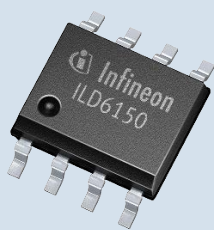


General Lighting

Semiconductors for Power Conversion & Smart Lighting



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Enable & Accelerate the Conversion from Traditional Lighting to LED Lighting

Due to the numerous advantages of LED technology, the lighting industry is undergoing a conversion phase from traditional light sources to LED lighting. This conversion presents the lighting industry as a whole with a series of challenges and opportunities.

Key Challenges

- Compatibility of LED retrofits with existing infrastructure
- Accelerated product life cycles
- High number of product variants
- Increasing R&D cost

Key Opportunities

- High energy savings
- Offers intelligent and more human-centric light including
 - Lower maintenance cost
 - Light according to the circadian rhythm of human beings
 - Light according to the age & health condition of people

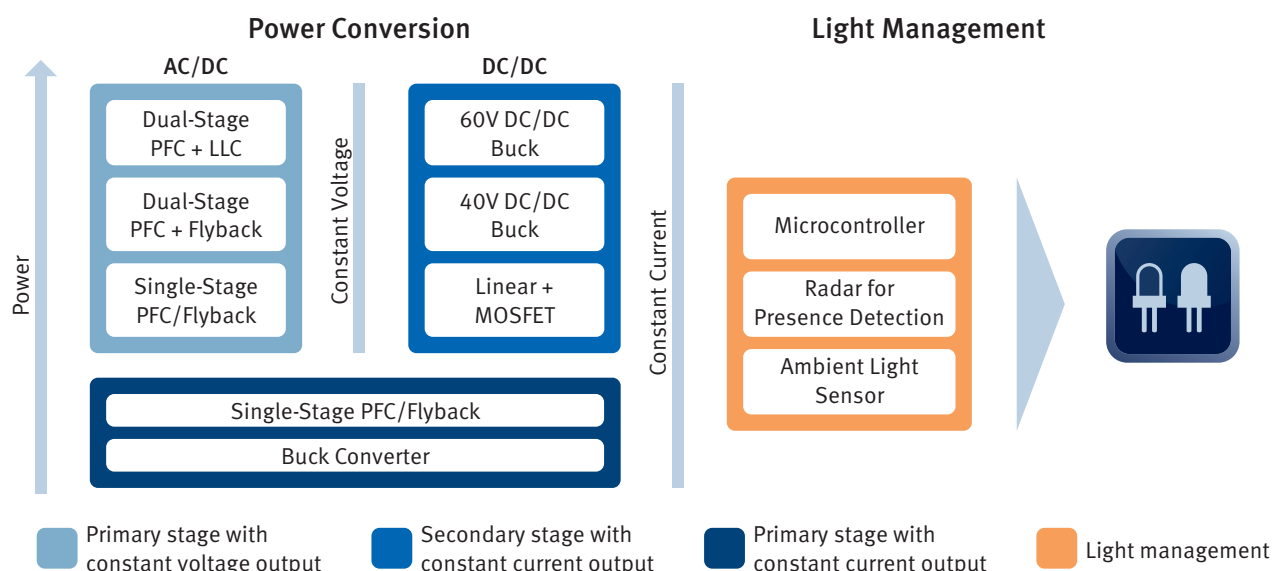
Infineon offers solutions and semiconductor products based on a deep understanding of the application needs of lighting customers.

Our range of products & solutions stretches from

- **Low-cost LED driver ICs** for LED retrofit lamps
- **Reference solutions** for LED retrofit lamps addressing compatibility challenges
- LED driver ICs that support a **platform approach** for LED drivers in commercial indoor & outdoor lighting
- **Comprehensive portfolio** of high-voltage MOSFETs (CoolMOST™) & low-voltage MOSFETs (OptiMOST™)
- **Benchmark** for linear- & switch-mode LED driver ICs for multi-string LED applications
- Microcontrollers with **dedicated peripherals** for intelligent lighting
- Sensor solutions for **presence detection** and **ambient light sensing** to generate additional energy savings

Besides the active role played by Infineon in shaping the conversion to LED lighting, the company is also one of the industry leaders in fluorescent lighting and HID lighting with

- Fluorescent controller ICs supporting a very low system BOM (bill of material), reduced production cost and setting the benchmark for the lowest total harmonic distortion (THD) and
- Leading-edge high-voltage MOSFET (CoolMOST™) portfolio





LED Retrofit Lamps

LED retrofit lamps enable the replacement of existing light sources and the fast adoption of LEDs in lighting systems. Retrofitting existing light sources with LEDs is not as easy as commonly assumed.

LED lamps do not have resistive characteristics like incandescent lamps and their power rating is usually significantly lower than incumbent light sources. This can lead to disturbing effects, such as flickering, or other types of light modulation, such as shimmering, during operation.

Infineon offers reference solutions that overcome compatibility issues in order to avoid the above-mentioned negative side effects. LED driver ICs and high-voltage MOSFETs are the key Infineon components in these solutions.

For more on the following reference solutions, please refer to the pages listed below

- Dimmable LED lamps for
 - Isolated (flyback) designs, **see page 9**
 - Non-isolated (buck) designs, **see page 10**

- Low-voltage halogen replacement lamps (MR16)
 - E-transformer compatible design for 7W/10W MR16, **see page 12**
 - E-transformer compatible design for 3W MR16, **see page 13**

Offline LED Retrofit Lamps

Compatibility with existing leading-edge and trailing-edge type dimmers is the main requirement for dimmable LED retrofit lamps. Flickering and shimmering at low light output levels are the big challenges.

Infineon Technologies offers several solutions that address the flicker and shimmer issues. At the same time, these solutions fulfill the form factor and cost requirements of this market segment.



LED Driver ICs for Dimmable & Non-Dimmable Retrofit Lamps

The ICL series features highly integrated LED driver ICs. Accurate primary-side control enables a low BOM and simplifies design.

Features

- Supports single-stage PFC/quasi-resonant flyback and PFC/floating buck topology
- Integrated HV start-up cell for short time to light
- Comprehensive protection features

Benefits

- Optimized for phase-cut dimming compatibility
- High efficiency of up to 90%
- Good line and load regulation capabilities
- Power factor of up to 98%



Product	Group	Type	Dimming	PFC	Topology	f_{RUN} [kHz]	$R_{\text{DS(on)}}$ [Ω]	V_{DS} (max)	Package
ICL8002G	Off-line LED driver	Controller	yes (trailing/DCM leading-edge mode)	–	Quasi-resonant flyback/buck	ZCD	–	–	PG-DSO-8

High-Voltage MOSFETs

CoolMOST™ Portfolio for Retrofit Lamps

With regard to retrofit, there is a strong shift towards non-isolated buck topologies where 500V CE MOSFETs are the preferred choice. Nevertheless, here we recommend the following CoolMOST™ voltage classes for the various topologies used in retrofit lamps.

Topology	Voltage Class	$R_{DS(on)}$	Packages
Non-isolated buck	500V CE	950mΩ–3Ω	DPAK, IPAK, TO-220 FP
Quasi-resonant flyback	800V CE	1Ω–2.8Ω	DPAK, IPAK
Fixed-frequent flyback	600V C6	950mΩ–3.3Ω	DPAK, TO-220 FP

500V CoolMOST™ CE Power MOSFET

The CoolMOST™ CE is a new technology platform for Infineon's market-leading high-voltage power MOSFETs designed according to the revolutionary SuperJunction (SJ) principle.

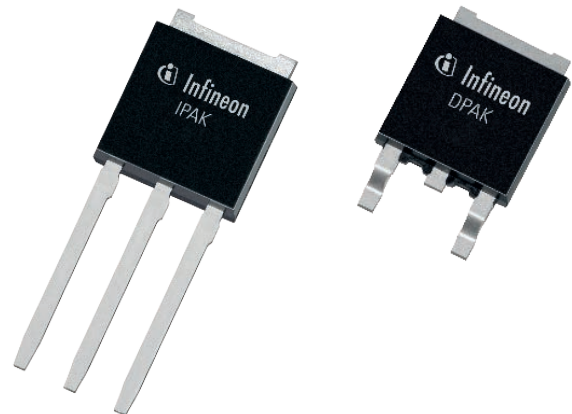
The 500V CE portfolio provides all the benefits of a fast switching SJ MOSFET while not compromising ease of use. As a complete CE series, devices achieve extremely low conduction and switching losses and can make switching applications more efficient, more compact, lighter and cooler.

Features

- Reduced energy stored in output capacitance E_{oss}
- Reduced gate charge Q_g
- High body diode ruggedness & reduced reverse recovery charge Q_{rr}

Benefits

- Low conduction losses
- Low switching losses
- Easy to use



$R_{DS(on)}$ [mΩ]	TO-252 (DPAK)	IPAK
3000	IPD50R3k0CE	IPU50R3k0CE
2000	IPD50R2k0CE	IPU50R2k0CE
1400	IPD50R1k4CE	IPU50R1k4CE
950	IPD50R3k0CE	IPU50R950CE

Depletion MOSFETs for Start-up Circuiting in LED Retrofit Lamps

Infineon is one of the few manufacturers to offer depletion-mode MOSFETs that are ideally suited for initial start-up circuiting in LED power supplies.

Alternative methods, such as start-up resistors, significantly reduce system efficiency with the following negative effects:

- Lower light output for the same input power – lower lumen/W
- Additional heat shortens the lifetime of the LED lamp

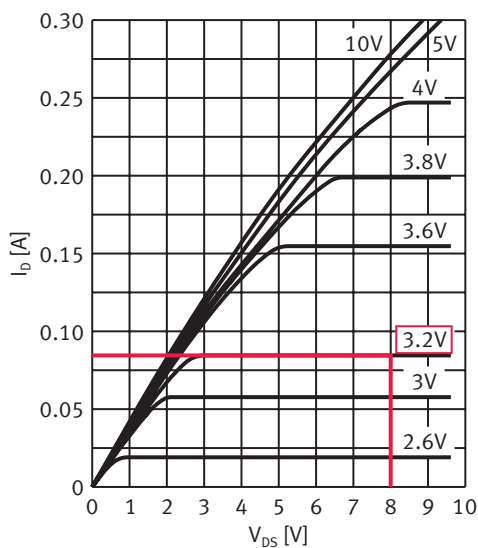
Depletion MOSFETs are normally on devices, meaning that they operate as an ON switch even when the gate to the source voltage (V_{GS}) is zero.

The graph shows the typical output characteristics of a standard enhancement MOSFET. In this example, a gate voltage of 3.2V has to be applied for around 0.08A of current at 8V V_{DS} .

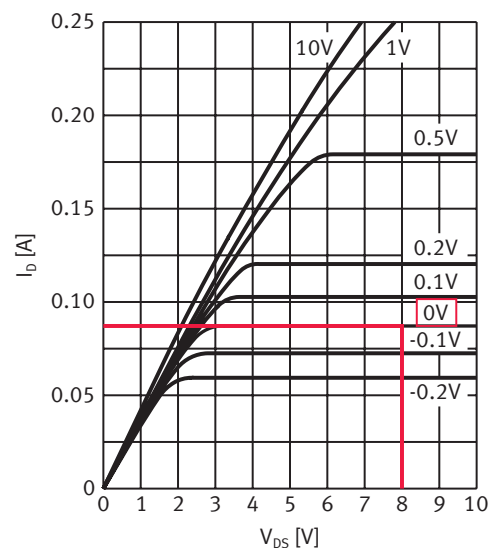
We can see that the graph for the depletion MOSFET is similar to that of the enhancement MOSFET, except that it has current even at a V_{GS} of 0V.

For a depletion MOSFET with the same conditions (0.08A, 8V V_{DS}), the gate voltage will be 0V as it is already in the ON-state. To turn off a depletion MOSFET, a negative gate-to-source voltage (V_{GS}) has to be applied, typically -2V or below.

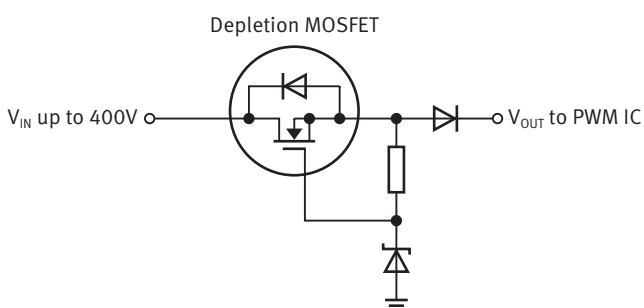
Output Characteristics of an Enhancement MOSFET



Output Characteristics of a Depletion MOSFET



A typical circuit configuration for such a power supply is shown in the figure below. When the main voltage regulator is up and running, it bypasses this circuit and provides power to the control IC.

