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With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

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Power management Guide 2017





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Introduction



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



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





Applications

POWER SUPPLIES

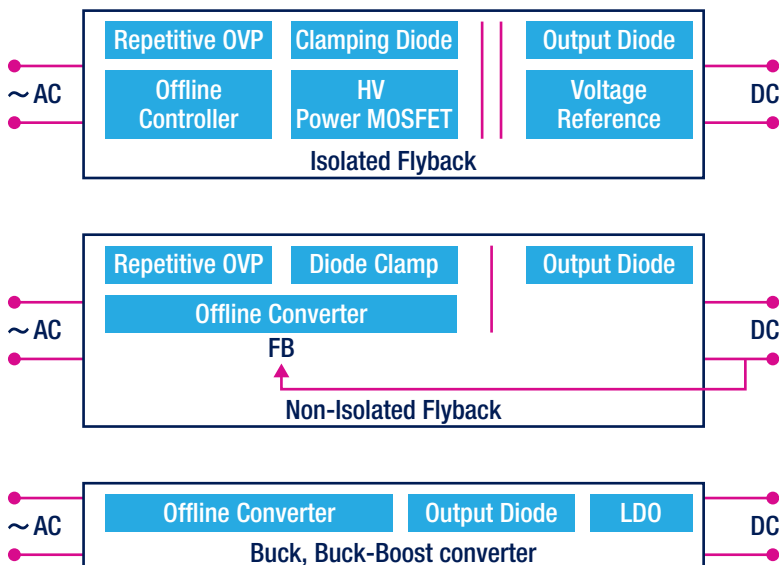
Auxiliary SMPS

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

		Offline converters		Offline controllers	HV power MOSFETs	Repetitive overvoltage protections	Clamping diodes	Volt. ref.	Output diodes	LDO
Buck		VIPerOP		-	-	-	-	-	STTH*06 STTH*08 STTH*10	
Buck-boost		VIPer*1								
Non-isolated flyback		VIPer*6								
Isolated flyback	PSR-CV	-		STCH02 L6566B	ST*N80K5 ST*N90K5 ST*N95K5 ST*N105K5 ST*N120K5 STW12N150K5 STW21N150K5 ST*3N170 SCT1000N170' (SiC MOSFET)	STRVS*	STTH*06 STTH*08 STTH*10 STTH*12	T*431 T*432	STPS* FERD*45 FERD*50 FERD*60 FERD*100	LDF, LDFM LDK220, LDK320 LDL212
	Regulation with optocoupler	VIPer*5 VIPer*7 VIPer*8	VIPerOP VIPer*1 VIPer*6 ALTAIR*							

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Typical configuration



MAIN EVALUATION BOARDS



STEVAL-ISA096V1
2 W, buck-boost



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



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



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

Note 1: coming soon * is used as a wildcard character for related part number

Battery chargers

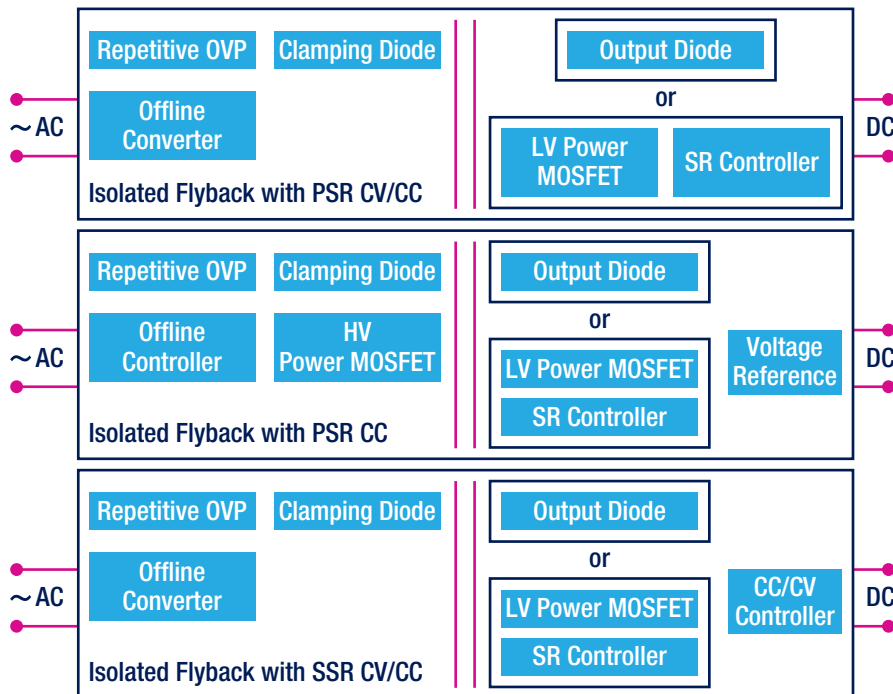
Designing lighter, smaller wall chargers for portable devices is one of the most critical challenges for developers. Excellent standby power consumption, high efficiency in all load conditions, primary-side regulation (PSR) control methods and a set of integrated protections (to minimize the component 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		Controllers	Power MOSFETs		Repetitive overvoltage protections	Clamping diodes	Output diodes	CC/CV controllers or Voltage Reference
			HV	LV							
Wall side	Flyback	SSR-CV/CC	VIPer*5 VIPer*7 VIPer*8	VIPer0P VIPer01V VIPer*6	-	-	-	STRVS*	STTH*06 STTH*08 STTH*10	FERD*45 FERD15S50 FERD20U50 FERD20U60 FERD*100 STPS*	TSM10* SEA0*
		PSR-CV	-	-	HVLED001A	ST*N65M2 ST*N65M6 ST*N70M6 ¹	-				T*431 T*432
		PSR-CC	-	-	STCH02	SCTH35N65G2V-7 ² (SiC MOSFET)	-				-
		PSC CV/CC	ALTAIR*	-	-	-	-				-
		Synch Rect	-	-	STSR30	-	ST*N4F7 ST*N6F7 ST*N10F7				-

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

Typical configuration



MAIN EVALUATION BOARDS



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



STEVAL-ISA176V1
5 W, optoless battery
charger



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

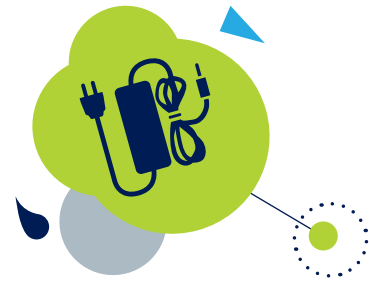


STEVAL-ISB041V1
Li-Ion/Li-Po linear battery
charger evaluation board
based on STBC02

Note 1: MP Q4 2017 2: coming soon * is used as a wildcard character for related part number

Adapters

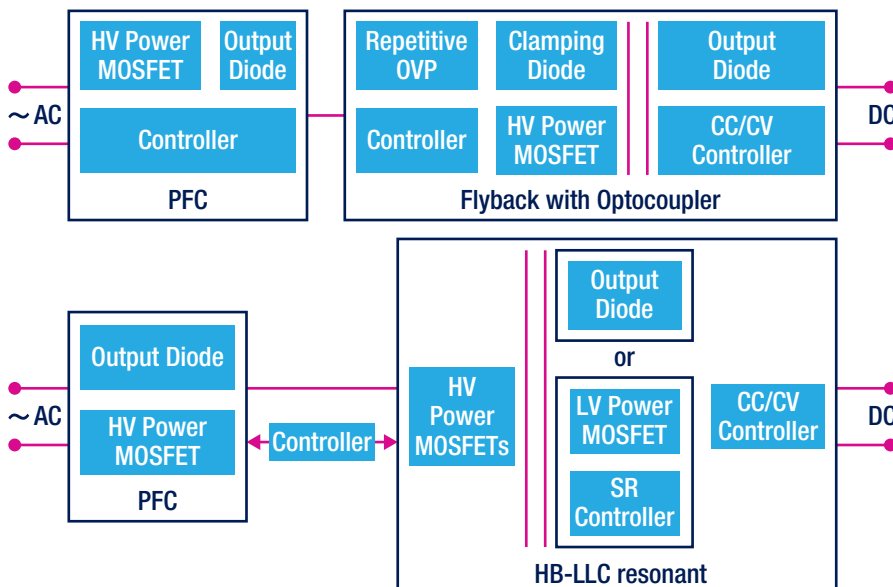
The adapter trend goes towards a significantly higher efficiency level, especially in partial load conditions, as well as towards their miniaturization (slimmer and lighter). Adapters require ICs enabling high efficiency with good EMI performance and low standby power, high performance MOSFETs in small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



