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# Power management Guide



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# Introduction



More than 30 years of technology innovation in power management directly resulting in value creation for our customers, from products to system solutions

There is no secret when designing a power management system or sub-system: regardless of the final use, whether it is an energy generation or distribution system, a power supply or a LED driving circuit, an industrial SMPS or an electric vehicle power application, it must provide high efficiency and low standby power, as well as high power density, reliability and safety, while respecting specific cost constraints.

The key enablers for any such system with the above features are discrete and integrated power semiconductors, which play a crucial role in every step along the energy supply chain and, when applied in conjunction with advanced control technologies, can drive continuous improvement in energy savings for homeowners and communities, and ultimately for the entire planet.

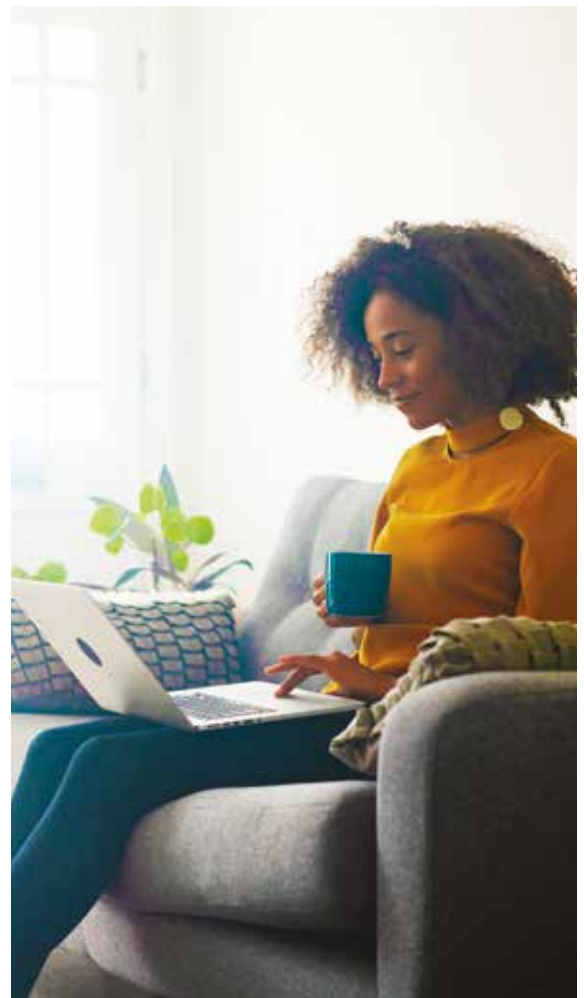
The technological innovation that has been at the core of ST's strategy for more than 25 years is the reason why ST today can offer an extensive range of cutting-edge products for power and energy management. ST's portfolio includes higher-efficiency power technologies such as:

- Silicon carbide power discretes
- HV and LV power MOSFET and IGBTs
- Customized power modules
- Diodes and Thyristors
- Protection devices and Filters
- AC-DC converters and controllers
- DC-DC converters
- Linear voltage regulators
- Analog ICs
- Battery management ICs
- Digital controllers
- STM32 microcontrollers
- MOSFET and IGBT gate drivers

Moreover, ST offers a variety of wireless and wired connectivity ICs as well as high performance sensors to complement the latest smart power electronics applications with additional sensor-driven features and monitoring functions.

ST is also committed to the development of GaN power devices, which represent a major step forward in power electronics by providing high-frequency operation with increased efficiency and higher power density than silicon based transistors.

Additionally, we provide a comprehensive range of reference designs and hardware and software evaluation and development tools, including the eDesignSuite tool that can help engineers design and optimize their high efficiency power solutions.



# Applications

## ENERGY GENERATION AND DISTRIBUTION

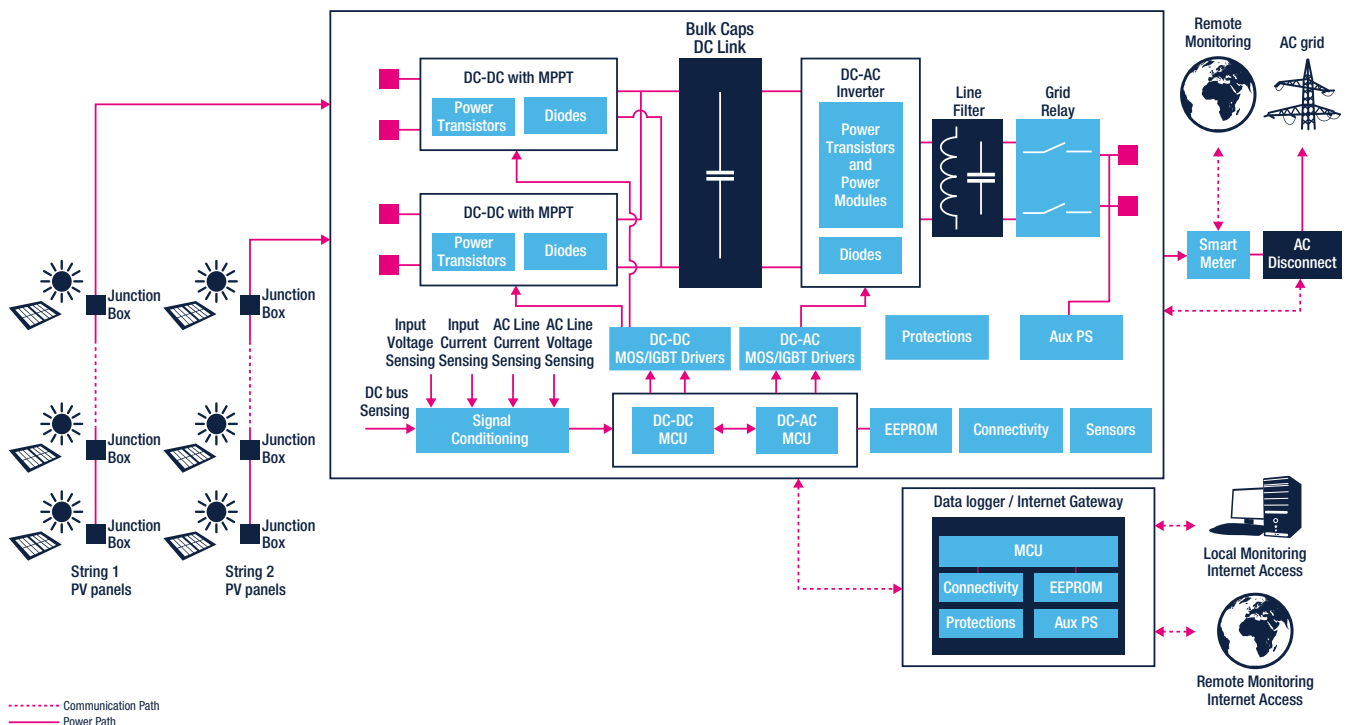
### Solar Centralized Generation - Solar Inverters (String and Central)

String and central inverters are the most common power conversion systems used for grid-connected solar applications. They comprise a DC-DC conversion stage, to adapt voltage levels and implement the Maximum Power Point tracking (MPPT) function to maximize energy transfer from the panel, and a DC-AC conversion stage to correctly shape current and voltage waveforms transferred to the AC grid. The inverter has an anti-islanding function that guarantees safety in case of AC disconnection. With power ranging from a few kilowatts for string and multi-string inverters to tens or hundreds of kilowatts for central inverter solutions, the trend is to use topologies with very high input voltages (up to 1500 V).

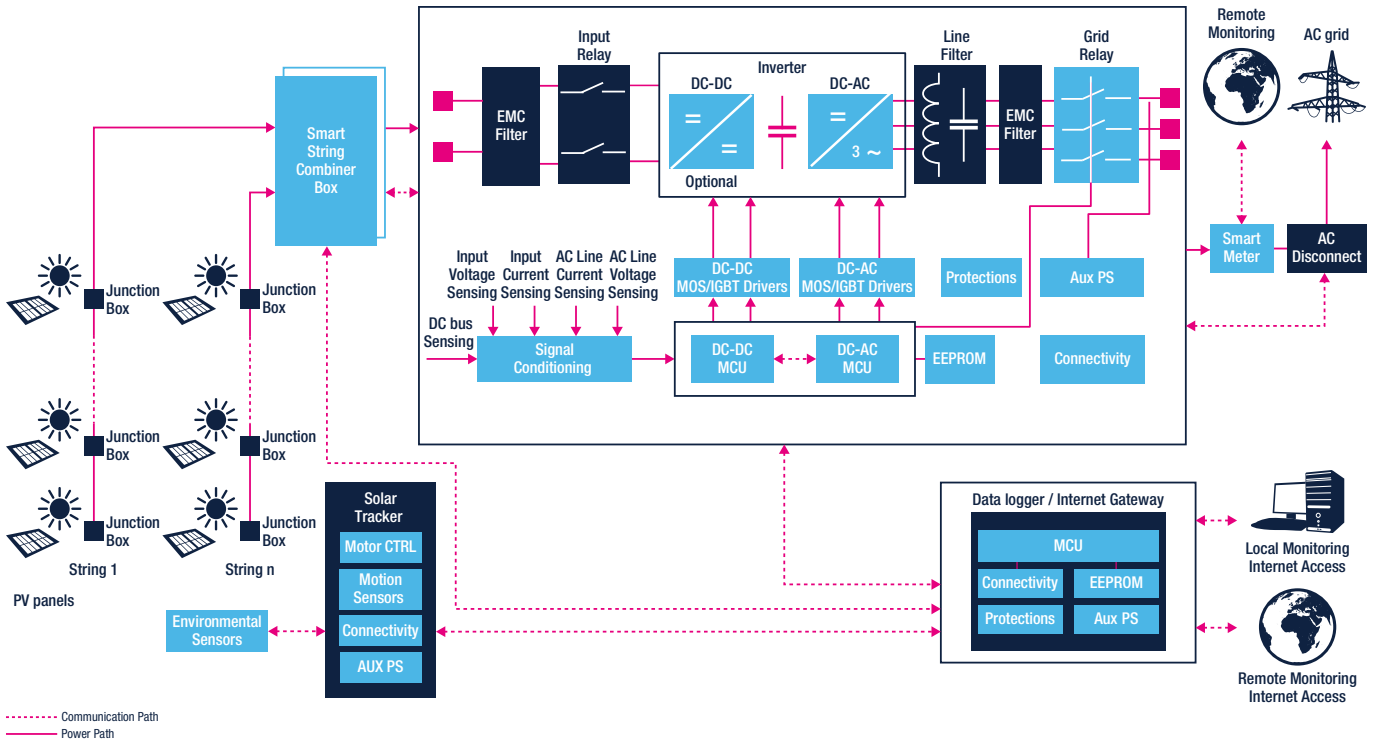


We offer a broad range of silicon-carbide (SiC) power MOSFETs - with the industry's highest operating junction temperature of 200 °C - and trench-gate field-stop IGBTs, that can be also combined into our high-efficiency ACEPACK power modules. Together with galvanically-isolated gate drivers and high-performance STM32 microcontrollers we enable engineers to design high-efficiency string and central inverters. In addition we have a range of wireless and wired connectivity solutions.

### Typical Block Diagram for String Inverter



## Typical Block Diagram for Central Inverter



## ST's product offering for String and Central Solar Inverter

	Power MOSFETs	IGBTs	Power Modules	Diodes & Discretes
<b>Inverter Power Stage DC-DC and DC-AC</b>	600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6 650 V MDmesh M5 ST*65M5 1200 V MDmesh K5 ST*N120K5 SiC MOSFETs SCT*N65G2, SCT*N120, SCT*N120G2	600 V V series STG*V60DF 650 V HB series STG*H65DFB 650 V HB2 series STG*H65DFB2 650 V M series STG*M65DF2 1200 V H series STG*H120DF2 1200 V M series STG*M120DF3	ACEPACK Power Modules A1P50S65M2 A1P25S12M3 A1P35S12M3 A2P75S12M3 A1P25M12W2-1 <sup>1</sup> A1P18M65W2-1 <sup>1</sup> A2F12M12W2-F1 <sup>1</sup> A1F25M12W2-F1 <sup>1</sup> A2U12M12W2F1 <sup>1</sup> <b>Thyristors SCRs</b> Thyristors SCRs for Grid Relay TN6050HP-12WY, TM8050H-8W	600 V Ultrafast STTH*06 STTH*R06 1200 V Ultrafast STTH*12 100 V Power Schottky STPS*100 SiC Diodes STPSC*065 STPSC*H12 TVS for Power MOSFET & IGBT Protection SMA4F, SMA6F, SMB15F series
<b>Inverter Driving &amp; Control stage</b>	<b>MCUs</b>	<b>MOSFET and IGBT Gate Drivers</b>	<b>Protections</b>	<b>Connectivity</b>
	STM32F334 STM32G4 STM32H7 STM32F3 STM32F4 STM32F7	HV HB Gate Drivers L649* Isolated Gate Drivers STGAP* Multiple LS Gate Drivers PM8834	TVS for Power Rail Surge Protection SMA4F, SMA6F, SMB15F, SMC30J series ESD and High Speed Port series for Ethernet and USB Protection	Zigbee, Thread STM32WB Bluetooth Low Energy BlueNRG, STM32WB Power Line Transceivers ST8500, ST7580 RS-422 and RS-485 ST3485*, STR485* Isolated Interfaces for wired connectivity STIS062x
<b>Data Logger/Internet Gateway</b>	<b>MCUs</b>	<b>EEPROM</b>	<b>Protections</b>	
	STM32F0 STM32G0 STM32F1 STM32F3	Standard Serial EEPROM	ESD and High Speed Port series for Ethernet and USB Protection	
<b>Solar Tracker</b>	<b>Motor CTRL</b>	<b>Motion Sensors</b>	<b>Environmental Sensors</b>	<b>Connectivity</b>
	3-phase Field Oriented Control (FOC)	Accelerometer IIS3DHH, IIS2DH, IIS2ICLX Magnetometer-IIS2MDC eCompass-ISM303DAC 6 axis IMU-ISM330DLC, ISM330DHCX	Pressure - LPS22HH Pressure water proof - LPS33W Temperature - STTS22H Humidity - HTS221	Bluetooth Low Energy BlueNRG, STM32WB

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

1 samples available in Q4 2021

## Solar Distributed Generation - Microinverter

In residential photovoltaic systems Microinverters are often used as an alternative to string inverters to perform the DC to AC power conversion at panel level, helping maximize energy yield and mitigate problems related to partial shading, dirt or single panel failures. A microinverter consists of a DC-DC converter - implementing maximum power point tracking (MPPT) - and a DC-AC inverter to shape current and voltage for injection into the AC grid. Data - including voltage, current and power generated - from all the microinverters in the installation are collected by a concentrator and dispatched to a local or remote monitoring and control access point.

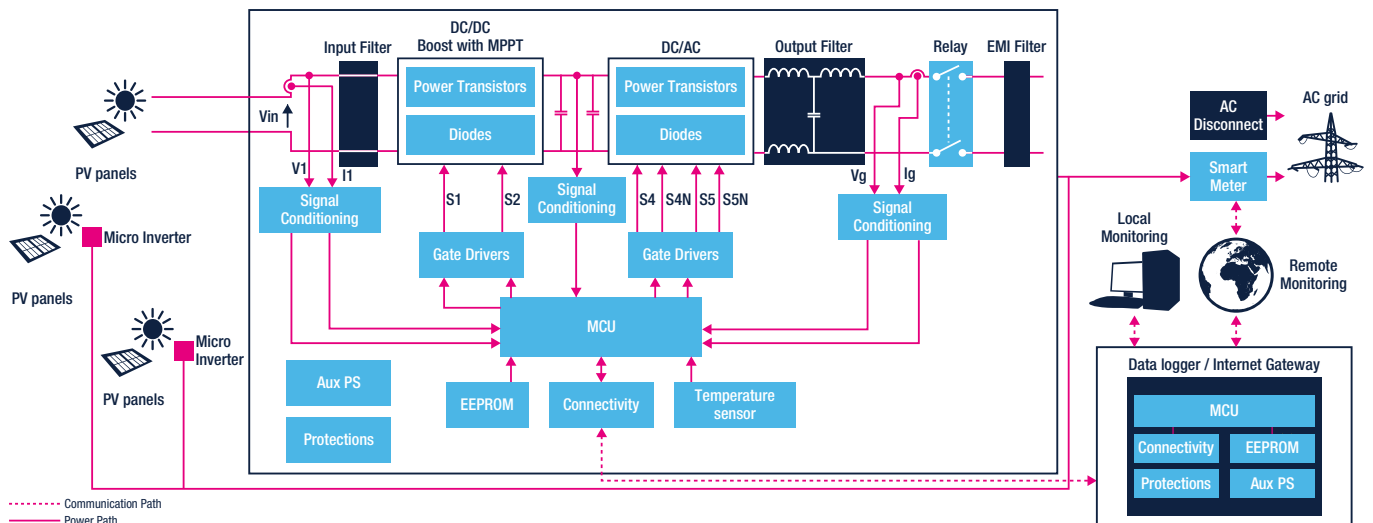
Our solution includes MDmesh and STripFET power MOSFETs, high-voltage, galvanically isolated gate drivers, high-voltage silicon-carbide (SiC) diodes together with high-performance STM32 microcontrollers - providing a set of dedicated peripherals to help implement complex power conversion control algorithms. A range of wireless and wired connectivity solutions including multi-standard power line modems complete the solution.

### ST's product offering for Microinverter

	Power MOSFETs	Diodes	Protections	Signal Conditioning
Microinverter Power Stage	60 V-100 V STripFET F7 ST*N6F7, ST*N8F7, ST*N10F7	600 V Ultrafast STTH*R06	TVS for Power MOSFET and Power Rail Surge Protection SMA4F, SMA6F, SMB15F series	Precision Op Amps (<50 MHz) TSZ*, TSV*, TS9*, LMV* Current Sensing TSC*
	600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2	1200 V Ultrafast STTH*S12	<b>Thyristors SCRs &amp; Triacs</b>	
	600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6	100 V Power Schottky STPS*100	Thyristors SCRs & Triacs for Grid Relay TN815-800B, TN1515-600B, T1635H-8G, T2550-12G	
	600 V MDmesh M6 ST*60M6	SiC Diodes STPSC*065 STPSC*H12		
	800 V-900 V MDmesh K5 ST*80K5, ST*90K5			
	SiC MOSFET SCT*N65G2			
Microinverter Driving & Control stage	<b>MCUs</b>	<b>MOSFET and IGBT Gate Drivers</b>	<b>Sensors</b>	<b>EEPROM</b>
	STM32F334 STM32G4 STM32H7 STM32F3 STM32F4 STM32F7	HV HB Gate Drivers L638*, L639*, L649* Isolated Gate Drivers STGAP* Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1	Pressure - LPS22HH Pressure water proof - LPS33W Temperature - STTS22H Humidity - HTS221	Standard Serial EEPROM
			<b>Protections</b>	<b>Connectivity</b>
			TVS for Power Rail Surge Protection SMA4F, SMA6F, SMB15F, SMC30J series	Zigbee, Thread STM32WB <sup>1</sup> Bluetooth Low Energy BlueNRG, STM32WB Power Line Transceivers ST8500, ST7580 RS-422, RS-485 and RS-232 ST3485*, STR485*, ST3232* Isolated Interfaces for wired connectivity STISO62x
Data Logger/Internet Gateway	<b>MCUs</b>	<b>EEPROM</b>	<b>Protections</b>	
	STM32F0 STM32G0	Standard Serial EEPROM	ESD and High Speed Port (HSP) series for Dataline ESD and EOS Protection	

Note: \* is used as a wildcard character for related part number 1 for Data Logger/Internet Gateway only

### Typical Block Diagram





## Solar Distributed Generation - Power Optimizer

In architectures based on the use of power optimizers, the maximum power point tracking (MPPT) function is performed at the level of photovoltaic panels, individually operating each one at its optimal I-V point which ensures maximum power generation. This results in an improved energy yield of the overall solar system compared to traditional string or central inverter based architectures.

Power optimizers can help minimize a system's design constraints as well as improve reliability and safety – by helping ensure compliance with the latest NEC 2017 regulations that require rapid shut-down in the event of grid disconnection, while at the same time reducing maintenance costs.

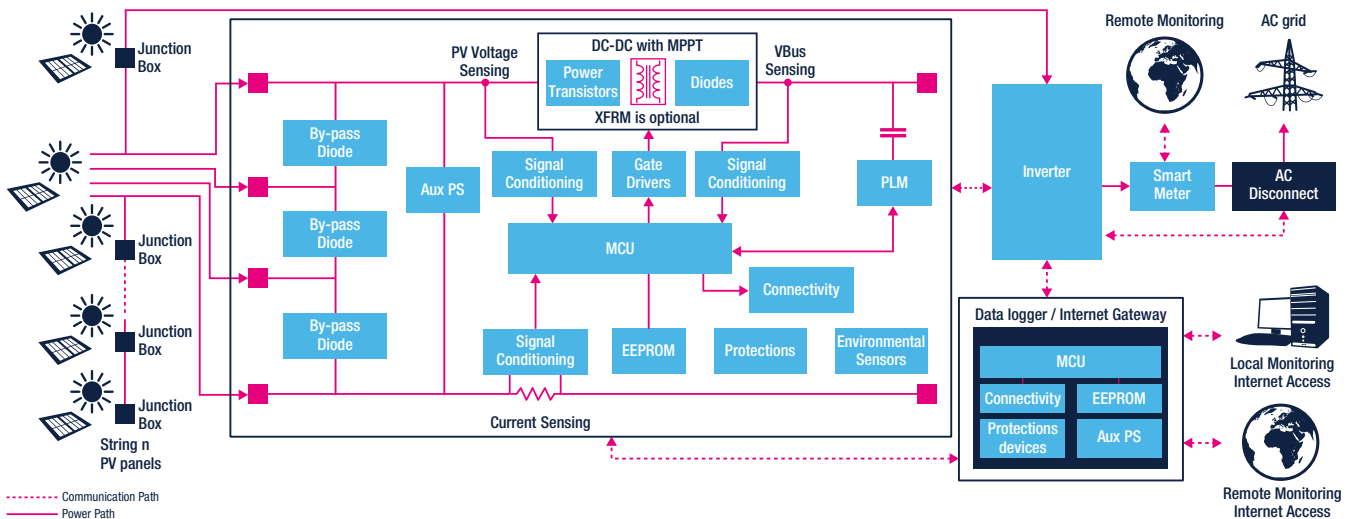
We provide high-performance STM32 microcontrollers as well as high-efficiency STripFET F7 LV Power MOSFETs, Diodes, SiC MOSFETs and trench-gate field-stop IGBTs, galvanically-isolated gate drivers and power line communication solutions to help achieve superior efficiency and reliability for power optimizer based architectures.

## ST's product offering for Power Optimizer

	MCUs	Power MOSFETs	Gate Drivers	By Pass Diodes	Diodes	Protections	Signal Conditioning
Power Optimizer	STM32F334 STM32F0 STM32G0 STM32F3 STM32G4	60 V to 100 V STripFET F7 ST*N6F7 ST*N8F7 ST*N10F7	HV HB Gate Drivers L649*	30 V to 45 V Power Schottky STPS*30 STPS*45 45 V FERD FERD*45	100 V to 200 V Power Schottky STPS*100, STPS*200 100 V FERD FERD*100	TVS for Power MOSFET & IGBT Protection SMA4F, SMA6F, SMB15F, SMC30J series  Power Rail Surge Protection SMA4F, SMA6F, SMB15F, SMC30J series  ESD Protection for I/O interfaces	Precision Op Amps (<50 MHz) TSZ*, TSV*, TS9*, LMV*  Current Sensing TSC*
			Isolated Gate Drivers STGAP*	IGBTs 600 V V series STG*V60DF 650 V HB series STG*H65DFB 650 V HB2 series STG*H65DFB2 650 V M series STG*M65DF2 1200 V H series STG*H120DF2 1200 V M series STG*M120DF3	Diodes 600 V Ultrafast STTH*06 STTH*R06 SiC Diodes STPSC*065 STPSC*H12		Connectivity
Inverter	STM32F334 STM32G4 STM32H7 STM32F3 STM32F4 STM32F7	SiC MOSFETs SCT*N65G2 SCT*N120 SCT*N120G2	Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1				Zigbee, Thread STM32WB <sup>1</sup>  Bluetooth Low Energy BlueNRG STM32WB  Power Line Transceivers ST8500, ST7580  Isolated Interfaces for wired connectivity STIS062x
Data Logger/Internet Gateway	MCUs STM32F0 STM32G0	EEPROM Standard Serial EEPROM				Protections ESD and High Speed Port series for Dataline ESD and EOS Protection	

Note: \* is used as a wildcard character for related part number 1 for Data Logger/Internet Gateway only

## Typical Block Diagram



## Energy Distribution - Home & Commercial Battery Storage Systems

The adoption of energy storage devices, whose reserve capacity can be used for balancing purposes, peak-load shaving or to shift loads, is increasingly widespread in energy distribution networks.

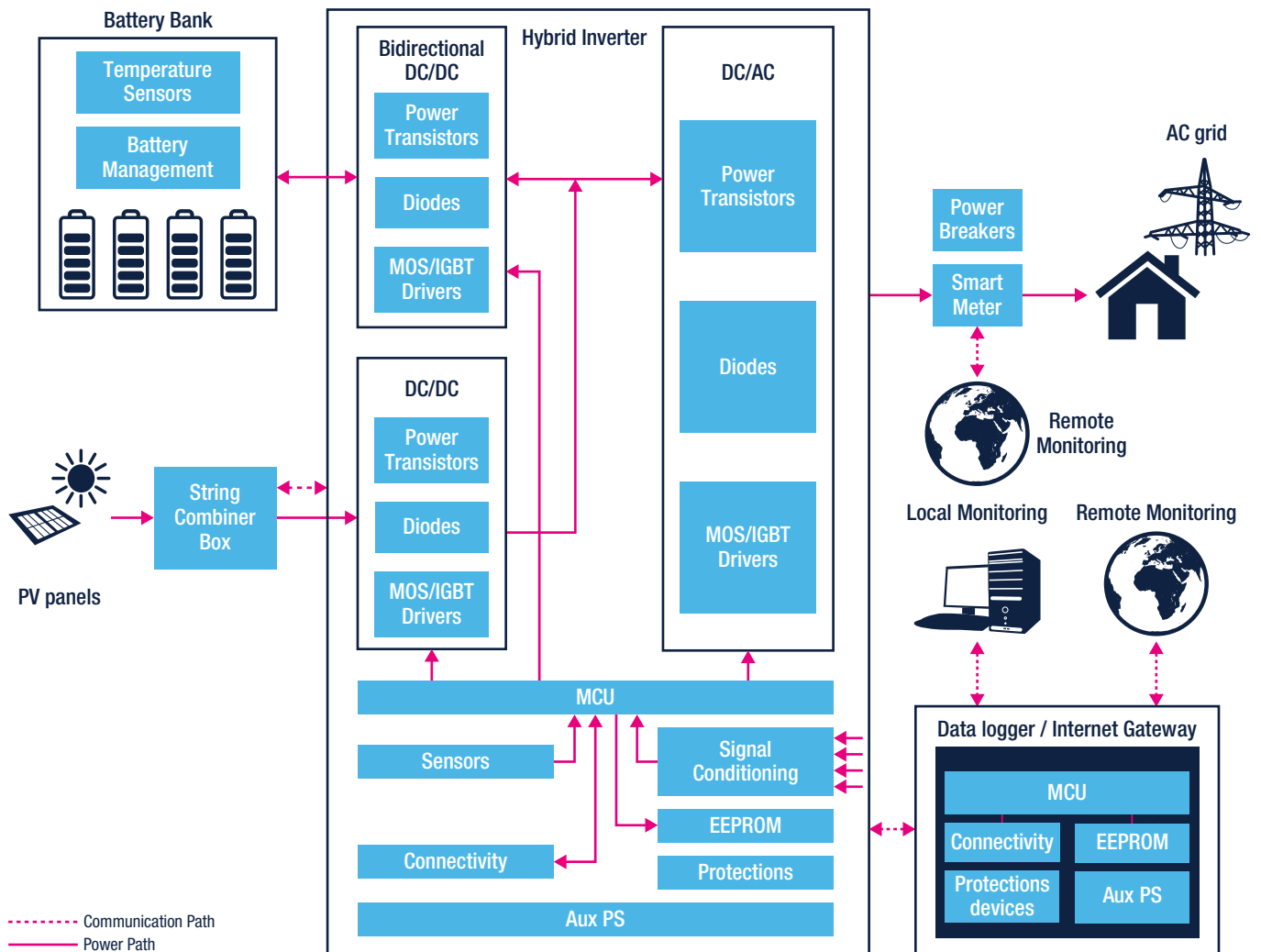
Two use cases are particularly important: the use in residential or commercial building to help reduce consumers' electricity bills by reducing energy consumption from the grid during peak hours and to help avoid stability and voltage drop issues associated with the fast-charging schedules of the increasing number of electric vehicles (EV).

By interacting with the grid, batteries and potentially solar panels, power converters are at the heart of these systems and must operate with high-efficiency and superior reliability over time.

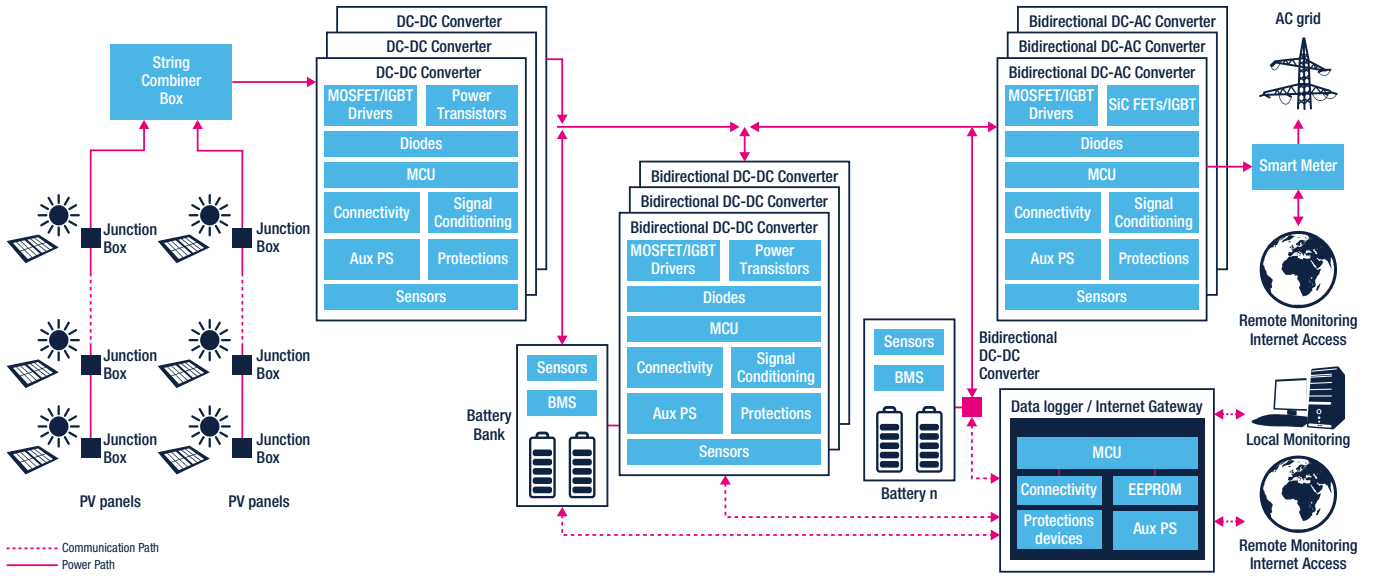
We can provide a range of power discretes including silicon-carbide (SiC) and silicon power transistors, ACEPACK power modules, silicon-carbide (SiC) and silicon diodes, isolated gate drivers and high-performance STM32 microcontrollers as well as energy metering ICs to help develop high-efficiency commercial battery storage systems.



### Typical Block Diagram - Home Battery Storage System



## Typical Block Diagram - Commercial Battery Storage System



## ST's product offering for Home & Commercial Battery Storage Systems

	Power MOSFETs	IGBTs	Power Modules	MOSFET and IGBT Gate Drivers	Diodes & Discretes
<b>DC-DC Converter &amp; Bidirectional DC-DC Converter</b>	40 V-100 V STripFET F7 <sup>1</sup> ST*N4F7, ST*N6F7, ST*N8F7, ST*N10F7		ACEPACK Power Modules A1P50S65M2 A1P25S12M3 A1P35S12M3 A2P75S12M3		600 V Ultrafast STTH*06 STTH*R06
<b>Power Stage</b>	600 V-650 V MDmesh M2 ST*60M2, ST*65M2  600 V-650 V MDmesh M6 ST*60M6, ST*65M6  600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2  600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6  800 V to 1200 V MDmesh K5 ST*80K5, ST*9*K5 ST*105K5, ST*120K5	600 V V series STG*V60DF  650 V HB series STG*H65DFB  650 V HB2 series STG*H65DFB2  650 V M series STG*M65DF2  1200 V H series STG*H120DF2  1200 V M series STG*M120DF3	A1P25M12W2-1 <sup>3</sup> A1P18M65W2-1 <sup>3</sup> A2F12M12W2-F1 <sup>3</sup> A1F25M12W2-F1 <sup>3</sup> A2U12M12W2F1 <sup>3</sup>  <b>Thyristors SCRs</b>  Thyristors SCRs for Power Breakers TS110-8 X0115	HV HB Gate Drivers L649*  Isolated Gate Drivers STGAP*  Multiple LS Gate Drivers PM8834  Single LS Gate Drivers PM88*1	800 V to 1200 V Ultrafast STTH*08 STTH*10 STTH*12  SiC Diodes STPSC*065 STPSC*H12  TVS for Power MOSFET & IGBT Protection and for Power Rail Surge Protection SMA4F, SMA6F, SMB15F, series
<b>DC-AC Converter</b>					
<b>Power Stage</b>	SIC MOSFETs SCT*N65G2 SCT*N120 SCT*N120G2 SCT*N170				
<b>System Control Stage</b>	<b>MCUs</b> STM32F334 STM32G4 STM32H7 STM32F3 STM32F4 STM32F7	<b>Signal Conditioning</b>  Precision Op Amps (<50 MHz) TSZ*, TSV*, TS9*, LMV*  Current Sensing TSC*	<b>EEPROM</b> Standard Serial EEPROM  <b>Protections</b> TVS for Power Rail Surge Protection SMA4F, SMA6F, SMB15F and ESD series	<b>Sensors</b> Pressure - LPS22HH Pressure water proof - LPS33W Temperature - STTS22H Humidity - HTS221  <b>BMS</b> L9963E, L9963T	<b>Connectivity</b> Power Line Transceivers ST8500, ST7580 RS-485 and RS-232 STR485*, ST3232*  Isolated Interfaces for wired connectivity STIS062x
<b>Data Logger/ Internet Gateway</b>	<b>MCUs</b> STM32F0 STM32G0 STM32F1 STM32F3	<b>Protections</b>  ESD and High Speed Port series for Dataline ESD and EOS Protection	<b>EEPROM</b>  Standard Serial EEPROM	<b>Connectivity</b> Power Line Transceivers ST8500, ST7580 Bluetooth Low Energy BlueNRG, STM32WB RS-485 and RS-232 STR485*, ST3232* Sub-1GHz RF Transceivers <sup>2</sup> S2-LP, SPIRIT1 Sub-1GHz Wireless MCU <sup>2</sup> STM32WL Zigbee, Thread, STM32WB  Isolated Interfaces for wired connectivity STIS062x	

Note: \* is used as a wildcard character for related part number      1 only for bidirectional dc-dc converter      2 only for commercial battery storage systems      3 samples available in Q4 2021

# POWER SUPPLIES

## Auxiliary SMPS

Many appliances and equipment require the availability of a switch-mode power supply (SMPS) that works separately from the main power supply to support, for instance, stand-by operation. Power ratings can vary from a few watts to tens of watts for these auxiliary supplies, which can be either isolated or non-isolated. To ensure good performance, engineers must choose the power topology – including fixed frequency or quasiresonant flyback – that best meets the efficiency, size, safety and cost requirements.

ST offers a wide portfolio of highly-integrated high voltage converters for applications up to 20 W, with an extremely low total stand-by consumption – down to less than 4 mW – and breakdown voltages as high as 1050 V. In addition to PWM switching controllers, power MOSFETs and diodes, we offer an extensive set of evaluation and development tools as well as reference designs to help engineers develop high-efficiency and compact auxiliary power supply solutions.

### Isolated Auxiliary SMPS

In the power range up to 20 W, ST helps the designers of high-power-density and cost-effective isolated auxiliary power supplies with higher switching frequencies solutions to minimize transformer and output capacitor size. The power stage is managed by a high voltage converter.

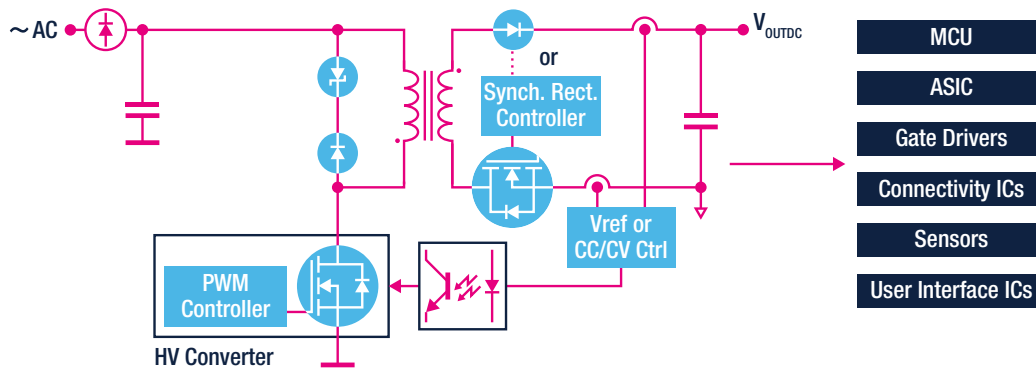
In the 20 to 75 W power range, the need to meet increasingly tight efficiency and stand-by requirements for auxiliary power supplies has pushed the use of quasi-resonant topologies replacing more mainstream fixed frequency based designs. The power stage is managed by an off-line controller coupled with HV power MOSFETs.

