

Power management Guide 2016





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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

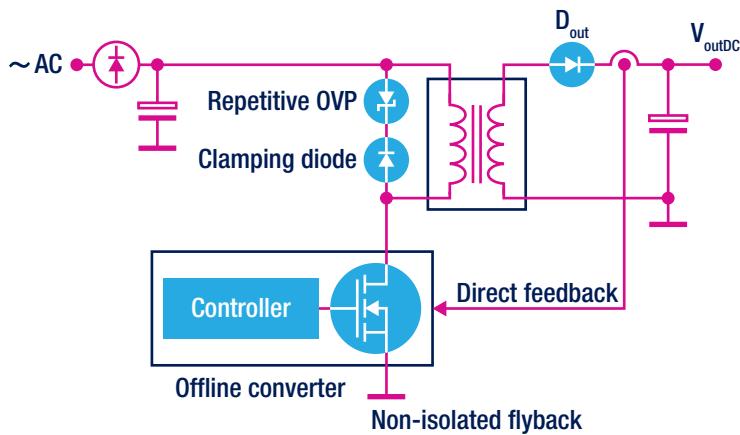
POWER SUPPLIES

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 VIPerOP devices) and high breakdown voltage of 800 V for the VIPerPLUS family and 900 V for the Altair05. 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.

| | | Offline converters | Offline controllers | HV power MOSFETs | Repetitive overvoltage protections | Clamping diodes | Volt. ref. | Output diodes | Linear voltage reg. | | | | | | | | |
|-----------------------------|-----------------------------|-------------------------------|--|------------------|------------------------------------|-----------------|------------|--|-------------------------------|--|--|--|--|--|--|--|--|
| Buck | | VIPerOP VIPer01 VIPer*6 | - | - | - | - | - | STTH*06 STTH*08 STTH*10 STTH*12 | LDF* LD39* LDK* LDL* | | | | | | | | |
| Buck-boost | | | | | | | | | | | | | | | | | |
| Non-isolated flyback | | | | | | | | | | | | | | | | | |
| Isolated flyback | PSR-CV | - | VIPerOP VIPer01 VIPer*6 ALTAIR* | STCH02 L6566B | STRVS* | T*431 T*432 | - | STPS* FERD*45 FERD*60 FERD*100 | LDF* LD39* LDK* LDL* | | | | | | | | |
| | Regulation with optocoupler | VIPer*5 VIPer*7 VIPer*8 | | | | | | | | | | | | | | | |

Topology example



MAIN EVALUATION BOARDS



Battery chargers

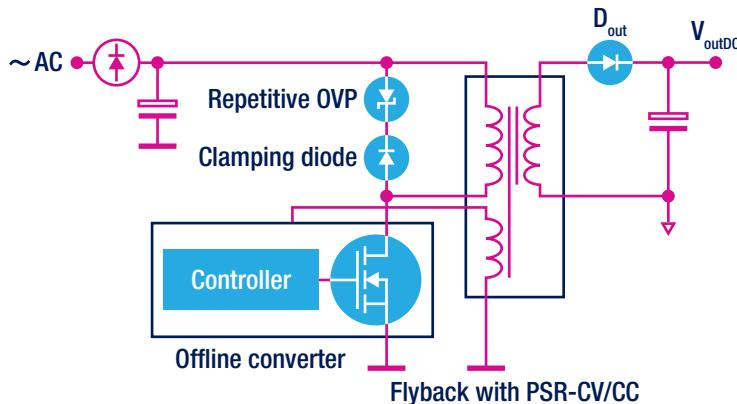
Designing lighter, smaller wall chargers for portable devices is one of the most critical challenges for developers. Excellent standby power consumption, high efficiency in all load conditions, primary-side regulation (PSR) control methods and a set of integrated protections (to minimize the component count on the circuit) are the main market requirements. High performing offline converters (Altair*) (i.e. controllers and MOSFET 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 various set of linear and switching battery charger and monitoring ICs integrating functions able to minimize power consuption 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.



| | | Offline converters | | Offline controllers | HV power MOSFETs | Repetitive overvoltage protections | Clamping diodes | Output diodes | CC/CV controllers | | | | |
|-----------------------------|---------|-------------------------------|-------------------------------|---------------------|------------------|------------------------------------|-----------------|--|---|-----------------|--|--|--|
| Wall side | Flyback | PSR-CV/CC | ALTAIR* | | - | - | STRVS* | STTH*06 STTH*08 STTH*10 STTH*12 | FERD*45 FERD20U50 FERD20U60D FERD*100 STPS* | TSM10* SEA0* | | | |
| | | PSR-CC | - | | STCH02 | ST*N65M2 | | | | | | | |
| Regulation with optocoupler | | VIPer*5 VIPer*7 VIPer*8 | VIPerOP VIPer01 VIPer*6 | | | | | | | | | | |
| PSR-CV | | - | - | - | - | | | | | | | | |

| | Battery charger ICs | | Battery monitoring ICs | Li-Ion battery |
|------------------|---|-----------|------------------------|----------------|
| | Linear | Switching | | |
| Application side | STBC02 L6924* STBC08 STC4054 STNS01 | STBCFG01 | STC3117 STC3115 | EFL700A39 |

Topology example



MAIN EVALUATION BOARDS



STEVAL-ISA124V1
5 W, battery charger with opto



STEVAL-ISA176V1
5 W, optoless battery charger



STEVAL-ISB033V1
5 W, switching battery charger for Li-Ion batteries

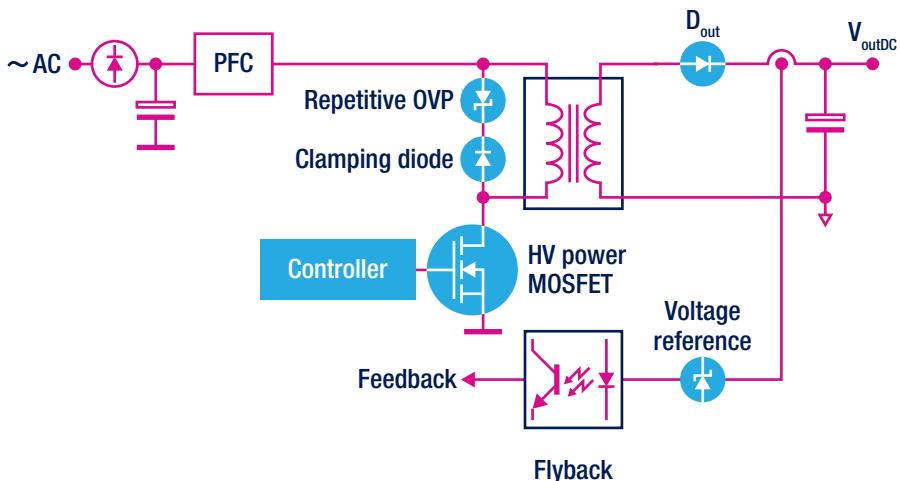
Adapters

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.



| | | Offline converters | | Controllers | | Power MOSFETs | | Repet. overvolt. protect. | Clamping diodes | Output diodes | CC/CV contr. | Volt. ref. | DC-DC conv. |
|-------------|-----------------------------|-------------------------------|--|-----------------------------|--------|--|---|---------------------------|---|---|-----------------|----------------|-------------|
| | | HV | LV | | | | | | | | | | |
| Flyback | Regulation with optocoupler | VIPer*5 VIPer*7 VIPer*8 | VIPerOP VIPer01 VIPer*6 ALTAIR* | L6566B L6566A | STCH02 | ST*N80K5 ST*N95K5 | - | STRVS* | STTH*06 STTH*08 STTH*10 STTH*12 | STPS* FERD*45 FERD*60 FERD*100 | TSM10* SEA0* | T*431 T*432 | - |
| | PSR-CV | - | - | - | - | - | - | | - | - | | - | |
| PFC Boost | TM | - | - | L6562A* L6563* L6564* | - | ST*N50M2 ST*N60M2 ST*N65M2 ST*N55M5 ST*N65M5 | - | - | STTH*L06 STTH*R06 STTH*06 | - | - | - | - |
| DC-DC stage | HB-LLC | - | - | L6599A* L6699 | STCMB1 | ST*N50DM2 ST*N60DM2 ST*N60M2 ST*N60M2-EP | - | - | STPS* FERD*45 FERD*60 FERD*100 STTH* (≥200 V series) | TSM10* SEA0* | T*431 T*432 | ST1S3* | - |
| Sync rect. | Flyback | SRK2000* SRK2001 | STSR30 STSR2* | SRK2000* SRK2001 | STCMB1 | ST*110N10F7 ST*100N10F7 | - | - | - | - | - | - | - |
| | Forward | | | | | STL*NS3LLH7 ST*N4LF7 STL220N6F7 ST*N6F7 STL130N8F7 ST*N10F7 ST*NF20D | | | | | | | |
| | HB-LLC | | | | | - | | | | | | | |

Topology example

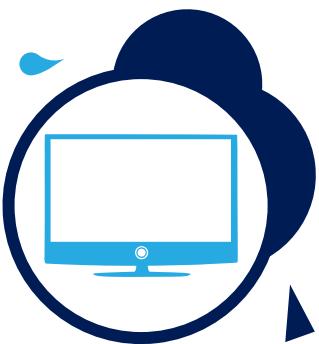


MAIN EVALUATION BOARDS



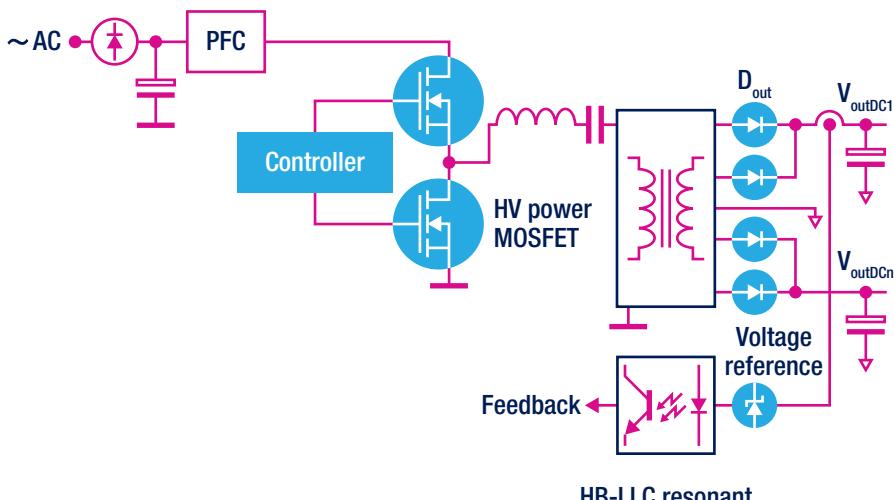
TV power supply units (PSU)

In addition to their outstanding image quality, new generation TVs gain attention for their slim silhouette and high energy efficiency; for which the TV's power supply is a key factor. The power supply unit (PSU) requires a low profile to maintain the TV's slim appearance and advanced silicon devices to ensure high efficiency. ST is able to offer both requirements: high-voltage MDmesh™ MOSFETs (K5, M2, DM2, M5 series), low-voltage STripFET MOSFETs (F7 series), FERD/Schottky and Ultrafast diodes are available in low-profile SMD packages such as 3.3 x 3.3 mm and 5 x 6 mm PowerFLAT™. STRVS protections against repetitive over-voltages feature small packages including flip-chip, SOD and uQFN. Dedicated smart analog controllers for PFC, HB-LLC resonant circuit, including the new combo controller (STCMB1) for both stages, and those for synchronous rectification enable energy-saving, high-power-density and lower-standby-power design solutions including protection features that are suitable for universal use in TVs of all sizes. The new generation of TV digital power supply units based on our STM32 microcontrollers or STNRG digital controllers guarantee more efficient and flexible solutions.



| | | Controllers | MCUs, digital controllers | Gate drivers | Power MOSFETs | | Repet overvolt. protect. | Clamping diodes | Output diodes | Volt. ref. | DC-DC conv. | | | | | |
|------------------------|----------------|-----------------------------|---|---------------------------|----------------------------------|---|--------------------------------|--|--|---|---|----------------|--|--|--|--|
| | | | | | HV | LV | | | | | | | | | | |
| Flyback | | L6566A L6566B | | - | ST*N80K5 ST*N95K5 | - | STRVS* | STTH*06 STTH*08 STTH*10 STTH*12 | STPS* FERD*45 FERD*60 FERD*100 STTH* (>200 V series) | T*431 T*432 | - | | | | | |
| PFC Boost | CCM | L4981* L4984D | STM32F0* STM32F1* STM32F334 STNRG* | TD35* PM8841 PM8851 | ST*N60M2 ST*N65M2 ST*N65M5 | - | - | - | STTH*R06 STTH*T06 STPSC*065 | - | - | | | | | |
| | | L6562A* L6563* L6564* | | | | | | | STTH*L06 STTH*06 | | | | | | | |
| | TM | | | | | | | | | | | | | | | |
| DC-DC stage | HB-LLC | L6599A* L6699 | | STCMB1 | L638* L639* L649* | ST*N50DM2 ST*N60DM2 ST*N50M2 ST*N60M2 ST*N60M2-EP | - | - | - | STPS*170 STPS*200 STTH* (>200 V series) | ST1S0* ST1S12 ST1S3* ST1S4* ST1S50 L598* | T*431 T*432 | | | | |
| Sync rect. | HB-LLC | SRK2000* SRK2001 | | STM32F334 STNRG* | PM8834 | - | | | | | | | | | | |
| | Flyback | STSR30 | | - | - | - | ST*110N10F7 ST*100N10F7 | - | - | - | - | - | | | | |

Topology example



MAIN EVALUATION BOARDS



Desktop PCs

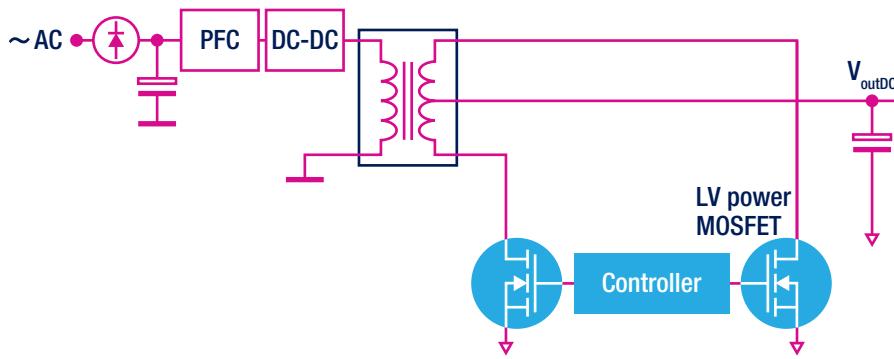
The requirements for the PC power market are a small form factor with better performance and embedded diagnostics.

An intelligent control scheme that enables the adaption of load variation to minimize power consumption, together with optimized power semiconductors, is the key in meeting market demands. The smart L4984D PFC controller operating with ST's proprietary CCM technique, high-voltage MDmesh™ MOSFETs used for the PFC and DC-DC stages, low-voltage STripFET MOSFETs for synchronous rectification, and SiC diodes (STPSC*) help designers develop the best possible PC power supply solutions to improve efficiency. Dedicated smart analog controllers allow a tailored solution for the main topologies used in the DC-DC stage with the STCMB1 combo controller (driving PFC + HB-LLC resonant circuits) and in the synchronous rectification stage with other ICs. ST's DC-DC converters guarantee high power density for the post-regulation. The ST devices best suited for each of the most common topologies are listed in the following table.



| | | Controllers | Power MOSFETs | | Output diodes | DC-DC converters | E-fuses | Linear voltage reg. | | |
|------------|-------------|-----------------------------|----------------------------------|---|---|-------------------------------------|---|-------------------------------|--|--|
| | | | HV | LV | | | | | | |
| PFC Boost | CCM | L4981* L4984D | ST*N60M2 ST*N65M2 ST*N65M5 | - | STTH*R06 STTH*T06 STPSC*065 | - | STEF01 ² STEF05 STEF12 | LDF* LD39* LDK* LDL* | | |
| | TM | L6562A* L6563* L6564* | | | STTH*L06 STTH*06 | | | | | |
| | DC-DC stage | HB-LLC | L6599A* L6699 | ST*N50DM2 ST*N60DM2 ST*N60M2 ST*N60M2-EP | STPS* FERD*45 FERD*60 FERD*100 STTH* (≥ 200 V series) | ST1S3* ST1S4* ST1S50 L598* | | | | |
| | Sync rect. | Asym HB | L6591 | | | | | | | |
| Sync rect. | HB-LLC | SRK2000* SRK2001 | | STL*NS3LLH7 ST*N4LF7 ¹ STL220N6F7 ST*N6F7 ST*N10F7 ST*NF20D | | - | - | - | | |
| | Asym HB | | | | | | | | | |

Typical configuration



SMPS with Sync rectification

MAIN EVALUATION BOARDS



STEVAL-ISA145V1

250 W, PFC TM + asym HB



EVL400W-ADP/ATX

400 W, PFC CCM + HB-LLC + sync rect.

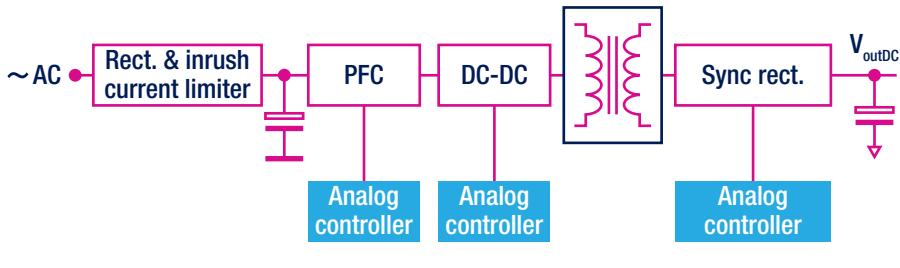
Servers and telecoms (analog solutions)

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 STripFET 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.



| | | Controllers | Power MOSFETs | | Diodes | DC-DC converters | | E-fuses | Linear voltage reg. | SCRs |
|---|-------------------|---------------------|------------------------------------|---|---|---|-------------------------------------|---|-------------------------------|--|
| | | | HV | LV | | HV | LV | | | |
| Rect. & inrush current limiter | | - | - | - | STTH3012 STTH6012 | - | - | - | - | TYN6* TYN8* TYN10* TYN12* TN5050H TN2015H |
| PFC | Boost | L4981* L4984D | ST*N60M2 ST*N65M2 ST*N65M5 | - | STTH*R06 STTH*T06 STPSC*06 STPSC*065 | - | - | STEF01 ¹ STEF05 STEF12 | LDF* LD39* LDK* LDL* | - |
| | Bridgeless | | | | | | | | | |
| DC-DC stage | HB-LLC | L6599A* L6699 | ST*N50DM2 ST*N60DM2 ST*N60M2 | - | STPS*150 STPS*200 STTH*02 STTH*03 STTH*04 | L698* ST1S14 L7985 L7986 L7987* | ST1S3* ST1S4* ST1S50 L598* | - | - | - |
| | Asym HB | L6591 | | | | | | | | |
| Sync rect. | HB-LLC | SRK2000* SRK2001 | - | STL*NS3LLH7 ST*N4LF7' STL220N6F7 ST*N6F7 ST*N10F7 ST*NF20D | - | - | - | - | - | - |
| | Asym HB | | | | | | | | | |

Typical configuration



Analog solution

MAIN EVALUATION BOARD

EVL400W-ADP/ATX
400 W, PFC (CCM)
+ HB-LLC + sync rect.