		Offline converters		Controllers		Power MOSFETs		Repet. overvolt. protect.	Clamping diodes	Output diodes	CC/CV contr.	Volt. ref.	DC-DC conv.	LDO
						HV	LV							
Flyback	Regulation with optocoupler	VIPer*5 VIPer*7 VIPer*8	VIPer0P VIPer*1 VIPer*6 ALTAIR*	L6566B L6566A	STCH02	ST*N80K5 ST*N90K5 ST*N95K5	-	STRVS*	STTH*06 STTH*08 STTH*10	STPS* FERD*45 FERD*50 FERD*60 FERD*100	TSM10* SEA0*	T*431 T*432	-	ST715 LDK320
	PSR-CV	-	-	-	-	-	-	-	-	-	-	-	-	-
PFC Boost	TM	-	-	L6562A* L6563* L6564*	STCMB1	ST*N50M2 ST*N60M2 ST*N65M2 ST*N55M5 ST*N65M5 ST*N60M6	-	-	-	STTH*L06 STTH*06	-	-	-	-
DC-DC stage	HB-LLC	-	-	L6599A* L6699	STCMB1	ST*N50DM2 ST*N60DM2 ST*N60M2 ST*N60M2-EP ST*N65M2-EP ST*N60M6	-	-	-	STPS* FERD*45 FERD*50 FERD*60 FERD*100	TSM10* SEA0*	T*431 T*432	ST1S3*	ST715 LDK320
Sync rect.	Flyback	-	-	STSR30 STSR2*	-	-	ST*110N10F7 ST*100N10F7	-	-	-	-	-	-	-
	Forward	-	-	SRK2000A SRK2001	-	-	STL*NS3LLH7 ST*N4LF7 ¹ ST*N6F7 STL130N8F7 ST*N10F7 ST*NF20D	-	-	-	-	-	-	-

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Typical configuration



MAIN EVALUATION BOARDS

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

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

USB Type-C™ Power delivery chargers and adapters

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

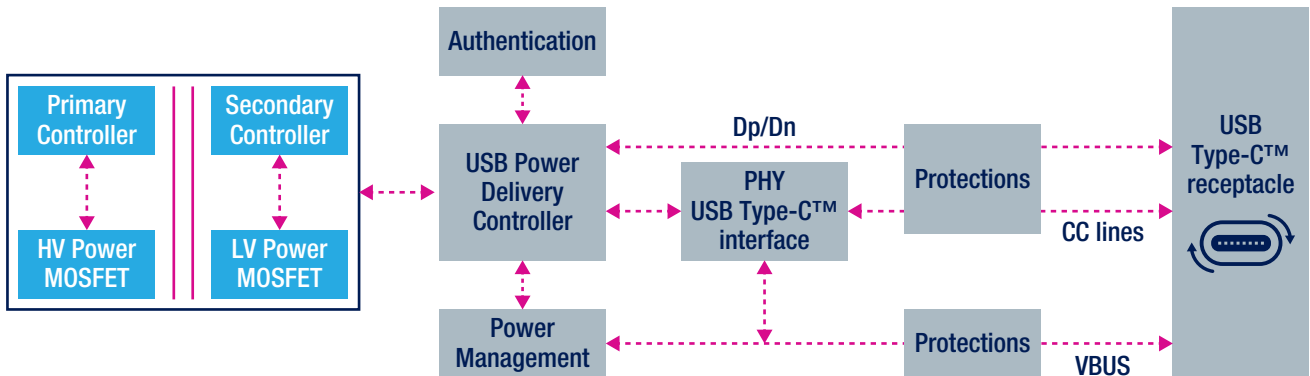
ST's portfolio for USB Type C and Power Delivery is designed to cope with various hardware/software partitioning solutions in order to best match your specific application requirements and design architecture: controllers ranging from STM32 general purpose MCU to hard-coded solution to fit different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

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

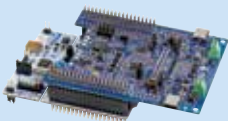


USB Type-C Power Delivery Subsystem							
	Type-C and USB-PD Controllers			Authencitcation & Secure MCUs	Protections		LDO
	Chipset		Hard Coded Controllers		ESD & EOS Protections for VBUS Power Delivery	ESD & EOS Protections for Communication Channel (CC lines)	
	MCUs	Type-C Controller/Interface				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

Typical configuration



MAIN EVALUATION BOARDS



P-NUCLEO-USB002
STUSB1602A USB Type-C and Power Delivery Nucleo Pack



STEVAL-CCC001
STUSB1600A USB Type-C evaluation board



STEVAL-ISC004V1
STUSB4710A evaluation board



STEVAL-USBPD45H²
45 W USB PD Type-C adapter based on STCH02 and STUSB4700

Note 1: under development 2: Available Q4 2017 * is used as a wildcard character for related part number

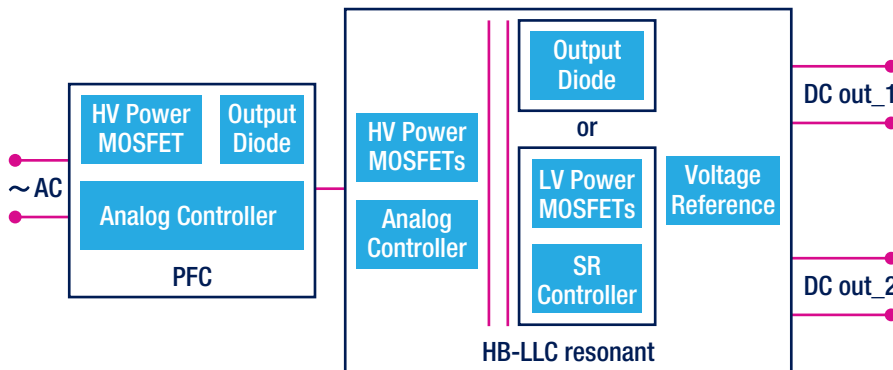
TV power supply units (PSU)

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, M2-EP, M6, DM2, M5 series), low-voltage STripFET MOSFETs (F7 series), FERD/Schottky and Ultrafast diodes are available in low-profile SMD packages such as PowerFLAT™ 3.3x3.3 and PowerFLAT™ 5x6. Furthermore the MDmesh™ M2 series is available also in the new TO-220FP wide creepage and in the new TO-220FP ultra narrow lead package. STRVS protections against repetitive over-voltages feature small packages including flip-chip, SOD and uQFN. Dedicated smart analog controllers for PFC, HB-LLC resonant circuit, including the new combo controller (STCMB1) for both stages, and those for synchronous rectification enable energy-saving, high-power-density and lower-standby-power design solutions including protection features that are suitable for universal use in TVs of all sizes. The new generation of TV digital power supply units based on our STM32 microcontrollers or STNRG digital controllers guarantee more efficient and flexible solutions.