### ST's recommended products for Isolated Auxiliary SMPS

		HV converters		Offline controllers	HV Power MOSFETs	MOSFET Protection	Voltage Ref CC/CV Ctrl	Output diodes	Synch Rect	LDO
Isolated flyback	PSR-CV			HVLED001*		Power MOSFET Protection SMA4F, SMA6F, SMB15F series				
	Regulation with optocoupler	VIPer*5 VIPer*7 VIPer*8	VIPer0P VIPer*1 VIPer*6 VIPer122 VIPer222 ALTAIR*	STCH03 L6566B L6566BH L6565	800 V to 1700 V MDmesh K5 ST*80K5, ST*9*K5, ST*105K5, ST*120K5, ST*150K5, ST*12N170K5 600 V-650 V MDmesh M6 ST*60M6, ST*65M6  SiC MOSFET SCT*N65G2	Reverse blocking diodes 600 V Ultrafast STTH*06  800 V to 1200 V Ultrafast STTH*08 STTH*10 STTH*12	Voltage Reference T*431 T*432  Voltage and Current Ctrl TSM*, SEA05*	Schottky, FERD STPS* FERD*45 FERD*50 FERD*60 FER*100	SR Controllers SRK1000*,SRK1001 LV Power MOSFETs 40 V-100 V STripFET F7 ST*N4F7, ST*N6F7, ST*N8F7, ST*N10F7	Low Dropout (LDO) Linear Regulators LDF LDFM LDK220 LDK320 LDL212 ST730 ST732

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

### Typical configuration for Isolated Auxiliary Power Supply up to 20 W based on VIPerPlus or 75 W and more based on PWM Controllers



### Main application boards and reference designs



**STEVAL-VP26K01F**

Three outputs, isolated SSR flyback converter with extended input voltage range for Smart Meter and Power Line Communication



**STEVAL-VP318L1F**

15 V/1.2 A Isolated SSR Flyback converter



**EVAL-STCH03-45W**

45 W/12 V QR flyback with adaptive synchronous rectification



**EVL6566B-65W-QR**

19 V - 65 W QR flyback

## Non Isolated Auxiliary SMPS

In a number of applications the reference of the secondary circuit is connected to the same reference as the primary – the AC mains. In such cases, an off-line non-isolated auxiliary power supply can be used to provide a regulated DC voltage using an inductor or low-cost transformer – with simplified isolation – as an energy transfer element by modulating the power supply’s duty-cycle.

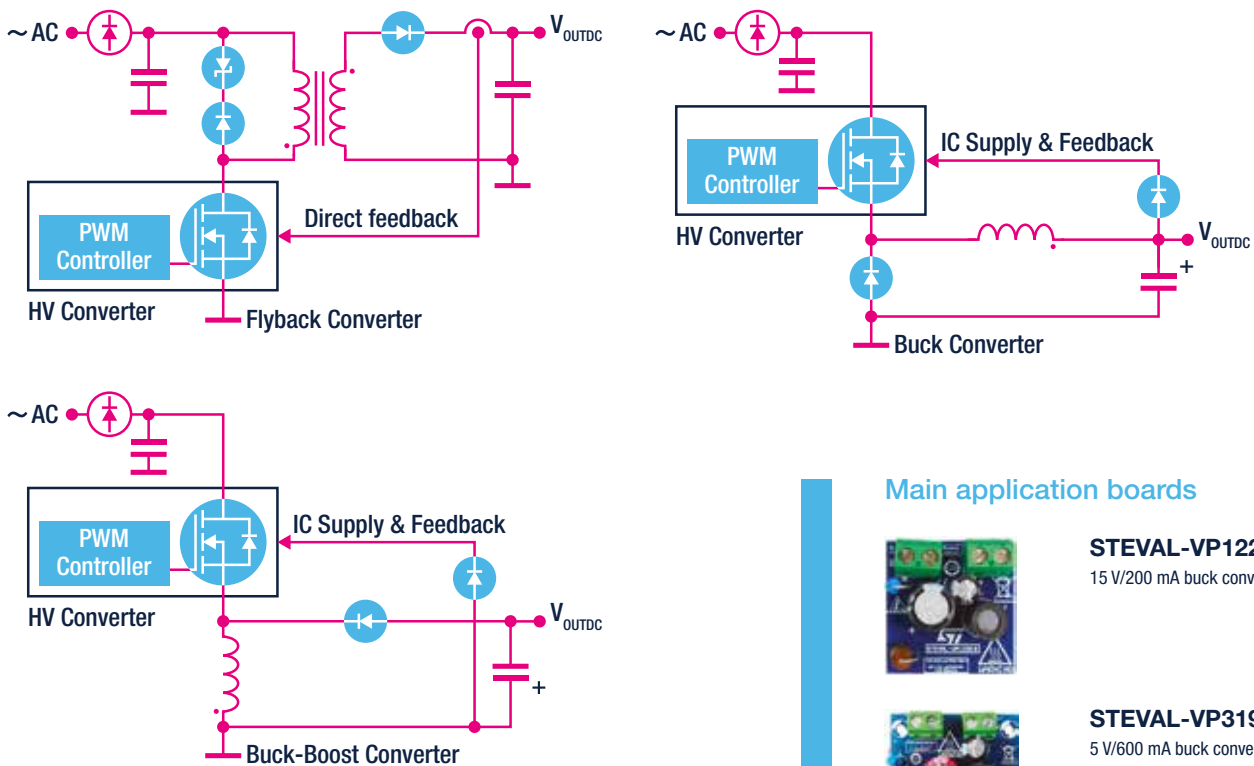
A buck – step-down – topology can be used to generate a positive output with respect to the common terminal and a buck-boost when the output voltage needs to be negative. A non-isolated flyback converter is the alternative when a higher output power is required.

## ST’s recommended products for Non-Isolated Auxiliary SMPS

	HV converters	VIPer Protection	Reverse blocking diodes	Output diodes	LDO
<b>Buck</b>				600 V Ultrafast STTH*06 800 V to 1200 V Ultrafast STTH*08 STTH*10	Low Dropout (LDO) Linear Regulators LDF, LDFM, LDK220, LDK320, LDL212, ST730, ST732
<b>Buck-boost</b>	VIPer0P VIPer*1 VIPer*6 VIPer122 VIPer222				
<b>Non-isolated flyback</b>		SMA4F, SMA6F, SMB15F series	600 V Ultrafast STTH*06 800 V to 1200 V Ultrafast STTH*08 STTH*10 STTH*12	Schottky, FERD STPS* FERD*45, FERD*50, FERD*60, FER*100	

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

### Typical configurations for Non-Isolated Auxiliary Power Supply



### Main application boards



**STEVAL-VP12201B**  
15 V/200 mA buck converter



**STEVAL-VP319X1B**  
5 V/600 mA buck converter



**STEVAL-VP22201B**  
5 V/0.36 A buck converter



**STEVAL-ISA196V1**  
5 V/1.2 A non-isolated flyback converter

## Smart Chargers and Adapters

### USB Type-C™ PD Adapters and Quick Chargers

The new slim and reversible USB Type-C™ connector with USB Power Delivery (PD) feature provides up to 100 W (20 V, 5 A) and more enabling a faster and more efficient charging solution. Having considerably expanded the capability of USB devices, these connectors are now widely found in wall chargers and adapters.

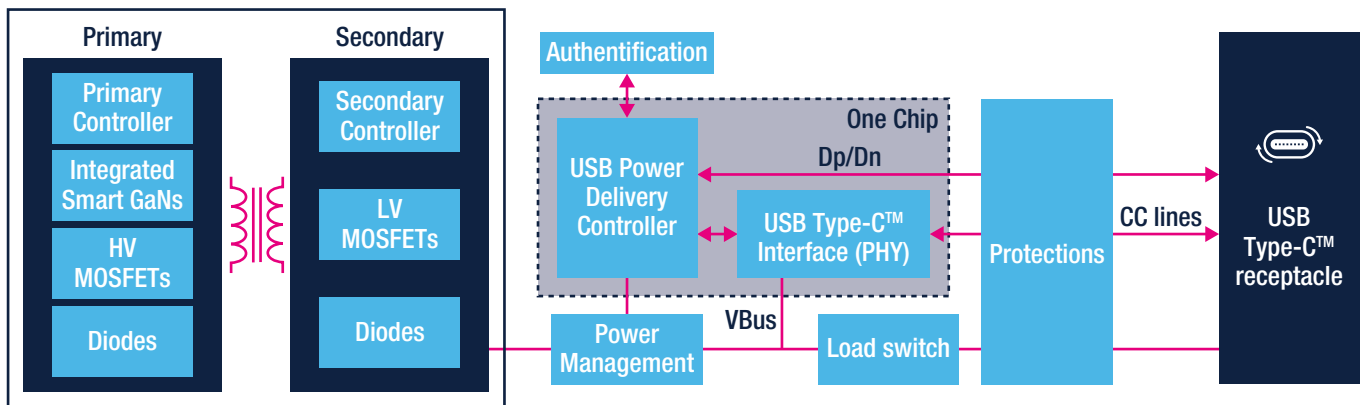
Designers of USB Type-C™ and Power Delivery compliant adapters and wall chargers can benefit from the MasterGaN series, an advanced power system-in package integrating a gate driver and two e-mode GaN transistors in half-bridge configuration, from stand-alone controllers, from STM32 microcontrollers and their associated protocol stack, our STSAFE secure element as well as a specifically developed range of protection and filtering devices.

### ST's recommended products for USB Type-C Power Delivery Smart Chargers and Adapters

Power Stage Primary Side				Power Stage Secondary Side				
Primary Controller	Integrated Smart GaNs	HV MOSFET	Diodes	Secondary Controller	LV MOSFET	Diodes		
PFC L656*	MASTERGAN2 MASTERGAN4 MASTERGAN5	600 V-650 V MDmesh M6 ST*60M6, ST*65M6 650 V MDmesh M5 ST*65M5	600 V Ultrafast for TM STTH*L06, STTH*06	SR Analog Controllers SRK1000, SRK1001 for Flyback SRK2000A, SRK2001, SRK2001A for LLC	100 V STRipFET F7 ST*N10F7	Output Diodes for Flyback Schottky STPS*, FERD FERD*45, FERD*50, FERD*60, FERD*100  Output Diodes for LLC Schottky STPS*, FERD FERD*45, FERD*50, FERD*60, FERD*100		
Type-C and USB-PD Controllers			Protections					
Programmable Solutions		Standalone Solutions	Authenticatcion & Secure MCUs	V <sub>rm</sub>	High surge current compact protection (V <sub>BUS</sub> )	Single and multi lines protection for MCUs Communication Channel (CC) and Side Band Use (SBU)	Type C Port protection Over voltage protection for USB-C and PD 3.0 controllers	LDO/ DC-DC
MCUs	Type-C Controller/ interface							
STM32G0, STM32G4, STM32L5		STUSB1600 STUSB1700 STUSB4500L STUSB4500 STUSB4700 STUSB4710 STUSB4761	STSAFE-A	20 V	ESDA25P35-1U1M ESDA24P140-1U3M	ESDL20-1BF4 ESDA25W	TCPP01-M12 TCPP02-M18 TCPP03-M20	ST715 LDK320 STPD01 ST730/2
STM32F0 STM32F3	STUSB1602A			15 V	ESDA17P100-1U2M ESDA15P50-1U1M	ESDA17P20-1U1M		Load Switch
				9 V	ESDA13P70-1U1M			
				5 V	ESDA7P120-1U1M	ESDA6V1L ESD051-1F4		

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

### Typical configuration



### Main application boards and reference designs



#### EVALMASTERGAN\*

High power density half-bridge high voltage driver with two 650 V enhanced mode GaN HEMT



#### EVLSTCH03-45WPD

45 W USB Type-C™ Power Delivery 3.0 adapter reference design with certified standalone controller



#### STEVAL-USBPD27S

27 W USB Type-C™ Power Delivery 3.0 adapter with PPS fetature

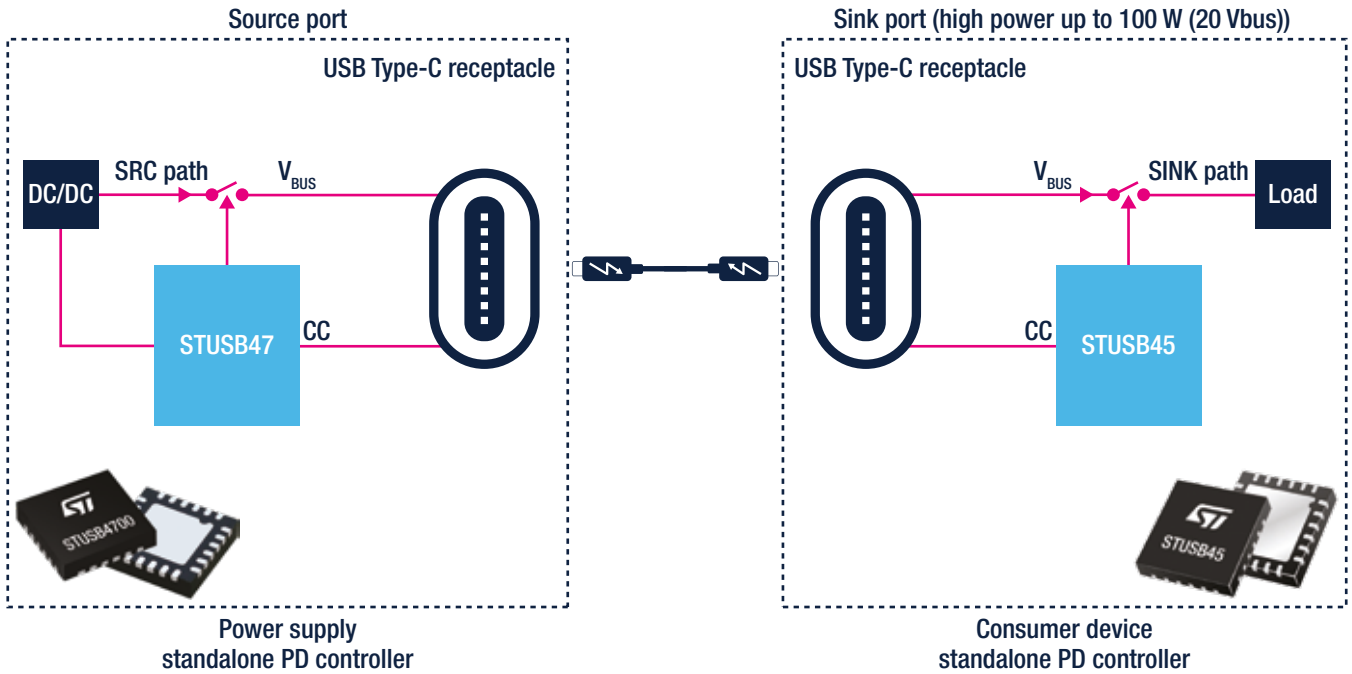


#### X-NUCLEO-SRC1M11<sup>1</sup>

USB Type-C Power Delivery Source expansion board based on TCPP02-M18<sup>1</sup>

Note: 1 available in Q4 2021

Typical block diagram with Certified Source and Sink Standalone Controllers



Main application boards and reference designs



**STEVAL-ISC004V1**

STUSB4710A USB Power Delivery evaluation board (with on-board DC-DC)



**STEVAL-ISC005V1**

STUSB4500 USB Power Delivery evaluation board



**EVAL-SCS001V1**

5 V-20 V SINK USB-PD reference design (migration from DC barrel)



**EVAL-SCS002V1**

5 V SINK USB-C reference design (migration from USB micro-B)



**X-NUCLEO-SNK1M1**

USB Type-C™ Power Delivery SINK expansion board based on TCPPO1-M12



**X-NUCLEO-DRP1M1**

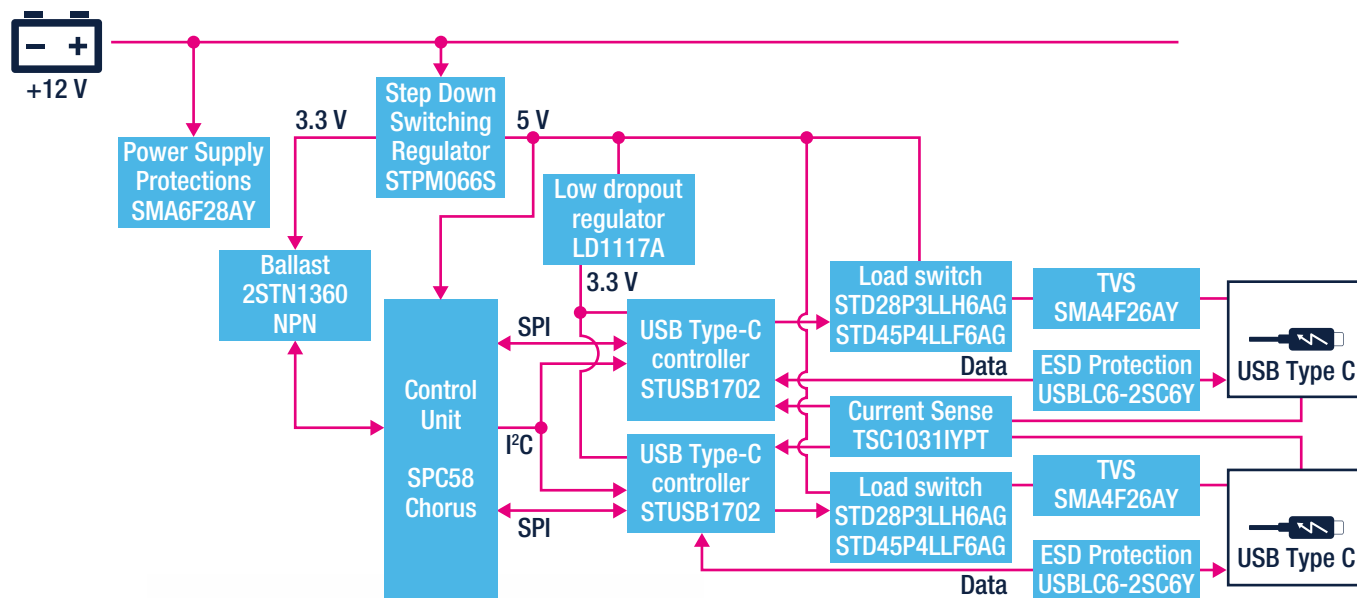
USB Type-C Power Delivery Dual Role Power expansion board based on TCPPO3-M20

## Automotive-grade USB Type-C and Power Delivery solution

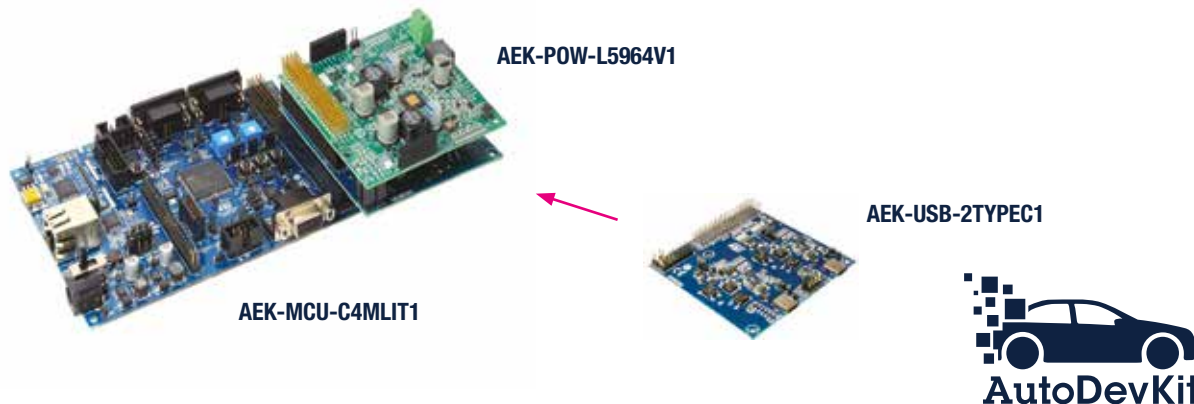
The USB Type-C and USB Power Delivery specifications allow smarter connectivity with fewer cables, less connectors and universal chargers.

The Type-C connector supports all the features of previous standards, and ports can be configured to only supply power in a Provider role, only sink power in a Consumer role, or be able to switch between both in a Dual role. Both data and power roles can be independently and dynamically swapped using the USB Power Delivery protocol. Most of the automotive applications require support for the Provider role only. When a USB device is connected, the Provider and the device (Consumer) negotiate a contract for the power objects through configuration channels.

### Typical Block Diagram for Automotive grade USB Power Delivery



Complete USB Power Delivery version 2.0 including software stack available in AutoDevKit.



### Digitally controlled dual-channel DC-DC suitable for USB Power Delivery 3.0

#### KEY FEATURES

- Dual independent channel up to 3 A each
  - Compatible with both 12 V and 24 V input
  - Combined channels for up to 100W
  - Digitally selectable fixed output voltages: 3.3 - 5 - 9 - 15 - 20 V
  - PPS-V: PWM programmable output voltages with 20 mV steps
  - PPS-I: PWM programmable output current with 50 mA steps
- More details available on AN5362



## Adapters for Tablets, Notebook and All-in-One (AIO) Computers

Power AC-DC adapters for notebooks, tablets and AIO need to be small, thin, lightweight and provide excellent EMI performance as well as ultra-low, highly efficient standby power, regardless of the load conditions.

A typical high-efficiency design includes a flyback stage with synchronous rectification and for higher power, a Power Factor Corrector (PFC) working in Transition Mode (TM) followed by a flyback, forward or half-bridge LLC resonant stage with synchronous rectification.

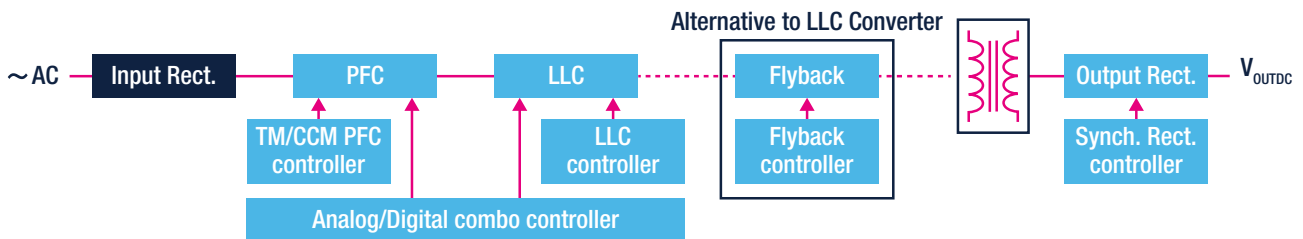
ST offers a broad range of high-voltage MDmesh™ and low-voltage STripFET power MOSFETs as well as standard and field-effect rectifiers (FERD). Our offering also includes a range of PFC, PWM primary controllers, synchronous rectification controllers, and single-chip analog and digital combo controllers.

## ST's recommended products for Tablets, Notebook and AIO Adapters

	Controllers	Power MOSFETs	Diodes	
<b>PFC Block</b>	TM Analog Controllers L6562A*, L6563*, L6564* CCM Analog Controllers L4985, L4986, L4981*, L4984D	600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 600 V-650 V MDmesh M6 ST*60M6, ST*65M6 650 V MDmesh M5 ST*65M5	600 V Ultrafast for TM STTH*L06, STTH*06, STTH15AC06* 600 V Ultrafast for CCM STTH*R06, STTH*T06	
	Converters & Controllers	Integrated Smart GaNs	Diodes & Protections	Voltage Reference, CG/CV Ctrl
<b>Isolation Stage</b>	HV Converters for Flyback SSR: VIPer*5, VIPer*7, VIPer*8 PSR: VIPer0P, VIPer*1, VIPer122, VIPer222, VIPer*6, ALTAIR* Flyback Controllers STCH03, L6566A, L6566B, L6565 PFC & LLC Combo Controllers STCMB1, STNRG011 LLC Analog Controllers L6599*, L6699 SR Analog Controllers SRK1000, SRK1001 for Flyback SRK2000A, SRK2001, SRK2001A for LLC	600 V MASTERGAN*	Output Diodes for Flyback Schottky, FERD, STPS*, FERD*45, FERD*50, FERD*60, FERD*100 Clamping Diodes for Flyback 600 V to 1000 V Ultrafast STTH*06, STTH*08, STTH*10 Output Diodes for LLC Schottky, FERD STPS* FERD*45, FERD*50, FERD*60, FERD*100 MOSFET protection for Flyback SMA6F, SMB15F series	Voltage Reference T*431, T*432 Voltage and Current Ctrl TSM*, SEA05*
		Power MOSFETs		Post Regulation
		800 V to 950 V MDmesh K5 ST*80K5, ST*9*K5 600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 600 V-650 V MDmesh M6 ST*60M6, ST*65M6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V MDmesh DM6 ST*60DM6 40 V-100 V STripFET F7 ST*N4F7, ST*N6F7, ST*N8F7, ST*N10F7		DC-DC Converters ST1S*, ST1S40, ST1S50 Low Dropout (LDO) Linear Regulators ST715 LDK320 ST715 ST730 ST732

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

### Typical Block Diagram with PFC Front-End



### Main application boards and reference designs



#### EVLCMB1-90WADP

19 V - 90 W adapter based on TM PFC and HB LLC analog combo controller



#### EVLSTNRG011-150

12 V - 150 W power supply based on TM PFC and HB LLC digital combo controller



#### EVLCMB1-AIO210W

12 V - 210 W adapter based on TM PFC and HB LLC analog combo controller



#### EVL400W-EUPL7

12 V - 400 W adapter based on CCM PFC and HB LLC analog controller

Note: EU CoC ver. 5 Tier 2 and EuP lot 6 Tier 2 compliance ensured

## Wireless Charging

Wireless chargers are expected to become ubiquitous in hotels, airports, cafes and other public places as they enable topping off the batteries of portable and wearable devices, letting the user forget about cables.

In a wireless battery charging system, power is transferred by electromagnetic induction (inductive power transfer) between a transmitting pad (TX) and the battery powered device (RX), such as a smartphone, smartwatch, or sports gear.

The power transmitter unit controls the current in the transmitting coil to transfer the correct amount of power as required by the receiver unit that continuously provides this information to the transmitter by modulating the transmitter carrier frequency through controlled resistive or capacitive load insertion. Generating the correct amount of power guarantees the highest level of end-to-end energy efficiency and helps limit the device's operating temperature.

ST has a wide range of wireless charger IC solutions including transmitters and receivers providing low stand-by power, accurate foreign objects detection (FOD) and reverse charging features. In order to prevent unwanted damage to any NFC Cards that might be close to the wireless charging source during operation, it is recommended to add an NFC Reader. The NFC Reader is able to detect the presence of the NFC Card or Tag (ST Reader ICs can detect Type A, B, F, or V NFC Cards), and therefore instruct the operating system to stop transmitting power.

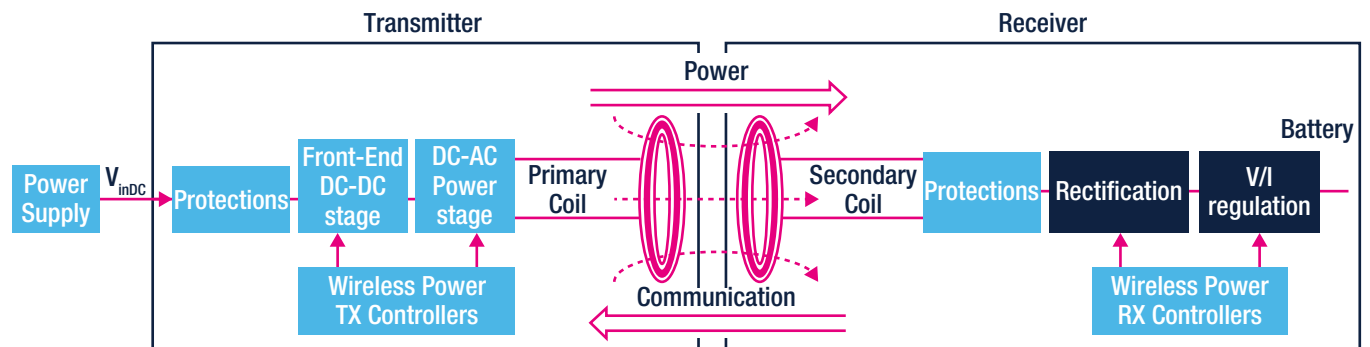
ST also offers evaluation and development tools and reference designs to help develop high-efficiency and compact wireless chargers that are Qi compliant for both Baseline Power Profile (BPP) and Extended Power Profile (EPP). Moreover, easy to use reference designs and evaluation boards enables customization with ST Super Charge protocol for personal electronics, industrial and medical applications.

## ST's recommended products for Wireless Charging

	Wireless charging ICs	Battery Charger ICs	MCUs	Gate drivers	Power MOSFETs	Protections	Diodes	NFC reader
<b>Transmitter</b>	STWBC2-LP <sup>1</sup> STWBC2-MP <sup>1</sup> STWBC2-HP <sup>1</sup>		STM32G0 STM32F334 STM32G4	L6743B	STL10N3LLH5, STL8DN6LF3, ST*N2VH5, STL8DN10LF3, STL6N3LLH6, STL10N3LLH5	TVS SMA4F, SMA6F, SMB15F series USB Port Protection TCPP01-M12	STPS*L30 STPS*45/60/100 FERD*45/60/100	ST25R3911B ST25R3912 ST25R3916
<b>Receiver</b>	STWLC68 STWLC88	STBC02				ESDALC14V2-1U2	BAT30F4, BAR46	

Note: \* is used as a wildcard character for related part number 1 available in Q4 2021

## Typical Block Diagram



## Main application boards and reference designs

### Transmitters



#### STEVAL-ISB68WTX

Qi-based 2.5 W wireless charger transmitter

### Receivers



#### STEVAL-ISB68WA

Qi-based wireless power receiver reference design for wearable applications up to 2.5 W



#### STEVAL-ISB68RX

Qi wireless power receiver for Baseline Power Profile (BPP) applications up to 5 W

### NFC Readers



#### ST25R3911B-DISCO

ST25R3911B based NFC Reader Discovery Board



#### ST25R3916-DISCO

ST25R3916 based NFC Universal Device Discovery Board

## Desktop PCs Power Supply

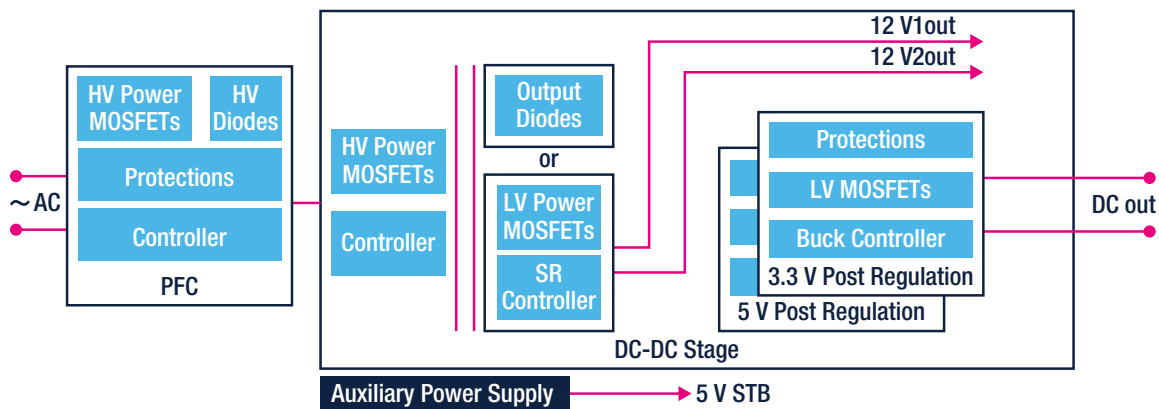
The requirements for the standard ATX PC power market are a small form factor with better performance. An intelligent control scheme that enables the adaption of load variation to minimize power consumption, together with optimized power semiconductors, is the key in meeting market demands. The smart analog and digital controllers, such as the STCMB1 and the STNRG011, the high-voltage MDmesh™ Power MOSFETs used for the PFC and DC-DC stages, the low-voltage STripFET Power MOSFETs for synchronous rectification, and SiC diodes (STPSC\*) help designers develop the best PC power supply solutions to improve efficiency. ST's DC-DC converters guarantee high power density for the post-regulation.

## ST's recommended products for Desktop PC's Power Supply

	Controllers	Power MOSFETs	Diodes & Discretes	Opamp V/I Sensing
PFC Block	TM Analog Controllers L6562A*, L6563*, L6564*	600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP	600 V Ultrafast for TM STTH*L06, STTH*06, STTH15AC06*	Precision Op Amps (<50 MHz) TSZ*, TSV*, TS9*, LMV*
	CCM Analog Controllers L4985, L4986, L4981*, L4984D	600 V-650 V MDmesh M6 ST*60M6, ST*65M6	600 V Ultrafast for CCM STTH*R06, STTH*T06	<b>MOSFET and IGBT Gate Drivers</b>
	MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG388A	650 V MDmesh M5 ST*65M5	SiC Diodes STPSC*065	Multiple LS Gate Drivers PM8834
			TVS for Power Rail Surge Protection SMAJ40CA-TR	Single LS Gate Drivers PM88*1
Isolation DC-DC Stage	PFC & LLC Combo Controllers STCMB1, STNRG011	600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP	Diodes	eFuses
	LLC Analog Controllers L6599*, L6699	600 V-650 V MDmesh M6 ST*60M6, ST*65M6	Output Diodes Schottky, FERD STPS*, FERD*45, FERD*50, FERD*60, FERD*100	STEF01 STEF05-STEF05S STEF12-STEF12S STEF12H60M
	Asymmetrical HB Controllers L6591	600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2	<b>Protections</b>	<b>MOSFET and IGBT Gate Drivers</b>
	MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG388A	600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6	TVS for Power MOSFET and Power Rail Surge Protection SMA4F, SMA6F, SMB15F series	HV HB Gate Drivers for GaNs STDRIVEG600
SR Analog Controllers SRK2000A, SRK2001, SRK2001A for LLC	40 V-100 V STripFET F7 ST*N4F7, ST*N6F7, ST*N8F7, ST*N10F7	<b>LDO</b>	HV HB Gate Drivers L649*	
		Low Dropout (LDO) Linear Regulators LDF, LDFM, LDK320, LDL212	Isolated Gate Drivers STGAP*	
Post Regulation	Controllers	Power MOSFETs	Voltage Reference	SR Multiple LS Gate Drivers PM8834
	L6726A, L673*, PM6680	STL90N3LLH6	T*431, T*432, TS33*	

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

### Typical configuration



### Main application boards and reference designs



**EVL6563S-250W**  
250 W transition-mode PFC pre-regulator



**EVL4984-350W**  
350 W CCM PFC pre-regulator demonstration board



**EVL400W-EUPL7**  
12 V - 400 W adapter based on CCM PFC and HB LLC analog controller

## Server & Telecom Power

### AC-DC PSU & DC-DC power distribution

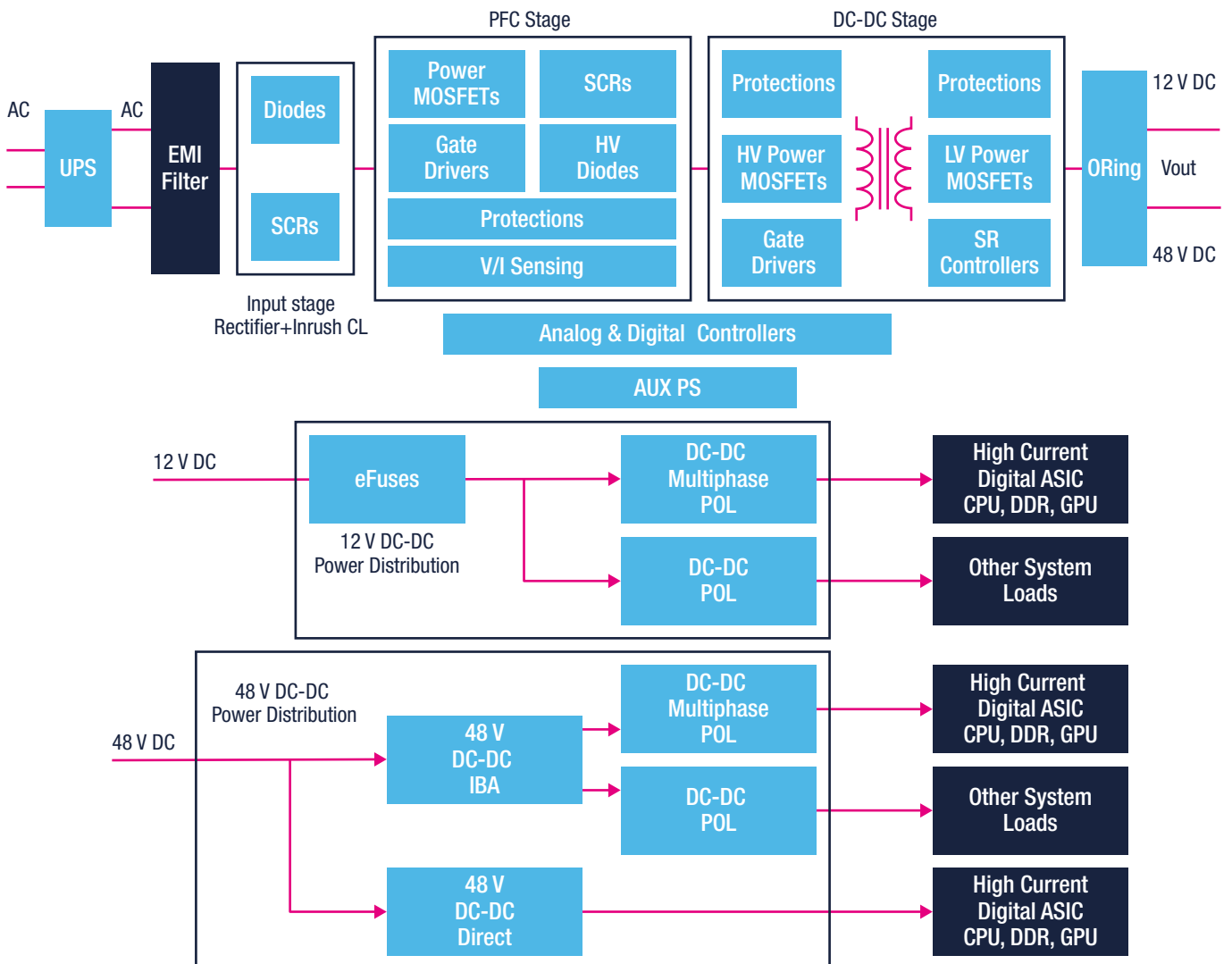
Data centers house thousands of servers, usually built in very dense network farms. Data center power requirements are constantly increasing and traditional power systems are no longer sufficient to meet this growing demand. The power distribution chain, from the front-end AC-DC stage to the back-end DC-DC power distribution, needs to deliver the best performance in terms of efficiency, power density and ability to interface with the digital world.

In telecom system power, the use of complex digital ASICs for managing growing data traffic is pushing further the power envelope. Telecom power management systems have to be highly energy-efficient and very dense to deliver the required high levels of power, while maintaining reasonable power consumption.

ST offers an extensive product and solution coverage to ensure the most optimized power design across the entire distribution chain. Our digital and analog controllers combined with MOSFETs and drivers are key ingredients for implementing the most efficient and most dense AC-DC power delivery. On the backend DC-DC power distribution, ST offers advanced solutions for the Point-of-Load conversion and a recently developed innovative DC-DC conversion from the 48 V DC supply.



