Efficient Lighting

Complete Solutions for Driving LEDs and Lamps

[www.infineon.com/lighting]

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Complete Solutions for Driving LEDs and Lamps

INFINEON DELIVERS INNOVATIVE, high-performance solutions with best-in-class technologies that can be used in a broad portfolio of applications ranging from room to automotive lighting, the activation of light sources, energy-saving lamps and light management systems. Our product portfolio consists of lamp ballast controllers as well as LED and lamp driver solutions characterized by high efficiency and cost effectiveness, which meet the evolving and expanding requirements of lighting applications.

- Highly efficient off-line LED driver IC for incandescent bulb replacement, lamp retrofits
- Smart ballast controller for fluorescent lamps
- CoolSET™ ICs for efficient off-line LED power supplies
- Low-cost BCR 4xx series LED drivers designed for industrial and automotive applications
- High-performance driver ICs with integrated diagnostic functions that are designed to supply constant current to white or color LEDs up to 500mA
- PROFET™ switches for advanced high-side applications

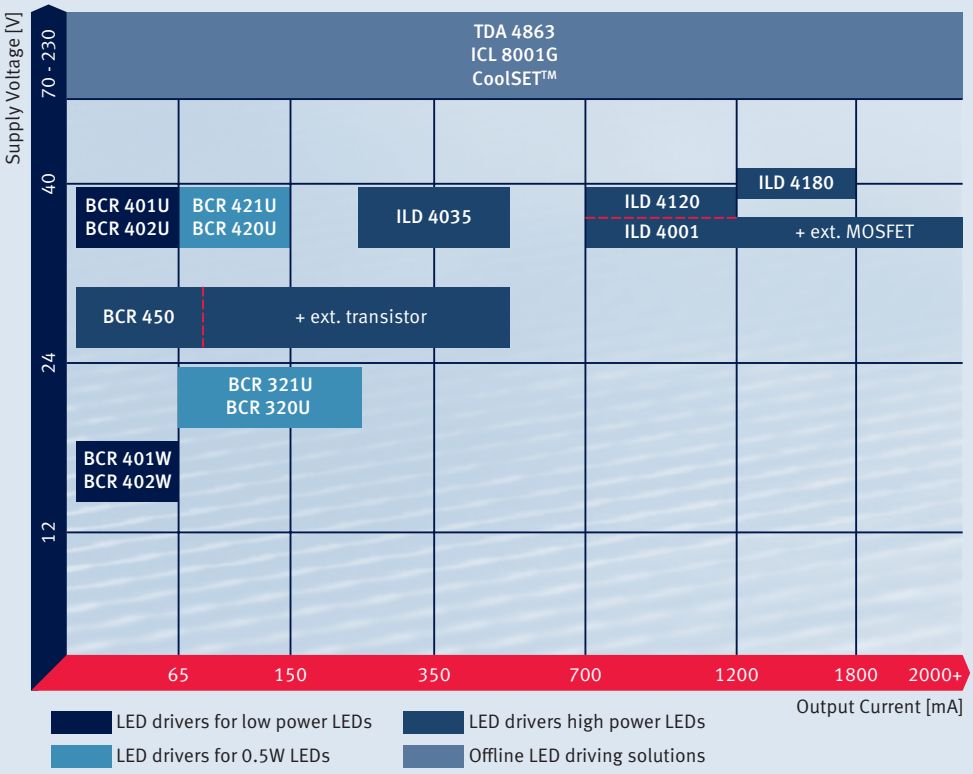
Due to our highest level of quality, service and technology, Infineon is an OSRAM “LED Light for you” certified partner, who supports costumers with outstanding and forward-looking solutions for Solid State Lighting (SSL).

LED Light for you powered by OSRAM CERTIFIED PARTNER

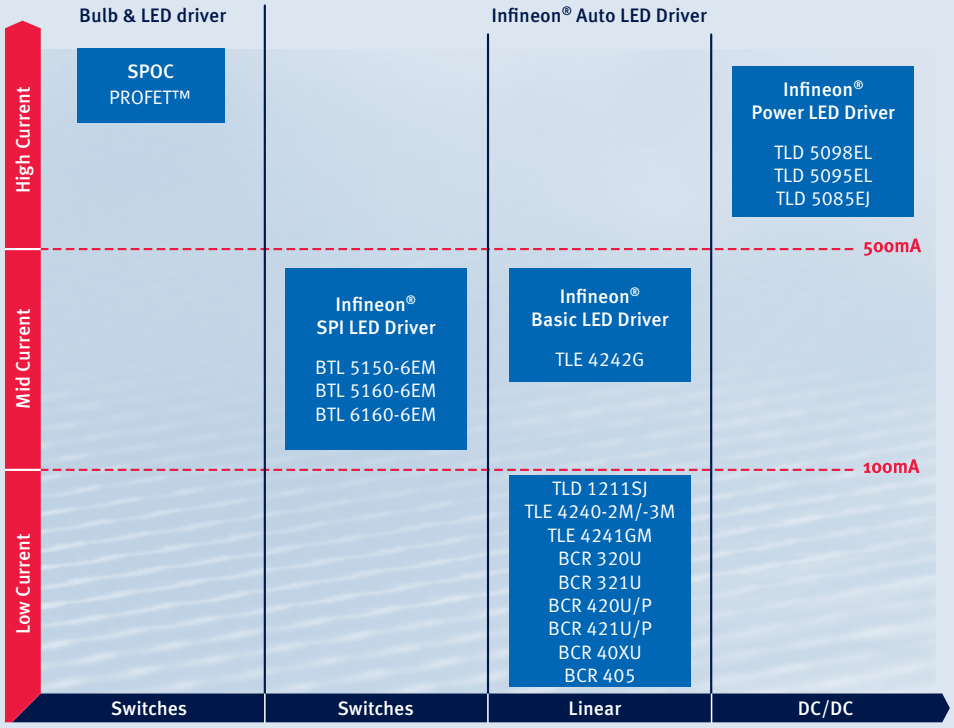
Smart ballast controllers

		Device		
		ICB 1FL02G	ICB 2FL01G	ICB 2FL02G
Technical Features	η › 90% @ low line Input Voltage	✓	✓	✓
	PF close to 1	✓	✓	✓
	THD	< 10%	< 5%	< 5%
	Improved THD in DCM	–	✓	✓
	Integrated High and Low Side	✓	✓	✓
	Integrated PFC	✓	✓	✓
	Supports Multilamp Design 1 - 4 Lamps	✓	✓	✓
	Universal Input Voltage Range Design	✓	✓	✓
Application Specific Features	EOL1 & 2 Detection	✓	adj.	adj.
	CapLoad 1 & 2 Detection	✓	1	✓
	Filament Detection	✓	✓	✓
	Dead Time: adjustable and self adapting	fix	✓	✓
	Emergency Lighting	–	✓	✓
	Supports Customer IN Circuit Test Mode	–	✓	✓
	Supports Choke Saturation during Ignition	–	✓	✓
	Supports low EMI Topologies	✓	✓	✓
	Supports Dimming	–	✓	✓

LED drivers for general lighting and industrial applications



LED and lamp drivers for automotive applications



General & Industrial

Outdoor lighting

- BCR 450
- TLE 4309
- ILD 4xxx
- ICL 8001G
- CoolSET™
- TDA 4863

Advertising and channel letters

- BCR 32x
- BCR 40x / BCR 450
- BCR 42x
- ICL 8001G
- CoolSET™

Architectural lighting

- BCR 32x
- BCR 40x / BCR 450
- BCR 42x
- TLE 4309
- ILD 4xxx
- ICL 8001G
- CoolSET™
- TDA 4863
- Smart Ballast IC

Indoor lighting

- BCR 32x
- BCR 40x / BCR 450
- BCR 42x
- TLE 4309
- ILD 4xxx
- ICL 8001G
- CoolSET™
- TDA 4863
- Smart Ballast IC

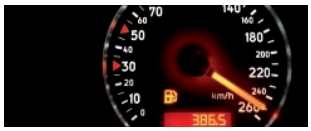
- Linear LED Drivers
- DC/DC LED Drivers
- Off-Line LED Drivers
- Current and Voltage Controller
- Smart Ballast Controllers
- Industrial MOSFETs
- Industrial Microcontrollers

- Linear LED Drivers
- DC/DC LED Drivers
- Switches
- Automotive MOSFETs
- Automotive Microcontrollers

Automotive

Backlighting

Dashboard



- BCR 40x
- TLE 424x
- BTL 5150-6EM
- BTL 5160-6EM
- BTL 6160-6EM

Navigation system

- BCR 40x
- TLD 5095EL
- TLD 5098EL
- BTL 5150-6EM
- BTL 5160-6EM
- BTL 6160-6EM

Interior

Interior illumination

- TLE 424x
- TLD 5085EJ
- BTL 5150-6EM
- BTL 5160-6EM
- BTL 6160-6EM

Interior indication

- BCR 40x
- TLE 424x
- TLD 5085EJ

Exterior

Front lighting / daytime running light

- TLD 5095EL
- TLD 5098EL
- SPI Power Controller (SPOC)
- PROFET ™

Rear/signal lighting

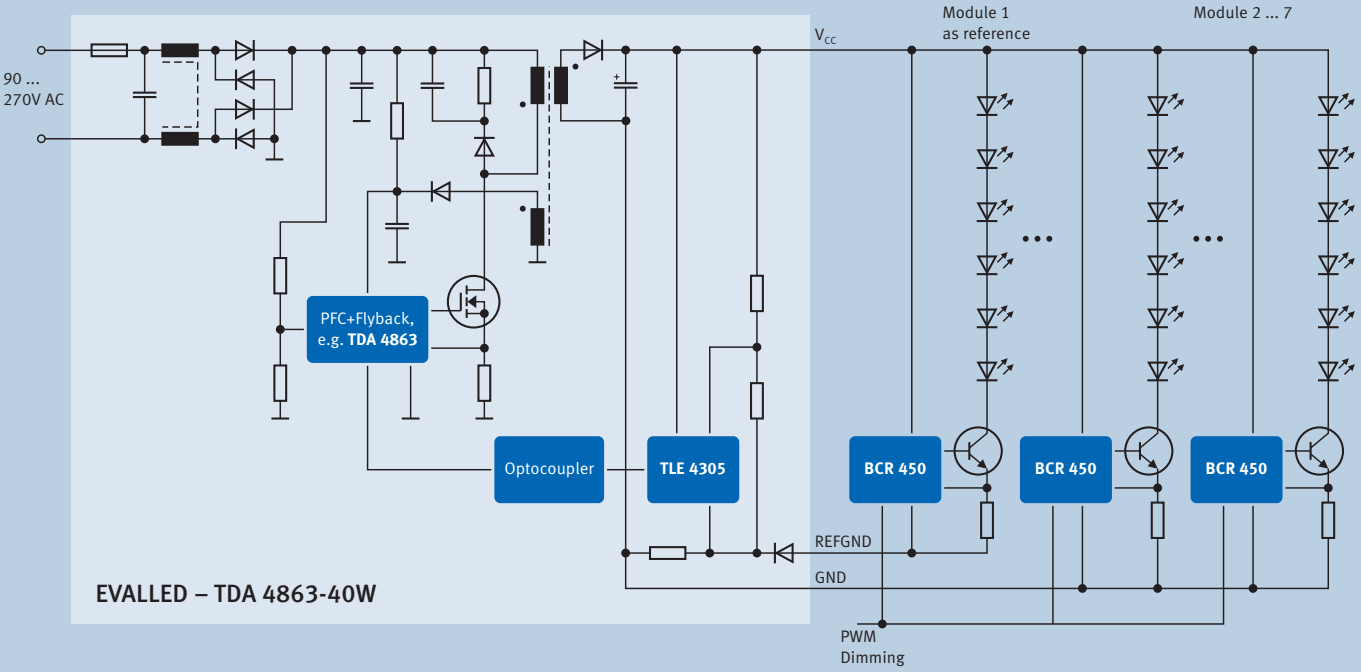
- BCR 40x
- TLE 424x
- TLD 5085EJ
- TLD 5095EL
- TLD 5098EL
- BTL 5150-6EM
- BTL 5160-6EM
- BTL 6160-6EM
- SPI Power Controller (SPOC)
- PROFET ™

General and Industrial Lighting

GLOBAL CONCERNS OVER climate change require to use our limited energy resources more efficiently. For a cleaner and sustainable future energy efficiency plays a key role. Approximately 20% of the global electrical energy is consumed for lighting applications. Emerging LED lighting applications are perfect candidates to address energy efficient solutions combined with environmental friendly materials. Transformation to new, intelligent LED lighting technologies for residential, commercial, industrial and outdoor lighting allow significant energy savings.

Infineon as global number 1 ranking Power Semiconductor Market leader for the last 6 consecutive years, offers an innovative product portfolio for off-line LED lighting applications supporting benchmark efficiency improvements, system miniaturization, reliability and overall cost savings.

40W Street and Indoor LED Lighting Solution



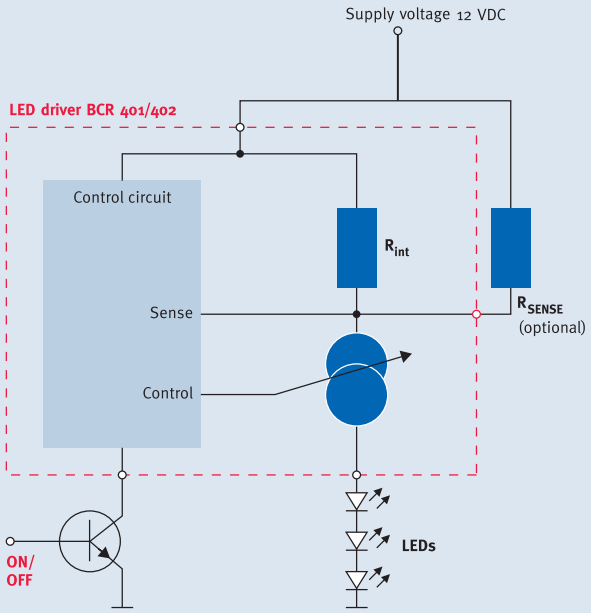
- PFC-DCM control IC as SMPS for conversion from 90 – 270V AC to 24V DC
- One linear LED driver BCR 450 per string in combination with a booster transistor control the LEDs

INFINEON OFFERS YOU an advantage through optimized system solutions. Via a combination of single-stage PFC+Flyback AC/DC converter, constant current control and linear drivers, the Infineon system sollution allows a high power factor, energy efficiency and low EMI. To cut a long story short: High performance at low system costs.

BCR 401W/BCR 402W

Lowest cost LED drivers for low power LEDs

Application Example



THE BCR 401W/BCR 402W ARE THE smallest size and lowest cost LED drivers.
The advantages versus resistor biasing are:

- Long life time of LEDs due to constant current in each LED string
- Homogenous LED light independent of V_f temperature increase and supply voltage variations
- See application note AN182 (page 35) for details on replacing resistors.

