ST Power Management
Selection Guide

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Introduction

As one of the world’s leading suppliers of both integrated and discrete power conversion semiconductor devices, ST’s power management devices enable energy-saving, high-power-density and lower-standby-power design solutions. Moreover they are able to support the migration from analog to digital designs to achieve increased flexibility, smaller form factors and higher efficiency. ST’s product portfolio includes highly-integrated AC-DC converters, switching DC-DC converters, silicon and SiC power MOSFETs, IGBTs, silicon and SiC rectifiers, protections, linear voltage regulators, battery management ICs (including wireless battery charger ICs), LED drivers, digital controllers, microcontrollers, photovoltaic ICs and more in a wide range of packages.

Today, optimizing complete solutions in terms of energy efficiency according to market requirements for features and performance is practically mandatory. The key element in developing a successful system is selecting the best silicon device. To help you find the best device for the most common applications (power supplies, LED lighting, renewable energy & harvesting, wireless charging, home appliances, welding, UPS and DC-DC computing), this guide provides a complete mapping of ST’s devices and includes information about dedicated system evaluation boards to better test the devices directly in your application and reduce the time to market. Using our eDesignSuite software tool, you can readily simulate power management circuits and choose the best-suited devices quickly and intelligently.

Applications

POWER SUPPLIES

Auxiliary SMPS

High-power-density and cost-effective auxiliary power supplies can be designed using a converter (where each IC includes a power MOSFET combined with control and protection circuitry in a single package) at a higher switching frequency to avoid a considerable increase in transformer and output capacitor size. ST offers a wide portfolio of highly-integrated offline converters up to 20 W with an extremely low total standby consumption (less than 4 mW for VIPer0P devices) and high breakdown voltage of 800 V for the VIPerPLUS family and 900 V for the AltairICs. To reduce BOM costs, the Altair family works as a constant-voltage primary-side regulator (PSR-CV) avoiding the need for a voltage reference and opto-coupler in the circuit. Discrete solutions consisting of an offline controller plus an external MOSFET are also supported by ST. New STRVS voltage suppressors improve system reliability against repetitive over-voltages. New FERD diodes feature a very low forward voltage and a low leakage reverse current improve the system efficiency. The ST devices best suited for each of the most common topologies are listed in the following table.

<table>
<thead>
<tr>
<th>Topology example</th>
<th>Offline converters</th>
<th>Offline controllers</th>
<th>HV power MOSFETs</th>
<th>Repetitive overvoltage protections</th>
<th>Clamping diodes</th>
<th>Vout ref.</th>
<th>Output diodes</th>
<th>Linear voltage reg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back</td>
<td>VIPer0P</td>
<td>VIPer01</td>
<td>STPS*</td>
<td>STTH*12</td>
<td>T*431</td>
<td>VIPer0P</td>
<td>T*432</td>
<td>-</td>
</tr>
<tr>
<td>Non-isolated flyback</td>
<td>VIPer0P</td>
<td>VIPer0P</td>
<td>VIPer0P</td>
<td>STPS*</td>
<td>STTH*10</td>
<td>VIPer0P</td>
<td>T*432</td>
<td>VIPer0P</td>
</tr>
<tr>
<td>Isolated flyback</td>
<td>VIPer0P</td>
<td>VIPer0P</td>
<td>VIPer0P</td>
<td>STPS*</td>
<td>STTH*12</td>
<td>VIPer0P</td>
<td>T*432</td>
<td>VIPer0P</td>
</tr>
<tr>
<td>Regulator with optocoupler</td>
<td>VIPer0P</td>
<td>VIPer0P</td>
<td>VIPer0P</td>
<td>STPS*</td>
<td>STTH*12</td>
<td>VIPer0P</td>
<td>T*432</td>
<td>VIPer0P</td>
</tr>
</tbody>
</table>

Note: *: is used as a wildcard character for related part number
Battery chargers

Designing lighter, smaller wall chargers for portable devices is one of the most critical challenges for developers. Excellent standby power consumption, high efficiency in all load conditions, primary-side regulation (PSR) control methods and a set of integrated protections (to minimize the component count on the circuit) are the main market requirements. High performing offline converters (Altair®) i.e. controllers and MOSFETs in the same package and a new offline controller (STCH02) combined with an external MOSFET can be used for a reliable, efficient and safe battery charger working in PSR (i.e. without using opto-coupler and post current/voltage regulation). New STRVS protections improve the system reliability against repetitive over-voltages. For the application side (portable applications), ST offers a variety of linear and switching battery charger and monitoring ICs integrating functions able to minimize power consumption and save space on PCBs. ST also offers the EnFilm™ thin-film battery, a new concept of extremely thin (220 µm), rechargeable solid-state batteries with fast constant-voltage charging.

Adapters

The adapter trend goes towards a significantly higher efficiency level, especially in partial load conditions, as well as towards their miniaturization (slimmer and lighter). Adapters require ICs enabling high efficiency with good EMI performance and low standby power, high performance MOSFETs in small packages and protections for high reliability and safety. For this purpose, ST offers a wide portfolio of dedicated ICs including PFC controllers working in Transition Mode (TM), smart analog controllers for HB-LLC resonant circuits as well as for synchronous rectification (dedicated to flyback/forward or HB-LLC circuits). The new combo controller (STCMB1) is able to manage both PFC and DC-DC stages. In addition to the high-voltage MDmesh™ MOSFETs series and the low-voltage STripFET MOSFETs, new FERD diodes, new STRVS protections against repetitive over-voltages and voltage reference complete our silicon offer for adapter needs. ST’s DC-DC converters guarantee high power density for post-regulation. The ST devices best suited for each of the most common topologies are listed in the following table.

### Topology example

![Topology example](image)

**Main Evaluation Boards**

- STEVAL-ISA124V1: 75 W, PFC + flyback converter
- STEVAL-ISA170V1: 150 W PFC + HB-LLC
- STEVAL-ISA033V1: 150 W PFC + HB-LLC + opto rect.

Note: * is used as a wildcard character for related part number
**Servers and telecoms (analog solutions)**

Increased output power, power density, energy efficiency and reliability are what server and telecom applications require today. ST offers a high-performing product portfolio reducing the total cost of the solution: SiC diodes (STPSC*), high-voltage MDmesh™ MOSFETs for PFC and DC-DC stages, low-voltage STHigFET MOSFETs for (synchronous rectification stage) and smart controllers are available for the mentioned stages. For the post-regulation, ST’s new high-voltage DC-DC converters offer input-voltage capability up to 61 V and deliver output currents up to 3 A with high switching frequency. High reliability against the inrush current is ensured by new SCRs in the front end stage. The ST devices best suited for each of the most common topologies are listed in the following table.

**Typical configuration**

![Typical configuration diagram](image)

**Servers and telecoms (digital solutions)**

Stringent international standards require, in Server/Telecom applications, greater efficiency, faster and more reliable protection functions, increased flexibility and monitoring that are only practically achievable using a digital approach. From 500 W to 2 kW, ST’s proven digital reference high-efficiency designs are available to help Server/Telecom application designers develop the best possible digital power supply solutions based on STM32 microcontrollers or STNRG digital controllers and advanced MOSFET drivers, including the new STDRIVEsmart advanced gate drivers (L639*, L649*). Very efficient and reliable solutions are ensured by using new high-voltage MDmesh™ MOSFET series in PFC and DC-DC stages, and the new low-voltage STHigFET MOSFETs in the synchronous rectification stage as well as SC diodes (STPSC*). For post-regulation, ST offers new DC-DC converters able to deliver output currents up to 4 A with high switching frequency. High reliability against the inrush current is ensured by new SCRs in the front end stage.

**Digital solution**

![Digital solution diagram](image)

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**Notes:**

1. available in Q3 2016
2. available in Q2 2016
3. is used as a wildcard character for related part number

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**Table:**

<table>
<thead>
<tr>
<th>Controllers</th>
<th>Power MOSFETs</th>
<th>Diodes</th>
<th>DC-DC converters</th>
<th>Linear voltage reg.</th>
<th>SCRs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFC</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Boost</td>
<td>L6981*</td>
<td>ST*N65M5</td>
<td>ST*N65M2</td>
<td>ST*N65M2</td>
<td></td>
</tr>
<tr>
<td>Bridgeless</td>
<td>L6984D*</td>
<td>ST*N65M5</td>
<td>ST*N65M2</td>
<td>ST*N65M2</td>
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</tr>
<tr>
<td>DC-DC stage</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HB-LLC</td>
<td>L60594*</td>
<td>ST*N65M2</td>
<td>ST*N65M2</td>
<td>ST*N65M2</td>
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<tr>
<td>Asym HB</td>
<td>L60591</td>
<td>ST*N65M2</td>
<td>ST*N65M2</td>
<td>ST*N65M2</td>
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<tr>
<td>Sync rect.</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HB-LLC</td>
<td>SRK2000*</td>
<td>ST*N65M2</td>
<td>ST*N65M2</td>
<td>ST*N65M2</td>
<td></td>
</tr>
<tr>
<td>Asym HB</td>
<td>SRK2001</td>
<td>ST*N65M2</td>
<td>ST*N65M2</td>
<td>ST*N65M2</td>
<td></td>
</tr>
</tbody>
</table>

**Typical configuration**

![Typical configuration diagram](image)

**MAIN EVALUATION BOARD**

<table>
<thead>
<tr>
<th>Controllers</th>
<th>Power MOSFETs</th>
<th>Diodes</th>
<th>DC-DC converters</th>
<th>Linear voltage reg.</th>
<th>SCRs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boost</td>
<td>STM32F301</td>
<td>ST*N60M2</td>
<td>ST*N60M2</td>
<td>ST*N60M2</td>
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<tr>
<td>Bridgeless</td>
<td>STM32F334</td>
<td>ST*N60M2</td>
<td>ST*N60M2</td>
<td>ST*N60M2</td>
<td></td>
</tr>
<tr>
<td>DC-DC stage</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>HB-LLC</td>
<td>L6980*</td>
<td>ST*N65M2</td>
<td>ST*N65M2</td>
<td>ST*N65M2</td>
<td></td>
</tr>
<tr>
<td>Asym HB</td>
<td>L6981*</td>
<td>ST*N65M2</td>
<td>ST*N65M2</td>
<td>ST*N65M2</td>
<td></td>
</tr>
<tr>
<td>Sync rect.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HB-LLC</td>
<td>STM32F334</td>
<td>ST*N60M2</td>
<td>ST*N60M2</td>
<td>ST*N60M2</td>
<td></td>
</tr>
<tr>
<td>Asym HB</td>
<td>STM32F301</td>
<td>ST*N60M2</td>
<td>ST*N60M2</td>
<td>ST*N60M2</td>
<td></td>
</tr>
</tbody>
</table>

**Digital solution**

![Digital solution diagram](image)

**MAIN EVALUATION BOARDS**

- STEVAL-ISA142V1: 300 W, Bridgeless PFC + HB-LLC + sync rect.  
- EVLSTRNG-1KW: 1 kW, multi-phase inverter: HB-LLC only
- STEVAL-ISA172V1: 2 kW, multi-phase inverter, Bridge PFC + HB-PS converters
- STEVAL-ISF039V1: Up to 7.4 kW, digital inrush current limiter based on SCRs
INDUSTRIAL WELDING

High efficiency and high switching frequency as well as reduced size and weight are the main requirements for welding applications. ST’s broad power portfolio offers energy and cost-saving products to meet the various welding power ranges. Both PFC and DC-DC stages, phase-shifted full-bridge (PS-FB) as well as two-transistor forward (TTF), can be managed by high-performing STM32 microcontrollers. New high-efficiency and high-power-density SiC MOSFETs (SCT*N120) or the suitable high-frequency series of trench-gate field-stop IGBTs driven by STDRIVEsmart gate drivers (L639*, and L649*) offer optimum performance and reduce cooling requirements and heatsink size while the new STGAP1S galvanically-isolated drivers guarantee high safety and reliability of the welding. Using SiC diodes (STPSC*) further improves system efficiency, taking advantage of silicon carbide’s superior physical characteristics over silicon. The ST devices best suited for industrial welding applications are listed in the following table.

