Energy-efficient solutions for LED lighting

October 2009

www.st.com/lighting
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ST’s commitment to energy saving

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

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

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

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

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

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 and LED array drivers

- Input voltage [Vdc]
- LED current [mA]

- STPIC6x595
- STP08xP05
- STP24DP05
- STP16x
- ST1S10
- ST8R00
- STCSxx/A
- L597xD/AD
- L598xA
- L6902D
- L6920D/DB
- L497x
- STBB1
Offline LED drivers: 85 to 265 Vac input voltage

Non-isolated

- L6562A/AT/3H (PFC-boost converter)
- L6562A/AT (modified buck converter)
- L6562A/AT (modified buck converter)
- VIPer53-E (buck converter)
- VIPerX2A-E/X7 (flyback converter) + TSM10xx
- VIPerX2A-E/16 (buck converter)

Isolated

- L6562A/AT/3H (PFC-boost converter)
- L6599A/AT (resonant controller)
- DC-DC converter for each LED string
- L6562A/AT/3H (PFC-boost converter)
- L6565 (quasi-resonant controller)
- DC-DC converter for each LED string
- L6562A/AT/3H (HPF) + DC-DC converter for each LED string
- VIPer22A-E/25/27/53-E (flyback converter) + TSM10xx
- VIPer12A-E/15/17 (flyback converter) + TSM10xx
- L6562A/AT (PFC-boost converter)
- L6562A/AT (modified buck converter)
- L6562A/AT (modified buck converter)
- VIPer53-E (buck converter)
- VIPerX2A-E/16 (buck converter)
LED application segments

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

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

VIPerx2, VIPerx6, VIPerx7, L6562A/AT/3H, L6599A/AT, STP04CM05, ST1S10, STCSxx/A, L597x/A/AD, L598x/A, L497x, L6902D

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

STCF0x, LED770x, PM660x

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

STP08DP05, STP16x, STP24DP05

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

STP04CM05, STP08xP05, STP16x, STPIC6x595, STCSxx/A, LED770x, L597xD/AD, L598x/A, L497x, L6902D, A597x
LED array drivers

STP04CM05

The STP04CM05 is a high-power LED driver and 4-bit shift register designed for power LED applications. The STP04CM05 contains a 4-bit serial in, parallel out shift register that feeds a 4-bit D-type storage register. In the output stage, four regulated current sources are designed to provide 80 to 400 mA constant current to drive the high powered LEDs. The STP04CM05 family guarantees 20 V output driving capability, allowing users to connect more LEDs in series. The high clock frequency, 30 MHz, also satisfies the system requirements which include high-volume data transmission. The STP04CM05 is well suited for very high brightness displays and special lighting applications. The STP04CM05 is offered in DIP-14, SO-14 and TSSOP16 exposed pad packages.

Key features

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

Key benefits

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

Application example

![Application example diagram]

<table>
<thead>
<tr>
<th>Sales code</th>
<th>Board</th>
<th>Description</th>
<th>Technical documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEVAL-ILL009V3</td>
<td>![Board image]</td>
<td>OSTAR projection module</td>
<td>AN2531: Generating multicolor light using RGB LEDs</td>
</tr>
<tr>
<td>STEVAL-ILL009V4</td>
<td>![Board image]</td>
<td>OSRAM Dragon LED module</td>
<td></td>
</tr>
<tr>
<td>STEVAL-ILL009V5</td>
<td>![Board image]</td>
<td>New RGB LED control board</td>
<td></td>
</tr>
</tbody>
</table>
**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**

![Application example diagram](image)

<table>
<thead>
<tr>
<th>Sales code</th>
<th>Board</th>
<th>Description</th>
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<tbody>
<tr>
<td>STEVAL-ILL002V3</td>
<td>![Board image]</td>
<td>High-brightness LED with diagnostics (40 LEDs)</td>
</tr>
<tr>
<td>STEVAL-ILL002V4</td>
<td>![Board image]</td>
<td>High-brightness LED with diagnostics (40 LEDs)</td>
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<table>
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<tr>
<th>Technical documents</th>
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<tr>
<td>UMI0181: Detection LED matrix evaluation kit</td>
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<tr>
<td>AN12478: STP08DP05, STP16DP05 Normal mode and error detection features</td>
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STP16x

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

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

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

**Application example**

![Diagram showing the usage of STP16x](image)

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| STEVAL-ILL003V2 | ![Board Image] | High-brightness LED driver without diagnostics (32 LEDs) based on STP16CP05 | AN2141: LED array reference design board
STP24DP05

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

Users can adjust the output current for each 8-channel group using three external resistors, controlling in this way the light intensity of the LEDs. The STP24DP05 guarantees a 20 V output driving capability, allowing users to connect more LEDs in series. The high clock frequency, 25 MHz, makes the device suitable for high data rate transmission. The 3.3 V voltage supply is useful for applications that interface any microcontroller from 3.3 V.

**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**

![Application Example Diagram]

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<td>STEVAL-ILL015V1</td>
<td>High-brightness RGB LED array with LED error detection</td>
<td>AN2841: LED dimming implemented on STM32 microcontroller</td>
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<td>UM0574: LED dimmer demonstration board based on the STP24DP05 and STM32</td>
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<td>UM0588: Multilayer C library for LED dimming used on systems with SPI and DMA capabilities</td>
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Boost converters
PM660x

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

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

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

Application example

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<tr>
<td>STEVAL-ISA056V1</td>
<td><img src="image_url" alt="Image" /></td>
<td>6-row, 30 mA LED driver with boost converter for notebook PC LCD-panel backlighting</td>
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**LED770x**

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

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

**Key features**

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

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

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

**Application example**

---

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

STEVAL-ILL021V1 | | LCD panel backlight demoboard based on LED7707 (6-row - 85 mA LED driver with boost converter) | AN2810: 6-row 85 mA LED driver with boost converter for LCD panel backlighting
The ST8R00 family of synchronous step-up DC-DC converters with current output cut-off function provide up to 1 A over an input voltage range of 4 V to 6 V and an output voltage range of 6 V to 12 V. The high switching frequency (1.2 MHz) allows the use of tiny surface-mount components. In addition to the resistor divider to set the output voltage value, only an inductor and two capacitors are required. A low output ripple is guaranteed by the current-mode PWM topology and by the use of low ESR surface-mounted ceramic capacitors. The device is available in two versions: burst mode (ST8R00) and continuous mode (ST8R00W) operation.

### Key features
- Very low supply current: 500 μA (typ)
- Output voltage: adjustable from 6 V to 12 V
- Output voltage accuracy: ±2%
- Output current: up to 1 A
- Very small DFN8 (4x4 mm) package

### Key benefits
- Efficiency up to 90%
- Few external components

### Application example

![Diagram showing the ST8R00 synchronous step-up DC-DC converter with current output cut-off function.](image)

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<th>Sales code</th>
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<th>Description</th>
<th>Technical documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEVAL-ISA48V2</td>
<td>![Board Image]</td>
<td>1 A/adjustable V&lt;sub&gt;OUT&lt;/sub&gt;, PWM synchronous step-up DC-DC converter based on ST8R00</td>
<td>AN2627: ST8R00 synchronous boost converter with output current cut-off function</td>
</tr>
</tbody>
</table>
L6920D/DB

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

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

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

**Key features**

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

**Key benefits**

- Monolithic and flexible solution
- High efficiency

**Application example**

![Application Circuit Diagram](image)

**Sales code**

<table>
<thead>
<tr>
<th>Board Description</th>
<th>Technical documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVAL6920DB1</td>
<td>AN2206: Designing with L6920DB, high efficiency synchronous rectifier step-up converter</td>
</tr>
<tr>
<td>LED flashlight demo board based on the L6920D Previous sales code: PSAL05-13</td>
<td>AN1941: Low-voltage LED driver using L6920D, L4971 and L6902D</td>
</tr>
</tbody>
</table>
**STCF05**

The STCF05 is a high-efficiency power supply solution to drive multiple flash LEDs in camera phones, PDAs and other hand-held devices. The synchronous boost topology with output current control guarantees the proper LED current over all possible conditions of battery level and LED forward voltage. All the functions of the device are controlled through the 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 overtemperature detection and protection with external NTC resistor
- Open and shorted LED failure detection and protection
- Chip over-temperature detection and protection
- Less than 1 μA standby current

**Key benefits**

- Few external components required

**Application example**

![Application diagram](image)

**Technical documents**

<table>
<thead>
<tr>
<th>Sales code</th>
<th>Board</th>
<th>Description</th>
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</tr>
</thead>
<tbody>
<tr>
<td>STEVAL-TLL007V1</td>
<td>![Image]</td>
<td>Power flash demo board based on STCF05 (includes motherboard based on uPSD)</td>
<td>AN2827: Driver for double flash LED with I²C interface</td>
</tr>
</tbody>
</table>
Buck converters

STCSx

The STCSx family is a BiCMOS constant-current source designed to provide a precise constant current starting from a varying input voltage source. It is designed to replace discrete-component LED driving solutions in low-voltage applications such as 5 V, 12 V or 24 V, providing benefits in terms of precision, integration and reliability. An external resistor is used to set the current up to 2 A with a ± 10 % precision; a dedicated pin can be used for PWM dimming. An open-drain pin output provides information on load disconnection conditions.

