

# FUTURE TECHNOLOGY MAGAZINE



**FUTURE  
ELECTRONICS**

ISSUE 19-iii

FUTURE TECHNOLOGY MAGAZINE

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New LED lighting and power technology for sports field lighting

AMERICAS EDITION

Application Spotlight on:

# Intelligent Lighting

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**First MCU-based solution qualified for Alexa Voice Service**

NXP Semiconductors has unveiled the world's first microcontroller-based voice control solution qualified with Amazon's Alexa voice service. This enables OEMs to quickly, easily and inexpensively add voice control to their products, giving their customers access to rich voice experiences with Alexa.

The NXP solution is based on an i.MX RT crossover platform, and runs on the Amazon FreeRTOS operating system.

**Extension of Vesta series of tunable-white light sources**

Bridgelux has expanded its Vesta® series of tunable-white and dim-to-warm light sources to help customers meet the increasing demands for environment-specific, personalized lighting.

The company has introduced new proprietary packaging technology which significantly improves near-field color uniformity and enhances beam quality when used with secondary optics.

It has also expanded the product portfolio to offer more options for light-emitting surface sizes, and new color-temperature options.

**New optical sensor from ams for mobile cardiovascular monitoring**

ams has introduced the AS7026, an optical sensor for continuous cardiovascular health monitoring which performs blood pressure measurement to medical-grade accuracy when mounted in a consumer wearable device such as a wristband or smart watch.

The AS7026 provides continuous heart rate, heart rate variability, blood pressure, and electrocardiography (ECG) measurements. The blood pressure measurement accuracy of the algorithm that the AS7026 runs is rated as medical grade (Grade B) under certain conditions when tested according to the IEEE 1708-2014 industry standard.

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**A vision for the luminaire of the future: producing and managing data as well as light**

**Just over 15 years ago, Future Electronics created a specialist division, Future Lighting Solutions, to enable customers and suppliers to generate revenue out of photons. At that time, much of the division's work was in helping customers to manage the transition from incandescent light sources to the then new technology of 'high-brightness' LEDs.**

Such is the fast pace of change in technology that this transition is already in a mature phase, and now the lighting industry faces a new, different and equally disruptive change: the commoditization of LED-based general lighting products. In the face of a worldwide oversupply of standard luminaires, lighting OEMs have suffered from eight consecutive years of falling prices. General lighting has become a much tougher business in which to make money and a cost-cutting strategy offers diminishing returns.

The longer but surer route to success is to add value for which the end customer, or lighting scheme specifier, is willing to pay. In Future Lighting Solutions' view, the industry needs to draw on existing assets: know-how and infrastructure. The lighting industry is an expert in creating systems based on a large number of electrically powered, light-emitting nodes situated above things and people.

In fact, a luminaire is an ideal location for sensors which collect data about activity in and the environment of an indoor space or a street, while avoiding the privacy concerns and costs of a video camera. If the data are valuable enough, the light that the luminaire produces could end up as the remote-controlled auxiliary function of a ceiling-mounted data acquisition and transmission device.

Of course, the industry has to find a way to extract profit from the data, by marketing a more expensive luminaire equipped with sensors and controls which can measure and manage the operating environment. An infrared heat map, for example, might detect that 70% fewer people occupy an area at

slower times of the day compared to the busiest times. A 'smart building' system could then automatically adjust lighting and heating without manual intervention. The energy saving provides value for which end customers and consumers might be prepared to pay.

- In this new smart lighting market, there are opportunities for businesses to:
- offer data services to facilities managers and municipalities through networked lighting infrastructure
  - produce light-emitting data acquisition devices
  - supply luminaires that can be controlled wirelessly

In every case, Future Lighting Solutions has the know-how and experience to help manufacturers. Our offering includes firmware, control software and hardware, with as much as possible of the complexity in licensing and other arrangements removed.

So now, with help from Future Lighting Solutions, OEMs can achieve differentiation and quality of light at the same time, and at an affordable cost.



**Stéphane Rosa**  
EMEA Director  
Future Lighting Solutions, a division of Future Electronics



**Optically-coupled gate driver IC offers safety and noise isolation**

VISHAY

**Vishay has released a new isolated IGBT/MOSFET driver which produces a high peak drive current of 2.5A with a high-efficiency, low power-drop MOSFET output stage, sufficient to directly drive high-power IGBTs with a rating up to 1,200V and 100A.**

The VOD3120 combines a control stage optically coupled to a rail-to-rail MOSFET power output circuit. This means it can provide safety and noise isolation for digitally-controlled power electronics systems such as AC inverters and motor drives.



VOD3120: 35kV/µs common-mode voltage rejection

The VOD3120 is rated for a maximum repetitive peak voltage of 891V. Intended for use in applications such as solar inverters, which often have digital controls close to noise-generating power devices, the VOD3120 benefits from a high common-mode voltage rejection rating of 35kV/µs to protect control circuitry from electrical noise.

The VOD3120 provides under-voltage lock-out protection with hysteresis. It operates from a supply-voltage range of 15V to 30V.



**APPLICATIONS**

- Solar inverters
- Motor drives
- Uninterruptible power supplies
- Induction hobs

**FEATURES**

- Compatible with industrial three-phase line voltages
- Highly efficient output drive dissipation
- Can be triggered by embedded digital controllers
- 0.5µs maximum propagation delay time
- Low-power CMOS output stage
- 5mA threshold current

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**HIGH POWER DENSITY**

**MDWI10 Series · 10W · DC-DC Converter**

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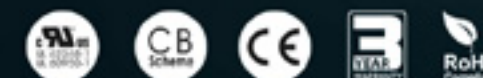
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**2.54x**  
Power Density  
UP



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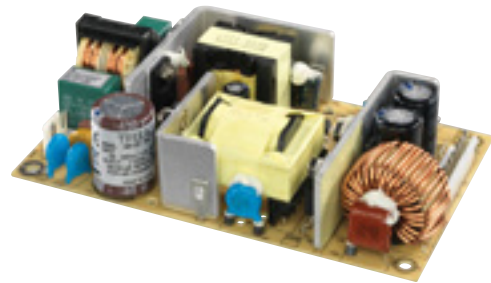


<b>GENERAL INDUSTRIAL</b> 1-60W DC-DC Converters 2-60W AC-DC Power Supplies	<b>ULTRA-HIGH ISOLATION</b> 1-60W DC-DC Converters	<b>RAILWAY CERTIFIED</b> 3-150W DC-DC Converters	<b>MEDICAL SAFETY</b> 1-20W DC-DC Converters 2-60W AC-DC Power Supplies
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# Solutions for Power Noise Suppression and Filtering



Triad manufactures a wide range of popular off-the-shelf and custom designed chokes, inductors and other magnetic components designed for EMI/RFI suppression and noise filtering near power components. Our advanced chokes and inductors offer superior performance, rugged construction, high quality, long life and excellent value. All are RoHS compliant.



## APPLICATION TECHNOLOGIES

- Class D amps
- di/dt inductors
- FETs
- IGBT modules
- LED drivers
- Output filtering
- Power converters

## CMF Dual Function Chokes



Triad's dependable CMF Series Chokes provide common mode suppression and stray inductance to suppress differential mode noise. In effect, the CMF combines the features of two separate components into one.

## KEY SPECIFICATIONS

- Rated current: 0.45A to 2.3A
- Rated inductance: 10mH to 100mH
- Resistance: 279mΩ to 1970mΩ
- Stray inductance: 200mH to 2100mH

## CME Common Mode Inductors



Triad's CME Series Common Mode Inductors provide EMI noise suppression. They feature our e-core and are used in various types of power supplies. They also provide highly effective differential mode filtering and meet regulatory requirements. Normally placed close to the input source, these compact inductors are constructed with UL rated 130°C materials.

## KEY SPECIFICATIONS

- Minimum inductance: 2mH to 67.5mH
- RMS current: 0.4A to 7.5A
- Maximum DC resistance: 0.5Ω to 2.02Ω
- Minimum leakage: 1.1μH to 720μH

## CMT Common Mode Inductors



Triad's CMT Series Common Mode Inductors provide common mode EMI suppression for power supplies. They feature our precision coil windings to eliminate noise and to minimize the AC line transmitted interference often created by high frequency switching power supplies. They also meet various regulatory requirements and are constructed with UL rated 130°C materials.

## KEY SPECIFICATIONS

- Minimum inductance: 1mH to 50mH
- Maximum current: 1.7A to 20A
- Maximum DCR: 0.006Ω to 0.45Ω

## CMT908 Encapsulated Common Mode Inductor

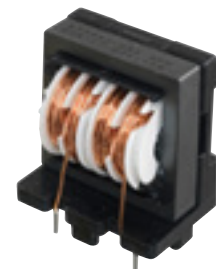


Triad's CMT908 Series Common Mode Inductor features a sealed encapsulated design that is ideal for rugged environments and where reliability is critical. It provides superior common mode EMI noise suppression for power supplies and other power devices.

## KEY SPECIFICATIONS

- Minimum inductance: 2.0mH to 16mH
- RMS current: 2.60A to 7.50A
- Maximum DCR: 0.020Ω to 0.160Ω
- Minimum leakage: 25.0μH to 180.0μH

## UT/ET Common Mode Inductors



Triad's UT/ET Series Common Mode Inductors help prevent EMI/RFI in a wide range of applications. Features include low leakage flux, high self-resonant frequency, high impedance at applicable frequency and low stray capacitance in section winding. Precision coil winding ensures excellent performance and reliability

## KEY SPECIFICATIONS

- Minimum inductance: 0.45mH to 120mH
- Maximum inductance difference: 100μH to 2500μH
- Maximum DCR: 0.1Ω to 3.7Ω
- Current rating: 0.5A to 4A

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# Robust optocouplers with phototriac output provide high noise isolation

## VISHAY

Vishay's VOT8024AM and VOT8121AM are new optocouplers which have a phototriac output for use as robust, isolated AC switches in home appliances and industrial equipment.

The devices feature a high off-state voltage rating of 800V and handle dV/dt swings of 1,000V/μs, offering equipment designers a robust switch solution which provides high noise isolation.



Vishay's VOT8024AM and VOT8121AM optocouplers are housed in a compact flat SOP-4 package

These optocouplers isolate low-voltage logic circuits from 120V, 240V, and 380V AC lines to provide a means to control resistive, inductive or capacitive loads, including motors, solenoids, high-current thyristors, or triacs and relays. They consist of a GaAs infrared LED optically coupled to either:

- A zero-crossing triac in the case of the VOT8024AM for EMI reduction without the need for external snubber networks
- A random-phase triac in the case of the VOT8121AM to enable phase-independent switching.

The high off-state voltage of the VOT8024AM and VOT8121AM enhances safety margins in one-phase applications, while still maintaining enough voltage headroom for three-phase applications. For additional safety, the optocouplers offer a withstanding isolation voltage of 3,750V<sub>rms</sub>. Low trigger currents of 5mA for the VOT8024AM and 10mA for the VOT8121AM facilitate an easy interface with the digital logic outputs of microcontroller-based IoT AC control systems. The 1,000V/μs load-slew immunity reduces the need for large, costly and inefficient snubber circuits.



