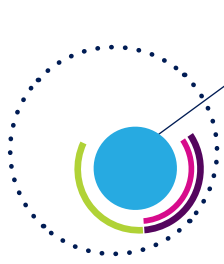




life.augmented

# Power management Guide 2017





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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 design of energy-saving, high-power-density and superior performance 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 and controllers, 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 and more in a wide range of packages.



Today, optimizing complete solutions in terms of energy efficiency according to market requirements and energy regulations is practically mandatory. The key element in developing a successful power system is the best semiconductor device selection. 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 on-board chargers for electric vehicles), 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.





# Applications

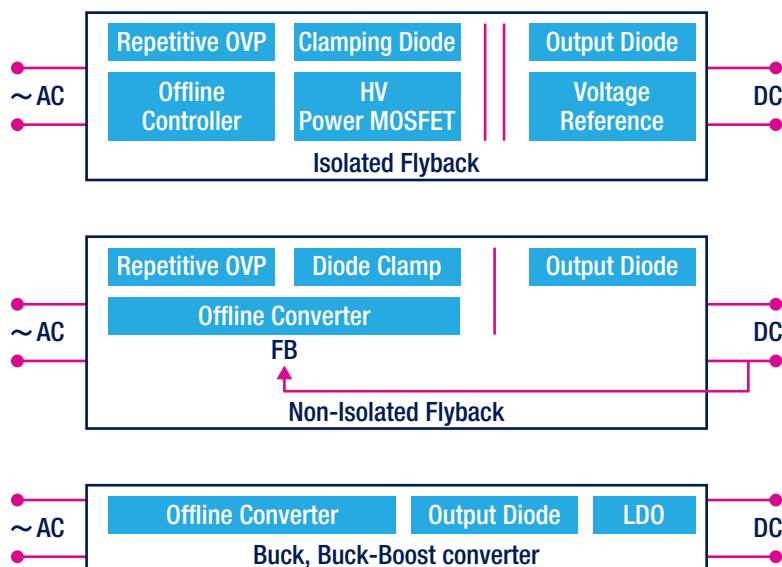
## POWER SUPPLIES

### 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.

|                      |                  | Offline converters            |  | Offline controllers | HV power MOSFETs                                                                                                                         | Repetitive overvoltage protections | Clamping diodes                          | Volt. ref.                    | Output diodes                            | LDO                                   |   |  |
|----------------------|------------------|-------------------------------|--|---------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------------------|-------------------------------|------------------------------------------|---------------------------------------|---|--|
| Buck                 |                  | VIPer0P<br>VIPer*1<br>VIPer*6 |  | -                   | -                                                                                                                                        | -                                  | -                                        | -                             | STTH*06<br>STTH*08<br>STTH*10            | LDF, LDFM<br>LDK220, LDK320<br>LDL212 |   |  |
| Buck-boost           |                  |                               |  |                     |                                                                                                                                          |                                    |                                          |                               |                                          |                                       |   |  |
| Non-isolated flyback |                  |                               |  |                     |                                                                                                                                          |                                    |                                          |                               |                                          |                                       |   |  |
|                      | PSR-CV           | -                             |  | STCH02<br>L6566B    | ST*N80K5<br>ST*N90K5<br>ST*N95K5<br>ST*N105K5<br>ST*N120K5<br>STW12N150K5<br>STW21N150K5<br>ST*3N170<br><br>SCT1000N170'<br>(SiC MOSFET) | STRVS*                             | STTH*06<br>STTH*08<br>STTH*10<br>STTH*12 | -                             |                                          |                                       |   |  |
|                      | Isolated flyback | Regulation with optocoupler   |  |                     |                                                                                                                                          |                                    |                                          | VIPer*5<br>VIPer*7<br>VIPer*8 | VIPer0P<br>VIPer*1<br>VIPer*6<br>ALTAIR* |                                       | - |  |
|                      |                  |                               |  |                     |                                                                                                                                          |                                    |                                          |                               |                                          |                                       |   |  |

### Typical configuration



### MAIN EVALUATION BOARDS



**STEVAL-ISA096V1**  
2 W, buck-boost



**STEVAL-ISA192V1**  
7 W not-isolated flyback with smart standby using VIPerOP and touch sensing



**STEVAL-ISA178V1**  
5 V/200 mA buck-converter based on VIPer01



**STEVAL-ISA183V1**  
16 W quasi resonant flyback converter for air conditioning applications using VIPer35LD

## Battery chargers

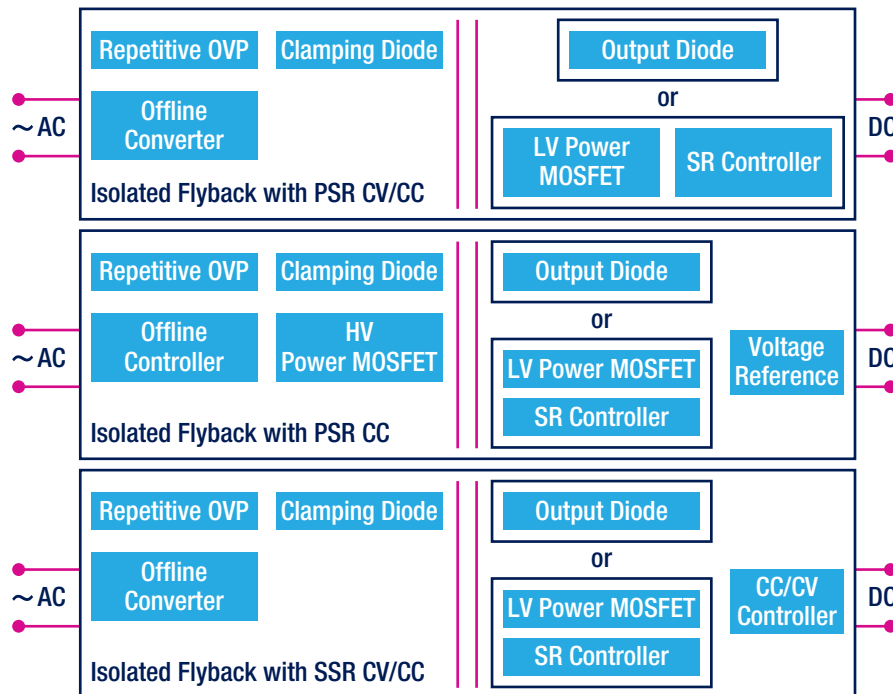
Designing lighter, smaller wall chargers for portable devices is one of the most critical challenges for developers. Excellent standby power consumption, high efficiency in all load conditions, primary-side regulation (PSR) control methods and a set of integrated protections (to minimize the component 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 consumption and save space on PCBs. ST also offers the EnFilm™ thin-film battery, a new concept of extremely thin (220 µm), rechargeable solid-state batteries with fast constant-voltage charging.



|           |         |            | Offline converters            |                                | Controllers | Power MOSFETs                                 |                                | Repetitive overvoltage protections | Clamping diodes               | Output diodes                                                       | CC/CV controllers or Voltage Reference |
|-----------|---------|------------|-------------------------------|--------------------------------|-------------|-----------------------------------------------|--------------------------------|------------------------------------|-------------------------------|---------------------------------------------------------------------|----------------------------------------|
|           |         |            |                               |                                |             | HV                                            | LV                             |                                    |                               |                                                                     |                                        |
| Wall side | Flyback | SSR-CV/CC  | VIPer*5<br>VIPer*7<br>VIPer*8 | VIPer0P<br>VIPer01V<br>VIPer*6 | -           | -                                             | -                              | STRVS*                             | STTH*06<br>STTH*08<br>STTH*10 | FERD*45<br>FERD15S50<br>FERD20U50<br>FERD20U60<br>FERD*100<br>STPS* | TSM10*<br>SEA0*                        |
|           |         | PSR-CV     | -                             | -                              | HVLED001A   | ST*N65M2<br>ST*N65M6<br>ST*N70M6 <sup>1</sup> | -                              |                                    |                               |                                                                     | T*431<br>T*432                         |
|           |         | PSR-CC     | -                             | -                              | STCH02      | SCTH35N65G2V-7 <sup>2</sup><br>(SiC MOSFET)   | -                              |                                    |                               |                                                                     |                                        |
|           |         | PSC CV/CC  | ALTAIR*                       | -                              | -           | -                                             | -                              |                                    |                               |                                                                     | -                                      |
|           |         | Synch Rect | -                             | -                              | STSR30      | -                                             | ST*N4F7<br>ST*N6F7<br>ST*N10F7 | -                                  | -                             | -                                                                   | -                                      |

|                  | Battery charger ICs                             |           | Battery monitoring ICs | Li-Ion battery |
|------------------|-------------------------------------------------|-----------|------------------------|----------------|
|                  | Linear                                          | Switching |                        |                |
| Application side | STBC02<br>STBC03<br>L6924*<br>STC4054<br>STNS01 | STBCFG01  | STC3117<br>STC3115     | EFL700A39      |

## Typical configuration



## MAIN EVALUATION BOARDS



**STEVAL-ISA193V1**  
15 W, 5 V- 3 A output  
CC primary sensing USB  
adapter based on STCH02



**STEVAL-ISA176V1**  
5 W, optoless battery  
charger



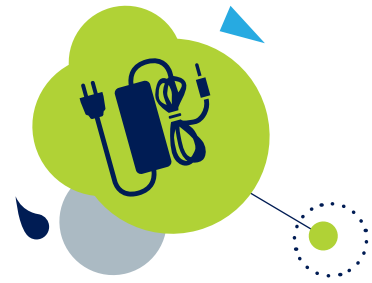
**STEVAL-ISB033V1**  
5 W, switching battery  
charger for Li-Ion batteries  
based on STBCFG01



**STEVAL-ISB041V1**  
Li-Ion/Li-Po linear battery  
charger evaluation board  
based on STBC02

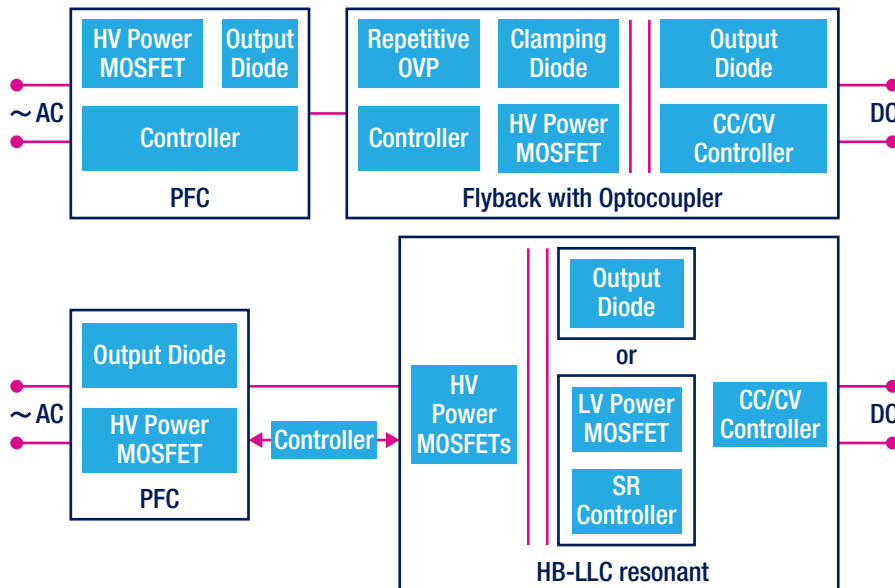
## Adapters

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.



|             |                             | Offline converters            |                               | Controllers                 |        | Power MOSFETs                                                                |                                                                                       | Repet. overvolt. protect. | Clamping diodes               | Output diodes                                      | CC/CV contr.    | Volt. ref.     | DC-DC conv. | LDO             |
|-------------|-----------------------------|-------------------------------|-------------------------------|-----------------------------|--------|------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------|-------------------------------|----------------------------------------------------|-----------------|----------------|-------------|-----------------|
|             |                             |                               |                               |                             |        | HV                                                                           | LV                                                                                    |                           |                               |                                                    |                 |                |             |                 |
| Flyback     | Regulation with optocoupler | VIPer*5<br>VIPer*7<br>VIPer*8 | VIPer0P<br>VIPer*1<br>VIPer*6 | L6566B<br>L6566A            | STCH02 | ST*N80K5<br>ST*N90K5<br>ST*N95K5                                             | -                                                                                     | STRVS*                    | STTH*06<br>STTH*08<br>STTH*10 | STPS*<br>FERD*45<br>FERD*50<br>FERD*60<br>FERD*100 | TSM10*<br>SEA0* | T*431<br>T*432 | -           | ST715<br>LDK320 |
|             | PSR-CV                      | -                             | ALTAIR*                       | -                           | -      | -                                                                            |                                                                                       |                           |                               |                                                    |                 |                |             |                 |
| PFC Boost   | TM                          | -                             |                               | L6562A*<br>L6563*<br>L6564* | STCMB1 | ST*N50M2<br>ST*N60M2<br>ST*N65M2<br>ST*N55M5<br>ST*N65M5<br>ST*N60M6         | -                                                                                     | -                         | -                             | STTH*L06<br>STTH*06                                | -               | -              | -           | -               |
| DC-DC stage | HB-LLC                      | -                             |                               | L6599A*<br>L6699            |        | ST*N50DM2<br>ST*N60DM2<br>ST*N60M2<br>ST*N60M2-EP<br>ST*N65M2-EP<br>ST*N60M6 | -                                                                                     | -                         | -                             | STPS*<br>FERD*45<br>FERD*50<br>FERD*60<br>FERD*100 | TSM10*<br>SEA0* | T*431<br>T*432 | ST1S3*      | ST715<br>LDK320 |
| Sync rect.  | Flyback                     | -                             |                               | STSR30                      |        | -                                                                            | ST*110N10F7                                                                           | -                         | -                             | -                                                  | -               | -              | -           | -               |
|             | STSR2*                      |                               |                               | ST*100N10F7                 |        |                                                                              |                                                                                       |                           |                               |                                                    |                 |                |             |                 |
|             | HB-LLC                      |                               |                               | SRK2000A<br>SRK2001         |        |                                                                              | STL*NS3LLH7<br>ST*N4LF7 <sup>1</sup><br>ST*N6F7<br>STL130N8F7<br>ST*N10F7<br>ST*Nf20D |                           |                               |                                                    |                 |                |             |                 |

### Typical configuration



### MAIN EVALUATION BOARDS

-  EVL6566A-75WES4  
75 W, PFC + flyback
-  STEVAL-ISA170V1  
150 W, PFC + HB-LLC + sync rect.
-  EVL CMB1-90WADP  
90 W, PFC + HB-LLC

## USB Type-C™ Power delivery chargers and adapters

Modern wall chargers and adapters for consumer and industrial applications take benefit of the USB Type-C™, the new slimmer connector featuring reversible plug and cable orientation, allowing designers to develop smaller, thinner and lighter products. Additionally the USB power delivery, which expands USB to deliver up to 100 W (20 V, 5 A) of power, enables more efficient and fast charging over USB.

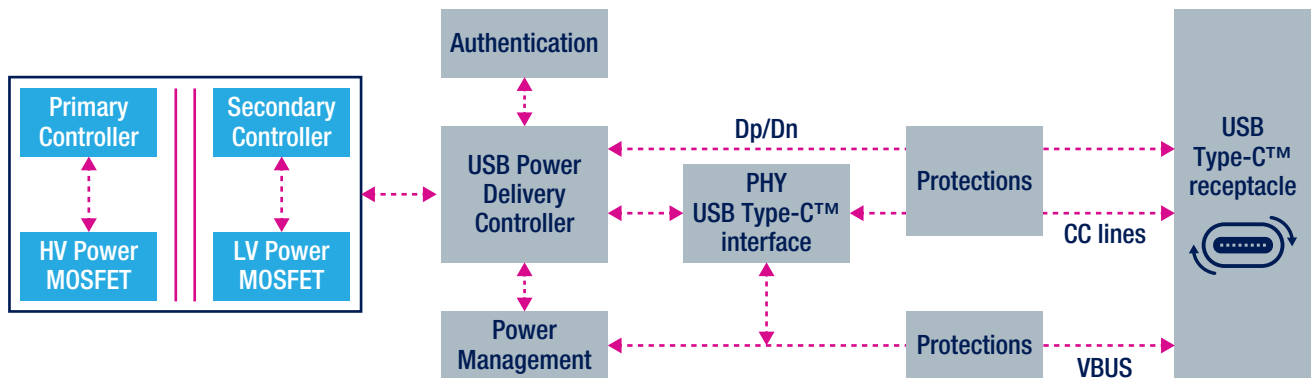
ST's portfolio for USB Type C and Power Delivery is designed to cope with various hardware/software partitioning solutions in order to best match your specific application requirements and design architecture: controllers ranging from STM32 general purpose MCU to hard-coded solution to fit different use cases and power ratings can be combined with a large product portfolio of protection and filtering covering all the application needs and with highly secure solution using STSAFE secure element family for strong authentication needs.

Certified Middleware Stack (X-CUBE-USBPD) enabling flexibility to various topologies and adaptability to USB specification evolution is also available.



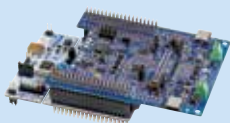
| USB Type-C Power Delivery Subsystem      |                               |                             |                         |                               |                                                                                                               |                                                                                                           |                 |
|------------------------------------------|-------------------------------|-----------------------------|-------------------------|-------------------------------|---------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-----------------|
|                                          | Type-C and USB-PD Controllers |                             |                         | Authencitcation & Secure MCUs | Protections                                                                                                   |                                                                                                           | LDO             |
|                                          | Chipset                       |                             | Hard Coded Controllers  |                               | ESD & EOS Protections for VBUS Power Delivery                                                                 | ESD & EOS Protections for Communication Channel (CC lines)                                                |                 |
|                                          | MCUs                          | Type-C Controller/Interface |                         |                               |                                                                                                               |                                                                                                           |                 |
| USB Type-C PD Adapter<br>1 Port Provider | STM32F0*<br>STM32F3*          | STUSB1600A<br>STUSB1602A    | STUSB4700<br>STUSB4710A | STSAFE-A                      | ESDA17P100-1U2M<br><br>ESDA25P35-1U1M<br>ESDA17P50-1U1M<br>ESDA15P60-1U1M<br>ESDA13P70-1U1M<br>ESDA7P120-1U1M | ESDALC20-1BF4<br>ESDA5-1BF4<br>ESDZV5H-1BU2<br><br>ESDA8P30-1T2 <sup>1</sup><br><br>ESDA25W5<br>ESDA6V1W5 | ST715<br>LDK320 |

## Typical configuration



7

## MAIN EVALUATION BOARDS



P-NUCLEO-USB002

STUSB1602A USB Type-C and Power Delivery Nucleo Pack



STEVAL-CCC001

STUSB1600A USB Type-C evaluation board



STEVAL-ISC004V1

STUSB4710A evaluation board



STEVAL-USBPD45H<sup>2</sup>

45 W USB PD Type-C adapter based on STCH02 and STUSB4700

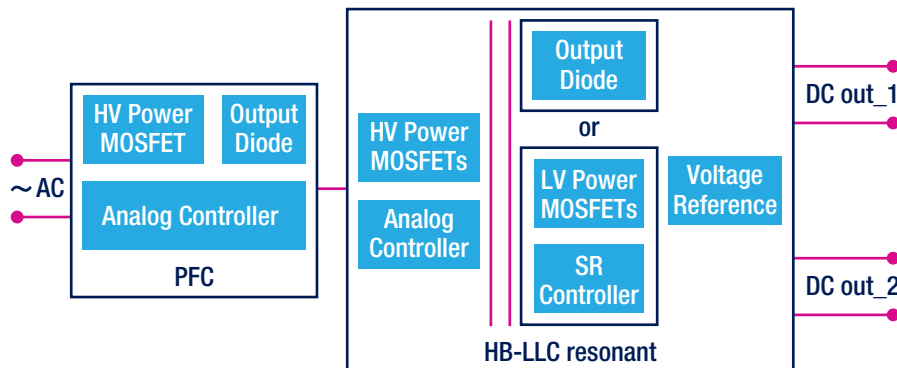
## TV power supply units (PSU)

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, M2-EP, M6, DM2, M5 series), low-voltage STripFET MOSFETs (F7 series), FERD/Schottky and Ultrafast diodes are available in low-profile SMD packages such as PowerFLAT™ 3.3x3.3 and PowerFLAT™ 5x6. Furthermore the MDmesh™ M2 series is available also in the new TO-220FP wide creepage and in the new TO-220FP ultra narrow lead package. 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                 |                                             | Gate drivers              | Power MOSFETs                                                             |                                                                         | Repet overvolt. protect. | Clamping diodes               | Output diodes                                            | Volt. ref.     | DC-DC conv.                                             |
|-------------|---------|-----------------------------|---------------------------------------------|---------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------|-------------------------------|----------------------------------------------------------|----------------|---------------------------------------------------------|
|             |         | Analog                      | MCU and digital                             |                           | HV                                                                        | LV                                                                      |                          |                               |                                                          |                |                                                         |
| Flyback     |         | L6566A<br>L6566B            | -                                           | -                         | ST*N80K5<br>STxN90K5<br>ST*N95K5                                          | -                                                                       | STRVS*                   | STTH*06<br>STTH*08<br>STTH*10 | STPS*<br>FERD*45<br>FERD*60<br>FERD*100<br>STPS*LCD170CB | T*431<br>T*432 | -                                                       |
| PFC Boost   | CCM     | L4981*<br>L4984D            | STM32F0*<br>STM32F1*<br>STM32F334<br>STNRG* | TD35*<br>PM8841<br>PM8851 | ST*N60M2 <sup>2</sup><br>ST*N65M2<br>ST*N65M5<br>ST*N60M6                 | -                                                                       | -                        | -                             | STTH*R06<br>STTH*T06                                     | -              | -                                                       |
|             | TM      | L6562A*<br>L6563*<br>L6564* |                                             |                           |                                                                           |                                                                         |                          |                               | STPSC*065<br>(SiC Diodes)<br><br>STTH*L06<br>STTH*06     |                |                                                         |
| DC-DC stage | HB-LLC  | L6599A*<br>L6699            | STCMB1                                      | L638*<br>L639*<br>L649*   | ST*N50DM2<br>ST*N60DM2<br>ST*N50M2<br>ST*N60M2<br>ST*N60M2-EP<br>ST*N60M6 | -                                                                       | -                        | -                             | STPS*                                                    | T*431<br>T*432 | ST1S0*<br>ST1S12<br>ST1S3*<br>ST1S4*<br>ST1S50<br>L598* |
| Sync rect.  | HB-LLC  | SRK2000A<br>SRK2001         |                                             | PM8834                    | -                                                                         | STL*NS3LLH7<br>ST*N4LF7 <sup>1</sup><br>ST*N6F7<br>ST*N10F7<br>ST*Nf20D | -                        | -                             | -                                                        | -              | -                                                       |
|             | Flyback | STSR30                      | -                                           | -                         | -                                                                         | ST*110N10F7<br>ST*100N10F7                                              | -                        | -                             | -                                                        | -              | -                                                       |

## Typical configuration



## MAIN EVALUATION BOARDS

**EVLSTNRG-170W**  
170 W, digital solution  
PFC+ HB-LLC

**EVL185W-LEDTV**  
185 W, analog solution  
PFC + HB-LLC

Note 1: MP Q4 2017 2: 600 V MDmesh™ M2 series is available also in the new TO-220FP wide creepage and in the new TO-220FP ultra narrow lead  
\* is used as a wildcard character for related part number

## Desktop PCs

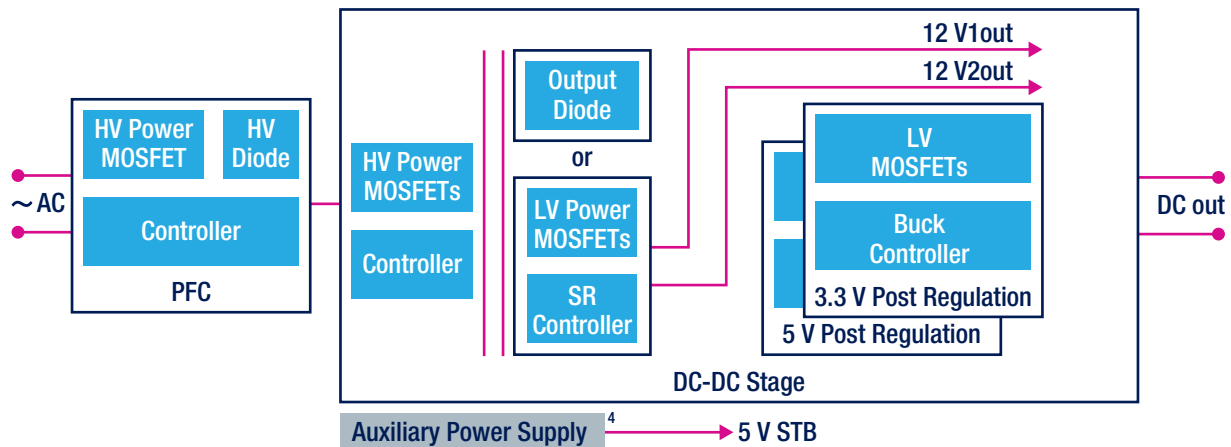
The requirements for the standard ATX PC power market are a small form factor with better performance.