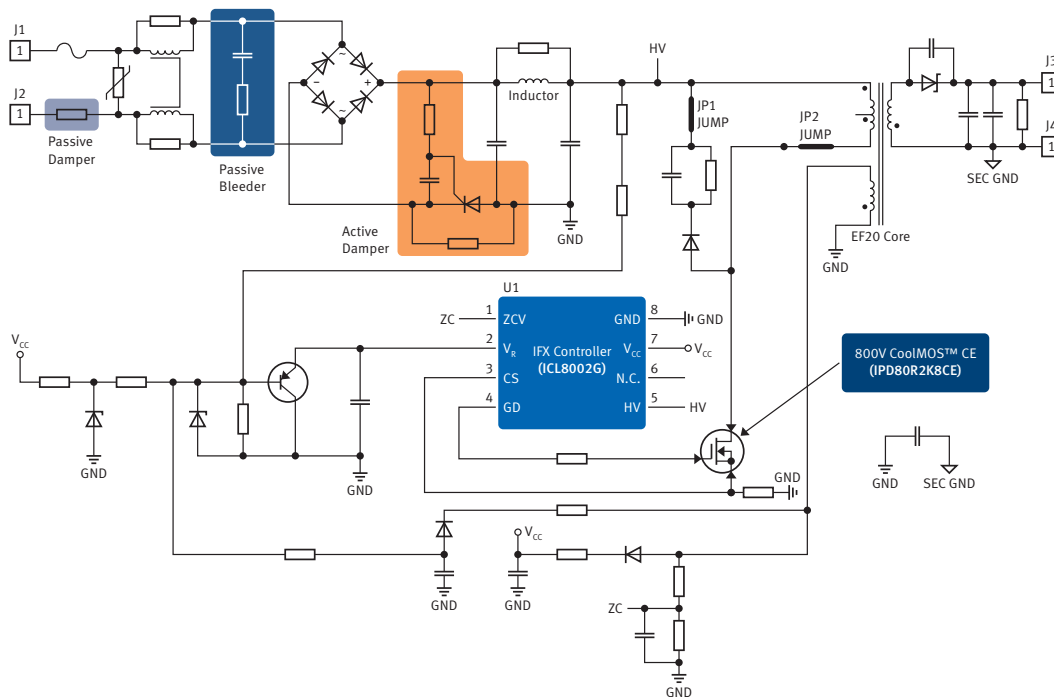


Name	Voltage [V]	$R_{DS(on)}$ [Ω]	Current [mA]	Package
BSS126	600	700	7	SOT-23

Application Example

Dimmable LED Bulb in Isolated Flyback Topology

13W Application Example with ICL8002G + CoolMOS™ 800V CE



Key Features & Benefits

- Excellent dimmer compatibility – flicker-free operation
- Isolated flyback topology $V_s = 230\text{VAC}$
- High efficiency of $> 88\%$
- Short time to light
- Low system cost due to primary control
- High-power factor > 0.9
- Small form factor

Infinite Component List

Product Type	Description
ICL8002G	Off-line LED controller for dimmable lighting applications
IPD80R2K8CE	MOSFET 800V CE

Related Application Note

Info Number	Description
AN-ICL8002G-LED-Flyback Demoboard	Quasi-resonant flyback converter for phase-cut dimming with a high-power factor

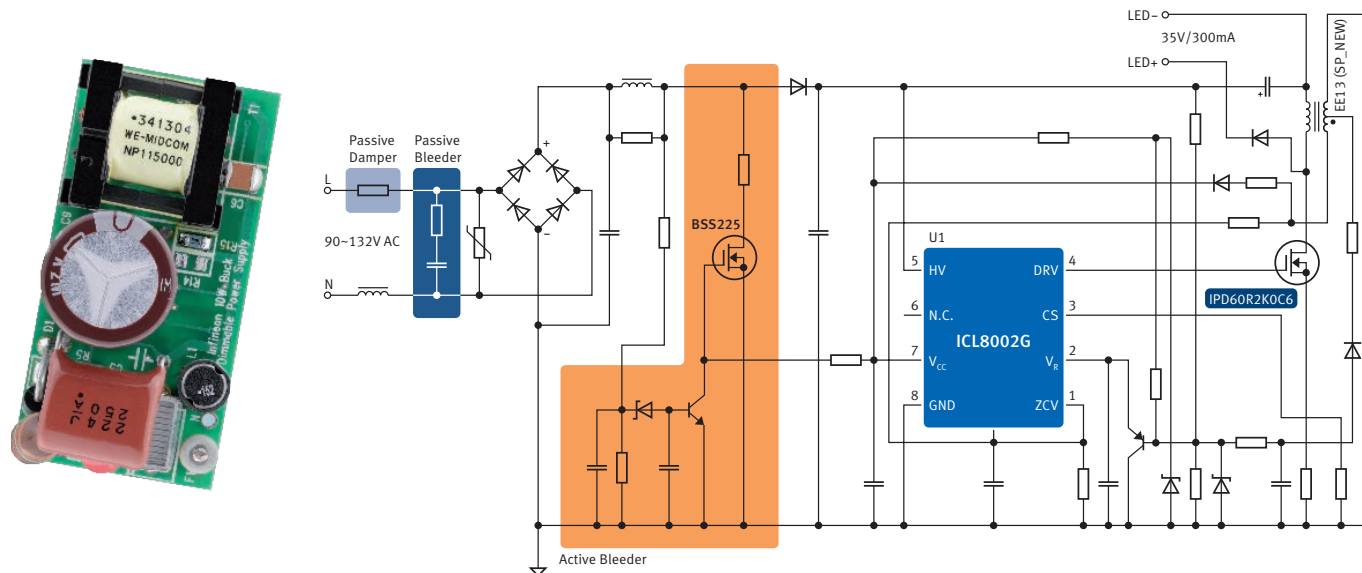
Related Evaluation Board

Board Name	Product	Description	Order Number
230V isolated control board for dimmable LED bulb	ICL8002G SPD02N80C3	Demoboard for dimmable 13W LED bulb in isolated flyback topology	EVALLED-ICL8002G-B1

Application Example

Dimmable LED Bulb in Non-Isolated Buck Topology

12W Application Example with ICL8002G + 600V CoolMOS™



Key Features & Benefits

- Excellent dimmer compatibility – flicker-free operation
- Non-isolated topology $V_S = 120\text{VAC}$
- High efficiency $> 85\%$
- Very low system cost due to non-isolated topology
- Very high-power factor > 0.95
- Small form factor

Infineon Component List

Product Type	Description
ICL8002G	Off-line LED controller for dimmable lighting applications
IPD60R2K0C6	MOSFET, 600V, 2Ω, DPAK
BSS225	MOSFET, 600V, 45Ω, SOT89

Related Application Note

Info Number	Description
AN-ICL8002G-LED-Buck Demoboard	Non-isolated buck converter for phase-cut dimming with a high-power factor

Related Evaluation Board

Board Name	Product	Description	Order Number
120V non-isolated control board for dimmable LED bulbs	ICL8002G IPD60R2K0C6	Demoboard for dimmable 12W LED bulb in non-isolated buck topology	EVALLED-ICL8002G-B2

MR16 Retrofit Lamps

The majority of MR16 lamps are designed for low-voltage operation of 12VAC. Fixtures designed for halogen lamps that use electronic transformers may need to be retrofitted with LED-compatible transformers, mainly because standard electronic transformers have a minimum power-usage requirement in order to function. MR16-compatible LED lamps incorporate full-wave rectification circuitry and can be used in most fixtures designed for MR16 halogen lamps.



The main requirements for MR16 retrofit lamps are:

- Low cost
- Compatibility with electronic transformers
- Thermal protection

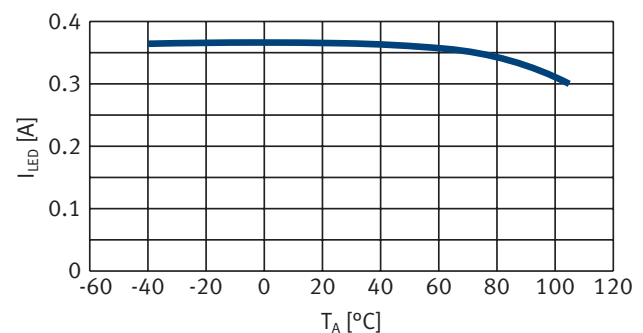
LED Driver ICs

The low-cost ILD4000 LED drivers can be scaled for the different power ratings of MR16 LED lamps. The LED driver IC ILD4035 and the LED controller IC ILD4001, as well as the small-signal MOSFETs BSS306N and BSR302N, are footprint compatible. By scaling with footprint-compatible devices, the cost position can be optimized in a very elegant manner in this extremely cost-sensitive application.

MR16 (up to 4W)	ILD4035
MR16 (3–7W)	ILD4001 + BSS306N (lowest cost 30V/2.3A MOSFET)
MR16 (7–10W)	ILD4001 + BSR302N (medium-cost 30V/3.7A MOSFET)

The ILD4035 incorporates a temperature protection circuit referring to the junction temperature of the IC. The higher the junction temperature, the lower the current of the LEDs. This feature helps to protect the LEDs against thermal overload.

Output Current of ILD4035 vs. Ambient Temperature



LED Driver ICs for MR16 Lamps

Product Type	Group	Topology	V _S (min) [V]	V _S (max) [V]	I _{out} (typ) [mA]	I _{out} (max) [mA]	Dimming	Package	P _{tot} (max) [mW]
ILD4001	LED controller	Buck	4.5	42	10	ext. Switch	Analog or Digital	SC74	500
ILD4035	LED driver IC	Buck	4.5	40	350	400	Analog or Digital	SC74	1000

The small SC-74 (SOT23-6) packages of ILD4001 and ILD4035 enable small designs.

Small-Signal MOSFETs

N-Channel Small-Signal MOSFETs

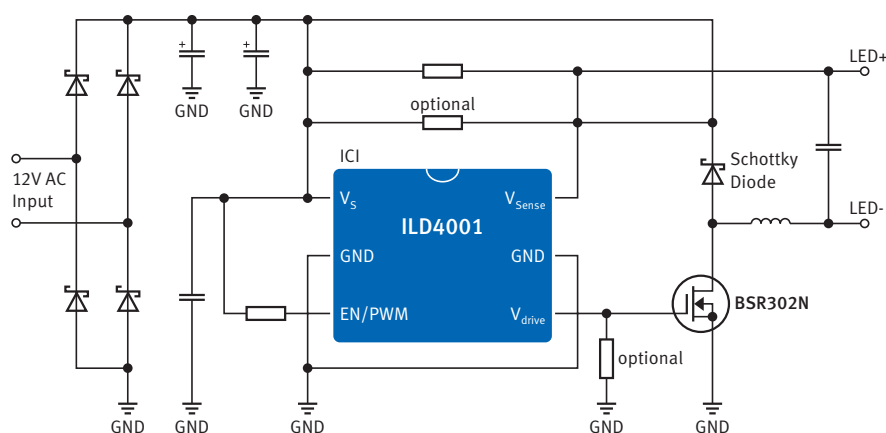
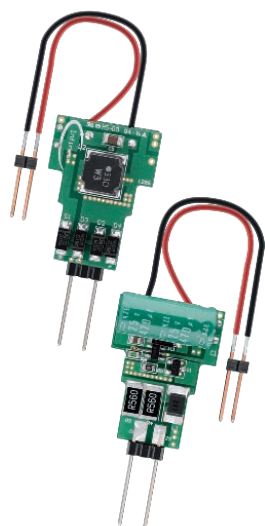
Name	Voltage [V]	R _{DS(on)} [mΩ]	Current [A]	Package
BSS306N	30	57	2.3	SOT-23
BSR302N	30	23	3.7	SC59

30V OptiMOST™ small-signal MOSFETs are targeted for low-power DC/DC converters. The low Q_g makes them ideal for driving directly from drivers and microcontrollers with 4.5V.

Application Example

MR16 LED Driver Board Compatible with Electronic Transformers

7W & 10W Application Example with ILD4001



Key Features & Benefits

- Flexibility to adjust the output current within a wide range
- Flicker-free operation with electronic transformers
- Thermal protection of LEDs without the use of NTC or PTC
- Low system cost
- Small form factor

Infineon Component List

Product Type	Description
ILD4001	High-power LED controller
BSR302N	Small-signal MOSFET
IBA3010A	Schottky diode (freewheeling and bridge rectification)

Related Application Note

Info Number	Description
AN-EVAL_E-Transformer-Compatible_MR16	MR16 7W/10W control board using ILD4001 step-down LED controller

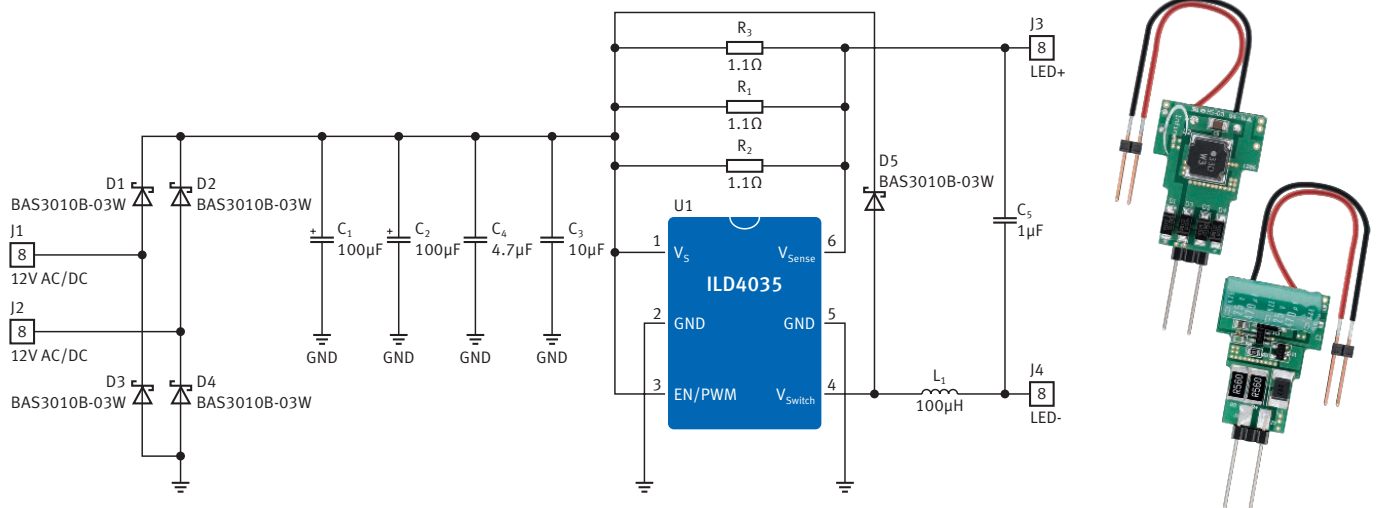
Related Evaluation Board

Board Name	Product	Description	Order Number
MR16 7W board	ILD4001 BSR302N	Control board for 7W MR16 low-voltage halogen replacement lamps	MR16 7W board
MR16 10W board	ILD4001 BSR302N	Control board for 10W MR16 low-voltage halogen replacement lamps	MR16 10W board

Application Example

MR16 LED Driver Board for Low Cost

3W Application Example with ILD4035



Key Features & Benefits

- Flicker-free operation with electronic transformers
- Thermal protection of LEDs without the use of NTC or PTC
- Remarkably low-cost solution
- Small form factor due to SC-74 package

Infineon Component List

Product Type	Description
ILD4035	LED driver IC
BAS3010B	Bridge rectification Schottky diode
BAS3010B	Freewheeling Schottky diode

Related Application Note

Description	Info Number/Internet Link
MR16 3W control board with ILD4035 step-down LED driver	AN 214 www.infineon.com/LED.appnotes

Related Evaluation Board

Board Name	Product	Description	Order Number
MR16 3W board	ILD4035 4xBAS3010A	Control board for 3W MR16 low-voltage halogen	MR16 3W board



LED Drivers

LED drivers are used to provide a constant current to LED light engines for several applications such as commercial indoor lighting, street lighting & high bay lighting.

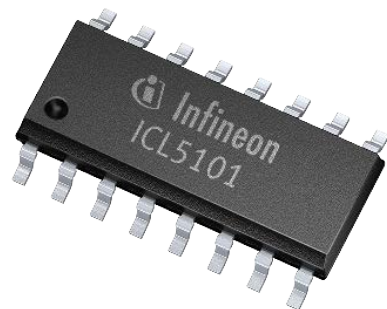
For such applications, the requirements in terms of efficiency, power factor, total harmonic distortion and system lifetime are usually much higher than for LED retrofit lamps.