## APPLICATIONS

- Power triac driver in solid-state relays
- 3-phase AC equipment
- Motor control
- Industrial control
- White goods and household electrical equipment
- Lighting controls

## FEATURES

- 100mA on-state current
- 1.2V forward voltage
- 400μA holding current
- Zero-voltage crossing detector
- >5mm creepage and clearance distances

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# Precision chip resistors handle high power loads up to 1W

## SUSUMU

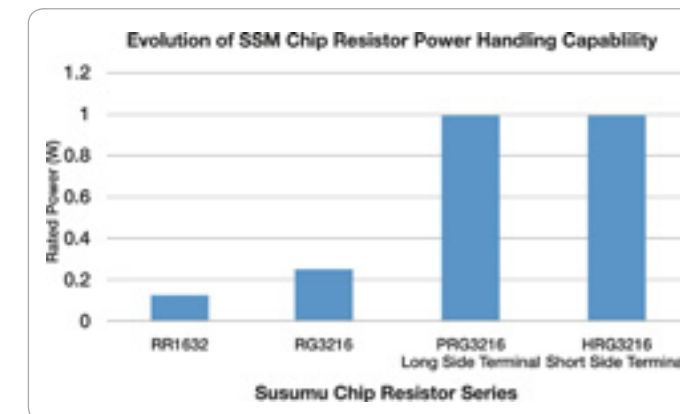
Susumu has introduced the HRG series of high-power chip resistors which offer precise and stable resistance over a wide temperature range and numerous temperature cycles.



The HRG series features conventional short side wrap-around terminals, in contrast to Susumu's PRG series resistors, which have long side

terminals. The proprietary thin-film resistor construction and enlarged bottom terminals mean that the HRG resistors are able to handle high power loads of up to 1W in a standard EIA 3216 case size, or 1206 in inches.

The Susumu HRG series is notable for its precise electrical characteristics and high reliability. The resistors are available with absolute resistor tolerances of 0.1% or 0.5%. The temperature coefficient of resistance is ±25ppm/°C or 50ppm/°C.



HRG series: precise and stable resistance over a wide temperature range



## APPLICATIONS

- Power supplies
- Power switching
- Automotive braking systems
- Test and measurement equipment
- Motor deflection circuits
- Sensor circuits
- Batteries
- Electric car chargers

## FEATURES

- Low noise
- Excellent high-frequency performance
- ±0.25% maximum drift after 1,000 hours at rated power at 70°C
- ±0.1% maximum drift after 1,000 hours at 85% relative humidity at 85°C
- ±0.1% maximum drift after 1,000 temperature cycles between -55°C and 125°C
- ±0.1% maximum drift after 1,000 hours at 155°C
- AEC-Q200 qualified

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# New Bluetooth 5.0 RF module gives developers the choice to optimise for range or data rate

PANASONIC

Panasonic's new PAN1762 series is an integrated Bluetooth® 5.0 radio module which supports operation in Bluetooth Low Energy (BLE) mode or a high data-rate mode.

The PAN1762 series, which has the part number ENW89853A1KF, gives designers the flexibility to achieve either a high data rate of 2Mbits/s using the module's high-speed PHY, or much longer range at a lower 500kbits/s or 125kbits/s data rate using the BLE-coded PHY.

High output power of up to 8dBm and industry-leading sensitivity of -105dBm at a data rate of 125kbits/s give a large link budget, helping developers to provide reliable and long-range operation even in challenging conditions. A new channel selection algorithm improves performance in environments which contain many other devices transmitting at 2.4GHz.



The Bluetooth 5.0 protocol also provides new BLE advertising extensions which allow for much higher amounts of data to be broadcast in connectionless scenarios, making the PAN1762 series suitable for use in beacon and mesh-networking applications. The device is ready for the implementation of the Bluetooth mesh v1.0 specification.

To provide maximum flexibility, the PAN1762 series RF module can be operated in hosted as well as stand-alone mode. Featuring built-in Flash memory provision of 128kbytes, the PAN1762 series may be used for the user application, thereby eliminating the need for an external processor, and reducing the complexity, size and cost of the host system.



APPLICATIONS

- IoT devices
- Wireless beacons
- Wireless sensor networks

FEATURES

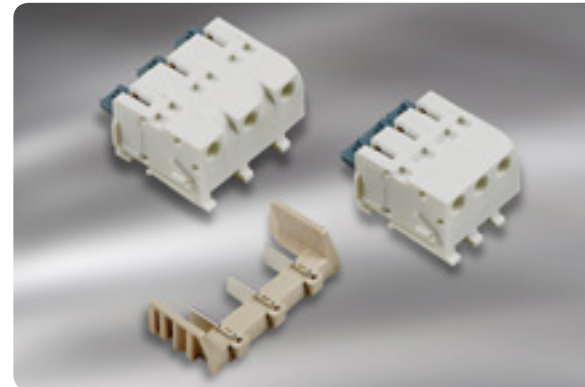
- 15.6mm x 8.7mm x 1.9mm surface-mount package
- 11mA Transmit current
- 5mA Receive current
- 18 general-purpose I/Os
- General-purpose ADC
- Wake-up inputs
- Two I<sup>2</sup>C and two serial peripheral interfaces
- UART interface

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# Poke-in wire connectors make wall-mounting easy

TE CONNECTIVITY

TE Connectivity's (TE) BUCHANAN WireMate two-piece poke-in series of connectors provides designers with a three-directional solution for wall-mounting a device. Terminations are easy to make, and present no difficulties even to the novice installer.



TE's BUCHANAN WireMate: Flat connector surface reserved for wire marking

Wires are routed through an opening in the wall to TE's BUCHANAN WireMate connector mounted on a wall plate. Once stripped of insulation, wires may be easily poked into the terminal block device, providing a reliable termination without the need for tooling. Wire extracting is also easy by means of a simple lever. The system provides a flat connector surface reserved for wire marking. Color options are available.

The mating header is surface-mounted to the PCB in the device to be mounted on the wall.

The two-piece combination allows for wall mounting of a device in three different directions: into the wall, along the wall, or in a twisting or rotating motion.

Separate headers and connectors are available with 2, 3, 4, 5, 6, 7 or 8 positions. The connector/header combinations are supplied in 5mm and 8mm versions.



APPLICATIONS

- Thermostats
- Smoke detectors
- Control panels
- Environmental monitors

FEATURES

- Current ratings: 5A for 18 AWG wire; 3A for 20 to 24 AWG wire
- 250V AC voltage rating
- 2mm panel thickness
- 10mm height from wall plate to PCB
- UL recognized

To buy products or download data go to: [www.FutureElectronics.com/resources/ftm](http://www.FutureElectronics.com/resources/ftm)

TE Connectivity, TE, TE connectivity (logo), and BUCHANAN are trademarks.

## USB dongle evaluation kit provides rapid prototyping platform for Bluetooth wireless system designs

The Panasonic evaluation kit for the PAN1762 series Bluetooth 5.0 radio module includes two identical USB dongles which provide a hardware platform enabling the designer to develop, run and debug code. Break-out headers provide an easy way to connect sensors and other devices.

The USB dongles provide a simple way for designers to evaluate the performance of the PAN1762 series module when operating in the intended application's typical operating conditions. The PAN1762 series dongles can run in host mode, AT command mode or stand-alone operating mode.

FTM Boards

The Panasonic PAN1762 evaluation kit is available from Future Electronics.  
Orderable Part Number: ENW89853AWKF

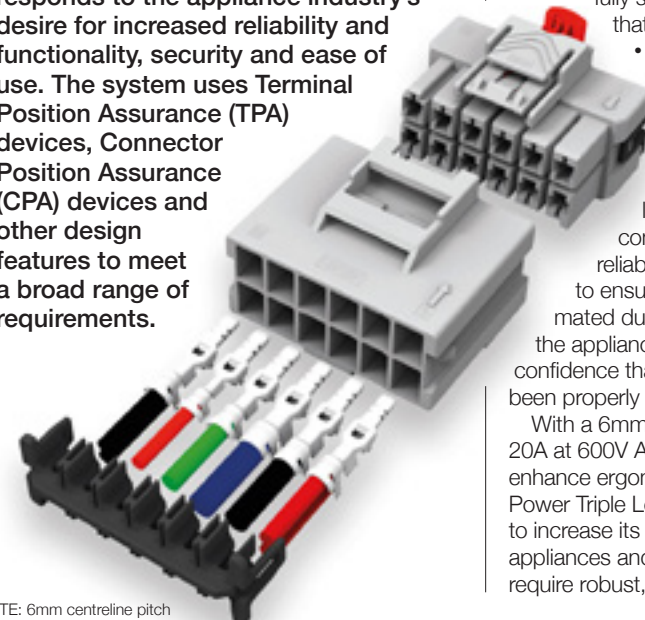
To buy development boards go to: [www.FutureElectronics.com/resources/ftm](http://www.FutureElectronics.com/resources/ftm)



# Secure three-in-one connector mechanism ensures appliance terminals remain fully seated in their housings

TE CONNECTIVITY

The Power Triple Lock connector solution from TE Connectivity (TE) responds to the appliance industry's desire for increased reliability and functionality, security and ease of use. The system uses Terminal Position Assurance (TPA) devices, Connector Position Assurance (CPA) devices and other design features to meet a broad range of requirements.



TE: 6mm centreline pitch

TE's Power Triple Lock connectors offer polarization and keying to help prevent connectors from mismatching. The connector locks in three ways:

- The cap or header and plug latch together
  - The TPA device helps ensure terminals are fully seated in the housing and remain that way
  - The CPA device locks the cap or header and plug together
- The Power Triple Lock connector's built-in latching capability comes from reducing two latches to a single, robust latch which makes it easier to connect, and improves connector reliability. The optional CPA device helps to ensure a fully mated connector stays mated during shipment, installation or when the appliance is in use. The TPA provides confidence that when installed, the contact has been properly inserted in the housing.

With a 6mm centreline pitch, ratings up to 20A at 600V AC and numerous features to enhance ergonomics and ease of assembly, the Power Triple Lock connector system continues to increase its appeal to manufacturers of appliances and many other product types that require robust, secure connections.



APPLICATIONS

- Refrigerators
- Dishwashers
- Washers and dryers
- Cooking appliances
- Water heaters
- Vacuum cleaners
- Garage door openers
- Automotive systems
- Industrial machinery
- Railway equipment

FEATURES

- Three material options for standard 105°C, high-temperature 150°C and glow-wire applications
- Four keying options
- Multiple colors
- Snagless design features help ensure fast, accurate connections on the assembly line
- 20A maximum current rating

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Power Triple Lock, TE Connectivity and TE connectivity (logo) are trademarks.