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.



|                 |         | Controllers                 |        | Power MOSFETs                                                 |                                                                         | Output diodes                                 | DC-DC converters                    | E-fuses                    | LDO                             |
|-----------------|---------|-----------------------------|--------|---------------------------------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------|-------------------------------------|----------------------------|---------------------------------|
|                 |         |                             |        | HV                                                            | LV                                                                      |                                               |                                     |                            |                                 |
| PFC Boost       | CCM     | L4981*<br>L4984D            | STCMB1 | ST*N60M2 <sup>2</sup><br>ST*N65M2<br>ST*N65M5                 | -                                                                       | STTH*R06<br>STTH*T06                          | -                                   |                            | -                               |
|                 | TM      | L6562A*<br>L6563*<br>L6564* |        |                                                               |                                                                         | STPSC*065 (SiC Diodes)<br>STTH*L06<br>STTH*06 |                                     |                            |                                 |
| DC-DC stage     | HB-LLC  | L6599A*<br>L6699            | L6591  | ST*N50DM2<br>ST*N60DM2<br>ST*N60M2<br>ST*N60M2-EP<br>ST*N60M6 | -                                                                       | STPS*<br>FERD*45<br>FERD*60<br>FERD*100       | ST1S3*<br>ST1S4*<br>ST1S50<br>L598* | STEF01<br>STEF05<br>STEF12 | LDF<br>LDFM<br>LDK320<br>LDL212 |
|                 | Asym HB |                             |        |                                                               |                                                                         |                                               |                                     |                            |                                 |
| Sync rect.      | HB-LLC  | SRK2000A<br>SRK2001         |        | -                                                             | STL*NS3LLH7<br>ST*N4LF7 <sup>1</sup><br>ST*N6F7<br>ST*N10F7<br>ST*NF20D | -                                             | -                                   |                            | -                               |
|                 | Asym HB |                             |        |                                                               |                                                                         |                                               |                                     |                            |                                 |
| Post Regulation | Buck    | L672*<br>L673*<br>PM6680A   |        | -                                                             | STD90NS3LLH7<br>STL60N3LLH5                                             | -                                             | -                                   | -                          | -                               |

## Typical configuration



## MAIN EVALUATION BOARDS



EVL400W-ADP/ATX

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

## Servers and telecoms: AC-DC power supply

Stringent international standards require for Server/Telecoms power supply greater efficiency, increased power density, faster and more reliable protection functions, increased flexibility and monitoring that are achievable using a proper mix of analog or dedicated digital controllers with advanced power discrete and analog ICs.

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), new STDRIVEsmart gate drivers (L639\*, L649\*). Smart controllers are available for the mentioned stages. For higher efficiency and power density systems, ST can offer also the breakthrough SiC MOSFET devices and the latest digital controller STNRGPF01.

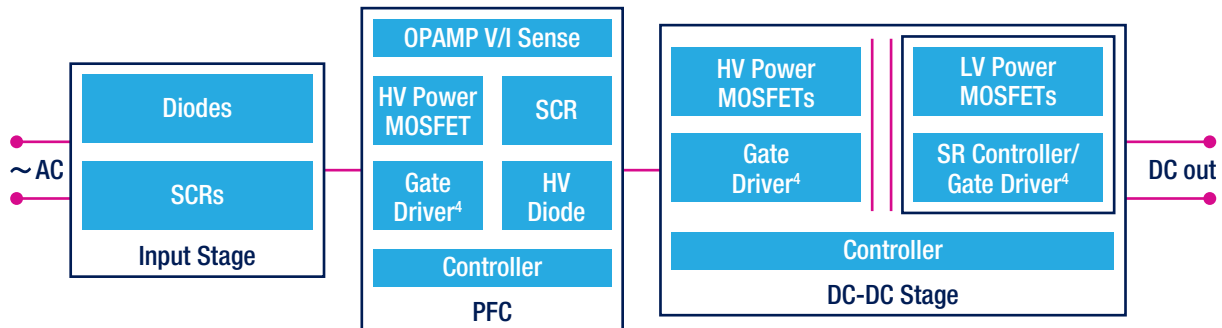
High robustness against the inrush current is ensured by new SCRs in the front end stage.

For the post-regulation, from 48 V to point-of-load (CPUs, memories and ASICs), ST's multi-IC direct power conversion enables a more efficient approach.



|                                                             |                      | SCRs                                                                                          | Controllers         |                                                           | Gate drivers                        | Power MOSFETs                                                                          |                                                                         | Diodes                                                      | DC-DC converters                            |                                     | E-fuses                    | LDO & Op Amps                                                               |
|-------------------------------------------------------------|----------------------|-----------------------------------------------------------------------------------------------|---------------------|-----------------------------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------------|-------------------------------------|----------------------------|-----------------------------------------------------------------------------|
|                                                             |                      |                                                                                               | Analog              | MCU and digital                                           |                                     | HV                                                                                     | LV                                                                      |                                                             | HV                                          | LV                                  |                            |                                                                             |
| <b>Input Stage<br/>(Rect. &amp; inrush current limiter)</b> |                      | TN1515-600B<br>TN2015H-6<br>TN4015H-6<br>TN5015H-6<br>TM8050H-8<br>TN3050H-12Y<br>TN5050H-12Y | -                   | -                                                         | -                                   | -                                                                                      | -                                                                       | STBR3012<br>STBR6012                                        | -                                           | -                                   | -                          | -                                                                           |
| <b>PFC</b>                                                  | <b>Boost</b>         | -                                                                                             | L4981*<br>L4984D    | STM32F0*<br>STM32F301<br>STM32F334<br>STNRG*<br>STNRGPF01 | TD35*<br>PM8841<br>PM8851<br>PM8834 | ST*N60M2<br>ST*N65M2<br>ST*N65M5<br>ST*N60M6                                           | -                                                                       | STTH*R06<br>STTH*T06<br><br>STPSC*065<br>(SiC Diodes)       | -                                           | -                                   | -                          | -                                                                           |
|                                                             | <b>Interl. Boost</b> |                                                                                               |                     |                                                           |                                     |                                                                                        |                                                                         |                                                             |                                             |                                     |                            |                                                                             |
|                                                             | <b>Bridgeless</b>    |                                                                                               |                     |                                                           |                                     |                                                                                        |                                                                         |                                                             |                                             |                                     |                            |                                                                             |
|                                                             | <b>Totem Pole</b>    | TN3050H-12WY<br>TN5050H-12WY                                                                  |                     |                                                           | STGAP1AS                            | SCT*35N65G2V <sup>1</sup><br>SCT*90N65G2V <sup>1</sup><br>(SiC MOSFETs)                |                                                                         | STTH30L06*<br>STBR*012*                                     |                                             |                                     |                            | TN3050H-12WY<br>TN5050H-12WY                                                |
| <b>DC-DC stage</b>                                          | <b>HB-LLC</b>        | -                                                                                             | L6599A*<br>L6699    | STM32F334<br>STNRG*                                       | L638*<br>L639*<br>L649*             | ST*N50DM2<br>ST*N60DM2<br>ST*N60M2<br>ST*N65DM2<br>ST*N60DM6<br>ST*N65DM6 <sup>3</sup> | -                                                                       | STPS*<br>FERD*45<br>FERD*50<br>FERD*60<br>FERD*100<br>STTH* | L698*<br>ST1S14<br>L7985<br>L7986<br>L7987* | ST1S3*<br>ST1S4*<br>ST1S50<br>L598* | STEF01<br>STEF05<br>STEF12 | LDF<br>LDFM<br>LD39050<br>LD39100<br>LD39200<br>LDL112<br>LDL212<br>LD59100 |
|                                                             | <b>HB-LC</b>         |                                                                                               |                     |                                                           |                                     |                                                                                        |                                                                         |                                                             |                                             |                                     |                            |                                                                             |
|                                                             | <b>FB-PS</b>         |                                                                                               |                     |                                                           |                                     |                                                                                        |                                                                         |                                                             |                                             |                                     |                            |                                                                             |
|                                                             | <b>Asym HB</b>       |                                                                                               | L6591               |                                                           |                                     |                                                                                        |                                                                         |                                                             |                                             |                                     |                            |                                                                             |
| <b>Sync rect.</b>                                           | <b>HB-LLC</b>        | -                                                                                             | SRK2000A<br>SRK2001 |                                                           | PM8834                              | -                                                                                      | STL*NS3LLH7<br>ST*N4LF7 <sup>2</sup><br>ST*N6F7<br>ST*N10F7<br>ST*Nf20D | -                                                           | -                                           | -                                   |                            | -                                                                           |
|                                                             | <b>Asym HB</b>       |                                                                                               |                     |                                                           |                                     |                                                                                        |                                                                         |                                                             |                                             |                                     |                            |                                                                             |

### Typical configuration



## MAIN EVALUATION BOARDS



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



**STEVAL-ISA147V3**  
500 W, bridgeless PFC  
+ HB-LLC conv. + sync rect.



**EVLSTNRG-1kW**  
1 kW, multi-phase interl.  
HB-LC conv.



**STEVAL-ISA172V2**  
2 kW, multi-phase interl.  
Boost PFC + FB-PS conv.



**STEVAL-ISF003V1**  
Up to 7.4 kW, digital  
inrush current limiter  
based on SCRs



**EVAL-IPFC01V1**  
3 kW three-channel  
interleaved PFC



## Servers and telecoms: 48 V direct conversion to CPUs, memories and ASICs

Cloud applications including Internet of Things, smartphone apps, and online services are executed in large datacenters comprising thousands of individual servers.

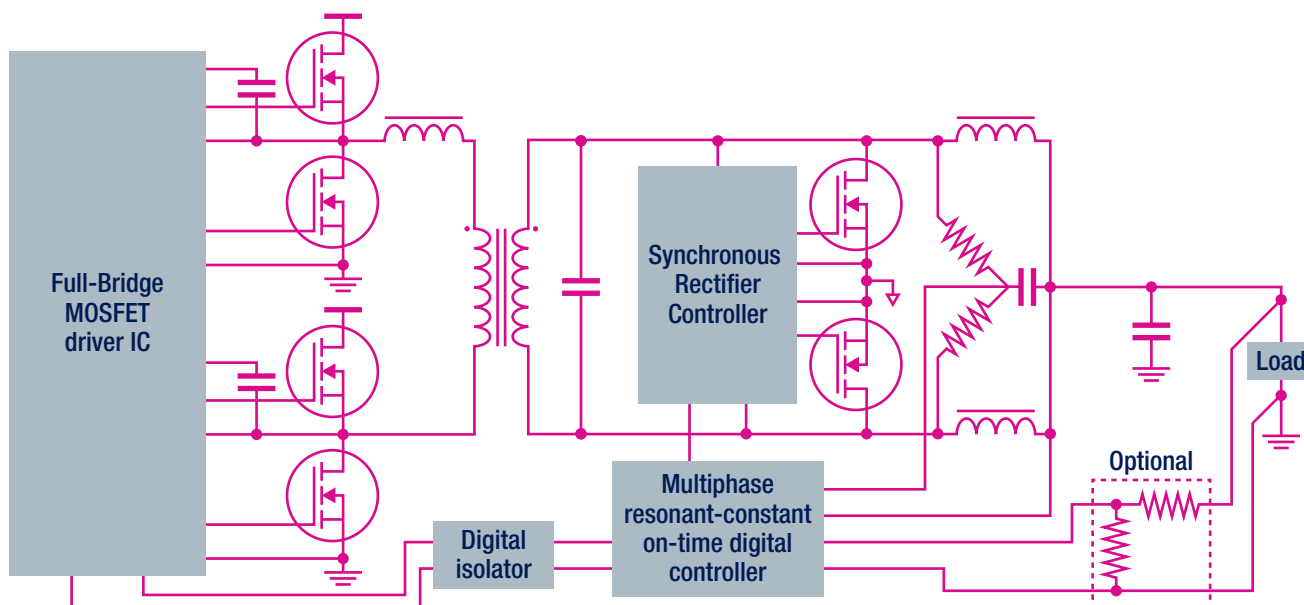
ST has developed a multi-IC solution called Isolated Resonant Direct Conversion technology, enabling a very effective distributed approach, reducing intermediate conversion steps and resulting in a more efficient and reliable system. The multi-IC solution is based on the STRG02 synchronous rectifier capable of zero-voltage and zero-current operation, the STRG04 high-voltage full-bridge MOSFET driver IC able to drive a wide range of external MOSFETs or GaN-based switches with programmable dead time and the STRG06 multiphase resonant-constant on-time digital controller with PMBus™, supporting up to 6 interleaved converters, able to deliver output voltage from 0.5 to 12 V and to support output power levels from 50 to more than 300 W. ST's turnkey solution generates flat efficiency curves ensuring the highest level of conversion both for light loads and high current demand.

All primary and secondary power MOSFETs always work at zero current and zero voltage. Power and heat come only from conduction losses, heatsinks, and not from the switching activity. Each power MOSFET produces a minimum amount of heat removing the need of expensive and complex heatsinks.



|               |                                                        | Controllers | Drivers | LV Power MOSFETs                         | DC-DC Converter | LDO              | eFuse  |
|---------------|--------------------------------------------------------|-------------|---------|------------------------------------------|-----------------|------------------|--------|
| Power Cell    | Full Bridge                                            | -           | STRG04  | STL120N8F7<br>STL35N75LF3                | ST1S40          | LDK220<br>LDK320 | STEF01 |
|               | Synchronous Rectifier                                  | -           | STRG02  | STL100N12F7<br>STL260N45LF7 <sup>1</sup> |                 | -                |        |
| Control Stage | Multiphase (up to 6 interleaved)<br>Resonant Converter | STRG06      | -       | -                                        |                 |                  |        |

### Typical configurations



### MAIN EVALUATION BOARD



ST has developed software tools, a GUI and several reference designs available on request and including:

- 54 V/12 V, 42 A 500 W: 96.5% peak efficiency; size 4.3 inch<sup>2</sup>
- 54 V/1 V, 78 A 78 W: 92.7% peak efficiency; size 1.1 inch<sup>2</sup>
- 54 V/CPU, VR13 165 W (TDP) and 360 W (peak power): 93.3% peak efficiency
- 54 V/3.3 V, 46 A 150 W: 95% peak efficiency; size 2.07 inch<sup>2</sup>
- 54 V/DDR4, 120 A: 93.2% peak efficiency; size 3.87 inch<sup>2</sup>

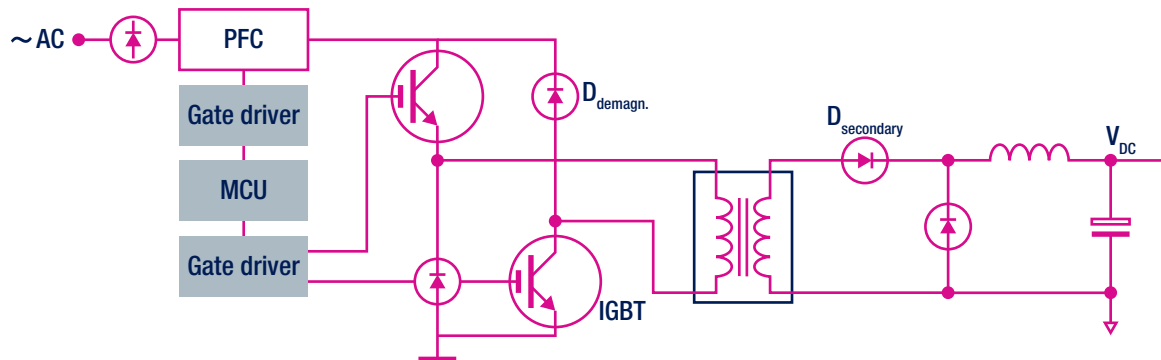
## INDUSTRIAL WELDING

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), VHV Power MOSFET 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 STGAP1AS 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.



|             |       | MCUs                               | Gate drivers                                    | IGBTs                                  | HV power MOSFETs                  | Diodes                                                            |                                           |                                                                    | DC-DC converters                           |                                                         |
|-------------|-------|------------------------------------|-------------------------------------------------|----------------------------------------|-----------------------------------|-------------------------------------------------------------------|-------------------------------------------|--------------------------------------------------------------------|--------------------------------------------|---------------------------------------------------------|
|             |       |                                    |                                                 |                                        |                                   | Boost                                                             | Demagn                                    | Secondary side                                                     | HV                                         | LV                                                      |
| PFC Boost   |       | STM32F0*<br>STM32F301<br>STM32F334 | TD35*<br>PM8834<br>PM8841<br>PM8851<br>STGAP1AS | STG*H65FB<br>STG*V60F<br>STG*H120F2    | SCT*N120<br>ST*N90K5<br>ST*N95DK5 | STTH*R06<br>STTH*T06<br>STTH*W06<br><br>STPSC*065<br>(SiC Diodes) | -                                         | -                                                                  | -                                          |                                                         |
| DC-DC stage | TTF   | STM32F334                          | L638*<br>L639*<br>L649*<br>STGAP1AS             | STG*H65DFB<br>STG*V60DF<br>STG*H120DF2 |                                   | -                                                                 | STTH*R06<br>STTH*06<br>STTH*10<br>STTH*12 | STTH*W02<br>STTH*W03<br>STTH*W04<br>STTH240F04TV1<br>STPS200170TV1 | L698*<br>L597*<br>L7985<br>L7986<br>L7987* | ST1S0*<br>ST1S12<br>ST1S3*<br>ST1S40<br>ST1S50<br>L598* |
|             | PS-FB |                                    |                                                 | -                                      | -                                 |                                                                   |                                           |                                                                    |                                            |                                                         |

### Typical configuration



Solution based on two-transistor forward topology

## LED LIGHTING - GENERAL ILLUMINATION

### Residential lighting

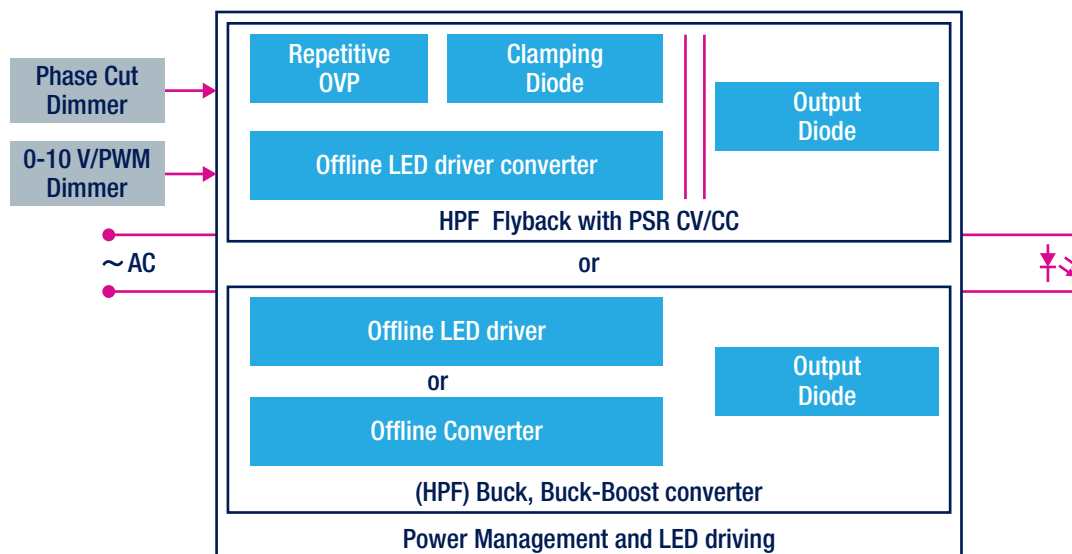
LED efficacy and driver IC market requirements are constantly evolving. Residential lighting applications need a high integration level, high efficiency, high power factor (PF), long lifetime, and dimming capabilities as well as a low system cost and component count.

ST offers a wide portfolio of highly integrated offline converters up to 15 W (each IC includes a power MOSFET combined with control and protection circuitry on a single chip) working with a high breakdown voltage of 800 V. Among these, HVLED805, HVLED807PF and HVLED815PF LED driver 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 | -                                    | -                                           | -                             | -                                  | -               | STPS*170AF<br>STPS3170UF<br>STPS4S200UF<br>STPSxxZF<br>STTHxxZF | LED5000<br>LED6000                           |
| Buck, Buck-boost              | -                                    | Viper0P<br>Viper*1<br>Viper*6               | -                             | -                                  | -               | STTH*                                                           | -                                            |
| HPF Buck-boost                | HVLED805<br>HVLED807PF<br>HVLED815PF | -                                           | -                             | -                                  | -               |                                                                 |                                              |
| HPF Flyback                   | PSR-CC/CV                            | -                                           | -                             |                                    |                 |                                                                 |                                              |
| Flyback                       | SSR-CC/CV                            | Viper*5<br>Viper*7<br>Viper*8               | Viper0P<br>Viper*1<br>Viper*6 | TSM10*<br>SEA0*                    | STRVS*          | STTH*06<br>STTH*08<br>STTH*10                                   | FERD*100<br>STPS*150<br>STPS*170<br>STPS*200 |
|                               | PSR-CV                               | -                                           | -                             | -                                  |                 |                                                                 |                                              |
|                               | PSR-CC/CV                            | ALTAIR*                                     |                               | -                                  |                 |                                                                 |                                              |

### Typical configuration

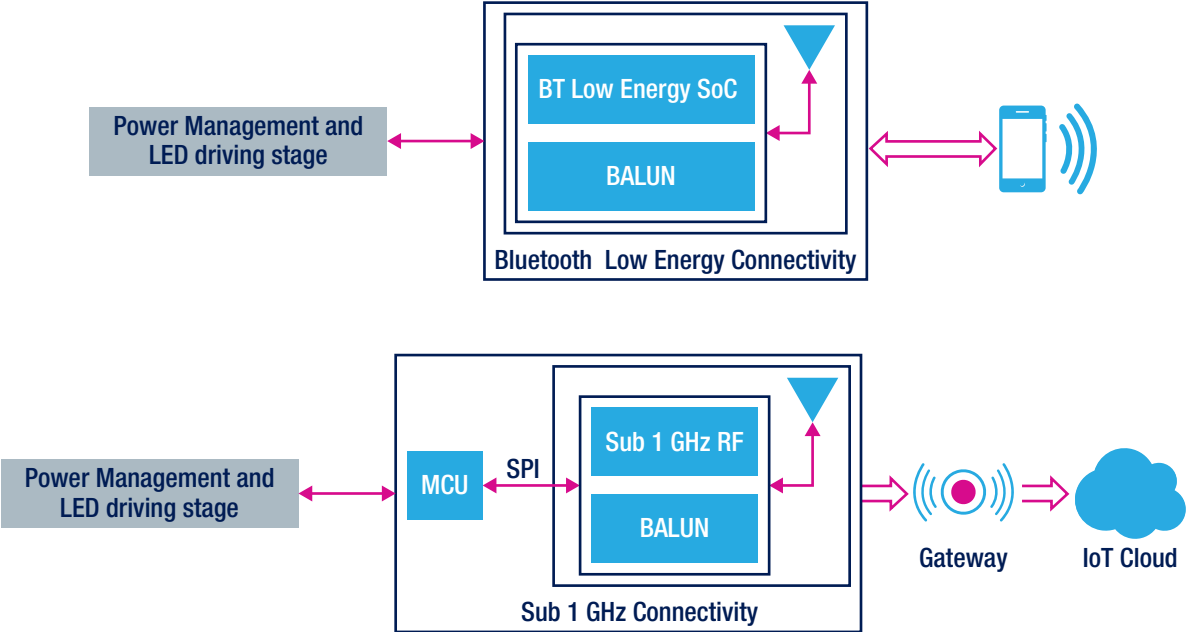


Note: \* is used as a wildcard character for related part number

ST offers products and solutions to enrich the LED lighting applications with wireless connectivity.

