

# Energy-efficient solutions for LED lighting



October 2009



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# ST's commitment to energy saving

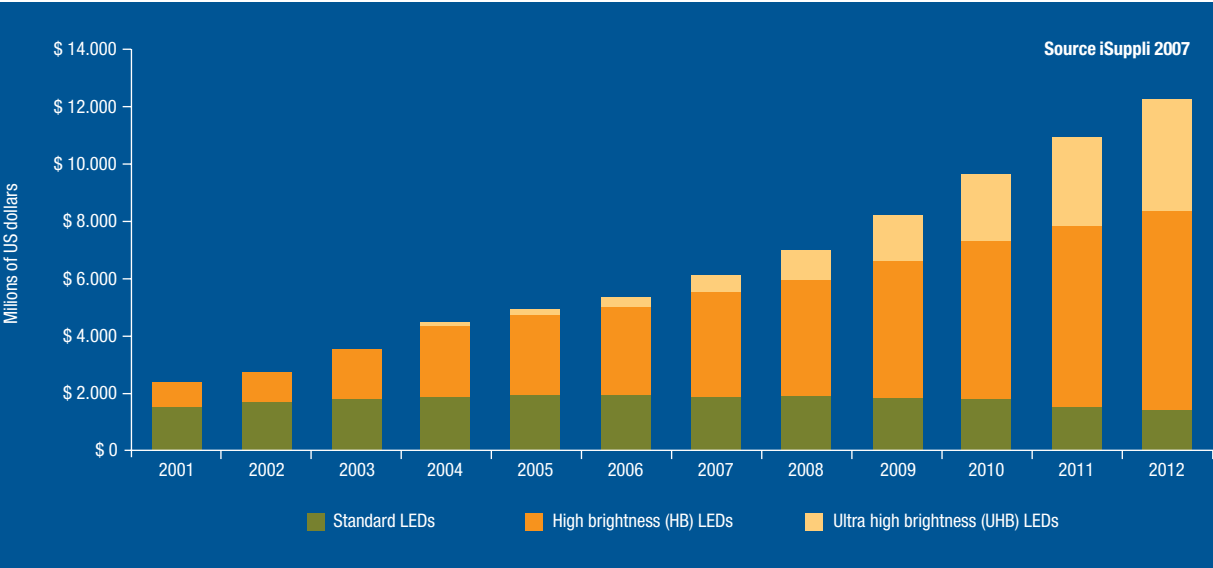
While technological progress has improved the quality of our lives, it has significantly increased global energy consumption, from 7 billion toe (tonne of oil equivalent) in 1980 to 12 billion toe in 2007\*. With increasing levels of greenhouse gases in the atmosphere and the dwindling of traditional energy resources, a more energy-efficient approach is required.

STMicroelectronics is committed to developing products and technologies that enable efficient power supply, from generation to consumption, across all microelectronics applications. STMicroelectronics follows two complementary approaches - reduction of energy consumption in the chip itself, and new ways to further improve energy efficiency in the end applications, such as lighting.

Lighting represents 15% of global electrical energy consumption, mainly in buildings and exterior applications. More efficient lighting thus offers potentially large savings in energy and is closely related to the performances of its control electronics.

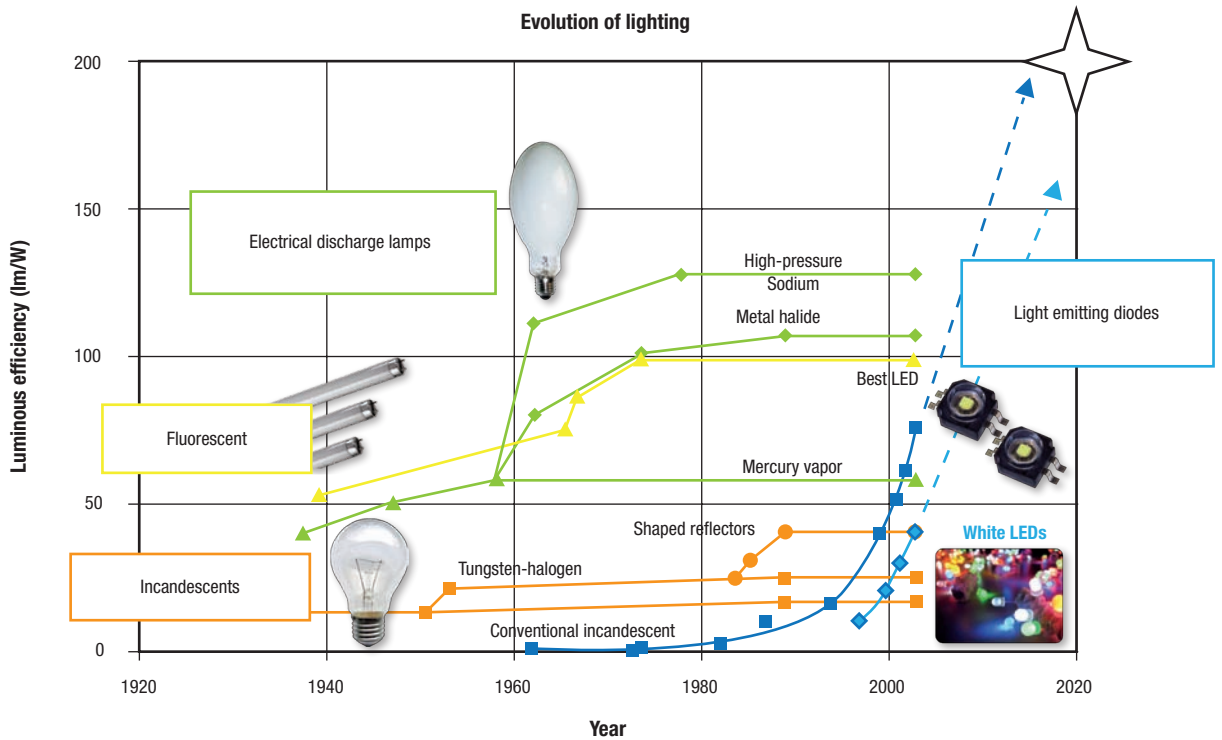
A leading provider of complete lighting solutions with smart management and high protection levels, STMicroelectronics supports energy-efficient electronic ballasts with a large portfolio of products (power discrete semiconductors, application-specific ICs and microcontrollers). These ICs combine all the functions required to generate more light from less energy, while ensuring longer lifetime for the lamps and full compliance with safety and power consumption regulations.

Light emitting diodes (LEDs), thanks to their numerous advantages, are set to become a new standard source of illumination for the 21st century.



\*Based on EIA: International Energy Outlook 2008 report #DOE/EIA-0484 (2008)

LEDs are essentially PN junction semiconductor diodes that emit a monochromatic (single color) light when operated in a forward biased direction. The basic structure of a LED consists of the die or light emitting semiconductor material, a lead frame where the die is actually placed, and the encapsulation epoxy which surrounds and protects the die. The first commercially usable LEDs were developed in the 1960's, but they have only recently reached significant levels of luminous efficiency.



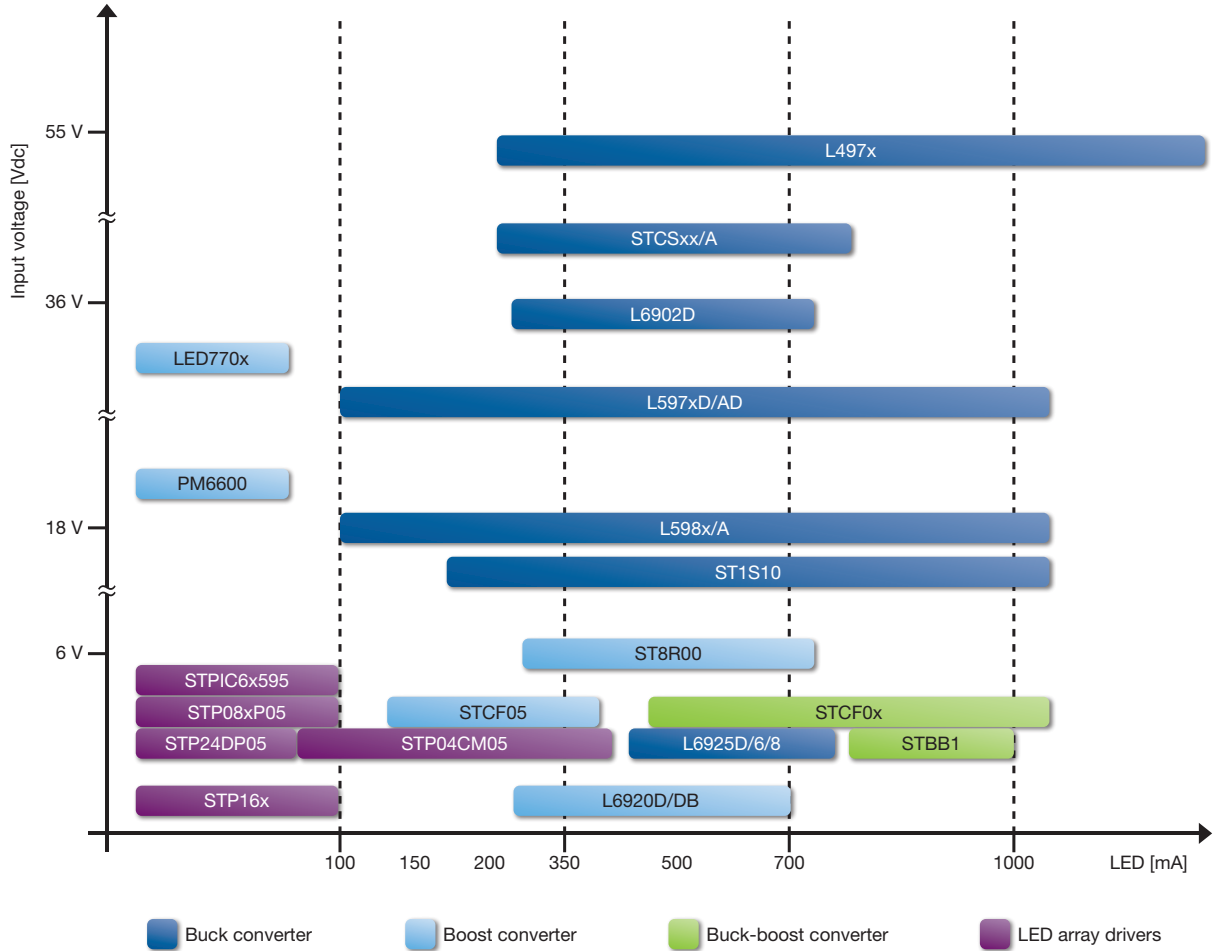
LEDs offer longer lifetimes (up to 100,000 hours), a wide color spectrum, small size and greater design flexibility. Moreover, LEDs increase safety through their low-voltage power supplies, and enhance user comfort as they turn on instantly and operate silently. LEDs are environment friendly because they have no gas inside, no UV and little infrared emission.

Most importantly, LEDs can save a lot of energy compared with standard lighting sources. It has been estimated that the replacement of 5% of all incandescent bulbs in the world (12.5 billion/year) with LED-based lighting would allow the saving of 60 TWh of electricity equivalent to 23.4 Gtonne of CO<sub>2</sub> a year.

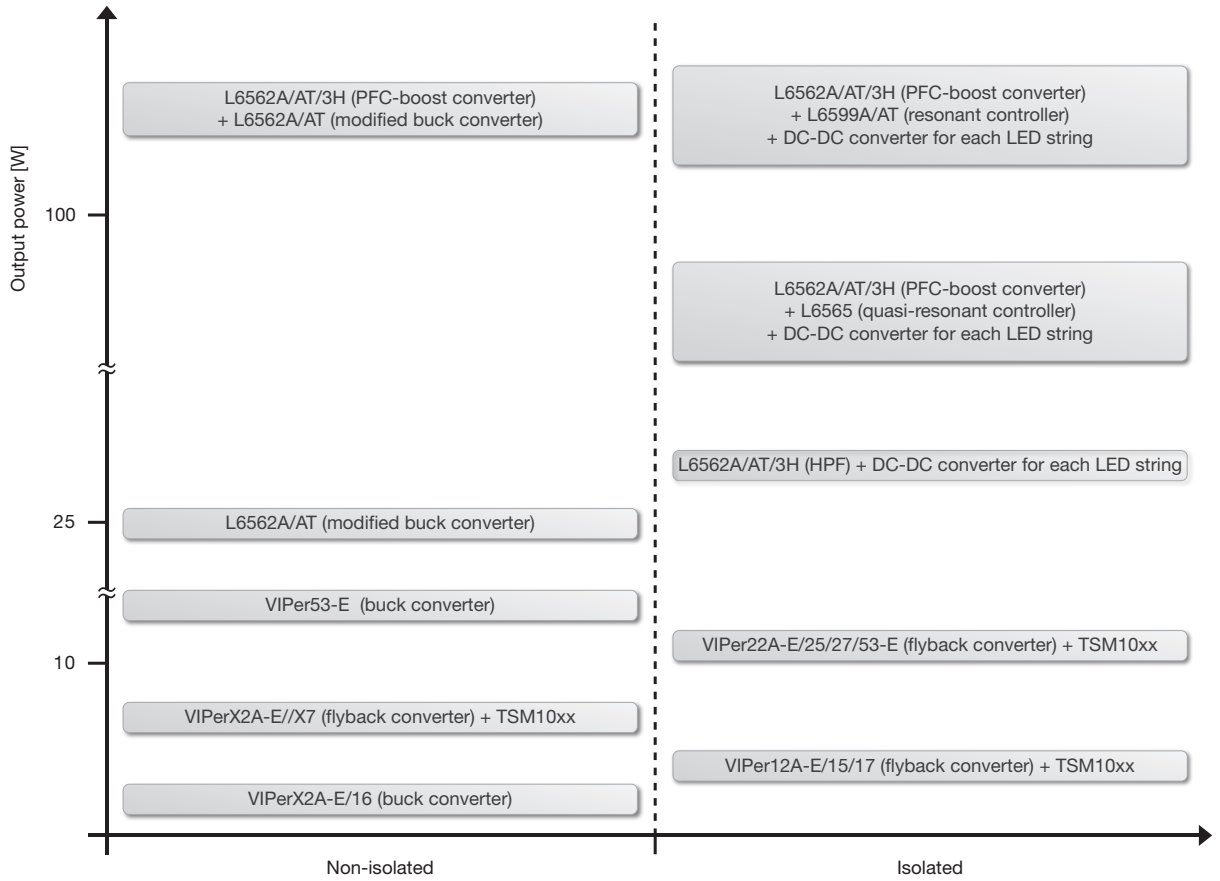
STMicroelectronics offers a large portfolio of compact and efficient LED driver solutions, fully addressing the lighting market and featuring all the functions needed to ensure greater power saving.

# ST's LED driver solutions

Low input voltage solutions: buck, boost, buck-boost and LED array drivers



## Offline LED drivers: 85 to 265 Vac input voltage



# LED application segments



**STP04CM05, STP08xP05, STP16x, STP24DP05**

## Displays and signs

- Full color video
- Monochrome message boards
- Variable message signs
- Transportation
- Information



## General illumination

- Residential lighting
- Commercial lighting
- Architectural lighting
- Street lighting
- Large area illumination
- Emergency lighting

**VIPerx2, VIPerx6, VIPerx7, L6562A/AT/3H, L6599A/AT, STP04CM05, ST1S10, STCSxx/A, L597xA/AD, L598x/A, L497x, L6902D**



**STCF0x, LED770x, PM660x**

## Backlighting

- Notebooks
- Netbooks
- LCDs
- PDAs
- Cell phones
- Digital cameras
- General backlighting



**STP08DP05, STP16x, STP24DP05**

## Signal lighting

- Road traffic signals
- Aviation
- Rail
- Navigation
- Emergency/police signals



## Automotive and consumer

- Interior lighting
- Exterior lighting
- Consumer electronics
- Televisions
- VCR/DVD/stereo/audio/video devices
- Household appliances
- Toys/games
- Security equipment

**STP04CM05, STP08xP05, STP16x, STPIC6x595, STCSxx/A, LED770x, L597xD/AD, L598x/A, L497x, L6902D, A597x**

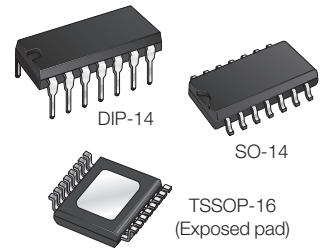


# LED array drivers

## STP04CM05

The STP04CM05 is a high-power LED driver and 4-bit shift register designed for power LED applications. The STP04CM05 contains a 4-bit serial in, parallel out shift register that feeds a 4-bit D-type storage register. In the output stage, four regulated current sources are designed to provide 80 to 400 mA constant current to drive the high powered LEDs.

The STP04CM05 family guarantees 20 V output driving capability, allowing users to connect more LEDs in series. The high clock frequency, 30 MHz, also satisfies the system requirements which include high-volume data transmission. The STP04CM05 is well suited for very high brightness displays and special lighting applications. The STP04CM05 is offered in DIP-14, SO-14 and TSSOP16 exposed pad packages.