		Controllers		Gate drivers	Power MOSFETs		Repet overvolt. protect.	Clamping diodes	Output diodes	Volt. ref.	DC-DC conv.
		Analog	MCU and digital		HV	LV					
Flyback		L6566A L6566B	-	-	ST*N80K5 STxN90K5 ST*N95K5	-	STRVS*	STTH*06 STTH*08 STTH*10	STPS* FERD*45 FERD*60 FERD*100 STPS*LCD170CB	T*431 T*432	-
PFC Boost	CCM	L4981* L4984D	STM32F0* STM32F1* STM32F334 STNRG*	TD35* PM8841 PM8851	ST*N60M2 ² ST*N65M2 ST*N65M5 ST*N60M6	-	-	-	STTH*R06 STTH*T06 STPSC*065 (SiC Diodes) STTH*L06 STTH*06	-	-
	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 ST*N60M6	-	-	-	STPS*	T*431 T*432	ST1S0* ST1S12 ST1S3* ST1S4* ST1S50 L598*
Sync rect.	HB-LLC	SRK2000A SRK2001	STM32F0* STM32F301 STM32F334 STNRG*	PM8834	-	-	-	-	-	-	-
	Flyback	STSR30									

Typical configuration



MAIN EVALUATION BOARDS



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

Desktop PCs

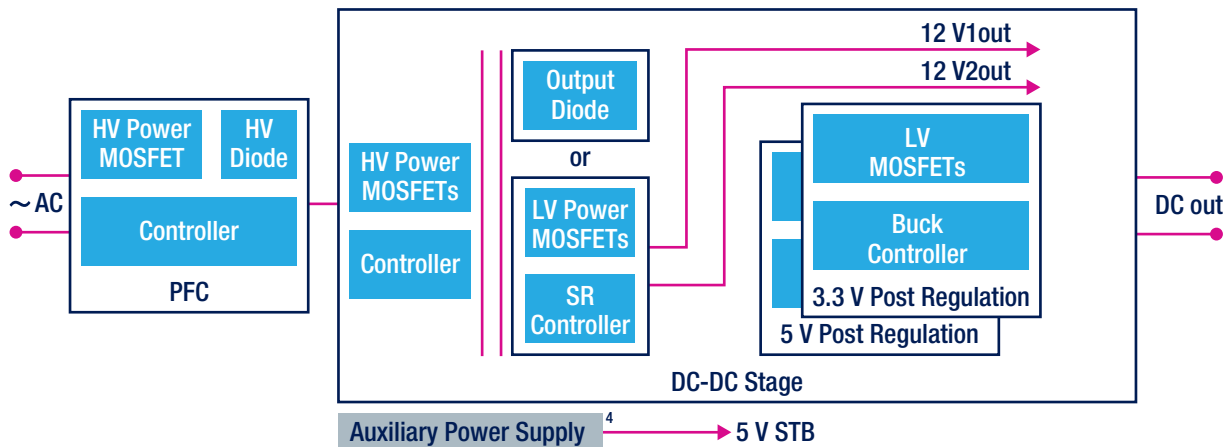
The requirements for the standard ATX PC power market are a small form factor with better performance.

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



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

Typical configuration



MAIN EVALUATION BOARDS



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

Note 1: MP Q4 2017 2: 600 V MDmesh™ M2 series is available also in the new TO-220FP wide creepage and in the new TO-220FP ultra narrow lead package 3: samples available by Q3 2017
4: refer to dedicated page * is used as a wildcard character for related part number

Servers and telecoms: AC-DC power supply

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

ST offers a high-performing product portfolio reducing the total cost of the solution: SiC diodes (STPSC*), high-voltage MDmesh™ MOSFETs (for PFC and DC-DC stages), low-voltage STripFET MOSFETs (for synchronous rectification stage), new STDRIVEsmart gate drivers (L639*, L649*). Smart controllers are available for the mentioned stages. For higher efficiency and power density systems, ST can offer also the breakthrough SiC MOSFET devices and the latest digital controller STNRGPF01.

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

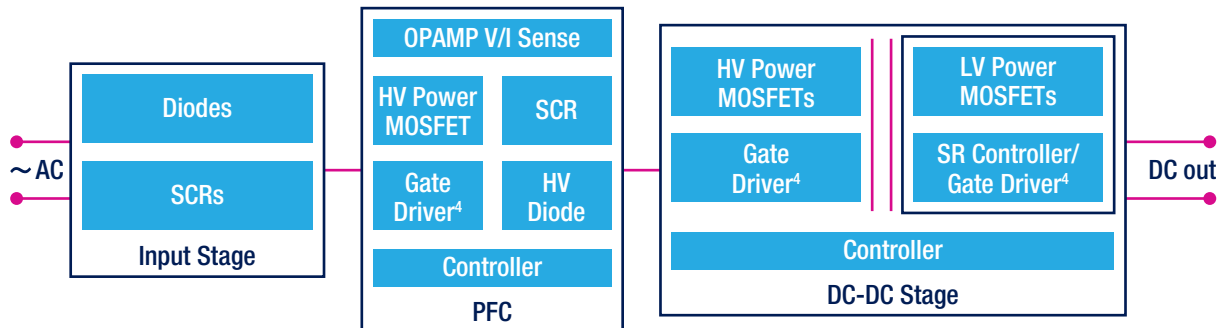
For the post-regulation, from 48 V to point-of-load (CPUs, memories and ASICs), ST's multi-IC direct power conversion enables a more efficient approach.



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	SCRs	Controllers		Gate drivers	Power MOSFETs		Diodes	DC-DC converters		E-fuses	LDO & Op Amps	
		Analog	MCU and digital		HV	LV		HV	LV			
Input Stage (Rect. & inrush current limiter)	TN1515-600B TN2015H-6 TN4015H-6 TN5015H-6 TM8050H-8 TN3050H-12Y TN5050H-12Y	-	-	-	-	-	STBR3012 STBR6012	-	-	-	-	
PFC	Boost	-	L4981* L4984D	STM32F0* STM32F301 STM32F334 STNRG* STNRGPF01	TD35* PM8841 PM8851 PM8834	ST*N60M2 ST*N65M2 ST*N65M5 ST*N60M6	-	STTH*R06 STTH*T06	-	-	-	
	Interl. Boost											
	Bridgeless					SCT*35N65G2V1 SCT*90N65G2V1 (SiC MOSFETs)	-	STPSC*065 (SiC Diodes)	-	-	-	
	Totem Pole	TN3050H-12WY TN5050H-12WY			STGAP1AS	SCT*35N65G2V SCT*90N65G2V1 (SiC MOSFETs)		STTH30L06* STBR*012*				TN3050H-12WY TN5050H-12WY
DC-DC stage	HB-LLC	-	L6599A* L6699	STM32F334 STNRG*	L638* L639* L649*	ST*N50DM2 ST*N60DM2 ST*N60M2 ST*N65DM2 ST*N60DM6 ST*N65DM6 ³	-	STPS* FERD*45 FERD*50 FERD*60 FERD*100 STTH*	L698* ST1S14 L7985 L7986 L7987*	ST1S3* ST1S4* ST1S50 L598*	STEF01 STEF05 STEF12	LDF LDFM LD39050 LD39100 LD39200 LDL112 LDL212 LD59100
	HB-LC											
	FB-PS											
	Asym HB		L6591									
Sync rect.	HB-LLC	-	SRK2000A SRK2001		PM8834	-	STL*NS3LLH7 ST*N4LF7 ² ST*N6F7 ST*N10F7 ST*NF20D	-	-	-		-
	Asym HB											

Typical configuration



Note 1: coming soon 2: MP Q1 2018 3: samples available by Q4 2017 4: only for Digital Controller * is used as a wildcard character for related part number