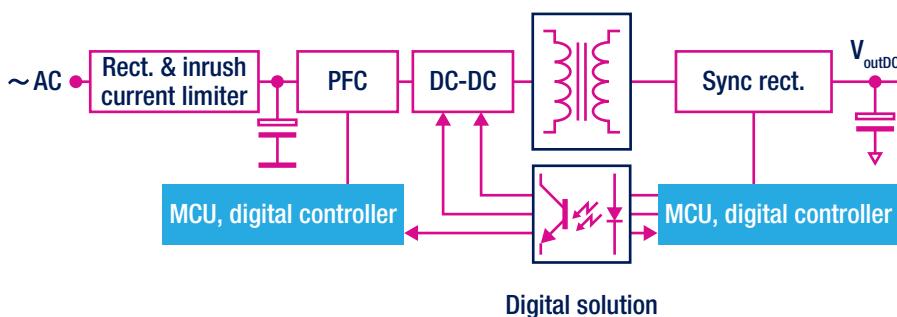
Servers and telecoms (digital solutions)

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™ MOSFETs series in PFC and DC-DC stages, and the new low-voltage STripFET MOSFETs in the synchronous rectification stage as well as SiC 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.



| | | MCUs, digital controllers | Gate drivers | Power MOSFETs | | Diodes | DC-DC converters | E-fuses | Linear voltage reg. | SCRs |
|---|---------------|--|-------------------------------------|------------------------------------|---|---|-------------------------------------|---|-------------------------------|--|
| | | | | HV | LV | | | | | |
| Rect. & inrush current limiter | | - | - | - | - | STTH3012 STTH6012 | - | - | - | TYN6* TYN8* TYN10* TYN12* TN5050H TN2015H |
| PFC | Boost | STM32F0* STM32F301 STM32F334 STNRG* | TD35* PM8841 PM8851 PM8834 | ST*N60M2 ST*N65M2 ST*N65M5 | - | STTH*R06 STTH*T06 STPSC*06 STPSC*065 | - | STEF01 ¹ STEF05 STEF12 | LDF* LD39* LDK* LDL* | - |
| | Interl. Boost | | | | | | | | | |
| | Bridgeless | | | | | | | | | |
| DC-DC stage | HB-LLC | STM32F334 STNRG* | L638* L639* L649* | ST*N50DM2 ST*N60DM2 ST*N60M2 | - | STPS*150 STPS*200 STTH*02 STTH*03 STTH*04 | ST1S3* ST1S4* ST1S50 L598* | - | - | - |
| | HB-LC | | | | | | | | | |
| | FP-PS | | | | | | | | | |
| Sync rect. | | STM32F334 STNRG* | PM8834 | - | STL*NS3LLH7 ST*N4LF7 ² STL220N6F7 ST*N6F7 ST*N10F7 ST*NF20D | - | - | - | - | - |
| | | | | | | | | | | |

Typical configuration



MAIN EVALUATION BOARDS

| | |
|--|--|
| | STEVAL-ISA147V1 500 W, bridgeless PFC + HB-LLC conv. + sync rect. |
| | EVLSTNRG-1kW 1 kW, multi-phase interl. HB-LC conv. |
| | STEVAL-ISA172V1 2 kW, multi-phase interl. Boost PFC + FB-PS conv. |
| | STEVAL-ISF003V1 ¹ Up to 7.4 kW, digital inrush current limiter based on SCRs |

DC-DC COMPUTING

Server and microserver

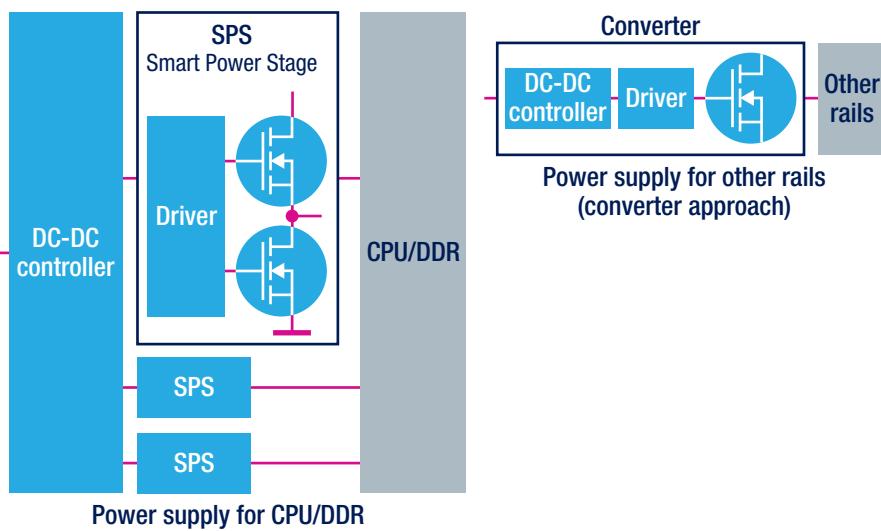
STMicroelectronics offers complete power management solutions for Intel CPU and DDR power supplies and all other rails for server and uservers. ST's STVCOT™ control loop technology, used in single- and multi-phase PWM DC-DC controllers, guarantees best performance in all load conditions. Moreover, it minimizes the number of components on the board and the number of phases, saving total space and cost.

The CPU/DDR power supply is implemented through the mentioned controllers jointly with the new Smart Power Stage (SPS) that includes the gate driver and MOSFETs. Concerning other rails, ST offers three solutions with a growing integration level: a single-phase DC/DC controller combined with an external gate driver and external MOSFETs, a DC-DC controller with embedded gate driver combined with external MOSFETs, and finally a monolithic solution that includes a controller, gate driver and MOSFETs in the same package. The ST devices best suited for DC-DC computing applications are listed in the following table.



| | DC-DC controllers | | | Gate drivers | Dual power MOSFETs | SPS Smart Power Stage | DC-DC converters | | Linear voltage reg. | | | |
|-------------|---------------------------|-----------------------------|------------------|--------------|--------------------|-----------------------|------------------|------------|---|--|--|--|
| | Single phase | | Multiphase | | | | Buck | Buck-Boost | | | | |
| | With embedded gate driver | Without embedded gate drive | | | | | | | | | | |
| CPU/DDR | - | - | PM677* PM676* | L6747* | STL*DN3LLH5 | PM677*SP ¹ | - | | LDF* LD39* LDK* LDL* | | | |
| | - | PM6697D | - | - | - | | - | | | | | |
| | PM6697 | - | - | - | - | | - | | | | | |
| Other rails | L673* | - | - | - | - | STL*DN3LLH5 | - | | ST1S0* ST1S1* PM8908 PM8903A PM8906 | | | |
| | - | PM7744 PM6697D | - | - | - | | - | | | | | |
| | - | - | - | - | - | | - | | | | | |
| | | | | | | | | | STBB* | | | |

Typical configurations



MAIN EVALUATION BOARD



Evaluation boards for CPU/DDR and other rails available on request

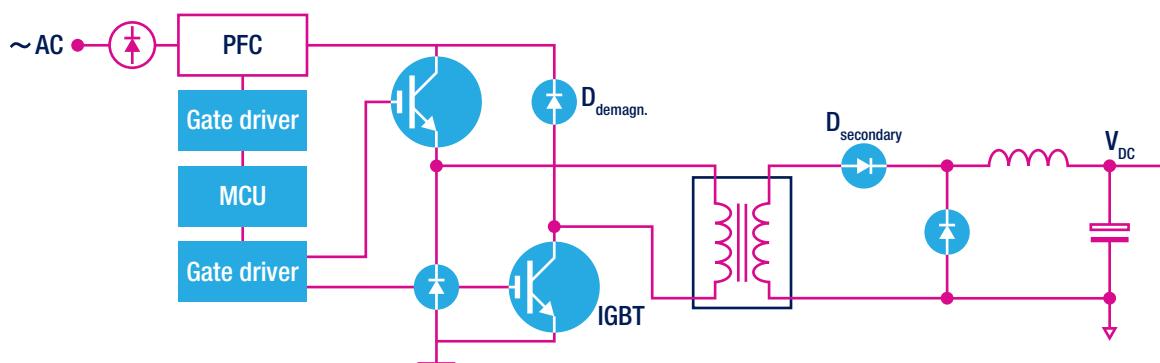
INDUSTRIAL WELDING

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.



| | | MCUs | Gate drivers | IGBTs | HV power MOSFETs | Diodes | | | DC-DC converters | | | | |
|-------------|--|-----------|--|--|-----------------------|-----------|----------|----------------|------------------|--------|--|--|--|
| PFC Boost | | | | | | Boost | Demagn. | Secondary side | HV | LV | | | |
| DC-DC stage | | STM32F0* | TD35* PM8834 PM8841 PM8851 STGAP1S | STG*H65DFB STG*V60DF STG*H120DF2 | SCT*N120 | STTH*R06 | - | - | - | | | | |
| | | | | | | STTH*T06 | - | - | | | | | |
| | | STM32F334 | | | | STTH*W06 | - | - | - | | | | |
| | | | | | | STPSC*065 | - | - | | | | | |
| | | PS-FB | | L638* L639* L649* STGAP1S | STG*H65FB STG*V60F | - | STTH*W02 | L698* L597* | | ST1S0* | | | |
| | | TTF | | | | | STTH*W03 | L7985 | | ST1S12 | | | |
| | | | | STTH*10 STTH*12 | | STTH*W04 | | L7986 | | ST1S3* | | | |
| | | | | | | | | L7987* | | ST1S40 | | | |
| | | | | | | | | | | ST1S50 | | | |
| | | | | | | | | | | L598* | | | |

Typical configuration



LED LIGHTING - GENERAL ILLUMINATION

Residential lighting

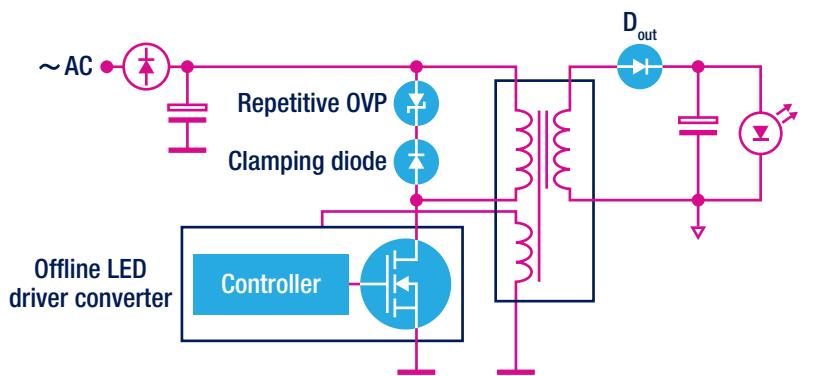
LED efficacy and driver IC market requirements are constantly evolving. Residential lighting applications need a high integration level, high efficiency, high power factor (PF), long lifetime, and dimming capabilities as well as a low system cost and component count.

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 converters work with a high PF and in constant-current/constant-voltage mode primary-side regulation (PSR-CC/CV) 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 converters (controller + MOSFET in the same chip), ST can support MR16 LED replacement lamps for halogen light bulbs.



| | | Offline LED driver converters | Offline converters suitable for LED driving | CC/CV controllers | Repetitive overvoltage protections | Clamping diodes | Output diodes | DC-DC LED driver converters |
|--------------------------------------|------------------------------------|--------------------------------------|---|-------------------------------|------------------------------------|-----------------|--|-------------------------------------|
| MR16 halogen bulb replacement | | - | - | - | - | - | BAT20J BAT* BAS* | LED5000 LED6000 |
| Buck, Buck-boost | | - | VIPerOP VIPer01 VIPer*6 | - | - | - | STTH* | - |
| HPF Buck-boost | | HVLED805 HVLED807PF HVLED815PF | - | - | - | - | | |
| HPF Flyback | PSR-CC/CV | | VIPer*5 VIPer*7 VIPer*8 | VIPerOP VIPer01 VIPer*6 | TSM10* SEAO* | STRVS* | STTH*06 STTH*08 STTH*10 STTH*12 | STPS*170AF STPS*4S200UF FERD* |
| Flyback | Regulation with optocoupler | - | - | - | - | STRVS* | STTH*06 STTH*08 STTH*10 STTH*12 | STPS*170AF STPS*4S200UF FERD* |
| | PSR-CV | | | | | | | |
| | PSR-CC/CV | | | | ALTAIR* | | | |

Topology example



HPF flyback with primary-side regulation (PSR-CV/CC)

MAIN EVALUATION BOARDS



EVLHLED815W10A
10 W, buck-boost LED driver



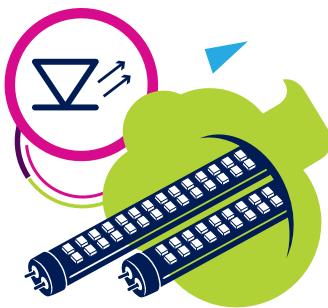
STEVAL-ILL055V1
11 W, flyback LED driver



EVALHLED815W15
15 W, flyback LED driver

Commercial and architectural lighting

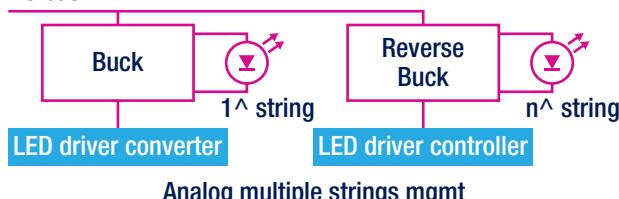
Commercial and architectural lighting applications usually require more than 20 W, a high power factor, high level of efficiency, cost-saving solution and the possibility of using more than one LED string with remote monitoring. In a single string case, working in constant-current primary-side regulation (PSR-CC) mode, ST's new flyback offline LED driver controller (HVLED003D¹) directly drives 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 MDmesh™ MOSFETs series (suggested for flyback) and the low-voltage STrixFET MOSFET series (used for reverse buck topologies) ensure all solutions are very efficient and reliable.



| | | Analog controllers | Digital controllers, MCUs | Gate drivers | Power MOSFETs | | Clamping diodes | Repetitive overvoltage protections | Output diodes | DC-DC LED driver converters |
|-----------------------|--------------|------------------------|--|-------------------------------------|----------------------|---------------------|--|------------------------------------|---|--|
| HPF Flyback | PSR-CC | HVLED003D ¹ | - | - | HV | LV | STTH*06 STTH*08 STTH*10 STTH*12 | STRVS* | STPS* FERD* | - |
| | PSR-CV | HVLED001* | | | ST*N80K5 ST*N95K5 | - | | | | |
| Multiple strings mgmt | Buck | - | - | - | - | - | - | - | FERD* STPS*170AF STPS*4S200UF STTH* (\geq 200 V series) | LED2000 LED2001 LED5000 LED6000 |
| | Reverse buck | HVLED002 | STLUX* STM32F334 STM32F301 STM32F0* STM8S* | TD35* PM8834 PM8841 PM8851 | - | ST*N6F7 ST*N10F7 | - | - | | |

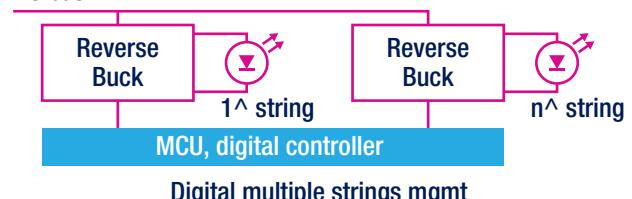
Typical configurations

DC bus



Analog multiple strings mgmt

DC bus



Digital multiple strings mgmt

MAIN EVALUATION BOARDS



STEVAL-ILL070V*
35 W, analog single-string LED driver



STEVAL-ILL069V2
35 W, analog power supply (CV_{out}) for LED driving



STEVAL-ILL074V1/V2
60 W, analog power supply (CV_{out}) for LED driving



STEVAL-ILL077V1
60 W, digital multiple-string LED driver



STEVAL-ILL051V2
18 V-3 A, buck LED driver converter



STEVAL-ILL054V2
18 V-4 A, buck LED driver converter

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-CC) control technique using a digital approach with a PFC regulator followed by a HB-LC resonant stage.