# Constant-current LED drivers: the simple, reliable and low-cost way to supply low- and mid-power LEDs

NEXPERIA

By Dr-Ing. Jan Preibisch  
Application Marketing Manager, Nexperia



The drive circuits for high-performance, high-power LEDs tend to use boost-buck converters with complex controllers that require a deep understanding of the topology to create reliable designs which comply with EMC regulations.

For low- and mid-power LEDs, however, the driver circuit can be very simple and robust: the solution is to use a constant-current LED driver which operates as a simple linear regulator. It is true that constant-current LED drivers are less efficient and lose more power than switching power converters. But their excellent EMC performance, reliability and simplicity, as well as the markedly lower cost at the system level, make them the preferred option for driving LEDs at currents of up to 500mA.

Drivers referred to in this article with the prefix NCR are available from Nexperia. They are used in constant-current source and automotive applications such as interior and exterior lighting, including lights for door handles, dashboards, number plates, indicators and rear clusters.

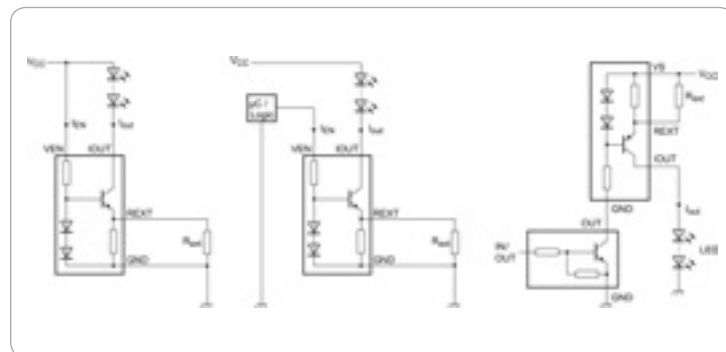


Fig. 1: Low- and high-side constant-current LED driver topologies

Figure 1 shows the basic circuits for driving LEDs with a single constant-current driver. Internally, such a driver consists of a Bipolar Junction Transistor (BJT), two diodes and two resistors. Constant-current drivers with a PNP BJT operate as high-side drivers, while those with an NPN BJT are low-side parts. One resistor defines the minimum output current; the other tunes the bias voltage and plays an important role in the Enable function.

The high-side constant-current driver has an Enable pin which is connected to ground; both the driver and thus the LED can be turned off by disconnecting this pin. In practice, this is performed by a Resistor-Equipped Transistor (RET), as illustrated in Figure 1, or by a MOSFET.

Low-side drivers, on the other hand, need a certain potential to be enabled. NCRx20x series drivers require a voltage in the range of the supply voltage to enable them. The NCRx21x driver can be enabled at a much lower voltage of 3.3V. This part draws a current of around 1 to 2mA at the Enable pin so it can easily be driven by the output pin of a microcontroller or a logic device. This is convenient for turning the LED on and off, and also for dimming with a PWM controller.

The dimming function is illustrated in Figure 2, which shows the mean of the output current as a function of the duty cycle for a NCR321Z driver for various switching frequencies with an external resistor of 6Ω. The graph displays a linear relationship between the duty cycle and the measured average output current. Even for frequencies above the recommended 10kHz, this linear relationship is maintained. The frequency should not exceed 10kHz however in the interest of compliance with EMC specifications.

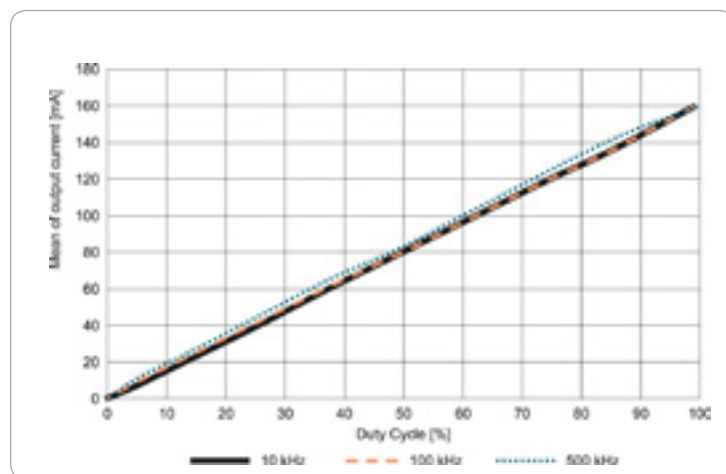


Fig. 2: Mean of the output current as a function of the duty cycle of a NCR321Z constant-current driver with an external resistor of 6Ω

The output current of most constant-current LED drivers is adjustable by an external resistor. Some types are tuned to commonly used currents. As they do not feature an external resistor, they are available in three-pin packages. In circuits which include an external resistor, it will be in parallel to the internal resistor, thereby lowering the effective resistance.

Low-side constant-current drivers with an NPN transistor – the NCRx2xx devices from Nexperia – have an internal resistor of 95Ω. An analysis of the measurement curves produces the following formula which enables the relationship between external resistor and output current to be estimated:

$$I_{out} \approx 0.5 \text{ mA} \left( \frac{R_{ext}}{\Omega} \right)^{-0.75}, \quad R_{ext} \approx 1\Omega \left( \frac{I_{out}}{0.5\text{mA}} \right)^{-1.33}$$

The value of the external resistor must not be so low that the maximum output current is exceeded. The majority of the output current will flow through the external resistor if it is smaller than the internal resistor; this is significant when the external resistor is small and the output current high. Nevertheless, a 0.25W resistor will be sufficient, since the power losses will not exceed 170mW even for a 250mA output current.

Constant-current drivers show a temperature dependence. At high temperatures the output current decreases slightly. The output current remains independent from the voltage drop across the driver, however. As the output current decreases with temperature, there is no risk of thermal runaway.

The minimum voltage drop across a constant-current driver is about 1.4V. Below this voltage, linear regulation does not work properly. Above it, the voltage drop across the constant-current driver dynamically adjusts to maintain the desired output current.

In low- and high-side configurations, the output voltage is always calculated as:

$$V_{out} = V_{CC} - V_{LED}$$

where:

$$V_{LED} = \text{voltage at the LEDs and } V_{CC} = \text{supply voltage}$$

Constant-current LED drivers are used when the brightness of an LED should be independent of the supply voltage to some degree. For example, the 12V power supply in a car fluctuates between 11V and 15V during normal operation. If the desired drive current and the voltage drop across the LEDs are known, the minimum possible supply voltage can be calculated by adding the voltage drop across the driver plus the voltage at the LEDs. The maximum allowed voltage is governed by the maximum-permitted voltage drop across the driver, or the total power dissipation, which can be estimated by the formula:  $P_{tot} \approx V_{out} \times I_{out}$ .

Hence the allowed operating range, if datasheet limits are not exceeded, can be specified as:

$$V_{LED} + 1.4V < V_{CC} < V_{LED} + \frac{P_{tot}}{I_{out}}$$

Constant-current drivers in the SOT457 package usually have a maximum power rating of 0.75W. For an output current of 50mA, this relates to a margin of 15V. Newly released devices in a SOT223 package from Nexperia have a higher maximum power rating of 1.25W, which raises the voltage margin to 25V.

Additionally, the voltage margin can be increased by reducing the output current. Placing two or more constant-current drivers in parallel, as illustrated in Figure 3, effectively doubles the current. Using this method, a current exceeding the capability of a single driver can be driven, or a smaller current per driver can be used to increase the voltage margin.

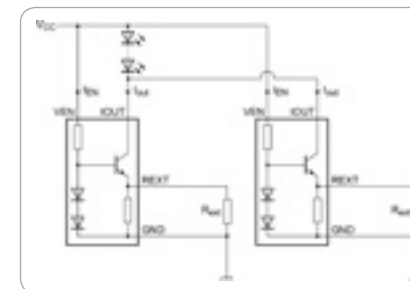


Fig. 3: Two low-side drivers in parallel operation

The use of two constant-current SOT223-packaged drivers with a drive capability of 250mA enables the circuit to drive 500mA LEDs with a voltage margin of 5V. When driving constant-current drivers in parallel, the accuracy of the external resistors is the most important factor for the symmetry of the output currents of the individual

drivers. Figure 4 illustrates the voltage margins depending on the output current for single and parallel drivers in SOT457 and SOT223 packages.

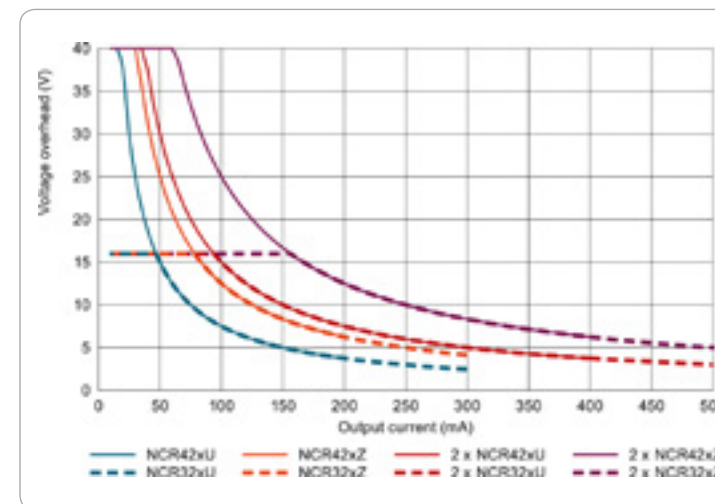


Fig. 4: Voltage margin of single and parallel drivers in SOT457 and SOT223 packages

In conclusion, constant-current LED drivers offer a very low-cost and easy-to-implement solution for driving low- and mid-power LEDs. Using packages with a higher maximum power rating provides a higher margin in the supply voltage, and parallel drivers can be used to increase the current capability.



Fig. 5: Nexperia constant-current LED drivers in SOT457 and SOT223 packages

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Making LED Lighting Solutions Simple™



## Philips Advance Xitanium LED Drivers with ComfortFade 50W (XI050C140V054PST1)

### Features & Benefits

- ComfortFade Technology for Smooth On-to-Off and Off-to-On Transitions
- Dim to Off Capability
- SimpleSet NFC based Programming
- 1% Min Dim
- 0-10V Dimming
- CSA, ETL, and UL Class P
- 50k hour Lifetime<sup>1</sup>
- 5-yr limited warranty

### Applications

- Indoor Linear
- Troffers
- Suspended
- Retrofit

75W, 40W, and 30W drivers will be introduced over a period of time into 2019

<sup>1</sup>Philips Advance Xitanium LED drivers are manufactured to engineering standards correlating to a designed and average life expectancy of 50,000 hours of operation at maximum rated case temperature. Minimum 90% survivals based on MTBF modeling.