MAIN EVALUATION BOARDS



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



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



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



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



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



EVAL-IPFC01V1
3 kW three-channel
interleaved PFC



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

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

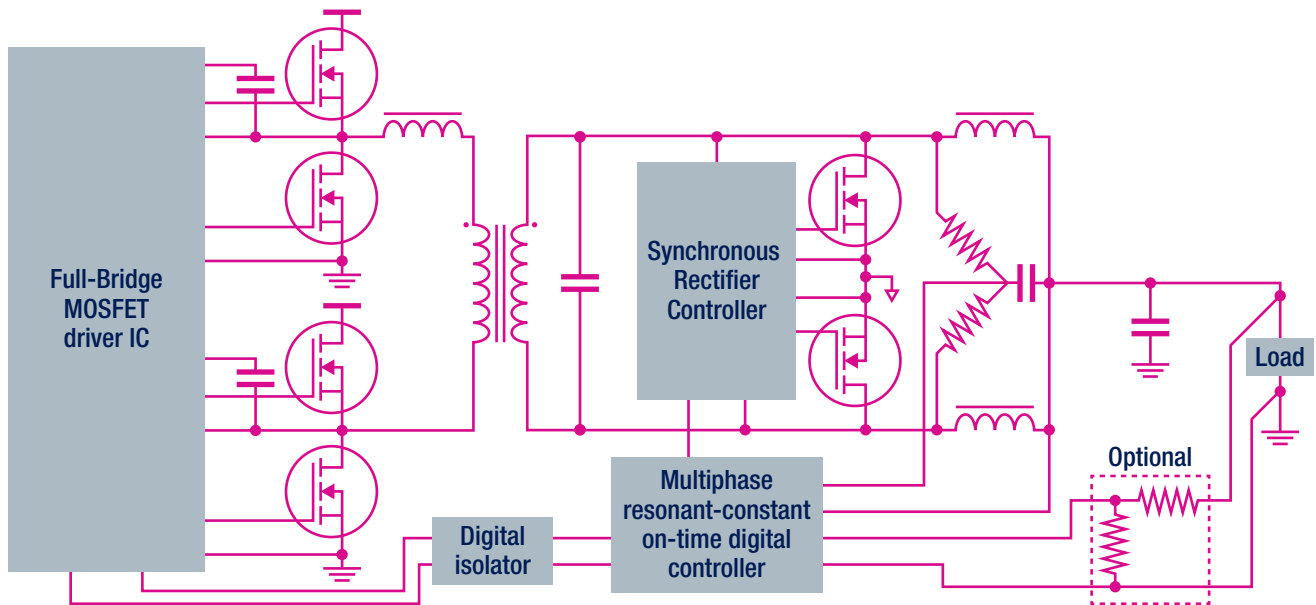
ST has developed a multi-IC solution called Isolated Resonant Direct Conversion technology, enabling a very effective distributed approach, reducing intermediate conversion steps and resulting in a more efficient and reliable system. The multi-IC solution is based on the STRG02 synchronous rectifier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

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



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

Typical configurations



MAIN EVALUATION BOARD



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

- 54 V/12 V, 42 A 500 W: 96.5% peak efficiency; size 4.3 inch²
- 54 V/1 V, 78 A 78 W: 92.7% peak efficiency; size 1.1 inch²
- 54 V/CPU, VR13 165 W (TDP) and 360 W (peak power): 93.3% peak efficiency
- 54 V/3.3 V, 46 A 150 W: 95% peak efficiency; size 2.07 inch²
- 54 V/DDR4, 120 A: 93.2% peak efficiency; size 3.87 inch²

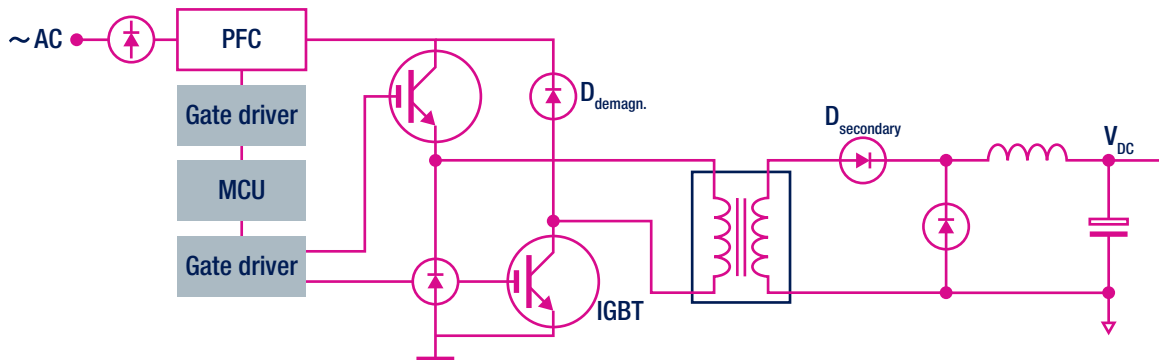
INDUSTRIAL WELDING

High efficiency and high switching frequency as well as reduced size and weight are the main requirements for welding applications. ST's broad power portfolio offers energy and cost-saving products to meet the various welding power ranges. Both PFC and DC-DC stages, phase-shifted full-bridge (PS-FB) as well as two-transistor forward (TTF), can be managed by high-performing STM32 microcontrollers. New high-efficiency and high-power-density SiC MOSFETs (SCT*N120), VHV Power MOSFET or the suitable high-frequency series of trench-gate field-stop IGBTs driven by STDRIVEsmart gate drivers (L639*, and L649*) offer optimum performance and reduce cooling requirements and heatsink size while the new STGAP1AS galvanically-isolated drivers guarantee high safety and reliability of the welding. Using SiC diodes (STPSC*) further improves system efficiency, taking advantage of silicon carbide's superior physical characteristics over silicon.



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

Typical configuration



Solution based on two-transistor forward topology

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

LED LIGHTING - GENERAL ILLUMINATION

Residential lighting

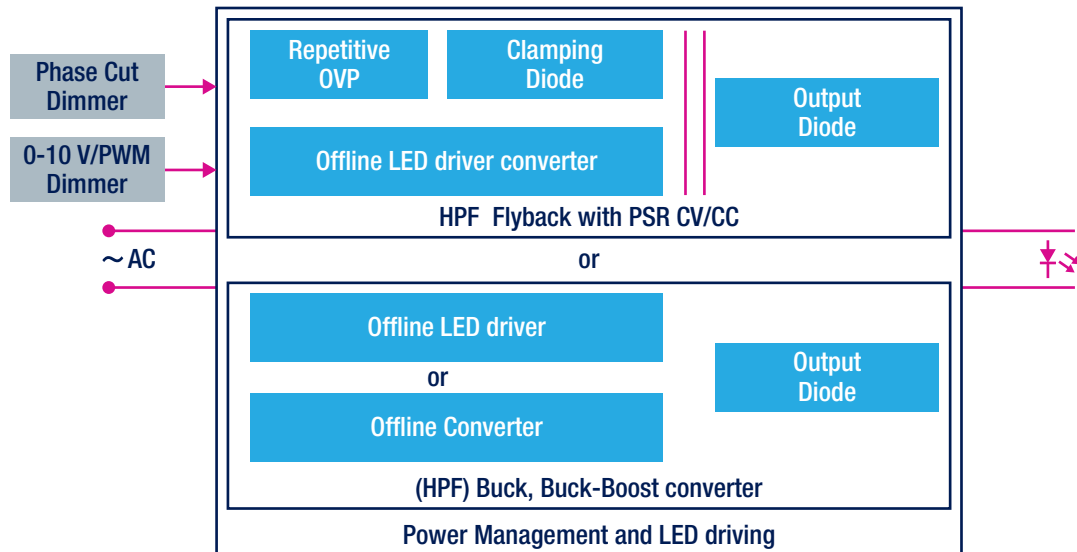
LED efficacy and driver IC market requirements are constantly evolving. Residential lighting applications need a high integration level, high efficiency, high power factor (PF), long lifetime, and dimming capabilities as well as a low system cost and component count.

ST offers a wide portfolio of highly integrated offline converters up to 15 W (each IC includes a power MOSFET combined with control and protection circuitry on a single chip) working with a high breakdown voltage of 800 V. Among these, HVLED805, HVLED807PF and HVLED815PF LED driver converters work with a high PF and in constant-current/constant-voltage mode primary-side regulation (PSR-CC/CV) avoiding the need of secondary side regulation ICs and opto-coupler in the circuit, thus reducing costs. Thanks to its high-power-density DC-DC LED driver converters (controller + MOSFET in the same chip), ST can support MR16 LED replacement lamps for halogen light bulbs.