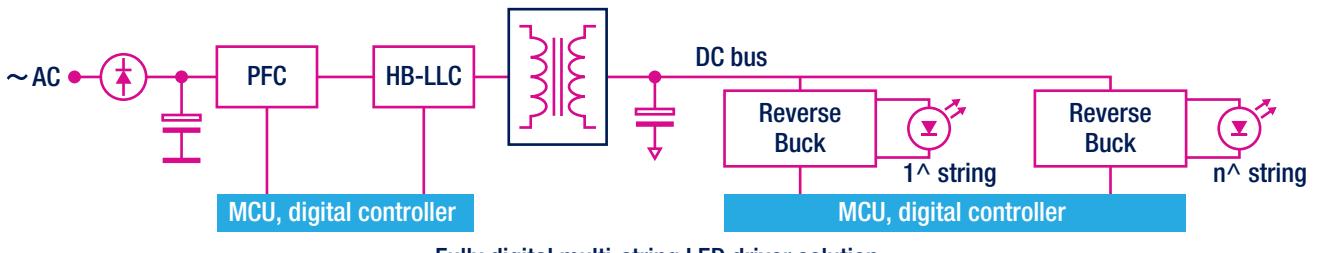
The multiple strings power supply architecture consists of a main power supply providing a constant bus voltage and a subsequent multiple strings. Usually the main power stage, consisting of a high power factor (HPF) flyback converter or a power factor correction (PFC) controller combined with an LLC 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).



| | | Analog controllers | Digital controllers, MCUs | Gate drivers | Power MOSFETs | | Clamping diodes | Repetitive overvoltage protections | Output diodes | DC-DC LED driver converters | DC-DC Conv. |
|-----------------------|--------------|-----------------------------|--|----------------------------------|--|---|--|------------------------------------|--|---|-------------|
| HPF Flyback | PSR-CV | HVLED001* | | | HV | LV | | | | | |
| HPF Flyback | PSR-CV | HVLED001* | - | - | ST*N80K5 ST*N95K5 | - | STTH*06 STTH*08 STTH*10 STTH*12 | STRVS* | STPS* FERD* | - | - |
| PFC Boost | CCM | L4981* L4984D | TD35* PM8841 PM8851 | ST*N60M2 ST*N65M2 | - | - | - | - | STTH*R06 STTH*T06 STPSC* | - | - |
| | TM | L6562A* L6563* L6564* | | | | | | | STTH*L06 STTH*06 | | |
| DC-DC stage | HB-LLC | L6599A* L6699 | STLUX* STM32F0* STM32F301 STM32F334 | L638* L639* L649* | ST*N50DM2 ST*N60DM2 ST*N60M2 | - | - | - | STPS* FERD* STTH* (\geq 200 V series) | L698* ST1S14 L7985 L7986 L7987* | - |
| | HB-LC | - | | | | | | | - | | |
| Sync rect. | | SRK2000* SRK2001 | PM8834 | - | STLUX* STM32F334 STM32F301 STM32F0* STM8S* | ST*N3LLH7 ST*N4LF7' STL220N6F7 ST*N6F7 ST*N10F7 ST*NF20D | - | - | - | LED5000 LED6000 | - |
| Multiple strings mgmt | Buck | - | | | | | | | | | |
| Multiple strings mgmt | Reverse buck | HVLED002 | TD35* PM8834 PM8841 PM8851 | ST*N6F7 ST*N10F7 STL11N6F7 | - | - | - | - | STPS* FERD* STTH* (\geq 200 V series) | - | - |

Typical configuration



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.

MAIN EVALUATION BOARDS



STEVAL-ILL066V1

100 W, digital single-string PSR-CC LED driver



STEVAL-ILL053V1

130 W, analog power supply (CV_{out}) for LED driving



STEVAL-ILL074V1/V2

60 W, analog power supply (CV_{out}) for LED driving



STEVAL-ILL077V1

60 W, digital multiple-string LED driver



STEVAL-ILL056V1

48 V-3 A, buck LED driver converter



STEVAL-ILL078V1

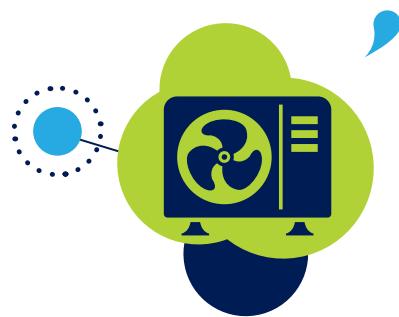
60 V-1 A, buck LED driver converter



MAJOR HOME APPLIANCES

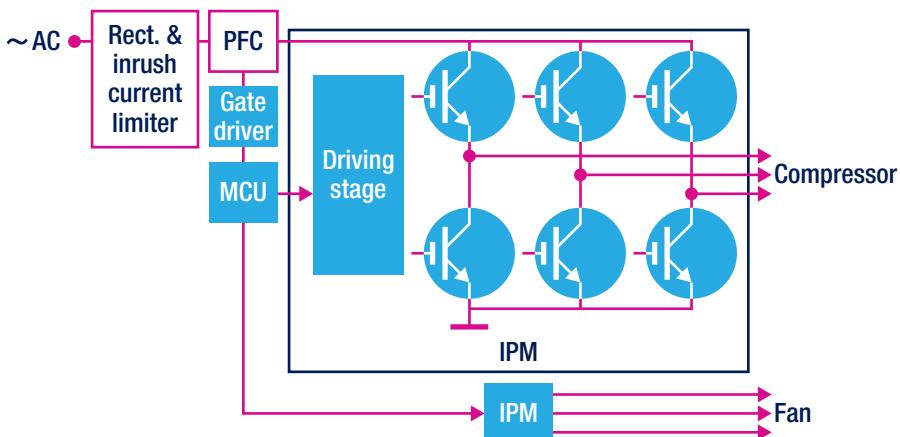
Air conditioning

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*, and 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 SLLIMM™ 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.



| | | MCUs | Gate drivers | IPM | IGBTs | HV power MOSFETs | Diodes | E-fuses | Linear voltage reg. | DC-DC converters | | SCRs | Triacs | LED array drivers | |
|--------------------------------|---------------|-------------------------------------|---|---------------------------|----------------------|--|---|-------------------------------|---------------------|------------------|----|--|---|------------------------------|---|
| | | | | | | | | | | HV | LV | | | | |
| Rect. & inrush current limiter | | - | - | - | - | - | STTH3012 STTH6012 | - | - | - | - | TN*10H-6 TN*15H-6 TYN6* TYN8* TYN10* TYN12* | - | - | |
| | | - | - | - | - | - | - | - | - | - | - | - | T1635T | - | |
| PFC | Boost | TD35* PM8841 PM8851 PM8834 | STM32F0* STM32F103 STM32F3* STM32F4* | STGW*V60DF STGW*H65DFB | ST*N65M5 ST*N65M2 | STTH*AC06 STTH*R06 STPSC*06 STPSC*065 | STEF01 ¹ STPW* ¹ | LDF* LD39* LDK* LDL* | - | - | - | - | - | - | |
| | Interl. Boost | | | | | | | | | | | | | | |
| | Bridgeless | | | | | | | | | | | | | | |
| 3-ph inverter | Compr. | L638* L639* L649* | STGIB*CH60 STGIB*M60 ¹ | STG*H60DF STG*M65DF2 | ST*N60DM2 | - | - | - | - | - | - | L698* L597* L7985 L7986 L7987* | ST1S0* ST1S12 ST1S3* ST1S40 ST1S50 L598* | - | - |
| | Fan | | | | | | | | | | | | | | |
| LED indicator | | - | | | | | | | | | | - | - | STP08 STP16* LED1642GW | |

Typical configuration



MAIN EVALUATION BOARDS



STEVAL-IHT008V1
1 kW, digital inrush current limiter based on Triac



STEVAL-IHM034V2
1.3 kW, dual motor control with PFC

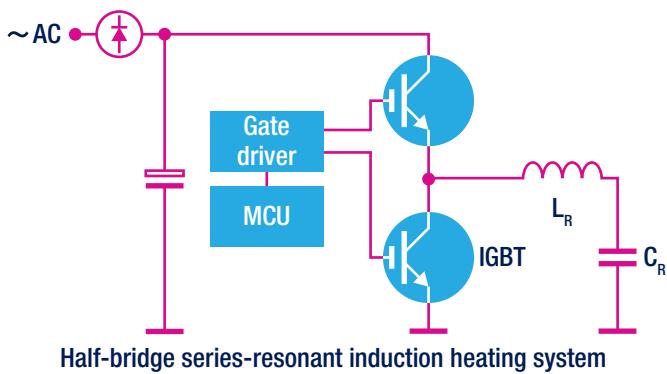
Induction heating

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 (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.



| | MCUs | Gate drivers | IGBTs | LED array drivers |
|---|--|---------------------------|-----------------------------|------------------------------|
| Single-switch quasi-resonant (voltage resonance) | STM8* STM32F100 | TD35* PM8841 PM8851 | STGW*IH125DF | - |
| HB series resonant (current resonance) | STM32F0* STM32F100 | L638* L639* L649* | STGW*H65DFB STGW*H60DLFB | - |
| User interface (front panel) | STM8* STM32F0* STM32F4*9 STM32F7* | - | - | STP08 STP16* LED1642GW |

Topology example



RENEWABLE ENERGY & HARVESTING

Photovoltaic (centralized)

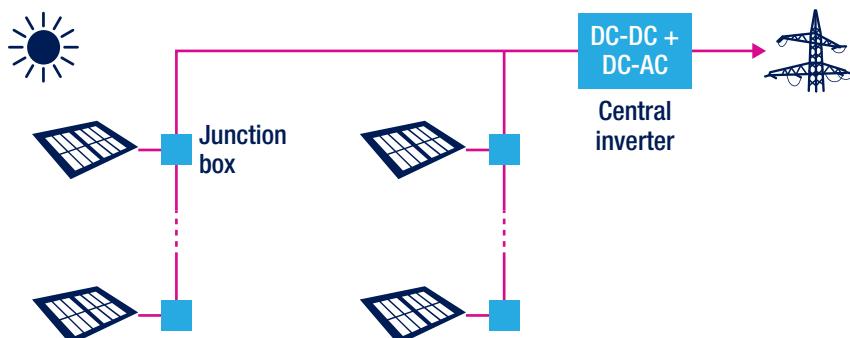
Centralized photovoltaic (PV) energy solutions use a central inverter architecture characterized by a single central inverter (where the entire DC output of a PV array is transformed and connected to the AC grid) and, at the panel level, by a junction box that provides only the bypass function and helps 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 (SCT*N120), the new trench-gate field-stop IGBTs series, the SiC 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.



| | | | MCUs | Gate drivers | HV power MOSFETs | IGBTs | Diodes | Bypass devices | | DC-DC converters | | | |
|------------------|-------------|-------------|--|------------------------------------|----------------------------------|-------|--|--------------------|---|--|---------------------------|--|--|
| Junction box | | Diodes | Cool bypass switches | HV | LV | | | | | | | | |
| Central inverter | DC-DC stage | FB-PS | STM32F1* STM32F2* STM32F3* STM32F4* STM32F7* | L638* L639* L649* STGAP1S | ST*60DM2 ST*65DM2 SCT*N120 | - | STTH*R06 STTH*06 STTH*S12 STPSC*065 STPSC*12 | - | | L6985F L6986 L597* L7985 L7986 L7987* | ST1S4* ST1S50 L598* | | |
| | DC-AC stage | FB mix freq | | | | | STGW*H65DFB STGW*H120DF2 | STTH*R06 STPSC* | - | | | | |
| | | 3-Level HB | | | | | SCT*N120 | | - | | | | |

Typical configuration



Centralized approach for a solar energy solution

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.

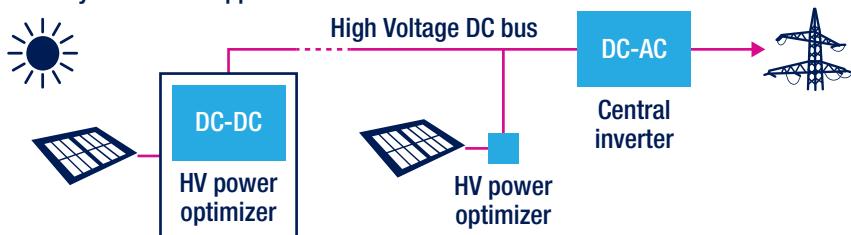
The fully distributed approach integrates, at the PV panel level, a microinverter that includes a complete converter (DC-DC with MPPT as well as DC-AC) and manages the AC grid connection. The high-performing STM32 microcontrollers, the new high-efficiency high-voltage MDmesh™ MOSFET series, the new low-voltage STripFET MOSFET series and the SiC diodes (STPSC*) 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.



| | | | MCUs | Gate drivers | Power MOSFETs | | IGBTs | Diodes | Bypass devices | | DC-DC converters | | |
|------------------|---------------------|-------------------|---|---|---------------|--------------------------------------|--------------|-------------------------------|-------------------------------|----------------------|--|---------------------------|--|
| Power optimizer | DC-DC stage | Isolated FB boost | | | HV | LV | | | Diodes | Cool bypass switches | HV | LV | |
| Central inverter | DC-AC stage | FB mix freq | STM32F103 STM32F3* STM32F4* | L638* L639* L649* STGAP1S | - | STH*N10F7 STH*N6F7 | - | STTH*R06 STTH*06 | STPS*30 STPS*45 FERD*45 | SPV15* | - | - | |
| | | 3-level HB | STM32F103 STM32F2* STM32F3* STM32F4* STM32F7* | | SCT*N120 | - | STGW*H65DFB | STTH*R06 STTH*06 STPSC* | - | | L6985F L6986 L597* L7985 L7986 L7987* | ST1S4* ST1S50 L598* | |
| Micro inverter | DC-DC Interl. Boost | | STM32F103 STM32F3* STM32F4* | TD35* PM8834 PM8841 PM8851 L638* L639* L649* STGAP1S | - | STH*N10F3 STH*N8F7 ST*160N75F3 | - | | - | | | | |
| | DC-AC FB mix freq. | | STM32F103 STM32F3* STM32F4* | | STB*N65M5 | - | STGW*H120DF2 | | - | | | | |

Typical configurations

Partially distributed approach



MAIN EVALUATION BOARD



STEVAL-ISV003V2
250 W, microinverter

Fully distributed approach



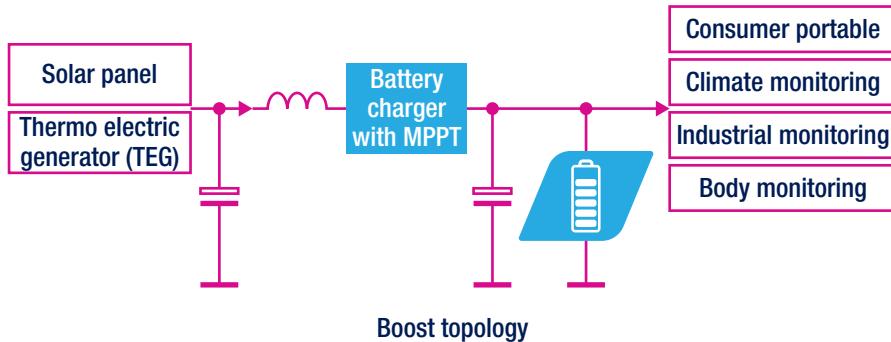
Solar – Thermo electric generator (TEG)

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 LDOs. 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.



| | | Low-power solar battery chargers with MPPT | Ultra-low-power solar & TEG battery chargers with MPPT | Li-Ion battery | Linear voltage regulators |
|------------------------------|------------|--|--|----------------|---------------------------|
| CV battery charger | Boost | SPV1040 | SPV1050 | - | STLQ* ST715 |
| | Buck-boost | - | | | |
| Charger for any battery type | Boost | - | EFL700A39 | - | - |
| | Buck-boost | - | | | |

Typical configuration



MAIN EVALUATION BOARDS



STEVAL-ISV0019V1
Boost energy harvester battery charger



STEVAL-IDS002V1
Autonomous wireless multisensor node powered by PV cells



STEVAL-IDS003V1
Autonomous wireless multisensor node powered by TEG

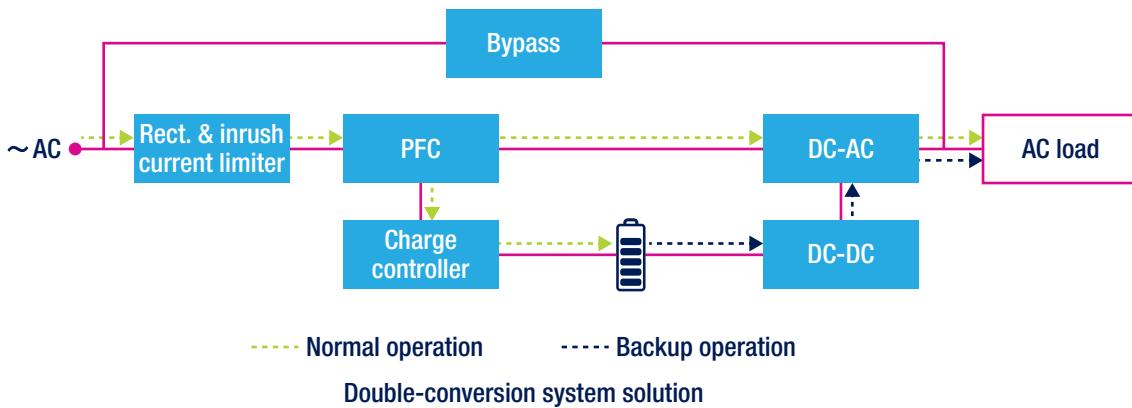
UNINTERRUPTABLE POWER SUPPLIES (UPS)

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.



| | | MCUs | Gate drivers | IGBTs | Power MOSFETs | | Diodes | SCRs | Triacs | Linear voltage regulators | DC-DC Conv. |
|-----------------------------------|--------------|----------------------|--|--|--|--|----------------------|---|--------|---------------------------------|---|
| | | | | | HV | LV | | | | | |
| Rect. & inrush current limiter | | | - | - | | | STTH3012 STTH6012 | TYN6* TYN8* TYN10* TYN12* TN*10H-6 TN*15H-6 | - | - | - |
| | | | | | | | | | | | |
| PFC Boost | | STM32F4* STM32F7* | PM8834 PM8841 PM8851 L638* L639* L649* PM8834 PM8841 PM8851 STGAP1S | PM8834 PM8841 PM8851 L638* L639* L649* PM8834 PM8841 PM8851 STGAP1S | ST*N60M2 ST*N65M2 ST*N65M5 ST*N50DM2 ST*N60DM2 ST*N60M2 ST*N6F7 ST*N8F7 ST*N10F7 STP*N3LL | STTH*T06 STTH*R06 STTH*S12 STPSC* STTH*06 STTH*12 STPSC* | T1635T | - | - | - | - |
| Charge controller | HB | | | | | | | | | | |
| DC-DC stage | Push Pull | | | | | | | | | | |
| DC-AC stage | NPC | | | | SCT*N120 | - | | | | | L698* ST1S14 L7985 L7986 L7987* |
| | FB | | | | STG*H65DFB STG*H120DF2 | - | | | | | |
| Bypass | | | - | - | - | - | | T2550-12 TPDV* TN5050H-12WY TYN6* TYN8* TYN10* TYN12* | - | - | - |