### Typical Block Diagram for Server PSU



## ST's product offering for Server and Telecom AC-DC PSU

		SCRs	Diodes	
<b>Input Stage (Rect. &amp; inrush current limiter)</b>			Bridge Rectifier Diodes STBR*08, STBR*12	
<b>PFC Block</b>	<b>Controllers</b>	High Temp. SCR TN*015H-6, TM8050H-8, TN*050H-12	<b>Diodes &amp; Protections</b>	<b>MOSFET and IGBT Gate Drivers</b>
	CCM Analog Controllers L4985, L4986, L4981*, L4984D MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG388A		<b>Power MOSFETs</b>	
		600 V-650 V MDmesh M2 ST*60M2, ST*65M2 600 V-650 V MDmesh M6 ST*60M6, ST*65M6 650 V MDmesh M5 ST*65M5 SiC MOSFETs SCT*N65G2	<b>V/I Sensing</b>	
		Isolated Sigma-Delta ADC ISOSD61, ISOSD61L Precision Op Amps (<50 MHz) TSZ*, TSV*, TS9*, LMV*	Isolated Sigma-Delta ADC ISOSD61, ISOSD61L Precision Op Amps (<50 MHz) TSZ*, TSV*, TS9*, LMV*	
<b>Isolation DC-DC Stage</b>	<b>Controllers</b>	<b>Power MOSFETs</b>	<b>Diodes</b>	<b>MOSFET and IGBT Gate Drivers</b>
	LLC Analog Controllers L6599A, L6699 Asym. HB Analog Controllers L6591 MCUs & Digital Controllers STM32F334, STM32G4, STNRG388A SR Analog Controllers SRK2000A, SRK2001, SRK2001A	600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 600 V-650 V MDmesh M6 ST*60M6, ST*65M6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6 SR 60 V-100 V StripFET F7 ST*N6F7 ST*N8F7 ST*N10F7	Output Diodes for LLC Schottky, FERD STPS* FERD*45, FERD*50, FERD*60 TVS for Power MOSFET and Power Rail Surge Protection SMA4F, SMA6F, SMB15, series	HV HB Gate Drivers for GaNs STDRIVEG600 HV HB Gate Drivers L649* Isolated Gate Drivers STGAP* SR Multiple LS Gate Drivers PM8834 SR HV HB Gate Drivers L649*
			<b>LDO</b>	<b>eFuses</b>
			Low Dropout (LDO) Linear Regulators LDF, LDFM, LD39050, LD39100, LD39200, LDL112, LDL212, LD59100, LD57100	STEF01 STEF05-STEF05S STEF12-STEF12S STEF12H60M

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

### Main application boards and reference designs



#### STEVAL-ISA147V3

500 W fully digital AC-DC  
power supply (D-SMPS)



#### STEVAL-ISA172V2

2 kW fully digital AC-DC  
power supply (D-SMPS)



#### STEVAL-DPSLLCK1

3 kW Full Bridge LLC  
resonant digital power supply



#### EVLSTNRG-1kW

1 kW SMPS digitally controlled  
multi-phase interleaved converter



#### STEVAL-DPSTPFC1

3.6 kW PFC totem pole with  
digital inrush current limiter

### Power Distribution for Modern Data Center

To support the evolution and expansion of cloud services, the internet of things, mobile apps and new generation of telecommunication infrastructure, the demand for data centers performance is growing exponentially with more powerful CPUs, and this segment is expanding in artificial intelligence and machine learning.

In the newest architecture a 48 V DC rail is generated from the AC-DC power supply unit that will then be converted to provide the number of DC rails needed to supply the variety of loads and circuits in the server. This conversion must meet stringent efficiency targets requiring innovative architectures like those developed by ST.

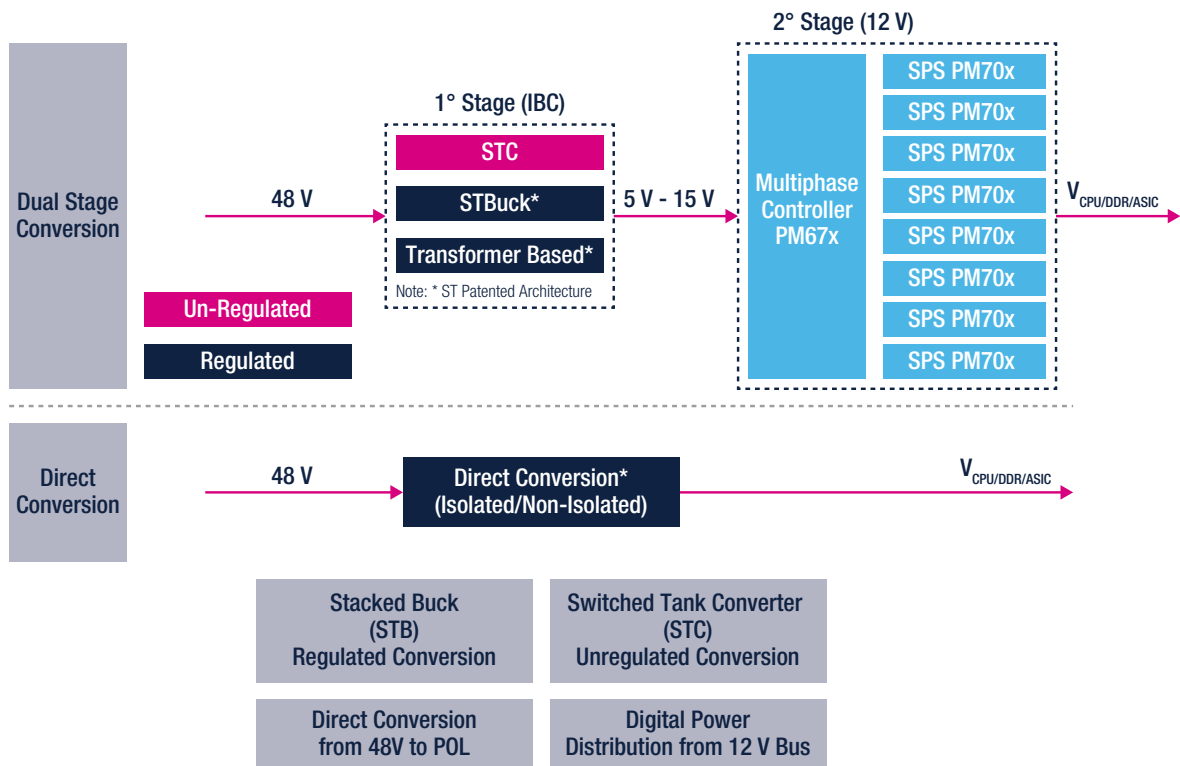
We offer a wide range of high-efficiency regulated and unregulated DC-DC conversion solutions including STB, STC, HSTC for 48 V to 12V intermediate bus conversion.

Moreover we offer 12V to Point of Load conversion including multi-phase digital controller and Smart Power Stages (SPS) to support the most recent INTEL and AMD CPU specifications.

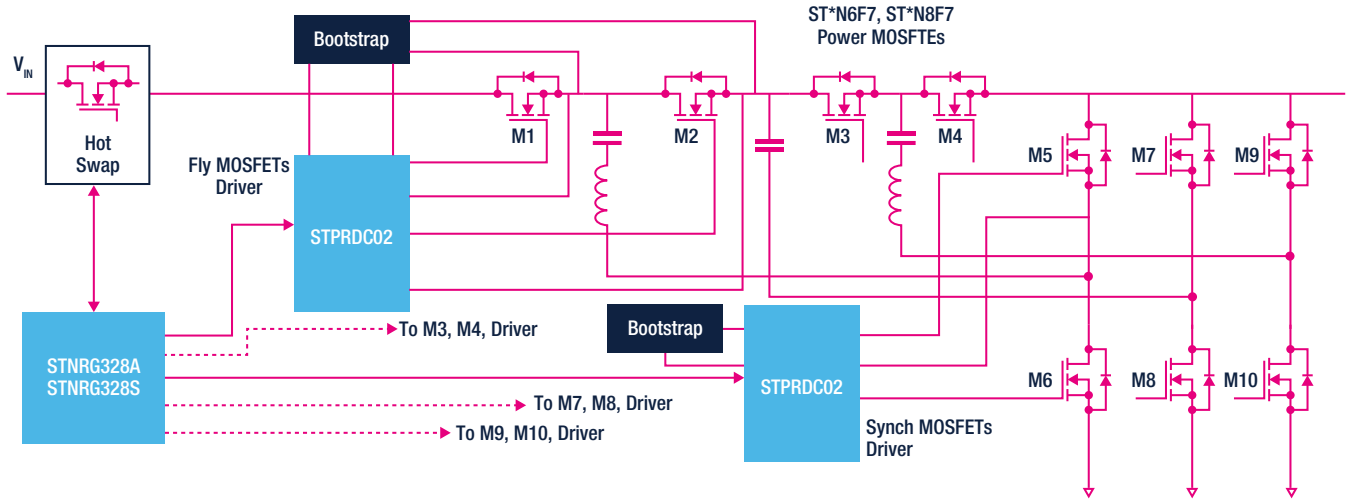
Finally, ST offers direct conversion solutions, from 48V to the point of load, based on the Power Stamp Alliance (PSA) products.



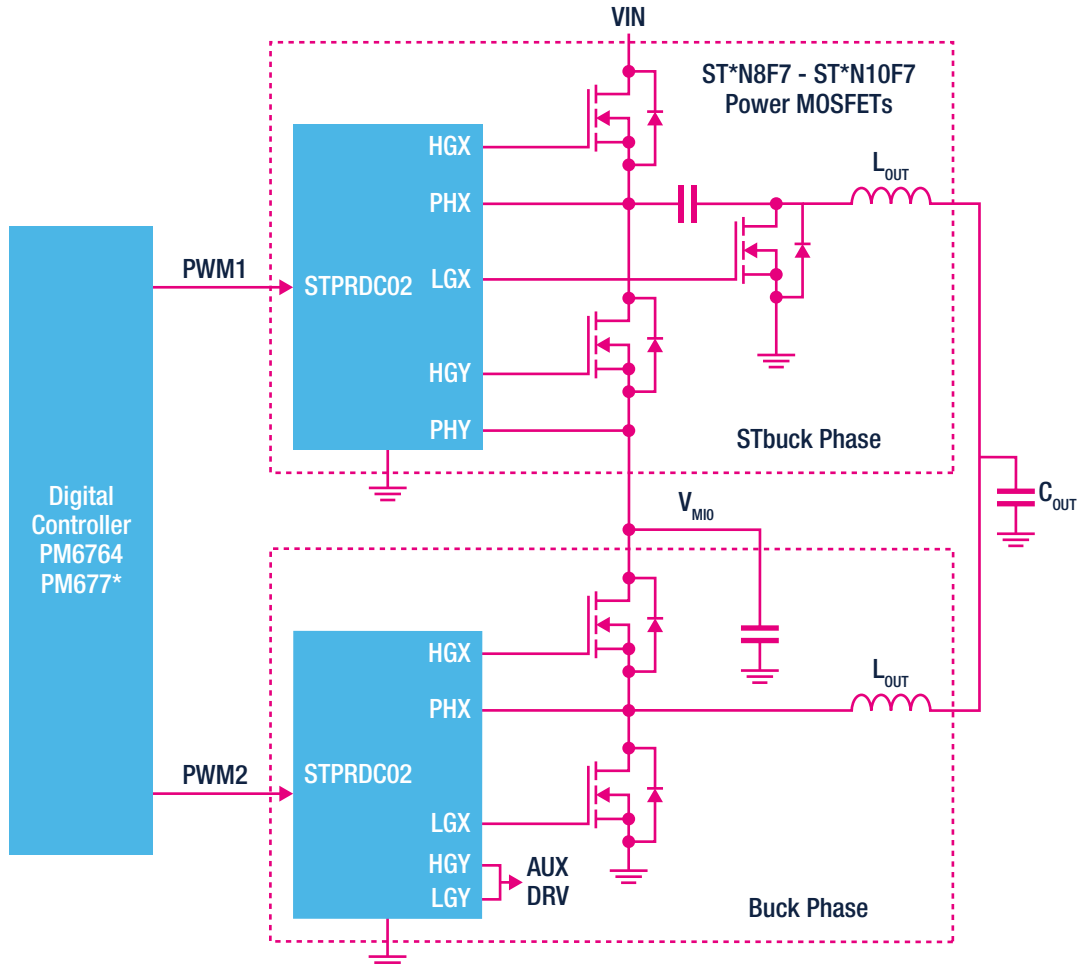
### Power Delivery for Modern Data Center



**Typical Configuration for Switched-Tank Converter (STC) System - 48 V to 12 V non isolated unregulated IBC**

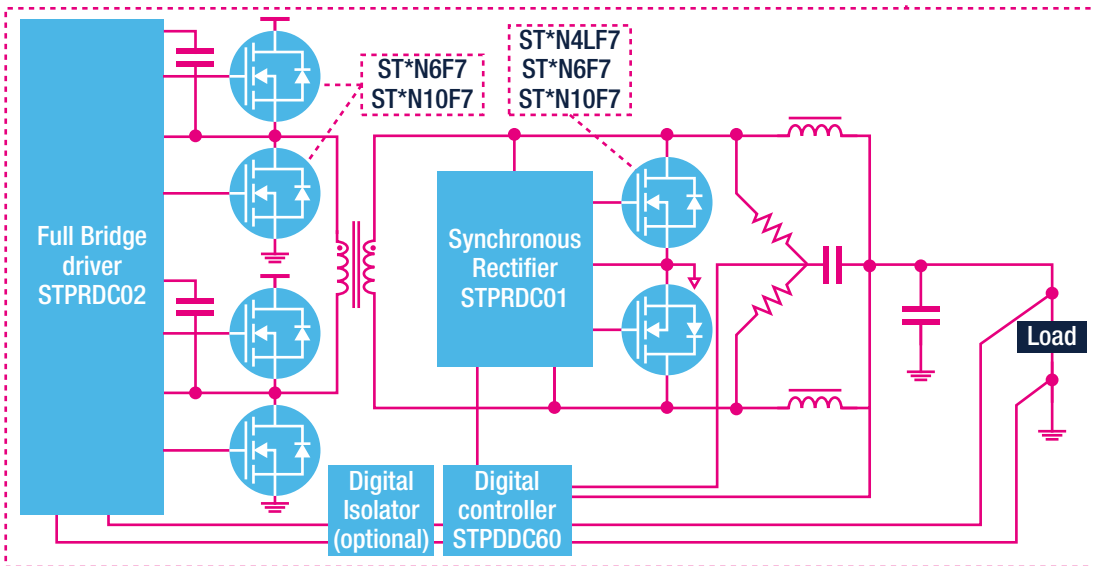
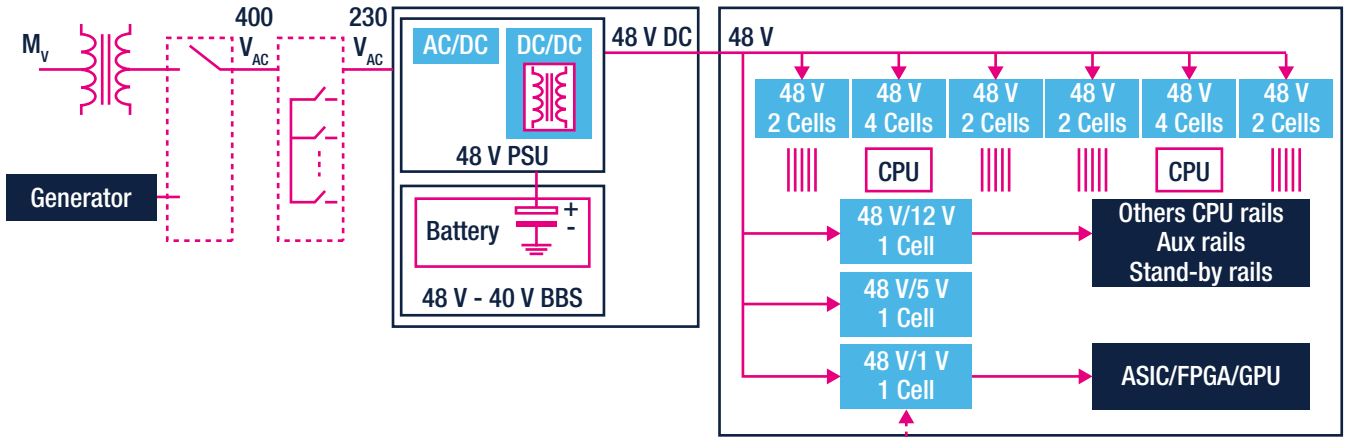


**Typical Configuration for STBUCK - 48 V to 12 V non isolated regulated IBC**



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

**Typical Configuration for 48 V Isolated Direct Conversion**



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



## SSD Power Management

Solid State Drives (SSD) serve the same function as Hard Disk Drives, but they have a different set of internal components; they have no moving parts and data is stored in flash memory. SSDs can access data faster than HDDs and have several other advantages such as better performance and robustness and lower power consumption. SSDs are widely used in desktop and notebook computers as well as for storage in data centers.

ST offers state-of-the-art products for SSD system architecture including Power Management ICs featuring protections and communication bus. Our portfolio of high-quality components allows the design of solutions meeting the most demanding requirements of both consumer SSD and enterprise-grade SSDs.

ST device family is ideal to design advanced power management solutions for microcontroller, DDR, Flash memory, on SSD server and consumer applications.

The IC series features multiple Buck and LDOs with programmable outputs and supports conversions from a wide range of input voltage buses as 12 V, 5 V and 3.3 V.

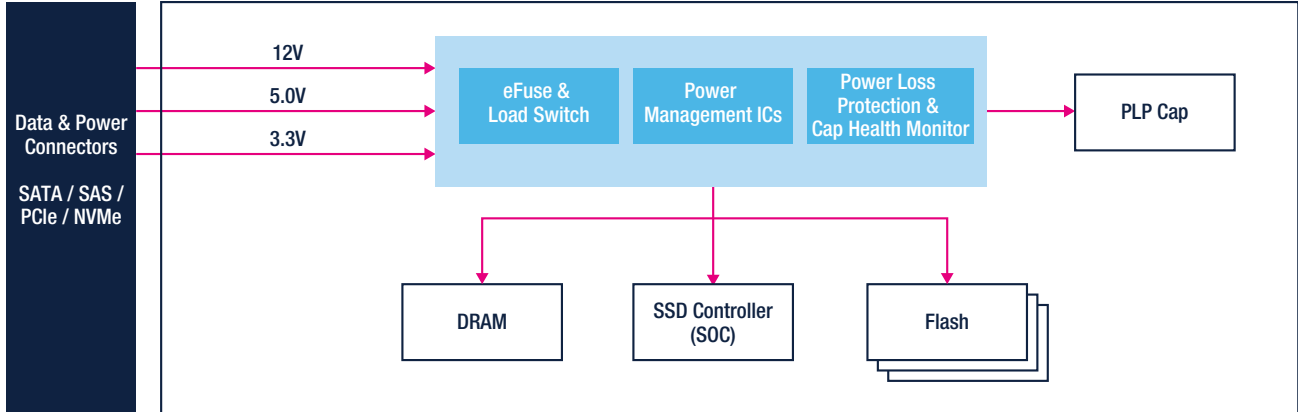
Electronic fuses (eFuses) for 3.3, 5 and 12 V, located at the power connector, minimize the system down-time, by protecting the SSD and the host from failures.

High switching frequency eases the design of compact application while specific control techniques ensures best in class efficiency at heavy and light load operation.

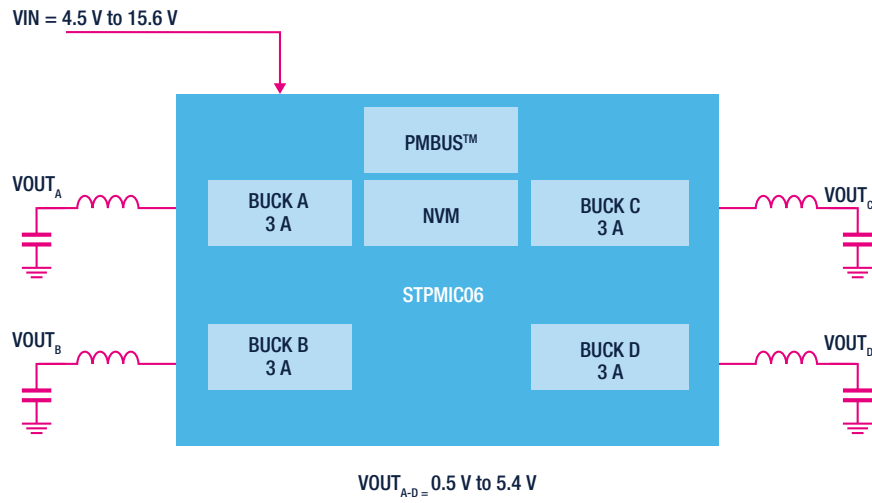
Full programmability via high speed serial interfaces as I<sup>2</sup>C and PMBus<sup>®</sup> allows configurability to fit different application requirements.



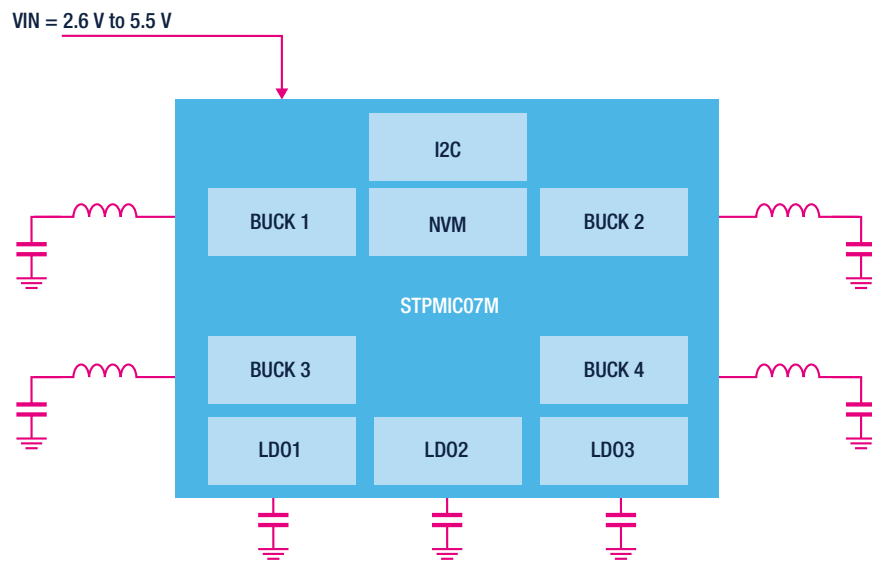
### Typical Block Diagram for SSD Power Management



## STPMIC06



## STPMIC07M



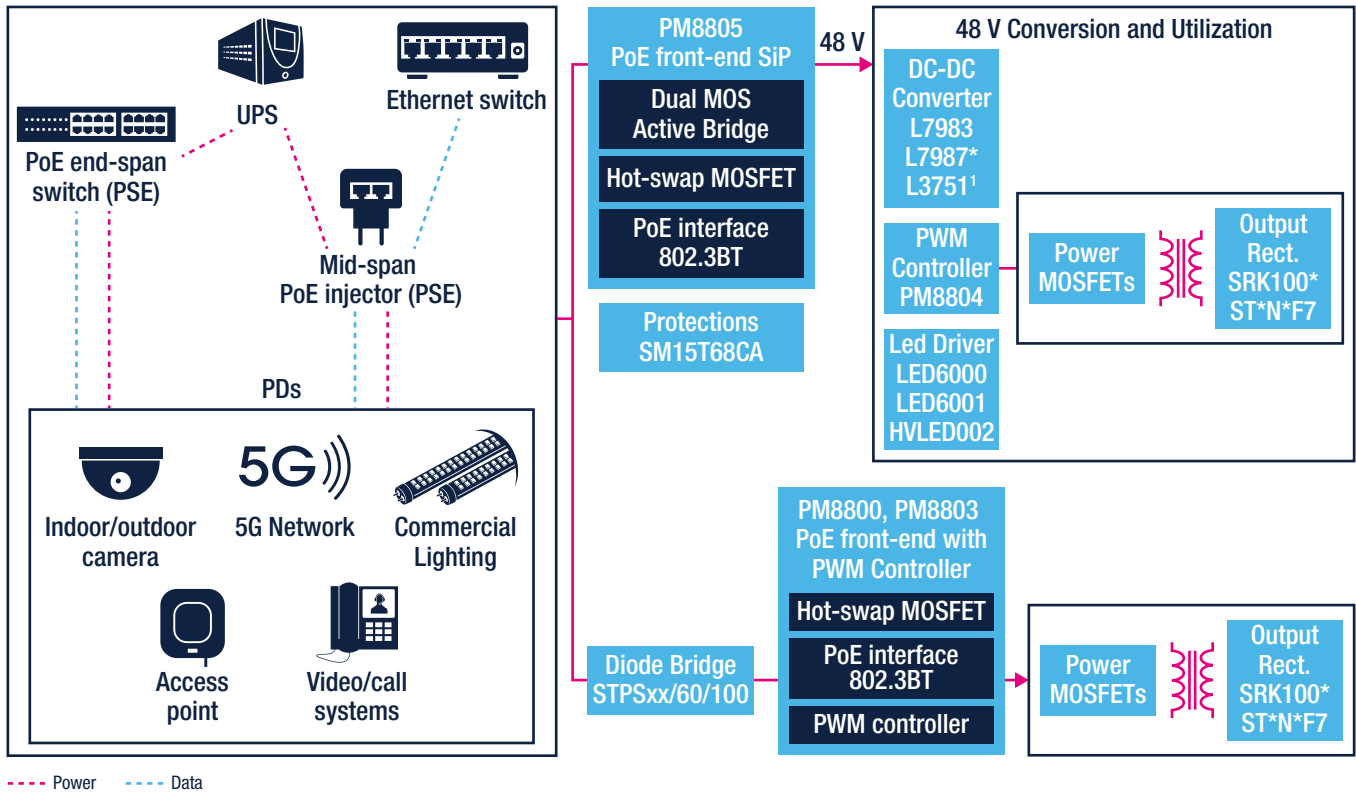
## Power over Ethernet (PoE)

Power over Ethernet (PoE) is a widely adopted technology used to transfer power and supply the powered device (PD) including wireless access points, VoIP phones over an RJ-45 cable also carrying data as described in the IEEE 802.3 standard and its evolutions including IEEE 802.3bt, IEEE 802.3at and IEEE 802.3af.

We offer a range of products providing a complete interface with all the functions required by the communication standard, including detection and classification as well as protection features such as under-voltage lockout (UVLO) and in-rush current limitation. In addition, these products can control hot-swap power MOSFETs that can greatly simplify the development of IEEE 802.3 compliant solutions for powered devices (PD).



### Typical block diagram for PoE Power Management



### Main application boards and reference designs



#### STEVAL-POE001V1

Power Over Ethernet (PoE) - IEEE 802.3bt compliant interface



#### STEVAL-POE002V1

5 V/8 A, synchronous flyback converter, Power over Ethernet (PoE) IEEE 802.3bt compliant reference design



#### STEVAL-POE003V1

5 V/20 A, active clamp forward converter, Power Over Ethernet (PoE) - IEEE 802.3bt compliant reference design



#### STEVAL-POE005V1

12 V/8 A, active clamp forward converter, Power Over Ethernet (PoE) IEEE 802.3bt compliant reference design



#### STEVAL-POE006V1

3.3 V/20 A, active clamp forward converter, Power Over Ethernet (PoE) IEEE 802.3bt compliant reference design

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

1 available in Q4 2021

## LED TV Power Supply

Beyond their outstanding image quality, new-generation televisions have a very thin design, are highly power-efficient and feature a stand-by power mode. Power Supply Units (PSUs) play a key role in ensuring TVs meet market requirements and have an elegant form factor.

To achieve these stringent requirements, PSUs typically have a Power Factor Corrector (PFC) stage and use advanced topologies, like half-bridge LLC (HB-LLC) resonant.

ST offers a broad portfolio of high-voltage MDmesh™ and low-voltage STripFET™ power MOSFETs, field-effect rectifier diodes (FERD), Schottky and Ultrafast diodes, a full range of protection ICs as well as dedicated analog and digital switching controllers which negate the necessity of auxiliary power by consuming very low power at no load. In addition, STM32 microcontrollers enable developers to exploit the full potential of digital PSU implementations.

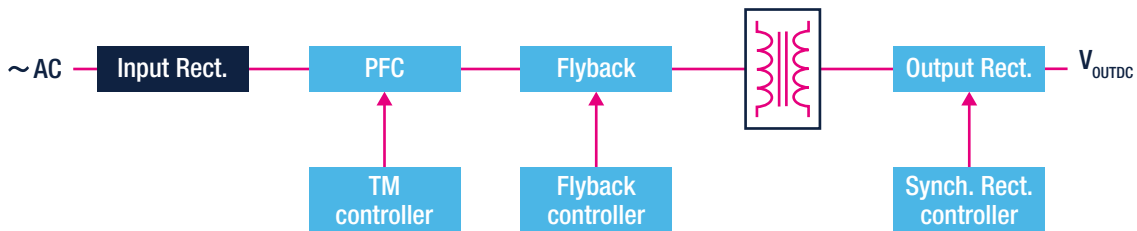


## ST's recommended products for LED TV Power Supply

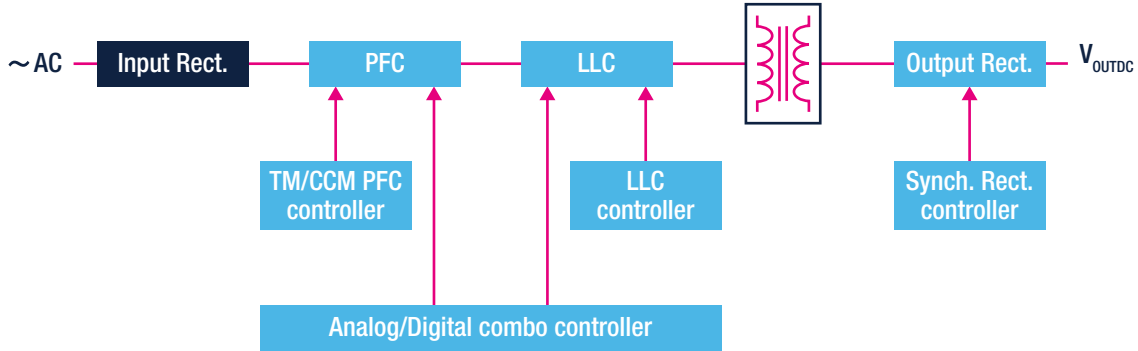
	Controllers	Power MOSFETs	Diodes	Opamp V/I Sensing
PFC Block	TM Analog Controllers L6562A*, L6563*, L6564* CCM Analog Controllers L4985, L4986, L4981*, L4984D MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG388A	600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 600 V-650 V MDmesh M6 ST*60M6, ST*65M6 650 V MDmesh M5 ST*65M5	600 V Ultrafast for TM STTH*L06 STTH*06 STTH15AC06* 600 V Ultrafast for CCM STTH*R06 STTH*T06 SiC Diodes STPSC*065	Precision Op Amps (<50 MHz) TSZ*, TSV*, TS9*, LMV*
				MOSFET and IGBT Gate Drivers
				Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1
Isolation Stage	Controllers	Integrated Smart GaNs	Diodes & Protections	MOSFET and IGBT Gate Drivers
	Flyback Controllers L6566A, L6566B, L6565, L6668, STCH03 PFC & LLC Combo Controllers STCMB1, STNRG011 LLC Analog Controllers L6599*, L6699 Asymmetrical HB Controllers L6591 MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG388A SR Analog Controllers SRK1000, SRK1001 for Flyback SRK2000A, SRK2001, SRK2001A for LLC	600 V MASTERGAN*	Output Diodes for Flyback Schottky, FERD, Ultrafast STPS*, FERD*, STTH*	HV HB Gate Drivers for GaNs STDRIVEG600 HV HB Gate Drivers L649* Isolated Gate Drivers STGAP*
		Power MOSFETs	Clamping Diodes for Flyback 600 V to 1000 V Ultrafast STTH*06, STTH*08, STTH*10	SR Multiple LS Gate Drivers PM8834
		600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 600 V-650 V MDmesh M6 ST*60M6, ST*65M6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V MDmesh DM6 ST*60DM6 60 V-100 V STripFET F7 ST*N6F7 ST*N8F7 ST*N10F7	Output Diodes for LLC Schottky, FERD STPS* FERD*45, FERD*50, FERD*60, FERD*100 MOSFET Protection for Flyback SMA4F, SMA6F, SMB15F series	SR HV HB Gate Drivers L649* Isolated Interfaces for wired connectivity STIS062x
	Voltage Reference	DC-DC Conversion		
		T*431, T*432	ST1S12, ST1S3*, ST1S4*, ST1S50	

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

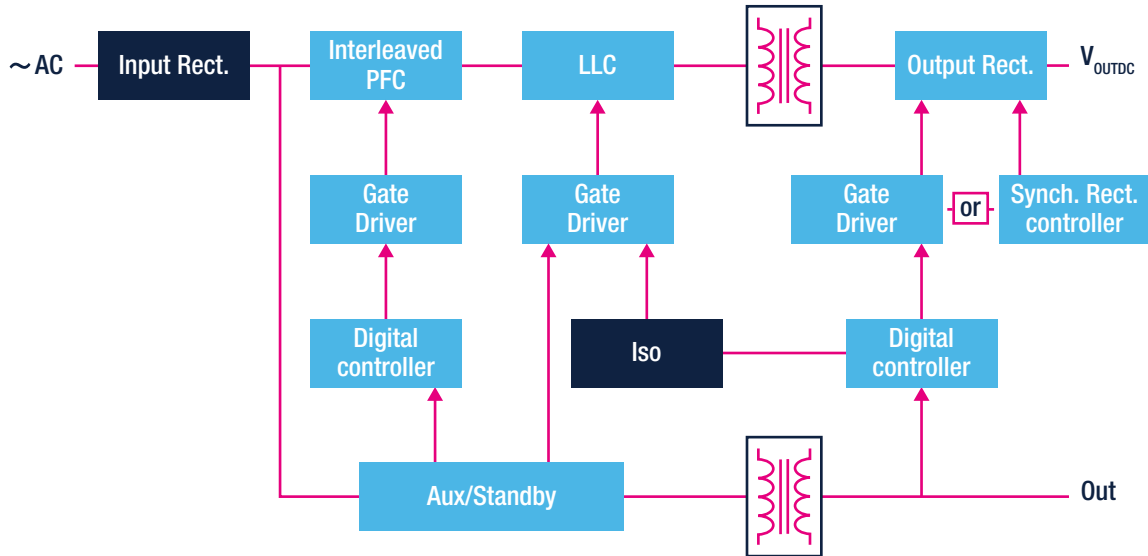
## Typical Block Diagram for Analog Control Solutions for Small Panel Size



**Typical Block Diagram: Analog Control Solutions with no Aux supply, for Small/Medium Panel Size**



**Typical Block Diagram for Digital Control Solutions for Medium/Large Panel Size**



**Main application boards and reference designs**



**EVLMG1-250WLLC**  
250 W Resonant DC-DC Converter based on LCC analog controller and GaN



**STEVAL-NRG011TV**  
200 W power supply based on STNRG011 digital combo for LED TV



**STEVAL-DPSTPFC1**  
3.6 kW PFC totem pole with digital inrush current limiter



**EVLCMB1-90WADP**  
19 V - 90 W adapter based on TM PFC and HB LLC analog combo controller



**EVLSTNRG011-150**  
12 V - 150 W power supply based on TM PFC and HB LLC digital combo controller



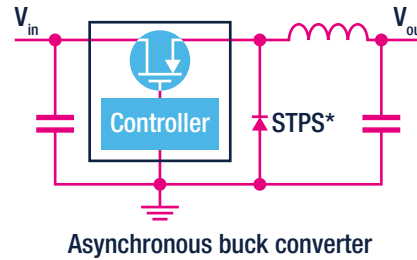
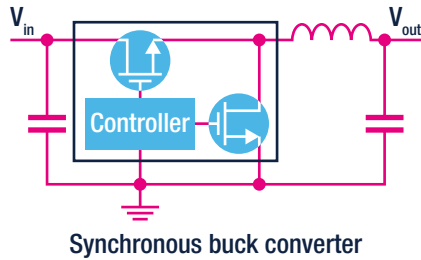
**EVLCMB1-AIO210W**  
12 V - 210 W adapter based on TM PFC and HB LLC analog combo controller

## DC-DC Conversion

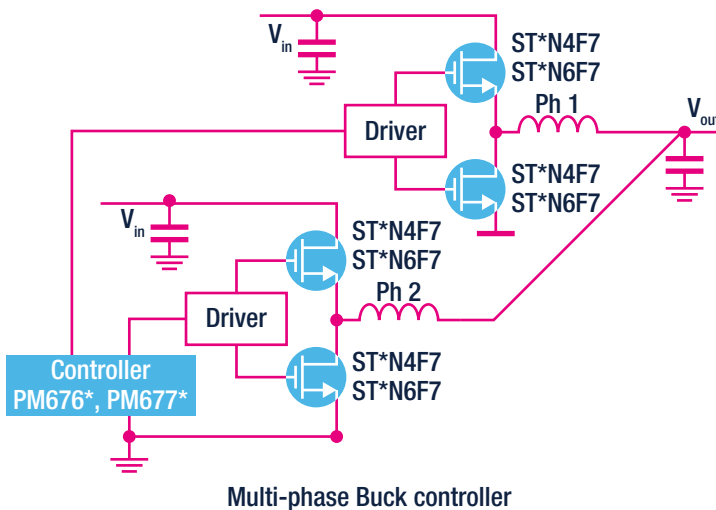
A DC-DC switching converter is used to locally supply any component or part of a system with the desired DC voltage and current. Depending on the application's relationship between the input and output voltage, engineers have to choose the best power topology – buck, boost, buck-boost or inverting, with or without synchronous rectification. In addition, they can decide to use an implementation based on monolithic ICs or with discrete power switches and controllers – or even an advanced digital implementation. Whatever the choice, the right semiconductor products are key to meet the specific efficiency and size design targets.

ST's broad product portfolio includes highly-integrated DC-DC converters and PWM controllers, power MOSFETs and rectifiers, protection ICs, linear voltage regulators, to address a wide range of topologies and power requirements. We also provide a comprehensive range of hardware and software evaluation and development tools including our eDesignSuite that helps engineers design high-efficiency DC-DC converters.