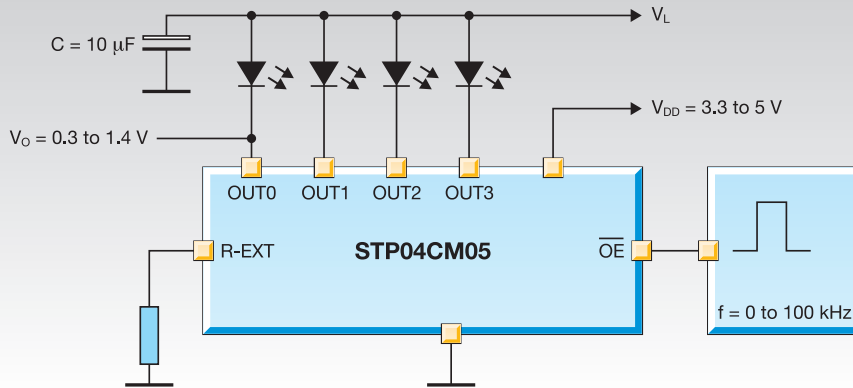
### Key features

- 4 constant-current output channels
- Adjustable output current (80 to 400 mA) using a single external resistor
- 20 V of output driving capability
- Serial data in/parallel data out
- Output enable pin for dimming (PWM)
- Maximum clock frequency: 30 MHz
- ESD protection: 2.5 kV HBM, 200 V MM

### Key benefits

- Thermal shutdown, output off when junction temperature exceeds limit
- Well suited for very high-brightness displays and special lighting applications
- Uniform and accurate current control in a single-chip solution

### Application example



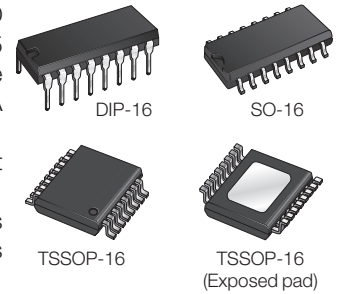
Sales code	Board	Description	Technical documents
STEVAL-ILL009V3		OSTAR projection module	
STEVAL-ILL009V4		OSRAM Dragon LED module	
STEVAL-ILL009V5		New RGB LED control board	AN2531: Generating multicolor light using RGB LEDs

# STP08xP05

The STP08xP05 series are monolithic, low-voltage, low-current, low-power LED drivers and 8-bit shift registers designed for LED panel displays. The STP08xP05 contains an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. In the output stage, eight regulated current sources provide 5 to 100 mA constant current to drive the LEDs.

Users can adjust LED brightness using an external resistor to control the output current or using a dedicated digital pin.

The STP08DP05 contains a built-in error-detection feature. This additional function is achieved without any increase in the pin number and any change in the pin functions compared to a standard device without error detection.



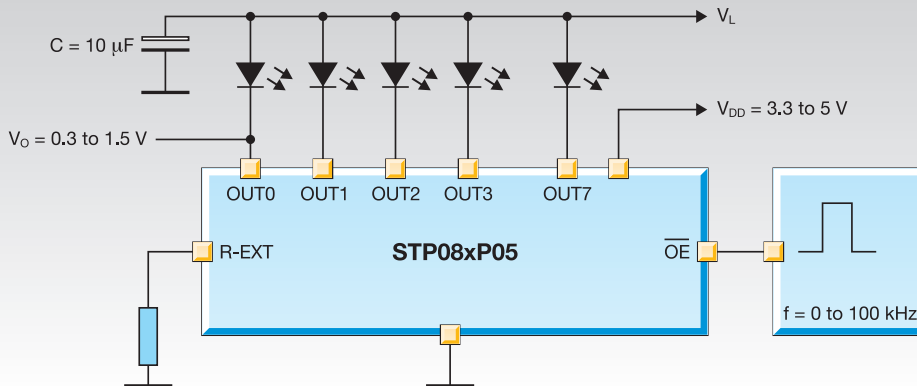
## Key features

- Low-voltage power supply: down to 3 V
- 8 constant-current output channels
- Adjustable output current through external resistor
- Serial data in/parallel data out
- 3.3 V microcontroller driveable
- Output current: 5 to 100 mA
- Maximum clock frequency: 30 MHz
- ESD protection: 2.5 kV HBM, 200 V MM
- Extended thermal range and protection with wide package portfolio

## Key benefits

- Uniform and accurate current control in a single-chip solution
- Common footprint design
- Thermal shutdown, output off when junction temperature exceeds limit
- Available and combinable features such as:
  - high precision
  - full error detection

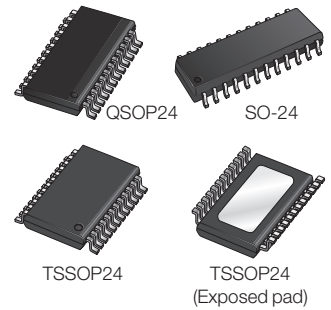
## Application example



Sales code	Board	Description	Technical documents
STEVAL-ILL002V3		High-brightness LED with diagnostics (40 LEDs)	UM0181: Detection LED matrix evaluation kit
STEVAL-ILL002V4		High-brightness LED with diagnostics (40 LEDs)	AN2478: STP08DP05, STP16DP05 Normal mode and error detection features

# STP16x

The STP16x series are monolithic, low-voltage, low-current, low-power LED drivers and 16-bit shift registers designed for LED panel displays. The STP16x contains a 16-bit serial-in, parallel-out shift register that feeds a 16-bit D-type storage register. In the output stage, sixteen regulated current sources provide from 3 mA to 100 mA constant current to drive the LEDs.



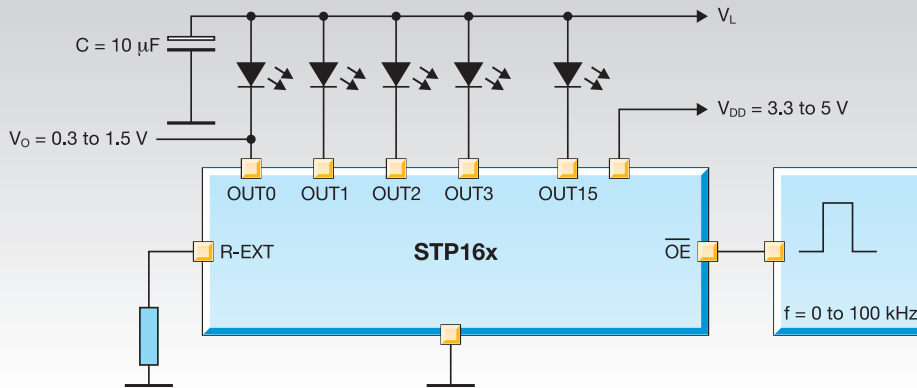
## Key features

- Low-voltage power supply: down to 3 V
- 16 constant-current output channels
- Adjustable output current through external resistor
- Serial data in/parallel data out
- 3.3 V microcontroller driveable
- Output current: 5 to 100 mA for STP16xP05 series
- Output current: 3 to 40 mA for STP16xPP05 series
- Maximum clock frequency: 30 MHz
- ESD protection: 2.5 kV HBM, 200 V MM
- Extended thermal range and protection with wide package portfolio

## Key benefits

- Thermal shutdown, output off when junction temperature exceeds limit
- Uniform and accurate current control in a single-chip solution
- Common footprint design
- Available and combinable features such as:
  - high precision
  - full error detection via SPI
  - auto power saving

## Application example



Sales code	Board	Description	Technical documents
STEVAL-ILL003V2		High-brightness LED driver without diagnostics (32 LEDs) based on STP16CP05	AN2141: LED array reference design board

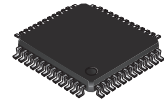
# STP24DP05

The STP24DP05 is a monolithic, low-voltage, low-current LED driver and 24-bit shift register designed for LED panel displays. The device contains an 8 x 3-bit serial-in, parallel-out shift register that feeds an 8 x 3-bit D-type storage register. In the output stage, 24 regulated current sources provide 5 to 80 mA constant current to drive the LEDs. The 8 x 3 shift register data flow sequence can be managed with two dedicated pins.

Users can adjust the output current for each 8-channel group using three external resistors, controlling in this way the light intensity of the LEDs.

The STP24DP05 guarantees a 20 V output driving capability, allowing users to connect more LEDs in series.

The high clock frequency, 25 MHz, makes the device suitable for high data rate transmission. The 3.3 V voltage supply is useful for applications that interface any microcontroller from 3.3 V.



TQFP48-EP

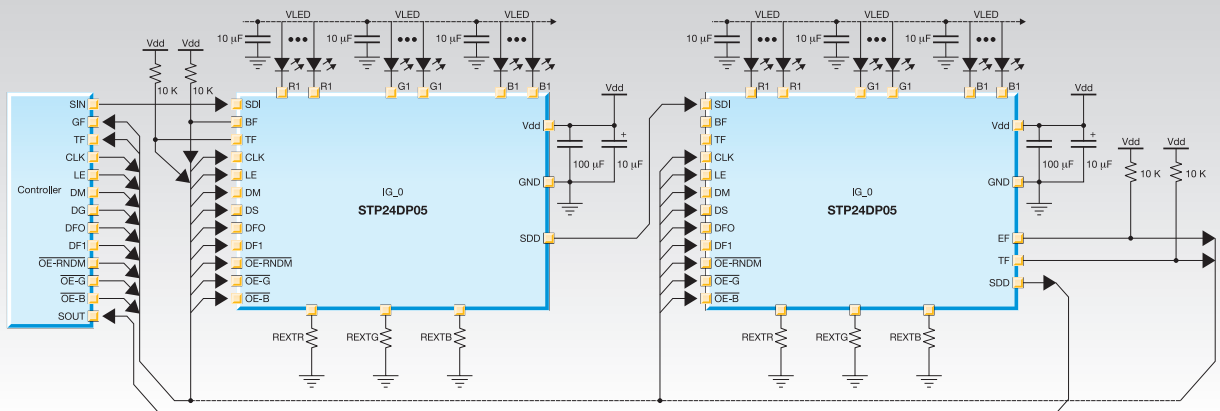
## Key features

- Low-voltage power supply: down to 3 V
- 3 x 8 constant-current output channels
- Adjustable output current through external resistor
- Serial data in/parallel data out
- 3.3 V microcontroller driveable
- Output current: 5 to 80 mA
- Maximum clock frequency: 25 MHz
- ESD protection: 2.5 kV HBM, 200 V MM

## Key benefits

- Thermal shutdown, output off when junction temperature exceeds limit
- Uniform and accurate current control in a single-chip solution
- Full error detection via SPI and flag pin
- Available and combinable features such as:
  - high precision
  - full error detection
  - auto power saving

## Application example

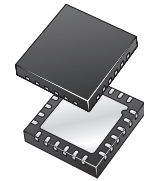


Sales code	Board	Description	Technical documents
STEVAL-ILL015V1		High-brightness RGB LED array with LED error detection	<p>AN2841: LED dimming implemented on STM32 microcontroller</p> <p>UM0574: LED dimmer demonstration board based on the STP24DP05 and STM32</p> <p>UM0588: Multilayer C library for LED dimming used on systems with SPI and DMA capabilities</p>

# Boost converters

## PM660x

The PM6600 consists of a high-efficiency monolithic boost converter and six controlled current generators (rows), specifically designed to supply LED arrays used in mobile PC LCD-panel backlighting. The device can manage a nominal output voltage up to 36 V (i.e. 10 white LEDs per row). The generators can be externally programmed to sink up to 32 mA and they can be dimmed via a PWM signal (1% dimming duty cycle at 20 kHz can be managed). The device detects and manages open and shorted LED faults and leaves unused rows floating. Basic protection (output overvoltage, internal MOSFET overcurrent and thermal shutdown) is provided.



VFQFPN-24

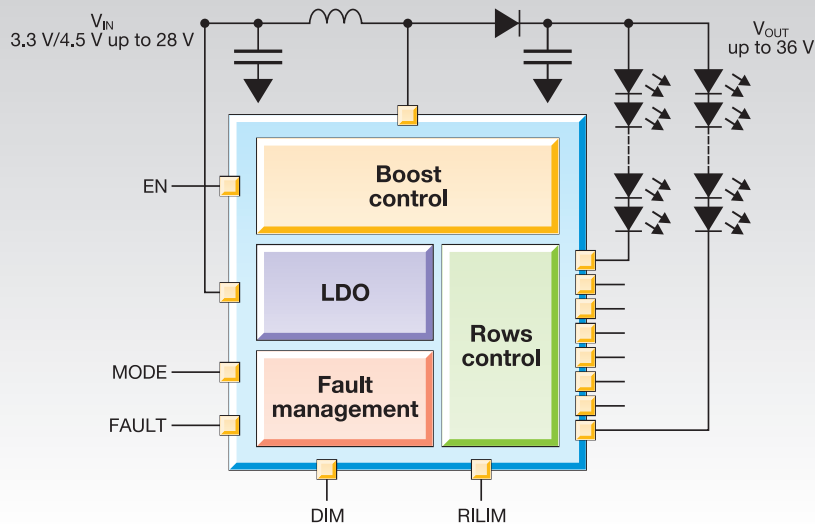
### Key features


- 6/8 rows with up to 10 LEDs each (60 or 80 LEDs)  
Monolithic solution up to 36 V output voltage
- Up to 1 MHz  $F_{sw}$  and high efficiency at light load
- Programmable LED current up to 32 mA @ highest precision/matching accuracy
- Supports analog and digital dimming
- SMBus/DPST enabled (PM6602 only)

### Key benefits

- Supports wide range of screen sizes from small netbooks to wide-screen notebooks with one device
- High integration, so few and small (cheap) external components
- Outstanding efficiency for longer battery life and energy saving

### Application example

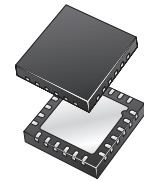


Sales code	Board	Description
STEVAL-ISA056V1		6-row, 30 mA LED driver with boost converter for notebook PC LCD-panel backlighting

# LED770x

The LED770x consists of a high-efficiency monolithic boost converter and six controlled-current generators (rows) specifically designed to supply LED arrays used in the backlighting of LCD panels. The device can manage an output voltage up to 36 V (i.e. 10 white LEDs per row).

The generators can be externally programmed to sink up to 85 mA (LED7707) and can be dimmed via a PWM signal. The device detects and manages open and shorted LED faults and leaves unused rows floating. Basic protection (output overvoltage, internal MOSFET overcurrent and thermal shutdown) is provided.



VFQFPN-24 4x4

## Key features

### Boost section

- Input voltage range: 4.5 V to 36 V
- Internal power MOSFET
- Up to 93% efficiency
- Up to 36 V output voltage
- Switching frequency: 200 kHz to 1 MHz
- Programmable soft-start, OVP and OCP
- External sync for multi-device applications

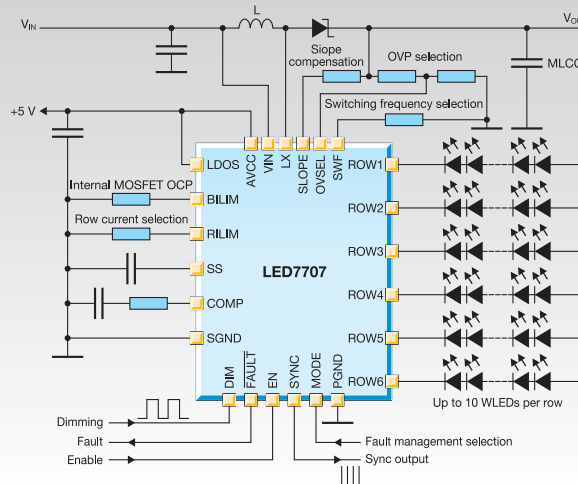
### Backlight driver section



- Six rows capable of driving multiple LEDs in series
- Up to 85 mA (LED7707) and 30 mA (LED7706) programmable output-current per row
- Rows in parallel to drive up to 510 mA LEDs (LED7707)
- ±1.5% current matching between rows
- Shorted and open LED fault detection
- PWM dimming (500 ns minimum dimming on-time LED7706)

## Key benefits

- Monolithic and flexible solution
- High efficiency
- Superior dimming capability
- Complete and flexible fault management

## Application example



Sales code	Board	Description	Technical documents
STEVAL-ILL020V1		LCD panel backlight demoboard based on LED7706 (6-row - 30 mA LED driver with boost converter)	AN2809: 6-row, 30-mA LED driver with boost converter for the backlight of LCD panels
STEVAL-ILL021V1		LCD panel backlight demoboard based on LED7707 (6-row - 85 mA LED driver with boost converter)	AN2810: 6-row 85 mA LED driver with boost converter for LCD panel backlighting

# ST8R00

The ST8R00 family of synchronous step-up DC-DC converters with current output cut-off function provide up to 1 A over an input voltage range of 4 V to 6 V and an output voltage range of 6 V to 12 V.

The high switching frequency (1.2 MHz) allows the use of tiny surface-mount components.

In addition to the resistor divider to set the output voltage value, only an inductor and two capacitors are required. A low output ripple is guaranteed by the current-mode PWM topology and by the use of low ESR surface-mounted ceramic capacitors.

The device is available in two versions: burst mode (ST8R00) and continuous mode (ST8R00W) operation.