<table>
<thead>
<tr>
<th>MCUs</th>
<th>Gate drivers</th>
<th>IGBTs</th>
<th>DC-DC converters</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFC Boost</td>
<td>STM32F200</td>
<td>PM8834</td>
<td>PM8851</td>
</tr>
<tr>
<td>PS-FB</td>
<td>STM32F200</td>
<td>STG165DFB</td>
<td>STG165DFB</td>
</tr>
<tr>
<td>TTF</td>
<td>STM32F200</td>
<td>STG165DFB</td>
<td>STG165DFB</td>
</tr>
</tbody>
</table>

Typical configuration

Solution based on two-transistor forward topology

LED LIGHTING - GENERAL ILLUMINATION

Residential lighting

LED efficacy and driver IC market requirements are constantly evolving. Residential lighting applications need a high integration level, high efficiency, high power factor (PF), long lifetime, and dimming capabilities as well as a low system cost and component count. ST offers a wide portfolio of highly integrated offline converters up to 15 W (each IC includes a power MOSFET combined with control and protection circuitry on a single chip) working with a high breakdown voltage of 800 V. Among these, HVLED805, HVLED807PF and HVLED815PF LED driver controllers work with a high PF and in constant-current/constant-voltage mode primary-side regulation (PSR-CC/CC) avoiding the need of secondary side regulation ICs and opto-coupler in the circuit, thus reducing costs. Thanks to its high-power-density DC-DC LED driver controllers (controller + MOSFET in the same chip), ST can support MR16 LED replacement lamps for halogen light bulbs.

<table>
<thead>
<tr>
<th>Offline LED driver converters</th>
<th>Offline converters suitable for LED driving</th>
<th>DC/CC controllers</th>
<th>Repetitive overvoltage protection</th>
<th>Clamping diodes</th>
<th>Output diodes</th>
<th>DC-DC LED driver converters</th>
</tr>
</thead>
<tbody>
<tr>
<td>MR16 halogen bulb replacement</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Buck, Buck-boost</td>
<td>VIPer0P VIPer01 VIPer08 VIPer06</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HPF Buck-boost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HPF Flyback</td>
<td>PSR-CC/CC</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
</tbody>
</table>

Typology example

Offline LED driver converter

Solution based on two-transistor forward topology

MAIN EVALUATION BOARDS

EVLHLED815W10A 10 W, buck-boost LED driver
STEVAL-ILO355V1 11 W, flyback LED driver
EVLHLED815W15 15 W, flyback LED driver

Note: * is used as a wildcard character for related part number
Commercial and architectural lighting

Commercial and architectural lighting applications usually require more than 20 W, a high power factor, high level of efficiency, cost-saving solution and the possibility of using more than one LED string with remote monitoring. In a single string case, working in constant-current primary-side regulation (PSR-CV) mode, ST’s new flyback offline LED driver controller HVLED001 (for flyback) directs the single string without having to use an optocoupler and secondary-side controller in the circuit. The multiple strings power supply architecture consists of a main power supply (usually a flyback) providing a constant bus voltage and subsequent multiple strings. ST’s offline LED controllers HVLED001* (for flyback) with constant-voltage primary-side regulation (PSR-CV) is available for the main SMPS. Multiple strings can be managed using analog or digital means. High power-density DC-DC LED driver buck converters (LED2000, LED2001, LED5000 and LED6000) or the new HVLED002 controller for reverse buck, are used for an analog implementation. To digitally manage multiple strings stage reverse buck, ST offers STLUX, a new series of dedicated digital lighting controllers as well as STM32 high-performance microcontrollers. ST’s high-voltage MOSFET series (suggested for flyback) and the low-voltage STrIFET MOSFET series (used for reverse buck topologies) ensure all solutions are very efficient and reliable.

Typical configurations

<table>
<thead>
<tr>
<th>DC bus</th>
<th>Buck</th>
<th>LED driver controller</th>
<th>MCU, digital controller</th>
<th>Digital multiple strings mgmt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1^ string</td>
<td>1^ string</td>
<td>Analog multiple strings mgmt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reverse Buck</td>
<td>Reverse Buck</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>n^ string</td>
<td>n^ string</td>
<td></td>
</tr>
<tr>
<td>Buck</td>
<td></td>
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</tr>
</tbody>
</table>

Street lighting

Energy efficiency, long lifetime, remote control, small form factor and extended temperature range (-40 °C) are the main requirements for the LED street lighting market. For single string, it is possible to implement the primary side regulation (PSR-CV) control technique using a digital approach with a PFC regulator followed by a HB-LC resonant stage. The multiple strings power supply architecture consists of a main power supply providing a constant bus voltage and a subsequent multiple strings. Usually the main power stage, consisting of a high power factor (HPF) flyback converter or a power factor correction (PFC) controller combined with an LLC resonant converter, provides the constant voltage bus. The subsequent LED strings control is implemented by multiple buck or reverse buck converters. ST offers analog and digital solutions to cover both stages (power and LED control).

### Typical configurations

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HFP Flyback</td>
<td>PSP-CV</td>
<td>PSP-CV</td>
<td>PSR-CC</td>
<td>PSR-CC</td>
</tr>
<tr>
<td>HFP Flyback</td>
<td>HVLED001</td>
<td>HVLED001</td>
<td>HVLED001</td>
<td>HVLED001</td>
</tr>
<tr>
<td>Multiple strings</td>
<td>STULUX*</td>
<td>STM32F334</td>
<td>STM32F334</td>
<td>STM32F334</td>
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<tr>
<td>Reverse Buck</td>
<td>TD35*</td>
<td>PM8834</td>
<td>PM8834</td>
<td>PM8834</td>
</tr>
<tr>
<td>LED driver</td>
<td>ST*N10F7-</td>
<td>ST*N10F7-</td>
<td>ST*N10F7-</td>
<td>ST*N10F7-</td>
</tr>
<tr>
<td>converters</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>DC-DC</td>
<td>-</td>
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<td>-</td>
</tr>
</tbody>
</table>

### Typical configuration

~AC → PFC → HB-LLC → DC bus → Reverse Buck → MCU, digital controller

<table>
<thead>
<tr>
<th>DC bus</th>
<th>Reverse Buck</th>
<th>MCU, digital controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>1^ string</td>
<td>Reverse Buck</td>
<td>MCU, digital controller</td>
</tr>
<tr>
<td>n^ string</td>
<td>Reverse Buck</td>
<td>MCU, digital controller</td>
</tr>
</tbody>
</table>

### Fully digital multi-string LED driver solution

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</tbody>
</table>

Note: 1: available in Q3 2016      *: is used as a wildcard character for related part number
In regard to analog solutions, ST’s has a wide offer. The new flyback offline LED controllers (HVLED001*) with constant-voltage primary-side regulation (PSR-CV) does not need an opto-coupler and voltage reference in the circuit (lower costs). The new STCMB1 smart offline combo controller for PFC and HB-LLC resonant circuits, the new HVLED002 led driver controller for reverse buck, and the dedicated high-voltage/high-current DC-DC LED driver converters (LED5000 and LED6000) for LED strings management ensure easy and efficient analog solutions. For high-efficiency and flexible digital solutions, ST offers STLUX, a new series of dedicated digital lighting controllers, along with high-performance STM32 microcontrollers to manage both power and LED driving (reverse buck) stages. The new high-voltage MDmesh™ MOSFETs series (suggested for flyback, PFC and LLC stages), the low-voltage StripFET MOSFETs series (used in reverse buck topologies) and the SiC diodes (STPSC*) make sure that solutions are very efficient and reliable.

Note: *: is used as a wildcard character for related part number

**MAIN EVALUATION BOARDS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEVAL-ILL053V1</td>
<td>120 W, analog power supply (CV) for LED driving</td>
</tr>
<tr>
<td>STEVAL-ILL056V1</td>
<td>48 V/2.5 A, buck LED driver converter</td>
</tr>
<tr>
<td>STEVAL-ILL066V1</td>
<td>100 W, digital single-string LED driver</td>
</tr>
<tr>
<td>STEVAL-ILL073V1</td>
<td>130 W, analog power supply (CVout) for LED driving</td>
</tr>
<tr>
<td>STEVAL-ILL074V1/V2</td>
<td>60 W, digital multiple-string LED driver</td>
</tr>
<tr>
<td>STEVAL-ILL077V1</td>
<td>60 W, digital multiple-string LED driver</td>
</tr>
<tr>
<td>STEVAL-ILL078V1</td>
<td>60 V-1 A, buck LED driver converter</td>
</tr>
</tbody>
</table>

Note: 1: available in Q2 2016

**MAJOR HOME APPLIANCES**

**Air conditioning**

The air conditioning market requires low-cost and high-energy-efficiency solutions. Thank to its product portfolio, ST is able to satisfy these requirements with suitable, dedicated power products for both power factor correction (PFC) and 3-phase inverter stages managed by high-performing STM32 microcontrollers combined with complementary new STDRIVESmart gate drivers (L639*, L649*), using new SiC diodes (STPSC*), high-efficiency PFC is guaranteed by the usage of new high-voltage MDmesh™ MOSFETs or suitable field-stop trench-gate IGBTs. To reduce the 3-phase inverter CTM design time and implementation efforts, ST offers the SSLIMM™ family (small, low-loss, intelligent molded module) of highly-integrated, high-efficiency industrial power modules (IPM) integrating the power stage, driving network and protections and features. Another approach for designing a 3-phase inverter is based on the use of six discrete IGBTs/MOSFETs and gate drivers mentioned before. High- and low-voltage DC-DC converters guarantee high power density for the post-regulation stages. High reliability against the inrush current is ensured by new SCRs in the front-end stage. The ST devices best suited for air conditioning applications are listed in the following table.