		Offline LED driver converters	Offline converters suitable for LED driving		CC/CV controllers	Repetitive overvoltage protections	Clamping diodes	Output diodes	DC-DC LED driver converters
MR16 halogen bulb replacement		-	-		-	-	-	STPS*170AF STPS3170UF STPS4S200UF STPSxxZF STTHxxZF	LED5000 LED6000
Buck, Buck-boost		-	VPer0P VPer*1 VPer*6		-	-	-	STTH*	-
HPF Buck-boost		HVLED805 HVLED807PF HVLED815PF	-		-	-	-		
HPF Flyback	PSR-CC/CV		-		-				
Flyback	SSR-CC/CV		VPer*5 VPer*7 VPer*8	VPer0P VPer*1 VPer*6	TSM10* SEA0*	STRVS*	STTH*06 STTH*08 STTH*10	FERD*100 STPS*150 STPS*170 STPS*200	-
	PSR-CV	-	-						
	PSR-CC/CV		ALTAIR*		-				

Typical configuration

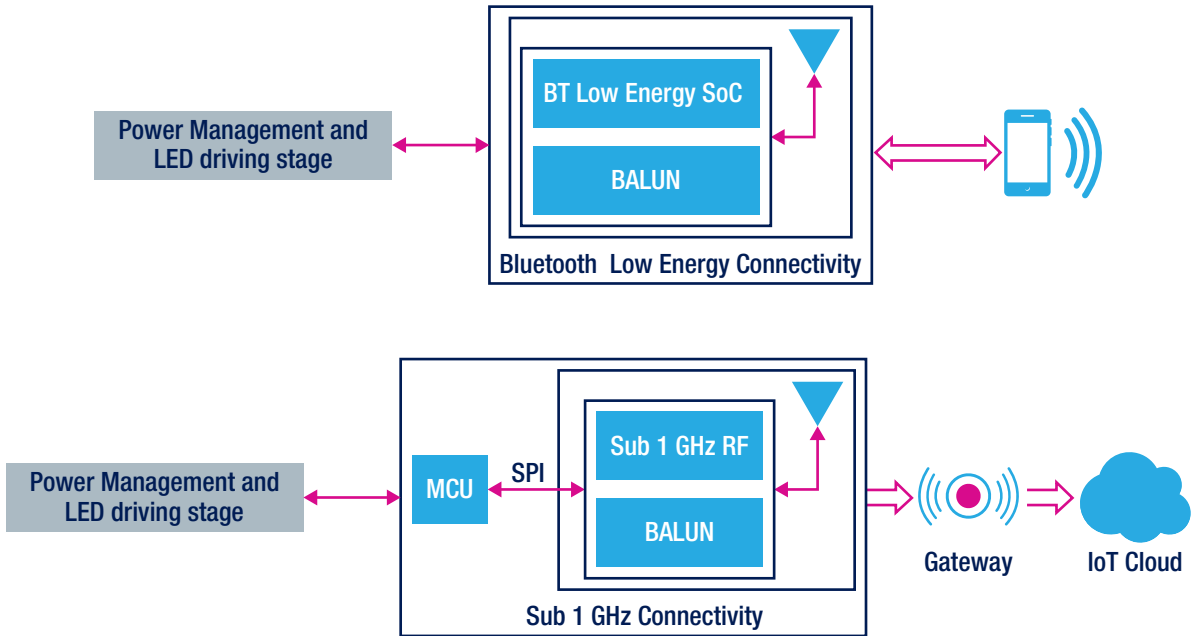


Note: * is used as a wildcard character for related part number

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

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

Typical configuration



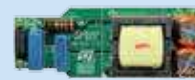
MAIN EVALUATION BOARDS



EVLHVLED815W10A
10 W, buck-boost LED driver



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



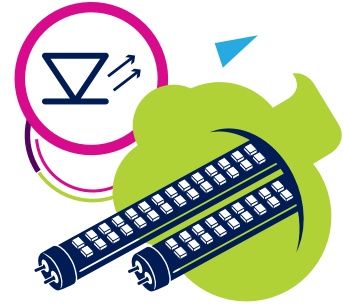
EVALHVLED815W15
15 W, flyback LED driver



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

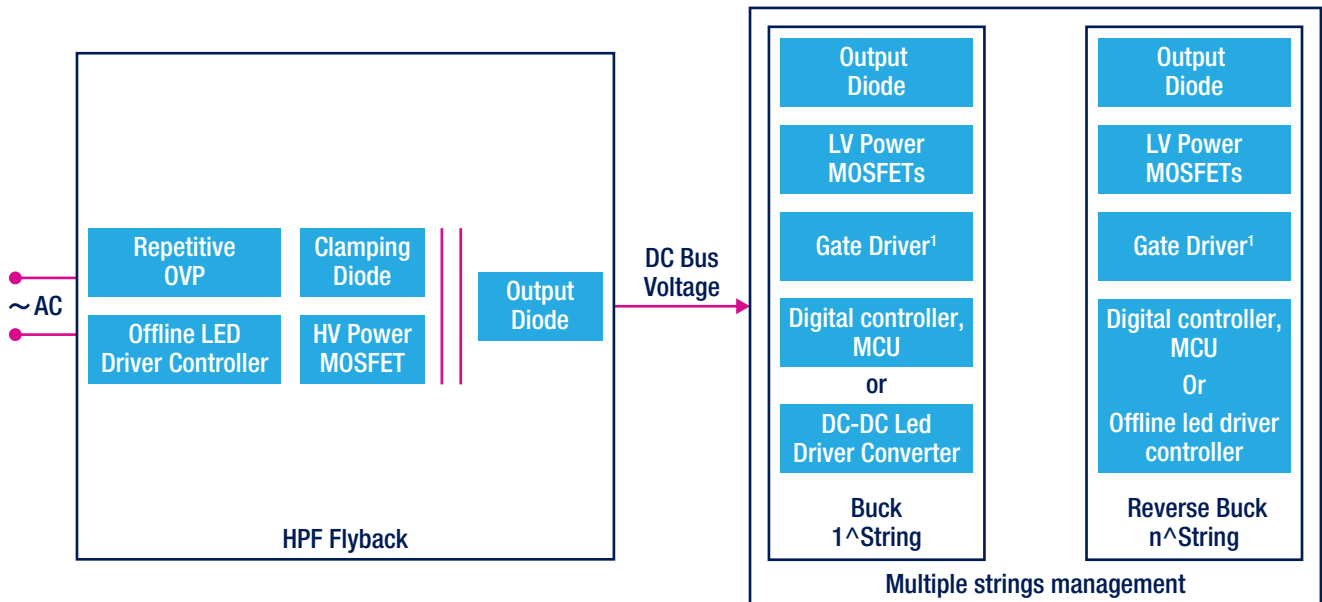
Commercial lighting

Commercial lighting applications usually require more than 20 W, a high power factor, high level of efficiency, cost-saving solution and the possibility of using more than one LED string with remote monitoring. The multiple strings power supply architecture consists of a main power supply (usually a flyback) providing a constant bus voltage and subsequent multiple strings. ST's offline LED controller HVLED001A (for flyback) with constant-voltage primary-side regulation (PSR-CV) is available for the main SMPS. Multiple strings can be managed using analog or digital means. High power-density DC-DC LED driver buck converters (LED2000, LED2001, LED5000 and LED6000) or the new HVLED002 controller for reverse buck, are used for an analog implementation. To digitally manage multiple strings stage (reverse buck), ST offers STLUX, a new series of dedicated digital lighting controllers as well as STM32 high-performance microcontrollers. ST's high-voltage MDmesh™ K5 MOSFETs series (suggested for flyback) and the low-voltage STripFET MOSFET series (used for reverse buck topologies) ensure all solutions are very efficient and reliable.



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

Typical configuration

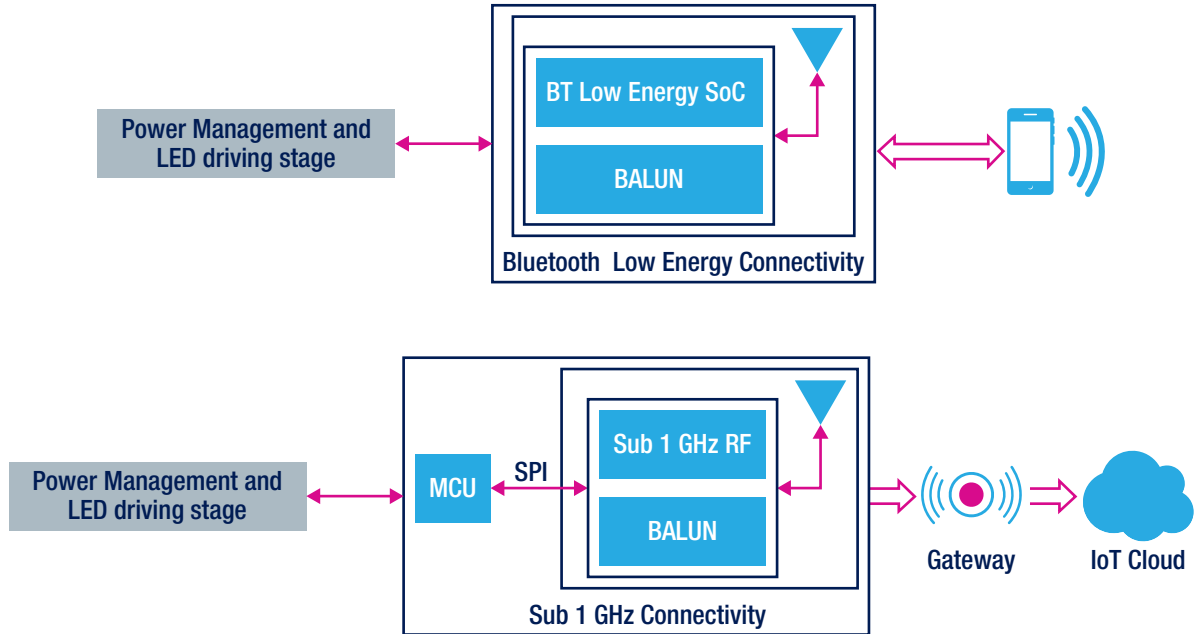


Note 1: only for digital solution * is used as a wildcard character for related part number