Key features

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

Key benefits

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

Application example

![Diagram of STCSx application example]

### Sales code

<table>
<thead>
<tr>
<th>Board</th>
<th>Description</th>
<th>Technical documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEVAL-ILL014V1</td>
<td>Constant-current controller for high-brightness LEDs based on STCS1A</td>
<td>UM0422: Constant current controller for high brightness LEDs</td>
</tr>
</tbody>
</table>
L6902D

The L6902D is a complete and simple step-down switching regulator with adjustable current limit. Based on a voltage-mode structure, it integrates a current error amplifier for constant-voltage and constant-current control.

**Key features**

- 1 A in small SO8 package with minimum external component count
- P-channel power MOSFET: no bootstrap capacitor
- Wide input voltage range: 8 V to 36 V
- Adjustable LED current ($V_{CS+} - V_{CS-} = 100$ 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**

![Application Circuit Diagram](image)

**Technical documents**

- AN2129: Dimming of super high-brightness LEDs with L6902D
- AN1941: Low Voltage LED Driver Using L6920D, L4971 and L6902D
- AN1891: Application ideas: driving LEDs using L497x, L597x, L692x DC-DC converters families
L597x

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

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

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

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

Key benefits

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

Key features

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

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

The L597x is a step-down monolithic power switching regulator capable of delivering more than 2 A DC current to the load depending on the application conditions. The output voltage can be set from 1.235 V to 35 V.
L598x

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

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

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

<table>
<thead>
<tr>
<th>Sales code</th>
<th>Board</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVAL5980</td>
<td><img src="image" alt="EVAL5980" /></td>
<td>0.7 A step-down switching regulator demonstration board based on the L5980</td>
</tr>
<tr>
<td>EVAL5981</td>
<td><img src="image" alt="EVAL5981" /></td>
<td>1 A step-down switching regulator demonstration board based on the L5981</td>
</tr>
<tr>
<td>EVAL5983</td>
<td><img src="image" alt="EVAL5983" /></td>
<td>1.5 A step-down switching regulator demonstration board based on the L5983</td>
</tr>
<tr>
<td>EVAL5985</td>
<td><img src="image" alt="EVAL5985" /></td>
<td>Evaluation board for L5985: 2 A step-down switching regulator</td>
</tr>
</tbody>
</table>
Application example

Conventional buck topology

Conventional buck topology with external op-amp reducing power losses

Inverting buck-boost topology

Positive buck-boost topology
**L6925/26/28**

This family of DC-DC monolithic regulators is specifically designed for extremely high efficiency. The L692x supply voltage can be as low as 2 V, allowing its use in applications supplied by a single Li-ion cell. The output voltage can be adjusted using an external divider down to 0.6 V. The duty cycle can saturate to 100%, allowing low drop-out operation. Low-consumption mode can be selected under light load conditions, allowing switching losses to be reduced. Other features include power good, overvoltage protection, short-circuit protection and thermal shutdown (150 °C).

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

### Key benefits
- Monolithic and flexible solution
- High efficiency

### Application example

![Conventional buck topology](image)

<table>
<thead>
<tr>
<th>Sales code</th>
<th>Board Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVAL6926D</td>
<td>L6926 high-efficiency monolithic synchronous step-down regulator evaluation board</td>
</tr>
<tr>
<td>EVAL6928D</td>
<td>L6928D high-efficiency monolithic synchronous step-down regulator evaluation board</td>
</tr>
<tr>
<td>EVAL6928Q1</td>
<td>L6928Q1 high-efficiency monolithic synchronous step-down converter evaluation board</td>
</tr>
</tbody>
</table>

### Technical documents
- AN1882: Designing with the L6926, high-efficiency monolithic synchronous step-down regulator
- AN1893: Designing with L6925D, high-efficiency monolithic synchronous step-down regulator
- AN2115: Designing an application with the L6928, high-efficiency monolithic synchronous step-down regulator
ST1S10

The ST1S10 is a high-efficiency step-down PWM current-mode switching regulator capable of providing up to 3 A of output current. The device operates with an input supply range from 2.5 V to 18 V and provides an adjustable output voltage. It operates either at a 900 kHz fixed frequency or can be synchronized to an external clock (from 400 kHz to 1.2 MHz). The high switching frequency allows the use of tiny SMD external components, while the integrated synchronous rectifier eliminates the need for a Schottky diode. The ST1S10 provides excellent transient response, and is fully protected against thermal overheating, switching overcurrent and output short circuit. The ST1S10 is the ideal choice for LED lighting in DC bus-powered applications.

Key features

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

Key benefits

- Typical efficiency: 90%
- Standby supply current: max 6 μA
- Minimum number of external components

Application example

Sales code | Board | Description
--- | --- | ---
STEVAL-ISA044V1 | ![Board Image] | 3 A synchronous 900 kHz step-down DC-DC converter with inhibit function
STEVAL-ISA044V2 | ![Board Image] | 3 A synchronous 900 kHz step-down DC-DC converter with inhibit function

Technical documents

- AN2620: 3 A high-frequency synchronous 900 kHz step-down converter based on the ST1S10
- AN2754: Buck high-brightness LED driver based on the ST1S10 step-down DC-DC converter voltage regulator
Buck-boost converters

STCF04

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

Key features

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

Application example
**STCF06**

The STCF06 is a high-efficiency power supply solution to drive a single-LED flash in camera phones, PDAs and other battery-powered devices. It is a buck-boost converter able to guarantee correct LED current control over all possible conditions of battery voltage and LED forward voltage. The output current control ensures correct current regulation over the forward voltage spread characteristics of the flash LED. All the functions of the device are controlled through the FC 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 FC 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

**Application example**

![Diagram of STCF06](image)

**Table:**

<table>
<thead>
<tr>
<th>Sales code</th>
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<th>Description</th>
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</thead>
<tbody>
<tr>
<td>STEVAL-TLL006V1</td>
<td><img src="image" alt="Board Image" /></td>
<td>High-power LED driver demo board for single flash with FC interface based on STCF06 (includes motherboard based on uPSD)</td>
<td>AN2730: High power LED driver for single Flash with FC interface</td>
</tr>
</tbody>
</table>
STBB1

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

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 μA

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

Application example

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

Fully compliant with eco standards, the VIPer series includes the VIPerx2 family and the new VIPerPlus family, with the subfamilies VIPerx7, VIPerx6 and VIPerx5, offering new functionalities as well as higher performance with lower component count. Both the output voltage and current can be regulated by using a bipolar-based circuitry in non-isolated applications or an optocoupler driven by a TSM device in isolated applications. This makes the VIPer series suitable for general LED illumination, interior decoration lighting, and neon and bulb replacement.

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

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

<table>
<thead>
<tr>
<th>Sales code</th>
<th>Board</th>
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</tr>
</thead>
<tbody>
<tr>
<td>STEVAL-ILL017V1</td>
<td><img src="image1.png" alt="Image" /></td>
<td>3.5 W non-isolated offline constant-current LED driver based on VIPer17HN</td>
</tr>
<tr>
<td>STEVAL-ILL001V1</td>
<td><img src="image2.png" alt="Image" /></td>
<td>Dimmable driver for HB power LEDs with VIPer22A (DALI connector)</td>
</tr>
<tr>
<td>STEVAL-ILL005V1</td>
<td><img src="image3.png" alt="Image" /></td>
<td>VIPer12A offline, constant-current driver for high-intensity LEDs</td>
</tr>
<tr>
<td>STEVAL-ILL026V1</td>
<td><img src="image4.png" alt="Image" /></td>
<td>3 W non-isolated offline LED driver based on VIPer22AS-E</td>
</tr>
</tbody>
</table>

Technical documents
- AN2042 VIPower: dimmable driver for high-brightness LEDs with VIPer22A-E
- AN1916 VIPower: offline constant-current LED driver using VIPer12/22A
Application example

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

Application example: flyback SMPS for offline LED driver

Current regulation

Efficiency variation

Vin = 110 Vac  
Vin = 220 Vac
L6562A/AT

The L6562A is a current-mode PFC controller operating in transition mode (TM). The highly linear multiplier includes a special circuit that reduces AC input current distortion and allows wide-range mains operation with an extremely low THD, even over a large load range. The output voltage is controlled by means of a voltage-mode error amplifier and an accurate internal voltage reference (1% @ Tj = 25 °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.).