| Wireless Connectivity             |                  |                      |                                                                  |                                                            |
|-----------------------------------|------------------|----------------------|------------------------------------------------------------------|------------------------------------------------------------|
|                                   | Chipset          |                      |                                                                  | Certified Module                                           |
|                                   | Connectivity IC  | MCU                  | Balun                                                            |                                                            |
| Bluetooth Low Energy Connectivity | BlueNRG-1        | -                    | BALF-NRG-02D3                                                    | SPBTLE-1S                                                  |
|                                   | BlueNRG-MS       | STM32F0*<br>STM32L0* |                                                                  | SPBTLE-RF<br>SPBTLE-RF0                                    |
| Sub 1 GHz Connectivity            | SPIRIT1<br>S2-LP | STM32F0*<br>STM32L0* | BALF-SPI-01D3<br>BALF-SPI-02D3<br>BALF-SP2-01D3<br>BALF-SP2-02D3 | SPSGRF (868 and 915 MHz)<br>SPSGRFC (433, 868 and 915 MHz) |

Typical configuration



MAIN EVALUATION BOARDS

**EVLHVLED815W10A**  
10 W, buck-boost LED driver

**STEVAL-ILL082V1/  
STEVAL-ILL083V1**  
Smart home lighting based on  
HVLED815PF and SPSGRF  
(STEVAL-ILL082V1) and  
SPBTLE-RF (STEVAL-ILL083V1)

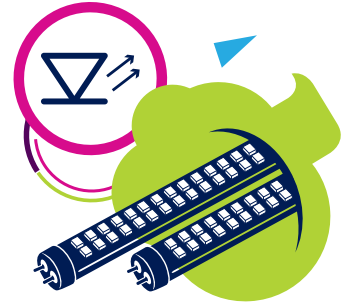
**EVALHVLED815W15**  
15 W, flyback LED driver



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

## Commercial lighting

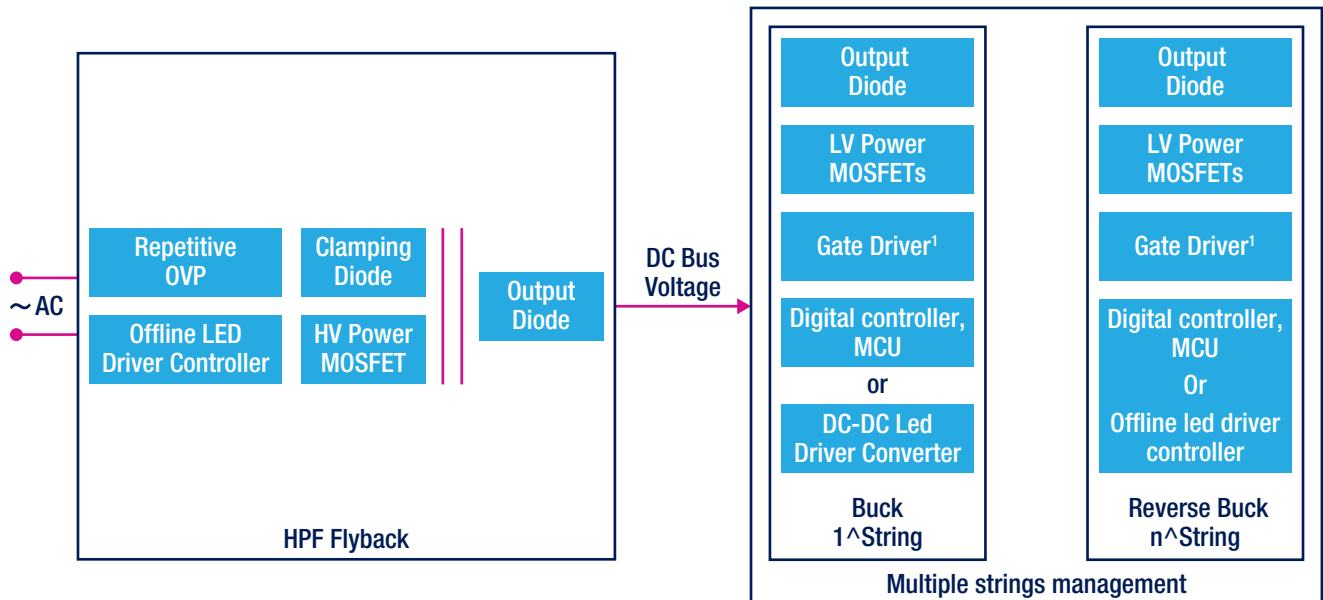
Commercial lighting applications usually require more than 20 W, a high power factor, high level of efficiency, cost-saving solution and the possibility of using more than one LED string with remote monitoring. The multiple strings power supply architecture consists of a main power supply (usually a flyback) providing a constant bus voltage and subsequent multiple strings. ST's offline LED controller HVLED001A (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™ K5 MOSFETs series (suggested for flyback) and the low-voltage STripFET MOSFET series (used for reverse buck topologies) ensure all solutions are very efficient and reliable.



|                       |              | Offline LED driver controller | Digital controllers, MCUs        | Gate drivers                        | Power MOSFETs                    |                     | Clamping diodes               | Repetitive overvoltage protections | Output diodes                                | DC-DC LED driver converters              |
|-----------------------|--------------|-------------------------------|----------------------------------|-------------------------------------|----------------------------------|---------------------|-------------------------------|------------------------------------|----------------------------------------------|------------------------------------------|
|                       |              |                               |                                  |                                     | HV                               | LV                  |                               |                                    |                                              |                                          |
| HPF Flyback           |              | HVLED001A                     | -                                | -                                   | ST*N80K5<br>ST*N90K5<br>ST*N95K5 | -                   | STTH*06<br>STTH*08<br>STTH*10 | STRVS*                             | FERD*100<br>STPS*150<br>STPS*170<br>STPS*200 | -                                        |
| Sepic                 |              |                               | -                                | -                                   | ST*N60M2<br>ST*N60DM2            | -                   | -                             | -                                  | -                                            | -                                        |
| Multiple strings mgmt | Buck         | -                             | STLUX*<br>STM32F334<br>STM32F301 | L6395                               | -                                | ST*N6F7<br>ST*N10F7 | -                             | -                                  | FERD15S50B<br>STPS*170AF<br>STPS*4S200UF     | LED2000<br>LED2001<br>LED5000<br>LED6000 |
|                       | Reverse buck | HVLED002                      | STM32F0*<br>STM8S*               | TD35*<br>PM8834<br>PM8841<br>PM8851 | -                                |                     | -                             | -                                  | STPSxxZF<br>STTHxxZF                         | -                                        |

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### Typical configuration

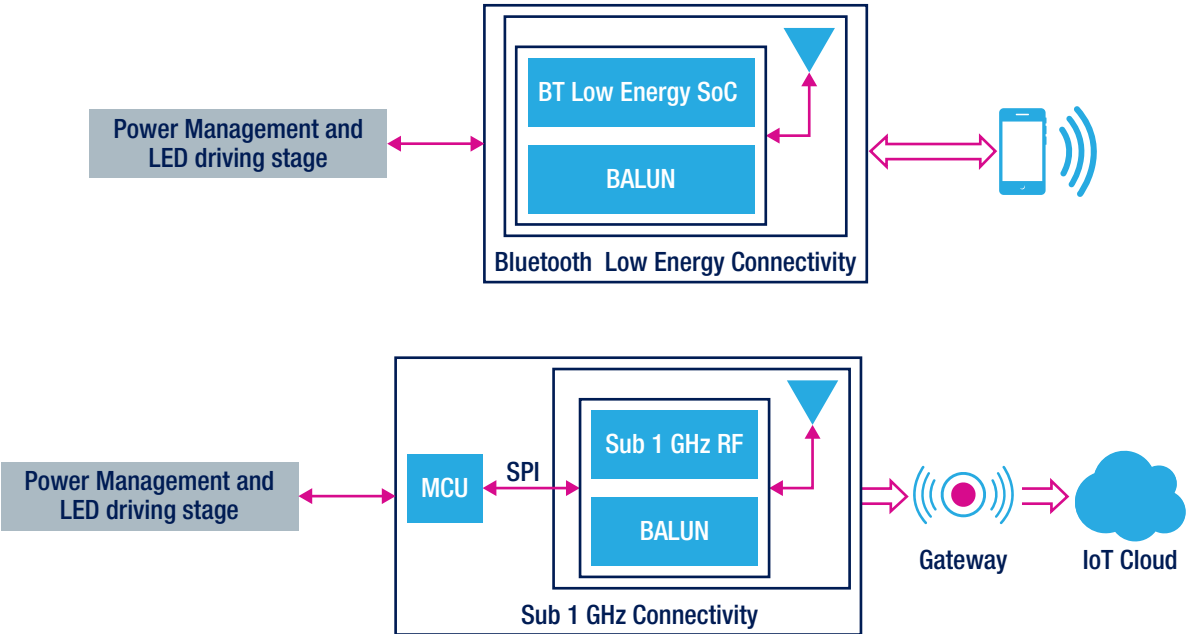


Note 1: only for digital solution \* is used as a wildcard character for related part number

ST offers products and solutions to enrich the LED lighting applications with wireless connectivity.

| Wireless Connectivity             |                  |                      |                                                                  |                                                            |
|-----------------------------------|------------------|----------------------|------------------------------------------------------------------|------------------------------------------------------------|
|                                   | Chipset          |                      |                                                                  | Certified Module                                           |
|                                   | Connectivity IC  | MCU                  | Balun                                                            |                                                            |
| Bluetooth Low Energy Connectivity | BlueNRG-1        | -                    | BALF-NRG-02D3                                                    | SPBTLE-1S                                                  |
|                                   | BlueNRG-MS       | STM32F0*<br>STM32L0* |                                                                  | SPBTLE-RF<br>SPBTLE-RF0                                    |
| Sub 1 GHz Connectivity            | SPIRIT1<br>S2-LP | STM32F0*<br>STM32L0* | BALF-SPI-01D3<br>BALF-SPI-02D3<br>BALF-SP2-01D3<br>BALF-SP2-02D3 | SPSGRF (868 and 915 MHz)<br>SPSGRFC (433, 868 and 915 MHz) |

Typical configuration



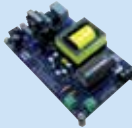
### MAIN EVALUATION BOARDS



**STEVAL-ILL080V1**  
18 W Tube replacement zero ripple LED driver using HVLED001A



**STEVAL-ILL069V2**  
35 W, analog power supply (CV<sub>out</sub>) for LED driving



**STEVAL-ILL070V4<sup>1</sup>**  
35 W, analog power supply (CC/CV) for single string led driver



**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

Note 1: available in Q4 2017    \* is used as a wildcard character for related part number

## 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.

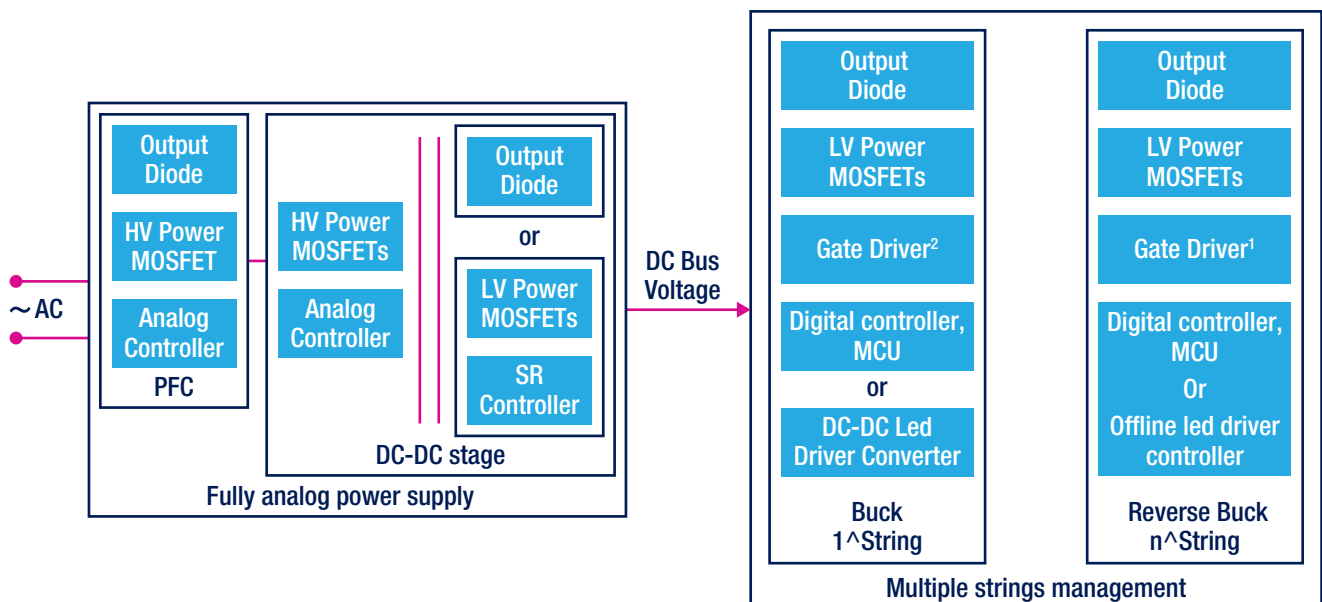
The multiple strings power supply architecture consists of a main power supply providing a constant bus voltage and a subsequent multiple strings. Usually the main power stage, consisting of a high power factor (HPF) flyback converter or a power factor correction (PFC) controller combined with an LLC 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. |   |                                     |
|-----------------------|--------------|-----------------------------|--------|--------------------------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------------------------------------------|-------------------------------|------------------------------------|-----------------------------------------------------------------|-----------------------------|-------------|---|-------------------------------------|
|                       |              |                             |        |                                                        |                                     | HV                                  | LV                                                                       |                               |                                    |                                                                 |                             |             |   |                                     |
| HPF Flyback           | PSR-CV       | HVLED001A                   |        | -                                                      | -                                   | ST*N80K5<br>ST*N90K5<br>ST*N95K5    | -                                                                        | STTH*06<br>STTH*08<br>STTH*10 | STRVS*                             | STPS*<br>FERD*<br>STTH*                                         | -                           | -           |   |                                     |
| PFC Boost             | CCM          | L4981*<br>L4984D            |        | STLUX*<br>STM32F0*<br>STM32F301<br>STM32F334           | TD35*<br>PM8841<br>PM8851           | ST*N60M2<br>ST*N65M2<br>ST*N60M2-EP | -                                                                        |                               | -                                  | STTH*R06<br>STTH*T06                                            | -                           | -           |   |                                     |
|                       | TM           | L6562A*<br>L6563*<br>L6564* | STCMB1 |                                                        |                                     |                                     |                                                                          |                               |                                    | STPSC*065<br>(SiC Diodes)<br>STTH*L06<br>STTH*06<br>STTH15AC06* |                             |             |   |                                     |
| DC-DC stage           | HB-LLC       | L6599A*<br>L6699            |        |                                                        |                                     | L638*<br>L639*<br>L649*             | ST*N50DM2<br>ST*N60DM2<br>ST*N60M2<br>ST*N65DM2                          |                               |                                    | -                                                               |                             |             | - | STPS*<br>FERD30M45D<br>FERD40U50CFP |
|                       | HB-LC        | -                           | -      |                                                        |                                     |                                     |                                                                          |                               |                                    |                                                                 |                             |             |   |                                     |
| Sync rect.            |              | SRK2000A<br>SRK2001         |        |                                                        | PM8834                              |                                     | STL*NS3LLH7<br>ST*N4LF7 <sup>1</sup><br>ST*N6F7<br>ST*N10F7<br>ST*N6F20D |                               | -                                  | -                                                               | -                           |             |   |                                     |
| Multiple strings mgmt | Buck         | -                           |        | STLUX*<br>STM32F334<br>STM32F301<br>STM32F0*<br>STM8S* | L6395                               | ST*N60M2<br>ST*N60M2-EP             | ST*N6F7<br>ST*N10F7                                                      | -                             | -                                  | STPS*<br>FERD*<br>STTH*<br>(≥200 V series)                      | LED5000<br>LED6000          | -           |   |                                     |
|                       | Reverse buck | HVLED002                    |        |                                                        | TD35*<br>PM8834<br>PM8841<br>PM8851 |                                     |                                                                          | -                             | -                                  | -                                                               | -                           |             |   |                                     |

## Typical configuration

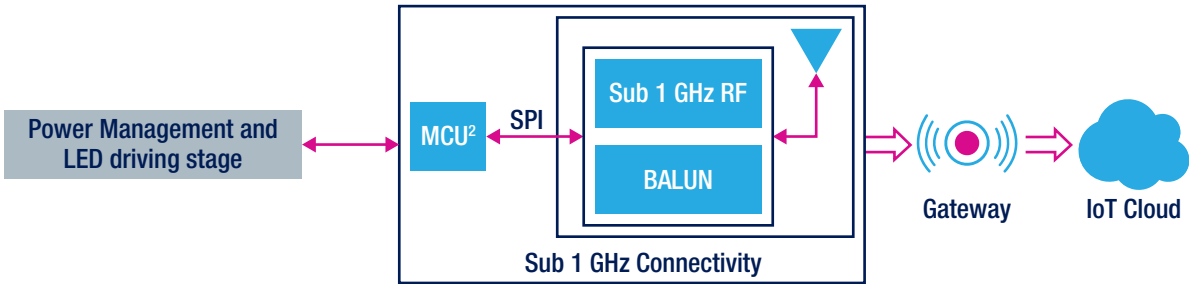


Note 1: MP Q4 2017    2: only for digital solution    \* is used as a wildcard character for related part number

In regard to analog solutions, ST's has a wide offer. The new flyback offline LED controllers (HVLED001A) 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.

| Wireless Connectivity  |                  |                      |                                                                  |                                                            |
|------------------------|------------------|----------------------|------------------------------------------------------------------|------------------------------------------------------------|
|                        | Chipset          |                      |                                                                  | Certified Module                                           |
|                        | Connectivity IC  | MCU                  | Balun                                                            |                                                            |
| Sub 1 GHz Connectivity | SPIRIT1<br>S2-LP | STM32F0*<br>STM32L0* | BALF-SPI-01D3<br>BALF-SPI-02D3<br>BALF-SP2-01D3<br>BALF-SP2-02D3 | SPSGRF (868 and 915 MHz)<br>SPSGRFC (433, 868 and 915 MHz) |

### Typical configuration



### MAIN EVALUATION BOARDS



**STEVAL-ILL066V2<sup>3</sup>**  
100 W, digital single-string PSR-CC LED driver



**STEVAL-ILL053V1**  
130 W, analog power supply (CV<sub>out</sub>) for LED driving



**STEVAL-ILL074V1/V2**  
60 W, analog power supply (CV<sub>out</sub>) 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



Note 1: MP Q4 2017    2: only for Analog Solution    3: available in Q4 2017    \* is used as a wildcard character for related part number

## MAJOR HOME APPLIANCES

### Refrigeration, washing, drying and miscellaneous equipment

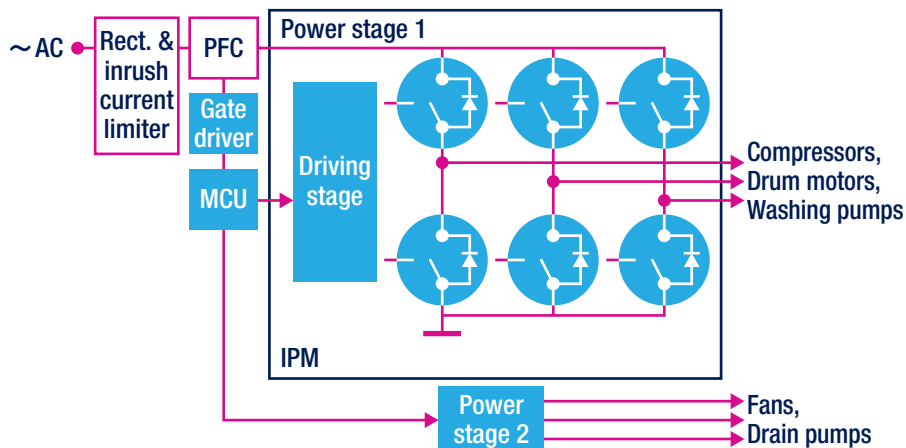
The white goods market requires low-cost and high-energy-efficiency solutions.

The refrigeration, washing, drying and the miscellaneous (Air conditioner, water heater) equipment are some of the major home appliance applications that ST, thanks to its wide product portfolio, is able to satisfy with suitable and 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 intelligent power modules (IPM) integrating the power stage (both on IGBT and MOSFET discretes), 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.



|                                |                                | MCUs                                                       | Gate drivers                        | IPM                                                                                                                                                | IGBTs                                     | HV power MOSFETs     | Diodes                             | Linear voltage reg.                                 | DC-DC converters                           |                                                         | SCRs                                                                                        | Triacs | LED array drivers |                               |
|--------------------------------|--------------------------------|------------------------------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|----------------------|------------------------------------|-----------------------------------------------------|--------------------------------------------|---------------------------------------------------------|---------------------------------------------------------------------------------------------|--------|-------------------|-------------------------------|
|                                |                                |                                                            |                                     |                                                                                                                                                    |                                           |                      |                                    |                                                     | HV                                         | LV                                                      |                                                                                             |        |                   |                               |
| Rect. & inrush current limiter |                                | -                                                          | -                                   | -                                                                                                                                                  | -                                         | -                    | STBR3012<br>STBR6012               | -                                                   | -                                          |                                                         | TN815-800B<br>TN1215-600B<br>TN1515-600B<br>TN1610H-6<br>TN2015H-6<br>TN4015H-6<br>TN5015-6 | -      | -                 |                               |
|                                |                                | -                                                          | -                                   | -                                                                                                                                                  | -                                         | -                    | -                                  | -                                                   | -                                          |                                                         | -                                                                                           | T1635T | -                 |                               |
| PFC                            | Boost Interl. Boost Bridgeless | STNRGPF01<br>STM32F0*<br>STM32F103<br>STM32F3*<br>STM32F4* | TD35*<br>PM8841<br>PM8851<br>PM8834 | -                                                                                                                                                  | STG*V60(D)F<br>STG*H65(D)FB<br>STG*HP65FB | ST*N65M5<br>ST*N65M2 | STTH*AC06<br>STTH*R06<br>STPSC*065 | LDF<br>LDFM<br>LDK220<br>LDK320<br>LDK715<br>LDL212 | -                                          |                                                         | -                                                                                           | -      | -                 |                               |
|                                | Compr.                         |                                                            | L638*<br>L639*<br>L649*             | STGIF*CH60<br>STGIB*CH60<br>STGIB*M60<br>STIB*60DM2 <sup>1</sup><br>STIPNS*M50 <sup>2</sup><br>STIPQ*M60<br>STGIPNS*H60 <sup>2</sup><br>STGIPQ*C60 | STG*H60DF<br>STG*M65DF2                   | ST*N60DM2            | -                                  |                                                     | L698*<br>L597*<br>L7985<br>L7986<br>L7987* | ST1S0*<br>ST1S12<br>ST1S3*<br>ST1S40<br>ST1S50<br>L598* | -                                                                                           | -      | -                 |                               |
| Fan                            |                                |                                                            |                                     |                                                                                                                                                    |                                           |                      |                                    |                                                     |                                            |                                                         |                                                                                             |        |                   |                               |
| Pumps                          |                                |                                                            |                                     |                                                                                                                                                    |                                           |                      |                                    |                                                     |                                            |                                                         |                                                                                             |        |                   |                               |
| LED indicator                  |                                |                                                            | -                                   |                                                                                                                                                    |                                           |                      |                                    |                                                     |                                            |                                                         |                                                                                             | -      | -                 | STP08*<br>STP16*<br>LED1642GW |

### Typical configuration



### MAIN EVALUATION BOARDS



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



**STEVAL-IPM\***  
300 W to 3 kW Power board based on SLLIMM™

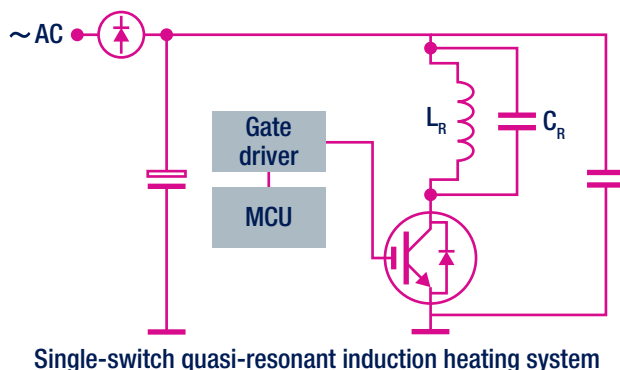
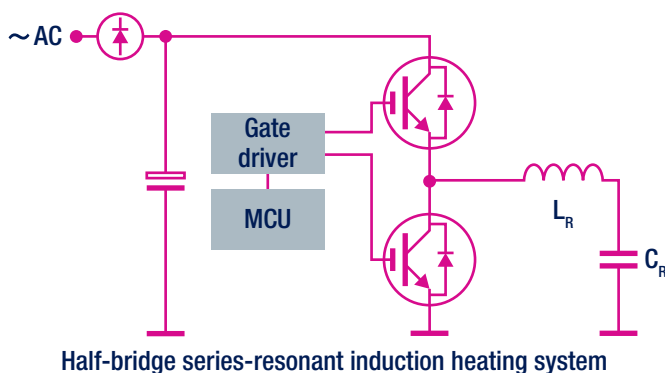
## Induction heating

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 and we are about to introduce a new 650 V IH series and a 1350 V series. 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            |
|---------------------------------------------------------|--------------------------------------------|---------------------------|------------------------------------------------------|------------------------------|
| <b>Single-switch quasi-resonant (voltage resonance)</b> | STM8*<br>STM32F100                         | TD35*<br>PM8841<br>PM8851 | STG*IH125DF<br>STG*IH135DLF2 <sup>1</sup>            | -                            |
| <b>HB series resonant (current resonance)</b>           | STM32F0*<br>STM32F100                      | L638*<br>L639*<br>L649*   | STG*H65DFB<br>STG*H60DLFB<br>STG*IH65DF <sup>1</sup> | -                            |
| <b>User interface (front panel)</b>                     | STM8*<br>STM32F0*<br>STM32F4*9<br>STM32F7* | -                         | -                                                    | STP08<br>STP16*<br>LED1642GW |

### Topology example



### MAIN EVALUATION BOARD



Board available on request  
1.8 kW, quasi-resonant induction cooking system

## 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 the new FERD diodes with a very low forward voltage and a low leakage reverse current.