**Typical configuration**

**MAIN EVALUATION BOARDS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEVAL-IHM034V2</td>
<td>1.5 kW, dual motor control with PFC</td>
</tr>
<tr>
<td>STEVAL-IHT008V1</td>
<td>1 kW, digital inrush current limiter based on Triac</td>
</tr>
</tbody>
</table>

Note: 1: available in Q2 2016

*: is used as a wildcard character for related part number
Induction heating

The induction heating market demands cost-effective, energy-efficient and reliable solutions. Resonant switching topologies, based on voltage or current resonance, are the most adopted and can be managed using high-performing STM32 microcontrollers. To best meet these requirements and fit the selected topologies, ST has developed the dedicated IH (1250 V) and HB (650 V) series of trench-gate field-stop IGBTs. Complementary new STDRIVEsmart gate drivers family (L638*, L639*, L649*) improves the reliability (robustness and noise immunity) of the application. Depending on your needs, new 8/16 channels LED array drivers allow to have an user-friendly human interface. ST's complete offer is given in the following table.

<table>
<thead>
<tr>
<th>Topology example</th>
<th>MCUs</th>
<th>Gate drivers</th>
<th>IGBTs</th>
<th>LED array drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-switch quasi-resonant (voltage resonance)</td>
<td>STM8*</td>
<td>TSD31* PM6841 PM6851</td>
<td>STGW*H125DF</td>
<td>-</td>
</tr>
<tr>
<td>HB series resonant (current resonance)</td>
<td>STM32F0* STM32F100</td>
<td>L638* L639* L649*</td>
<td>STGW<em>H65DFB STGW</em>H60DFB</td>
<td>-</td>
</tr>
<tr>
<td>User interface (front panel)</td>
<td>STM8* STM32F0* STM32F100 STM32F27*</td>
<td>- - -</td>
<td>STP08* STPH* LED1642GW</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: * is used as a wildcard character for related part number

Typical configuration

- Central inverter
- DC-DC converters
- Bypass switches
- HV power MOSFETs
- IGBTs
- Diodes

<table>
<thead>
<tr>
<th>Junction box</th>
<th>DC-DC stage</th>
<th>DC-AC stage</th>
<th>Central inverter</th>
<th>Typical configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>STGW<em>S120DF3 STGW</em>M65DF2</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>STGW<em>S120DF3 STGW</em>M120DF3 STGW*S120DF3</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>STGW<em>S120DF3 STGW</em>M120DF3 STGW*M65DF2</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>STGW<em>S120DF3 STGW</em>M120DF3 STGW*M65DF2</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: * is used as a wildcard character for related part number

RENEWABLE ENERGY & HARVESTING

Photovoltaic (centralized)

Centralized photovoltaic (PV) energy solutions use a central inverter architecture characterized by a single central inverter (where the entire DC output of a PV array is transformed and connected to the AC grid) and, at the panel level, by a junction box that provides only the bypass function and helps prevent localized hotspots. For the junction box, ST offers two products families with a very low forward voltage and a low leakage reverse current: cool bypass switches (dedicated high-efficiency photovoltaic ICs) and the new FERD diodes. By integrating high-performance STM32 microcontrollers, the new high-efficiency SiC MOSFETs (STC*N120), the new trench-gate field-stop IGBTs series, the SC diodes (STPSC*) and the new STGAP1S galvanically-isolated gate drivers, it’s possible to guarantee a high-efficiency central inverter implementation. High- and low-voltage DC-DC converters guarantee high power density for the post-regulation stages. Due to their low per watt costs and the simplicity of design, central inverters are the power conversion systems of choice for large PV power plants.
Photovoltaic (distributed)

A distributed photovoltaic (PV) energy architecture converts power using an embedded maximum power point tracking (MPPT) mechanism at the PV panel level. A partially distributed approach integrates a power optimizer (a DC-DC converter with MPPT and communication capabilities) and a central inverter for the DC-AC conversion and grid connection. In regards to the power optimizer, the bypass function is covered by ST with two products: families featuring a very low forward voltage and low leakage reverse current: cool bypass switches (dedicated high-efficiency photovoltaic ICs) and new FERD diodes. The new high-efficiency SiC MOSFETs (SCT*N120) and the new trench-gate field-stop IGBTs series, guarantee a high-efficiency DC-AC central inverter. The fully distributed approach integrates, at the PV panel level, a microinverter that includes a complete converter (DC-DC with MPPT as well as DC-AC) and manages the AC grid connection. The high-performing STM32 microcontrollers, the new high-efficiency high-voltage MDmesh™ MOSFET series, the new low-voltage STripFET MOSFET series and the SiC diodes (STFSC*) guarantee a high-efficiency converter while the new STGAP1S galvanically-isolated gate drivers offer high safety and reliability. High- and low-voltage DC-DC converters guarantee high power density for the post-regulation stages.

Typical configurations

A partially distributed approach integrates an STGW*H120DF2 Interl. Boost stage for high-voltage DC bus, STM32F103 microcontroller for central inverter control, STPS*45 diodes for power optimization, STEVAL-ISV003V2 main evaluation board for high power density, and a high voltage DC bus (HV power optimizer) powered by STGW*H65DFB. An STGW*H120DF2 microinverter with STM32F103 central inverter, STPS*45 diodes, and STEVAL-ISV003V2 main evaluation board is used for a fully distributed approach.

Solar – Thermo electric generator (TEG)

Today’s Internet of Things (IoT) is based on the exchange of data among remote sensing units, often in a large number and located in very inaccessible places, necessitating energy-wise and fully autonomous devices to guarantee service continuity and very low maintenance cost. Also consumer portable applications (smartphone, camera, fitness, etc) need more and more continuous autonomous energy sources. This means using a battery charger powered by a harvested or renewable energy source with high conversion efficiency and its proper battery charging management. To meet this demand, ST offers dedicated products like the SPV1040 high-efficiency low-power solar constant-voltage (CV) battery charger with MPPT for outdoor, and the SPV1050 ultra low power solar and TEG energy-harvesting charger for any battery type and supercapacitor in indoor environments with embedded MPPT and LiDOS. These requirements involve not only the electronics but also reliable, good-quality Li-Ion batteries. ST also provides ultra-thin, fast recharging Li-Ion batteries with a long cycle life and low capacity loss, making them suitable for renewable energy and harvesting applications. The ST devices best suited for each of the most common topologies are listed in the following table.

### Typical configuration

**Boost topology**

- **Solar panel**
- **Battery charger with MPPT**
- **Thermo electric generator (TEG)**
- **Consumer portable**
- **Climate monitoring**
- **Industrial monitoring**
- **Body monitoring**

**Low-power solar battery chargers with MPPT**

<table>
<thead>
<tr>
<th>Device</th>
<th>SPV1040</th>
</tr>
</thead>
<tbody>
<tr>
<td>CV battery charger</td>
<td>-</td>
</tr>
<tr>
<td>Back-boost</td>
<td>-</td>
</tr>
</tbody>
</table>

**Ultra-low-power solar & TEG battery chargers with MPPT**

<table>
<thead>
<tr>
<th>Device</th>
<th>SPV1050</th>
</tr>
</thead>
<tbody>
<tr>
<td>CV battery charger</td>
<td>-</td>
</tr>
<tr>
<td>Back-boost</td>
<td>-</td>
</tr>
</tbody>
</table>

**Li-ion battery**

<table>
<thead>
<tr>
<th>Device</th>
<th>SPV1050</th>
</tr>
</thead>
<tbody>
<tr>
<td>CV battery charger</td>
<td>-</td>
</tr>
<tr>
<td>Back-boost</td>
<td>-</td>
</tr>
</tbody>
</table>

### Typical configurations

- **Partial distribution**
  - **High Voltage DC bus (HV power optimizer)**
  - **DC-AC (Central inverter)**
  - **Main evaluation board**: STEVAL-ISV003V2 (250 W microinverter)

- **Fully distribution**
  - **DC-DC (Microinverter)**
  - **AC grid**
  - **Microinverter**

**Notes:** * is used as a wildcard character for related part number
UNINTERRUPTABLE POWER SUPPLIES (UPS)

Today the vast increase of sensitive loads due to the explosion in digital technology requires a high-quality supply of electrical power. In addition to its primary function of ensuring the continuity of service, an uninterruptable power supply (UPS) improves the quality of the voltage supplied to the load (computer, industrial processes, instrumentation, telecommunication, etc.). The double-conversion configuration usually is used for high-end applications in particular for medium- or high-power UPSs; offline systems are adopted for low power applications. Each stage of these configurations (PFC, charge controller, etc.) is supported by ST’s portfolio. SiC diodes (STPSC*), new high-voltage MDmesh™ MOSFETs (M2, DM2, M5 series), new low-voltage STripFET MOSFETs (F6, F7 series), trench-gate field-stop IGBTs, SiC MOSFETs (SCT*N120), new STGAP1S galvanically-isolated gate drivers and high-performance STM32 microcontrollers guarantee high reliability and efficiency.

WIRELESS CHARGING

In the coming years, wireless charging applications will become more and more common for a wide range of applications starting with today’s smartphone charging. ST already offers dedicated and general-purpose wireless ICs for Transmitter (Tx) and Receiver (Rx) side able to support Qi/PMA market standard and the main topologies: STWBC-WA (Tx) and STWLC04 (Rx) for wearables, STWBC (Tx) and STWLC03 (Rx) for the other mobile applications. The use of new low-voltage STripFET MOSFETs guarantees high-efficiency converters. To reduce the time to market, a complete wireless kit (Tx + Rx) for wearables and a general-purpose wireless evaluation boards are available.