The advantages versus discrete solutions are:

- Only one part instead of a multiple components
- Pretested output current

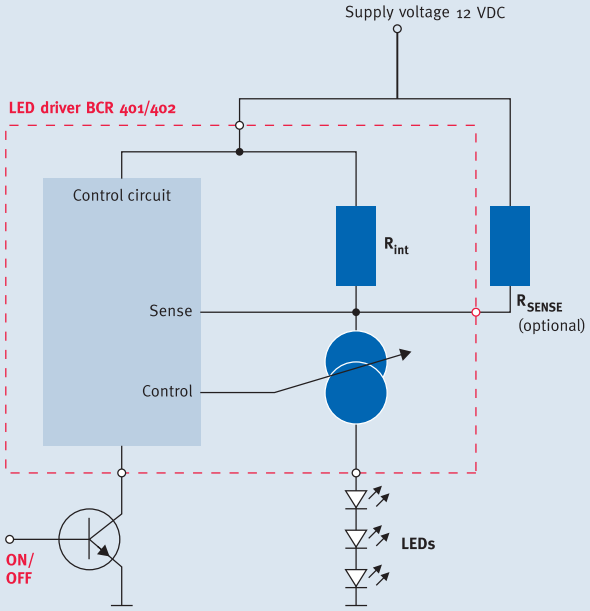
Key Features & Benefits

- Output current from 10mA up to 60mA (adjustable by external resistor)
- Supply voltage up to 24V (details in application note AN097)
- Reduction of output current at high temperatures contributing to long lifetime of LEDs
- Easy to use
- Power dissipation of 500mW
- Very small SOT-343 package

BCR 401U/BCR 402U/BCR 405U

Low cost LED drivers for low power LEDs

Application Example



THE BCR 40XU ARE THE LOW COST LED drivers for low power LEDs with a higher input voltage and higher power dissipation than BCR 40xW types.

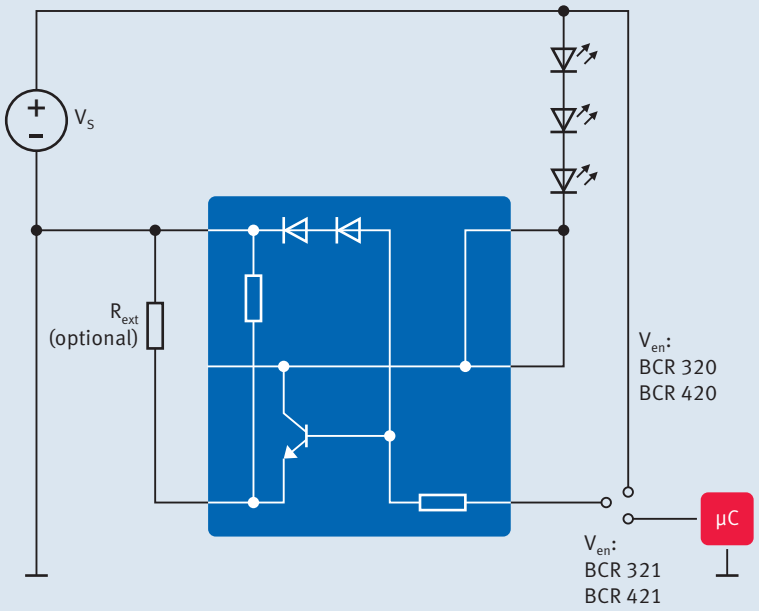
Key Features & Benefits

- Output current from 10mA up to 65mA (adjustable by external resistor)
- Supply voltage of 40V or higher (details in application note AN097)
- Reduction of output current at high temperatures contributing to long lifetime of LEDs
- Easy to use
- Power dissipation of 750mW
- Small size SC-74 package

BCR 32xU/BCR 42xU

Low cost LED drivers for medium power LEDs

Application Example



THE BCR 32XU AND BCR 42XU LED DRIVERS are dedicated LED drivers for 0.5W LEDs with a maximum output current of 250mA. They are optimized in terms of cost, size and feature set for medium power LEDs.

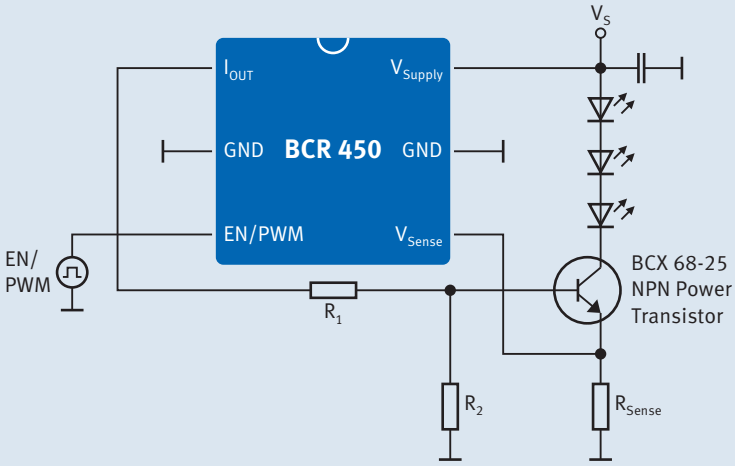
Key Features & Benefits

- Output current from 10mA up to 250mA for BCR 32xU (150mA for BCR 42xU)
- Supply voltage of 40V or higher for BCR 42xU (24V for BCR 32xU)
- Direct microcontroller interface for dimming at the BCR 421U and BCR 321U
- Reduction of output current at high temperatures contributing to long lifetime of LEDs
- Easy to use
- Power dissipation of 1000mW
- Small size SC-74 package

BCR 450

Low voltage drop LED controller for medium & high power LEDs

Application Example



THE BCR 450 IS AN LED CONTROLLER used in combination with a bipolar transistor to drive medium power and high power LEDs.

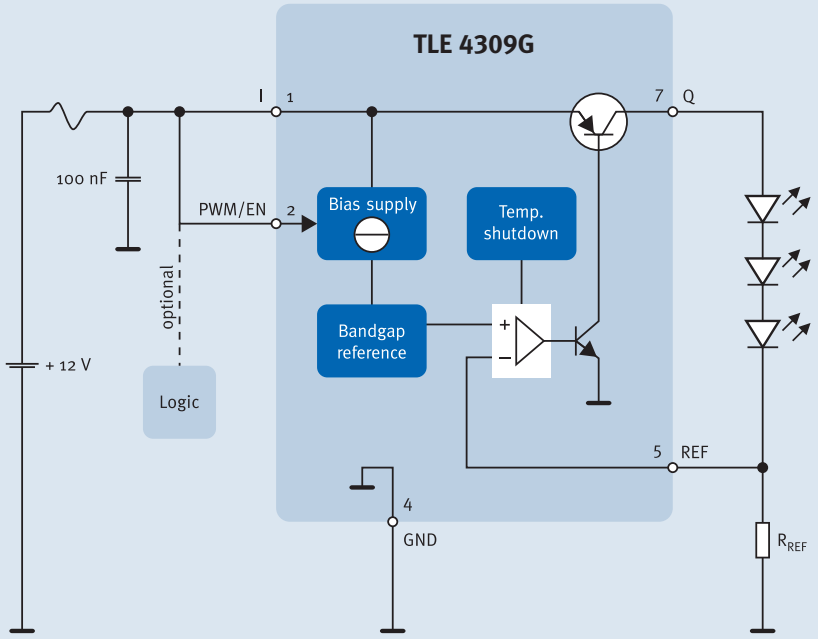
Key Features & Benefits

- Linear LED controller
- Very low voltage overhead of 0.5V including sense resistor & external transistor
- Thermal shutdown protects the LEDs from thermal overstress
- No EMI problems
- No lifetime limiting electrolytic capacitors required
- Benchmark in cost due to flexible external power stage

TLE 4309G

500mA adjustable linear LED driver

Application Example



Key features

- Adjustable constant current up to 500mA
- PWM/Enable input
- <1µA quiescent current when disabled
- Overtemperature protection
- Short-circuit proof
- Reverse polarity protection
- TO-263 package

THE TLE 4309G IS AN INTEGRATED ADJUSTABLE constant current source for driving loads up to 500mA. The output current level can be adjusted with an external shunt resistor. Supplying high-power LEDs with the TLE 4309G ensures constant brightness independent from supply voltage or LED forward voltage spread. Therefore, LED lifetime is extended by protecting from overcurrent and overtemperature. The PWM/EN input permits LED brightness regulation by pulse width modulation. Setting the pin to “low” switches off the IC entirely. Due to the high impedance of the PWM/EN input, the TLE 4309G can be used as a protected high-side switch. Protection circuits prevent damage to the IC in case of overload, short circuit, and reverse polarity. A chip temperature monitoring circuit shuts off the power stage and prevents the IC from destruction under fault conditions. The LEDs are also protected against reverse supply. Input voltage peaks up to 45V are absorbed by the IC, preventing the LEDs from overcurrent. The TLE 4309G is provided in the surface mounted PG-TO-263.

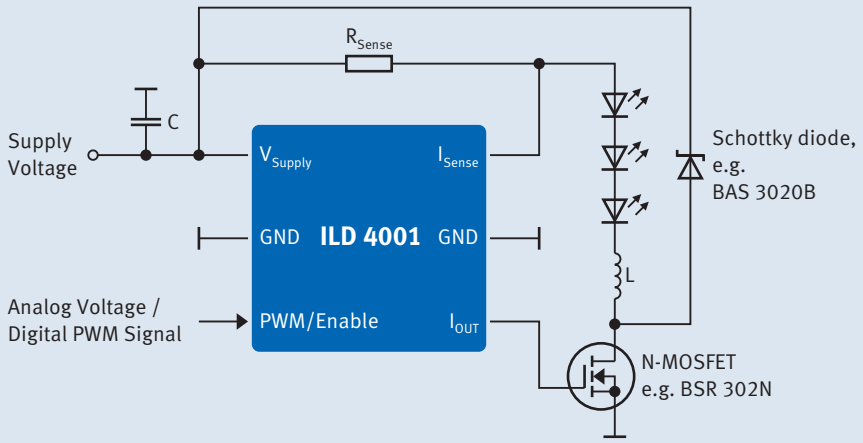
Benefits

- Supports all LEDs with currents up to 500mA
- Exact brightness setting
- Complete protection
- Allows extended LED lifetime

ILD 4001

LED controller with external MOSFET for high-power LEDs

Application Example



THE ILD 4001 IS A STEP DOWN LED CONTROLLER with external power stage in a very small SC-74 package tailored to drive LEDs with 700mA up to 10A.

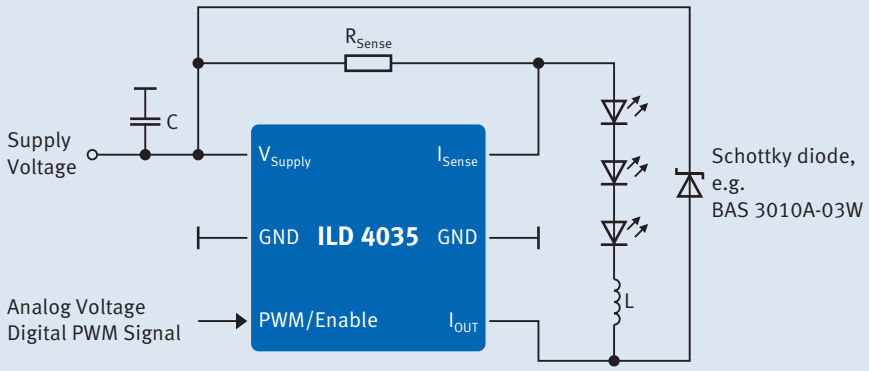
Key Features & Benefits

- Output current of 700mA up to 10A with external MOSFET
- Input voltage range from 4.5V to 40V
- Up to 500kHz switching frequency
- PWM and analog dimming
- Protection functions like overvoltage, overcurrent and thermal shutdown
- Very small 6-pin SC-74 package

ILD 4035

350mA LED driver for general lighting

Application Example



THE ILD 4035 IS A STEP DOWN CONVERTER with integrated power stage in a very small SC-74 package tailored to drive 1W LEDs.

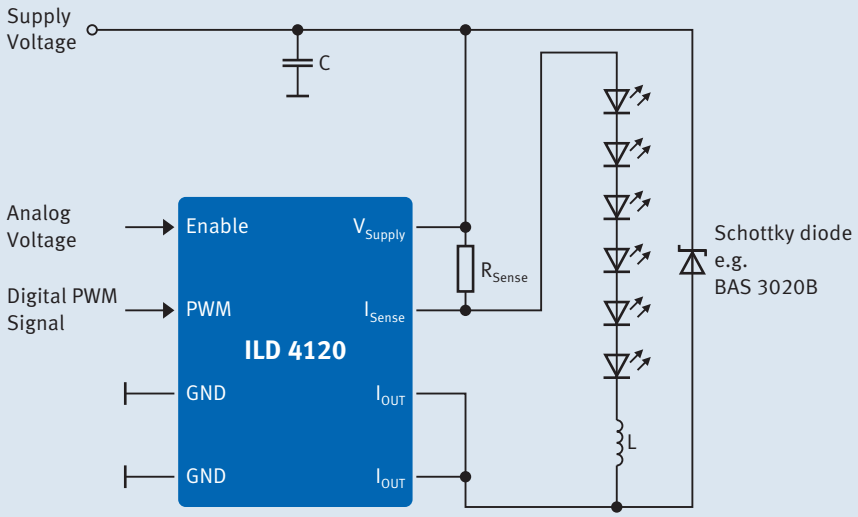
Key Features & Benefits

- 350mA output current (max. output current of 500mA)
- Integrated power stage
- Input voltage range from 4.5V to 40V
- Up to 500kHz switching frequency
- PWM and analog dimming
- Protection functions like overvoltage, overcurrent and thermal shutdown
- Very small 6-pin SC-74 package

ILD 4120

1.2A LED driver for general lighting

Application Example



THE ILD 4120 IS A STEP DOWN CONVERTER with integrated power stage in a small thermally enhanced DSO-8 package tailored to drive 3W LEDs.

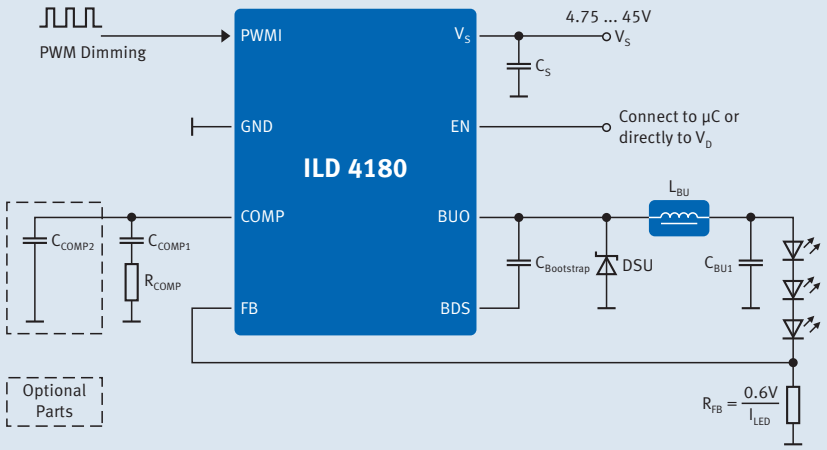
Key Features & Benefits

- 1200mA output current (max. output current of 1500mA)
- Integrated power stage
- Input voltage range from 4.5V to 40V
- Up to 500kHz switching frequency
- PWM and analog dimming
- Protection functions like overvoltage, overcurrent and thermal shutdown
- Small 8-pin thermally enhanced DSO-8 package

ILD 4180

1.8A LED driver for ultra-high-power LEDs

Application Example



THE ILD 4180 IS A MONOLITHIC INTEGRATED high-brightness LED driver circuit, that provides all active functions for a constant current switching regulator, capable of delivering up to 1.8A load current with excellent line and load regulation.