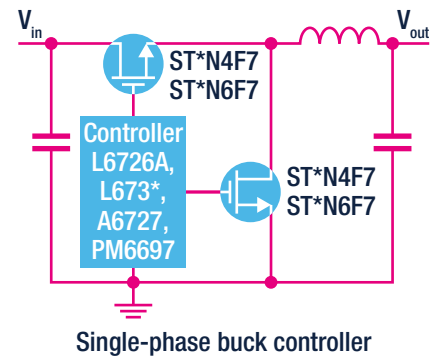
### Typical buck configuration: up to 61 Vin/3 A Iout



### Typical multi-phase configuration: up to 12 Vin, very high output current



### Typical single phase discrete configuration: up to 18 Vin, high output current



## Main application boards and reference designs



**STEVAL-ISA152V1**

Asynch. buck up to 60 Vin,  
3.3 Vout - 3 A Iout



**STEVAL-ISA208V1**

Synch. Buck 38 Vin,  
5 Vout-3 A Iout



**STEVAL-1PS02B**

Synch. Buck with Aux Switch,  
5.5 Vin, Dynamic Voltage  
Selection up to 2.5V - 400 mA



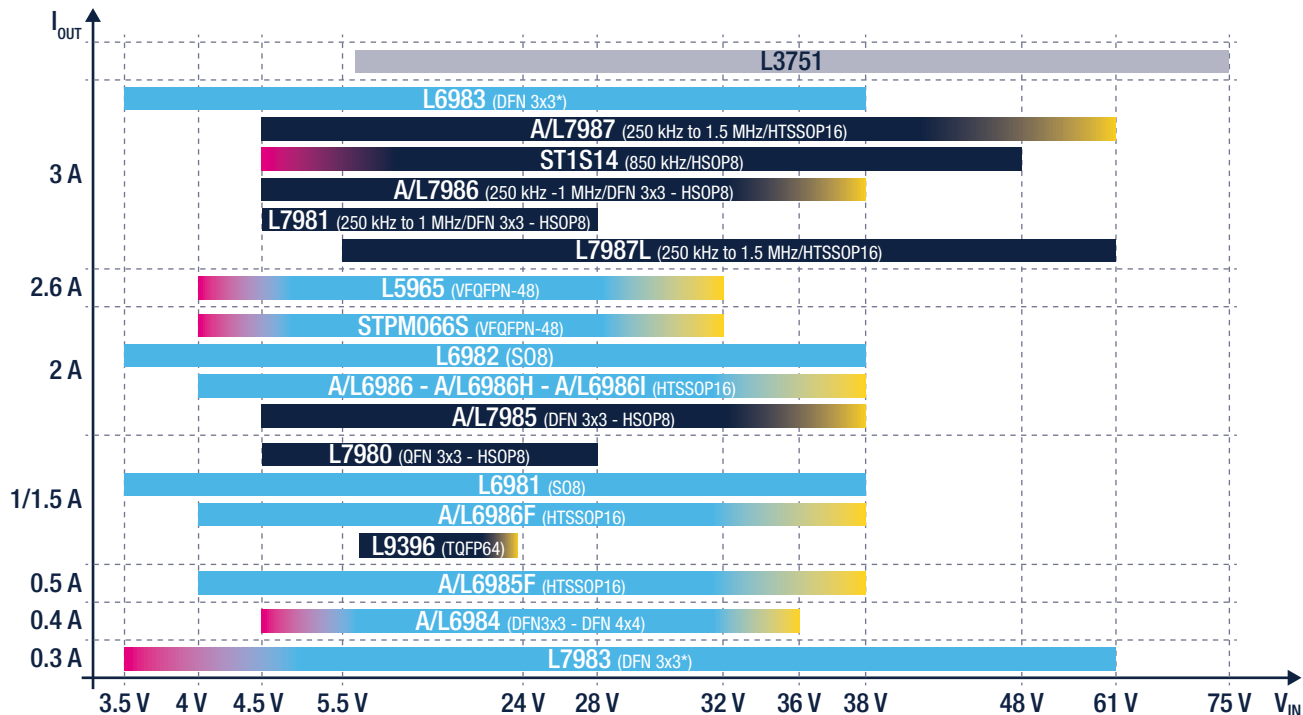
**STEVAL-ISA205V1**

Synch. Buck 12 Vin,  
3.3 Vout-2 A Iout, Auto. Grade

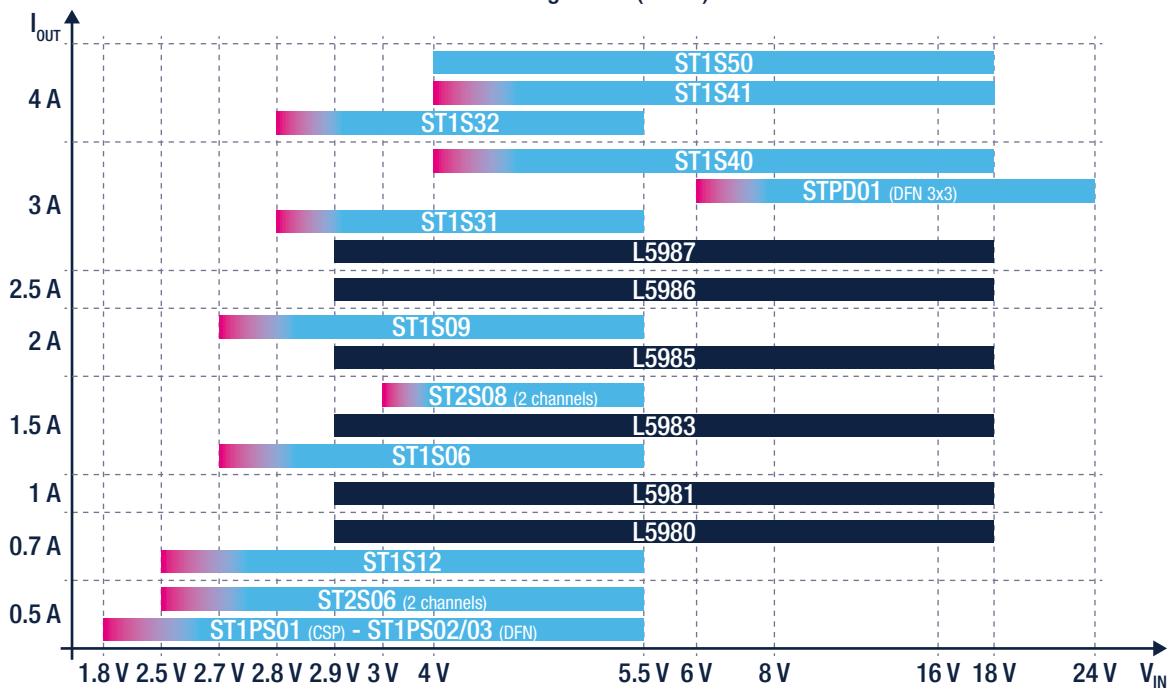
Note: \* is used as a wildcard character for related part number

# ST's product offering for Switching Converters (DC-DC)

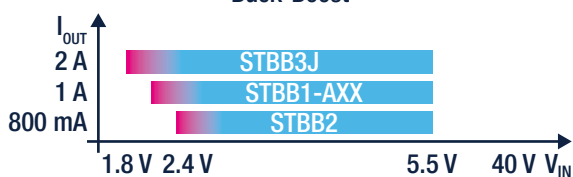
## 24 V Bus



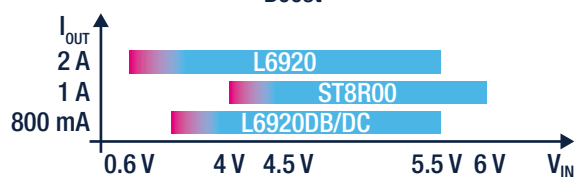
## Post-Regulation (<24 V)



## Buck-Boost



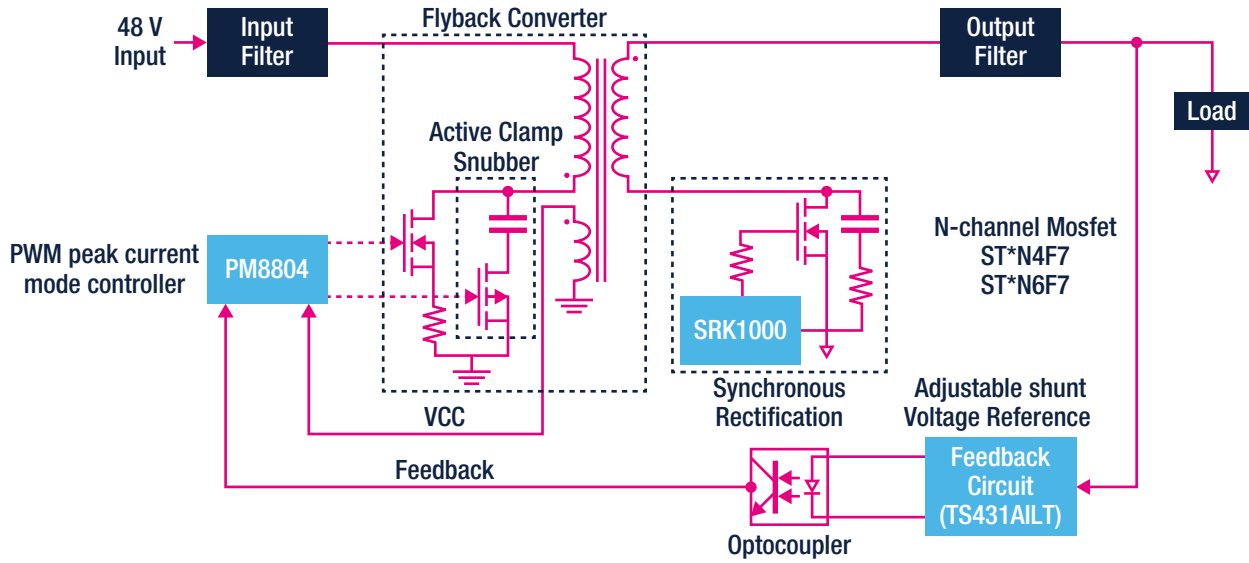
## Boost



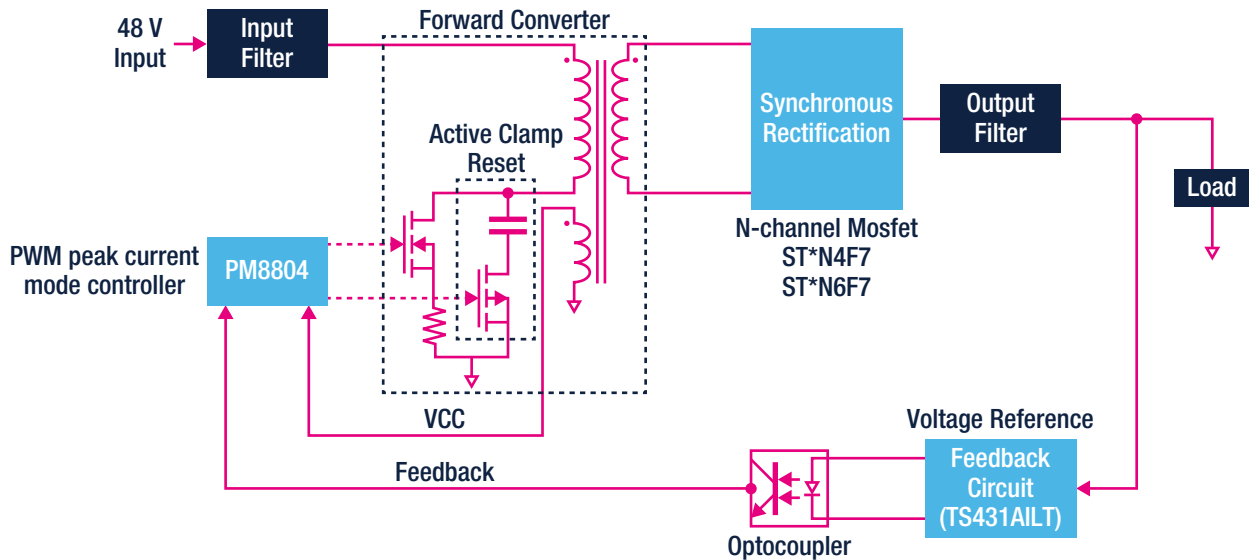
■ Asynchronous ■ Automotive ■ Synchronous ■ Compact BOM ■ Controller

Note: \* dual, parallel up to 7 A

Typical 48 Vin, up to 65 W Pout, Synchronous Flyback configuration



Typical 48 Vin, > 65 W Pout, Active Clamp Forward configuration



Main evaluation boards



**STEVAL-ISA203V1**

- Input Voltage range: 42 - 56 V DC
- Switching Frequency - 250 kHz
- Output:
  - Power - 60 W
  - Voltage - 12 V DC
  - Current - 5 A
- Peak Efficiency > 94%



**STEVAL-ISA204V1**

- Input Voltage range: 42 - 56 V DC
- Switching Frequency - 250 kHz
- Output:
  - Power - 100 W
  - Voltage - 5 V DC
  - Current - up to 20 A
- Peak Efficiency > 94%

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

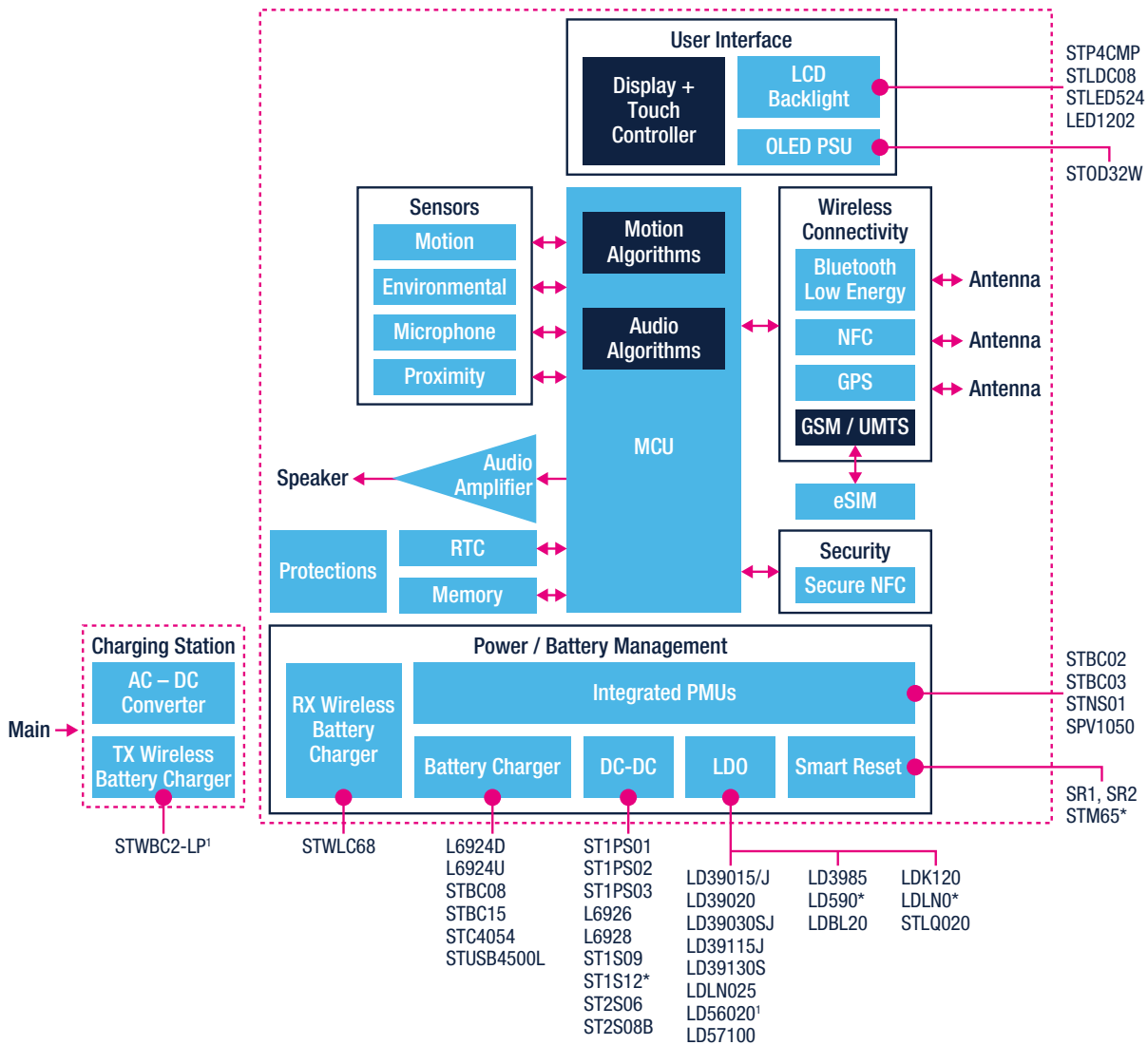


# WEARABLE DEVICES - POWER MANAGEMENT

Wearable devices, by their very nature, must be compact and comfortable for the user. They need to deliver precise information about the user states and conditions, have low power consumption and the right level of performance to make them convenient and easy to use. ST's products for wearable devices are designed to meet the needs of the most demanding systems with a portfolio covering smart watches, fitness trackers, heart-rate monitors, sports equipment and a variety of other wearable devices. Our portfolio includes digital processing, sensors, connectivity, security and power management solutions that can make the difference in a challenging and competitive market.

Specifically for power management, ST provides a range of solutions to match the needs of very small form factor with outstanding efficiency performance and longer battery life.

## Typical Block Diagram of Smart Watch



## Main application boards and reference designs



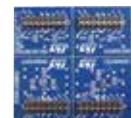
### STEVAL-1PS01AJR/1PS01DJR/1PS01EJR

Evaluation board based on the ST1PS01 400 mA nano-quiescent synchronous step-down converter with digital voltage selection



### STEVAL-1PS02B

Evaluation board based on the ST1PS2 400 mA nano-quiescent synchronous step-down converter with digital voltage selection and AUX switch



### STEVAL-LDO001V1

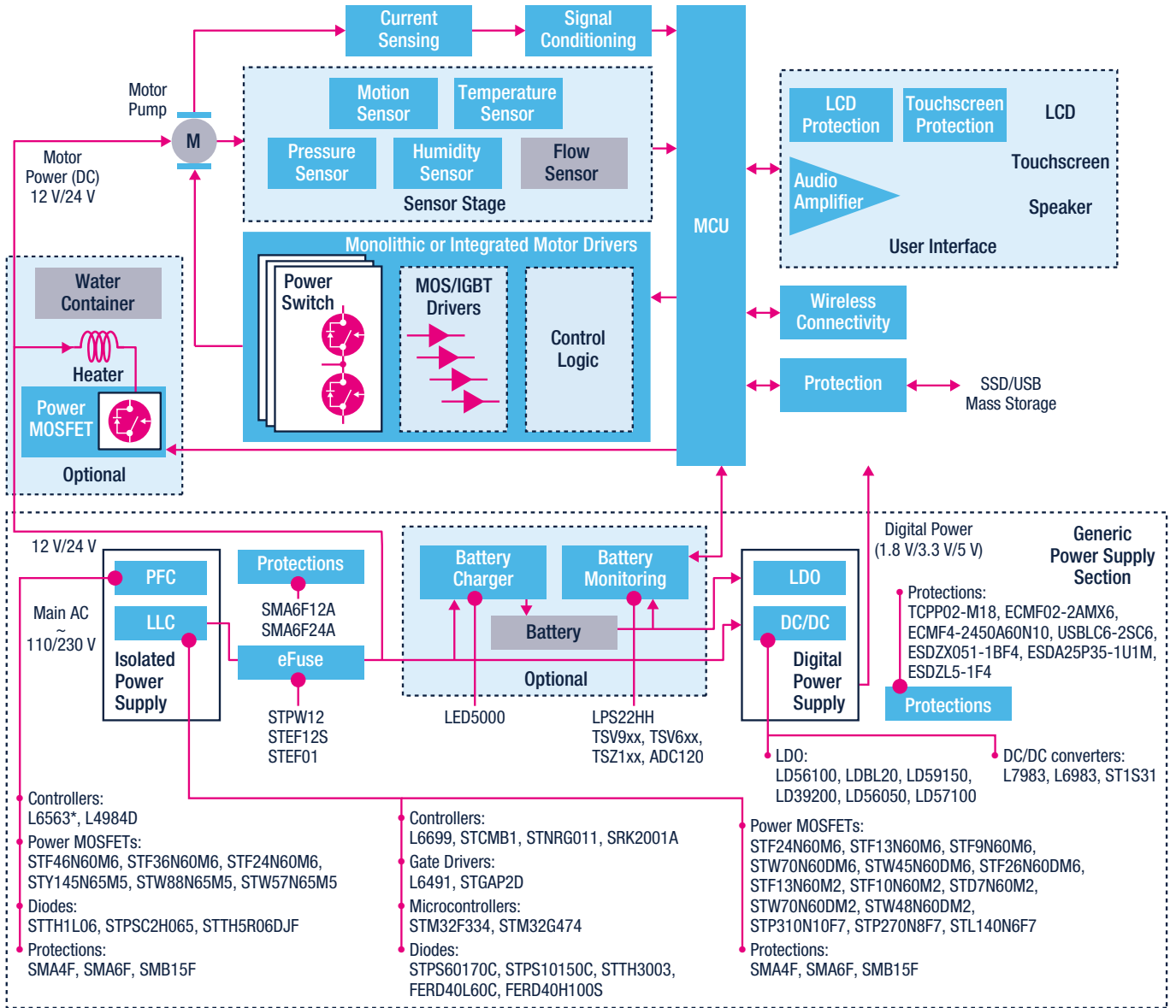
Quad high performance LDO evaluation board based on LDLB20, LDLN025, LD39130S and STLQ020

Note: \* is used as a wildcard character for related part number 1 available in Q4 2021

# MEDICAL POWER SUPPLY

The mission critical nature of medical devices demands high quality, reliable and safe products. Our goal is to consistently deliver products that meet this criteria and to help our Customers to meet this goal. Medical Power supplies are crucial part of the equipment, usually you can have open frame, enclosed, fanless, and configurable models as well as wall-mount adapters and DC-DC modules. Often the backup battery is part of the Power Supply to guarantee the continuity of the operation also in case of interruption of main energy.

## Typical Block Diagram of Medical Power Supply for Artificial Ventilators



### Main application boards and reference designs



**EVL6563S-100W**

100 W transition-mode PFC pre-regulator



**EVLSTNRG011-150**

12 V - 150 W power supply based on TM PFC and HB LLC digital combo controller



**STEVAL-L7983ADJ**

12 V/0.3 A step down DC/DC converter (VIN = 12 to 60 V)

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



# LED LIGHTING AND CONTROLS

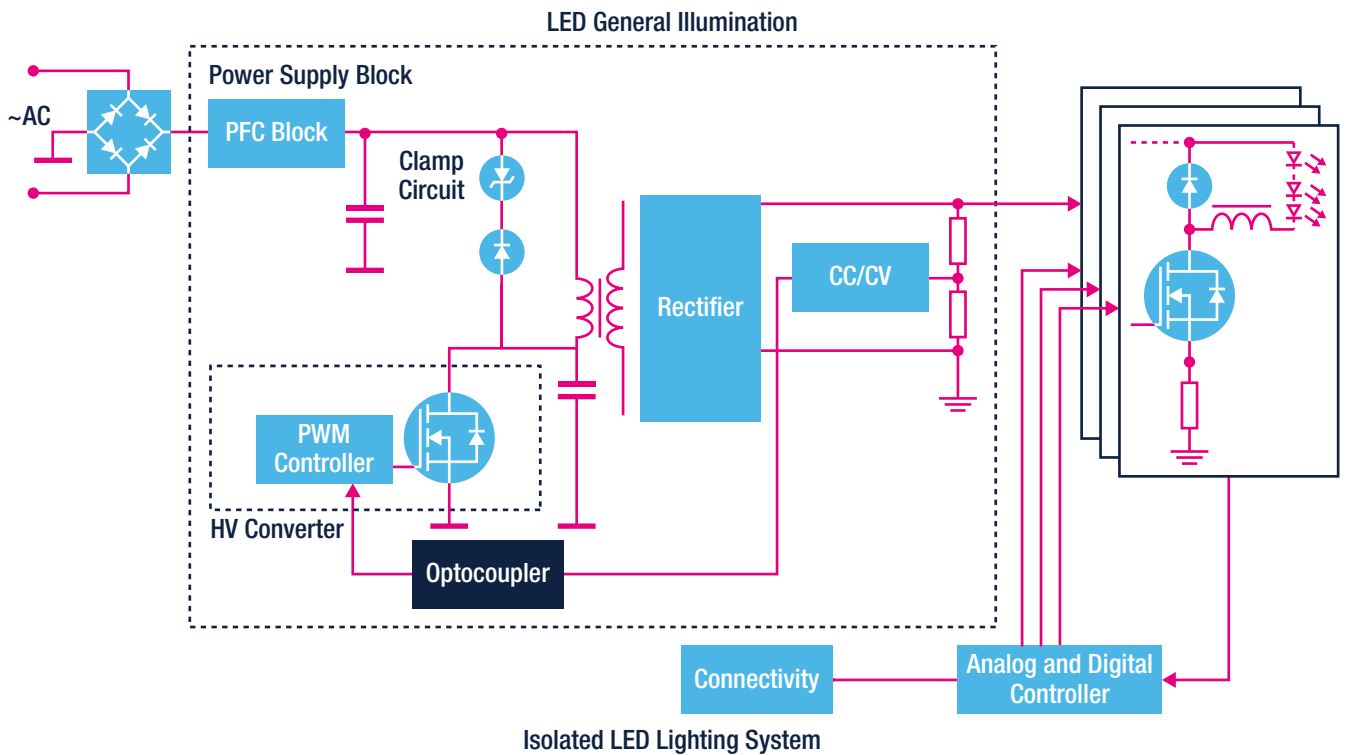
## LED General Illumination

LED lamps and bulbs can have a number of different form-factors depending on the specific use, size and dimension of the application, including retrofit bulbs, high-bay lights, low-bay lights, emergency lights. Driving a string of LEDs involves AC-DC and DC-DC conversion – designed using non-isolated, isolated, single stage or multi-stage topologies – which must ensure high efficiency and reliability at a competitive cost point.

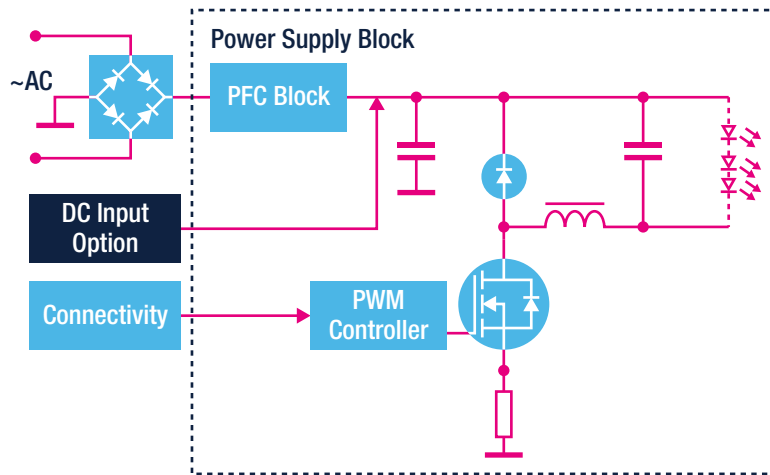
Modern applications include a range of connectivity features to implement remote monitoring and control, making LED lighting a pillar of the smart home, smart building and smart city environment. ST's portfolio includes a variety of RF transceivers, wireless MCUs, network processor ICs and fully certified modules for key wireless connectivity technologies. Our embedded software for BLE Mesh enables mesh networking of connected smart lighting end products.

For the LED driving stage we have a range of pulse-width modulation (PWM) and power factor correction (PFC) controllers, power MOSFETs and diodes as well as a comprehensive set of hardware evaluation and development tools including reference designs to help developers design high-efficiency LED lighting solutions.

### Typical Block Diagram



Isolated LED Lighting System



Non-Isolated LED Lighting System

## ST's product offering for LED General Illumination

	Controllers	Power MOSFETs	Diodes	MOSFET and IGBT Gate Drivers		
<b>PFC Block</b>	TM Analog Controllers L6562*, L6563*, L6564* CCM Analog Controllers L4985, L4986, L4981*, L4984D MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STLUX, STNRG388A	800 V to 1200 V MDmesh K5 ST*80K5, ST*9*K5, ST*105K5, ST*120K5 600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 600 V-650 V MDmesh M6 ST*60M6, ST*65M6 SiC MOSFET SCT*N65G2	600 V Ultrafast for TM STTH*L06, STTH*06, STTH15AC06* 600 V Ultrafast for CCM STTH*R06, STTH*T06 SiC Diodes STPSC*065	Single LS Gate Drivers PM88*1		
<b>Isolation Stage</b>	Offline LED Drivers HVLED001B, HVLED001A, HVLED007, HVLED8* HV Converters VIPer0P, VIPer*1, VIPer*6, VIPer122, VIPer222, VIPer*5, VIPer*7, VIPer*8 LLC Analog Controllers L6599*, L6699 PFC & LLC/LCC Combo Controllers STCMB1, STNRG011, STNRG012 MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STM8S, STLUX, STNRG388A SR Analog Controllers SRK1000, SRK1001 for Flyback SRK2000A, SRK2001, SRK2001A for LLC	800 V to 950 V MDmesh K5 ST*80K5, ST*9*K5 950V MDmesh DK5 ST*95DK5 600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 600 V-650 V MDmesh M6 ST*60M6, ST*65M6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V MDmesh DM6 ST*60DM6 60 V-100 V STripFET F7 ST*N6F7, ST*N8F7, ST*N10F7 <b>Integrated Smart GaNs</b> 600 V MASTERGAN*	Clamping Diodes for Flyback 600 V to 1000 V Ultrafast STTH*06, STTH*08, STTH*10 Output Diodes for Flyback Schottky, FERD, Ultrafast STPS*, FERD*, STTH* Output Diodes for LLC/LCC Schottky, FERD STPS* FERD*45, FERD*50, FERD*60, FERD*100 MOSFET Protection for Flyback SMA4F, SMA6F, SMB15F series SCR protection switch TNx015H-6"	Voltage Reference T*431, T*432 Voltage and Current Ctrl TSM*, SEA05*		
				<b>Signal Conditioning</b>		
				TSB*, TSX*, TSV*		
				<b>MOSFET and IGBT Gate Drivers</b>		
				HV HB Gate Drivers L649* Isolated Gate Drivers STGAP* Multiple LS Gate Drivers PM8834		
<b>Multiple strings management</b>	Offline LED Drivers HVLED002 MCUs & Digital Controllers STM32F0, STM32G0, STM32F334, STM32G4, STM8S, STLUX, STNRG388A	600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 600 V-650 V MDmesh M6 ST*60M6, ST*65M6 STripFET F7 ST*N4F7, ST*N6F7, ST*N10F7	Schottky Diodes STPS* FERD Diodes FERD* ≥ 200 V Ultrafast Diodes STTH* <b>DC-DC LED Drivers</b> LED5000, LED6000, ST1CC40, LED2000, LED2001	HV HB Gate Drivers L649*, L6395 Single LS Gate Drivers PM88*1 Multiple LS Gate Drivers PM8834		
	<b>Bluetooth Low Energy (BLE MESH)</b>	<b>2.4 GHz Multi Standard (ZigBee, Thread, 802.15.4)</b>		<b>Sub-1GHz</b>		
<b>Wireless Connectivity</b>	BLE 5.2 SoC BlueNRG-1, BlueNRG-2, BlueNRG-LP BLE Network Processor BlueNRG-MS, BlueNRG-2N Baluns BALF-NRG-0*D3, BALF-NRG-02J5 Dual core MCUs BLE 5.0 STM32WB IPD (Integrated Passive Device) MLPF-WB55-01E3, MLPF-WB55-02E3	BlueNRG Modules BlueNRG-M0, BlueNRG-M2 STM32 Wireless Module STM32WB5MMG	2.4 GHz Dual Core Wireless MCUs STM32WB	STM32 Wireless Module STM32WB5MMG	Sub-1GHz Wireless MCU STM32WL Sub-1GHz Transceivers S2-LP, SPIRIT1 Sub-1GHz Transmitters STS1TX, S2-LPTX MCUs STM32F0, STM32G0, STM32L0 Baluns BALF-SPI-0*D3, BALF-SPI2-0*D3	SPSGRF (868 and 915 MHz) SPSGRFC (433, 868 and 915 MHz)

### Main application boards



**EVLHVLED007W35F**

35 W LED driver with very low THD, based on Transition Mode Flyback converter (CVout)



**EVAL-PSR01B-35W**

35 W LED Driver with very high efficiency based on QR flyback converter with PSR (CVout)



**EVAL-SSR01B-35W**

35 W LED Driver with very high efficiency based on QR flyback converter with SSR (CC /CV)



**EVAL-IBD002-35W**

35 W Inverse buck with LED current control and with Analog/PWM dimming



**STEVAL-LLL012V1**

Smart LED driver with high power factor using BLE Mesh network for indoor lighting



**STEVAL-ILL078V1**

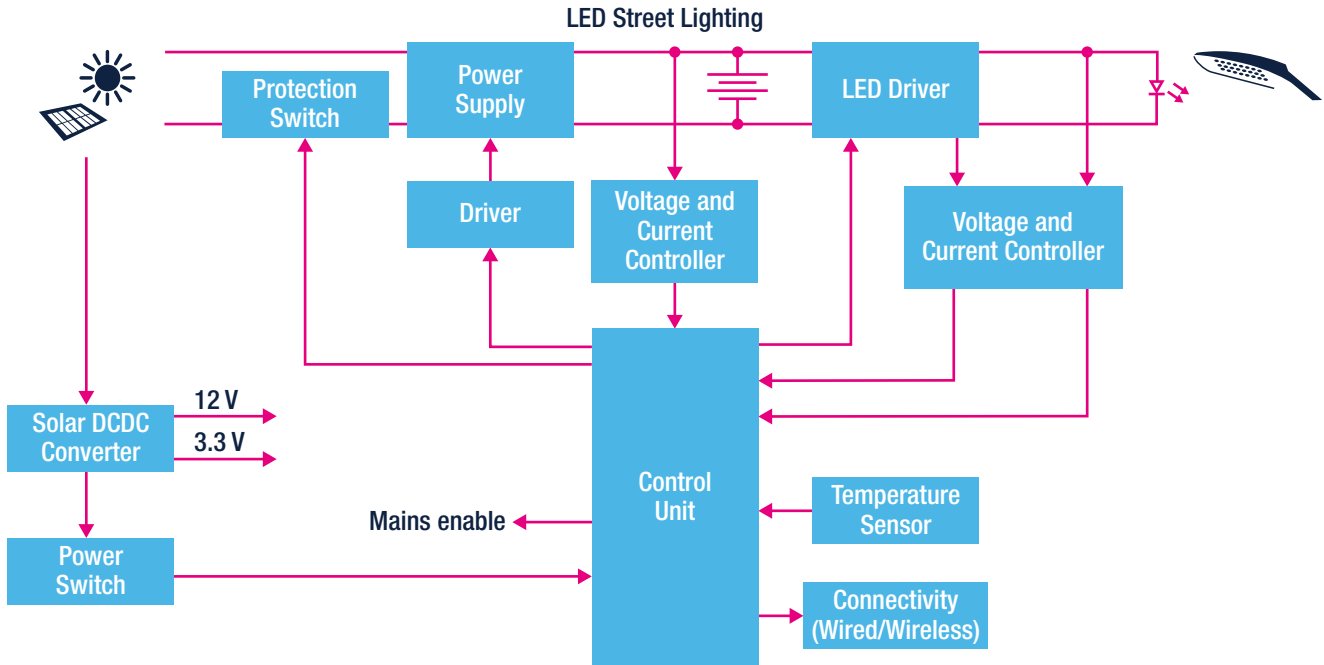
1A, up to 60 V Vin, buck LED driver with digital dimming

## LED Street Lighting

Street lighting installations have evolved from basic energy-hungry illumination spots to central devices enabling a set of services, such as presence and traffic level monitoring and incident detection surveillance, while optimizing illumination levels to specific road and weather conditions to support administrations transforming cities in Smart Cities.

We have a broad range of wired and wireless connectivity, power management and LED driving solutions. A range of high-performance and low-power STM32 microcontrollers together with presence, proximity, camera and environmental sensors as well as MEMS microphones enable design of advanced street lighting systems.

### Typical Block Diagram



### Main application boards



#### STEVAL-LLL008V1

100 W - 1.4 A constant current LED Driver with Sub-1GHz connectivity based on QR Flyback and inverse buck converters.



#### STEVAL-LLL008V1

75 W LED driver (CC/CV) with Sub-1GHz connectivity



#### STEVAL-LLL008V1

75 W AC-DC digitally controlled non isolated constant current LED driver



#### EVL80WLED-STCH03

80 W - 1 A primary side current loop control LED driver based on QR flyback converter



#### EVL150W-HVSL

150 V - 1 A LED driver featuring TM PFC and LCC resonant converter with STCMB1 combo controller



#### EVL6699-HVSL

150 V - 1 A LED driver featuring TM PFC and LCC resonant converter with L6699



#### STEVAL-ILL066V2

100 W LED street lighting with DALI2.0 communication interface using the STLUX385A digital controller



#### STEVAL-ILL053V2

48 V - 130 W high efficiency converter with PFC for LED street lighting

## ST's product offering for LED Street Lighting

	Controllers	Power MOSFETs	Diodes & Protections	MOSFET and IGBT Gate Drivers
<b>Power Supply</b>	TM PFC Analog Controllers L6562*, L6563*, L6564*	800 V to 1050 V MDmesh K5 ST*80K5, ST*9*K5, ST*105K5	600 V Ultrafast for TM PFC STTH*L06, STTH*06, STTH15AC06*	HV HB Gate Drivers for GaNs STDRIIVE600
	CCM PFC Analog Controllers L4985, L4986, L4981*, L4984D	950V MDmesh DK5 ST*95DK5	600 V Ultrafast for CCM PFC STTH*R06, STTH*T06	Single LS Gate Drivers PM88*1
	Offline LED drivers HVLEDO01B, HVLEDO01A, HVLEDO07	600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP	SiC Diodes STPSC*065	Multiple LS Gate Drivers PM8834
	PFC & LLC/LCC Combo Controllers STCMB1, STNRG011, STNRG012	600 V-650 V MDmesh M6 ST*60M6, ST*65M6	Output Diodes for Flyback Schottky, FERD, Ultrafast STPS*, FERD*, STTH*	HV HB Gate Drivers L649*
LLC/LCC Controllers L6599A*, L6699	600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2	Clamping Diodes for Flyback 600 V to 1000 V Ultrafast STTH*06, STTH*08, STTH*10	Isolated Gate Drivers STGAP*	
MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STLUX, STNRG388A	600 V MDmesh DM6 ST*60DM6	Output Diodes for LLC/LCC Schottky, FERD	<b>Voltage Reference, CC/CV Ctrl</b>	
SR Analog Controllers SRK1000, SRK1001 for Flyback SRK2000A, SRK2001, SRK2001A for LLC	SiC MOSFET SCT*N65G2	STPS*, FERD*45, FERD*50, FERD*60, FERD*100	Voltage Reference T*431, T*432	
	<b>Integrated Smart GaNs</b>	MOSFET Protection for Flyback SMA4F, SMA6F, SMB15F series	Voltage and Current Ctrl TSM*, SEA05*	
	600 V MASTERGAN*	SCR protection switch TNx015H-6	<b>Signal Conditioning</b>	
			TSB*, TSX*, TSV*	
	<b>Controllers</b>	<b>DC-DC Buck LED Drivers</b>	<b>DC-DC Boost LED Drivers</b>	<b>LED Array Drivers</b>
<b>LED Driver</b>	Offline LED drivers HVLEDO02	LED5000, LED6000, ST1CC40, LED2000, LED2001	LED6001, LED7707, LED7708	STP04/08/16/24, STCS*, LED8102S
	<b>Temperature Sensors</b>	<b>Control Unit</b>	<b>Protection Switch</b>	<b>Diodes &amp; Discretes</b>
<b>Sensing, Processing, Control, LED Bypass</b>	STLM20 STTS751 LM135Z	MCUs STM32F0, STM32G0	60 V-100 V STripFET F7 ST*N6F7, ST*N8F7, ST*N10F7	LBP01
	<b>Wired - Power Line Communication</b>	<b>Wireless - Sub-1GHz</b>	<b>Wireless - Sigfox</b>	<b>Wireless - LoRa</b>
<b>Connectivity</b>	Power Line Transceivers ST7570, ST7580, ST7590	Sub-1GHz Wireless MCU STM32WL Sub-1GHz Transceivers S2-LP, SPIRIT1 Sub-1GHz Transmitters STS1TX, S2-LPTX MCUs STM32F0, STM32G0, STM32L0 Balun BALF-SPI-0*D3, BALF-SPI2-0*D3 Certified Modules SPSGRF (868 and 915 MHz) SPSGRFC (433, 868 and 915 MHz)	Sub-1GHz Wireless MCU STM32WL Sub-1GHz Transceivers S2-LP Sub-1GHz Transmitters S2-LPTX Sub-1GHz Wireless MCU STM32WL MCUs STM32L0, STM32L4 Baluns BALF-SPI2-01D3 Secure MCUs STSAFE-A100	LoRa Wireless MCU STM32WL MCUs STM32L0, STM32L1, STM32L4 Embedded Software I-CUBE-LRWAN Secure MCUs STSAFE-A100

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

1 available in Q4 2020



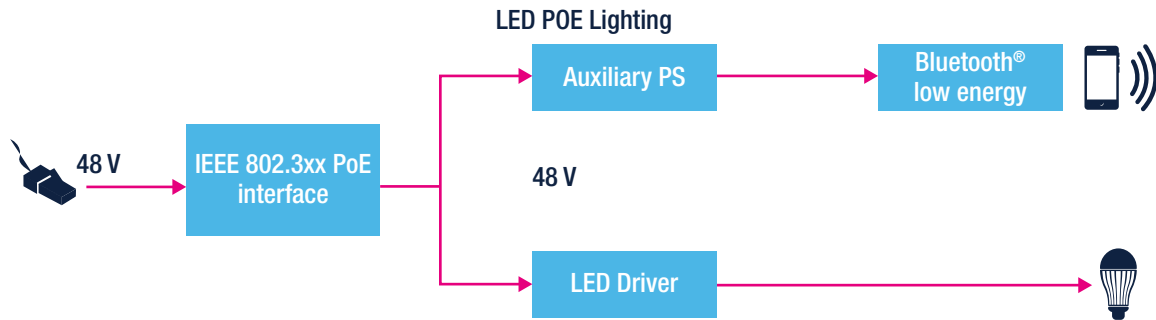
## LED POE Lighting

Power over Ethernet (PoE) is a widely adopted technology used to supply a powered device (PD) over an RJ-45 cable while carrying data. Described in the IEEE 802.3 standard and its enhancements including IEEE 802.3bt, IEEE 802.3at and IEEE 802.3af, this technology is becoming attractive for LED lighting.