Example of high-end configuration



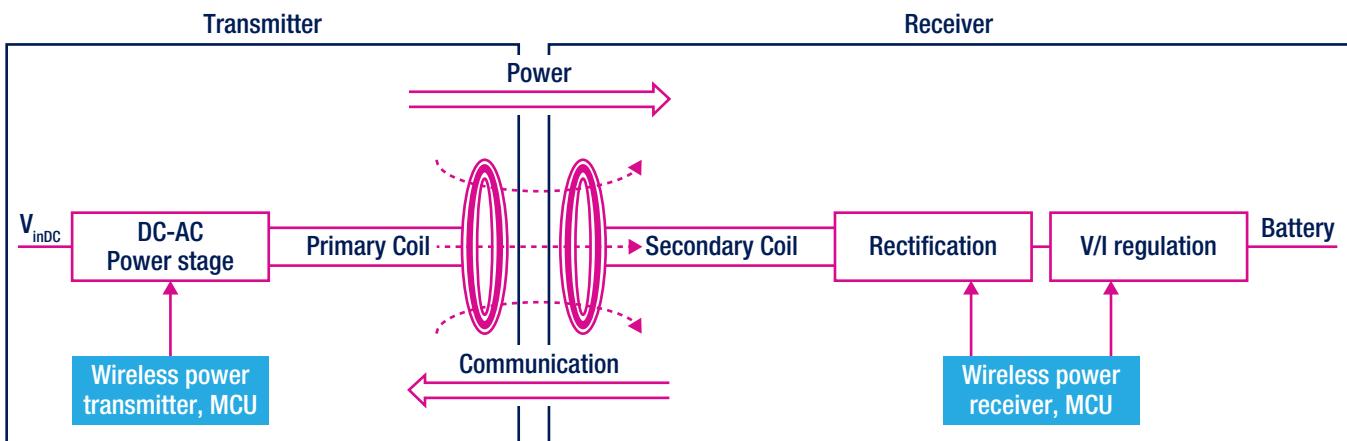
WIRELESS CHARGING

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 STrixFET 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.



| | | | Wireless charging ICs, MCUs | Gate drivers | Power MOSFETs | Protections | Diodes |
|-------------|----------------------------|----|---|------------------------------|--|--------------|----------------|
| Transmitter | DC-AC stage | HB | STWBC STWBC-WA ¹ STM32F0* | L6747* L6749 ¹ | STL*NS3LLH7 ST*N2VH5 ST*P2UH7 ST*H3LL | - | - |
| | | FB | | | | | |
| Receiver | Rectification | | STWLCO3 STWLCO4 ¹ STM32F0* | - | - | SMM4F SMA | STPS* FERD* |
| | Voltage/Current regulation | | | | | | |

Typical configuration



MAIN EVALUATION BOARDS



STEVAL-ISBN027V1

Qi A11 Wireless charger transmitter based on STWBC



STEVAL-ISB036V1¹

Wireless charger receiver
based on STWLC03



STEVAL-ISB038V1¹

Wireless charging reference design kit for wearables based on STWBC-WA and STWLCO4



Software tools

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/](https://my.st.com/anologsimulator/)

eDesignSuite The smart way to design your application



SMART SIMULATOR AND SYSTEM DESIGN ENGINE

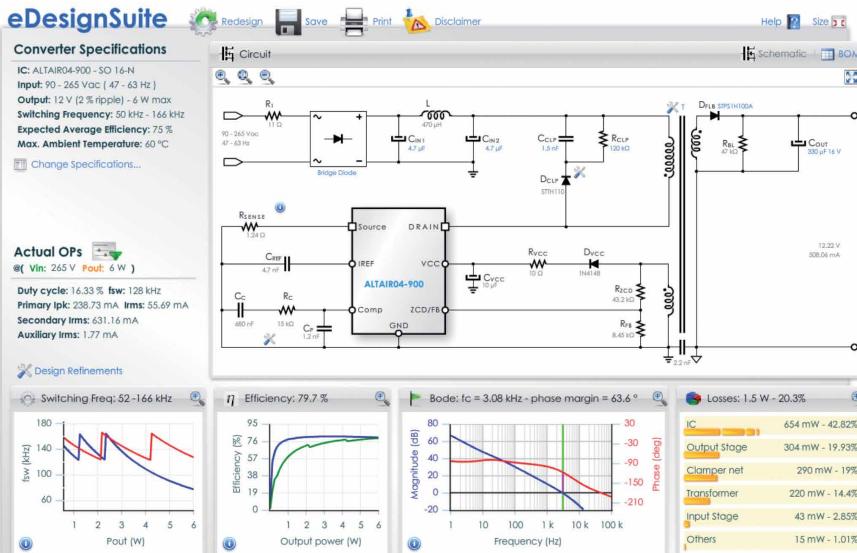
Power conversion and LED lighting

- Automatic proposal for complete solution or fully customizable design
- Fully annotated and interactive schematics
- Complete and interactive bill of materials
- Set of analysis diagrams (main current and voltage simulations, efficiency curves, Bode stability and power-loss data)
- Fully interactive transformer design

SMART SELECTOR

Diodes

- Part numbers proposed based on application electrical specifications
- I-V curves comparison among several part numbers
- Power losses calculated based on voltage/current target application waveforms



Smart simulator and system design engine view

CONFIGURATORS

STLUX & STNRG SMEDs configurator

- SMED configurator schemes
- Input configuration
- Clock, comparators and ADC settings
- FSM (finite state machine) configuration
- C code generation
- Load register setting on board in a click



Products

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.

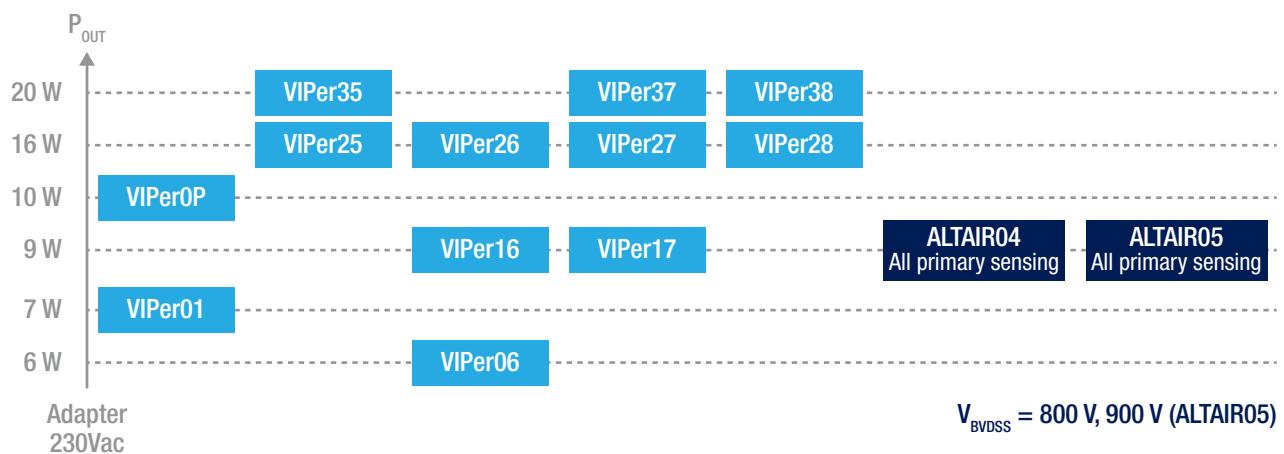
The **VIPerPlus series** (VIPerOP, VIPer01 devices and VIPer*5, VIPer*6, VIPer*7, VIPer*8 families) features an 800 V avalanche-rugged power MOSFET and leading-edge PWM controller and consumes less than 4 mW for VIPerOP, 12 mW for VIPer01 and 30 mW in standby for the others. It also comes with the largest 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/CV). It means opto-less implementation, thus significantly reducing component count.



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-CV using VIPerOP, VIPer01 and VIPer*6
- PSR-CV/CC and tight tolerance using ALTAIR*
- Buck & buck-boost topologies supported by VIPerOP, VIPer01 and VIPer*6



MAIN APPLICATIONS



Consumer
electronics



Factory
automation



Home
appliances



Lighting



Metering



Home
automation

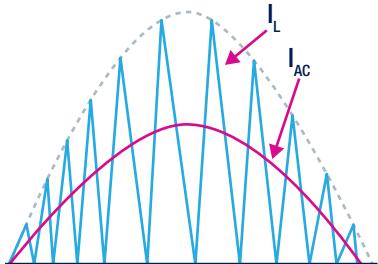
www.st.com/ac-dc-converters
www.st.com/high-voltage-ac-dc-converters
www.st.com/viperplus

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.

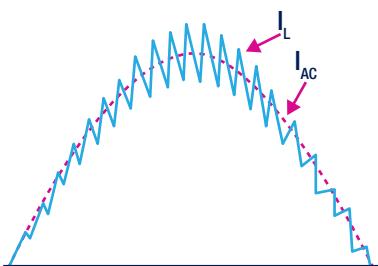
These devices embed advanced protection features, which make SMPS more robust and compact, requiring fewer external components. These features include output overvoltage, brown-out, feedback disconnection and boost inductor saturation protection. The high-voltage start-up capability, present in the L6564H and L6563H, helps improve the SMPS standby efficiency in systems that do not include an auxiliary power supply.

TM PFC controllers



| | Basic features | Advanced protections | Remote on/off control | Tracking boost function | Interface for cascaded converter |
|---------|----------------|----------------------|-----------------------|-------------------------|----------------------------------|
| L6562A* | ● | | | | |
| L6564* | ● | ● | ● | | |
| L6563* | ● | ● | ● | ● | ● |

CCM PFC controllers



| | |
|--------|---|
| L4984D | Line-modulated, fixed-off-time (LM-FOT) control |
| L4981A | Fixed frequency, average-current mode |
| L4981B | Line modulated frequency, average-current mode |

MAIN APPLICATIONS



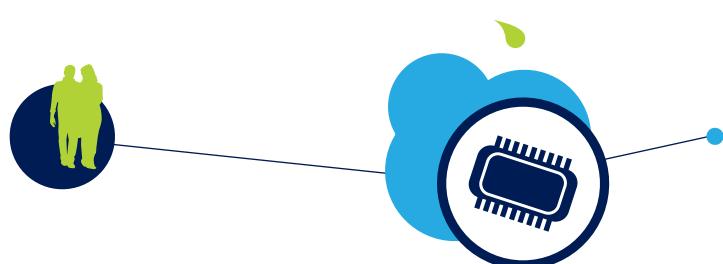
Adapters and TVs
L6562A*, L6563*, L6564*



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



Desktop PCs and servers
L4981*, L4984D



PWM and resonant 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.

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
- Suited for SMPS with PFC front-end (A version)
- Suited for SMPS with 3-phase mains (BH version)
- 700 V start up (A/B version), 840 V start up (BH version)

L6565

- Offline quasi-resonant controller
- Constant power vs mains change
- Ultra-low start-up current

Combo controller (PFC+LLC)

STCMB1

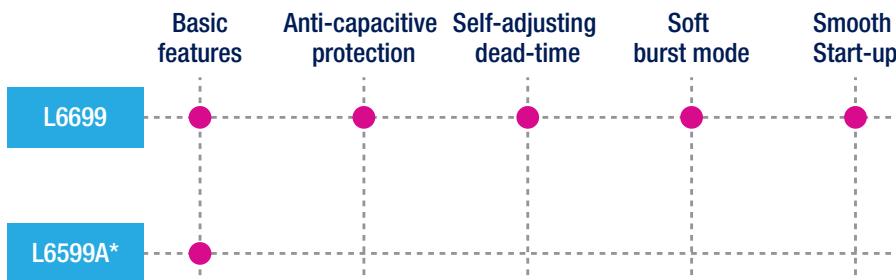
- 800 V start-up voltage
- Embedded X-cap discharge circuit
- Transition Mode (TM) PFC control method
- Self-adjusting dead-time and anticipative mode for LLC

Asymmetrical half-bridge controller

L6591

- PFC interface
- Brown out
- 700 V start-up voltage

HB-LLC resonant controllers



MAIN APPLICATIONS



Tablets and smartphones
L6565, L6566*, STCH02



Laptops
L6565, L6566*, STCH02,
STCMB1



High-power adapters and TVs
L6565, L6566*, L6599A*,
L6699, STCMB1



Desktop PCs, commercial,
architectural and street lighting
L6599A*, L6699, STCMB1

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

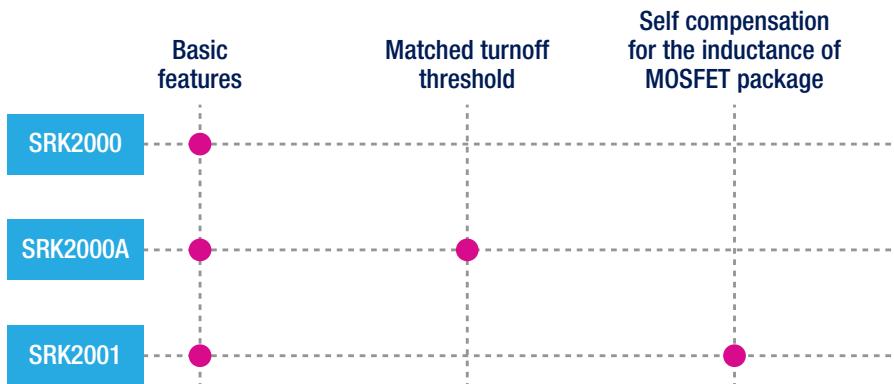
STSR2P*

- Possibility to operate in discontinuous mode
- Smart turn-off anticipation timing

SYNCHRONOUS RECTIFICATION BENEFITS

- Improved efficiency
- Better thermal performance
- High power density
- Increased reliability

SR controllers for LLC resonant



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MAIN APPLICATIONS



High-power adapters and TVs
STSR30, STSR2P*



Desktop PCs and Servers/Telecom
SRK2000, SRK2000A, SRK2001



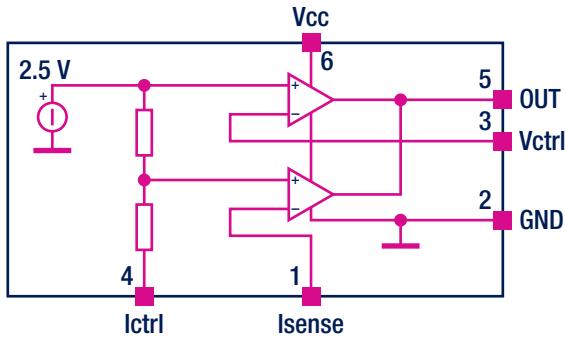
Note: *: is used as a wildcard character for related part number

www.st.com/ac-dc-converters
www.st.com/synchronous-rectification-controllers

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

SEA01

- Advanced CC/CV controller with online digital trimming
- 0.1% voltage reference precision up to 36 V_{cc}
- 200 μA low quiescent current

SEA05

- Advanced CC/CV controller (SEA05)
- Advanced CC/CV controller with efficient LED pilot lamp driver (SEA05L)
- 0.5% voltage reference precision up to 36 V_{cc}
- Low quiescent current: 200 μA (SEA05), 250 μA (SEA05L)
- Current sense threshold 50 mV (SEA05)
- 4% current loop precision (SEA05L)

SEA05L

TSM10*

- Compact solution
- Easy compensation
- 0.5 and 1% voltage reference precision

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MAIN APPLICATIONS



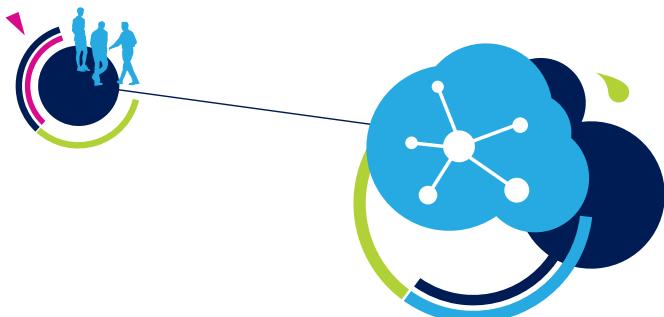
Adapters



Battery chargers



Residential, commercial, architectural and street lighting



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

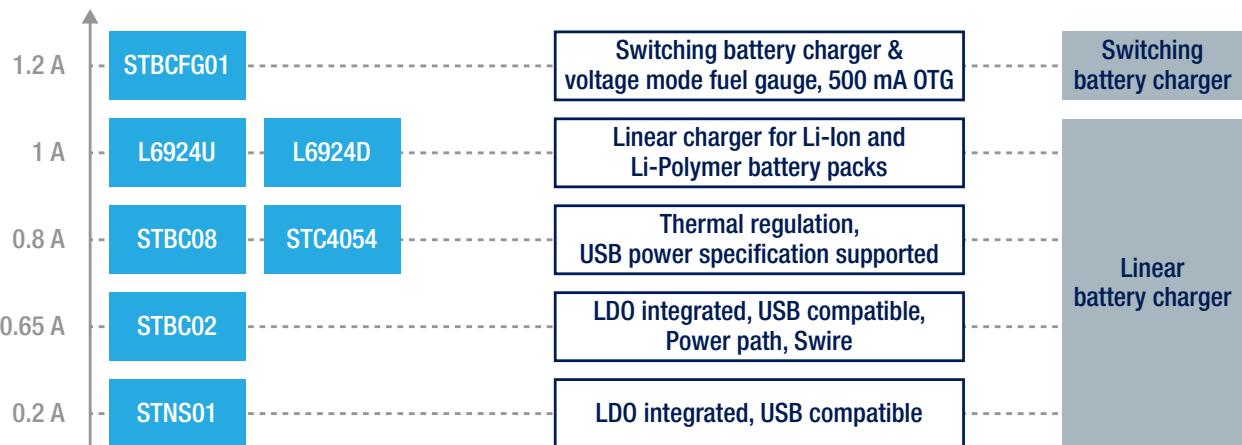
www.st.com/ac-dc-converters
www.st.com/voltage-and-current-controllers

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



Battery monitoring

SCT3115

- OptimGauge™ algorithm for STC3115
- OptimGauge+™ algorithm for SCT3117
- Coulomb counter and voltage gas gauge operations
- Programmable low battery alarm
- Internal T sensor

SCT3117

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MAIN APPLICATIONS



Bluetooth accessories
STBC08, STC4054



USB
L6924U, STBC08, STC4054, STBCFG01



Fitness
STNS01, STBC02



Smartphones
STBC02, L6924U, L6924D, STBC08, STC4054,
STBCFG01, STC3115, 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 STWLCO4 dedicated to wearable application and the STWLCO3, compliant with both Qi and PMA standards, which is suitable for smartphones, tablets, medical applications.

