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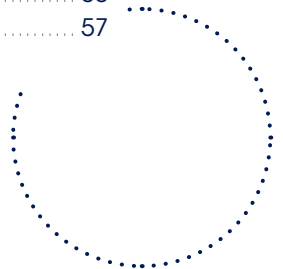
# Power management Guide 2016





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# Introduction



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

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



# Applications

## POWER SUPPLIES

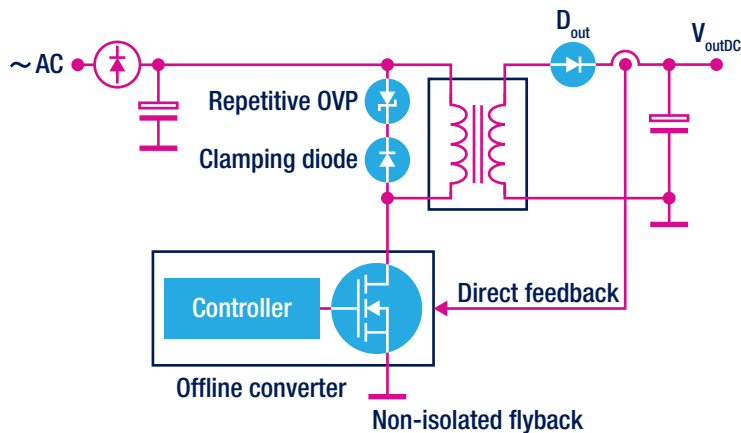
### Auxiliary SMPS

High-power-density and cost-effective auxiliary power supplies can be designed using a converter (where each IC includes a power MOSFET combined with control and protection circuitry in a single package) at a higher switching frequency to avoid a considerable increase in transformer and output capacitor size. ST offers a wide portfolio of highly-integrated offline converters up to 20 W with an extremely low total standby consumption (less than 4 mW for VIPerOP devices) and high breakdown voltage of 800 V for the VIPerPLUS family and 900 V for the Altair05. To reduce BOM costs, the Altair family works as a constant-voltage primary-side regulator (PSR-CV) avoiding the need for a voltage reference and opto-coupler in the circuit. Discrete solutions consisting of an offline controller plus an external MOSFET are also supported by ST. New STRVS voltage suppressors improve system reliability against repetitive over-voltages. New FERD diodes feature a very low forward voltage and a low leakage reverse current improve the system efficiency. The ST devices best suited for each of the most common topologies are listed in the following table.

		Offline converters		Offline controllers	HV power MOSFETs	Repetitive overvoltage protections	Clamping diodes	Volt. ref.	Output diodes	Linear voltage reg.
<b>Buck</b>									STTH*06 STTH*08 STTH*10 STTH*12	
<b>Buck-boost</b>		VIPerOP VIPer01 VIPer*6		-	-	-	-	-		
<b>Non-isolated flyback</b>								T*431 T*432		
<b>Isolated flyback</b>	<b>PSR-CV</b>	-						-		LDF* LD39* LDK* LDL*
	<b>Regulation with optocoupler</b>	VIPer*5 VIPer*7 VIPer*8	VIPerOP VIPer01 VIPer*6 ALTAIR*	STCH02 L6566B	ST*N80K5 ST*N95K5 ST*N105K5 ST*N120K5 STW12N150K5 STW21N150K5 ST*3N170	STRVS*	STTH*06 STTH*08 STTH*10 STTH*12	T*431 T*432	STPS* FERD*45 FERD*60 FERD*100	

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### Topology example



### MAIN EVALUATION BOARDS



STEVAL-ISA096V1  
2 W, buck-boost



STEVAL-ISA113V1  
4.2 W, non-isolated flyback



STEVAL-ISA116V1  
5 W, buck



STEVAL-ISA171V1  
15 W, isolated flyback

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

## Battery chargers

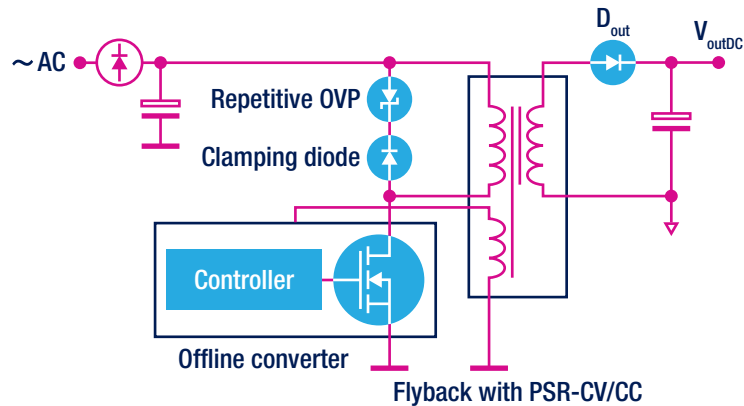
Designing lighter, smaller wall chargers for portable devices is one of the most critical challenges for developers. Excellent standby power consumption, high efficiency in all load conditions, primary-side regulation (PSR) control methods and a set of integrated protections (to minimize the component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



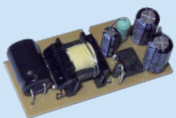
		Offline converters	Offline controllers	HV power MOSFETs	Repetitive overvoltage protections	Clamping diodes	Output diodes	CC/CV controllers		
Wall side	Flyback	PSR-CV/CC	ALTAIR*		-	-	STTH*06 STTH*08 STTH*10 STTH*12	FERD*45 FERD20U50 FERD20U60D FERD*100 STPS*	-	
		PSR-CC	-		-	-				
		Regulation with optocoupler	VIPer*5 VIPer*7 VIPer*8	VIPer0P VIPer01 VIPer*6	STCH02	ST*N65M2				STRVS*
		PSR-CV	-		-	-				

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

## Topology example



## MAIN EVALUATION BOARDS



**STEVAL-ISA124V1**  
5 W, battery charger with opto



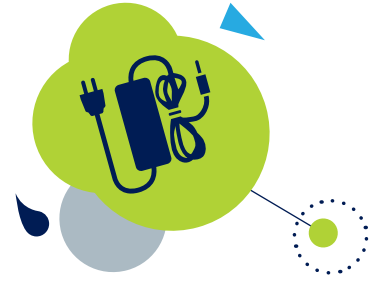
**STEVAL-ISA176V1**  
5 W, optoless battery charger



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

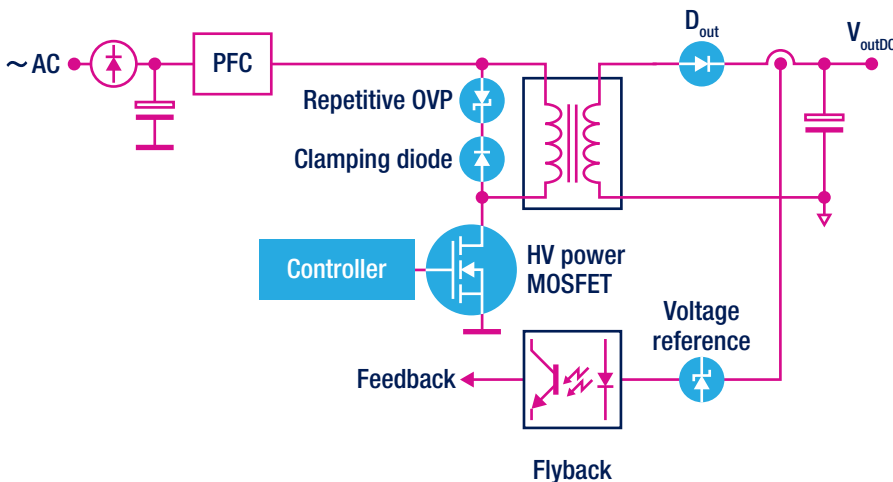
## Adapters

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



		Offline converters		Controllers		Power MOSFETs		Repet. overvolt. protect.	Clamping diodes	Output diodes	CC/CV contr.	Volt. ref.	DC-DC conv.
						HV	LV						
Flyback	Regulation with optocoupler	VIPer*5 VIPer*7 VIPer*8	VIPer0P VIPer01 VIPer*6 ALTAIR*	L6566B L6566A	STCH02	ST*N80K5 ST*N95K5	-	STRVS*	STTH*06 STTH*08 STTH*10 STTH*12	STPS* FERD*45 FERD*60 FERD*100	TSM10* SEA0*	T*431 T*432	-
	PSR-CV	-	-	-	-	-	-		-	-	-	-	-
PFC Boost	TM	-	-	L6562A* L6563* L6564*	-	ST*N50M2 ST*N60M2 ST*N65M2 ST*N55M5 ST*N65M5	-	-	-	STTH*L06 STTH*R06 STTH*06	-	-	-
DC-DC stage	HB-LLC	-	-	L6599A* L6699	STCMB1	ST*N50DM2 ST*N60DM2 ST*N60M2 ST*N60M2-EP	-	-	-	STPS* FERD*45 FERD*60 FERD*100 STTH* (≥200 V series)	TSM10* SEA0*	T*431 T*432	ST1S3*
Sync rect.	Flyback	-	-	STSR30	-	-	ST*110N10F7 ST*100N10F7	-	-	-	-	-	-
	Forward	-	-	STSR2*	-	-	STL*NS3LLH7 ST*N4LF7 <sup>1</sup> STL220N6F7 ST*N6F7 STL130N8F7 ST*N10F7 ST*Nf20D	-	-	-	-	-	-
	HB-LLC	-	-	SRK2000* SRK2001	-	-	-	-	-	-	-	-	-

### Topology example



### MAIN EVALUATION BOARDS

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

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

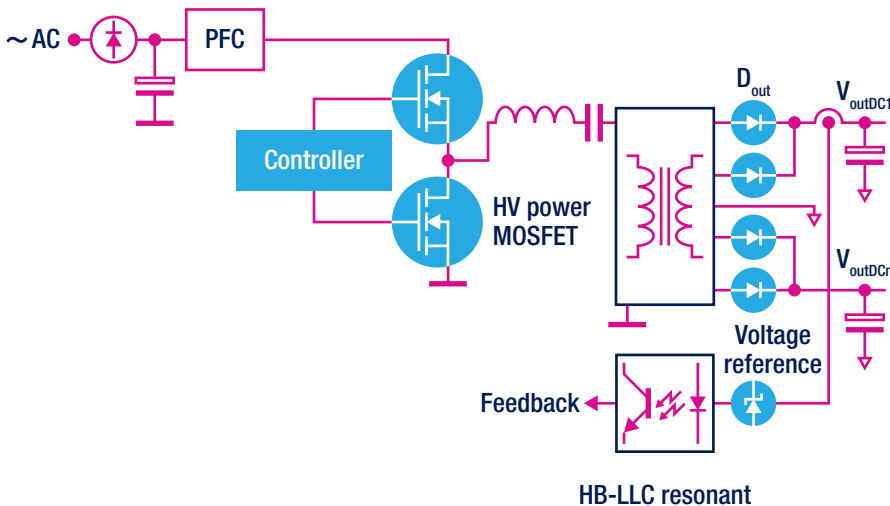
## TV power supply units (PSU)

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



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

### Topology example



### MAIN EVALUATION BOARDS



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



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

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

## Desktop PCs

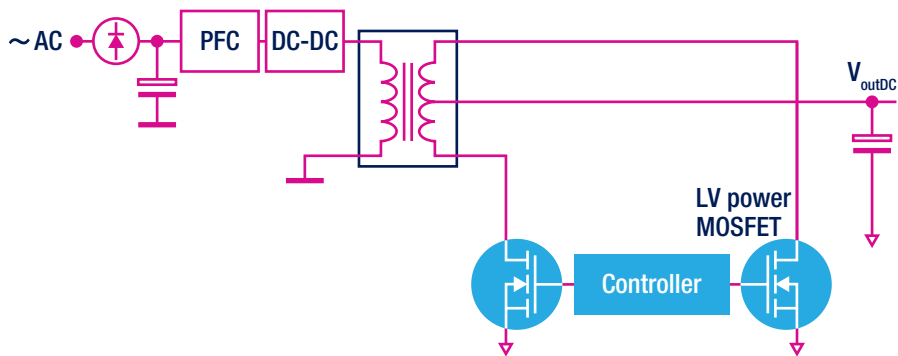
The requirements for the PC power market are a small form factor with better performance and embedded diagnostics.

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



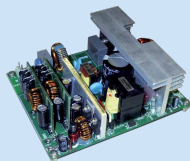
		Controllers		Power MOSFETs		Output diodes	DC-DC converters	E-fuses	Linear voltage reg.
				HV	LV				
PFC Boost	CCM	L4981* L4984D		ST*N60M2 ST*N65M2 ST*N65M5	-	STTH*R06 STTH*T06 STPSC*065	-	STEF01 <sup>2</sup> STEF05 STEF12	LDF* LD39* LDK* LDL*
	TM	L6562A* L6563* L6564*							
DC-DC stage	HB-LLC	L6599A*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

### Typical configuration



SMPS with Sync rectification

### MAIN EVALUATION BOARDS



STEVAL-ISA145V1  
250 W, PFC TM + asym HB



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

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



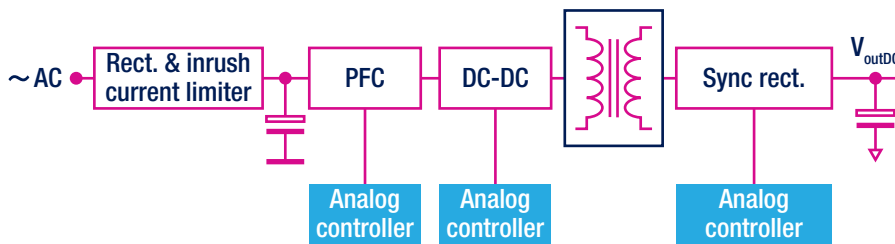
## Servers and telecoms (analog solutions)

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



		Controllers	Power MOSFETs		Diodes	DC-DC converters		E-fuses	Linear voltage reg.	SCRs
			HV	LV		HV	LV			
<b>Rect. &amp; inrush current limiter</b>		-	-	-	STTH3012 STTH6012	-	-	-	-	TYN6* TYN8* TYN10* TYN12* TN5050H TN2015H
<b>PFC</b>	<b>Boost</b>	L4981* L4984D	ST*N60M2 ST*N65M2 ST*N65M5	-	STTH*R06 STTH*T06 STPSC*06 STPSC*065	-	-	STEF01 <sup>1</sup> STEF05 STEF12	LDF* LD39* LDK* LDL*	-
	<b>Bridgeless</b>									
<b>DC-DC stage</b>	<b>HB-LLC</b>	L6599A* L6699	ST*N50DM2 ST*N60DM2 ST*N60M2	-	STPS*150 STPS*200 STTH*02 STTH*03 STTH*04	L698* ST1S14 L7985 L7986 L7987*	ST1S3* ST1S4* ST1S50 L598*			
	<b>Asym HB</b>	L6591								
<b>Sync rect.</b>	<b>HB-LLC</b>	SRK2000* SRK2001	-	STL*NS3LLH7 ST*N4LF7 <sup>1</sup> STL220N6F7 ST*N6F7 ST*N10F7 ST*Nf20D	-	-	-	-	-	-
	<b>Asym HB</b>									

### Typical configuration



Analog solution

### MAIN EVALUATION BOARD

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

## Servers and telecoms (digital solutions)

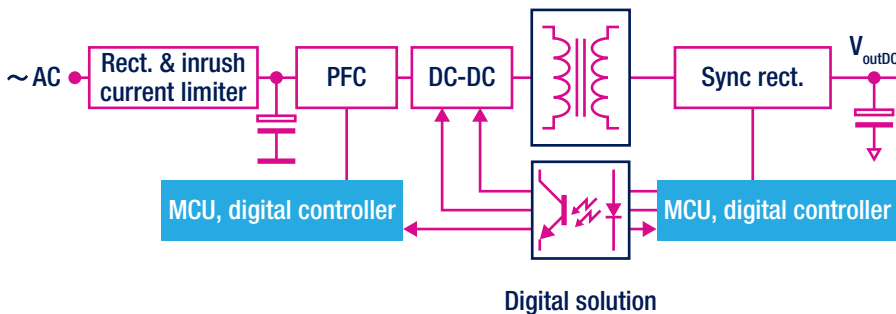
Stringent international standards require, in Server/Telecom applications, greater efficiency, faster and more reliable protection functions, increased flexibility and monitoring that are only practically achievable using a digital approach. From 500 W to 2 kW, ST's proven digital reference high-efficiency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