Example of high-end configuration

<table>
<thead>
<tr>
<th>MCDs</th>
<th>Gate drivers</th>
<th>IGBTs</th>
<th>Power MOSFETs</th>
<th>Diodes</th>
<th>SCR</th>
<th>Triacs</th>
<th>Linear voltage regulators</th>
<th>DC-DC Coms.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rect. &amp; inrush current limiter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>STTH3012</td>
<td>STTH6012</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PFC Boost</td>
<td>PM6834</td>
<td>PM6841</td>
<td>PM6851</td>
<td>STWBC02</td>
<td>STWBC02</td>
<td>-</td>
<td>T6321</td>
<td>-</td>
</tr>
<tr>
<td>Charge controller</td>
<td>L636*</td>
<td>L639*</td>
<td>L64*</td>
<td>STWBC02</td>
<td>STWBC02</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DC-DC stage</td>
<td>STM31P2*</td>
<td>STM31P2*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DC-AC stage</td>
<td>STM31P2*</td>
<td>STM31P2*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bypass</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: * is used as a wildcard character for related part number
eDesignSuite

eDesignSuite is an easy-to-use, comprehensive software suite ready to help customers define their needs by transforming their application requirements into satisfactory solutions based on the wide range of ST products. The suite includes a smart simulator and system design engine able to suggest products and topologies for various types of applications (power supply, photovoltaic, battery charger, LED lighting, signal conditioning and RF design); smart selectors to help select the types of products (e.g. diodes) best suited to your application; and configurators to reduce implementation time and efforts for setting product parameters for the specific application (e.g. STLUX & STNRG SMEDs for lighting and power, Workbench for motor control). To discover and test all the features of eDesignSuite, you can visit (after the online registration) https://my.st.com/analogsimulator/

SMART SIMULATOR AND SYSTEM DESIGN ENGINE

Power conversion and LED lighting
- Automatic proposal for complete solution or fully customizable design
- Fully annotated and interactive schematics
- Complete and interactive bill of materials

SMART SELECTION

Diodes
- Set of analysis diagrams (main current and voltage simulations, efficiency curves, Bode stability and power-loss data)
- Fully interactive transformer design

CONFIGURATORS

STLUX & STNRG SMEDs configurator
- SMED configurator schemes
- Input configuration
- Clock, comparators and ADC settings
- FSM (finite state machine) configuration
- Load register setting on board in a click

SMART SIMULATOR AND SYSTEM DESIGN ENGINE VIEW

AC-DC CONVERSION ICs

High-voltage converters
ST’s high-voltage AC-DC converters combine an advanced pulse width modulation (PWM) controller with a high-voltage power MOSFET in a single package. This makes them ideally suited for offline switch mode power supplies (SMPS) with output power spanning from a few to a few tens of watts.

The VIPerPlus series (VIPer0P, VIPer01 devices and VIPer5, VIPer6, VIPer7, VIPer8 families) features an 800 V avalanche-rugged power MOSFET and leading-edge PWM controller and consumes less than 4 mW for VIPer0P, 12 mW for VIPer01 and 30 mW in standby for the others. It also comes with the largest choice of protection schemes and supports different topologies.

The Altair series has a built-in 800/900 V avalanche-rugged power MOSFET and a PWM controller specifically designed to work in constant-current/constant-voltage primary-side regulation (PSR-CC/CC). It means opto-less implementation, thus significantly reducing component count.

Products

VIPerPLUS & ALTAIR

- PWM controller + HV power MOSFET in the same package
- Increased robustness using 800 V AR MOSFET
- Extremely low consumption
- Better integration and minimal BoM
- Flexible and easy to use
- Flyback topology supported
- Regulation with optocoupler using all ICs
- PSR-CC using VIPer0P, VIPer01 and VIPer*6
- PSR-CC/CC and tight tolerance using ALTAIR*
- Buck & buck-boost topologies supported by VIPer0P, VIPer01 and VIPer*6

<table>
<thead>
<tr>
<th>POUT</th>
<th>VIPer01</th>
<th>VIPer25</th>
<th>VIPer35</th>
<th>VIPer26</th>
<th>VIPer36</th>
<th>VIPer37</th>
<th>VIPer38</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 W</td>
<td>VIPer01</td>
<td>VIPer26</td>
<td>VIPer36</td>
<td>VIPer37</td>
<td>VIPer38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 W</td>
<td>VIPer01</td>
<td>VIPer26</td>
<td>VIPer36</td>
<td>VIPer37</td>
<td>VIPer38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 W</td>
<td>VIPer01</td>
<td>VIPer26</td>
<td>VIPer36</td>
<td>VIPer37</td>
<td>VIPer38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 W</td>
<td>VIPer01</td>
<td>VIPer26</td>
<td>VIPer36</td>
<td>VIPer37</td>
<td>VIPer38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 W</td>
<td>VIPer01</td>
<td>VIPer26</td>
<td>VIPer36</td>
<td>VIPer37</td>
<td>VIPer38</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ALTAIR04
All primary sensing

ALTAIR05
All primary sensing

V_MOS = 800 V, 900 V (ALTAR05)

MAIN APPLICATIONS

Consumer electronics
- Factory automation
- Home appliances
- Lighting
- Metering
- Home automation

Note: * is used as a wildcard character for related part number
### PFC controllers

ST power factor correction (PFC) controllers operate in transition mode (TM, suitable for $P \leq 250$ W) and continuous current mode (CCM, suitable for $P > 250$ W), and are suitable for a wide-range-mains operation. These devices embed advanced protection features, which make SMPS more robust and compact, requiring fewer external components. These features include output overvoltage, brown-out, feedback disconnection and boost inductor saturation protection. The high-voltage start-up capability, present in the L6564H and L6563H, helps improve the SMPS standby efficiency in systems that do not include an auxiliary power supply.

### PWM, resonant and combo controllers

ST’s portfolio of advanced controllers includes a variety of primary controllers intended to fit high-performance applications. Very high efficiency is achieved with single-ended topologies at a fixed switching frequency or with quasi-resonant operation; the new STCH02 offline constant-current primary-side regulation controller (PSR-CC) guarantees very low power consumption at no load condition. For high-power, high-current applications, ST offers controllers for half-bridge resonant and asymmetrical half-bridge topologies. The new STCMB1 combo controller including high-voltage start-up, Xcap discharge circuit, PFC and LLC resonant driving stages, guarantees high performance and high integration with a smaller pinout.

### MAIN APPLICATIONS

**Adapters and TVs**
- L6562A*, L6563*, L6564*

**Commercial, architectural and street lighting**
- L6562A*, L6563*, L6564*, L4981*, L4984D

**Desktop PCs and servers**
- L4981A, L4984D

**Flyback controllers**
- STCH02
  - Offline quasi-resonant controller in SO-8 package
  - Constant-current primary-side regulation mode (PSR-CC) or constant-voltage regulation with optocoupler
  - Advanced burst mode operation (< 10 mW consumption @ no load)
  - 650 V HV start-up
- L6566*
  - Offline fixed-frequency or quasi-resonant controllers
  - S suited for SMPS with PFC front-end (A version)
  - S suited for SMPS with 3-phase mains (BH version)
  - 700 V start up (A/B version), 840 V start up (BH version)

**Line-modulated, fixed-off-time (LM-FOT) control**
- L6564*

**Fixed frequency, average-current mode**
- L6563*

**Line modulated frequency, average-current mode**
- L4984D

**Asymmetrical half-bridge controller**
- L6591
  - PFC interface
  - Brown out
  - 700 V start-up voltage

**HB-LLC resonant controllers**
- L6699

**Basic features**
- Anti-capacitive protection
- Soft burst mode
- Smooth Start-up

**Main applications**

**Asymmetrical half-bridge controller**
- L6565
  - Constant power vs mains change
  - Ultra-low start-up current

---

Note: * is used as a wildcard character for related part number
Synchronous rectification controllers

Synchronous rectifiers are used to drive power MOSFETs that replace the rectification diodes in the secondary side of SMPS, thus providing high efficiency especially in low-output-voltage, high-current power supplies. The product portfolio supports the most common flyback, forward and LLC resonant topologies. The main benefits include high efficiency, space saving, cost reduction and high reliability.

SR controllers for Flyback
STSR30
- Possibility to operate in discontinuous mode
- Automatic turn-off for D<14%

SR controllers for Forward
STSR2P*
- Possibility to operate in discontinuous mode
- Smart turn-off anticipation timing

SR controllers for LLC resonant

<table>
<thead>
<tr>
<th>Basic features</th>
<th>Matched turnoff threshold</th>
<th>Self compensation for the inductance of MOSFET package</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRK2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRK2000A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRK2001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SYNCHRONOUS RECTIFICATION BENEFITS
- Improved efficiency
- Better thermal performance
- High power density
- Increased reliability

Voltage and current controllers
ST offers a wide range of highly-integrated voltage controllers for constant-voltage (CV), constant-current (CC) SMPS applications, such as adapters, battery chargers and LED pilot lamps. They enable a more robust design, safer SMPS, very low power dissipation and low stress for secondary-side components.

SEA05 internal block diagram

CC/CV controllers for chargers, adapters and others

<table>
<thead>
<tr>
<th>SEA01</th>
<th>SEA05</th>
<th>TSM10*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced CC/CV controller with online digital trimming</td>
<td>Advanced CC/CV controller with efficient LED pilot lamp driver</td>
<td>Compact solution</td>
</tr>
<tr>
<td>0.1% voltage reference precision up to 36 Vcc</td>
<td>0.5% voltage reference precision up to 36 Vcc</td>
<td>Easy compensation</td>
</tr>
<tr>
<td>200 µA low quiescent current</td>
<td>Low quiescent current: 200 µA (SEA05), 250 µA (SEA05L)</td>
<td>0.5 and 1% voltage reference precision</td>
</tr>
</tbody>
</table>

SEA01 internal block diagram

SEA05L internal block diagram

MAIN APPLICATIONS

<table>
<thead>
<tr>
<th>High-power adapters and TVs</th>
<th>Desktop PCs and Servers/Telecom</th>
</tr>
</thead>
</table>

MAIN APPLICATIONS

<table>
<thead>
<tr>
<th>Adapters</th>
<th>Battery chargers</th>
<th>Residential, commercial, architectural and street lighting</th>
</tr>
</thead>
</table>

Note: *: is used as a wildcard character for related part number
BATTERY MANAGEMENT ICs

Battery chargers and battery monitoring ICs

ST’s battery chargers are specifically designed for the portable and mobile markets, and add value to new designs by minimizing power consumption and reducing the space on the PCB. These products offer charge currents from as little as 200 mA up to 1.2 A and can be used for any rechargeable lithium-ion and Li-Polymer battery. Using very simple topologies, some of these devices also feature a power-path function offering instant-on operation and thermal regulation according to the JEITA international standard.

Battery chargers

<table>
<thead>
<tr>
<th>Current (A)</th>
<th>Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>STBCFG01</td>
</tr>
<tr>
<td>1</td>
<td>L6924U, L6924D</td>
</tr>
<tr>
<td>0.8</td>
<td>STBC08, STC4054</td>
</tr>
<tr>
<td>0.65</td>
<td>STBC02</td>
</tr>
<tr>
<td>0.2</td>
<td>STNS01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching battery charger &amp; voltage mode fuel gauge, 500 mA OTG</td>
</tr>
<tr>
<td>Linear charger for Li-Ion and Li-Polymer battery packs</td>
</tr>
<tr>
<td>Thermal regulation, USB power specification supported</td>
</tr>
<tr>
<td>LDO integrated, USB compatible, Power path, Swire</td>
</tr>
<tr>
<td>LDO integrated, USB compatible</td>
</tr>
</tbody>
</table>

Battery monitoring

<table>
<thead>
<tr>
<th>Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCT3115</td>
</tr>
<tr>
<td>SCT3117</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>OptimGauge™ algorithm for STC3115</td>
</tr>
<tr>
<td>OptimGauge™ algorithm for SCT3117</td>
</tr>
<tr>
<td>Coulomb counter and voltage gas gauge operations</td>
</tr>
<tr>
<td>Programmable low battery alarm</td>
</tr>
<tr>
<td>Internal T sensor</td>
</tr>
</tbody>
</table>

MAIN APPLICATIONS

Bluetooth accessories

STBC08, STC4054

Smartphones

STBC02, L6924U, L6924D, STBC08, STC4054, STBCFG01, SCT3115, SCT3117

Portable media players

STBC02, L6924U, STNS01, STC3115, STC3117

Digital cameras

L6924U, L6924D, STC3115, STC3117

Wireless charging ICs

ST fully covers wireless charging applications with dedicated ICs for both transmitter and receiver sides. The STWBC, compatible with Qi standard, and the STWBC-WA, dedicated to wearable applications, make up ST’s wireless power transmitters (Tx) family. The receiver family (Rx) consists of the STWLC04 dedicated to wearable application and the STWLC03, compliant with both Qi and PMA standards, which is suitable for smartphones, tablets, medical applications.