Wireless power transmitters



STWBC

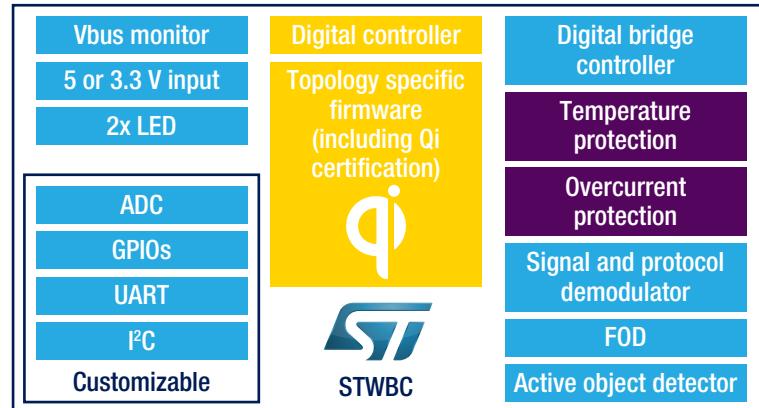
- Supports applications up to 5 W
- Qi A11 certified

STWBC-WA¹

- Supports applications up to 1 W
- Wireless power transmitter dedicated to wearables

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



Wireless power receivers



STWLCO3

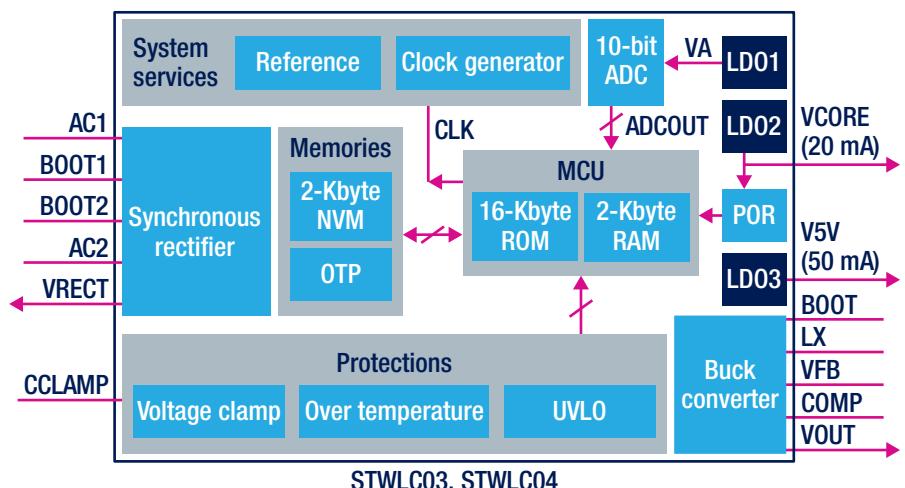
- Supports applications up to 7.5 W
- Multiple Qi and PMA standard compliant

STWLCO4¹

- Supports applications up to 1 W
- Wireless power receiver dedicated to wearables

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



MAIN APPLICATIONS



Wireless battery
charger transmitters
STWBC



Medical & healthcare equipment
STWLCO3



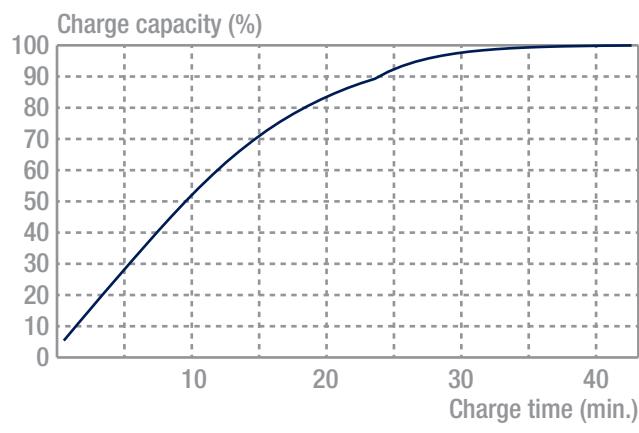
Tablets and smartphones
STWLCO3



Wearables
Transmitter STWBC-WA¹
Receiver STWLCO4¹

Thin-film batteries

ST's EnFilm™ thin-film batteries are a new concept of extremely thin (220 µm), rechargeable solid-state batteries with fast constant-voltage recharge and a lifetime of more than 10 years or 4000 cycles. They feature a LiCoO₂ cathode, LiPON ceramic electrolyte and a lithium anode, on a 25.7 x 25.7 mm footprint and are completely safe from risks of burning or explosion.



Charge done at constant voltage of 4.2 V at 30 °C

THIN FILM BATTERY MAIN BENEFITS

- 10 years life time
- Up to 4000 charges/discharge cycle
- Extremely thin
- Fast Recharge: 30 min
- Pulse current up to 10 mA

EnFilm™ thin film rechargeable battery: the energy of things

EFL700A39

- Capacity: 700 µAh
- Nominal voltage: 3.9 V
- Cycling voltage: 4.2 - 3.0 V
- Dimension: 25.7 x 25.7 mm
- Thickness: 220 µm
- UN Manual Test Criteria, Part III, subsection 38.3
- UL compliant
- IEC 62133
- Flexibility: ISO 7816



MAIN APPLICATIONS



Fitness and wearables



NFC
RF ID tags



Sensors and networks



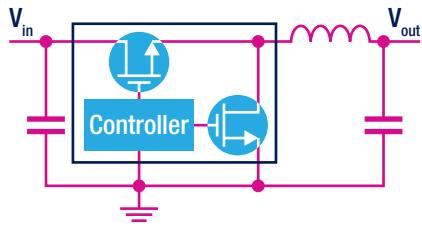
Smart cards



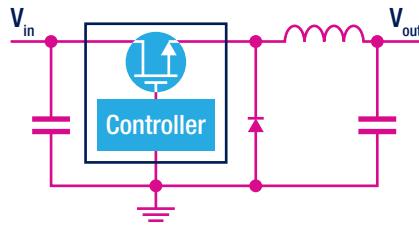
DC-DC SWITCHING CONVERSION ICS

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.



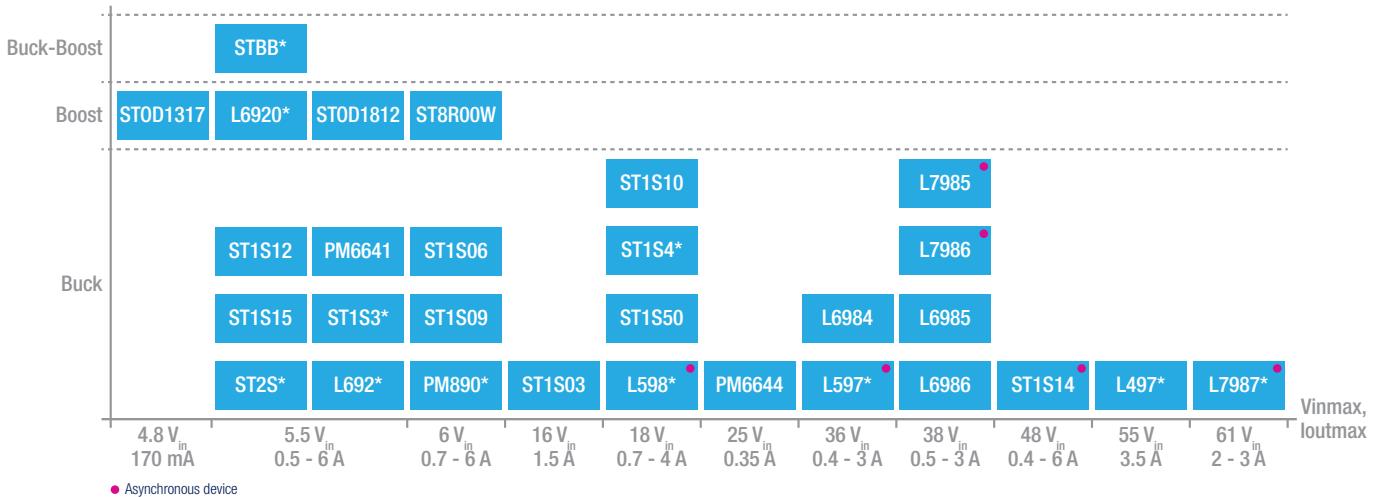
Synchronous buck converter



Asynchronous buck converter

DC-DC CONVERTERS MAIN FEATURES

- Up to 61 V_{in}/3 A
- Synchronization capability
- Internal compensation
- Low consumption
- Adjustable fsw
- Internal soft start
- Low quiescent current



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MAIN APPLICATIONS



Smartphones



TVs



Computing



Solar

UPS

Lighting



Set-top boxes



Wearables

ST1S0*, ST1S1*, ST1S3*, ST1S4*, ST1S50,
ST2S*, L598*, PM664*, STBB*, L6920*,
STOD1812, STOD1317, ST8R00W



Server/Telecom

PM890*, ST1S1*, ST1S3*,
ST1S4*, ST1S50, STBB*,
L598*, L698*, L798*



Home appliances

ST1S0*, ST1S1*, ST1S3*,
ST1S4*, ST1S50, L497*, L597*,
L598*, L698*, L798*



Factory automation

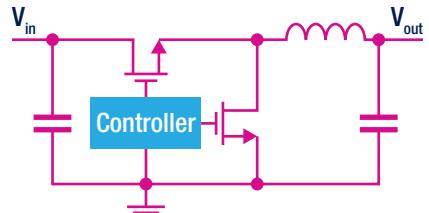
Note: *: is used as a wildcard character for related part number

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

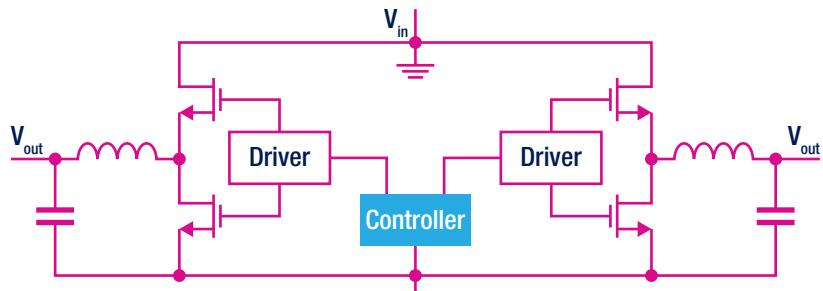
| | |
|--------|---|
| L672* | Single- phase cost effective PWM controller |
| L673* | Single-phase PWM controller with embedded driver and light load efficiency optimization |
| L6997 | Single- phase PWM controller up to 35Vin |
| PM7744 | Advanced single-phase controller with NVM (non-volatile memory) and telemetry |
| PM6697 | Analog single-phase controller with SVID with or without SPS compatibility |
| PM6680 | Dual-output PWM controller up to 36Vin |



Single-phase buck controller

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 |



Multi-phase buck controller

MAIN APPLICATIONS



Servers



Microservers



Telecoms

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* STLUX*

Common features

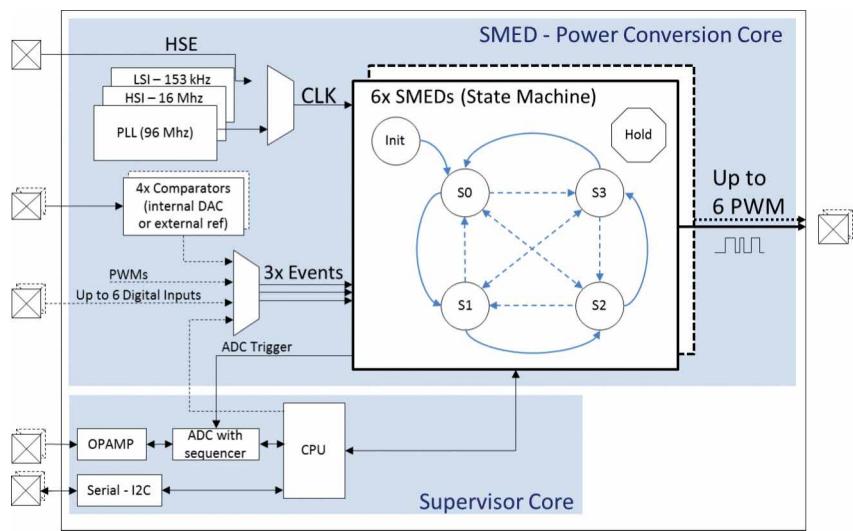
- Innovative digital control technique based on 6 programmable SMEDs with max PWM resolution of 1.3 ns
- Customizable algorithm for higher conversion efficiency
- Internal 96 MHz PLL
- Operating temperature -40 to 105°C
- Serial, I²C and GPIO interfaces

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-strings lighting applications
- DALI 2.0 for remote control and connectivity



STNRG* internal block diagram

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MAIN APPLICATIONS



Solar
STNRG*



UPS
STNRG*



HEV charging stations
STNRG*



Factory automation
STNRG*



Commercial, architectural and street lighting
STLUX*

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

STM32F334

- 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 (25ns from fault input to PWM stop)

STM32 F0 series, the MCUs for cost sensitive applications

STM32F0*8

STM32F0*2

STM32F0*1

STM32F0*0

- Cortex®-M0 core
- Entry level, from 16 to 256 Kbytes
- USB crystal-less TSSOP20
6 Kbytes, 32-bit
- 8-/16-bit solutions and ecosystem



STM32F334 features

MAIN APPLICATIONS



Solar



Welding



Commercial, architectural and street lighting



Server/Telecom



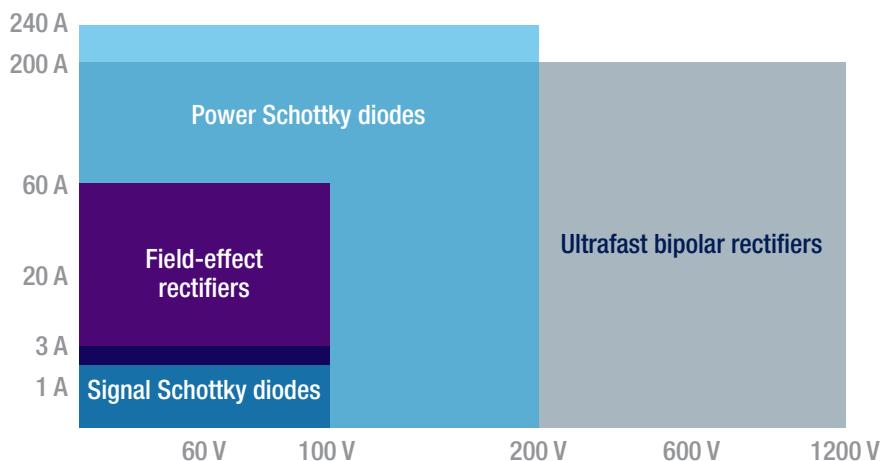
Factory automation

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.



Field-effect rectifiers (FERD)

| | |
|---------|--------------------------|
| FERD*U* | Low V_F |
| FERD*M* | Low I_R |
| FERD*S* | Best V_F/I_R trade-off |

Power Schottky diodes

| | |
|---------|--------------------------|
| STPS*L* | Low V_F |
| STPS*M* | Best V_F/I_R trade-off |

Ultrafast rectifiers

| | |
|-------|---|
| STTH* | Various V_F/t_{RR} trade-off to achieve best performance in any application |
|-------|---|

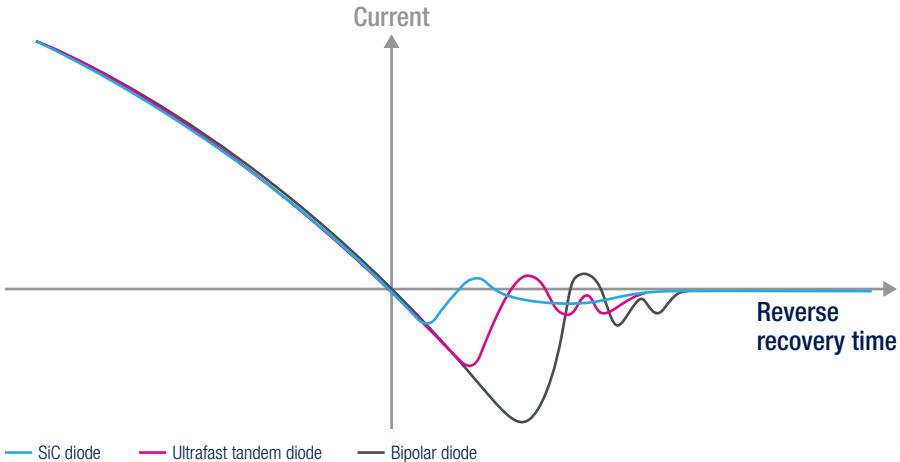
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MAIN APPLICATIONS



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

650 V SiC diodes in insulated TO-220 packages: the solution to speed production

STPSC*06

- 600 V
- High efficiency thanks to low forward voltage drop
- Ideal for applications without current surge

STPSC*065

- 650 V (STPSC*065)
- 2 x 650 V (STPSC*13) dual in series diodes
- Best trade-off between efficiency and robustness thanks to the high Ifsm
- Ideal for applications with high current surge

STPSC*13

MAIN APPLICATIONS



Solar inverters
STPSC*06



HEV
STPSC*065



UPS
STPSC*06



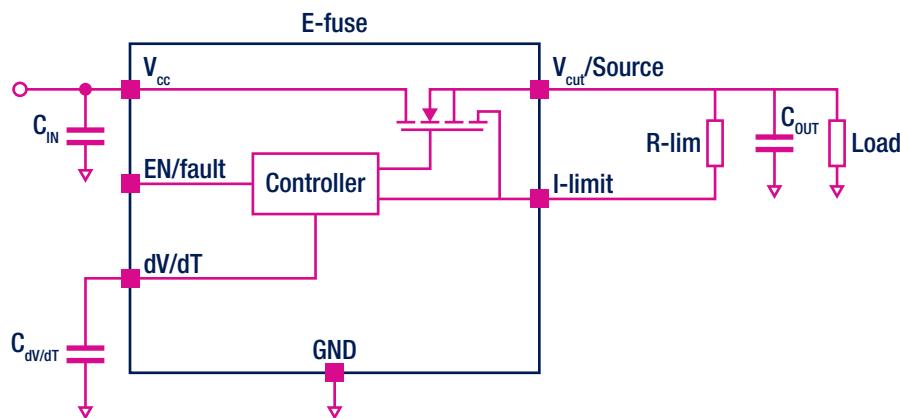
Servers/Telecoms and PFC
STPSC*065, STPSC*13

HOT-SWAP POWER MANAGEMENT

E-fuses

E-fuses are electronic fuses that can replace larger conventional fuses or other protection, reducing ownership costs in production and in the field.