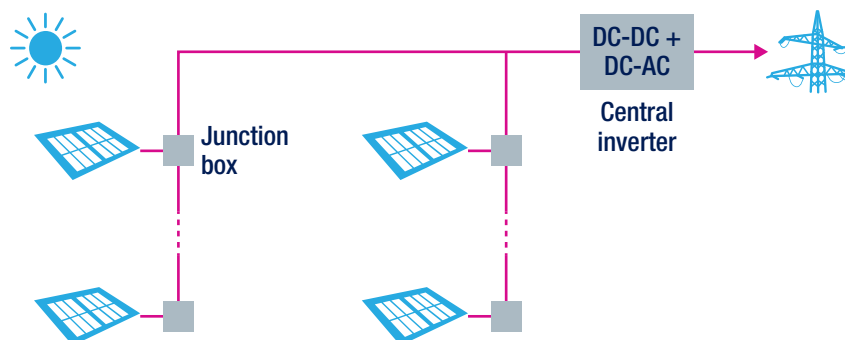
By integrating high-performance STM32 microcontrollers, the new high-efficiency SiC MOSFETs (SCT\*N120), the new trench-gate field-stop IGBTs series, the SiC diodes (STPSC\*) and the new STGAP1AS galvanically-isolated gate drivers, it's possible to guarantee a high-efficiency central inverter implementation.

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 Diodes                    | DC-DC converters                                     |                           |  |  |
|------------------|-------------|-------------|----------------------------------------------------------|-------------------------------------|----------------------------------|-----------------------------------------------------------------------|---------------------------------------|----------------------------------|------------------------------------------------------|---------------------------|--|--|
|                  |             |             |                                                          |                                     |                                  |                                                                       |                                       |                                  | HV                                                   | LV                        |  |  |
| Junction box     |             |             | -                                                        | -                                   | -                                | -                                                                     | -                                     | STPS*30<br>STPS*45<br>FERD30M45D | -                                                    | -                         |  |  |
| Central inverter | DC-DC stage | FB-PS       | STM32F1*<br>STM32F2*<br>STM32F3*<br>STM32F4*<br>STM32F7* | L638*<br>L639*<br>L649*<br>STGAP1AS | ST*60DM2<br>ST*65DM2<br>SCT*N120 | -                                                                     | STTH*06<br>STTH*S12                   | -                                | L6985F<br>L6986<br>L597*<br>L7985<br>L7986<br>L7987* | ST1S4*<br>ST1S50<br>L598* |  |  |
|                  |             |             |                                                          |                                     |                                  | STPSC*065<br>STPSC*12<br>(SiC Diodes)                                 |                                       |                                  |                                                      |                           |  |  |
|                  | DC-AC stage | FB mix freq |                                                          |                                     | SCT*N120                         | STG*H65DFB<br>STG*V60DF<br>STG*H120DF2                                | STTH*R06                              | -                                |                                                      |                           |  |  |
|                  |             | 3-Level HB  |                                                          |                                     |                                  | STG*H120DF2<br>STG*S120DF3<br>STG*M120DF3<br>STG*H65DFB<br>STG*M65DF2 | STPSC*065<br>STPSC*12<br>(SiC Diodes) |                                  |                                                      |                           |  |  |

### 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 the new FERD diodes featuring a very low forward voltage and low leakage reverse current. 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.

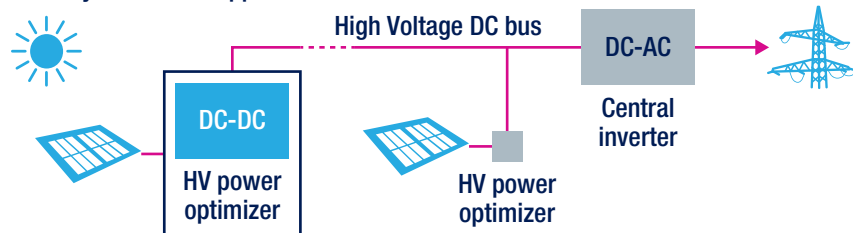
The fully distributed approach integrates, at the PV panel level, a microinverter that includes a complete converter (DC-DC with MPPT as well as DC-AC) and manages the AC grid connection. The high-performing STM32 microcontrollers, the new high-efficiency high-voltage MDmesh™ MOSFET series, the new low-voltage STripFET MOSFET series and the SiC diodes (STPSC\*) guarantee a high-efficiency converter while the new STGAP1AS 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.



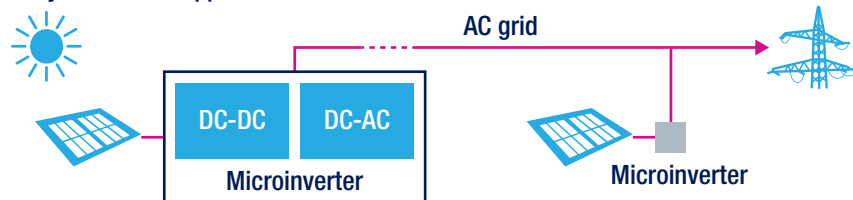
|                  |                     |                   | MCUs                                                      | Gate drivers                        | Power MOSFETs            |                                      | IGBTs      | Diodes                                | Bypass Diode                  | DC-DC converters                                     |                           |
|------------------|---------------------|-------------------|-----------------------------------------------------------|-------------------------------------|--------------------------|--------------------------------------|------------|---------------------------------------|-------------------------------|------------------------------------------------------|---------------------------|
|                  |                     |                   |                                                           |                                     | HV                       | LV                                   |            |                                       |                               | HV                                                   | LV                        |
| Power optimizer  | DC-DC stage         | Isolated FB boost | STM32F103<br>STM32F3*<br>STM32F4*                         | L638*<br>L639*<br>L649*<br>STGAP1AS | -                        | STH*N10F7<br>STH*N6F7                | -          | STTH*R06<br>STTH80S06W                | STPS*30<br>STPS*45<br>FERD*45 | -                                                    |                           |
| Central inverter | DC-AC stage         | FB mix freq       | STM32F103<br>STM32F2*<br>STM32F3*<br>STM32F4*<br>STM32F7* |                                     | SCT*N120<br>(SiC MOSFET) | -                                    | STG*H65DFB | STTH*R06<br>STTH*06                   | -                             | L6985F<br>L6986<br>L597*<br>L7985<br>L7986<br>L7987* | ST1S4*<br>ST1S50<br>L598* |
|                  |                     | 3-level HB        | STG*H120DF2                                               |                                     |                          |                                      |            |                                       |                               |                                                      |                           |
| Micro inverter   | DC-DC Interl. Boost |                   | STM32F103<br>STM32F3*<br>STM32F4*                         | TD35*<br>PM8834<br>PM8841<br>PM8851 | -                        | STH*N10F3<br>STH*N8F7<br>ST*160N75F3 | -          | STPSC*065<br>STPSC*12<br>(SiC Diodes) | -                             |                                                      |                           |
|                  | DC-AC FB mix freq.  |                   | L638*<br>L639*<br>L649*<br>STGAP1AS                       | STB*N65M5                           | -                        |                                      |            |                                       |                               |                                                      |                           |

## Typical configurations

### Partially distributed approach



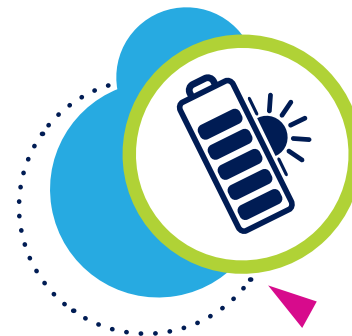
### Fully distributed approach



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

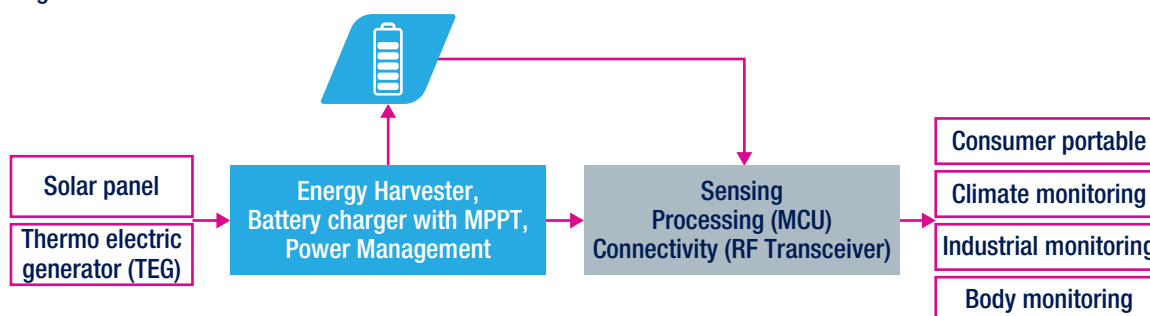
## Solar – Thermo electric generator (TEG)

Today's Internet of Things (IoT) is based on the exchange of data among remote sensing units and nodes, 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.



|            |               |                    | Battery Charger with MPPT | Battery Charger     | Thin-film batteries | Linear voltage regulators |
|------------|---------------|--------------------|---------------------------|---------------------|---------------------|---------------------------|
| PV         | 400 mW to 3 W | Boost              | SPV1040                   | -                   | -                   | STLQ015<br>STLQ020        |
| PV and TEG | Up to 400 mW  | Boost & Buck-Boost | SPV1050                   | STBC15 <sup>1</sup> | EFL700A39           | ST715<br>LD39130S         |

### Typical configuration



### MAIN EVALUATION BOARDS



**STEVAL-GPT001V1<sup>2</sup>**  
Solar Rechargeable Smart  
Watch with SPV1050



**STEVAL-IDS002V1**  
Autonomus wireless  
multisensor node powered  
by PV cells



**STEVAL-IDS003V1<sup>3</sup>**  
Autonomus wireless  
multisensor node  
powered by TEG

## UNINTERRUPTIBLE POWER SUPPLIES (UPS)

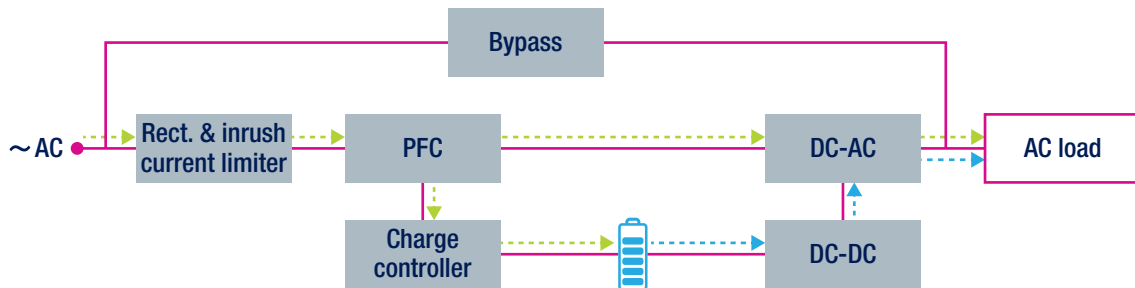
Today the vast increase of sensitive loads due to the explosion in digital technology requires a high-quality supply of electrical power. In addition to its primary function of ensuring the continuity of service, an uninterruptible power supply (UPS) improves the quality of the voltage supplied to the 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 STGAP1AS galvanically-isolated gate drivers and high-performance STM32 microcontrollers guarantee high reliability and efficiency.



|                                |           | MCUs and Digital Controllers      | Gate drivers                           | IGBTs                     | Power MOSFETs                      |                                            | Diodes                                                         | SCRs                                                                    | Triacs                                              | Linear voltage regulators                   | DC-DC Conv. |
|--------------------------------|-----------|-----------------------------------|----------------------------------------|---------------------------|------------------------------------|--------------------------------------------|----------------------------------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------------------|-------------|
|                                |           |                                   |                                        |                           | HV                                 | LV                                         |                                                                |                                                                         |                                                     |                                             |             |
| Rect. & inrush current limiter |           | -                                 | -                                      | -                         | -                                  |                                            | STBR3012<br>STBR6012                                           | TN4015H-6<br>TN5015H-6<br>TM8050H-8<br>TN3050H-12Y<br>TN5050H-12Y       | -                                                   | -                                           | -           |
|                                |           |                                   |                                        |                           |                                    |                                            | -                                                              | -                                                                       | T1635T                                              | -                                           | -           |
| PFC Boost                      |           | STNRGPF01<br>STM32F4*<br>STM32F7* | PM8834<br>PM8841<br>PM8851             | STG*H65DFB<br>STG*V60DF   | ST*N60M2<br>ST*N65M2<br>ST*N65M5   | -                                          | STTH*T06<br>STTH*R06<br>STTH*S12<br><br>STPSC*<br>(SiC Diodes) | -                                                                       | -                                                   | -                                           | -           |
| Charge controller              | HB        | STM32F4*<br>STM32F7*              | L638*<br>L639*<br>L649*                |                           | ST*N50DM2<br>ST*N60DM2<br>ST*N60M2 | -                                          | STTH*T06<br>STTH*12<br><br>STPSC*<br>(SiC Diodes)              | -                                                                       | -                                                   | -                                           | -           |
| DC-DC stage                    | Push Pull |                                   | PM8834<br>PM8841<br>PM8851<br>STGAP1AS |                           | -                                  | ST*N6F7<br>ST*N8F7<br>ST*N10F7<br>STP*N3LL |                                                                |                                                                         | LDF<br>LDFM<br>LDK220<br>LDK320<br>LDK715<br>LDL212 | L698*<br>ST1S14<br>L7985<br>L7986<br>L7987* |             |
| DC-AC stage                    | NPC       |                                   | L638*<br>L639*<br>L649*<br>STGAP1AS    | STG*H65DFB<br>STG*H120DF2 | SCT*N120                           | -                                          |                                                                |                                                                         |                                                     |                                             |             |
|                                | FB        |                                   |                                        | -                         | STP110N8F6<br>ST*N8F7<br>ST*N10F7  |                                            |                                                                |                                                                         |                                                     |                                             |             |
| Bypass                         |           | -                                 | -                                      | -                         | -                                  | -                                          | -                                                              | T2550-12<br>TPDV*<br>TN5050H-12WY<br>TYN6*<br>TYN8*<br>TYN10*<br>TYN12* | -                                                   | -                                           | -           |

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### Example of high-end configuration



----- Normal operation      ..... Backup operation

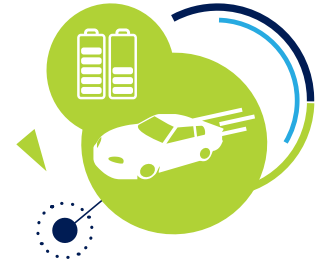
Double-conversion system solution

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

## e-MOBILITY

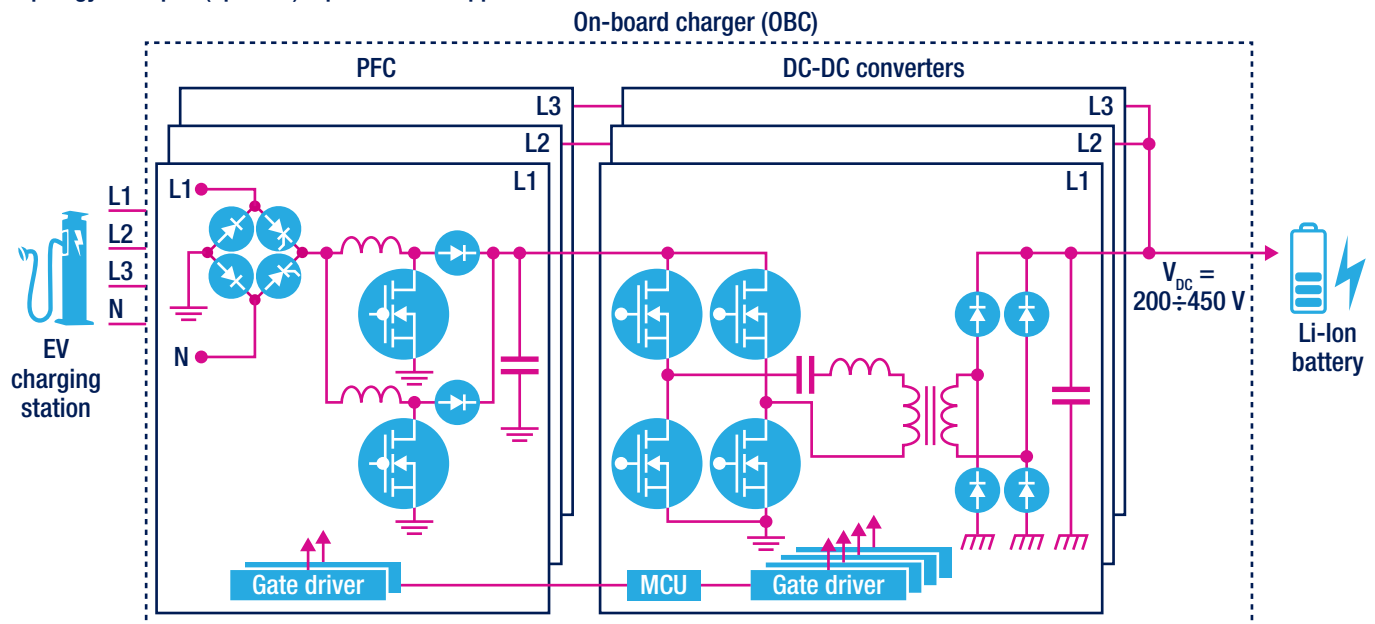
### On-board chargers

One of the key element of electric (EV) or plug-in hybrid (HEV) vehicles is the traction high voltage battery ( $200\text{ V}_{\text{DC}}$  -  $450\text{ V}_{\text{DC}}$ ). In the car the on-board charger (OBC) allows the charging of the battery from home AC mains plug or private/public outlets (AC charging station). Typical AC power charging level goes from 3.6 kW (single phase) to 22 kW (three phase). In case of 3ph+N input, a modular approach based on 3 modules PFCi+DC-DCi (one for each phase) with the common output, can be implemented. With this approach every module can be managed like a single phase module allowing an easy system implementation, a more system reliability and an higher system efficiency. ST is able to offer a complete product portfolio including silicon and SiC power MOSFETs, silicon and SiC diodes, protections, gate drivers, and microcontrollers, in accordance to AEC-Q100 and AEC-Q101 standards.



|             |                           | HV Input rectification and LF path devices |                              | MCUs                                   | Gate Drivers      | HV Power MOSFETs                                                                                                                             |                               | HV output diodes                                                                                                                                | Bypass diodes             | Protections              |
|-------------|---------------------------|--------------------------------------------|------------------------------|----------------------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|--------------------------|
|             |                           | Diodes                                     | SCRs <sup>2</sup>            |                                        |                   | Silicon                                                                                                                                      | SiC                           |                                                                                                                                                 |                           |                          |
| PFC         | Interleaved boost         | STTH16L06C-Y<br>STTH30L06-Y<br>STBR*012-Y  | TN3050H-12Y                  | SPC58<br>E Line<br>N Line <sup>3</sup> | STGAP1AS          | STB43N65M5<br>STW62N65M5<br>STW78N65M5                                                                                                       | SCTH35N65G2V-7AG <sup>1</sup> | STPSC12065-Y<br>STPSC20065-Y<br>STPSC40065C-Y<br>STPSC12065-Y<br>STPSC20065-Y<br>STPSC20H065C-Y<br>STPSC40065C-Y                                | STTH30L06-Y<br>STBR*012-Y | SM4TY                    |
|             | Semi-bridgeless           | STBR*012-Y                                 | -                            |                                        |                   |                                                                                                                                              |                               |                                                                                                                                                 |                           |                          |
|             | Totem pole                | STTH30L06-Y<br>STBR*012-Y                  | TN3050H-12WY<br>TN5050H-12WY |                                        |                   |                                                                                                                                              |                               |                                                                                                                                                 |                           |                          |
|             | Vienna original (3-Phase) | -                                          | -                            | SPC57<br>K Line                        | A6387<br>STGAP1AS | STW62N65M5<br>STW78N65M5                                                                                                                     | -                             | STPSC10H12-Y<br>STPSC15H12-Y<br>STPSC20H12-Y<br>STPSC12065-Y<br>STPSC20065-Y<br>STPSC20H065C-Y<br>STPSC40065C-Y<br>STTH30ST06-Y                 | -                         | SM4TY<br>SM6TY<br>SM30TY |
|             | Vienna modified (3-phase) | STTH30L06-Y<br>STBR*012-Y                  | TN3050H-12WY<br>TN5050H-12WY |                                        |                   |                                                                                                                                              |                               |                                                                                                                                                 |                           |                          |
| DC-DC stage | FB-PS                     | -                                          | -                            |                                        |                   | STW45N60DM2AG<br>STW58N60DM2AG<br>STW72N60DM2AG<br>STWA50N65DM2AG <sup>1</sup><br>STWA58N65DM2AG <sup>1</sup><br>STWA65N65DM2AG <sup>1</sup> | -                             | STPSC10H12-Y<br>STPSC15H12-Y<br>STPSC20H12-Y<br>STTH15RQ06-Y<br>STTH30RQ06-Y<br>STPSC12065-Y<br>STPSC12H065-Y<br>STPSC20065WY<br>STPSC20H065CWY | -                         | SM4TY<br>SM6TY<br>SM30TY |
|             | FB-LLC                    |                                            |                              |                                        |                   |                                                                                                                                              |                               |                                                                                                                                                 |                           |                          |
|             | 3-Level HB LLC            |                                            |                              |                                        |                   |                                                                                                                                              |                               |                                                                                                                                                 |                           |                          |

### Topology example: (3ph + N) input modular approach



Note 1: samples available on request    2: SCR option to replace relay for inrush current limit    3: available in Q1-2018    \* is used as a wildcard character for related part number