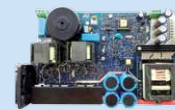
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		MCUs, digital controllers	Gate drivers	Power MOSFETs		Diodes	DC-DC converters	E-fuses	Linear voltage reg.	SCRs
				HV	LV					
<b>Rect. &amp; inrush current limiter</b>		-	-	-	-	STTH3012 STTH6012	-	-	-	TYN6* TYN8* TYN10* TYN12* TN5050H TN2015H
<b>PFC</b>	<b>Boost</b>	STM32F0* STM32F301 STM32F334 STNRG*	TD35* PM8841 PM8851 PM8834	ST*N60M2 ST*N65M2 ST*N65M5	-	STTH*R06 STTH*T06 STPSC*06 STPSC*065	-	-	-	-
	<b>Interl. Boost</b>									
	<b>Bridgeless</b>									
<b>DC-DC stage</b>	<b>HB-LLC</b>	STM32F334 STNRG*	L638* L639* L649*	ST*N50DM2 ST*N60DM2 ST*N60M2	-	STPS*150 STPS*200 STTH*02 STTH*03 STTH*04	ST1S3* ST1S4* ST1S50 L598*	STEF01 <sup>1</sup> STEF05 STEF12	LDF* LD39* LDK* LDL*	-
	<b>HB-LC</b>									
	<b>FP-PS</b>									
<b>Sync rect.</b>			PM8834	-	STL*NS3LLH7 ST*N4LF7 <sup>2</sup> STL220N6F7 ST*N6F7 ST*N10F7 ST*Nf20D	-	-	-	-	

### Typical configuration



### MAIN EVALUATION BOARDS



**STEVAL-ISA147V1**  
500 W, bridgeless PFC  
+ HB-LLC conv.  
+ sync rect.



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



**STEVAL-ISA172V1**  
2 kW, multi-phase interl.  
Boost PFC + FB-PS conv.



**STEVAL-ISF003V1<sup>1</sup>**  
Up to 7.4 kW, digital  
inrush current limiter  
based on SCRs

# DC-DC COMPUTING

## Server and microserver

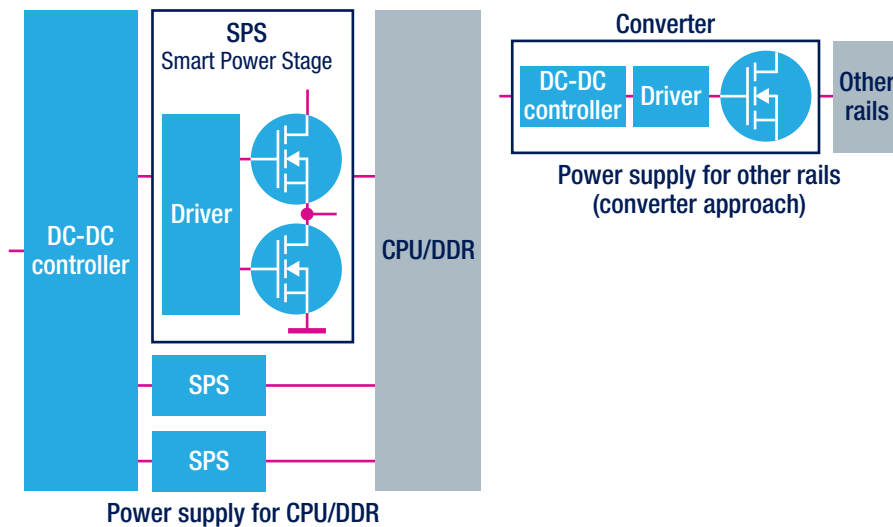
STMicroelectronics offers complete power management solutions for Intel CPU and DDR power supplies and all other rails for server and μservers. ST's STVCOT™ control loop technology, used in single- and multi-phase PWM DC-DC controllers, guarantees best performance in all load conditions. Moreover, it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

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



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

### Typical configurations



**MAIN EVALUATION BOARD**

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

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

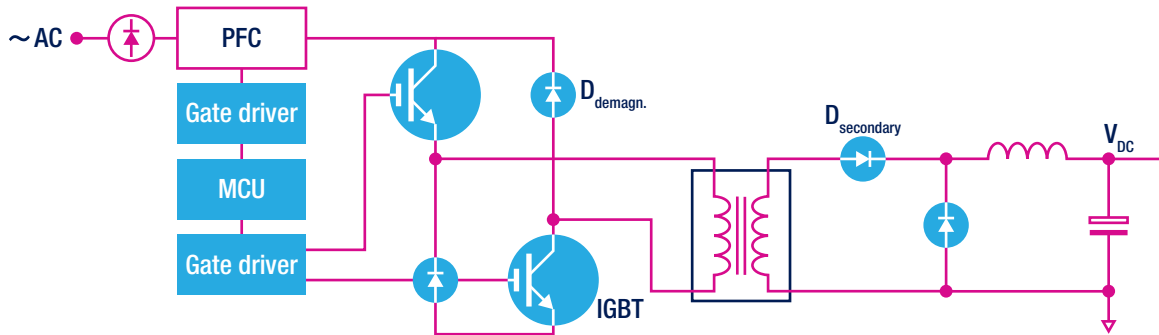
## INDUSTRIAL WELDING

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



		MCUs	Gate drivers	IGBTs	HV power MOSFETs	Diodes			DC-DC converters	
						Boost	Demagn	Secondary side	HV	LV
PFC Boost		STM32F0* STM32F301 STM32F334	TD35* PM8834 PM8841 PM8851 STGAP1S	STG*H65DFB STG*V60DF STG*H120DF2	SCT*N120	STTH*R06 STTH*T06 STTH*W06 STPSC*065	-	-	-	
DC-DC stage	PS-FB	STM32F334	L638* L639* L649* STGAP1S	STG*H65FB STG*V60F		-	-	STTH*W02 STTH*W03 STTH*W04	L698* L597* L7985 L7986 L7987*	ST1S0* ST1S12 ST1S3* ST1S40 ST1S50 L598*
	TTF				-	STTH*R06 STTH*06 STTH*10 STTH*12	-	-		

### Typical configuration



Solution based on two-transistor forward topology

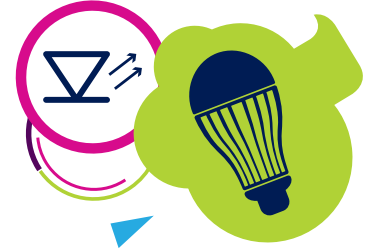


# LED LIGHTING - GENERAL ILLUMINATION

## Residential lighting

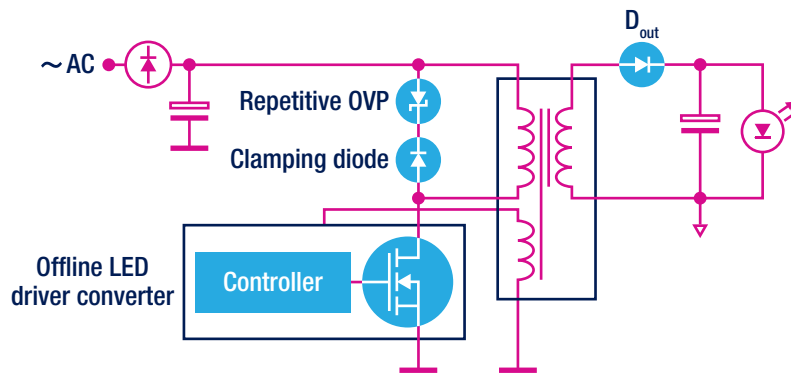
LED efficacy and driver IC market requirements are constantly evolving. Residential lighting applications need a high integration level, high efficiency, high power factor (PF), long lifetime, and dimming capabilities as well as a low system cost and component count.

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	
<b>MR16 halogen bulb replacement</b>	-	-	-	-	-	BAT20J BAT* BAS*	LED5000 LED6000	
<b>Buck, Buck-boost</b>	-	VIPer0P VIPer01 VIPer*6	-	-	-	STTH*	-	
<b>HPF Buck-boost</b>	HVLED805 HVLED807PF HVLED815PF	-	-	-	-	-	-	
<b>HPF Flyback</b>	<b>PSR-CC/CV</b>	-	-	-	-	-	-	
<b>Flyback</b>	<b>Regulation with optocoupler</b>	-	VIPer*5 VIPer*7 VIPer*8	VIPer0P VIPer01 VIPer*6	TSM10* SEA0*	STRVS*	STTH*06 STTH*08 STTH*10 STTH*12	STPS*170AF STPS*4S200UF FERD*
	<b>PSR-CV</b>	-	-	-	-			
	<b>PSR-CC/CV</b>	-	ALTAIR*	-	-			

### Topology example



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

### MAIN EVALUATION BOARDS



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



**STEVAL-ILL055V1**  
11 W, flyback LED driver

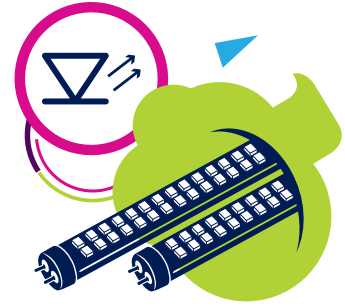


**EVALHVLED815W15**  
15 W, flyback LED driver

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

## Commercial and architectural lighting

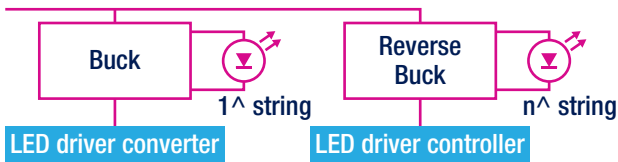
Commercial and architectural lighting applications usually require more than 20 W, a high power factor, high level of efficiency, cost-saving solution and the possibility of using more than one LED string with remote monitoring. In a single string case, working in constant-current primary-side regulation (PSR-CC) mode, ST's new flyback offline LED driver controller (HVLED003D<sup>1</sup>) directly drives the single string without having to use an optocoupler and secondary-side controller in the circuit. The multiple strings power supply architecture consists of a main power supply (usually a flyback) providing a constant bus voltage and subsequent multiple strings. ST's offline LED controllers HVLED001\* (for flyback) with constant-voltage primary-side regulation (PSR-CV) is available for the main SMPS. Multiple strings can be managed using analog or digital means. High power-density DC-DC LED driver buck converters (LED2000, LED2001, LED5000 and LED6000) or the new HVLED002 controller for reverse buck, are used for an analog implementation. To digitally manage multiple strings stage (reverse buck), ST offers STLUX, a new series of dedicated digital lighting controllers as well as STM32 high-performance microcontrollers. ST's high-voltage MDmesh™ MOSFETs series (suggested for flyback) and the low-voltage STripFET MOSFET series (used for reverse buck topologies) ensure all solutions are very efficient and reliable.



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

### Typical configurations

DC bus



Analog multiple strings mgmt

DC bus



Digital multiple strings mgmt

### MAIN EVALUATION BOARDS



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



STEVAL-ILL069V2  
35 W, analog power supply (CV<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-ILL051V2  
18 V-3 A, buck LED driver converter



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

Note: 1: available in Q3 2016 \* : 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.

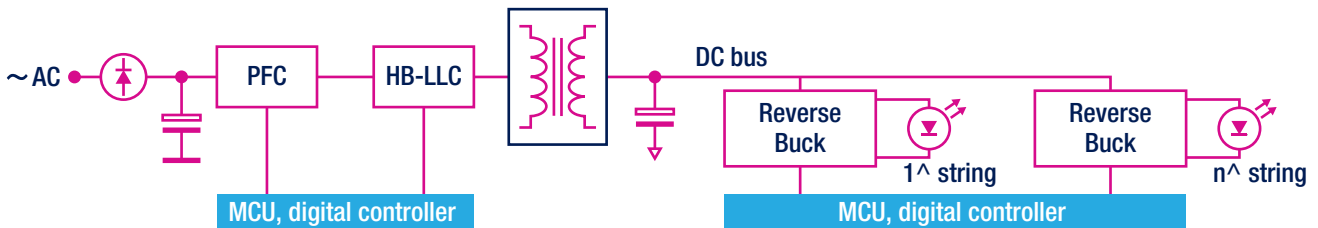
The multiple strings power supply architecture consists of a main power supply providing a constant bus voltage and a subsequent multiple strings. Usually the main power stage, consisting of a high power factor (HPF) flyback converter or a power factor correction (PFC) controller combined with an LLC 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					
<b>HPF Flyback</b>	<b>PSR-CV</b>	HVLED001*		-	-	ST*N80K5 ST*N95K5	-	STTH*06 STTH*08 STTH*10 STTH*12	STRVS*	STPS* FERD*	-	-
<b>PFC Boost</b>	<b>CCM</b>	L4981* L4984D		STLUX* STM32F0* STM32F301 STM32F334	TD35* PM8841 PM8851	ST*N60M2 ST*N65M2	-		-	STTH*R06 STTH*T06 STPSC*	-	-
	<b>TM</b>	L6562A* L6563* L6564*	STCMB1							STTH*L06 STTH*06		
<b>DC-DC stage</b>	<b>HB-LLC</b>	L6599A* L6699								L638* L639* L649*		
	<b>HB-LC</b>	-	-									
<b>Sync rect.</b>		SRK2000* SRK2001			PM8834		STL*NS3LLH7 ST*N4LF7 <sup>1</sup> STL220N6F7 ST*N6F7 ST*N10F7 ST*NF20D			-		-
<b>Multiple strings mgmt</b>	<b>Buck</b>	-		-	-	-	-	-	-		LED5000 LED6000	-
	<b>Reverse buck</b>	HVLED002		STLUX* STM32F334 STM32F301 STM32F0* STM8S*	TD35* PM8834 PM8841 PM8851		ST*N6F7 ST*N10F7 STL11N6F7	-	-	STPS* FERD* STTH* (≥200 V series)	-	-

### Typical configuration



Fully digital multi-string LED driver solution

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

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

## MAIN EVALUATION BOARDS



**STEVAL-ILL066V1**  
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





# MAJOR HOME APPLIANCES

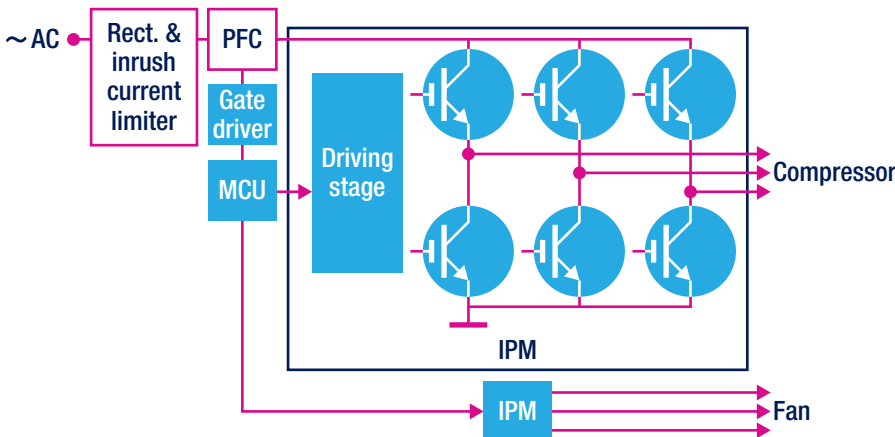
## Air conditioning

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



	MCUs	Gate drivers	IPM	IGBTs	HV power MOSFETs	Diodes	E-fuses	Linear voltage reg.	DC-DC converters		SCRs	Triacs	LED array drivers	
									HV	LV				
Rect. & inrush current limiter	-	-	-	-	-	STTH3012 STTH6012	-	-	-	-	TN*10H-6 TN*15H-6 TYN6* TYN8* TYN10* TYN12*	-	-	
	-	-	-	-	-	-	-	-	-	-	-	T1635T	-	
PFC	Boost	TD35* PM8841 PM8851 PM8834	-	STGW*V60DF STGW*H65DFB	ST*N65M5 ST*N65M2	STTH*AC06 STTH*R06 STPSC*06 STPSC*065	STEF01* STPW*1	LDF* LD39* LDK* LDL*	-		-	-	-	-
	Interl. Boost													
	Bridgeless													
3-ph inverter	Compr.	STM32F0* STM32F103 STM32F3* STM32F4*	L638* L639* L649*	STGIB*CH60 STGIB*M60 <sup>1</sup>	STG*H60DF STG*M65DF2	ST*N60DM2	-	-	L698* L597* L7985 L7986 L7987*	ST1S0* ST1S12 ST1S3* ST1S40 ST1S50 L598*	-	-	-	-
	Fan			STGIPN*H60 STGIPQ*C60										
LED indicator											-	-	STP08 STP16* LED1642GW	