DNF8 4x4 mm

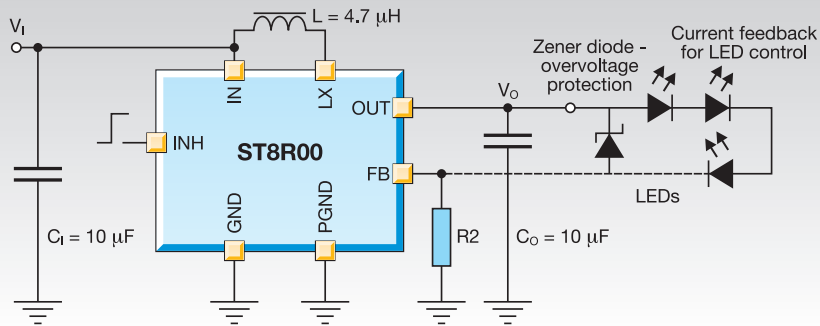
## Key features

- Very low supply current: 500  $\mu$ A (typ)
- Output voltage: adjustable from 6 V to 12 V
- Output voltage accuracy:  $\pm$ 2%
- Output current: up to 1 A
- Very small DFN8 (4x4 mm) package

## Key benefits

- Efficiency up to 90%
- Few external components

## Application example



Sales code	Board	Description	Technical documents
STEVAL-ISA48V2		1 A/adjustable $V_{OUT}$ PWM synchronous step-up DC-DC converter based on ST8R00	AN2627: ST8R00 synchronous boost converter with output current cut-off function

## L6920D/DB

The L6920DB is a high-efficiency monolithic step-up switching converter IC specifically designed for battery-powered applications. The MSOP8 package minimizes PCB space. It requires only three external components to convert the battery voltage to the selected output voltage. The minimum output voltage is 1.8 V, suitable to supply the most advanced ASICs and microprocessors.

High switching frequency allows for a low-profile, small-sized inductor and output capacitor to be used.

Reference voltage, low-battery detection and shutdown are provided together with overcurrent protection.



MSOP8

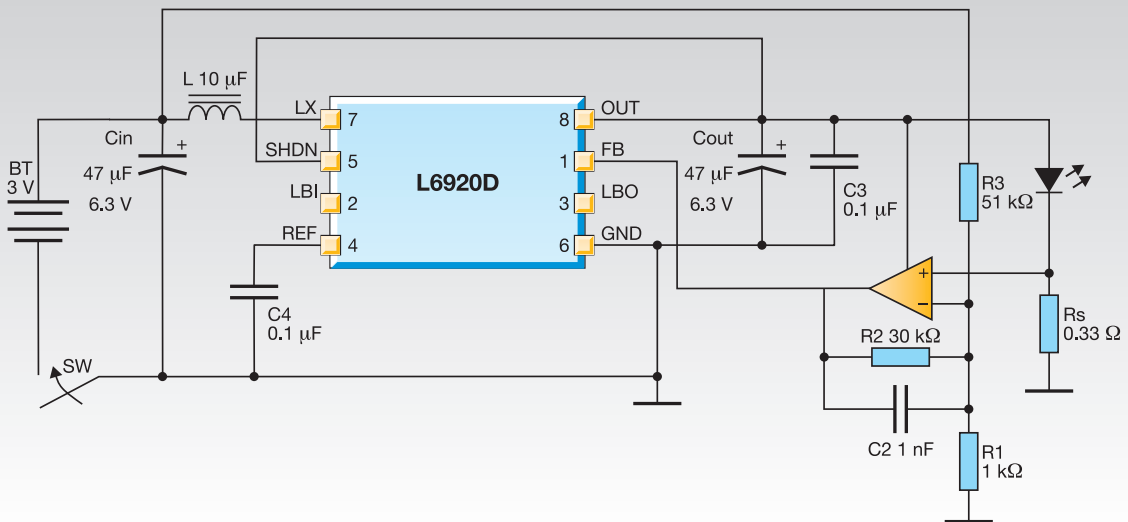
### Key features



- 0.8 V start-up input voltage
- Input voltage: up to 5.5 V
- Internal synchronous rectifier
- Adjustable output voltage: from 1.8 V (L6920DB)
- Low battery voltage detection
- 750 mA input current limit (L6920DB) (1 A for L6920D)

### Key benefits

- Monolithic and flexible solution
- High efficiency

### Application example



Sales code	Board	Description	Technical documents
EVAL6920DB1		L6920DB synchronous rectification step-up converter evaluation board	AN2206: Designing with L6920DB, high efficiency synchronous rectifier step-up converter
STEVAl-ILL008V1		LED flashlight demo board based on the L6920D Previous sales code: PSAL05-13	AN1941: Low-voltage LED driver using L6920D, L4971 and L6902D

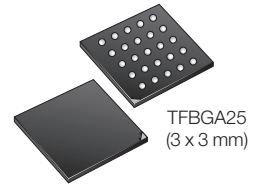


# STCF05

The STCF05 is a high-efficiency power supply solution to drive multiple flash LEDs in camera phones, PDAs and other hand-held devices.

The synchronous boost topology with output current control guarantees the proper LED current over all possible conditions of battery level and LED forward voltage.

All the functions of the device are controlled through the I<sup>2</sup>C bus that allows to reduce logic pins on the package and to save PCB traces on the board.



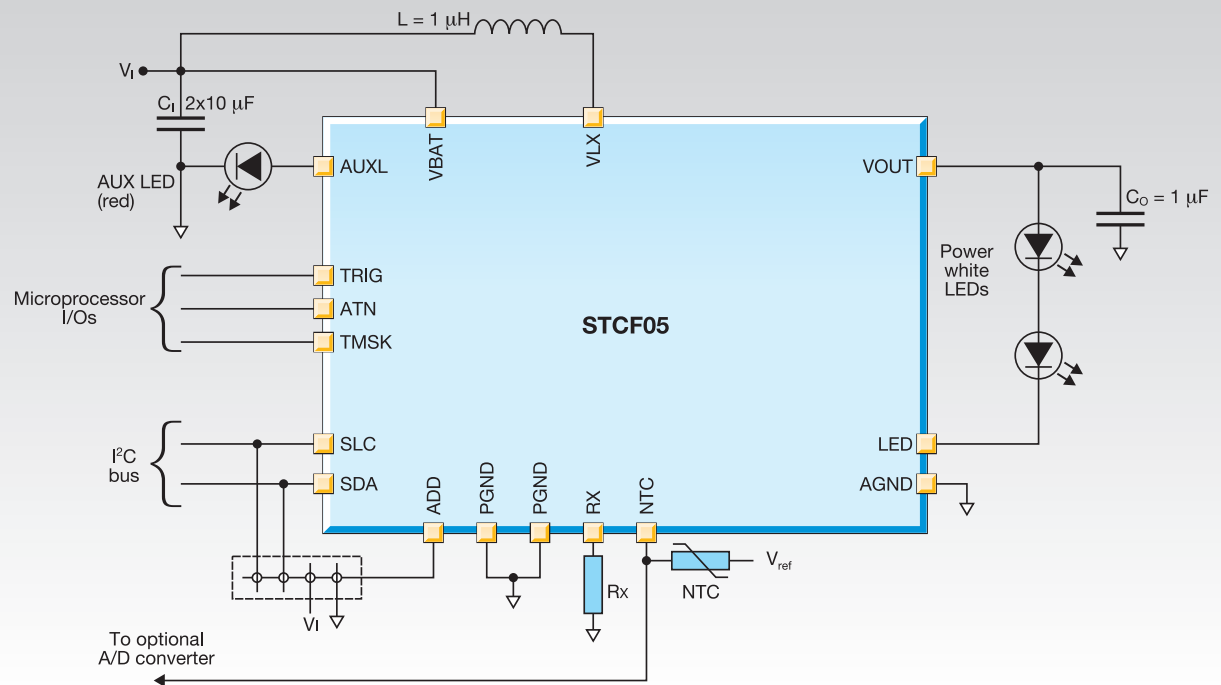
## Key features

- 1.8 MHz fixed frequency PWM control
- Efficiency up to 92%
- Full I<sup>2</sup>C control
- LED overtemperature detection and protection with external NTC resistor
- Open and shorted LED failure detection and protection
- Chip over-temperature detection and protection
- Less than 1 μA standby current

## Key benefits

- Few external components required

## Application example



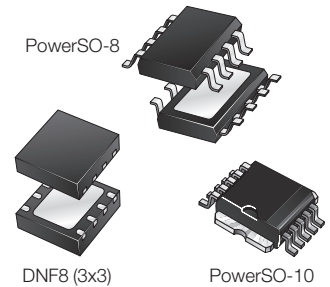
Sales code	Board	Description	Technical documents
STEVAL-TLL007V1		Power flash demo board based on STCF05 (includes motherboard based on uPSD)	AN2827: Driver for double flash LED with I <sup>2</sup> C interface

# Buck converters

## STCSx

The STCSx family is a BiCMOS constant-current source designed to provide a precise constant current starting from a varying input voltage source. It is designed to replace discrete-component LED driving solutions in low-voltage applications such as 5 V, 12 V or 24 V, providing benefits in terms of precision, integration and reliability.

An external resistor is used to set the current up to 2 A with a  $\pm 10\%$  precision; a dedicated pin can be used for PWM dimming. An open-drain pin output provides information on load disconnection conditions.



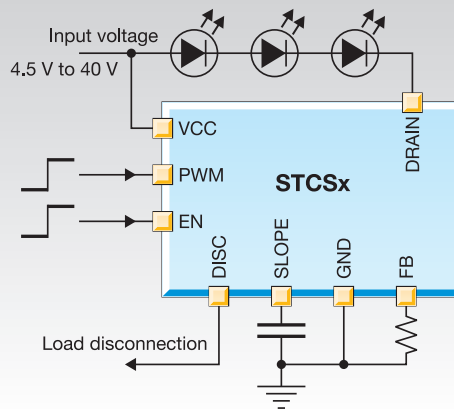
### Key features


- Adjustable current set from 0.1 A to 2.0 A (STCS2), 1.5 A (STCS1), 500 mA (STCS05)
- Adjustable turn-on ramp-up from 10  $\mu$ s to 10 ms, set with external capacitor to reduce the EMI noise
- Microprocessor-compatible dimming input that turns the LED current on/off
- MLP-8L 3x3 mm and PowerSO8 (STCS1), SO8 (STCS05), PowerSO10 (STCS2)

### Key benefits

- Supports wide range of screen sizes from small netbooks to wide-screen notebooks with one device
- High integration, so few and small (cheap) external components
- Outstanding efficiency for longer battery life and energy saving

### Application example



Sales code	Board	Description	Technical documents
STEVAL-ILL014V1		Constant-current controller for high-brightness LEDs based on STCS1A	UM0422: Constant current controller for high brightness LEDs

# L6902D

The L6902D is a complete and simple step-down switching regulator with adjustable current limit.

Based on a voltage-mode structure, it integrates a current error amplifier for constant-voltage and constant-current control.



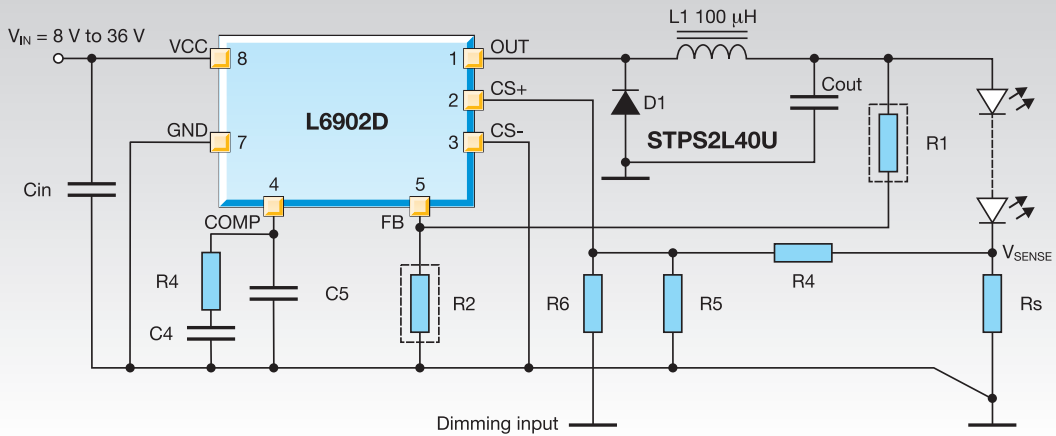
## Key features


- 1 A in small SO8 package with minimum external component count
- P-channel power MOSFET: no bootstrap capacitor
- Wide input voltage range: 8 V to 36 V
- Adjustable LED current ( $V_{CS+} - V_{CS-} = 100 \text{ mV}$ )
- High switching frequency: 250 kHz
- External  $V_{REF}$  available

## Key benefits

- Monolithic and flexible solution
- High efficiency
- Low power dissipation
- OVP available
- Dimming capability

## Application example



Sales code	Board	Description	Technical documents
STEVAL-ILL010V1		High-intensity LED dimming driver based on L6902	<p>AN2129: Dimming of super high-brightness LEDs with L6902D</p> <p>AN1941: Low Voltage LED Driver Using L6920D, L4971 and L6902D</p> <p>AN1891: Application ideas: driving LEDs using L497x, L597x, L692x DC-DC converters families</p>

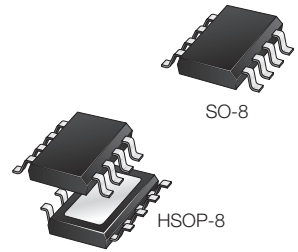
## L597x

The L597x is a step-down monolithic power switching regulator capable of delivering more than 2 A DC current to the load depending on the application conditions. The output voltage can be set from 1.235 V to 35 V.

The device uses an internal P-channel D-MOSFET (with a typical  $R_{DS(on)}$  of 250 m $\Omega$ ) as switching element to minimize the size of the external components. An internal oscillator fixes the switching frequency at 250 kHz.

Having a minimum input voltage of 4.4 V only, it is particularly suitable for 5 V buses, available in all computer related applications.

Pulse-by-pulse current limit with the internal frequency modulation offers an effective constant-current short-circuit protection.







### Key features

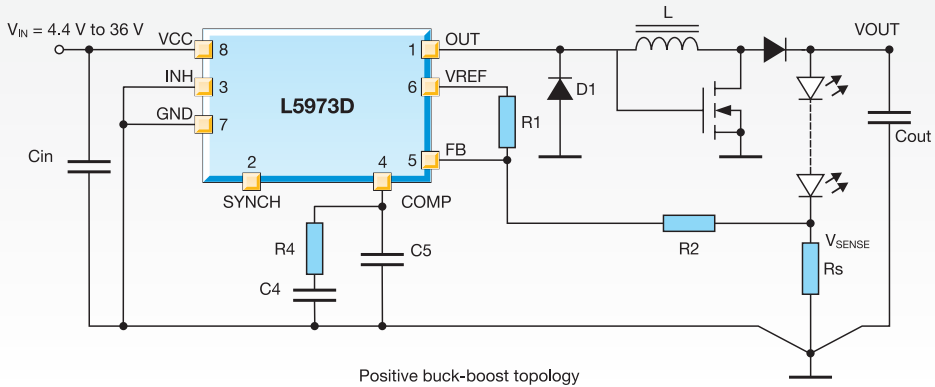
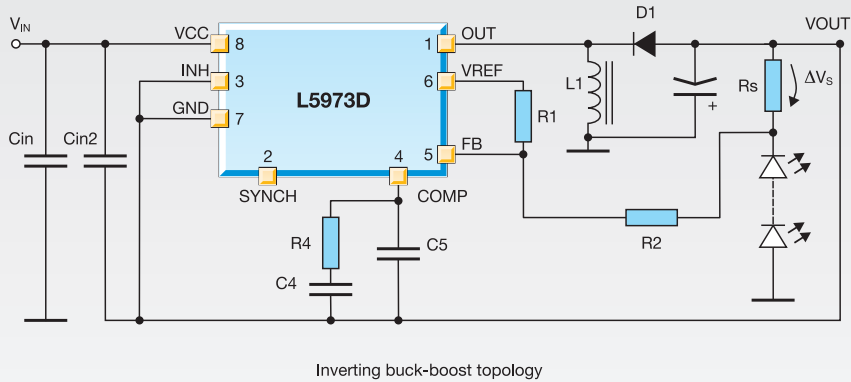
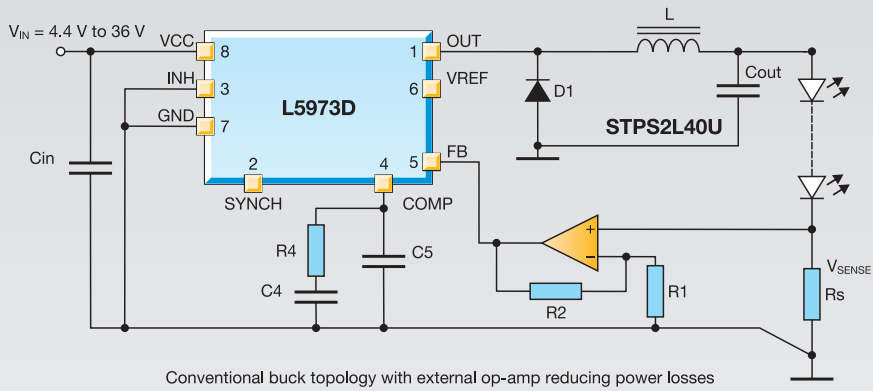
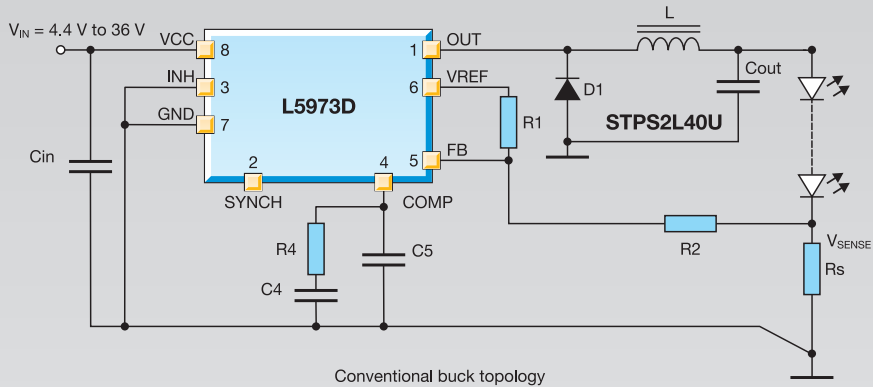
- More than 2 A in small SO8 package with minimum external component count
- P-channel power MOSFET: no bootstrap capacitor
- Wide input voltage range: 4.4 V to 36 V
- High switching frequency: 250 kHz/500 kHz, sync up to 700 kHz
- Inhibit pin
- Embedded protection features

### Key benefits

- Monolithic and flexible topology solutions
- Wide input voltage range compatible with MR16 standard
- High efficiency
- Low power dissipation
- Automotive grade available (A597x)

Sales code	Board	Description	Technical documents
EVAL5970D		L5970D up to 1 A step-down switching regulator evaluation board	AN1330: Designing with the L5970D 1 A high-efficiency DC-DC converter
EVAL5972D		L5972D up to 2 A step-down switching regulator evaluation board	AN1517: Designing with the L5972D high-efficiency DC-DC converter
EVAL5973D		L5973D up to 2.5 A step-down switching regulator evaluation board	AN1518: Designing with the 2.5 A DC-DC converter L5973D
EVAL5973AD		L5973AD 2 A step-down switching regulator evaluation board	AN1723: Designing with L5973AD high efficiency DC-DC converter

## Application example



# L598x

The L598x is a step-down switching regulator with embedded power MOSFET, and can deliver up to 3 A to the load depending on the application conditions. The input voltage can range from 2.9 V to 18 V. Requiring a minimum of external components, the device includes an internal 250 kHz switching-frequency oscillator that can be externally adjusted up to 1 MHz.