We have a range of products providing a complete interface with all the functions required by the communication standard including detection and classification, protection features such as under-voltage lockout (UVLO) and in-rush current limitation as well as the control of the hot-swap power MOSFETs that can greatly simplify the development of IEEE 802.3 compliant solutions for powered devices (PD). We also have high-efficiency, optimized DC-DC conversion solutions for supplying the LEDs.



### Typical Block Diagram



### ST's product offering for LED PoE Lighting

PoE Interface	Protections	Auxiliary Power Supply	LED Driver		Bluetooth LE
IEEE 802.3bt PM8805	TVS for Power Rail Surge Protection SMA4F, SMB15F	Buck Converter L7983 L7987L	Buck LED6000	60 V-100 V STRipFET F7 ST*N6F7, ST*N8F7, ST*N10F7	Bluetooth Low Energy SoC, Wireless MCUs, Modules BlueNRG-*, STM32WB*
IEEE 802.3at PM8803					
IEEE 802.3af PM8800A					

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

### Main application boards



#### STEVAL-POEL45W1

45 W PoE powered LED lighting with BLE control



#### STEVAL-ILL078V1

1 A, up to 60V Vin, buck LED driver board based on the LED6000



## Lighting Controls

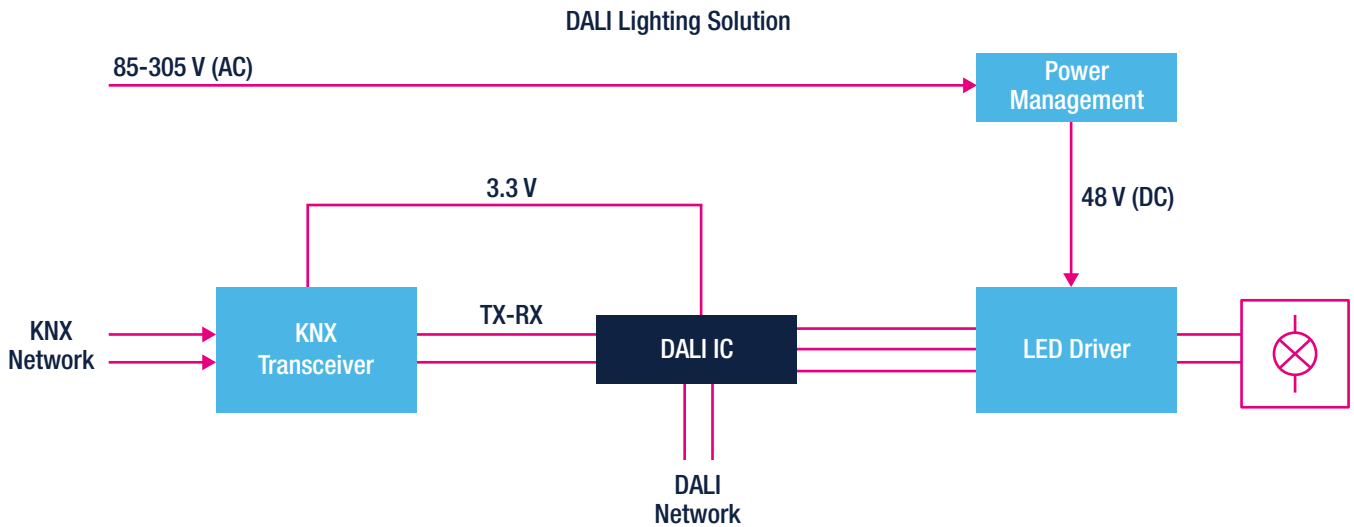
Lighting controls have evolved from simple triac dimmers to more sophisticated architectures including light sensors, digital and PWM dimmers, DALI network-based systems and wireless programming solutions.

ST's long-term partnerships with major lighting suppliers combined with our leadership in discrete and integrated power devices enable us to offer high efficiency and cost-optimized solutions for all types of lighting applications and their control – both wired (e.g. Powerline) or wireless (RF) – for industrial, residential, commercial, and architectural lighting applications.

### DALI Lighting Solution

Digital Addressable Lighting Interface (DALI) is a trademark for a network-based technology used to effectively control lighting in building automation. Originally defined in IEC 60929 standards, it's updated in IEC 62386 which includes LED device types. We provide a range of analog and digital controllers including the STLUX family and the STM32 microcontrollers to implement the AC-DC and DC-DC power converter and run the DALI protocol.

### Typical Block Diagram for DALI Lighting System



### ST's product offering for Lighting Controls

LED Driver		Power Management	KNX Transceiver
Digital Controllers STLUX	MCUs STM32F1, STM32L1, STM8	Refer to LED General Illumination section	TVS Protection on KNX Bus SMAJ40CA-TR
Development Tools STSW-STLUXLIB02, STSW-STLUXMED02	Embedded Software STSW-DALI002, STSW-DALI001, STSW-STM8025		STKNX

### Main application boards



#### STEVAL-ILL066V2

100 W LED street lighting evaluation board with DALI2.0 communication interface using the STLUX385A digital controller



#### STEVAL-ILM001V1

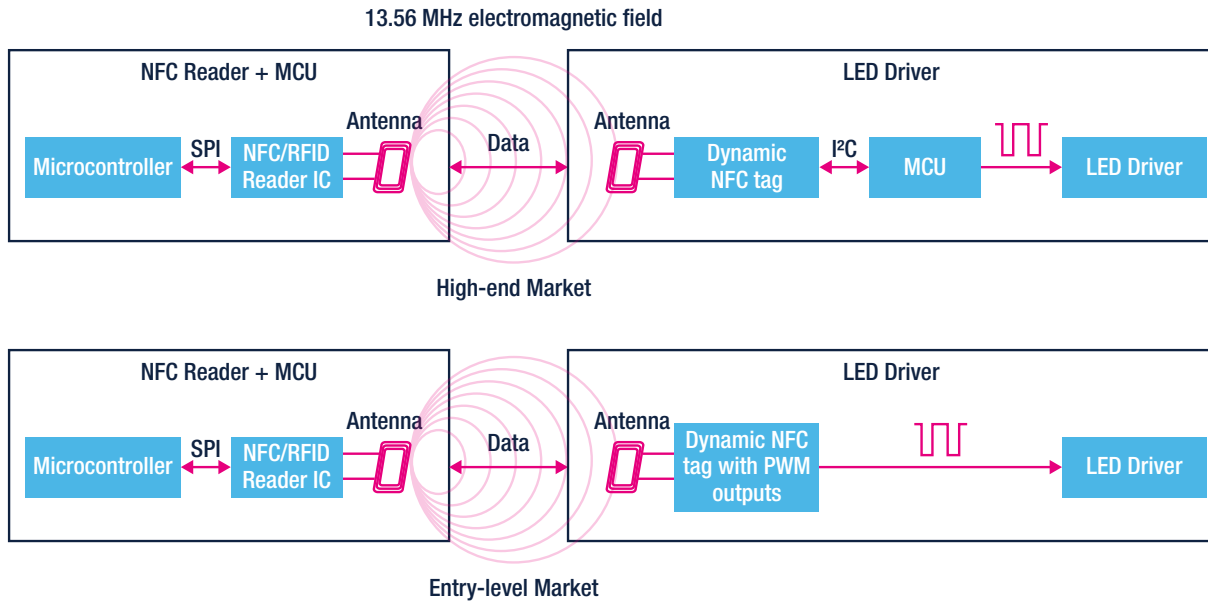
Plug-in hardware module for the STM8S-DISCOVERY interface for DALI communication

## LED Wireless Programming

Today's smart LED bulbs let users control features including brightness and color. These properties are controlled through the driver and can be programmed and modified at any time during manufacturing, distribution, installation or maintenance. The use of NFC technology enables wireless programming using a smartphone, tablet or portable RFID/NFC reader, without having to power up the LED driver, and brings enhanced flexibility and energy-savings in addition to reducing development time and cost.

STMicroelectronics offers optimized and complete LED driver programming solutions with its comprehensive NFC portfolio, fully addressing the lighting market and featuring all the functions needed for wireless LED programming.

### Typical Block Diagram of LED Wireless Programming



## ST's product offering for LED Wireless Programming

	NFC/RFID Reader IC	Protections	Microcontrollers	
<b>NFC Reader + MCU</b>	ST25R	Antenna Protection Reader: ESDZV18-1BF4 Tag: USBULC6-2M6	STM8S STM32F0, STM32G0	
	<b>Dynamic NFC Tag</b>		<b>MCUs and Digital Controllers</b>	<b>LED Driver</b>
<b>LED Driver for high-end market</b>	ST25DV-I <sup>2</sup> C Series		STM8S STM32F0, STM32G0 STM32F3, STM32F334, STM32G4 STLUX	HVLED001*, HVLED002 LED600*, LED5000, LED2000 STP04/08/16/24
	<b>Dynamic NFC Tag with PWM Output</b>			<b>LED Driver</b>
<b>LED Driver for entry-level market</b>	ST25DV-PWM Series			HVLED001*, HVLED002 LED600*, LED5000, LED2000 STP04/08/16/24, LED12/16/24*, LED8102S

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

### Main application boards



#### USBULC6-2M6

Discovery kit for ST25R3911B high performance HF reader/NFC



#### ST25DV-PWM-eSET

Discovery kit for the ST25DV-PWM NFC/RFID tag IC

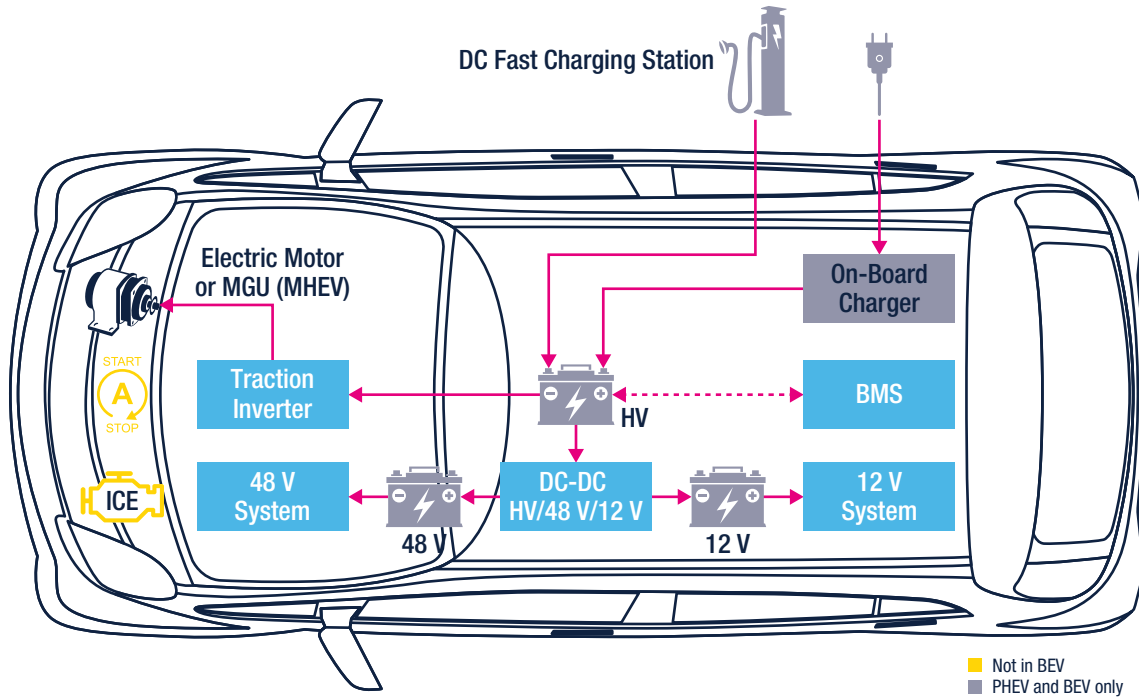


#### ST25DV-DISCOVERY

Discovery kit for ST25DV04 Dynamic NFC/RFID tag IC

# ELECTRO-MOBILITY

## Key applications



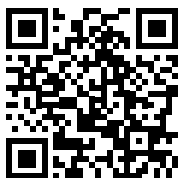
## Solutions

ST's key products and solutions for Electro-Mobility applications include:

SiC MOSFETs and Diodes	Transceivers	Signal Conditioning	Power Management	32-bit Automotive Microcontrollers
Power MOSFETs and IGBTs	Power Diodes and thyristors	EOS and ESD Protection	BCD Integrated and Isolated Drivers	



HW & SF Development Tools – Sample Kits, Evaluation Kits, Product Selectors



## FIND OUT MORE

[www.st.com/electro-mobility](http://www.st.com/electro-mobility)

- Battery Management System (BMS)
- Charging Station
- DC-DC Converter
- Small Electric Vehicles
- Electric Traction (Main Inverter)
- Mild Hybrid 48 V Systems

- On Board Charger (OBC)
- Acoustic Vehicle Alerting System (AVAS)
- HV Battery Disconnect & Fire-off System
- Vehicle Control Unit (VCU)

## Main Traction Inverter

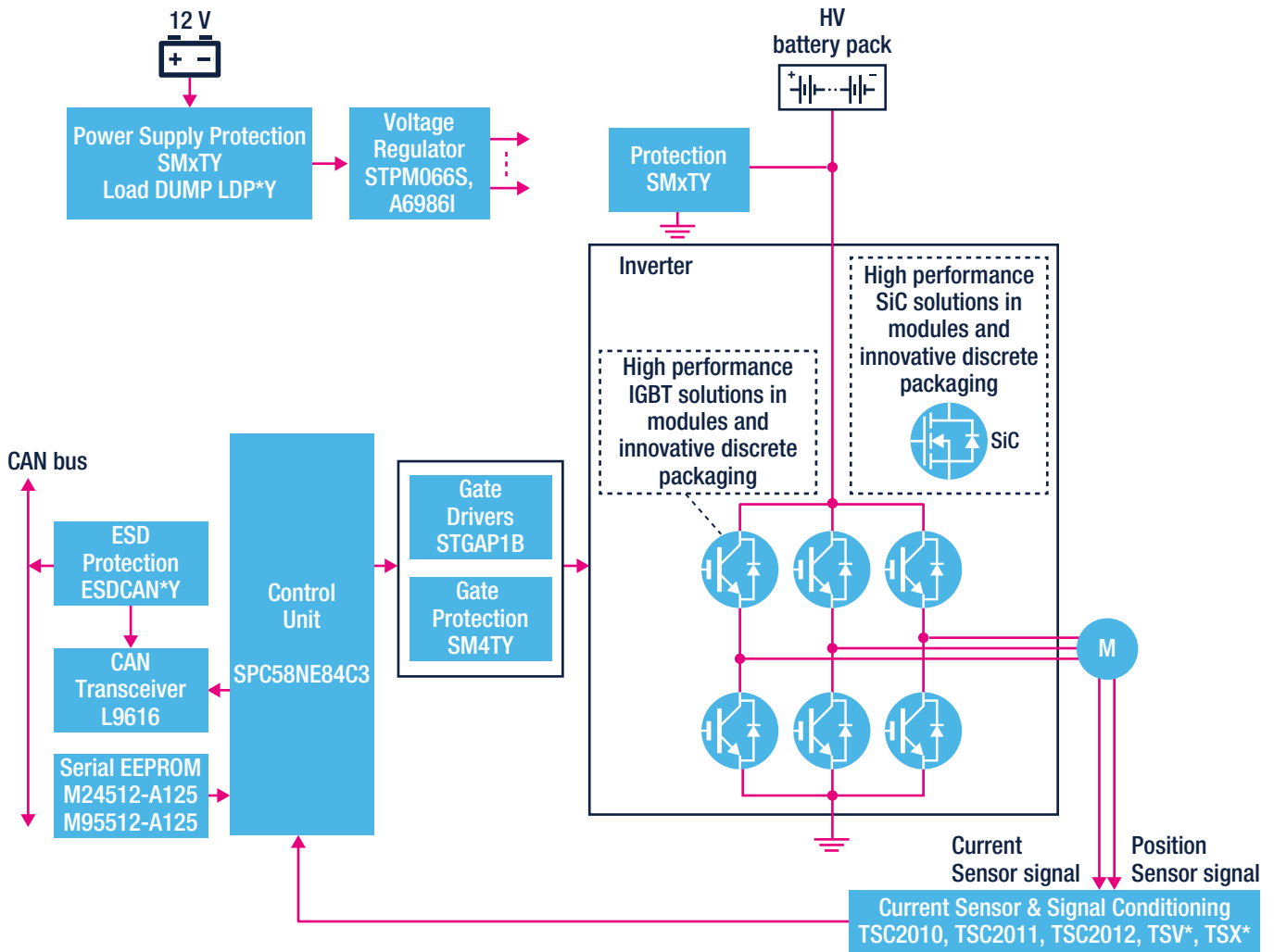
The traction inverter converts energy from the vehicle's battery to drive the electrical engine. This key component has a direct impact on a vehicle's road performance, driving range and reliability, which also depends on the inverter's weight and size.

Subject to all the possible stress found in a road vehicle from heat and vibrations, these converters must be able to handle high power and currents along with the associated Electro Magnetic Compatibility (EMC) challenges as well as provide fail-safe operation to ensure dependability and safety for the driver and passengers.

To help developers increase the inverter's power efficiency and reduce size and weight, ST has a wide portfolio of discrete semiconductors including AEC-Q101 qualified silicon and silicon-carbide (SiC) MOSFETs and diodes as well as IGBTs. These are complemented by AEC-Q100 qualified galvanically isolated IGBT and MOSFET gate drivers and SPC5 32-bit automotive microcontrollers for implementing scalable, cost-effective and energy-efficient solutions.



### Typical Block Diagram - Main Inverter



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



**FIND OUT MORE**

[www.st.com/main-inverter-electric-traction](http://www.st.com/main-inverter-electric-traction)

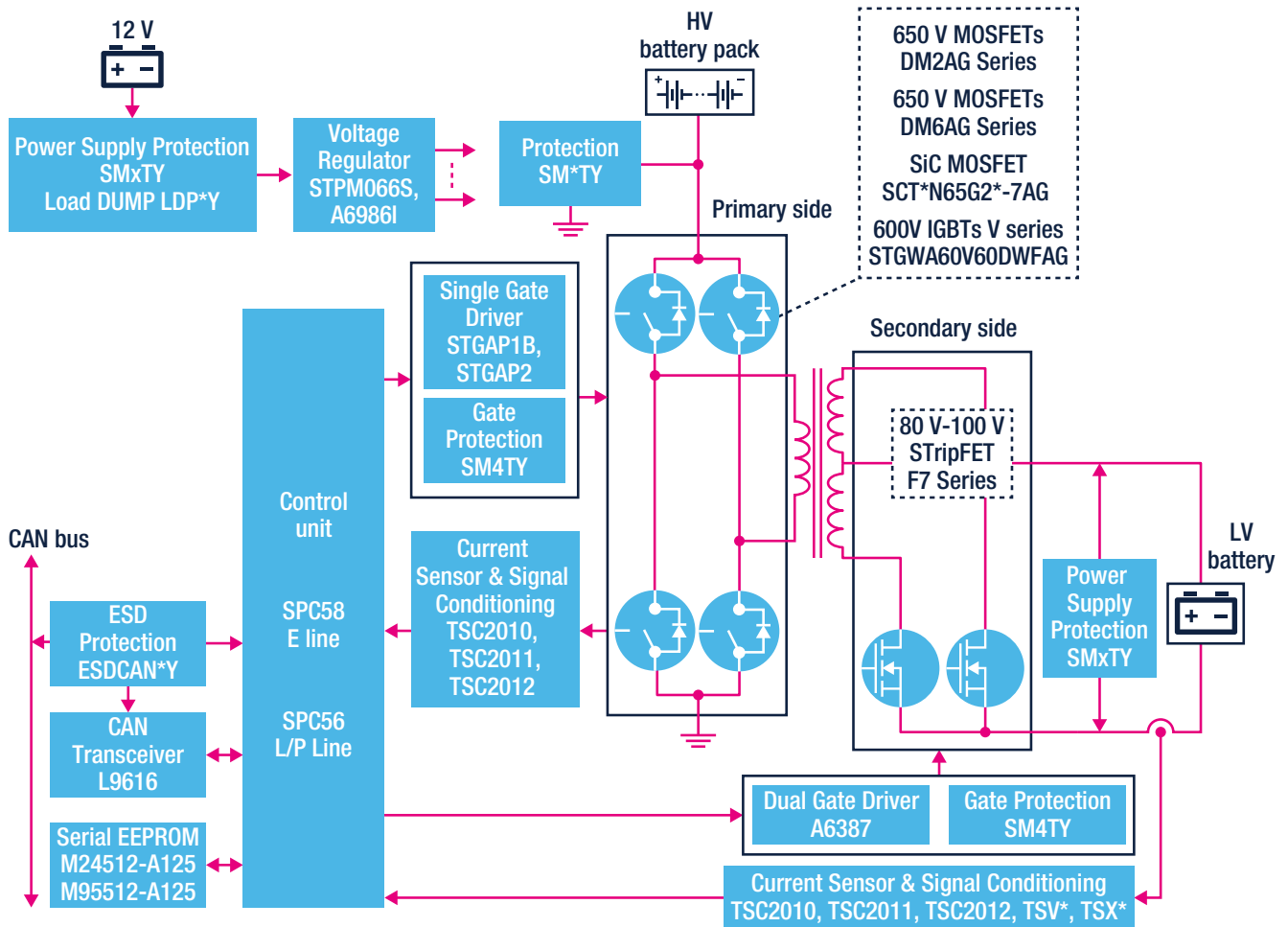
## Bidirectional DC/DC Converter

Electric vehicles (EV) use two different power systems; a high-voltage battery (200 to 800 V<sub>DC</sub>) for traction and a low-voltage (12/48 V) one for supplying all the electric appliances in the vehicle. Traditionally, the low-voltage battery was charged from the alternator, but in today's vehicles it gets its power from the high-voltage battery pack. However, in specific electric car architectures, this low voltage battery should be ready to help recharge the high-voltage battery pack in order to provide energy for cranking the car. This means that the on-board DC-DC converter must be bi-directional and very efficient as well as highly reliable in order to run the complex control algorithms needed to ensure an energy-efficient solution.

ST has a wide offer of discrete semiconductors including AEC-Q101 qualified silicon and silicon-carbide (SiC) MOSFETs and diodes as well as IGBTs. These are complemented by AEC-Q100 qualified galvanically isolated IGBT and MOSFET gate drivers and SPC5 32-bit automotive microcontrollers to enable scalable, cost-effective and energy-efficient solutions for implementing these challenging converters.



### Typical Block Diagram - Bidirectional DC/DC Converter



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



**FIND OUT MORE**

[www.st.com/bidirectional-dc/dc-converter](http://www.st.com/bidirectional-dc/dc-converter)

## 48 V Start-Stop System

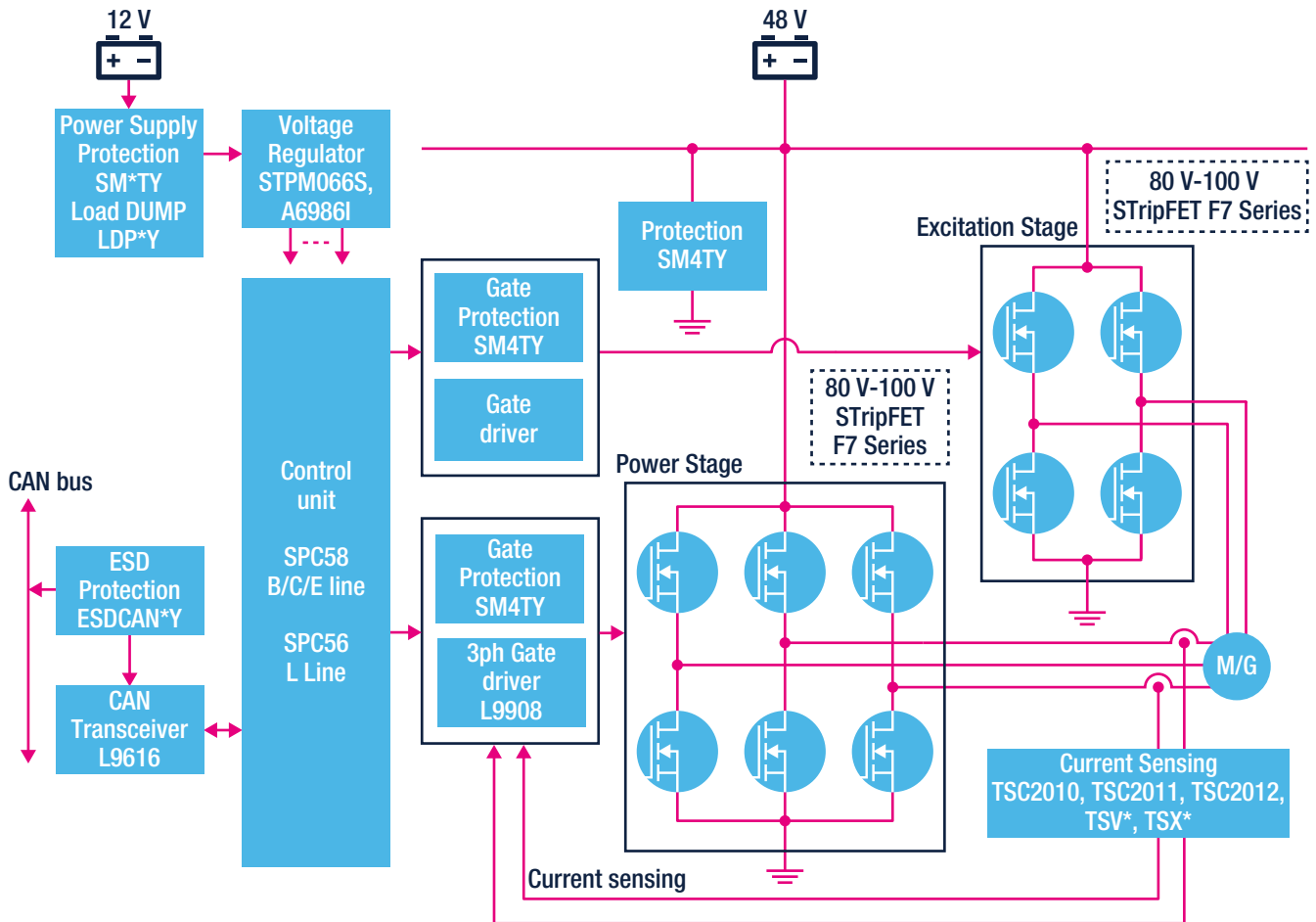
A start-stop system aims at reducing the amount of engine idle time, by shutting down and restarting the internal combustion engine automatically when the vehicle stops. Thus, it contributes to improving fuel economy and reducing CO2 emissions. This is especially useful in urban environments where vehicles can spend significant amounts of time in traffic.

Start-stop operations require power electronics that can handle high current during cranking and ensure reliability during start stop cycles, operating on/off at high temperatures

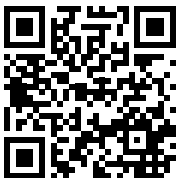
ST's solutions include silicon power MOSFETs, protections, gate drivers and microcontrollers which are in accordance to AEC-Q100 and AEC-Q101 standards.



### Typical Block Diagram - Start-Stop system



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



### FIND OUT MORE

[www.st.com/48v-start-stop-system](http://www.st.com/48v-start-stop-system)

## On-Board Charger (OBC)

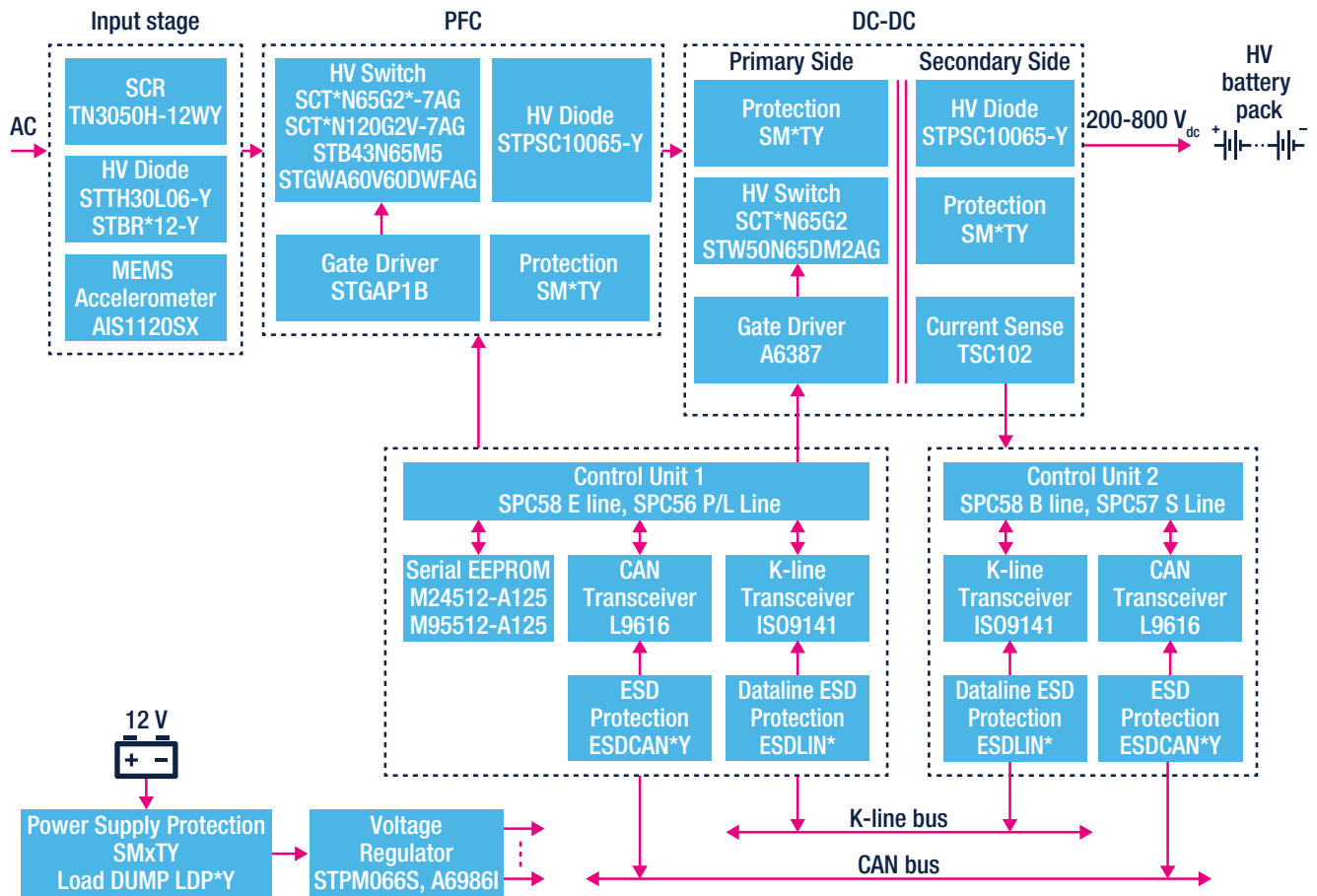
At the heart of any electric (EV) or plug-in hybrid (HEV) vehicle lies the high-voltage (200 to 800 Vdc) battery and its associated charging system. The on-board charger (OBC) provides the means to recharge the battery from the AC mains either at home or from outlets found in private or public charging stations.

From a 3.6 kW single-phase to a 22 kW three-phase high-power converter, today's OBCs must have the highest possible efficiency and reliability to ensure rapid charging times as well as meet the limited space and weight requirements.

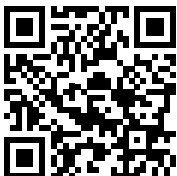
ST has a wide offer of discrete semiconductors including AEC-Q101 qualified silicon and silicon-carbide (SiC) MOSFETs and diodes as well as IGBTs. These are complemented by AEC-Q100 qualified galvanically isolated IGBT and MOSFET gate drivers and SPC5 32-bit automotive microcontrollers for implementing these challenging converters.



### Typical Block Diagram - OBC



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



**FIND OUT MORE**

[www.st.com/on-board-charger](http://www.st.com/on-board-charger)

## Battery Management

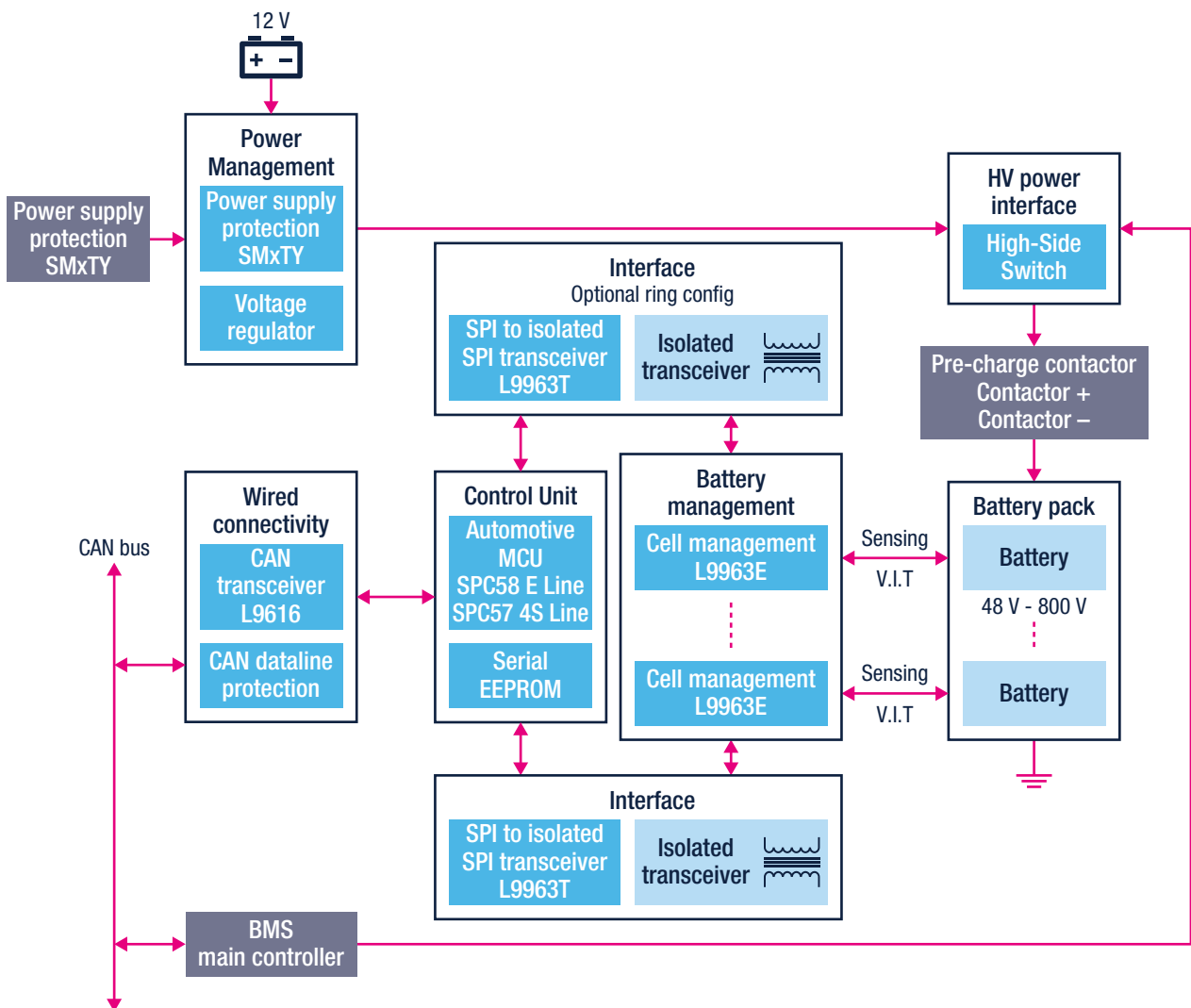
Automotive Battery Management System (BMS) must be able to meet critical features such as voltage, temperature and current monitoring, battery state of charge (SoC) and cell balancing of lithium-ion (Li-ion) batteries.