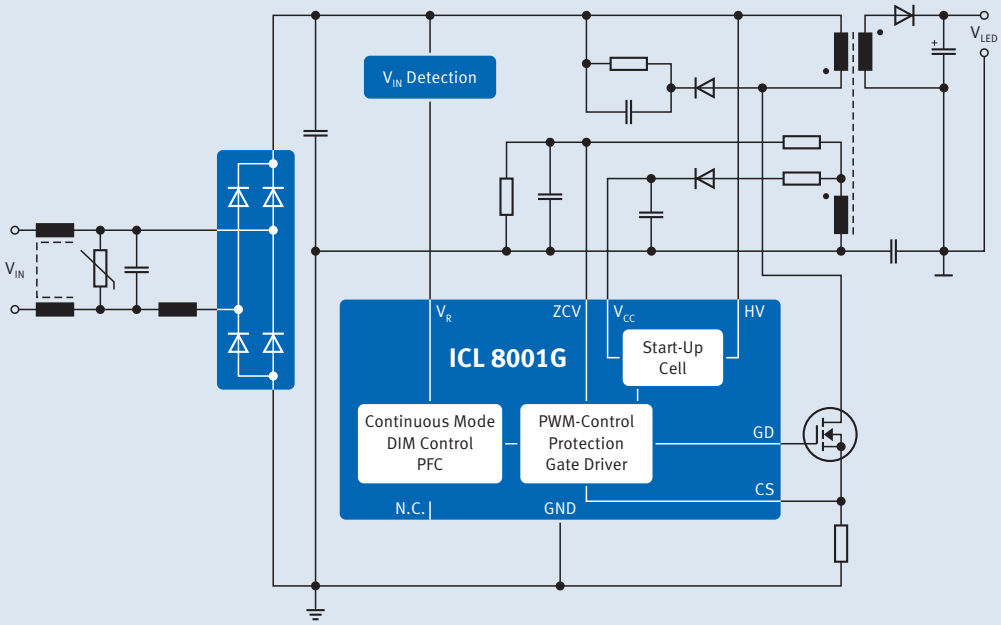
Key Features & Benefits

- Adjustable up to 1.8A constant current
- Typical output voltage: V_{BAT} –1V difference
- Integrated power stage
- Input voltage range from 4.75V to 45V
- 370kHz switching frequency
- PWM input for LED dimming and enable input pin
- Very small, thermally enhanced package
- Few external components because of high integration

ICL 8001G

Single stage flyback and PFC controller for off-line LED lighting applications

Application Example



ICL 8001G IS DESIGNED FOR OFF-LINE LED lighting applications with high efficiency requirements such as incandescent bulb replacements (40/60/100W) and lamp retrofits. Infineon provides a single stage flyback solution with PFC and dimming functionality. Innovative primary control techniques combined with accurate PWM generation for phase cut dimming enable solutions with significant reduced component count on a single sided driver PCB for smallest form factor.

Benefit

- ICL 8001G simplifies LED driver implementation at best-in-class BOM costs

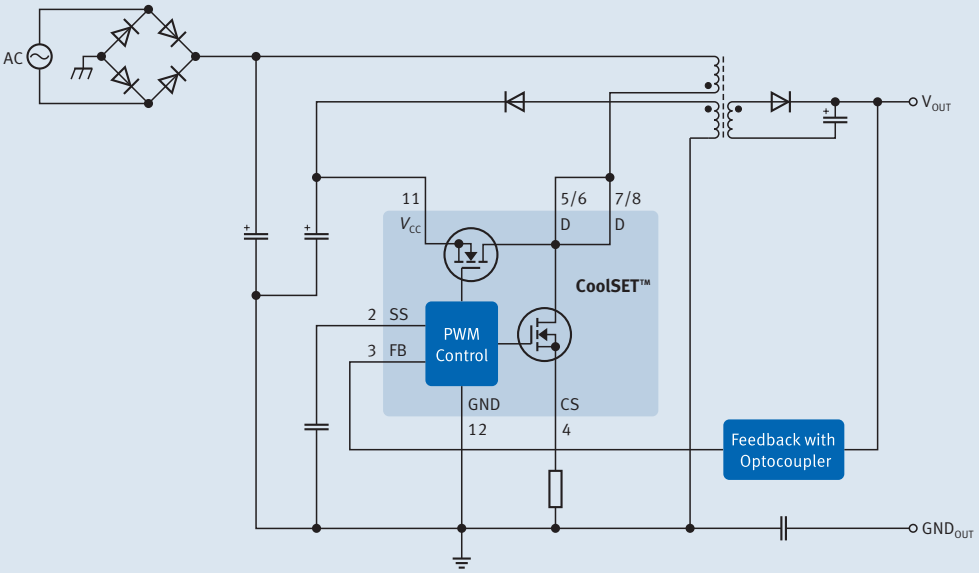
Key Features

- High and stable efficiency over wide operating range
- Optimized for trailing- and leading-edge dimmer
- Precise PWM for primary PFC and dimming control
- Power cell for V_{CC} pre-charging with constant current
- Built-in digital soft-start
- Foldback correction and cycle-by-cycle peak current limitation
- V_{CC} over-/undervoltage lockout
- Auto restart mode for short circuit protection
- Adjustable latch-off mode for output overvoltage protection

CoolSET™

Off-line LED driver solution for higher power LEDs

Application Example for LED driver ‹25W



Key Features

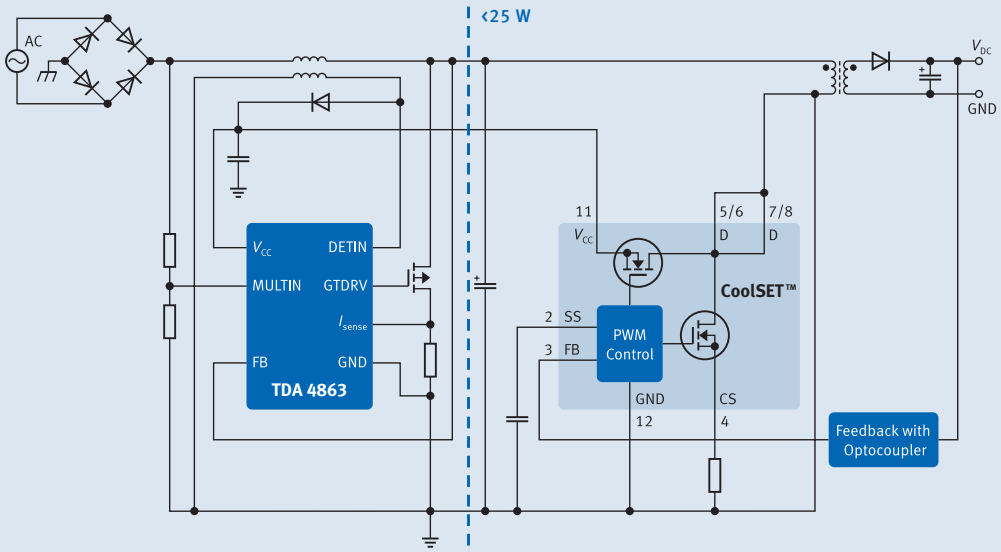
- Integration of control IC and leading-edge CoolMOS™ FET technology
- 650V or 800V rated for universal input compatibility
- Start-up cell for reduced component count
- Low standby power
- Frequency jitter for good EMC performance
- Overvoltage protection
- Overcurrent protection
- Overtemperature protection
- Auto restart

FOR HIGH POWER LEDS INFINEON TECHNOLOGIES provides a compact and flexible off-line LED driver solution, which is designed for maximum safety, reliability and improved EMI performance, while protecting the LEDs during load transients. The compact design is suitable for universal input voltage and drives up to ten series LEDs at typical 350mA with high efficiencies. The circuit also features a highly accurate output current control and a very low stand-by power rating during no load condition.

Benefit

- CoolSET™ simplifies LED driver implementation with minimized external component count

Application Example for LED driver ›25W



Key Features TDA 4863

- Discontinuous Conduction Mode (DCM) Power Factor Correction (PFC) Controller
- High power factor, low THD
- Internal startup with low current consumption
- UVLO with hysteresis
- Output overvoltage protection
- Excellent light load behaviour
- Totem pole output with active shutdown
- DSO-8 & DIP-8 packages

Benefits

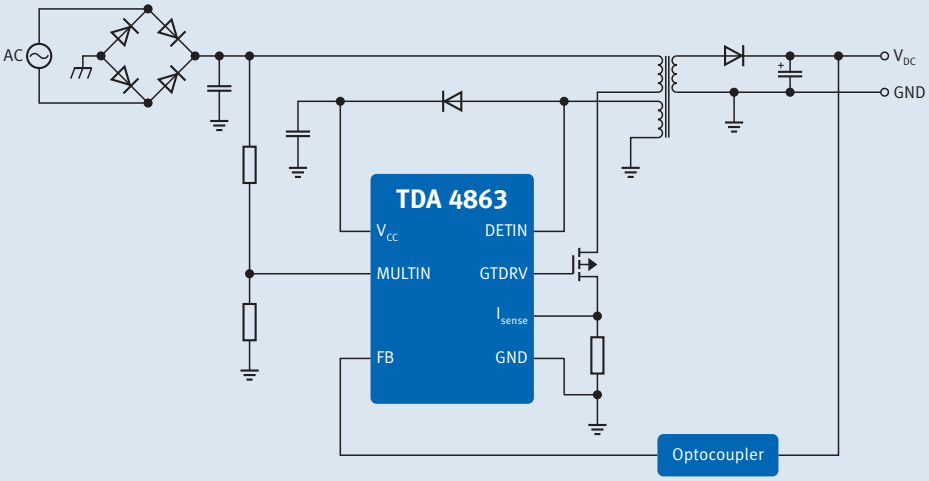
- Active power factor correction with TDA 4863
- Flexible and modular design
- High lifetime through system without electrolytic capacitor
- Low EMI filter requirements
- Universal input range

RoHS

TDA 4863

PFC-DCM controller for off-line LED lighting applications

Application Example



Key Features

- Single Stage PFC and flyback control
- Power factor close to one
- Zero current detector for discontinuous operation mode
- V_{CC} overvoltage protection
- V_{CC} undervoltage lockout
- Internal start-up timer with low current consumption
- Internal leading-edge blanking

THE TDA 4863 IC PROVIDES PFC AND FLYBACK FUNCTIONALITY in a single stage topology. In comparison to a classical two stage approach this topology allows significant system BOM reduction. The concept is optimized for driving LEDs in general- and street-lighting applications with a power range of up to 80W.

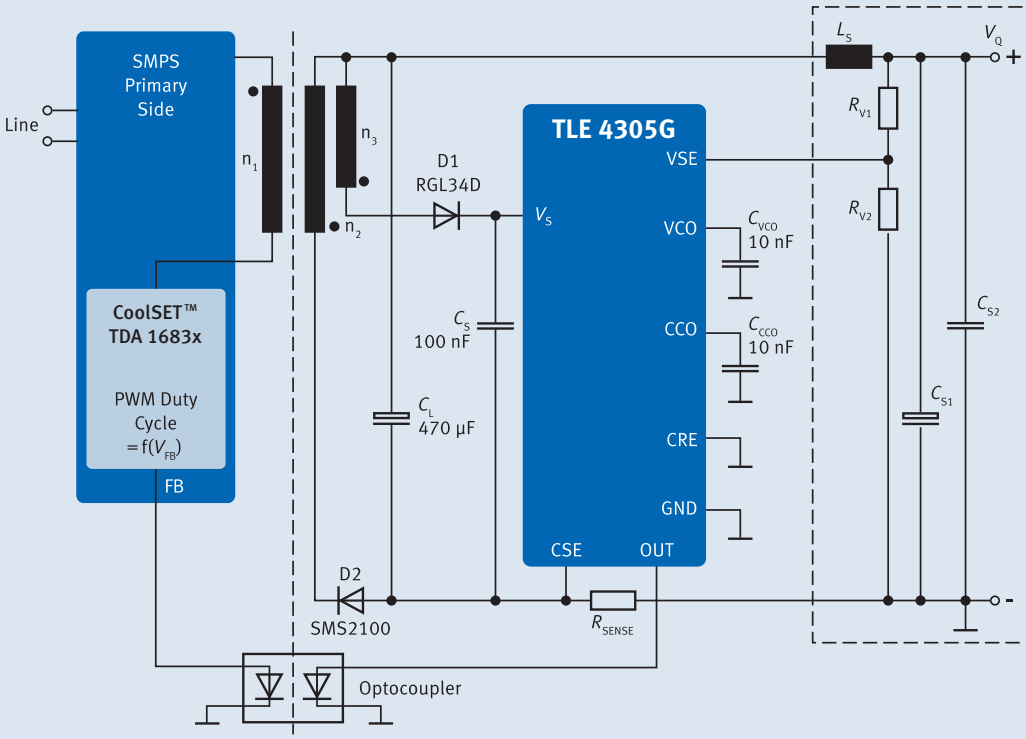
Benefits

- Constant LED current regulation and/or constant voltage regulation at the output
- Discontinous conduction mode controller allows optimum efficiency
- High power factor, low THD
- UVLO with hysteresis
- Cycle-by-cycle input current limitation

TLE 4305G

Current and voltage controller

Application Example



THE TLE 4305G IS SPECIFICALLY DESIGNED to control the output voltage and the output current of a switch mode power supply. Independent compensation networks for the voltage- and for the current-loop can be realized with external circuitry.

The device contains a high accuracy bandgap reference voltage, two Operational Transconductance Amplifiers (OTA), an optocoupler driver output stage and a high-voltage bias circuit. The device is based on the Infineon Double-Isolated Power Line technology (DOPL), which allows to produce high precision bipolar-voltage regulators with breakdown voltages of up to 45V.

Benefits

- Minimized Bill-Of-Material (BOM)
- Integrated temperature compensated current and voltage
- Operational Transconductance Amplifier (OTA)
- Driver for optocoupler implemented

Key Features

- Wide supply voltage operation range
- Wide ambient temperature operation range
- Minimized external circuitry
- High voltage regulation accuracy
- High current-limit regulation accuracy
- Low temperature drift
- Internal fixed amplification
- Independent voltage and current-loop compensation
- DSO-8 package

Smart Ballast Controllers

SMART BALLAST CONTROL ICS FROM INFINEON INTEGRATE all of the lamp start, run and protection features required by current and future fluorescent lamp ballasts. Digital mixed signal power control is employed enabling speedy, cost effective and stable ballast designs with the minimum of external components. Reliable and robust high voltage isolation is achieved using Infineon's proprietary Coreless Transformer Technology (CLT).