### Typical configuration



### MAIN EVALUATION BOARDS



STEVAL-IHT008V1

1 kW, digital inrush current limiter based on Triac



STEVAL-IHM034V2

1.3 kW, dual motor control with PFC

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

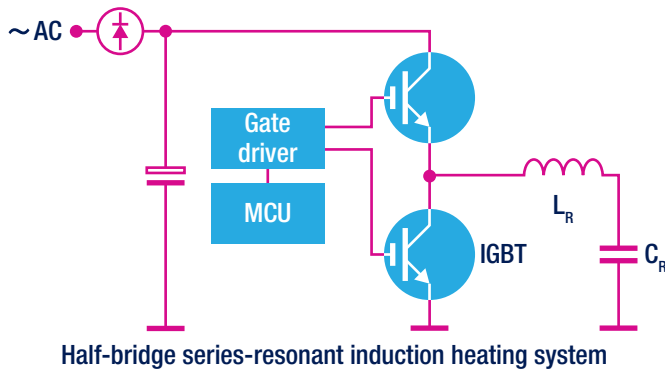
## Induction heating

The induction heating market demands cost-effective, energy-efficient and reliable solutions. Resonant-switching topologies, based on voltage or current resonance, are the most adopted and can be managed using high-performing STM32 microcontrollers. To best meet these requirements and fit the selected topologies, ST has developed the dedicated IH (1250 V) and HB (650 V) series of trench-gate field-stop IGBTs. Complementary new STDRIVEsmart gate drivers family (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* STM32F100	TD35* PM8841 PM8851	STGW*IH125DF	-
<b>HB series resonant (current resonance)</b>	STM32F0* STM32F100	L638* L639* L649*	STGW*H65DFB STGW*H60DLFB	-
<b>User interface (front panel)</b>	STM8* STM32F0* STM32F4*9 STM32F7*	-	-	STP08 STP16* LED1642GW

### Topology example



### MAIN EVALUATION BOARD



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

# RENEWABLE ENERGY & HARVESTING

## Photovoltaic (centralized)

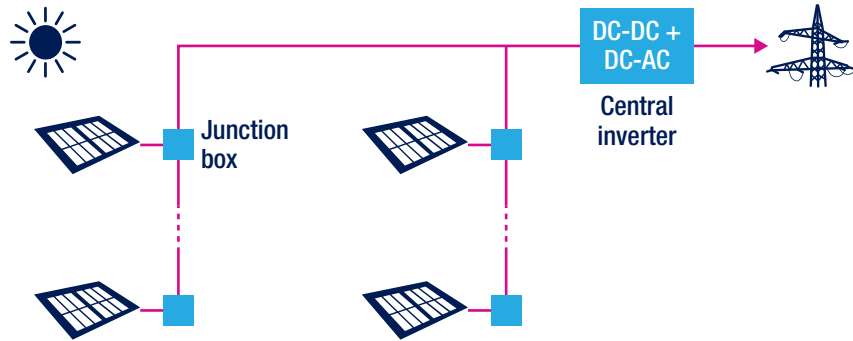
Centralized photovoltaic (PV) energy solutions use a central inverter architecture characterized by a single central inverter (where the entire DC output of a PV array is transformed and connected to the AC grid) and, at the panel level, by a junction box that provides only the bypass function and helps prevent localized hotspots. For the junction box, ST offers two products families with a very low forward voltage and a low leakage reverse current: cool bypass switches (dedicated high-efficiency photovoltaic ICs) and the new FERD diodes. By integrating high-performance STM32 microcontrollers, the new high-efficiency SiC MOSFETs (SCT\*N120), the new trench-gate field-stop IGBTs series, the SiC diodes (STPSC\*) and the new STGAP1S galvanically-isolated gate drivers, it's possible to guarantee a high-efficiency central inverter implementation.

High- and low-voltage DC-DC converters guarantee high power density for the post-regulation stages. Due to their low per watt costs and the simplicity of design, central inverters are the power conversion systems of choice for large PV power plants.



			MCUs	Gate drivers	HV power MOSFETs	IGBTs	Diodes	Bypass devices		DC-DC converters	
								Diodes	Cool bypass switches	HV	LV
<b>Junction box</b>			-	-	-	-	-	STPS*30 STPS*45 FERD*	SPV15*	-	-
<b>Central inverter</b>	<b>DC-DC stage</b>	<b>FB-PS</b>	STM32F1* STM32F2* STM32F3* STM32F4* STM32F7*	L638* L639* L649* STGAP1S	ST*60DM2 ST*65DM2 SCT*N120	-	STTH*R06 STTH*06 STTH*S12 STPSC*065 STPSC*12	-	-	L6985F L6986 L597* L7985 L7986 L7987*	ST1S4* ST1S50 L598*
		<b>DC-AC stage</b>									
	<b>3-Level HB</b>	-			-	STGW*H120DF2 STGW*S120DF3 STGW*M120DF3 STGW*H65DFB STGW*M65DF2	-				

### Typical configuration



Centralized approach for a solar energy solution

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

## Photovoltaic (distributed)

A distributed photovoltaic (PV) energy architecture converts power using an embedded maximum power point tracking (MPPT) mechanism at the PV panel level. A partially distributed approach integrates a power optimizer (a DC-DC converter with MPPT and communication capabilities) and a central inverter for the DC-AC conversion and grid connection. In regards to the power optimizer, the bypass function is covered by ST with two products families featuring a very low forward voltage and low leakage reverse current: cool bypass switches (dedicated high-efficiency photovoltaic ICs) and new FERD diodes. The new high-efficiency SiC MOSFETs (SCT\*N120) and the new trench-gate field-stop IGBTs series, guarantee a high-efficiency DC-AC central inverter.

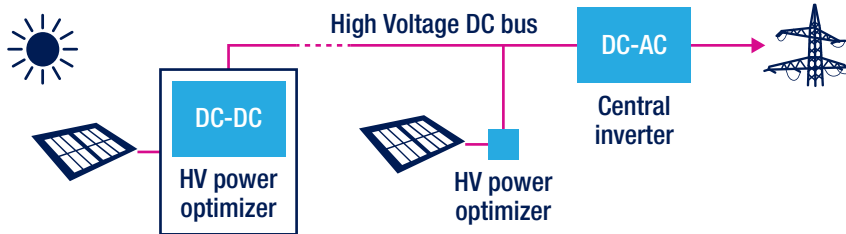
The fully distributed approach integrates, at the PV panel level, a microinverter that includes a complete converter (DC-DC with MPPT as well as DC-AC) and manages the AC grid connection. The high-performing STM32 microcontrollers, the new high-efficiency high-voltage MDmesh™ MOSFET series, the new low-voltage STripFET MOSFET series and the SiC diodes (STPSC\*) guarantee a high-efficiency converter while the new STGAP1S galvanically-isolated gate drivers offer high safety and reliability. High- and low-voltage DC-DC converters guarantee high power density for the post-regulation stages.



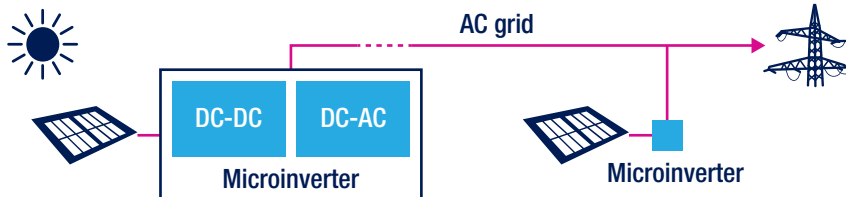
			MCUs	Gate drivers	Power MOSFETs		IGBTs	Diodes	Bypass devices		DC-DC converters	
Power optimizer	DC-DC stage	Isolated FB boost			HV	LV			Diodes	Cool bypass switches	HV	LV
			STM32F103 STM32F3* STM32F4*	L638* L639* L649* STGAP1S	-	STH*N10F7 STH*N6F7	-	STTH*R06 STTH*06	STPS*30 STPS*45 FERD*45	SPV15*	-	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

### Typical configurations

#### Partially distributed approach



#### Fully distributed approach



### MAIN EVALUATION BOARD



STEVAL-ISV003V2  
250 W, microinverter

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



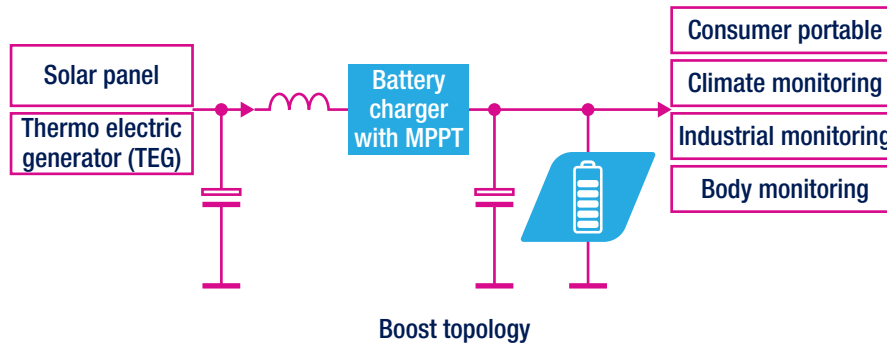
## Solar – Thermo electric generator (TEG)

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



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

### Typical configuration



### MAIN EVALUATION BOARDS



**STEVAL-ISV0019V1**  
Boost energy harvester battery charger



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



**STEVAL-IDS003V1**  
Autonomus wireless multisensor node powered by TEG

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

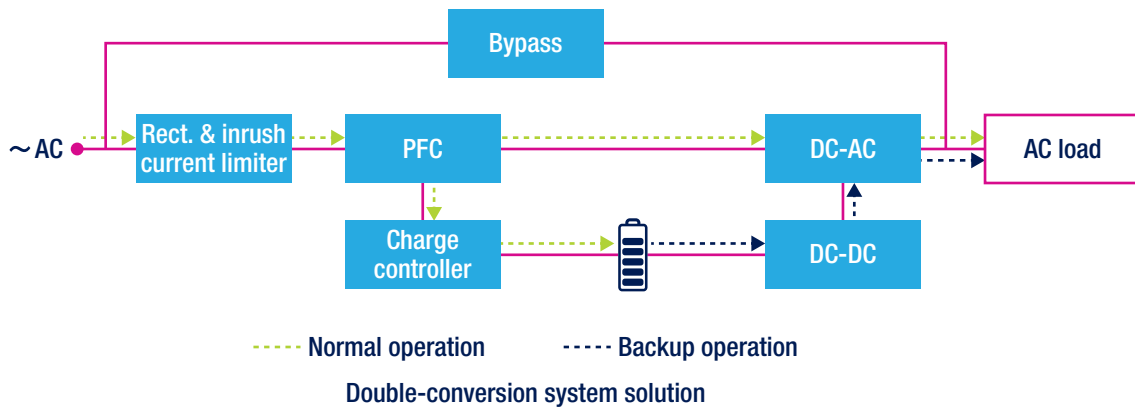
## UNINTERRUPTABLE POWER SUPPLIES (UPS)

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



		MCUs	Gate drivers	IGBTs	Power MOSFETs		Diodes	SCRs	Triacs	Linear voltage regulators	DC-DC Conv.
					HV	LV					
<b>Rect. &amp; inrush current limiter</b>		-	-	-	-	-	STTH3012 STTH6012	TYN6* TYN8* TYN10* TYN12* TN*10H-6 TN*15H-6	-	-	-
<b>PFC Boost</b>			PM8834 PM8841 PM8851		ST*N60M2 ST*N65M2 ST*N65M5	-	STTH*T06 STTH*R06 STTH*S12 STPSC*	-	T1635T	-	-
<b>Charge controller</b>	<b>HB</b>		L638* L639* L649*	STG*H65DFB STG*V60DF	ST*N50DM2 ST*N60DM2 ST*N60M2	-					
<b>DC-DC stage</b>	<b>Push Pull</b>	STM32F4* STM32F7*	PM8834 PM8841 PM8851 STGAP1S		-	ST*N6F7 ST*N8F7 ST*N10F7 STP*N3LL	STTH*06 STTH*12 STPSC*			LDF* LD39* LDK* LDL*	L698* ST1S14 L7985 L7986 L7987*
<b>DC-AC stage</b>	<b>NPC</b>		L638* L639* L649* STGAP1S	STG*H65DFB STG*H120DF2	SCT*N120	-					
	<b>FB</b>					STP110N8F6 ST*N8F7 ST*N10F7 STP90N55F4 STP110N55F6					
<b>Bypass</b>		-	-	-	-	-	-	T2550-12 TPDV* TN5050H-12WY TYN6* TYN8* TYN10* TYN12*	-	-	-

### Example of high-end configuration



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

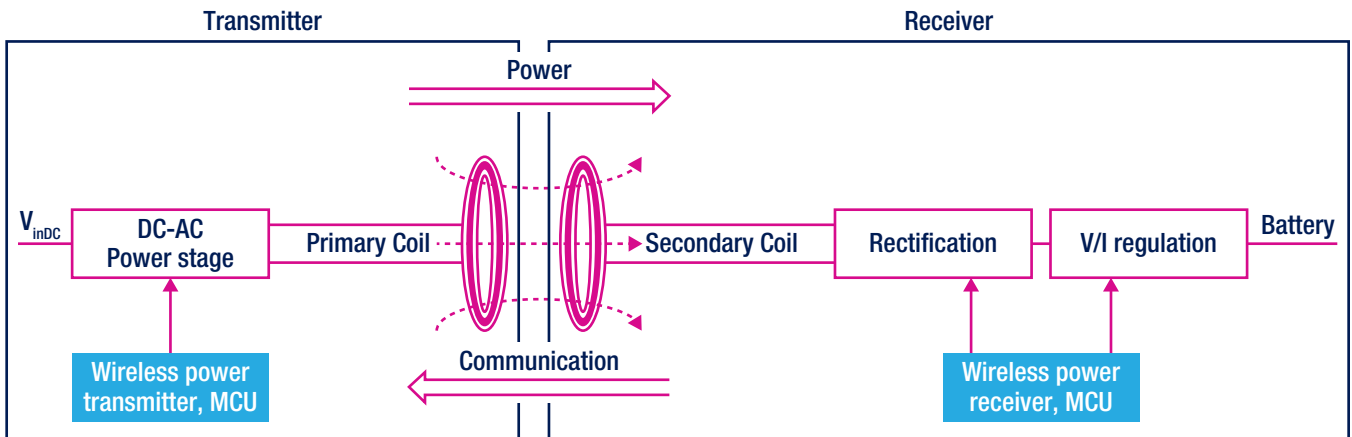
## WIRELESS CHARGING

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



			Wireless charging ICs, MCUs	Gate drivers	Power MOSFETs	Protections	Diodes
Transmitter	DC-AC stage	HB	STWBC STWBC-WA <sup>1</sup> STM32F0*	L6747* L6749 <sup>1</sup>	STL*NS3LLH7 ST*N2VH5 ST*P2UH7 ST*H3LL	-	-
		FB					
Receiver	Rectification		STWLC03 STWLC04 <sup>1</sup> STM32F0*	-	-	SMM4F SMA	STPS* FERD*
	Voltage/Current regulation						

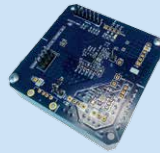
### Typical configuration



### MAIN EVALUATION BOARDS



STEVAL-ISB027V1  
Qi A11 Wireless charger transmitter based on STWBC



STEVAL-ISB036V1<sup>1</sup>  
Wireless charger receiver based on STWLC03



STEVAL-ISB038V1<sup>1</sup>  
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



### SMART SIMULATOR AND SYSTEM DESIGN ENGINE

#### Power conversion and LED lighting

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

### SMART SELECTOR

#### Diodes

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



Smart simulator and system design engine view

### CONFIGURATORS

#### STLUX & STNRG SMEDs configurator

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





# Products

## AC-DC CONVERSION ICs

### High-voltage converters

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

The **VIPerPlus series** (VIPer0P, VIPer01 devices and VIPer\*5, VIPer\*6, VIPer\*7, VIPer\*8 families) features an 800 V avalanche-rugged power MOSFET and leading-edge PWM controller and consumes less than 4 mW for VIPer0P, 12 mW for VIPer01 and 30 mW in standby for the others. It also comes with the largest choice of protection schemes and supports different topologies.