Indeed, the main functions of a Battery Management System for electric vehicles are:

- **Battery protection** in order to prevent operations outside its safe operating area
- **Battery monitoring** by estimating the battery pack state of charge (SoC) and state of health (SoH) during charging and discharging
- **Battery optimization** thanks to cell balancing that improves the battery life and capacity, thus optimizing the driving range for hybrid (HEV), plug-in (PHEV) and full electric vehicles (BEV)



Typical Block Diagram - Automotive Battery Management System (BMS)



FIND OUT MORE

<https://www.st.com/en/applications/electro-mobility/automotive-battery-management-system-bms.html>





## DC Fast Charging Station

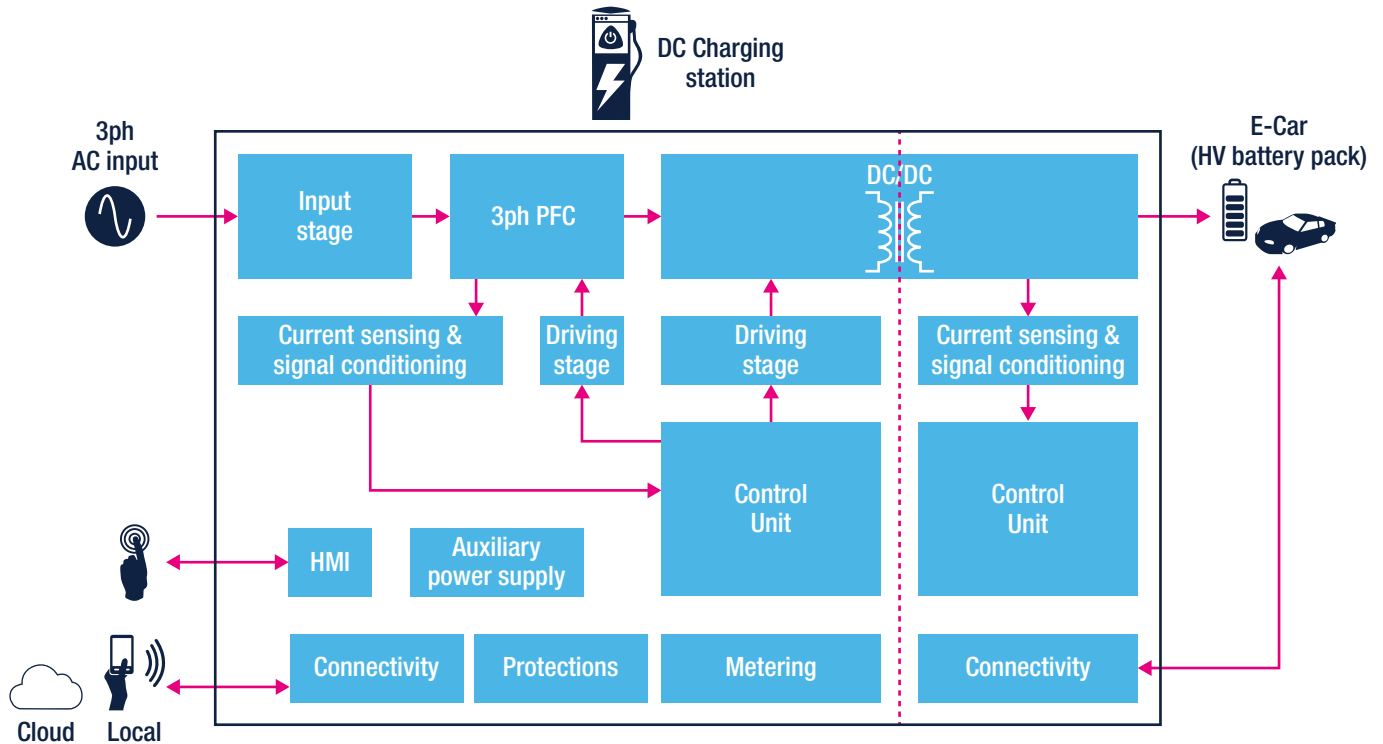
The number of full electric vehicles (EVs) is rapidly growing and, as a result, the charging infrastructure is also expanding, including DC fast charging stations, which have the attractive capability of providing the vehicle with a 100 km driving range in just 10-12 minutes.

While architectures based on renewable sources and battery storage technologies – to take charging stations off-grid are emerging, mainstream solutions are fed from the grid and a converter – in the range of 120 kW or more - has a 3-phase input Power Factor Correction (PFC) stage and an isolated DC-DC converter. DC Charging stations also provide secure connectivity and authentication with the vehicle.

We can provide a range of power discretes including silicon-carbide (SiC) and silicon power MOSFETs and diodes, isolated gate drivers as well as high-performance STM32 microcontrollers to help develop high-efficiency, high-power density DC charging stations.



### Typical Block Diagram - DC Fast Charging Station



### Main application boards and reference designs



**STDES-PFCBIDIR**  
15 kW, three-phase, three-level Active Front End (AFE) bidirectional converter



**STDES-VIENNARECT**  
15 kW, three-phase Vienna rectifier with low cost mixed-signal control for power factor correction



**STEVAL-DPSTPFC1**  
3.6 kW PFC totem pole with digital inrush current limiter

## ST's product offering for DC Fast Charging Station

		Input stage	3ph PFC	DC/DC		Control units		Driving stage	Current sensing & signal conditioning	Aux SMPS	HMI	Metering	Connectivity		
				1^ side	2^ side	1^ side	2^ side						1^ side	2^ side	
Rectifiers	SiC series - 650 V		•	•											
	SiC series - 1200 V		•	•											
	Ultrafast RQ series - 600 V		•	•	•										
	Ultrafast R series - 600 V		•	•						•					
	STBR series - 800V/1200V	•	•												
	Schottky series - 40/45/60/100 V									•					
Thyristors	TN series - 1200 V	•													
	TYN series - 1200 V	•													
	TM8050H series - 800 V	•													
	TN3050H, TN6050HP series -1200 V	•													
TVS protections	SM4TY, SM6TY, SM15TY, SM30TY		•	•	•					•					
HMI ESD protections	ESDaxxY series, EMIF06-1005MX12Y										•				
Power MOSFETs	SiC series - 650/1200 V		•	•											
	M5 series - 650 V		•												
	M6 series - 600/650 V		•	•											
	DM6 series - 600/650 V			•											
	DM2 series - 600/650 V			•											
	K5 series - 1200 V		•							•					
IGBTs	H series - 1200 V		•												
	HB series - 650 V		•	•											
	HB2 series - 650 V		•	•											
	V series - 600V		•	•											
ACEPACK Power Modules	Customized modules		•	•											
MCUs (32bit)	STM32F334, STM32G4, STM32F3		•	•		•									
	STM32F0, STM32F1, STM32G0				•		•								
Gate drivers	L6491							•							
	STGAP1B							•							
Memories (EEPROM)	M24**, M95**					•									
Isolated Sigma-Delta ADC	IS0SD61, IS0SD61L								•						
Current sense amplifiers	TSC102, TSC2010, TSC2011, TSC2012, TSV*, TSZ*		•						•						
HV converters	VIPer*7, VIPer*6, VIPer26K									•					
Offline controllers	L6566BH, STCH03									•					
Voltage regulators	STPM066S, L5965, L9396, A6986I, A798*, A698*									•					
	L798*, L698*									•					
CAN transceivers	L9616													•	
CAN ESD protections	ESDCAN*Y Series							•				•		•	
Power line transceivers	ST2100												•	•	
	ST7540, ST7580, ST8500												•		
Bluetooth Low Energy Transceiver	SoC and Wireless MCUs	BlueNRG-* STM32WB5*											•		
	STM32 Wireless Module	STM32WB5MMG											•		
	Modules	BlueNRG-M0, BlueNRG-M2											•		
NFC/RFID	Dynamic tags	M24SR, ST25DV-I2C											•	•	
	Readers	ST25R											•	•	
Metering ICs	STPM32, STPM33, STPM34, STPMS2, STISO621										•				
LED array drivers	LED1642, STP08, STP16, LED77*, LED8102S, LED1202, STLED316S									•					

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

## INDUSTRIAL POWER & TOOLS

### Industrial Welding

Arc welding is an assembling process that joins metal parts by causing their fusion through high-current flowing through the electrode and the base material. The current, either DC or AC, is generated by a specifically designed high-frequency inverter switched mode power supply (SMPS) usually based on half-bridge, full-bridge, and two-transistor forward topologies.

The main requirements in an SMPS for welding are high efficiency and reliability as well as power density to enable lighter and more compact designs.

We have a range of power MOSFETS and diodes – both Si and SiC based for higher efficiency – and IGBTs as well as galvanically isolated gate drivers and high-performance 32-bit STM32 microcontrollers to enable compact designs with higher efficiency.

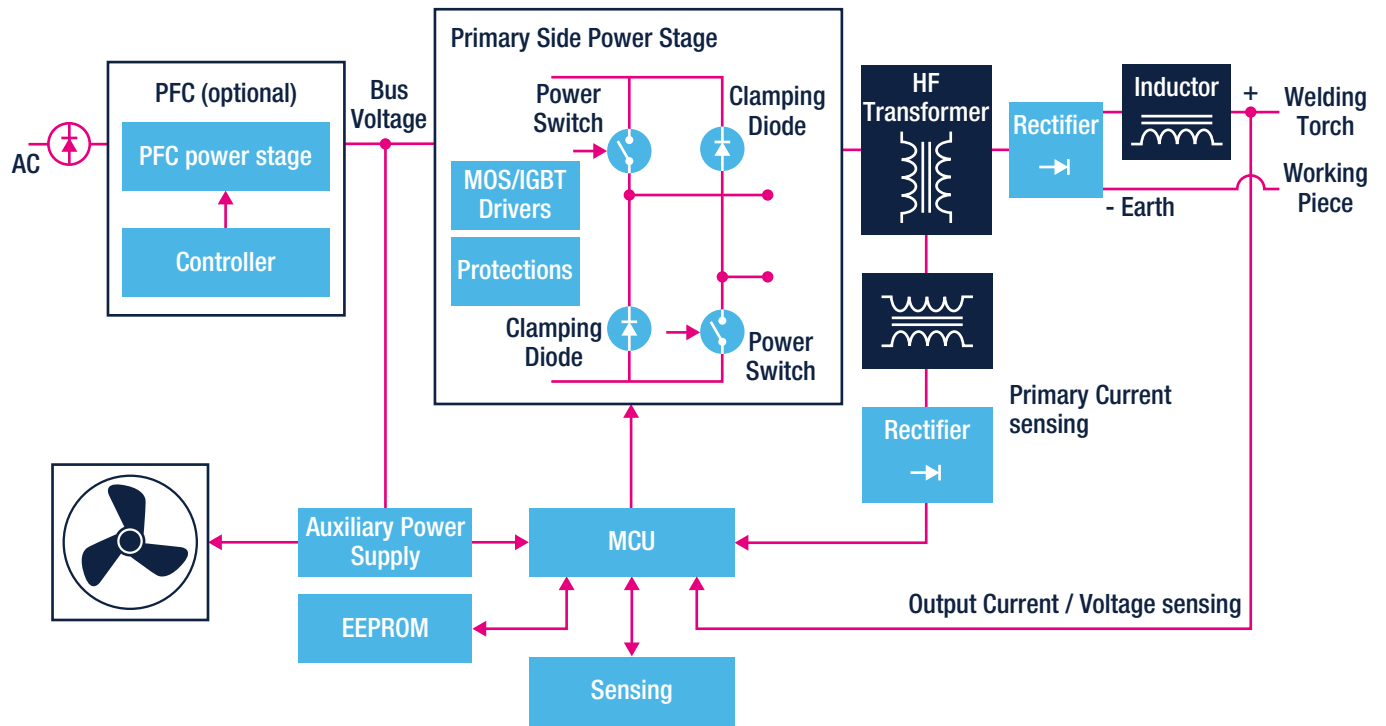


### ST's product offering for Industrial Welding

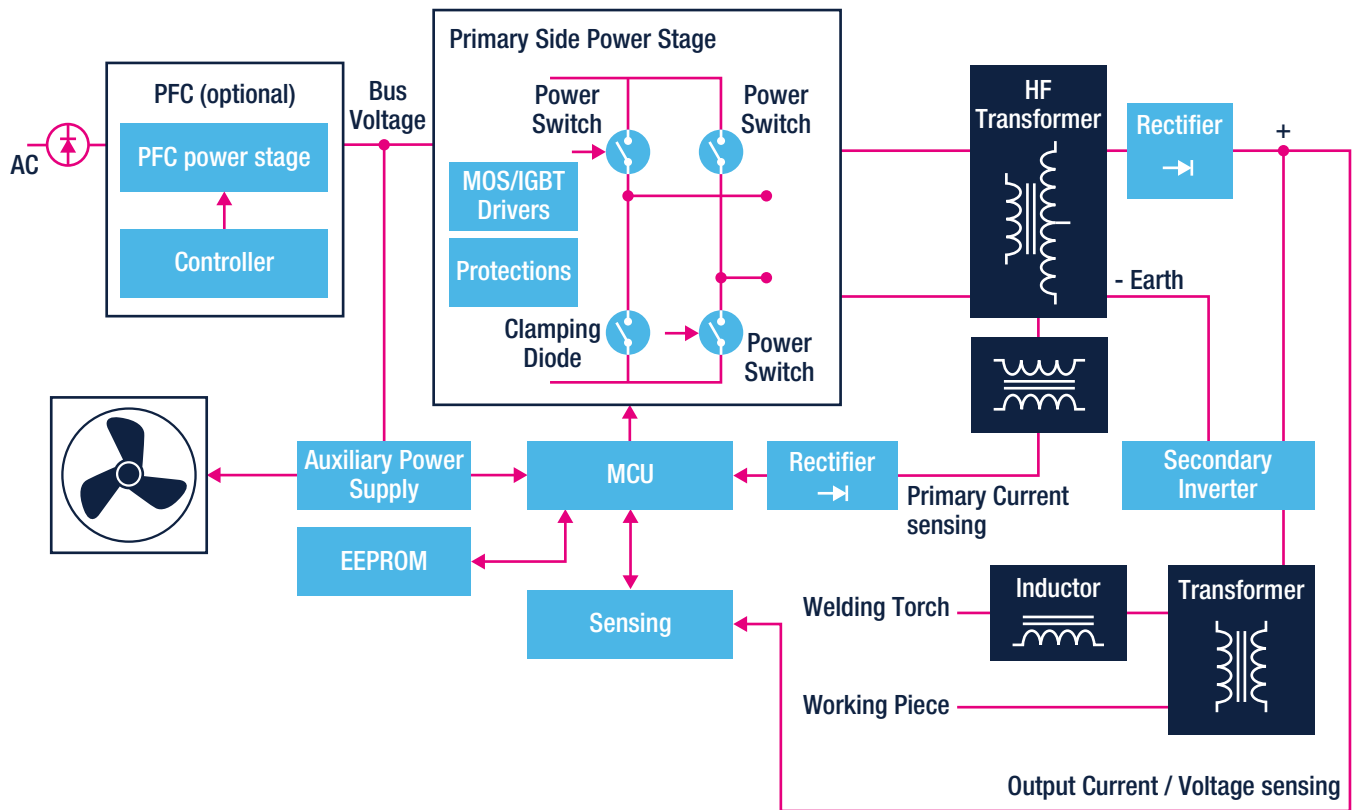
	MCUs & Digital Controllers	MOSFET/IGBT Gate Drivers	IGBTs & Power Modules	Power MOSFETs	Diodes & Protections
<b>PFC</b>	MCUs STM32F0 STM32G0 STM32F301 STM32F334 STM32G4 Digital Controllers STNRG388A	Single LS Gate Drivers PM88*1, TD35* Multiple LS Gate Drivers PM8834 Isolated Gate Drivers STGAP* HV HB Gate Drivers L649*	600 V V series STG*V60F 650 V HB series STG*HP65FB 650 V HB2 series STG*HP65FB2 1200 V H series STG*H120F2	600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 600 V-650 V MDmesh M6 ST*60M6, ST*65M6 650V MDmesh M5 ST*65M5 650 V-1200 V SiC MOSFETs SCT*N65G2, SCT*N120	600 V Ultrafast STTH*W06, STTH*R06, STTH*T06 1200 V Ultrafast STTH*S12 SiC Diodes STPSC*065, STPSC*H12 TVS for Power Rail Surge Protection SM*T, SM*F, SMC30J series
<b>DC-DC TTF</b>				650 V MDmesh M5 ST*65M5 600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP	600 V Ultrafast STTH*R06, STTH*06 1000-1200 V Ultrafast STTH*10, STTH*12
<b>DC-DC PS-FB</b>	STM32F334 STM32G4 STM32F301 STM32F1 STM32F3	Isolated Gate Drivers STGAP* HV HB Gate Drivers L649*	600 V V series STG*V60DF 650 V HB series STG*H65DFB 650 V HB2 series STG*H65DFB2 1200 V H series STG*H120DF2 ACEPACK Power Modules Customized Modules	600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V-650 V MDmesh M6 ST*60M6, ST*65M6 600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6 800 V to 1200 V MDmesh K5 ST*80K5, ST*9*K5, ST*105K5, ST*120K5 950 V to 1050 V MDmesh DK5 ST*95DK5, ST*105DK5 650 V-1200 V SiC MOSFETs SCT*N65G2, SCT*N120	TVS for Power Rail Surge Protection SM*T, SM*F, SMC30J series
<b>Secondary Inverter</b>			600 V V series STG*V60DF 650 V HB series STG*H65DFB 650 V HB2 series STG*H65DFB2	600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V-650 V MDmesh M6 ST*60M6, ST*65M6 600 V MDmesh DM6 ST*60DM6	200 V to 400 V Ultrafast STTH*W02, STTH*W03, STTH*W04, STTH240F0 Power Schottky High Temperature STTH*10, STTH*12 TVS for Power Rail Surge Protection SM*T, SM*F, SMC30J series

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

Typical configuration for Single-Phase Architecture for Low/Medium Power Welding



Typical configuration for Single and Three-Phase Architectures for Medium/High Power Welding



## Uninterruptible Power Supplies (UPS)

Uninterruptible Power Supplies (UPS) ensure continuity of supply by converting the DC voltage from a battery or battery bank to an AC voltage with the requested amplitude and frequency in case of power outages.

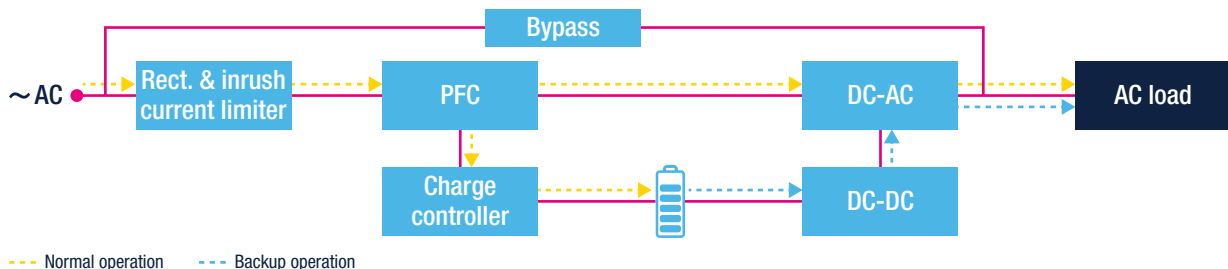
Depending on application requirements, an UPS can be built with a simple off-line configuration or with a double conversion online method for high-end, medium- or high-power UPSs. This also improves the quality of the power supplied to sensitive loads including computers, servers, smart industry machines, instrumentation and telecommunication equipment. We offer high-performance discrete devices including high- and low-voltage power MOSFETs, IGBTs, thyristors and silicon-carbide (SiC) diodes and power MOSFETs as well as galvanically-isolated and high-voltage gate drivers, PFC controllers and high-performance STM32 microcontrollers to enable high-efficiency, high-reliability UPS designs.

### ST's product offering for Uninterruptible Power Supplies (UPS)

		SCRs & TRIACs		Diodes		SCRs & TRIACs	
<b>Rect. &amp; inrush current limiter</b>		High Temp. SCR TN*015H-6, TN*050H-8, TN*050H-12W High Temp. Triacs T1635T		Bridge Rectifier Diodes STBR*08, STBR*12		Bypass Standard SCR TYN6*, TYN8*, TYN10*, TYN12* High Temp. SCR TN5050H-12WY Standard and Snubberless Triacs T2550-12, TPDV*	
	MCUs & Digital Controllers	Power MOSFETs	IGBTs	Diodes	Opamp V/I Sensing	Protections	
<b>PFC Block</b>	MCUs STM32F0, STM32G0, STM32F301, STM32F334, STM32G4 Digital Controllers STNRG388A	600 V-650 V MDmesh M2 ST*60M2, ST*65M2	600 V V series STG*V60F	600 V Ultrafast for CCM STTH*R06 STTH*T06 SiC Diodes STPSC*065 STPSC*H12	Precision Op Amps (<50 MHz) TSZ*, TSV*, TS9*, LMV*	TVS for Power MOSFET Protection SMA4F, SMA6F, SMB15F series	
		600 V-650 V MDmesh M6 ST*60M6, ST*65M6 650 V MDmesh M5 ST*65M5 SiC MOSFET SCT*N65G2	650 V HB series STG*HP65FB 650 V HB2 series STG*HP65FB2 1200 V H series STG*H120F2		<b>MOSFET and IGBT Gate Drivers</b> Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1 HV HB Gate Drivers L649* Isolated Gate Drivers STGAP*		
	MCUs	Power MOSFETs		Diodes	<b>MOSFET and IGBT Gate Drivers</b>		
<b>Charge Controller</b>	STM32F334 STM32G4 STM32F4 STM32F7 STM32H7	600 V-650 V MDmesh M2 ST*60M2, ST*65M2 600 V-650 V MDmesh M6 ST*60M6, ST*65M6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6		600 V Ultrafast STTH*06 1200 V Ultrafast STTH*12 SiC Diodes STPSC*065 STPSC*H12	HV HB Gate Drivers L649* Isolated Gate Drivers STGAP*		
		<b>Power MOSFETs</b>	<b>IGBTs</b>		<b>MOSFET and IGBT Gate Drivers</b>	<b>Post Regulation</b>	
<b>DC-AC Stage</b>		SiC MOSFET SCT*N65G2	600 V V series STG*V60DF 650 V HB series STG*H65DFB 650 V HB2 series STG*H65DFB2 1200 V H series STG*H120DF2		Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1 HV HB Gate Drivers L649* Isolated Gate Drivers STGAP*	DC-DC Converters L698*, ST1S14, L7983, L7985, L7986, L7987* Low Dropout (LDO) Linear Regulators LDF, LDFM, LDK220, LDK320, LDK715, LDL212, ST730/2	
<b>DC-DC Stage</b>		60 V-100 V STripFET F7 ST*N6F7, ST*N8F7, ST*N10F7					

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

#### Typical block diagram for Online UPS with double conversion stage



# MAJOR HOME APPLIANCES

## Refrigeration, Washing, Drying and Miscellaneous Equipment

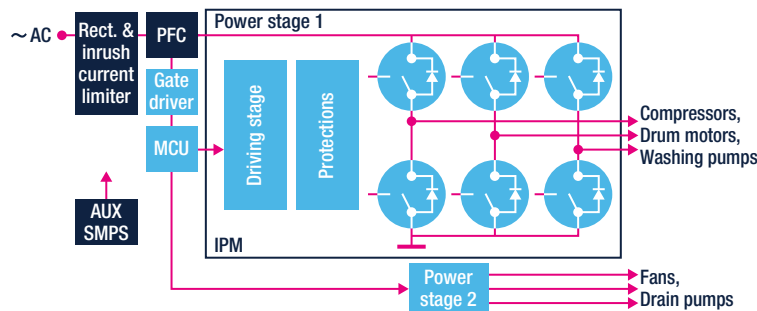
The white goods market requires low-cost and high-energy-efficiency solutions. The refrigeration, washing, drying and the miscellaneous (Air conditioner, water heater) equipment are some of the major home appliance applications that ST, thanks to its wide product portfolio, is able to satisfy with suitable and dedicated power products and high-performing STM32 microcontrollers combined with complementary gate drivers (L638\* and L649\*). Using SiC diodes (STPSC\*), new high-voltage MDmesh MOSFETs or suitable field-stop trench-gate IGBTs, high-efficiency PFC is guaranteed. To reduce the 3-phase inverter design effort, 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. Another approach for designing a 3-phase inverter is based on the use of six discrete IGBTs/MOSFETs with the new 3-phase gate drivers STDRIVE601. High reliability against the inrush current is ensured by new SCRs in the front-end stage. STPW programmable electronic power breaker family provides a convenient, integrated solution for quickly and safely disconnecting a faulty load from a 12 V bus.

## ST's product offering for Refrigeration, Washing, Drying and Miscellaneous Equipment

	SCRs & TRIACs	Diodes		LED Drivers		HV Converters
<b>Rect. &amp; inrush current limiter</b>	High Temp. SCR TN*015H-6, TN1610H-6, TN*050H-12W High Temperature T-Series and 8H-Triacs Txx35T-8 and Txx35H-8	Bridge Rectifier Diodes STBR*08, STBR*12	<b>User Interface</b>	LED Array Drivers STP04/08/16/24 LED12/16/24* STCS*, LED8102S	<b>AUX SMPS</b>	VIPerPlus
	MCUs & Digital Controllers	IGBTs	Diodes	Opamp V/I Sensing	Power MOSFETs	Power Breakers
<b>PFC Block</b>	MCUs STM32F0, STM32G0, STM32F103, STM32F301, STM32F334, STM32G4, STM32F4 Digital Controllers STNRG388A	600 V V series STG*V60F 650 V HB series STG*HP65FB 650 V HB2 series STG*HP65FB2	STTH*AC06 STTH*R06 STPSC*065 DLF	Precision Op Amps (<50 MHz) TSZ*, TSV*, TS9*, LMV*	600 V-650 V MDmesh M2 ST*60M2, ST*65M2	STPW12
				<b>MOSFET and IGBT Gate Drivers</b>	600 V-650 V MDmesh M6 ST*60M6, ST*65M6	<b>Protections</b>
				Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1	650 V MDmesh M5 ST*65M5 SiC MOSFET SCT*N65G2	TVS for Power Rail SMA4F, SMA6F, SMB15F, SMC30J series
	MCUs	IGBTs	IPM	MOSFET and IGBT Gate Drivers	Power MOSFETs	Post Regulation
<b>3Ph Inverter Compressor, Drum Motor, Fan, Pumps</b>	STM32F0, STM32G0, STM32F103, STM32F301, STM32F334, STM32G4, STM32F4	600 V H series STG*H60DF 650 V M series STG*M65DF2	IPM for compressor and drum motor STGIPQ*60T-H STIPQ*M60T-H STGIF*CH60(T)S-L(E) STGIB*CH60(T)S-L(E) STGIB*M60(T)S-L(E) STIB*60DM2T-L IPM for fan and pumps STIPNS*M50T-H STGIPNS*H60T-H STIPQ*M60 STGIPQ*60T-H	3-Phase HV Gate Driver STDRIVE601 HV HB Gate Drivers L638*, L649* Isolated Gate Drivers STGAP* <b>Protections</b> TVS for Power Rail Surge Protection SMA4F, SMA6F, SMB15F, SMC30J series	600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6 SiC MOSFET SCT*N65G2	DC-DC Converters L698*, ST1S14, L7985, L7986, ST1S4*, ST1S50 Low Dropout (LDO) Linear Regulators LDF, LDFM, LDK220, LDK320, LDK715, LDL212

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

### Typical configuration



### Main application boards



#### STEVAL-IHT008V1

1 kW, digital inrush current limiter based on Triac



#### STEVAL-IPM\*

300 W to 3 kW Power board based on SLLIMM™

## Induction Cooking

Induction cooking ranges must be efficient, safe and provide friendly user interfaces. Resonant-switching topologies are typically used for the power converter in these appliances, as they also help achieve lower levels of electro-magnetic interferences (EMI).

We have specifically developed trench-gate field-stop IGBTs and diodes that, together with a selection of high-voltage gate drivers and high-performance STM32 microcontrollers, are ideal for high-efficiency converters. ST also offers environmental sensors and the LED and LCD display drivers, touchscreen controllers and proximity and sensors required for touch or touch-less user interfaces. The ST25R NFC reader portfolio will allow induction hubs to communicate with cookware to negotiate power transfer, making kitchen appliance cordless.

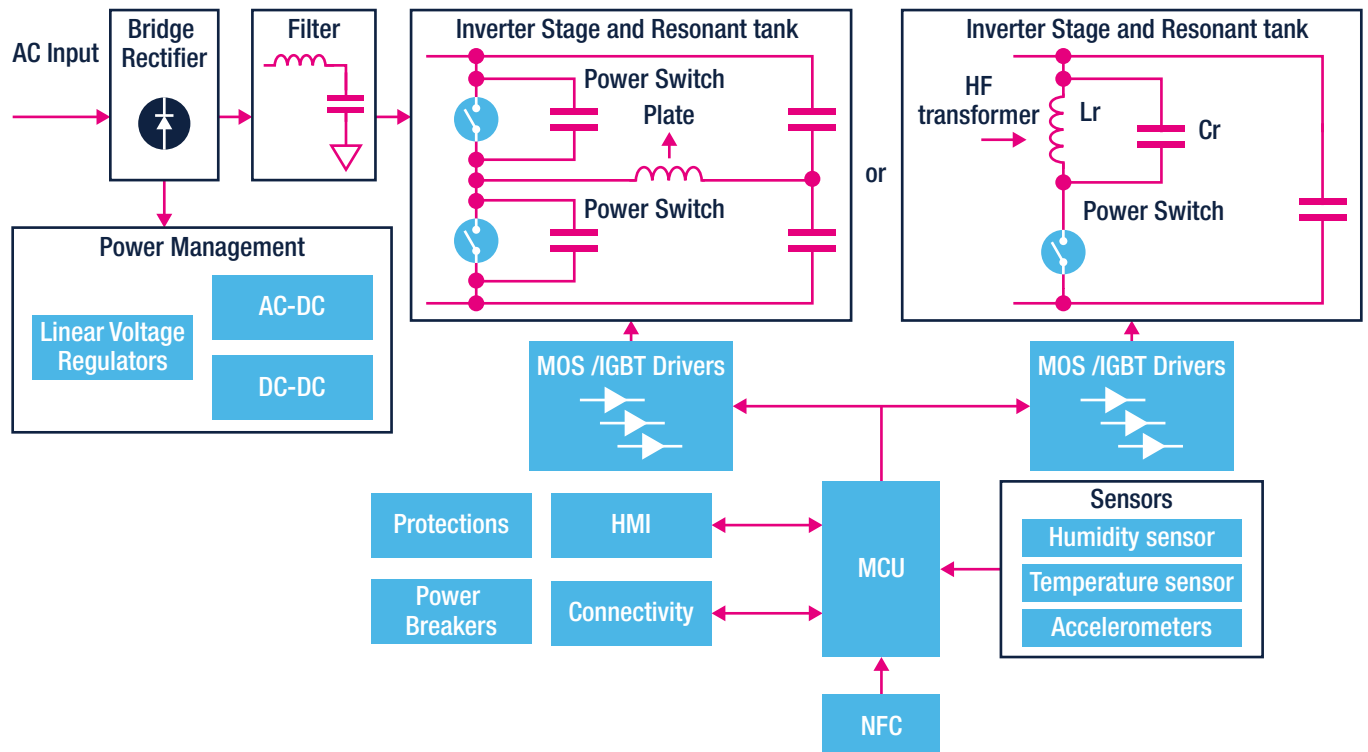


## ST's product offering for Induction Cooking

	MCUs	IGBTs	Gate Drivers	Sensors	NFC		
<b>Single-switch quasi-resonant (voltage resonance)</b>	STM8 STM32G0 STM32F0 STM32F301	1250 V IH series STG*IH125DF	Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1	Environmental Sensors Humidity - HTS221 Temperature - STLM20 Temperature - STTS751	ST25R3916, ST25R3918		
<b>HB series resonant (current resonance)</b>	STM32F0, STM32G0, STM32F303, STM32G4	600 V HB series STG*H60DLFB 650 V IH series STG*IH65DF	HV HB Gate Drivers L649* Isolated Gate Drivers STGAP*	Motion Sensors Accelerometer - IIS3DHHIC Proximity Sensors ToF - VL53L*, VL6180*	<b>Connectivity</b> Bluetooth Low Energy SoC, Wireless MCUs, Modules BlueNRG-*, STM32WB*		
<b>User interface (front panel)</b>	STM8, STM32F0, STM32G0, STM32F4, STM32F7	LED Array Drivers STLED316S, STLED524, STP04/08/16/24, LED1642GW, LED8102S, LED12/16/24*	<b>Power Management</b>	AC-DC VIPerPlus	DC-DC L698*, ST1S14, L7983, L7985, L7986, L7987*	LDO LDF, LDFM, LDK220, LDK320, LDK715, LDL212, ST730, ST732	Power Breakers STPW12

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

### Topology example





# Software tools

eDesignSuite is a comprehensive easy-to-use design aid tool supporting a wide range of ST products  
Discover more!



## eDesignSuite

eDesignSuite is a comprehensive and flexible suite of design aid utilities and engineering tools, that streamlines development of winning solutions with a wide range of ST products meeting user's application requirements.

Explore the advanced features of our Power Management Design Center, an on-line design tool that smartly helps designers of power management systems and subsystems accelerating the engineering development process - select-evaluate-refine and prototyping - for a large and growing number of ICs and Discrete in our broad portfolio. The software tool supports a variety of switching power converters, in power supply, digital power, LED lighting and battery charger applications, making easy the design path from user's specification to circuit's analysis and customization.

The main features of the tool are: automatic proposal for complete solution or fully customizable design, fully annotated and interactive schematics, complete and interactive bill of materials, main current and voltage simulations, efficiency curves, Bode stability and power-loss data, and fully interactive transformer design.

<https://eds.st.com/>

### SMART SELECTOR & CALCULATOR

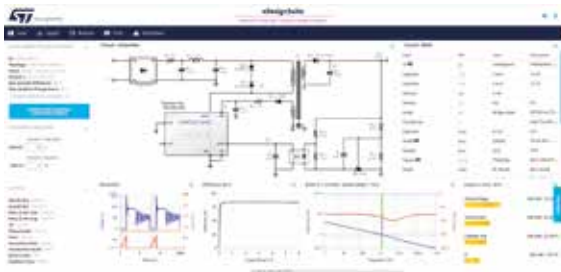
- Generates a list of products that meets user input criteria that extends beyond those found on product data sheet.
- Provides the value of one or more variable or component value for a pre-defined circuit to fit a specified behavior

### CIRCUIT SIMULATOR

- Performs a simulation on a pre-defined, customizable circuit providing an extensive range of internal variables to enable a thorough evaluation of the circuit

### THERMO-ELECTRICAL COMPONENT SIMULATOR

- Enables an electrical and thermal analysis that predicts device behavior at the specified operating conditions that includes application related stimuli.
- It (also) generate a list of products whose allowed ratings are within the operating point specified.



### POWER MANAGEMENT DESIGN CENTER

Power supply, digital power and led lighting

- Automatic proposal for complete solution or fully customizable design
- Fully annotated and interactive schematics
- Complete and interactive BOM
- Set of analysis diagrams (main current and voltage simulations, efficiency curves, Bode stability and power-loss data)
- Fully interactive transformer design
- LLC Digital power design based on STM32
- Evaluation board advisor for faster prototyping

# 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, VIPer122, VIPer222 and VIPer\*1, VIPer\*5, VIPer\*6, VIPer\*7, VIPer\*8 families) features an 800 V avalanche-rugged power MOSFET and leading-edge PWM controller and consumes less than 4 mW for VIPer0P, 10 mW for VIPer\*1 and 30 mW in standby for the others. It also comes with the largest choice of protection schemes and supports different topologies.

The VIPer26K belongs to VIPer\*6 family and integrates a 1050 V avalanche-rugged power MOSFET, suitable for cost effective 1-phase/3-phases smart meters, industrial systems and lighting power supplies.

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.



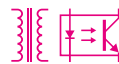
1050 V	10 W	VIPer26K	Very High Voltage SMPS Embedded E/A for direct output regulation/fly-back or buck converter
900 V	7 W	Altair04	Accurate Primary Side Regulation Constant current/constant voltage
800 V	Up to 18 W	VIPer01-11-31	Logic Level MOSFET - 5 V supply voltage Embedded E/A, Very low standby consumption, 18 V DC start-up voltage
	6 W	VIPer0P	Zero Power Mode Smart standby management through buttons or MCU
	Up to 15 W	VIPer06-16-26	Embedded E/A Direct output regulation/settable current limit/fly-back or buck converter
		VIPer17-27-37	Brown-out Output OVP, current limit, fly-back with optocoupler
		VIPer28-38	Peak Power Output OVP, current limit, fly-back with optocoupler
		VIPer25-35	Quasi Resonant Output OVP, current limit, fly-back with optocoupler
730 V	Up to 8 W	VIPer122-222	Embedded E/A, 730 V BV Optimized for low power

Flyback  
Primary side regulation



VIPer01-11-31	VIPer122-222
VIPer26K	VIPer06-16-26
Altair04-05	VIPer0P

Flyback  
Secondary side regulation



VIPer01-11-31	VIPer122-222	VIPer28-38
VIPer26K	VIPer06-16-26	VIPer25-35
VIPer27-37	VIPer0P	VIPer122-222

Buck Converter  
Up to 600 mA Output Current



VIPer01-11-31	VIPer122-222
VIPer26K	VIPer06-16-26
	VIPer0P

### MAIN APPLICATIONS

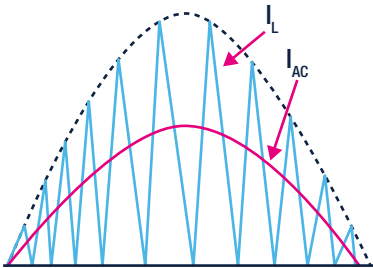


## PFC controllers

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.

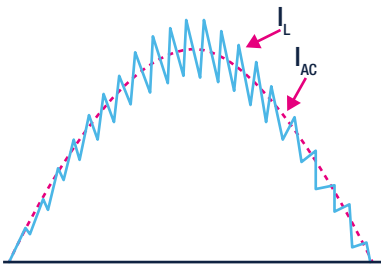
These devices embed advanced protection features, which make SMPS more robust and compact, requiring fewer external components. These features include output overvoltage, brown-out, feedback disconnection and boost inductor saturation protection. The high-voltage start-up capability, present in the L6564H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

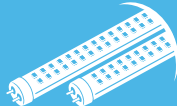


L4984D	Line-modulated, fixed-off-time (LM-FOT) control
L4981A	Fixed frequency, average-current mode
L4981B	Line modulated frequency, average-current mode
L4985A/B	Quasi-fixed frequency, peak-current mode
L4986A/B	Quasi-fixed frequency, peak-current mode, adjustable PGOOD

## MAIN APPLICATIONS



Adapters and TVs  
L6562A\*, L6563\*, L6564\*,  
L4985, L4986



Commercial and street lighting  
L6562A\*, L6563\*, L6564\*,  
L4985, L4986, L4981\*, L4984D



Desktop PCs and Server  
L4985, L4986,  
L4981\*, L4984D

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

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

## 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 STCH03 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 STCMB1 and STNRG011 combo controllers including high-voltage start-up, Xcap discharge circuit, PFC and resonant driving stages, guarantee high performance and high integration with a smaller pinout. The new STNRG012 is specifically designed to support LED lighting and industrial applications requiring DC source management, with additional THD optimizer function.