## Key features

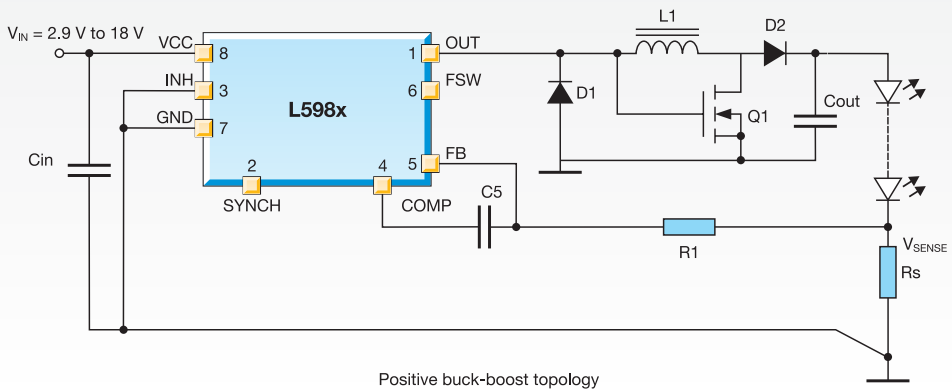
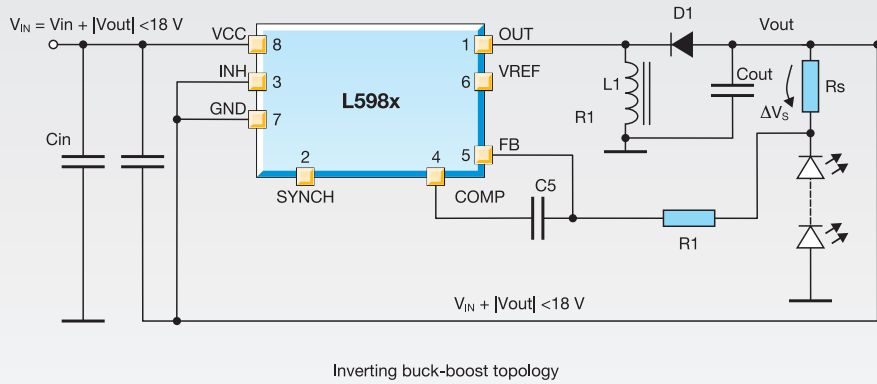
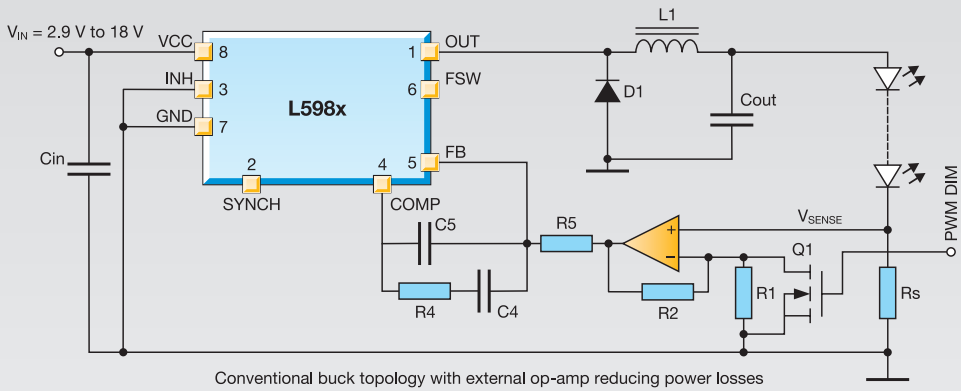
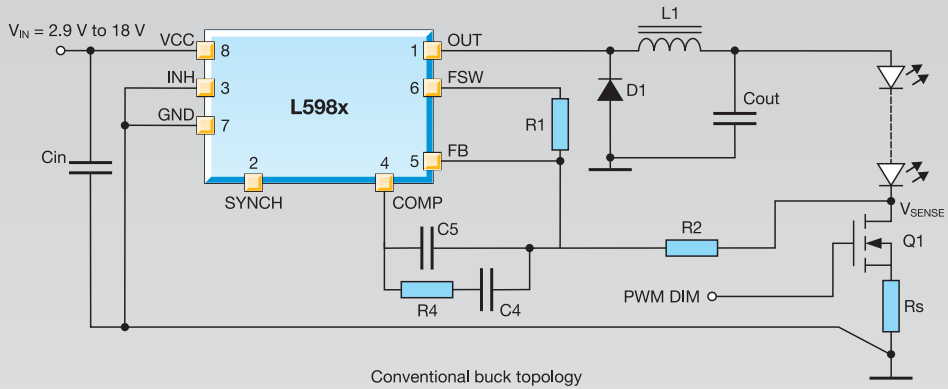
- More than 3 A in small QFN3x3-8L package with minimum external component count
- P-channel power MOSFET: no bootstrap capacitor
- Wide input voltage range: 2.9 V to 18 V
- High switching frequency: 250 kHz, adjustable up to 1 MHz, with synchronization capability (180° out of phase)
- Internal soft-start
- Inhibit pin
- Suitable for MLCC output filter
- Typ  $R_{DS(on)} = 140 \text{ m}\Omega$

## Key benefits

- Monolithic and flexible topology solutions
- Low power dissipation
- High efficiency
- Compact applications

Sales code	Board	Description
EVAL5980		0.7 A step-down switching regulator demonstration board based on the L5980
EVAL5981		1 A step-down switching regulator demonstration board based on the L5981
EVAL5983		1.5 A step-down switching regulator demonstration board based on the L5983
EVAL5985		Evaluation board for L5985: 2 A step-down switching regulator

## Application example

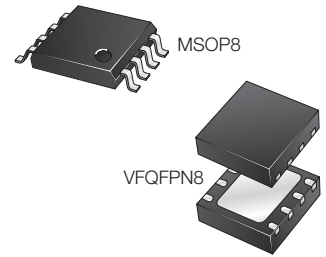


## L6925/26/28

This family of DC-DC monolithic regulators is specifically designed for extremely high efficiency. The L692x supply voltage can be as low as 2 V, allowing its use in applications supplied by a single Li-ion cell. The output voltage can be adjusted using an external divider down to 0.6 V.

The duty cycle can saturate to 100 %, allowing low drop-out operation.

Low-consumption mode can be selected under light load conditions, allowing switching losses to be reduced. Other features include power good, overvoltage protection, short-circuit protection and thermal shutdown (150 °C).



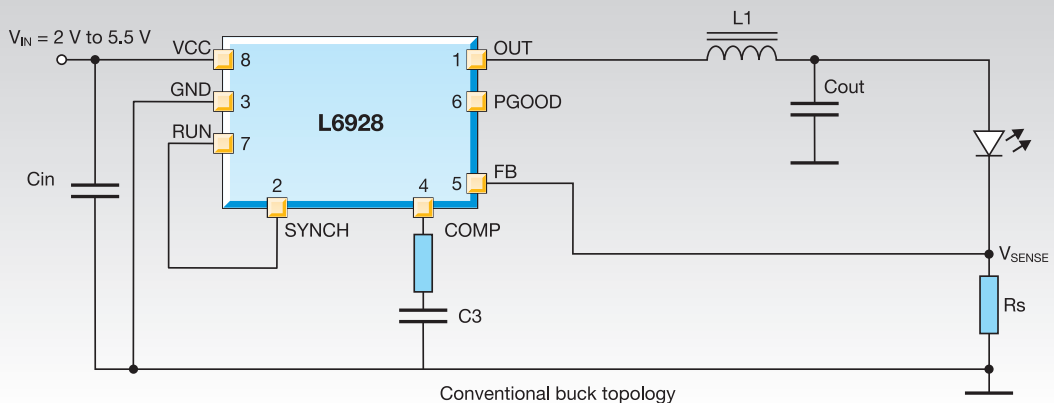
### Key features




- Input voltage range: 2 V to 5.5 V (2.7 V for L6925)
- Output voltage: adjustable 0.6 V to  $V_{IN}$
- Internal synchronous switch
- Switching frequency: 1.4 MHz (L6928) to 600 kHz (L6925/6), with selectable low-noise or low-consumption mode
- Output current: up to 800 mA
- High efficiency > 90%
- Low drop-out operation up to 100% duty cycle
- Embedded protection features

### Key benefits

- Monolithic and flexible solution
- High efficiency

### Application example



Sales code	Board	Description	Technical documents
EVAL6926D		L6926 high-efficiency monolithic synchronous step-down regulator evaluation board	AN1882: Designing with the L6926, high-efficiency monolithic synchronous step-down regulator
EVAL6928D		L6928D high-efficiency monolithic synchronous step-down regulator evaluation board	AN1893: Designing with L6925D, high-efficiency monolithic synchronous step-down regulator
EVAL6928Q1		L6928Q1 high-efficiency monolithic synchronous step-down converter evaluation board	AN2115: Designing an application with the L6928, high-efficiency monolithic synchronous step-down regulator

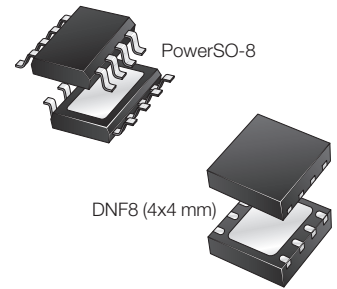


# ST1S10

The ST1S10 is a high-efficiency step-down PWM current-mode switching regulator capable of providing up to 3 A of output current. The device operates with an input supply range from 2.5 V to 18 V and provides an adjustable output voltage.

It operates either at a 900 kHz fixed frequency or can be synchronized to an external clock (from 400 kHz to 1.2 MHz). The high switching frequency allows the use of tiny SMD external components, while the integrated synchronous rectifier eliminates the need for a Schottky diode.

The ST1S10 provides excellent transient response, and is fully protected against thermal overheating, switching overcurrent and output short circuit. The ST1S10 is the ideal choice for LED lighting in DC bus-powered applications.



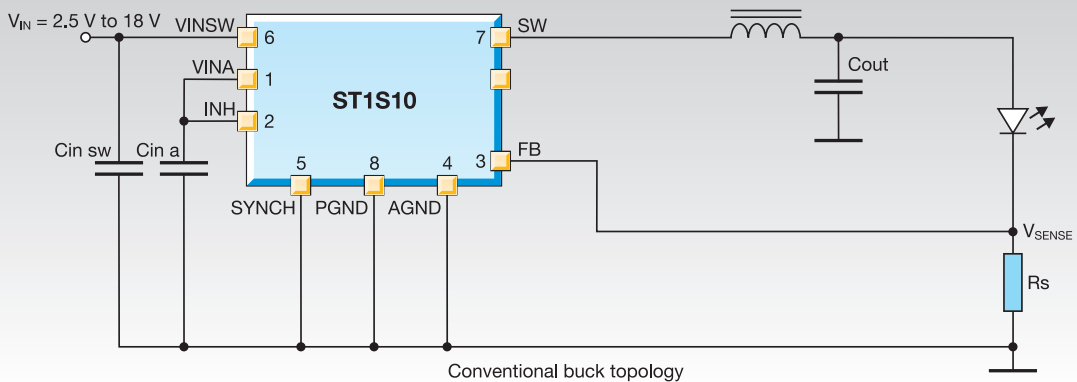
## Key features



- Output voltage: adjustable from 0.8 V
- Input voltage: 2.5 V to 18 V
- Output current capability: 3 A
- Synchronous rectification
- Inhibit function
- Synchronizable switching frequency: 400 kHz to 1.2 MHz
- Internal soft start
- Dynamic short-circuit protection

## Key benefits

- Typical efficiency: 90%
- Standby supply current: max 6  $\mu$ A
- Minimum number of external components

## Application example

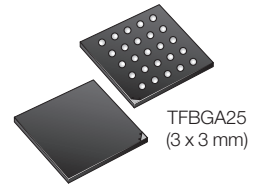


Sales code	Board	Description	Technical documents
STEVAL-ISA044V1		3 A synchronous 900 kHz step-down DC-DC converter with inhibit function	AN2620: 3 A high-frequency synchronous 900 kHz step-down converter based on the ST1S10
STEVAL-ISA044V2		3 A synchronous 900 kHz step-down DC-DC converter with inhibit function	AN2754: Buck high-brightness LED driver based on the ST1S10 step-down DC-DC converter voltage regulator

# Buck-boost converters

## STCF04

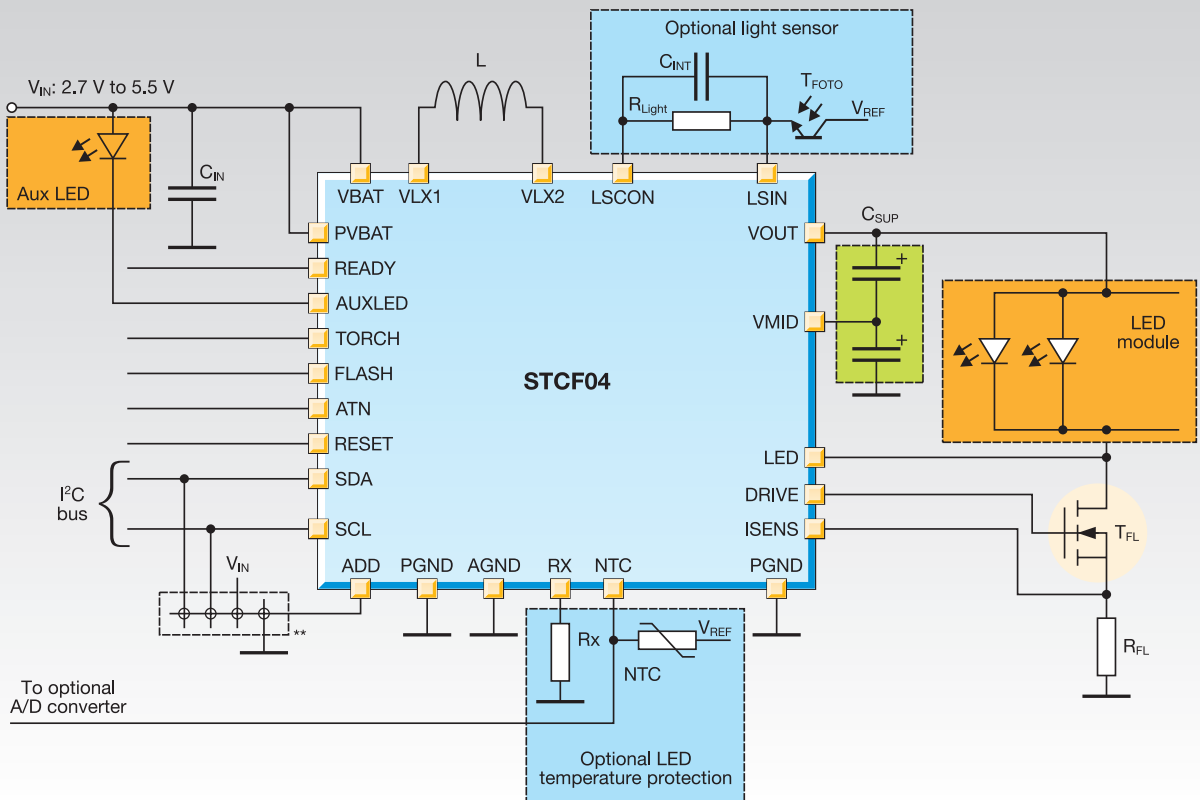
The STCF04 is a dedicated and space-optimized high-efficiency solution for driving a LED flash module in camera phones, PDAs and other handheld devices using the SuperCap technology. It is based on a DC-DC buck-boost converter, which ensures correct and efficient charging control and monitoring of the SuperCap within the entire battery voltage range. The output current control ensures good current regulation over the forward voltage spread characteristics of the flash LEDs in torch and flash mode operation. The SuperCap charging current is programmed to a defined value which avoids overload of the battery.