LED Driver ICs

The LED driver IC ICL5101, available end of 2014, is a combo IC for PFC and LLC topology with the following highlights:

Key Features & Benefits

- Secondary-side constant voltage or constant current control
- PFC in CCM mode during nominal load and DCM mode in low-load condition down to 0.1% for operation without audible noise
- High-power quality with $PF > 0.96$, $THD < 10\%$
- Highest efficiency of up to 94% due to resonant topology
- Allows secondary-side IC dimming down to 1%
- PFC/LLC combo IC allows the best matching of PFC stage and LLC stage timing control
- Supports a wide input voltage range from 90–305V
- Ultra-fast time to light $< 100\text{ms}$
- Complete set of protection features including external thermal protection



High-Voltage MOSFETs

CoolMOS™ Portfolio for LED Drivers

Due to its low cost and easy implementation, quasi-resonant flyback is the most commonly used topology in LED drivers. This makes CoolMOS™ 800V CE the perfect fit for this application.

In addition to this, other topologies, such as fixed-frequency flyback topology, are supported by 600V or 650V-type MOSFETs. For high-power lighting applications, where each percentage point counts, the P6-type for high performance and low $R_{DS(on)}$ MOSFETs are the preferred choice.

Topology	Voltage Class	$R_{DS(on)}$	Packages
Quasi-resonant flyback	800V CE	1Ω ... 2.8Ω	DPAK, IPAK
Quasi-resonant flyback	800V C3	85mΩ ... 0.95Ω	DPAK, TO-220 FP
Quasi-resonant flyback	900V C3	340mΩ ... 1.2Ω	TO-220 FP
Fixed-frequency flyback	600V C6	190mΩ ... 3.3Ω	DPAK, TO-220 FP
Fixed-frequency flyback	650V C6	190mΩ ... 3.3Ω	DPAK, TO-220 FP
PFC stage	600V P6	99mΩ ... 600mΩ	DPAK, TO-220 FP
LLC stage	500V CE	190mΩ ... 950mΩ	DPAK, TO-220 FP

CoolMOS™ 800V CE

Outstanding Cost/Performance for Lighting Applications

The 800V CoolMOS™ CE is Infineon's high-performance device family offering 800V breakdown voltage. Designed according to the SuperJunction (SJ) principle, it provides all the benefits of a fast switching SJ MOSFET without compromising ease of use.

The CE targets lighting applications and the new 800V selection is specifically aimed at LED applications. With this specific CoolMOS™ CE family, Infineon combines its long experience as the leading SJ MOSFET supplier with best-in-class innovation.

The low $R_{DS(on)}$ enables low conduction losses. Furthermore, it makes switching applications more efficient, more compact, lighter and cooler.

In the growing LED market, the 800V CoolMOS™ CE offers an outstanding price/performance ratio providing a competitive edge while being optimized for ease of use and efficiency in such applications.

Features

- Low area-specific ON-state resistance ($R_{DS(on)} \cdot A$)
- Low energy stored in output capacitance (E_{oss})
- Low gate charge (Q_g)
- High body diode ruggedness & reduced reverse recovery charge (Q_{rr})
- Easily controllable switching behavior

Benefits

- Low conduction losses
- Low switching losses
- Optimized efficiency at light load
- Optimal for soft-switching applications
- Easy to use

$R_{DS(on)}$ [mΩ]	DPAK (TO-252)	IPAK (TO-251)
2800	IPD80R2K8CE	IPU80R2K8CE
1400	IPD80R1K4CE	IPU80R1K4CE
1000	IPD80R1K0CE	IPU80R1K0CE

Low-Voltage MOSFETs

OptiMOS™ Portfolio for LED Drivers

OptiMOS™ is the market-leading low-voltage power MOSFET family from Infineon. Covering 20V to 250V, OptiMOS™ consistently sets the benchmark in key

specifications for power system design including ON-state resistance, leading to reduced power losses and improved overall efficiency.

OptiMOS™ Product Portfolio for LED Drivers

$R_{DS(on)}$ max @ $V_{GS} = 10V$ [mΩ]	Name	$R_{DS(on)}$ [mΩ]	Package
---	------	----------------------	---------

OptiMOS™ 80V Normal Level

11–20	BSC123N08NS3 G	12.3	Super SO8
	IPD135N08N3 G	13.5	TO-252, DPAK
30–40	BSC340N08NS3 G	34.0	Super SO8

OptiMOS™ 100V Normal Level

12–18	BSC160N10NS3 G	16.0	Super SO8
	IPD122N10N3 G	12.2	TO-252, DPAK
2x75	BSC750N10ND G	75.0	Super SO8

OptiMOS™ 100V Logic Level

12–18	BSC123N10LS G	12.3	Super SO8
20–40	BSC205N10LS	20.5	Super SO8
	BSC265N10LSF G	26.5	Super SO8

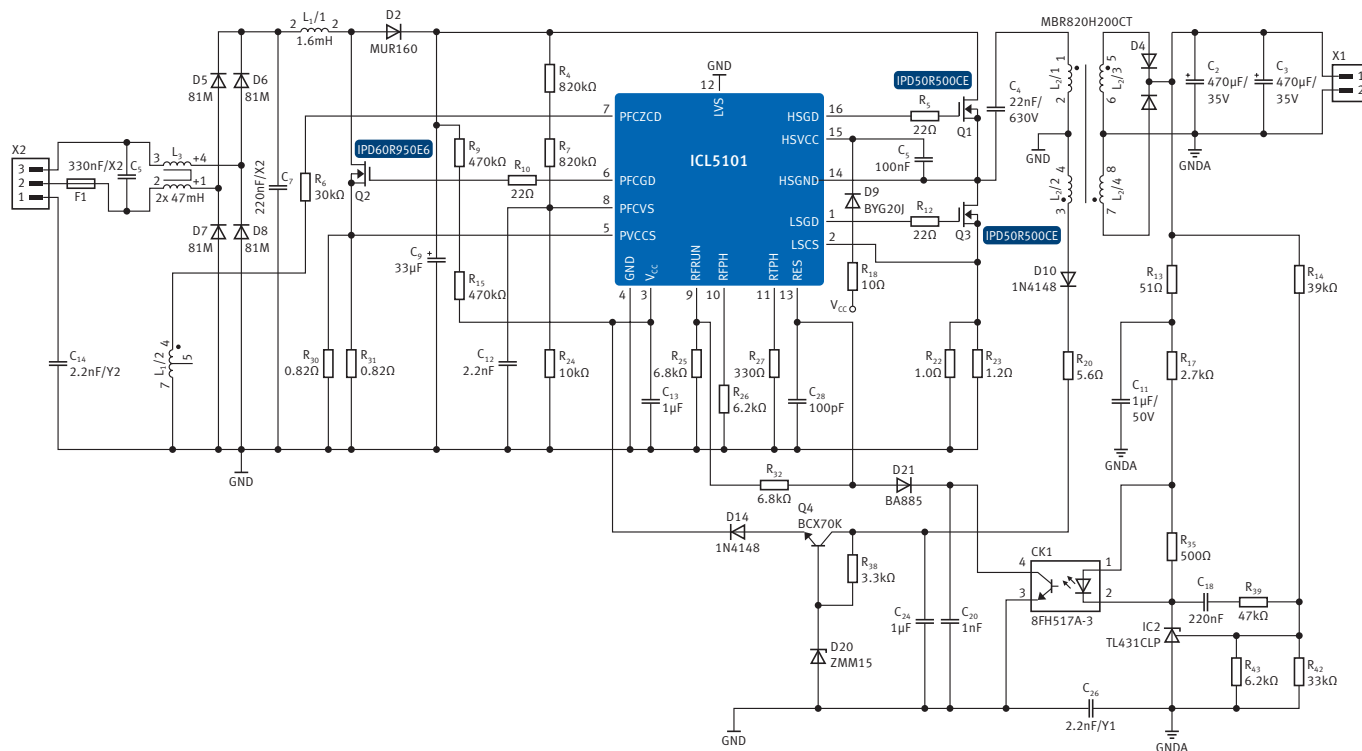
OptiMOS™ 150V Logic Level

16–30	BSC190N15NS3 G	19.0	Super SO8
	IPD200N15N3 G	20.0	TO-252, DPAK
30–60	BSC360N15NS3 G	36.0	Super SO8
	IPD530N15N3 G	53.0	TO-252, DPAK
	BSC520N15NS3 G	52.0	Super SO8

Application Example

110W LED Driver

Application with Constant Voltage Output with ICL5101 + 600V & 500V CoolMOST™



Key Features & Benefits

- Highest efficiency of 94%
- Very high-power factor of 99%
- Very low THD < 5%
- Low bill of material due to combo IC and high integration

Infineon Component List

Part Number	Details
ICL5101	LED driver IC
IPD50R500CE	CoolMOST™ for LLC stage
IPD60R950E6	CoolMOST™ for PFC stage



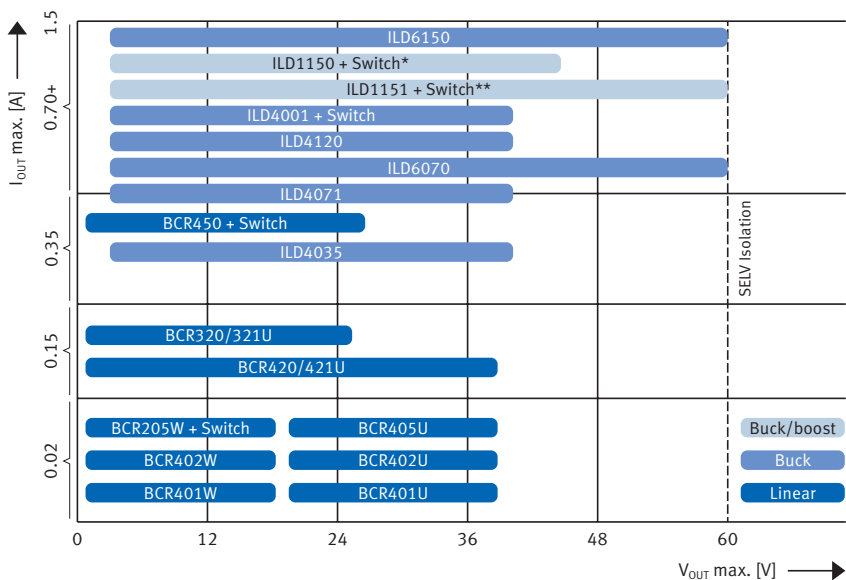
LED Strips & Multichannel LED Applications

The LED driver ICs consist of two main product families

- The BCR series is the smallest size and lowest cost product family for linear LED driver ICs.
- The ILD series features DC/DC LED driver ICs with the highest efficiency.

Both families come with a line-up of regulators with an integrated power stage and a line-up of controllers that allow the utmost scalability via flexible dimensioning of the output stage.

Family Overview of LED Driver ICs for General Lighting Applications



* max. 45V in Boost and SEPIC configuration
 ** max. 60V in Boost and SEPIC configuration

Linear LED Driver ICs

The BCR linear LED drivers are perfectly suited for driving LED currents from 10mA to 250mA, making them the ideal choice for low- to mid-power LEDs in general lighting applications.

This represents the lowest cost solution that requires an ultra-low external part count and PCB space. The light output can be adjusted via an external resistor. PWM dimming is supported either by a microcontroller interface or by means of an external digital transistor.

Thanks to its negative thermal coefficient, the LED load will be protected from overheating.



Low-Power LED Driver ICs (5–65mA)

Product Type	Group	Topology	V _S (min) [V]	V _S (max) [V]	I _{out} (typ) [mA]	I _{out} (max) [mA]	Dimming	Package	P _{tot} (max) [mW]
BCR205W	LED controller	Linear	1.8	18	0.5	ext. Switch	no	SOT343	100
BCR401U	LED drivers for low-power LEDs	Linear	1.4 + V _{FLED}	40	10.0	65	Digital	SC74	750
BCR401W	LED drivers for low-power LEDs	Linear	1.2 + V _{FLED}	18	10.0	60	Digital	SOT343	500
BCR402U	LED drivers for low-power LEDs	Linear	1.4 + V _{FLED}	40	20.0	65	Digital	SC74	750
BCR402W	LED drivers for low-power LEDs	Linear	1.4 + V _{FLED}	18	20.0	60	Digital	SOT343	500
BCR405U	LED drivers for low-power LEDs	Linear	1.4 + V _{FLED}	40	50.0	65	Digital	SC74	750

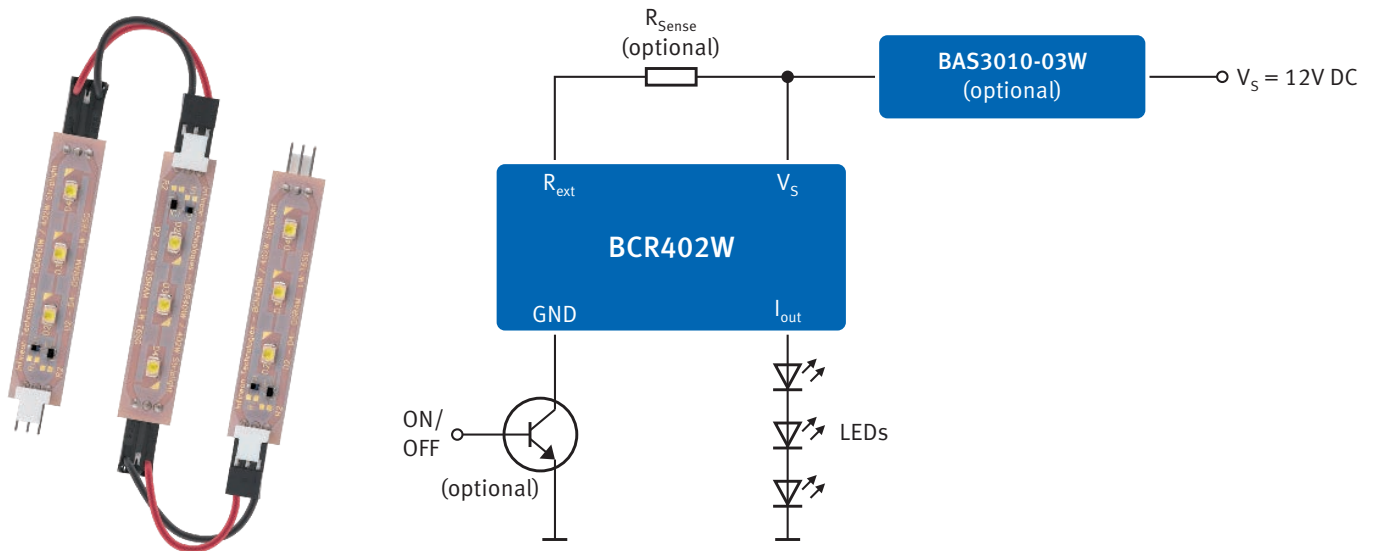
Medium- & High-Power LED Driver ICs (65–500mA)