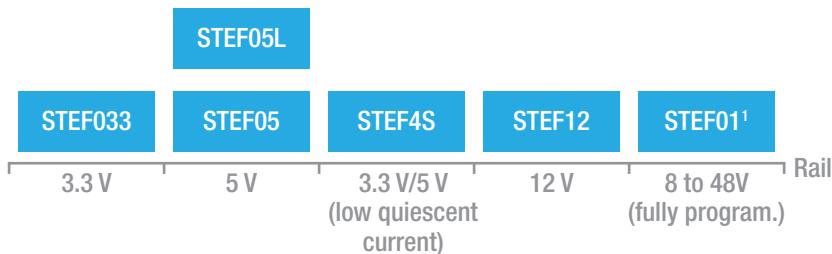
Unlike fuses, they offer complete and flexible management of the fault (overcurrent/overvoltage), without requiring replacement after actuation. They thus help to improve equipment uptime and availability and also reduce maintenance costs and false returns. Compared to traditional protection devices, these new electronic fuses enable versatile and simple programming of protection parameters, such as overcurrent threshold and start-up time.



E-FUSE MAIN FEATURES

- Do not degrade or require replacement after a trip event
- Programmable over-current protection and turn-on time
- Latched or autoretry function
- Overvoltage clamp
- Over-temperature protection
- Integrated power device
- Internal undervoltage lockout

E-fuses, a smart offer for a lots applications



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MAIN APPLICATIONS



Home appliances
STEF05, STEF01¹, STEF12



HD and SSD
STEF033, STEF05,
STEF05L, STEF4S, STEF12



USB connections
STEF05, STEF05L



Factory automation
STEF01¹, STEF12



Set-top boxes
STEF12



Power breakers & current limiter ICs

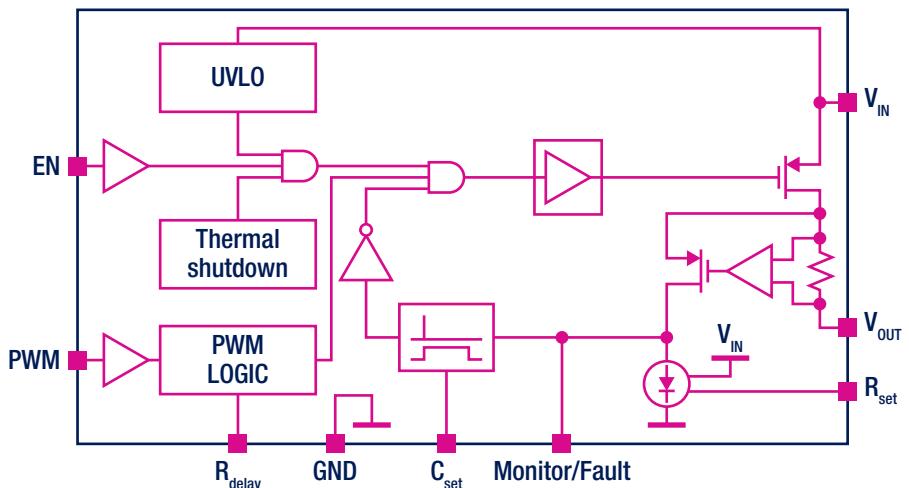
Connected in series to the power rail, ST's power breakers are able to disconnect the electronic circuitry if power consumption exceeds the programmed limit. When this happens, the device automatically opens the integrated power switch, disconnecting the load, and notifies the remote monitoring feature.

Current limiter ICs are designed to work with an external MOSFET to protect power supplies from anomalous external current demands.

Power breakers

STPW05¹ **STPW12¹**

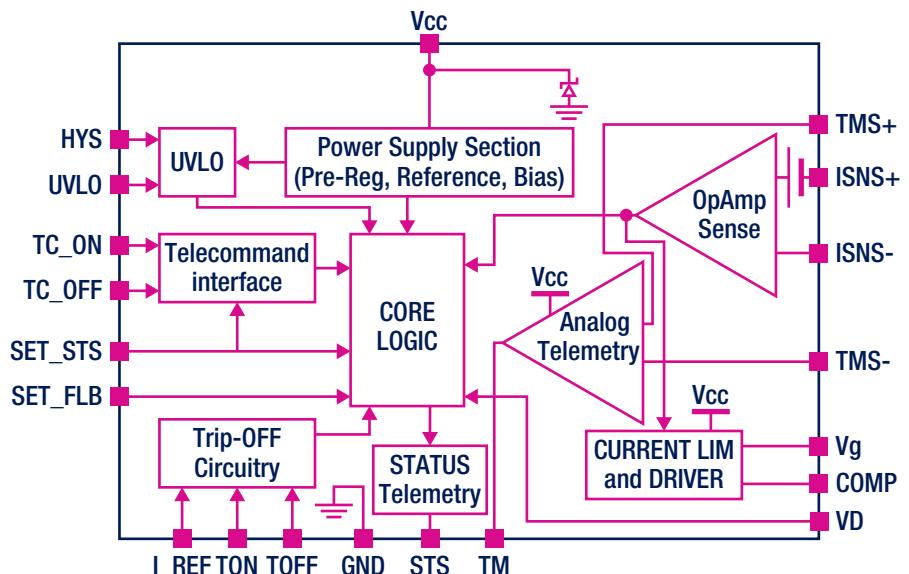
- Auto-retry function with programmable delay
- Adjustable precise power limitation from 11 to 16 W
- 5 V (STPW05) and 12 V (STPW12) rails
- Programmable power limit masking time
- Over-temperature protection
- Integrated N-channel power MOSFET
- Internal undervoltage lockout



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
STPW05¹, STPW12¹



Air conditioning
STPW05¹, STPW12¹



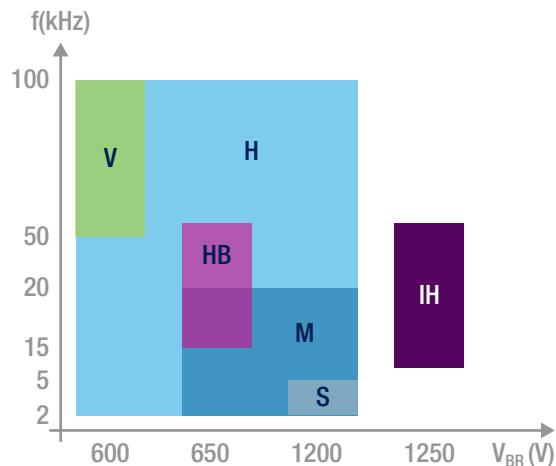
Factory automation
STPW05¹, STPW12¹, STFC01



Servers/Telecoms
STFC01

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 μ s of short-circuit capability @ starting $T_j = 150$ °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 $T_j = 150$ °C
- Wide safe operation area (SOA)
- Soft and fast recovery antiparallel diode
- Suited for asymmetric half-bridge, 3-level half bridge, 3-phase inverter and full bridge topologies

IH series

STG*IH*

- Medium f_{sw}
- Minimized tail current
- Low drop forward voltage diode
- Suited for single-switch quasi-resonant topology

HB series

STG*H*B

- Medium f_{sw}
- Very low saturation voltage
- Minimal tail current turn-off time
- Suited for TTF and Boost-CCM topologies

H series

STG*H*

- | | |
|---|---|
| 600 V family | 1200 V family |
| • 3 μ s of short-circuit capability | • 5 μ s of short-circuit capability @ starting $T_j = 150$ °C |
| • Low saturation voltage | • Low turn-off losses |
| • Minimal collector turn-off | • Very fast turn-on |

V series

STG*V*

- High f_{sw} series
- Tail less switching off
- Low conduction losses
- Suited for TTF, Boost CCM and FB topologies

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MAIN APPLICATIONS



Welding
H, HB, V



Solar

Inverter: S, M - Boost: H, HB



UPS
S, M, H



Home appliances
H, HB



Air conditioning
S, M, H, HB



Motor control
S, M

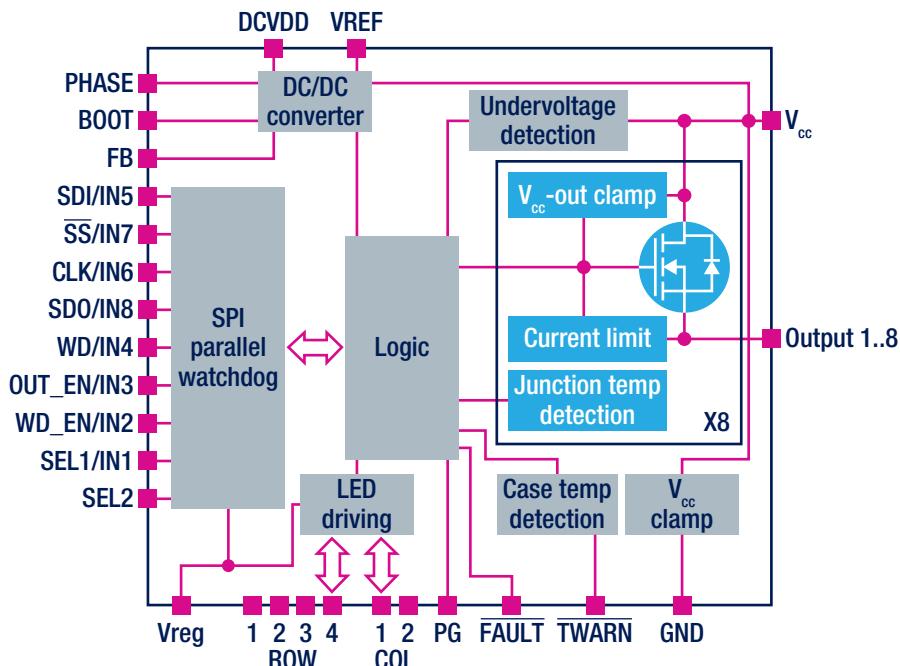


Induction heating
HB, IH

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.



IPS MAIN FEATURES

- Logic
- Driving
- Protections
- Diagnostic
- Power stage
- ...all on a single chip

ISO8200*, the galvanic isolated IPS ideal for factory automation



MAIN APPLICATIONS



Factory automation



Vending machines



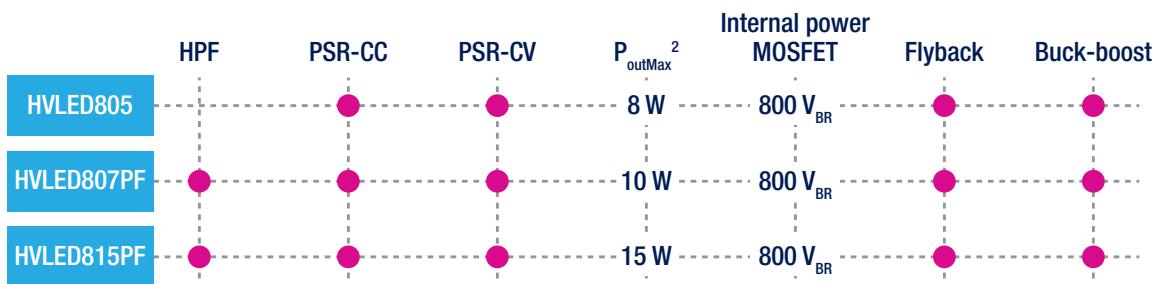
Renewable energy

LED DRIVERS

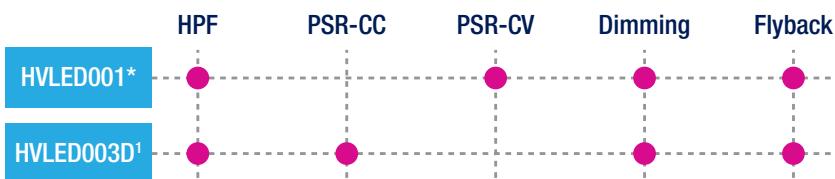
Offline LED drivers

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/CV). HVLED* controllers are also available for high 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

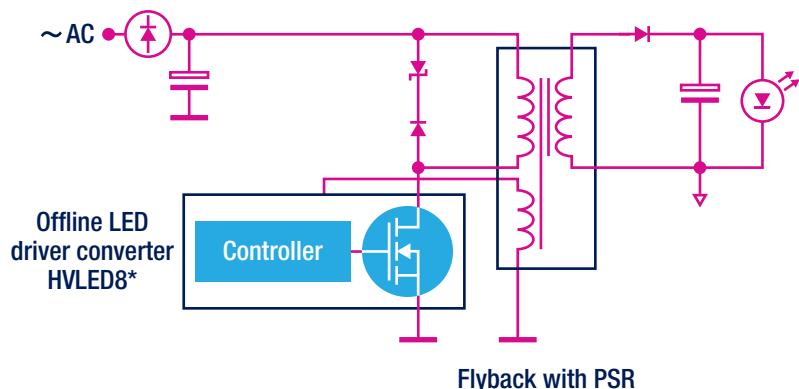


Offline LED controllers with PSR



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Topology example



MAIN APPLICATIONS



Residential lighting

HVLED805, HVLED807PF, HVLED815PF



Commercial, architectural, and street lighting

HVLED001*, HVLED003D¹

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.

DC-DC LED drivers converters

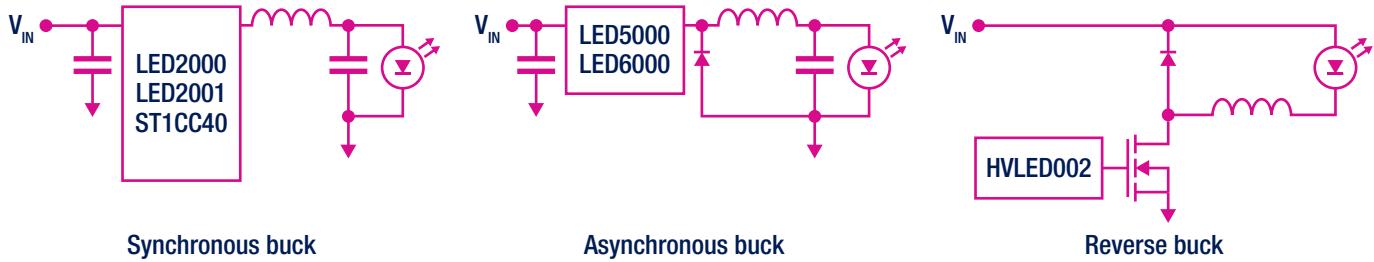
| | Buck | Buck-boost | I_{outMax} | Dimming | V_{inMax} | Synchronous |
|---------|------|------------|--------------|---------|-------------|-------------|
| LED2000 | ● | | 3 A | ● | 18 V | ● |
| LED2001 | ● | | 4 A | ● | 18 V | ● |
| ST1CC40 | ● | | 3 A | | 18 V | ● |
| LED5000 | ● | ● | 3 A | ● | 48 V | |
| LED6000 | ● | ● | 3 A | ● | 61 V | |

DC-DC LED drivers controllers

| | Reverse buck | Buck-boost | Boost & Sepic | Dimming | V_{inMax} |
|----------|--------------|------------|---------------|---------|-------------|
| HVLED002 | ● | | | ● | 30 V |
| LED6001 | | ● | ● | ● | 36 V |

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Topology examples



MAIN APPLICATIONS



Halogen bulbs
replacements and home
appliances
LED2000, LED2001



Traffic signals
LED2000, LED2001,
ST1CC40,
LED5000, LED6000



Street lighting
LED5000,
LED6000,
HVLED002



Emergency lighting
LED6001,
ST1CC40

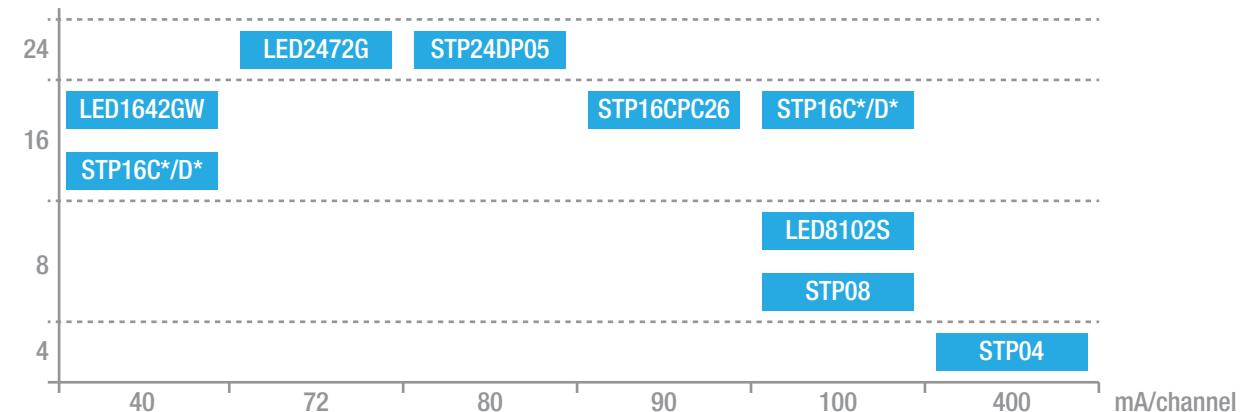


Commercial and
architectural lighting
LED5000, LED6000,
LED6001, HVLED002

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.

Channels



24 channel RGB (8x3) drivers

- Current gain control (LED2472G), constant current (STP24DP05)
- Error detection
- Autopower saving (LED2472G)

16 channel drivers

- Current gain control (LED1642GW), constant current (STP16C*D*)
- Error detection (STP16C*D*)
- Autopower saving
- Local dimming (LED1642GW), global dimming (STP16C*D*)

4/8 channel drivers

- Constant current
- Direct I/O (LED8102S)
- Error detection (STP08)
- Global dimming

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MAIN APPLICATIONS



Traffic signals

LED8102S, LED2472G,
STP24DP05, STP04



Large panel signs

LED1642GW, LED2472G,
STP24DP05, STP16, STP08



Home appliances

LED8102S, STP16,
STP08, LED1642GW



Special lighting

STP04, LED1642GW,
LED2472G, LED8102S

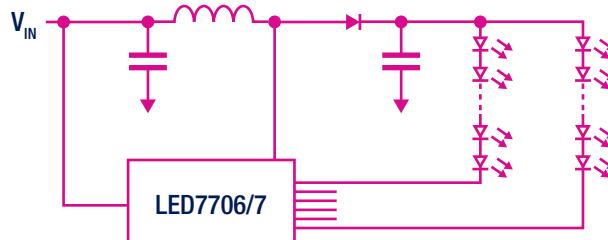
LED row drivers

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.

