effect) due to the increased camera gain. Using an IR illuminator **quality image is notably improved**, while enjoying all intrinsic camera qualities.



LX345IR (45°): if P = 20mt, D = 16,82mt **LX325IR (25°):** if P = 35mt, D = 15,94mt

LX945IR (45°): if P = 35mt, D = 29,43mt
D = 27,33mt

LX925IR (25°): if P = 60mt,

LX1845IR (45°): if P = 60mt, D = 50,46mt
D = 47,84mt

LX1825IR (25°): if P = 105mt,

ON REQUEST: LEDS WITH 940NM WAVELENGHT AND COLLIMATORS WITH ILLUMINATION ANGLE OF 6°

Our updated product range offers solutions for a vast majority of standard applications in CCTV systems design and installation. We are also able to design illuminators according to specific needs: **both for wider ranges** (in case the use of more units is not enough) **and for shorter ones** (in case by a minimum light intensity, light emission is still too much).

March 2007/LC