### Key features

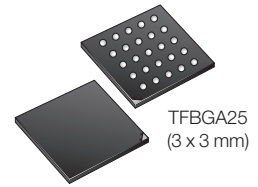
- Selectable 200 mA/400 mA SuperCap charging current
- Active balancing of SuperCap voltage
- LED over-temperature detection and protection with external NTC resistor
- Shorted LED failure detection and protection
- Chip over-temperature detection and protection

### Application example



# STCF06

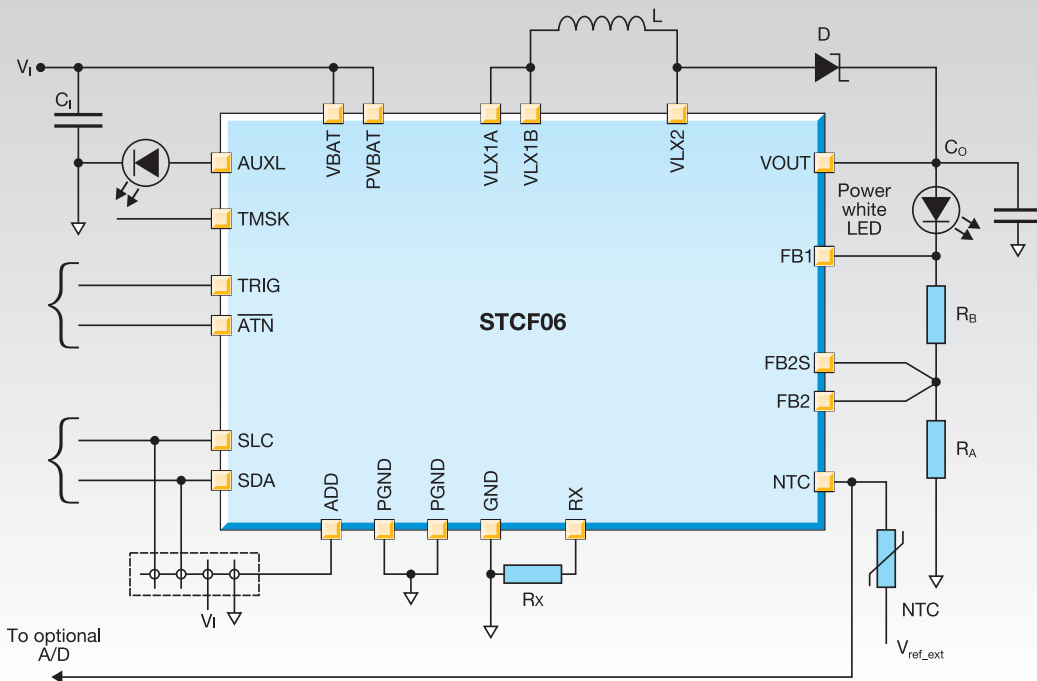
The STCF06 is a high-efficiency power supply solution to drive a single-LED flash in camera phones, PDAs and other battery-powered devices. It is a buck-boost converter able to guarantee correct LED current control over all possible conditions of battery voltage and LED forward voltage. The output current control ensures correct current regulation over the forward voltage spread characteristics of the flash LED. All the functions of the device are controlled through the I<sup>2</sup>C bus which helps to reduce logic pins on the package and to save PCB tracks on the board.



## Key features

- 1.8 MHz fixed frequency PWM control
- Efficiency up to 80%
- Full I<sup>2</sup>C control
- LED over-temperature detection and protection with external NTC resistor
- Open and shorted LED failure detection and protection
- Chip over-temperature detection and protection
- Less than 1  $\mu$ A standby current

## Application example



Sales code	Board	Description	Technical documents
STEVAL-TLL006V1		High-power LED driver demo board for single flash with I <sup>2</sup> C interface based on STCF06 (includes motherboard based on uPSD)	AN2730: High power LED driver for single Flash with I <sup>2</sup> C interface

# STBB1

The STBB1 is a fixed-frequency, high-efficiency, buck-boost DC-DC converter able to provide output voltages ranging from 1.2 V to 5.5 V and input voltages from 2.0 V to 5.5 V. The device can operate with input voltages higher than, equal to, or lower than the output voltage making the product suitable for single lithium-ion, multicell alkaline or NiMH applications where the output voltage is within the battery voltage range.



DNF10 (3 x 3 mm)

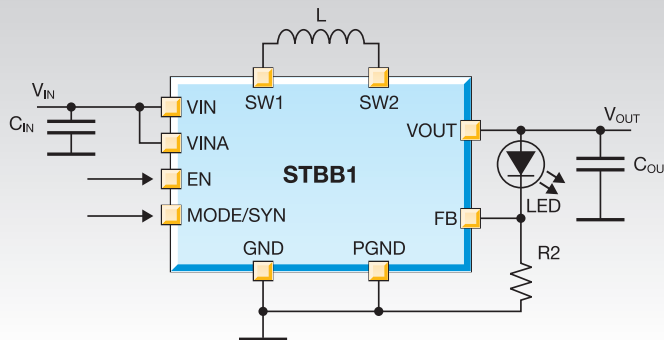
## Key features

- Operating input voltage range from 2.0 V to 5.5 V
- 2% DC feedback voltage tolerance
- Synchronous rectification
- Shutdown function
- 1.5 MHz switching frequency
- Power save mode at light load
- Typical efficiency: > 94 %
- 1 A output current capability
- Shutdown current < 1  $\mu$ A

## Key benefits

- Minimum number of external components
- MHz frequency allows the use of tiny external components

## Application example





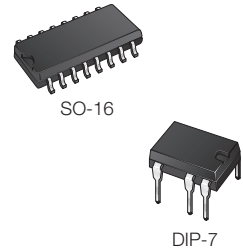
# Offline solutions

## VIPer®

ST's VIPer series of offline switch-mode power supplies combines an optimized, high-voltage, vertical power MOSFET with state-of-the-art PWM circuitry. The result is a truly innovative offline LED SMPS solution that is simpler, quicker, less expensive and able to address low-power, high-efficiency applications delivering up to 14 W with a universal input voltage range.

Fully compliant with eco standards, the VIPer series includes the VIPerx2 family and the new VIPerPlus family, with the subfamilies VIPerx7, VIPerx6 and VIPerx5, offering new functionalities as well as higher performance with lower component count.

Both the output voltage and current can be regulated by using a bipolar-based circuitry in non-isolated applications or an optocoupler driven by a TSM device in isolated applications. This makes the VIPer series suitable for general LED illumination, interior decoration lighting, and neon and bulb replacement.







### Key features

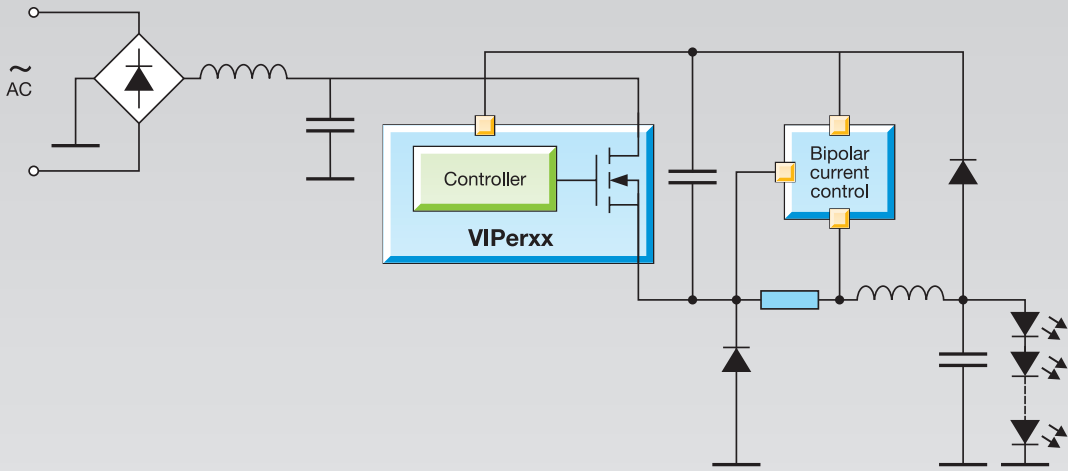
- Step-down current-mode PWM regulator
- Output voltage: adjustable from 0.8 V
- Input voltage: 2.5 V to 18 V
- 2% DC output voltage tolerance
- Synchronous rectification
- Inhibit function
- Synchronizable switching frequency: 400 kHz to 1.2 MHz
- Internal soft start
- Dynamic short-circuit protection
- Typical efficiency: 90%
- Output current capability: 3 A
- Standby supply current: max 6  $\mu$ A over temperature range
- Operating junction temperature: -25 °C to 125 °C

### Key benefits

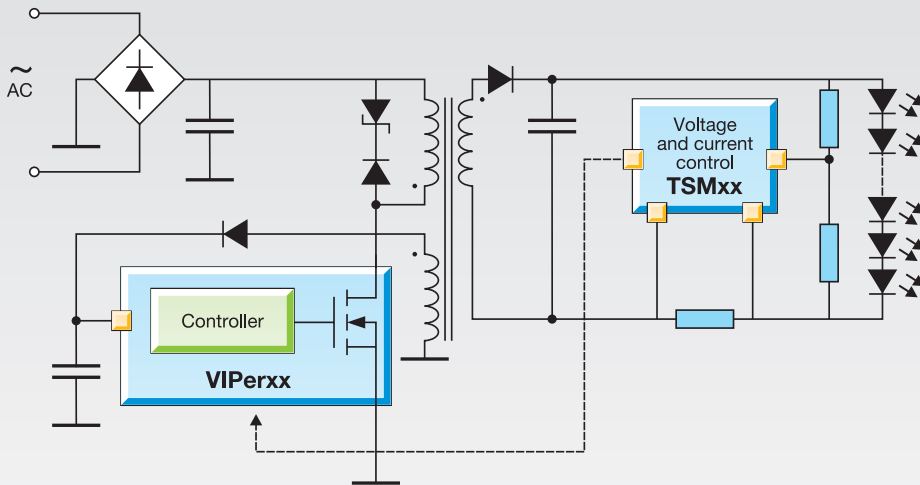
- Cost-effective solutions with minimum component count
- High robustness
- Advanced controllers and functionalities
- Easily meets all new energy regulations:
  - High efficiency
  - Minimum standby current
- Portfolio with high differentiation and continuous improvement
- Technical support by tools and competence centers

Sales code	Board	Description	Technical documents
STEVAL-ILL017V1		3.5 W non-isolated offline constant-current LED driver based on VIPer17HN	
STEVAL-ILL001V1		Dimmable driver for HB power LEDs with VIPer22A (DALI connector)	AN2042 VIPower: dimmable driver for high-brightness LEDs with VIPer22A-E
STEVAL-ILL005V1		VIPer12A offline, constant-current driver for high-intensity LEDs	AN1916 VIPower: offline constant-current LED driver using VIPer12/22A
STEVAL-ILL026V1		3 W non-isolated offline LED driver based on VIPer22AS-E	

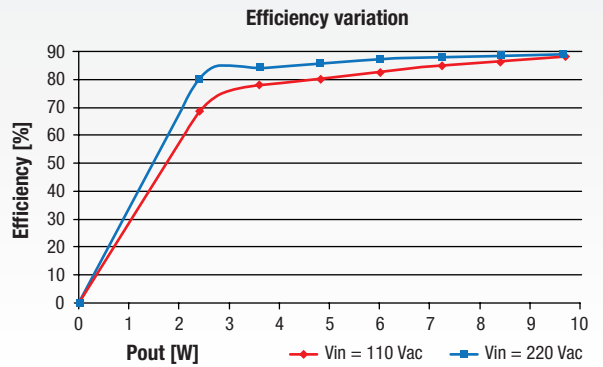
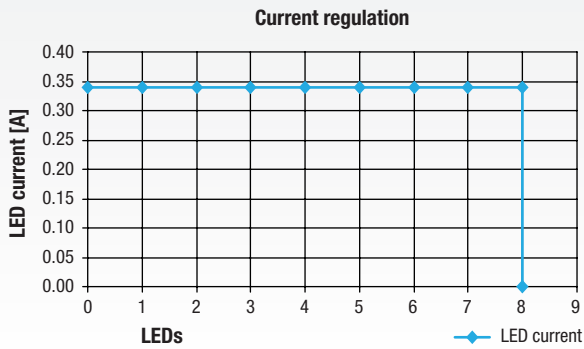
## Application example



Application example: buck SMPS offline LED driver (non isolated)



Application example: flyback SMPS for offline LED driver

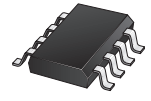


# L6562A/AT

The L6562A is a current-mode PFC controller operating in transition mode (TM). The highly linear multiplier includes a special circuit that reduces AC input current distortion and allows wide-range mains operation with an extremely low THD, even over a large load range. The output voltage is controlled by means of a voltage-mode error amplifier and an accurate internal voltage reference (1% @  $T_j = 25^\circ\text{C}$ ). The device features extremely low consumption (60  $\mu\text{A}$  max. before start-up and <5 mA operating) and includes a disable function suitable for IC remote on/off control, which makes it easier to comply with energy saving requirements (Blue Angel, EnergyStar, Energy2000, etc.).



DIP-8



SO-8

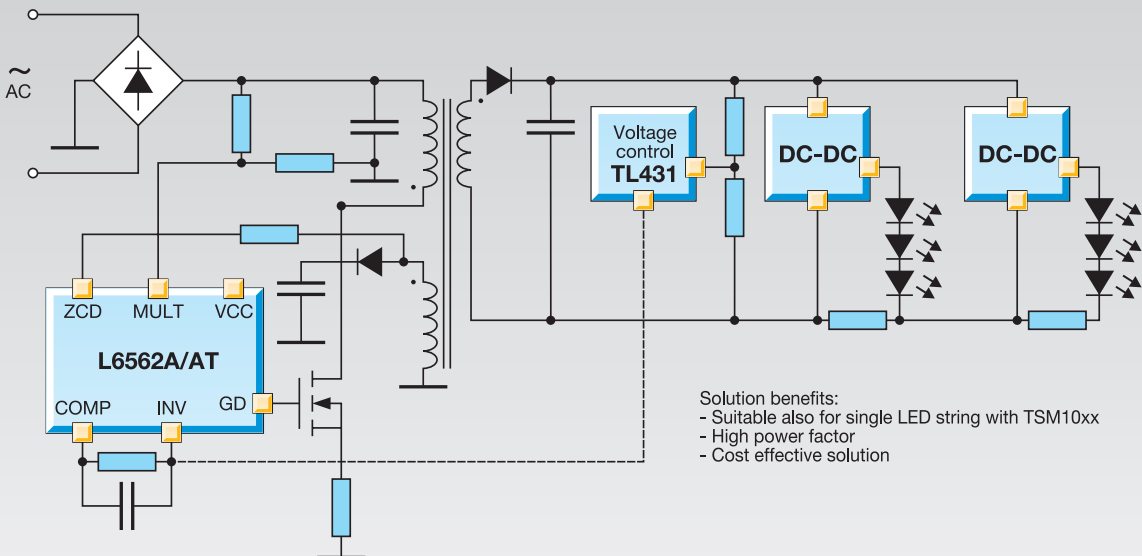
## Key features

- Proprietary multiplier design for minimum THD
- Very accurate adjustable output OVP protection
- Ultra-low start-up current: 30  $\mu\text{A}$
- Low quiescent current: 2.5 mA
- Digital leading-edge blanking on current sense
- Disable function on E/A pin
- 1% (@  $T_j = 25^\circ\text{C}$ ) internal reference voltage

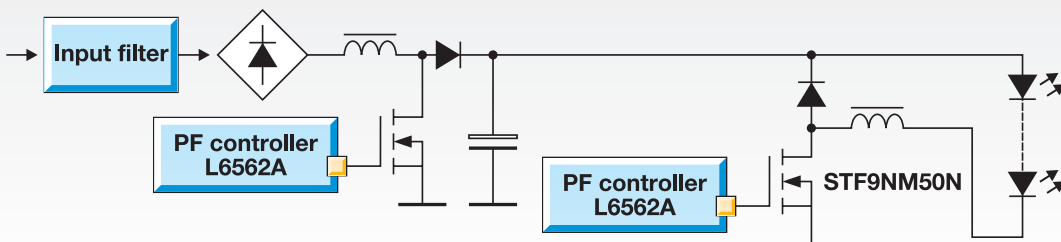
## Key benefits

- More total power available
- More power available on each outlet
- Better efficiency in energy transportation
- Transformer size reduction
- Reduction of disturbances on the line
- Compliance with EN61000-3-2 regulation mandatory for input power >75 W

## Application example




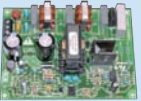



Application example: single-stage high power factor flyback converter for multiple LED strings



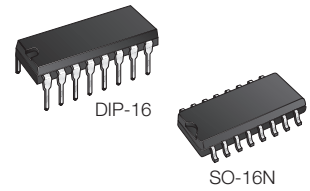
Application example: offline two stages solution, modified buck topology with PFC stage



Sales code	Board	Description	Technical documents
STEVAL-ILL013V1		80 W offline LED driver with dimming based on L6562A	UM0670: 80 W offline LED driver with PFC
STEVAL-ILL016V1		15 W offline Triac dimmable LED driver (USA market - 115 V)	AN2711: 15 W offline Triac dimmable LED driver
EVL6562A-LED		Constant-current inverse buck LED driver using the L6562A	AN2928: Modified buck converter for LED applications
EVL6562A-35WFLB		35 W wide-range high power factor flyback converter using L6562A	AN2838: 35 W wide-range high power factor flyback converter demonstration board using the L6562A
STEVAL-ILL027V1		18 W single-stage offline LED driver based on L6562A	

## L6599A/AT

The L6599 is a double-ended controller specific for the series-resonant half-bridge topology. It provides 50% complementary duty cycle: the high-side and low-side switches are driven on/off 180° out-of-phase for exactly the same time. Output voltage regulation is obtained by modulating the operating frequency. A fixed dead-time inserted between the turn-off of one switch and the turn-on of the other one guarantees soft-switching and enables high-frequency operation.