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% (@ Tj =25 °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

- Suitable also for single LED string with TSM10xx
- Cost effective solution

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

Application example: offline two stages solution, modified buck topology with PFC stage
<table>
<thead>
<tr>
<th>Sales code</th>
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<th>Description</th>
<th>Technical documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEVAL-ILL013V1</td>
<td><img src="image1" alt="Image" /></td>
<td>80 W offline LED driver with dimming based on L6562A</td>
<td>UM0670: 80 W offline LED driver with PFC</td>
</tr>
<tr>
<td>STEVAL-ILL016V1</td>
<td><img src="image2" alt="Image" /></td>
<td>15 W offline Triac dimmable LED driver (USA market - 115 V)</td>
<td>AN2711: 15 W offline Triac dimmable LED driver</td>
</tr>
<tr>
<td>EVL6562A-LED</td>
<td><img src="image3" alt="Image" /></td>
<td>Constant-current inverse buck LED driver using the L6562A</td>
<td>AN2928: Modified buck converter for LED applications</td>
</tr>
<tr>
<td>EVL6562A-35WFLB</td>
<td><img src="image4" alt="Image" /></td>
<td>35 W wide-range high power factor flyback converter using L6562A</td>
<td>AN2838: 35 W wide-range high power factor flyback converter demonstration board using the L6562A</td>
</tr>
<tr>
<td>STEVAL-ILL027V1</td>
<td><img src="image5" alt="Image" /></td>
<td>18 W single-stage offline LED driver based on L6562A</td>
<td></td>
</tr>
</tbody>
</table>
The L6599 is a double-ended controller specific for the series-resonant half-bridge topology. It provides 50% complementary duty cycle: the high-side and low-side switches are driven on/off 180° out-of-phase for exactly the same time. Output voltage regulation is obtained by modulating the operating frequency. A fixed dead-time inserted between the turn-off of one switch and the turn-on of the other one guarantees soft-switching and enables high-frequency operation.

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

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

### Application example

Application example: offline two-stage solution, LLC resonant half bridge with PFC stage
L6565

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

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

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

**Application example**

![Application example: offline two-stage solution, high-voltage flyback with PFC](image)

<table>
<thead>
<tr>
<th>Sales code</th>
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</tr>
</thead>
<tbody>
<tr>
<td>STEVAL-ISA019V2</td>
<td>![Board Image]</td>
<td>80 W ESBT quasi-resonant wide-range SMPS with L6565 for 3-phase application</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN2495: 3-phase 80 W SMPS with very wide-range input voltage based on the L6565 and ESBT STC04IE170HV</td>
</tr>
</tbody>
</table>
STM8S: robust and reliable

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

- 2 internal RC oscillators with dual independent watchdogs
- Clock security system (CSS) to monitor the failure of external clock source
- Complementary copy of configuration option bytes and EMS reset
- Low emission in accordance with the IEC 61967 standards
- Outstanding robustness performance according to IEC 1000-4-2 and IEC 1000-4-4 standards
- High current injection immunity (1 μA leakage current when 4 mA current is injected in adjacent pin)
- Dedicated firmware library compliant to Class B of IEC 60335
Large family
A large product family allows platform validation and simplifies migration from one product to another. This is a great advantage to speed up development with a maximum reuse of the work already invested.
- It improves time to market
- It reduces risk
- It optimizes resources

Simple device selection
The STM8S family is available in two lines: the Performance line and Access line. With F_CPU specified up to 24 MHz, the Performance line is ideal when processing power is needed. The Access line is an affordable solution when cost efficiency is the main concern. Both lines share the same architecture and peripheral set making navigation possible across the portfolio.

Features and benefits

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

STM8S product lines

STM8S20x Performance line
- STM8 core @ 24 MHz
- Up to 128 Kbytes Flash
- Up to 6 Kbytes SRAM
- Up to 2 Kbytes EEPROM
- CAN 2.0B
- 2nd UART

STM8S10x Access line
- STM8 core @ 16 MHz
- Up to 32 Kbytes Flash
- Up to 2 Kbytes SRAM
- Up to 1 Kbytes EEPROM

STM8S portfolio

Memory size
- 128 KB
- 64 KB
- 32 KB
- 16 KB
- 8 KB
- 4 KB

Pin count
- 20 pins TSSOP20/ VQFN20
- 32 pins LQFP32/ VQFN32
- 44 pins LQFP44
- 48 pins LQFP48/ VQFN48
- 64 pins LQFP64
- 80 pins LQFP80

*under qualification
System features:
- Universal AC input voltage
- Mains failure and external brightness detection
- Four selectable modes:
  - Emergency lighting
  - Twilight with switch
  - Twilight pocket lamp
  - Li-ion battery charger with over-temperature protection
STM32

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

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

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

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

Key benefits

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

Cortex-M3 core

Leading edge architecture
Excellent real-time behaviour

Outstanding power efficiency

Sub µA RTC, low voltage
0.27 mA/MHz, low-power modes

Superior and innovative peripherals

USB OTG, Ethernet, dual CAN, ADC 12-bit, advanced timers

Maximum integration

Reset circuitry clocks, oscillators, PLL regulator RTC, watchdog

Cost and space saving

Address all your needs and beyond

Environment friendly, suits low-power operation

Future proof design

STM32 platform

more than 70 fully compatible devices

Extensive tools and software

Various IDE, starter kits, libraries, RTOS and stacks

More time for innovation

Improved productivity
STM32, the optimal platform choice

The STM32 is an optimal choice to support many applications with the same platform:
- From reduced memory and pin requirements to larger needs
- From performance demanding to battery operated
- From simple cost-sensitive to complex high-value

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

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

STM32, the largest portfolio

The STM32 offers the widest selection of microcontroller devices:
- Up to 72 MHz Cortex-M3 CPU
- 4-Kbyte to 64-Kbyte SRAM
- Four lines: Performance, USB Access, Access and Connectivity lines
- Pin-to-pin, software and peripheral compatibility across family
- 2.0 to 3.6 V power supply, 5 V tolerant I/Os
- -40 to +85 °C or up to 105 °C operating temperature range
STM32F10x family block diagram

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

- **Cortex-M3 CPU**: 36/72 MHz
- **JTAG/SW debug**
- **ETM**
- **Nested vectored interrupt controller**
- **1 x systemic timer**
- **DMA**: up 12 channels
- **SDIO**: SD/SDIO/MMC/CE-ATA
- **CRC**
- **2 x 16-bit PWM synchronized AC timer**
- **Up to 16 external interrupts**
- **Up to 80 I/Os**
- **1x SPI**
- **1x USART/LIN Smartcard/IrDa modem-control**
- **Flash IF**: Up to 512 KBytes Flash memory
- **Up to 64 KBytes SRAM**
- **Up to 84 Bytes backup data**
- **FSMC SRAM/NOR/NAND/CF/LC parallel interface**
- **Ethernet MAC 10/100 with IEEE 1588, MII/RMII**
- **1 x USB OTG 2.0 Full Speed with PHY**
- **Clock control**
- **ARM Lite high-speed bus matrix/arbiter (max. 72 MHz)**
- **ARM peripheral bus (max. 36 MHz)**
- **ARM peripheral bus (max. 72 MHz)**
- **6 x 16-bit timer**
- **2 x watchdog (independent and window)**
- **2 x 12-bit DAC**
- **3 x 12-bit ADC / 1 MSPS up to 21 channels**
- **Temperature sensor**
- **Bridge**
- **Power supply Reg 1.8 V POR/PDR/PVD**
- **XTAL oscillators up to 40 kHz + 3-25 MHz**
- **Internal RC oscillators 40 kHz + 8 MHz**
- **PLL block (3 PLLs)**
- **RTC / AWU**
- **1 x USB 2.0FS**
- **2 x CAN 2.0B**
- **4 x USART/LIN Smartcard/IrDa modem-control**
- **2 x SPI/I²S**
- **2 x I²C**
- **ARM peripheral bus (max. 36 MHz)**
- **ARM peripheral bus (max. 72 MHz)**
- **Bridge**
- **ARM Lite high-speed bus matrix/arbiter (max. 72 MHz)**
- **Flash IF**: Up to 512 KBytes Flash memory
- **Up to 64 KBytes SRAM**
- **Up to 84 Bytes backup data**
- **FSMC SRAM/NOR/NAND/CF/LC parallel interface**
- **Ethernet MAC 10/100 with IEEE 1588, MII/RMII**
- **1 x USB OTG 2.0 Full Speed with PHY**
- **Clock control**
- **ARM Lite high-speed bus matrix/arbiter (max. 72 MHz)**
- **ARM peripheral bus (max. 36 MHz)**
- **6 x 16-bit timer**
- **2 x watchdog (independent and window)**
- **2 x 12-bit DAC**
- **3 x 12-bit ADC / 1 MSPS up to 21 channels**
- **Temperature sensor**
- **Bridge**
- **Power supply Reg 1.8 V POR/PDR/PVD**
- **XTAL oscillators up to 40 kHz + 3-25 MHz**
- **Internal RC oscillators 40 kHz + 8 MHz**
- **PLL block (3 PLLs)**
- **RTC / AWU**
- **1 x USB 2.0FS**
- **2 x CAN 2.0B**
- **4 x USART/LIN Smartcard/IrDa modem-control**
- **2 x SPI/I²S**
- **2 x I²C**