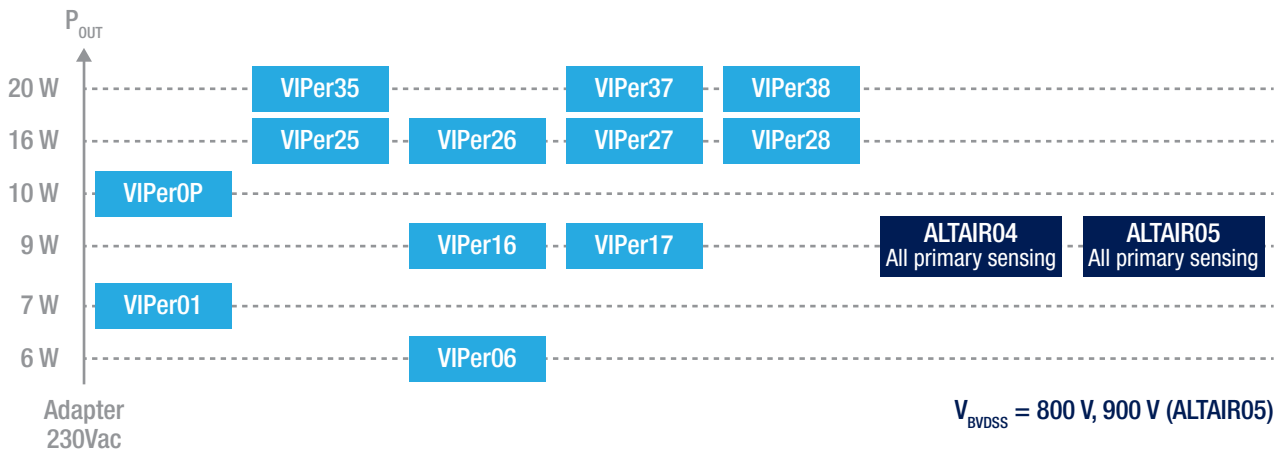
The Altair series has a built-in 800/900 V avalanche-rugged power MOSFET and a PWM controller specifically designed to work in constant-current/constant-voltage primary-side regulation (PSR-CC/CV). It means opto-less implementation, thus significantly reducing component count.



### 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, VIPer01 and VIPer\*6
  - PSR-CV/CC and tight tolerance using ALTAIR\*
- Buck & buck-boost topologies supported by VIPer0P, VIPer01 and VIPer\*6



## MAIN APPLICATIONS



Consumer electronics



Factory automation



Home appliances



Lighting



Metering



Home automation

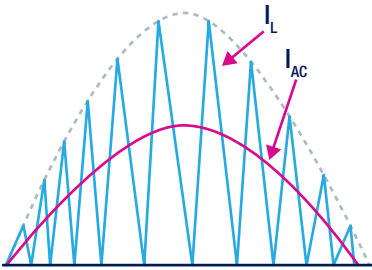
[www.st.com/ac-dc-converters](http://www.st.com/ac-dc-converters)  
[www.st.com/high-voltage-ac-dc-converters](http://www.st.com/high-voltage-ac-dc-converters)  
[www.st.com/viperplus](http://www.st.com/viperplus)

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

## PFC controllers

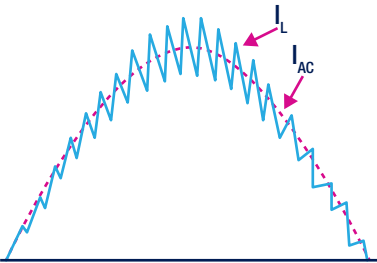
ST **power factor correction (PFC) controllers** operate in transition mode (TM, suitable for  $P \leq 250$  W) and continuous current mode (CCM, suitable for  $P > 250$  W), and are suitable for a wide-range-mains operation. These devices embed advanced protection features, which make SMPS more robust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

### 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

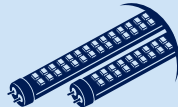
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## MAIN APPLICATIONS



### Adapters and TVs

L6562A\*, L6563\*, L6564\*



### Commercial, architectural and street lighting

L6562A\*, L6563\*, L6564\*, L4981\*, L4984D



### Desktop PCs and servers

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

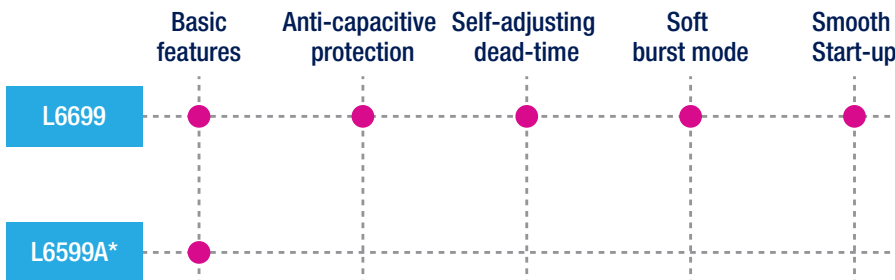
#### L6566\*

- 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

### HB-LLC resonant controllers



### 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 anticapacitive mode for LLC

### Asymmetrical half-bridge controller

#### L6591

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

## MAIN APPLICATIONS



**Tablets and smartphones**  
L6565, L6566\*, STCH02



**Laptops**  
L6565, L6566\*, STCH02, STCMB1



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



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

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

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

## Synchronous rectification controllers

**Synchronous rectifiers** are used to drive power MOSFETs that replace the rectification diodes in the secondary side of SMPS, thus providing high efficiency especially in low-output-voltage, high-current power supplies.

The product portfolio supports the most common flyback, forward and LLC resonant topologies. The main benefits include high efficiency, space saving, cost reduction and high reliability.

### SR controllers for Flyback

**STSR30**

- Possibility to operate in discontinuous mode
- Automatic turn-off for  $D < 14\%$

### SR controllers for Forward

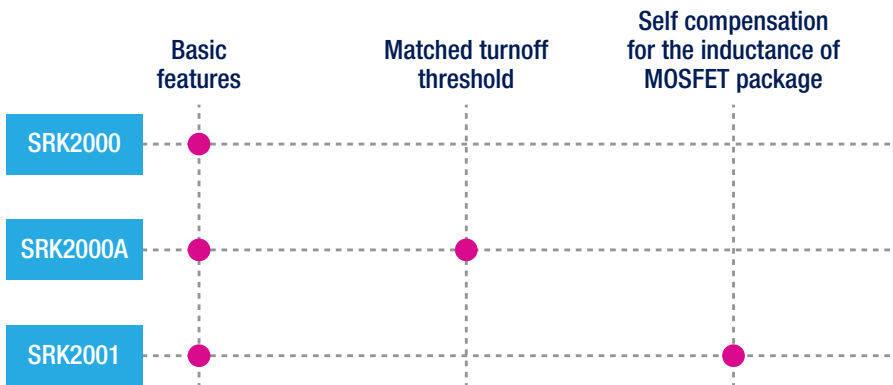
**STSR2P\***

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

## SYNCHRONOUS RECTIFICATION BENEFITS

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

### SR controllers for LLC resonant



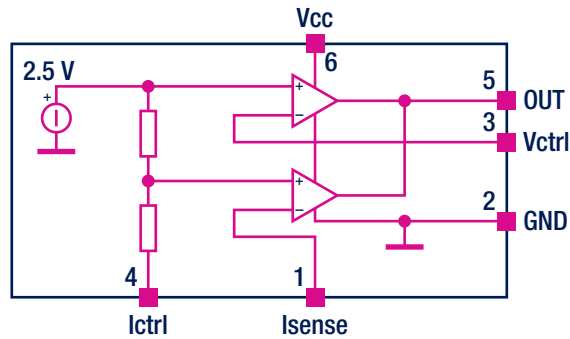
## MAIN APPLICATIONS



## 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

## MAIN APPLICATIONS



Adapters



Battery chargers



Residential, commercial, architectural and street lighting

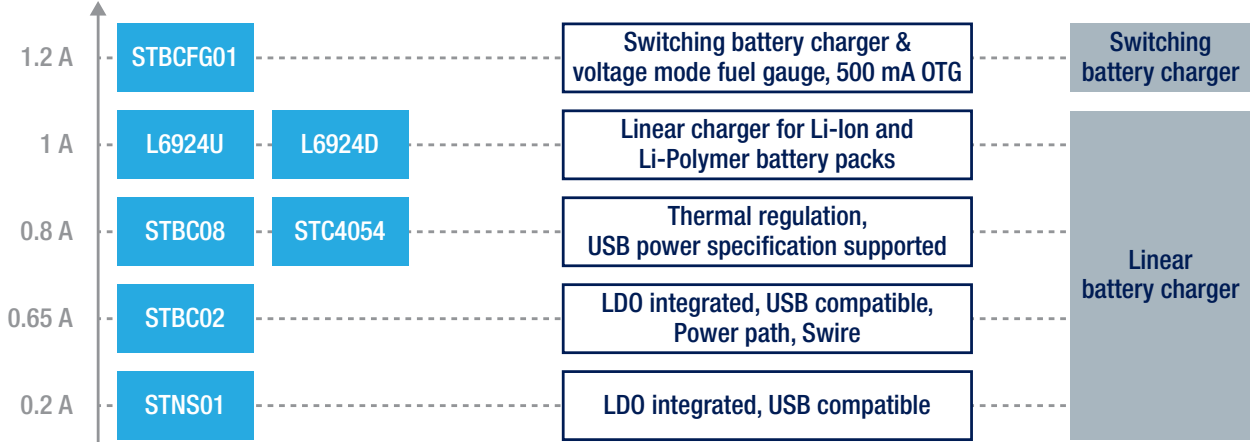


# BATTERY MANAGEMENT ICs

## 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 200 mA up to 1.2 A and can be used for any rechargeable lithium-ion and Li-Polymer battery. Using very simple topologies, some of these devices also feature a power-path function offering instant-on operation and thermal regulation according to the JEITA international standard.

### Battery chargers



### Battery monitoring

**SCT3115**

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

**SCT3117**

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

## MAIN APPLICATIONS



**Bluetooth accessories**  
STBC08, STC4054



**USB**  
L6924U, STBC08, STC4054, STBCFG01



**Fitness**  
STNS01, STBC02



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



**Portable media players**  
STBC02, L6924U, STNS01, SCT3115, SCT3117



**Digital cameras**  
L6924U, L6924D, SCT3115, SCT3117



## Wireless charging ICs

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

### Wireless power transmitters

STWBC

STWBC-WA<sup>1</sup>

#### STWBC

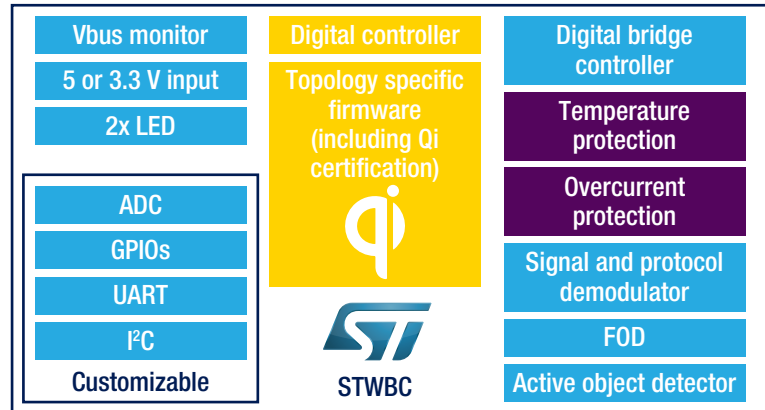
- Supports applications up to 5 W
- Qi A11 certified

#### STWBC-WA<sup>1</sup>

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

#### Common features

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



### Wireless power receivers

STWLC03

STWLC04<sup>1</sup>

#### STWLC03

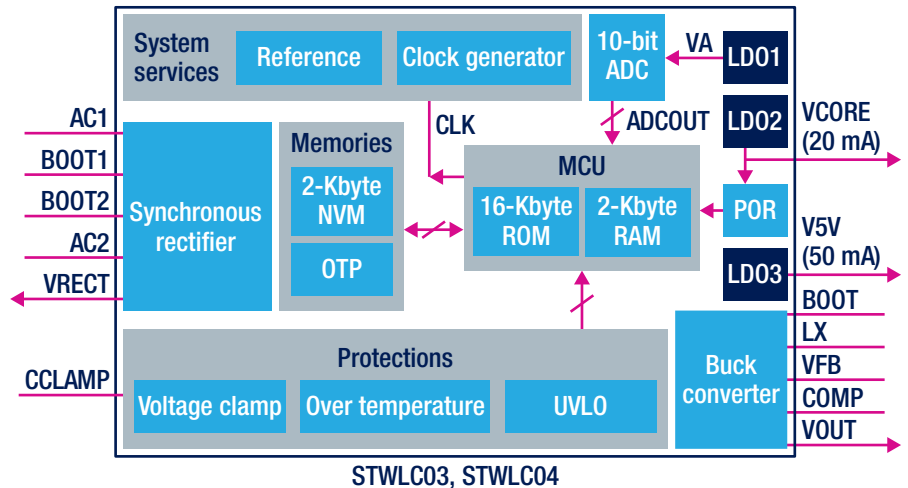
- Supports applications up to 7.5 W
- Multiple Qi and PMA standard compliant

#### STWLC04<sup>1</sup>

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

#### Common features

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



## MAIN APPLICATIONS



**Wireless battery charger transmitters**  
STWBC



**Medical & healthcare equipment**  
STWLC03



**Tablets and smartphones**  
STWLC03

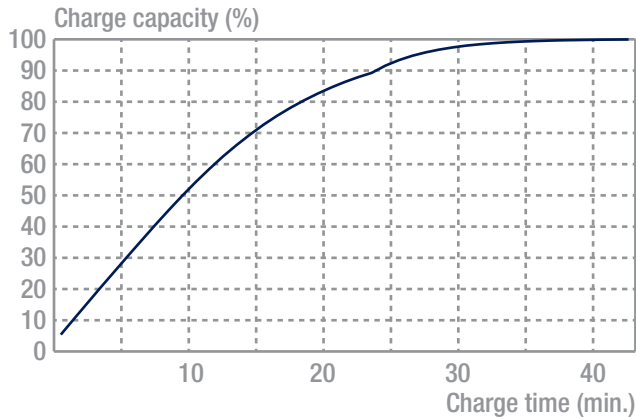


**Wearables**  
Transmitter STWBC-WA<sup>1</sup>  
Receiver STWLC04<sup>1</sup>

## Thin-film batteries

ST's **EnFilm™ thin-film batteries** are a new concept of extremely thin (220 µm), rechargeable solid-state batteries with fast constant-voltage recharge and a lifetime of more than 10 years or 4000 cycles.

They feature a LiCoO2 cathode, LiPON ceramic electrolyte and a lithium anode, on a 25.7 x 25.7 mm footprint and are completely safe from risks of burning or explosion.