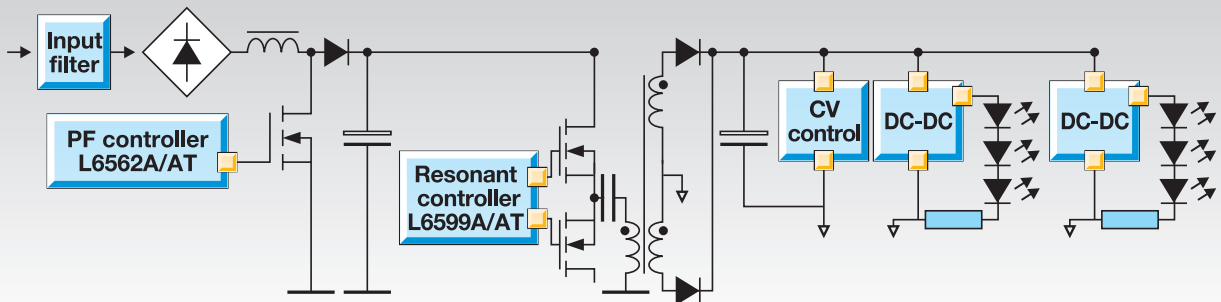
### Key features

- 50% duty cycle, variable frequency control of resonant half-bridge
- High-accuracy oscillator
- Operating frequency: up to 500 kHz
- Two-level OCP: frequency shift and latched shutdown
- Interface with PFC controller
- Latched disable input
- Burst-mode operation at light load
- Input for power-on/off sequencing or brownout protection
- Non-linear soft-start for monotonic output voltage rise

### Key benefits

- Advanced standby performances
- Compliance to the main worldwide energy programs (EPA2, Energy Star, etc.)
- Compliance to the main worldwide EMI regulations

### Application example



Application example: offline two-stage solution, LLC resonant half bridge with PFC stage

# L6565

The L6565 is a current-mode primary controller IC, specifically designed to build offline quasi-resonant ZVS (zero voltage switching at switch turn-on) flyback converters. Quasi-resonant operation is achieved by means of a transformer demagnetization sensing input that triggers the switch's turn-on. The converter's power-capability variations with the mains voltage are compensated by line voltage feedforward. At light load, the device features a special function that automatically lowers the operating frequency while maintaining the operation as close to ZVS as possible. In addition to very low start-up and quiescent currents, this feature helps keep the consumption from the mains low at light load to be Blue Angel and Energy Star compliant.



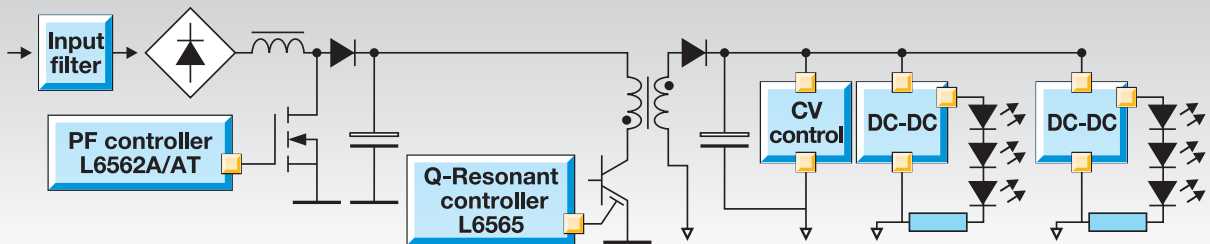
## Key features

- Quasi-resonant (QR) zero voltage switching (ZVS) topology
- Line feedforward to deliver constant power versus mains change
- Frequency foldback for optimum standby efficiency
- Pulse-by-pulse and hiccup-mode OCP
- Ultra-low start-up (< 70  $\mu$ A) and quiescent current (< 3.5 mA)
- Disable function (on/off control)
- $\pm$ 400 mA totem pole gate driver with UVLO pull-down

## Key benefits

- Superior efficiency
- Compliant to main world wide EMI regulations
- Blue Angel, Energy Star compliant

## Application example



Application example: offline two-stage solution, high-voltage flyback with PFC

Sales code	Board	Description	Technical documents
STEVAL-ISA019V2		80 W ESBT quasi-resonant wide-range SMPS with L6565 for 3-phase application	AN2495: 3-phase 80 W SMPS with very wide-range input voltage based on the L6565 and ESBT STC04IE170HV

# Microcontrollers

## STM8S

STMicroelectronics' STM8S family of general-purpose 8-bit Flash microcontrollers offers ideal solutions for industrial and appliance market requirements. An advanced core version combined with a 3-stage pipeline ranks the STM8S microcontroller in the top position for performance. The true embedded EEPROM and the calibrated RC oscillator bring a significant cost effectiveness to the majority of applications. An easy-to-use and intuitive development environment contributes to improving time to market.

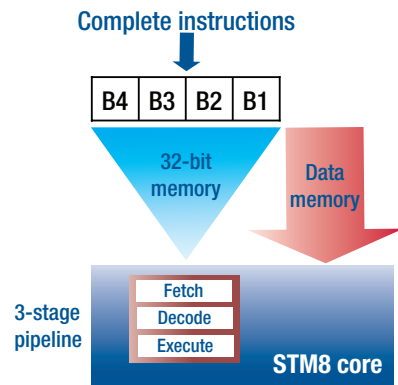
### STM8S: robust and reliable

In addition to performance, comprehensive design specifications and specific peripheral features make the STM8S robust and reliable:

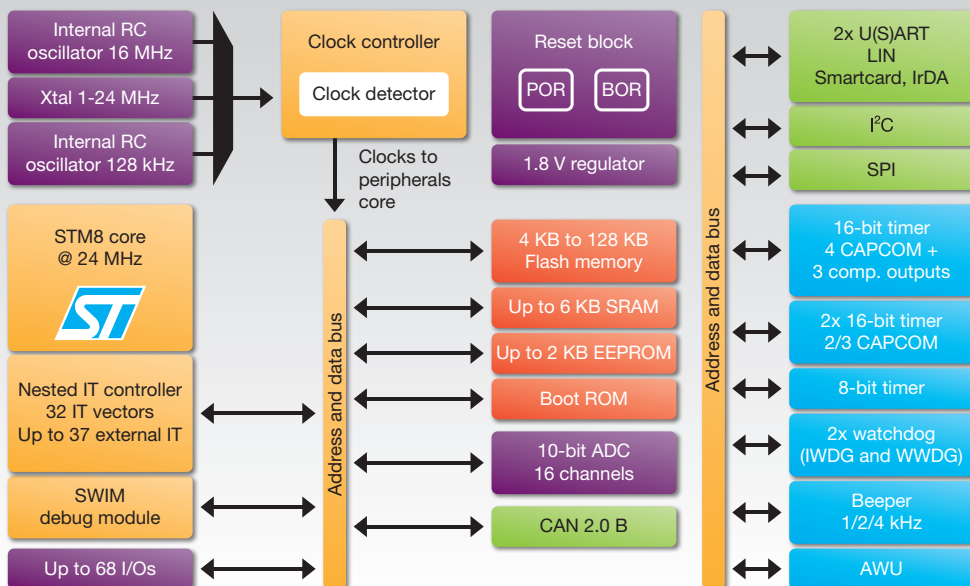
- 2 internal RC oscillators with dual independent watchdogs
- Clock security system (CSS) to monitor the failure of external clock source
- Complementary copy of configuration option bytes and EMS reset
- Low emission in accordance with the IEC 61967 standards
- Outstanding robustness performance according to IEC 1000-4-2 and IEC 1000-4-4 standards
- High current injection immunity (1  $\mu$ A leakage current when 4 mA current is injected in adjacent pin)
- Dedicated firmware library compliant to Class B of IEC 60335

### STM8 core

- 1.6 CPI average
- 20 MIPS peak @ 24 MHz
- 32-bit memory interface
- 3-stage pipeline
- 16-bit index registers
- 20 addressing modes



### Block diagram



## Features and benefits

Features	Benefits
2.95 to 5.5 V, -40 to +125 °C range	Ideal for industrial and appliance requirements
Up to 20 MIPS @ 24 MHz, Harvard architecture	Optimized core performance and code-size efficiency
16-bit advanced control timer	Satisfies all needs with configurable modes, motor control, capture, compare, PWM, and others
Embedded true EEPROM, 300 Kcycles	Lower system cost
CAN, 2xU(S)ART, SPI, I <sup>2</sup> C	All essential communication peripherals supporting various protocols
Single-voltage Flash memory with single-byte programming granularity	In-application programming (IAP), in-circuit programming (ICP)
4 low-power modes	Efficient power management
Trimable 16 MHz and 128 kHz internal RC oscillators with dual independent watchdogs and 2 μs fast switching between clock sources	Reduced cost, robust clock architecture, optimized power consumption
Integrated POR and BOR	Reliable reset mechanism during power up and down
Low emission and high current injection immunity	Outstanding EMC, no need for extra protection
4 to 128 Kbyte Flash in 20 to 80 pin packages	Package-in-package compatible across family, ideal choice of platform
On-chip debugging and programming through single-wire interface, SWIM	Easy to use, non-intrusive and low-cost development environment
Up to 16-channel 10-bit ADC ±1 LSB with scan mode, conversion time < 3 μs	Fast and accurate A/D converter

## Simple device selection

The STM8S family is available in two lines: the Performance line and Access line.

With  $F_{CPU}$  specified up to 24 MHz, the Performance line is ideal when processing power is needed.

The Access line is an affordable solution when cost efficiency is the main concern.

Both lines share the same architecture and peripheral set making navigation possible across the portfolio.

### STM8S product lines



### STM8S20x Performance line



### STM8S10x Access line

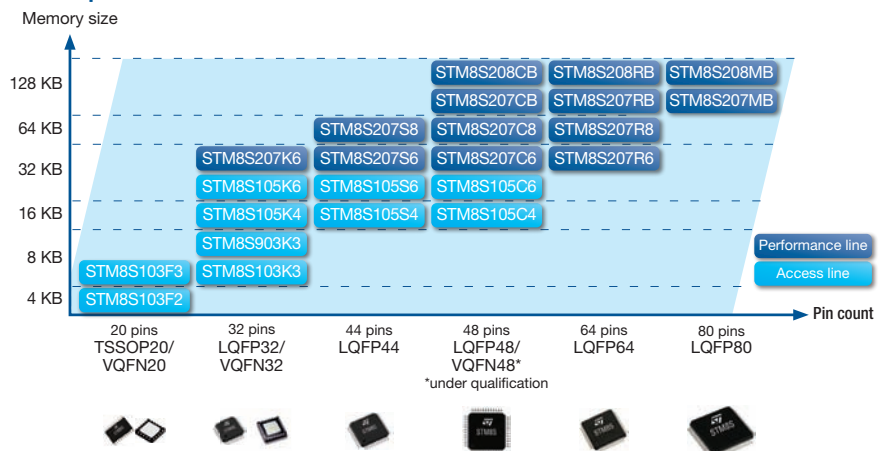


## Large family

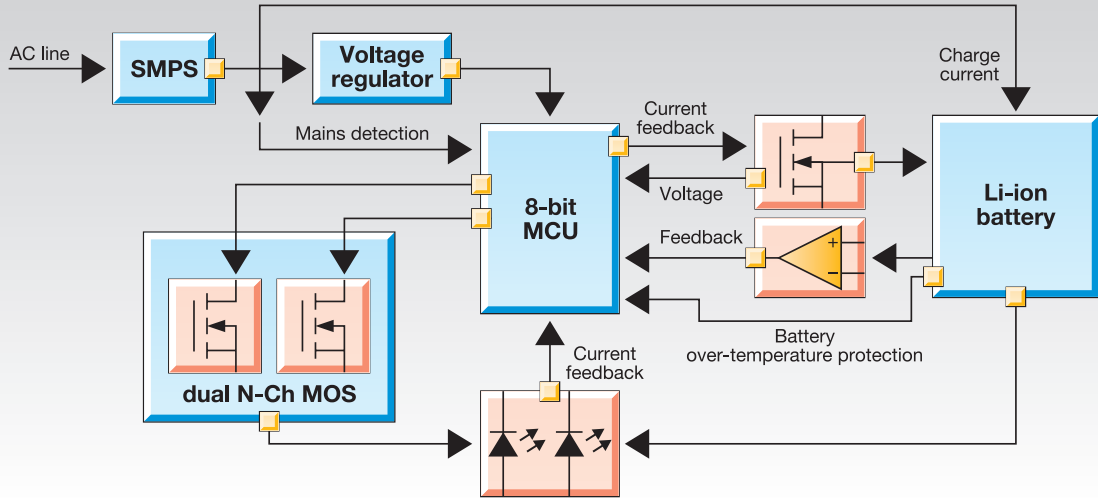
A large product family allows platform validation and simplifies migration from one product to another. This is a great advantage to speed up development with a maximum reuse of the work already invested.

- It improves time to market
- It reduces risk
- It optimizes resources

### STM8S portfolio



## 8-bit microcontroller based LED emergency lighting



### System features:

- Universal AC input voltage
- Mains failure and external brightness detection
- Four selectable modes:
  - Emergency lighting
  - Twilight with switch
  - Twilight pocket lamp
  - Li-ion battery charger with over-temperature protection

# STM32

The STM32 family of 32-bit Flash microcontrollers is based on the breakthrough ARM Cortex™-M3 core – a core specifically developed for embedded applications that require a combination of high-performance, real-time, low-power and low-cost operation. The STM32 family benefits from the Cortex-M3 architectural enhancements (including the Thumb-2® instruction set) that deliver improved performance combined with better code density, and a tightly coupled nested vectored interrupt controller that significantly speeds response to interrupts, all combined with industry-leading power consumption. STMicroelectronics was a lead partner in developing the Cortex-M cores and with STM32 offers a comprehensive portfolio of advanced MCUs that we are committed to extending in capability, price range and features to cover the needs of microcontroller convergence.

The STM32 family is built to offer new degrees of freedom to MCU users. It offers a complete 32-bit product range that combines high-performance, real-time, low-power and low-voltage operation, while maintaining full integration and ease of development.






It eases migration from the 16-bit world thanks to its high level of features integration, its easy-to-use architecture, its low-power capability and cost-effectiveness.


The STM32 family will enable you to create new applications, and design in the innovations you have been long dreaming about.

## Key benefits

- Leading-edge architecture with the latest Cortex-M3 core from ARM
- Excellent real-time behaviour
- Outstanding power efficiency
- Superior and innovative peripherals
- Maximum integration
- Easy development, fast time to market



<p><b>Cortex-M3 core</b></p>  <p>Leading edge architecture Excellent real-time behaviour</p>	<p><b>Outstanding power efficiency</b></p>  <p>Sub µA RTC, low voltage 0.27 mA/MHz, low-power modes</p>	<p><b>Superior and innovative peripherals</b></p>  <p>USB OTG, Ethernet, dual CAN, ADC 12-bit, advanced timers</p>	<p><b>Maximum integration</b></p>  <p>Reset circuitry clocks, oscillators, PLL regulator RTC, watchdog</p>	<p><b>Extensive tools and software</b></p>  <p>Various IDE, starter kits, libraries, RTOS and stacks</p>
<p><b>Future proof design</b></p>	<p><b>Environment friendly, suits low-power operation</b></p>	<p><b>Address all your needs and beyond</b></p>	<p><b>Cost and space saving</b></p>	<p><b>More time for innovation improved productivity</b></p>



**STM32 platform**  
**more than 70 fully compatible devices**

## STM32, the optimal platform choice

The STM32 is an optimal choice to support many applications with the same platform:

- From reduced memory and pin requirements to larger needs
- From performance demanding to battery operated
- From simple cost-sensitive to complex high-value

The total pin-to-pin, peripheral and software compatibility across the family gives you full flexibility across more than 70 devices.