Product Type	Group	Topology	V _S (min) [V]	V _S (max) [V]	I _{out} (typ) [mA]	I _{out} (max) [mA]	Dimming	Package	P _{tot} (max) [mW]
BCR320U	LED drivers for mid-power LEDs	Linear	1.4 + V _{FLED}	24 + V _{FLED}	250	300	no	SC74	1
BCR321U	LED drivers for mid-power LEDs	Linear	1.4 + V _{FLED}	24 + V _{FLED}	250	300	Digital	SC74	1
BCR420U	LED drivers for mid-power LEDs	Linear	1.4 + V _{FLED}	40 + V _{FLED}	150	200	no	SC74	1
BCR421U	LED drivers for mid-power LEDs	Linear	1.4 + V _{FLED}	40 + V _{FLED}	150	200	Digital	SC74	1
BCR450	LED controller	Linear	3.0	27	70	ext. Switch	Digital	SC74	500
TLE4309G	LED drivers for linear high-power LEDs	Linear	4.5	24	500	500	Digital	TO263	–

Application Example

LED Strips with Low-Power LEDs I_{out} for 10–60mA

Application Example with BCR402W



Key Features & Benefits

- Homogenous light output in different LED strings
- Easy to implement with a low component count
- No resistor required for common currents such as 10mA/20mA
- Flexibility to adjust the current via an external resistor from 10mA up to 60mA
- Negative thermal coefficient protecting the lifetime of LEDs

Infineon Component List

Product Type	Description
BCR402W	Low-power LED driver
BAS3010A-03W	Schottky diode for reverse polarity protection (RPP) – 12V board
BAT64-03W	Schottky diode for reverse polarity protection (RPP) – 24V board

Related Application Note

Description
Comparison of resistor biasing versus BCR401W / BCR402W LED driver biasing of +12V & +24V DC low-current LED striplights

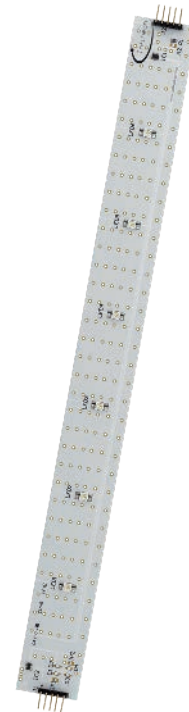
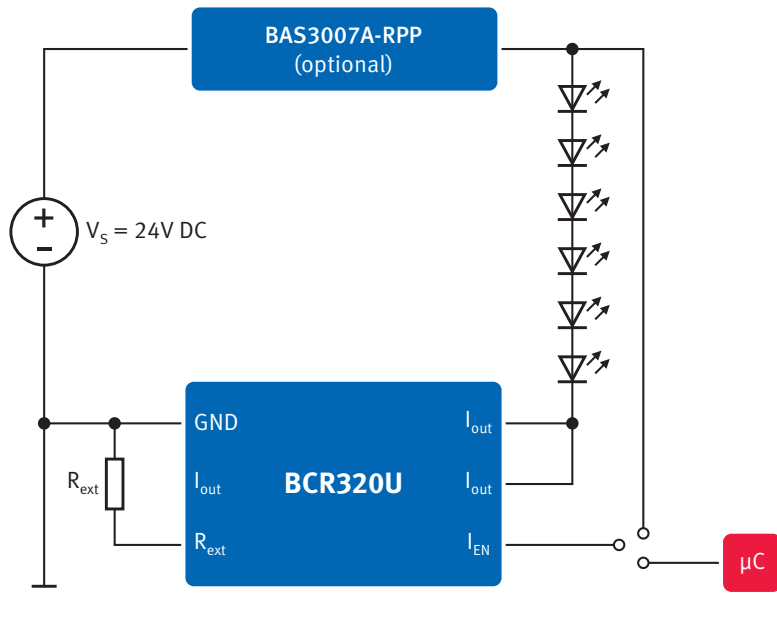
Related Evaluation Board

Board Name	Product	Description	Order Number
12V low-current LED demoboard	BCR402W BAS3010A-03W	12V BCR402W demoboard driving 3x 0.2W LEDs in series	BCR402W 12V LED board
24V low-current LED demoboard	BCR402W BAT64-03W	24V BCR402W demoboard driving 6x 0.2W LEDs in series	BCR402W 24V LED board

Application Example

LED Strip with Medium-Power LEDs I_{out} for 65–200mA

Application Example with BCR320U



Key Features & Benefits

- Homogenous light output in different LED strings regardless of V_f and supply voltage
- Easy to implement with a low component count
- Flexibility to adjust the current via an external resistor from 10mA up to 250mA
- Direct microcontroller interface for PWM dimming for BCR421U and BCR321U or dimming via PWM power
- Negative thermal coefficient protecting the lifetime of LEDs
- High-power dissipation capability

Infiniteon Component List

Product Type	Description
BCR320U	Medium-power LED driver
BAS3007A-RPP	Schottky bridge for reverse polarity protection (RPP)

Related Application Note

Info Number	Description
AN212	Driving half-watt LEDs on a lightstrip with BCR320U, BCR321U or BCR420U, BCR421U

Related Evaluation Board

Board Name	Product	Description	Order Number
24V Half-watt LED demoboard	BCR320U BAS3007A-RPP	24V BCR320U striplight demoboard driving 6x 0.5W LEDs in series	BCR320U HW LED board

DC/DC LED Driver ICs

Infinion has a broad portfolio of DC/DC LED drivers that support currents from 150mA to 3A, making them the ideal choice for high- and ultra-high-power LEDs in general lighting applications.

The buck topology is supported by the ILD4000 and ILD6000 families. Buck/boost, boost and SEPIC configuration are supported by the ILD1150 family. The ILD4000 is the low-cost DC/DC LED driver IC family with a breakdown voltage of 40V and basic thermal protection. The ILD6000 is the feature-rich DC/DC LED driver IC family with a breakdown voltage of 60V and advanced thermal protection.

Efficiency can be as high as 98% across a wide range of operation conditions. For the vast majority of buck LED drivers, users have the choice of dimming concepts: PWM or analog voltage.

Integrated smart thermal protection, along with overvoltage and overcurrent protection, contribute to a longer LED lifetime.

LED Driver ICs for Buck Topology

Product Type	Group	V _s (min) [V]	V _s (max) [V]	I _{out} (typ) [mA]	I _{out} (max) [mA]	Dimming	Package	P _{tot} (max) [mW]
ILD4001	LED controller	4.5	42	10	ext. Switch	Analog or Digital	SC74	500
ILD4035	LED drivers for buck high-power LEDs	4.5	40	350	400	Analog or Digital	SC74	1000
ILD4071	LED drivers for buck high-power LEDs	5.0	40	100	700	Analog or Digital	PG-DSO-8	–
ILD4120	LED drivers for buck high-power LEDs	4.5	40	1200	1200	Analog or Digital	PG-DSO-8	1500
ILD6070	LED drivers for buck high-power LEDs	4.5	60	700	700	Analog or Digital	PG-DSO-8	–
ILD6150	LED drivers for buck high-power LEDs	4.5	60	1500	1500	Analog or Digital	PG-DSO-8	–

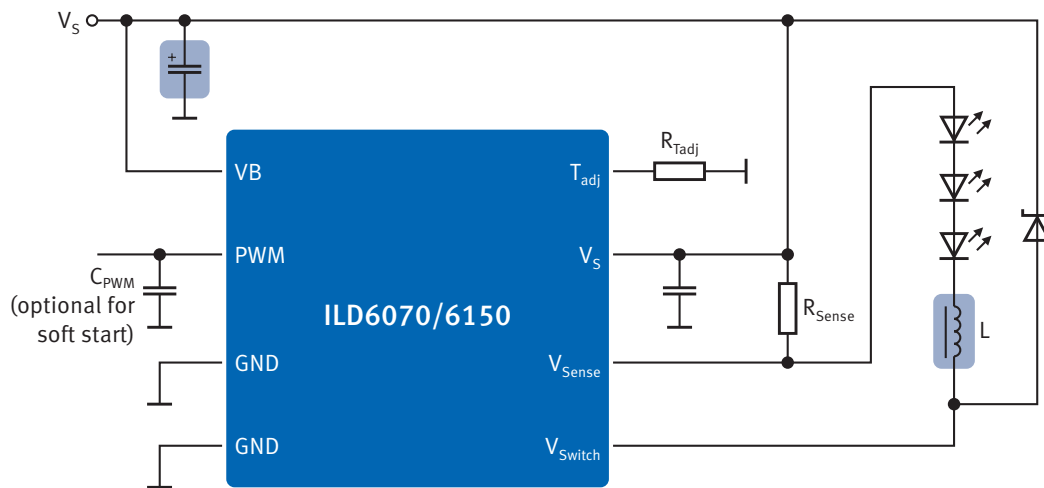
LED Driver ICs for Buck/Boost, Boost and SEPIC Topology

Product Type	Group	V _s (min) [V]	V _s (max) [V]	I _{out} (typ) [mA]	I _{out} (max) [mA]	Dimming	Package	P _{tot} (max) [mW]
ILD1150	LED controller	–	45	90	ext. Switch	Digital	SSOP-14	–
ILD1151	LED controller	–	45	90	ext. Switch	Analog or Digital	SSOP-14	–

Application Example

Driving High-Power LEDs

Application Example with DC/DC Buck Converter ILD6070/6150 (max. 60V supply voltage)



Key Features & Benefits

- Wide usable input voltage from 4.5–60V
- Compatible with a big variety of LEDs with an output current of 1500mA
- Provides both PWM or analog dimming options
- More lumen/watt due to high efficiency of up to 98%
- High output current accuracy $\pm 3\%$ enables adjustment of the required light color and light intensity
- Contrast ratio 3000:1
- Small PG-DSO-8 exposed pad package
- Advanced thermal protection including (for details, please refer to the next page)
 - Current reduction in a slope enables the protection of LED lifetime
 - Trigger point of thermal protection can be adjusted
 - No need for external NTC or PTC, thereby reducing system cost
 - Light color doesn't change during thermal protection mode

Infinite Component List

Part Number	Details
ILD6070/6150	LED driver IC

Related Application Note

Info Document	Description
Application Note AN-EVAL-ILD6070	60V/0.7A Highly efficient step-down LED driver with adjustable thermal protection
Application Note AN-EVAL-ILD6150	60V/1.5A Highly efficient step-down LED driver with adjustable thermal protection

Related Evaluation Board

Part Number	Details
Evaluation Board EVALLED-ILD6070	ILD6070 60V/0.7A Highly efficient step-down LED driver with adjustable thermal protection
Evaluation Board EVALLED-ILD6150	ILD6150 60V/1.5A Highly efficient step-down LED driver with adjustable thermal protection

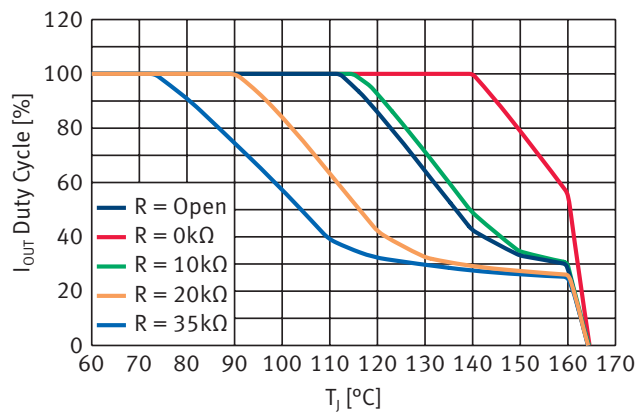
Advanced Thermal Protection with the ILD6000 Family

Managing the heat emitted from the LED components and electronics is a key challenge in implementing high-quality and durable LED lighting systems. The most common way luminary designers handle thermal management is by designing the heat sink for worst-case scenarios. These worst cases may occur very rarely or never during the lifetime of the LED lighting system. Designing the heat sink for the worst-case scenario results in a high system cost.

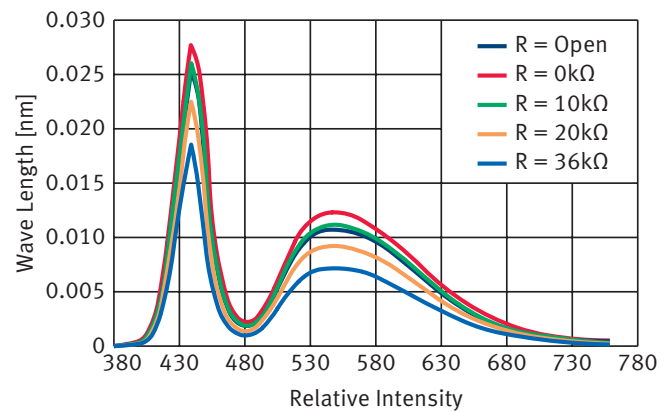
Thanks to the patent-pending smart thermal management technology used in the ILD6000 LED driver family, the lifetime and cost of LED designs can be significantly improved. This results in various benefits for luminary manufacturers and end users:

- Current reduction in a slope enables
 - Starting thermal protection at a lower temperature range (example 100°C to 120°C). Protection starting at such temperature levels allows protection of the LED lifetime
 - No outage of light during thermal protection mode – sufficient light will be available in most cases
- Reduced system cost for thermal protection since
 - No NTC is required if the driver IC can be thermally coupled to the LEDs
 - Heat sink design can be optimized for the most likely use cases, not for the worst case
- Flexibility to
 - Use the LED driver IC with or without an NTC – external NTC can be used if the LED driver is separated from the LED light engine
 - Adjust the temperature for triggering the start of thermal protection depending on the end customer and application needs (see graph below)
- The light color doesn't change during the thermal protection mode – the end user might not realize that the LED system is in thermal protection mode (see graph below)
- Improved total cost of ownership due to increasing the lifetime of the LED system