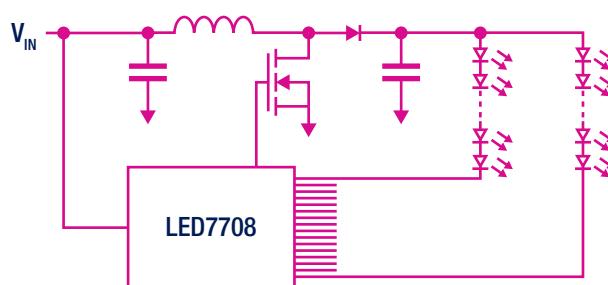
LED row driver converters

| | | |
|--------|---------|-------------|
| | LED7707 | • 85 mA/row |
| 6 rows | LED7706 | • 30 mA/row |
| 5 rows | STLED25 | • 25 mA/row |
| 4 rows | STLD41 | • 30 mA/row |
| 1 row | STLA02* | • 20 mA/row |
| | STLD40D | |



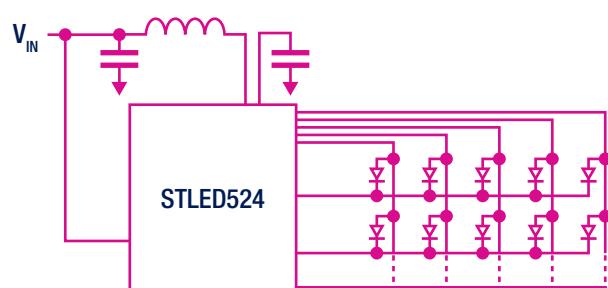
LED row driver controllers

| | | |
|---------|---------|---|
| 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



Smartphones
STLED25, STLD40D



Game consoles
STLD41



Keyboard and accessories
STLA02*



Home appliances and ATMs
LED7706, LED7707, LED7708

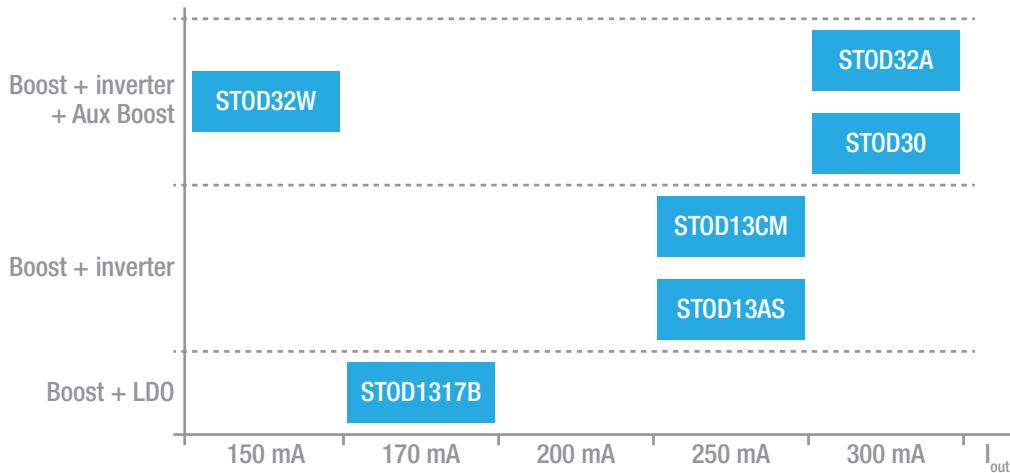


Wearables
STLED524

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.



1 channel driver (for displays up to 4")

STOD1317B

- Wide output range (up to 13 V)
- Very low output ripple
- High efficiency
- 100 mV LDO output drop

2 channel drivers (for displays up to 5")

STOD13AS

- High efficiency in overall output range
- Wide output negative range (STOD13AS)
- External feedback output sense (STOD13CM)

3 channel drivers (for displays up to 6")

STOD30, STOD32W

- Programmable auxiliary boost for driver ICs
- 100 mA output load in flipchip (STOD32W)
- Wide output negative range (STOD30)

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MAIN APPLICATIONS



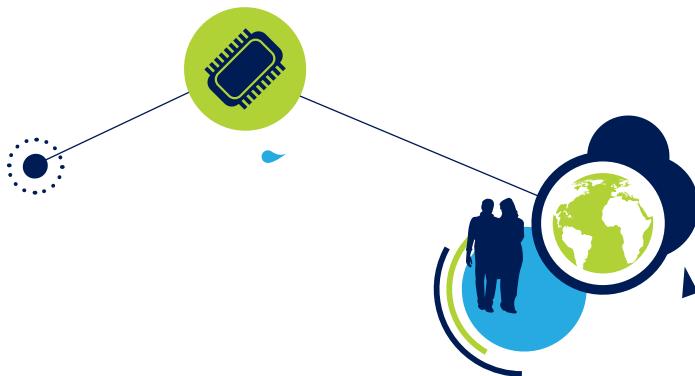
Fitness and wearables
STOD32W, STOD1317B



Low-end smartphones
STOD1317B,
STOD13AS/CM, STOD30

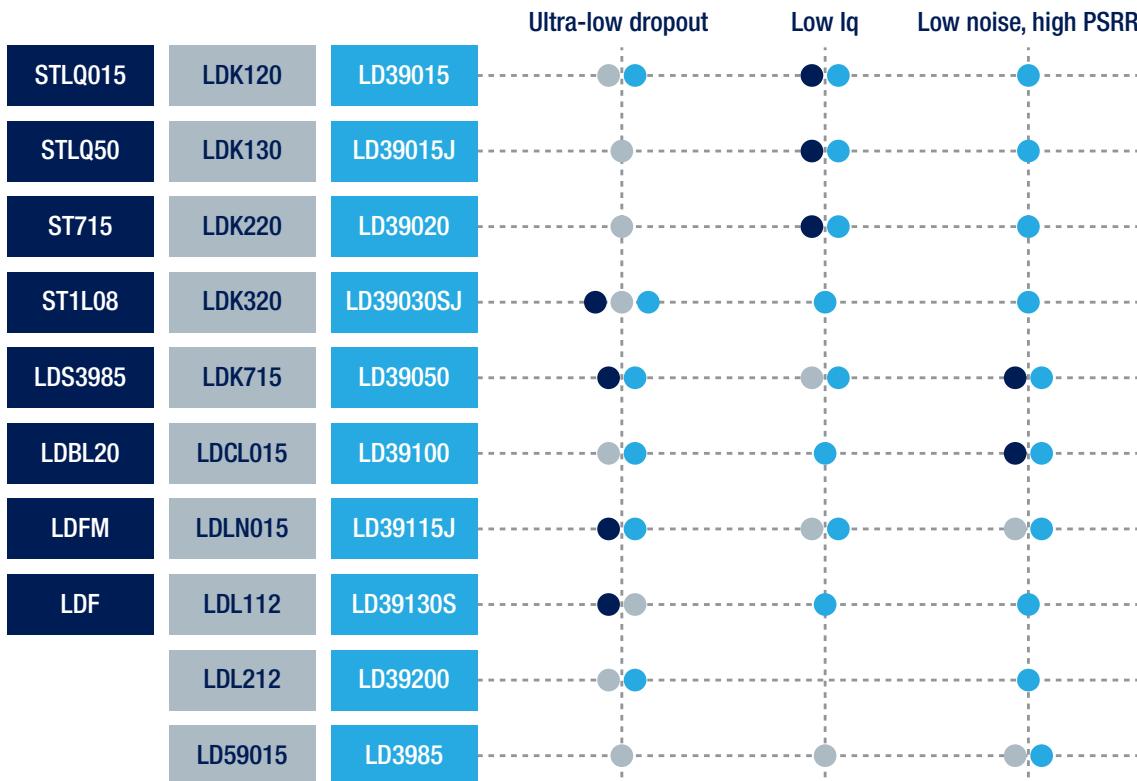


High-end smartphones
STOD30, STOD32A



LINEAR VOLTAGE 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 µA 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 I_{out} capability and packaging

Low quiescent current I_Q

- 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,
ST1L08, LDBL20, LD59015



Healthcare
STLQ*, ST715, LD39130



Fitness and wearables
LD39130, LDLN*, LD39115,
LD39020, LD39030, LDBL20

LNB SUPPLIES

LNB supplies ICs

ST's **LNB (low-noise block) supply ICs** are intended for analog and digital satellite receivers, satellite TVs, satellite PC cards. These devices are monolithic voltage regulator and interface ICs specifically designed to provide the 13/18 V power supply and the 22 kHz tone signaling to the LNB downconverter in antenna dishes or to the multi-switch box.



Single tuner ICs

LNBH25S

LNBH29

LNBH30

Dual-tuner IC

LNBH26S

Main common features

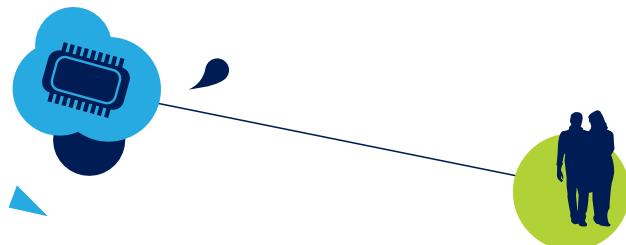
- Complete interface between LNB and I²C bus
- 15 output voltage levels
- Output surge robustness up to 40 V
- P2P compatibility between single- and dual-tuner versions
- Stable with ceramic and electrolytic capacitors
- Built-in high-efficiency 12 V DC-DC converter
- Selectable output current limit by external resistor
- Compliant with main satellite-receiver output-voltage specifications
- Accurate built-in 22 kHz tone generator suits widely accepted standards
- Internal overload and over-temperature protection

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MAIN APPLICATIONS

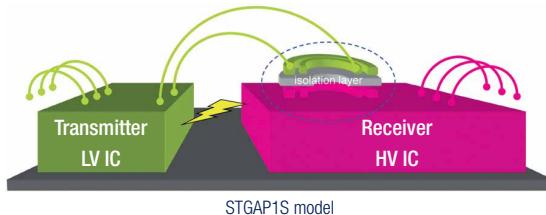


Set-top boxes and PC card satellite receiver

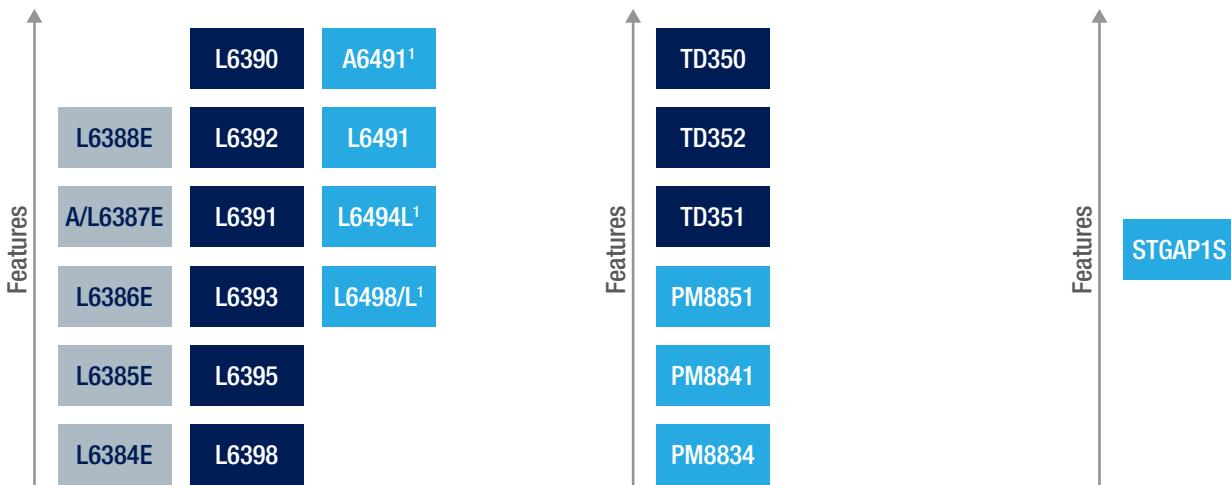


MOSFET AND IGBT DRIVERS

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 L639*, L649* and STDRIVEgap STGAP1S offer smart functionalities to protect and simplify application implementation and usage.



Robustness and reliability, system integration and flexibility: that's ST's gate driver offer you



600 V Half bridge gate drivers

- 4 A source/sink driver high current capability (L6491)
- Integrated bootstrap diode
- Adjustable deadtime (L6494L)
- Comparator, op amp integrated, smart SD, interlocking and program. DT (L6390)
- Smart shutdown (L649*, L639*)
- 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

L638*E, TD35*, L639*, L6491, L6494L¹,
L6498/L¹, PM8841, PM8851



Commercial, architectural
and street lighting

PM8834, PM8841, PM8851



Solar inverters, HEV / EV,
and factory automation

STGAP1S, PM8841, PM8851

PHOTOVOLTAIC ICS

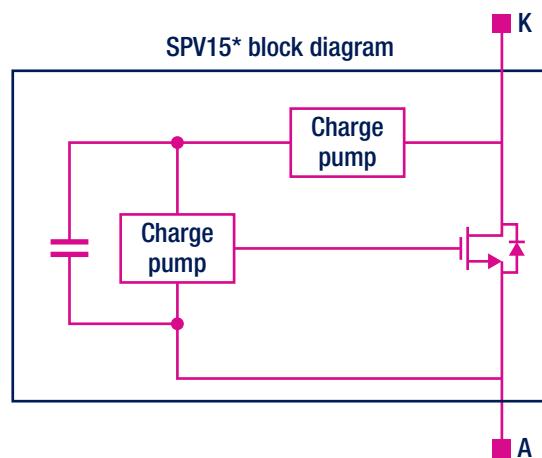
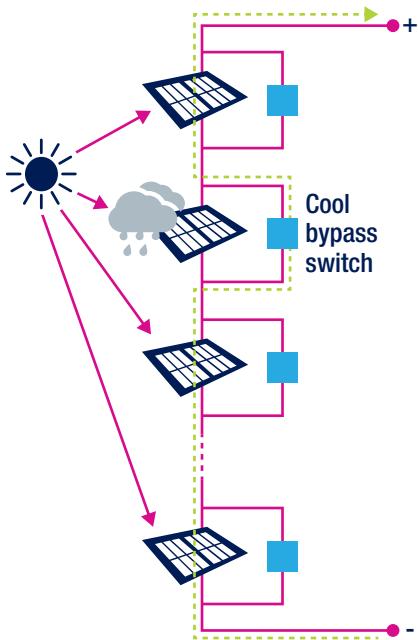
Cool bypass switches

ST's **cool bypass switches** provide a system-in-package (SiP) solution for photovoltaic applications by providing a bypass path to the current while keeping the power dissipation at the bottom in any working condition - a key benefit compared to conventional Schottky diodes as it ensures a much longer lifetime and system reliability. This is translated into the "cool" attribute that indicates the important capability of these devices to ensure a much lower forward voltage drop and reverse leakage current.

The devices consist of a power MOSFET accurately driven by an embedded controller. This all in one SiP strongly enhances the reliability of the system (robustness to ESD and surges).

| | Reverse voltage | Average current rectified |
|-----------------------|-----------------|---------------------------|
| SPV1512N | 12 V | 16 A |
| SPV1520N | 20 V | 16 A |
| SPV1540N ¹ | 40 V | 16 A |

When a PV panel is shaded, the cool bypass switch offers an alternative path to the current to prevent hotspot phenomena and to guarantee the maximum power contribution of the entire cell string.



MAIN APPLICATIONS



Centralized and distributed solar solutions

DC-DC converters with embedded MPPT algorithm

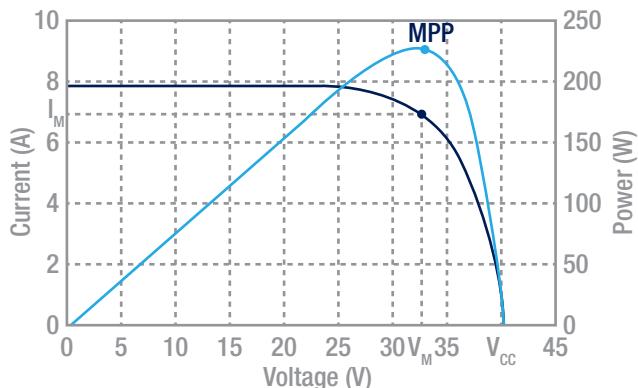
The maximum power point tracking (MPPT) algorithm maximizes the power output by photovoltaic panels according to temperature and solar irradiation conditions.

The SPV1040 is a monolithic DC-DC synchronous boost converter able to harvest the energy generated by even a single solar cell characterized by a very low output voltage. It is especially designed to work in outdoor environments with loads up to about 3 W.

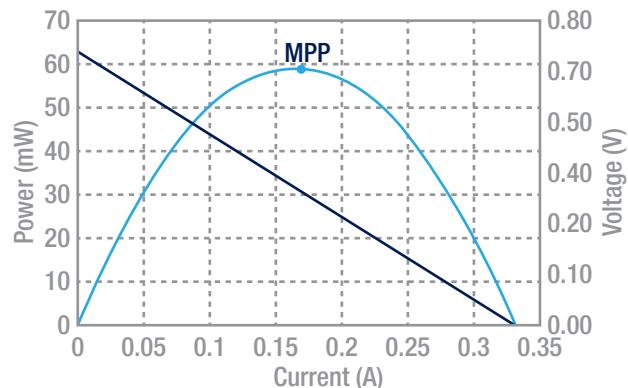
The SPV1050 is an ultra-low-power battery charger and energy harvester (from photovoltaic cells or a thermo-electric generators) that guarantees a very fast charge of supercapacitors and any type of battery including thin-film solid-state batteries. It is specifically designed to work in indoor environments or with very small thermal gradients with loads up to about 350 mW.

| | Power capability | Converter type |
|--|------------------|-------------------------------|
| SPV1040 Solar battery charger with embedded MPPT | < 3 W | Sync Boost |
| SPV1050 Ultra-low-power energy harvester (PV/TEG) and battery charger with embedded MPPT and LDOs | ≤ 350 mW | Sync Boost Sync Buck-Boost |

Solar curves



Thermo-electric generator (TEG)



MAIN APPLICATIONS



Smartphones, digital cameras, and camcorders
SPV1040



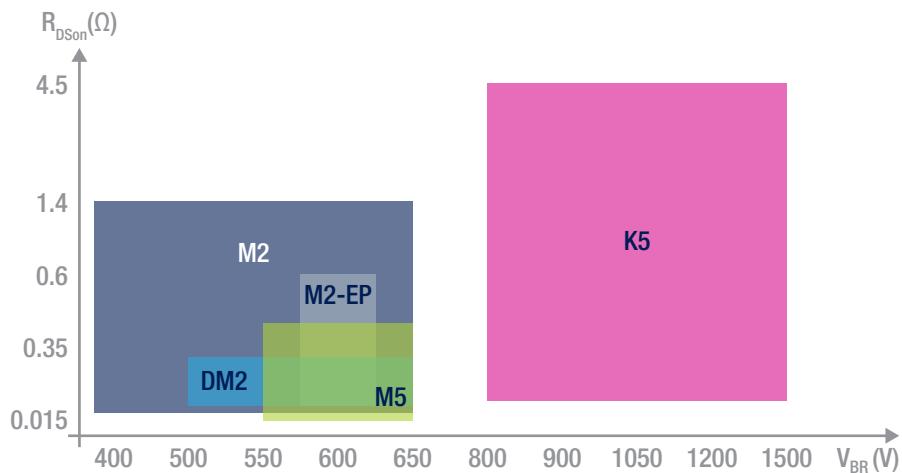
Fitness, climate, home and factory automation monitoring
SPV1050



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.