All our smart ballast controllers feature

- Integrated high performance PFC stage
- Intelligent digital/mixed signal power control
- Integrated high voltage half bridge driver
- Parameter setting by resistors only
- Highly accurate timing and frequency control over a wide temperature range

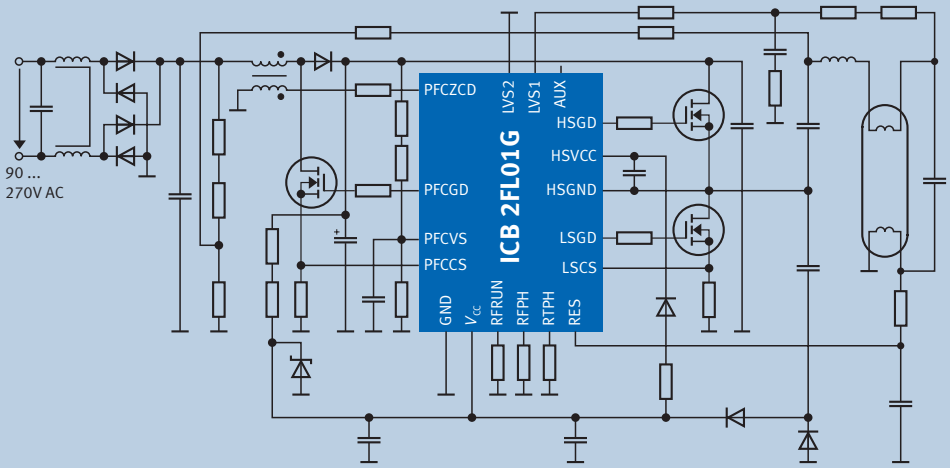
Feature Comparison 1st & 2nd Generation Smart Ballast Controllers

Feature	Benefit	ICB 2FL0xG	ICB 1FL0xG
Able to handle lamp chokes with high saturation behavior.	Optimized lamp choke size and reduced BOM costs.	✓	–
Special in-circuit test mode for faster test time.	Dramatically reduced time for key tests such as end of life detection, preheat / ignition timeout and pre run operation modes.	✓	–
Separate adjustable levels of lamp overload and rectifier effect detection.	Enables ballast compatibility with a wider range of lamp types.	Separate adjustable of EOL1, EOL2	Not separate adjustable of EOL1, EOL2
Adjustment of the preheat time.	Flexible support of both current and voltage mode pre-heating.	0-2500ms	0–2000ms
No high voltage capacitor required for detection of lamp removal (capacitive mode operation).	Reduced BOM costs.	✓	–
Intelligent discrimination between surge & half bridge overcurrent events.	Automaticly restart by surge and inverter overcurrent events.	✓	–
Skipped preheating when line interruption < 500ms.	Meets standards for emergency lighting (according to DIN VDE 0108).	✓	–
Excellent dynamic PFC performance enables very low THD across wide load ranges.	Suitable for dimming & multi-power ballasts.	✓	–
Self adapting dead time adjustment of the half bridge driver.	Eases design of multi-power ballasts and reduces EMI.	✓	Fixed
At fault mode one single restart.	Enhanced the reliability of ballast.	✓	–

ICB 2FL01G

2nd generation smart ballast controller

Application Example



SMART BALLAST CONTROLLER ICB 2FL01G is designed to control a fluorescent lamp ballast including

- Discontinuous conduction mode Power Factor Correction (PFC)
- Lamp inverter control and
- High Voltage Level-Shift Half Bridge Driver with Coreless Transformer Technology in one package

Product Highlights

- Critical conduction mode PFC with overcurrent and overvoltage protection and internal loop compensation
- Adjustable end-of-life detection in multi lamp topologies and detection of capacitive mode operation
- Improved reliability and minimized spread due to digital and optimized analog control functions
- Improved ignition control for an operation close to the magnetic saturation
- Improved THD and harmonic distortion for low power application in DCM

ICB 2FL01G

2nd generation smart ballast controller

Key Features

- Special In-circuit test mode
- Enhanced dynamic PFC performance over wide load range
- Separate adjustable levels of lamp overload and rectifier effect detection
- Intelligent discrimination between surge & lamp End of Life (EOL) events
- Parameters set with resistors only
- Drives up to four lamps with few external components
- Adjustable lamp EOL & fault detection modes
- Automatic dead-time control of half bridge driver
- Highly accurate timing and frequency control over wide temperature range (-25 to +125°C)

Benefits

- Halving the time for key tests such as EOL detection and preheat operation modes
- Very suitable for multi-power ballasts
- Enables ballast compatibility with a wider range of lamp types. Enhanced functionality with series connected lamps
- Lamp can automatically restart following surge events and correctly handle EOL events
- Improved ballast stability and reduced system cost
- Reduced complexity & system costs
- Enables ballast compatibility with a wider range of lamps
- Eases design of multi-power ballasts and reduces EMI
- Reliable, stable ballast designs

ICB 2FL02G

2nd generation smart ballast controller

ICB 2FL02G is functionally similar to ICB 2FL01G in all key respects, with a number of optimizations for dimming ballasts.

- The 'Cap Load 1' detection feature is disabled. This means that current mode preheating is not fully supported as it is with the ICB 2LF01G. Current Mode Preheating is not required for dimming ballasts.
- The Self Adapting Dead Time range between HS & LS Gate Drivers has been changed to the range 1.05µs to 2.0µs.
- The maximum operating frequency of the inverter is increased to 160kHz in both pre-heat and run modes.

In summary, the ICB 2FL02G is optimized for dimming ballasts and is also suitable for non-dimming ballasts with voltage mode pre-heating.

ICB 1FL02G/ICB 1FL03G

1st generation smart ballast controller

ICB 1FL03G is functionally similar to the ICB 1FL02G, with the difference that it drives only up to two lamps, compared to four lamps for ICB 1FL02G.

For feature comparison 1st and 2nd generation smart ballast controllers please refer to page 24.

Industrial MOSFETs

Infineon CoolMOS™ – The revolutionary power MOSFET family

CoolMOS™

THE REVOLUTIONARY CoolMOS™ POWER MOSFET family enables a significant reduction of conducting and switching losses in Switched Mode Power Supplies (SMPS).

Our latest generation of high voltage power MOSFETs will make AC/DC power supplies even more efficient, more compact, lighter and cooler. This target is achieved by offering the lowest on-state resistance per package outline, the fastest switching speed and the lowest gate drive requirements of high voltage MOSFETs commercially available.

New CoolMOS™ C6 Series - Affordable Energy-Efficient Power MOSFETs

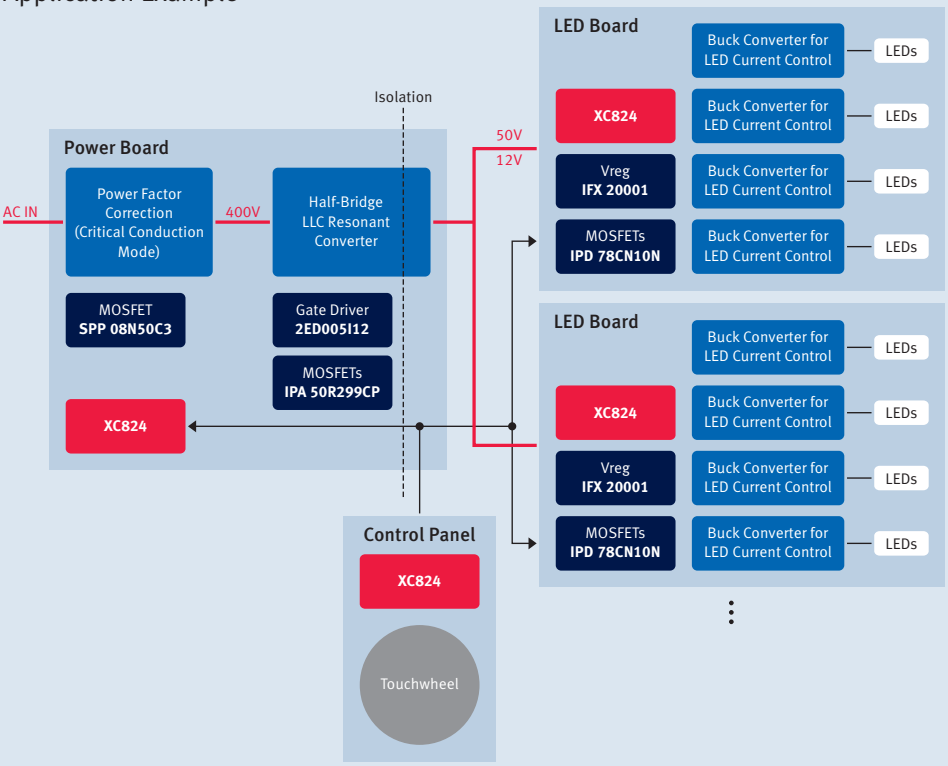
With the new 600V CoolMOS™ C6 series, energy conversion applications such as PFC (Power Factor Correction) or PWM (Pulse Width Modulation) stages can be made significantly more energy efficient. The new C6 technology combines the advantages of modern superjunction or compensation devices including ultra-low area specific on-resistance (for example, only 99mΩ in a TO-220 package), and reduced capacitive switching losses while offering easy control of the switching behavior as well as high body diode ruggedness. C6 is the right choice for hard switching applications because it makes them more efficient, more compact, lighter and cooler.

Voltage Class	500V	600V	650V	800V	900V
CooMOS™C3	●	●	●	●	●
CoolMOS™CFD		●			
CoolMOS™CP	●	●			
CoolMOS™C6		●	●		

Package	TO-247	TO-247max	TO-220	TO-220 FullPAK	D²PAK (TO-263)	I²PAK (TO-262)	D-PAK (TO-252)	IPAK (TO-251)	IPAK Short Leads (TO-251 Short Leads)
CooMOS™C3	●		●	●	●	●	●	●	●
CoolMOS™CP	●		●	●	●	●	●		●
CoolMOS™C6	●	●	●	●	●	●	●		●
CoolMOS™CFD	●		●	●		●			

Industrial Microcontrollers
High-brightness LED

Application Example



THE NO. 1 TREND IN LIGHTING TODAY IS PROBABLY the advance made by high-brightness LEDs, driven by the high energy-efficiency and durability of LED. Beyond this, connectivity with lighting networks offers yet another incentive to increase the efficency of designs. In this example, a master/slave topology with our XC822 enables a flexible LED street lighting system. Thanks to this network, communication commands like on/off or dimming can be transferred to the LED lamps from a single centralized control panel.

Key Features

- MDU coprocessor for constant power or current control
- Master/slave topology for a flexible multilamp system
- Communication of on/off and dimming comands via the MCU serial interface

Product Portfolio for General and Industrial Lighting

Linear LED Drivers

Linear LED drivers

Product	Description	Package	V_{CC} max. [V]	Current range[2]		$V_{Overhead}$ [V]	P_{tot} [mW]
				I_d typ. [mA]	I_d max. [mA]		
BCR 401W	LED driver with output current up to 60mA	SOT-343	18[1]	10	60	1.2	500
BCR 402W	LED driver with output current up to 60mA	SOT-343	18[1]	20	60	1.2	500
BCR 401U	LED driver with output current for high power dissipation up to 65mA	SC-74	40	10	65	1.4	750
BCR 402U	LED driver with output current for high power dissipation up to 65mA	SC-74	40	20	65	1.4	750
BCR 405U	LED driver with output current for high power dissipation up to 65mA	SC-74	40	50	65	1.4	750
BCR 320U	LED driver for currents up to 250mA	SC-74	24[1]	10	250	1.4	1000
BCR 321U	LED driver for currents up to 250mA with µ-controller interface	SC-74	24[1]	10	250	1.4	1000
BCR 420U	LED driver for currents up to 150mA	SC-74	40[1]	10	150	1.4	1000
BCR 421U	LED driver for currents up to 150mA with µ-controller interface	SC-74	40[1]	10	150	1.4	1000
TLE 4309G	Max. 500mA linear LED driver with integr. power stage	TO263-7	45	adj.	500	Overcurrent, Overvoltage + Thermal Protection	
BCR 450	Linear LED controller with thermal protection	SC-74	27	200	700		

DC/DC LED Drivers

DC/DC LED drivers

Product	Description	Package	V_{CC} max. [V]	Current range[2]		Protection functions
				I_d typ. [mA]	I_d max. [mA]	
ILD 4001	Buck LED controller with thermal protection	SC-74	40	1000	10000	Overcurrent, Overvoltage + Thermal Protection
ILD 4035	350mA Buck LED driver with thermal LED protection	SC-74	40	350	500	
ILD 4120	1200mA Buck LED driver with thermal LED protection	DSO-8	40	1200	1500	
ILD 4180	1800mA Buck LED driver with thermal protection	DSO-8	45	1800	2000	

Off-Line LED Drivers

ICL 8001G

Product Type	V_{CC} min. [V]	V_{CC} max. [V]	I_{CC} max. [mA]	Operating Mode	Protection features
ICL 8001	10.5	25	2.3	Quasi-resonant	Thermal, Output Overvoltage, Supply Under/Over-voltage, Short winding

CoolSET™

Product Type	Voltage [V]	$R_{ON(max)}$ [mΩ]	Operating Mode	Switching Frequency [kHz]	Standby Mode	Protection Features Mode	Power rating @ 230VAC ±15% [W]	Wide Range Power Rating [W]
ICE 3B 0365J	650	6.45	Fixed frequency PWM with jittering	67	Active burst mode	Autorestart	17	9
ICE 3B 0565J	650	4.70	Fixed frequency PWM with jittering	67	Active burst mode	Autorestart	22	11
ICE 3B 1565J	650	1.70	Fixed frequency PWM with jittering	67	Active burst mode	Autorestart	38	19

TDA 4863

Product Type	V_{CC} min. [V]	V_{CC} max. [V]	I_{CC} max. [mA]	$I_{StartUP}$ [µA]	$I_{OUTRise}$ [A]	$f_{Operation}$ [kHz]	D_{MAX} [%]	PF	THD	PFC Mode
TDA 4863	10	22	20	100	0.5	uo to 200	n.a.	~ 0.99	‹ 10%	DCM

1) Higher supply voltage possible by stacking a string of LEDs above the LED driver

2) Current can be adjusted by usage of external resistor

Current and Voltage Controller

Current and voltage controller

Product Type	Package	Reference Voltage [V]	Supply Voltage [V]	Temperature Range [°C]	Gain Bandwidth
TLE 4305G	PG-DSO-8	2.5	8-42	-40 ... +150	500kHz typ.

Smart Ballast Controllers

ICB 2FL01G

Short Form Data	min.	typ.	max.
Package		SO-19	
Operating voltage range	10V	–	17.5V
Turn-on threshold	–	14V	–
Supply current during UVLO and fault mode	–	110µA	170µA
Operating frequency of inverter during run mode	20kHz	–	120kHz
Operating frequency of inverter during preheating mode	F_{RFRUN}	–	150kHz
Preheating time	0ms	–	2500ms
Adjustable self-adapting dead time max between LS and HS gate drive	2.25µs	2.50µs	2.75µs
Adjustable self-adapting dead time min between LS and HS gate drive	1.00µs	1.25µs	1.50µs
Operating voltage range of floating HS gate drive	-900V	–	+900V
LS current limitation threshold: Ignition/Start up/Soft Start/Pre Run	1.5V	1.6V	1.7V
LS current protection threshold during run mode and preheating	0.75V	0.80V	0.85V
End-of-life detection threshold	-40µA	–	+40µA
Detection of Non-ZVS operation cap mode 1 and 2	–	–	–
PFC preconverter control with critical and discontinuous CM	–	–	–
Maximum controlled on-time	18µs	22.7µs	26µs
Hysteresis of zero current detector	–	1.0V	–
PFC current limitation threshold	–	1.0V	–
Reference voltage for control of bus voltage	2.47V	2.5V	2.53V
Overvoltage detection threshold	2.68V	2.73V	2.78V
Under voltage detection threshold	1.835V	1.88V	1.915V
Open loop detection	0.237V	0.31V	0.387V
Junction operating temperature range	-25°C	–	+125°C
Pb-free lead plating; RoHS compliant	–	–	–

ICB 2FL02G

ICB 2FL02G is functionally similar to ICB 2FL01G in all key respects, with a number of optimizations for dimming ballasts.