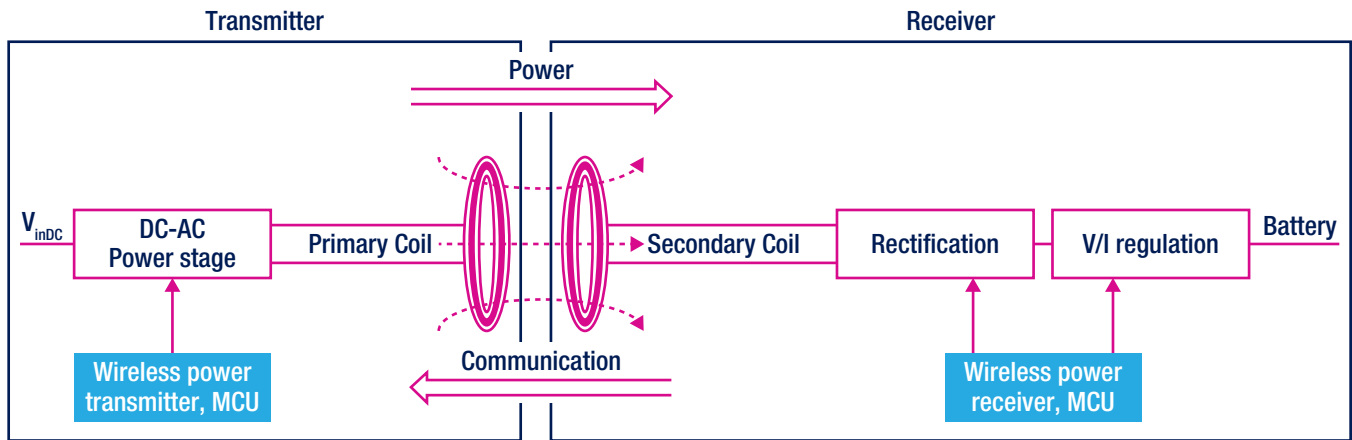
## WIRELESS CHARGING

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 and AirFuel market standard and the main topologies: STWBC-WA (Tx) and STWLC04 (Rx) for wearables, STWBC (5 W Tx), STWBC-EP (15 W Tx) and STWLC03 (5 W Rx), STWLC33 (15 W Rx) for the other mobile applications. The use of new low-voltage STripFET MOSFETs guarantees high-efficiency converters. To reduce the time to market, a complete wireless kit (Tx + Rx) for wearables and a general-purpose wireless evaluation boards are available.



|             |                            |    | Wireless charging ICs, MCUs               | Gate drivers | Power MOSFETs                                                                   | Protections     | Diodes                             |
|-------------|----------------------------|----|-------------------------------------------|--------------|---------------------------------------------------------------------------------|-----------------|------------------------------------|
| Transmitter | DC-AC stage                | HB | STWBC<br>STWBC-WA<br>STWBC-EP<br>STM32F0* | L6747*       | STL*NS3LLH7<br>ST*N2VH5<br>ST*P2UH7<br>STL8DN10LF3<br>STL6N3LLH6<br>STL10N3LLH5 | -               | STPSxx45/60/100<br>FERDxx45/60/100 |
|             |                            | FB |                                           |              |                                                                                 |                 |                                    |
| Receiver    | Rectification              |    | STWLC03<br>STWLC04<br>STWLC33<br>STM32F0* | -            | -                                                                               | SMM4F<br>SMA6J* | BAT30F4<br>BAR46                   |
|             | Voltage/Current regulation |    |                                           |              |                                                                                 |                 |                                    |

### Typical configuration



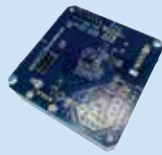
27

### MAIN EVALUATION BOARDS



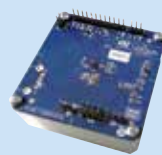
STEVAL-ISB027V1

Qi A11 Wireless charger transmitter based on STWBC



STEVAL-ISB036V1

Wireless charger receiver based on STWLC03



STEVAL-ISB042V1<sup>1</sup>

Wireless Charger TRx: Qi 15 W/Airfuel inductive 5 W dual mode receiver and Qi based 3 W transmitter with STWLC33



STEVAL-ISB044V1

Qi 15W Wireless Charger transmitter based on STWBC-EP



STEVAL-ISB038V1

Wireless charging reference design kit for wearables based on STWBC-WA and STWLC04



# 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/>

## eDesignSuite The smart way to design your application

Power  
Conversion



LED Lighting



Signal  
Conditioning



RF Design



Smart Selectors  
& Configurators



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## SMART SIMULATOR AND SYSTEM DESIGN ENGINE

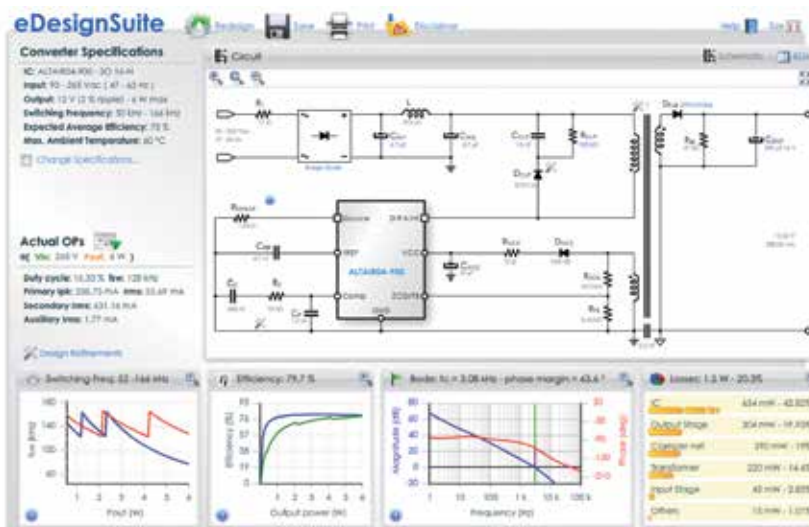
### Power conversion and LED lighting

- 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
- New iPFC design based on STNRGPF01 digital controller, including c code generation

## 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** (ViPer0P and ViPer\*1, 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 ViPer0P, 10 mW for ViPer\*1 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 ViPer0P, ViPer\*1 and ViPer\*6
  - PSR-CV/CC and tight tolerance using ALTAIR\*
- Buck & buck-boost topologies supported by ViPer0P, ViPer\*1 and ViPer\*6

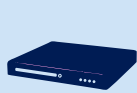
|                                              |                                   |         |  |         |  |                      |          |         |  |
|----------------------------------------------|-----------------------------------|---------|--|---------|--|----------------------|----------|---------|--|
| Different features for different controllers | ViPer0P<br>Zero-Power Mode        |         |  |         |  | ViPer0P              |          |         |  |
|                                              | ViPer series 1<br>Low VCC voltage | ViPer01 |  |         |  | ViPer11 <sup>1</sup> |          |         |  |
|                                              | ViPer series 5<br>Quasi-resonant  |         |  |         |  |                      | ViPer25  | ViPer35 |  |
|                                              | ViPer series 6<br>Minimal BoM     | ViPer06 |  | ViPer16 |  |                      | ViPer26  |         |  |
|                                              | ViPer series 7<br>Brown-out       |         |  | ViPer17 |  |                      | ViPer27  | ViPer37 |  |
|                                              | ViPer series 8<br>Peak power      |         |  |         |  |                      | ViPer28  | ViPer38 |  |
|                                              | Altair<br>PSR CC/CV               |         |  |         |  | Altair04             | Altair05 |         |  |

### Different MOSFET size for different output power capabilities

|                               | 4 W                 | 6 W                 | 8 W                 |                     | 12 W               | 15 W              |
|-------------------------------|---------------------|---------------------|---------------------|---------------------|--------------------|-------------------|
| Fly-back Converter 85-265 Vac |                     |                     |                     |                     |                    |                   |
| Buck Converter                | 150 mA              | 200 mA              | 200 mA              |                     | 350 mA             |                   |
| Max $R_{DS(on)}$ / $I_{DLIM}$ | 30 $\Omega$ /350 mA | 24 $\Omega$ /400 mA | 20 $\Omega$ /400 mA | 14 $\Omega$ /700 mA | 7 $\Omega$ /700 mA | 4.5 $\Omega$ /1 A |

$V_{BVDSS} = 800 \text{ V}, 900 \text{ V (ALTAIR05)}$

## MAIN APPLICATIONS



Consumer  
electronics



Factory  
automation



Home  
appliances



Lighting



Metering



Home  
automation

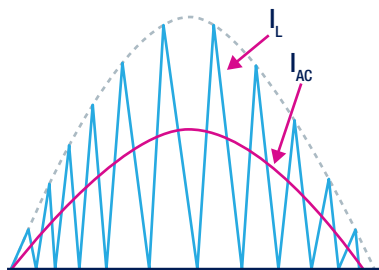
[www.st.com/ac-dc-converters](http://www.st.com/ac-dc-converters)  
[www.st.com/high-voltage-ac-dc-converters](http://www.st.com/high-voltage-ac-dc-converters)  
[www.st.com/viperplus](http://www.st.com/viperplus)

## 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.

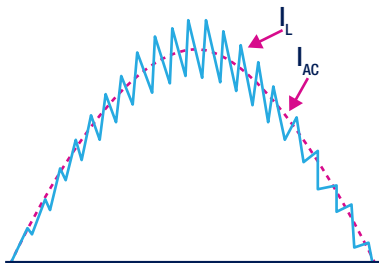
These devices embed advanced protection features, which make SMPS more robust and compact, requiring fewer external components. These features include output overvoltage, brown-out, feedback disconnection and boost inductor saturation protection. The high-voltage start-up capability, present in the L6564H 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 and street lighting**  
L6562A\*, L6563\*, L6564\*, L4981\*, L4984D



**Desktop PCs and Server**  
L4981\*, L4984D



[www.st.com/ac-dc-converters](http://www.st.com/ac-dc-converters)  
[www.st.com/pfc-controllers](http://www.st.com/pfc-controllers)

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

## 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

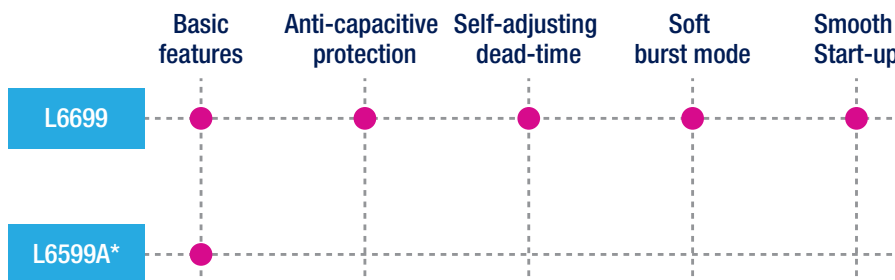
- 800 V start-up voltage
- Embedded X-cap discharge circuit
- Transition Mode (TM) PFC control method
- Self-adjusting dead-time and antiparallel mode for LLC

### 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 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

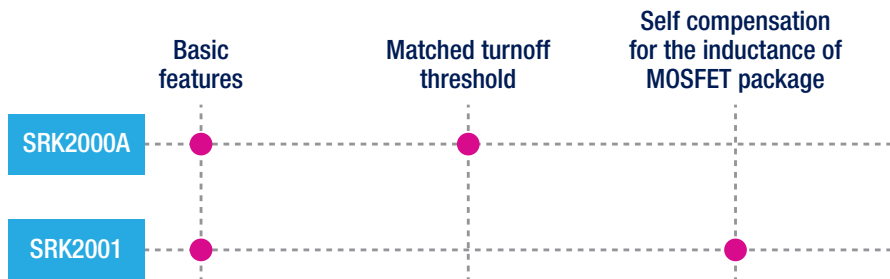
#### STSR2P\*

- 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



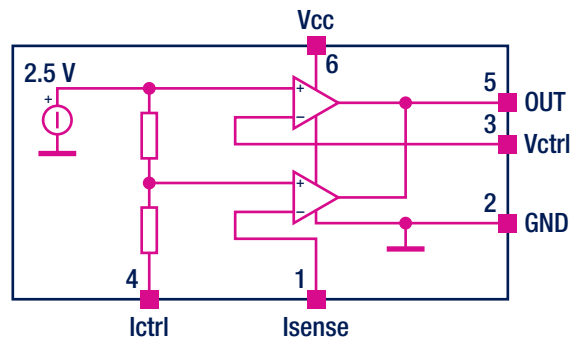
## MAIN APPLICATIONS



## 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<sub>cc</sub>
- 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<sub>cc</sub>
- 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 and street lighting

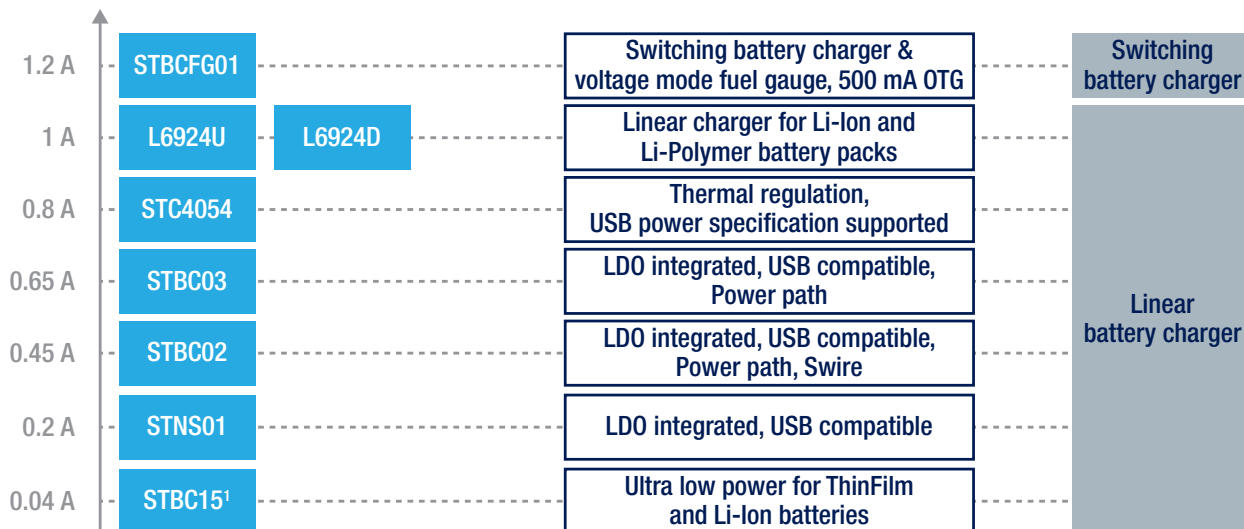


## BATTERY MANAGEMENT ICs

### 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 40 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



#### STBC02/ STBC03

- Embed a linear battery charger, a 150 mA LDO, 2 SPDT load switches and a protection circuit module
- STBC02 embeds a smart reset/watchdog and a single wire interface for IC control
- Use a CC/CV algorithm with programmable (only STBC02) fast charge, precharge and termination current

ST's **battery fuel gauge ICs** can be located in the battery pack or in the handheld device and integrate functions to monitor the battery voltage, current and temperature. Using a built-in Coulomb counter, these fuel gauge ICs calculate battery charge and store the data in 16-bit register resolution for retrieval by the system controller. Access is via an industry-standard I<sup>2</sup>C interface, enabling the controller to create an accurate graphical representation of the remaining battery-operating time.

#### STC3115

- OptimGauge™ algorithm for STC3115
- OptimGauge+™ algorithm for SCT3117

#### STC3117

- Coulomb counter and voltage gas gauge operations
- Programmable low battery alarm
- Internal temperature sensor

### FUEL GAUGE ICs MAIN BENEFITS

- 3 % accuracy of battery state of charge no need for shunt resistor
- Accurate estimation of battery state of charge at power-up
- Reliable battery swap detection
- SoH and impedance tracking with OptimGauge+ algorithm (ST IP)
- Charger enable and system reset control for accurate OCV reading
- Minimum form factor

### MAIN APPLICATIONS



Bluetooth accessories  
STC4054



USB  
L6924U, STC4054, STBCFG01



Fitness  
STNS01, STBC02, sSTBC03



Smartphones  
STBCFG01, STC3115, SCT3117

## Wireless charging ICs

ST fully covers wireless charging applications with dedicated ICs for both transmitter and receiver. The STWBC and STWBC-EP, compatible with Qi standard, and the STWBC-WA, dedicated to wearable applications, make-up ST's wireless power transmitters (Tx) family. The receiver family (Rx) consists of the STWLC04 dedicated to wearable application, the STWLC03, compliant with both Qi and PMA standards, which is suitable for smartphones, tablets, medical applications and the STWLC33 which is new multi-mode Qi/AirFuel inductive wireless power Rx/Tx solution.

### Wireless power transmitters

| STWBC | STWBC-WA | STWBC-EP |
|-------|----------|----------|
|-------|----------|----------|

#### STWBC

- Supports applications up to 5 W
- Qi A11 certified

#### STWBC-WA

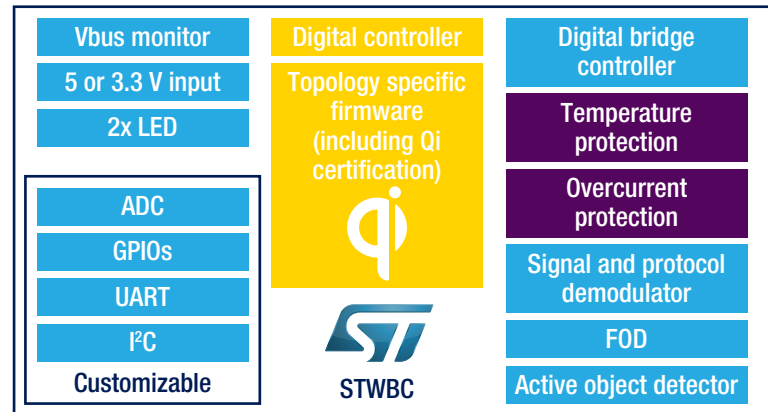
- Supports applications up to 2.5 W
- Wireless power transmitter dedicated to wearables

#### STWBC-EP

- Supports application up to 15 W
- Qi extended power certified

#### Common features

- Digital feedback with foreign object detection (FOD)
- Smart standby (best in class consumption)
- GUI for configuration and run-time analysis
- Firmware customization via API



### Wireless power receivers

| STWLC03 | STWLC04 | STWLC33 |
|---------|---------|---------|
|---------|---------|---------|

#### STWLC03

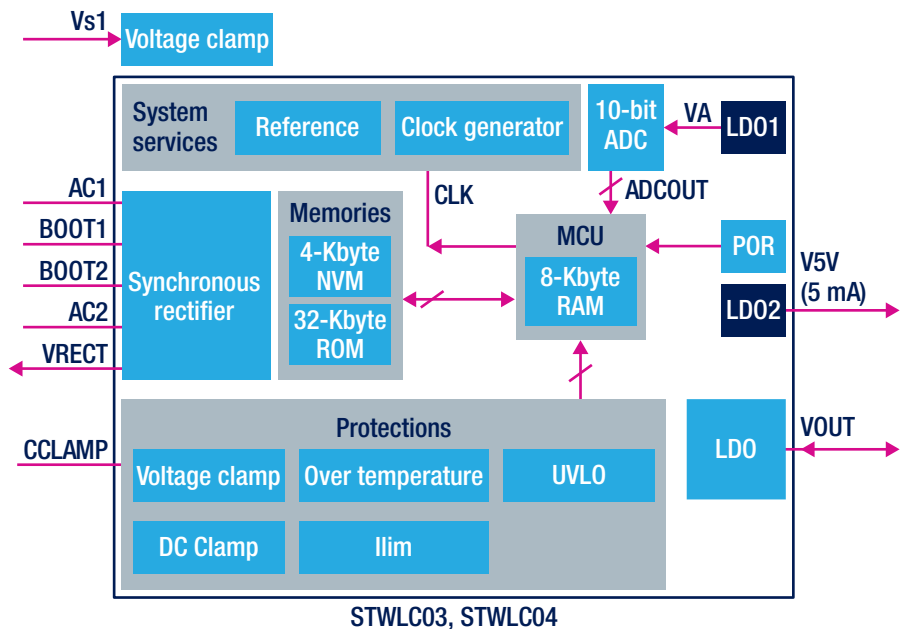
- Supports applications up to 7.5 W
- Multiple Qi and PMA standard compliant

#### STWLC04

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

#### STWLC33

- Supports up to 15 W output power in RX mode and 5 W in TX mode
- Multiple Qi and Airfuel inductive standard compliant
- Outstanding total system efficiency
- Precise voltage and current measurements for FOD function



## MAIN APPLICATIONS



**Wireless battery charger transmitters**  
STWBC, STWBC-EP



**Medical & healthcare equipment**  
STWLC03



**Tablets and smartphones**  
STWLC03, STWLC33

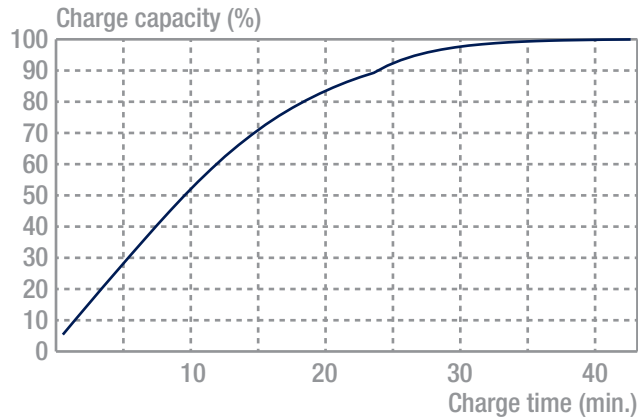


**Wearables**  
Transmitter STWBC-WA  
Receiver STWLC04

## 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 LiCoO<sub>2</sub> 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



### Ultra low consumption linear charger for thin film battery

#### STBC15<sup>1</sup>

- Microbatteries charging and monitoring circuit
- Charging current up to 40 mA (set by dedicated pin)
- 150 nA quiescent current
- Reverse current protection from battery to supply input
- Programmable floating voltage with 0.5 % accuracy
- Battery overcurrent protection
- Battery over discharge protection switch totally disconnects battery for cell durability
- Shelf-mode supported, no battery mechanical switch needed

## MAIN APPLICATIONS



Fitness and wearables



RF ID tags



Sensors and networks



Smart cards

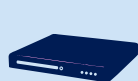
## DC-DC converters

The image shows two circuit diagrams side-by-side. The left diagram is labeled 'Synchronous buck converter' and the right is labeled 'Asynchronous buck converter'. Both diagrams show an input voltage  $V_{in}$  connected to an inductor and a load capacitor. The synchronous converter uses two MOSFETs (one switching, one freewheeling) controlled by a 'Controller' block. The asynchronous converter uses a single MOSFET and a diode for freewheeling.