K5 series

ST*N*K5

- Very low $R_{DS(on)}$
- Small Q_g and capacitance
- Small packages available
- Suited for hard switching topologies

M5 series

ST*N*M5

- Extremely low $R_{DS(on)}$
- High switching speed
- Suited for hard switching topologies

M2/M2-EP series

ST*N*M2

ST*N*M2-EP

- Extremely low Q_g
- Optimized for light load conditions
- Tailored for high-frequency applications (M2-EP)
- Suited for hard switching & ZVS/LLC topologies

DM2 series

ST*N*DM2

- Improved trr of intrinsic diode
- High dV/dt capability
- Suited for ZVS/LLC topologies

MAIN APPLICATIONS



Adapters
K5, M5, M2, M2-EP



Solar inverters, welding, HEVs, and UPS
K5, M5, DM2



Residential, commercial,
architectural and street lighting
K5, M2

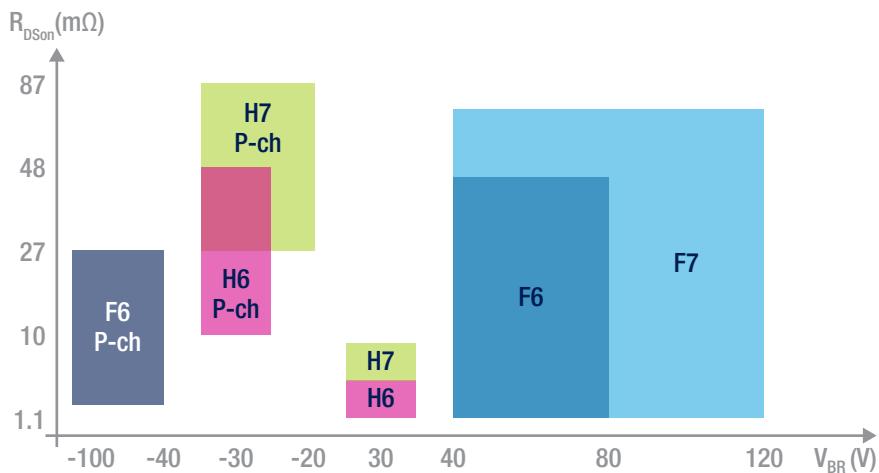


Servers/Telecoms
M5, M2, M2-EP, DM2

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.



H6 series

ST*N*H6

- Very good R_{DS(on)}
- Soft diode recovery
- Suited for OR-ing, square-wave HB, battery mgmt topologies

H7 series

ST*N*H7

- Extremely low R_{DS(on)}
- High current capability
- Monolithic Schottky
- Super logic level (P-channel)
- Suited for reverse buck, buck-boost, battery mgmt, forward and buck topologies

F6 series

ST*N*F6

- Wide voltage range
- Soft diode recovery
- Very good R_{DS(on)}
- Suited for load-safety switch, buck and sync rectification

F7 series

ST*N*F7

- Extremely low R_{DS(on)}
- Optimized body diode (low Q_{rr}) and intrinsic capacitance
- Proper Crss/Ciss ratio
- Suited for flyback and sync rectification

MAIN APPLICATIONS



Small motor control and
USB battery chargers

F6



HDD, power tools, STB,
and game consoles

H6, H7



Servers/Telecoms
and SMPS

H6, H7, F6, F7



UPS, e-bikes,
and fans

F6

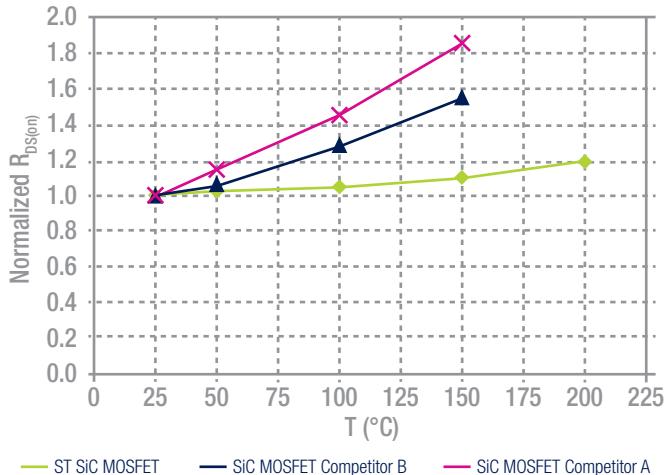


Solar inverters,
forklifts, and EHVs

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.



SiC MOSFETS MAIN BENEFITS

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

SiC MOSFETs, the real breakthrough in high voltage switching

SCT*N120

SCT*N65G2¹

SCT*N65G2V¹

- $V_{BR} = 1200\text{ V}$ (SCT*N120),
 650 V (SCT*N65G2/G2V)
- Low power losses at high temperature
- High operating temperature capability
(200 °C)
- Body diode with no recovery losses
- Low power losses at high temperatures
- Easy to drive
- Low gate charge (SCT*N65G2V)

MAIN EVALUATION BOARD



4 kW
Boost inverter evaluation board
Available on request

MAIN APPLICATIONS



Motor control



HEVs / EVs



Welding



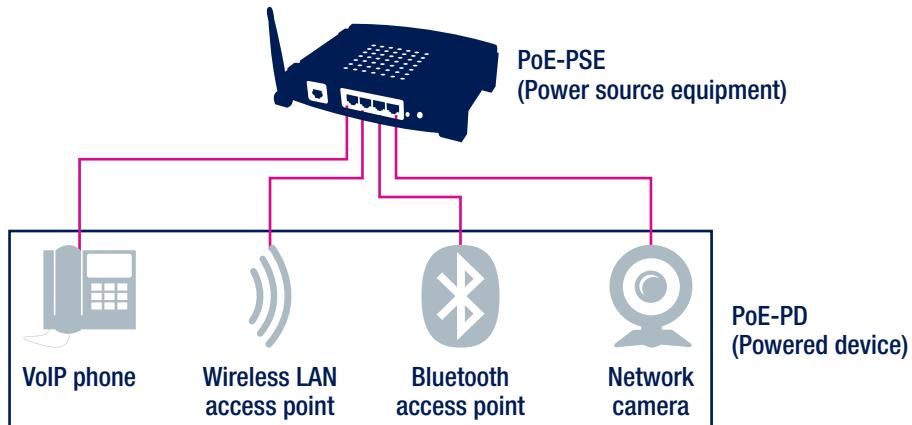
UPS



Solar inverters

POWER OVER ETHERNET ICs

Power over Ethernet (PoE) is a widely adopted technology used to transfer both data and electrical power over an RJ-45 cable. ST offers solutions for PoE applications on the powered devices (PD) side that integrate a standard power over Ethernet (PoE) interface and a current mode PWM controller to simplify the design of the power supply sections of all powered devices. ST's PoE-PD ICs are compliant with both the more recent IEEE 802.3at specification, commonly known as PoE+, and the former IEEE 802.3af (PoE).



PoE-PD devices

PM8803

- IEEE 802.3at PD interface
- PWM current mode controller with double gate driver
- Integrated 100 V, 0.45 W, 1 A hot-swap MOSFET
- Supports flyback, forward active clamp, and flyback with synchronous rectification topologies

PM8801

- Sleep mode with LED indicator and Maintain Power Signature
- IEEE 802.3at PD interface + PWM current mode ctrl with double gate driver
- Integrated 100 V, 0.45 W, 640 mA hot-swap MOSFET
- Supports flyback, forward active clamp, and flyback with synchronous rectification topologies

PM8800A

- IEEE 802.3af PD interface
- PWM current mode controller
- Integrated 100 V, 0.5 W, 800 mA hot-swap MOSFET
- Supports both isolated and non-isolated topologies

Main standards

PM8800A

PoE
(IEEE 802.3af)

13 W

PM8803, PM8801

PoE+
(IEEE 802.3at)

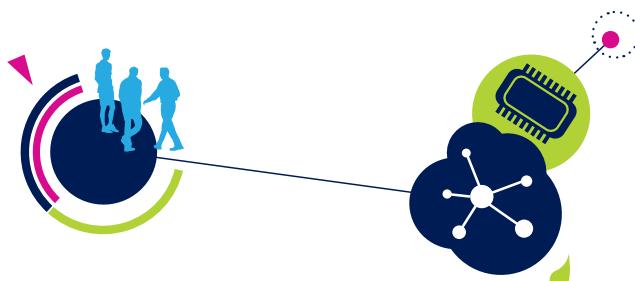
25 W

PM8803 with external booster

4-pair PoE

60 W

Power at
PoE-PD input

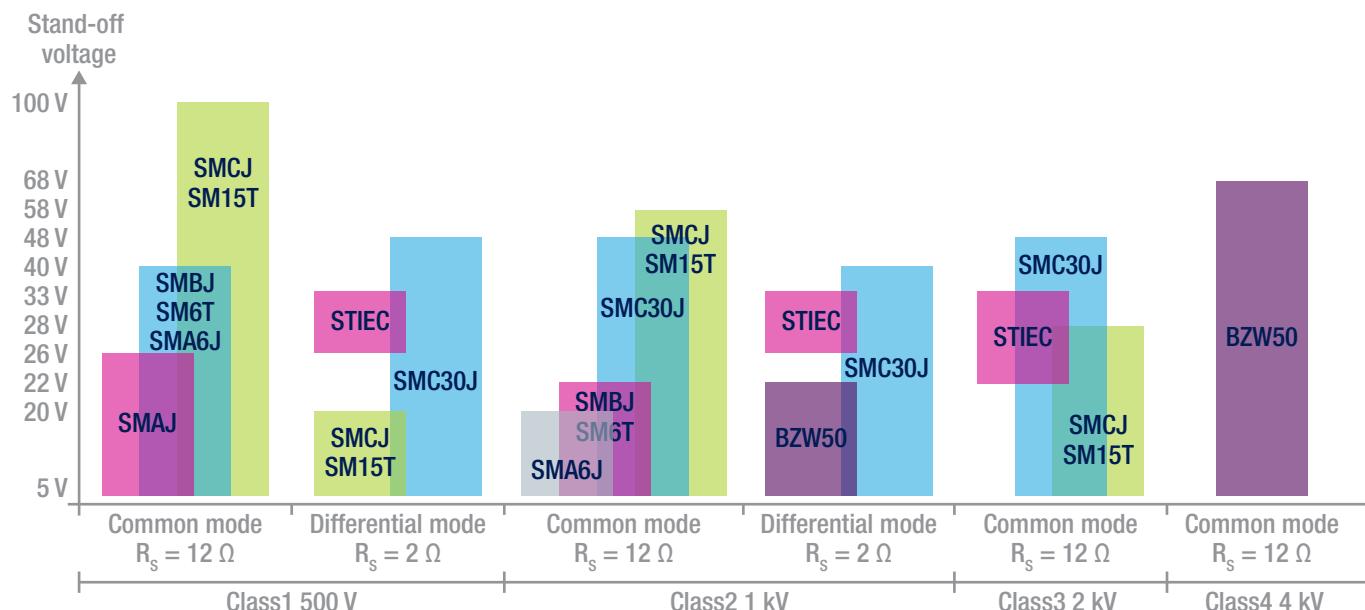


PROTECTION DEVICES

EOS 8/20 μ s surge protection

ST's **EOS 8/20 μ s 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.



EOS protections, upgraded performance at high application temperature



MAIN APPLICATIONS



Offline and DC-DC power supplies, PFC



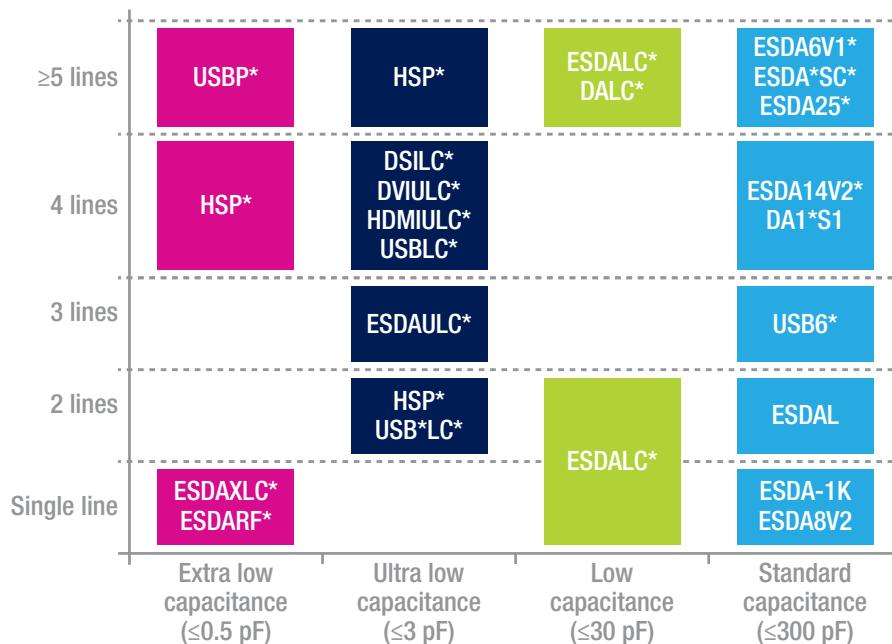
Solar inverters



Smart metering

ESD protection

Driven by market needs, **ST's ESD protection devices**, including transient voltage surge suppressors (TVS), clamping diodes and arrays, or Transils™, 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.



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MAIN APPLICATIONS



Tablets, smartphones, and digital cameras



Healthcare



I/O microcontrollers and signal conditioning



Factory automation
Human machine interface (HMI)



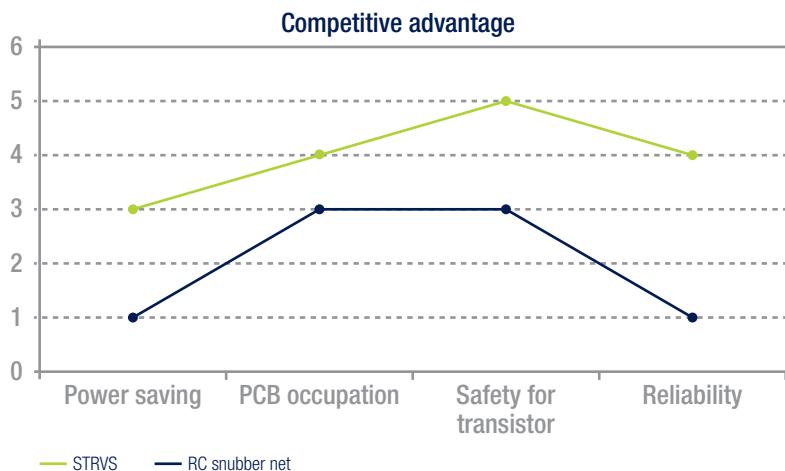
Smart metering



SIM cards, Ethernet,
and HDMI/DVI ports

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.



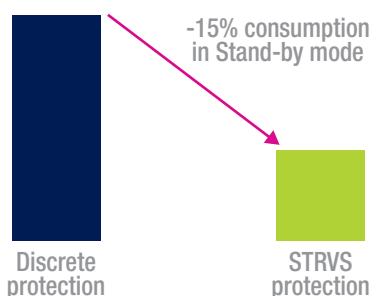
STRVS MAIN BENEFITS

- 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

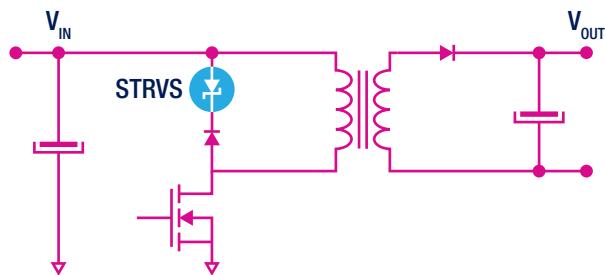
STRVS, the Transil series dedicated against repetitive overvoltage in high temperature conditions

STRVS*

- Clamping voltage characteristics defined at 25 °C, 85 °C and 125 °C
- Stand-off voltage range: from 85 V to 188 V
- Low leakage current: 0.2 µA at 25 °C
- Maximum operating junction temperatures:
 - SMB and SMC: 150 °C
 - DO-15 and DO-201: 175°C



STRVS topology usage example



MAIN APPLICATIONS



Adapters



Smart metering



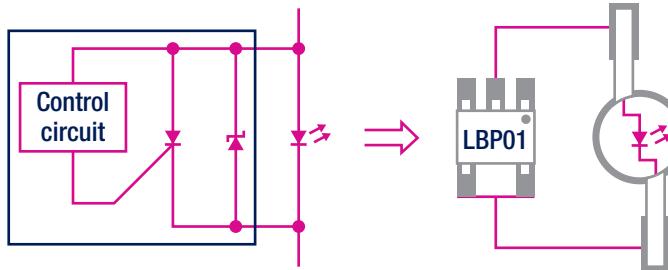
Solar inverters



Residential, commercial, architectural and street lighting

LED bypass protection

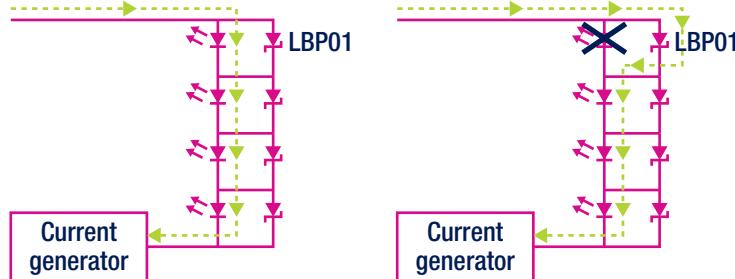
The LBP01 series of LED bypass protection devices are bypass switches that can be connected in parallel with 1 or 2 LEDs. In the event of a LED failure, this device shunts the current through other LEDs. It also provides overvoltage protection against surges as defined in IEC61000-4-2 and IEC61000-4-5.



LBP01 get reliable your led application

LBP01

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



MAIN APPLICATIONS



Display panels



Residential, commercial, architectural and street lighting



Emergency lighting



Traffic signals

www.st.com/lbp01



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