Function	ICB 2FL01G	ICB 2FL02G
Cap load 1 protection	Activated	Deactivated
Suitable for dimming	Yes	Optimized
Max adjustable run frequency	max. 120kHz	max. 140kHz
Adjustable dead time	1.25µs to 2.5µs	1.05µs to 2.00µs
Dead time detector level	-100mV	-50mV
Capacitive mode 2 detector level 3	-100mV	-50mV

ICB 1FL02G

Short Form Data	min.	typ.	max.
Package		SO-18	
Operating voltage range	10.5V	–	17V
Turn-on threshold	–	14V	–
Supply current during UVLO and fault mode	–		150µA
Operating frequency of inverter during RUN mode	20kHz	–	100kHz
Operating frequency of inverter during preheating mode	F_{RFRUN}	–	150kHz
Preheating time	0ms	–	2000ms
Dead time between LS and HS date drive	–	1750ns	–
Operating voltage range of floating HS gate drive	-900V	–	+900V
LS current limitation threshold during Ignition	–	0.8V	–
LS current protection threshold	–	1.6V	–
End-of-life detection threshold	-230µA	–	+230µA
Amplitude ratio for detection of rectifier effect	0.85	–	1.15
Detection of Non-ZVS operation cap mode 1 and 2	–	–	–
PFC preconverter control with cirtical and discontinuous CM	–	–	–
Maximum controlled on-time	–	23.5µs	–
Hysteresis of zero current detector	–	1.0V	–
PFC current limitation threshold	–	1.0V	–
Reference voltage for control of bus voltage	2.47V	2.5V	2.53V
Over voltage detection threshold	–	2.75V	–
Under voltage detection threshold	–	1.83V	–
Open loop detection	–	0.375V	–
Junction operating temperature range	-25°C	–	+125°C
Pb-free lead plating; RoHS compliant	–	–	–

ICB 1FL03G

ICB 1FL03G is functionally similar to the ICB 1FL02G, with the difference that it drives only up to two lamps, compared to four lamps for ICB 1FL02G.

Industrial MOSFETs

To get a detailed overview of our industrial MOSFET product portfolio, please visit www.infineon.com/IMM-MOSFETs.

Industrial Microcontrollers

XC82x

Sales Code	Package	Flash	Touch Control	MDU	ADC Channels	Temperature
SAF-XC822T-0FRI	PG-TSSOP-16	2KB	Yes	No	4	-40 – 85°C
SAF-XC822-1FRI	PG-TSSOP-16	4KB	No	No	4	-40 – 85°C
SAF-XC822T-1FRI	PG-TSSOP-16	4KB	Yes	No	4	-40 – 85°C
SAF-XC822M-1FRI	PG-TSSOP-16	4KB	No	Yes	4	-40 – 85°C
SAF-XC824M-1FGI	PG-DSO-20	4KB	No	Yes	4	-40 – 85°C
SAF-XC824MT-1FGI	PG-DSO-20	4KB	Yes	Yes	4	-40 – 85°C
SAK-XC824M-1FGI	PG-DSO-20	4KB	No	Yes	4	-40 – 125°C
SAF-XC822MT-1FRI	PG-TSSOP-16	4KB	Yes	Yes	4	-40 – 85°C

XC83x

Sales Code	Package	Flash	Touch Control	VC[1)]	ADC Channels	Temperature
SAF-XC835MT-2FGI	PG-DSO-24	8KB	Yes	Yes	4	-40 – 85°C
SAF-XC836T-2FRI	PG-TSSOP-28	8KB	Yes	No	8	-40 – 85°C
SAF-XC836M-1FRI	PG-TSSOP-28	4KB	No	Yes	8	-40 – 85°C
SAF-XC836M-2FRI	PG-TSSOP-28	8KB	No	Yes	8	-40 – 85°C
SAF-XC836MT-2FRI	PG-TSSOP-28	8KB	Yes	Yes	8	-40 – 85°C
SAF-XC836-2FRI	PG-TSSOP-28	8KB	No	No	8	-40 – 85°C

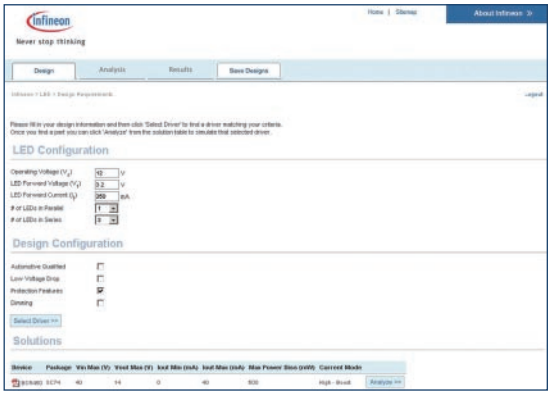
1) VC = Vector Computer (MDU + CORDIC)

Support Tools

LED Application Design Tool for General Lighting and Industrial Applications

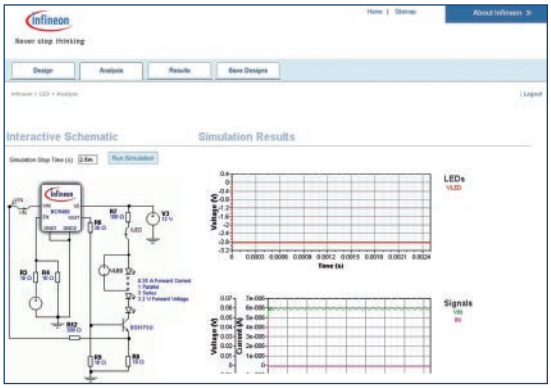
1. Design requirements

- Enter your application-specific parameters
- Choose a LED driver from the selection list



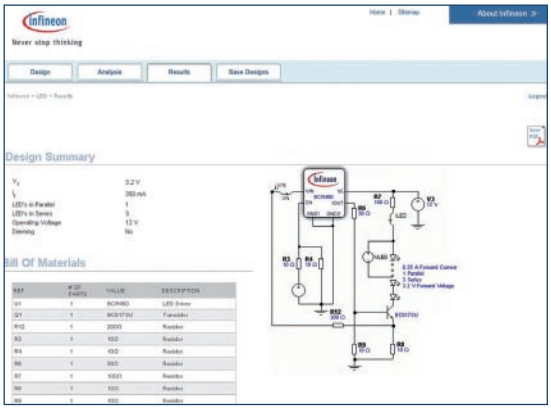
2. Analysis

- Check the generated schematic and modify parameters, if necessary
- Simulate your application schematic



3. Results

- Review your Bill-Of-Materials
- Download an overview of your LED application circuit



4. Save your design for later modification!

For more details and registration: www.infineon.com/leddriverselectiontool

Evaluation Boards

Board name	Product	Description	Order No.
LED driver demoboard	TLE 4242G TLE 4309G	This board is designed to demonstrate the performance of our linear LED driver TLE 4242G and TLE 4309G with Osram high-brightness LEDs. It is possible to choose between the two drivers. A potentiometer allows to attitude the PWM-frequency for dimming the LEDs.	Demoboard TLE 4242G LED Driver/4309
Demoboard TLD 5085	TLD 5085EJ	This application board shall enable you to test the performance of the TLD 5085EJ, Buck Converter for driving LED.	Demoboard TLD 5085
Demoboard TLD 5095EL	TLD 5095EL	This application board should enable you to test the performance of the TLD 5095EL, boost converter for driving LED in boost to battery and boost to ground configuration.	Demoboard TLD 5095EL
LED driver demoboard	CooLSET™ ICE 3B0365JG	Low-cost, highly efficient LED driver for multiple LEDs (24V/350mA).	EVAL-ACDC LED-ICE 3B0365JG
Evaluation board ICB 2FL01G	ICB 2FL01G	Demoboard for fluorescent lamp ballast with smart ballast controller second-generation ICB 2FL01G.	Eval ICB 2FL01G
Evaluation board ICB 2FL02G	ICB 2FL02G	Demoboard for fluorescent lamp ballast with smart ballast controller second-generation ICB 2FL02G.	Eval ICB 2FL02G
Evaluation board ICB 1FL02G	ICB 1FL02G	Demoboard for fluorescent lamp ballast with smart ballast controller second-generation ICB 1FL02G.	Eval ICB 1FL02G
XC822 Easy Kit	SAF-XC822MT-1FRI	■ CPU clock – 24.0mHz ■ On-Chip Memory: – 256 Bytes RAM, – 256 Bytes XRAM, – 4 kBytes Flash	KIT_XC822_EK_V1 SP000781092
LED driver demoboard	ICL 8001G	60W equ. bulb 110V	EVAL-LED ICL 8001G-Bulb01
LED driver demoboard	ICL 8001G	60W equ. bulb 230V	EVAL-LED ICL 8001G-Bulb02
LED driver demoboard	ICL 8001G / TLE 4305G	8W board	EVAL-LED ICL 8001G-8W
LED driver demoboard	TDA 4863	40W Street / Indoor Lighting	EVAL-LED TDA 4863- 40W
1W and 3W LED demoboard	BCR 450	Shows how to drive high-power LEDs (1W, 3W) with the BCR 450 ■ Max. supply voltage: 27V, max. current up to 2A ■ BCR 450 + the 3 different booster transistors on one board ■ BAS 3007A-RPP on board (optional) ■ Can be connected to a string of LEDs ■ Dimming of LEDs with externally applied PWM signal possible	BCR 450 board SP000417098
12V low current LED demoboard	BCR 402W	The BCR 40xW series is an ideal drop-in replacement for resistor-based channel letter solutions ■ 12V supply voltage, 20mA current ■ BCR 402W with footprint for external resistor for adjusting the current ■ Footprint for Schottky diodes (can be replaced by jumpers) ■ 3 x 0.2W LEDs in series	BCR 402W 12V LED board SP000748242
24V low current LED demoboard	BCR 402W	The BCR 402W can be operated at higher voltages than 18V DC by simply putting a string of LEDs above the LED driver to reduce the supply voltage below 18V DC ■ 24V supply voltage, 20mA current - BCR 402W with footprint for external resistor for adjusting the current ■ Footprint for Schottky diodes (can be replaced by jumpers) ■ 6 x 0.2W LEDs in series	BCR 402W 24V LED board SP000748244

Application Notes

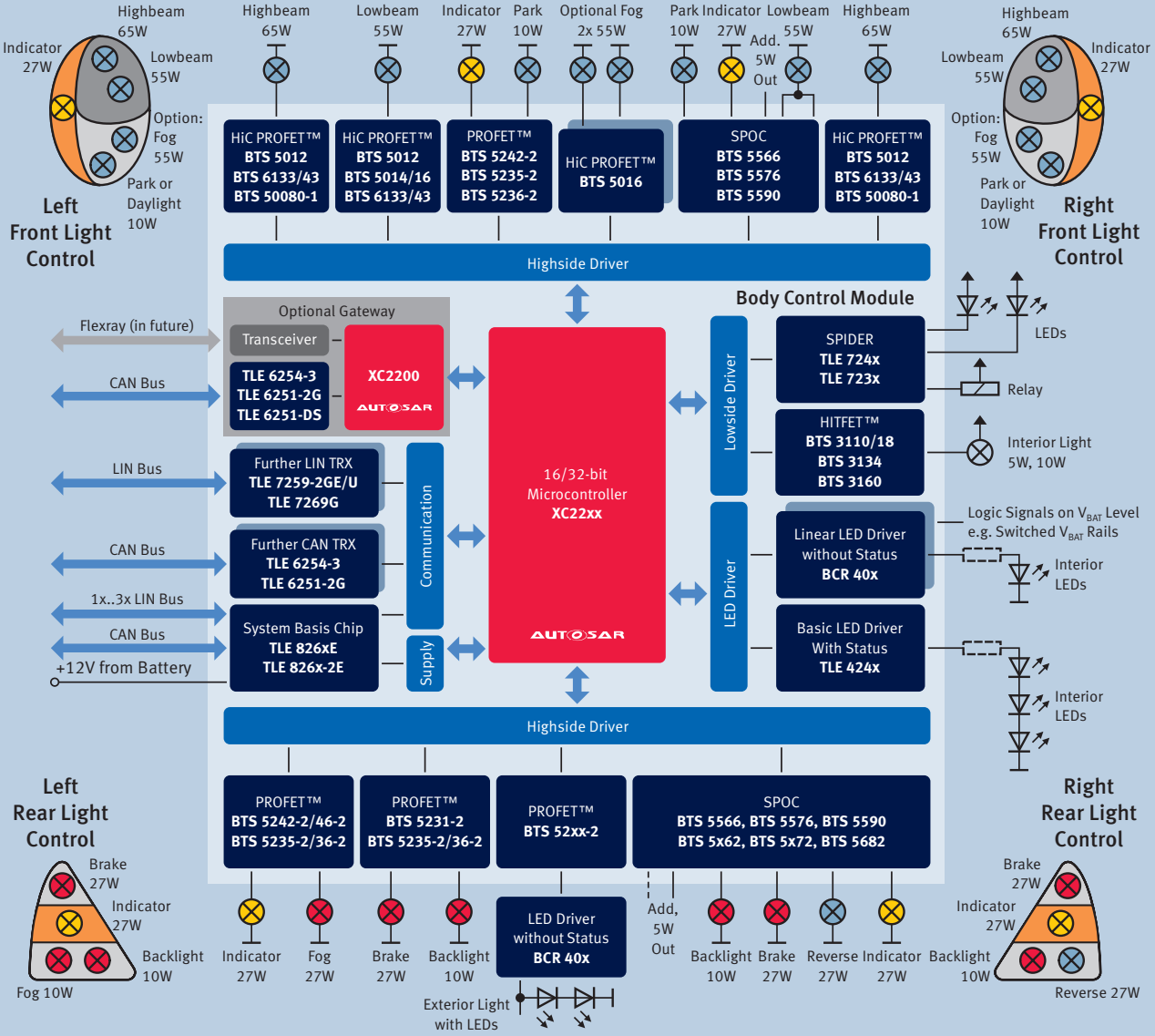
Application note	Info number / Internet link
Using BCR 402R/BCR 402U at high supply voltages.	AN097 www.infineon.com/lowcostleddriver
BCR 400 family of constant-current, linear mode LED drivers for lighting applications from 10mA-700mA.	AN101 www.infineon.com/lowcostleddriver
BCR 450 using OSRAM Platinum Dragon LW_W5SN.	AN105 www.infineon.com/lowcostleddriver
CoolSET™ - Off-line LED Driver application solutions.	www.infineon.com/off-line_LED_driver
ICB 2FL01G Smart Ballast Control IC for Fluorescent Lamp Ballasts Demoboard and for 54W T5 Single Lamp Design with Voltage Mode Preheating.	www.infineon.com/smartlighting
ICB 2FL02G Smart Ballast Control IC for Fluorescent Lamp Ballasts Dimming Demoboard 26W TC-TEL Single Lamp Design.	www.infineon.com/smartlighting
ICB 1FL02G Smart Ballast Control IC for Fluorescent Lamp Ballasts.	www.infineon.com/smartlighting
40W LED Street-/Indoor Lighting.	AN186 www.infineon.com/off-line_LED_driver
EVAL-LED-ICL 8001G-Bulb02.	www.infineon.com/LED-Bulb
EVAL-LED-ICL 8001G-8W.	www.infineon.com/LED-Bulb
Driving low power LED strips with the low-cost LED driver BCR402W.	AN182 www.infineon.com/lowcostleddriver

Automotive Applications

INFINEON OFFERS A WIDE VARIETY of automotive qualified products dedicated for LED driving in the interior and exterior area, e.g. protected single and multi-channel power switches for bulbs and LEDs, protected linear LED drivers with diagnostic functionality, switched DC/DC buck and boost high-current LED driver, LEDs in front lights.

The exemplary diagram shows a typical central body control module consisting of a microcontroller, lighting elements, power switches as well as supply ICs and network transceivers.

