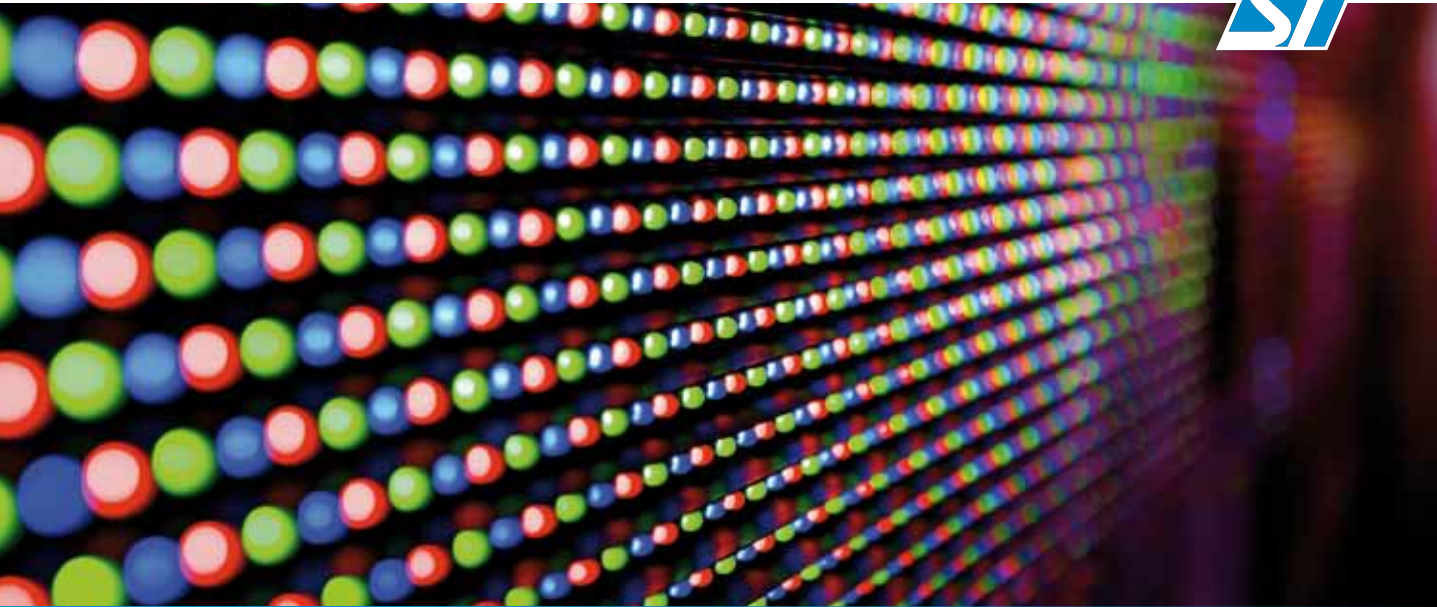


Energy-efficient solutions for LED lighting



STMicroelectronics

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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 (tonnes of oil equivalent) in 1980 to 13.6 billion toe in 2015 (forecast)*. 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 solutions, 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.

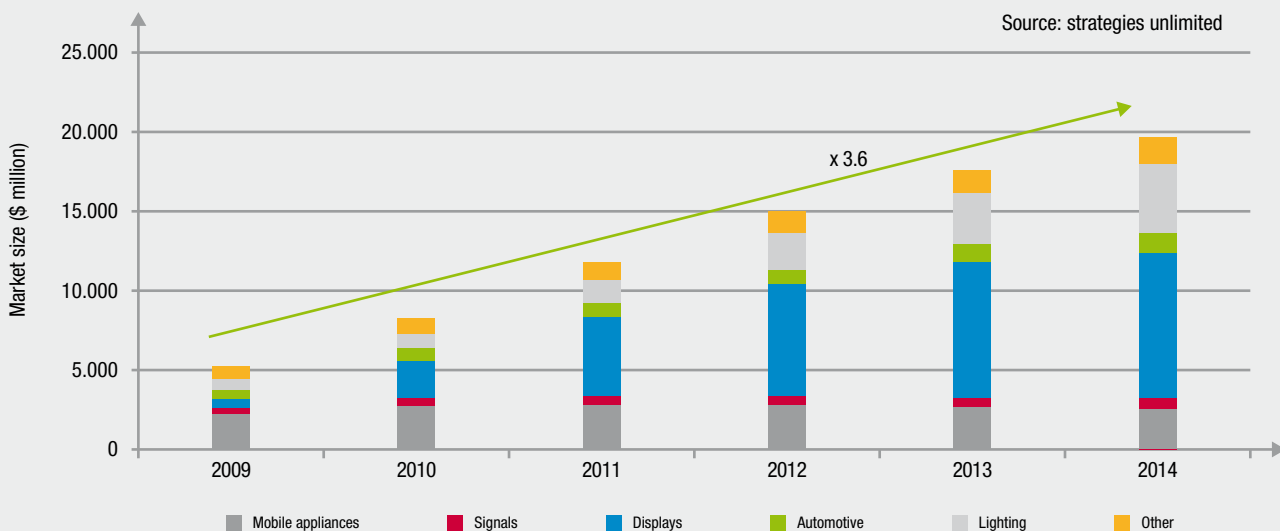
Lighting represents 15% of global electrical energy consumption, mainly in buildings and exterior applications. More efficient lighting thus offers potentially large savings in energy and is closely related to the performances of its control electronics.

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.

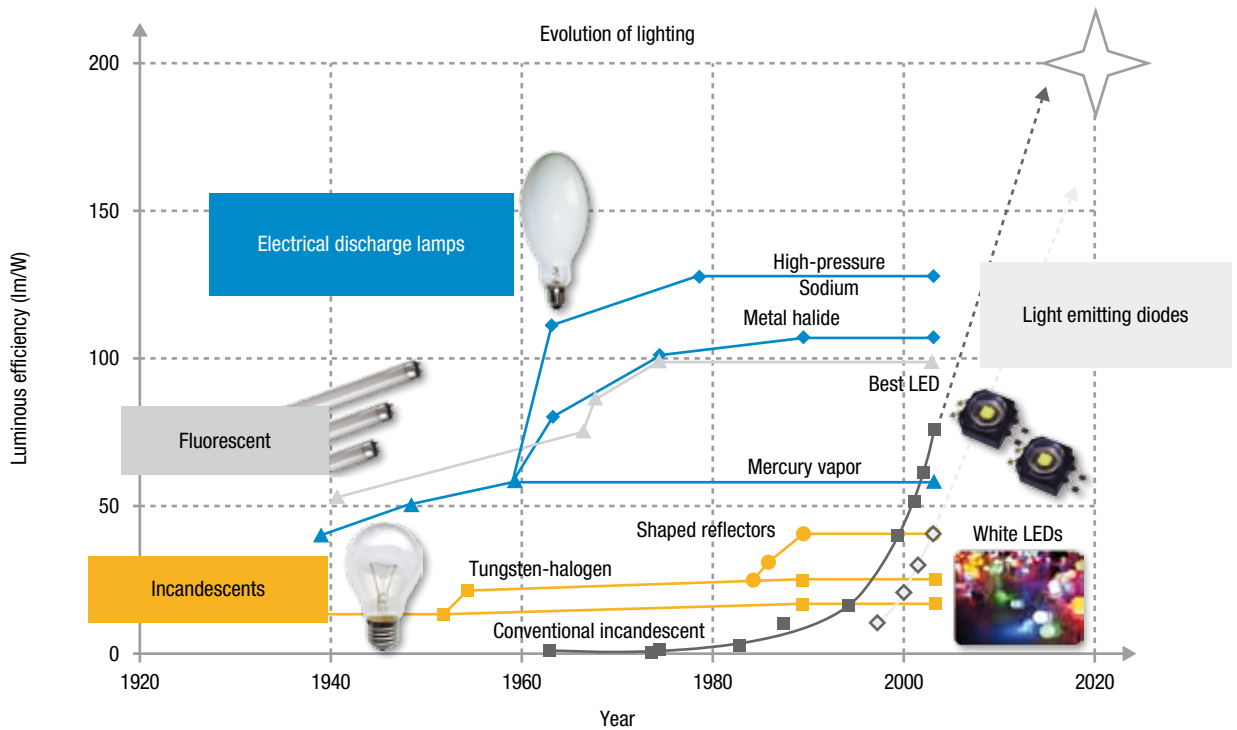
Light emitting diodes (LEDs), thanks to their numerous advantages, are set to become a new standard source of illumination for the 21st century.

HB LED market forecast 2009-2014



Note:
* Based on EIA: International Energy Outlook 2010 report #: DOE/EIA-0484(2010)

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.

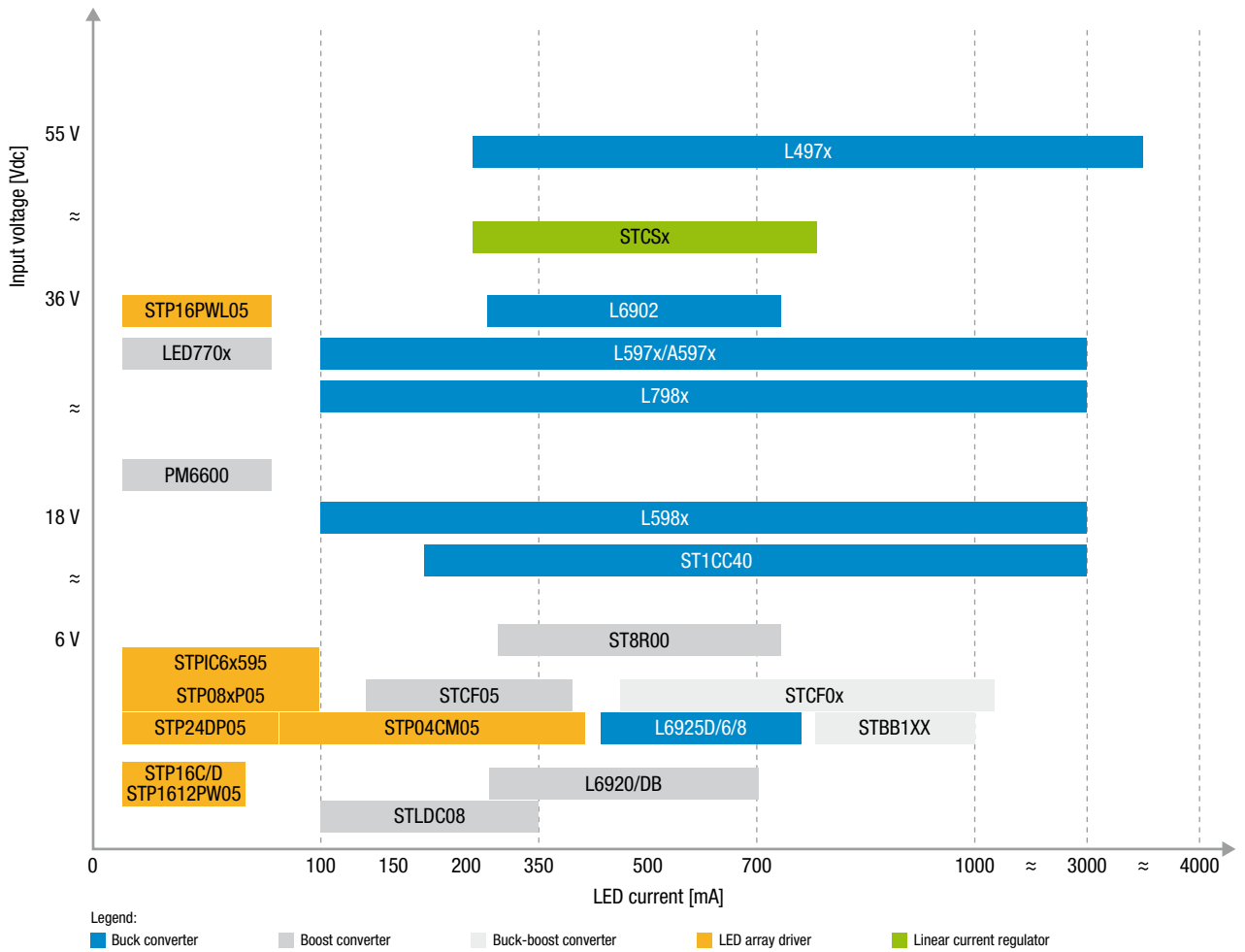
Most importantly, LEDs can save a lot of energy compared with standard lighting sources. It has been estimated that the replacement of 5% of all incandescent bulbs in the world (12.5 billion/year) with LED-based lighting would allow the saving of 60 TWh of

electricity equivalent to 23.4 Gtonne of CO₂ a year.

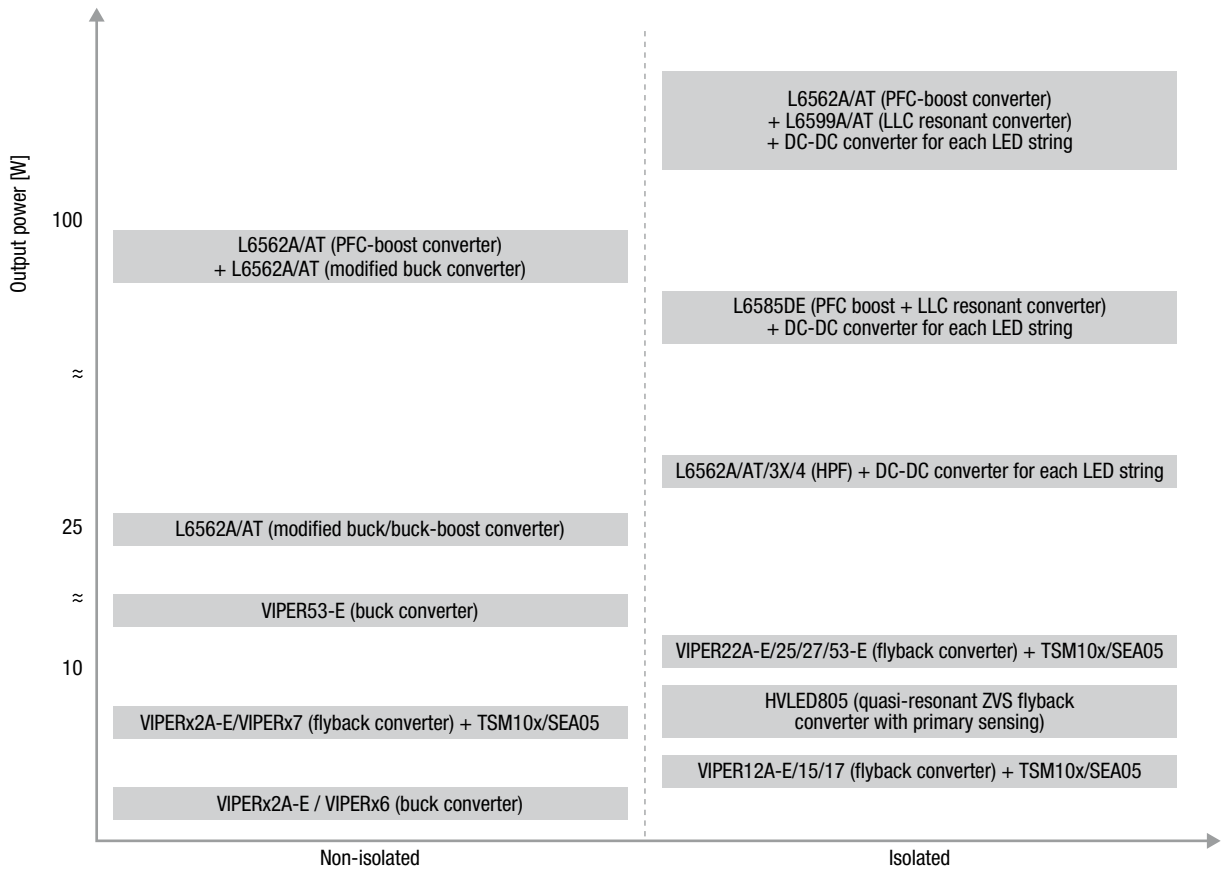
STMicroelectronics offers a large portfolio of compact and efficient LED driver solutions, fully addressing the lighting market and featuring all the functions needed to ensure greater power saving.

ST's LED driver solutions

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



Offline LED drivers: 85 to 265 Vac input voltage



LED application segments



Displays and signs

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

STP04CM05, STP08xP05, STP16C/D, STP1612PW05, STP24DP05



General illumination

- Residential lighting
- Commercial lighting
- Architectural and decorative lighting
- Street lighting and public illumination
- Emergency lighting

HVLED805, VIPer, L6562A/AT, L6599A/AT, L6585DE, STP04CM05, ST1CC40x, STCSx, L597x, L598x, L497x, L6902, L798x



LCD backlighting

- LED TVs
- PC monitors
- Notebooks
- Netbooks
- Mid- to large-sized LCDs

LED7706/07/08, PM6600, STP16PWL05



Mobile appliances and DSC flash lighting

- Smartphones
- MP3/PMP
- Video game consoles
- Auto navigation/GPS
- Digital still cameras

STLDC08, ST8R00, L6920/DB, L6925D/26/28, ST1CC40, STCF04, STCF06, STBB1XX



Traffic signals

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

STP08DP05, STP16C/D, STP1612PW05, STP24DP05, LED7706/07



Automotive

- Interior lighting
- Exterior lighting
- Infotainment display backlighting

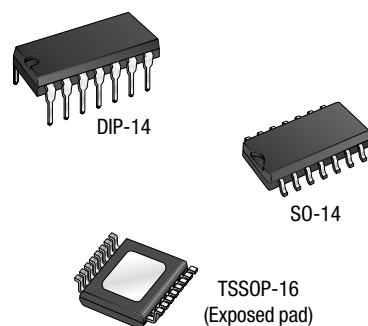
A597xD/AD, A6902D, LED7706/07, STCSx, STP08xP05, STP16C/D, STPIC6x595

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.