### Flyback controllers

#### STCH03

- 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)
- UVP, autorestart/latched OVP and internal OTP
- 650 V HV start up

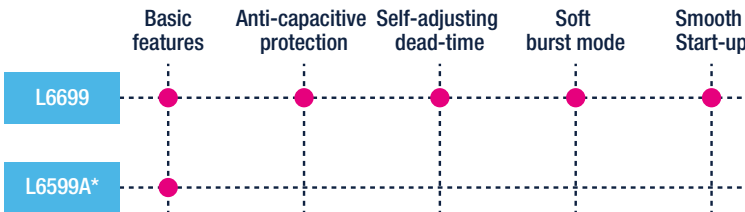
#### L6566\*

- 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)
- Brownout protection

#### L6565

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

### HB-LLC resonant controllers



### Analog combo controller (PFC+LLC/LCC)

#### STCMB1

- 800 V start-up voltage
- Embedded X-cap discharge circuit
- Transition Mode (TM) PFC control method
- Enhanced fixed on time TM PFC controller
- Self-adjusting dead-time and anticapacitive mode for LLC
- Time-shift control of resonant half-bridge

### Multi-mode digital combo controller (PFC+LLC/LCC)

#### STNRG011

#### STNRG012

- Onboard 800 V startup circuit, line sense and X-cap discharge compliant with IEC 62368-1, for reduced standby power (STNRG011 only)
- DC source management with no X-cap discharge (STNRG012 only)
- THD optimizer for LED Lighting applications (STNRG012 only)
- Enhanced fixed on time multi-mode TM PFC controller
- Time-shift control of resonant half-bridge
- ROM memory for SW digital algorithms
- NVM memory for programmable key application parameters

### Asymmetrical half-bridge controller

#### L6591

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

## MAIN APPLICATIONS



Tablets and smartphones  
L6565, L6566\*, STCH03



Laptops  
L6565, L6566\*, STCH03,  
STCMB1, STNRG011



High-power adapters and TVs  
L6565, L6566\*; L6599A\*,  
L6699, STCMB1, STNRG011



Desktop PCs, commercial  
and street lighting  
L6599A\*, L6699, STCMB1,  
STNRG011, STNRG012

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

[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)

## Integrated Smart GaNs - MasterGaN series

The MasterGaN series is an advanced power system-in-package integrating an offline gate driver and two enhancement mode GaN transistors in half-bridge configuration.

The integrated power GaNs feature 650 V drain-source breakdown voltage, while the high side of the embedded gate driver can be easily supplied by the integrated bootstrap diode.

The MasterGaN series allows far greater power supply efficiency and higher power density to drastically reduce the cost of ownership. The greater power density can help designers develop fast chargers and USB-PD adapters as much as four times smaller and three times lighter.

Thanks to the superior efficiency and frequency performance with respect to conventional Si MOSFET, heatsinks can be either eliminated or heavily reduced in size, translating into immediate weight reduction benefits for fast chargers, USBPD adapters, LED lighting drivers, TV power supplies and server/telecom power supply designs.

MasterGaN series is composed by five devices, sharing same package, QFN 9x9, and same half-bridge gate driver, but embedding GaNs with different RDS(on) to better address wide power range and various topologies.


### KEY FEATURES AND BENEFITS

600 V system-in-package integrating half-bridge gate driver and high voltage power GaN transistors:

- QFN 9 x 9 x 1 mm package
- Embedded gate driver easily supplied by the integrated bootstrap diode

- Overtemperature protection
- Extended 3.3 to 15 V input range with hysteresis and pull-down
- Accurate internal timing match
- Interlocking function

- -40 to 125°C operating temperature range
- High switching frequency >1 MHz
- No investment to learn GaN required
- Fast time-to-market

Part Number	General description	Output current max (A) @25 °C	High side RDS(on) (mΩ)	Low side RDS(on) (mΩ)	Supported topologies
MASTERGAN1	High power density 600 V half-bridge high voltage driver with two 650 V enhancement mode GaN HEMT 	10	150	150	Resonant, ACF
MASTERGAN2		6.5	225	150	ACF
MASTERGAN3		4	450	225	ACF
MASTERGAN4		6.5	225	225	Resonant, ACF, inverse buck
MASTERGAN5		4	450	450	Resonant, ACF

### MAIN APPLICATIONS



Adapters and TVs



Battery chargers



PC Desktop and Server/Telecoms



UPS



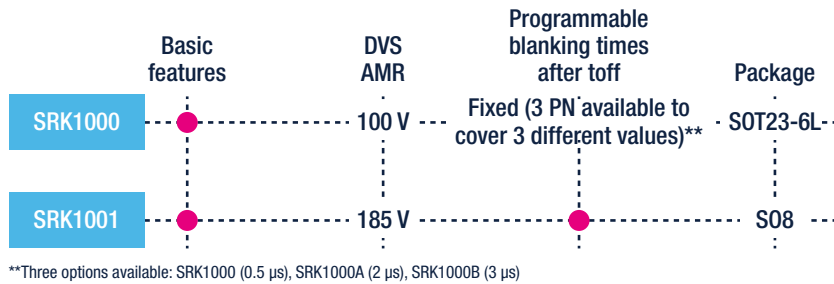
Lighting

## 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 and LLC resonant topologies. The main benefits include high efficiency, space saving, cost reduction and high reliability.

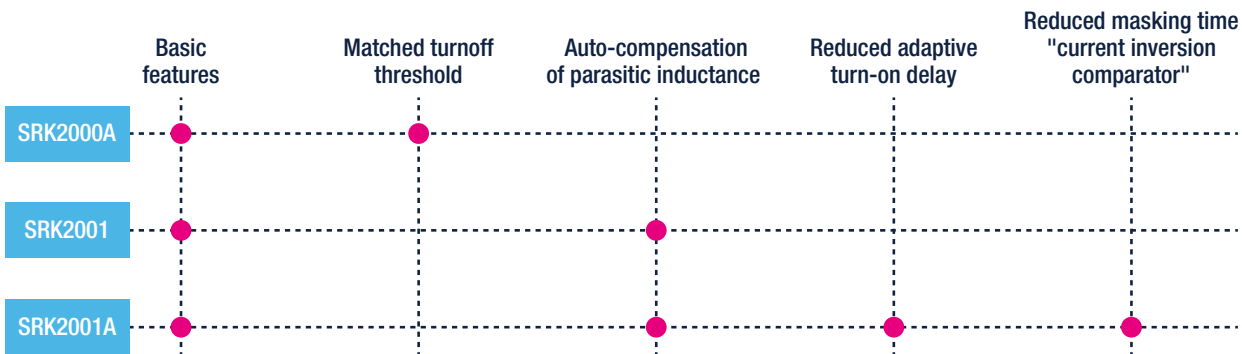
### SR Controllers for Flyback



### SYNCHRONOUS RECTIFICATION BENEFITS

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

### SR controllers for LLC resonant



### MAIN APPLICATIONS



High-power adapters and TVs  
SRK1000, SRK1001



Desktop PCs and Server/Telecoms  
SRK2000A, SRK2001, SRK2001A

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

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

## Signal conditioning

Signal conditioning devices include **Operational Amplifiers** and **Current Sense Amplifiers**. These devices enable accurate and fast current measurement in power supplies. **Comparators** are also very powerful allies of the power supply designer to implement protection features such as over-temperature, over-current, and over/under voltage.



### Operational Amplifiers

#### TSZ181, TSZ182

- Operating voltage 2.2 to 5.5 V
- 5 V zero-drift amplifier
- Input offset voltage 25  $\mu\text{V}$  max
- Temperature up to 150  $^{\circ}\text{C}$
- Gain bandwidth 3 MHz

#### TSV7721/2/3

- Operating voltage 1.8 to 5.5 V
- Low rail only input
- Vio max 200  $\mu\text{V}$
- Gain bandwidth 22 MHz

### Current Sense Amplifiers

#### TSC103

- Operating voltage 2.9 to 70 V
- Surviving voltage on shunt -16 to 75 V
- Amplification gain x50 x100
- Package TSSOP8, SO8

#### TSC2010/1/2

- Bi-directional
- Operating voltage -20 to 70 V
- Amplification gain x20 x60 x100
- Offset voltage  $\pm 200 \mu\text{V}$  max
- 2.7 to 5.5 V supply voltage
- Gain error 0.3% max
- Packages MiniSO8 SO8

### Comparators

#### TS3021, TS3022

- Propagation delay 38 ns
- Low current consumption: 73  $\mu\text{A}$
- Rail-to-rail inputs
- Push-pull outputs
- Supply operation from 1.8 to 5 V

#### TSB711/2, TSB7191/2

- Operating voltage 2.2 to 5.5 V (TSB71) and 2.7 to 36 V (TSB719)
- 36 V amplifier
- Input offset voltage 300  $\mu\text{V}$  max
- Gain bandwidth 6 MHz (unity gain stable) or 22 MHz

#### TSV792

- Operating voltage 1.8 to 5.5 V
- Rail-to-rail input and output
- Vio max 200  $\mu\text{V}$
- Gain bandwidth 50 MHz

#### TSC101

- Operating voltage 2.8 to 30 V
- Surviving voltage on shunt -0.3 to 60 V
- Amplification gain x20 x50 x100
- Package SOT23-5

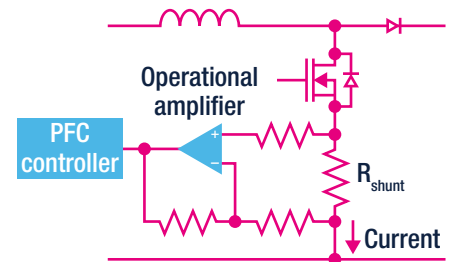
#### TSC21\*

- Bi-directional
- Operating voltage -0.3 to 26 V
- Amplification gain x50 x75 x100 x200 x500 x1000
- Offset voltage  $\pm 35 \mu\text{V}$  max
- Gain error 1% max
- Packages QFN10, SC70-6

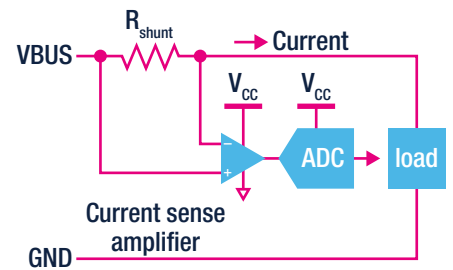
#### TS3011

- Propagation delay 8 ns
- Low current consumption 470  $\mu\text{A}$
- Rail-to-rail inputs
- Push-pull outputs
- Supply operation from 2.2 to 5 V

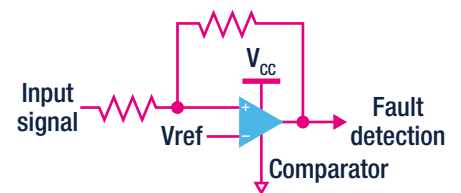
### Typical application schematic for low-side current measurement in a PFC



### Typical application schematic for high-side current measurement



### Typical application schematic for fault detection using a non-inverting comparator, with hysteresis



## MAIN APPLICATIONS



Wireless battery charger transmitters



Server/Telecom



Solar



UPS



Lighting



Factory automation

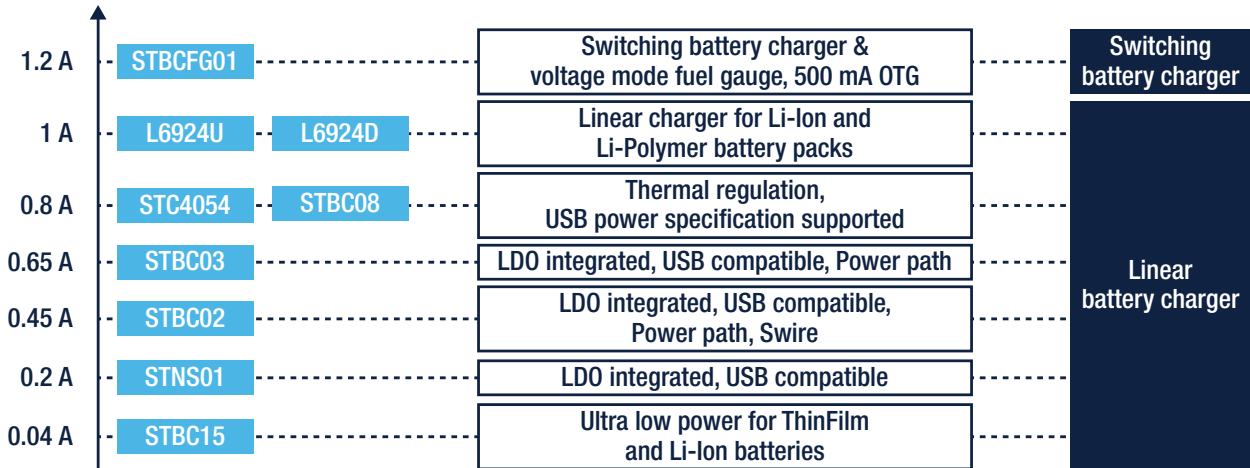
[www.st.com/opamps](http://www.st.com/opamps)  
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# BATTERY MANAGEMENT ICs

## Battery chargers and battery monitoring ICs

ST's **battery chargers** are specifically designed for the portable and mobile markets, and add value to new designs by minimizing power consumption and reducing the space on the PCB. These products offer charge currents from as little as 40 mA up to 1.2 A and can be used for any rechargeable lithium-ion and Li-Polymer battery. Using very simple topologies, some of these devices also feature a power-path function offering instant-on operation and thermal regulation according to the JEITA international standard.

### Battery chargers



#### STBC02/ STBC03

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

#### STBC15

- Microbatteries charging and monitoring circuit
- Charging current up to 40 mA (set by dedicated pin)
- 150 nA quiescent current

ST's **battery fuel gauge ICs** can be located in the battery pack or in the handheld device and integrate functions to monitor the battery voltage, current and temperature. Using a built-in Coulomb counter, these fuel gauge ICs calculate battery charge and store the data in 16-bit register resolution for retrieval by the system controller. Access is via an industry-standard I2C interface, enabling the controller to create an accurate graphical representation of the remaining battery-operating time.

#### STC3115

- OptimGauge™ algorithm for STC3115
- OptimGauge+™ algorithm for SCT3117
- Coulomb counter and voltage gas gauge operations

#### STC3117

- Programmable low battery alarm
- Internal temperature sensor

### FUEL GAUGE ICs MAIN BENEFITS

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

### MAIN APPLICATIONS



Bluetooth accessories  
STC4054



USB  
L6924U, STC4054, STBCFG01



Fitness  
STNS01, STBC02, STBC03



Smartphones  
STBCFG01, STC3115, SCT3117



## Wireless charging ICs

ST fully covers wireless charging applications with **dedicated ICs for both transmitter and receiver**. The STWBC, STWBC-EP and STWBC-MC, 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 STWLC68 dedicated to Qi compliant consumer applications.



### Wireless charger transmitter ICs

- STWBC2-HP
- STWBC2-MP
- STWBC86\*

#### STWBC2-HP

- Supports applications up to 70 W
- Qi 1.2.4 / 1.3 compatible
- Qi certified reference design with MP-A2 topology and supports MP-A22

#### STWBC2-MP

- Optimized for standard Qi Extended Power Profile (EPP) applications for up to 15 W
- Qi 1.2.4 / 1.3 compatible

#### STWBC86\*

- Optimized for standard Qi Baseline Power Profile (BPP) applications for up to 5 W
- Monolithic solution with integrated full-bridge inverter
- Popular applications are not only Tx for public spaces like restaurants, offices, and airports, but also chargers for wearable and hearable devices

### Wireless charger receiver ICs

- STWLC38\*
- STWLC68
- STWLC86\*
- STWLC88
- STWLC98

#### STWLC38\*

- Qi 1.3 compatible
- Supports up to 15 W Rx for Qi Extended Power Profile
- Supports up to 5 W Rx for Qi Baseline Power Profile
- Supports up to 5 W in Tx mode (coil dependent)
- ARC (Adaptive Rectifier Configuration) mode for enhanced spatial freedom

#### STWLC68

- Qi 1.2.4 compatible
- Supports up to 5 W Rx with STWLC68JRH
- Supports up to 20 W Rx and up to 5 W in Tx mode (coil dependent) with STWLC68JRF

#### STWLC88

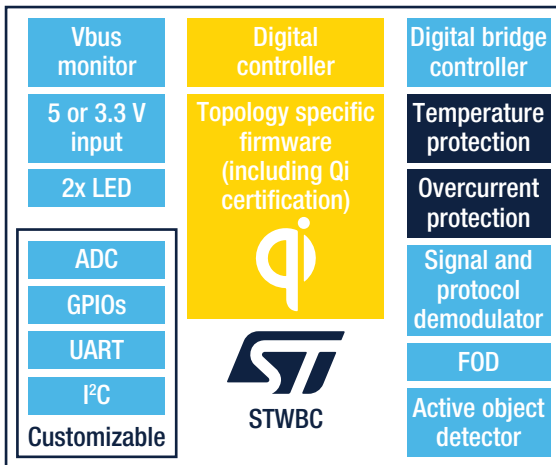
- Qi 1.2.4 compatible
- Supports up to 50 W Rx
- Supports up to 12 W in Tx mode (coil dependent)

#### STWLC86\*/98

- Qi 1.3 compatible
- Supports up to 30 W (STWLC86) /70W (STWLC98) Rx
- Supports up to 7.5 W (STWLC86) /15 W (STWLC98) in Tx mode (coil dependent)
- Embedded OS for Qi 1.3 standalone certification (STWLC98)
- ARC (Adaptive Rectifier Configuration) mode for enhanced spatial freedom
- ARM 32-bit Cortex™-M3 core up to 64 MHz (STWLC98)
- Optimized device size (STWLC98)

#### Common features

- Industry leading efficiency
- Accurate foreign object detection (FOD)
- Best-in-class power consumption with smart standby
- GUI for run-time analysis, tuning and basic customization
- Firmware customization via API
- Robust device protection from over-voltage, over-current and over-temperature events



### MAIN APPLICATIONS



Wireless charger transmitters  
STWBC2-HP, STWBC2-MP, STWBC86



Smartphones, Tablets, and Laptops  
STWLC68, STWLC86, STWLC88, STWLC98



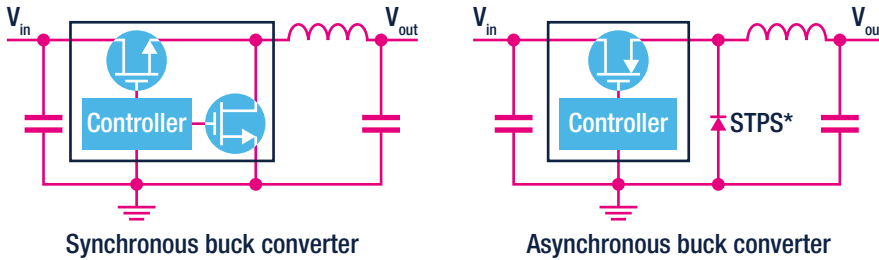
Wearables and Hearables  
STWLC38, STWBC86

Note: \* available in Q4 2021

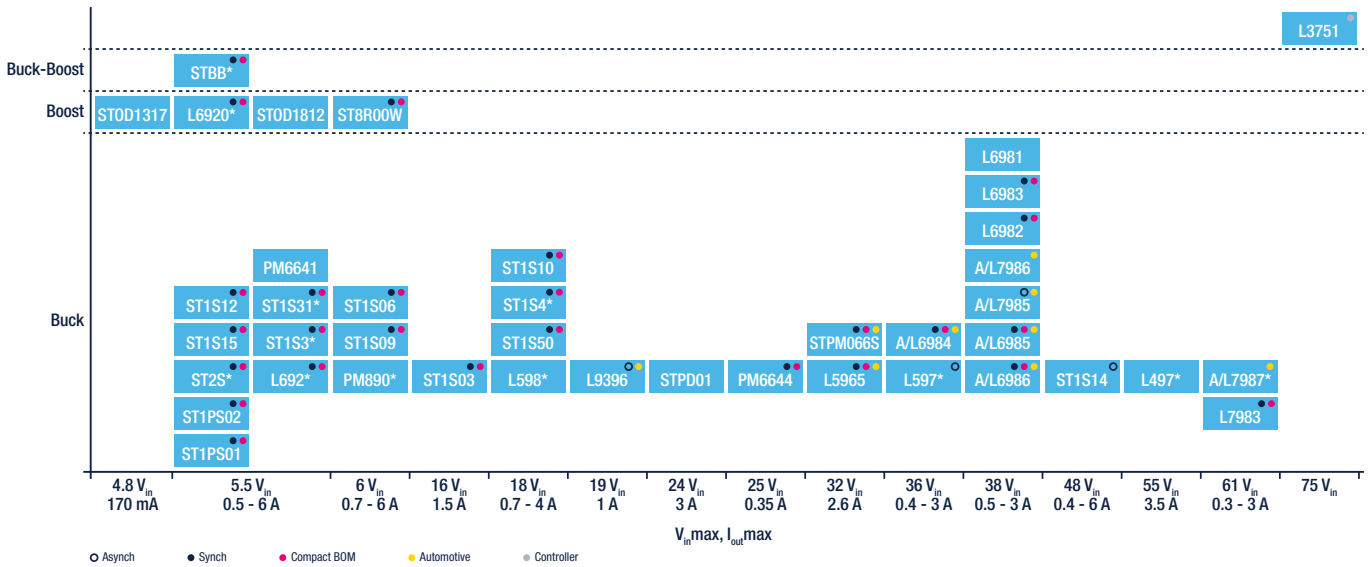
# DC-DC SWITCHING CONVERSION ICS

## 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.



- ### DC-DC CONVERTERS MAIN FEATURES
- Up to 61 VIN/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

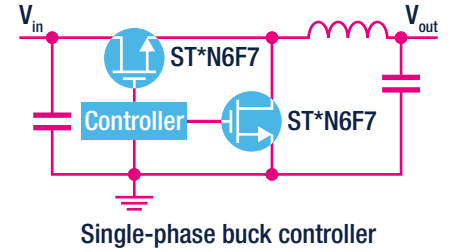
Note: \* is used as a wildcard character for related part number

## 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.

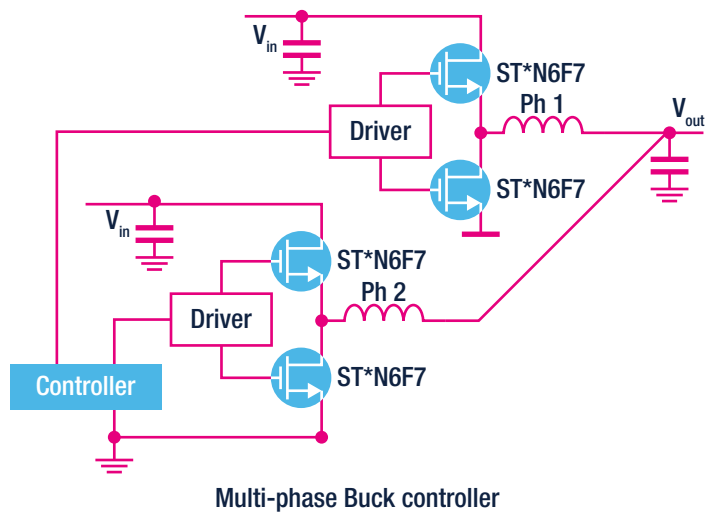
### Single-phase Buck controllers

- L672\*** Single-phase cost effective PWM controller
- L673\*** Single-phase PWM controller with embedded driver and light load efficiency optimization
- PM6697** Analog single-phase controller with SVID with embedded gate driver
- 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



Server



Microserver



Telecoms



PC desktop

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

[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)

# MULTI-OUTPUT CONTROLLERS AND REGULATORS

**STPMIC1**, an ST's high performance fully integrated power management IC, is the ideal companion chip of the **STM32MP1 microprocessor** series being also optimized by design, to power applications requiring low power and high efficiency. The STPMIC1 integrates both switching and linear regulators and it is specifically designed to supply all required power rails for the STM32MP1 and for other components on the board such as DDR, Flash memory, Wi-Fi and Bluetooth connectivity ICs to mention some, providing a total system solution.



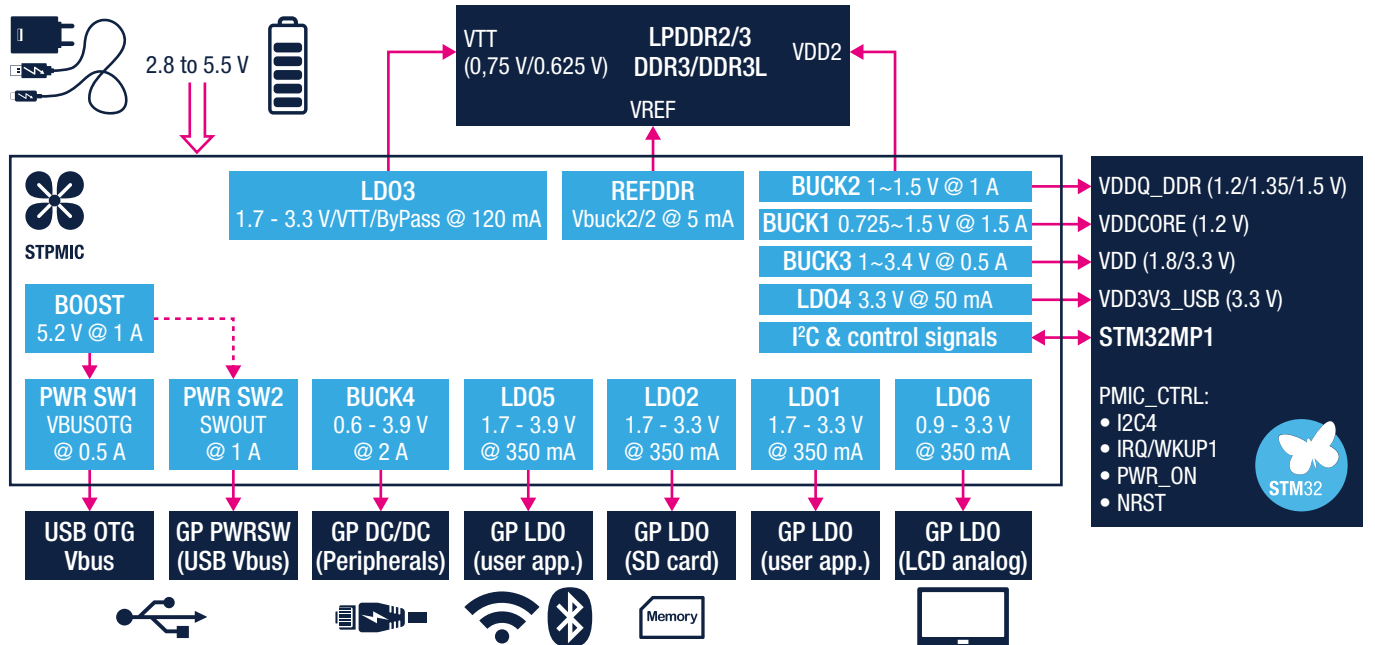
## STPMIC1 versions

	Pre-programmed (typ when VIN = 5 V)		Pre-programmed (typ when VIN = battery)		Not pre-programmed (custom application)		Pre-programmed (typ when VIN = 5 V)		Pre-programmed (typ when VIN = battery)	
	STPMIC1A		STPMIC1B		STPMIC1C		STPMIC1D		STPMIC1E	
	Default output Voltage (V)	Rank	Default output Voltage (V)	Rank	Default output Voltage (V)	Rank	Default output Voltage (V)	Rank	Default output Voltage (V)	Rank
LD01	1.8	0	1.8	0	1.8	0	1.8	0	1.8	0
LD02	1.8	0	2.9	2	1.8	0	1.8	0	1.8	0
LD03	1.8	0	1.8	0	1.8	0	1.8	0	1.8	0
LD04	3.3	3	3.3	3	3.3	0	3.3	3	3.3	3
LD05	2.9	2	2.9	2	1.8	0	3.3	2	2.9	2
LD06	1.0	0	1.0	0	1.0	0	1.0	0	1.0	0
REFDDR	0.55	0	0.55	0	0.55	0	0.55	0	0.55	0
BOOST	5.2	N/A	5.2	N/A	5.2	N/A	5.2	N/A	5.2	N/A
BUCK1	1.2	2	1.2	2	1.1	0	1.2	3	1.2	3
BUCK2	1.1	0	1.1	0	1.1	0	1.1	0	1.1	0
BUCK3	3.3	1	1.8	1	1.2	0	3.3	1	1.8	1
BUCK4	3.3	2	3.3	2	1.15	0	1.2	2	1.2	2

Rank = 0: rail not autom. turned ON  
 Rank = 2: rail autom. turned ON after further 3 ms

Rank = 1: rail autom. turned ON after 7 ms  
 Rank = 3: rail autom. turned ON after further 3 ms

## STPMIC1 and STM32MP1



### MAIN APPLICATIONS

Home automation

Industrial control

POS terminals

Networking

Medical monitoring

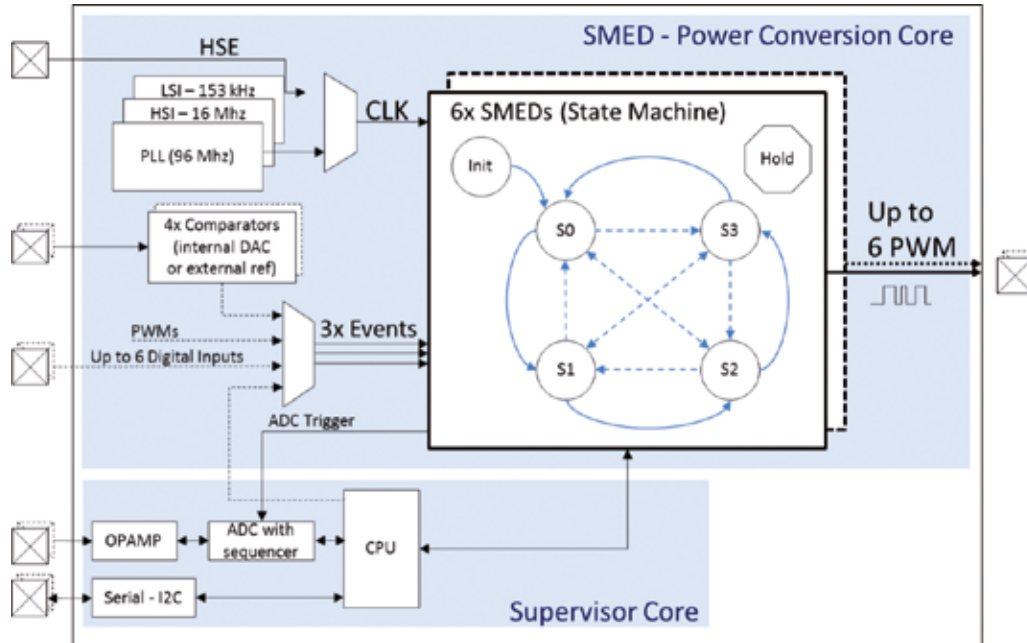


# DIGITAL POWER CONTROLLERS AND MICROCONTROLLERS

## Digital power controllers

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

### Digital controllers tailored for power conversion and lighting applications



STNRG\* internal block diagram

STNRG\*

STLUX\*

- Common features
- Innovative digital control technique based on 6 programmable SMEDs with max PWM resolution of 1.3 ns
- Customizable algorithm for higher conversion efficiency
- Internal 96 MHz PLL
- Operating temperature -40 to 105 °C
- Serial, I2C and GPIO interfaces
- STNRG\*
- Digital controller tailored for power conversion
- Up to 4 comparators with external reference
- STLUX\*
- Digital controller tailored for lighting applications
- Suitable for primary-side regulation and multi-strings lighting applications
- DALI 2.0 for remote control and connectivity

## MAIN APPLICATIONS



Solar  
STNRG388A



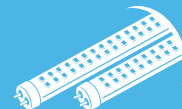
HEV charging stations  
STNRG388A



UPS  
STNRG338A



Factory automation  
STNRG388A



Commercial, architectural and street lighting  
STLUX\*



[www.st.com/stlux](http://www.st.com/stlux)  
[www.st.com/stnrg](http://www.st.com/stnrg)

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

## Microcontrollers for digital power

The **32-bit microcontrollers** most suitable for power management applications are the STM32F334 and the STM32G474 MCU from the mixed-signal **STM32F3 series** and **STM32G4 series**, the STM32H743 MCU from the high performance **STM32H7 series** and those of the entry-level **STM32G0 series**.

The STM32G0 series has a 32-bit ARM® Cortex®-M0+ core (with MPU) running at 64 MHz and is particularly well suited for cost-sensitive applications. STM32G0 MCUs combine real-time performance, low-power operation, and the advanced architecture and peripherals of the STM32 platform.

The STM32F3 series MCU combines a 32-bit ARM® Cortex®-M4 core (with FPU and DSP instructions) running at 72 MHz with a high-resolution timer and complex waveform builder plus event handler.

The STM32G4 series and his 32-bit ARM® Cortex®-M4 core running at 170 MHz is in the continuity of STM32F3 series, keeping leadership in analogue leading to cost reduction at the application level and a simplification of the application design, he explores new segments and applications.

Finally, the STM32H7 series has a 32-bit ARM® Dual core Cortex®-M7 + Cortex®-M4 (480 MHz + 240 MHz) or Single-core Cortex®-M7 (480 MHz) with precision FPU, DSP and advanced MPU.

STM32 F3, G4 and H7 series contain a flexible high-resolution timer to generate highly accurate pulse-width modulated (PWM) signals for stable control of switched-mode power circuits.

These MCU specifically address digital power conversion applications such as digital switched-mode power supplies, lighting, welding, solar, wireless charging, motor control and way more.

### STM32G0

- Cortex®-M0 core
- Very low power consumption
- Timer frequency up to 128 Mhz resolution (8ns)
- High-speed ADCs for precise and accurate control
- More RAM for Flash: up to 36 KB SRAM for 128 KB and 64 KB Flash memory

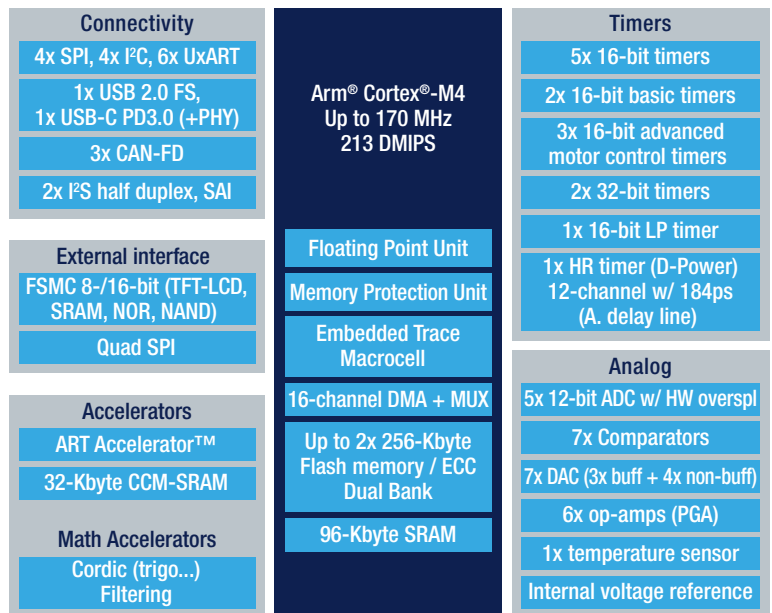
### STM32F334

- Cortex®-M4 core
- High resolution timer V1 (217ps resolution) with waveform builder and event handler
- 12-bit ADCs up 2.5 Msps conversion time
- Built-in analog peripherals for signal conditioning and protection (25ns from fault input to PWM stop)

### STM32G474

- Cortex®-M4 core
- High resolution timer V2 (184ps resolution) with waveform builder and event handler
- Mathematical accelerator, digital smps and power factor correction
- High-speed ADCs for precise and accurate control (4Msps)
- Dual bank flash for live upgrade
- Digital Power Supply and PFC Design Workshop with STM32 MCUs in collaboration with the company partner Biricha

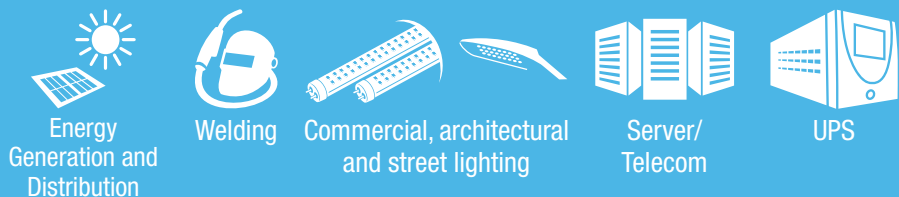
### STM32G474 block diagram



### STM32H743

- Cortex®-M7 core
- High performance up to 480 MHz
- High resolution timer V1 (2.1ns resolution) for real time control
- High-speed ADCs for precise and accurate control (3.6 Msps)

### MAIN APPLICATIONS



[www.st.com/stm32](http://www.st.com/stm32)

STM32 Digital Power Ecosystem



## Automotive microcontrollers for in-car digital power


**SPC5** automotive microcontrollers family are suited for in-car digital power applications such as traction inverters, on-board chargers, bidirectional DC/DC as well as Battery Management Systems.

**SPC58 E-line** combines real-time behavior with ISO26262 ASIL-D safety.

The embedded hardware security module (HSM) ensures protection against cyber security attacks.

The Generic Time Module (GTM) completes the peripheral set by delivering a high-performance timer, synchronization units, embedded hardware DPLL and micro-cores.

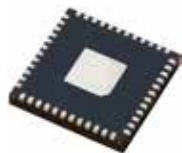
**SPC58 Chorus** family provides a connected, secure and scalable platform delivering a wide range of communication interfaces and low-power capabilities to complete the in-car connectivity needs.

	SPC58 E Line
<b>Core</b>	Triple 3x e200z4d @ 180 MHz
<b>eFlash Code</b>	4 MB to 6 MB
<b>Timers</b>	GTM3
<b>Safety</b>	ASIL-D
<b>Advanced Networking</b>	8x CAN-FD FlexRay 2x Ethernet
<b>Security</b>	HSM medium
<b>ADC</b>	5x 12 bit (SAR) 3x 10 bit (SAR) 6x 16 bit (SigmaDelta)
<b>High Temperature support (165 Tj)</b>	Qualified

### Package Options



eTQFP 64-176  
(exposed pad)



QFN 48  
(exposed pad)



### Networking



### Scalability

Up to:  
3 cores, 200 MHz, 10 MB flash



### Secure & Safety

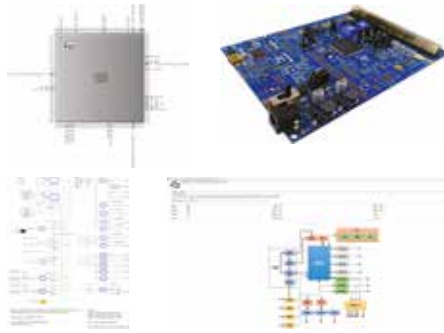


Evita  
Medium/Full





ST offers a complete ecosystem rich of partners, discovery tools, and the free to download SPC5-Studio IDE containing all peripherals drivers and graphical interface for configuration.