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

### THIN FILM BATTERY MAIN BENEFITS

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

## EnFilm™ thin film rechargeable battery: the energy of things

**EFL700A39**

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



### MAIN APPLICATIONS



Fitness and wearables



RF ID tags



Sensors and networks



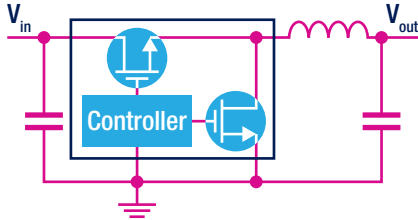
Smart cards



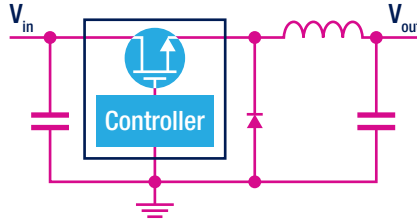
# DC-DC SWITCHING CONVERSION ICs

## DC-DC converters

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



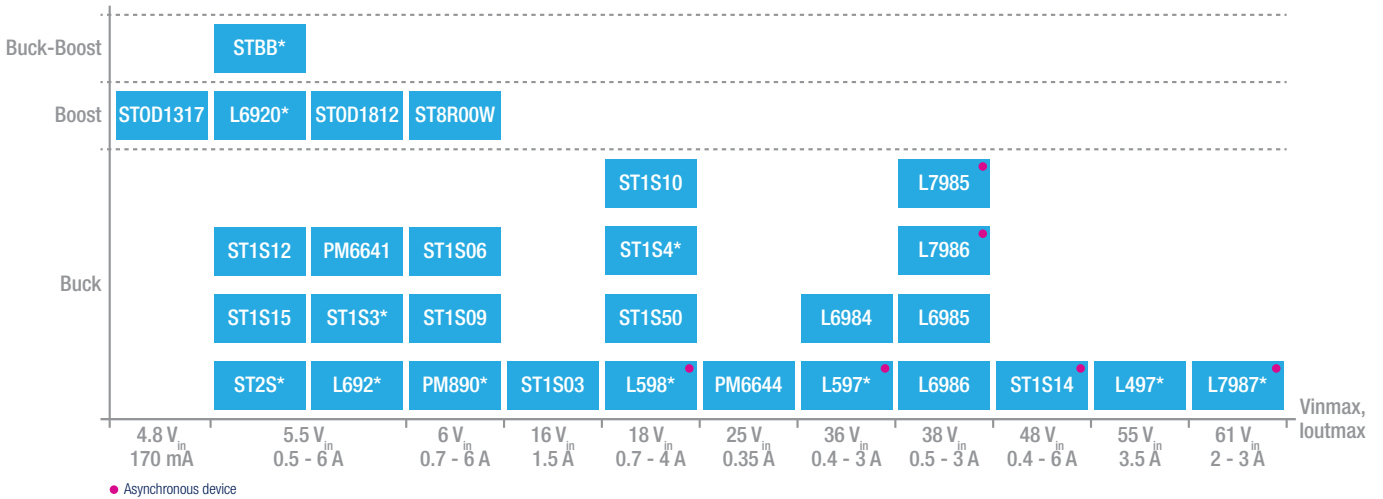
Synchronous buck converter



Asynchronous buck converter

### DC-DC CONVERTERS MAIN FEATURES

- Up to 61 V<sub>IN</sub>/3 A
- Synchronization capability
- Internal compensation
- Low consumption
- Adjustable fsw
- Internal soft start
- Low quiescent current



### MAIN APPLICATIONS



Smartphones



TVs



Computing



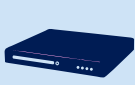
Solar



UPS



Lighting



Set-top boxes



Wearables



Server/Telecom



Home appliances



Factory automation

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

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

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

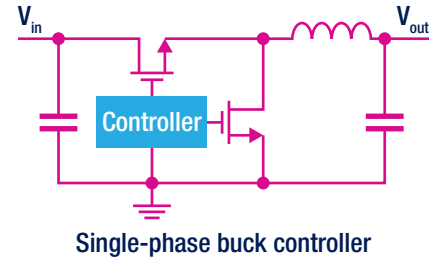
Note: \* is used as a wildcard character for related part number

## DC-DC controllers

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

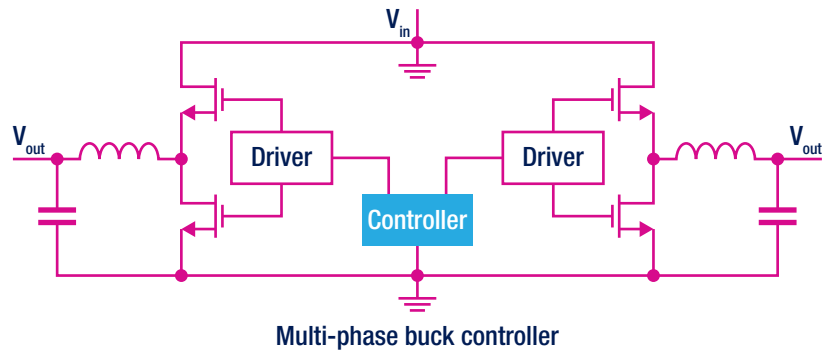
### Single-phase Buck controllers

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



### Multi-phase Buck controllers

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



## MAIN APPLICATIONS



[www.st.com/dc-dc-switching-converters](http://www.st.com/dc-dc-switching-converters)  
[www.st.com/single-phase-controllers](http://www.st.com/single-phase-controllers)  
[www.st.com/multi-phase-controllers](http://www.st.com/multi-phase-controllers)

# DIGITAL CONTROLLERS/MICROCONTROLLERS

## Digital 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

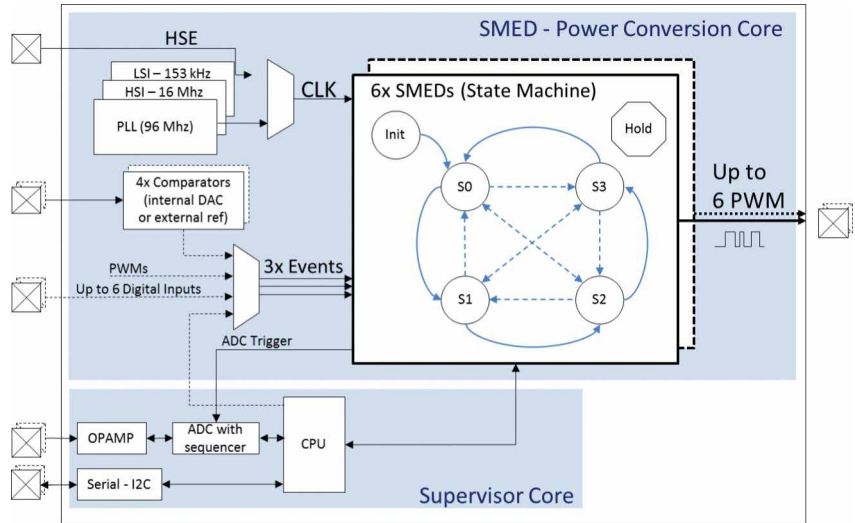
- Innovative digital control technique based on 6 programmable SMEDs with max PWM resolution of 1.3 ns
- Customizable algorithm for higher conversion efficiency
- Internal 96 MHz PLL
- Operating temperature -40 to 105°C
- Serial, I<sup>2</sup>C and GPIO interfaces

#### 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

### MAIN APPLICATIONS



**Solar**  
STNRG\*



**UPS**  
STNRG\*



**HEV charging stations**  
STNRG\*



**Factory automation**  
STNRG\*



**Commercial, architectural and street lighting**  
STLUX\*

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

## Microcontrollers

The **32-bit microcontrollers** most suitable for power management applications are those of the entry-level **STM32F0 series** and the STM32F334 MCU from the mixed-signal **STM32F3 series**.

The STM32F0 series has a 32-bit ARM® Cortex®-M0 core and is particularly well suited for cost-sensitive applications. STM32F0 MCUs combine real-time performance, low-power operation, and the advanced architecture and peripherals of the STM32 platform.

The STM32F334 MCU combines a 32-bit ARM® Cortex®-M4 core (with FPU and DSP instructions) running at 72 MHz with a high-resolution timer (217 ps) and complex waveform builder plus event handler. This MCU specifically addresses digital power conversion applications such as digital switched-mode power supplies, lighting, welding, solar and wireless charging high number of integrated analog peripherals leading to cost reduction at the application level and a simplification of the application design.

### STM32F334, the MCU tailored for digital SMPS

#### STM32F334

- Cortex®-M4 core
- High resolution timer with waveform builder and event handler
- High-speed ADCs for precise and accurate control
- Built-in analog peripherals for signal conditioning and protection (25ns from fault input to PWM stop)

### STM32 F0 series, the MCUs for cost sensitive applications

#### STM32F0\*8

#### STM32F0\*2

#### STM32F0\*1

#### STM32F0\*0

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



STM32F334 features

## MAIN APPLICATIONS



Solar



Welding



Commercial, architectural and street lighting



Server/Telecom



Factory automation

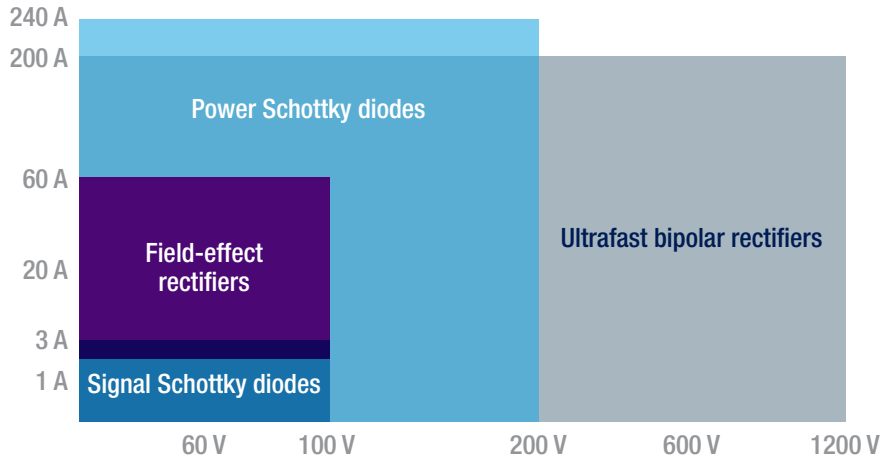


# DIODES AND RECTIFIERS

## Silicon diodes

ST offers **Schottky** and **ultrafast silicon rectifier solutions** for all market requirements. ST's latest developments include M series, based on Schottky technology, with improved avalanche rating and the integration of higher currents in low-profile PowerFLAT™ packages. Our range of small-signal Schottky diodes with flip-chip and SOD-923 devices helps meet the most stringent space-saving requirements, especially for portable communication equipment.

For high-efficiency rectification or freewheeling functions, our new field-effect rectifier diodes, **the FERD family**, improve the power density capability of the converters.



### Field-effect rectifiers (FERD)

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

### Power Schottky diodes

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

### Ultrafast rectifiers

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

## MAIN APPLICATIONS

**Adapters**  
Schottky, FERD

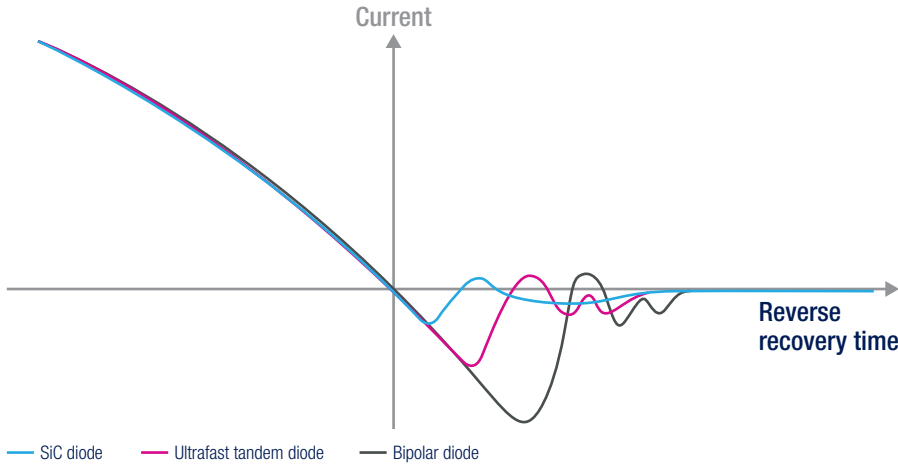
**Solar inverters and PFC**  
Ultrafast

[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

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



### SIC DIODES BENEFITS

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

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

#### STPSC\*06

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

#### STPSC\*065

#### STPSC\*13

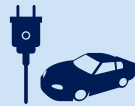
- 650 V (STPSC\*065)
- 2 x 650 V (STPSC\*13) dual in series diodes
- Best trade-off between efficiency and robustness thanks to the high I<sub>fsm</sub>
- Ideal for applications with high current surge

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### MAIN APPLICATIONS



Solar inverters  
STPSC\*06



HEV  
STPSC\*065



UPS  
STPSC\*06



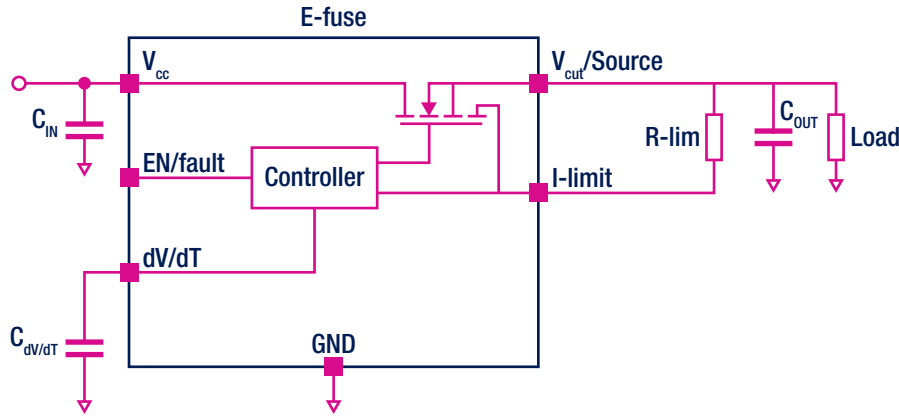
Servers/Telecoms and PFC  
STPSC\*065, STPSC\*13

# HOT-SWAP POWER MANAGEMENT

## E-fuses

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

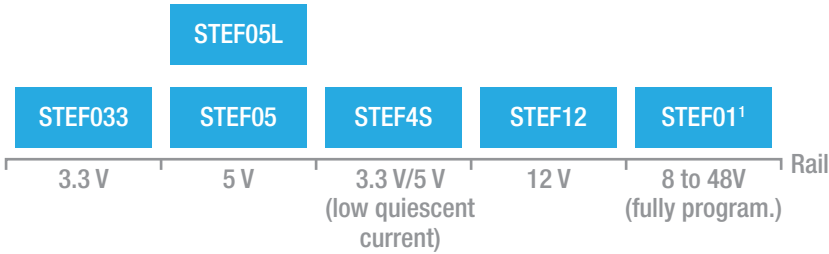
Unlike fuses, they offer complete and flexible management of the fault (overcurrent/overvoltage), without requiring replacement after actuation. They thus help to improve equipment uptime and availability and also reduce maintenance costs and false returns. Compared to traditional protection devices,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



### E-FUSE MAIN FEATURES

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

E-fuses, a smart offer for a lots applications



### 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.

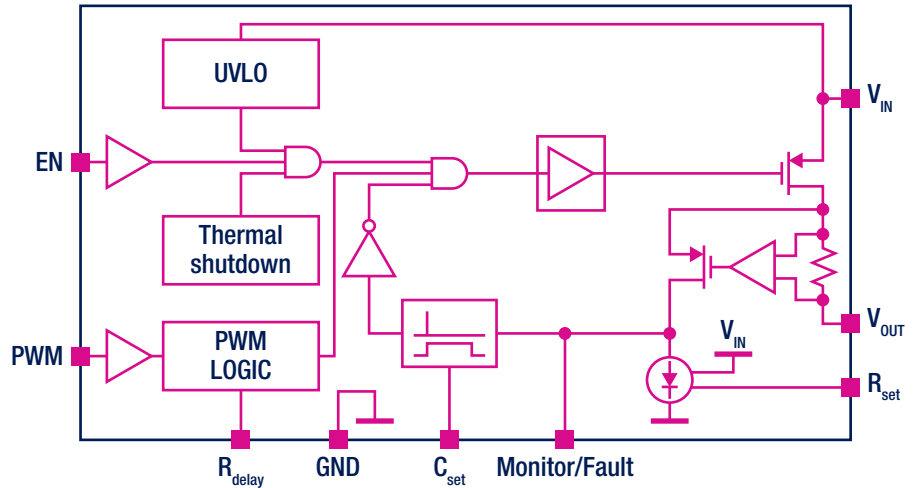
Current limiter ICs are designed to work with an external MOSFET to protect power supplies from anomalous external current demands.