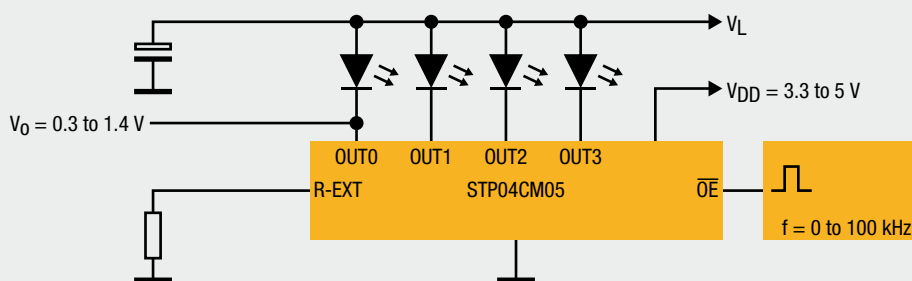
Key features

- 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



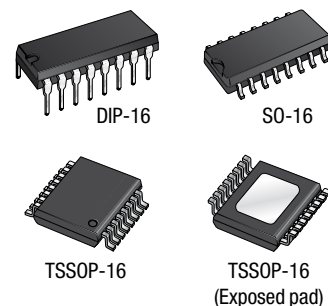
| Sales code | Board | Description | Technical documents |
|-----------------|-------|---------------------------|--|
| STEVAL-ILL009V3 | | OSTAR projection module | |
| STEVAL-ILL009V4 | | OSRAM Dragon LED module | |
| STEVAL-ILL009V5 | | New RGB LED control board | AN2531: Generating multicolor light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



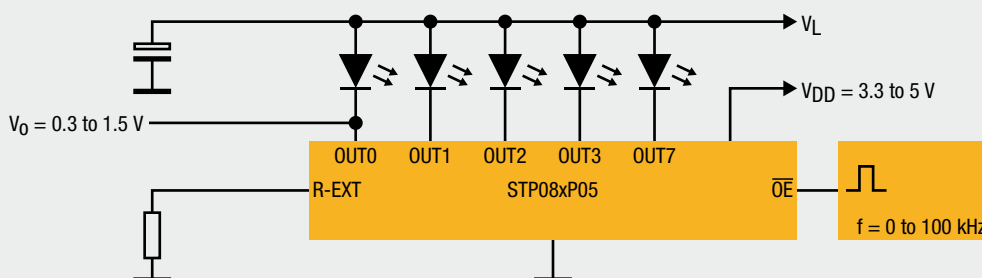
Key features



- 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

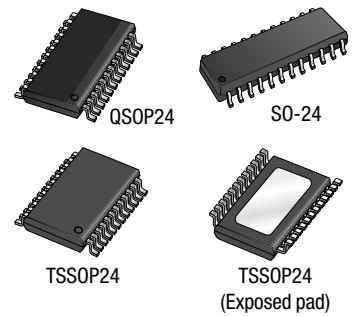


| Sales code | Board | Description | Technical documents |
|-----------------|---|--|---|
| STEVAL-ILL002V3 |  | High-brightness LED with diagnostics (40 LEDs) | UM0181: Detection LED matrix evaluation kit |
| STEVAL-ILL002V4 |  | High-brightness LED with diagnostics (40 LEDs) | AN2478: STP08DP05, STP16DP05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

STP16C/D - STP1612PW05

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.

The STP1612PW05 has an individually adjustable PWM brightness control for each output channel. The PWM counters are selectable via a serial interface with 4096 or 65536 steps (12 or 16 bits). It also provides enhanced pulse-width modulation counting algorithms called e-PWM to reduce flickering effects (ghost visual effects), so improving the overall image quality. The device features 8-bit gain (256 steps) for global LED brightness adjustment with two selectable ranges.



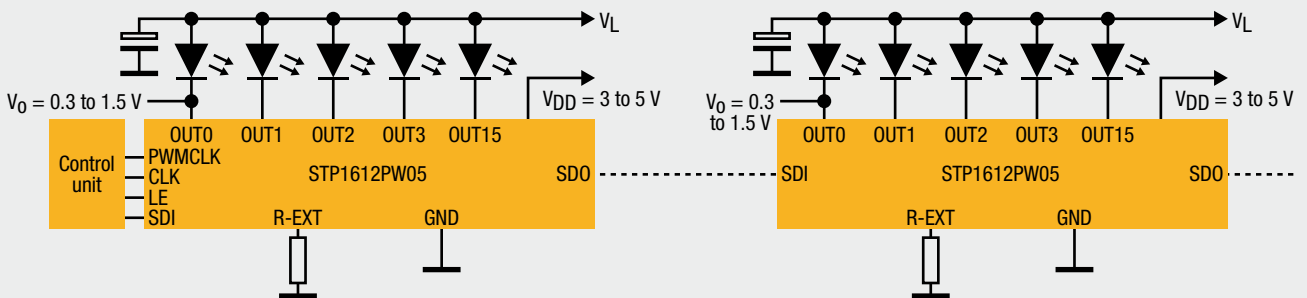
Key features

- Supply voltage: 3.3 or 5 V
- 16 constant-current output channels
- Adjustable output current through external resistor
- Serial data in/parallel data out
- 3.3 V microcontroller driveable
- Programmable progressive output delay
- Thermal protection and thermal flag
- 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
 - balanced turn on/off
- Available and combinable features such as:
 - enhanced PWM for reduced flickering effects (STP1612PW05)
 - SPI programming with dual-size 16-bit or 256-bit shift register (STP1612PW05)
 - 8-bit current gain control by means of 256 steps in two selectable ranges (STP1612PW05)

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 |
| STEVAL-ILL024V1 STEVAL-ILL025V1 | | Master/slave board for LED display based on STM32 microcontroller LED matrix display panel based on STP16DP05 | UM0767: STEVAL-ILL024V1 and STEVAL-ILL025V1 demonstration boards based on the STP16DP05 LED matrix driver and STM32F103VB |
| STEVAL-ILL028V1 | | RGB LED driver for color displays and backlighting based on the STP1612PW05 and STM32 | UM0882: STEVAL-ILL028V1 LED dimmer board using STP1612PW05 and STM32 UM0885: Multilayer C library used to drive STP1612PW05 on the systems with SPI |

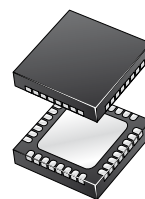
STP16PWL05

The STP16PWL05 is a 16-channel, constant-current LED driver designed for display backlighting.

Each channel can be programmed using external resistors at two different current sink levels.

The device is configured through a serial interface to support basic dimming current techniques (PWM) by using a 12/16-bit gray-scale. It is also able to support different error detection modes, providing the results externally through the serial interface.

The device is capable of providing a master brightness control through a current gain adjust (CGA), with two selectable ranges available. The STP16PWL05 can synchronize or be synchronized to other similar devices by using the dedicated pin.



VFQFPN-32 5x5

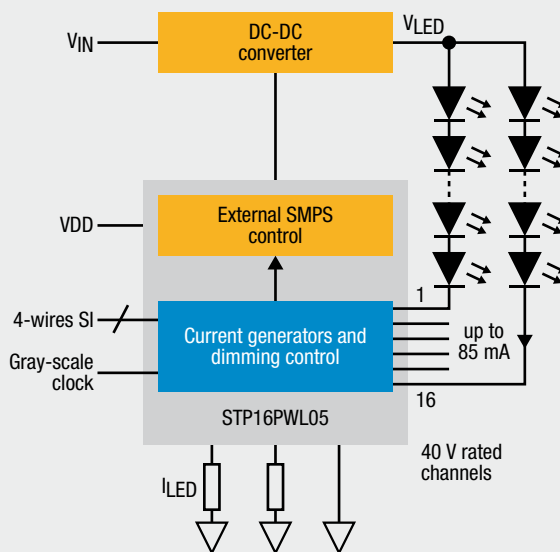
Key features

- 16 low-side programmable channels
- Up to 85 mA per channel current capability
- Paralleable channels for higher LED current
- $\pm 3\%$ channel current accuracy
- $\pm 1.5\%$ channel-to-channel current matching
- Programmable off-state (bias) channel current
- External SMPS control (adaptive LED supply voltage) for higher efficiency
- 4-wire, 30 MHz serial interface
- 2/16-bit gray-scale (PWM) brightness control for local dimming
- Grouped or independent PWM channel control
- Programmable gray-scale latency
- Master/slave chain configuration supported

Key benefits

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

Application example



| Sales code | Board | Description |
|-----------------|-------|---|
| STEVAL-ILL036V1 | | Multi-channel LED driver with external DC-DC feedback control for medium/large LCD panel backlights based on STP16PWL05 and STM32F103C6T6 |

| Technical documents |
|---------------------|
|---------------------|

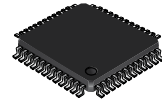
STP24DP05

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

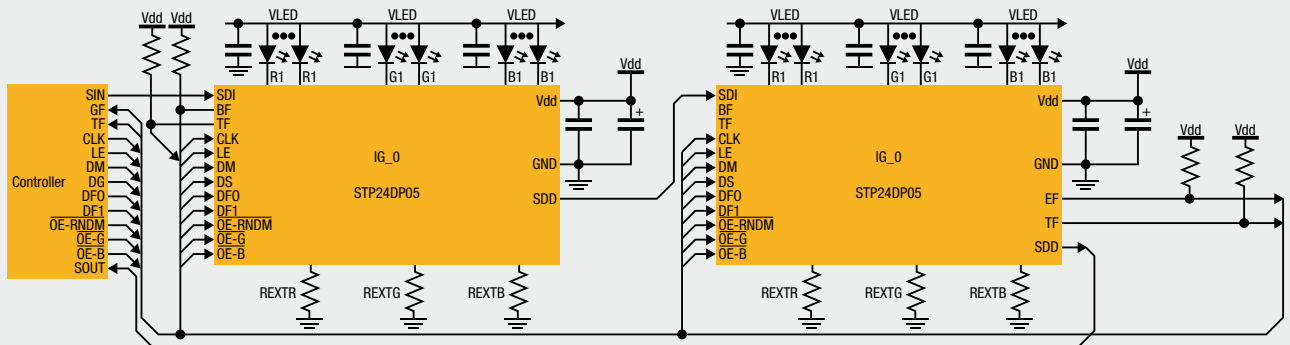
Key features

- 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 |
|------------------------------------|-------|---|
| STEVAL-ILL015V1 | | High-brightness RGB LED array with LED error detection |
| STEVAL-ILL032V1 STEVAL-ILL033V1 | | Multicolor LED matrix demo based on STP24DP05BTR Master/slave unit for multicolor LED matrix demo based on STM32F103VET6 |

| Technical documents |
|--|
| AN2841: LED dimming implemented on STM32 microcontroller |
| UM0574: LED dimmer demonstration board based on the STP24DP05 and STM32 |
| UM0588: Multilayer C library for LED dimming used on systems with SPI and DMA capabilities |

Boost converters

PM6600

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

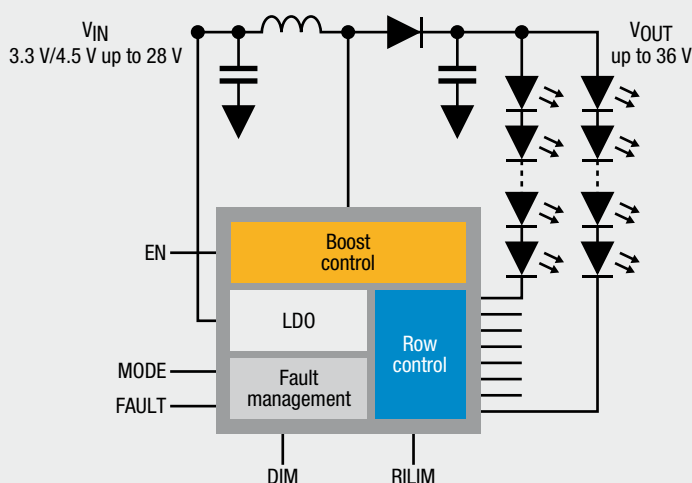
Key features

- 6 rows with up to 10 LEDs per row (60 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 at highest precision/matching accuracy
- Supports analog and digital dimming

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

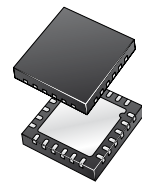


| Sales code | Board | Description |
|-----------------|-------|---|
| STEVAL-ISA056V1 | | 6-row, 30 mA LED driver with boost converter for notebook PC LCD-panel backlighting |

LED7706/7

The LED7706/7 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 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

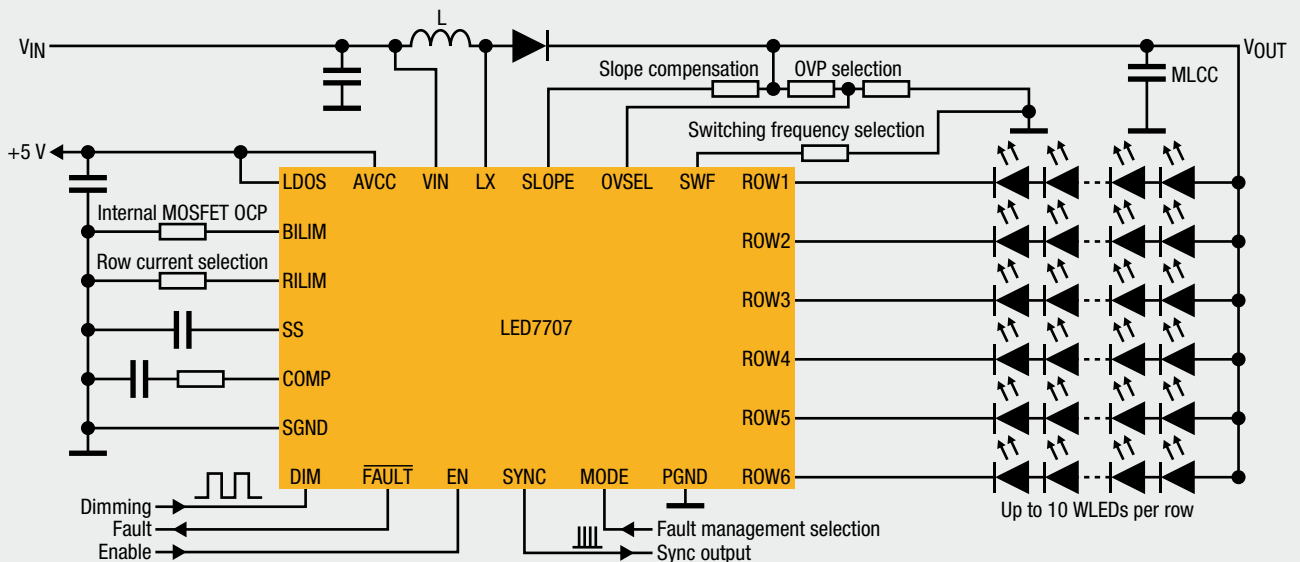
Backlight driver section

- 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)
- $\pm 1.5\%$ 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 |

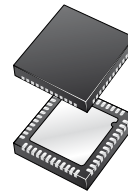
LED7708

The LED7708 has been specifically designed to supply several LEDs starting from a single low-voltage rail in order to address TV and monitor backlight, medium and large size LCD panel backlight and RGB/RGGB backlight applications.

It integrates a boost controller, sixteen current generators and a 4-wire serial interface.

The boost controller regulates the output voltage in an adaptive way according to the LED's need, resulting in improved overall efficiency. All the current generators are 40 V rated, allowing the LED7708 to drive several LEDs in series on each channel. The channels can be put in parallel for higher output current. The brightness of the LEDs is controlled by using the serial interface. A selectable 12-bit or 16-bit gray-scale brightness control allows independent PWM on each channel. A programmable on-chip dimming oscillator is provided for external circuitry simplification. The device has dedicated pins to lock/synchronize with other devices (master or slave) for noise reduction in multi-device applications.

The LED7708 implements basic protection (OVP, OCP and thermal shutdown), as well as LED-array protection. It can detect and manage open-LED and shorted-LED faults and different fault management options are available in order to cover most application needs.



VFQFPN-48 7x7

Key features

Boost controller section

- Input voltage range (LDO): 3.6 to 36 V
- Adaptive output voltage for high efficiency
- Internal +5 V LDO for gate driver supply
- Internal +3.3 V LDO for device supply
- High-performance external MOSFET driver
- Switching frequency: 250 kHz to 1 MHz
- Programmable OV and OC protection
- Fixed-frequency peak current mode control
- External synchronization for multi-device applications
- Over-temperature alert and thermal shutdown

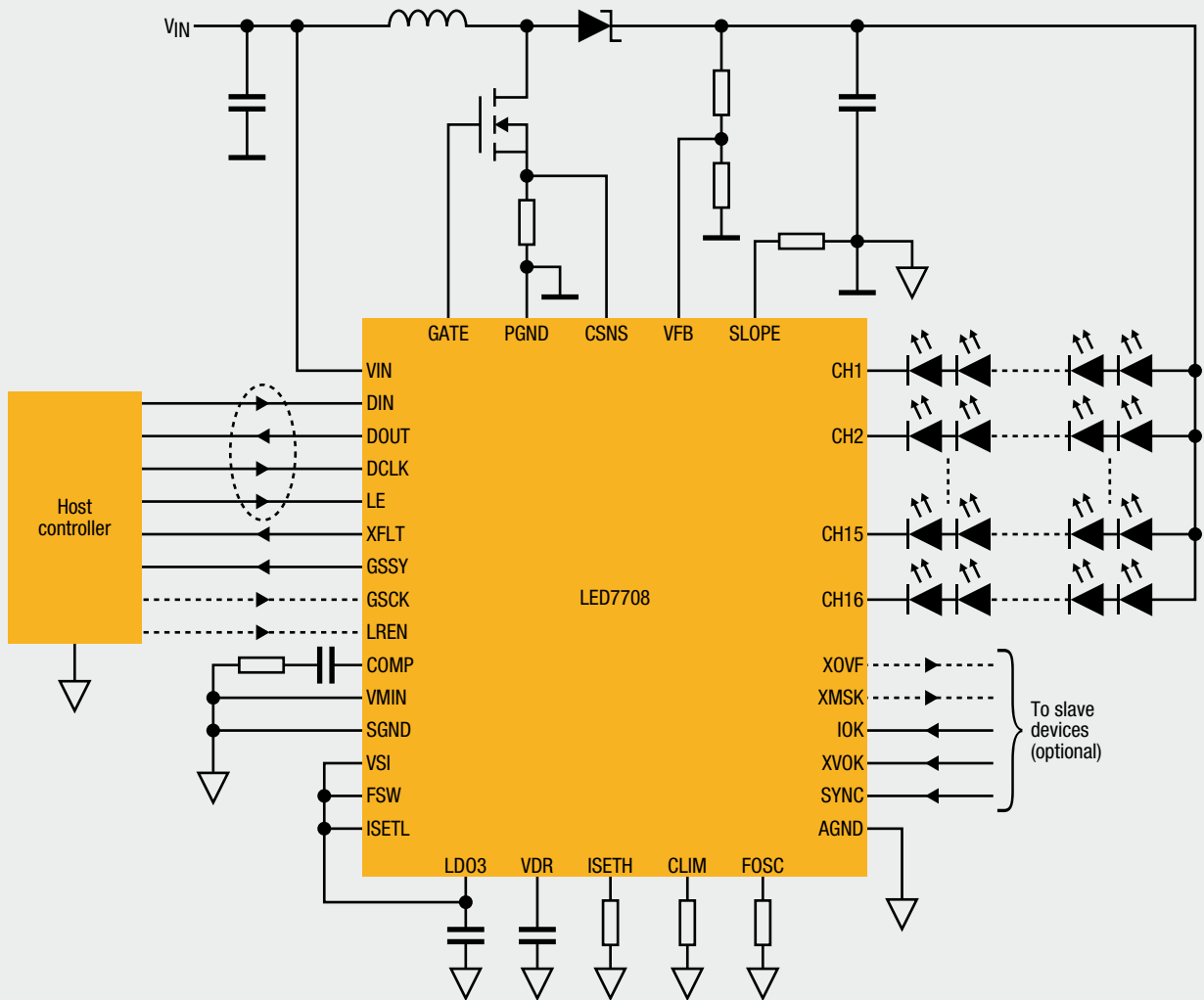
LED array driver section


- 16 channels with 85 mA/ch current capability
- Channel current accuracy: $\pm 3\%$
- $\pm 1.5\%$ max channel-to-channel current matching
- LED short-circuit and open-channel fault detection and management
- 4-wire, 30 MHz serial interface
- Serial data formats: 16 x 16 bits, 1 x 256 bits or 1 x 192 bits
- Grouped or independent channel PWM control
- Selectable 12/16-bit gray-scale brightness control for local dimming
- Programmable internal dimming oscillator
- Programmable gray-scale latency
- Master/slave chain configuration supported