For up to date warranty information please go to <http://www.usa.lighting.philips.com/support/support/warranty>

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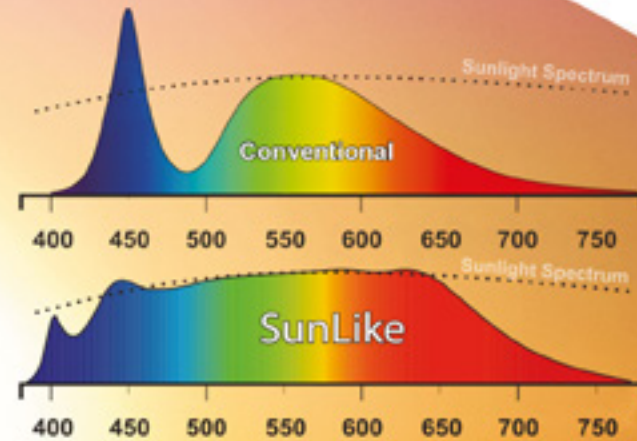
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Powered by 



3030 package 0.2W and 1W  
COB package from 6W to 25W

- Improves the light experience for human health benefits
- Closely matches the spectrum of natural sunlight
- Harmonizes light output with natural circadian rhythms
- Minimizes negative effects of conventional LED light sources

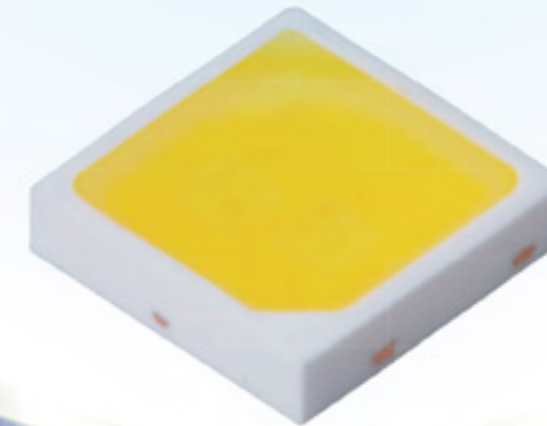


Visit [seoulsemicon.com](http://seoulsemicon.com) to learn more about SunLike Series LEDs.  
[info.europe@seoulsemicon.com](mailto:info.europe@seoulsemicon.com)

 **SEOUL SEMICONDUCTOR**

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**The Mid Power race began with NICHIA.  
We continue to lap the pack.**



## NICHIA's new 757 V3 Series

### Features & Benefits

Industry's leading performance plus the highest level of quality for Mid Power LEDs.

### Applications

Office (linear, spotlight), architectural, streetlight, tunnel, wall mount, healthcare, industrial, downlight, and many more.

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[www.NICHIA.com](http://www.NICHIA.com)



  
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# Power logic shift register with multiple open-drain outputs reduces footprint of LED lighting boards

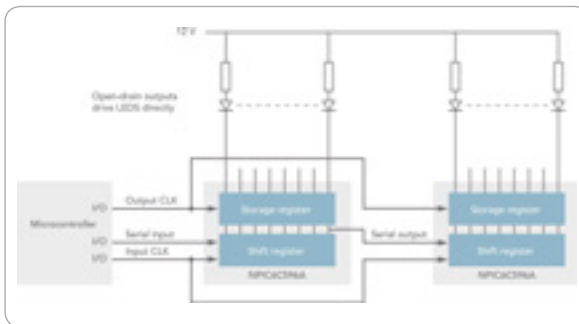
NEXPERIA

Nexperia supplies various series of shift registers which enable designers of LED lighting systems to save space by using a compact, low-cost microcontroller to control the power supply to multiple LEDs. Suitable shift registers from Nexperia for this application include standard 8-bit devices such as the popular 74HC595, and also the newer NPIC6C series, which offers more advanced features.

Nexperia's NPIC6C is a range of 12- and 8-bit power logic shift registers which meet the needs of 5V control logic circuits, as well as other applications. These devices include a serial output for cascading and allow for an input clock frequency of at least 10MHz. The NPIC6C shift registers can be used to replace the 74HC595 in existing designs.

Some parts in the NPIC6C portfolio offer a serial output delay to provide a longer data hold time, improving the timing margin and making it easier to cascade many shift registers. The NPIC6C series is available in TSSOP packages, and also in DQFN packages which save space and include a heat-sink, ideal for use at higher currents.

NPIC6C functions are also available in Nexperia's Q100 portfolio of AEC-Q100 qualified parts for use in automotive applications.



The NPIC6C596A can replace an 74HC595 and 16 external MOSFETs



### APPLICATIONS

- Signage
- Graphical status panels
- Fault status indicators
- Automotive lighting

### FEATURES

- Low on-resistance
- Simple control interface
- Supports I/O expansion
- Low power consumption
- Cascadable
- Operating temperature range: -40°C to 125°C



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## Renesas Synergy™ Platform

# RAPID DALI DEVICE DEVELOPMENT WITH RENESAS SYNERGY™

DALI 2 Lighting – Complete Hardware and Software Solution



### Hardware & Software designed for IEC 62386 Version 2 (DALI 2.0) compliance

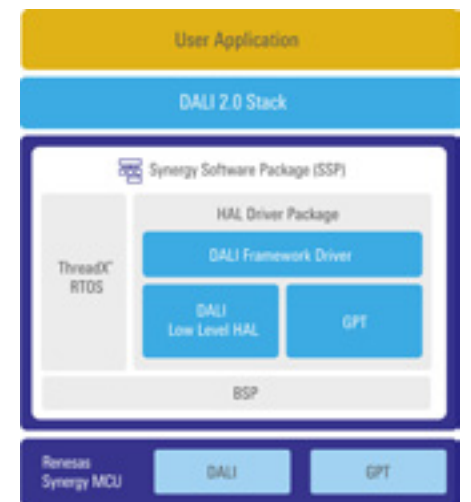
The digital addressable lighting interface (DALI) enables lighting devices from different manufacturers to communicate via a common control protocol, allowing interoperability and compliance for dimming and lighting control. The Renesas Synergy™ S128 MCU Group helps developers create new and innovative products by including a DALI hardware block to offload the DALI bus protocol, leaving more MCU resources for your end-device application.

The S128 MCU Group uses a 32 MHz Arm® Cortex®-M0+ MCU with 256 KB of flash and 24 KB of SRAM. The DALI 2 hardware module is compliant with IEC 62386 Version 2 protocols.

In addition, the S128 MCU Group features a comprehensive set of analog, digital, and communications peripherals that enable development of differentiated and compelling lighting products.

DALI hardware is only one part of the equation when developing a lighting solution. Renesas has partnered with CS Lab to provide a robust and standards-compliant DALI stack that is fully integrated with the Synergy Software Package (SSP). An evaluation version of the DALI 2.0 compliant stack is available from the Synergy gallery as a software add-on.

Licenses for production use can be obtained directly from CS Lab.



# The perfect module for any application

Take control with Seoul Semiconductor for faster and more competitive ways to market

Seoul Semiconductor provides customers with advanced module capabilities and technology solutions that extend across a wide range of application and performance requirements. As the number two LED manufacturer in the world (non-captive), Seoul Semiconductor has a proven track record of success in helping customers to simplify their processes and save on production costs, all while taking advantage of Seoul Semiconductor's vertically integrated technology and quality.

Partner with Seoul Semiconductor to increase your speed to market or expand your capabilities into new areas without investing in added equipment or staff expertise. From linear DC designs to complex AC engines driven by proprietary Acrich and Wicop technologies, Seoul Semiconductor can seamlessly support even the most complex custom and reference module designs in a timely and professional manner.

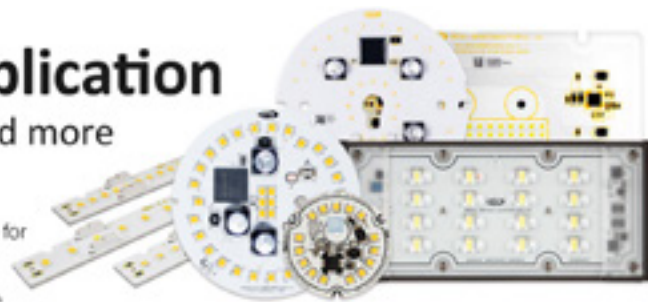
Linear reference modules are available as an excellent turnkey solution for projects of any size. The HE, SE, and Industrial series reference modules utilize Seoul Semiconductor's flagship high efficacy 5830 LEDs to deliver efficacies from an upper range of 189 to 202lm/W at typical driving currents.

The Value series is the perfect alternative for cost-sensitive projects, featuring similar technologies but with a high performing and cost effective 3528 package in place for efficacies up to 189lm/W at typical driving currents. Each linear reference module is UL and CE recognised, features uniformity of light and color (3 SDCM standard), and comes with a Zhaga compatible mounting pattern for easy installation.

Seoul Semiconductor takes pride in offering a variety of modules for specific lighting applications including round, tunable white, outdoor Wicop engines with heat-sinks and optics, proprietary blackhole lenses for increased uniformity and decreased optical depth, and Acrich AC modules that range from 4 to 105W with an added benefit of being Triac dimmable. Seoul Semiconductor can also integrate the NanoDriver into modular solutions for a product that is both low flicker and Title 24 compliant.

### Features

- Vertical integration allows variety of technology and footprint choices including 3030, 5630, 3528, Wicop, 3535 and 5050
- Custom and reference designs available
- DC and AC designs



- Several lens options for both high-power and mid-power designs
- 3 SDCM standard
- Multiple design, manufacturing, and support locations
- Numerous reference designs available through Future Electronics

### Applications

- Street and area
- Indoor commercial
- Industrial and residential
- Driver on board
- Color tuning



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### Rapid DALI 2 Prototyping with the S128 Development Kit

Renesas provides the Synergy S128 development kit (DK-S128) for rapid prototyping of your next DALI design. The kit allows access to all pins on the S128 MCU and features an onboard DALI interface connector that enables developers to quickly create DALI master or slave device configurations. The DK-S128 features a J-Link® onboard interface for easy programming and debugging.

Other features available on the DK-S128 are capacitive touch sliders and buttons, USB, CAN, and RS232/RS485.

**FTM Boards**  
 The Renesas DK-S128 development kit is available from Future Electronics.  
**Orderable Part Number: YSDKS128E10**  
 To buy development boards go to: [www.FutureElectronics.com/resources/ftm](http://www.FutureElectronics.com/resources/ftm)



# Linear Series Reference Guide

Seoul Semiconductor is one of the top two independent (non-captive) LED manufacturers in the world, with an extensive portfolio of more than 12,000 patents in LED and driver technology. This linear series reference guide features an array of solutions that provide uniformity of light and color as well as easy installation with a Zhaga compatible mounting pattern. Working with an innovative leader like Seoul gives customers leading-edge technology, along with security against IP litigation.