Adjustable trigger for thermal protection

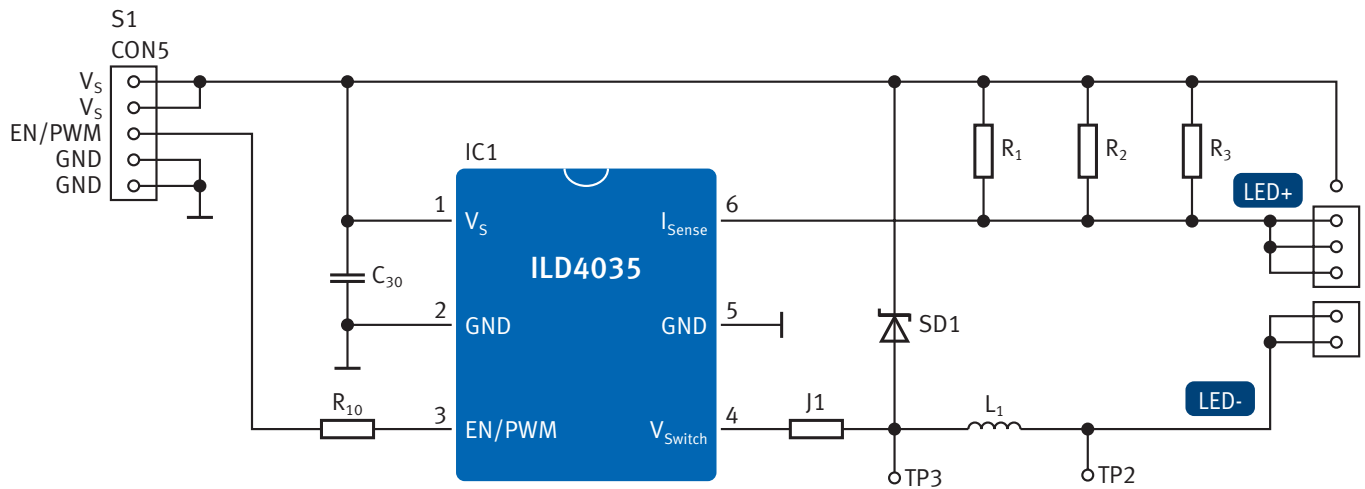


PWM modulated light output keeps color constant during thermal protection



Application Example Driving High-Power LEDs

Application Example with ILD4035, 350mA in Small SC-74 Package



Key Features & Benefits

- Input voltage from 4.5–40V
- Designed to meet required cost
 - ILD4035 for driving LEDs up to 350mA
- High output current accuracy $\pm 3\%$
- Contrast ratio 1000:1
- Overtemperature protection
 - Current reduction in a slope enables protection of the LED lifetime
 - No external NTC/PTC required
 - No outage of light during thermal protection mode
 - Enables optimized heat sink design

Infiniteon Component List

Part Number	Details
ILD4035	LED driver IC
BAS3010	Schottky diode

Related Application Note

Info Number	Description
AN 215	Driving 1W LEDs with ILD4035

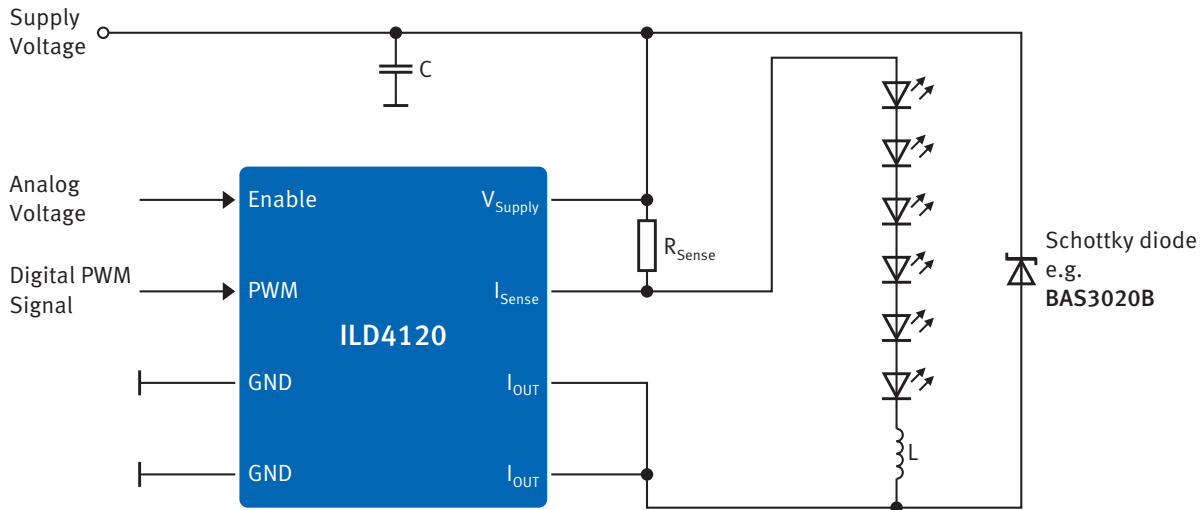
Related Evaluation Board

Part Number	Details
Evaluation Board ILD4035 24V	Drive 1W LEDs with the buck LED driver ILD4035 24V and 12V supply voltage version available. The 350mA preset LED current analog voltage and PWM pin for dimming can be connected to a string of 1W LEDs.

Application Example

Driving High-Power LEDs

Application Example with ILD4120, up to 1200mA in SO-8 (Exposed) Package



Key Features & Benefits

- Input voltage from 4.5–40V
- Designed to meet required cost
 - ILD4035 for driving LEDs up to 350mA
- High output current accuracy $\pm 3\%$
- Contrast ratio 1000:1
- Overtemperature protection
 - Current reduction in a slope enables protection of the LED lifetime
 - No external NTC/PTC required
 - No outage of light during thermal protection mode
 - Enables optimized heat sink design

Infineon Component List

Part Number	Details
ILD4120	LED driver IC
BAS3020B	Schottky diode

Related Application Note

Info Number	Description
AN 270	Driving 2W LEDs with ILD4120

Related Evaluation Board

Part Number	Details
Evaluation Board ILD 4120 24V	Drive 3W LEDs with the buck LED driver ILD4120 24V and 12V supply voltage version available. The 700mA preset LED current analog voltage and PWM pin for dimming can be connected to a string of 3W LEDs.



Fluorescent & HID Lamp Ballasts

Infineon Technologies offers dedicated controllers for fluorescent lighting with the lowest system cost due to a high level of integration and a great system performance. This is thanks to a chip design based on a deep understanding of the application requirements and customer needs.

In addition, Infineon also offers a broad portfolio of best-in-class high-voltage MOSFETs for fluorescent and high-intensity discharge lamp ballasts.

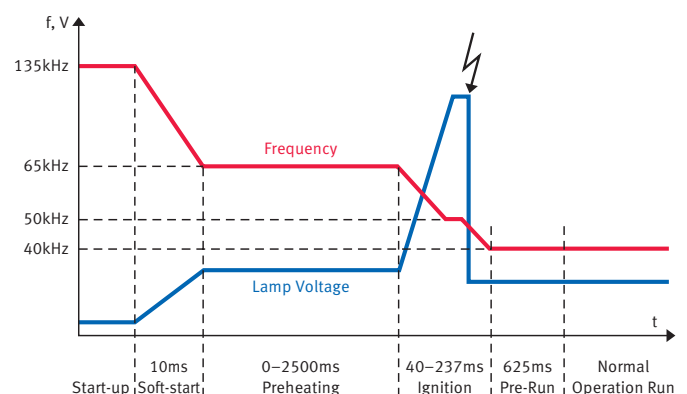
Fluorescent Controller ICs

Ballast control ICs from Infineon integrate all functions required to operate fluorescent lighting lamps such as preheat, ignition and run-mode capabilities, along with protection features.

Digital mixed-signal power control is employed. This enables speedy, cost-effective and stable ballast designs with a minimum number of external components.

Reliable and robust high-voltage isolation is achieved using Infineon's proprietary CoreLess Transformer technology (CLT).

Infineon's smart ballast fluorescent controllers feature integrated control for all operating phases



Product Highlights

- Integrated high-performance critical conduction mode PFC stage
- Improved Total Harmonic Distortion (THD) and harmonic distortion for low-power applications in DCM mode
- Built-in protection functions such as Over-Voltage Protection (OVP) and Over-Current Protection (OCP)
- Adjustable end-of-life detection in multi-lamp topologies and detection of capacitive mode operation
- Intelligent digital-/mixed-signal lamp inverter control
- Integrated high-voltage level-shift half-bridge driver using coreless transformer technology

Product Type List

Product Type	Package	PFC	Topology	Half-Bridge Driver [V]	Adj. Run Frequency [kHz]	Lamp Connection	Dimmable	Protection
ICB2FL01G	DSO-19 (300mil)	CrCM	Half-Bridge	±900	max. 120	Serial, Parallel (type 1-4)	Yes	Surge, capacitive mode, EOL ¹⁾ , PFC under- and overvoltage, PFC and HB overcurrent
ICB2FL02G	DSO-19 (300mil)	CrCM	Half-Bridge	±900	max. 140	Serial, Parallel (type 1-4)	Optimized	
ICB2FL03G	DSO-16 (150mil)	CrCM	Half-Bridge	±650	max. 120	Serial (type 1-2)	Yes	

1) EOL including lamp overload and rectifier effect detection

Key Features

- Able to handle lamp chokes with high saturation behavior
- Special in-circuit test mode for a faster test time
- Parameters set with resistors only
- Excellent dynamic PFC performance enables very low THD across wide load ranges
- Separate adjustable levels of lamp overload and rectifier effect detection (EOL1, EOL2)
- Intelligent discrimination between surge and half-bridge overcurrent events
- Self-adapting dead-time adjustment of the half-bridge driver
- Highly accurate timing and frequency control over a wide temperature range (-40 to 125°C)

Benefits

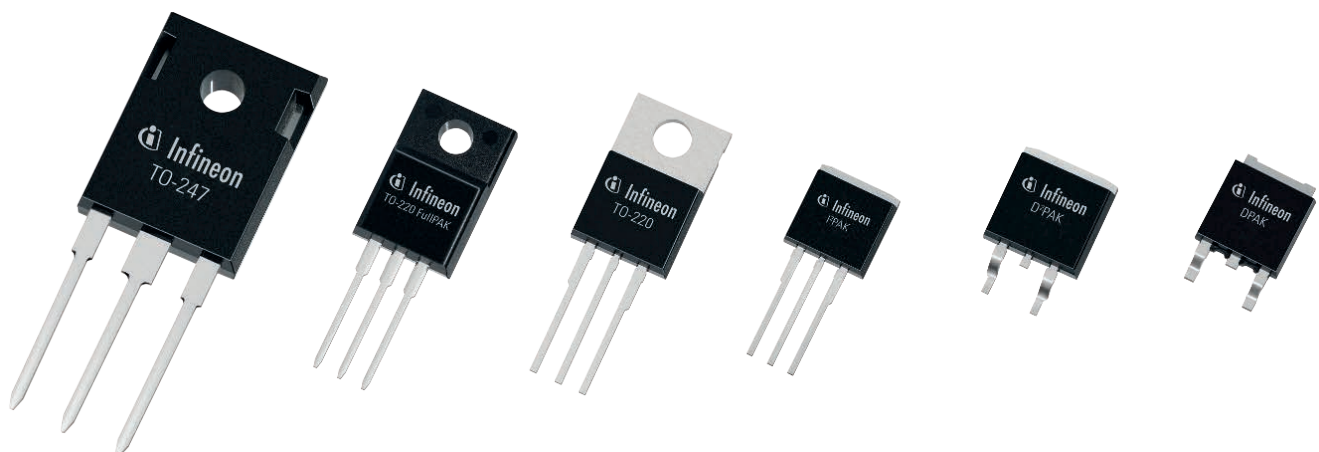
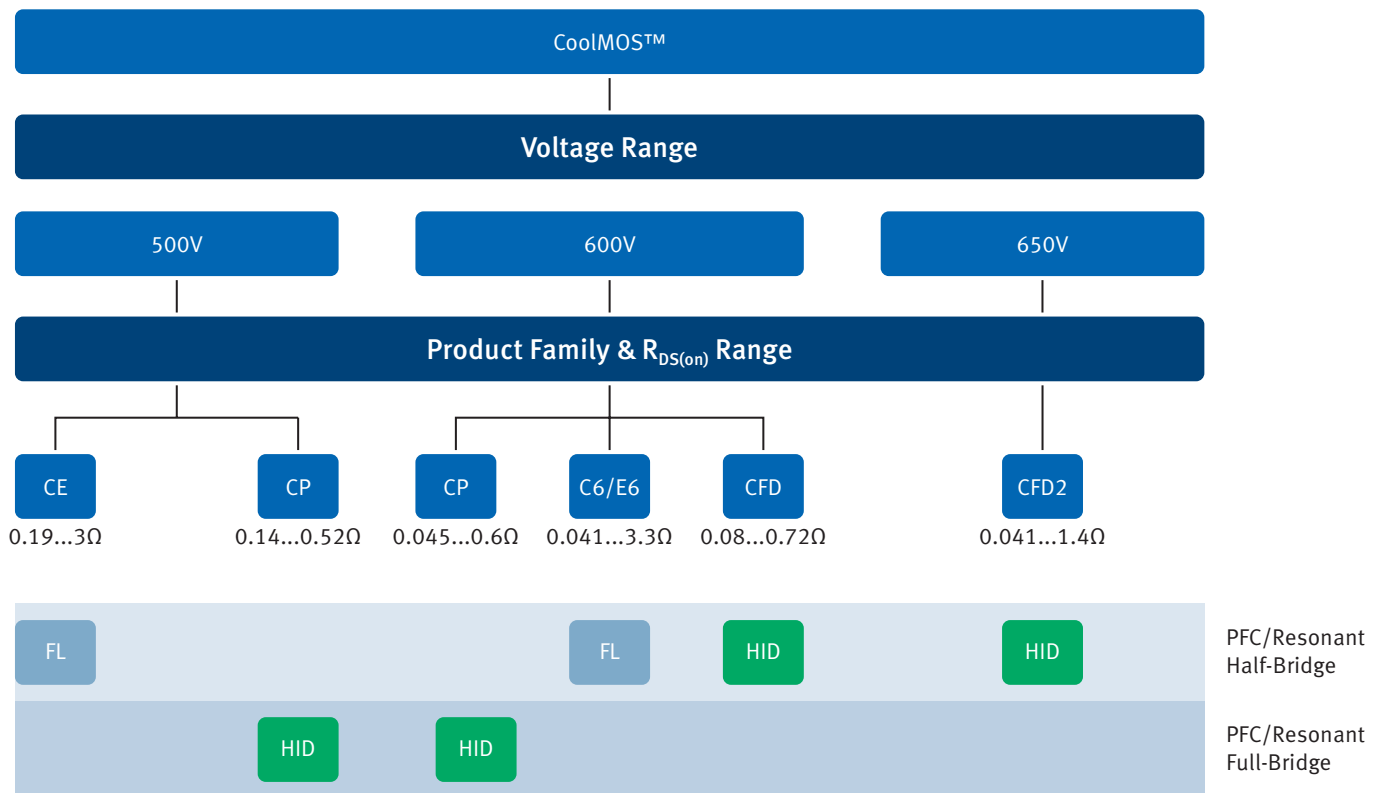
- Optimized lamp choke size, reduced BOM costs
- Halves the time for key tests such as end-of-life detection and preheat/operation modes
- Reduced system cost and improved ballast stability
- Suitable for dimming & multi-power ballasts
- Enables ballast compatibility with a wider range of lamp types
- Lamp can automatically restart following surge events and correctly handle EOL events
- Simplifies the design of multi-power ballasts and reduces EMI
- Reliable, stable ballast designs

High-Voltage MOSFETs

CoolMOS™ Portfolio for Fluorescent & HID Lighting

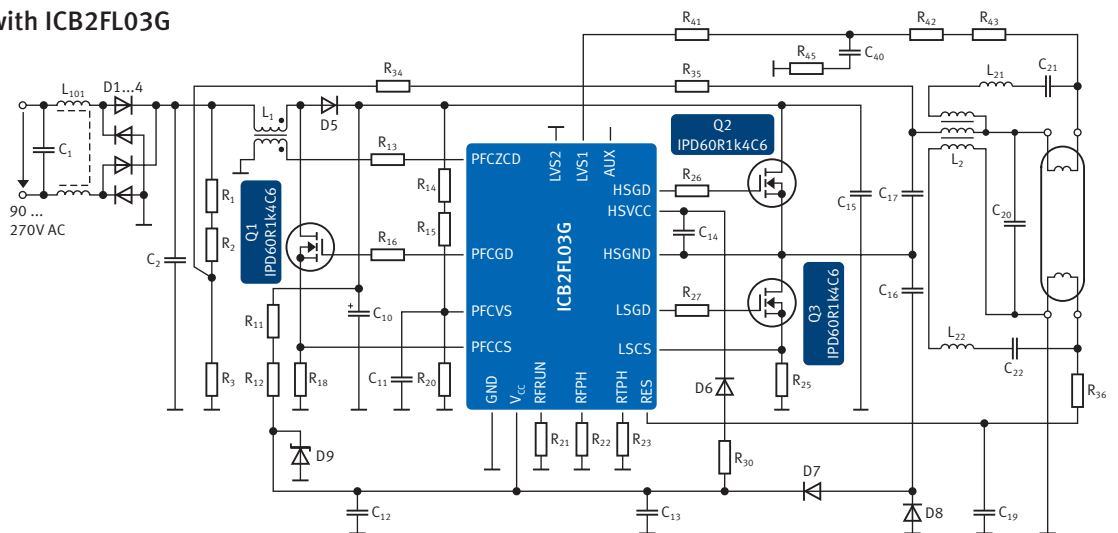
Infinite offers best-in-class power MOSFETs. The selection table below shows an overview of the most suitable voltage and $R_{DS(on)}$ classes for fluorescent (FL) and HID lighting.