Key benefits

- Flexible solution
- High efficiency
- Superior brightness control
- Complete and smart fault management

Application example



| Sales code | Board | Description | Technical documents |
|-----------------|---|---|---------------------|
| STEVAL-ILL035V1 |  | Multi-channel LED driver with integrated boost controller for medium/large LCD panel backlight based on LED7708 and STM32F103C6T6 | |

ST8R00

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



DFN 4x4 mm

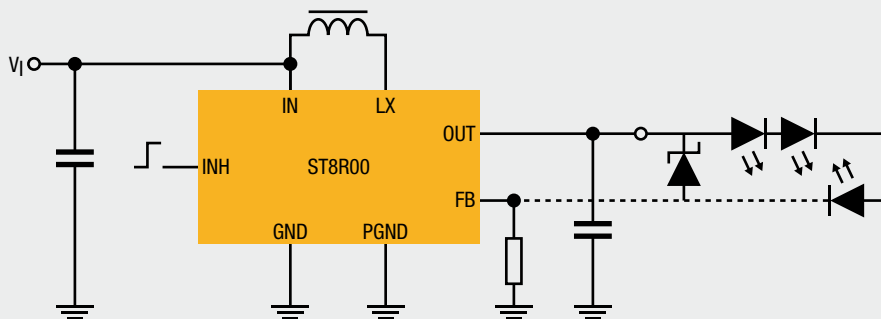
Key features

- Very low supply current: 500 μ A (typ)
- Output voltage: adjustable from 6 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%
- Only a 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 |

L6920/DB

The L6920/DB 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

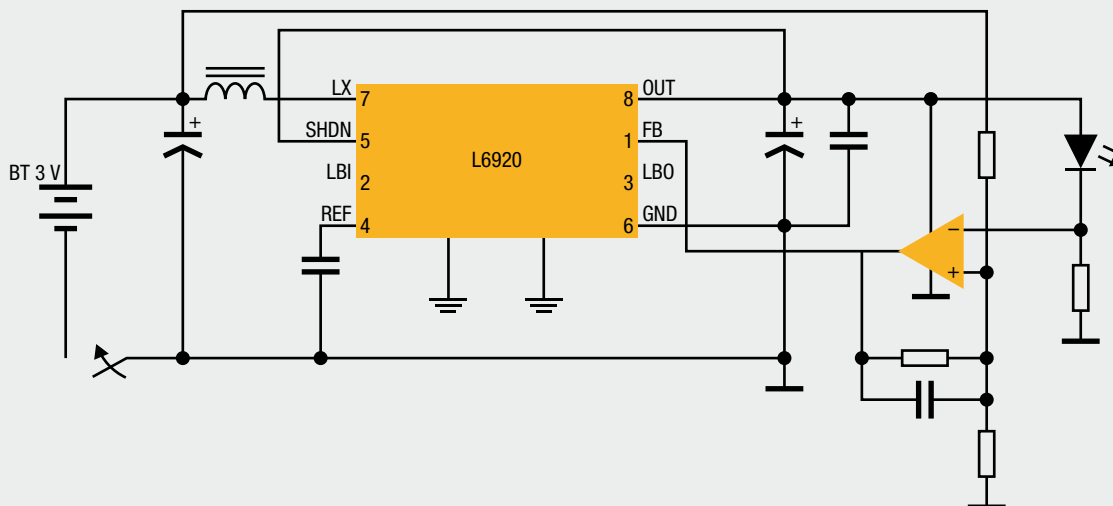
Key features



- 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 L6920)

Key benefits

- Monolithic and flexible solution
- High efficiency

Application example



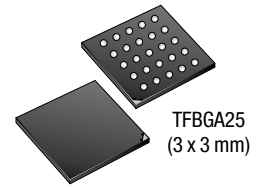
| Sales code | Board | Description | Technical documents |
|-----------------|---|---|---|
| EVAL6920DB1 |  | L6920DB synchronous rectification step-up converter evaluation board | AN2206: Designing with L6920DB, high efficiency synchronous rectifier step-up converter |
| STEVAL-ILL008V1 |  | LED flashlight demo board based on the L6920/DB Previous sales code: PSAL05-13 | AN1941: Low-voltage LED driver using L6920/DB, L4971 and L6902D |

STCF05

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

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

All the functions of the device are controlled through the I²C bus that allows to reduce logic pins on the package and to save PCB traces on the board.



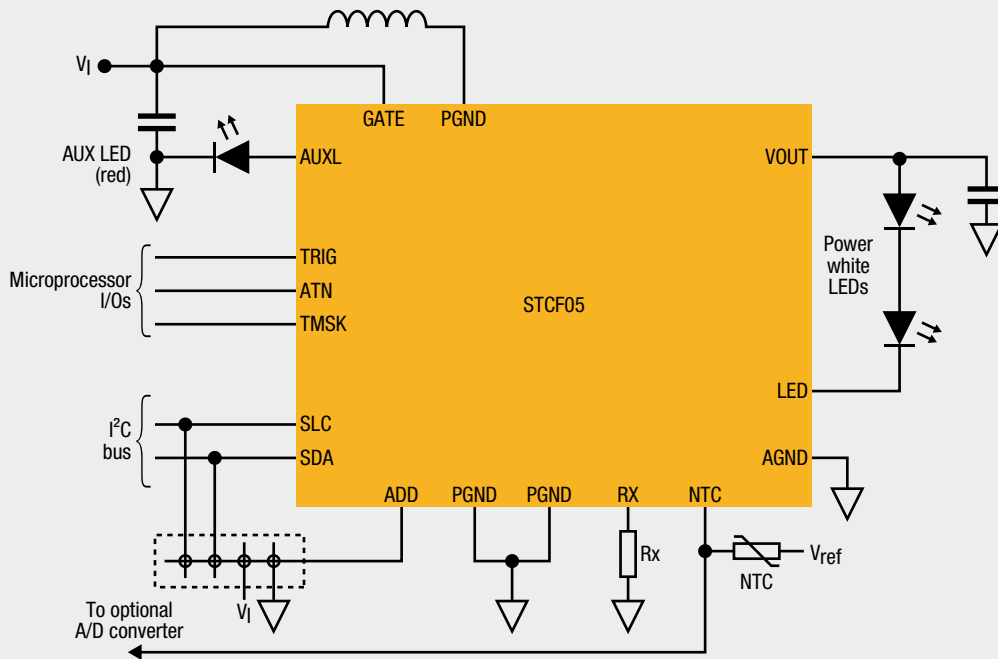
Key features

- 1.8 MHz fixed frequency PWM control
- Efficiency up to 92%
- Full I²C 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 μA standby current

Key benefits

- Only a few external components required

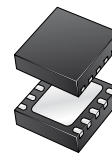
Application example



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

STLDC08

The STLDC08 LED driver step-up controller is optimized to operate from one or two NiCd/NiMH or alkaline cells. The IC is able to drive an external MOSFET (N-channel) enabling it for use with wide power levels. Hysteretic control eliminates the need for small signal control loop compensation. The IC integrates an FET driver for a precise PWM dimming. STLDC08 comes in a DFN10 (3 x 3 mm) package.



DNF10L (3 x 3 mm)

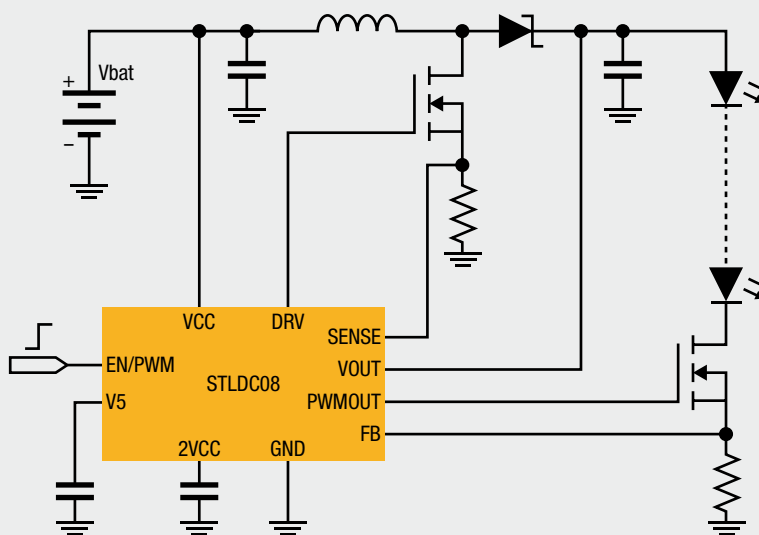
Key features

- Minimum input voltage range: 0.8 to 3.6 V
- 20 V overvoltage protection
- Drives N-channel MOSFET or NPN bipolar transistor
- No control loop compensation required
- FET driver for very precise PWM dimming
- Operates also using $R_{DS(on)}$ as sense resistor

Key benefits

- Flexible solution to cover different power levels
- Minimized number of external components for compact solutions
- High efficiency
- Brightness control using inhibit pin

Application example

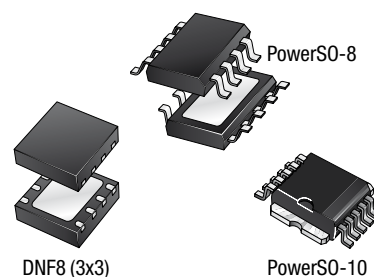


Linear current regulators

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 including 5 V supplies, 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.



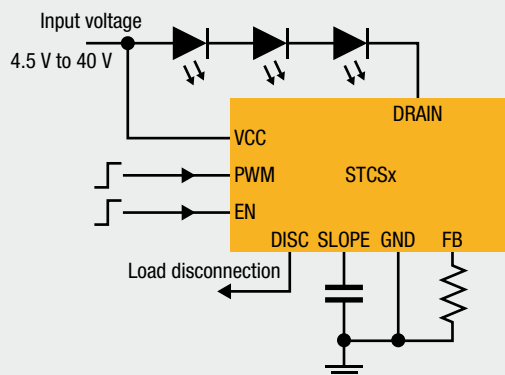
Key features



- Adjustable current set from 0.1 A to 2.0 A (STCS2/A), 1.5 A (STCS1/A), 500 mA (STCS05/A)
- Adjustable turn-on ramp-up from 10 μ 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 only a 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 |
| STEVAL-ILL030V1 |  | LED lighting control using DMX512 control based on STM32F102C6T6 and STCS1APHR | UM1004: DMX512-based LED lighting solution |

Buck converters

L6902

The L6902 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.



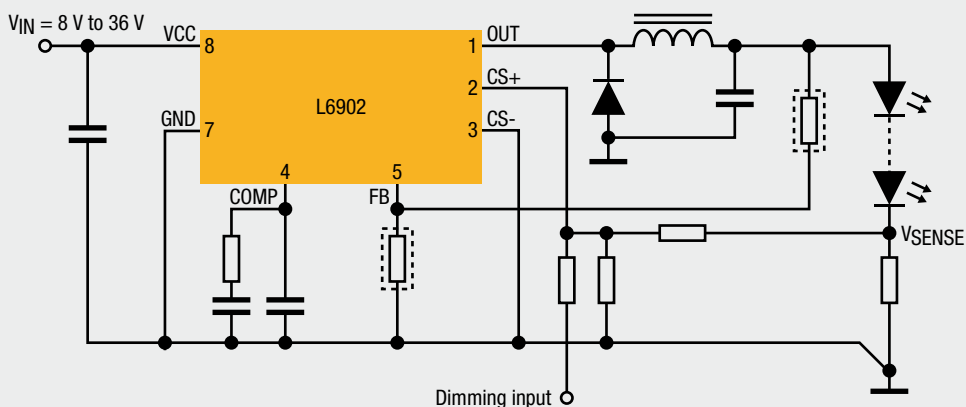
Key features


- 1 A in small SO8 package with minimum external component count
- P-channel power MOSFET: no bootstrap capacitor
- Wide input voltage range: 8 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/A597x

The L597x/A597x series of step-down monolithic power switching regulators is capable of delivering up to 3 A DC current to the load depending on the application conditions. The output voltage can be set from 1.235 V to 35 V.

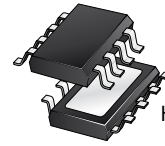
The devices use an internal P-channel D-MOSFET (with a typical $R_{DS(on)}$ of 250 m Ω) as switching element to minimize the size of the external components. An internal oscillator fixes the switching frequency at 250 kHz.

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.



S0-8



HSOP-8

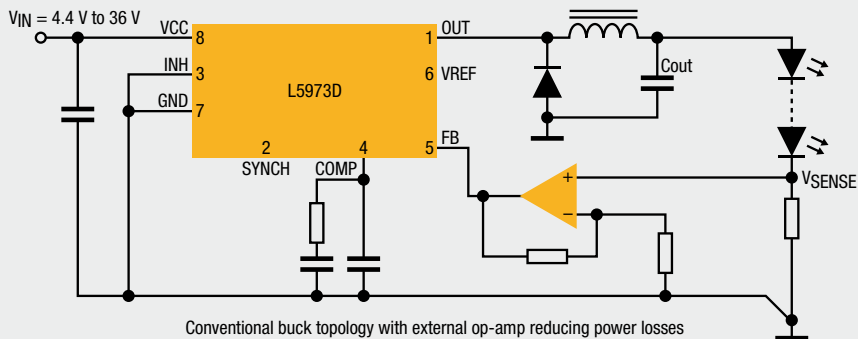
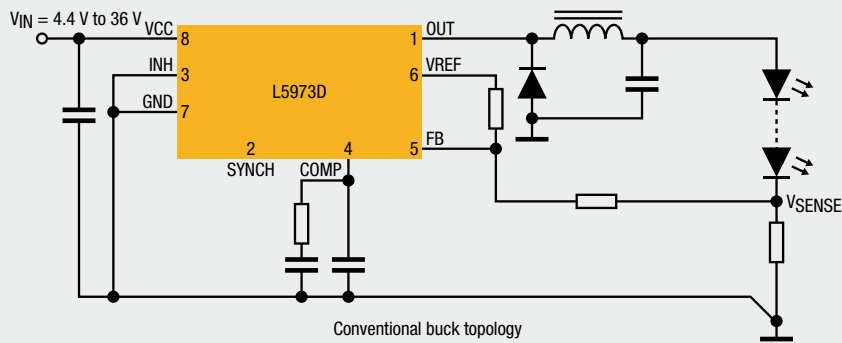
Key features

- Up to 3 A output current
- P-channel power MOSFET: no bootstrap capacitor
- Wide input voltage range: 4.4 to 36 V
- High switching frequency: 250 kHz/500 kHz, sync up to 700 kHz
- Inhibit pin
- Embedded protection features
- Automotive grade available (A597x)

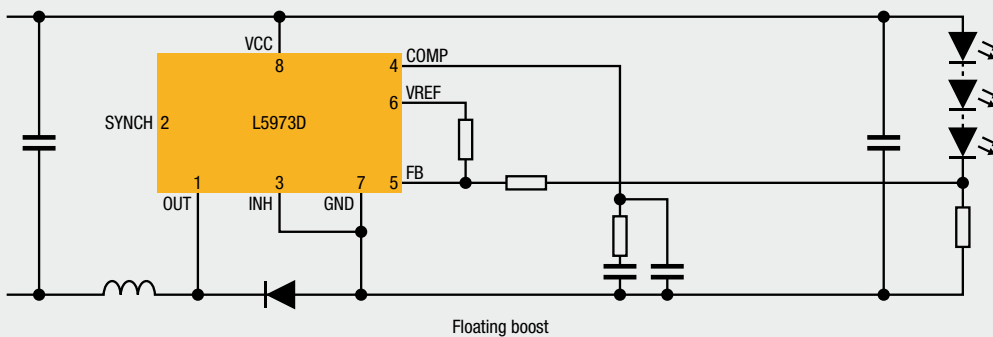
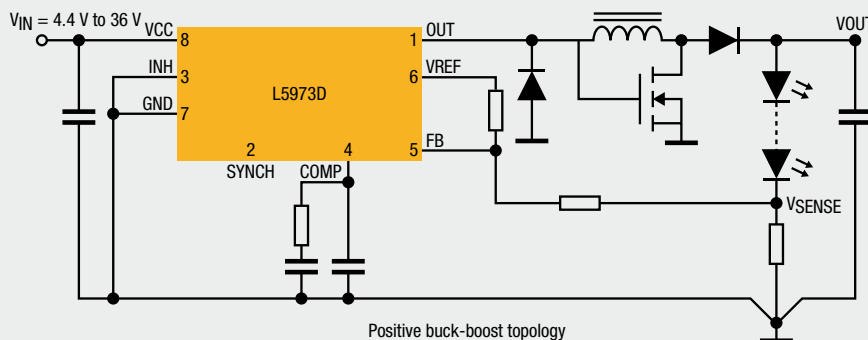
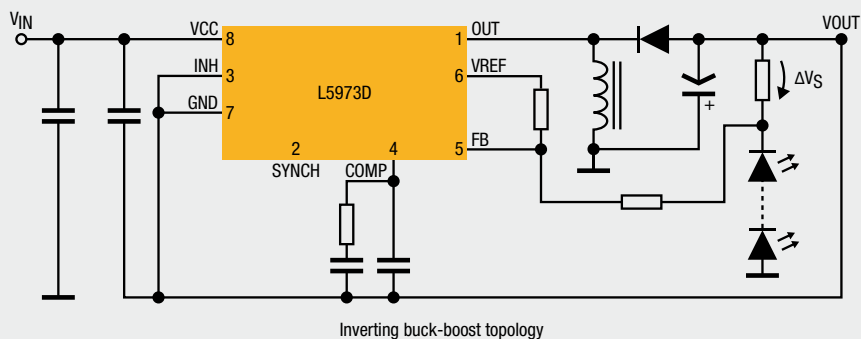
Key benefits





- Standard dimming capability
- Monolithic and flexible topology solutions
- Wide input voltage range compatible with MR16 standard
- High efficiency
- Low power dissipation

Application example



Application example

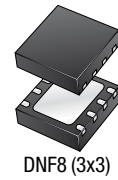


| Sales code | Board | Description | Technical documents |
|------------|---|---|---|
| EVAL5970D |  | L5970D up to 1 A step-down switching regulator evaluation board | AN1330: Designing with the L5970D 1 A high-efficiency DC-DC converter |
| EVAL5972D |  | L5972D up to 2 A step-down switching regulator 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 |

L598x

The L598x series of step-down switching regulators with embedded power MOSFETs 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. Only requiring a minimum of external components, the devices include an internal 250 kHz switching-frequency oscillator that can be externally adjusted up to 1 MHz.