Wireless power transmitters

<table>
<thead>
<tr>
<th>Device</th>
<th>MAIN APPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STWBC</td>
<td>Wireless battery charger transmitters</td>
</tr>
<tr>
<td>STWBC-WA</td>
<td>Medical &amp; healthcare equipment</td>
</tr>
<tr>
<td></td>
<td>Tablets and smartphones</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supports applications up to 5 W</td>
</tr>
<tr>
<td>Qi A11 certified</td>
</tr>
</tbody>
</table>

Wireless power receivers

<table>
<thead>
<tr>
<th>Device</th>
<th>MAIN APPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STWLC03</td>
<td>Wireless battery charger transmitters</td>
</tr>
<tr>
<td>STWLC04</td>
<td>Medical &amp; healthcare equipment</td>
</tr>
<tr>
<td></td>
<td>Tablets and smartphones</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supports applications up to 7.5 W</td>
</tr>
<tr>
<td>Multiple Qi and PMA standard compliant</td>
</tr>
</tbody>
</table>

STWLC04

<table>
<thead>
<tr>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supports applications up to 1 W</td>
</tr>
<tr>
<td>Wireless power receiver dedicated to wearables</td>
</tr>
</tbody>
</table>

Common features

- Digital feedback with foreign object detection (FOD)
- Smart standby (3 mW consumption)
- GUI for configuration and run-time analysis
- Firmware customization via AP

STWLC03

<table>
<thead>
<tr>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supports applications up to 1 W</td>
</tr>
<tr>
<td>Wireless power receiver dedicated to wearables</td>
</tr>
</tbody>
</table>

Common features

- 32-bit embedded core
- Integrated buck converter with sync rectifier
- Foreign object detection (FOD) feature for safe operation
- Direct charge of Li-Ion battery support

STWLC04

<table>
<thead>
<tr>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supports applications up to 5 W</td>
</tr>
<tr>
<td>Qi A11 certified</td>
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</table>

STWLC03

<table>
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<tbody>
<tr>
<td>Supports applications up to 1 W</td>
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<tr>
<td>Wireless power receiver dedicated to wearables</td>
</tr>
</tbody>
</table>

Common features

- Digital feedback with foreign object detection (FOD)
- Smart standby (3 mW consumption)
- GUI for configuration and run-time analysis
- Firmware customization via AP

Note: * is used as a wildcard character for related part number.
DC-DC CONVERSION ICs

DC-DC converters
ST offers a wide portfolio of monolithic DC-DC switching converters (i.e. controller and MOSFET in the same package). This broad portfolio of ICs is composed of highly-specialized products to meet every market requirement. High reliability and robustness for industrial (factory automation, UPS, solar, home appliances, lighting, etc.) and other high-voltage applications. High efficiency at any load and a high level of performance for consumer (smartphones, digital cameras, portable fitness devices, LED TVs, set top boxes, Blue-ray players, computer & storage, etc) and server/telecom applications.

Note: *: is used as a wildcard character for related part number

MAIN APPLICATIONS

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</table>

DC-DC CONVERTERS
MAIN FEATURES
• Up to 61 V Vin /3 A
• Synchronization capability
• Internal compensation
• Low consumption
• Adjustable fsw
• Internal soft start
• Low quiescent current

Synchronous buck converter
Asynchronous buck converter

Vin Vout Controller

Vinmax, Ioutmax
4.8 V 170 mA
5.5 V 0.5 - 0.6 A
6 V 0.7 - 0.8 A
16 V 1.5 A
18 V 0.7 - 4 A
20 V 0.35 A
36 V 0.4 - 3 A
38 V 0.5 - 5 A
46 V 0.4 - 6 A
55 V 3.5 A
61 V 2 - 3 A

MAIN APPLICATIONS

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</tbody>
</table>

DC-DC controllers
ST offers a wide portfolio of DC-DC switching controllers for server and telecom applications according to market requirements: single-phase controllers with embedded drivers, advanced single-phase controllers with embedded non-volatile memory (NVM), and our newest controllers with or without SPS (Smart Power Stage) compatibility as well as multiphase digital controllers for CPU & DDR memory power supplies.

Single-phase Buck controllers

L672* Single-phase cost effective PWM controller
L673* Single-phase PWM controller with embedded driver and light load efficiency optimization
L6987 Single-phase PWM controller up to 35 Vin
PM7744 Advanced single-phase controller with NVM (non-volatile memory) and telemetry
PM6697 Analog single-phase controller with SVID with or without SPS compatibility
PM6680 Dual-output PWM controller up to 36 Vin

Multi-phase Buck controllers

PM676* Fully digital buck controller with PMBus for CPU/DDR
PM677* Fully digital buck controller with PMBus for advanced CPU/DDR

MAIN APPLICATIONS

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Note: *: is used as a wildcard character for related part number

Note: *: is used as a wildcard character for related part number
DIGITAL CONTROLLERS/MICROCONTROLLERS

Digital controllers
ST’s offers a number of advanced digital controllers, featuring innovative solutions to optimize converter efficiency in a wide range of load conditions (especially at light loads) and to have more flexibility. ST offers two main digital controller families tailored for specific applications: STLUX for lighting and STNRG for power conversion. In STLUX and STNRG families, the innovative SMED (state machine, event-driven) digital technology and the integrated microcontroller make STLUX and STNRG easily programmable and versatile. SMED is a hardware state machine triggered by internal or external events.

Digital controllers tailored for power conversion and lighting applications

- **STNRG**
  - Digital controller tailored for power conversion
  - Up to 4 comparators with external reference

- **STLUX**
  - Digital controller tailored for lighting applications
  - Suitable for primary-side regulation and multi-string lighting applications
  - DALI 2.0 for remote control and connectivity

Common features
- Innovative digital control technique based on 6 programmable SMEDs with max PWM resolution of 1.3 ns
- Customizable algorithm for higher conversion efficiency
- Internal 96 MHz PLL
- Operating temperature -40 to 105°C
- Serial, I2C and GPIO interfaces

STNRG*
- Digital controller tailored for power conversion
- Up to 4 comparators with external reference

STLUX*
- Digital controller tailored for lighting applications
- Suitable for primary-side regulation and multi-string lighting applications
- DALI 2.0 for remote control and connectivity

Microcontrollers
The 32-bit microcontrollers most suitable for power management applications are those of the entry-level STM32F0 series and the STM32F334 MCU from the mixed-signal STM32F3 series. The STM32F0 series has a 32-bit ARM® Cortex®-M0 core and is particularly well suited for cost-sensitive applications. STM32F0 MCUs combine real-time performance, low-power operation, and the advanced architecture and peripherals of the STM32 platform. The STM32F334 MCU combines a 32-bit ARM® Cortex®-M4 core (with FPU and DSP instructions) running at 72 MHz with a high-resolution timer (217 ps) and complex waveform builder plus event handler. This MCU specifically addresses digital power conversion applications such as digital switched-mode power supplies, lighting, welding, solar and wireless charging high number of integrated analog peripherals leading to cost reduction at the application level and a simplification of the application design.

STM32F334, the MCU tailored for digital SMPS
- Cortex®-M4 core
- High resolution timer with waveform builder and event handler
- High-speed ADCs for precise and accurate control
- Built-in analog peripherals for signal conditioning and protection (20ns from fault input to PWM stop)

STM32 F0 series, the MCUs for cost sensitive applications
- Cortex®-M0 core
- Entry level, from 16 to 256 Kbytes
- USB crystal-less TSSOP20
- 6 Kbytes, 32-bit

STM32F334 features
- ARM Cortex-M4 72 MHz
- Nested vector interrupt controller (NVIC)
- JTAG/SW debug
- 20-byte backup register
- 8-byte CCM code-SRAM
- 64-Kbyte Flash memory
- 4-byte I2C
- 2x CAN 2.0B
- 1x SPI
- 1x I2C
- 1x CAN 2.0B
- 1x SPI
- 1x I2C
- 1x USART/LIN, smartcard, IrDA, modem control
- 1x IrDA
- 1x USART/LIN, smartcard, IrDA, modem control
- 1x SPI
- 1x I2C
- 1x USART/LIN, smartcard, IrDA, modem control
- 1x SPI
- 1x I2C
- 1x USART/LIN, smartcard, IrDA, modem control

STM32F334
- 32-bit ARM-based MCU
- 72 MHz ARM Cortex-M4 core
- 64 Kbyte Flash memory
- Up to 12 Kbyte SRAM
- 20-byte backup register
- 8-byte CCM code-SRAM
- ARM Cortex-M4
- 72 MHz
- Nested vector interrupt controller (NVIC)
- JTAG/SW debug
- 20-byte backup register
- 8-byte CCM code-SRAM
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- Up to 12 Kbyte SRAM
- 20-byte backup register
- 8-byte CCM code-SRAM

Note: *: is used as a wildcard character for related part number
DIODES AND RECTIFIERS

Silicon diodes

ST offers Schottky and ultrafast silicon rectifier solutions for all market requirements. ST’s latest developments include M series, based on Schottky technology, with improved avalanche rating and the integration of higher currents in low-profile PowerFLAT™ packages. Our range of small-signal Schottky diodes with flip-chip and SOD-923 devices helps meet the most stringent space-saving requirements, especially for portable communication equipment. For high-efficiency rectification or freewheeling functions, our new field-effect rectifier diodes, the FERD family, improve the power density capability of the converters.

Note: *: is used as a wildcard character for related part number

MAIN APPLICATIONS

Adapters
Schottky, FERD

Solar inverters and PFC
Ultrafast

SIC diodes

For power converter applications where silicon diodes reach the limits of their operating temperature and power density, ST’s first- and second-generation silicon carbide devices offer optimal reliability. SIC diodes are high-performance power Schottky diodes that feature a silicon-carbide substrate. This wide bandgap material enables the design of high-voltage Schottky diodes, and ST offers rectifiers up to 2 x 650 V (dual diodes in series). They present negligible reverse recovery at turn-off and minimal capacitive turn-off behavior which is independent of temperature. The 1st generation of 600 V diodes offers the best forward and switching characteristics. The 2nd generation of 650 V diodes offers more surge robustness for optimal use in circuits featuring current spikes.