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



Smartphones



## Wearables

## Server/Telecom

## Home appliances

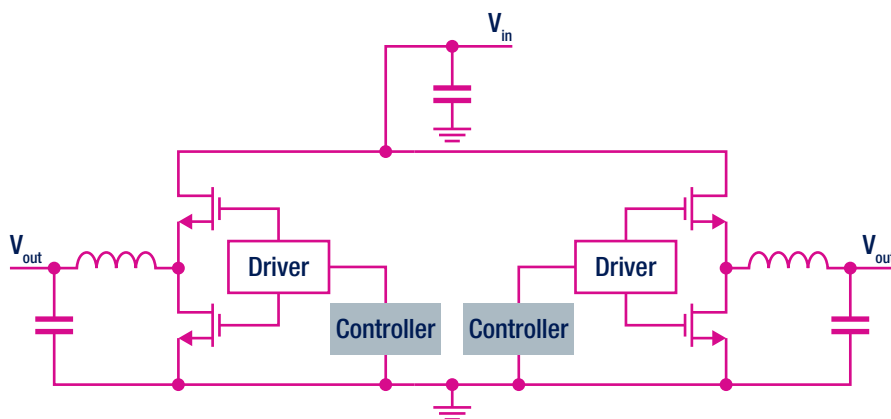
## Factory automation

[www.st.com/dc-dc-switching-converters](http://www.st.com/dc-dc-switching-converters)

## Multi-output regulators

This family of DC-DC regulators is designed to provide advanced power management solutions with specific control techniques to achieve best-in-class efficiency at low load and with a variety of technical solutions to fit all application needs: different number of switching regulators, embedded LDO solutions, different voltage ratings to fit specific applications from 2.7 V up to 15.6 V.

|          | Input Voltage                     | Number of Sw. Buck Regulatros | LDO    | eFuse              | Serial Interface       | Special Functions                                                                |
|----------|-----------------------------------|-------------------------------|--------|--------------------|------------------------|----------------------------------------------------------------------------------|
| STPMIC01 | 2.7 V - 5.5 V                     | 6                             | 0.25 A |                    | I <sup>2</sup> C       | Low quiescent current (35 uA), Automatic PWM ↔ PFM transition                    |
| STPMIC02 | 4.3 V - 5.5 V;<br>10.5 V - 13.2 V | 2                             |        | 5 V & 12 V (3.5 A) | I <sup>2</sup> C       | Temperature monitor and shutdown                                                 |
| STPMIC03 | 5 V - 12 V                        | 2                             | 0.1 A  |                    | I <sup>2</sup> C & SPI |                                                                                  |
| STPMIC06 | 4.5 V - 15.6 V                    | 4                             |        |                    | I <sup>2</sup> C       | 3 Amp current capability (w/ embedded Lowside MOS), interleaving synchronization |
| L7292    | 2.7 V - 5.5 V                     | 5                             |        |                    | I <sup>2</sup> C       | PWM and PFM modes                                                                |



Multi-Output Regulators

## MAIN APPLICATIONS



Server/Telecom



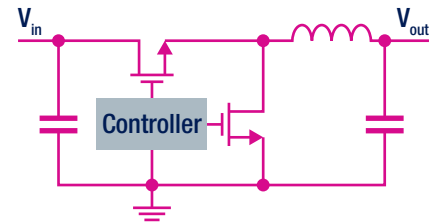
HD and SSD

## 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

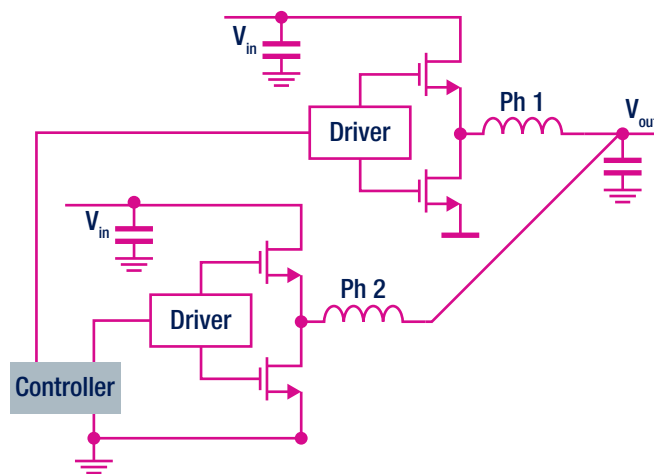
|        |                                                                                         |
|--------|-----------------------------------------------------------------------------------------|
| L672*  | Single- phase cost effective PWM controller                                             |
| L673*  | Single-phase PWM controller with embedded driver and light load efficiency optimization |
| L6997  | Single- phase PWM controller up to 35Vin                                                |
| PM7701 | Advanced single-phase controller with NVM (non-volatile memory) and telemetry           |
| PM6697 | Analog single-phase controller with SVID with embedded gate driver                      |
| 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



Server



Microserver



Telecoms



PC desktop

## DIGITAL POWER CONTROLLERS AND MICROCONTROLLERS

### Digital power controllers

ST 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

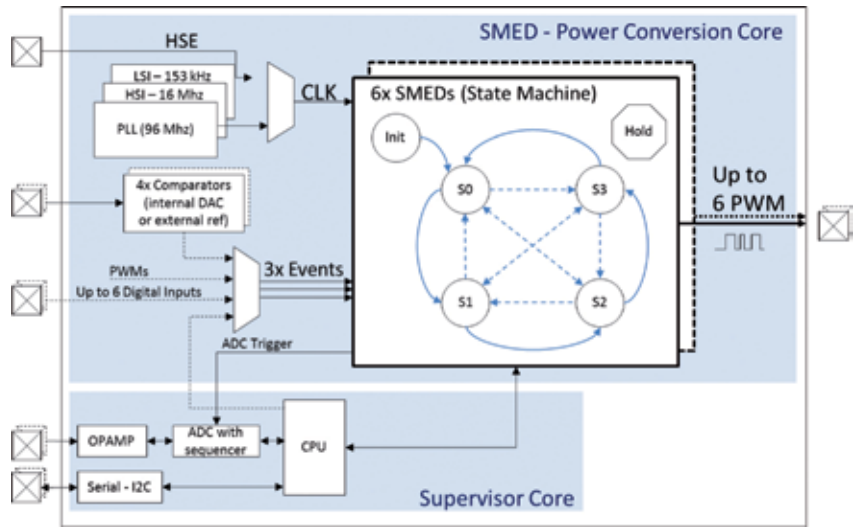
- Innovative digital control technique based on 6 programmable SMEDs with max PWM resolution of 1.3 ns
- Customizable algorithm for higher conversion efficiency
- Internal 96 MHz PLL
- Operating temperature -40 to 105°C
- Serial, I<sup>2</sup>C and GPIO interfaces

#### 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

### Digital controller for interleaved CCM boost PFC

#### STNRGPF01

- Digital controller fully configurable through GUI for fast and easy design, does not require writing any firmware
- Up to 3-channel interleaved boost PFC
- Ideal for wide power range above 1 kW
- Reduced EMI filter and inductor volume
- Reduced output capacitor RMS current
- Flexible working frequency up to 300 kHz to drive both MOSFETs and IGBTs
- Configurable phase shedding for wide load range high efficiency conversion
- Soft start-up to reduce electrical stress and to manage inrush current PFC Soft Power-On
- On-chip UART/I<sup>2</sup>C digital interfaces for convenient connectivity
- Ideal for outdoor applications with -40 to +105 °C operating range

### MAIN APPLICATIONS



Solar  
STNRG\*



UPS  
STNRG\*



HEV charging stations  
STNRG\*



Factory automation  
STNRG\*



Commercial, architectural and street lighting  
STLUX\*

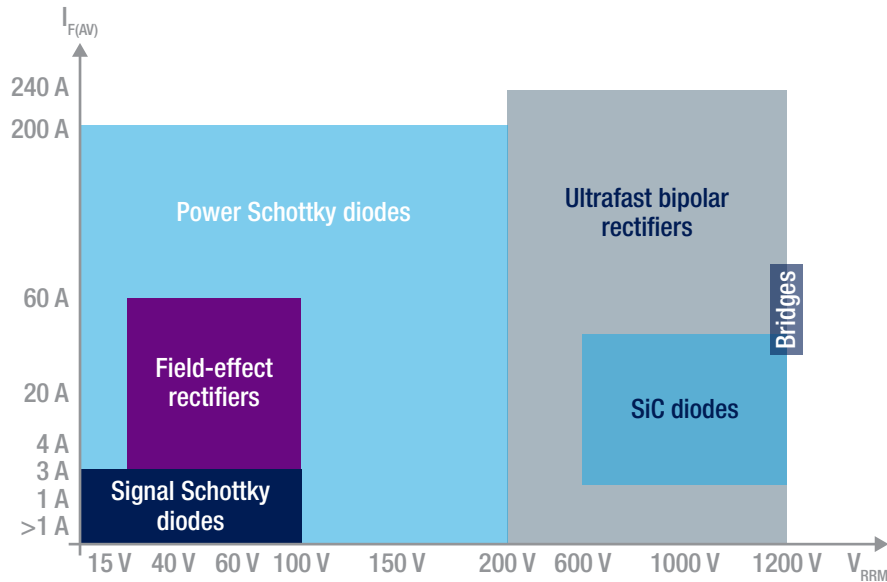


## DIODES AND RECTIFIERS

### 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.



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#### Field-effect rectifiers (FERD)

**FERD\***

Low voltage diodes, for high efficiency and high power density applications

#### Power Schottky diodes

**STPS\***

Power Schottky diodes for low voltage general purpose applications

#### Ultrafast rectifiers

**STTH\***

Ultrafast high voltage diodes for general purpose application

### MAIN APPLICATIONS



Adapters and TVs



Battery chargers



Solar inverters, welding, HEVs, and UPS



Residential, commercial, architectural and street lighting



PC Desktop and Server/Telecoms



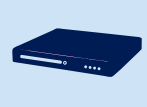
HEV charging stations



Factory automation



Home appliances



Consumer electronics

[www.st.com/schottky](http://www.st.com/schottky)  
[www.st.com/ultrafast-rectifiers](http://www.st.com/ultrafast-rectifiers)  
[www.st.com/field-effect-rectifier-diodes](http://www.st.com/field-effect-rectifier-diodes)

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

## SiC diodes

ST's silicon carbide diodes range from 600 to 1200 V – as single and dual diodes – and feature unbeatable reverse recovery characteristics and improved VF. Available in a wide variety of packages, from D<sup>2</sup>PAK to TO-247 and the insulated TO-220AB/AC, they offer great flexibility to designers looking for efficiency, robustness and fast time-to-market.

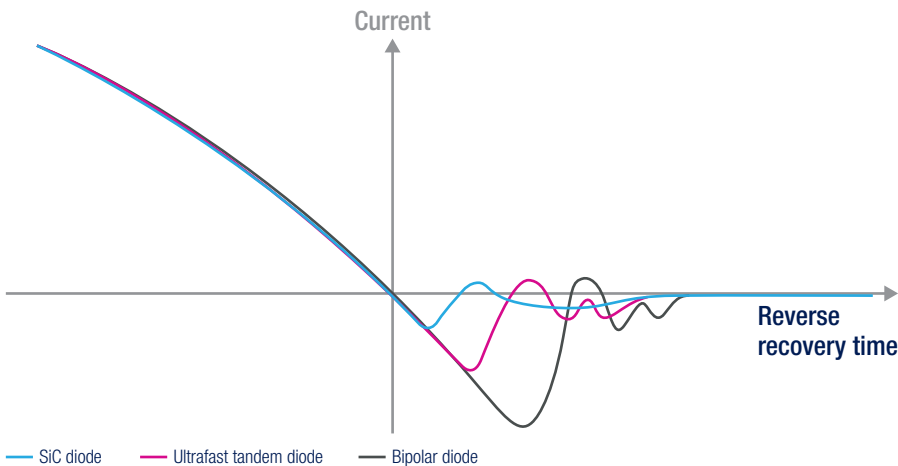
ST's SiC Schottky diodes show a significant power-loss reduction and are commonly used in hard-switching applications such as high-end-server and telecom power supplies, while also intended for solar inverters, motor drives and uninterruptible power supplies (UPS). ST's automotive-grade 650 and 1200 V SiC diodes – AEC-Q101-qualified and PPAP capable – feature the lowest forward voltage drop (VF) on the market, for optimal efficiency in electric vehicle (EV) applications.

Main characteristics:

- High efficiency of the power converter (thanks to low forward conduction and switching losses)
- High power integration with dual diodes for reduced PCB form factor
- Significant reduction of power converter size and cost
- Low EMC impact, for simplified certification and reduced time-to-market
- Natural high robustness ensuring very high reliability

Our range of 1200 V silicon-carbide (SiC) JBS (Junction Barrier Schottky) diodes meet designers' needs for superior efficiency, low weight, small size, and improved thermal characteristics for performance-oriented applications.

Offering the best-in-class forward voltage (lowest VF) and state-of-the-art robustness, our 1200 V SiC diodes provide extra freedom to achieve high efficiency and reliability with lower current rating and therefore lower cost, while reducing operating temperature and extending application lifetime. The 1200 V SiC diode family covers current ratings from 2 to 40 A, including automotive-qualified devices, in surface-mount DPAK HV (high-voltage) and D<sup>2</sup>PAK, or through-hole TO-220AC and TO-247LL (long-lead) packages.



### 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

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

STPSC\*065

STPSC\*13

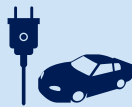
- 650 V (STPSC\*065)
- 2 x 650 V (STPSC\*13) dual in series diodes
- Best trade-off between efficiency and robustness thanks to the high Ifsm
- Ideal for applications with high current surge

### MAIN APPLICATIONS



Solar inverters

STPSC\*065, STPSC\*12



HEV

STPSC\*065



UPS

STPSC\*065, STPSC\*12



Server/Telecoms and PFC

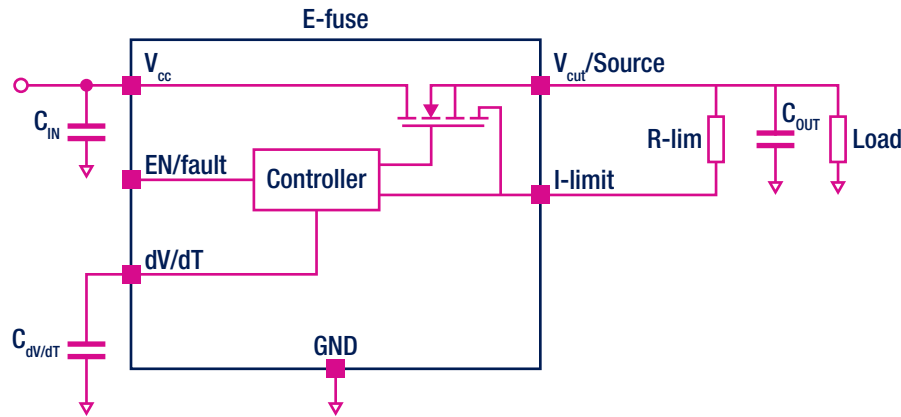
STPSC\*065, STPSC\*12

## 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.

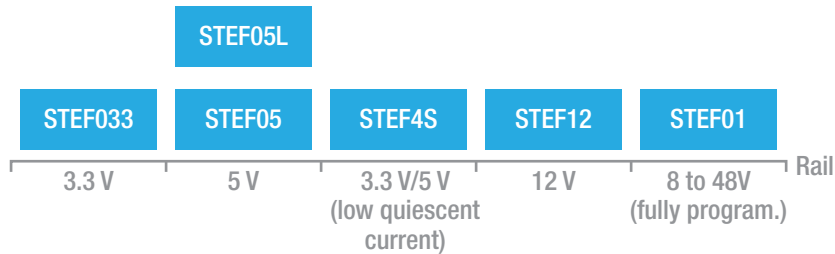
Unlike fuses, they offer complete and flexible management of the fault (overcurrent/overvoltage), without requiring replacement after actuation. They thus help to improve equipment uptime and availability and also reduce maintenance costs and false returns. Compared to traditional protection devices, 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



### MAIN APPLICATIONS



**Home appliances**  
STEF05, STEF01, STEF12



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



**USB connections**  
STEF05, STEF05L



**Factory automation**  
STEF01, 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.

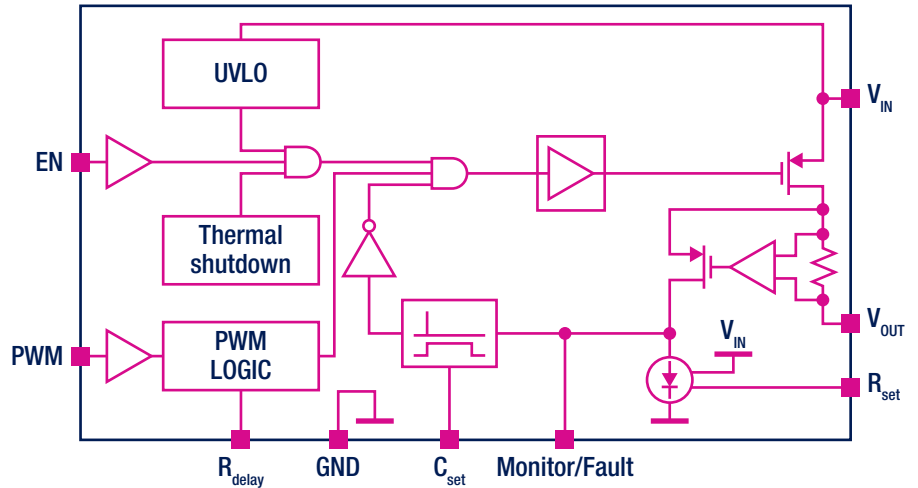
Current limiter ICs are designed to work with an external MOSFET to protect power supplies from anomalous external current demands.

### Power breakers

#### STPW05<sup>1</sup>

#### STPW12<sup>1</sup>

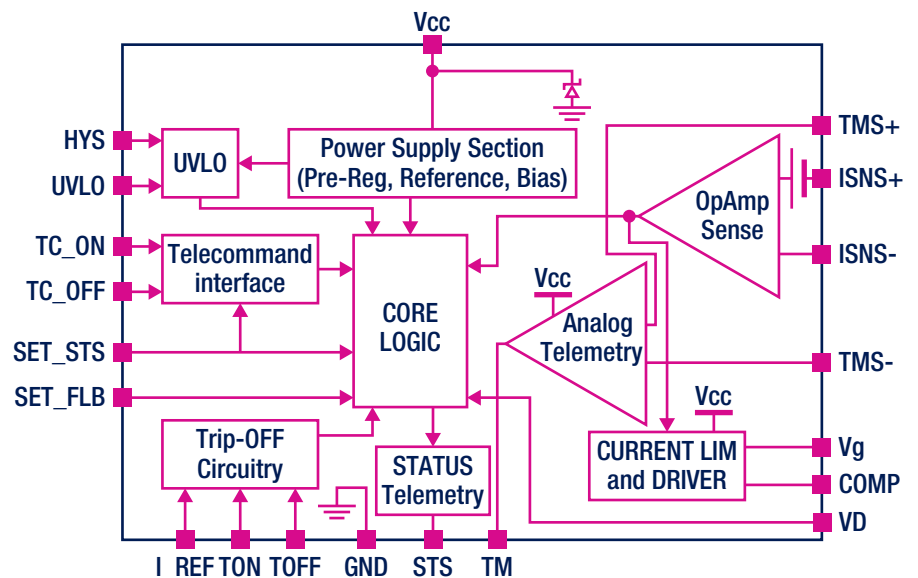
- Auto-retry function with programmable delay
- Adjustable precise power limitation from 11 to 16 W
- 5 V (STPW05) and 12 V (STPW12) rails
- Programmable power limit masking time
- Over-temperature protection
- Integrated N-channel power MOSFET
- Internal undervoltage lockout



### Current limiter IC

#### STFC01

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



## MAIN APPLICATIONS



Home appliances  
STPW05<sup>1</sup>, STPW12<sup>1</sup>



Air conditioning  
STPW05<sup>1</sup>, STPW12<sup>1</sup>



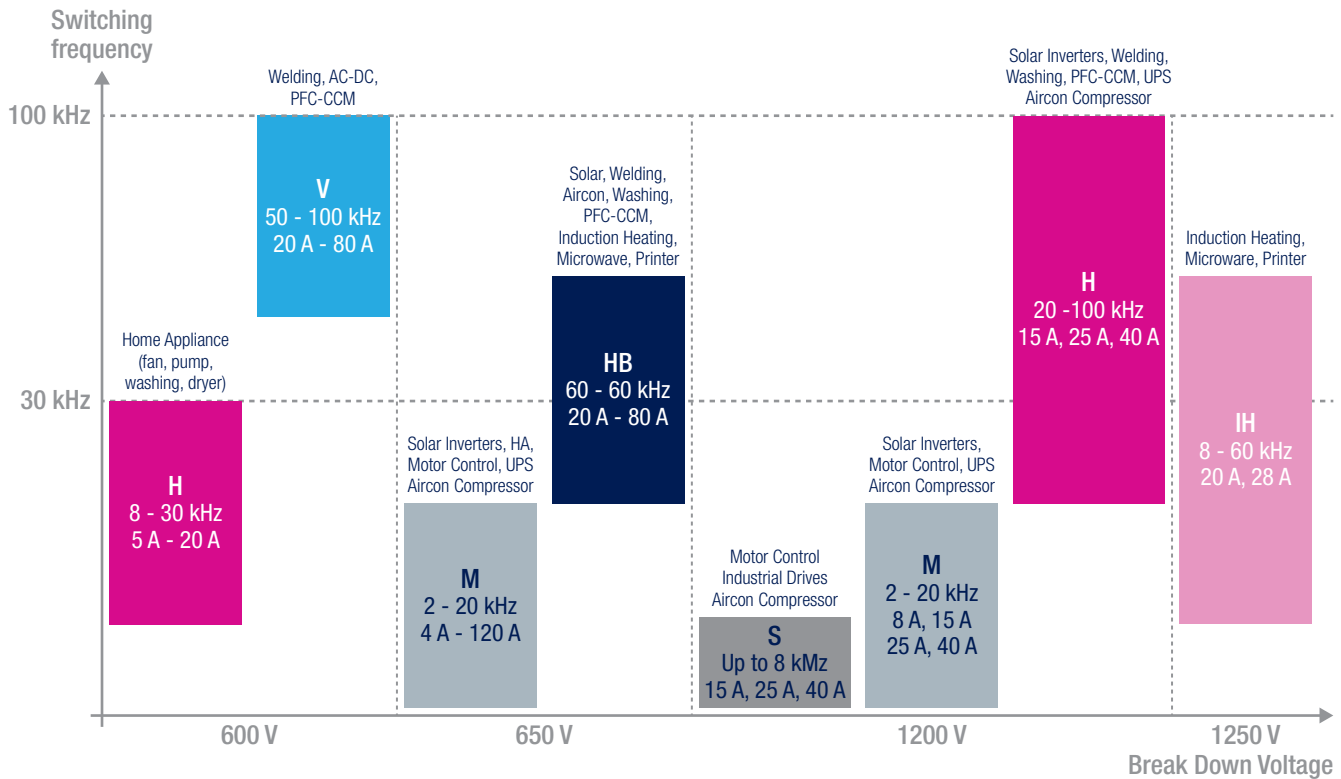
Factory automation  
STPW05<sup>1</sup>, STPW12<sup>1</sup>, STFC01



Server/Telecoms  
STFC01

## IGBTs

ST provides a large portfolio of **IGBTs** with breakdown voltages between 600 and 1350 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\*S120DF3

- 10  $\mu$ s of short-circuit capability @ starting  $T_j = 150$  °C
- Wide safe operating area (SOA)
- Soft and fast recovery antiparallel diode
- Low drop series: very low  $V_{CE(sat)}$
- Suitable for very low frequency application, up to 8 kHz

### M series

#### STG\*M\*

- 650 V family
- 6  $\mu$ s of min short-circuit capability @ starting  $T_j = 150$  °C
  - Wide safe operating area (SOA)
  - From 4 to 120 A as current capability
  - Very soft and fast recovery antiparallel diode
  - Suitable for any inverter system up to 20 kHz
  - AEC-Q101 qualified devices
- 1200 V family
- 10  $\mu$ s of min short-circuit capability @ starting  $T_j = 150$  °C
  - From 8 to 40 A as current capability
  - Freewheeling diode tailored for target application
  - Suitable for any inverter system up to 20 kHz

### IH series

#### STG\*IH\*

- 650 V family
- Very low  $V_{CE(sat)}$ : 1.4 V @  $I_{CN}$
  - Very low  $E_{off}$
  - Low drop forward voltage diode
  - Designed for soft commutation application only
  - Mass production in Q1 2018
- 1250 V family
- Minimized tail current
  - Very low drop freewheeling diode
  - Tailored for single-switch topology
- 1350 V family
- Enhanced efficiency
  - Very high robustness
  - Mass production in Q1 2018

## HB series

### STG\*H\*B

- Very low saturation voltage
- Minimal tail current turn-off
- Optimum trade-off between conduction and switching losses
- Very low thermal resistance
- 4 leads package available
- Very high robustness in final application

## H series

### STG\*H\*

600 V family

- 3  $\mu$ s of short-circuit capability
- Low saturation voltage
- Minimal collector turn-off
- Series optimized for home appliance applications

1200 V family

- 5  $\mu$ s of short-circuit capability @ starting  $T_j = 150^\circ\text{C}$
- Low turn-off losses
- Up to 100 kHz as switching frequency

## V series

### STG\*V60\*F

- High  $f_{\text{sw}}$  series
- Tail less switching off
- Very low turn-off switching losses
- Soft and very fast recovery antiparallel diode
- Up to 100 kHz in hard switching topologies

## MAIN APPLICATIONS



Welding  
HB, V



Solar



UPS



Home appliances



Air conditioning



Motor control



Induction heating



## Intelligent power module - SLLIMM™

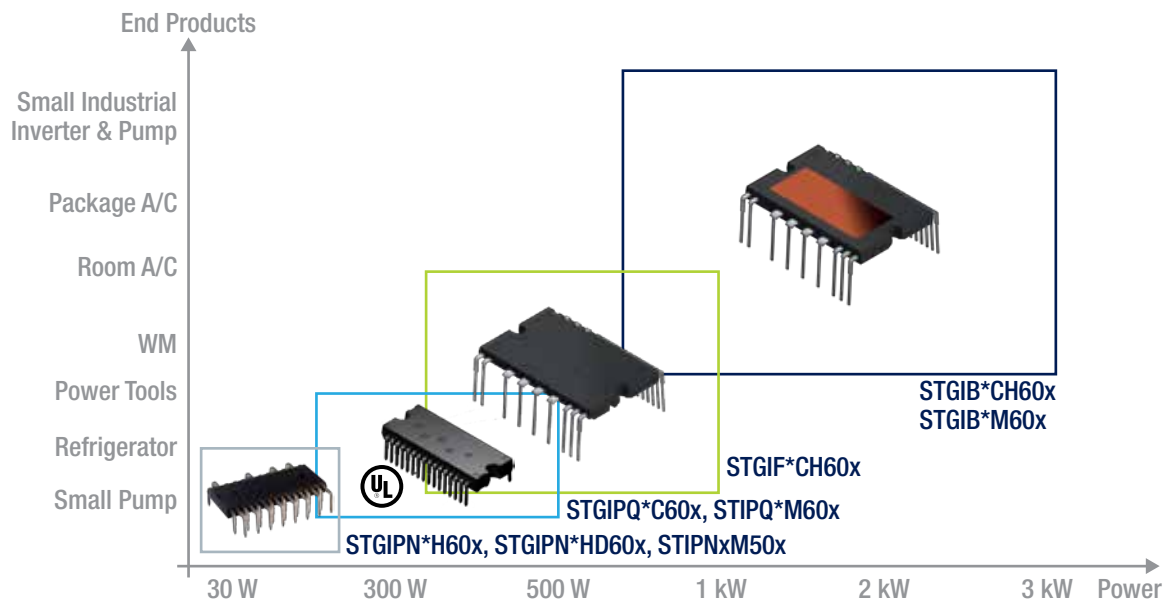
The SLLIMM, small low-loss intelligent molded module, is the new ST's family of compact, high efficiency, dualin-line intelligent power modules (IPM), with optional extra features. This family includes both nano and big package solutions IGBT, MOSFET and Super Junction Mosfet based. The best compromise between conduction and switching energy with an outstanding robustness and EMI behavior making the new products ideal to enhance the efficiency of compressor, pumps, fans and any motor drives working up to 20 kHz in hardswitching circuitries and for an application power range from 25 W to 3 kW.