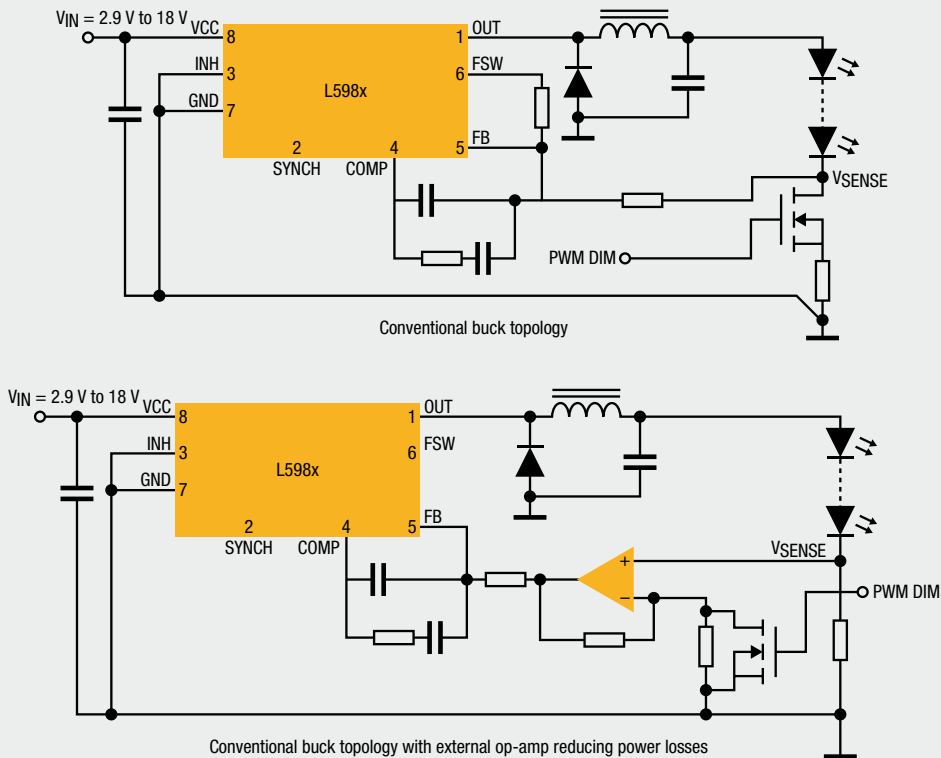
Key features

- Up to 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 mΩ

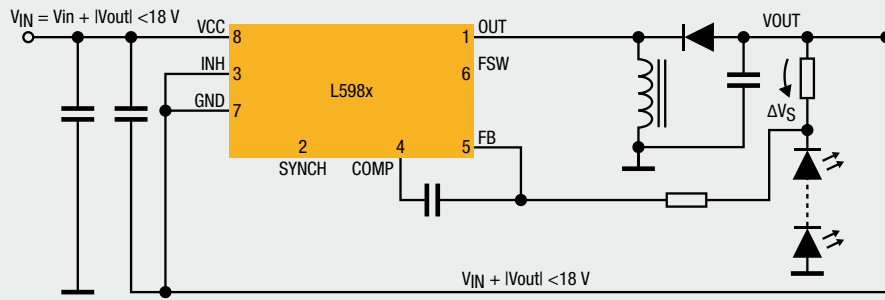
Key benefits

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

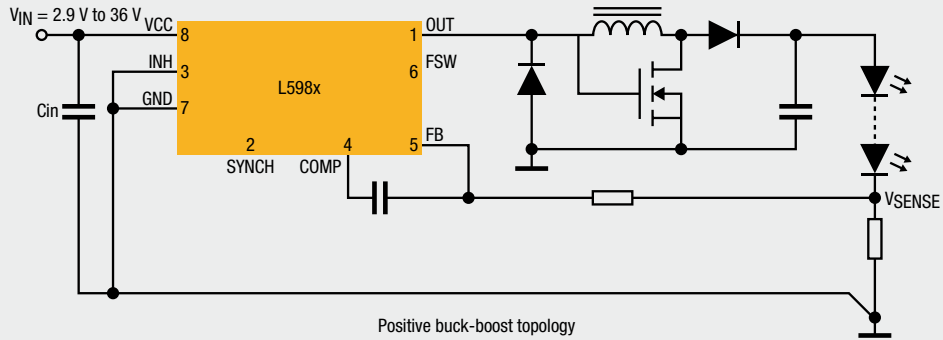
Application example



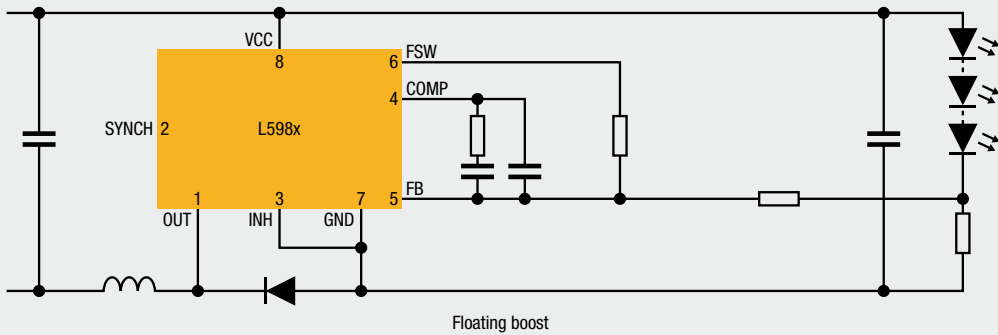
Application example







Inverting buck-boost topology



Positive buck-boost topology



Floating boost

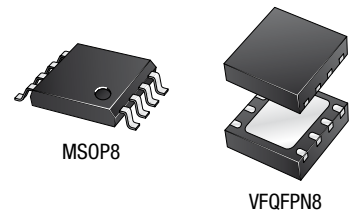
| Sales code | Board | Description |
|------------|---|--|
| EVAL5980 |  | 0.7 A step-down switching regulator demonstration board based on the L5980 |
| EVAL5981 |  | 1 A step-down switching regulator demonstration board based on the L5981 |
| EVAL5983 |  | 1.5 A step-down switching regulator demonstration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

L6925D/26/28

This series 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).



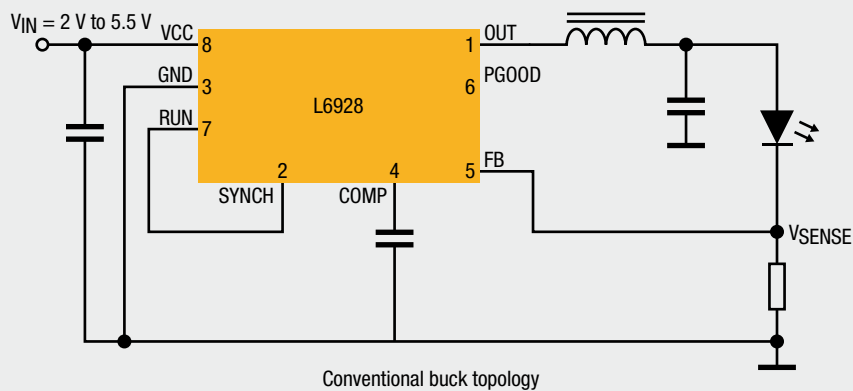
Key features

- Input voltage range: 2 to 5.5 V (2.7 V for L6925D)
- Output voltage: adjustable 0.6 V to V_{IN}
- Internal synchronous switch
- Switching frequency: 1.4 MHz (L6928) to 600 kHz (L6925D/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

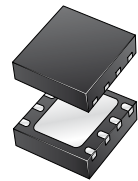


| Sales code | Board | Description | Technical documents |
|------------|-------|---|---|
| EVAL6926D | | L6926 high-efficiency monolithic synchronous step-down regulator evaluation board | AN1882: Designing with the L6926, high-efficiency monolithic synchronous step-down regulator |
| EVAL6928D | | 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 |

ST1CC40

The ST1CC40 is a fixed-frequency, step-down DC-DC converter designed to operate as a constant-current source. The device operates with an input supply range from 3.5 to 18 V and provides up to 3 A output current with accurate regulation, which makes it suitable for driving high-power LEDs.

Synchronous rectification improves overall system performance. The current is set by an external resistor with 100 mV typ. feedback voltage, thus minimizing the power loss on the sensing resistor. A 900 kHz switching frequency combined with low-impedance ceramic capacitors minimize possible output ripple. The device is protected against thermal overheating, switching overcurrent and output short circuit.



DFN - 8L 4 x 4 mm

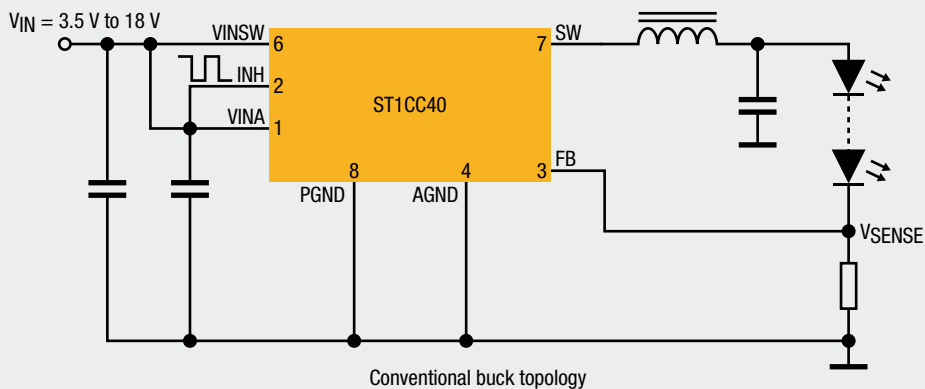
Key features

- Switching frequency: 900 kHz
- Output current capability: 3 A
- Output voltage: adjustable from 0.8 V up to V_{in}
- Max operating input voltage: up to 18 V
- Feedback voltage: 100 mV
- Integrated 70 m Ω low-side $R_{DS(on)}$ MOSFET
- Integrated 90 m Ω high-side $R_{DS(on)}$ MOSFET
- Standby supply current: 6 μ A over temperature range
- Inhibit input pin for enabling and PWM dimming of the LEDs
- Fast transient response
- SO8 and MLP4x4 packages

Key benefits

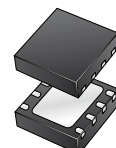
- Enhanced dimming performance
- High efficiency, up to 95%
- Minimized component count
- Flexibility of the application covering 5 V and 12 V buses
- Tiny SMD external components for compact LED drivers
- Minimized power losses on sensing resistor

Application example



L798x

The L798x is a step-down switching regulator family with an embedded, 3.7 A (minimum) current-limited power MOSFET, so it is able to deliver up to 3 A to the load depending on the application conditions. The input voltage can range from 4.5 to 28 V, while the output voltage can be set starting from 0.6 V to V_{IN} . Only requiring a minimum set of external components, the device includes an internal 250 kHz switching frequency oscillator that can be externally adjusted up to 1 MHz. The QFN and the HSOP packages with exposed pad reduce R_{thJA} down to 60 °C/W and 40 °C/W respectively.



VFQFPN8 3 x 3



HSOP8
exposed pad

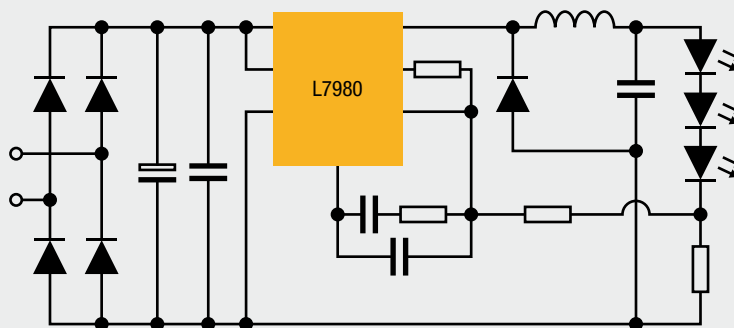
Key features

- Up to 3 A output current in small QFN3x3-8L or HSOP8 package
- P-channel power MOSFET: no bootstrap capacitor and 100% maximum duty cycle
- Wide input voltage range: 4.5 up to 28 V
- Closed-loop soft start
- High switching frequency (250 kHz, adjustable up to 1 MHz) with synchronization capability (180° out of phase)
- Embedded protection features (overcurrent, over-temperature)
- Typical $R_{DS(on)}$: 180 mΩ
- Alternative topologies: inverting buck-boost, positive buck boost

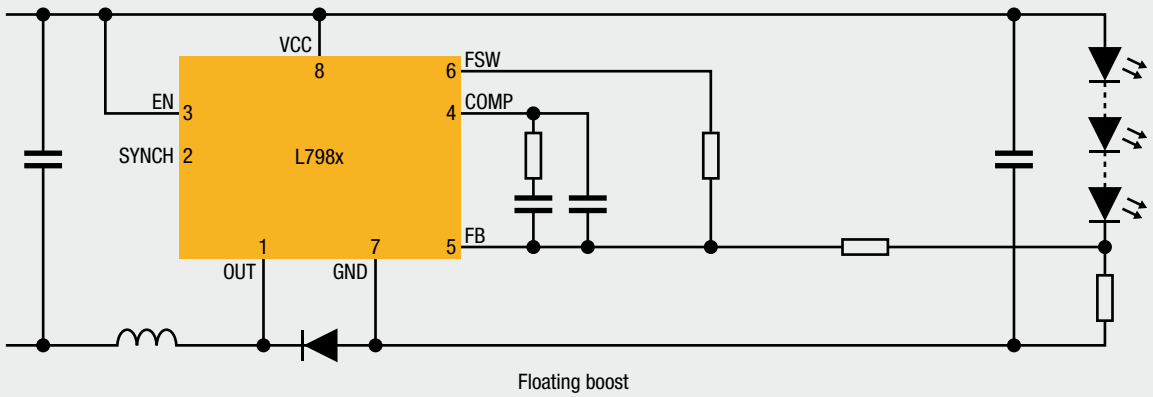
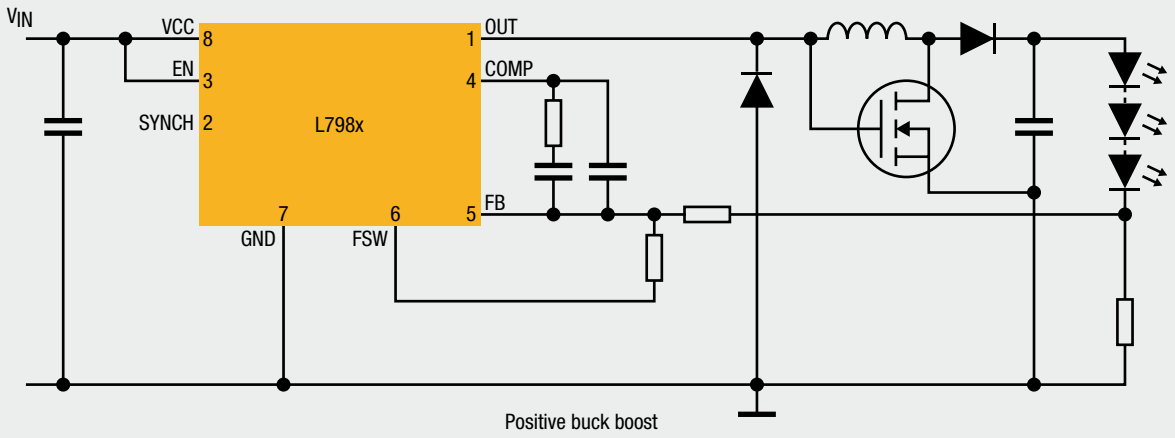
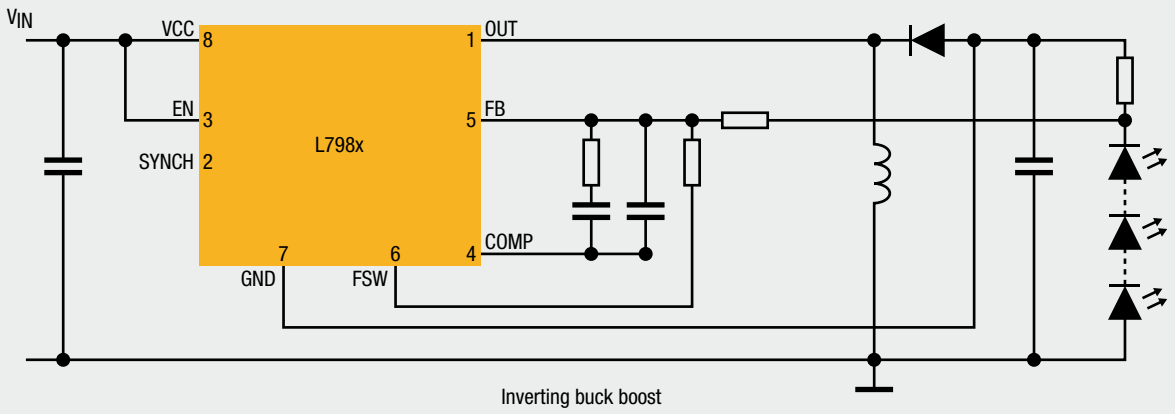
Key benefits