SIC DIODES BENEFITS

• High efficiency adding value to the power converter
• Reduced size and cost of the power converter
• Low EMC impact, simplifying certification and speeding time to market
• High robustness ensuring high reliability of the power converter
• Gain on PCB and mounting cost with the dual diodes

MAIN APPLICATIONS

Solar inverters
STPSC*06

HEV
STPSC*065

UPS
STPSC*06

Servers/Telecoms and PFC
STPSC*065, STPSC*13

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MAIN APPLICATIONS

Adapters
Schottky, FERD

Solar inverters and PFC
Ultrafast

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• Gain on PCB and mounting cost with the dual diodes

MAIN APPLICATIONS

Solar inverters
STPSC*06

HEV
STPSC*065

UPS
STPSC*06

Servers/Telecoms and PFC
STPSC*065, STPSC*13
Power breakers & Current limiter ICs

Connected in series to the power rail, ST’s power breakers are able to disconnect the electronic circuitry if power consumption exceeds the programmed limit. When this happens, the device automatically opens the integrated power switch, disconnecting the load, and notifies the remote monitoring feature. Current limiter ICs are designed to work with an external MOSFET to protect power supplies from anomalous external current demands.

**Power breakers**

STPW05  STPW12

- Auto-retry function with programmable delay
- Adjustable precise power limitation from 11 to 16 W
- 5 V (STPW05) and 12 V (STPW12) rails
- Programmable power limit masking time
- Over-temperature protection
- Integrated N-channel power MOSFET
- Internal undervoltage lockout

**Current limiter IC**

STFC01

- Wide Vcc range (10 - 48 V)
- Fully programmable current limitation
- P-channel MOSFET driving capability
- Remote On/Off control
- Latch, autoretry or foldback configuration
- Analog and digital current monitoring (status telemetry)
- Undervoltage lockout

**MAIN APPLICATIONS**

Home appliances
STPW05, STPW12

Air conditioning
STPW05, STPW12

Factory automation
STPW05, STPW12, STFC01

Server/Telecoms
STFC01

Notes:
- * is used as a wildcard character for related part number
- Note: 1: available in Q3 2016

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**IGBTS**

ST provides a large portfolio of IGBTs with breakdown voltages between 600 and 1250 V with state-of-the-art trench-gate field-stop technology. ST’s IGBTs feature the optimal trade-off between switching performance and on-state behavior due to their proprietary technology and to the 175 °C max operation junction temperature, delivering greater all round energy efficient system designs in applications such as motor control, photovoltaic, UPS, automotive, induction heating, welding, lighting and others.

**S series**

- STG*S*
  - 10 µs of short-circuit capability @ starting Tj = 150 °C
  - Wide safe operating area (SOA)
  - Soft and fast recovery antiparallel diode
  - Suited for asymmetric half bridge topology

**M series**

- STG*M*
  - 6us/10us (650 V/1200 V series) short-circuit capability @starting Tj = 150 °C
  - Wide safe operating area (SOA)
  - Soft and fast recovery antiparallel diode
  - Suited for asymmetric half bridge, 3-level half bridge, 3-phase inverter and full bridge topologies

**H series**

- STG*H*
  - Medium fsw
  - Very low saturation voltage
  - Minimal collector turn-off time
  - Suits for TTF and Boost-CCM topologies

**V series**

- STG*V*
  - High fsw series
  - Tail less switching off
  - Low conduction losses
  - Suits for TFF, Boost CCM and FB topologies

**MAIN APPLICATIONS**

Welding
Inverter: S, M - Boost: H, HB

Solar

UPS
S, M, H

Home appliances
H, HB

Air conditioning
S, M, H, HB

Motor control
S, M

Induction heating
HB, IH

Notes:
- * is used as a wildcard character for related part number
- Note: *: is used as a wildcard character for related part number
INTELLIGENT POWER SWITCHES

STMicroelectronics offers intelligent power switches (IPS) for low- and high-side configurations. ST’s IPS feature a supply voltage range from 6 to 60 V, overload and short-circuit protection, current limitation set for industrial applications, different diagnostic types, high-burst, surge and ESD immunity, very low power dissipation and fast demagnetization of inductive loads. Devices are designed using ST’s latest technologies, thus offering state-of-the-art solutions in any application field.

ISO8200*, the galvanic isolated IPS ideal for factory automation

MAIN APPLICATIONS

Factory automation  Vending machines  Renewable energy

Note: 1: available in Q2 2016  2: available in Q4 2016  *: is used as a wildcard character for related part number

LED DRIVERS

Offline LED drivers

Dedicated LED drivers operating from the AC mains ensure highly-accurate LEDs managing to provide a high level of light quality and avoid flickering. By combining a state-of-the-art low-voltage technology for the controller and an extremely robust 800 V technology for the power MOSFET in the same package, HVLED8* converters (i.e. controller + MOSFET in the same package) feature an efficient, compact and cost-effective solution to drive LEDs directly from the rectified mains. This family of converters works in constant-current / constant-voltage primary-side regulation (PSR-CC/PSR-CV). HVLED8* controllers are also available for higher power needs working in constant-current (PSR-CC) or constant-voltage (PSR-CV) primary-side regulation; a dimming function is also available. For both families (HVLED converters and controllers), the primary-side regulation cuts bill-of-material costs, while also simplifying design and reducing the space occupied by LED control circuitry.

Offline LED converters with PSR

<table>
<thead>
<tr>
<th></th>
<th>PSR-CC</th>
<th>PSR-CV</th>
<th>P_{out}\text{max}</th>
<th>Internal power MOSFET</th>
<th>Flyback</th>
<th>Buck-boost</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVLED805</td>
<td></td>
<td></td>
<td>8 W</td>
<td>800 V_{ds}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HVLED807PF</td>
<td></td>
<td></td>
<td>10 W</td>
<td>800 V_{ds}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HVLED815PF</td>
<td></td>
<td></td>
<td>15 W</td>
<td>800 V_{ds}</td>
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<td></td>
</tr>
</tbody>
</table>

Offline LED controllers with PSR

<table>
<thead>
<tr>
<th></th>
<th>PSR-CC</th>
<th>PSR-CV</th>
<th>Dimming</th>
<th>Flyback</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVLED001*</td>
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<tr>
<td>HVLED003D*</td>
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</tbody>
</table>

Topology example

Offline LED driver converter HVLED8*

Flyback with PSR

MAIN APPLICATIONS

Residential lighting  HVLED805, HVLED807PF, HVLED815PF
Commercial, architectural, and street lighting  HVLED001*, HVLED003D*

Note: 1: available in Q3 2016  2: power level @ 230 V/mains  *: is used as a wildcard character for related part number
**DC-DC LED drivers**

ST’s monolithic buck switching regulators offer input voltage capability up to 61 V and deliver output currents up to 4 A with high switching frequency. They enable simple, efficient and cost-effective solutions for driving high-brightness LEDs. They also feature dedicated circuitry for dimming. Boost regulators provide the necessary high voltages to drive multiple LEDs in series, guaranteeing accurate LED current matching.

<table>
<thead>
<tr>
<th>DC-DC LED drivers converters</th>
<th>Buck</th>
<th>Buck-boost</th>
<th>I_{\text{out_max}}</th>
<th>Dimming</th>
<th>V_{\text{out_max}}</th>
<th>Synchronous</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED2000</td>
<td></td>
<td></td>
<td>3 A</td>
<td></td>
<td>18 V</td>
<td></td>
</tr>
<tr>
<td>LED2001</td>
<td></td>
<td></td>
<td>4 A</td>
<td></td>
<td>18 V</td>
<td></td>
</tr>
<tr>
<td>ST1CC40</td>
<td></td>
<td></td>
<td>3 A</td>
<td></td>
<td>18 V</td>
<td></td>
</tr>
<tr>
<td>LED5000</td>
<td></td>
<td></td>
<td>3 A</td>
<td></td>
<td>48 V</td>
<td></td>
</tr>
<tr>
<td>LED6000</td>
<td></td>
<td></td>
<td>3 A</td>
<td></td>
<td>61 V</td>
<td></td>
</tr>
</tbody>
</table>

**DC-DC LED drivers controllers**

<table>
<thead>
<tr>
<th>DC-DC LED drivers controllers</th>
<th>Reverse buck</th>
<th>Buck-boost</th>
<th>Boost &amp; Sepic</th>
<th>Dimming</th>
<th>V_{\text{out_max}}</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVLED002</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30 V</td>
</tr>
<tr>
<td>LED6000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>36 V</td>
</tr>
</tbody>
</table>

**Topology examples**

- **Synchronous buck**
  - LED2000
  - LED2001
  - ST1CC40
- **Asynchronous buck**
  - LED5000
  - LED6000
- **Reverse buck**
  - HVLED002

**LED array drivers**

ST’s LED array drivers fully integrate all functions required to drive high-brightness LEDs. These devices allow constant-current control in a single-chip solution. The external parts are reduced to only one resistor that sets the preferred maximum current for all outputs. Devices also come with additional features such as high current, high precision, local and global LED brightness adjustment, thermal shutdown, error detection and auto power-saving functionalities.

**MAIN APPLICATIONS**

- **Halogen bulbs replacements and home appliances**: LED2000, LED2001
- **Traffic signals**: LED2000, LED2001, ST1CC40, LED5000, LED6000, HVLED002
- **Street lighting**: LED5000, LED6000, HVLED002
- **Emergency lighting**: LED5000, ST1CC40
- **Commercial and architectural lighting**: LED5000, LED6000, LED6001, HVLED002

**Note**: *:* is used as a wildcard character for related part number.
LED row drivers
LED row drivers are essentially boost regulators that provide the necessary high voltages to drive multiple LEDs in series, guaranteeing accurate LED current matching. ST offers both single- and multi-channel high-efficiency boost LED drivers featuring a wide dimming range, low noise and small footprint. They also embed protection functions such as overvoltage and overcurrent protection, thermal shutdown and LED-array protection.