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


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

Typical configuration



MAIN EVALUATION BOARDS

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

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

 **STEVAL-ILL070V4¹**
35 W, analog power supply (CC/CV) for single string led driver

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

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

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

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

Street lighting

Energy efficiency, long lifetime, remote control, small form factor and extended temperature range (-40 °C) are the main requirements for the LED street lighting market. For single string, it is possible to implement the primary side regulation (PSR-CC) control technique using a digital approach with a PFC regulator followed by a HB-LC resonant stage.

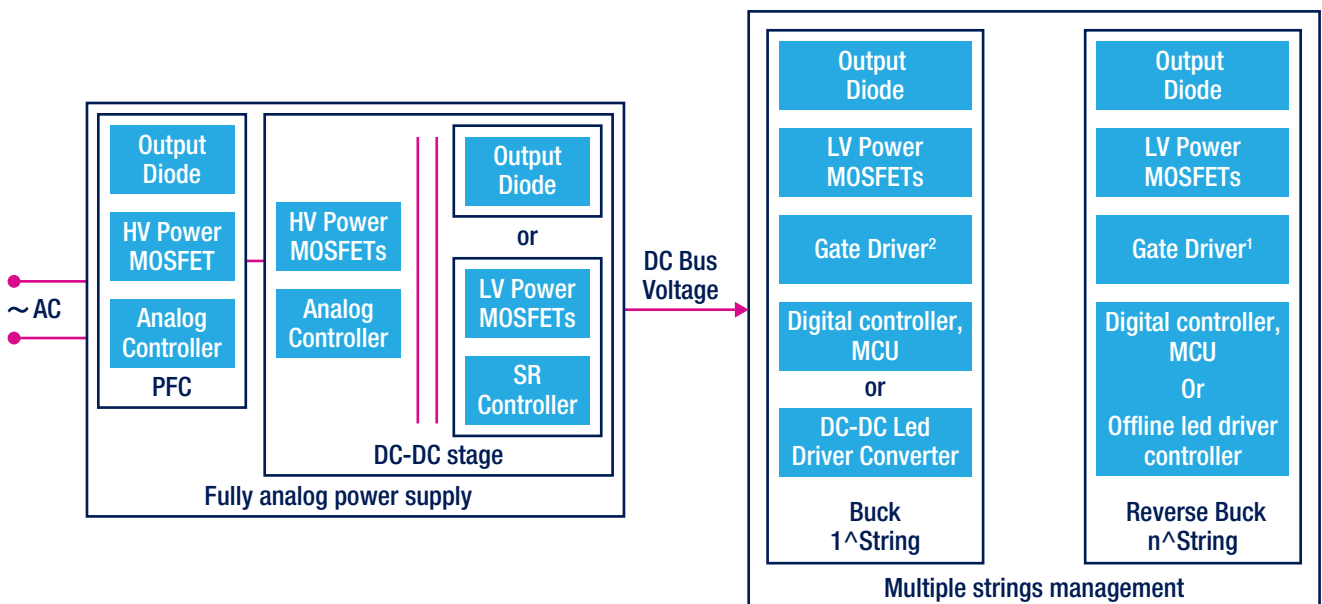
The multiple strings power supply architecture consists of a main power supply providing a constant bus voltage and a subsequent multiple strings. Usually the main power stage, consisting of a high power factor (HPF) flyback converter or a power factor correction (PFC) controller combined with an LLC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

The subsequent LED strings control is implemented by multiple buck or reverse buck converters. ST offers analog and digital solutions to cover both stages (power and LED control).



		Analog controllers	Digital controllers, MCUs	Gate drivers	Power MOSFETs		Clamping diodes	Repetitive overvoltage protections	Output diodes	DC-DC LED driver converters	DC-DC Conv.	
					HV	LV						
HPF Flyback	PSR-CV	HVLED001A	-	-	ST*N80K5 ST*N90K5 ST*N95K5	-	STTH*06 STTH*08 STTH*10	STRVS*	STPS* FERD* STTH*	-	-	
PFC Boost	CCM	L4981* L4984D	STCMB1	STLUX* STM32F0* STM32F301 STM32F334	TD35* PM8841 PM8851	ST*N60M2 ST*N65M2 ST*N60M2-EP	-	-	STTH*R06 STTH*T06	-	-	
	TM	L6562A* L6563* L6564*							STPSC*065 (SiC Diodes) STTH*L06 STTH*06 STTH15AC06*			
DC-DC stage	HB-LLC	L6599A* L6699	-	-	L638* L639* L649*	ST*N50DM2 ST*N60DM2 ST*N60M2 ST*N65DM2	-	-	STPS* FERD30M45D FERD40U50CFP	-	L698* ST1S14 L7985 L7986 L7987*	
	HB-LC	-							-			
Sync rect.		SRK2000A SRK2001			PM8834		STL*NS3LLH7 ST*N4LF7 ¹ ST*N6F7 ST*N10F7 ST*Nf20D		-		-	
Multiple strings mgmt	Buck	-	STLUX* STM32F334 STM32F301 STM32F0* STM8S*	L6395	TD35* PM8834 PM8841 PM8851	ST*N60M2 ST*N60M2-EP	ST*N6F7 ST*N10F7	-	-	STPS* FERD* STTH* (≥200 V series)	LED5000 LED6000	-
	Reverse buck	HVLED002								-	-	-

Typical configuration

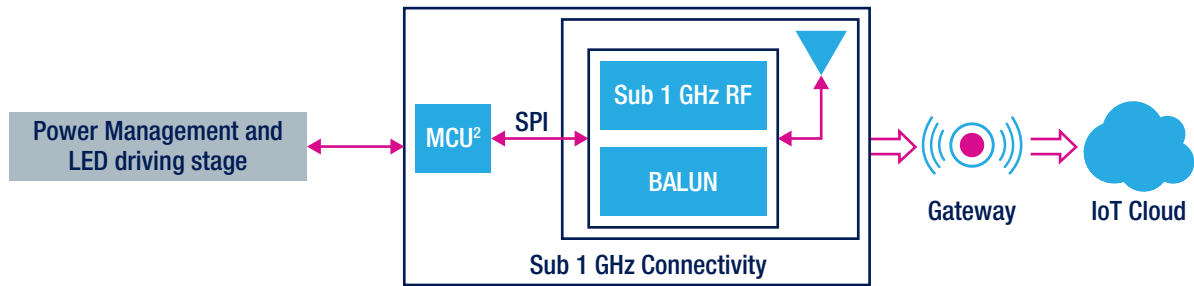


Note 1: MP Q4 2017 2: only for digital solution * is used as a wildcard character for related part number

In regard to analog solutions, ST's has a wide offer. The new flyback offline LED controllers (HVLED001A) with constant-voltage primary-side regulation (PSR-CV) does not need an opto-coupler and voltage reference in the circuit (lower costs). The new STCMB1 smart offline combo controller for PFC and HB-LLC resonant circuits, the new HVLED002 led driver controller for reverse buck, and the dedicated high-voltage/high-current DC-DC LED driver converters (LED5000 and LED6000) for LED strings management ensure easy and efficient analog solutions. For high-efficiency and flexible digital solutions, ST offers STLUX, a new series of dedicated digital lighting controllers, along with high-performance STM32 microcontrollers to manage both power and LED driving (reverse buck) stages. The new high-voltage MDmesh™ MOSFETs series (suggested for flyback, PFC and LLC stages), the low-voltage STripFET MOSFETs series (used in reverse buck topologies) and the SiC diodes (STPSC*) make sure that solutions are very efficient and reliable.