### Power breakers

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

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

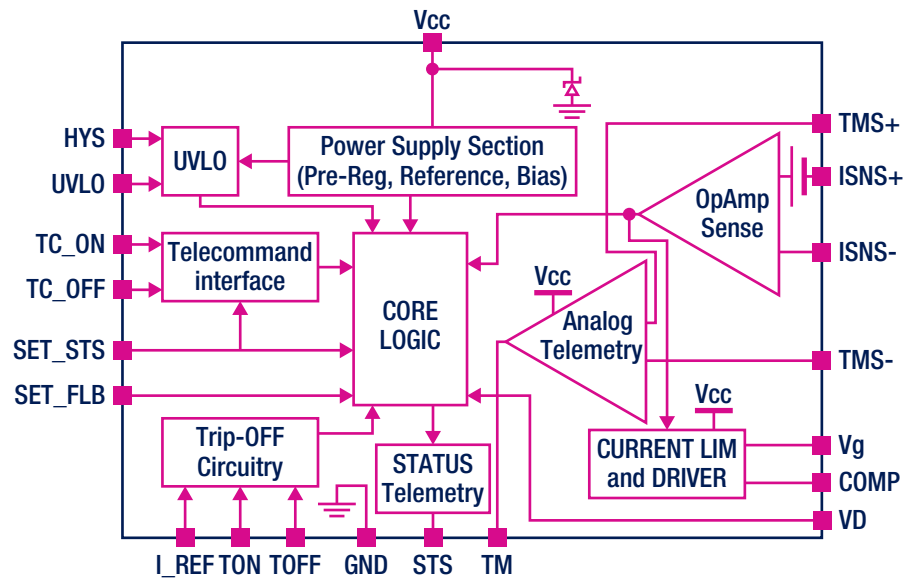
- Auto-retry function with programmable delay
- Adjustable precise power limitation from 11 to 16 W
- 5 V (STPW05) and 12 V (STPW12) rails
- Programmable power limit masking time
- Over-temperature protection
- Integrated N-channel power MOSFET
- Internal undervoltage lockout



### 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>



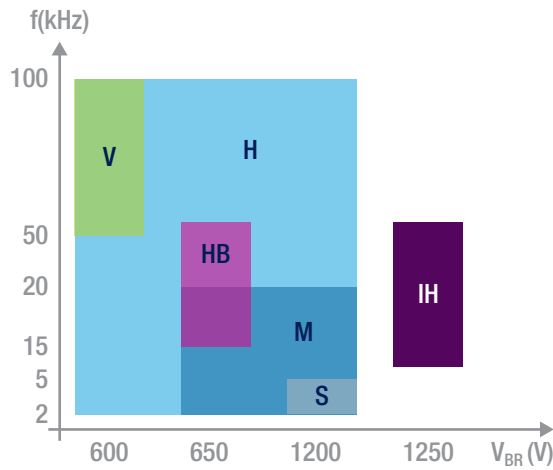
Factory automation  
STPW05<sup>1</sup>, STPW12<sup>1</sup>, STFC01



Servers/Telecoms  
STFC01

# IGBTs

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



## S series

**STG\*S\***

- 10 μs of short-circuit capability @ starting  $T_j = 150\text{ °C}$
- Wide safe operating area (SOA)
- Soft and fast recovery antiparallel diode
- Suited for asymmetric half-bridge topology

## M series

**STG\*M\***

- 6μs/10μs (650 V/1200 V series) short-circuit capability @starting  $T_j = 150\text{ °C}$
- Wide safe operation area (SOA)
- Soft and fast recovery antiparallel diode
- Suited for asymmetric half-bridge, 3-level half bridge, 3-phase inverter and full bridge topologies

## IH series

**STG\*IH\***

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

## HB series

**STG\*H\*B**

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

## H series

**STG\*H\***

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

## V series

**STG\*V\***

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

## MAIN APPLICATIONS



**Welding**  
H, HB, V



**Solar**  
Inverter: S, M - Boost: H, HB



**UPS**  
S, M, H



**Home appliances**  
H, HB



**Air conditioning**  
S, M, H, HB



**Motor control**  
S, M

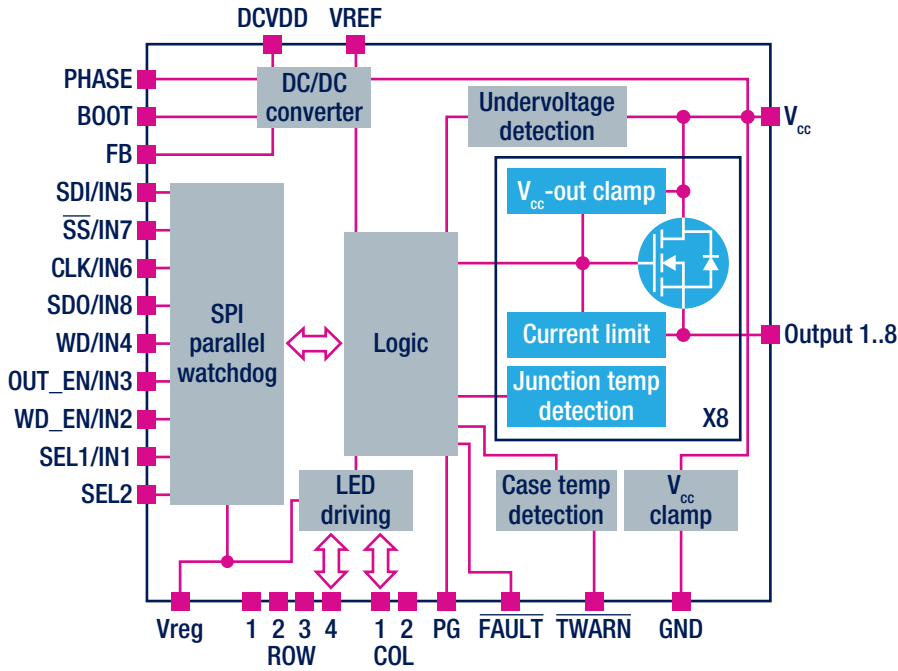


**Induction heating**  
HB, IH

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

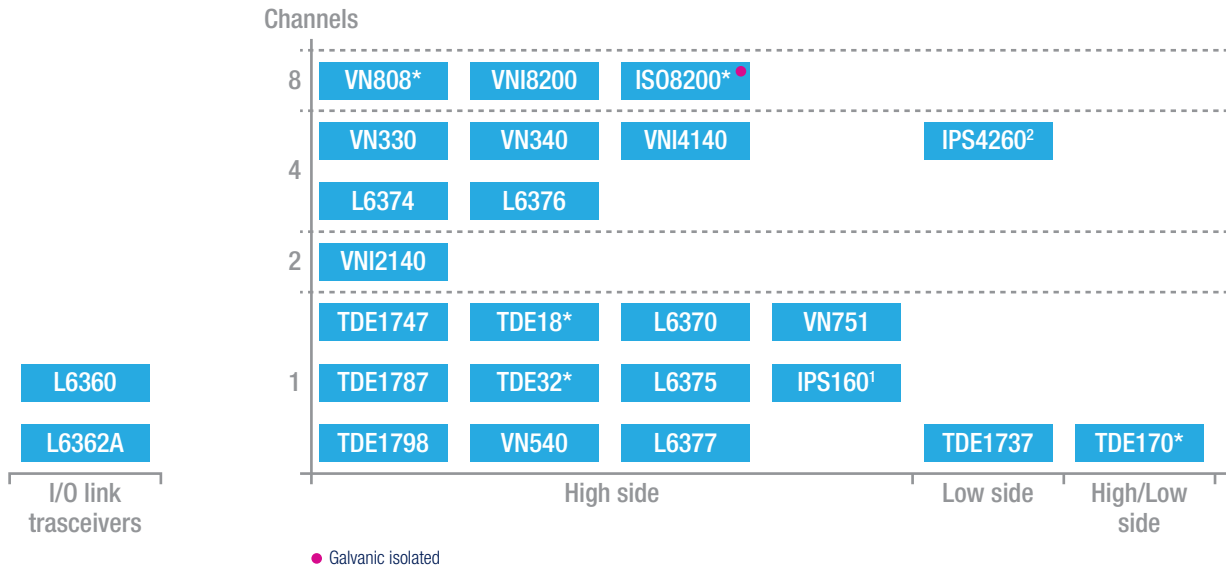
# INTELLIGENT POWER SWITCHES

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



- ### IPS MAIN FEATURES
- Logic
  - Driving
  - Protections
  - Diagnostic
  - Power stage
  - ...all on a single chip

ISO8200\*, the galvanic isolated IPS ideal for factory automation



## MAIN APPLICATIONS



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

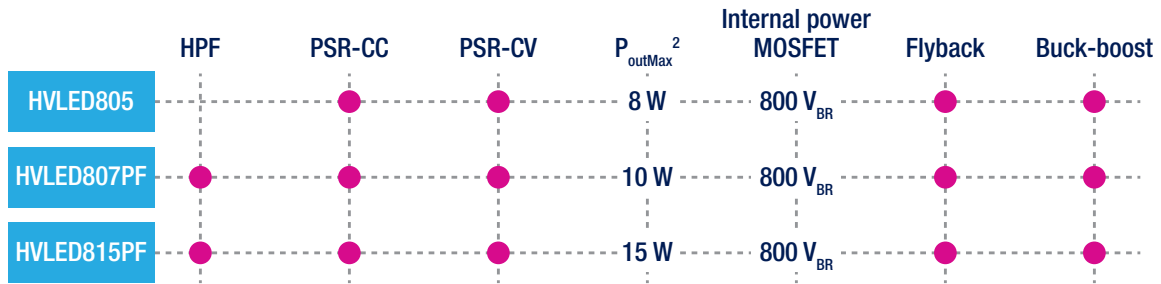


# LED DRIVERS

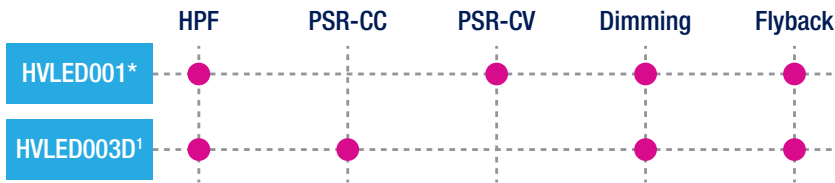
## Offline LED drivers

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

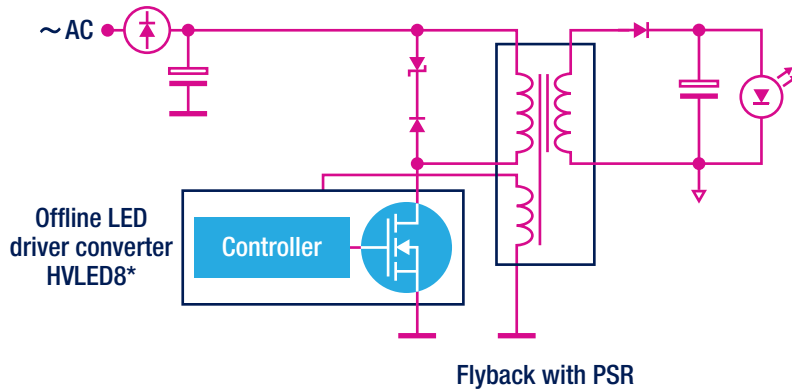
### Offline LED converters with PSR



### Offline LED controllers with PSR



### Topology example

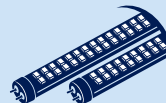


## MAIN APPLICATIONS



### Residential lighting

HVLED805, HVLED807PF, HVLED815PF



### Commercial, architectural, and street lighting

HVLED001\*, HVLED003D<sup>1</sup>

## 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.

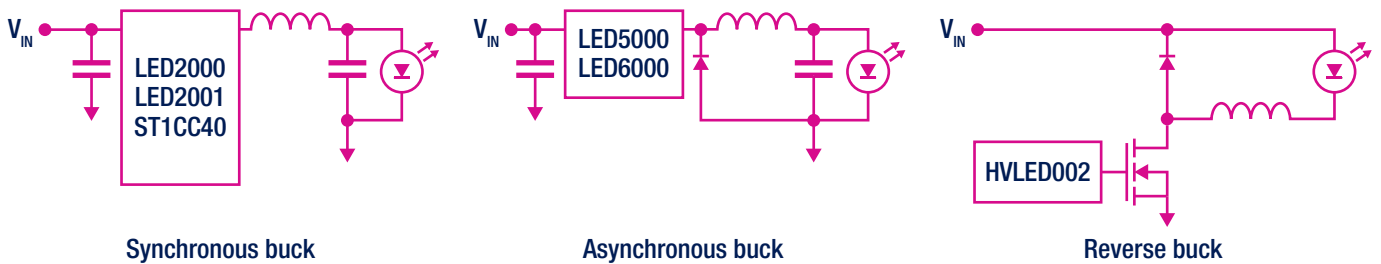
### DC-DC LED drivers converters



### DC-DC LED drivers controllers



### Topology examples



## MAIN APPLICATIONS



**Halogen bulbs replacements and home appliances**  
LED2000, LED2001



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



**Street lighting**  
LED5000, LED6000, HVLED002



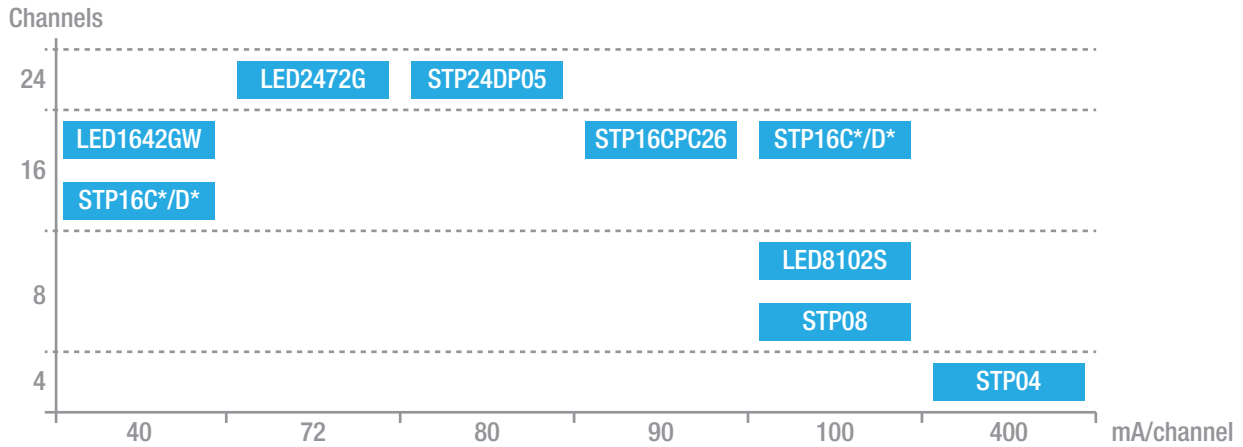
**Emergency lighting**  
LED6001, ST1CC40



**Commercial and architectural lighting**  
LED5000, LED6000, LED6001, HVLED002

## LED array drivers

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



### 24 channel RGB (8x3) drivers

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

### 16 channel drivers

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

### 4/8 channel drivers

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

## MAIN APPLICATIONS



### Traffic signals

LED8102S, LED2472G, STP24DP05, STP04



### Large panel signs

LED1642GW, LED2472G, STP24DP05, STP16, STP08



### Home appliances

LED8102S, STP16, STP08, LED1642GW



### Special lighting

STP04, LED1642GW, LED2472G, LED8102S

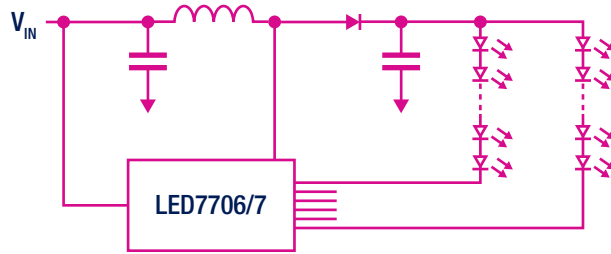
## LED row drivers

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

ST offers both single- and multi-channel high-efficiency boost LED drivers featuring a wide dimming range, low noise and small footprint. They also embed protection functions such as overvoltage and overcurrent protection, thermal shutdown and LED-array protection.

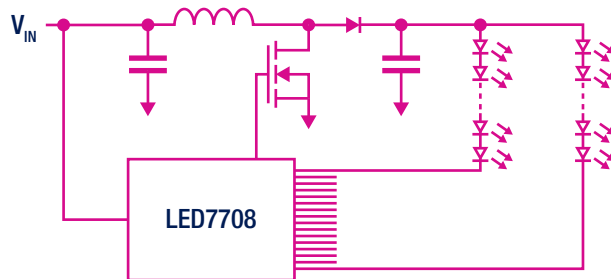
### LED row driver converters

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



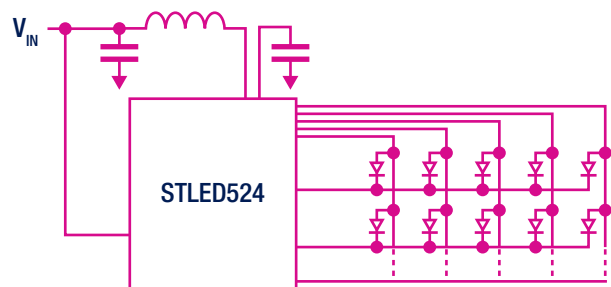
### LED row driver controllers

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



### LED matrix driver

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



## MAIN APPLICATIONS



Smartphones  
STLED25, STLD40D



Game consoles  
STLD41



Keyboard and accessories  
STLA02\*



Home appliances and ATMs  
LED7706, LED7707, LED7708

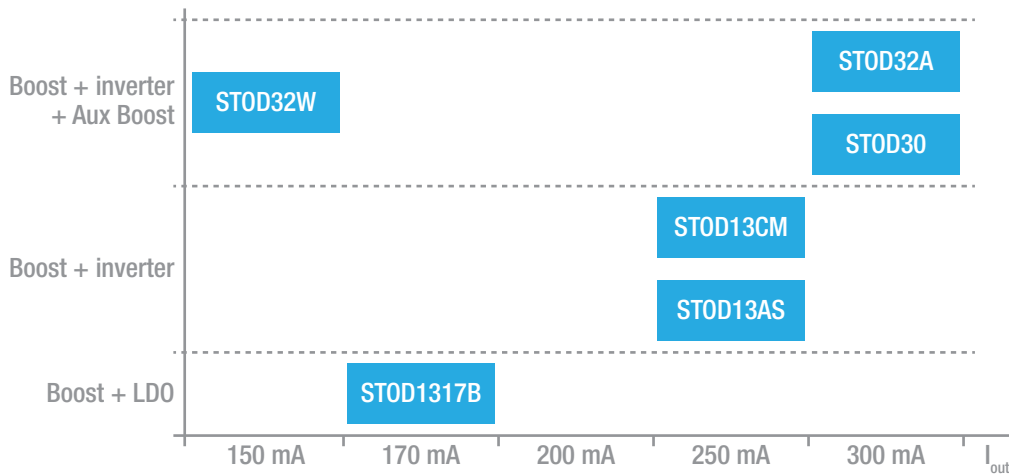


Wearables  
STLED524

## OLED drivers

ST supplies over 70% of the world's ICs to power AMOLED displays that enable today's advanced handheld devices to deliver high quality web and video experiences on the move.