- Monolithic and flexible solution
- Wide input voltage range compatible with MR16 standard
- High efficiency
- Minimum external component count
- Suitable for MLCC output filter

Application example for MR16 LED retrofit



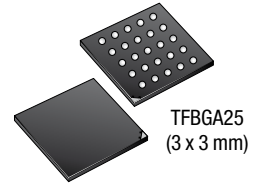
Application example



Buck-boost converters

STCF04

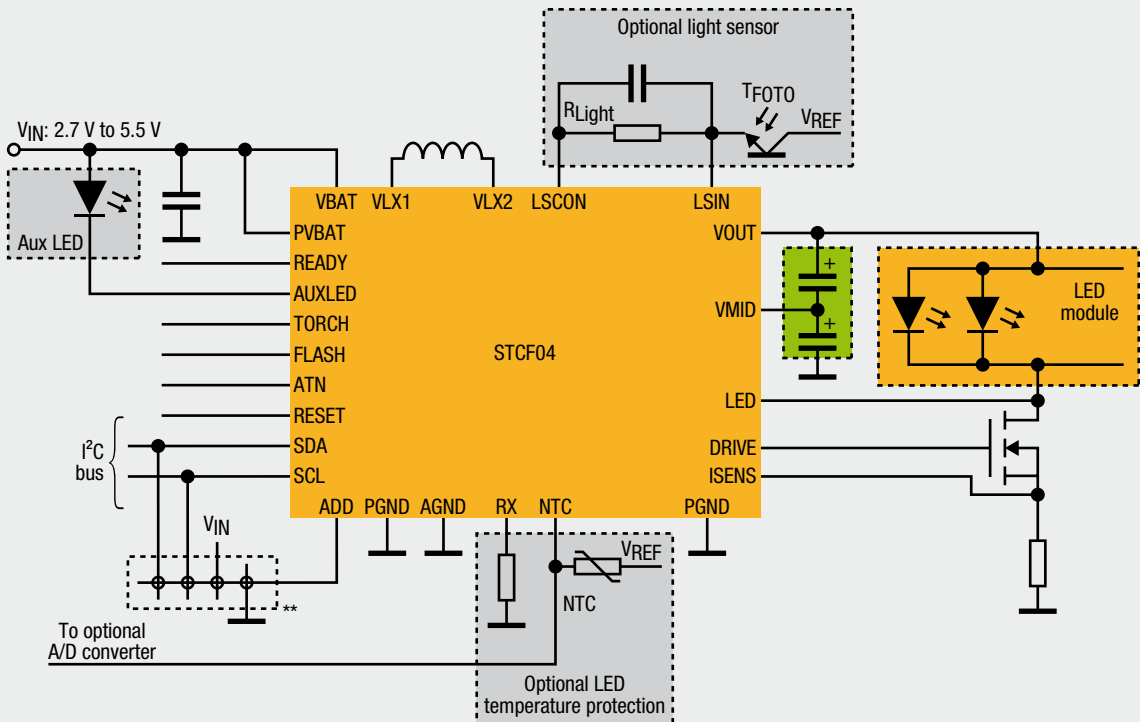
The STCF04 is a dedicated and space-optimized high-efficiency solution for driving a LED flash module in camera phones, PDAs and other handheld devices using the SuperCap technology. It is based on a DC-DC buck-boost converter, which ensures correct and efficient charging control and monitoring of the 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

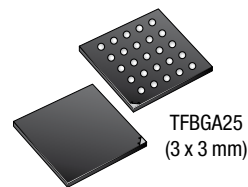
Application example



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.

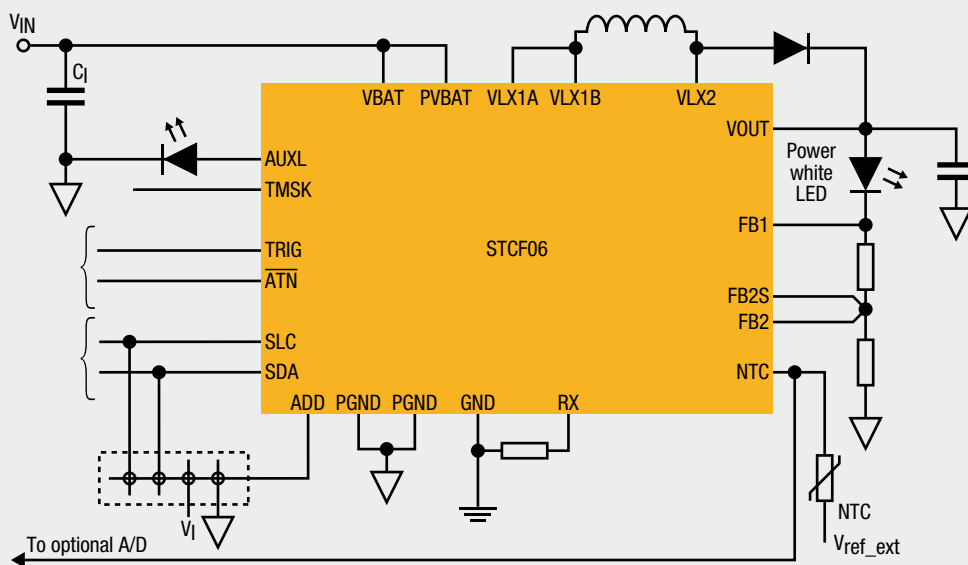
All the functions of the device are controlled through the I²C bus which helps to reduce logic pins on the package and to save PCB tracks on the board.




Key features

- 1.8 MHz fixed frequency PWM control
- Efficiency up to 80%
- Full I²C 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 μ A standby current

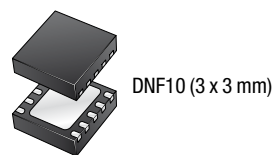
Application example



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

STBB1XX

The STBB1XX 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.



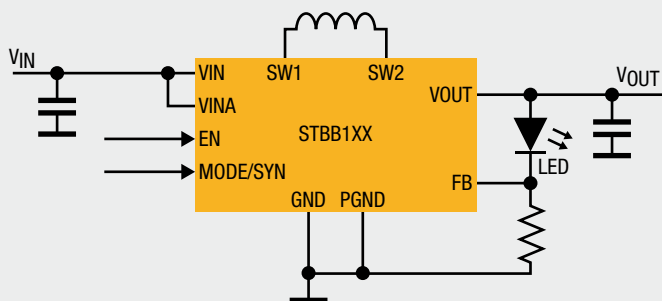
Key features

- 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 μ A

Key benefits

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

Application example



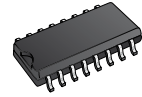
High-voltage converters

HVLED805

The HVLED805 is a high-voltage primary switcher intended for direct operation from the rectified mains with minimized external parts to provide an efficient, compact and cost-effective solution for LED driving. It combines a high-performance, low-voltage PWM controller chip and an 800 V, avalanche-rugged power MOSFET in the same package.

The PWM is a current-mode controller IC specifically designed for ZVS (zero voltage switching) flyback LED drivers, with constant output current (CC) regulation using primary sensing feedback. This eliminates the need for the optocoupler, the secondary voltage reference, and the current sense on the secondary side, still maintaining a good LED current accuracy. Moreover, it guarantees safe operation when a short circuit of one or more LEDs occurs.

In addition, the device can also provide a constant output voltage regulation (CV): it allows the application able to work safely when the LED string opens due to a failure.



S0-16N

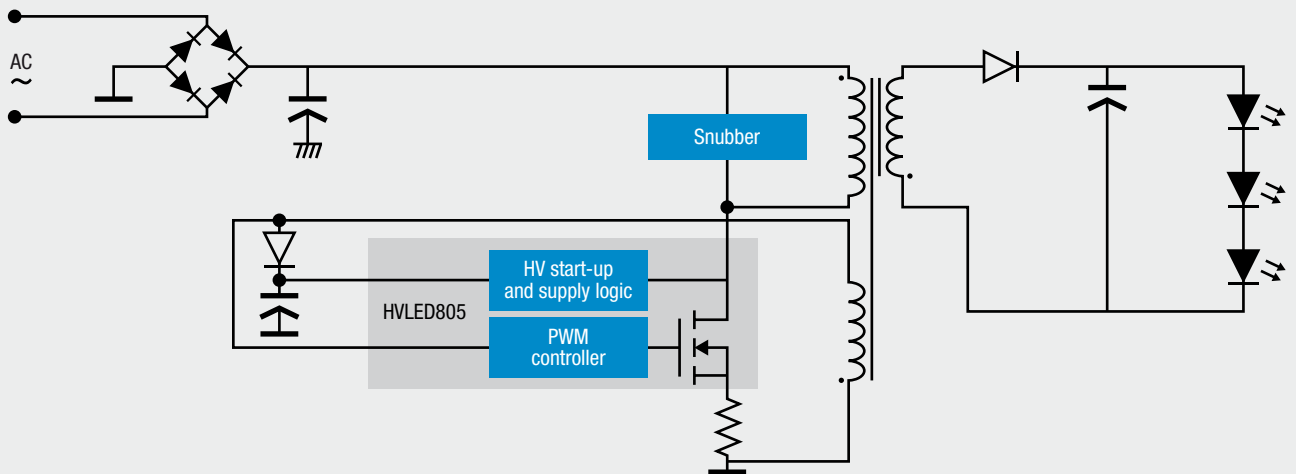
Key features

- 5% accuracy on constant LED output current with primary control
- Optocoupler not needed
- 800 V avalanche-rugged internal power MOSFET
- Quasi-resonant zero voltage switching (ZVS) operation
- Internal high-voltage start-up
- Safe against open or shorted LED string
- Automatic self supply
- Input voltage feed-forward for mains independent constant-current regulation

Key benefits

- Accurate primary current control avoids the use of secondary sensing, reducing costs and complexity
- Internal power MOSFET high-voltage start-up allows compact applications
- Zero voltage switching improves efficiency
- Reduced external part count allows very small form factors

Application example



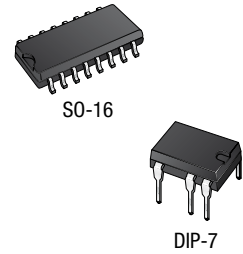
| Sales code | Board | Description | Technical documents |
|-----------------|-------|--|---------------------|
| EVALHVLED805 | | 4.2 W off-line LED driver with primary side regulation | |
| STEVAL-ILL037V1 | | 3.2 W LED power supply based on HVLED805 | |

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

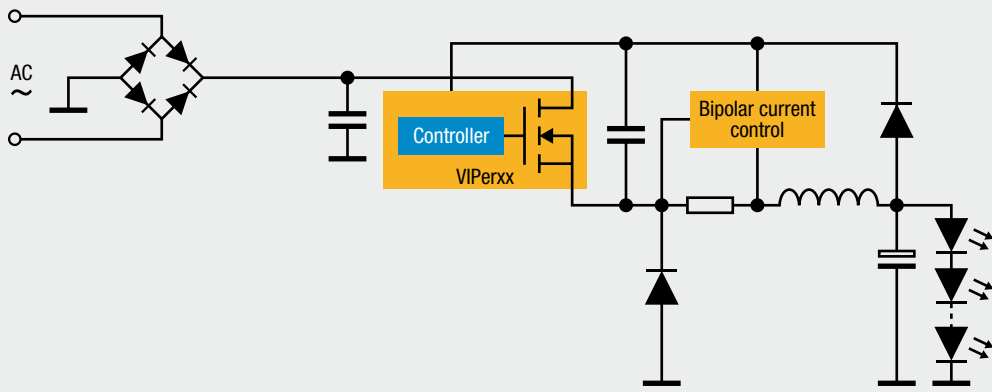
- 800 V avalanche-rugged power section
- PWM operation with fixed frequency and frequency jittering or QR control for valley switching operation
- Standby power < 50 mW at 265 Vac
- Hysteretic thermal shutdown
- HV startup
- Limiting current with adjustable set point
- Extra power timer for extra power capability

Key benefits

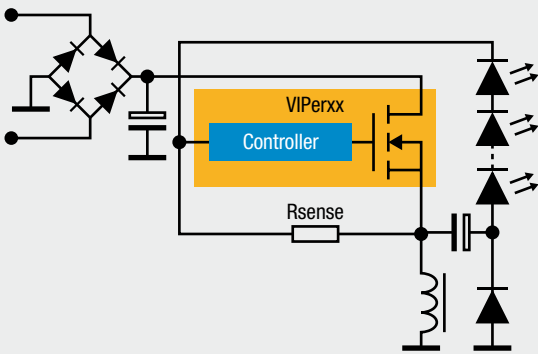
- Cost-effective solutions with minimum component count
- High robustness
- Advanced controllers and functionalities
- Easily meets all new energy regulations:
 - High efficiency
 - Minimum standby current
- Portfolio with high differentiation and continuous improvement
- Technical support by tools and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

| Sales code | Board | Description | Technical documents |
|-----------------|-------|---|---|
| STEVAL-ILL017V1 | | 3.5 W non-isolated offline constant-current LED driver based on VIPer17HN | AN2811: 3.5 W non-isolated offline constant-current LED driver based on VIPER17 |
| STEVAL-ILL026V1 | | 3 W non-isolated offline LED driver based on VIPer22AS-E | AN2961: STEVAL-ILL026V1 non-isolated 3 W offline LED driver based on the VIPER22A-E |
| EVLVIP27-7WLED | | 3.5 W non-isolated offline constant-current LED driver based on VIPer17HN | AN3212: 3.5 W to 7 W high power factor offline LED driver based on VIPer devices |

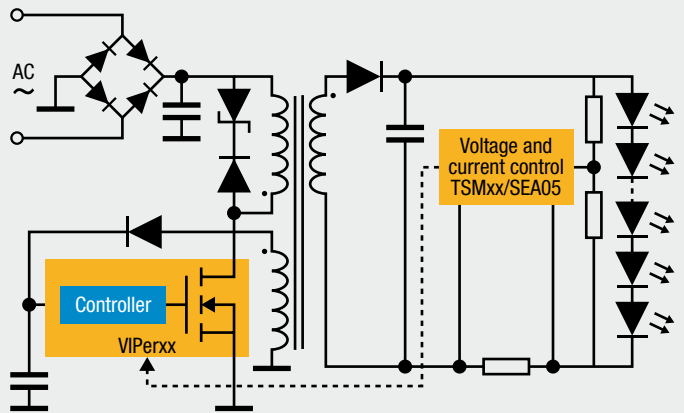
Application example



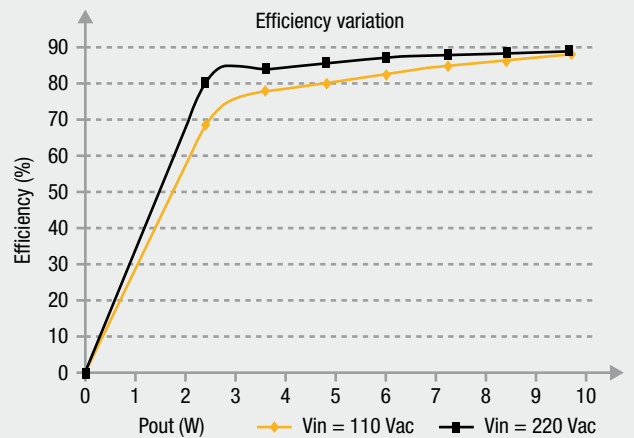
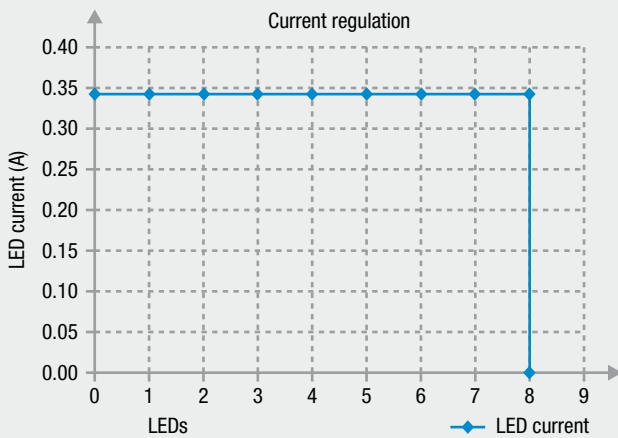
Application example: buck SMPS offline LED driver



Application example: buck-boost SMPS offline LED driver



Application example: flyback SMPS for offline LED driver



PFC controllers

L6562A/AT

The L6562A/AT 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% @ $T_j = 25\text{ }^\circ\text{C}$).

The device features extremely low consumption (60 μA 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.). In addition to the typical boost converter used as PFC front-end preregulator in dual-stage solutions, the L6562A/AT is suitable for modified buck converters, buck-boost converters and single-stage HPF flyback converters covering up to 100 W.