**Abbreviations**

- AWU: Auto wake-up capability with RTC alarm
- CAN: Controller area network
- CF: CompactFlash
- CRC: Cyclic redundancy check
- DMA: Direct memory access
- ETM: Embedded Trace Macrocell
- IDA: Infrared Data Association
- JTAG/SW debug: JTAG/SW debug
- Nested vectored interrupt controller: Nested vectored interrupt controller
- POR: Power-down reset
- PDR: Power-on reset
- PVD: Programmable voltage
- PS: Inter-IC sound
- LIN: Local Interconnect network
- MI: Media independent interface
- MMC: MultiMediaCard
- RMI: Reduced media independent interface
- RTC: Real-time clock
- SD: Secure digital
- SDIO: Secure digital input output
- USART: Universal sync/async receiver transmitter
Demonstration board features

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

<table>
<thead>
<tr>
<th>Sales code</th>
<th>Board</th>
<th>Description</th>
<th>Technical documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEVAL-ILL022V1</td>
<td></td>
<td>25 W LED street light with 80 W solar energy charger based on STM32</td>
<td>UM0512: Solar-LED streetlight controller 25 W LED lamp driver with 80 W battery charger based on the STM32F101Rx</td>
</tr>
</tbody>
</table>
# Product selection guide

## LED array drivers

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
<th>I/O</th>
<th>$V_{\text{in}}$ (V)</th>
<th>Bit-to-bit accuracy (+/- %)</th>
<th>$I_{\text{out}}$ (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STP04CM05</td>
<td>4-bit constant-current power LED driver</td>
<td>Serial in/parallel out</td>
<td>3.3 to 5.5</td>
<td>1</td>
<td>80 to 400</td>
</tr>
<tr>
<td>STP08DP05</td>
<td>8-bit constant-current LED driver with output error detection</td>
<td>Serial in/parallel out</td>
<td>3.0 to 5.5</td>
<td>1.5</td>
<td>5 to 100</td>
</tr>
<tr>
<td>STP08CP05</td>
<td>8-bit constant-current LED driver</td>
<td>Serial in/parallel out</td>
<td>3.0 to 5.5</td>
<td>1.5</td>
<td>5 to 100</td>
</tr>
<tr>
<td>STP16CP05</td>
<td>16-bit constant-current LED driver</td>
<td>Serial in/parallel out</td>
<td>3.0 to 5.5</td>
<td>1.5</td>
<td>5 to 100</td>
</tr>
<tr>
<td>STP16DP05</td>
<td>16-bit constant-current LED driver with output error detection</td>
<td>Serial in/parallel out</td>
<td>3.0 to 5.5</td>
<td>1.5</td>
<td>5 to 100</td>
</tr>
<tr>
<td>STP16CP5S05</td>
<td>16-bit constant-current LED driver with auto-power saving and output error detection</td>
<td>Serial in/parallel out</td>
<td>3.0 to 5.5</td>
<td>1.5</td>
<td>5 to 100</td>
</tr>
<tr>
<td>STP16DP5S05</td>
<td>16-bit constant-current LED driver with auto-power saving and output error detection</td>
<td>Serial in/parallel out</td>
<td>3.0 to 5.5</td>
<td>1.5</td>
<td>5 to 100</td>
</tr>
<tr>
<td>STP16PC05</td>
<td>16-bit constant-current LED driver with balanced on/off</td>
<td>Serial in/parallel out</td>
<td>3.0 to 5.5</td>
<td>1.5</td>
<td>5 to 100</td>
</tr>
<tr>
<td>STP16CP5P05</td>
<td>16-bit low-current, high-precision LED driver</td>
<td>Serial in/parallel out</td>
<td>3.0 to 5.5</td>
<td>2</td>
<td>3 to 40</td>
</tr>
<tr>
<td>STP16DP5P05</td>
<td>16-bit low-current, high-precision LED driver with output error detection</td>
<td>Serial in/parallel out</td>
<td>3.0 to 5.5</td>
<td>2</td>
<td>3 to 40</td>
</tr>
<tr>
<td>STP16CP5PS05</td>
<td>16-bit low-current, high-precision LED driver with auto-power saving</td>
<td>Serial in/parallel out</td>
<td>3.0 to 5.5</td>
<td>2</td>
<td>3 to 40</td>
</tr>
<tr>
<td>STP24DP05</td>
<td>24-bit constant-current LED driver with output error detection</td>
<td>Serial in/parallel out</td>
<td>3.0 to 5.5</td>
<td>3</td>
<td>5 to 80</td>
</tr>
<tr>
<td>STPIC06S95</td>
<td>8-bit LED driver with overvoltage protection</td>
<td>Serial in/parallel out</td>
<td>4.5 to 5.5</td>
<td>N/A</td>
<td>100 continuous</td>
</tr>
<tr>
<td>STPIC06S95</td>
<td>8-bit LED driver</td>
<td>Serial in/parallel out</td>
<td>4.5 to 5.5</td>
<td>N/A</td>
<td>100 continuous</td>
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</table>

## Boost converters

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
<th>$I_{\text{out}}$ (mA)</th>
<th>Rows</th>
<th>$V_{\text{in}}$ (V)</th>
<th>$V_{\text{out}}$ (V)</th>
<th>LEDs (white)</th>
<th>$F_{\text{sw}}$ (kHz)</th>
<th>Package</th>
<th>Extra functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM6600</td>
<td>6-row 32 mA LED driver with boost regulator for mobile PC LCD panel backlight</td>
<td>up to 32</td>
<td>6</td>
<td>4.7 to 28</td>
<td>up to 36</td>
<td>60</td>
<td>570 to 750</td>
<td>VFQFPN4x4-24L</td>
<td>PWM dim, adj SS, INH, sync, adj OVP, fault management</td>
</tr>
<tr>
<td>LED7706</td>
<td>6-row 30 mA LED driver with boost regulator for LCD panel backlight</td>
<td>up to 30</td>
<td>6</td>
<td>4.5 to 36</td>
<td>up to 36</td>
<td>60</td>
<td>200 to 1000</td>
<td>QFN4x4-24L</td>
<td>PWM dim, adj SS, INH, sync, adj OVP, fault management</td>
</tr>
<tr>
<td>LED7707</td>
<td>6-row 85 mA LED driver with boost regulator for LCD panel backlight</td>
<td>up to 85</td>
<td>6</td>
<td>4.5 to 36</td>
<td>up to 36</td>
<td>60</td>
<td>200 to 1000</td>
<td>QFN4x4-24L</td>
<td>PWM dim, adj SS, INH, sync, adj OVP, fault management</td>
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<tr>
<td>L6920D</td>
<td>High-efficiency synchronous step-up converter</td>
<td>0.8 (lpk)</td>
<td>1</td>
<td>0.6 to 5.5</td>
<td>2 to 5.2</td>
<td>1</td>
<td>Up to 1000</td>
<td>TSSOP8</td>
<td>LBI and LBO, Vref, shutdown</td>
</tr>
<tr>
<td>L6920D8</td>
<td>High-efficiency synchronous step-up converter</td>
<td>1 (lpk)</td>
<td>1</td>
<td>0.6 to 5.5</td>
<td>1.8 to 5.2</td>
<td>1</td>
<td>Up to 1000</td>
<td>MSOP8</td>
<td>LBI and LBO, Vref, shutdown</td>
</tr>
<tr>
<td>ST8R00</td>
<td>Micropower synchronous step-up converter</td>
<td>1</td>
<td>1</td>
<td>4 to 6</td>
<td>6 to 12</td>
<td>3</td>
<td>1200</td>
<td>DFN4x4-8L</td>
<td>Burst mode and continuous mode, INH</td>
</tr>
<tr>
<td>STC6F05</td>
<td>High-power white LED driver with I2C interface</td>
<td>0.4*</td>
<td>1</td>
<td>2.5 to 5.5</td>
<td>Vbat to 10.2</td>
<td>2</td>
<td>1800</td>
<td>TFBGA3x3-25L</td>
<td>Flash mode, torch mode, dim, fault management</td>
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</table>