CoolMOS™ Selection Table for Lighting Applications



Application Example Demoboard for 54W T5 Single Lamp Design with Voltage Mode Preheating

Application Example with ICB2FL03G



Key Features & Benefits

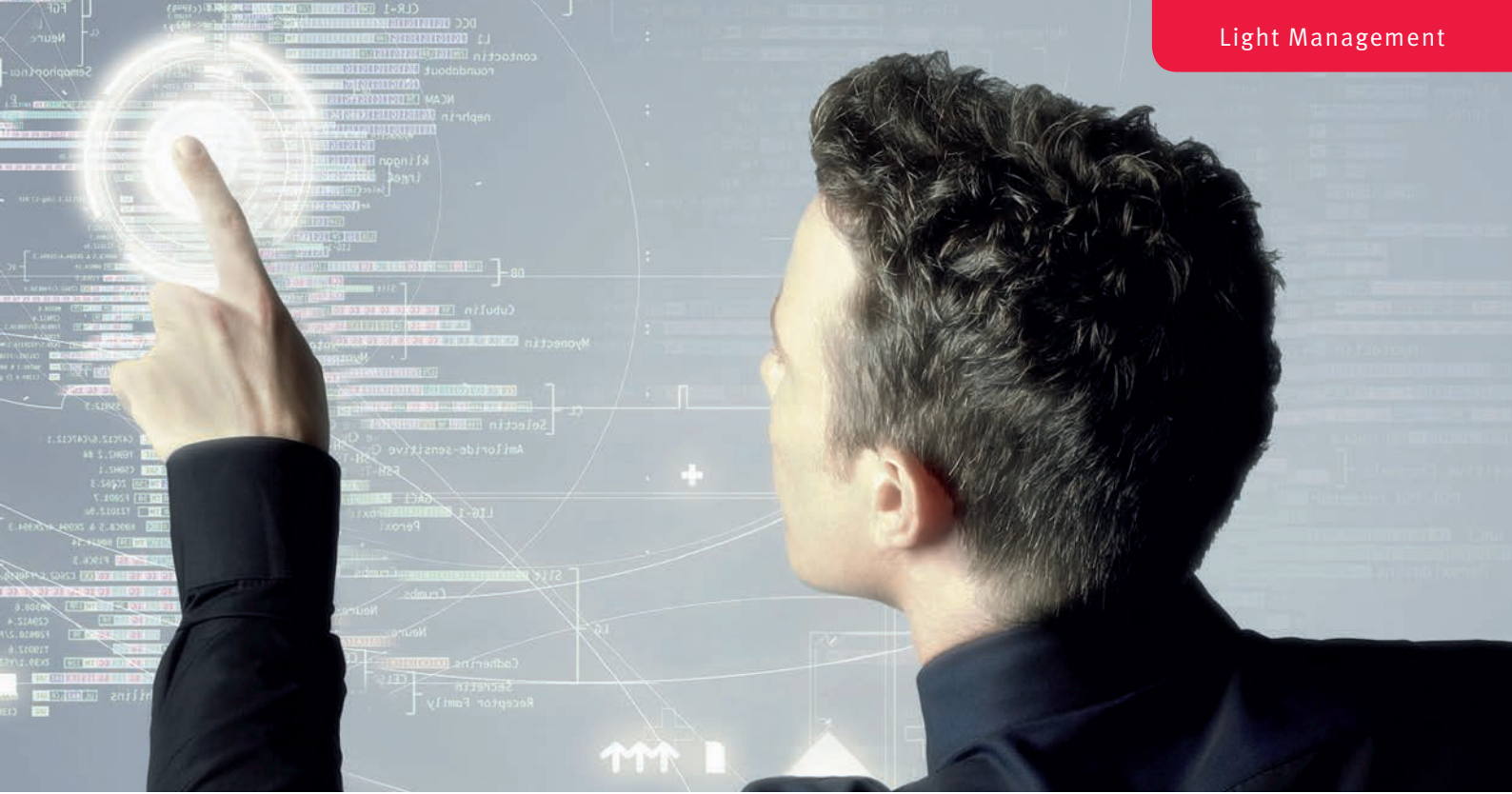
- 54W T5 single lamp design with voltage mode preheating
- Active PFC in Critical/Discontinuous Conduction Mode (CritCM/DCM) and a half-bridge topology for lamp inverter
- Components used
 - ICB2FL03G smart lamp ballast controller in a DSO-16 package
 - MOSFET switches 3x IPD60R1K4C6 in TO252 for PFC and half-bridge
- Efficiency > 93% with lamp after 30min operation in run mode @ 230VACRMS > 0.99 @ 230VACRMSPF
- THD < 4% @ 230VACRMS
- Proprietary ignition control allows for operation close to the magnetic saturation of inductors
- Implementation of numerous monitoring and protection features for highest reliability (surge, inverter/PFC-overcurrent, bus over-/undervoltage, EOL1 overload, EOL2 rectifier effect, emergency detection according to VDE0108)
- Supports customer in-circuit test mode for reduced tester time
- Assembly option on PCB for dimming functionality

Related Application Note

Info Number	Description
AN ICB2FL03G	ICB2FL03G smart ballast control IC for fluorescent lamp ballasts

Related Evaluation Board

Board Name	Product	Description	Order Number
Evaluation board ICB2FL03G	ICB2FL03G	CoolMOS™ MOSFET design with voltage mode preheating using amp ICB2FL03G	Eval ICB2FL03G



Light Management

There are various fields where light management, also known as smart lighting, can be of benefit to people due to:

- Realizing further energy savings via the implementation of presence detectors and/or ambient light detectors
- Adapting light levels and light color in accordance with the needs of users – human-centric light
- Automation for enabling more comfortable use, such as predefined settings
- Diagnosis functions to enable easier maintenance
- Maintaining lumen levels over lifetime

LED lighting offers new smart lighting opportunities. This is due to the fact that LEDs are the first light sources that actually extend their lifetime when they are switched on/off frequently. Furthermore, compared to other light sources they generate higher energy savings when dimmed. Yet another benefit is that electronics is an integral part of LED luminaries and can be easily connected to lighting control systems.

Smart lighting features can be implemented in decentralized or centralized control systems. When used with centralized control systems, different wired or wireless communication systems are used.

Microcontrollers & sensors are key components for enabling smart lighting.

Main functions of **microcontrollers** in lighting:

- Enable connectivity to bus systems such as DALI, DMX, KNX etc.
- Enable connectivity to sensors
- Enable the programming of intelligent light features as required by the end user

Main functions of **sensors** in lighting:

- Detect presence
- Detect the ambient light level

Microcontrollers for LED Lighting

XMC1000 Family

The XMC1000 product family integrates the ARM® Cortex™-M0 core into a leading-edge 65nm manufacturing process in order to overcome the limitations of contemporary 8-bit designs. The XMC1000 offers current 8-bit users a new opportunity to enjoy 32-bit power, without having to compromise on price or ease of use. Three product series cover a range of application fields.



- The XMC1100 series is designed for easy entry into the XMC world
- The XMC1200 line features dedicated peripherals for LED lighting designs and
- The XMC1300 series addresses real-time control requirements in many fields, such as digital power conversion applications

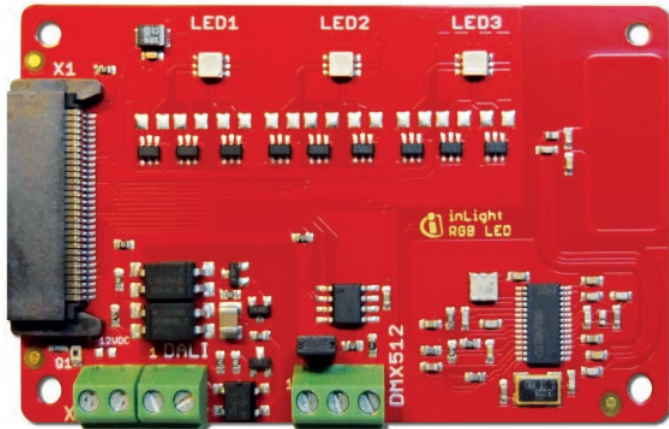
DAVE™ is a complete free development environment for XMC microcontrollers. It features a complete SW development tool-chain and DAVE™ Apps for reducing SW complexity and time-to-market.

Product Series	System			Timers			Signal Processing		Communication	Application Specific		
	Co-Processor	Flash Memory	RAM	CCU4	CCU8	POSIF	ADC	AnaComp	USIC	LED Brightness & Color Control	LED Display Control	Touch Control
XMC1100	–	8–64KB	16KB	4ch, 16-bit	–	–	1x 12-bit	–	2ch, UART, SPI, I ² C, I ² S	–	–	–
XMC1200	–	16–200KB	16KB	4ch, 16-bit	–	–	2x 12-bit	up to 3	2ch, UART, SPI, I ² C, I ² S	9ch	64 segment	16 buttons
XMC1300	MATH (CORDIC/DIV)	8–200KB	16KB	4ch, 16-bit	8ch, 16-bit	1x	2x 12-bit	3x	2ch, UART, SPI, I ² C, I ² S	9ch	–	–

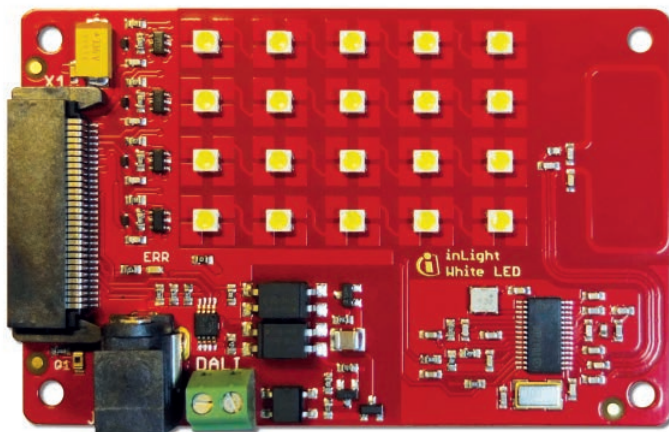
Key Features & Benefits of the XMC1000 Family

- Low-cost 32-bit MCU with a programmable memory of up to 200KB Flash
- Connectivity (UART, SPI, I²C, I²S) to, for example, external motion or light sensors and a DALI or DMX lighting bus
- Free DAVE™ App with DALI stack
- Specific easy-to-use peripherals for flicker-free LED-dimming, automated calibration to various drivers and smooth color mixing
- Fast ADC (< 0.5µs) and peripheral interconnects for precise real-time control loops

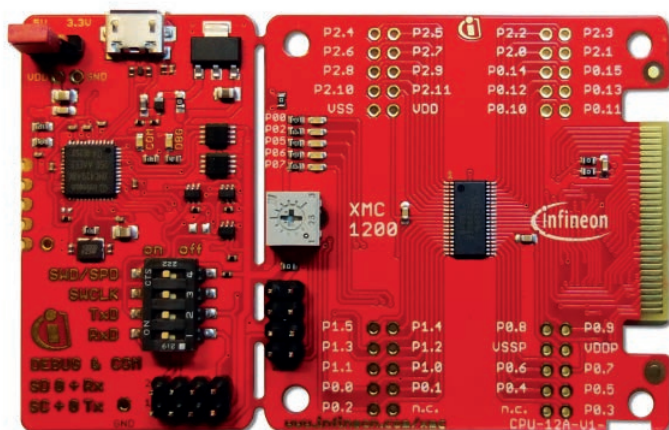
Evaluation Kit with two Different Evaluation Cards featuring XMC1200