### KEY FEATURES

- 600 V, IGBT based from 3 A to 35 A DC rating at 25 °C
- 600 V, Super Junction MOSFET based from 3 A to 5 A DC rating at 25 °C
- 500 V, MOSFET based from 0.5 A to 2 A DC rating at 25 °C
- Low VCE(sat), Low Rds(on)
- Optimize driver and silicon for low EMI
- Lowest Rth value on the market for the DBC package versions
- Internal bootstrap diode
- 175 °C of maximum operating junction temperature
- Separate open emitter outputs
- NTC on board
- Integrated temperature sensor
- Comparator for fault protection
- Shutdown input/fault output
- Isolation rating of 1500 Vrms/min

### KEY BENEFITS

- Easy to drive through microcontroller
- Higher robustness and reliability
- Plug'n Play solution



### MAIN APPLICATIONS



Fan



Fridge



Washing Machine



Air conditioning

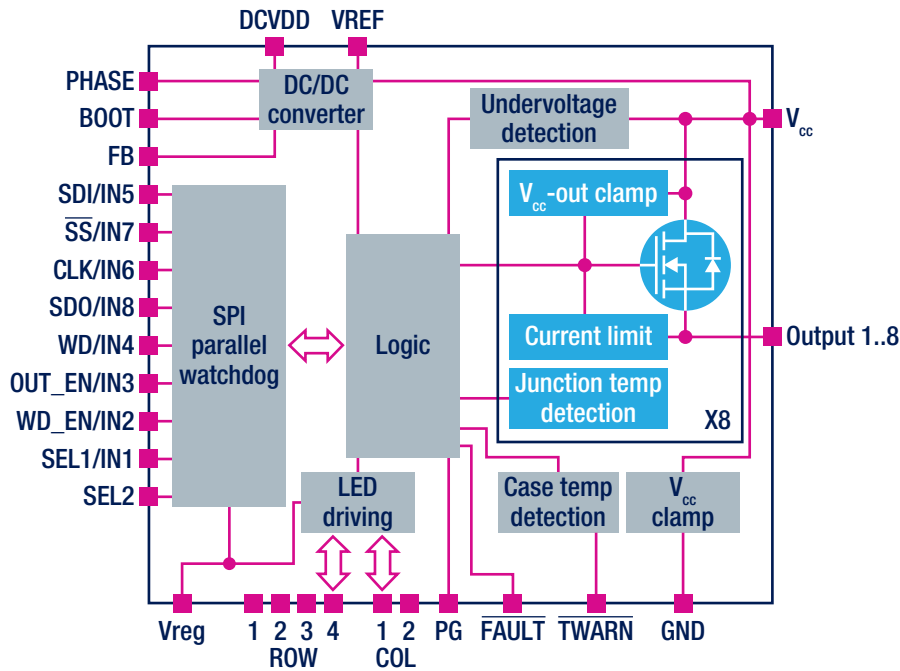


Motor control

## 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

IS08200\*, the galvanic isolated IPS ideal for factory automation



## MAIN APPLICATIONS



## 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). HVLED001A controller is also available for high power needs working in 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

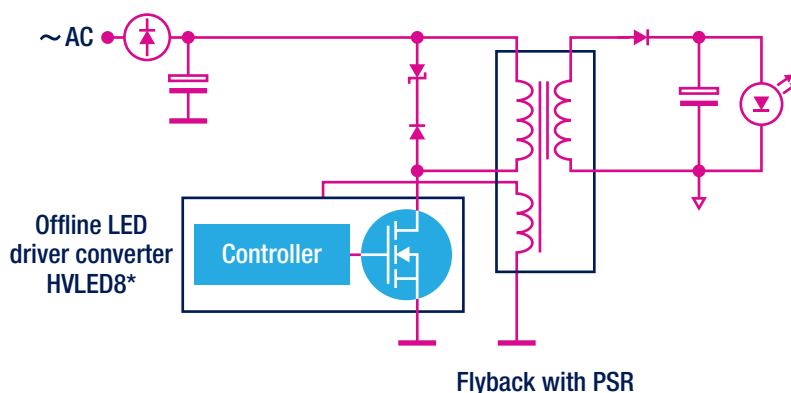
|            | HPF | PSR-CC | PSR-CV | $P_{outMax}^1$ | Internal power MOSFET | Flyback | Buck-boost |
|------------|-----|--------|--------|----------------|-----------------------|---------|------------|
| HVLED805   |     | ●      | ●      | 8 W            | 800 V <sub>BR</sub>   | ●       | ●          |
| HVLED807PF | ●   | ●      | ●      | 10 W           | 800 V <sub>BR</sub>   | ●       | ●          |
| HVLED815PF | ●   | ●      | ●      | 15 W           | 800 V <sub>BR</sub>   | ●       | ●          |

### Offline LED controllers with PSR

|           | HPF | PSR-CC | PSR-CV | Dimming | Flyback |
|-----------|-----|--------|--------|---------|---------|
| HVLED001A | ●   |        | ●      | ●       | ●       |

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### Topology example



## MAIN APPLICATIONS



**Residential lighting**  
HVLED807PF, HVLED815PF



**Commercial and street lighting**  
HVLED001A

## 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.

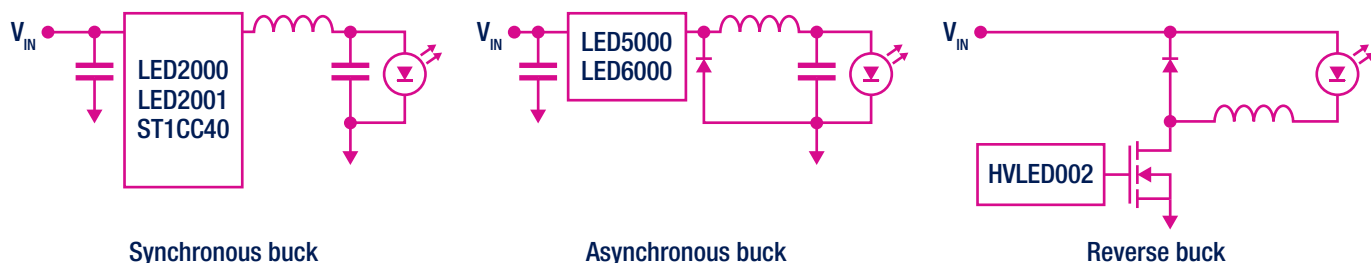
### DC-DC LED drivers converters

|         | 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        |
| STLDC08  |              |            | ●             | ●       | 3.6 V       |

### Topology examples



## MAIN APPLICATIONS



**Halogen bulbs replacements and home appliances**  
LED5000, LED6000



**Traffic signals**  
LED2000, LED2001, ST1CC40, LED5000, LED6000



**Street lighting**  
LED5000, LED6000, HVLED002



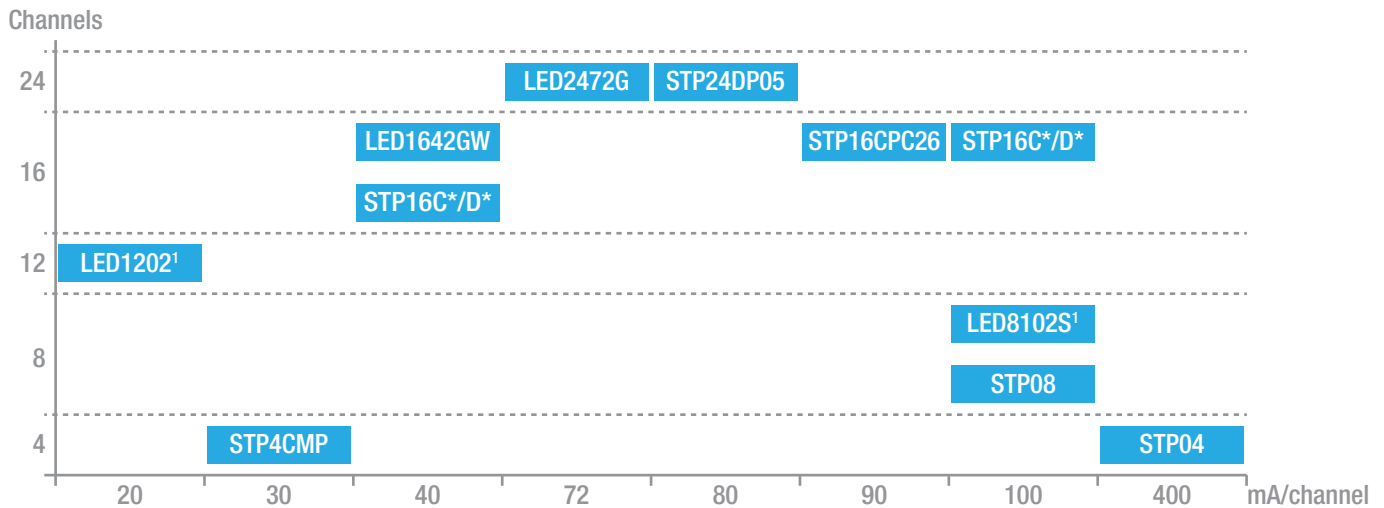
**Emergency lighting**  
LED6001, ST1CC40



**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.



### 24 channel RGB (8x3) drivers

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

### 12/16 channel drivers

- Current gain control (LED1642GW), constant current (STP16C\*/D\*)
- Error detection (STP16C\*/D\*)
- Dot correction (LED1202)
- Autopower saving
- Local dimming (LED1642GW, LED1202), global dimming (STP16C\*/D\*)

### 4/8 channel drivers

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

## MAIN APPLICATIONS



### Traffic signals

LED8102S, LED2472G, STP24DP05, STP04



### Large panel signs

LED1642GW, LED2472G, STP24DP05, STP16, STP08



### Home appliances

LED8102S, STP16, STP08, LED1642GW, STP4CMP



### Special lighting

STP04, LED1642GW, LED2472G, LED8102S



wearable/  
High End consumer  
LED1202

## LED row drivers

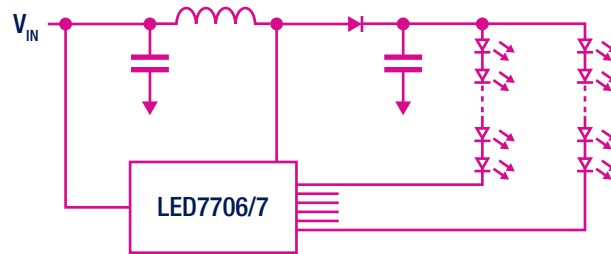
LED row drivers are essentially boost regulators that provide the necessary high voltages to drive multiple LEDs in series, guaranteeing accurate LED current matching.

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

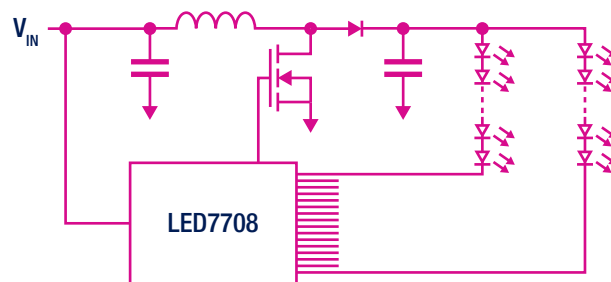
|        |         |                           |
|--------|---------|---------------------------|
| 6 rows | LED7707 | • 85 mA/row               |
|        | LED7706 | • 30 mA/row               |
| 5 rows | STLED25 | • 25 mA/row               |
| 4 rows | STLD41  | • 30 mA/row               |
|        | STLA02* | • 20 mA/row               |
| 1 row  | STLD40D | • 0.5 A/1.5 A/<br>2 A/row |
|        | STCS*   |                           |

Global dimming



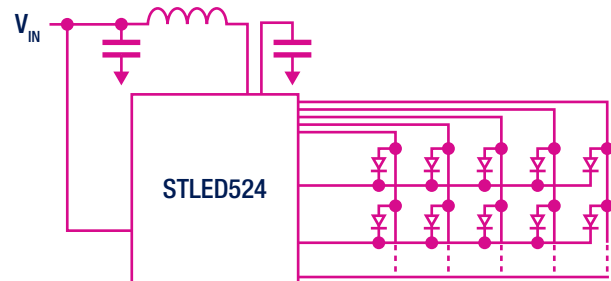
### LED row driver controllers

|         |         |                                                     |
|---------|---------|-----------------------------------------------------|
| 16 rows | LED7708 | • 85 mA/row<br>• Grouped or independent row dimming |
|---------|---------|-----------------------------------------------------|



### LED matrix driver

|               |          |                                                          |
|---------------|----------|----------------------------------------------------------|
| 5 x 24 matrix | STLED524 | • 20 mA/dot<br>• 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, STCS\*

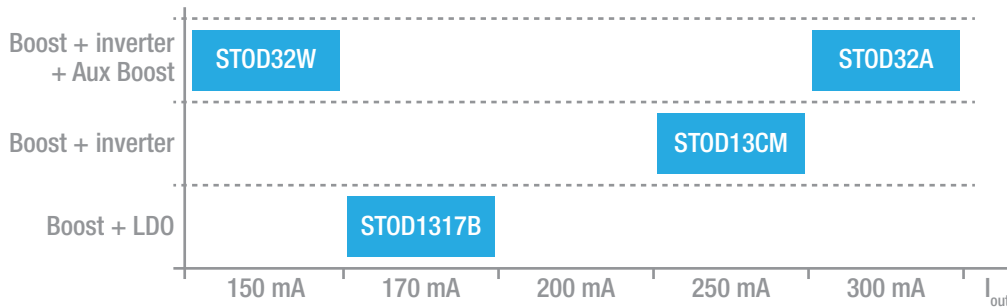


Wearables  
STLED524

## 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")

STOD13CM

- High efficiency in overall output range
- Wide output negative range
- External feedback output sense

### 3 channel drivers (for displays up to 6")

STOD32A, STOD32W

- Programmable auxiliary boost for driver ICs
- 100 mA output load in flipchip (STOD32W)
- Wide output negative range (STOD32A)

## MAIN APPLICATIONS



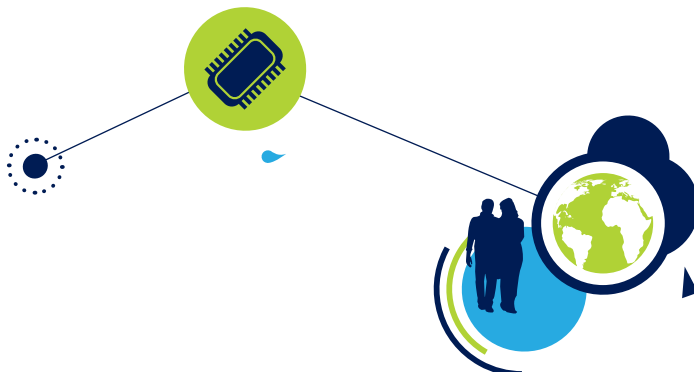
**Fitness and wearables**  
STOD32W, STOD1317B



**Low-end smartphones**  
STOD1317B, STOD13CM

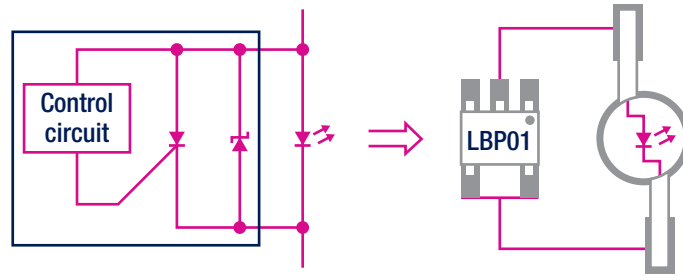


**High-end smartphones**  
STOD32A



## LED bypass protection

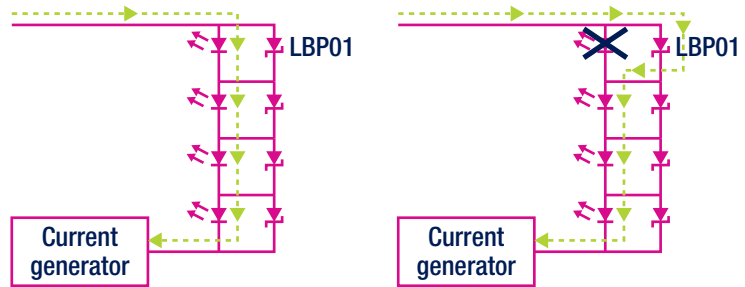
The **LBP01 series** of LED bypass protection devices are bypass switches that can be connected in parallel with 1 or 2 LEDs. In the event of a LED failure, this device shunts the current through other LEDs. It also provides overvoltage protection against surges as defined in IEC 61000-4-2 and IEC 61000-4-5



### 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

## 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 0.3 to 20  $\mu$ A 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  $\mu$ Vrms). 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 | Low Iq | Low noise, high PSRR |
|---------|---------|-----------|-------------------|--------|----------------------|
| STLQ015 | LDK120  | LD39015   | ●                 | ●      | ●                    |
| STLQ50  | LDK130  | LD39015J  | ●                 | ●      | ●                    |
| ST715   | LDK220  | LD39020   | ●                 | ●      | ●                    |
| ST1L08  | LDK320  | LD39030SJ | ●                 | ●      | ●                    |
| LDS3985 | LDK715  | LD39050   | ●                 | ●      | ●                    |
| LDBL20  | LDCL015 | LD39100   | ●                 | ●      | ●                    |
| LDFM    | LDLN015 | LD39115J  | ●                 | ●      | ●                    |
| LDF     | LDL112  | LD39130S  | ●                 | ●      | ●                    |
| STLQ020 | LDL212  | LD39200   | ●                 | ●      | ●                    |
| LDLN025 | LD59015 | LD3985    | ●                 | ●      | ●                    |

### Ultra-low dropout

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

### Low quiescent current Iq

- Extending battery life
- Suitable for space-constrained battery-powered applications

### Low noise, high PSRR

- High signal fidelity
- Reduced size of external filter components

## MAIN APPLICATIONS



### Tablets, smartphones, and digital camera

LD39115, LD39130, LD39020/30,  
ST1L08, LDBL20, LD59015, LDLN025,  
STLQ020



### Healthcare

STLQ015, STLQ020,  
ST715, LD39130



### Fitness and wearables

LD39130, LDLN015,  
LDLN025, LD39115,  
LD39020, LD39030,  
LDBL20, STLQ020

## 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

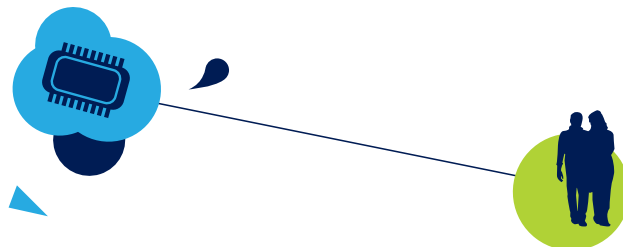
#### Main common features

- Complete interface between LNB and I<sup>2</sup>C 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

## MAIN APPLICATIONS

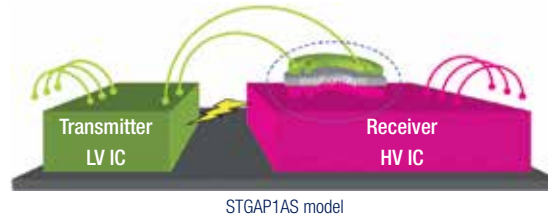


Set-top boxes and PC card satellite receiver



## 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 STGAP1AS offer smart functionalities to protect and simplify application implementation and usage.

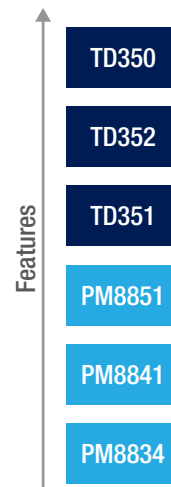


Robustness and reliability, system integration and flexibility: that's ST's gate driver offer you



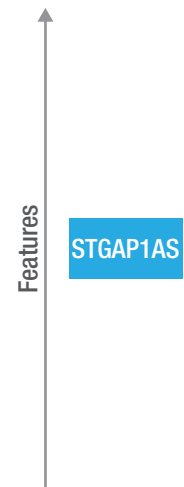
### 600 V Half bridge gate drivers

- 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



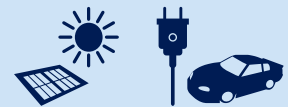
**Factory automation, home appliances, and motor control**

L638\*E, TD35\*, L639\*, L6491, L6494L<sup>1</sup>, L6498/L<sup>1</sup>, PM8841, PM8851



**Commercial, architectural and street lighting**

PM8834, PM8841, PM8851



**Solar inverters, HEV / EV, and factory automation**  
STGAP1AS, PM8841, PM8851

## PHOTOVOLTAIC ICs

### DC-DC converters with embedded MPPT algorithm

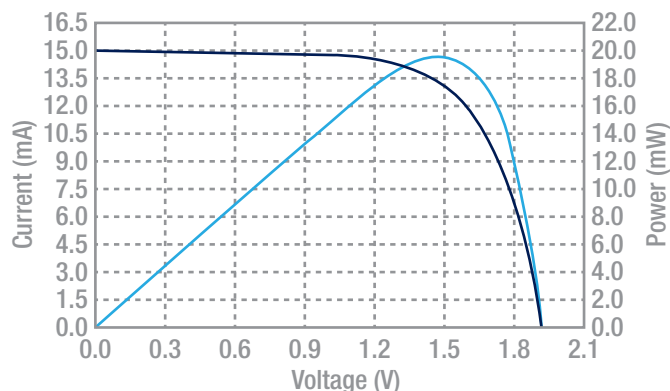
The maximum power point tracking (MPPT) algorithm maximizes the power output by photovoltaic panels according to temperature and solar irradiation conditions.

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.