<b>HE</b> High efficacy 5630 LEDs deliver efficacies up to 202Lm/W	<b>SE</b> High efficacy 5630 LEDs deliver efficacies up to 189Lm/W	<b>Value</b> High performing and cost effective 3528 LEDs deliver efficacies up to 183Lm/W	<b>Industrial</b> High efficacy 5630 LEDs deliver efficacies up to 194Lm/W
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	Part Number	Dimensions (mm)	Typ Lm	Typ Lm/W	Typ IF (mA)	Typ VF (V)	Max IF (mA)	LED Package
HE	SMJD-3606036B-XXN100B33E038AI	560*20	1330		195		390	STW8Q14D-E3
	SMJD-3611060B-XXN100C21E038AI		2210	202	325	33.6	650	
	SMJD-3622120B-XXN100E42E038AI	1120*20	4420		650		1300	
SE	SMJD-3607024B-XXN100B30E038AI	560*20	1300		200		300	STW8Q14D-E3
	SMJD-3614048B-XXN100C60E038AI		2600	190	400	33.6	600	
	SMJD-3621072B-XXN100D91E038AI	3910		600		900		
Value	SMJD-3606024C-XXN100B10E038AI	560*20	1100		175		280	STW8A2PD-E1
	SMJD-3612048C-XXN100C20E038AI		2200	183	350	34.2	560	
	SMJD-3618072C-XXN100D30E038AI	3300		525		840		
Industrial Standard	SMJD-3624144B-XXN100E35E038AI	560*20	4350	196.5	660	33.4	1650	STW8Q14D-E3
	SMJD-4253182B-XXN100J70E038AI	1120*20	9700	182.5	1300	40.8	1820	

\*Each series tested @ 25 degrees C 4000K Ra80

### Key Applications

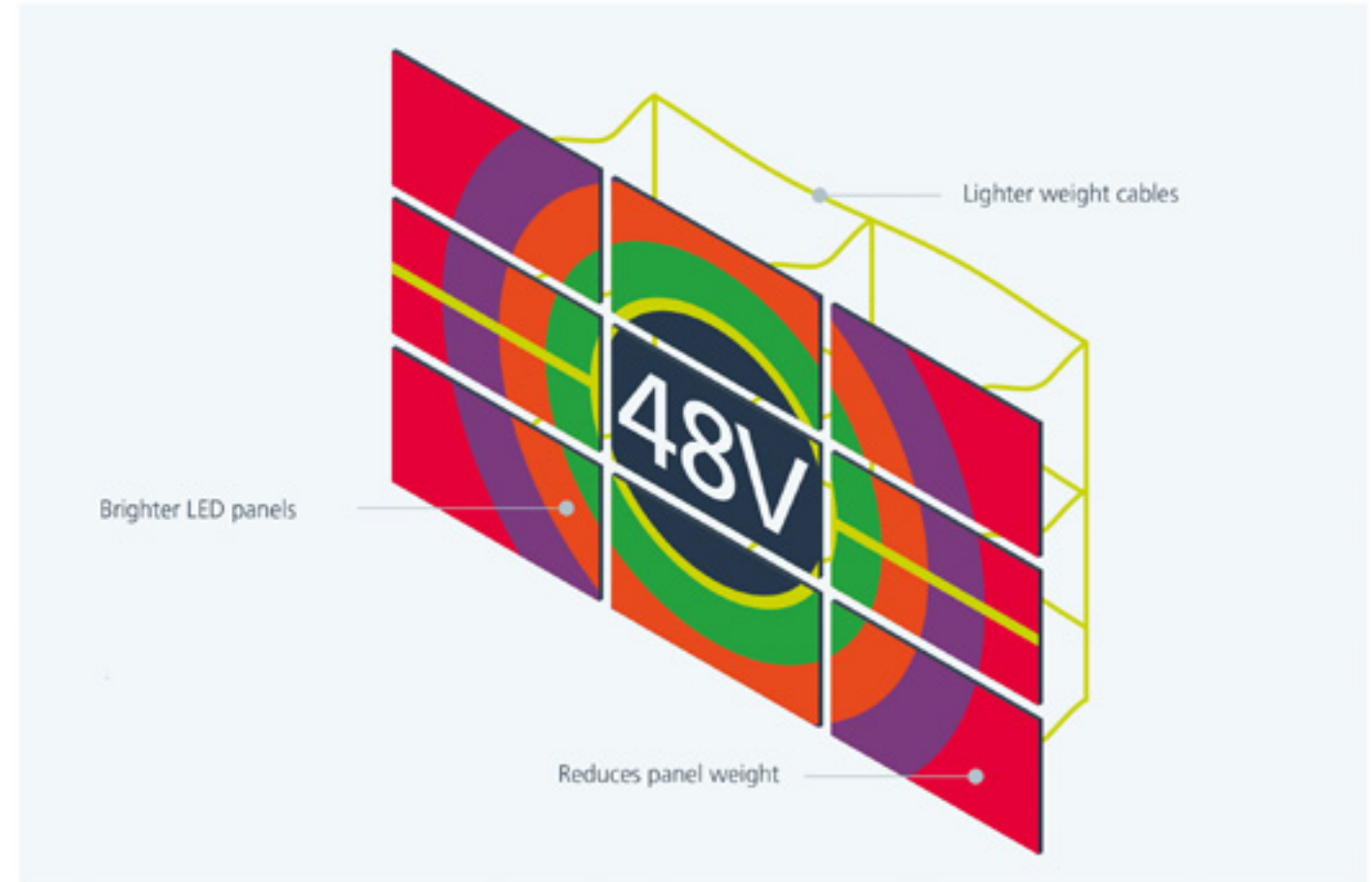


### Certifications



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# Delivering lighter, brighter LED panels with 48V high-density, high-efficiency converters



**PI354x**  
ZVS buck regulators offer 48V input and 2.5V to 12V output up to 10A with efficiency >95%.  
10.0 x 10.0 x 2.5mm

**NBM2317**  
Bidirectional DC-DC converter enable 12V to 48V or 48V to 12V at 800W with 98% efficiency.  
22.8 x 17.3 x 7.4mm

Learn a more efficient way to power your LEDs at [vicorpower.com](http://vicorpower.com)



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Reveal the Whitest White and Highlight Rich Colors

## High Impact Retail Lighting Solutions

*Lighting that sells.*



### Creating branded experiences with high impact lighting.

The retail sector provides an attractive business opportunity for luminaire manufacturers. Savvy retailers are seeking lighting solutions that produce a branded experience aimed directly at their target customers. This creates an excellent opportunity to market high impact lighting solutions that use modern, connected technology to attract and motivate today's consumer.

Lumileds understands what drives retailers' lighting decisions and offers a comprehensive portfolio that allows luminaire manufacturers to create limitless lighting effects. These solutions can help manufacturers create the unique experiences their retail customers desire – whether that's warm and inviting, cool and edgy, or anything in between.

### Products – Top picks from our portfolio that add the best value



**Matrix Platform:** Simplifying system design through integrated connectivity, controls and application specific driver topologies, enabling smaller and more elegant luminaires. Reducing system costs through a patented circuitry for CCT tuning and dim to warm electronics that pairs with single channel drivers and can achieve high definition pulse width modulation dimming down to 0.1%.



**LUXEON CoB Core Range:** Due to its small Light Emitting Surface (LES) and industry-leading thermal resistance, LUXEON CoB is easy to work with, enabling simplified and less expensive luminaire designs.



**LUXEON CoB Core Range – High Density:** Providing unsurpassed performance, lifetime and quality of light for spotlights and downlights, including ultra-efficient 90+ CRI that eliminates the tradeoff between efficacy and quality of light.



**LUXEON CoB Stylist Series:** Accentuates merchandise through special color points and spectrally engineered solutions.



**LUXEON 2835 Line:** A collection of compact devices that allows for design freedom and provides a superior overall system solution when a project requires high lumen output and good efficacy.



**LUXEON 2835 Stylist Series:** Mid power series offering industry leading efficiency and reliability in a wide variety of voltage and lumen output options for linear lighting solutions.

### What makes Lumileds solution better and different?

- The only 90CRI with breakthrough efficacy, which eliminates the tradeoff between desired light quality and required lm/W
- Specifically created for retail lighting, LUXEON Stylist Series creates impactful lighting, revealing the whitest whites and highlighting rich colors to increasing contrast
- Both LUXEON Stylist Series and custom white color points are offered across CoB and Mid Power products for perfectly consistent spot, downlight and linear lighting
- Enables the design of high punch miniature fixtures with superior quality of light and crisp uniform beams

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# Lighting the World ONE LED AT A TIME

## NICHIA's Optisolis™

### When perfection is the only option



## Optisolis™



757 Series  
Ultra-High CRI

- No UV emission
- Full spectrum close to natural sunlight
- Less disruptive circadian rhythm
- High color fidelity (Rf)
- Full color gamut (Rg)

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# Simple circuits implement low-cost LED driver with Bluetooth Low Energy wireless dimming

## ON SEMICONDUCTOR

ON Semiconductor supplies highly integrated radio and power-conversion products which make it possible to implement a simple, low-cost system for wirelessly dimming LEDs powered by a direct AC LED driver.

The circuit is based on a highly integrated Bluetooth® Low Energy radio System-In-Package (SIP), the RSL10 SIP, which enables wireless control of an LED fixture's brightness. At the fixture, the ON Semiconductor NCL30170 implements a direct AC power-conversion circuit to provide a tightly regulated current to an LED lamp. Light intensity can be dynamically set by the user via a programmable dimming function, controlled with a smartphone app. Thanks to the devices' low-power technology, the overall system offers stand-by consumption of less than 200mW even though it does not use a switch-mode power supply.

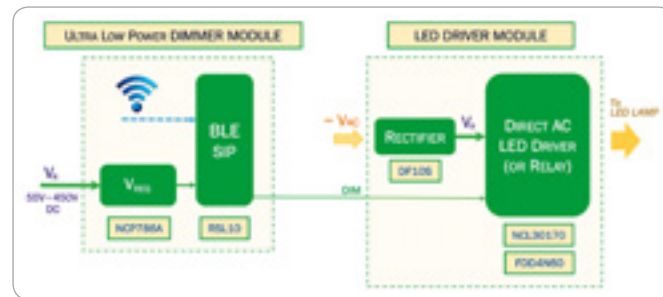
**Bluetooth Low Energy SIP includes radio transceiver and antenna**  
ON Semiconductor's RSL10 SIP is a complete Bluetooth® 5 certified Low Energy wireless SIP including a 2.4GHz radio transceiver, antenna and passive components. It provides the easiest way to implement low-power Bluetooth Low Energy technology in wireless applications including wireless dimmer modules.

The RSL10 SIP, which has the part number NCH-RSL10-101S51-ACG, supports both Bluetooth Low Energy and proprietary 2.4GHz radio protocols. Featuring ON Semiconductor's RSL10 2.4GHz System-on-Chip (SoC), the RSL10 SIP offers very high radio performance, including Receive sensitivity of -94dBm and Transmit power of up to +6dBm. It supports Firmware Over The Air (FOTA) updating.