DIP-8



SO-8

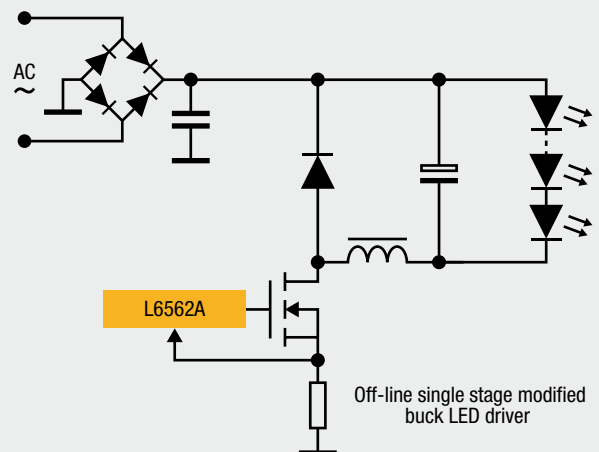
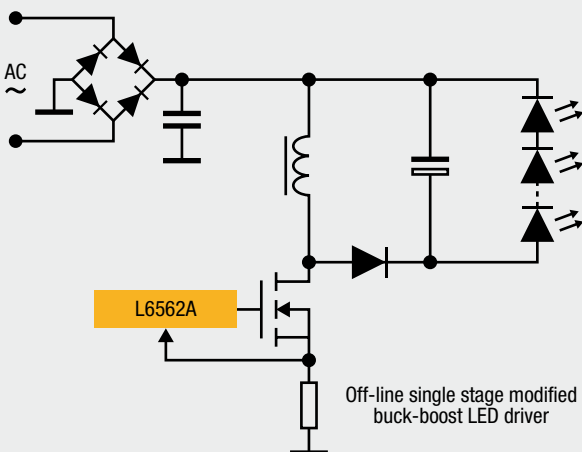
Key features

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

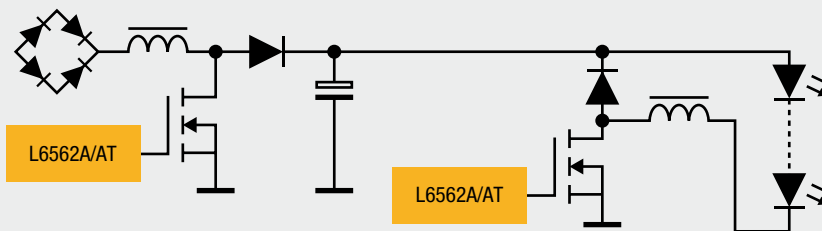
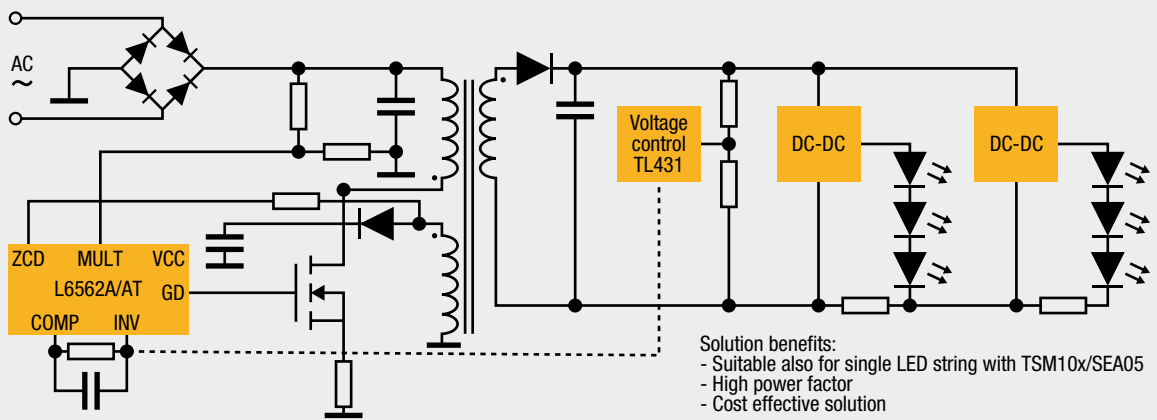
Key benefits

- 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







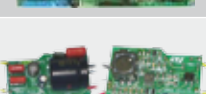
Application example



Application example



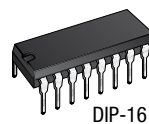
Application example: offline two stages solution, modified buck topology with PFC stage

| 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 AN2928: Modified buck converter for LED applications |
| STEVAL-ILL016V2 |  | 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 | AN2983: Constant current inverse buck LED driver using L6562A |
| 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-ILL027V2 |  | 18 W single-stage offline LED driver based on L6562A | AN3111: 18 W single-stage offline LED driver |
| STEVAL-ILL019V1 |  | 35 W offline LED driver for 4-channel high-brightness RGB LED based on L6562A | UM0926: STEVAL-ILL019V1 offline RRGB LED driver demonstration board with high PF |
| STEVAL-ILL034V1 |  | LED Driver for A 19 lamp based on L6562A (USA market) | AN3256: LED driver for A 19 lamp |

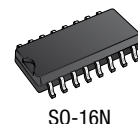
Resonant and quasi-resonant controllers

L6599A/AT

The L6599A/AT 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 deadtime inserted between the turn-off of one switch and the turn-on of the other one guarantees soft-switching and enables high-frequency operation.



DIP-16



SO-16N

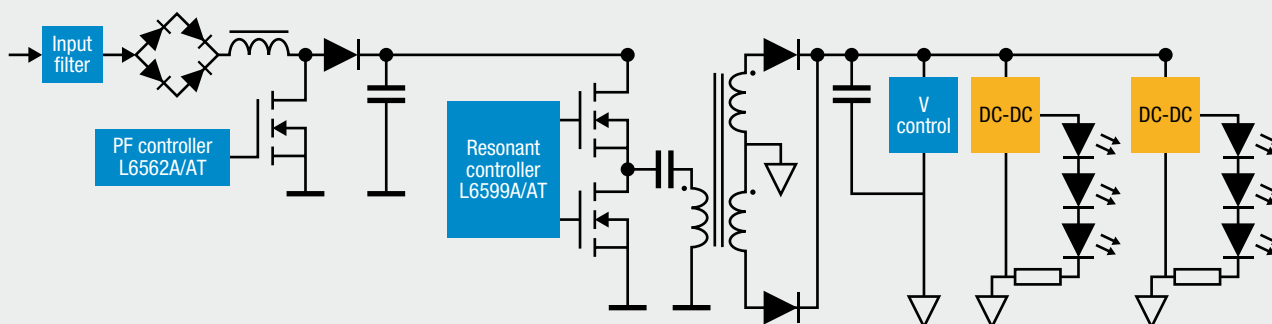
Key features

- 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-stages solution, LLC resonant half bridge with PFC stage

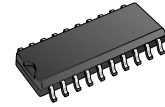
| Sales code | Board | Description | Technical documents |
|----------------|-------|---|---|
| EVL130W-SL-EU | | 48 V - 130 W LED street lighting SMPS based on L6562AT and L6599AT for European input mains range | AN3105: 48 V - 130 W high efficiency converter with PFC for LED street lighting applications - European version |
| EVL130W-STRLIG | | 48 V - 130 W LED street lighting SMPS based on L6562AT and L6599AT for wide input mains range | AN3106: 48 V - 130 W high-efficiency converter with PFC for LED street lighting applications |

L6585DE

The L6585DE integrates all the functions required to ensure correct operation of electronic ballasts and high-brightness LED power supplies. This combo IC generates more light from less energy, and is compliant with major safety and power consumption regulations.

The L6585DE one-chip solution replaces two separate ICs (a PFC and a resonant half bridge controller), greatly reducing design time and complexity, lowering costs and providing a flexible solution.

High programmability and a wide range of protection features help customers design cost-effective and reliable applications.



S0-20

Key features

PFC section

- Transition mode PFC with overcurrent and overvoltage protection
- Feedback disconnection and choke saturation detection
- Undervoltage lockout
- Wide-range mains operation with THD always below 10%
- High current capability drivers (300 mA source and 600 mA sink)

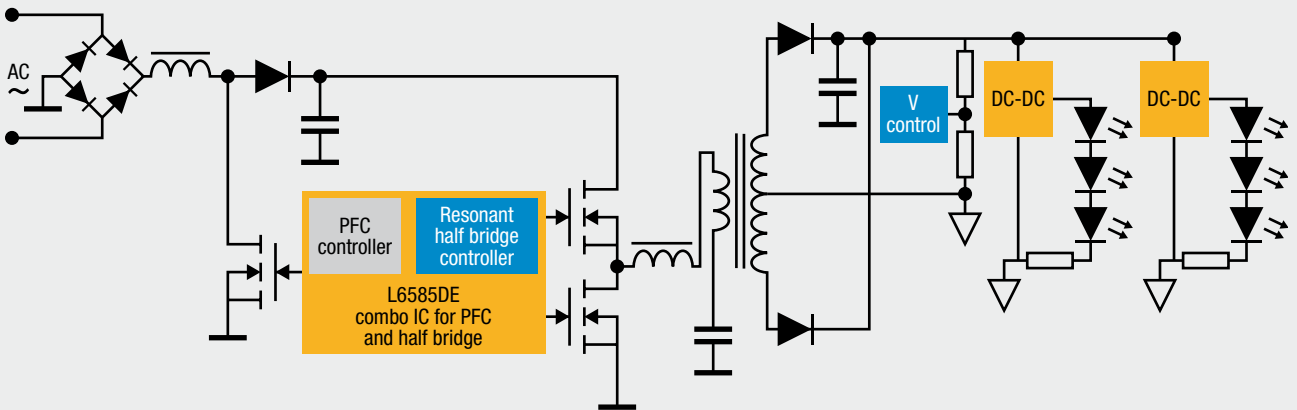
Half bridge section

- 3% oscillator precision
- 1.2 μ s deadtime
- Smart hard switching detection
- High current capability drivers (290 mA source and 480 mA sink)
- Overcurrent control

Key benefits

- One-chip solution for double-stage SMPS topology
- Suitable for high-efficiency and small form factor LED SMPS with very high output power
- Design flexibility
- Maximized SMPS reliability

Application example



Microcontrollers

STM8

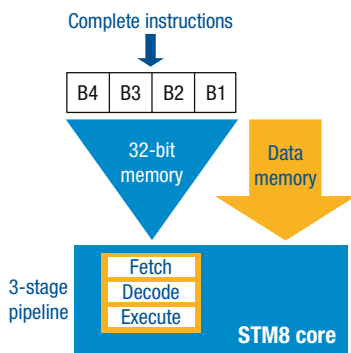
The STM8 is a platform of technologies, IPs and tools which forms the basis of STMicroelectronics' comprehensive family of 8-bit microcontrollers. These cover a wide range of applications from low-power and consumer electronics, through home appliances and factory automation to automotive segments.

The platform provides outstanding levels of digital and analog performance combined with a high level of cost effectiveness.

Implemented around a high-performance 8-bit core and a state-of-the-art set of peripherals, the microcontrollers in the STM8 family are manufactured using an ST-proprietary 130 nm embedded non-volatile memory technology.

STM8 core

The STM8 core is an evolution of the industry-standard ST7 core. It has been significantly improved to reach 1.6 cycles per instruction and up to 24 MHz clock frequency.



The key features of the STM8 core are:

- Harvard architecture
- 16-bit index registers and stack pointer
- 32-bit memory interface and 3-stage pipeline
- Extended instruction set
- Enhanced stack pointer operations
- Move instruction for fast data transfer
- Hardware division (16 / 8)
- Faster multiplication (8 x 8)
- 8-bit signed arithmetic support
- Advanced addressing modes including indexed addressing
- Statistically optimized instruction tables
- Dedicated firmware library for DALI (Digital Addressable Lighting Interface) to allow energy saving, comfort, advanced and remote control for modern lighting applications

STM8S MCU family for industrial applications

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.

STM8L ultra-low-power MCU family

STMicroelectronics proposes an ultra-low-power family of MCUs based on the 8-bit and 32-bit cores. The STM8L MCU family, based on the STM8 proprietary core, is the entry point of the platform.

The STM8L family combines high performance and ultra-low power consumption using a new proprietary ultra-low leakage process and optimized architecture. This family is declined in three different lines, making the STM8L an optimal family to support many applications with special care on power savings.

The STM8L101 is the entry point for the ultra-low-power 8-bit portfolio. It is cost optimized and offers a high level of integration in an ultra-small footprint. The STM8L151 is the feature-rich 8-bit solution. The STM8L152 has an additional segment LCD driver compared to the STM8L151.

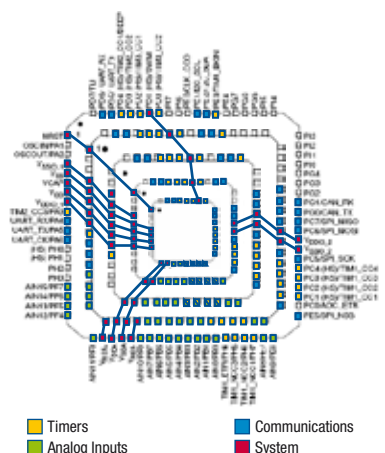
STM8A automotive MCU family

This product line of 8-bit Flash microcontrollers responds to the specific needs of automotive applications. From product specifications, on through design and manufacturing, the focus is on reliability, application robustness and low system cost. The integrated true data EEPROM features top notch endurance and data retention throughout the full temperature range. With its extended temperature range up to 150 °C ambient temperature, the STM8A is the ideal and economic solution for the growing market of automotive 8-bit applications.

Tools for everyone

The ecosystem of advanced STM8 tools is a scalable offer to satisfy all needs. From free-of-charge software tools, including free compiler licenses, to low-cost starter kits and affordable evaluation boards for multiple applications, ST tools and support open the door to the ST microcontroller universe.

ST's fully tested, optimized and validated downloadable source-code libraries are immediately available for new application development.



STM8S product lines


Common core peripherals and architecture:

| |
|---|
| UART LIN/smartcard/IrDA |
| µC 400 kHz multimaster |
| SPI 10 MHz |
| Up to 3x 16-bit timer 8-bit timer |
| 2x watchdogs (WDG and WWDG) |
| AWU beeper 1/2/4 kHz |
| 10-bit ADC Up to 16 channels |
| Xtal 16 MHz and 128 kHz internal RC oscillators |
| SWIM debug module |


STM8S903x Application specific line

| | | | | | | |
|--|------------------|-----------------|---------------------|----------------------|----------------------|---------------|
|  STM8 core @ 16 MHz | 8-Kbyte Flash | 1-Kbyte SRAM | 640-bytes EEPROM | 7 analog channels | Voltage reference | Timer sync |
|--|------------------|-----------------|---------------------|----------------------|----------------------|---------------|


STM8S20x Performance line

| | | | | | |
|--|-----------------------------|--------------------------|----------------------------|----------|----------|
|  STM8 core @ 24 MHz | Up to 128-Kbyte Flash | Up to 6-Kbyte SRAM | Up to 2-Kbyte EEPROM | CAN 2.0B | 2nd UART |
|--|-----------------------------|--------------------------|----------------------------|----------|----------|

STM8S10x Access line

| | | | |
|--|----------------------------|--------------------------|----------------------------|
|  STM8 core @ 16 MHz | Up to 32-Kbyte Flash | Up to 2-Kbyte SRAM | Up to 1-Kbyte EEPROM |
|--|----------------------------|--------------------------|----------------------------|

STM8S10x Access line*

| | | |
|--|----------------------------|-----------------|
|  STM8 core @ 16 MHz | Up to 64-Kbyte Flash | 1-Kbyte SRAM |
|--|----------------------------|-----------------|

Note: *Available in Q2/2011

STM8L product lines

Common core peripherals and architecture:

| |
|---|
| Communication peripherals USART, SPI, µC |
| Multiple 16-bit timer |
| Internal 16 MHz and 38 kHz RC oscillators |
| Watchdog (dual watchdogs on STM8L15x/16x) |
| Reset circuitry POR/PDR |
| 2x comparators |


STM8L162

| | | | | | | | | | | | |
|--|----------------------------|--------------------------|-----------------------|--------------------------------|----------------|----------------------------|-----|--------------------------------------|---------------|-------------|----------------|
|  STM8 core @ 16 MHz | Up to 64-Kbyte Flash | Up to 4-Kbyte SRAM | Reset + BOR PVD | Main osc. input 1-16 MHz | Data EEPROM | RTC with 32 kHz osc. | DMA | 12-bit ADC (1 µs) Temp. sensor | 12-bit DAC | LCD 8x40 | AES 128-bit |
|--|----------------------------|--------------------------|-----------------------|--------------------------------|----------------|----------------------------|-----|--------------------------------------|---------------|-------------|----------------|

STM8L152

| | | | | | | | | | | |
|--|----------------------------|--------------------------|-----------------------|--------------------------------|----------------|----------------------------|-----|--------------------------------------|---------------|-------------|
|  STM8 core @ 16 MHz | Up to 64-Kbyte Flash | Up to 4-Kbyte SRAM | Reset + BOR PVD | Main osc. input 1-16 MHz | Data EEPROM | RTC with 32 kHz osc. | DMA | 12-bit ADC (1 µs) Temp. sensor | 12-bit DAC | LCD 8x40 |
|--|----------------------------|--------------------------|-----------------------|--------------------------------|----------------|----------------------------|-----|--------------------------------------|---------------|-------------|

STM8L151

| | | | | | | | | | |
|--|----------------------------|--------------------------|-----------------------|--------------------------------|---------------------------------|----------------------------|-----|--------------------------------------|---------------|
|  STM8 core @ 16 MHz | Up to 64-Kbyte Flash | Up to 4-Kbyte SRAM | Reset + BOR PVD | Main osc. input 1-16 MHz | Up to 2-Kbyte Data EEPROM | RTC with 32 kHz osc. | DMA | 12-bit ADC (1 µs) Temp. sensor | 12-bit DAC |
|--|----------------------------|--------------------------|-----------------------|--------------------------------|---------------------------------|----------------------------|-----|--------------------------------------|---------------|

STM8L101

| | | |
|--|----------------------------|----------------------------|
|  STM8 core @ 16 MHz | Up to 8-Kbyte Flash* | Up to 1.5-Kbyte SRAM |
|--|----------------------------|----------------------------|

Abbreviations:

BOR: Brown-out reset
Osc.: Oscillator

POR: Power-on reset
PDR: Power-down reset


PVD: Programmable voltage detector
RTC: Real-time clock

STM8A product lines

Common core peripherals and architecture:

| |
|---|
| Up to 2x U(S)ART |
| µC 400 kHz multimaster |
| SPI 10 MHz |
| Up to 3x 16-bit timer 8-bit timer |
| 2x watchdogs (WDG and WWDG) |
| AWU Beeper 1/2/4 kHz |
| 10-bit ADC Up to 16 channel |
| Xtal 16 MHz and 128 kHz internal RC oscillators |
| SWIM debug module |