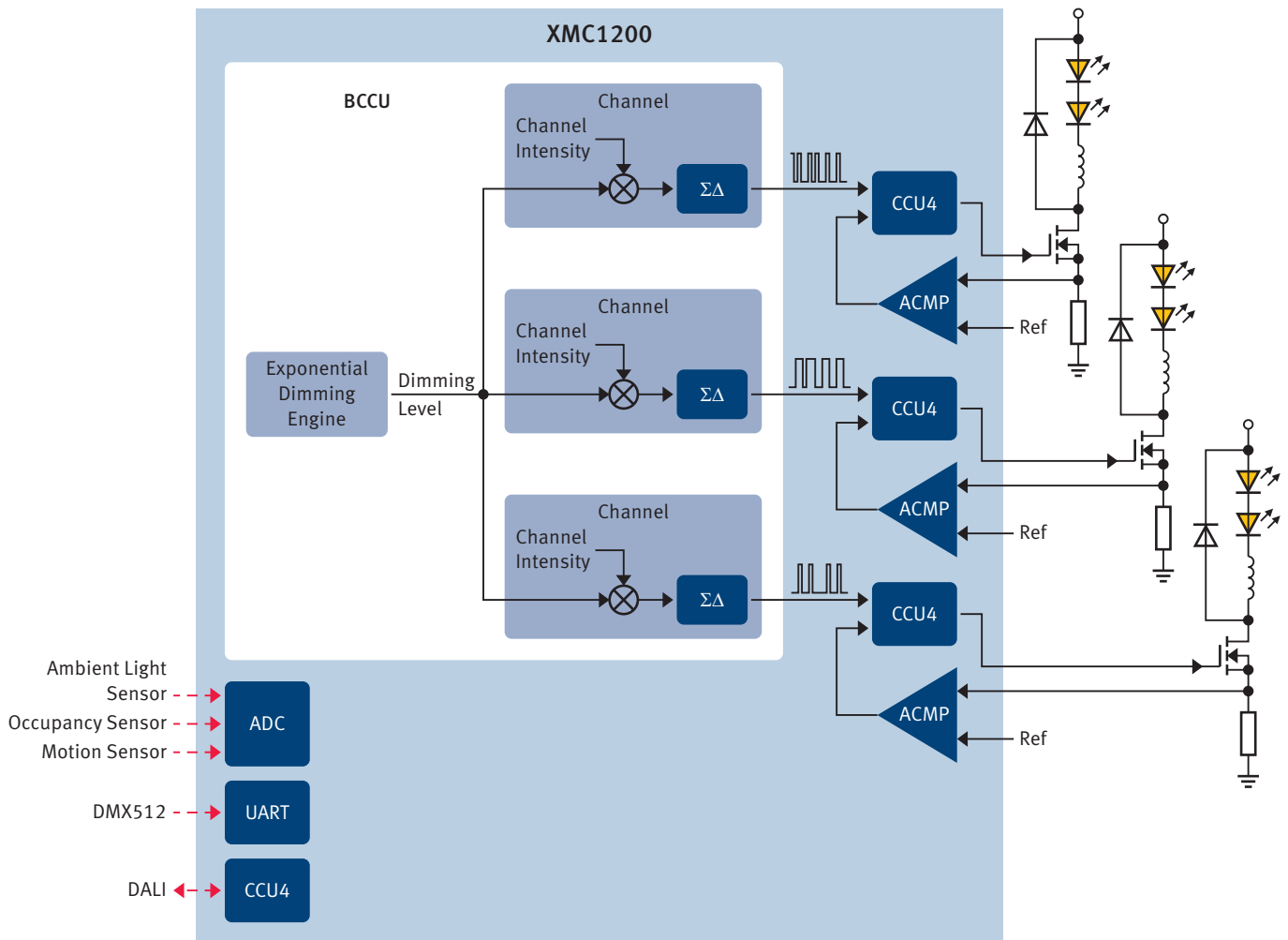


- Color LED card
 - 3 RGB LEDs represent 9 LED channels
 - Each channel is driven by a BCR421 linear LED driver and modulated by a PDM output
 - Isolated DALI interface
 - Non-isolated DMX interface
 - RF interface
 - Ambient light sensor



- White LED card
 - 20 white low-power LEDs
 - 4 channels
 - Each channel is driven by a BCR450 linear LED driver (20mA) and modulated by a packed PDM output
 - Sense voltage of each channel is measured by the ADC to evaluate ADC triggering by BCCU
 - Isolated DALI interface
 - RF interface
 - Temperature sensor
 - Ambient light sensor

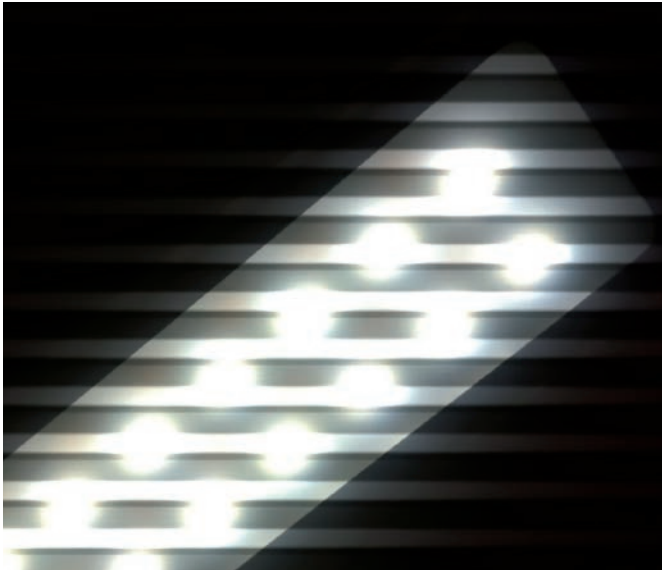




Thanks to their Brightness and Color Control Unit (BCCU), XMC1000 products offer a unique module for automatically controlling the dimming level and color of multichannel LED lamps. Users can quickly configure their ideal solution without the need for an expert

knowledge of lighting. Furthermore, XMC1000 products can also be used as DALI or DMX512 slaves and therefore comply with standard lighting communication protocols. DAVE™ Apps are available for both standards.

Superior Flicker Control thanks to the Brightness & Color Control Unit (BCCU)



2kHz flicker with a commercial stand-alone ballast – annoying lines are visible when filmed with an HD camera.



Infineon solution with XMC1000. Flickering (40–50kHz) is neither visible nor detectable by HD cameras.

Key Features of the Brightness and Color Control Unit (BCCU)

- Automatic high-frequency brightness modulation based on the $\Sigma\Delta$ principle enables completely flicker-free dimming through 9 output channels
- Automatic exponential dimming and linear intensity changes make brightness or color changes appear smooth and natural to the human eye
- An integrated packer function ensures controlled switching rates for a wide range of high-power LED drivers
- BCCU, CCU4 and the on-chip analog comparators are interconnected via the ERU connection matrix for highly efficient dimmable peak-current control setups

Radar Sensors

24GHz Radar Demonstrator Kit for Presence Detection

A lot of energy is currently wasted due to illuminated areas where nobody is present. Passive infrared (PIR) is a simple way of detecting presence. However, passive infrared sensors are not suited for presence detection

- In big areas such as warehouses, factories etc.
- In outdoor weather conditions (rain, fog, snow...)
- For radial movements

Compared to infrared, radar solutions from Infineon can cover areas about 10 times larger.

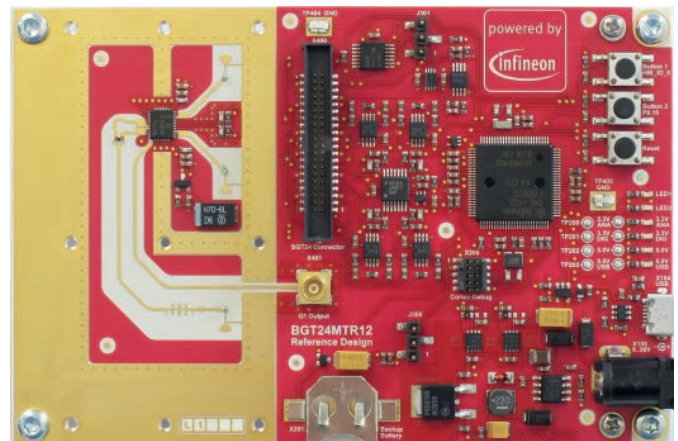
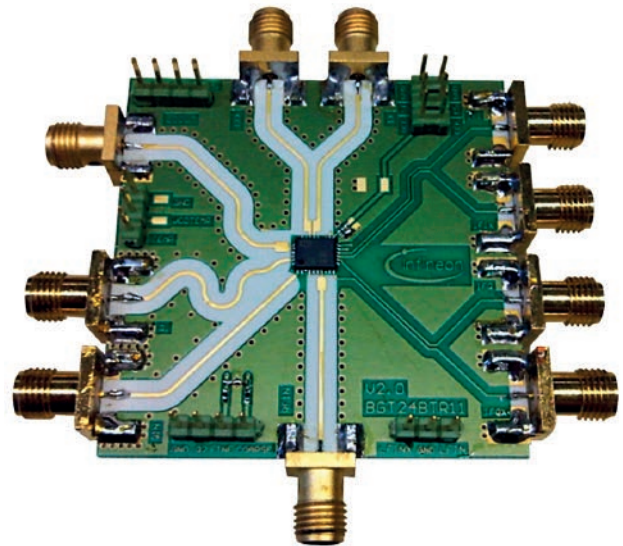
A further key advantage of microwave 24GHz radar solutions for presence detection is their fine resolution in detecting and discriminating the motion of small objects, along with the direction and speed of objects. Microwave radar precision also enables the location of individuals to be determined.

Infineon offers a 24GHz Radar Demonstrator Kit based on the radar transceiver BGT24MTR11 in combination with the microcontroller XMC4500, along with a second kit using BGT24MTR12 together with the microcontroller XMC4400 developed by System Design House partners.

The radar sensor solution based on the BGT24Mxx 24GHz ISM Band Radar Transceiver Family saves around 30% board space compared to discrete line-ups. This is due to the fact that it offers the highest level of integration currently available on the market.

In addition to conserving board space, the high integration of the Infineon solution – where the transmit and receive channels are on a single chip – makes the design easy as no 24GHz RF matching/RF transmission lines are required.

The industrial standard VQFN package can be mounted in standard SMT production lines. Infineon offers 3 different components – the BGT24MTR11 which combines one transmit and one receive channel, the BGT24MTR12 which comprises one transmit and two receive channels, and the BGT24MR2, a chip with two receive channels, combinable with both chipsets.

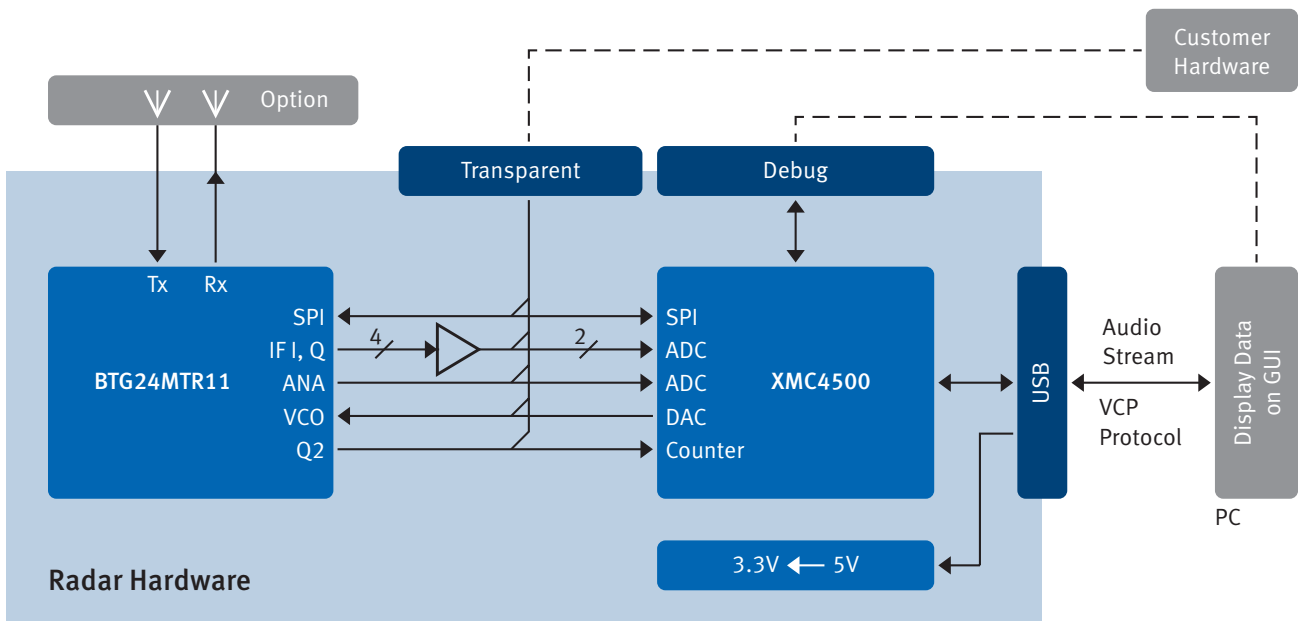


Lighting Applications

- Street lighting
- High bay lighting i.e. for warehouses
- Parking garage lighting
- Mining lights

Features & Benefits

- Temperature range: -40°C ~ 105°C
- Detection range up to 50m @ 500mW power consumption (BGT24MTR11)
- Lower power consumption of 50mW @ 10% duty cycle mode (BGT24MTR11)
- Accuracy in cm-range for near-field operation
- Fully integrated solution, only 1 external blocking-C required
- Enabler for using standard dielectric PCB material (Rogers) and assembly lines for reducing the design-cycle time and production cost by a factor of ~4



From hotline support to a complete solution – Infineon’s System Design House partners offer all stages of support to get your radar system up and running.



RFbeam Microwave GmbH

Ambient Light Sensor

Another way of realizing further energy savings in lighting applications is to make use of the available daylight and to adjust the LED light output to the minimum required level.

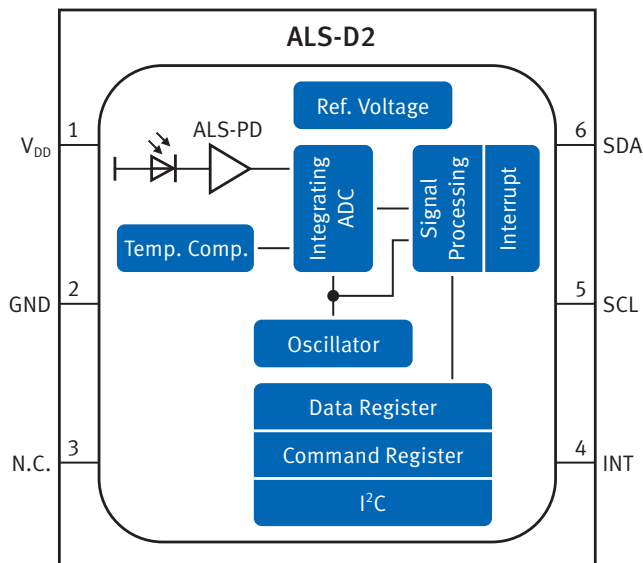
In addition to energy savings, balancing the LED light with daylight increases the quality of light due to the broad spectrum of daylight.

The best way of harvesting daylight involves measuring the available light level. The ambient light sensor ALS-D2 is perfectly suited to measuring daylight due to response characteristics that are highly comparable with the human eye.

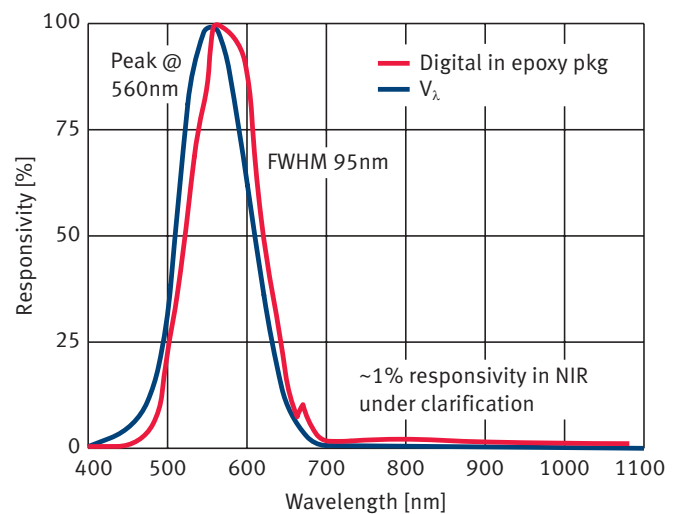
High Accuracy Ambient Light Sensor with an I²C Interface

The ALS-D2 is a high accuracy ambient light digital 16-bit resolution sensor in a miniature transparent small-size package. It includes a highly sensitive photo diode, a low-noise amplifier, a 16-bit A/D converter and supports an easy-to-use I²C bus communication interface and additional interrupt feature. The ambient light result is available as a digital value.