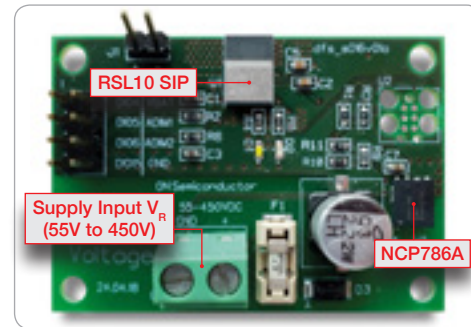
The RSL10 SIP provides a complete radio system for devices connecting to a Bluetooth Low Energy network. It includes two processor cores, an Arm® Cortex®-M3 controller core and an LPDSP32 for intensive signal-processing functions. It also has built-in power management, 384kbytes of Flash memory and configurable analog and digital sensor interfaces. Both the RSL10 and RSL10 SIP feature an AES-128 encryption engine to protect transmitted data.

Fully certified to worldwide wireless standards, the RSL10 SIP markedly reduces time-to-market and cost by removing the need for antenna design.

In a dimmer module circuit, the RSL10 SIP may be supplied by an ON Semiconductor NCP786A ultra-low quiescent current linear regulator operating directly from an AC input rectified by an RS1A.



ON Semiconductor: Selection of power and radio parts for wireless LED dimming and power



Ultra low-power smart lighting dimmer with RSL10 SIP



### APPLICATIONS

- Smart and connected lighting systems

### FEATURES (RSL10)

- Certified to worldwide wireless standards including FCC, CE, IC, KCC and MIC
- Supply-voltage range: 1.1V to 3.3V
- I<sup>2</sup>C and serial peripheral interfaces
- Pulse-width modulation interface

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**FTM Boards**

The RSL10 eval board is supplied in an Arduino®-compliant form factor and features an on-board J-Link adaptor.

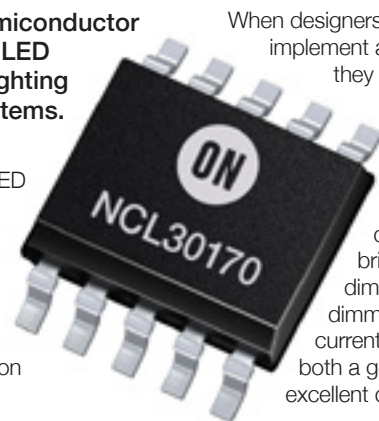
**Orderable Part Number:** RSL10-SIP-001GEVB

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# Direct AC drive LED driver provides PFC and precise constant-current regulation

The NCL30170 from ON Semiconductor is a linear, constant-current LED controller for use in smart lighting and phase-cut dimming systems.

The controller manages multiple LED channels in series using ON Semiconductor's proprietary auto-commutation topology. It offers highly accurate regulation of the constant-current output, as well as giving a high power factor of 0.99 and total harmonic distortion of less than 10%.



When designers use the NCL30170 to implement a direct AC LED driver circuit, they can achieve a very low system bill-of-materials cost as well as robust driver performance. The device provides a wide analog dimming range down to 5% of maximum brightness with a linear dimming curve. In phase-cut dimming applications, input-current shape modulation provides both a good power factor and excellent dimmer compatibility.



### APPLICATIONS

- Smart and connected lighting systems
- Indoor and outdoor LED lighting

### FEATURES (NCL30170)

- High-voltage start-up
- Flexible selection of the number of LED channels
- Single controller for LED arrays rated up to 300W
- Over-voltage protection
- Short-circuit protection
- Thermal shut-down protection

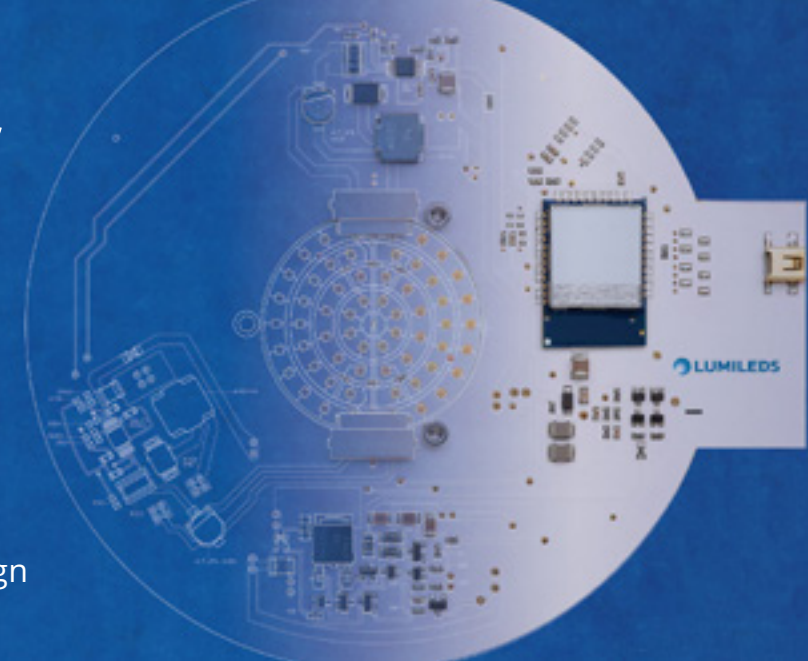
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# Every feature you want, and a few you didn't know you needed.



## Matrix Platform

Infinitely configurable, integrated LED light engines tailored to the most demanding design requirements. **Yours.**



Luminaire manufacturers often view their design challenges as unique, yet virtually all share a common imperative: the need to get to market fast with highly differentiated lighting solutions capable of outpacing the competition. Fortunately, there's a proven solution that brings increased agility and next-generation designs within reach: *Matrix Platform from Lumileds.*

### The shortest distance from inspiration to innovation

Matrix Platform challenges status quo manufacturing models by combining industry-leading LUXEON LEDs with the power of proprietary Advanced Technologies – then custom configuring them on substrates to fit manufacturers' specific requirements. The result is a game-changing solution tailored to meet the most demanding design specifications and yield maximum supply chain value.

### Matrix Platform Advanced Technologies pave the way for design and manufacturing breakthroughs

What truly sets Matrix Platform apart is its portfolio of exclusive Advanced Technologies. Tapping into decades of optical, electrical, mechanical and thermal expertise – as well as global LED design and manufacturing experience – Lumileds has once again raised the bar with its first wave of Advanced Technologies.

### Advanced Technologies optimize Matrix Platform performance, efficiency and predictability

#### An integrated approach to supply chain simplification.

At Lumileds, providing luminaire manufacturers with a streamlined process for achieving optimal design and engineering outcomes has always been a primary goal. Matrix Platform takes this commitment to new levels by leveraging Lumileds many years of in-house production expertise – from individual LED die to integrated LED light engines – to deliver a single-source solution for the highest quality luminaires and lighting systems. This holistic approach reduces LED inventory, dramatically minimizes waste and yield loss, and improves product reliability. And the benefits don't end there. Manufacturers also have access to the Lumileds technology roadmap to help lay a solid foundation for future product planning.

By combining the industry's finest LEDs with proprietary technologies and unparalleled design expertise, Matrix Platform delivers tailored, application-specific light engines that are ready for installation into final luminaire assemblies, reducing complexity and accelerating time to market – and time to revenue.

## Matrix Platform Advanced Technologies



### Oberon Intelligent Assembly

This proprietary pick-and-place system features the industry's only algorithmic LED mixing technology—guaranteeing consistent characteristics and performance board to board.



### Integrated Light Guides

These advanced components soften high-intensity LED pixels to create a more uniform light surface, an increasingly important end game as luminaire form factors become smaller and smaller.



### Integrated Drivers

These application-specific topologies are designed to address the trend of incorporating more electronic components—including the all-important power source—into a fully integrated, driver-on-board LED system. Integrated Drivers can also be tailored to unique manufacturer requirements, helping amp up system-level optimization.



### Connectivity and Controls

This sophisticated functionality allows lighting designers to bring cutting-edge luminaires to market that can be controlled remotely, using an app or other device.



### Color Tuning Electronics

This patented circuitry technology allows LEDs to mimic the warm, yellow dimming pattern that is the hallmark of halogen bulbs by controlling both a warm and a cool LED with two drivers that pair seamlessly with simple single channel drivers.

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# New mid-power LED achieves class-leading efficacy of 223lm/W

## SEOUL SEMICONDUCTOR

Seoul Semiconductor has introduced a new version of its 3030 mid-power LED which offers best-in-class efficacy, as well as excellent resistance to sulfur corrosion for use in outdoor and harsh environments.

The new 3030C series LEDs are specified with efficacy of up to 223lm/W, making them ideal for use in high-performance luminaires. Excellent efficacy is maintained at all drive current levels: the 3030C LED shows very little droop up to the maximum drive current of 200mA, which means that the designer does not have to trade-off lm/\$ against lm/W.

A new architecture implemented by Seoul Semiconductor in the 3030C provides

outstanding thermal performance and corrosion resistance, as well as giving a small board footprint. Based on Seoul Semiconductor's WICOP package technology, the 3030C is a flip-chip device with no wire bond.

It offers excellent resistance to sulfur corrosion: it achieves 98.4% lumen maintenance after 504 hours' 15ppm H<sub>2</sub>S exposure at 40°C/80% relative humidity.

Junction-to-solder thermal resistance is just 7.5°C/W.



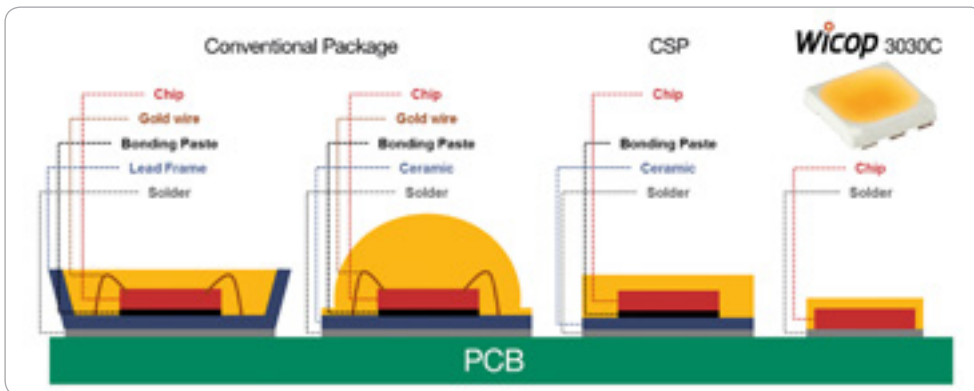
### APPLICATIONS

- Industrial lighting
- Outdoor lighting
- Commercial lighting
- Residential lighting
- Bulb replacement

### FEATURES

- Available in seven CCT options from 2700K to 6500K
- CRI >80
- 120° viewing angle

To buy products or download data go to: [www.FutureElectronics.com/resources/ftm](http://www.FutureElectronics.com/resources/ftm)



3030C series' WICOP package technology provides excellent corrosion resistance

# LED modules for outdoor lighting compatible with standard optics and drivers

## SEOUL SEMICONDUCTOR

Seoul Semiconductor supplies two series of compact, high-brightness LED modules which provide for a low bill-of-materials cost because of their compatibility with standard, off-the-shelf optics and drivers.