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

Typical configuration



MAIN EVALUATION BOARDS



STEVAL-ILL066V2³
100 W, digital single-string PSR-CC LED driver



STEVAL-ILL053V1
130 W, analog power supply (CV_{out}) for LED driving



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



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



STEVAL-ILL056V1
48 V-3 A, buck LED driver converter



STEVAL-ILL078V1
60 V-1 A, buck LED driver converter



MAJOR HOME APPLIANCES

Refrigeration, washing, drying and miscellaneous equipment

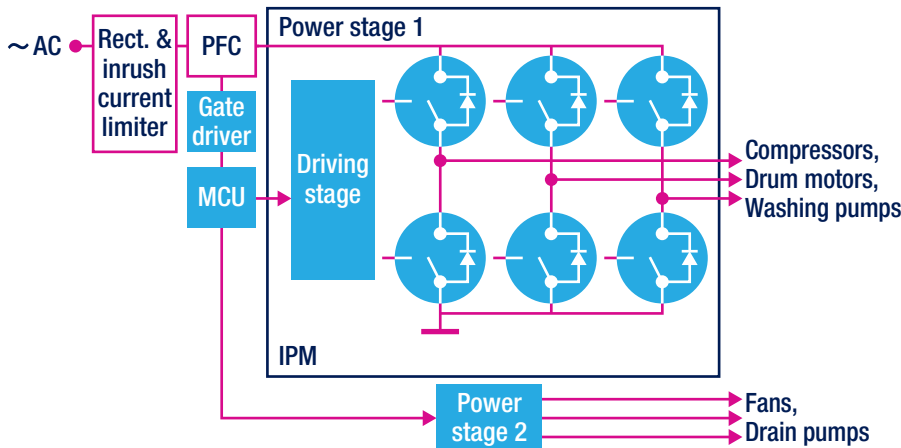
The white goods market requires low-cost and high-energy-efficiency solutions. The refrigeration, washing, drying and the miscellaneous (Air conditioner, water heater) equipment are some of the major home appliance applications that ST, thanks to its wide product portfolio, is able to satisfy with suitable and dedicated power products for both power factor correction (PFC) and 3-phase inverter stages managed by high-performing STM32 microcontrollers combined with complementary new STDRIVEsmart gate drivers (L639*, and L649*). Using new SiC diodes (STPSC*), high-efficiency PFC is guaranteed by the usage of new high-voltage MDmesh™ MOSFETs or suitable field-stop trench-gate IGBTs. To reduce the 3-phase inverter CTM design time and implementation efforts, ST offers the SLLIMM™ family (small low-loss intelligent molded module) of highly-integrated, high-efficiency intelligent power modules (IPM) integrating the power stage (both on IGBT and MOSFET discretes), driving network and protections and features. Another approach for designing a 3-phase inverter is based on the use of six discrete IGBTs/MOSFETs and gate drivers mentioned before. High- and low-voltage DC-DC converters guarantee high power density for the post-regulation stages. High reliability against the inrush current is ensured by new SCRs in the front-end stage.



20

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

Typical configuration



MAIN EVALUATION BOARDS



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



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

Note 1: available in Q4 2017 2: SMD package options available in Q4 2017 3: suitable for Interleaved PFC * is used as a wildcard character for related part number

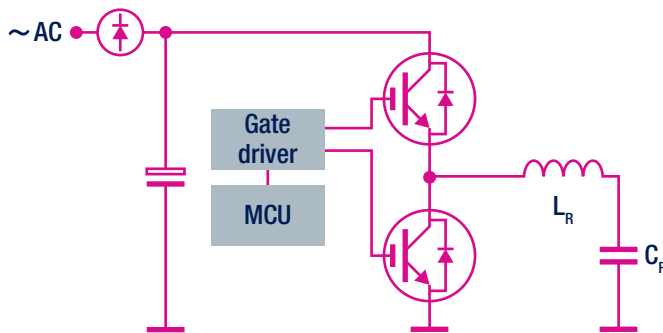
Induction heating

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 and we are about to introduce a new 650 V IH series and a 1350 V series. Complementary new STDRIVEsmart gate drivers family (L639*, L649*) improves the reliability (robustness and noise immunity) of the application. Depending on your needs, new 8/16 channels LED array drivers allow to have an user-friendly human interface. ST's complete offer is given in the following table.

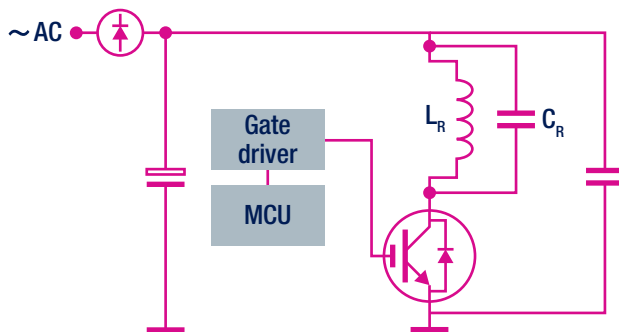


	MCUs	Gate drivers	IGBTs	LED array drivers
Single-switch quasi-resonant (voltage resonance)	STM8* STM32F100	TD35* PM8841 PM8851	STG*IH125DF STG*IH135DLF2 ¹	-
HB series resonant (current resonance)	STM32F0* STM32F100	L638* L639* L649*	STG*H65DFB STG*H60DLFB STG*IH65DF ¹	-
User interface (front panel)	STM8* STM32F0* STM32F4*9 STM32F7*	-	-	STP08 STP16* LED1642GW

Topology example



Half-bridge series-resonant induction heating system



Single-switch quasi-resonant induction heating system

MAIN EVALUATION BOARD



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

RENEWABLE ENERGY & HARVESTING

Photovoltaic (centralized)

Centralized photovoltaic (PV) energy solutions use a central inverter architecture characterized by a single central inverter (where the entire DC output of a PV array is transformed and connected to the AC grid) and, at the panel level, by a junction box that provides only the bypass function and helps prevent localized hotspots. For the junction box, ST offers the new FERD diodes with a very low forward voltage and a low leakage reverse current.

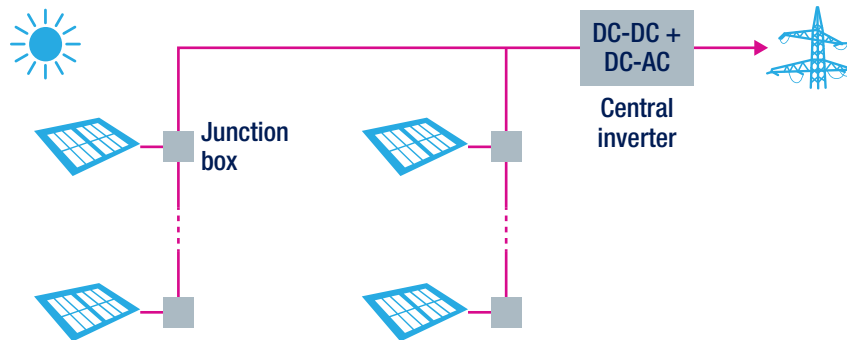
By integrating high-performance STM32 microcontrollers, the new high-efficiency SiC MOSFETs (SCT*N120), the new trench-gate field-stop IGBTs series, the SiC diodes (STPSC*) and the new STGAP1AS galvanically-isolated gate drivers, it's possible to guarantee a high-efficiency central inverter implementation.

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



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

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 the new FERD diodes featuring a very low forward voltage and low leakage reverse current. The new high-efficiency SiC MOSFETs (SCT*N120) and the new trench-gate field-stop IGBTs series, guarantee a high-efficiency DC-AC central inverter.