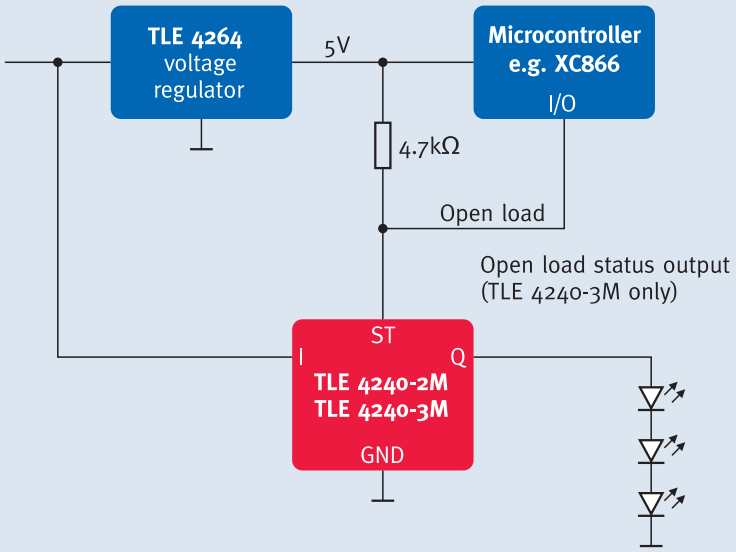
Central Body Control Module



TLE 4240-2M/-3M

Infineon® Basic LED driver – linear LED driver for low to medium current LEDs

Application Example



THE TLE 4240-2M/-3M IS A MONOLITHIC integrated, low dropout linear constant current source. It is designed to supply white or color LEDs in order to achieve constant brightness and extended LED lifetime, independent from supply voltage or LED forward voltage class.

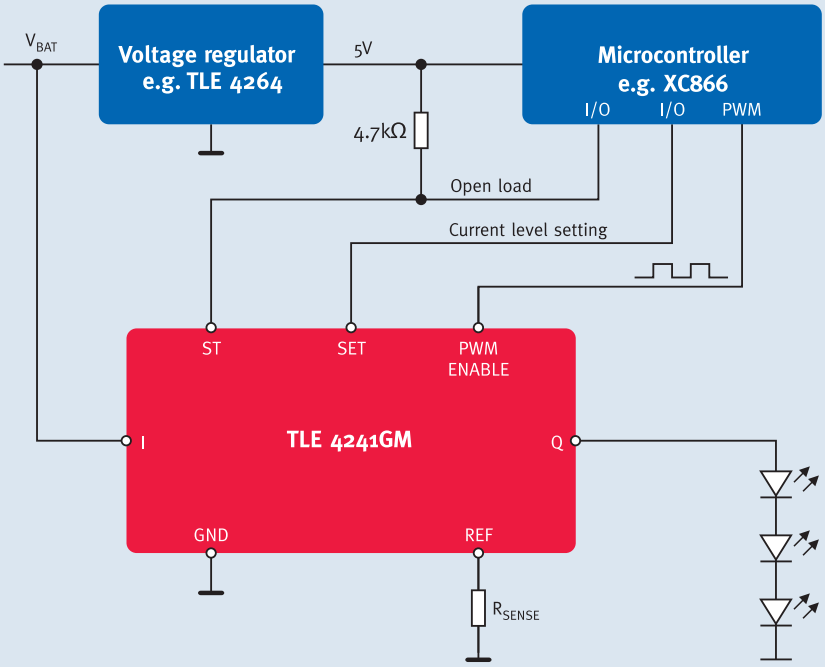
Key Features & Benefits

- Constant output current of typ. 60mA
- Low dropout voltage
- Open load diagnosis output (version TLE 4240-3M)
- Safe operation area circuit monitoring drop voltage
- Short-circuit protection to GND and V_{BAT} (up to 45V)
- Reverse polarity protected
- Small PG-SCT-595-5 package
- Constant LED brightness
- Extended LED lifetime
- Small footprint

TLE 4241GM

Infineon® Basic LED driver – linear LED driver for low to medium current LEDs

Application Example



THE TLE 4241GM IS AN INTEGRATED adjustable constant current source, providing an output current adjustable via different means. The IC is designed to supply LEDs under the severe conditions of automotive applications resulting in constant brightness and extended LED lifetime.

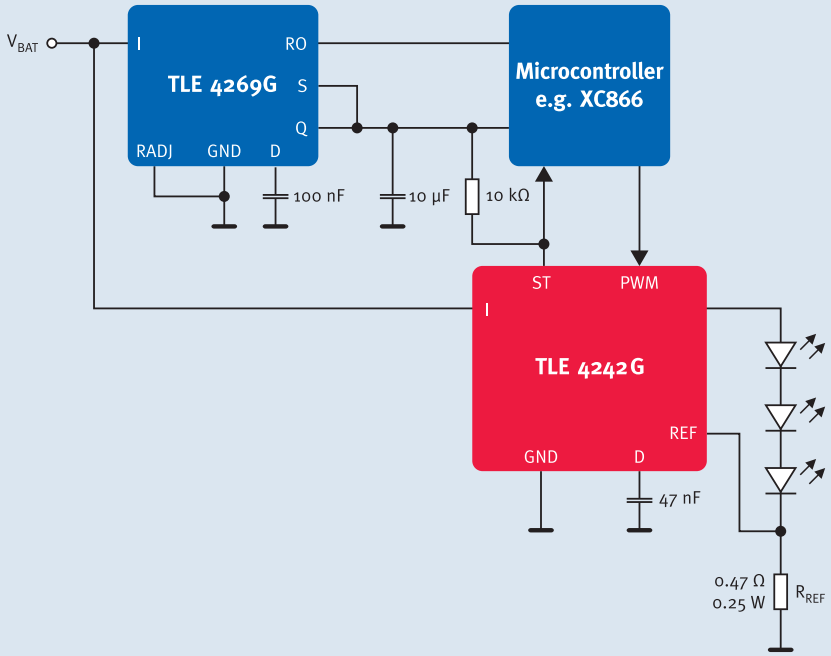
Key Features & Benefits

- Adjustable constant output current up to 70mA
- Low dropout voltage
- Dual mode for tail and stoplight (high/low current SET)
- PWM input (e.g. for individual dimming) up to 1kHz
- Open load diagnosis output
- Input voltage range up to 45V
- Reverse polarity protected
- Short-circuit protection to GND and V_{BAT}
- DSO-8 package

TLE 4242G

Infineon® Basic LED driver – linear LED driver for low to medium current LEDs

Application Example



THE TLE 4242G IS AN INTEGRATED ADJUSTABLE constant current source, driving loads up to 500mA. The output current level can be adjusted via an external resistor. The IC is designed to supply high-power LEDs (e.g. Osram Dragon LA W57B) under the severe conditions of automotive applications resulting in constant brightness and extended LED lifetime.

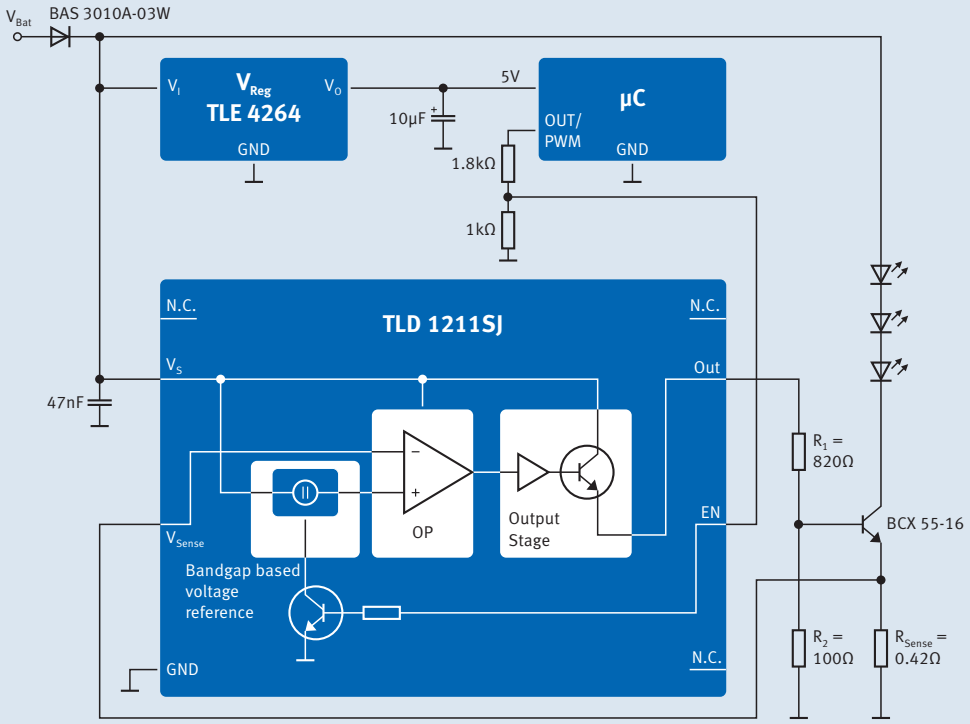
Key Features & Benefits

- Adjustable output current up to 500mA
- Low dropout voltage
- PWM input (dimming, switching between brake and tail light, etc.)
- Diagnosis output
- Overtemperature protection
- Short-circuit protection to GND and V_{BAT}
- Reverse polarity protected
- Input voltage range up to 45V
- TO-263 package for best thermal behaviour

TLD 1211SJ [1)]

Infineon® Basic LED driver – linear LED driver for low to medium current LEDs

Application Example



THE TLD 1211SJ IS AN INTEGRATED ADJUSTABLE current source. It is designed to supply LEDs realizing constant brightness and to extended LED lifetime. The TLD 1211SJ is able to drive output current up to 85mA. By using an additional external output stage up to 2.5A for high current LEDs are possible.

Key Features

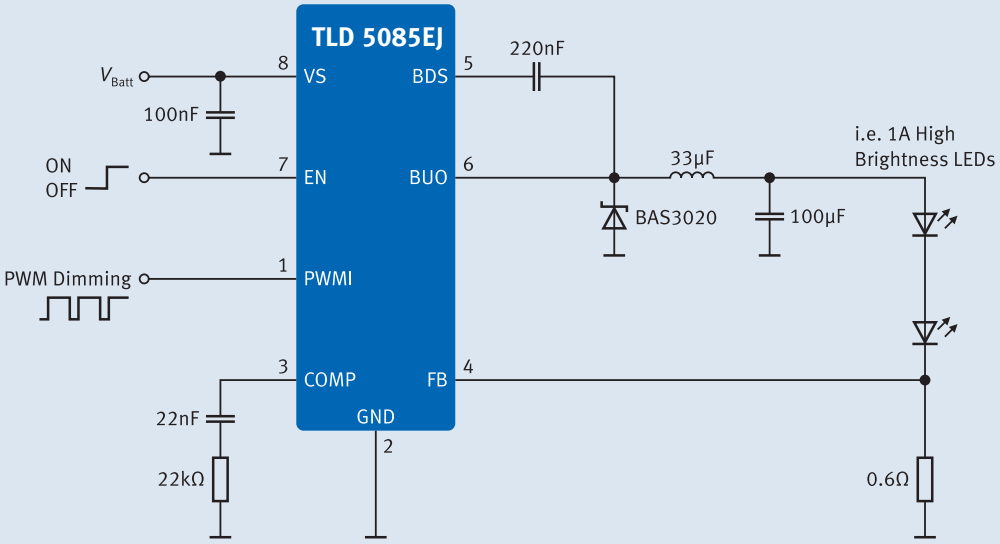
- Max. output current 85mA
- With external transistor option currents up to 2.5A
- Improved precision of I_{out}: ± 10% in whole operating range
- Overvoltage protection
- Temperature dependent to current reduction
- Enables input for PWM operation
- Very small DSO-8 package
- PWM capability for LED dimming

1) Available, Q3/2010

TLD 5085EJ

Infineon® Power LED driver – DC/DC LED driver for high current LED lighting

Application Example



THE TLD 5085EJ IS A SMART LED BUCK driver circuit, that provides all active functions for a constant current switching regulator, capable of delivering up to 1.8A load current with excellent line and load regulation.

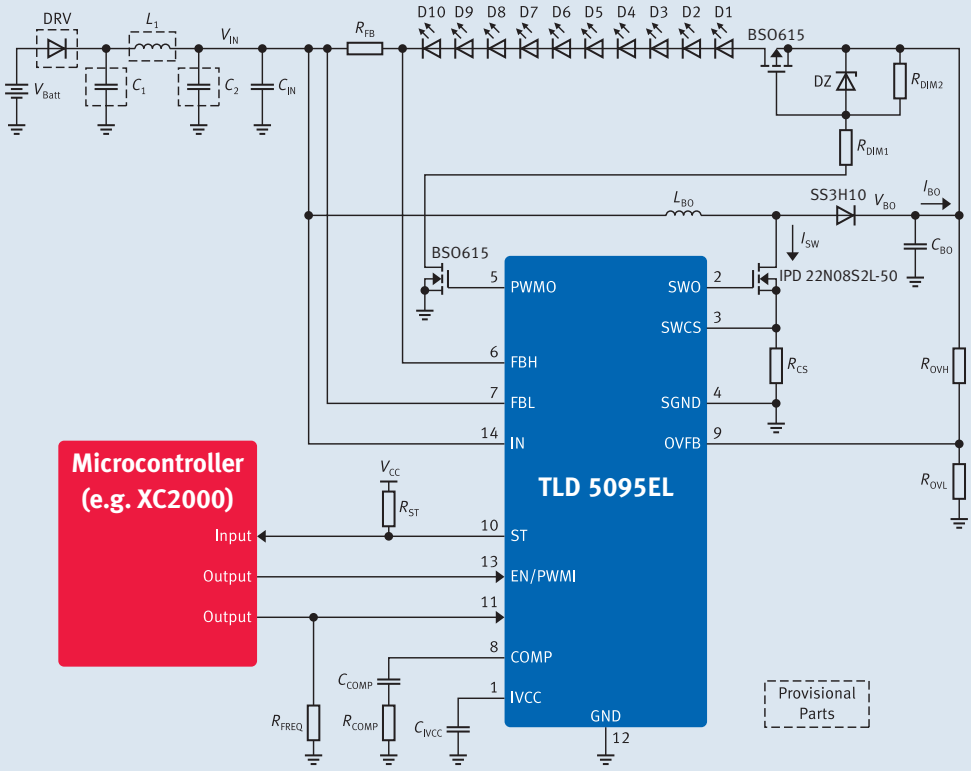
Key Features & Benefits

- Adjustable up to 1.8A constant current
- Typical output voltage V_{BAT} –1V difference
- Integrated power stage
- Input voltage range from 4.75V to 45V
- 370kHz switching frequency
- PWM input for LED dimming and enable input pin
- Very small, thermally enhanced package (DSO-8 size)
- PWM capability for LED dimming
- Few external components because of high integration (power stage)

TLD 5095EL

Infineon® Power LED driver – DC/DC LED driver for high current LED lighting

Application Example



THE TLD 5095EL IS A SMART LED BOOST controller with built in protection and diagnostic features. The main function of these devices is to step-up (boost) the output voltage and regulate a constant LED current. The device has an implemented status pin for diagnostic function.