### WICOP Y22 LED-based modules

One module series is offered in 2x6 and 2x8 LED configurations which are compatible with the Zhaga Book 15 footprint. Featuring an array of Seoul Semiconductor WICOP Y22 single-chip high-power LEDs, these modules offer a typical 5,000lm luminous flux at a module-level efficacy of 165lm/W when operating at 85°C. The modules are supplied with CCT options from 2700K to 6500K, specified with a four-step ellipse tolerance of chromaticity. As standard the minimum



Outdoor LED modules: Wide choice of CCT options

CRI is 70, with CRI 80 available on request.

These robust modules are ideal for use in streetlights and other applications in which operators are concerned to minimize maintenance and repair costs. They are rated for an L90 lifetime of longer than 100,000 hours at a continuous operating temperature of 85°C.

These Seoul Semiconductor modules include an NTC temperature sensor for active thermal protection. They are most commonly supplied with LEDiL STRADA-2X2CSP or HB-2X2 lenses, although custom lens arrays are available from Seoul Semiconductor.

### 5050 multi-chip LED-based module

Seoul Semiconductor also supplies an outdoor lighting module in a 2x6 array based on its 5050 multi-chip high-power LED.

This module is optimized for use with the LEDiL STRADA-IP-2X6 streetlight lens. It is also compatible with the LEDiL HB-IP-2X6 lens. The product, which offers an excellent cost: brightness ratio, typically produces 4,000lm at an efficacy of 160lm/W at 85°C. Maximum light output is 8,000lm.

This module is available as standard in 3000K and 4000K color-temperature options, with a minimum CRI of 70 and 5 SDCM binning. Other ANSI-compliant CCT options are available on request.



### APPLICATIONS

- Streetlights
- Industrial lighting

### FEATURES

- Compatible with common off-the-shelf LED drivers
- CE compliant
- UL recognized
- Five-year warranty

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Solutions with the Highest Punch and Best Quality of Light



# Sports Lighting Solutions

Change the game.

## LUXEON LEDs usher in a bold new era in sports lighting

To satisfy the unique demands associated with illuminating sports venues, Lumileds offers transformative Sports Lighting Solutions. Available as application-optimized LEDs or using Lumileds Matrix Platform, these innovative lighting products enable consistent performance and adhere to precise optical and electrical specifications—attributes essential for sports lighting fixtures.

LUXEON LEDs are optimized for sports venues large and small. Recognizing the need for effective and efficient stadium and arena lighting, Lumileds created its category-defining Sports Lighting Solutions. Working closely with leading sports lighting manufacturers, these state-of-the-art LUXEON LEDs can be found in many of the highest-profile venues.

### Products – Top picks from our portfolio that add the best value



**Matrix Platform:** Simplifying system design through integrated connectivity, controls and application specific driver topologies, enabling smaller and more elegant luminaires. Reducing system costs through a patented circuitry for CCT tuning and dim to warm electronics that pairs with single channel drivers and can achieve high definition pulse width modulation dimming down to 0.1%.



**LUXEON V/LUXEON V2:** Designed for outdoor stadium lighting, LUXEON V is a Chip Scale Package-based higher light output single package LED that supports directional applications and enables smaller fixtures and optics with high-intensity beams. With the new LUXEON V2, manufacturers can design with a proven package that delivers the most usable light and unmatched performance. In addition, it is compatible with existing optical designs and easily leverages existing ecosystems—making it ideal for indoor arenas and recreational fields.



**LUXEON MX:** Providing industry-leading efficiency and double the flux compared to previous designs, this high power LED enables cost-effective, high-reliability fixtures for a range of outdoor lighting applications.



**LUXEON 5050:** Setting the standard for high lumen per watt (lm/W), this advanced solution enables compact fixture design and optimal performance, plus its cost-effectiveness allows manufacturers to produce energy-saving fixtures that frequently qualify for utility rebates.

### What makes Lumileds solution better and different?

- Matrix Platform, including Oberon algorithmic LED mixing technology, provides identical and predictable fixture-to-fixture system performance (system lumen output, uniformity and electrical characteristics)
- High efficacy at high drive currents enables high flux density fixtures
- Optimized radiation pattern and small source size enable fixtures with narrow beam angles that minimize glare, spill light and allow for the use of smaller optics. This in combination with the lowest thermal resistance in the industry support reduced heatsinking, size and weight

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# RGB + white multi-die LED provides high luminous flux for use in entertainment lighting

## SEOUL SEMICONDUCTOR

The RGBW 40W from Seoul Semiconductor is a color-tunable, high-power red/green/blue/white multi-die LED for use in entertainment lighting and architectural lighting applications.



The 40W device, which has the part number S1C0-4758400003, provides a high luminous flux from its surface-mount 4.7mm x 5.8mm package. Light-output values at a nominal drive current of 1A are rated at:

- Red: 122lm
- Green: 216lm
- White: 302lm
- Blue radiant power: 1,321mW

The maximum drive current is 2.5A. The construction of the multi-die package allows the dies to be mounted close together underneath a flat lens for optimal color mixing.

The device can achieve a narrow beam width with the use of a secondary optic.

In addition to the 40W LED, a 15W RGBW version is available in a package with the same footprint. The 15W version, which has a part number S1C0-4758150000, has a nominal drive current of 0.7A.

A 60W version is also available for applications which require a higher power output. It is supplied in a 5.8mm x 6.4mm surface mount-package and has the part number S1C0-5864600000. Specified with a nominal current of 1.4A, its maximum rated drive current is 4.5A.

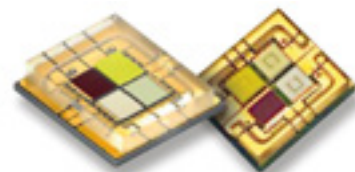


### APPLICATIONS

- Entertainment lighting
- Architectural lighting
- Outdoor lighting
- Spotlights

### FEATURES

- Dominant wavelengths:
  - Red: 625nm
  - Green: 525nm
  - Blue: 453nm
- White CIE co-ordinates: x = 0.31, y = 0.32
- 120° viewing angle

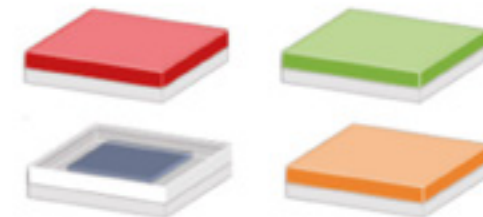


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## NICHIA's Direct Mountable Chip Color Series



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- Amber

### Applications

- High End architecture
- Emergency vehicle
- Stage lighting
- And more...

### Features

- Phosphor converted
- Same footprint / same height
- Same forward voltage
- Red stable at higher temperatures



## LUXEON 2835 Color Line

*The best performance, the most colors.*

Lumileds is enabling a new era of color lighting with the newly introduced LUXEON 2835 Color Line

This mid power line consists of 12 colors (including whites) that achieve the best performance in its class. The superior flux and efficacy of this line of phosphor-converted and direct color LEDs enable flawless color mixing for the rapidly growing markets of color-tunable lamps and architectural and entertainment lighting. Flawless color mixing is achieved using the same technology that characterizes every Lumileds color LED offering. The new LUXEON 2835 Line contains LEDs with matching focal lengths, which enables minimal halos and superior color mixing in all color applications. In addition, all 12 colors have matching polarity which simplifies the PCB design versus competitive LEDs.



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## New digital AC-DC power controller for LED drivers includes serial command interface to any MCU or smart sensor

INFINEON

The XDPL8221 from Infineon is a digital dual-stage Power Factor Correction (PFC) and flyback power controller IC for AC-DC LED drivers which provides constant-current and constant-voltage outputs and supports PWM dimming functionality.

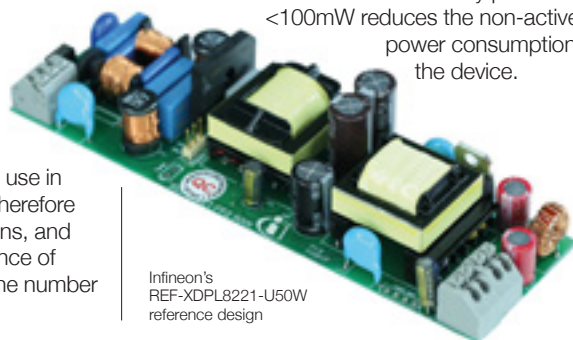
It features a UART serial interface which enables any microcontroller, sensor or wireless control device to directly configure the driver's maximum current and the dimming level with simple UART commands. The UART interface also enables an external device to retrieve status information and monitor driver operational data in real time.

Providing primary-side regulation, a digital control loop, system protection and other built-in functions, the controller reduces the number of external components required in an LED driver. The device, which has the orderable part number XDPL8221XUMA1, also enables the use of small bus and output capacitors.

Unlike fixed-function analog power controllers, the digital XDPL8221 provides one-time programmable configuration options which enable OEMs to adjust features of the chip's operation, such as the output current limit or the maximum output power, for use in different applications. The XDPL8221 therefore enables customizable LED driver designs, and simplifies the generation and maintenance of multiple board variants while keeping the number of stock-keeping units to a minimum.

The dual-stage XDPL8221 separates the quasi-resonant PFC function from the output-current regulation circuit. This ensures that there is low variation in the output current, reducing the flicker effect on the LED light output to a level that cannot be perceived. The flyback controller stage automatically switches between quasi-resonant, discontinuous conduction and active burst modes to provide the best performance for the application conditions.

This results in outstanding electrical performance including a power factor of >0.9 and total harmonic distortion of <15%. The dim-to-off feature with low stand-by power of <100mW reduces the non-active power consumption of the device.



Infineon's REF-XDPL8221-U50W reference design



### APPLICATIONS

- AC-DC drivers for LED lighting

### FEATURES

- Input-voltage range:
  - 90V to 305V AC
  - 127V to 430V DC
- Flicker-free dimming down to 1% of nominal current
- Configurable brown-out and brown-in protections
- Under- and over-voltage protection
- Open load protection
- Output short protection
- Configurable adaptive temperature protection

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### FTM Boards

Infineon's XDPL8221 reference designs demonstrate the performance of the XDPL8221 in a typical application. Thanks to the XDPL8221 digital platform, their parameters can be easily configured to meet any application requirement.

Orderable Part Numbers:  
REF-XDPL8221-U50W and REF-XDPL8221-U100W

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Solutions to Increase Light Output and Perfect Color Consistency



## Architectural Lighting Solutions

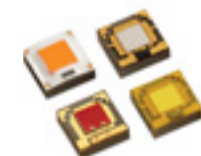
For the perfect effect.

We work closely with architects and lighting designers to engineer unparalleled LED solutions that deliver functionality and pure aesthetics. Fixture and luminaire designers require a comprehensive portfolio of solutions for indoor and outdoor architectural lighting to create stunning lighting effects for a variety of venues. Lumileds understands lighting's performance needs and the driving force behind the desire for lighting fixtures with integrated wireless lighting controls and other Internet of Things (IoT) based functionality.