* $I_{\text{out}}$ (A)

## Buck converters

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
<th>$I_{\text{out}}$ (A)</th>
<th>$V_{\text{out}}$ (V)</th>
<th>$V_{\text{in}}$ (V)</th>
<th>LEDs (white)</th>
<th>$F_{\text{sw}}$ (kHz)</th>
<th>Package</th>
<th>Extra functions</th>
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</thead>
<tbody>
<tr>
<td>L4976</td>
<td>1 A step-down switching regulator</td>
<td>1</td>
<td>8 to 55</td>
<td>up to Vin</td>
<td>15</td>
<td>15 Up to 300</td>
<td>DIP8/S016W</td>
<td>Vref</td>
</tr>
<tr>
<td>L4971</td>
<td>1.5 A step-down switching regulator</td>
<td>1.5</td>
<td>8 to 55</td>
<td>up to Vin</td>
<td>15</td>
<td>15 Up to 300</td>
<td>DIP8/S016W</td>
<td>INH</td>
</tr>
<tr>
<td>L4978</td>
<td>2 A step-down switching regulator</td>
<td>2</td>
<td>8 to 55</td>
<td>up to Vin</td>
<td>15</td>
<td>15 Up to 300</td>
<td>DIP8/S016W</td>
<td>INH</td>
</tr>
<tr>
<td>L4973</td>
<td>3.5 A step-down switching regulator</td>
<td>3.5</td>
<td>8 to 55</td>
<td>up to Vin</td>
<td>15</td>
<td>15 Up to 300</td>
<td>DIP8/S020</td>
<td>Vref, INH, sync</td>
</tr>
<tr>
<td>L5970D</td>
<td>1 A step-down switching regulator</td>
<td>1</td>
<td>4.4 to 36</td>
<td>up to Vin</td>
<td>9</td>
<td>250</td>
<td>SO8</td>
<td>Vref, INH, sync</td>
</tr>
<tr>
<td>L5970D4</td>
<td>1 A step-down switching regulator</td>
<td>1</td>
<td>4.4 to 36</td>
<td>up to Vin</td>
<td>9</td>
<td>500</td>
<td>SO8</td>
<td>Vref, INH, sync</td>
</tr>
<tr>
<td>L5972D</td>
<td>1.5 A step-down switching regulator</td>
<td>1.5</td>
<td>4.4 to 36</td>
<td>up to Vin</td>
<td>9</td>
<td>250</td>
<td>SO8</td>
<td>-</td>
</tr>
<tr>
<td>L5973D4</td>
<td>1.5 A step-down switching regulator</td>
<td>1.5</td>
<td>4.4 to 36</td>
<td>up to Vin</td>
<td>9</td>
<td>500</td>
<td>HSOP8</td>
<td>Vref, INH, sync</td>
</tr>
<tr>
<td>L5973D</td>
<td>2 A step-down switching regulator</td>
<td>2</td>
<td>4.4 to 36</td>
<td>up to Vin</td>
<td>9</td>
<td>250</td>
<td>HSOP8</td>
<td>Vref, INH, sync</td>
</tr>
<tr>
<td>L6902D</td>
<td>Step-down switching regulator with adjustable current limit up to 1 A</td>
<td>1</td>
<td>8 to 36</td>
<td>up to Vin</td>
<td>9</td>
<td>250</td>
<td>SO8</td>
<td>Vref, CC/CV mode</td>
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</table>

* $I_{\text{out}}$ (A)
### Buck converters (cont’d)

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
<th>( I_{\text{out}} ) (A)</th>
<th>( V_{\text{IN}} ) (V)</th>
<th>( V_{\text{OUT}} ) (V)</th>
<th>LEDs (white)</th>
<th>( F_{\text{SW}} ) (kHz)</th>
<th>Package</th>
<th>Extra functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>L5980</td>
<td>0.7 A step-down switching regulator</td>
<td>0.7</td>
<td>2.9 to 18</td>
<td>up to ( V_{\text{IN}} )</td>
<td>4</td>
<td>Up to 1000</td>
<td>QFN3x3-8L</td>
<td>Adj ( F_{\text{SW}} ), INH, sync</td>
</tr>
<tr>
<td>L5981</td>
<td>1 A step-down switching regulator</td>
<td>1</td>
<td>2.9 to 18</td>
<td>up to ( V_{\text{IN}} )</td>
<td>4</td>
<td>Up to 1000</td>
<td>QFN3x3-8L</td>
<td>Adj ( F_{\text{SW}} ), INH, sync</td>
</tr>
<tr>
<td>L5983</td>
<td>1.5 A step-down switching regulator</td>
<td>1.5</td>
<td>2.9 to 18</td>
<td>up to ( V_{\text{IN}} )</td>
<td>4</td>
<td>Up to 1000</td>
<td>QFN3x3-8L</td>
<td>Adj ( F_{\text{SW}} ), INH, sync</td>
</tr>
<tr>
<td>L5985</td>
<td>2 A step-down switching regulator</td>
<td>2</td>
<td>2.9 to 18</td>
<td>up to ( V_{\text{IN}} )</td>
<td>4</td>
<td>Up to 1000</td>
<td>QFN3x3-8L</td>
<td>Adj ( F_{\text{SW}} ), INH, sync</td>
</tr>
<tr>
<td>L5986/A</td>
<td>2.5 A step-down switching regulator</td>
<td>2.5</td>
<td>2.9 to 18</td>
<td>up to ( V_{\text{IN}} )</td>
<td>4</td>
<td>Up to 1000</td>
<td>QFN3x3-8L</td>
<td>Adj ( F_{\text{SW}} ), INH, sync</td>
</tr>
<tr>
<td>L5987/A</td>
<td>3 A step-down switching regulator</td>
<td>3</td>
<td>2.9 to 18</td>
<td>up to ( V_{\text{IN}} )</td>
<td>4</td>
<td>Up to 1000</td>
<td>QFN3x3-8L</td>
<td>Adj ( F_{\text{SW}} ), INH, sync</td>
</tr>
<tr>
<td>L6925D</td>
<td>800 mA step-down synchronous switching regulator</td>
<td>0.8</td>
<td>2.7 to 5.5</td>
<td>up to ( V_{\text{IN}} )</td>
<td>1</td>
<td>600</td>
<td>QFN3x3-8L/MSOP8</td>
<td>Pgood, run, sync</td>
</tr>
<tr>
<td>L6926</td>
<td>800 mA step-down synchronous switching regulator</td>
<td>0.8</td>
<td>2 to 5.5</td>
<td>up to ( V_{\text{IN}} )</td>
<td>1</td>
<td>600</td>
<td>QFN3x3-8L/MSOP8</td>
<td>Pgood, run, sync</td>
</tr>
<tr>
<td>L6928</td>
<td>800 mA step-down synchronous switching regulator</td>
<td>0.8</td>
<td>2 to 5.5</td>
<td>up to ( V_{\text{IN}} )</td>
<td>1</td>
<td>1400</td>
<td>QFN3x3-8L/MSOP8</td>
<td>Pgood, run, sync</td>
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<tr>
<td>ST1S10</td>
<td>Monolithic synchronous step-down regulator</td>
<td>3</td>
<td>2.5 to 18</td>
<td>0.8 to 16</td>
<td>3</td>
<td>900</td>
<td>DFN4x4-8L / HSOP8</td>
<td>sync</td>
</tr>
<tr>
<td>STCS05</td>
<td>0.5 A max constant-current LED driver</td>
<td>0.5</td>
<td>4.5 to 40</td>
<td>( V_{\text{IN}} - V_{\text{DROP}} )</td>
<td>9</td>
<td>-</td>
<td>SO8</td>
<td>Dimming, diagnostics, EN</td>
</tr>
<tr>
<td>STCS05A</td>
<td>0.5 A max constant-current LED driver</td>
<td>0.5</td>
<td>4.5 to 40</td>
<td>( V_{\text{IN}} - V_{\text{DROP}} )</td>
<td>9</td>
<td>-</td>
<td>SO8</td>
<td>Dimming, diagnostics, EN</td>
</tr>
<tr>
<td>STCS1</td>
<td>1.5 A max constant-current LED driver</td>
<td>1.5</td>
<td>4.5 to 40</td>
<td>( V_{\text{IN}} - V_{\text{DROP}} )</td>
<td>9</td>
<td>-</td>
<td>DFN3x3-8L</td>
<td>Dimming, diagnostics, EN</td>
</tr>
<tr>
<td>STCS1A</td>
<td>1.5 A max constant-current LED driver</td>
<td>1.5</td>
<td>4.5 to 40</td>
<td>( V_{\text{IN}} - V_{\text{DROP}} )</td>
<td>9</td>
<td>-</td>
<td>DFN3x3-8L</td>
<td>Dimming, diagnostics, EN</td>
</tr>
<tr>
<td>STCS2</td>
<td>2 A max constant-current LED driver</td>
<td>2</td>
<td>4.5 to 40</td>
<td>( V_{\text{IN}} - V_{\text{DROP}} )</td>
<td>9</td>
<td>-</td>
<td>PowerSO-10</td>
<td>Dimming, diagnostics, EN</td>
</tr>
<tr>
<td>STCS2A</td>
<td>2 A max constant-current LED driver</td>
<td>2</td>
<td>4.5 to 40</td>
<td>( V_{\text{IN}} - V_{\text{DROP}} )</td>
<td>9</td>
<td>-</td>
<td>PowerSO-10</td>
<td>Dimming, diagnostics, EN</td>
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</tbody>
</table>