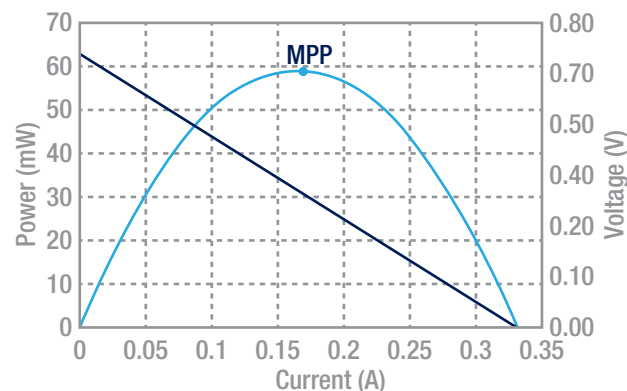
The SPV1050 is an ultra-low-power battery charger and energy harvester (from photovoltaic cells or a thermo-electric generators) that guarantees a very fast charge of supercapacitors and any type of battery including thin-film solid-state batteries. It is specifically designed to work in indoor environments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

|                                                                                                           | Output Power Capability | Harvesting Source | Target Battery                              | Topology                      | Other Features                                                                         |
|-----------------------------------------------------------------------------------------------------------|-------------------------|-------------------|---------------------------------------------|-------------------------------|----------------------------------------------------------------------------------------|
| <b>SPV1040</b><br>Outdoor solar battery charger with embedded MPPT                                        | 400 mW to 3 W           | PV                | Any type*                                   | Sync Boost                    | Over-current and Over-temperature protection, input reverse polarity protection        |
| <b>SPV1050</b><br>Indoor ultra-low-power energy harvester and battery charger with embedded MPPT and LDOs | < 400 mW                | PV and TEG        | Any type (including supercap and EFL700A39) | Sync Boost<br>Sync Buck-Boost | Over-voltage and under-voltage battery protection, n. 2 embedded LDOs (1.8 V and 3.3V) |

Solar curves



Thermo-electric generator (TEG)



### MAIN APPLICATIONS



Smartphones, digital cameras, and camcorders  
SPV1040

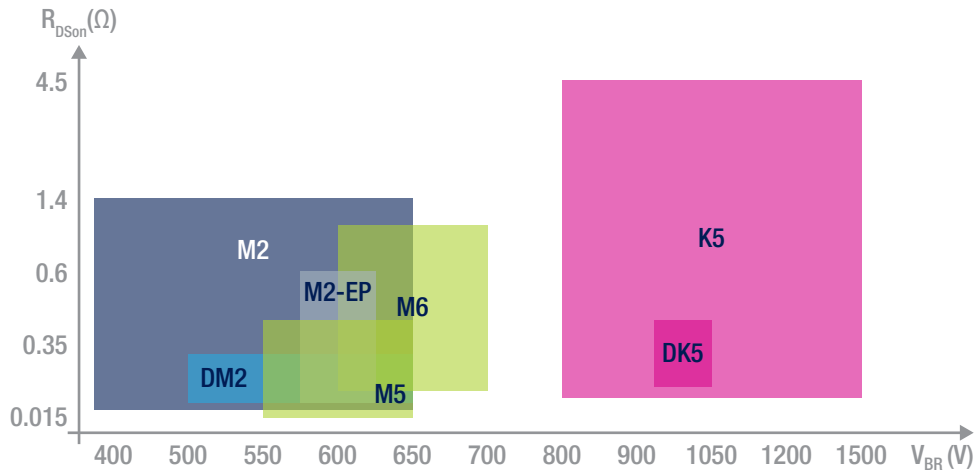


Fitness, climate, home and factory automation monitoring  
SPV1050

## 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 Qg 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 & DM6 series

##### ST\*N\*DM2

##### ST\*N\*DM6

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

#### DK5 Series

##### ST\*N\*DK5

- Lowest trr @ Very High Voltage BVDSS
- High dV/dt capability
- Targeting high power 3-phases industrial equipment

#### M6 series

##### ST\*N\*M6

- Lower  $R_{DS(on)}$  x area vs previous generation
- Extremely low gate charge ( $Q_g$ )
- Optimized capacitances profile for better efficiency @ light load
- Optimized threshold voltage ( $V_{TH}$ ) and gate resistance ( $R_G$ ) values for soft switching

## MAIN APPLICATIONS



#### Adapters

K5, M5, M2, M2-EP, M6



#### Solar inverters, welding, HEVs, and UPS

K5, M5, DM2, DM6, DK5



#### Residential, commercial, architectural and street lighting

K5, DK5



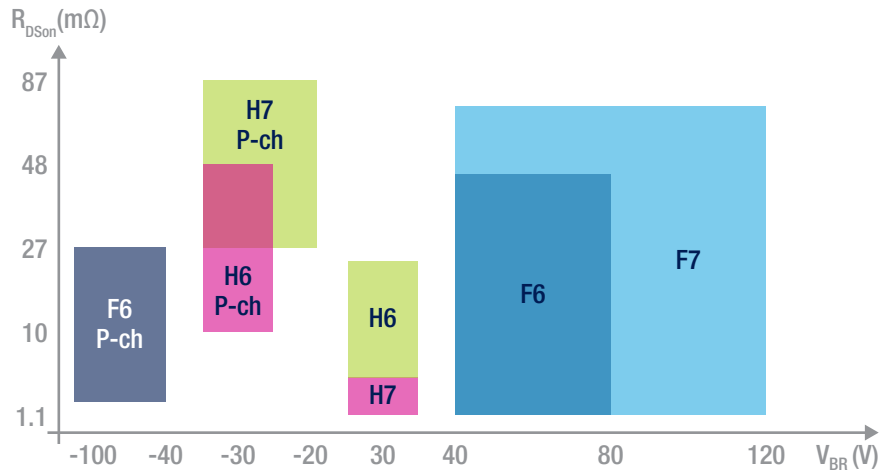
#### Server/Telecoms

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, D<sup>2</sup>PAK, SOT-223, TO-220, TO-220FP, TO-247, PowerFLAT (5 x 6)/(3.3 x 3.3)/(2 x 2), 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



Server/Telecoms  
and SMPS  
H7, F7



UPS, e-bikes,  
and fans  
F6, F7

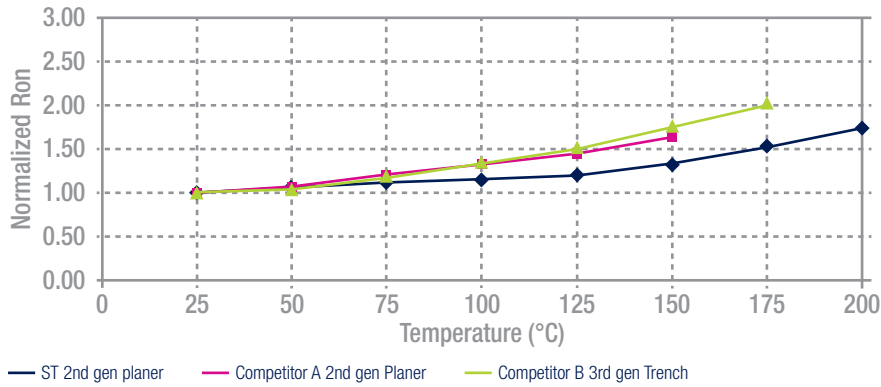


Solar inverters,  
forklifts, and EHVs  
F7

## SiC MOSFETs

Based on the advanced and innovative properties of wide bandgap materials, ST's silicon carbide (SiC) MOSFETs feature very low  $R_{DS(on)}$  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.

### Normalized $R_{DS(on)}$ vs. temperature



### 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\*N65G2V<sup>1</sup>

- $V_{BR} = 1200$  V (SCT\*N120), 650 V (SCT\*N65G2V)
- 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<sup>1</sup>)

### MAIN EVALUATION BOARD

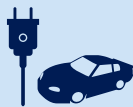


4 kW  
Boost inverter evaluation board  
Available on request

### MAIN APPLICATIONS



Motor control



HEVs / EVs



Welding



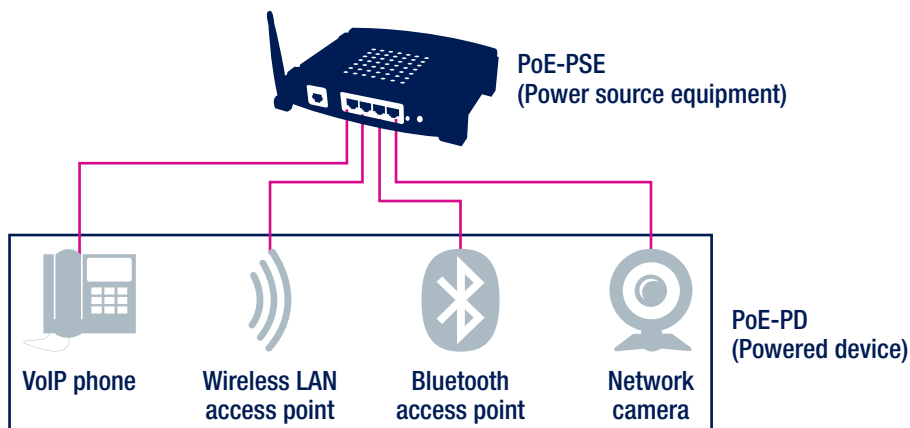
UPS



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

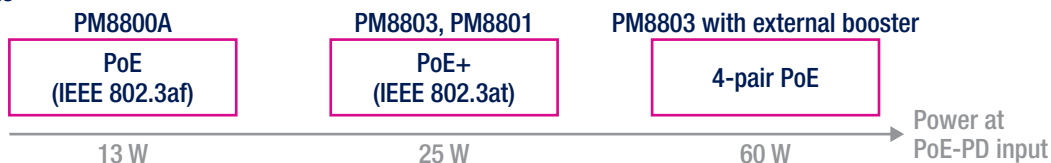
#### PM8801

- 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



### Power over Ethernet power supply protection

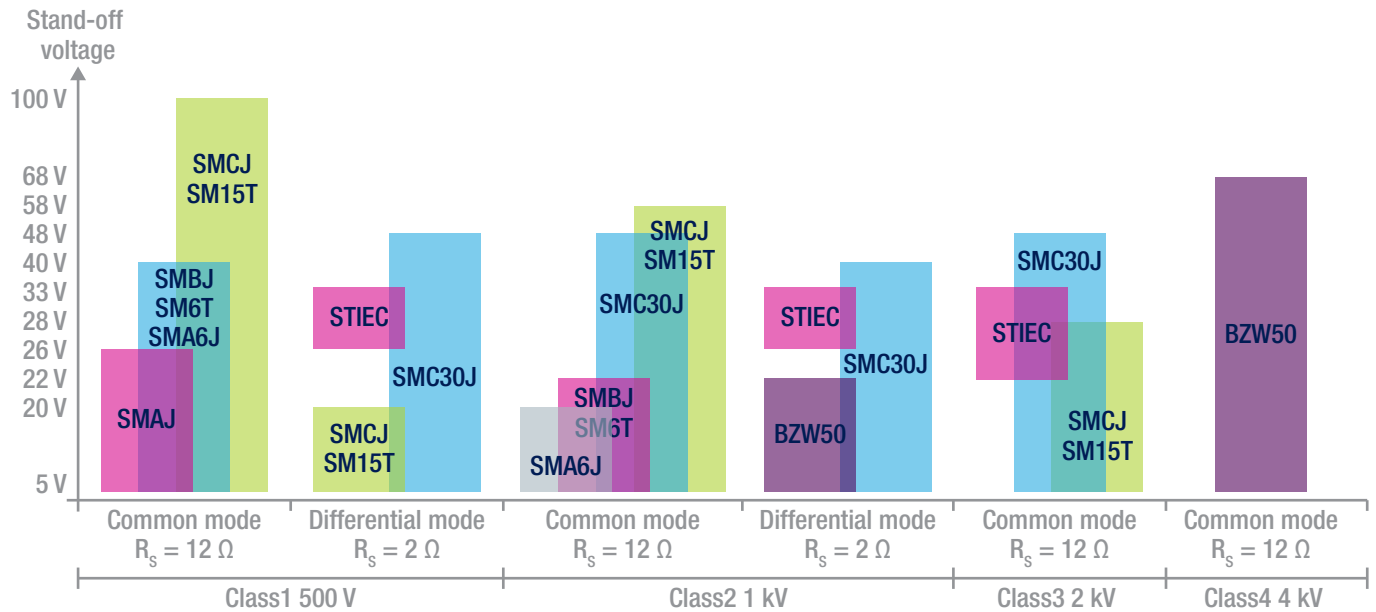
#### PEP01-5841

- Power supply protection compliant with IEC61000-4-5 Level 2 : 1 kV
- Allow to use 100 V power MOSFET
- Stand off voltage: 58 V
- Surface mount SO-8 package

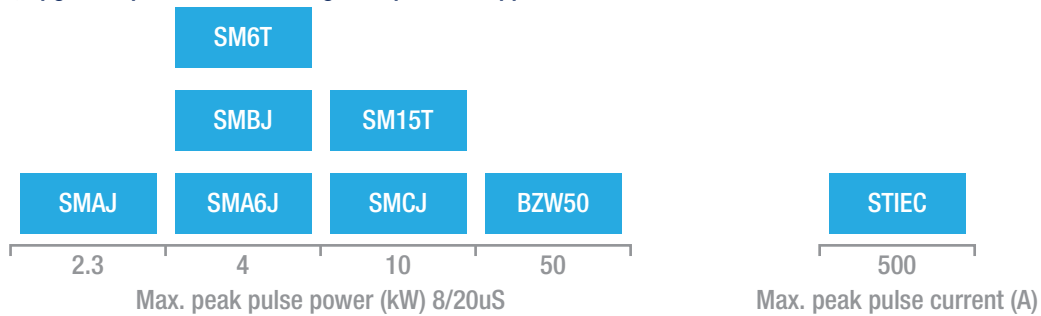
## PROTECTION DEVICES

### EOS 8/20 $\mu$ s surge protection

ST's 8/20  $\mu$ s surge protection comply with IEC 61000-4-5 for power supply lines or datalines. A large choice of package is available to meet application requirements



### EOS protections, upgraded performance for high temperature applications



## MAIN APPLICATIONS



Offline and DC-DC power supplies, PFC



Solar inverters



Smart metering

## ESD protection

Driven by market needs, ST's ESD protection devices are available as single line devices for flexibility and multi-line arrays for integration in compact application. All this devices are rated according to IEC 61000-4-2 and specific requirements, such as low capacitance, bandwidth for high speed lines.

A large choice of package is available to meet application requirements.

|                | Extra low capacitance<br>( $\leq 0.5$ pF) | Ultra low capacitance<br>( $\leq 3$ pF) | Low capacitance<br>( $\leq 30$ pF) | Standard capacitance<br>( $\leq 300$ pF) |
|----------------|-------------------------------------------|-----------------------------------------|------------------------------------|------------------------------------------|
| $\geq 5$ lines | HSP                                       | HSP*                                    | ESDALC* - DALC*                    | ESDA6V1* - ESDA*SC* - ESDA25*            |
| 4 lines        | HSP*                                      | DVIULC* - HDMIULC*                      |                                    | ESDA14V2* - DA1*S1                       |
| 3 lines        |                                           | ESDAULC*                                |                                    | USB6*                                    |
| 2 lines        |                                           | HSP* - USB*LC*                          | ESDALC*                            | ESDAL                                    |
| Single line    | ESDAXLC* - ESDARF*                        |                                         |                                    | ESDA-1K - ESDA8V2                        |

## Power delivery Protections

Ultimate TVS protection for USB fast-charging ports

### ESDAXxP

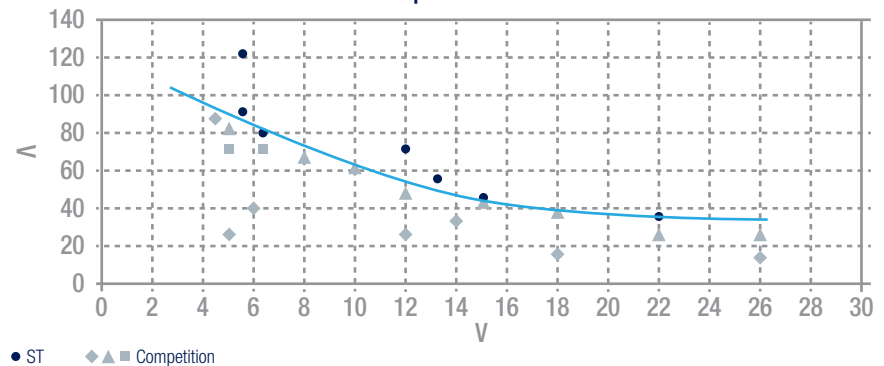
Strong and thin protection, the ESDAXxP-1U1M series helps to stop damages due to the surge events

### KEY FEATURES & BENEFITS

- Complete voltage range 5 V, 9 V, 12 V, 15 V and 20 V.
- A unique small and thin package for all the voltages (1.0 mm x 1.6 mm x 0.55 mm) minimizing the PCB area consumption.
- Highest housed 8/20 $\mu$ s IPP in the market, from 35 A to 120 A.

## Peak pulse current performances

### IPP 8/20 $\mu$ s versus VRM



|                                       | ESDA7P60-1U1M | ESDA7P120-1U1M | ESDA13P70-1U1M | ESDA15P60-1U1M | ESDA17P50-1U1M | ESDA17P100-1U2M | ESDA25P35-1U1M |
|---------------------------------------|---------------|----------------|----------------|----------------|----------------|-----------------|----------------|
| Stand-off voltage ( $V_{RM}$ )        | 5.5 V         | 5.5 V          | 12 V           | 13.2 V         | 15 V           | 15 V            | 22 V           |
| Peak pulse current (IPP 8/20 $\mu$ s) | 60 A          | 120 A          | 70 A           | 60 A           | 50 A           | 160 A           | 35 A           |

## MAIN APPLICATIONS



Tablets, smartphones, and digital cameras



Healthcare



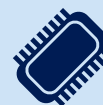
I/O microcontrollers and signal conditioning



Factory automation  
Human machine interface (HMI)



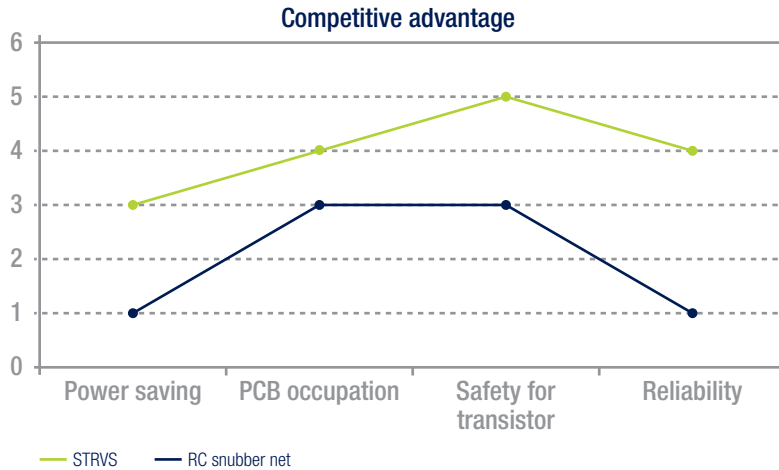
Smart metering



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.



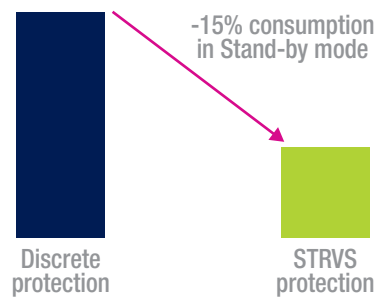
### STRVS MAIN BENEFITS

- 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

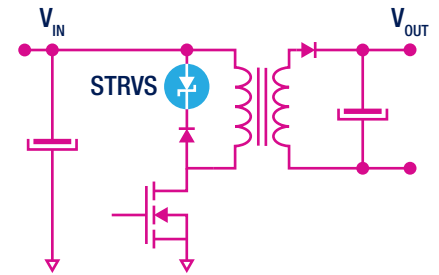
## STRVS, the Transil series dedicated against repetitive overvoltage in high temperature conditions

### 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



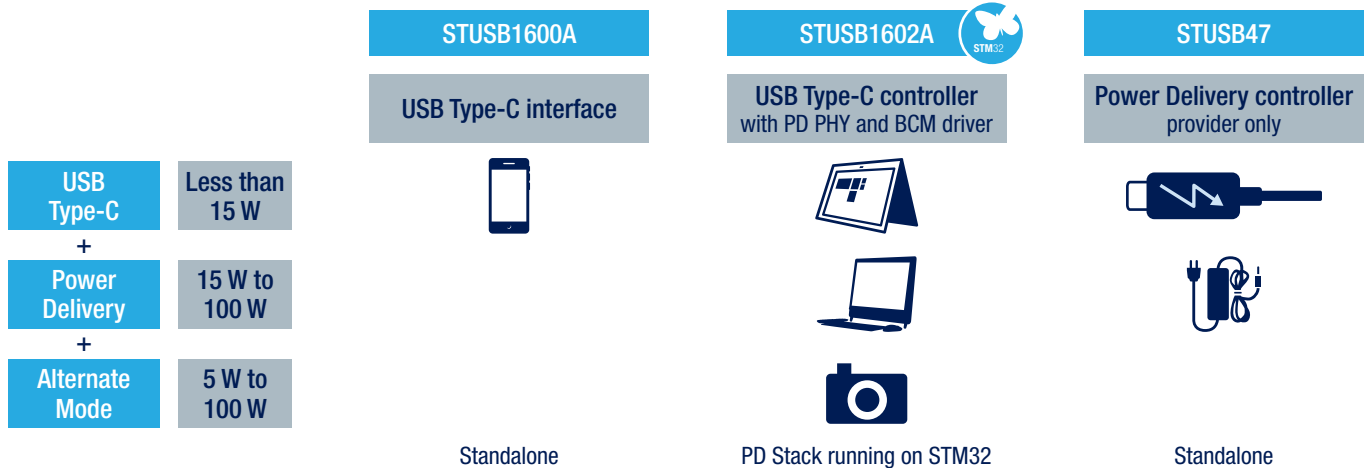
Residential, commercial, architectural and street lighting

## USB TYPE-C AND POWER DELIVERY CONTROLLERS

With an extensive technology and IPs portfolio, ST can provide a range of solutions for USB type-C and Power Delivery to support implementations in a variety of devices.

Manufactured using ST's 20 V process technology, the certified STUSB Family controller IC integrates short-circuit, over-voltage, over-current protection to eliminate the need for external circuitry. Additionally, it offers plug power support ( $V_{CONN}$ ) with up to 600 mA programmable current capability and, per the USB Power Delivery specification, it integrates Bi-Phase Mark Coded (BMC) Physical Layer (PHY) coding and decoding logic. Integration of such features in a single-chip Type-C™ controller enables fast migration to USB Type-C™, while minimizing MCU-resource requirements compared to alternate solutions.

STUSB Family cover all the applications with optimized partitioning from USB Type-C™ Interface for 15 W device to Power delivery PHY and BMC Driver ICs companion chip of STM32 based solution to standalone Full Hardware USB PD Controller optimized for AC adapters.



### USB Type-C™ Interface

#### STUSB1600A

- Roles: Source/Sink/Dual Role Power
- Configurable start-up profiles (embedded FTP memory)
- Integrated VCONN switch
- Adjustable current limit (600 mA max)
- OVP, OCP, UVP, short protection
- Direct interface to MCU thru I<sup>2</sup>C + IRQ
- Dead battery support
- Dual power supply:
  - VBUS = (4.6 V - 22 V) - AMR = 28 V
  - VSYS = (3.0 V; 5.5 V)

### Power delivery PHY and BMC Driver IC companion chip of STM32 based solution

#### STUSB1602A

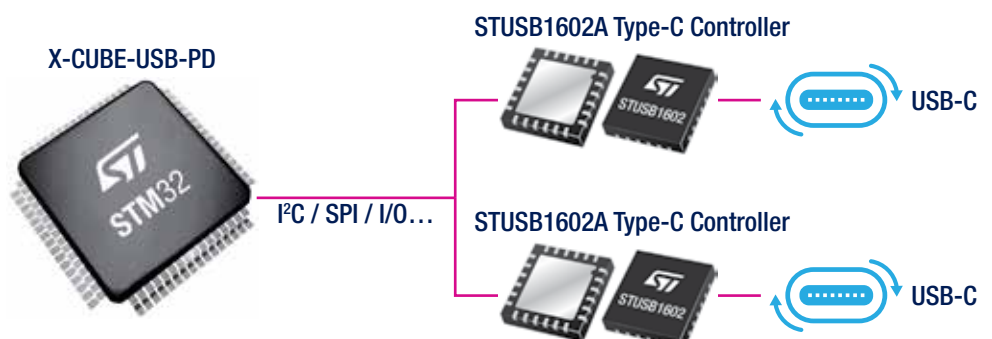
- Roles: Source/Sink/Dual Role Power
- Configurable start-up profiles (embedded FTP memory)
- Integrated VCONN switch
- Adjustable current limit (600 mA max)
- OVP, OCP, UVP, short protection
- I<sup>2</sup>C, SPI+ IRQ MCU interface – Dual I<sup>2</sup>C address support
- Integrated Voltage monitoring
- Integrated VBUS discharge path
- Accessory & dead battery support
- Dual power supply:
  - VBUS = (4.6 V - 22 V) - AMR = 28 V
  - VSYS = (3.0 V; 5.5 V)

### Full hardware USB PD controller optimized for AC adapters

#### STUSB47

- Role: Source
- Support all USB PD profiles
- Configurable start-up profiles (embedded FTP memory)
- Dedicated Voltage & Current control Interface
- Integrated Voltage monitoring
- Integrated VBUS discharge path
- Auto-run support
- Nominal power supply
- VBUS = (4.6 V - 22 V)
- AMR = 28 V

STM32 as system/device policy manager running USB Power Delivery stack and application specific layers



# life.augmented



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