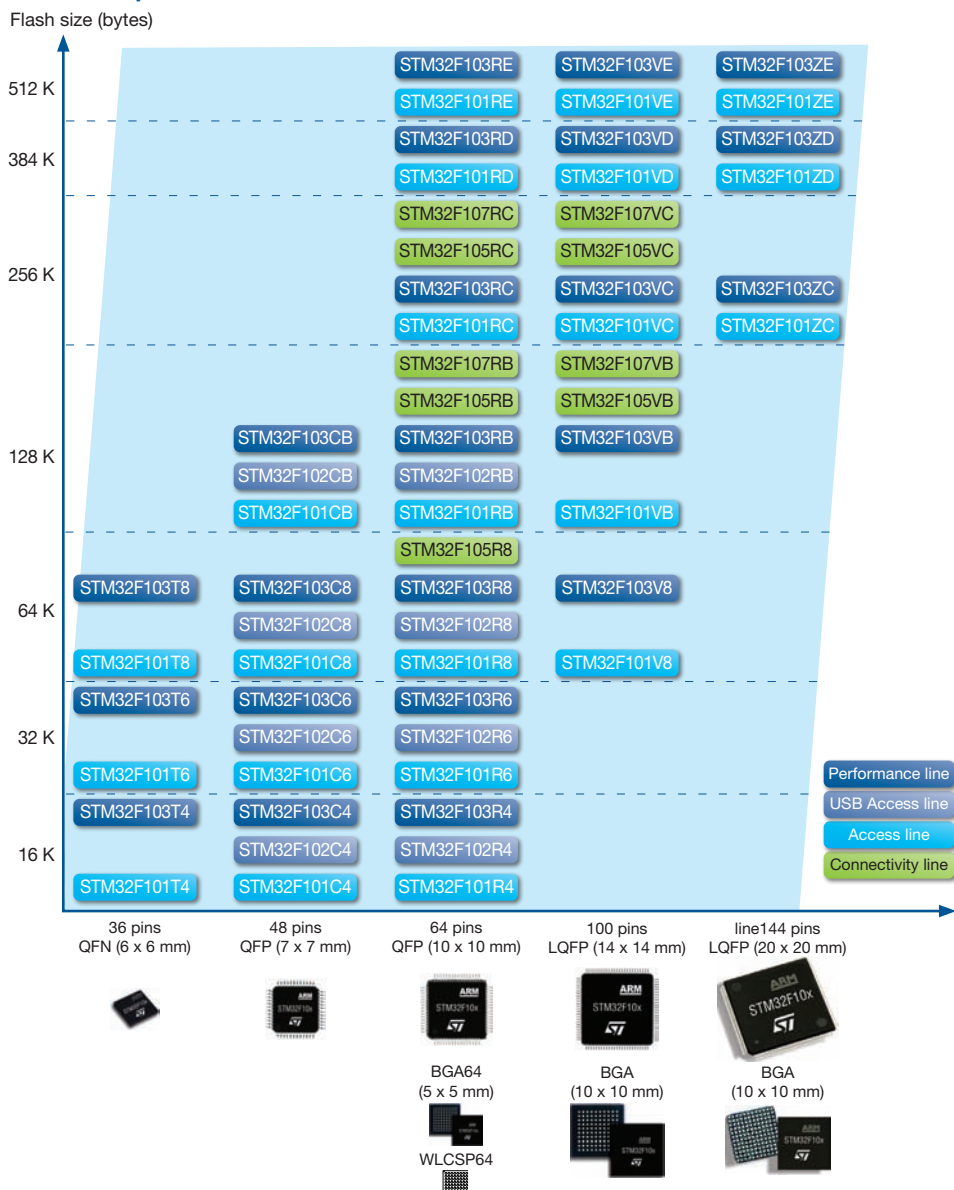
You can upgrade to a higher or downgrade to a lower memory size, or use different packages without changing your initial layout or software.

## STM32, the largest portfolio

The STM32 offers the widest selection of microcontroller devices:

- Up to 72 MHz Cortex-M3 CPU
- 4-Kbyte to 64-Kbyte SRAM
- Four lines: Performance, USB Access, Access and Connectivity lines
- Pin-to-pin, software and peripheral compatibility across family
- 2.0 to 3.6 V power supply, 5 V tolerant I/Os
- -40 to +85 °C or up to 105 °C operating temperature range

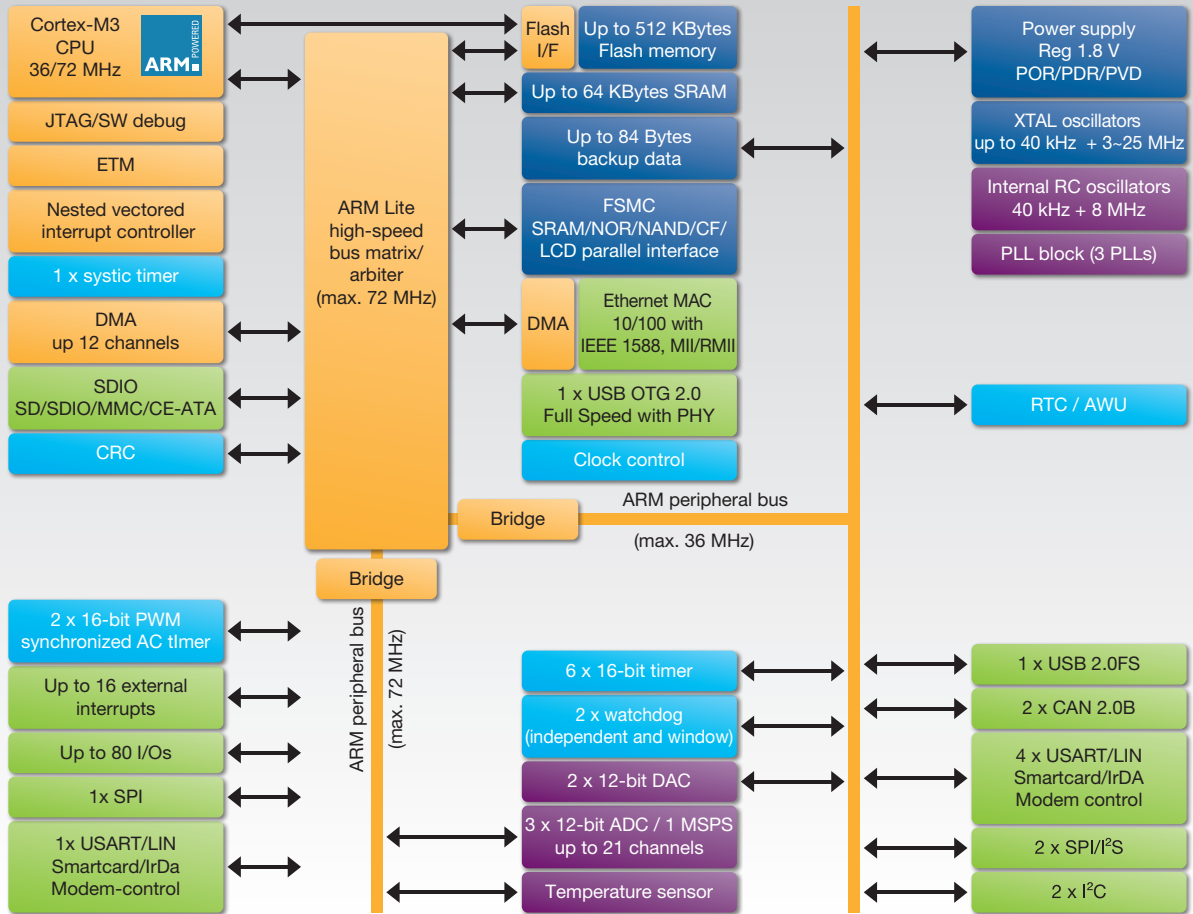
### STM32F10x portfolio





## STM32F10x family block diagram

This block diagram shows all the available peripherals. For exact product content, please refer to the device summary.

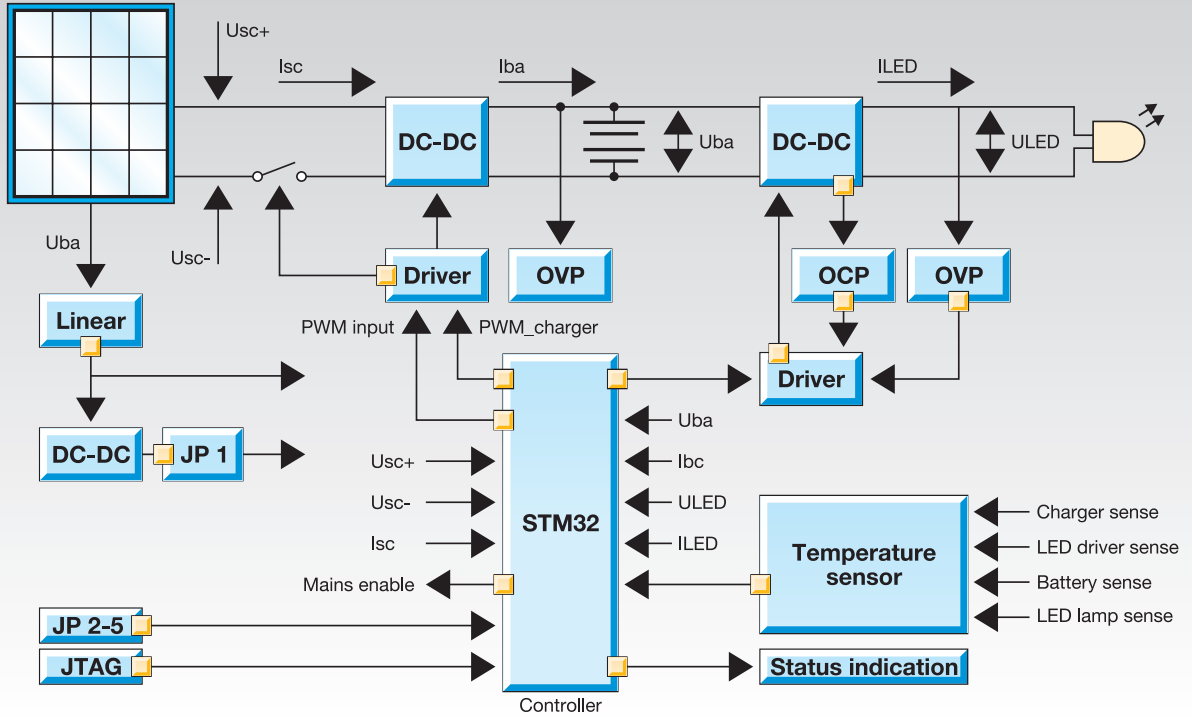


AWU: Auto wake-up capability with RTC alarm  
 CAN: Controller area network  
 CF: CompactFlash  
 CRC: Cyclic redundancy check  
 DMA: Direct memory access  
 ETM: Embedded Trace Macrocell  
 IrDA: Infrared Data Association

I<sup>2</sup>S: Inter-IC sound  
 LIN: Local interconnect network  
 MII: Media independent interface  
 MMC: MultiMediaCard  
 PDR: Power-down reset  
 POR: Power-on reset  
 PVD: Programmable voltage

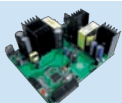
RMII: Reduced media independent interface  
 RTC: Real-time clock  
 SDIO: Secure digital input output  
 SD: Secure digital  
 USART: Universal sync/async receiver transmitter

## 25 W LED street light driver with 80 W solar energy charger



### Demonstration board features

- Ambient light detection
- Solar light perturbation and observation
- Optimized battery charge circuit with indicators (green LED indicates fully charged and red LED indicates system in charging state)
- LED light panel temperature detection
- LED panel light time controlled by DIP switch and monitoring by microprocessor
- JTAG pin for onboard programming and debugging

Sales code	Board	Description	Technical documents
STEVAl-ILL022V1		25 W LED street light with 80 W solar energy charger based on STM32	UM0512: Solar-LED streetlight controller 25 W LED lamp driver with 80 W battery charger based on the STM32F101Rx

# Product selection guide

## LED array drivers

Part number	Description	I/O	V <sub>DD</sub> (V)	Bit-to-bit accuracy (+/- %)	I <sub>out</sub> (mA)
STP04CM05	4-bit constant-current power LED driver	Serial in/parallel out	3.3 to 5.5	1	80 to 400
STP08DP05	8-bit constant-current LED driver with output error detection	Serial in/parallel out	3.0 to 5.5	1.5	5 to 100
STP08CP05	8-bit constant-current LED driver	Serial in/parallel out	3.0 to 5.5	1.5	5 to 100
STP16CP05	16-bit constant-current LED driver	Serial in/parallel out	3.0 to 5.5	1.5	5 to 100
STP16DP05	16-bit constant-current LED driver with output error detection	Serial in/parallel out	3.0 to 5.5	1.5	5 to 100
STP16CS05	16-bit constant-current LED driver with auto-power saving	Serial in/parallel out	3.0 to 5.5	1.5	5 to 100
STP16DS05	16-bit constant-current LED driver with auto-power saving and output error detection	Serial in/parallel out	3.0 to 5.5	1.5	5 to 100
STP16CPC05	16-bit constant-current LED driver with balanced on/off	Serial in/parallel out	3.0 to 5.5	1.5	5 to 100
STP16CPP05	16-bit low-current, high-precision LED driver	Serial in/parallel out	3.0 to 5.5	2	3 to 40
STP16DPP05	16-bit low-current, high-precision LED driver with output error detection	Serial in/parallel out	3.0 to 5.5	2	3 to 40
STP16CPS05	16-bit low-current, high-precision LED driver with auto-power saving	Serial in/parallel out	3.0 to 5.5	2	3 to 40
STP16DPS05	16-bit low-current, high-precision LED driver with auto-power saving and output error detection	Serial in/parallel out	3.0 to 5.5	2	3 to 40
STP24DP05	24-bit constant-current LED driver with output error detection	Serial in/parallel out	3.0 to 5.5	3	5 to 80
STPIC6C595	8-bit LED driver with overvoltage protection	Serial in/parallel out	4.5 to 5.5	N/A	100 continuous
STPIC6D595	8-bit LED driver	Serial in/parallel out	4.5 to 5.5	N/A	100 continuous

## Boost converters

Part number	Description	I <sub>LED</sub> (mA)	Rows	V <sub>IN</sub> (V)	V <sub>OUT</sub> (V)	LEDs (white)	F <sub>sw</sub> (kHz)	Package	Extra functions
PM6600	6-row 32 mA LED driver with boost regulator for mobile PC LCD panel backlight	up to 32	6	4.7 to 28	up to 36	60	570 to 750	VFQFPN4x4-24L	PWM dim, adj SS, INH, sync, adj OVP, fault management
LED7706	6-row 30 mA LED driver with boost regulator for LCD panel backlight	up to 30	6	4.5 to 36	up to 36	60	200 to 1000	QFN4x4-24L	PWM dim, adj SS, INH, sync, adj OVP, fault management
LED7707	6-row 85 mA LED driver with boost regulator for LCD panel backlight	up to 85	6	4.5 to 36	up to 36	60	200 to 1000	QFN4x4-24L	PWM dim, adj SS, INH, sync, adj OVP, fault management
L6920D	High-efficiency synchronous step-up converter	0.8 (I <sub>pk</sub> )	1	0.6 to 5.5	2 to 5.2	1	Up to 1000	TSSOP8	LBI and LBO, Vref, shutdown
L6920DB	High-efficiency synchronous step-up converter	1 (I <sub>pk</sub> )	1	0.6 to 5.5	1.8 to 5.2	1	Up to 1000	MSOP8	LBI and LBO, Vref, shutdown
ST8R00	Micropower synchronous step-up converter	1	1	4 to 6	6 to 12	3	1200	DFN4x4-8L	Burst mode and continuous mode, INH
STCF05	High-power white LED driver with I <sup>2</sup> C interface	0.4*	1	2.5 to 5.5	V <sub>bat</sub> to 10.2	2	1800	TFBGA3x3-25L	Flash mode, torch mode, dim, fault management

\* I<sub>LED</sub> (A)

## Buck converters

Part number	Description	I <sub>OUT</sub> (A)	V <sub>IN</sub> (V)	V <sub>OUT</sub> (V)	LEDs (white)	F <sub>sw</sub> (kHz)	Package	Extra functions
L4976	1 A step-down switching regulator	1	8 to 55	up to V <sub>in</sub>	15	Up to 300	DIP8/SO16W	Vref
L4971	1.5 A step-down switching regulator	1.5	8 to 55	up to V <sub>in</sub>	15	Up to 300	DIP8/SO16W	INH
L4978	2 A step-down switching regulator	2	8 to 55	up to V <sub>in</sub>	15	Up to 300	DIP8/SO16W	INH
L4973	3.5 A step-down switching regulator	3.5	8 to 55	up to V <sub>in</sub>	15	Up to 300	DIP18/SO20	Vref, INH, sync
L5970D	1 A step-down switching regulator	1	4.4 to 36	up to V <sub>in</sub>	9	250	S08	Vref, INH, sync
L5970AD	1 A step-down switching regulator	1	4.4 to 36	up to V <sub>in</sub>	9	500	S08	Vref, INH, sync
L5972D	1.5 A step-down switching regulator	1.5	4.4 to 36	up to V <sub>in</sub>	9	250	S08	-
L5973AD	1.5 A step-down switching regulator	1.5	4.4 to 36	up to V <sub>in</sub>	9	500	HSOP8	Vref, INH, sync
L5973D	2 A step-down switching regulator	2	4.4 to 36	up to V <sub>in</sub>	9	250	HSOP8	Vref, INH, sync
L6902D	Step-down switching regulator with adjustable current limit up to 1 A	1	8 to 36	up to V <sub>in</sub>	9	250	S08	Vref, CC/CV mode