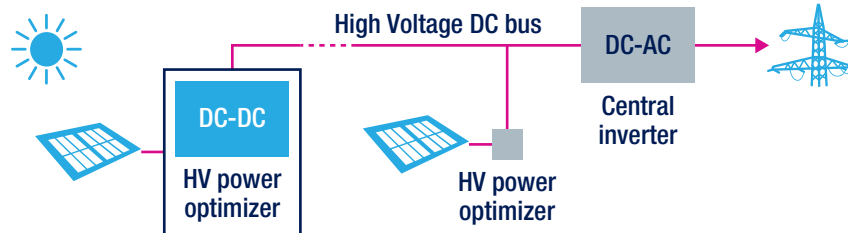
The fully distributed approach integrates, at the PV panel level, a microinverter that includes a complete converter (DC-DC with MPPT as well as DC-AC) and manages the AC grid connection. The high-performing STM32 microcontrollers, the new high-efficiency high-voltage MDmesh™ MOSFET series, the new low-voltage STripFET MOSFET series and the SiC diodes (STPSC*) guarantee a high-efficiency converter while the new STGAP1AS galvanically-isolated gate drivers offer high safety and reliability. High- and low-voltage DC-DC converters guarantee high power density for the post-regulation stages.



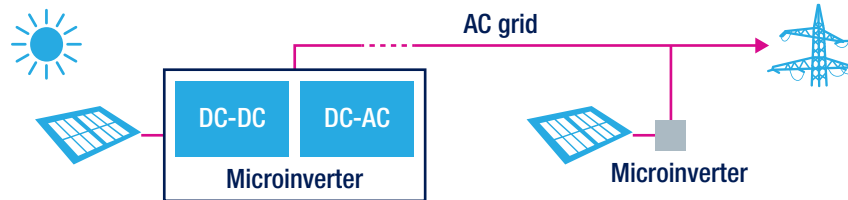
			MCUs	Gate drivers	Power MOSFETs		IGBTs	Diodes	Bypass Diode	DC-DC converters	
					HV	LV				HV	LV
Power optimizer	DC-DC stage	Isolated FB boost	STM32F103 STM32F3* STM32F4*	L638* L639* L649* STGAP1AS	-	STH*N10F7 STH*N6F7	-	STTH*R06 STTH80S06W	STPS*30 STPS*45 FERD*45	-	
Central inverter	DC-AC stage	FB mix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

Typical configurations

Partially distributed approach



Fully distributed approach



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

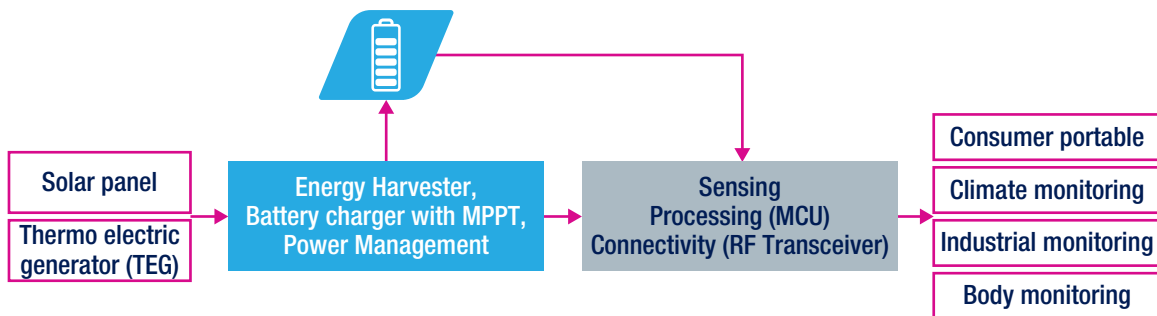
Solar – Thermo electric generator (TEG)

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



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

Typical configuration



MAIN EVALUATION BOARDS



STEVAL-GPT001V1²
Solar Rechargeable Smart Watch with SPV1050



STEVAL-IDS002V1
Autonomus wireless multisensor node powered by PV cells



STEVAL-IDS003V1³
Autonomus wireless multisensor node powered by TEG

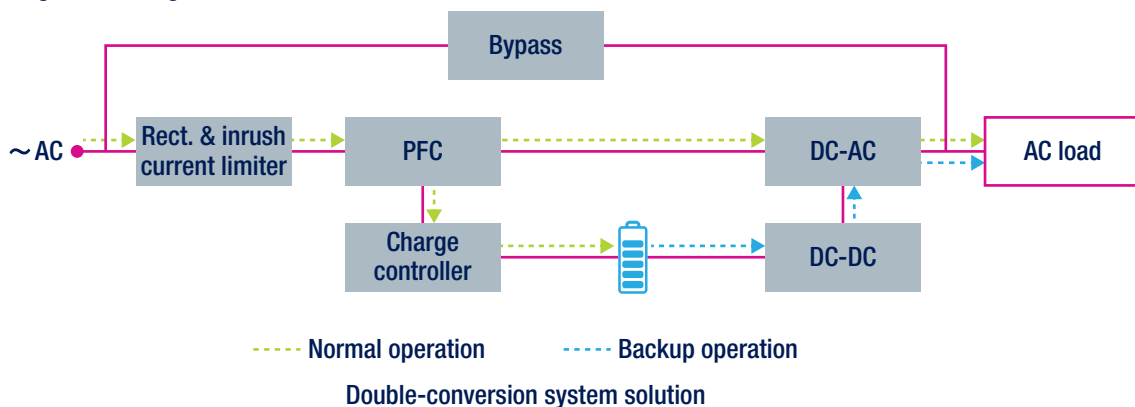
UNINTERRUPTABLE POWER SUPPLIES (UPS)

Today the vast increase of sensitive loads due to the explosion in digital technology requires a high-quality supply of electrical power. In addition to its primary function of ensuring the continuity of service, an uninterruptable power supply (UPS) improves the quality of the voltage supplied to the load (computer, industrial processes, instrumentation, telecommunication, etc.). The double-conversion configuration usually is used for high-end applications in particular for medium- or high-power UPSs; offline systems are adopted for low power applications. Each stage of these configurations (PFC, charge controller, etc.) is supported by ST's portfolio. SiC diodes (STPSC*), new high-voltage MDmesh™ MOSFETs (M2, DM2, M5 series), new low-voltage STripFET™ MOSFETs (F6, F7 series), trench-gate field-stop IGBTs, SiC MOSFETs (SCT*N120), new STGAP1AS galvanically-isolated gate drivers and high-performance STM32 microcontrollers guarantee high reliability and efficiency.



		MCUs and Digital Controllers	Gate drivers	IGBTs	Power MOSFETs		Diodes	SCRs	Triacs	Linear voltage regulators	DC-DC Conv.
					HV	LV					
Rect. & inrush current limiter		-	-	-	-	-	STBR3012 STBR6012	TN4015H-6 TN5015H-6 TM8050H-8 TN3050H-12Y TN5050H-12Y	-	-	-
PFC Boost		STNRGPF01 STM32F4* STM32F7*	PM8834 PM8841 PM8851	-	ST*N60M2 ST*N65M2 ST*N65M5	-	STTH*T06 STTH*R06 STTH*S12 STPSC* (SiC Diodes)	-	-	-	-
Charge controller	HB	-	L638* L639* L649*	STG*H65DFB STG*V60DF	ST*N50DM2 ST*N60DM2 ST*N60M2	-	-	-	-	-	-
DC-DC stage	Push Pull	STM32F4* STM32F7*	PM8834 PM8841 PM8851 STGAP1AS	-	-	ST*N6F7 ST*N8F7 ST*N10F7 STP*N3LL	STTH*06 STTH*12 STPSC* (SiC Diodes)	-	-	LDF LDFM LDK220 LDK320 LDK715 LDL212	L698* ST1S14 L7985 L7986 L7987*
DC-AC stage	NPC	-	L638* L639* L649* STGAP1AS	STG*H65DFB STG*H120DF2	SCT*N120	-	-	-	-	-	-
	FB	-	-	-	-	STP110N8F6 ST*N8F7 ST*N10F7	-	-	-	-	-
Bypass		-	-	-	-	-	-	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