Circuit Block Diagram



Spectral Responsivity



ALS sensitivity spectrum close to the human eye photopic curve V_λ .

Human eye curve adoption achieved via on-chip filtering.

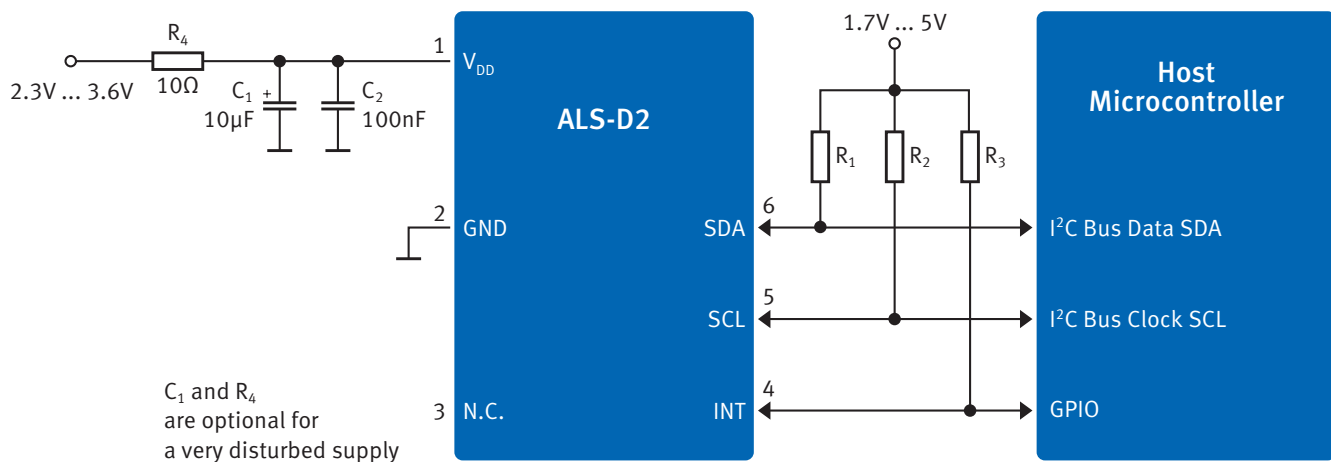
Ambient Light Function

- Built-in photo diode response comparable to the human eye response
- 16-bit dynamic range for ambient light detection from 0lx to ~7.2klx with resolution down to 0.002lx/ct
- 100Hz and 120Hz flicker noise rejection
- Low temperature coefficient
- High accuracy

Features

- Package type: surface mount 6 pin, PCB-based package
- Dimensions (L x W x H in mm): 2 x 2 x 0.85
- AEC-Q101 qualified
- High operating temperature release: -40°C to 110°C
- Supply voltage range V_{DD} : 2.3V to 3.6V
- Communication via I²C interface, I²C bus H-level range: 1.7V to 5V
- Low stand-by current consumption: < 3.5µA, power-down current consumption: 2.3µA
- The ALS-D2 is available as a packaged component or as bare-die on-wafer.

Application Circuit



Light Desk: Lighting Selection & Design Tool

The new Lighting Application Finder enables you to quickly select, design, simulate and buy the right lighting circuit for your application requirements.

The tool comprises residential, commercial, outdoor & architectural – as well as automotive – lighting solutions for various technologies, such as LED, fluorescent, HID, xenon or bulbs.

- Explore the vast Infineon lighting portfolio with more than 1,000 parts (linear and DC/DC driver and controller ICs, μ C, MOSFETs, smart high-side switches, etc.)
- Design & simulate your solution online
- Offline simulation: download the SIMetrix engine, schematics, SPICE models etc.
- Buy the BOM online via Arrow, Digikey, Mouser and Chip1Stop.

Please visit the Light Desk at www.infineon.com/lightdesk

LightDesk
Online LED Design Tool for General Lighting Applications

FIND A SOLUTION SELECT YOUR PARTS ANALYZE SOLUTION VIEW RESULTS VIEW BOM VIEW SUMMARY DOWNLOAD

- Explore the vast Infineon Lighting Portfolio
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- Offline Simulation: Download the Simetrix Engine, Schematics, SPICE Models, etc.
- Buy the BOM online via DigiKey, Mouser, Arrow

Feedback

SCREENSHOTS

STEP-BY-STEP GUIDE

Step-by-Step Guide
Short introduction how to use the online design tool

SAMPLE DELIVERABLES

Sample BOM Sample Report

+ Supported Parts [Lighting Products](#) MOSFETs (CoolMOS™, OptiMOS™) Smart High-Side Switches (PROFET™, SPOC™) Diodes Microcontrollers (ARM® Cortex™-M0)

AC/DC Offline PWM/PFC Driver IC
ICL8001G ICL8002G ICL8002G ICL8001G ICL8002G

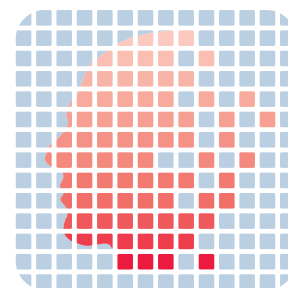
Basic Linear LED Driver IC (Automotive)
TLD1121EL TLD1124EL TLD1125EL TLD1313EL TLD1314EL TLD2311EL TLD2314EL

DC/DC Driver IC
ILD2035 E6327 ILD4035 E6327 ILD4071 ILD4120 E6327 ILD4180 ILD6070 ILD6150

DC/DC Driver IC (Automotive)
TLD5045EJ TLD5085EJ

DC/DC LED Controller IC (Buck)
ILD4001 E6327

DAVE™ Teams up with the Well-Established ARM® Ecosystem



With DAVE™, software developers can generate a tailored software library to efficiently use the innovative set of peripherals of the XMC microcontrollers. DAVE™ is a free and complete development platform based on Eclipse CDT including the ARM GNU compiler, a free debugger with Flash loader and the data visualization tool xSPY.

The generated code can be also used in third-party tools such as Atollic, IAR, Keil MDK, Rowley and TASKING.

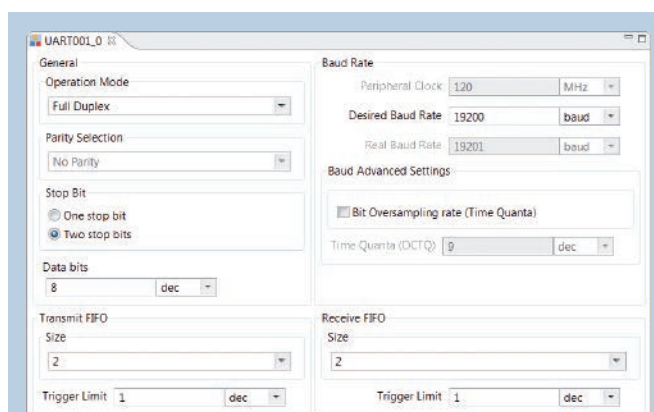
DAVE™ comes with an extensive and powerful library of applications – DAVE™ Apps. DAVE™ Apps are object-oriented software building blocks. A DAVE™ App represents an application use case such as the generation of a PWM signal, measurement of analog signals or various types of data communication. Even middleware components such as communication stacks, file systems or specific target applications like motor control or lighting are available as DAVE™ Apps.

<p>Service Apps</p> <ul style="list-style-type: none"> ■ Clock, Reset ■ Power mgmt. ■ Watchdog ■ DMA ■ NVIC/Exception ■ I/O, EBU, Flash ■ Debug log ■ ... 	<p>Standard Middleware Apps</p> <ul style="list-style-type: none"> ■ USB stack, and drivers ■ TCP/IP stack ■ SD/MMC, File system ■ GUI lib plus LCD driver ■ RTOS
<p>Specific Middleware Apps</p> <ul style="list-style-type: none"> ■ Motor control ■ Lighting ■ Power conversion ■ HMI 	<p>Peripheral Apps</p> <ul style="list-style-type: none"> ■ PWM, Capture, Timer, Counter ■ UART, SPI, I²C CAN, ... ■ ADC, DAC, ... ■ POSIF, ...

Select a DAVE™ App from a large library of more than 170 Apps

For more information and free downloads, visit www.infineon.com/dave

A major innovation highlight of DAVE™ is the resource solver. While the user selects and configures the DAVE™ Apps on a logical level, the resource solver ensures that the necessary chip resources are properly assigned and mapped. Resource mapping can be done fully automatically by the solver which takes into consideration the required inter-chip connectivity and user-defined constraints such as manually assigned pins.



Configure the DAVE™ App using a graphical user interface

The code generated based on the selected and configured DAVE™ Apps is in fact a software library which is accessible as a fully documented and human-readable source code that provides all the functions (APIs) required to build the final application. With DAVE™, software developers are free to concentrate on differentiating their IP, leaving the time-consuming, low-level and middleware work to DAVE™ Apps.

```
int main(void)
{
    //Initialization of the HW used by DAVE
    DAVE_Init();
    // Send data via UART channel defined in hand
    UART001_WriteData(UART001_Handle0,data);
    // Read data via UART channel defined in hand
    Readdata = UART001_ReadData(UART001_Handle0);
}
```

Complete your application using the APIs or macros from the generated library.

Evaluation Boards & Kits

Board Name	Product	Description	Order Number
Evaluation board ICB2FL01G	ICB2FL01G CoolMOST™ MOSFET	Demoboard for 54W T5 single fluorescent lamp design with voltage mode preheating using ICB2FL01G	AN ICB2FL03G www.infineon.com/smartlighting
Evaluation board ICB2FL02G	ICB2FL03G CoolMOST™ MOSFET	Demoboard for dimmable 26W TC-TEL single fluorescent lamp design using ICB2FL02G	AN ICB2FL03G www.infineon.com/smartlighting
Evaluation board ICB2FL03G	ICB2FL03G CoolMOST™ MOSFET	Demoboard for 54W T5 single fluorescent lamp design with voltage mode preheating using ICB2FL03G	AN ICB2FL03G www.infineon.com/smartlighting
230V isolated dimmable LED bulb board	ICL8002G SPD02N80C3	Demoboard for dimmable 13W LED bulb in isolated flyback topology	EVALLED-ICL8002G-B1
120V non-isolated dimmable LED bulb board	ICL8002G IPD60R2K0C6	Demoboard for dimmable 12W LED bulb in non-isolated buck topology	EVALLED-ICL8002G-B2
120V isolated dimmable LED PAR38 board	CL8002G IPI60R190C6 IPD60R600C6 BSS225	Demoboard for dimmable 20W LED PAR38 in isolated flyback topology	EVALLED-ICL8002G-B3
MR16 3W board	ILD4035 4x BAS3010A	Control board for 3W MR16 low-voltage halogen	MR16 3W board
MR16 7W board	ILD4001 BSR302N	Control board for 7W MR16 low-voltage halogen replacement lamps	MR16 3W board
MR16 10W board	ILD4001 BSR302N	Control board for 10W MR16 low board voltage halogen replacement lamps	MR16 10W board
ILD4001 0.7A board	ILD4001 BSR302N	Evaluation board for high-power LEDs at ILD4001 0.7A board DC voltage input using ILD4001	ILD4001 0.7A board
ILD4001 1A board	ILD4001 BSP318S	Evaluation board for high-power LEDs at ILD4001 1A board DC voltage input using ILD4001	ILD4001 1A board
ILD4120 board	ILD4120	Evaluation board for high-power LEDs at ILD4120 board DC voltage input using ILD4120	ILD4120 board
ILD4035 12V board	ILD4035	Evaluation board for high-power LEDs at ILD4035 12V board 12DC voltage input using ILD4035	ILD4035 12V board
ILD4035 24V board	ILD4035	Evaluation board for high-power LEDs at ILD4035 24V board 24DC voltage input using ILD4035	ILD4035 24V board
ILD1151 in boost in voltage mode topology	ILD1151	Boost to GND configuration (B2G) – topology BOOST in voltage mode	Demoboard ILD1151 Ver1
ILD1151 in boost topology	ILD1151	Boost to GND configuration + short to GND protection (B2G + S2G) – topology BOOST	Demoboard ILD1151 Ver2
ILD1151 in buck-boost topology	ILD1151	Boost to battery (B2B) – topology BUCK/BOOST	Demoboard ILD1151 Ver3
ILD1151 in buck-boost topology (SEPIC configuration)	ILD1151	SEPIC configuration – topology BUCK/BOOST	Demoboard ILD1151 Ver4
BCR450 board	BCR450 BAS3007A-RPP	Evaluation board for mid- & high-power board LEDs voltage input using BCR450	BCR450 board
BCR320U board	BCR320U BAS3007A-RPP	Evaluation board for mid-power LEDs voltage input using BCR320U	BCR320U HW LED board
BCR402W 12V board	BCR402W BAS3010A	LED strip for low-power LEDs voltage input using BCR402W	BCR402W 12V LED board
BCR402W 24V board	BCR402W BAT64-03W	LED strip for low-power LEDs voltage input using BCR402W	BCR402W 24V LED board
ILD6070 board	ILD6070	Evaluation board for high-power LEDs at EVALLED-ILD6070DC voltage input using ILD6070	EVALLED-ILD6070
ILD6150 board	ILD6150	Evaluation board for high-power LEDs at EVALLED-ILD6150DC voltage input using ILD6150	EVALLED-ILD6150
Evaluation board XC82x Easy Kit	XC822	Evaluation board for XC82x 8-bit microcontroller series	KIT_XC822_EK_V1
Evaluation board XC83x Easy Kit	XC836	Evaluation board for XC83x 8-bit microcontroller series	KIT_XC836_EK_V1
DALI PHY adapter	XC836	Adapter board to connect 8-bit microcontroller evaluation boards to simulate and configure a DALI network on a physical DALI bus	KIT_XC822_XC836_DALI
LED Lighting Application Kit	XMC1200	Microcontroller (32-bit)	KIT_XMC1x_AK_LED_001
XMC1200 Boot Kit	XMC1200	Microcontroller (32-bit)	KIT_XMC12_BOOT_001



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Published by
Infineon Technologies AG
85579 Neubiberg, Germany

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Order Number: B127-H9377-G4-X-7600
Date: 03 / 2014

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