ST's dedicated **AMOLED power ICs** add value to new designs by simplifying power supply in the circuitry ensuring outstanding energy efficiency and results in longer battery life. In addition, high immunity to mobile communication noise keeps display consistent and flicker free.



### 1 channel driver (for displays up to 4")

STOD1317B

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

### 2 channel drivers (for displays up to 5")

STOD13AS

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

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

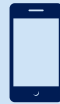
STOD30, STOD32W

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

## MAIN APPLICATIONS



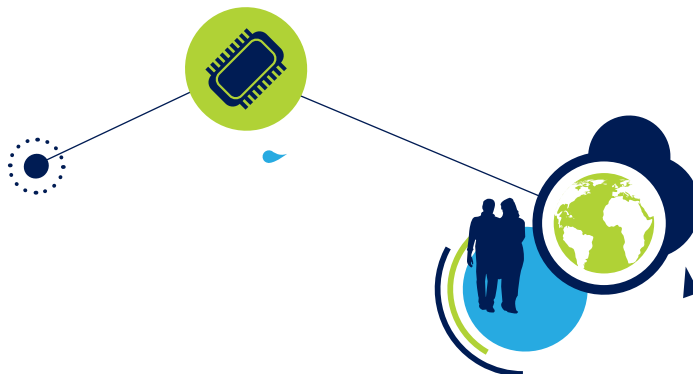
**Fitness and wearables**  
STOD32W, STOD1317B



**Low-end smartphones**  
STOD1317B,  
STOD13AS/CM, STOD30

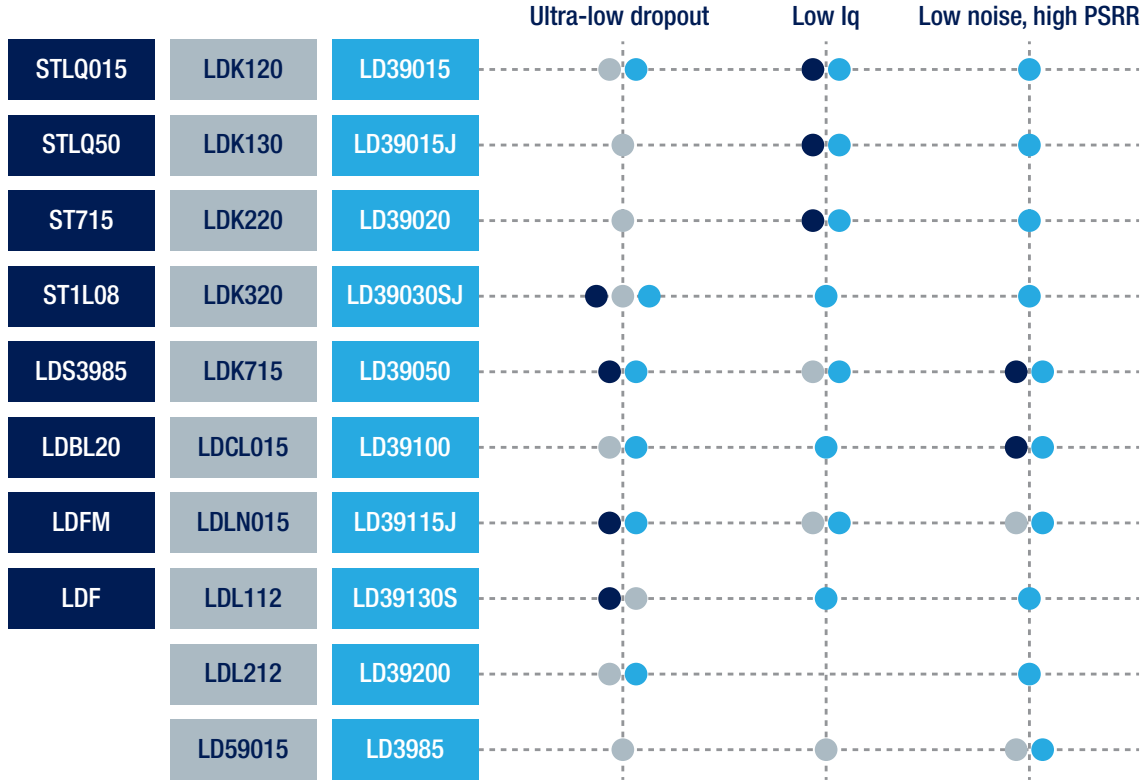


**High-end smartphones**  
STOD30, STOD32A



# LINEAR VOLTAGE REGULATORS

ST offers a complete portfolio of industry-standard high-performance regulators for both positive and negative outputs. Among our products, you can find the optimal combination of ultra-low dropout voltage (from 50 to 220 mV for 100 mA to 3 A load current) and low quiescent current - for the highest efficiency design - (from 1 to 20  $\mu$ 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

- High efficiency in low-/medium-power applications
- Best cost/performance trade-off
- Large offer for lout 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



**Healthcare**  
 STLQ\*, ST715, LD39130



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

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



# 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

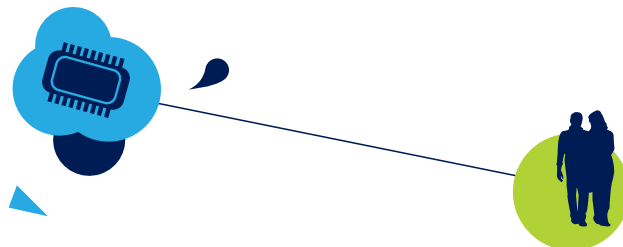
### Main common features

- 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



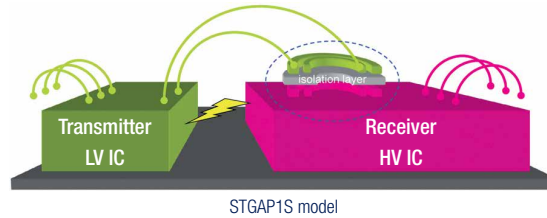
Set-top boxes and PC card satellite receiver



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

## MOSFET AND IGBT DRIVERS

ST's **power MOSFET and IGBT drivers** include integrated high-voltage half-bridge, single and multiple low-voltage gate drivers. The MOSFET/IGBT drivers provide state-of-the-art integration, reducing BOM cost and final application dimensions, while also increasing robustness and noise immunity. In particular the STDRIVEsmart families L639\*, L649\* and STDRIVEgap STGAP1S offer smart functionalities to protect and simplify application implementation and usage.



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



### 600 V Half bridge gate drivers

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

### Low side gate drivers

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

### Galvanically-isolated single gate driver

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

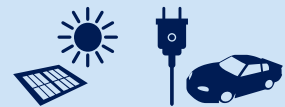
## MAIN APPLICATIONS



**Factory automation, home appliances, and motor control**  
L638\*E, TD35\*, L639\*, L6491, L6494L\*, L6498/L\*, PM8841, PM8851



**Commercial, architectural and street lighting**  
PM8834, PM8841, PM8851



**Solar inverters, HEV / EV, and factory automation**  
STGAP1S, PM8841, PM8851

# PHOTOVOLTAIC ICs

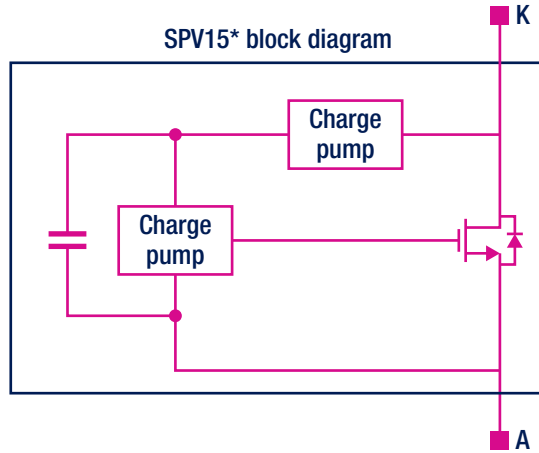
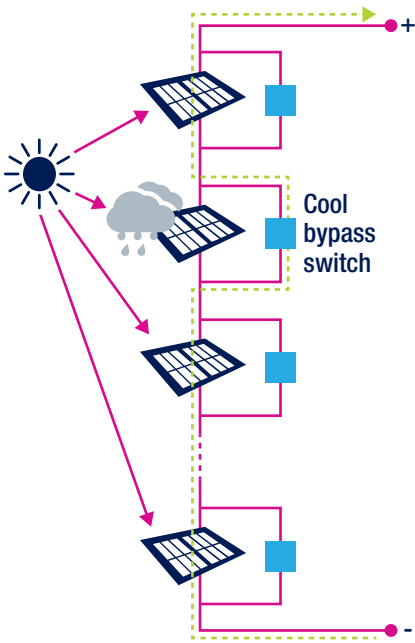
## Cool bypass switches

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

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

	Reverse voltage	Average current rectified
SPV1512N	12 V	16 A
SPV1520N	20 V	16 A
SPV1540N <sup>1</sup>	40 V	16 A

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



### MAIN APPLICATIONS



Centralized and distributed solar solutions

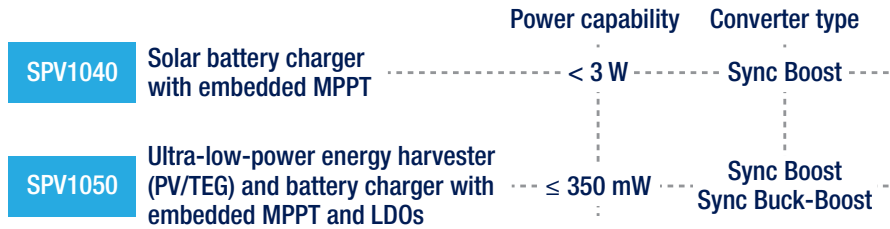
Note: 1: available in Q3 2016

## DC-DC converters with embedded MPPT algorithm

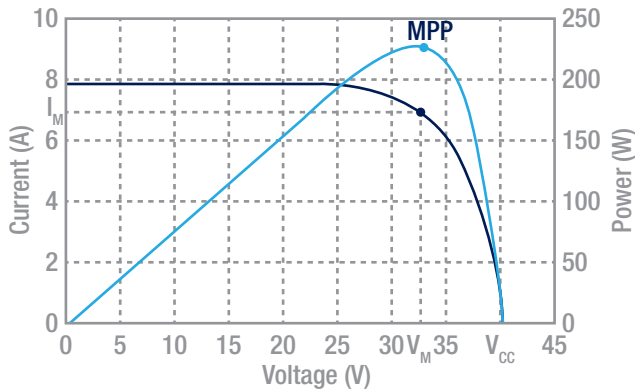
The maximum power point tracking (MPPT) algorithm maximizes the power output by photovoltaic panels according to temperature and solar irradiation conditions.

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.

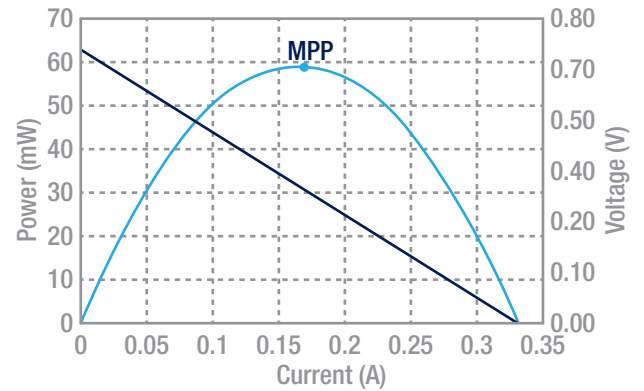
The SPV1050 is an ultra-low-power battery charger and energy harvester (from photovoltaic cells or a thermo-electric generators) that guarantees a very fast charge of supercapacitors and any type of battery including thin-film solid-state batteries. It is specifically designed to work in indoor environments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



Solar curves



Thermo-electric generator (TEG)



### MAIN APPLICATIONS



Smartphones, digital cameras, and camcorders  
SPV1040



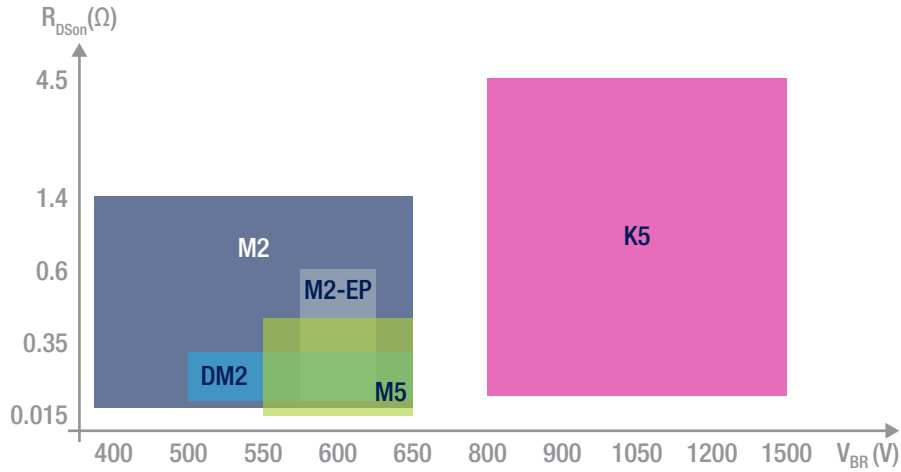
Fitness, climate, home and factory automation monitoring  
SPV1050



# POWER MOSFETS

## High-voltage power MOSFETs (silicon)

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



### K5 series

ST\*N\*K5

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

### M5 series

ST\*N\*M5

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

### M2/M2-EP series

ST\*N\*M2

ST\*N\*M2-EP

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

### DM2 series

ST\*N\*DM2

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

## MAIN APPLICATIONS



Adapters

K5, M5, M2, M2-EP



Solar inverters, welding, HEVs, and UPS



K5, M5, DM2



Residential, commercial, architectural and street lighting

K5, M2



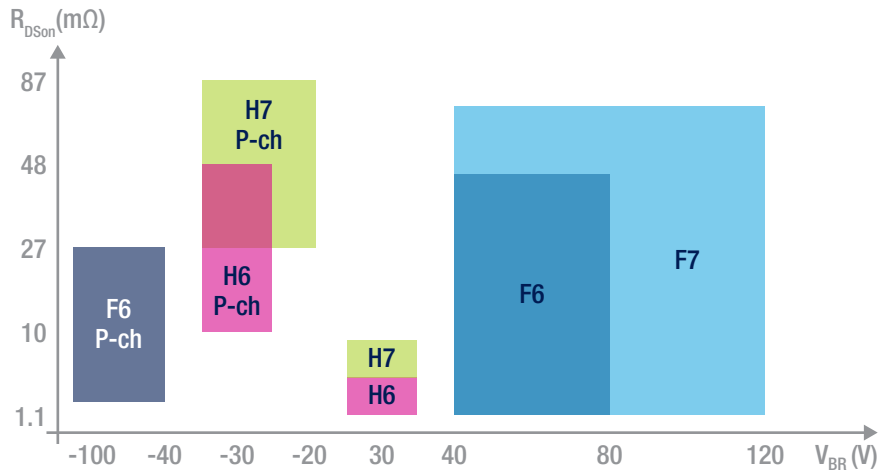
Servers/Telecoms

M5, M2, M2-EP, DM2

## Low-voltage power MOSFETs (silicon)

ST's LV **MOSFET** portfolio offers a broad range of breakdown voltages from -100 V to 120 V, with low gate charge and low on-resistance, combined with state-of-the-art packaging.

ST's STripFET MOSFETs support a wide voltage range for synchronous rectification, UPS, motor control, SMPS, power-over-Ethernet (PoE), inverter, automotive and other applications in a wide range of miniature and high-power packages: DPAK, D<sup>2</sup>PAK, ISOTOP, Max247, SOT-223, TO-220, TO-220FP, TO-247, PowerFLAT (5 x 6 mm)/(3.3 x 3.3 mm)/(2 x 2 mm), SO-8 and SOT23-6L.