### Products – Top picks from our portfolio that add the best value



**LUXEON C Color Line:** With an advanced portfolio of color and white LEDs, this innovative line is designed for flawless color mixing. By featuring a single focal length for all colors, LUXEON C Color Line provides consistent radiation patterns from secondary optics and maximizes optical efficiency. Along with a low dome design that keeps the effective light source small while improving light extraction, these LEDs are optimal for the most demanding architectural applications.



**LUXEON CZ Color Line:** Delivering up to 48% higher "punch" and available in 21 color options, these high performance solutions eliminate crosstalk and ensure a true color point when LEDs are closely packed. Created with the same robust building blocks as the award-winning LUXEON C Color Line, these powerful products feature identical focal length in an undomed design.



**LUXEON 2835 Color Line:** LUXEON 2835 Color Line is a complete color portfolio offering design flexibility for the dynamic needs of architectural applications.



**LUXEON MultiColor Module 0.5W:** The LUXEON MultiColor Module 0.5W is a compact 3-in-1 package that offers flexibility and versatility. With the ability to control individually or all at the same time the color control is precise.

### What makes Lumileds solution better and different?

- Tight beam control, producing a smoother image or allowing for perfect color mixing
- Industry's broadest color gamut offering ensuring any color point can be achieved in customer's designs
- Industry leading performance in output, punch and quality of light
- World-class, in-house phosphor capabilities delivering vivid colors and superb color matching for perfectly consistent scenes and effects

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# LEDs promise dramatic cost savings and important operational benefits in new generation of sports field lighting equipment

By François Mirand  
EMEA Technical Director, Future Lighting Solutions

While most other lighting applications are now completing their transition to LED light sources, the manufacturers of the floodlights which illuminate football pitches, tennis courts and other large outdoor sports fields have until recently retained a preference for conventional High Intensity Discharge (HID) lamps. HID lamps offer high flux and a high-quality light output, and the electrical and optical considerations in using them are easy for floodlight designers to deal with, as shown in Figure 1.



Fig. 1: The ArenaVision MVF404 metal halide lamp from Philips Lighting, part of its range of high-flux HID lamps for sports lighting. (Image credit: Philips Lighting, a brand of Signify.)

But there are signs that the tide might be turning towards new and improved LED and driver solutions: for instance, Philips Lighting grabbed headlines with its installation of LED luminaires to light the playing surface of the Ekaterinburg Arena in Yekaterinburg, one of the Russian stadiums that hosted 2018 World Cup football matches.

So which factors are encouraging the switch to LED light sources in sports field lighting? And how different is the design of an LED-based sports field luminaire from that of an HID-based floodlight?

## High cost of HID lamp replacement

There are two strong reasons why operators of stadiums and sports arenas will be happy to see the end of HID lamp technology. First is the limited operating lifetime of the lamps: a typical B50 lifetime (mean time before failure) of just 5,000 hours. This means that HID floodlights require frequent lamp replacements. And since the lamp to be replaced might be as much as 25m in the air at the top of a narrow pole, special access and safety equipment and skilled technicians are required, at a considerable cost.

The other main drawback of HID lamps is their behaviour in the event of an unexpected shutdown, for instance when a stadium's power circuit fails. HID lamps require a 10-15 minute cool-down period before restarting, and then after re-starting take 5 minutes to reach full brightness. This period of darkness and partial lighting is potentially catastrophic if a power failure occurs during a well-attended match: the safety and public order consequences of holding a crowd of tens of thousands of people inside a dark stadium, with play suspended, are extremely serious.

## READ THIS ARTICLE TO FIND OUT ABOUT:

- The factors which have deterred manufacturers of stadium lighting equipment from using LED light sources
- The safety, performance and cost advantages of LEDs in stadium lighting
- New LEDs, drivers and lenses which are suitable for use in large LED lamps for stadium lighting

An LED-based light source eliminates both these problems: the lifetime rating of an LED light source in a floodlight depends on the way in which the design is implemented, but will typically be in the range of 50,000 to 100,000 hours; and LEDs can be turned on instantly at full brightness when the power is switched on or restored after a mains power outage.

Other important benefits to the use of LED light sources for sports field lighting include higher efficacy, low voltage at start-up, and support for dimming and dynamic lighting effects.

## Considerations in LED floodlight system design

The advantages to be gained from the use of LEDs in floodlights are, then, very considerable. But the nature of the application puts particular constraints on the design of high-mast LED lighting, and until recently these have hindered OEMs' attempts to use LEDs in sports field lighting. In 2018, however, suppliers of LEDs, drivers and optics introduced a number of new products which addressed the special requirements of high-mast stadium lighting, and it is now easier than before to create an effective floodlight design based on an LED light source.

The difficulty of making LED floodlights stems from a combination of strict requirements. The playing surface which needs uniform illumination and no shadows is large: for tennis, the court itself is 260m<sup>2</sup> and the total area including space for line judges, players' seating and so on is around 680m<sup>2</sup>. For football the space is even larger: the pitch is around 7,000m<sup>2</sup> and the total illuminated area is around 10,000m<sup>2</sup>. The illumination requirement depends on whether the field is for use by amateurs, and requires less bright light, or for a high-level professional spectator sport: in the latter case, illuminance of >1,000lux might be required at the playing surface.

Depending on the height of the mast and the size of the playing area, this calls for a light output ranging from hundreds to thousands of kilolumens from the light source. This high light output has to be provided from the smallest possible light-emitting surface, to avoid obstructing spectators' view, and to impose the lowest possible wind loading on the pole.

In professional stadium lighting, light quality is also tightly specified by TV broadcasters through its Television Lighting Consistency Index (TLCI) specification for color rendering.

The HID lamp is a particularly good solution to the problems of size and weight: a single 2kW HID lamp produces 150,000-200,000lm, so few lamps need to be mounted on each mast, as shown in Figure 2.

The challenge when designing with LEDs is to keep the Light-Emitting Surface (LES) as small as possible, difficult when using general-purpose LED chips, which typically produce around 300lm each. With such devices, a high-mast floodlight would require too many units and would occupy too large an area.

Suitable LED options, however, are now available. Nichia's NV9W149AM is a multi-die LED which produces a nominal output of 2,490lm of CRI 90 light at a drive current of 2.1A, although it can be driven at a continuous current of up to 3A.



Fig. 2: Philips ArenaVision floodlighting lit up the Phoenix Snow Stadium at the South Korea winter Olympics in 2018. (Image credit: Philips Lighting)

It is supplied in a package measuring 7mm x 7mm x 3.1mm. Offering high efficacy and light quality, it enables system designers to achieve the very high light output required even by professional sports stadiums in a luminaire with a small total footprint.

## Positioning of high-power drivers

The design challenge is not limited to the selection and integration of the LEDs: the choice of the power supply to the LEDs also has serious consequences.

Two important factors determine the choice of LED driver. First, the driver supplies a high load, potentially more than 500W in lighting systems for professional football stadiums, for instance. No driver is 100% efficient, and the power loss is dissipated from the driver as waste heat. Designers of LED lighting equipment tend to think of an integrated driver unit as a self-managing black box that requires no external thermal management. In this case, however, the designer would do well to consider how large amounts of heat can be safely drawn from the case of the driver to the ambient air without overheating the air in the system's enclosure.

The other concern in driver selection is weight: the lighter the luminaire, the narrower the pole can be, and the less structural support is required for canopy-mounted lighting. The EFD-1K2SxxxDV series of 1.2kW LED drivers from Inventronics, for instance, is an excellent choice for high-flux luminaires. A robust 6.6kg, as shown in Figure 3, it weighs less than an equivalent power system consisting of multiple drivers each with a lower power rating.



Fig. 3: An EFD-1K2SxxxDV 1.2kW LED driver from Inventronics weighs 6.6kg

An alternative to mounting the driver at the top of the mast, next to the LEDs, is remote mounting at the foot of the pole. This is a novel approach to LED power-system design, for which there is no requirement in other applications. Because of the long distance that control signals must travel between a remote driver and the LEDs, remote mounting can impair the operation of the feedback loop, leading to instability in the power output and in turn causing perceptible impairment of the light output. In addition, the designer will have to account for the voltage drop along the cable, and handle system EMC requirements. Driver manufacturers, however, are beginning to take the requirements of remote mounting into consideration as they develop special new driver products.

In their choice of LED driver, high-mast floodlight designers will also want to consider the specifications for output ripple, which causes light flicker and so is of critical importance for the lighting of broadcast events: it should be limited to less than 2%.

The choice of the dimming interface is also of importance to enable dynamic lighting features, such as flashing or dimming patterns. Fixture manufacturers tend to look for DMX control because of its faster response time compared to DALI. Few high-power drivers offer a DMX interface, and this makes DMX-to-0-10V converters such as Inventronics' CNV-DMXR valuable.

## Optical design considerations

The last important element of the system for consideration in sports field lighting is beam control. In a typical four-mast topology, with a mast at each corner of a rectangular playing area, the light must throw light precisely onto a quadrant of the total surface from a great height.

Conventional LED collimators provide for excellent beam control from a small point source of light. The small optical losses in a collimator are dissipated as waste heat. In very high-flux systems, this generates a lot of heat, and in fact too much for the polycarbonate (PC) or PMMA materials normally used in lenses for LEDs, which tend to deform at high temperature.

Here too, component suppliers have been developing specialist products suited to sports field lighting. For example, LEDiL supplies the FN16258 STELLA-RS, a lens which produces a 23° spot beam with an LES of 19mm and which is compatible with LEDs with an LES of up to 30mm, as shown in Figure 4. It is made of silicone, a material which is resistant to very high temperatures, but which is heavy and less mechanically stable than PC or PMMA.



Fig. 4: The FN16258 STELLA-RS lens from LEDiL is made of high temperature-resistant silicone. (Image credit: LEDiL)

## Improving the total cost of ownership and much more

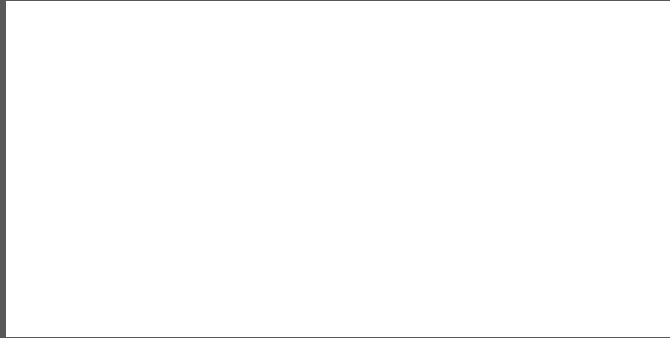
As so often with LED technology, the extra initial cost of LED-based sports field lighting will be recouped over the lifetime of the system, in reduced maintenance and replacement expenses and lower energy bills. The quality and the flexible operational controls of an LED lighting system provide important additional benefits. As this article has shown, the development of an LED-based replacement for traditional HID lamps requires careful consideration of various electrical, thermal, mechanical and optical issues, but as Ekaterinburg's World Cup stadium shows, the LED is the light source of the future for stadium lighting.

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