### Buck-boost converters

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
<th>( I_{\text{LED}} ) (A)</th>
<th>Rows</th>
<th>( V_{\text{IN}} ) (V)</th>
<th>( V_{\text{OUT}} ) (V)</th>
<th>LEDs (white)</th>
<th>( F_{\text{SW}} ) (kHz)</th>
<th>Package</th>
<th>Extra functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>STCF02</td>
<td>High-power white LED driver</td>
<td>0.6</td>
<td>1</td>
<td>2.7 to 4.5</td>
<td>2.5 to 5.1</td>
<td>1</td>
<td>1800</td>
<td>QFN4x4-20L</td>
<td>Flash mode, torch mode, fault management</td>
</tr>
<tr>
<td>STCF03</td>
<td>High-power white LED driver with I2C interface</td>
<td>0.8</td>
<td>1</td>
<td>2.7 to 5.5</td>
<td>2.5 to 5.3</td>
<td>1</td>
<td>1800</td>
<td>QFN4x4-20L / TFBGA3x3-25L</td>
<td>Flash mode, torch mode, ready mode, dimming, fault management</td>
</tr>
<tr>
<td>STCF04</td>
<td>High-power white LED SuperCap driver with I2C interface</td>
<td>0.6/0.8</td>
<td>1</td>
<td>2.7 to 5.5</td>
<td>2.5 to 5.3</td>
<td>1</td>
<td>1800</td>
<td>TFBGA3x3-25L</td>
<td>Flash mode, torch mode, ready mode, dimming, fault management</td>
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<tr>
<td>STCF06</td>
<td>White LED driver with I2C interface</td>
<td>1/1.3/1.5</td>
<td>1</td>
<td>2.7 to 5.5</td>
<td>2.5 to 5</td>
<td>1</td>
<td>1800</td>
<td>TFBGA3x3-25L</td>
<td>Flash mode, torch mode, ready mode, dimming, fault management</td>
</tr>
<tr>
<td>STBB1</td>
<td>High-efficiency dual-mode buck-boost DC-DC converter</td>
<td>1</td>
<td>1</td>
<td>2 to 5.5</td>
<td>1.2 to 5.5</td>
<td>1</td>
<td>1500</td>
<td>DFN3x3-10L</td>
<td>Auto mode, PWM mode</td>
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### VIPer

<table>
<thead>
<tr>
<th>Part number</th>
<th>Package</th>
<th>Power capability max (wide range input) (V)</th>
<th>Drain source voltage min (V)</th>
<th>( V_{\text{IN}} )</th>
<th>( R_{\text{DSON}} ) (Ω)</th>
<th>( F_{\text{SW}} ) typ (kHz)</th>
<th>Extra functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIPER22AS-E</td>
<td>SO-8</td>
<td>7</td>
<td>730</td>
<td>9</td>
<td>7</td>
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<td>VIPER22ADIP-E</td>
<td>DIP-8</td>
<td>12</td>
<td>730</td>
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<td>17</td>
<td>60</td>
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<tr>
<td>VIPER12AS-E</td>
<td>SO-8</td>
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<td>730</td>
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<tr>
<td>VIPER12ADIP-E</td>
<td>DIP-8</td>
<td>8</td>
<td>730</td>
<td>9</td>
<td>8</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>VIPER17LN</td>
<td>DIP-7</td>
<td>7</td>
<td>800 (avalanche rugged)</td>
<td>8.5</td>
<td>23.5 (internal clamp)</td>
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</table>
### VIper (cont’d)

<table>
<thead>
<tr>
<th>Part number</th>
<th>Package</th>
<th>Power capability max (wide range input) (V)</th>
<th>Drain source voltage min (V)</th>
<th>$V_{DD}$ (min) (V)</th>
<th>$V_{DD}$ (max) (V)</th>
<th>$R_{DS(\text{on})}$ (max) ($\Omega$)</th>
<th>$F_{SW}$ typ (kHz)</th>
<th>Extra functions</th>
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<tbody>
<tr>
<td>VIPER17HN</td>
<td>DIP-7</td>
<td>800 (avalanche rugged)</td>
<td>8.5</td>
<td>23.5</td>
<td>20</td>
<td>115</td>
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<td>PWM current limiting mode, burst mode</td>
</tr>
<tr>
<td>VIPER17LD</td>
<td>SO16N</td>
<td>800 (avalanche rugged)</td>
<td>8.5</td>
<td>23.5</td>
<td>20</td>
<td>60</td>
<td></td>
<td>PWM current limiting mode, burst mode</td>
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<tr>
<td>VIPER17HD</td>
<td>SO16N</td>
<td>800 (avalanche rugged)</td>
<td>8.5</td>
<td>23.5</td>
<td>20</td>
<td>115</td>
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<td>PWM current limiting mode, burst mode</td>
</tr>
<tr>
<td>Viper27LN</td>
<td>DIP-7</td>
<td>800 (avalanche rugged)</td>
<td>8.5</td>
<td>23.5</td>
<td>8</td>
<td>60</td>
<td></td>
<td>PWM current limiting mode, burst mode</td>
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<tr>
<td>Viper27HN</td>
<td>DIP-7</td>
<td>800 (avalanche rugged)</td>
<td>8.5</td>
<td>23.5</td>
<td>8</td>
<td>115</td>
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<td>PWM current limiting mode, burst mode</td>
</tr>
<tr>
<td>Viper16LN</td>
<td>DIP-7</td>
<td>800 (avalanche rugged)</td>
<td>10.5</td>
<td>23.5</td>
<td>20</td>
<td>60</td>
<td></td>
<td>PWM current limiting mode, burst mode</td>
</tr>
<tr>
<td>Viper16HN</td>
<td>DIP-7</td>
<td>800 (avalanche rugged)</td>
<td>10.5</td>
<td>23.5</td>
<td>20</td>
<td>115</td>
<td></td>
<td>PWM current limiting mode, burst mode</td>
</tr>
<tr>
<td>Viper16LD</td>
<td>SO16N</td>
<td>800 (avalanche rugged)</td>
<td>10.5</td>
<td>23.5</td>
<td>20</td>
<td>60</td>
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<td>PWM current limiting mode, burst mode</td>
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### Power Factor Correctors

<table>
<thead>
<tr>
<th>Part number</th>
<th>Package</th>
<th>Description</th>
<th>Topology</th>
<th>RoHS compliant</th>
<th>$V_{CC}$ (V)</th>
<th>Supply current (mA)</th>
<th>Gate drive capability (source/sink) (A)</th>
<th>Delay to output (ns)</th>
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</thead>
<tbody>
<tr>
<td>L6562</td>
<td>DIP-8</td>
<td>Improved TM power factor corrector</td>
<td>Boost, flyback</td>
<td>Yes</td>
<td>10.3 to 22</td>
<td>3.5</td>
<td>0.6 / 0.8</td>
<td>200</td>
</tr>
<tr>
<td>L6562A</td>
<td>DIP-8</td>
<td>Enhanced TM power factor corrector</td>
<td>Boost, flyback</td>
<td>Yes</td>
<td>10.5 to 22.5</td>
<td>3.5</td>
<td>0.6 / 0.8</td>
<td>175</td>
</tr>
<tr>
<td>L6562AT</td>
<td>DIP-8</td>
<td>Enhanced TM power factor corrector</td>
<td>Boost, flyback</td>
<td>Yes</td>
<td>10.5 to 22.5</td>
<td>3.5</td>
<td>0.6 / 0.8</td>
<td>175</td>
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### Resonant and Quasi Resonant Controllers