LED row driver converters

<table>
<thead>
<tr>
<th>Rows</th>
<th>85 mA/Row</th>
<th>30 mA/Row</th>
<th>25 mA/Row</th>
<th>30 mA/Row</th>
<th>20 mA/Row</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>LED7707</td>
<td>LED7706</td>
<td>LED7707/7</td>
<td>LEDD25</td>
<td>LEDA02*</td>
</tr>
<tr>
<td>5</td>
<td>LED7706</td>
<td>LEDD25</td>
<td>LEDA02*</td>
<td>LEDA02*</td>
<td>LEDD40D</td>
</tr>
<tr>
<td>4</td>
<td>LEDA02*</td>
<td>LEDD41</td>
<td>LEDA02*</td>
<td>LEDA02*</td>
<td>LEDD40D</td>
</tr>
<tr>
<td>1</td>
<td>LEDA02*</td>
<td>LEDD40D</td>
<td>LEDD40D</td>
<td>LEDD40D</td>
<td>LEDD40D</td>
</tr>
</tbody>
</table>

LED row driver controllers

16 rows LED7708
- 85 mA/row
- Grouped or independent row dimming

LED matrix driver

5 x 24 matrix STLED524
- 20 mA/dot
- Adjustable luminance for each LED (dot)

MAIN APPLICATIONS

Steady and accurate dimming

STLED25, STLD40D

Wearables

STLA02*

Keyboards and accessories

STLA02*

Home appliances and ATMs

LED7706, LED7707, LED7708

Smartphones

STLED25, STLD40D

OLED drivers

ST supplies over 70% of the world’s ICs to power AMOLED displays that enable today’s advanced handheld devices to deliver high quality web and video experiences on the move. ST’s dedicated AMOLED power ICs add value to new designs by simplifying power supply in the circuitry ensuring outstanding energy efficiency and results in longer battery life. In addition, high immunity to mobile communication noise keeps display consistent and flicker free.

<table>
<thead>
<tr>
<th>Driver</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>STOD1317B</td>
<td>Wide output range (up to 13 V)</td>
</tr>
<tr>
<td>STOD13AS</td>
<td>High efficiency in overall output range</td>
</tr>
<tr>
<td>STOD13CM</td>
<td>External feedback output sense (STOD13CM)</td>
</tr>
</tbody>
</table>

Note: * is used as a wildcard character for related part number

MAIN APPLICATIONS

Fitness and wearables
STOD32W, STOD1317B

Low-end smartphones
STOD1317B, STOD13AS, STOD30

High-end smartphones
STOD30, STOD32A

Note: * is used as a wildcard character for related part number
LINEAR REGULATORS
ST offers a complete portfolio of industry-standard high-performance regulators for both positive and negative outputs. Among our products, you can find the optimal combination of ultra-low dropout voltage (from 50 to 220 mV for 100 mA to 3 A load current) and low quiescent current – for the highest efficiency design – from 1 to 20 mA (for 50 mA to 2 A) or dynamic performance for the best transient response, power supply ripple rejection (up to 92 dB at 1 kHz) and low noise (as low as 6.3 µVrms). All this coupled with a choice of the smallest form factor packages for size-conscious applications such as a 0.47 x 0.47 mm STSTAMP™ package.

- Ultra-low dropout
  - High efficiency in low-/medium-power applications
  - Best cost/performance trade-off
  - Large offer for Iout capability and packaging

- Low quiescent current Iq
  - Extending battery life
  - Suitable for space-constrained battery-powered applications

- Low noise, high PSRR
  - High signal fidelity
  - Reduced size of external filter components

MAIN APPLICATIONS
- Tablets, smartphones, and digital camera
  - LD39115, LD39130, LD39020/30, ST715, LDL120, LD59015
- Healthcare
  - STLQ*, ST715, LD39130
- Fitness and wearables
  - LD39130, LDL39, LD39115, LD39020, LD39030, LD59015

Note: *: is used as a wildcard character for related part number

MOSFET AND IGBT DRIVERS
ST’s power MOSFET and IGBT drivers include integrated high-voltage half-bridge, single and multiple low-voltage gate drivers. The MOSFET/IGBT drivers provide state-of-the-art integration, reducing BOM cost and final application dimensions, while also increasing robustness and noise immunity. In particular the STDRIVEsmart families Le639*, Le649* and STDRIVEgap STGAP1S offer smart functionalities to protect and simplify application implementation and usage.

- 600 V Half bridge gate drivers
  - 4 A source/sink driver high current capability (Le6491)
  - Integrated bootstrap diode
  - Adjustable deadtime (Le6494L)
  - Comparator, op amp integrated, smart SD, interleaving and program, DT (Le6390)
  - Smart shutdown (Le649*, Le639*)
  - Extended temperature range (A version)

- Low side gate drivers
  - 2 level turn-off (TD35*)
  - Miller clamp (TD35*)
  - Pulse transf / opto input (TD35*)
  - Dual independent low side driver (PM8834)
  - 4 A source/sink driver high current capability (PM8834)

- Galvanically-isolated single gate driver
  - 4 kV isolation
  - High voltage rail up to 1.5 kV
  - 5 A source/sink driver current capability
  - 2 Level turn-off
  - Miller clamp, negative gate supply
  - Optimized for SiC MOSFET driving

MAIN APPLICATIONS
- Factory automation, home appliances, and motor control
  - Le638E, TD35*, Le649*, Le649L, Le6494L, Le6494L1, PM8841, PM8851
- Commercial, architectural and street lighting
  - PM8834, PM8841, PM8851
- Solar inverters, HEV / EV, and factory automation
  - STGAP1S, PM8841, PM8851

Note: 1: available in Q3 2016  *: is used as a wildcard character for related part number
POWER MOSFETS

High-voltage power MOSFETs (silicon)

ST's HV MOSFET portfolio offers a broad range of breakdown voltages from 400 to 1500 V, with low gate charge and low on-resistance, combined with state-of-the-art packaging. ST’s MDmesh™ high-voltage MOSFETs technology has enhanced power-handling capability, resulting in high-efficiency solutions. Supporting applications for a wide voltage range such as switch mode power supplies, lighting, DC-DC converters, motor control and automotive applications, ST has the right MOSFET for your design.

<table>
<thead>
<tr>
<th>Series</th>
<th>Part Number</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>K5</td>
<td>ST<em>N</em>K5</td>
<td>Very low R_{D(son)}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Small Qg and capacitance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Small packages available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suited for hard switching topologies</td>
</tr>
<tr>
<td>DM2</td>
<td>ST<em>N</em>DM2</td>
<td>Improved tr of intrinsic diode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High dv/dt capability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suited for ZVS/LLC topologies</td>
</tr>
<tr>
<td>M2</td>
<td>ST<em>N</em>M2</td>
<td>Extremely low R_{D(son)}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High switching speed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suited for hard switching topologies</td>
</tr>
<tr>
<td>M2-EP</td>
<td>ST<em>N</em>M2-EP</td>
<td>Extremely low R_{D(son)}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Optimized for light load conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tailored for high-frequency applications (M2-EP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suited for hard switching &amp; ZVS/LLC topologies</td>
</tr>
<tr>
<td>M5</td>
<td>ST<em>N</em>M5</td>
<td>Very good R_{D(son)}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soft diode recovery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suited for OR-ing, square-wave HB, battery mgmt topologies</td>
</tr>
<tr>
<td>H6</td>
<td>ST<em>N</em>H6</td>
<td>Extremely low R_{D(son)}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soft diode recovery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suited for flyback and sync rectification</td>
</tr>
<tr>
<td>H7</td>
<td>ST<em>N</em>H7</td>
<td>Extremely low R_{D(son)}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High current capability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Monolithic Schottky</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Super logic level (P-channel)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suited for reverse buck, buck-boost, battery mgmt, and buck topologies</td>
</tr>
<tr>
<td>F6</td>
<td>ST<em>N</em>F6</td>
<td>Wide voltage range</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soft diode recovery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Very good R_{D(son)}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suited for load-safety switch, buck and sync rectification</td>
</tr>
</tbody>
</table>

Main applications:

- **K5, M5, M2, M2-EP** for adapters, solar inverters, welding, HEVs, and UPS
- **K5, M5, DM2** for residential, commercial, architectural and street lighting
- **M5, M2, M2-EP, DM2** for servers/telecoms

Low-voltage power MOSFETs (silicon)

ST’s LV MOSFET portfolio offers a broad range of breakdown voltages from -100 V to 120 V, with low gate charge and low on-resistance, combined with state-of-the-art packaging. ST’s STripFET MOSFETs support a wide voltage range for synchronous rectification, UPS, motor control, SMPS, power-over-Ethernet (PoE), inverter, automotive and other applications in a wide range of miniature and high-power packages: DPAK, D2PAK, ISOTOP, Max247, SOT-223, TO-220, TO-220FP, TO-247, PowerFLAT (5 x 6 mm)/(3.3 x 3.3 mm)/(2 x 2 mm), SO-8 and SOT23-6L.

<table>
<thead>
<tr>
<th>Series</th>
<th>Part Number</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>F6</td>
<td>ST<em>N</em>F6</td>
<td>Very good R_{D(son)}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High current capability</td>
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<td>Monolithic Schottky</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Super logic level (P-channel)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suited for reverse buck, buck-boost, battery mgmt, and buck topologies</td>
</tr>
<tr>
<td>F7</td>
<td>ST<em>N</em>F7</td>
<td>Extremely low R_{D(son)}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Optimized body diode (low Q_{rr}) and intrinsic capacitance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Proper Ciss/Crss ratio</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suited for flyback and sync rectification</td>
</tr>
</tbody>
</table>

Main applications:

- **Small motor control and USB battery chargers** for F6
- **HDD, power tools, STB, and game consoles** for H6, H7
- **Servers/Telecoms and SMPS** for H6, H7, F6, F7
- **UPS, e-bikes, and game consoles** for F6
- **Solar inverters, forklifts, and EHVs** for F7
SiC MOSFETs
Based on the advanced and innovative properties of wide bandgap materials, ST’s silicon carbide (SiC) MOSFETs feature very low RDS(on) per area for the 650 V/1200 V rating combined with excellent switching performance, translating into more efficient and compact designs. ST is among the first companies to produce high-voltage SiC MOSFETs. This new family features the industry’s highest temperature rating of 200 °C for improved thermal design of power electronics systems. Compared to silicon MOSFETs, SiC MOSFETs also feature significantly reduced switching losses with minimal variation versus the temperature. These features render the device perfectly suitable for high-efficiency and high power density applications.

Main Applications
- Motor control
- HEVs / EVs
- Welding
- UPS
- Solar inverters

SiC MOSFETs, the real breakthrough in high voltage switching
- V_{br} = 1200 V (SCT*N120), 650 V (SCT*N65G2/G2V)
- Low power losses at high temperature
- High operating temperature capability (200 °C)

Main Evaluation Board
- 4 kW Boost inverter evaluation board
- Available on request

Main Benefits
- Smaller form factor and lighter systems
- Reduced size/cost of passive components
- Higher system efficiency
- Reduced cooling requirements and heatsink size

EOS protections, upgraded performance at high application temperature
- Max. peak pulse power (kW)
- Max. peak pulse current (A)

Note: 1: available in Q3 2016
*: is used as a wildcard character for related part number

Protections
EOS 8/20 μs surge protection
ST’s EOS 8/20 μs power surge protectors and suppressors comply with the IEC 61000-4-5 surge standard. Including transient voltage surge suppressors, TVS clamping or Transil™ diodes, the EOS 8/20 protections shield against surges related to power/datalines and fully support both power line and dataline application class requirements. A large choice of packages, from 0402 to SMC packages, is provided to bring flexibility to designers and reliability to the application.
ESD protection
Driven by market needs, ST’s ESD protection devices, including transient voltage surge suppressors (TVS), clamping diodes and arrays, or Transil™, focus on IEC 61000-4-2 compliance, protection efficiency with low clamping voltage, protection reliability with low leakage current and signal integrity with ultra-low capacitance and ultra-wide bandwidth. Standard packaging options are available, as well as advanced options which include single- and multiple-line, compact, flat, and flow-through versions to optimize space constraints.