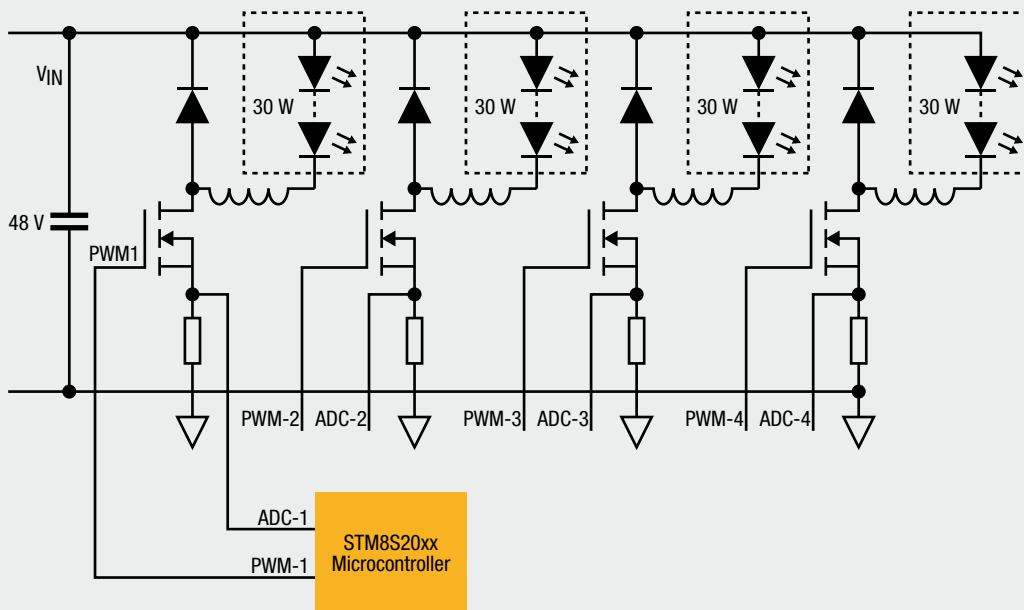
STM8AF62xx Standard line

| | | | |
|--|-----------------------------|--------------------------|----------------------------|
|  STM8 core up to 24 MHz | Up to 128-Kbyte Flash | Up to 6-Kbyte SRAM | Up to 2-Kbyte EEPROM |
|--|-----------------------------|--------------------------|----------------------------|

STM8AF52xx CAN line

| | | | | |
|--|-----------------------------|--------------------------|----------------------------|----------|
|  STM8 core up to 24 MHz | Up to 128-Kbyte Flash | Up to 6-Kbyte SRAM | Up to 2-Kbyte EEPROM | CAN 2.0B |
|--|-----------------------------|--------------------------|----------------------------|----------|

Digital constant current controller for multi-string LED driving based on STM8S





Demonstration board features

- Inverse buck topology
- LED string independent average current control
- Input DC bus voltage: 48 V
- System power: 120 W
- Switching frequency: 100 kHz
- Ripple current: <10%
- Global dimming from 0% to 100% at 225 Hz (PWM dimming)
- Independent linear dimming on 4 channels
- Short-circuit protection (short-to-ground and short-on-LED)
- Remote control interface (option)
- Suitable for LED street lighting and multicolor LED driving

Demonstration board key benefits

- Accurate LED average current control for long LED lifetime
- Ground referred power MOSFET, no gate driver need
- Low-voltage sensing circuit
- Can also work without an output capacitor
- Able to compensate V_f variation due to thermal issue
- High efficiency up to 98%
- No flicker
- Suitable for RGBW lights

| Sales code | Board | Description | Technical documents |
|-----------------|---|--|---|
| STEVAL-ILL031V1 |  | Digital constant current controller for LED driving based on STM8S208X | AN3151: Digital constant-current controller for LED applications based on STM8S208X |
| STEVAL-ILL031V2 |  | Strip of 10 LEDs for STEVAL-ILL031V1 | |

STM32

The STM32 family of 32-bit Flash microcontrollers based on the ARM Cortex™-M processor is designed to offer new degrees of freedom to MCU users. It brings 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 with its high level of feature integration, its easy-to-use architecture, its low-power capability and cost effectiveness.






The STM32 family helps you create new applications and design in the innovations you have long been dreaming about.

STMicroelectronics is a lead partner in developing Cortex-M cores and, with the STM32, offers a comprehensive portfolio of advanced MCUs that we are committed to extending in capability, competitive price range and features to cover the needs of microcontroller convergence.

Key benefits

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



| | | | | |
|--|--|--|--|---|
| <p>Real-time performance</p> <p>Cortex Intelligent Processors by ARM</p>  <p>Leading-edge architecture Excellent real-time behavior</p> | <p>Outstanding power efficiency</p>  <p>Sub μA RTC, low-voltage low-power modes</p> | <p>Superior and innovative peripherals</p>  <p>USB-OTG high speed, Ethernet, dual CAN, 12-bit ADC, advanced timers</p> | <p>Maximum integration</p>  <p>Reset circuitry, clocks, oscillators, PLL regulator, RTC, watchdog</p> | <p>Extensive tools and software</p>  <p>Various IDE, starter kits, libraries, RTOS and stacks</p> |
| <p>Future-proof design</p> | <p>Environment friendly, suits low-power operation</p> | <p>Address all your needs and beyond</p> | <p>Cost and space saving</p> | <p>More time for innovation</p> |



STM32 platform

More than 180 compatible devices

STM32 (cont'd)

STM32, a solid foundation for growth

The STM32 platform forms a solid foundation on which to build our portfolio. With new products addressing new applications, the complete STM32 product family now comprises three series, each dedicated to a specific segment.

More choice with STM32 series

- The general-purpose F-1 series addresses a wide range of applications, from the lowest price-sensitive designs to computing-intensive, high memory footprint ones.
- Get the highest performance with the F-2 series for computing-intensive applications and advanced connectivity. The F-2 series maintains compatibility with the F-1 series.
- Design ultra-low-power applications with the L-1 series for those who are power conscious and seek the absolute lowest energy consumption. The L-1 series maintains compatibility with the F-1 series.



Outstanding performance, up to 120 MHz
F-2 series
 Up to 120 MHz -150 DMIPS with ART Accelerator™
 Highest performance Cortex-M MCU
 Advanced features

General purpose
F-1 series
 Five families
 Ethernet USB OTG
 From 16-Kbyte up to 1-Mbyte Flash
 36 pins to 144 pins

Ultra-low power
L-1 series
 EnergyLite™ technology
 Ultra-low power consumption
 Up to 128-Kbyte Flash

STM32 product lines

Common core peripherals and architecture:

| |
|---|
| Communication peripherals: USART, SPI, I²C |
| Multiple general-purpose timers |
| Integrated reset and brown-out warning |
| Multiple DMA |
| 2x watchdogs Real-time clock |
| Integrated regulator PLL and clock circuit |
| External memory interface (FSMC) |
| Dual 12-bit DAC |
| Up to 3x 12-bit ADC (1 µs or 0.5 µs for F-2 series) |
| Main oscillator and 32 kHz oscillator |
| Low-speed and high-speed internal RC oscillators |
| -40 to +85 °C and up to 105 °C operating temperature range |
| Low voltage 2.0 to 3.6 V or 1.65 to 3.6 V (L-1 and F-2 series) 5.0 V tolerant I/Os |
| Temperature sensor |

F-2 series - STM32F207/217 and STM32F205/215

| | | | | | | | | |
|-----------------------|----------------------|---------------------|----------------------|------------------|-------------|-----------------------------------|--------------------|-------------------------------|
| 120 MHz Cortex-M3 CPU | Up to 128-Kbyte SRAM | Up to 1-Mbyte Flash | 2x USB 2.0 OTG FS/HS | 3-phase MC timer | 2x CAN 2.0B | SDIO 2x I²S audio Camera IF | Ethernet IEEE 1588 | Crypto/hash processor and RNG |
|-----------------------|----------------------|---------------------|----------------------|------------------|-------------|-----------------------------------|--------------------|-------------------------------|

F-1 series - Connectivity line STM32F105/STM32F107

| | | | | | | | |
|----------------------|---------------------|-----------------------|----------------|------------------|-------------|--------------|--------------------|
| 72 MHz Cortex-M3 CPU | Up to 64-Kbyte SRAM | Up to 256-Kbyte Flash | USB 2.0 OTG FS | 3-phase MC timer | 2x CAN 2.0B | 2x I²S audio | Ethernet IEEE 1588 |
|----------------------|---------------------|-----------------------|----------------|------------------|-------------|--------------|--------------------|

F-1 series - Performance line STM32F103

| | | | | | | |
|----------------------|---------------------|---------------------|---------------|------------------|----------|----------------|
| 72 MHz Cortex-M3 CPU | Up to 96-Kbyte SRAM | Up to 1-Mbyte Flash | USB FS device | 3-phase MC timer | CAN 2.0B | SDIO 2x I²S |
|----------------------|---------------------|---------------------|---------------|------------------|----------|----------------|

F-1 series - USB Access line STM32F102

| | | | |
|----------------------|---------------------|-----------------------|---------------|
| 48 MHz Cortex-M3 CPU | Up to 16-Kbyte SRAM | Up to 128-Kbyte Flash | USB FS device |
|----------------------|---------------------|-----------------------|---------------|

F-1 series - Access line STM32F101

| | | |
|----------------------|---------------------|---------------------|
| 36 MHz Cortex-M3 CPU | Up to 80-Kbyte SRAM | Up to 1-Mbyte Flash |
|----------------------|---------------------|---------------------|

F-1 series - Value line STM32F100

| | | | | |
|----------------------|---------------------|-----------------------|------------------|-----|
| 24 MHz Cortex-M3 CPU | Up to 32-Kbyte SRAM | Up to 512-Kbyte Flash | 3-phase MC timer | CEC |
|----------------------|---------------------|-----------------------|------------------|-----|

L-1 series - STM32L151/2

| | | | | | | | |
|----------------------|---------------------|-----------------------|---------------|----------------------|----------|------------|---------------------|
| 32 MHz Cortex-M3 CPU | Up to 16-Kbyte SRAM | Up to 128-Kbyte Flash | USB FS device | Data EEPROM 4 Kbytes | LCD 8x40 | Comparator | BOR MSI VScal |
|----------------------|---------------------|-----------------------|---------------|----------------------|----------|------------|---------------------|

Abbreviations:
 FS: Full speed
 HS: High speed

MC: Motor control
 MSI: Multi-speed internal oscillator
 RNG: Random number generator

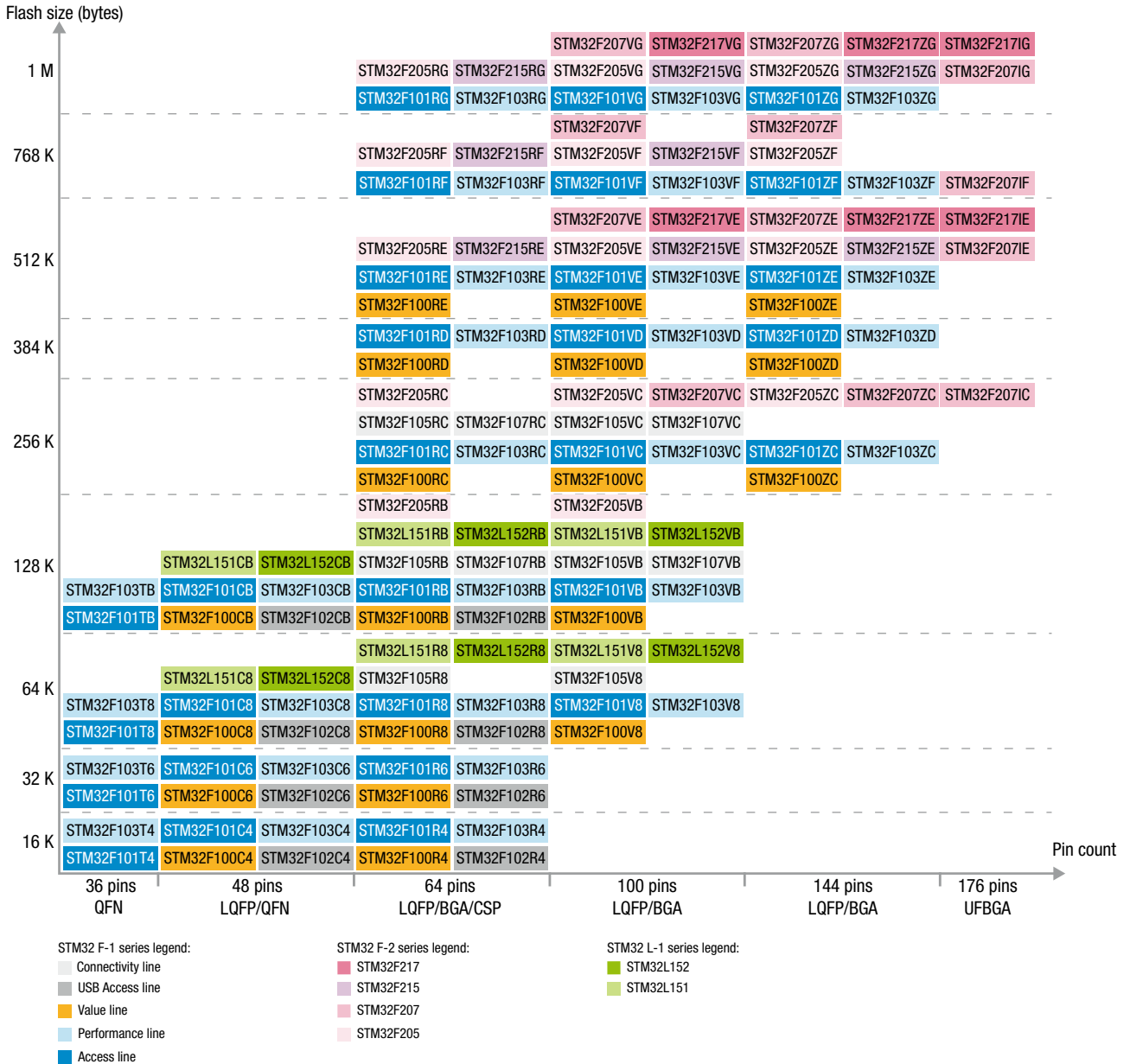
SDIO: Secure digital input/output
 VScal: Voltage scaling

STM32, the optimal platform choice

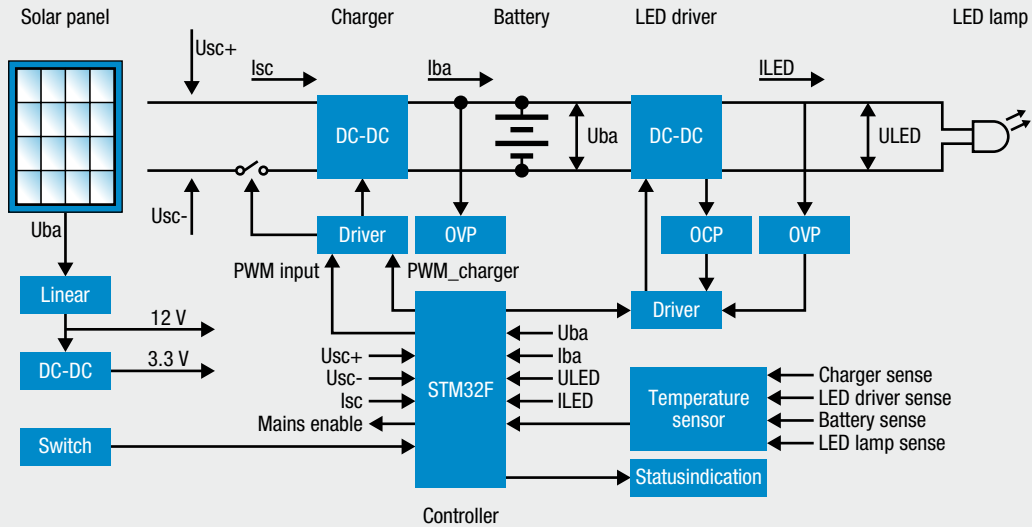
The STM32 is the optimal choice to support many applications with the same platform.

All product lines in the three series are pin-to-pin and software compatible, making it easy to upgrade to higher or downgrade to lower memory size. Numerous applications may be addressed using the sole STM32 platform.