### H6 series

ST\*N\*H6

- Very good R<sub>DS(on)</sub>
- Soft diode recovery
- Suited for OR-ing, square-wave HB, battery mgmt topologies

### H7 series

ST\*N\*H7

- Extremely low R<sub>DS(on)</sub>
- 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<sub>DS(on)</sub>
- Suited for load-safety switch, buck and sync rectification

### F7 series

ST\*N\*F7

- Extremely low R<sub>DS(on)</sub>
- Optimized body diode (low Q<sub>rr</sub>) and intrinsic capacitance
- Proper Crss/Ciss ratio
- Suited for flyback and sync rectification

## MAIN APPLICATIONS



Small motor control and  
USB battery chargers

F6



HDD, power tools, STB,  
and game consoles

H6, H7



Servers/Telecoms  
and SMPS

H6, H7, F6, F7



UPS, e-bikes,  
and fans

F6

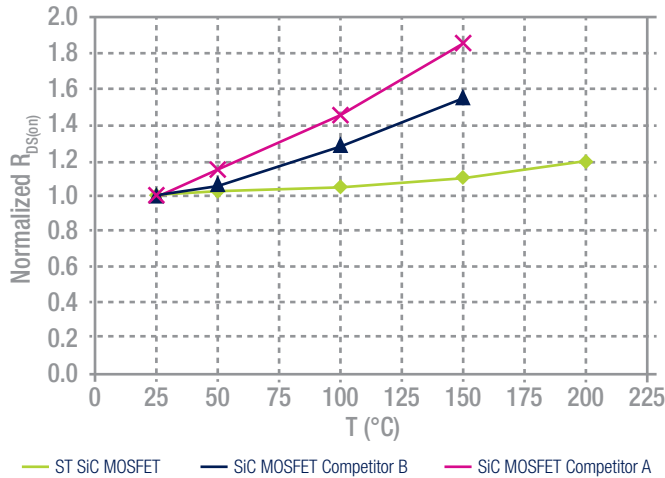


Solar inverters,  
forklifts, and EHV

F7

## SiC MOSFETs

Based on the advanced and innovative properties of wide bandgap materials, ST's silicon carbide (SiC) MOSFETs feature very low RDS(on) per area for the 650 V/1200 V rating combined with excellent switching performance, translating into more efficient and compact designs. ST is among the first companies to produce high-voltage **SiC MOSFETs**. This new family features the industry's highest temperature rating of 200 °C for improved thermal design of power electronics systems. Compared to silicon MOSFETs, SiC MOSFETs also feature significantly reduced switching losses with minimal variation versus the temperature. These features render the device perfectly suitable for high-efficiency and high power density applications.



### SiC MOSFETS MAIN BENEFITS

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

### SiC MOSFETs, the real breakthrough in high voltage switching

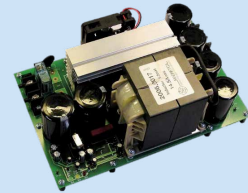
SCT\*N120

SCT\*N65G2\*

SCT\*N65G2V\*

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

### MAIN EVALUATION BOARD



4 kW  
Boost inverter evaluation board  
Available on request

55

### MAIN APPLICATIONS



Motor control



HEVs / EVs



Welding



UPS

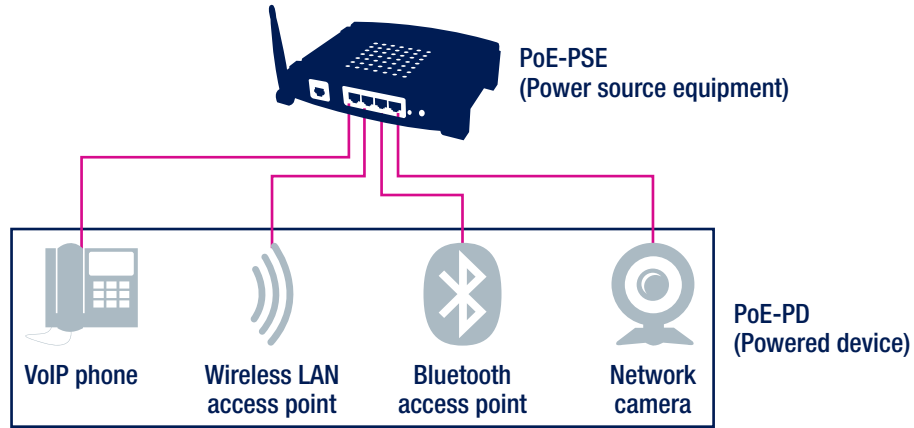


Solar inverters



## 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

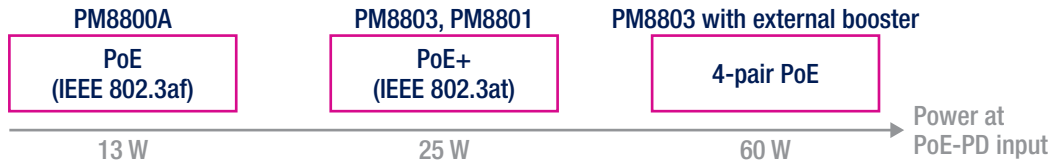
- Sleep mode with LED indicator and Maintain Power Signature
- IEEE 802.3at PD interface + PWM current mode ctrl with double gate driver
- Integrated 100 V, 0.45 W, 640 mA hot-swap MOSFET
- Supports flyback, forward active clamp, and flyback with synchronous rectification topologies

#### 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

56

### Main standards

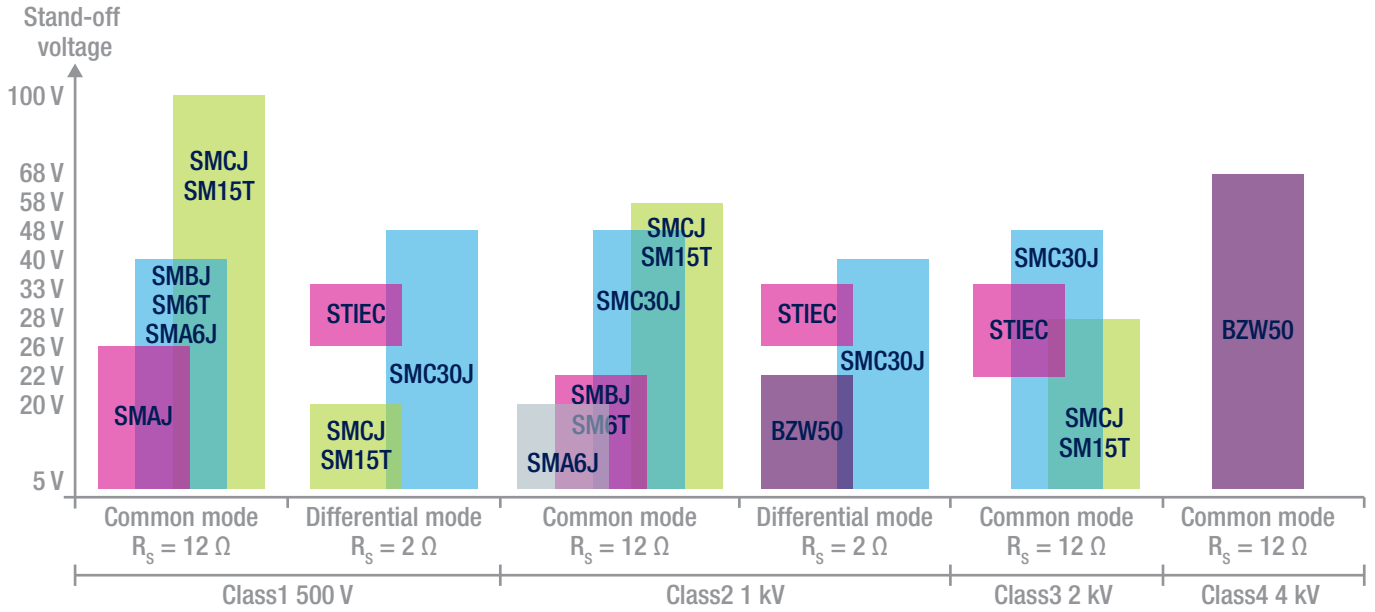


## PROTECTION DEVICES

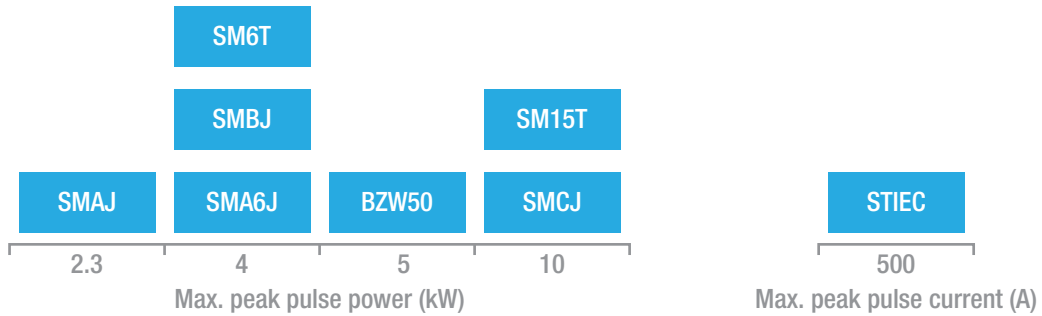
### EOS 8/20 $\mu$ s surge protection

ST's **EOS 8/20  $\mu$ s power surge protectors and suppressors** comply with the IEC 61000-4-5 surge standard. Including transient voltage surge suppressors, TVS clamping or Transil™ diodes, the EOS 8/20 protections shield against surges related to power/datalines and fully support both power line and dataline application class requirements.

A large choice of packages, from 0402 to SMC packages, is provided to bring flexibility to designers and reliability to the application.



### EOS protections, upgraded performance at high application temperature



### MAIN APPLICATIONS



Offline and DC-DC power supplies, PFC



Solar inverters

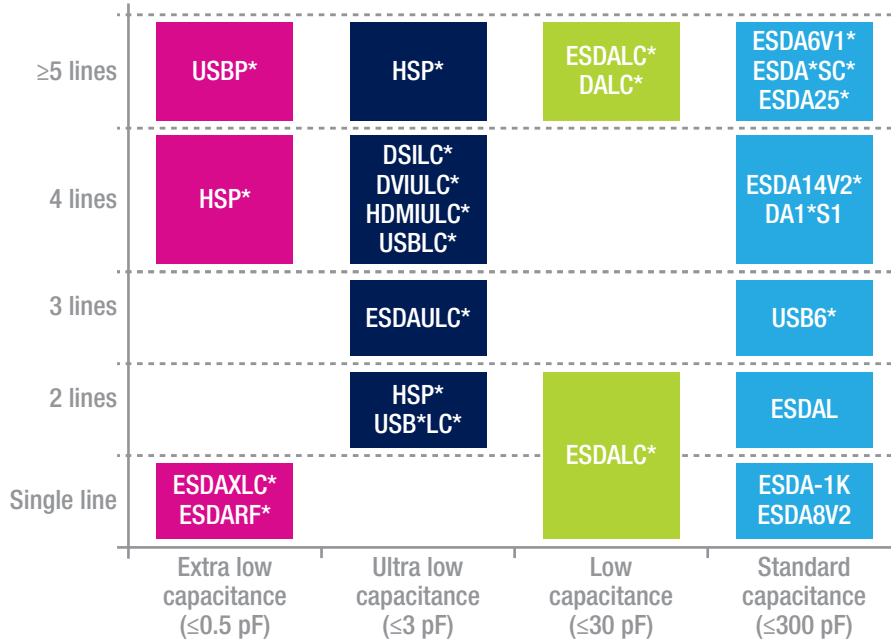


Smart metering

## ESD protection

Driven by market needs, **ST's ESD protection devices**, including transient voltage surge suppressors (TVS), clamping diodes and arrays, or Transils™, focus on IEC 61000-4-2 compliance, protection efficiency with low clamping voltage, protection reliability with low leakage current and signal integrity with ultra-low capacitance and ultra-wide bandwidth.

Standard packaging options are available, as well as advanced options which include single- and multiple-line, compact, flat, and flow-through versions to optimize space constraints.



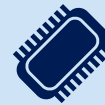
### MAIN APPLICATIONS



Tablets, smartphones, and digital cameras



Healthcare



I/O microcontrollers and signal conditioning



Factory automation  
Human machine interface (HMI)



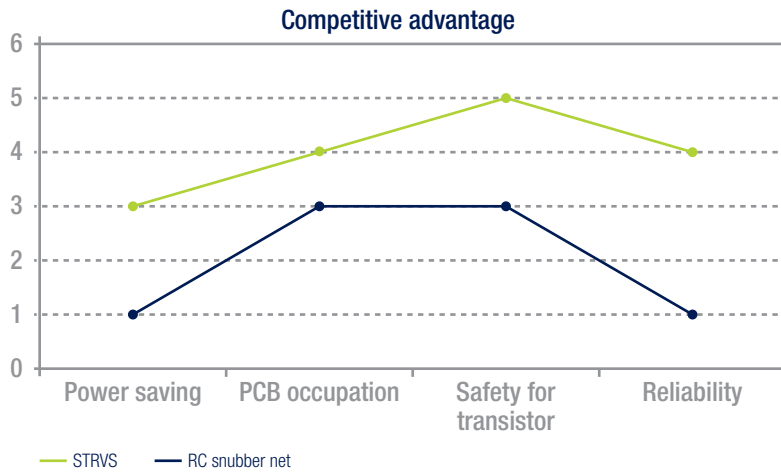
Smart metering



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.



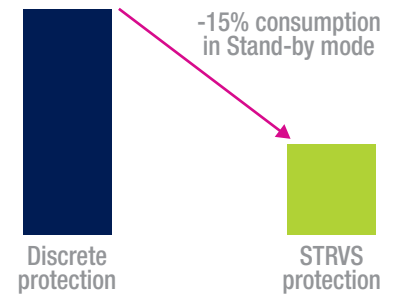
### STRVS MAIN BENEFITS

- 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

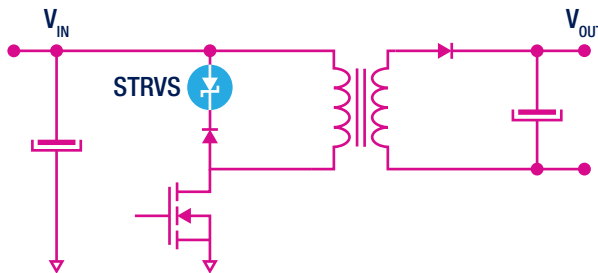
## STRVS, the Transil series dedicated against repetitive overvoltage in high temperature conditions

### 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

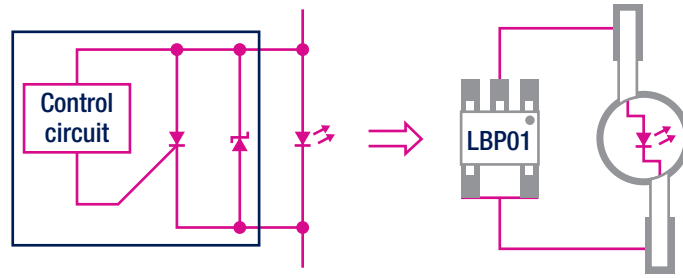


Residential, commercial, architectural and street lighting

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

## LED bypass protection

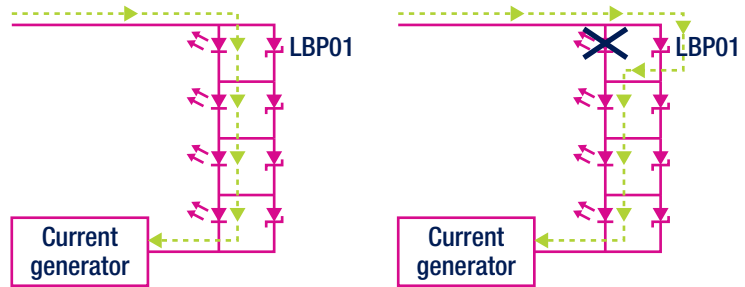
The **LBP01 series** of LED bypass protection devices are bypass switches that can be connected in parallel with 1 or 2 LEDs. In the event of a LED failure, this device shunts the current through other LEDs. It also provides overvoltage protection against surges as defined in IEC61000-4-2 and IEC61000-4-5.



## LBP01 get reliable your led application

### LBP01

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



## MAIN APPLICATIONS



Display panels



Residential, commercial, architectural and street lighting



Emergency lighting



Traffic signals

[www.st.com/lbp01](http://www.st.com/lbp01)



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