<table>
<thead>
<tr>
<th>Part number</th>
<th>Package</th>
<th>Description</th>
<th>Topology</th>
<th>RoHS compliant</th>
<th>$V_{CC}$ (V)</th>
<th>Gate drive capability (mA)</th>
<th>Quescent current (mA)</th>
<th>Oscillator frequency (kHz)</th>
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<tbody>
<tr>
<td>L6599A</td>
<td>DIP-16</td>
<td>High-voltage improved resonant controller</td>
<td>Resonant half-bridge</td>
<td>Yes</td>
<td>8.85 to 16</td>
<td>3.5</td>
<td>0.6 / 0.8</td>
<td>200</td>
</tr>
<tr>
<td>L6599AT</td>
<td>DIP-16</td>
<td>High-voltage improved resonant controller</td>
<td>Resonant half-bridge</td>
<td>Yes</td>
<td>8.85 to 16</td>
<td>3.5</td>
<td>0.6 / 0.8</td>
<td>175</td>
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<tr>
<td>L6565</td>
<td>DIP-8</td>
<td>Quasi-resonant SMPS controller</td>
<td>Buck, boost, buck-boost, flyback</td>
<td>Yes</td>
<td>10.3 to 18</td>
<td>3.5</td>
<td>0.6 / 0.8</td>
<td>175</td>
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### Power MOSFETs

<table>
<thead>
<tr>
<th>Part number</th>
<th>$V_{DS}$ (V)</th>
<th>$R_{DS(\text{on})}$ max (Ω)</th>
<th>$I_D$ (A)</th>
<th>Package</th>
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<tbody>
<tr>
<td>STx3NF06L</td>
<td>60</td>
<td>0.1</td>
<td>3</td>
<td>SDT-223</td>
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<tr>
<td>STx5NF06L</td>
<td>60</td>
<td>0.055</td>
<td>5</td>
<td>SO-8</td>
</tr>
<tr>
<td>STx4DNF06L</td>
<td>60</td>
<td>0.055</td>
<td>4</td>
<td>SO-8 DUAL</td>
</tr>
<tr>
<td>STx4NF100</td>
<td>100</td>
<td>0.06</td>
<td>4</td>
<td>SO-8</td>
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<tr>
<td>STx19NF20</td>
<td>200</td>
<td>0.160</td>
<td>15</td>
<td>TO-220/TO-220FP/DPAK</td>
</tr>
<tr>
<td>STx20NF20</td>
<td>200</td>
<td>0.125</td>
<td>18</td>
<td>TO-220/TO-220FP/DPAK</td>
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<tr>
<td>STx16NF25</td>
<td>250</td>
<td>0.235</td>
<td>13</td>
<td>TO-220/TO-220FP/DPAK</td>
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<td>STx50NF25</td>
<td>250</td>
<td>0.069</td>
<td>45</td>
<td>TO-220/DPAK</td>
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<tr>
<td>STx4NK50Z</td>
<td>500</td>
<td>2.7</td>
<td>3</td>
<td>TO-220/TO-220FP/DPAK/IPAK</td>
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<tr>
<td>STx6N52K3</td>
<td>525</td>
<td>1.2</td>
<td>5</td>
<td>TO-220/TO-220FP/DPAK/IPAK</td>
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<tr>
<td>STx7N52K3</td>
<td>525</td>
<td>0.98</td>
<td>6.3</td>
<td>TO-220/TO-220FP/DPAK/IPAK</td>
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## Power MOSFETs (cont’d)

<table>
<thead>
<tr>
<th>Part number</th>
<th>V_{DSS} (V)</th>
<th>R_{DSS} (max) (Ω)</th>
<th>I_{D} (A)</th>
<th>Package</th>
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<tbody>
<tr>
<td>STx5NK60Z</td>
<td>600</td>
<td>1.6</td>
<td>5</td>
<td>TO-220/TO-220FP/DPAK</td>
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<td>STx6NM60N</td>
<td>600</td>
<td>0.92</td>
<td>4.7</td>
<td>TO-220/TO-220FP/DPAK/IPAK</td>
</tr>
<tr>
<td>STx3N62K3</td>
<td>620</td>
<td>2.5</td>
<td>2.7</td>
<td>TO-220/TO-220FP/DPAK/IPAK</td>
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<tr>
<td>STx6N52K3</td>
<td>620</td>
<td>1.2</td>
<td>5.5</td>
<td>TO-220/TO-220FP/DPAK/IPAK</td>
</tr>
<tr>
<td>STx3NK80Z</td>
<td>800</td>
<td>4.5</td>
<td>2.5</td>
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<tr>
<td>STx5NK80Z</td>
<td>800</td>
<td>2.4</td>
<td>4.3</td>
<td>TO-220/TO-220FP</td>
</tr>
<tr>
<td>STx7NM80</td>
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<td>0.300</td>
<td>6.5</td>
<td>TO-220/TO-220FP/DPAK/IPAK</td>
</tr>
<tr>
<td>STx5N95K3</td>
<td>925</td>
<td>3</td>
<td>3.5</td>
<td>TO-220/TO-220FP/DPAK/IPAK</td>
</tr>
<tr>
<td>STx7N99K3</td>
<td>925</td>
<td>1.35</td>
<td>7.2</td>
<td>TO-220/TO-220FP/TO-247</td>
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<tr>
<td>STx13N95K3</td>
<td>925</td>
<td>0.85</td>
<td>9.3</td>
<td>TO-220/TO-220FP/TO-247</td>
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## Demonstration boards

<table>
<thead>
<tr>
<th>Sales code</th>
<th>Board</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEVAL-ILL001V1</td>
<td><img src="image1" alt="Demonstration boards" /></td>
<td>Dimmable driver for high-brightness power LEDs with VIPer22A (DALI connector)</td>
</tr>
<tr>
<td>STEVAL-ILL002V3</td>
<td><img src="image2" alt="Demonstration boards" /></td>
<td>High-brightness LED driver with diagnostics (40 LEDs) based on STP08DP05</td>
</tr>
<tr>
<td>STEVAL-ILL002V4</td>
<td><img src="image3" alt="Demonstration boards" /></td>
<td>High-brightness LED driver with diagnostics (40 LEDs) based on STP08DP05</td>
</tr>
<tr>
<td>STEVAL-ILL003V2</td>
<td><img src="image4" alt="Demonstration boards" /></td>
<td>High-brightness LED driver without diagnostics (32 LEDs) based on STP16CP05</td>
</tr>
<tr>
<td>STEVAL-ILL005V1</td>
<td><img src="image5" alt="Demonstration boards" /></td>
<td>VIPer12A offline, constant-current driver for high-intensity LEDs</td>
</tr>
<tr>
<td>STEVAL-ILL006V1</td>
<td><img src="image6" alt="Demonstration boards" /></td>
<td>VIPer22A offline, constant-current driver for high-intensity LEDs</td>
</tr>
<tr>
<td>STEVAL-ILL007V1</td>
<td><img src="image7" alt="Demonstration boards" /></td>
<td>High-intensity LED driver for MR-16 format based on L5973D</td>
</tr>
<tr>
<td>STEVAL-ILL008V1</td>
<td><img src="image8" alt="Demonstration boards" /></td>
<td>LED flashlight demo based on the L6920D</td>
</tr>
<tr>
<td>STEVAL-ILL009V3</td>
<td><img src="image9" alt="Demonstration boards" /></td>
<td>OSTAR projection module</td>
</tr>
<tr>
<td>STEVAL-ILL009V4</td>
<td><img src="image10" alt="Demonstration boards" /></td>
<td>OSRAM Dragon LEDs module</td>
</tr>
<tr>
<td>STEVAL-ILL009V5</td>
<td><img src="image11" alt="Demonstration boards" /></td>
<td>New RGB LED control board based on STP04CM05 and ST1S10</td>
</tr>
<tr>
<td>STEVAL-ILL010V1</td>
<td><img src="image12" alt="Demonstration boards" /></td>
<td>High-intensity LED dimming driver based on L6902</td>
</tr>
<tr>
<td>STEVAL-ILL013V1</td>
<td><img src="image13" alt="Demonstration boards" /></td>
<td>80 W offline LED driver with dimming based on L6562A</td>
</tr>
<tr>
<td>STEVAL-ILL014V1</td>
<td><img src="image14" alt="Demonstration boards" /></td>
<td>Constant-current controller for high-brightness LEDs based on STCS1A</td>
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### Demonstration boards (cont’d)