STM32 portfolio



25 W LED street light with 80 W solar energy charger based on STM32




Demonstration board features

- Maximum power point tracker (MPPT) for more efficient energy use
- Automatic day/night detection
- Automatic battery/mains switchover
- Constant-current control for LED lamp
- Battery charge control with temperature monitoring
- Easy system monitoring via debug indicators

Demonstration board key benefits

- Flexible solution
- Full protection function for battery, LED lamp and solar panel
- High efficiency

| Sales code | Board | Description | Technical documents |
|-----------------|---|--|---|
| STEVAL-ILL022V1 |  | 25 W LED streetlight with 80 W solar-energy charger based on STM32 | <p>AN2946: Solar-LED streetlight controller with 25 W LED lamp driver and 85 W battery charger based on the STM32F101Rx</p> <p>UM0512: STEVAL-ILL022V1 solar-LED streetlight controller with 25 W LED lamp driver and 80 W battery charger based on the STM32F101Rx</p> |

Product selection guide

LED array drivers

| Part number | Description | I/O | V _{DD} (V) | Bit-to-bit accuracy (+/- %) | I _{OUT} (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 |
| STP16CPS05 | 16-bit constant-current LED driver with auto-power saving | Serial in/parallel out | 3.0 to 5.5 | 1.5 | 5 to 100 |
| STP16DPS05 | 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 | 1 | 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 | 1 | 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 | 1 | 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 | 1 | 3 to 40 |
| STP1612PW05 | 16-channel LED driver with 16-bit PWM, 8-bit gain and full LED error detection | Serial in/parallel out | 3.0 to 5.5 | 1.5 | 3 to 60 |
| 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 _{OUT} (mA) | Rows | V _{IN} (V) | V _{OUT} (V) | LEDs (white) | F _{sw} (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 |
| LED7708 | 16-channel 85 mA LED driver with boost controller, 12/16-bit gray-scale and 4-wire serial interface | up to 85 | 16 | 4.5 to 36 | Up to 100 | 320 | 250 to 1000 | VFQFPN 7x7-48 | PWM group dim, local dim, sync, adj OVP and OCP, fault management |
| L6920D | High-efficiency synchronous step-up converter | 0.8 (lpk) | 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 (lpk) | 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 ² C interface | 400 | 1 | 2.5 to 5.5 | Vbat to 10.2 | 2 | 1800 | TFBGA3x3-25L | Flash mode, torch mode, dim, fault management |
| STLDC08 | Step-up controller for LED supply | N.A. | 1 | 0.8 to 3.6 | 20 | 5 | N.A. | DFN10L3x3 | En/PWM |

Buck converters

| Part number | Description | I _{OUT} (A) | V _{IN} (V) | V _{OUT} (V) | LEDs (white) | F _{sw} (kHz) | Package | Extra functions |
|-------------|-------------------------------------|----------------------|---------------------|----------------------|--------------|-----------------------|------------|------------------|
| L4976 | 1 A step-down switching regulator | 1 | 8 to 55 | up to Vin | 15 | Up to 300 | DIP8/SO16W | Vref |
| L4971 | 1.5 A step-down switching regulator | 1.5 | 8 to 55 | up to Vin | 15 | Up to 300 | DIP8/SO16W | INH |
| L4978 | 2 A step-down switching regulator | 2 | 8 to 55 | up to Vin | 15 | Up to 300 | DIP8/SO16W | INH |
| L4973 | 3.5 A step-down switching regulator | 3.5 | 8 to 55 | up to Vin | 15 | Up to 300 | DIP18/SO20 | Vref, INH, sync |
| L5970D | 1 A step-down switching regulator | 1 | 4 to 36 | up to Vin | 9 | 250 | SO8 | Vref, INH, sync |
| L5970AD | 1 A step-down switching regulator | 1 | 4 to 36 | up to Vin | 9 | 500 | SO8 | Vref, INH, sync |
| L5972D | 1.5 A step-down switching regulator | 1.5 | 4 to 36 | up to Vin | 9 | 250 | SO8 | - |
| L5973AD | 1.5 A step-down switching regulator | 1.5 | 4 to 36 | up to Vin | 9 | 500 | HSOP8 | Vref, INH, sync |
| L5973D | 2 A step-down switching regulator | 2 | 4 to 36 | up to Vin | 9 | 250 | HSOP8 | Vref, INH, sync |
| A5970D | 1 A step-down switching regulator | 1 | 4 to 36 | up to Vin | 9 | 250 | SO8 | Automotive grade |
| A5970AD | 1 A step-down switching regulator | 1 | 4 to 36 | up to Vin | 9 | 500 | SO8 | Automotive grade |
| A5972D | 1.5 A step-down switching regulator | 1.5 | 4 to 36 | up to Vin | 9 | 250 | SO8 | Automotive grade |
| A5973AD | 1.5 A step-down switching regulator | 1.5 | 4 to 36 | up to Vin | 9 | 500 | HSOP8 | Automotive grade |
| A5973D | 2 A step-down switching regulator | 2 | 4 to 36 | up to Vin | 9 | 250 | HSOP8 | Automotive grade |

Buck converters (cont'd)

| Part number | Description | I _{OUT} (A) | V _{IN} (V) | V _{OUT} (V) | LEDs (white) | F _{sw} (kHz) | Package | Extra functions |
|-------------|--|----------------------|---------------------|-------------------------------------|--------------|-----------------------|-------------------------------|----------------------------------|
| L5974D | 2.5 A step-down switching regulator | 2.5 | 4 to 36 | up to V _{IN} | 9 | 250 | S08 | Inhibit, Vref, Sync |
| L5974AD | 2 A step-down switching regulator | 2 | 4 to 36 | up to V _{IN} | 9 | 500 | S08 | Inhibit, Vref, Sync |
| A5974D | 2.5 A step-down switching regulator | 2.5 | 4 to 36 | up to V _{IN} | 9 | 250 | S08 | Automotive grade |
| A5974AD | 2 A step-down switching regulator | 2 | 4 to 36 | up to V _{IN} | 9 | 500 | S08 | Automotive grade |
| L5975D | 3 A step-down switching regulator | 3 | 4 to 36 | up to V _{IN} | 9 | 250 | S08 | Inhibit, Vref, Sync |
| L5975AD | 2.5 A step-down switching regulator | 2.5 | 4 to 36 | up to V _{IN} | 9 | 500 | S08 | Inhibit, Vref, Sync |
| A5975D | 3 A step-down switching regulator | 3 | 4 to 36 | up to V _{IN} | 9 | 250 | S08 | Automotive grade |
| A5975AD | 2.5 A step-down switching regulator | 2.5 | 4 to 36 | up to V _{IN} | 9 | 500 | S08 | Automotive grade |
| L6902D | Step-down switching regulator with adjustable current limit up to 1 A | 1 | 8 to 36 | up to V _{IN} | 9 | 250 | S08 | Vref, CC/CV mode |
| L5980 | 0.7 A step-down switching regulator | 0.7 | 2.9 to 18 | up to V _{IN} | 4 | Up to 1000 | QFN3x3-8L | Adj F _{sw} , INH, sync |
| L5981 | 1 A step-down switching regulator | 1 | 2.9 to 18 | up to V _{IN} | 4 | Up to 1000 | QFN3x3-8L | Adj F _{sw} , INH, sync |
| L5983 | 1.5 A step-down switching regulator | 1.5 | 2.9 to 18 | up to V _{IN} | 4 | Up to 1000 | QFN3x3-8L | Adj FF _{sw} , INH, sync |
| L5985 | 2 A step-down switching regulator | 2 | 2.9 to 18 | up to V _{IN} | 4 | Up to 1000 | QFN3x3-8L | Adj F _{sw} , INH, sync |
| L5986/A | 2.5 A step-down switching regulator | 2.5 | 2.9 to 18 | up to V _{IN} | 4 | Up to 1000 | QFN3x3-8L/HSOP8 | Adj F _{sw} , INH, sync |
| L5987/A | 3 A step-down switching regulator | 3 | 2.9 to 18 | up to V _{IN} | 4 | Up to 1000 | QFN3x3-8L/HSOP8 | Adj F _{sw} , INH, sync |
| L6925D | 800 mA step-down synchronous switching regulator | 0.8 | 2.7 to 5.5 | up to V _{IN} | 1 | 600 | MSOP8 | LBI and LBO |
| L6926 | 800 mA step-down synchronous switching regulator | 0.8 | 2 to 5.5 | up to V _{IN} | 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 _{IN} | 1 | 1400 | QFN3x3-8L/MSOP8 | Pgood, run, sync |
| L7980 | 2 A step-down switching regulator | 2 | 4.5 to 28 | up to V _{IN} | 7 | 250 to 1000 | VFQFPN8 3x3/HSOP8 exposed pad | En, sync, SS, OCP, OTP |
| L7981 | 3 A step-down switching regulator | 3 | 4.5 to 28 | up to V _{IN} | 7 | 250 to 1000 | VFQFPN8 3x3/HSOP8 exposed pad | En, sync, SS, OCP, OTP |
| ST1CC40 | 3 A, 900 KHz, monolithic synchronous step-down constant current LED driver | 3 | 3 to 18 | up to V _{IN} | 4 | 900 | DFN4x4-8L | Dimming, OCP, OTP |
| 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 _{IN} - V _{DROP} | 9 | - | S08 | Dimming, diagnostics, EN |
| STCS05A | 0.5 A max constant current LED driver | 0.5 | 4.5 to 40 | V _{IN} - V _{DROP} | 9 | - | S08 | Dimming, diagnostics, EN |
| STCS1 | 1.5 A max constant-current LED driver | 1.5 | 4.5 to 40 | V _{IN} - V _{DROP} | 9 | - | DFN3x3-8L/HSOP8 | Dimming, diagnostics, EN |
| STCS1A | 1.5 A max constant-current LED driver | 1.5 | 4.5 to 40 | V _{IN} - V _{DROP} | 9 | - | DFN3x3-8L/HSOP8 | Dimming, diagnostics, EN |
| STCS2 | 2 A max constant-current LED driver | 2 | 4.5 to 40 | V _{IN} - V _{DROP} | 9 | - | PowerSO-10 | Dimming, diagnostics, EN |
| STCS2A | 2 A max constant-current LED driver | 2 | 4.5 to 40 | V _{IN} - V _{DROP} | 9 | - | PowerSO-10 | Dimming, diagnostics, EN |

Buck-boost converters

| Part number | Description | I _{OUT} (A) | Rows | V _{IN} (V) | V _{OUT} (V) | LEDs (white) | F _{sw} (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 ² 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 |
| STCF031 | High-power white LED driver with I ² 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 ² 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 ² 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, |

High-voltage converters

| Part number | Package | Power capability max (wide range input) (W) | Drain source voltage min (V) | V _{DD} | | R _{DS(on)} (Ω) | F _{sw, typ} (kHz) | Extra functions |
|---------------|---------|---|------------------------------|-----------------|-----------------------|-------------------------|----------------------------|---------------------------------------|
| | | | | min (V) | max (V) | | | |
| HVLED805 | S016N | 7 | 800 (avalanche rugged) | 11.5 | 23.5 | 11 | 166 | ZVS, PWM current mode, burst mode |
| 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 |
| VIPER17HN | DIP-7 | 7 | 800 (avalanche rugged) | 8.5 | 23.5 (in missing) | 20 | 115 | PWM current limiting mode, burst mode |

High-voltage converters (cont'd)

| Part number | Package | Power capability max (wide range input) (W) | Drain source voltage min (V) | V_{DD} | | $R_{DS(on)}$ (Ω) | F_{sw} typ (kHz) | Extra functions |
|-------------|--------------|---|------------------------------|-----------------------------|-----------------------|---------------------------|--------------------|--|
| | | | | min (V) | max (V) | | | |
| 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 |
| VIPER15L | SO16N, DIP-7 | 7 | 800 (avalanche rugged) | 8.5 | 23.5 (internal clamp) | 20 | 136 | ZCD, PWM current limiting mode, burst mode |
| VIPER15H | SO16N, DIP-7 | 7 | 800 (avalanche rugged) | 8.5 | 23.5 (internal clamp) | 20 | 225 | ZCD, PWM current limiting mode, burst mode |
| VIPER25L | SO16N, DIP-7 | 13 | 800 (avalanche rugged) | 8.5 | 23.5 (internal clamp) | 7 | 136 | ZCD, PWM current limiting mode, burst mode |
| VIPER25H | SO16N, DIP-7 | 13 | 800 (avalanche rugged) | 8.5 | 23.5 (internal clamp) | 7 | 225 | ZCD, PWM current limiting mode, burst mode |
| VIPER26L | SO16N, DIP-7 | 13 | 800 (avalanche rugged) | 11.5 | 23.5 (internal clamp) | 7 | 60 | PWM current limiting mode, burst mode |
| VIPER26H | SO16N, DIP-7 | 13 | 800 (avalanche rugged) | 11.5 | 23.5 (internal clamp) | 7 | 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, buck, flyback | Yes | 10.3 to 22 | 3.5 | 0.6 / 0.8 | 200 |
| L6562A | DIP-8, SO-8 | Enhanced TM power factor corrector | Boost, buck, 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, buck, 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) | Supply 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 |
| L6585DE | SO-20 | Combo IC for PFC and half-bridge ballast control | | | 11 to 16 | 300/600 ¹ 290/480 ² | | 7 | |




Note: 1. PFC
2. HB

















Power MOSFETs
















| Part number | V _{DSS} (V) | R _{DS(on)} (max) (Ω) | Package |
|--------------|----------------------|-------------------------------|---|
| STx90N4F3 | 40 | 0.0065 | DPAK/TO-220/IPAK |
| STx200N4F3 | 40 | 0.004 | D ² PAK/TO-220 |
| STx270N4F3 | 40 | 0.0025 | D ² PAK/TO-220 |
| STL70N4LLF5 | 40 | 0.0065 | PowerFLAT 5x6 |
| STL80N4LLF3 | 40 | 0.005 | PowerFLAT 5x6 |
| STL140N4LLF5 | 40 | 0.00275 | PowerFLAT 5x6 |
| STx3NF06L | 60 | 0.1 | SOT-223 |
| STS5NF60L | 60 | 0.055 | SO-8 |
| STS4DNF60L | 60 | 0.055 | SO-8 DUAL |
| STL28N8F3 | 80 | 0.05 | PowerFLAT 3.3 x 3.3 |
| STS4NF100 | 100 | 0.06 | SO-8 |
| STx19NF20 | 200 | 0.16 | TO-220/TO-220FP/D ² PAK |
| STx20NF20 | 200 | 0.125 | TO-220/TO-220FP/DPAK |
| STx16NF25 | 250 | 0.235 | TO-220/TO-220FP/DPAK |
| STx50NF25 | 250 | 0.069 | TO-220/D ² PAK |
| STQ3N45K3-AP | 450 | 3.8 | IPAK/SOT-223/T092 |
| STx8NM50N | 500 | 0.79 | DPAK/TO-220/TO-220FP |
| STx10NM50N | 500 | 0.63 | DPAK/TO-220/TO-220FP |
| STx11NM50N | 500 | 0.47 | DPAK/TO-220/TO-220FP |
| STx14NM50N | 500 | 0.32 | DPAK/D ² PAK |
| STx19NM50N | 500 | 0.25 | TO-220/TO-220FP |
| STx23NM50N | 500 | 0.19 | D ² PAK/TO-247/TO-220FP |
| STx28NM50N | 500 | 0.158 | D ² PAK/TO-247/TO-220FP |
| STx5N52K3 | 525 | 1.5 | D ² PAK/DPAK/TO-220FP/TO-220/IPAK |
| STx6N52K3 | 525 | 1.2 | DPAK/TO-220FP |
| STx7N52DK3 | 525 | 1.15 | DPAK/TO-220FP/TO-220 |
| STx7NM60N | 600 | 0.9 | DPAK/TO-220/TO-220FP |
| STx9NM60N | 600 | 0.7 | DPAK/TO-220/TO-220FP |
| STx10NM60N | 600 | 0.55 | DPAK/TO-220/TO-220FP |
| STx13NM60N | 600 | 0.36 | DPAK/TO-220/TO-220F |
| STx18NM60N | 600 | 0.285 | D ² PAK/TO-247/TO-220FP |
| STx22NM60N | 600 | 0.22 | D ² PAK/TO-247/TO-220FP |
| STx24NM60N | 600 | 0.19 | D ² PAK/TO-247/TO-220FP |
| STx26NM60N | 600 | 0.165 | D ² PAK/TO-247/TO-220FP |
| STx2N62K3 | 620 | 3.5 | |
| STx3N62K3 | 620 | 2.5 | D ² PAK/DPAK/TO-220FP/TO-220/IPAK |
| STx4N62K3 | 620 | 1.95 | DPAK/D ² PAK/TO-220FP/IPAK/TO-220/I ² PAK |
| STx5N62K3 | 620 | 1.6 | D ² PAK/DPAK/TO-220FP/TO-220/IPAK |
| STx6N62K3 | 620 | 1.2 | IPAK/DPAK/TO-220/TO-220FP |
| STx10N65K3 | 650 | 1 | TO-220FP |
| STx3NK80Z | 800 | 4.5 | TO-220/TO-220FP/DPAK/IPAK |
| STx5NK80Z | 800 | 2.4 | TO-220/TO-220FP |
| STx7NM80 | 800 | 1.05 | TO-220/TO-220FP/DPAK/IPAK |
| STx11NM80 | 800 | 0.4 | D ² PAK/TO-220/TO-220FP/TO-247 |
| STS3N95K3 | 925 | 6.3 | TO-220/TO-220FP/DPAK/IPAK |
| STx5N95K3 | 925 | 3.5 | TO-220/TO-220FP |
| STx7N95K3 | 925 | 1.35 | TO-220/TO-220FP/DPAK/IPAK |
| STx13N95K3 | 925 | 0.85 | D ² PAK/TO-220/TO-220FP/TO-247 |

Demonstration boards

| Sales code | Board | Description |
|-----------------|---|--|
| 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-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 |
| 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) |

| Sales code | Board | Description |
|-----------------|---|---|
| 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 |
| STEVAL-ILL026V1 |  | 3 W non-isolated offline LED driver based on VIPer22AS-E |
| STEVAL-ILL027V2 |  | 18 W single-stage offline LED driver based on L6562A |
| STEVAL-ILL028V1 |  | RGB LED driver for color displays and backlighting based on the STP1612PW05 and STM32 |
| STEVAL-ILL030V1 |  | LED lighting control using DMX512 control based on STM32F102C6T6 and STCS1APHR |
| STEVAL-ILL031V1 |  | Digital constant current controller for LED driving based on STM8S208X |
| STEVAL-ILL031V2 |  | Strip of 10 LEDs for STEVAL-ILL031V1 |
| STEVAL-ILL032V1 |  | Multicolor LED matrix demo based on STP24DP05BTR |

| Sales code | Board | Description |
|-----------------|---|---|
| STEVAL-ILL033V1 |  | Master/Slave Unit for Multicolor LED matrix demo based on STM32F103VET6 |
| STEVAL-ILL034V1 |  | LED Driver for A 19 lamp based on L6562A (USA market) |
| STEVAL-ILL035V1 |  | Multi-channel LED driver with integrated boost controller for medium/large LCD panel backlight based on LED7708 and STM32F103C6T6 |
| STEVAL-ILL036V1 |  | Multi-channel LED driver with external DC-DC feedback control for medium/large LCD panel backlights based on STP16PWL05 and STM32F103C6T6 |
| STEVAL-ILL037V1 |  | 3.2 W LED power supply based on HVLED805 |
| 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 ² 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 |

| Sales code | Board | Description |
|-----------------|---|---|
| EVAL5985 |  | Evaluation board for L5985: 2 A step-down switching regulator |
| EVAL6920D |  | L6920D 1 V high-efficiency synchronous step-up converter evaluation board |
| 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 |
| EVALHVLED805 |  | 4.2 W off-line LED driver with primary side regulation |
| EVL6562A-35WFLB |  | 35 W wide-range high power factor flyback converter using L6562A |
| EVL6562A-LED |  | Constant current inverse buck LED driver using the L6562A |
| EVLVIP27-7WLED |  | 3.5 W to 7 W high power factor offline LED driver bases on VIPer devices |
| EVL130W-SL-EU |  | 48 V - 130 W LED street lighting SMPS based on L6562AT and L6599AT for European input mains range |
| EVL130W-STRLIG |  | 48 V - 130 W LED street lighting SMPS based on L6562AT and L6599AT for wide input mains range |
| 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 |




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