### Standard packaging options
- Single line
  - Extra low capacitance (≤0.5 pF)
  - Low capacitance (≤30 pF)
  - Standard capacitance (≤300 pF)
- 2 lines
  - Low capacitance (≤30 pF)
  - Standard capacitance (≤300 pF)
- 3 lines
  - Low capacitance (≤30 pF)
  - Standard capacitance (≤300 pF)
- 4 lines
  - Low capacitance (≤30 pF)
  - Standard capacitance (≤300 pF)
- ≥5 lines
  - Low capacitance (≤30 pF)
  - Standard capacitance (≤300 pF)

### Transil™ devices
- **ESDA**
- **ESDAV1**
- **ESDAV2**
- **Esdal**
- **USB**
- **USB6**
- **USBLC**
- **USBP**
- **HSP**
- **DSILC**
- **DVIULC**
- **HDMIULC**
- **USB**
- **DA1**
- **S1**
- **ESDA1K**
- **ESDA8V2**

### ESDAXLC*
- **ESDA**
- **USB**
- **6**
- **LC**
- **USBP**

### ESDARF*
- **ESDA**
- **USB**
- **6**
- **LC**
- **USBP**

### Repetitive voltage suppressor
In applications, overvoltage constraints may not always come from lightning, electrical overstress or electrostatic discharge, but from the circuit itself. In such cases, standards do not apply. Repetitive surges may raise protection device temperature. The ST’s STRVS family is the first TVS series to be specified against repetitive overvoltages in high temperature conditions. Protection devices must be selected according to their power capability at high junction temperatures and their clamping voltage specified at high temperature.

### STRVS MAIN BENEFITS
- Better Transil™ selection for cost optimization (oversizing avoided)
- Fixed and reliable clamping voltage
- Reduced power consumption vs discrete protection (RC snubber)
- Customer design effort reduced

### STRVS topology usage example

![STRVS topology usage example](image)

### MAIN APPLICATIONS
- Tablets, smartphones, and digital cameras
- Healthcare
- I/O microcontrollers and signal conditioning
- Factory automation
- Human machine interface (HMI)
- Smart metering
- SIM cards, Ethernet, and HDMI/DVI ports

### STRVS MAIN APPLICATIONS
- Smart metering
- Residential, commercial, architectural and street lighting

Note: * is used as a wildcard character for related part number
LED bypass protection

The LBP01 series of LED bypass protection devices are bypass switches that can be connected in parallel with 1 or 2 LEDs. In the event of a LED failure, this device shunts the current through other LEDs. It also provides overvoltage protection against surges as defined in IEC61000-4-2 and IEC61000-4-5.

MAIN APPLICATIONS

- Traffic signals
  - Keep LED strings on in case of LED open mode failure
  - Reduced maintenance cost
  - Increase lifetime of the lighting system

- Residential, commercial, architectural and street lighting
- Emergency lighting
- Traffic signals

RUTRONIK POWER

The Markets are Changing

Changing markets demand new solutions. Many markets are saturated, and products are being ever more replaceable and increasingly offering similar functionality thanks to growing standardization. Technological, regulatory and economic challenges along with growing functional complexity are a reality of numerous market segments, particularly for the industrial, automation, automotive and white goods (electronic household appliances for private and commercial use) segments.

Trends in High-Performance Electronics

In addition to the trends in the market segments, there are also developments that are affecting the entire high-performance electronics sector. The most important of these developments are "digital power" also with the related topics of "functional safety" and "robustness". These have direct effects on operating conditions, technology and manufacturing methods.

Digital Power

One "power future trend" is that of "digital power", also referred to as "intelligent digital power". In electrical engineering, this buzzword refers to digitally controlled or monitored power supply units. In conventional switched-mode power supply units, an analog switch controls and monitors the output voltage. In digital power supply units, a microcontroller or DSP handles one or several of these functions. The control process is integrated into the controller at software level.

One of the major advantages of digitally-controlled switched power supply units over analog solutions is the option of being able to intervene in the control process at any time and to adapt it to the current needs of the power supply. While this increases the level of effectiveness of the digital PSU compared to an analog variant, this does also increase the amount of technical development work required, which is reflected in the costs. Digital technology aims to satisfy the needs of the now ever more complex power supply systems.

Functional Safety and Robustness

Innovations that do not take safety into account cannot endure, which is why high functional safety and robustness are essential. In a robustness validation, for example, the reliability of electronic components is assessed by comparing the specific product requirements against the actual service life, taking into account the increase in efficiency.

The fundamental concept behind functional safety is the strategy for reducing actual risks. The goal is to create a safe system in that every reasonable measure has been taken to avoid damage to property and danger to people, ensuring traditional safety measures.
RUTRONIK POWER gives absolute priority not only to reducing the prevailing complexity of the offer-range but also to providing solutions with comprehensive system solutions that are optimized to the customer's needs. RUTRONIK POWER focuses marketing of product groups for which theoretical assistance is necessary, down to the development of logistics support activities ranging from the design-in process, the product evaluation and application development, the strategic lasting several years. FAEs are particularly important for technical customer support. RUTRONIK's experts advise and compile relevant expertise, not only for individual products and technologies, but also on their compatibility with one another. This helps to guarantee extensive support – with development at application level by professionally qualified experts in respect of the overall application, the market and its requirements. RUTRONIK's experts have a profound understanding of all relevant factors, with specialists from a variety of fields supporting each other, enabling the benefit of synergies across teams to be utilized more effectively, because market segments overlap in numerous aspects – and customers benefit from such coordinated consulting. This understanding of not only the customer’s requirements but also the technical options and the market conditions enables a precisely tailored solution to be developed – not off the shelf, but customized specifically to the customer’s needs. The RUTRONIK POWER team consists of specialists from the active power semiconductors, passive, electromechanical and embedded segments, utilizing the company’s extensive product portfolio.

The Core Segments are:

- **Power Semiconductors**
- **Resistors**
- **Inductivities**
- **Capacitors**
- **Connectors & cables**
- **Relays, batteries, fuses, switches, heat management**
- **Power Supplies**

**The Advantages**

RUTRONIK POWER serves as a single source for all components, from individual components to a basis for operational applications. But RUTRONIK POWER does not compete with its customers with its own components and applications, because the extensive range is combined into complete, vertically integrated system solutions. The product portfolio consists of decided manufacturers who are leaders in their respective fields and with some of whom the company has worked for decades. This ensures an extensive and consistent transfer of knowledge from the very start, both between the supplier and Rutronik as well as a collective exchange of expertise with the customer, for example concerning seminars, webinars and professional conferences.

The bundling of expertise and experience in the RUTRONIK POWER team guarantees that the customer receives extensive advice in respect of the overall application, the market and its requirements. RUTRONIK’s experts have a profound understanding of all relevant factors, with specialists from a variety of fields supporting each other, enabling the benefit of synergies across teams to be utilized more effectively, because market segments overlap in numerous aspects – and customers benefit from such coordinated consulting. This understanding of not only the customer’s requirements but also the technical options and the market conditions enables a precisely tailored solution to be developed – not off the shelf, but customized specifically to the customer’s needs. The RUTRONIK POWER team consists of specialists from the active power semiconductors, passive, electromechanical and embedded segments, utilizing the company’s extensive product portfolio.

**Impacts**

These trends cover many industries and are directly related to operating conditions, technologies and manufacturing processes. In other words, changes to operating conditions or other techniques or manufacturing processes will also mean the involvement of different requirements imposed upon the installed components. This can be more clearly illustrated in the example of energy storage. If the conditions in which a battery is operated or if new technologies or manufacturing processes are implemented, this gives rise to new requirements imposed upon the charging strategy or the battery management system.

The operating parameters are of critical importance to the service life of an energy storage facility within an application. While developers often have no influence on the operating conditions, there is scope for optimization in the battery management system, although this scope is often used inadequately. As a result, operating conditions are changed without implementing the battery management system accordingly. In this connection, the most frequent recorded electrical failures are due to defective or discharged starter batteries. Specifically in the automotive industry, such battery failures were mainly found in luxury vehicles until the year 2000. The main cause was the growth in electronic component use and other electricity consumers in the vehicles, because even in a parked vehicle, the starter battery is constantly being discharged by the monitoring and control electronics. While the currents involved here – referred to as “standby currents” – are low, the battery can suffer from deep discharge if left dormant for long periods of time. For manufacturers, this raises the question of whether this know-how needs to be developed internally or whether the market might offer a suitable solution.

The Answer – RUTRONIK POWER

RUTRONIK POWER is much more than a complete portfolio of power components for various voltage classes and different applications. RUTRONIK POWER also offers a selection of components for a variety of applications suitable for the respective circuit. This means that under every position in the block diagram, there are products from multiple selected suppliers in the respective product segments. RUTRONIK accommodates as broad a range of requirements as possible here – whether low-cost or high-performance. For example, for a motor control circuit in the power range of 2KW, RUTRONIK offers appropriately designed IGBT modules, gate drivers as well as microcontrollers, driver modules, heatsinks and plug connectors.

For power semiconductors, RUTRONIK caters for everything today, from discrete to high-integration components, power ICs and power modules. As a broadline distributor, RUTRONIK offers all other components in addition to its power semiconductors, not only active but also electromechanical and passive components. The spectrum ranges from simple plug connectors to supercaps. This covers around 98% of the PCB. This also applies to other product segments such as high-current connectors supporting up to 1,000A and supercaps supporting up to 3,400 farad/cell.

But RUTRONIK POWER is much more than a broad selection of components. The decisive difference lies in RUTRONIK compiling relevant expertise, not only for individual products and technologies, but also on their compatibility with one another. This helps to guarantee extensive support – with development at application level by professionally qualified Field Application Engineers (FAEs). Product Managers at component level and supply at the end of a product lifecycle lasting several years. FAEs are particularly important for technical customer support. RUTRONIK’s experts advise and support activities ranging from the design-in process, the product evaluation and application development, the strategic marketing of product groups for which theoretical assistance is necessary, down to the development of logistics solutions with comprehensive system solutions that are optimized to the customer’s needs. RUTRONIK POWER focuses less on individual components and more on the overall solution.

RUTRONIK gives absolute priority not only to reducing the prevailing complexity of the offer-range but also to providing support at the product development stage at application level with relevant technical expertise and vertical system solutions based on suitable components.