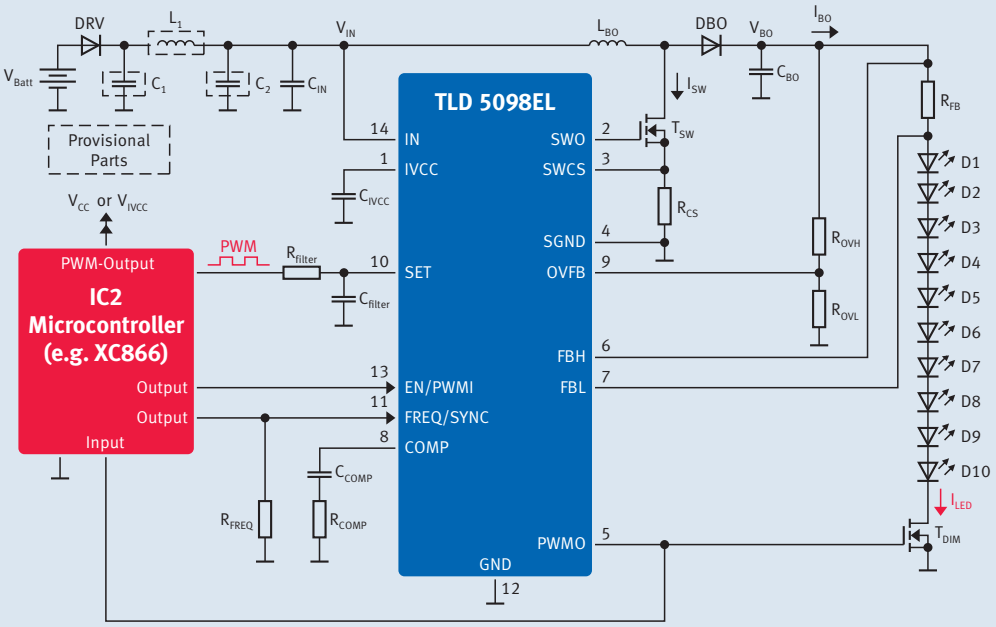
Key Features & Benefits

- Implemented status pin to indicate fault conditions
- Wide input voltage range from 4.75V to 45V
- Constant current or constant voltage regulation
- Very low shutdown current: I_q< 10µA
- Flexible switching frequency, 100kHz to 500kHz
- Synchronization with external clock source
- PWM dimming
- Output overvoltage protection
- Internal soft start
- Overtemperature shutdown
- Available in a small, thermally enhanced PG-SSOP-14 exposed pad package
- Very small, thermally enhanced package (DSO-8 size, fine pitch)
- Well-suited for head lamp and DRL applications
- High flexibility in terms of LED chain length, three configurations possible
- Works in return to ground, return to battery and sepic configuration
- Dedicated feature set specified for LED application in automotive

TLD 5098EL [1)]

Infineon® Power LED driver – DC/DC LED driver for high current LED lighting

Application Example



THE TLD 5098EL IS A SMART LED BOOST controller with built-in protection and diagnostic features. The main function of these devices is to step-up (boost) the output voltage and regulate a constant LED current. The device has an implemented analog dimming feature to adjust the average LED current.

Key Features & Benefits

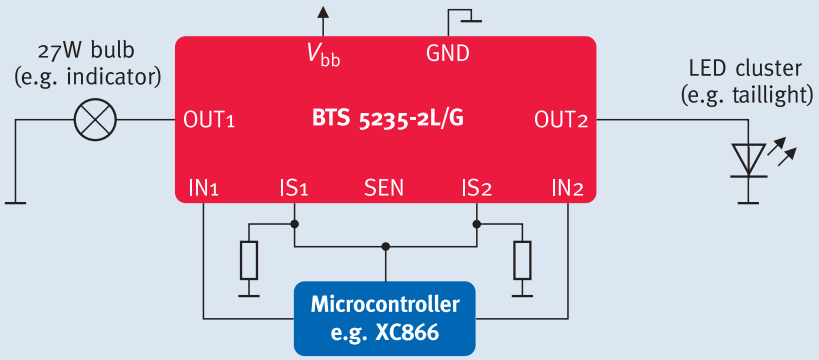
- Analog dimming feature to adjust average LED current
- Wide input voltage range from 4.75V to 45V
- Constant current or constant voltage regulation
- Very low shutdown current: I_q<10µA
- Flexible switching frequency from 100 kHz to 500 kHz
- Synchronization with external clock source
- PWM dimming
- Output overvoltage protection
- Internal soft start
- Overtemperature shutdown
- Available in a small, thermally enhanced PG-SSOP-14 exposed pad package
- Very small, thermally enhanced package (DSO-8 size, fine pitch)
- Well-suited for head lamp and DRL applications
- High flexibility in terms of LED chain length, three configurations possible
- Works in return to ground, return to battery and sepic configuration
- Dedicated feature set specified for LED application in automotive

1) Available, Q4/2010

Green PROFET™ Switches

For advanced high-side applications

Application Example



Product Portfolio

- BTS 5231-2GS
- BTS 5235-2G
- BTS 5235-2L
- BTS 5236-2GS
- BTS 5242-2L
- BTS 5246-2L

INFINEON'S NEW PROFET™ "-2" FAMILY is a set of 2-channel high-side power drivers ranging from 19 to 140mΩ. They offer complete protection against the harsh automotive environment. Their state-of-the-art diagnostic features cover all possible failures that the application may encounter.
The family is suitable to drive LED lamps, bulb lamps, as well as inductive loads such as motors for various automotive and industrial applications. Because of high current limitation values, devices in the family can turn on high capacitive loads without overheating.
All ICs in the family have current sense and their diagnostics signal can differentiate between open loads and short circuits in the ON-state. The complete family is PWM-capable in order to improve bulb lifetime.

Benefits

- State-of-the-art diagnostics and protection feature set for high-side applications
- High current limitation values
- Lifetime improvement for light bulbs due to PWM capability
- Improved short-circuit robustness (especially BTS 5231-2GS, BTS 5236-2GS)

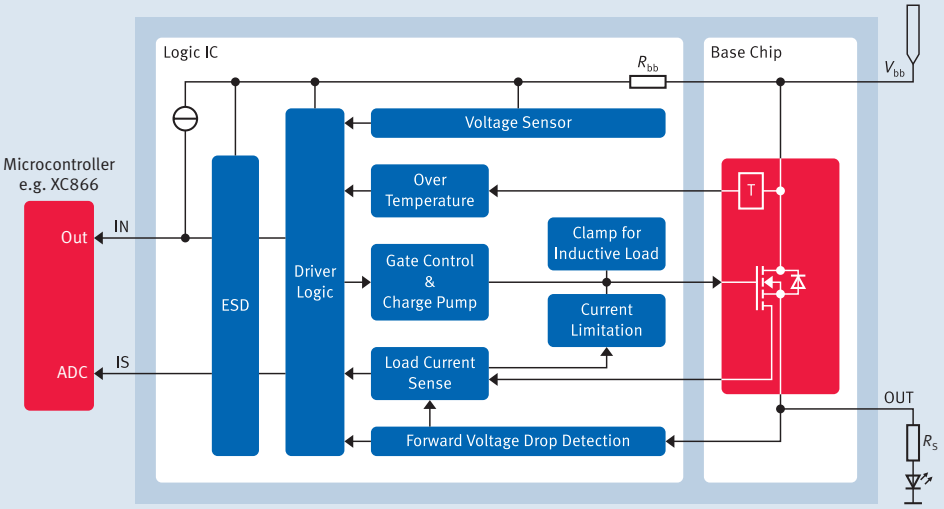
Key Features

- 2-channel high-side power driver (140mΩ)
- CMOS- and TTL-compatible input
- Openload detection in OFF- and ON-state
- Proportional loadcurrent sense
- Differentiation between OL and SC in ON-state
- Shortcircuit protection
- Thermal shutdown
- Overvoltage protection (incl. load dump)
- Under- and overvoltage shutdown
- Loss of ground and loss of V_{bb} protection
- SOP-20/SOP-14/SOP-12 exposed pad package

High-Current PROFET™ Switches in Green DPAK

Power and flexibility

Application Example



Product Portfolio

- BTS 6143D
- BTS 6133D
- BTS 5012SDA
- BTS 5014SDA
- BTS 5016SDA
- BTS 50080-1TEA
- BTS 50080-1TEB

Key Features

- Overload, short circuit, overtemperature and overvoltage protection
- Loss of ground and loss of V_{bb} protection
- Open load detection
- Multi-step current limitation
- Current sense with fault signal generation
- Very low stand-by current
- Optimized Electromagnetic Compatibility (EMC)
- PWM capability

INFINEON'S HIGH CURRENT PROFET™ in Green DPAK package are a family of single channel high-side drivers (with $R_{DS(on)}$ ranging from 8 to 16mΩ). The devices have the same functionality and are pin-to-pin compatible, thus they enable scalability by $R_{DS(on)}$ and related parameters. They all have current sense, and provide an embedded set of protection and diagnostic features, also including ReverSave™. The family is suitable to drive all types of resistive (bulbs, heaters), inductive (solenoids, motors) and capacitive loads, and are particularly suitable for loads with high inrush current, such as high-beam/low-beam conventional and HID, fog lights, trailer nodes, etc.
The inverse load current capability, available only on BTS 6133D and BTS 50080-1TEB, makes these devices optimized for driving HID lamps.

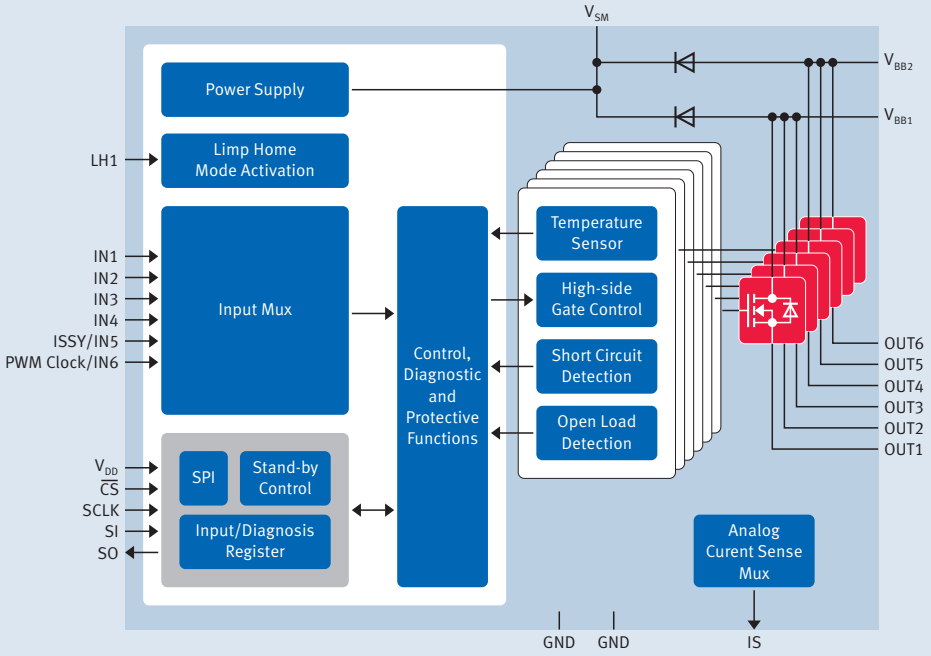
Benefits

- Scalability, allowing complex load combination partitioning and optimized board design and layout
- ReverSave™ function; switching the power transistor on, in case of reverse battery, reducing power dissipation
- Protection of both, the load and the device, with failure diagnostic capability
- Load current monitoring from 500mA to several amperes and high current limitation values

BTL 5150-6EM/BTL 5160-6EM/BTL 6160-6EM

Infineon® SPILED driver – SPI controlled high-side switch for LED lighting

Application Example



THE INFINEON SPILED FAMILY HAS THREE new members. Each of them is a monolithical IC with a separated battery feed concept. The devices can be selected by their feature sets cranking or integrated PWM engine. Infineon® SPILED is an integrated solution for low power LEDs and can address safety critical applications because of the implemented limp home functionality.

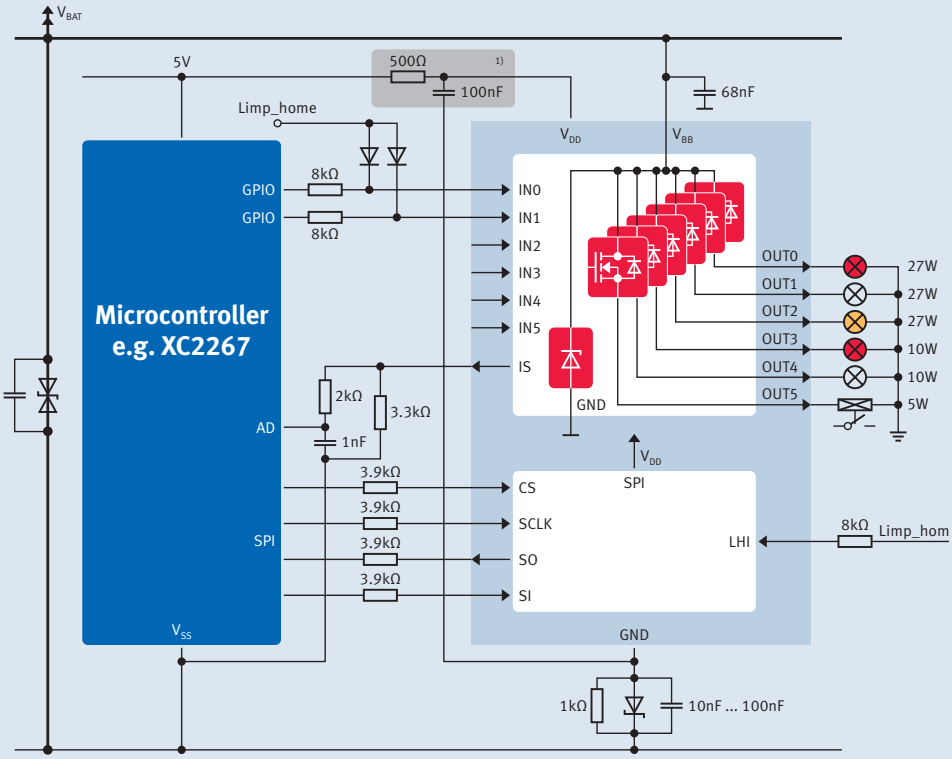
Key Features & Benefits

- Left and right rear lights driving concept possible due to two battery feeds
- Overvoltage protection for the load
- Complete control and diagnosis of six channels
- Overload detection possible also through SPI only (no ADC port necessary)
- Withstand negative transient down to -41V without external components
- Integrated reverse battery protection
- Limp home feature
- Low voltage cranking feature down to 3V (only BTL 5160-6EM & BTL 6160-6EM)
- PWM generation enables a full PWM capability of all loads (only BTL 6160-6EM)
- Very small exposed pad package

SPI Power Controller (SPOC)

Integrated multi-channel switches for body lighting

Application Example



Key Features

- Integration of two to six channels inside one device
- Bulb/LED load type configuration via SPI for load optimization (for products with LED mode)
- 8-bit (SPOC I/II/DUO) or 16-bit (SPOC Front Light) SPI for control and state-of-the-art diagnostics
- Selectable and/or combination for parallel inputs (PMW control)
- Multiplexed proportional load-current sense
- Fail-safe functionality with limp-home mode

SPOC CONSISTS OF A FAMILY OF TWO TO SIX CHANNEL integrated high-side switches suitable for driving front, rear and central lighting loads into a Body Control Module (BCM). The complexity and density of BCMs is constantly increasing with more loads and features inside the module, and car manufacturers are looking for modular BCM concepts which allow them to use the same platform with various options. For example multiple car models, with or without LED option. The SPOC devices, scaled by number of channels and features, address this trend and integrate multiple channels inside one package to reduce board space. SPOC devices feature a Serial Peripheral Interface (SPI), enabling customers to save I/Os in the microcontroller and reduce the amount of external components, required in a discrete implementation. The LED mode of SPOC devices is programmable via SPI.