<table>
<thead>
<tr>
<th>Sales code</th>
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<tbody>
<tr>
<td>STEVAL-ILL015V1</td>
<td><img src="image1.png" alt="Image" /> High-brightness RGB LED array with LED error detection based on the STP24DP05 and STM32</td>
<td></td>
</tr>
<tr>
<td>STEVAL-ILL016V2</td>
<td><img src="image2.png" alt="Image" /> 15 W offline Triac dimmable LED driver based on L6562AD and TSM1052 (USA market - 115 V)</td>
<td></td>
</tr>
<tr>
<td>STEVAL-ILL017V1</td>
<td><img src="image3.png" alt="Image" /> 2 W not-isolated offline constant-current LED driver based on VIPer17HN</td>
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</tr>
<tr>
<td>STEVAL-ILL018V1</td>
<td><img src="image4.png" alt="Image" /> OSRAM Golden Dragon white LED module (LUW W5AM)</td>
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<tr>
<td>STEVAL-ILL018V2</td>
<td><img src="image5.png" alt="Image" /> OSRAM Golden Dragon warm white LED module (LCW W5AM)</td>
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<tr>
<td>STEVAL-ILL018V3</td>
<td><img src="image6.png" alt="Image" /> OSRAM Golden Dragon amber (red) LED module (LA W55M)</td>
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</tr>
<tr>
<td>STEVAL-ILL018V4</td>
<td><img src="image7.png" alt="Image" /> OSRAM Golden Dragon blue LED module (LB W55M)</td>
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<tr>
<td>STEVAL-ILL019V1*</td>
<td><img src="image8.png" alt="Image" /> 35 W offline LED driver for 4-channel high-brightness RGB LED based on L6562A</td>
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</tr>
<tr>
<td>STEVAL-ILL020V1</td>
<td><img src="image9.png" alt="Image" /> LCD panel backlight demo board based on LED7706 (6 rows - 30 mA LED driver with boost converter)</td>
<td></td>
</tr>
<tr>
<td>STEVAL-ILL021V1</td>
<td><img src="image10.png" alt="Image" /> LCD panel backlight demo board based on LED7707 (6 rows - 85 mA LED driver with boost converter)</td>
<td></td>
</tr>
<tr>
<td>STEVAL-ILL022V1</td>
<td><img src="image11.png" alt="Image" /> 25 W LED street light with 80 W solar energy charger based on STM32</td>
<td></td>
</tr>
<tr>
<td>STEVAL-ILL023V1</td>
<td><img src="image12.png" alt="Image" /> High-efficiency switching LED Driver for high-current LEDs based on L6726A</td>
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<tr>
<td>STEVAL-ILL024V1</td>
<td><img src="image13.png" alt="Image" /> Mother/slave board for LED display based on STM32 microcontroller</td>
<td></td>
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<tr>
<td>STEVAL-ILL025V1</td>
<td><img src="image14.png" alt="Image" /> LED matrix display panel based on STP16DP05</td>
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</table>

*Available in Q1 2010*
<table>
<thead>
<tr>
<th>Sales code</th>
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<th>Description</th>
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<tbody>
<tr>
<td>STEVAL-ILL026V1</td>
<td><img src="image1.png" alt="Image" /> 3 W non-isolated offline LED driver based on VIPer22AS-E</td>
<td>STEVAL-TLL003V1 LED power flash driver based on STCF02.</td>
</tr>
<tr>
<td>STEVAL-TLL003V1</td>
<td><img src="image2.png" alt="Image" /> LED power flash driver based on STCF02</td>
<td>STEVAL-TLL004V1 LED power flash driver based on STCF03.</td>
</tr>
<tr>
<td>STEVAL-TLL004V1</td>
<td><img src="image3.png" alt="Image" /> Power flash Evaluation board based on STCF03 and ST7 MCU (includes the STEVAL-TLL004V1)</td>
<td>STEVAL-TLL005V1 High-power LED driver demo board for single flash with i²C interface based on STCF06 (includes motherboard based on uPSD).</td>
</tr>
<tr>
<td>STEVAL-TLL006V1</td>
<td><img src="image4.png" alt="Image" /> Power flash demo board based on STCF05 (includes motherboard based on uPSD)</td>
<td>STEVAL-TLL007V1 Power flash demo board based on STCF05 (include motherboard based on uPSD).</td>
</tr>
<tr>
<td>EVAL4971</td>
<td><img src="image5.png" alt="Image" /> L4971 1.5 A step-down switching regulator evaluation board</td>
<td>EVAL4973 L4973 3.5 A step-down switching regulator evaluation board.</td>
</tr>
<tr>
<td>EVAL4973</td>
<td><img src="image6.png" alt="Image" /> L4973 3.5 A step-down switching regulator evaluation board</td>
<td>EVAL5970D L5970D up to 1 A step-down switching regulator evaluation board.</td>
</tr>
<tr>
<td>EVAL5970D</td>
<td><img src="image7.png" alt="Image" /> L5970D up to 1 A step-down switching regulator evaluation board</td>
<td>EVAL5972D L5972D up to 2 A step-down switching regulator evaluation board.</td>
</tr>
<tr>
<td>EVAL5972D</td>
<td><img src="image8.png" alt="Image" /> L5972D up to 2 A step-down switching regulator evaluation board</td>
<td>EVAL5973AD L5973AD 2 A step-down switching regulator evaluation board.</td>
</tr>
<tr>
<td>EVAL5973AD</td>
<td><img src="image9.png" alt="Image" /> L5973AD 2 A step-down switching regulator evaluation board</td>
<td>EVAL5973D L5973D up to 2.5 A step-down switching regulator evaluation board.</td>
</tr>
<tr>
<td>EVAL5973D</td>
<td><img src="image10.png" alt="Image" /> L5973D up to 2.5 A step-down switching regulator evaluation board</td>
<td>EVAL5985 Evaluation board for L5985: 2 A step-down switching regulator.</td>
</tr>
<tr>
<td>EVAL5985</td>
<td><img src="image11.png" alt="Image" /> Evaluation board for L5985: 2 A step-down switching regulator</td>
<td>EVAL6920D L6920D 1 V high-efficiency synchronous step-up converter evaluation board.</td>
</tr>
<tr>
<td>EVAL6920D</td>
<td><img src="image12.png" alt="Image" /> L6920D 1 V high-efficiency synchronous step-up converter evaluation board</td>
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## Demonstration boards (cont’d)

<table>
<thead>
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<th>Sales code</th>
<th>Board</th>
<th>Description</th>
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<tbody>
<tr>
<td>EVAL6920DB1</td>
<td><img src="image1.png" alt="EVAL6920DB1" /></td>
<td>L6920DB synchronous rectification step-up converter evaluation board</td>
</tr>
<tr>
<td>EVAL6926D</td>
<td><img src="image2.png" alt="EVAL6926D" /></td>
<td>L6926 high-efficiency monolithic synchronous step-down regulator evaluation board</td>
</tr>
<tr>
<td>EVAL6928D</td>
<td><img src="image3.png" alt="EVAL6928D" /></td>
<td>L6928D high-efficiency monolithic synchronous step-down regulator evaluation board</td>
</tr>
<tr>
<td>EVL6562A-35WFLB</td>
<td><img src="image4.png" alt="EVL6562A-35WFLB" /></td>
<td>35 W wide-range high power factor flyback converter using L6562A</td>
</tr>
<tr>
<td>EVL6562A-LED*</td>
<td><img src="image5.png" alt="EVL6562A-LED*" /></td>
<td>Constant current inverse buck LED driver using the L6562A</td>
</tr>
<tr>
<td>STEVAL-ISA056V1</td>
<td><img src="image6.png" alt="STEVAL-ISA056V1" /></td>
<td>6-row, 30 mA LED driver with boost converter for notebook PC LCD-panel backlighting</td>
</tr>
<tr>
<td>STEVAL-ISA048V1</td>
<td><img src="image7.png" alt="STEVAL-ISA048V1" /></td>
<td>1 A/adjustable Vout PWM synchronous step-up DC-DC converter based on ST8R00</td>
</tr>
<tr>
<td>STEVAL-ISA044V1</td>
<td><img src="image8.png" alt="STEVAL-ISA044V1" /></td>
<td>3 A synchronous 900 kHz step-down DC-DC converter with inhibit function</td>
</tr>
<tr>
<td>STEVAL-ISA044V2</td>
<td><img src="image9.png" alt="STEVAL-ISA044V2" /></td>
<td>3 A synchronous 900 kHz step-down DC-DC converter with inhibit function</td>
</tr>
<tr>
<td>STEVAL-ISA019V2</td>
<td><img src="image10.png" alt="STEVAL-ISA019V2" /></td>
<td>80 W ESBT quasi-resonant wide-range SMPS with L6565 for 3-phase application</td>
</tr>
</tbody>
</table>

* Available in Q1 2010