# Product selection guide (cont'd)

## Buck converters (cont'd)

Part number	Description	I <sub>OUT</sub> (A)	V <sub>IN</sub> (V)	V <sub>OUT</sub> (V)	LEDs (white)	F <sub>sw</sub> (kHz)	Package	Extra functions
L5980	0.7 A step-down switching regulator	0.7	2.9 to 18	up to V <sub>IN</sub>	4	Up to 1000	QFN3x3-8L	Adj F <sub>sw</sub> , INH, sync
L5981	1 A step-down switching regulator	1	2.9 to 18	up to V <sub>IN</sub>	4	Up to 1000	QFN3x3-8L	Adj F <sub>sw</sub> , INH, sync
L5983	1.5 A step-down switching regulator	1.5	2.9 to 18	up to V <sub>IN</sub>	4	Up to 1000	QFN3x3-8L	Adj F <sub>sw</sub> , INH, sync
L5985	2 A step-down switching regulator	2	2.9 to 18	up to V <sub>IN</sub>	4	Up to 1000	QFN3x3-8L	Adj F <sub>sw</sub> , INH, sync
L5986/A	2.5 A step-down switching regulator	2.5	2.9 to 18	up to V <sub>IN</sub>	4	Up to 1000	QFN3x3-8L/HSOP8	Adj F <sub>sw</sub> , INH, sync
L5987/A	3 A step-down switching regulator	3	2.9 to 18	up to V <sub>IN</sub>	4	Up to 1000	QFN3x3-8L/HSOP8	Adj F <sub>sw</sub> , INH, sync
L6925D	800 mA step-down synchronous switching regulator	0.8	2.7 to 5.5	up to V <sub>IN</sub>	1	600	MSOP8	LBI and LBO
L6926	800 mA step-down synchronous switching regulator	0.8	2 to 5.5	up to V <sub>IN</sub>	1	600	QFN3x3-8L/MSOP8	Pgood, run, sync
L6928	800 mA step-down synchronous switching regulator	0.8	2 to 5.5	up to V <sub>IN</sub>	1	1400	QFN3x3-8L/MSOP8	Pgood, run, sync
ST1S10	Monolithic synchronous step-down regulator	3	2.5 to 18	0.8 to 16	3	900	DFN4x4-8L / HSOP8	sync
STCS05	0.5 A max constant-current LED driver	0.5	4.5 to 40	V <sub>IN</sub> - V <sub>DROP</sub>	9	-	S08	Dimming, diagnostics, EN
STCS05A	0.5 A max constant current LED driver	0.5	4.5 to 40	V <sub>IN</sub> - V <sub>DROP</sub>	9	-	S08	Dimming, diagnostics, EN
STCS1	1.5 A max constant-current LED driver	1.5	4.5 to 40	V <sub>IN</sub> - V <sub>DROP</sub>	9	-	DFN3x3-8L/HSOP8	Dimming, diagnostics, EN
STCS1A	1.5 A max constant-current LED driver	1.5	4.5 to 40	V <sub>IN</sub> - V <sub>DROP</sub>	9	-	DFN3x3-8L/HSOP8	Dimming, diagnostics, EN
STCS2	2 A max constant-current LED driver	2	4.5 to 40	V <sub>IN</sub> - V <sub>DROP</sub>	9	-	PowerSO-10	Dimming, diagnostics, EN
STCS2A	2 A max constant-current LED driver	2	4.5 to 40	V <sub>IN</sub> - V <sub>DROP</sub>	9	-	PowerSO-10	Dimming, diagnostics, EN

## Buck-boost converters

Part number	Description	I <sub>LED</sub> (A)	Rows	V <sub>IN</sub> (V)	V <sub>OUT</sub> (V)	LEDs (white)	F <sub>sw</sub> (kHz)	Package	Extra functions
STCF02	High-power white LED driver	0.6	1	2.7 to 4.5	2.5 to 5.1	1	1800	QFN4x4-20L	Flash mode, torch mode, fault management
STCF03	High-power white LED driver with I <sup>2</sup> C interface	0.8	1	2.7 to 5.5	2.5 to 5.3	1	1800	QFN4x4-20L / TFBGA3x3-25L	Flash mode, torch mode, ready mode, dimming, fault management
STCF03I	High-power white LED driver with I <sup>2</sup> C interface	0.6/0.8	1	2.7 to 5.5	2.5 to 5.3	1	1800	TFBGA3x3-25L	Flash mode, torch mode, ready mode, dimming, fault management
STCF04	High-power white LED SuperCap driver with I <sup>2</sup> C interface	Up to 10	1	2.7 to 5.5	up to 5.5	1	1800	TFBGA3x3-25L	Flash mode, torch mode, ready mode, dimming, fault management
STCF06	White LED driver with I <sup>2</sup> C interface	1/1.3/1.5	1	2.7 to 5.5	2.5 to 5	1	1800	TFBGA3x3-25L	Flash mode, torch mode, ready mode, dimming, fault management
STBB1	High-efficiency dual-mode buck-boost DC-DC converter	1	1	2 to 5.5	1.2 to 5.5	1	1500	DFN3x3-10L	Auto mode, PWM mode,

## VIPer

Part number	Package	Power capability max (wide range input) (V)	Drain source voltage min (V)	V <sub>DD</sub>		R <sub>DS(on)</sub> (Ω)	F <sub>sw typ</sub> (kHz)	Extra functions
				min (V)	max (V)			
VIPER22AS-E	S0-8	7	730	9	7	17	60	PWM current limiting mode, burst mode
VIPER22ADIP-E	DIP-8	12	730	9	12	17	60	PWM current limiting mode, burst mode
VIPER12AS-E	S0-8	5	730	9	5	30	60	PWM current limiting mode, burst mode
VIPER12ADIP-E	DIP-8	8	730	9	8	30	60	PWM current limiting mode, burst mode
VIPER17LN	DIP-7	7	800 (avalanche rugged)	8.5	23.5 (internal clamp)	20	60	PWM current limiting mode, burst mode

## VIPer (cont'd)

Part number	Package	Power capability max (wide range input) (V)	Drain source voltage min (V)	$V_{DD}$		$R_{DS(on)}$ ( $\Omega$ )	$F_{sw}$ typ (kHz)	Extra functions
				min (V)	max (V)			
VIPER17HN	DIP-7	7	800 (avalanche rugged)	8.5	23.5 (internal clamp)	20	115	PWM current limiting mode, burst mode
VIPER17LD	SO16N	7	800 (avalanche rugged)	8.5	23.5 (internal clamp)	20	60	PWM current limiting mode, burst mode
VIPER17HD	SO16N	7	800 (avalanche rugged)	8.5	23.5 (internal clamp)	20	115	PWM current limiting mode, burst mode
VIPER27LN	DIP-7	13	800 (avalanche rugged)	8.5	23.5 (internal clamp)	8	60	PWM current limiting mode, burst mode
VIPER27HN	DIP-7	13	800 (avalanche rugged)	8.5	23.5 (internal clamp)	8	115	PWM current limiting mode, burst mode
VIPER16LN	DIP-7	7	800 (avalanche rugged)	10.5 (internal self supply)	23.5 (internal clamp)	20	60	PWM current limiting mode, burst mode
VIPER16HN	DIP-7	7	800 (avalanche rugged)	10.5 (internal self supply)	23.5 (internal clamp)	20	115	PWM current limiting mode, burst mode
VIPER16LD	SO16N	7	800 (avalanche rugged)	10.5 (internal self supply)	23.5 (internal clamp)	20	60	PWM current limiting mode, burst mode
VIPER16HD	SO16N	7	800 (avalanche rugged)	10.5 (internal self supply)	23.5 (internal clamp)	20	115	PWM current limiting mode, burst mode

## Power factor correctors

Part number	Package	Description	Topology	RoHS compliant	$V_{cc}$ (V)	Supply current (mA)	Gate drive capability (source/sink) (A)	Delay to output (ns)
L6562	DIP-8, SO-8	Improved TM power factor corrector	Boost, flyback	Yes	10.3 to 22	3.5	0.6 / 0.8	200
L6562A	DIP-8, SO-8	Enhanced TM power factor corrector	Boost, flyback	Yes	10.5 to 22.5	3.5	0.6 / 0.8	175
L6562AT	DIP-8, SO-8	Enhanced TM power factor corrector with extended temperature range	Boost, flyback	Yes	10.5 to 22.5	3.5	0.6 / 0.8	175

## Resonant and quasi resonant controllers

Part number	Package	Description	Topology	RoHS compliant	$V_{cc}$ (V)	Gate drive capability (mA)	Quiescent current (mA)	Oscillator frequency (kHz)
L6599A	DIP-16, SO-16N	High-voltage improved resonant controller	Resonant half-bridge	Yes	8.85 to 16	3.5	0.6 / 0.8	200
L6599AT	DIP-16, SO-16N	High-voltage improved resonant controller	Resonant half-bridge	Yes	8.85 to 16	3.5	0.6 / 0.8	175
L6565	DIP-8, SO-8	Quasi-resonant SMPS controller	Buck, boost, buck-boost, flyback	Yes	10.3 to 18	3.5	0.6 / 0.8	175







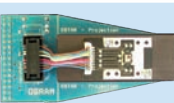
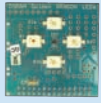



## Power MOSFETs

Part number	$V_{DSS}$ (V)	$R_{DS(on)}$ (max) ( $\Omega$ )	$I_D$ (A)	Package
STx3NF06L	60	0.1	3	SOT-223
STS5NF60L	60	0.055	5	SO-8
STS4DNF60L	60	0.055	4	SO-8 DUAL
STS4NF100	100	0.06	4	SO-8
STx19NF20	200	0.160	15	TO-220/TO-220FP/D <sup>2</sup> PAK
STx20NF20	200	0.125	18	TO-220/TO-220FP/DPAK
STx16NF25	250	0.235	13	TO-220/TO-220FP/DPAK
STx50NF25	250	0.069	45	TO-220/D <sup>2</sup> PAK
STx4NK50Z	500	2.7	3	TO-220/TO-220FP/DPAK/IPAK
STx6N52K3	525	1.2	5	TO-220/TO-220FP/DPAK/IPAK
STx7N52K3	525	0.98	6.3	TO-220/TO-220FP/DPAK/IPAK















## Power MOSFETs (cont'd)

Part number	$V_{DS}$ (V)	$R_{DS(on)}$ (max) ( $\Omega$ )	$I_D$ (A)	Package
STx5NK60Z	600	1.6	5	TO-220/TO-220FP/DPAK
STx6NM60N	600	0.92	4.7	TO-220/TO-220FP/DPAK/IPAK
STx3N62K3	620	2.5	2.7	TO-220/TO-220FP/DPAK/IPAK
STx6N52K3	620	1.2	5.5	TO-220/TO-220FP/DPAK/IPAK
STx3NK80Z	800	4.5	2.5	TO-220/TO-220FP/DPAK/IPAK
STx5NK80Z	800	2.4	4.3	TO-220/TO-220FP
STx7NM80	800	0.300	6.5	TO-220/TO-220FP/DPAK/IPAK
STx5N95K3	925	3	3.5	TO-220/TO-220FP/DPAK/IPAK
STx7N95K3	925	1.35	7.2	TO-220/TO-220FP/TO-247
STx13N95K3	925	0.85	9.3	TO-220/TO-220FP/TO-247

# Demonstration boards



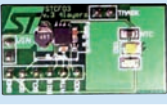








Sales code	Board	Description
STEVAL-ILL001V1		Dimmable driver for high-brightness power LEDs with VIPer22A (DALI connector)
STEVAL-ILL002V3		High-brightness LED driver with diagnostics (40 LEDs) based on STP08DP05
STEVAL-ILL002V4		High-brightness LED driver with diagnostics (40 LEDs) based on STP08DP05
STEVAL-ILL003V2		High-brightness LED driver without diagnostics (32 LEDs) based on STP16CP05
STEVAL-ILL005V1		VIPer12A offline, constant-current driver for high-intensity LEDs
STEVAL-ILL006V1		VIPer22A offline, constant-current driver for high-intensity LEDs
STEVAL-ILL007V1		High-intensity LED driver for MR-16 format based on L5973D
STEVAL-ILL008V1		LED flashlight demo based on the L6920D
STEVAL-ILL009V3		OSTAR projection module
STEVAL-ILL009V4		OSRAM Dragon LEDs module
STEVAL-ILL009V5		New RGB LED control board based on STP04CM05 and ST1S10
STEVAL-ILL010V1		High-intensity LED dimming driver based on L6902
STEVAL-ILL013V1		80 W offline LED driver with dimming based on L6562A
STEVAL-ILL014V1		Constant-current controller for high-brightness LEDs based on STCS1A

# Demonstration boards (cont'd)

Sales code	Board	Description
STEVAL-ILL015V1		High-brightness RGB LED array with LED error detection based on the STP24DP05 and STM32
STEVAL-ILL016V2		15 W offline Triac dimmable LED driver based on L6562AD and TSM1052 (USA market - 115 V)
STEVAL-ILL017V1		2 W not-isolated offline constant-current LED driver based on VIPer17HN
STEVAL-ILL018V1		OSRAM Golden Dragon white LED module (LUW W5AM)
STEVAL-ILL018V2		OSRAM Golden Dragon warm white LED module (LCW W5AM)
STEVAL-ILL018V3		OSRAM Golden Dragon amber (red) LED module (LA W55M)
STEVAL-ILL018V4		OSRAM Golden Dragon blue LED module (LB W55M)
STEVAL-ILL019V1*		35 W offline LED driver for 4-channel high-brightness RGB LED based on L6562A
STEVAL-ILL020V1		LCD panel backlight demoboard based on LED7706 (6 rows - 30 mA LED driver with boost converter)
STEVAL-ILL021V1		LCD panel backlight demoboard based on LED7707 (6 rows - 85 mA LED driver with boost converter)
STEVAL-ILL022V1		25 W LED street light with 80 W solar energy charger based on STM32
STEVAL-ILL023V1		High-efficiency switching LED Driver for high-current LEDs based on L6726A
STEVAL-ILL024V1		Mother/slave board for LED display based on STM32 microcontroller
STEVAL-ILL025V1		LED matrix display panel based on STP16DP05

\* Available in Q1 2010



Sales code	Board	Description
STEVAL-ILL026V1		3 W non-isolated offline LED driver based on VIPer22AS-E
STEVAL-TLL003V1		LED power flash driver based on STCF02
STEVAL-TLL004V1		LED power flash driver based on STCF03
STEVAL-TLL005V1		Power flash Evaluation board based on STCF03 and ST7 MCU (includes the STEVAL-TLL004V1)
STEVAL-TLL006V1		High-power LED driver demo board for single flash with I <sup>2</sup> C interface based on STCF06 (includes motherboard based on uPSD)
STEVAL-TLL007V1		Power flash demo board based on STCF05 (include motherboard based on uPSD)
EVAL4971		L4971 1.5 A step-down switching regulator evaluation board
EVAL4973		L4973 3.5 A step-down switching regulator evaluation board
EVAL5970D		L5970D up to 1 A step-down switching regulator evaluation board
EVAL5972D		L5972D up to 2 A step-down switching regulator evaluation board
EVAL5973AD		L5973AD 2 A step-down switching regulator evaluation board
EVAL5973D		L5973D up to 2.5 A step-down switching regulator evaluation board
EVAL5985		Evaluation board for L5985: 2 A step-down switching regulator
EVAL6920D		L6920D 1 V high-efficiency synchronous step-up converter evaluation board

# Demonstration boards (cont'd)

Sales code	Board	Description
EVAL6920DB1		L6920DB synchronous rectification step-up converter evaluation board
EVAL6926D		L6926 high-efficiency monolithic synchronous step-down regulator evaluation board
EVAL6928D		L6928D high-efficiency monolithic synchronous step-down regulator evaluation board
EVL6562A-35WFLB		35 W wide-range high power factor flyback converter using L6562A
EVL6562A-LED*		Constant current inverse buck LED driver using the L6562A
STEVAL-ISA056V1		6-row, 30 mA LED driver with boost converter for notebook PC LCD-panel backlighting
STEVAL-ISA048V1		1 A/adjustable Vout PWM synchronous step-up DC-DC converter based on ST8R00
STEVAL-ISA044V1		3 A synchronous 900 kHz step-down DC-DC converter with inhibit function
STEVAL-ISA044V2		3 A synchronous 900 kHz step-down DC-DC converter with inhibit function
STEVAL-ISA019V2		80 W ESBT quasi-resonant wide-range SMPS with L6565 for 3-phase application

\* Available in Q1 2010





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