Benefits

- Scalability by feature (basic, LED mode, PWM engine, external drive capability, watchdog, adjustable slew rate) and number of channels (two to six)
- I/O savings with SPI daisy-chain configuration, particularly for BCMs with higher complexity/load density
- Less external components, routing effort and reduced board space
- PWM via SPI possible
- PWM engine integrated (only in SPOC front light devices BTS 6460SF and BTS 6480SF)

1) For filtering and protection purposes

Automotive MOSFETs

Infineon OptiMOS™ – benchmark for automotive MOSFETs

OptiMOS™ Products are Best-in-Class

OptiMOS™ SUPERIOR PERFORMANCE IS BASED on Infineon's leading MOSFET technology combined with the unsurpassed quality of robust package:

- Best-in-class $R_{DS(on)}$ performance for increased system efficiency
- Highest current DPAK + D^2PAK on the market for reduced ECU module size
- Lowest switching and conduction power losses for increased thermal system reliability
- Robust green package for easy process handling

New OptiMOS™-T2 Product Family

New OptiMOS™-T2 trench technology is the benchmark for applications in energy efficiency, CO_2 reduction, electric drives, etc. The new OptiMOS™-T2 product family extends the existing families of OptiMOS™-T and OptiMOS™.

OptiMOS™ Robust Green Package

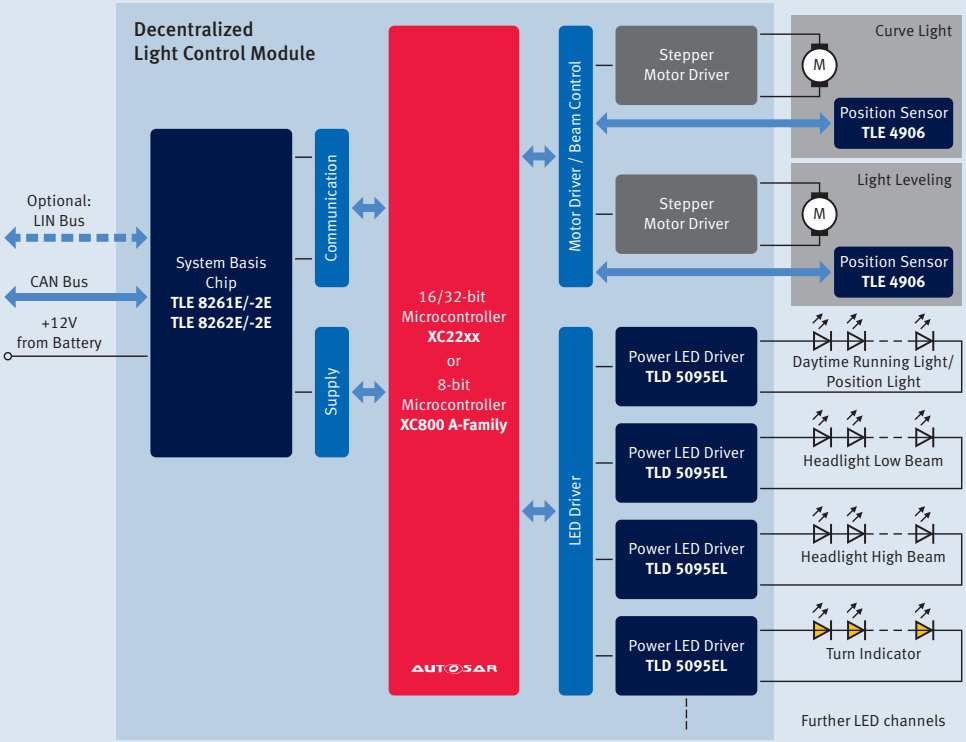
OptiMOS™ robust package is the benchmark for quality and reliability. Robust package sustains 260°C GREEN reflow processes at MSL1 combined with automotive qualification. No special handling or dry-pack is needed. All green packages are in compliance with RoHS/WEEE guidelines.

		Voltage Class [V]	OptiMOS™-T2 (Trench)	OptiMOS™-T (Trench)	OptiMOS™ (Planar)
	Single MOSFET				
NEW!	N-Channel	30	•		•
NEW!	N-Channel	40	•	•	•
	N-Channel	55			•
NEW!	N-Channel	60	•		
	N-Channel	75			•
	N-Channel	100		•	
NEW!	P-Channel	30 + 40	•		
	Dual MOSFET				
NEW!	Dual N-Channel	2 x 55		•	•
	P+N-Channel	30 + 55		•	

Automotive Microcontrollers

Decentralized front light module

Application Example



DECENTRALIZED FRONT LIGHT modules are used if the control of light functions is transferred to separate ECUs close to the front light modules. It combines functions to control LEDs and stepper motor control for advanced front light control (AFS). In order to establish AFS functionality, it needs to process information regarding the vehicle speed, steering angle and further vehicle parameters usually distributed via CAN bus.

Key Features

- 32–768KB Flash with emulated EEPROM
- Up to 6 CAN
- Up to 10 flexible serial interfaces including LIN
- Up to 24 ADC channels with up to 12-bit resolution
- Up to 32 PWM channels
- Low space packages
- Up to 4 CCU6 units

Benefits

- Light bulb supervision without CPU load
- Motor drive modules CCU6
- Supports all kinds of lighting systems: HID, LED, etc.
- Fully scalable over package and memory
- Flexible power concept
- Memory protection unit (MPU) to fulfill AUTOSAR requirement
- High-speed ADC: 650ns conversion cycle

[www.infineon.com/XC2000] [www.infineon.com/XC800]

Product Portfolio for Automotive Lighting

Linear LED Drivers

Automotive LED drivers

Product	Package	Green	Output Current [mA]	Operating Range [V]	Drop Voltage [V]	Accuracy (%)	Inhibit input	PWM
BCR 320U	PG-SC74	●	250	25	1.4	10	No	No
BCR 321U	PG-SC74	●	250	25	1.4	10	Yes	Yes
BCR 420U	PG-SC74	●	150	40	1.4	10	No	No
BCR 421U	PG-SC74	●	150	40	1.4	10	Yes	Yes
BCR 401U	PG-SC74	●	10	40	1.4	10	No	No
BCR 402U	PG-SC74	●	20	40	1.4	10	No	No
BCR 405U	PG-SC74	●	50	40	1.4	10	No	No

Basic LED drivers

Product	Package	Green	Output Current [mA]	Output Current [mA]	Operating Range [V]	Drop Voltage [V]	Accuracy (%)	Inhibit input	PWM
TLE 4240-2M	PG-SCT595	●	60	Fixed	45	0.5	10	Yes	Yes
TLE 4240-3M	PG-SCT595	●	60	Fixed	45	0.5	10	Yes	Yes
TLE 4241GM	PG-DSO-8	●	8/65	Adj.	45	0.3	20	Yes	Yes
TLE 4242G	PG-TO-263-7	●	500	Adj.	45	0.35	5	Yes	Yes
TLD 1211SJ	PG-DSO-8	●	85 (up to 2.5A with external transistor)		28			Yes	Yes

DC/DC LED Drivers

Power LED drivers

Product	Package	Topo-logy	Max.Input Voltage [V]	Output Voltage [V]	Output Current [A]	Accuracy (%)	Short-circuit Protection	Overtem-perature Protection	PWM Dimming	Enable Pin
TLD 5085EJ	PG-DSO-8	Buck	40	adj. <16	1.8	±2	Yes	Yes	Yes	Yes
TLD 5095EL	PG-DSO-14	Boost	45	adj. <45	ext. MOS	±4	Yes	Yes	Yes	Yes
TLD 5098EL	PG-DSO-14	Boost	60	adj. <60	ext. MOS	±4	Yes	Yes	Yes	Yes

Switches

PROFET™ – BTS 52xx

Product Type	Package	R_{ON} @ T_j = 25°C [mΩ]	$R_{ON\ (max)}$ @ T_j = 150°C [mΩ]	$V_{BB\ (max)}$ [V]
BTS 5231-2GS	PG-DSO-14	140	260	28
BTS 5235-2G	PG-DSO-20	60	115	28
BTS 5236-2GS	PG-DSO-14	50	100	28
BTS 5235-2L	PG-DSO-12	60	115	28
BTS 5242-2L	PG-DSO-12	25	48	28
BTS 5246-2L	PG-DSO-12	19	38	28

High current PROFET™

Product Type	Package	R_{ON} @ T_j = 25°C [mΩ]	$R_{ON\ (max)}$ @ T_j = 150°C [mΩ]	$V_{BB\ (max)}$ [V]
BTS 5016SDA	PG-TO252-5	16	32	38
BTS 5014SDA	PG-TO252-5	14	28	38
BTS 5012SDA	PG-TO252-5	12	24	38
BTS 6133D	PG-TO252-5	10	18	38
BTS 6143D	PG-TO252-5	10	18	38
BTS 50080-1TEB	PG-TO252-5	8	16	38
BTS 50080-1TEA	PG-TO252-5	8	16	38

SPI power controller (SPOC)

Product Type	Package	Family	Channels	Load Driving Capability	LED Mode	Cranking Mode	Watchdog	Slewrate Control	External Drive Capability	PWM Engine
BTS 5566G	PG-DSO-36	SPOC I	5	3 x 27W + 2 x 10W	Yes	No	No	No	No	No
BTS 5576G	PG-DSO-36	SPOC I	5	3 x 27W + 2 x 10W	Yes	No	No	No	No	No
BTS 5590G	PG-DSO-36	SPOC I	5	3 x 27W + 2 x 10W	Yes	No	Yes	No	No	No
BTS 5562E	PG-DSO-36 Exposed Pad	SPOC II	5	3 x 27W + 2 x 10W	No	No	No	No	No	No
BTS 5662E	PG-DSO-36 Exposed Pad	SPOC II	6	3 x 27W + 2 x 10W + 1 x 5W	No	No	No	No	No	No
BTS 5572E	PG-DSO-36 Exposed Pad	SPOC II	5	3 x 27W + 2 x 10W	Yes	No	No	No	No	No
BTS 5672E	PG-DSO-36 Exposed Pad	SPOC II	6	3 x 27W + 2 x 10W + 1 x 5W	Yes	No	No	No	No	No
BTS 5682E	PG-DSO-36 Exposed Pad	SPOC II	6	3 x 27W + 2 x 10W + 1 x 5W	Yes	Yes	No	No	No	No
BTS 5264SF	PG-DSO-36	SPOC DUO	2	2 x 4.5mΩ	No	No	No	No	No	No
BTS 5274SF	PG-DSO-36	SPOC DUO	2	2 x 4.5mΩ	No	No	No	Yes	No	No
BTS 5266SF	PG-DSO-36	SPOC DUO	2	2 x 6mΩ	No	No	No	No	No	No
BTS 5276SF	PG-DSO-36	SPOC DUO	2	2 x 6mΩ	No	No	No	Yes	No	No
BTS 5268SF	PG-DSO-36	SPOC DUO	2	2 x 8mΩ	No	No	No	No	No	No
BTS 5278SF	PG-DSO-36	SPOC DUO	2	2 x 8mΩ	No	No	No	Yes	No	No
BTS 5460SF	PG-DSO-36	SPOC FL	4	2 x 65W + 2 x 27W	Yes	No	No	No	No	No
BTS 5480SF	PG-DSO-36	SPOC FL	4	2 x 65W + 2 x 27W	Yes	No	No	No	Yes	No
BTS 6460SF	PG-DSO-36	SPOC FL	4	2 x 65W + 2 x 27W	Yes	No	No	No	No	Yes
BTS 6480SF	PG-DSO-36	SPOC FL	4	2 x 65W + 2 x 27W	Yes	No	No	No	Yes	Yes

Automotive MOSFETs

To get a detailed overview of our automotive MOSFET product portfolio, please visit www.infineon.com/ATV-MOSFETs.

Automotive Microcontrollers

8-bit microcontrollers

XC800 A-family

Product Type	Frequency [MHz]	Flash [KB]	RAM [KB]	CAN	ADC	PWM Channels	Touch Control	Capture Compare Units	Package	Temperature [°C]
XC82-Series	24	4	0.5	–	4	4	1	–	SSOP-24	-40–150
XC83-Series	24	4/8	0.5	–	8	4	1	–	TSSOP-28	-40–150
XC86-Series	27	4/8/16	0.8	–	8	4	–	–	TSSOP-38	-40–150
XC88-Series	20/24	24/32	1.8	up to 2	8	4	–	–	QFP-48 QFP-64	-40–150
XC87-Series	27	52/64	3	up to 2	8	10	–	1	QFP-64 VQFN-48	-40–125

16/32-bit microcontrollers

XC2200 family

Product Type	Frequency [MHz]	Flash [KB]	RAM [KB]	CAN	ADC	PWM Channels	Serial interfaces (USIC[1])	Capture Compare Units	Package	Temperature [°C]
U-Series	40	32–64	8	0	7/10	up to 20	1	2	TSSOP-38 VQFN-48	-40–125
L-Series	40	96–160	12	up to 2	10/19	up to 24	2	3	VQFN-48 QFP-64	-40–125
N-Series	40–80	192–320	34	up to 6	9/16	up to 24	4	3	QFP-64 QFP-100	-40–125
M-Series	40–80	448–832	50	up to 6	16/24	up to 32	2	5	QFP-64 QFP-100 QFP-144	-40–125

1) USIC: can be configured as UART, LIN, SPI/QSPI, I²C, I²S

Support Tools

Evaluation Boards

Board name	Product	Description	Order No.
PROFET™ demo kit	BTS 5241L BTS 5234G BTS 5230GS BTS 6143D	Evaluation kit to demonstrate the functionality of the BTS 5241L, BTS 5234G and BTS 5230GS. These are 2-channel, smart power PROFET™ (high-side switches), except BTS 6143D which is a singlechannel device. The control board is equipped with a C868BA microcontroller. It is built to be reverse polarity protected. The power boards are directly connected to the control board.	Demoboard PROFET™ V2.0
SPOC (SPI power controller for advanced light control)	BTS 5590GX	The universal body control module is intended to be used as a system evaluation board for several automotive power devices. It consists of a control unit and a power unit. The control unit is intended to control the power unit as well as to receive commands from a user interface. The power unit contains two BTS 5590GX for system evaluation purposes.	Demoboard BTS 5590GX
BTS 5590GX demoboard	Multi-channel switch	This board is part of the SPOC (SPI power controller for advanced light control) demo kit.	
SPOC II - Power easy kit	BTS 5662E BTS 5672E BTS 5682E Multi-channel switch	The SPOC II power easy kit is intended to be used as a system evaluation board for several automotive power devices like BTS 5662E, BTS 5672E and BTS 5682E. It consists of a control unit and power unit. The control unit is intended to control the power unit as well as receive commands from a user interface.	Demoboard BTS 5672E/ BTS 5682E
HITFET™ protected low-side power switch	BTS 3256D Low-side switch	Protected low-side power switch (10mΩ at 25°C). This board enables easy startup and connectivity for the new power HITFET™ BTS 3256D. Enables easy read out of digital status via LED, and easy slew rate change via variable resistor on board.	Demoboard BTS 3256D
HIC-PROFET™	BTS 500x0-1EGA High-side switch	For a quick start to lab evaluation, this demoboard drives loads such as heating, glow plugs or lamps in 12 V DC applications. It uses two devices from the BTS 500x0-1EGA product family, which can be used in parallel and also to drive two independent loads. The board can be used on a stand-alone basis, but also in combination with power easy kit for quick start of software evaluation.	Demoboard BTS 50050-1EGA Demoboard BTS 50060-1EGA Demoboard BTS 50070-1EGA Demoboard BTS 50080-1EGA

Application Notes

Application note	Internet link
Sense accuracy of smart power switches to diagnose lamps.	www.infineon.com/profet
Define PWM duty cycle to stabilize light emission.	www.infineon.com/profet
Inverse operation behavior of the BTS 6143D and members of this product family.	www.infineon.com/profet

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