MAIN APPLICATIONS



Vehicle Security



Software over-the-air



Parking Services



Remote Assistance



Maintenance free



Safety



HEV

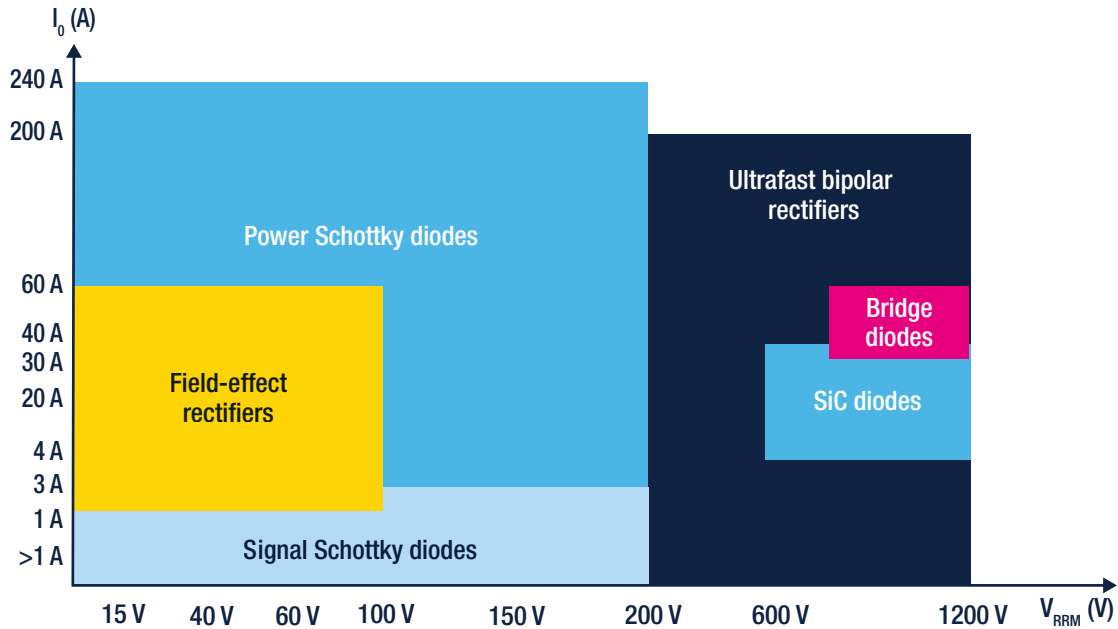
[www.st.com/spc5](http://www.st.com/spc5)

## DIODES AND RECTIFIERS

ST's **Schottky** and **Ultrafast** diode portfolio includes 650 to 1200 V SiC and 45 to 100 V field-effect rectifier diodes (**FERD**) ensuring that designers can take advantage of the very latest technologies to develop cost-efficient, high-efficiency converter/inverter solutions. Depending on the targeted application and its voltage, developers can choose from a wide range of devices to ensure the best compromise in terms of forward voltage drop (VF) and leakage current (IR) as well as other characteristics.



 **AEC-Q101 automotive-grade qualified diodes and rectifiers >**



### Field-effect rectifiers (FERD)

**FERD\***

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

### Power Schottky diodes

**STPS\***

Power Schottky diodes for low voltage general purpose applications

### Ultrafast rectifiers

**STTH\***

Ultrafast high voltage diodes for general purpose application

### MAIN APPLICATIONS



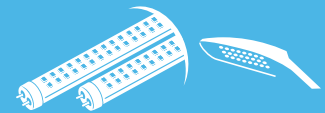
Adapters and TVs



Battery chargers



Solar inverters, welding, HEVs, and UPS



Residential, commercial, architectural and street lighting



PC Desktop and Server/Telecoms



HEV charging stations



Factory automation



Home appliances



Consumer electronics

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

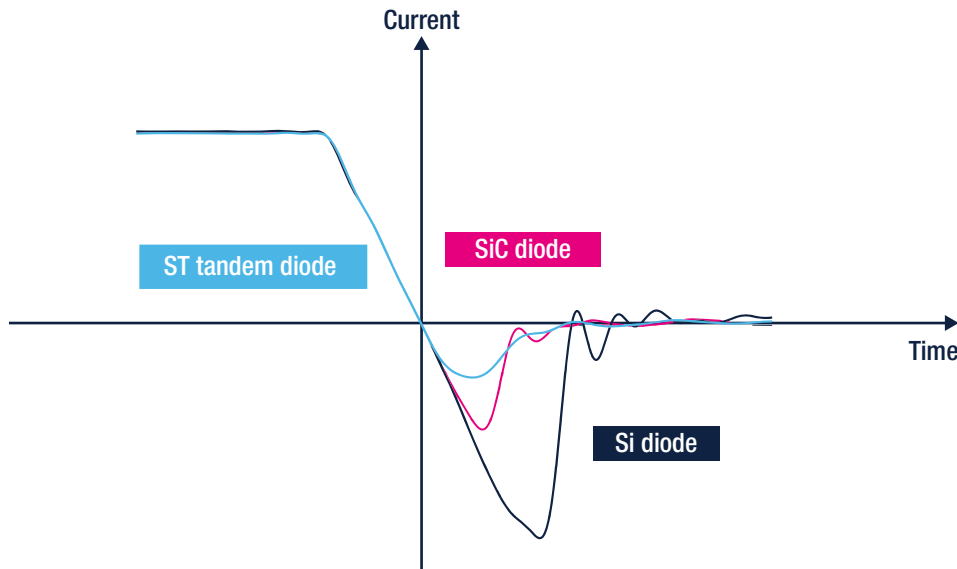
[www.st.com/schottky](http://www.st.com/schottky)  
[www.st.com/ultrafast-rectifiers](http://www.st.com/ultrafast-rectifiers)  
[www.st.com/field-effect-rectifier-diodes](http://www.st.com/field-effect-rectifier-diodes)

## SiC diodes

In addition to ensuring compliance with today's most stringent energy efficiency regulations (Energy Star, 80Plus, and European Efficiency), ST's **silicon-carbide** diodes show four times better dynamic characteristics with 15% less forward voltage (VF) than standard silicon diodes. Silicon-carbide diodes belong to our STPOWER™ family.

The efficiency and robustness of solar inverters, motor drives, uninterruptible power supplies and circuits in electrical vehicles are therefore greatly improved by the use of silicon-carbide (SiC) diodes.

ST proposes a 600 to 1200 V range with single and dual diodes encapsulated in package sizes from DPAK to TO-247, including the ceramic insulated TO-220 as well as the slim and compact PowerFLAT™ 8x8 featuring an excellent thermal performance, the new standard for high-voltage (HV) surface-mount (SMD) packages and available for 650 V SiC Diodes from 4 A to 10 A.



SiC diodes provide zero recovery time with negligible switching losses

### 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\*065

STPSC\*H12

- 650 V (STPSCx065)
- 1200 V (STPSC\*H12)
- 2 available trade-offs, low VF and High surge

### MAIN APPLICATIONS



Solar inverters

STPSC\*065, STPSC\*H12



HEV

STPSC\*065



UPS

STPSC\*065, STPSC\*H12



Charging Station

STPSC\*065,  
STPSC\*H12



Server/Telecoms and PFC

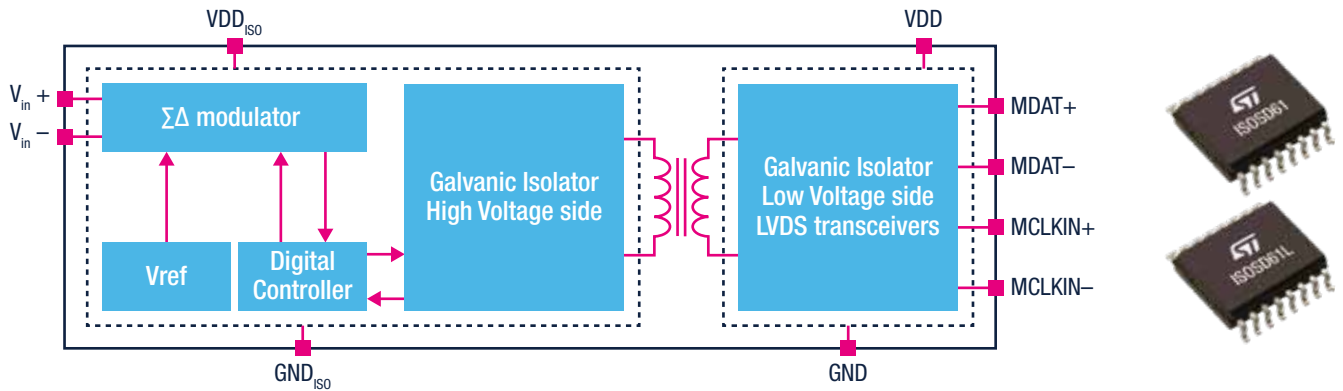
STPSC\*065, STPSC\*H12

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

[www.st.com/sic-diodes](http://www.st.com/sic-diodes)

## GALVANIC ISOLATED SIGMA-DELTA ADC

The galvanically isolated **ISOSD61/ISOSD61L** second order Sigma-Delta modulator, based on the highly successful ST transformer coupling technology, is available in either the single-ended (**ISOSD61**) and differential (**ISOSD61L**) signaling versions. It converts analog input signals into high-speed single-bit digital data streams, from which analog information can be recovered by a low-pass filter and further processed by a host controller. The modulator protects the output peripheral interface with a galvanic isolation barrier that separates low and high voltage domains and blocks stray currents between different grounds. The silicon-based isolation technology offers a number of advantages over traditional opto-coupling, including significantly lower power consumption, higher data transfer rates and greater reliability for longer device lifetime.



### KEY FEATURES

- 2nd order 16-bit Sigma-Delta Modulator
- $\pm 320$  mV Full Scale Differential Input Signal Range
- Up to 25 MHz external clock input for easier synchronization
- Up to 50 kHz Bandwidth
- 86 dB typical SNR
- - 83 dB typical THD
- 30 kV/ $\mu$ s typical Common-Mode Transient Immunity
- 6 kV VPEAK Highest Allowable Over-Voltage (VIOTM)
- 6 kV VPEAK Maximum Surge Insulation Voltage (VIO SM)
- 1.2 kV VPEAK Maximum Working Insulation Voltage (VIORM)
- Flexible interface options: Low Voltage Differential Signaling (LVDS) and Single Ended (TTL/CMOS) options
- $-40$  °C to  $+125$  °C extended industrial temperature range
- SO-16 wide package

### Product table

Part Number	Version	Input Range	Max. Clock Frequency	Resolution	SNR	Isolation	CMTI	Package & Packing
ISOSD61	TTL/CMOS	$\pm 320$ mV	25 MHz	16-bit	86 dB	1.2 kV Viorm	30 kV/us	S016W Tray
ISOSD61TR	TTL/CMOS							S016W Tape & Reel
ISOSD61L	LVDS							S016W Tray
ISOSD61LTR	LVDS							S016W Tape & Reel

### MAIN APPLICATIONS



Servo drive



Factory automation



EV charging station



Server & telecom power

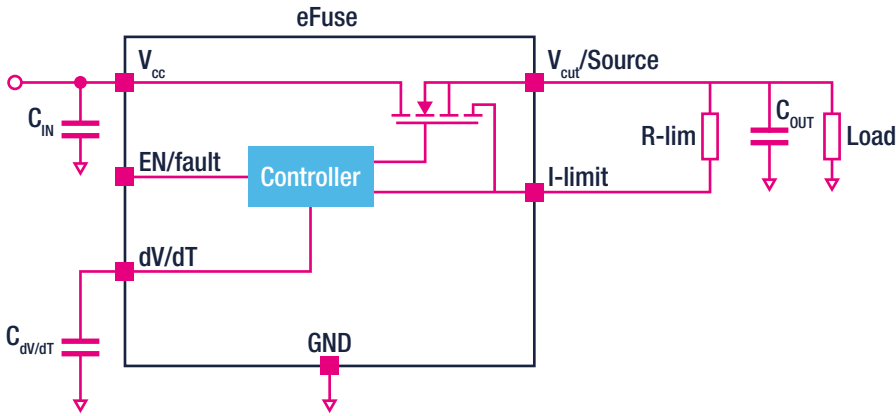


# HOT-SWAP POWER MANAGEMENT

## eFuses

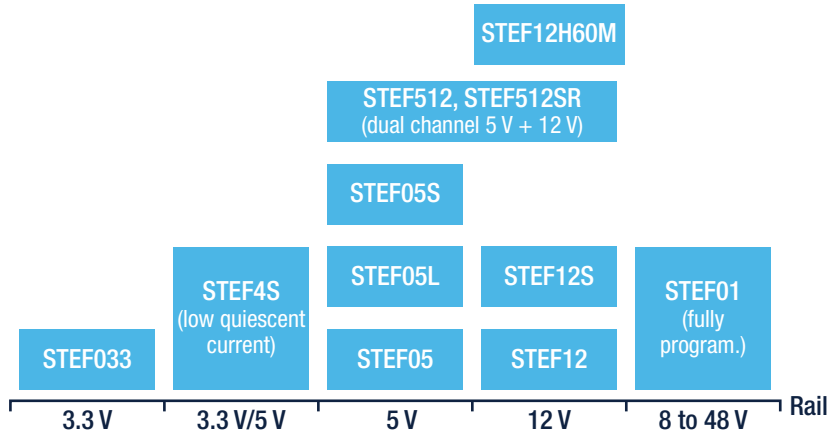
**eFuses** are electronic fuses that can replace larger conventional fuses or other protection, reducing ownership costs in production and in the field.

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.



**eFuses, a smart offer for a lots applications**

- ### eFuse 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



### MAIN APPLICATIONS



**Home appliances**  
STEF05, STEF01,  
STEF12, STEF12S



**Server and Data Storage**  
STEF033, STEF05, STEF05L,  
STEF4S, STEF12,  
STEF05S, STEF12S,  
STEF512, STEF512SR



**USB connections**  
STEF05, STEF05L,  
STEF05S



**Factory automation**  
STEF01,  
STEF12, STEF12S



**Set-top boxes**  
STEF12,  
STEF12S

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

## Power breakers

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.

STMicroelectronics' STPW programmable electronic power breaker family provides a convenient, integrated solution for quickly and safely disconnecting a faulty load from a 12 V bus.

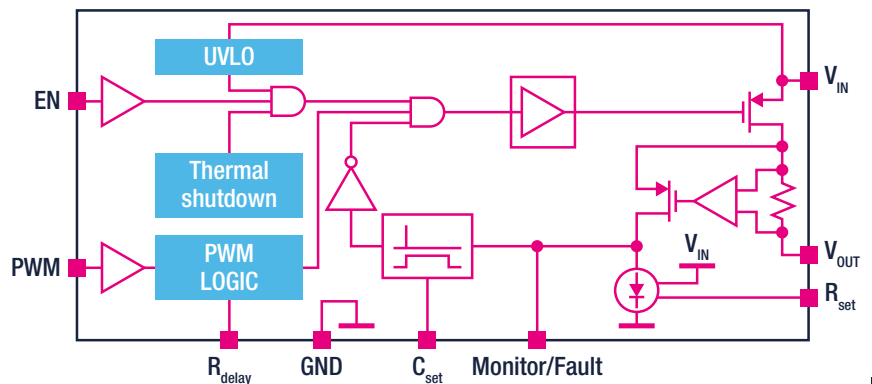
Inserted between the power rail and the load, the STPW power breakers contain a low-resistance (50 mΩ) power switch and precision circuitry for sensing the load power. If the user-programmed limit is exceeded, the switch turns off and a signal on the dedicated monitor/fault pin informs the host system. In normal operation, this output presents an analog voltage proportional to the load power to permit continuous monitoring.

Also featuring built-in auto-restart after a user-adjustable delay, and programmable PWM masking time to prevent protection triggering by inrush current, the STPW family simplifies design for safety and eases certification to standards such as the UL 60730 specifications for abnormal operation. This integrated solution effectively replaces discrete circuitry or a combination of ICs such as a current-sense amplifier or a hot-swap controller plus MOSFET switches, by offering improved accuracy and saving board space and bill of materials for each load protected.

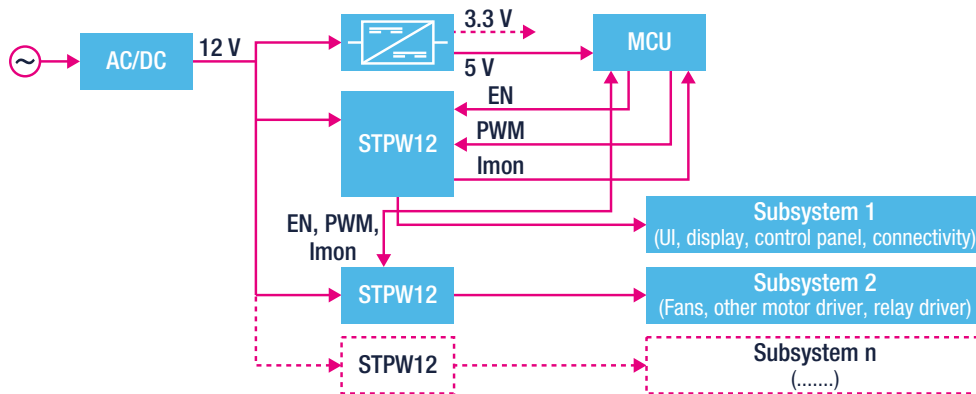
### Power breakers

#### STPW12

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



### Typical home appliance block diagram for STPW12



### MAIN APPLICATIONS



Home appliances  
STPW12



Air conditioning  
STPW12



Factory automation  
STPW12

## IGBTs

ST offers a comprehensive portfolio of **IGBTs (Insulated Gate Bipolar Transistors)** ranging from 600 to 1250 V in trench-gate field-stop (TFS) technologies.

Featuring an optimal trade-off between switching performance and on-state behavior (variant), ST's IGBTs are suitable for industrial and automotive segments in applications such as general-purpose inverters, motor control, home appliances, HVAC, UPS/SMPS, welding equipment, induction heating, solar inverters, traction inverters, on-board chargers & fast chargers.

### Breakdown Voltage

600 V	650 V	1200 V	1250 V
-------	-------	--------	--------

### Current

5 to 20 A	20 to 80 A	4 to 200 A	20 to 80 A	15 to 100 A	20 to 50 A	15 to 75 A	8 to 75 A	15 to 40 A	20 A, 30 A
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### Switching frequency

8 to 30 kHz	50 to 100 kHz	2 to 20 kHz	16 to 60 kHz	Up to 8 kHz	2 to 20 kHz	20 to 100 kHz	16 to 60 kHz
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### IGBT Series

H	V	M	HB	HB2	IH	S	M	H	IH
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### Focus Applications

Home appliances (fans, pumps, washing machines and dryers)	Welding, high frequency converters PFC, solar, UPS, charger	Industrial motor control, automotive traction inverter, GPI, Air-Con	High frequency converters, PFC, solar, UPS, charger, welding, induction heating and soft switching	Induction heating and soft switching	Industrial motor control, GPI, Air-Con	PFC, welding, high frequency converters, solar, UPS, charger	Induction heating, microwave and soft switching
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#### H series

STG\*H\*

600 V family

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

1200 V family

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

#### V series

STG\*V60\*F

- Optimized for high switching frequencies

- Negligible current tail at turn-off
- Very low turn-off switching losses
- Soft and very fast recovery antiparallel diode
- Up to 100 kHz in hard switching topologies
- AEC-Q101 qualified device

#### M series

STG\*M\*

650 V family

- 6  $\mu$ s of min short-circuit capability @ starting  $T_J = 150^\circ\text{C}$
- Wide safe operating area (SOA)
- Very soft and fast recovery antiparallel diode
- Suitable for any inverter system up to 20 kHz
- AEC-Q101 qualified devices

1200 V family

- 10  $\mu$ s of min short-circuit capability @ starting  $T_J = 150^\circ\text{C}$
- Freewheeling diode tailored for target application
- Suitable for any inverter system up to 20 kHz



## HB series

### STG\*H\*B

- Low saturation voltage
- Minimal tail current turn-off
- Different diode option
- Optimum trade-off between conduction and switching losses
- Low thermal resistance
- 4 leads package available
- Very high robustness in final application
- Automotive eligible

## HB2 series

### STG\*H\*FB2

- Very low saturation voltage
- Reduced gate charge
- Different diode option
- Optimum trade-off between conduction and switching losses
- Low thermal resistance
- 4 leads package available
- High efficiency in final application
- Automotive eligible

## IH series

### STG\*IH\*

- 650 V IH family
- Very low VCE(sat): 1.5 V @ ICN
- Very low Eoff
- Low drop forward voltage diode
- Designed for soft commutation application only
- 1250 V IH family
- Minimized tail current
- Very low drop freewheeling diode
- Tailored for single-switch topology

## S series

### STG\*S120DF3

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

## MAIN APPLICATIONS



Welding



Solar



UPS



Home appliances



Air conditioning



Motor control



Induction heating

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

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

## INTELLIGENT POWER MODULE - SLLIMM™

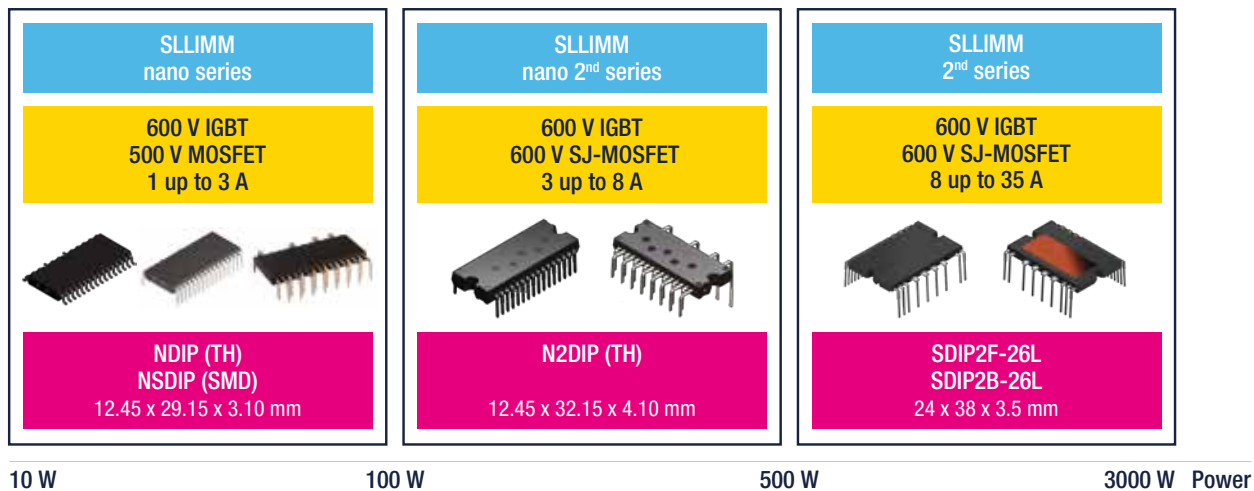
The **SLLIMM**, small low-loss intelligent molded module, is the ST's family of compact, high efficiency, dual-in-line **intelligent power modules (IPM)**, with optional extra features. This family includes different solutions in terms of package (SMD, through hole, full molded and DBC) and silicon technology (IGBT, MOSFET and Super Junction MOSFET). Optimally balancing conduction and switching energy with an outstanding robustness and EMI behavior makes the new products ideal to enhance the efficiency of compressors, pumps, fans and any motor drives working up to 20 kHz in hard switching circuitries and for an application power range from 10 W to 3 KW.

### KEY FEATURES

- 600 V, IGBT based from 3 A to 35 A DC rating at 25 °C
- 600 V, Super Junction Mosfet based from 3 A to 15 A DC rating at 25 °C
- 500 V, MOSFET based, 1 A and 2 A DC rating at 25 °C
- Low VCE(sat), Low RDS(on)
- Optimize driver and silicon for low EMI
- Lowest Rth value on the market for the DBC package versions
- Internal bootstrap diode
- Maximum junction temperature: 175 °C for IGBT and 150 °C for SJ-MOSFET
- Separate open emitter outputs
- NTC on board
- Integrated temperature sensor
- Comparator for fault protection
- Shutdown input/fault output
- Isolation rating of 1500 Vrms/min

### KEY BENEFITS

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



### MAIN APPLICATIONS



Fan



Fridge



Washing Machine



Air conditioning

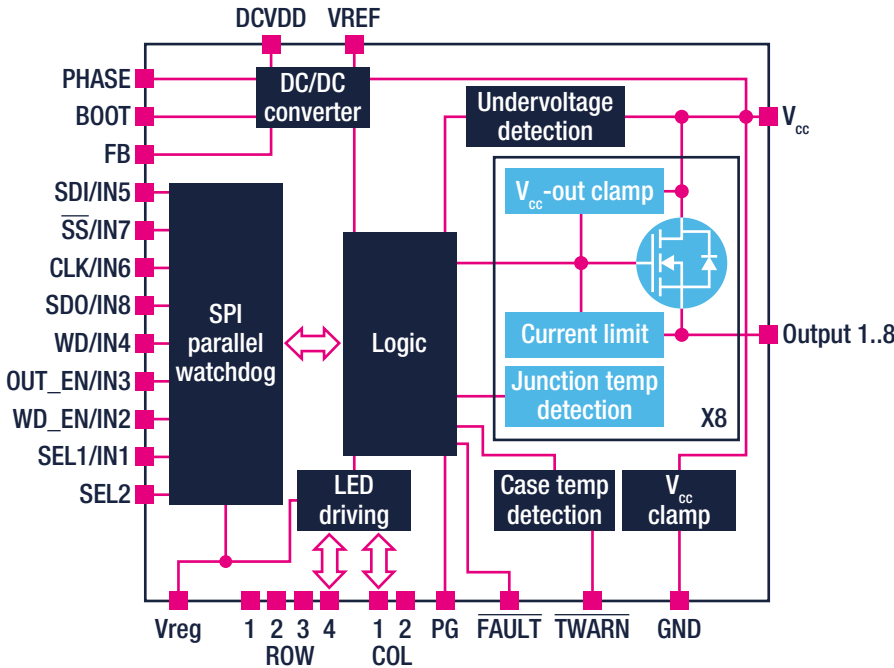


Motor control

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

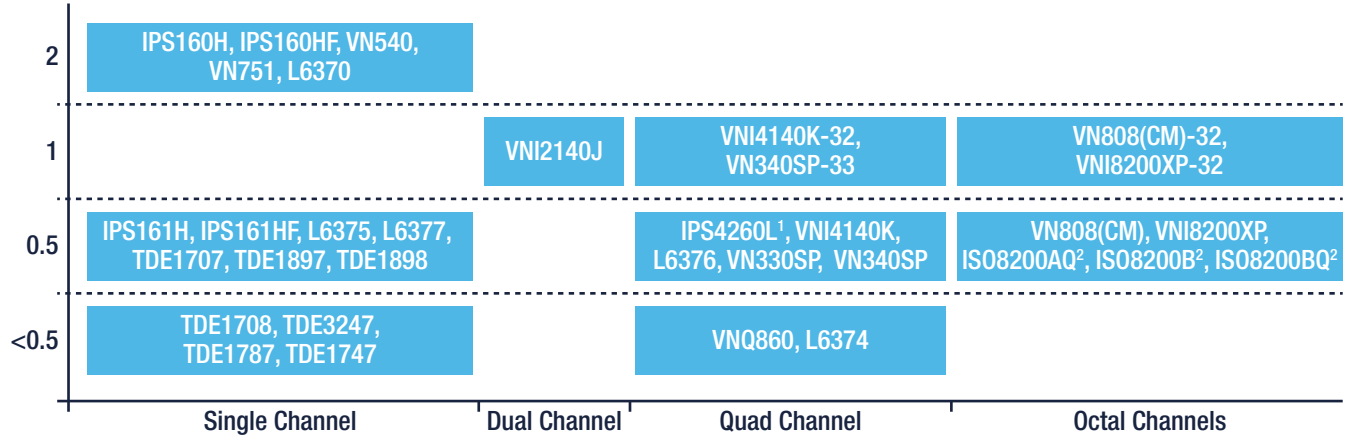
# INTELLIGENT POWER SWITCHES

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
  - Isolation
  - ...all on a single chip

Output Current/Channel (A)



Note 1: low side switch    2: isolated

## MAIN APPLICATIONS



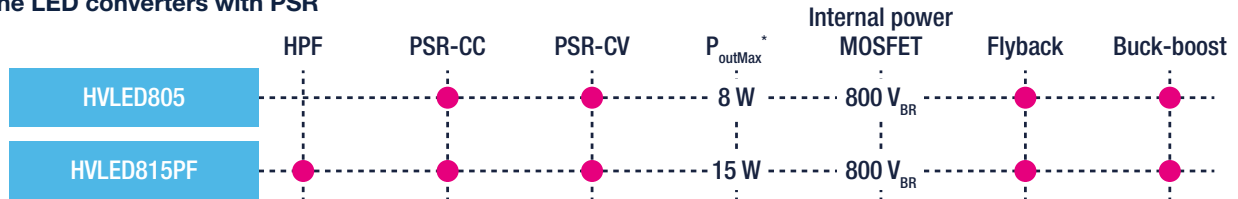
[www.st.com/ips](http://www.st.com/ips)

# LED DRIVERS

## Offline LED drivers

Dedicated **LED drivers** operating from the AC mains ensure highly-accurate LEDs control to provide a high level of light quality and avoid flickering. By combining a state-of-the-art low-voltage technology for the controller and an extremely robust 800 V technology for the power MOSFET in the same package, HVLED8\* converters (i.e controller + MOSFET in the same package) feature an efficient, compact and cost-effective solution to drive LEDs directly from the rectified mains. This family of converters works in constant-current / constant-voltage primary-side regulation (PSR-CC/CV). HVLED001A and HVLED001B controllers are also available for high power needs working in constant-voltage (PSR-CV) primary-side regulation; a dimming function is also available. For both families (HVLED converters and controllers), the primary-side regulation cuts bill-of-material costs, while also simplifying design and reducing the space occupied by LED control circuitry.

### Offline LED converters with PSR



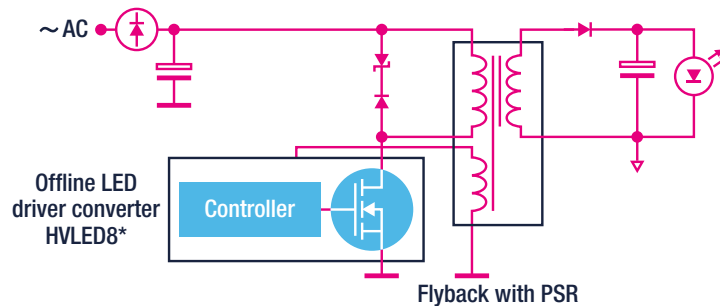
### Offline LED controllers with PSR



### Offline LED controllers



### Topology example



## MAIN APPLICATIONS



Residential lighting  
HVLED815PF



Commercial and street lighting  
HVLED001A, HVLED001B, HVLED007

Note: \* output power for european input voltage 230 Vac

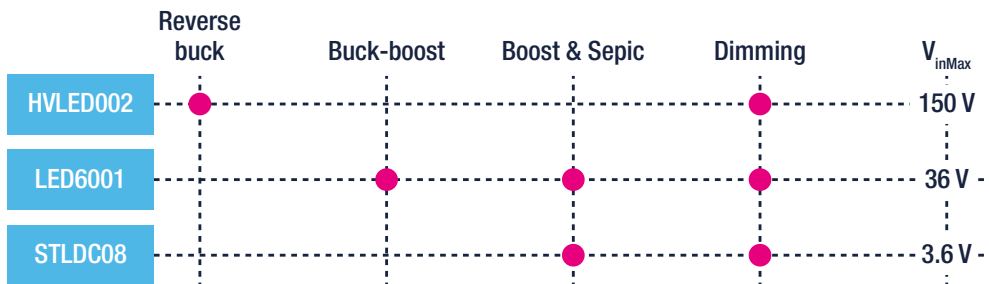
## DC-DC LED drivers

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.

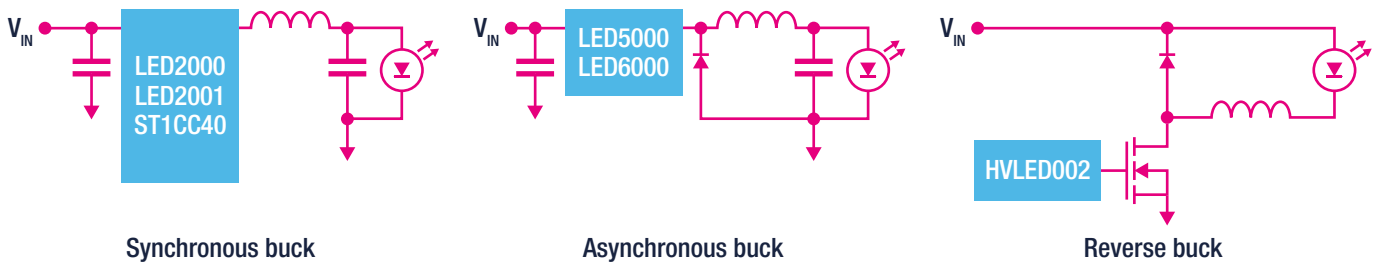
### DC-DC LED drivers converters



### DC-DC LED drivers controllers



### Topology examples



## MAIN APPLICATIONS



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



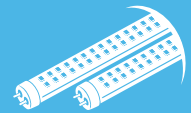
**Traffic signals**  
LED2000, LED2001, ST1CC40, LED5000, LED6000



**Street lighting**  
LED5000, LED6000, HVLED002



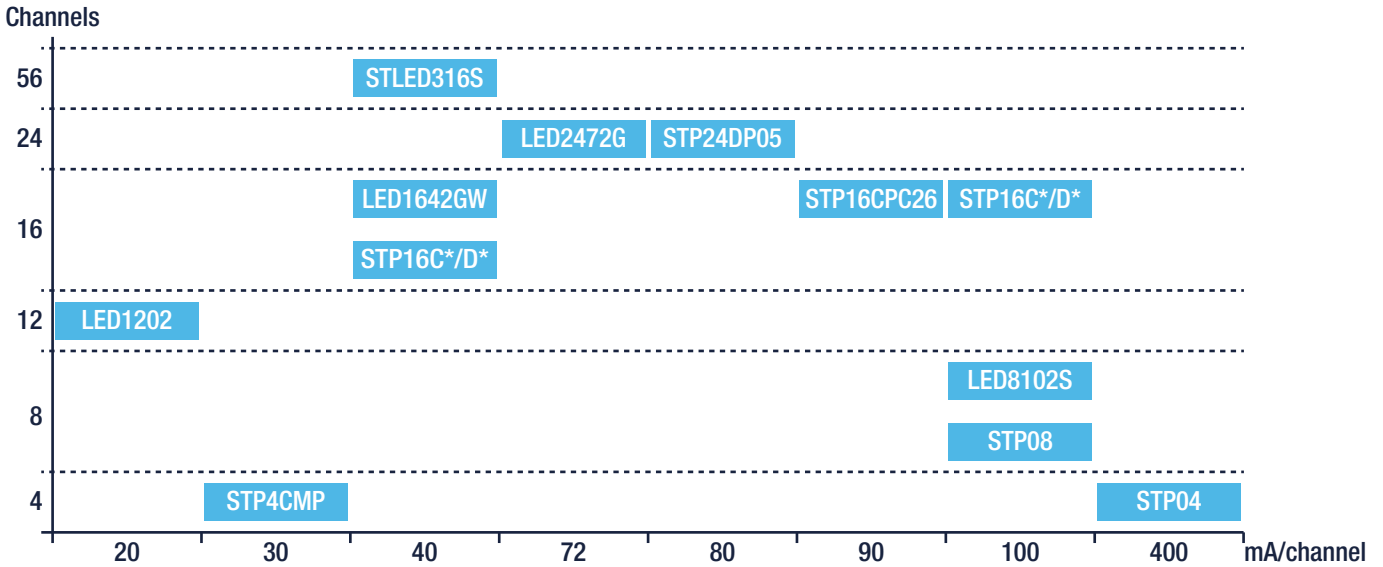
**Emergency lighting**  
LED6001, ST1CC40



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

## LED array drivers

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



### 24 channel RGB (8x3) drivers

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

### 12/16 channel drivers

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

### 4/8 channel drivers

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

### 16 Digit, 56 LED Matrix

- 40 mA Current capability
- 6 Key-scanning (8 x 2 matrix)
- 3-wire serial bus interface

## MAIN APPLICATIONS



### Traffic signals

LED8102S, LED2472G, STP24DP05, STP04



### Large panel signs

LED1642GW, LED2472G, STP24DP05, STP16, STP08



### Home appliances

LED8102S, STP16, STP08, LED1642GW, STP4CMP



### Special lighting

STP04, LED1642GW, LED2472G, LED8102S



Wearable/  
High End consumer  
LED1202

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

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

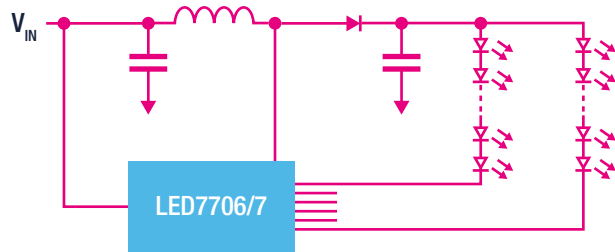
## LED row drivers

**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.

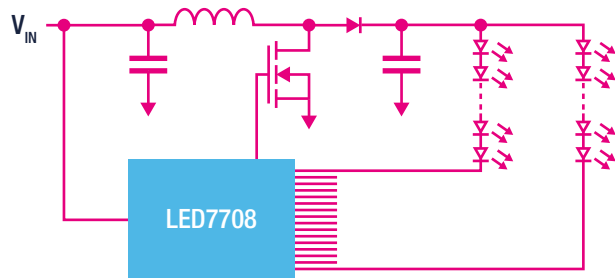
### LED row driver converters

6 rows	LED7707	• 85 mA/row	Global dimming
	LED7706	• 30 mA/row	
1 row	STLA02*	• 20 mA/row	
	STLD40D		
	STCS*	• 0.5 A/1.5 A/ 2 A/row	



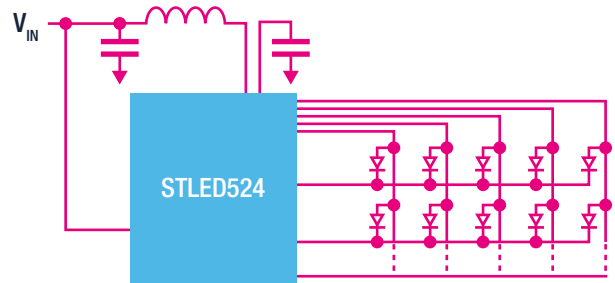
### LED row driver controllers

16 rows	LED7708	• 85 mA/row • Grouped or independent row dimming
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### LED matrix driver

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



Smartphones  
STLED25, STLD40D



Keyboard and accessories  
STLA02\*



Home appliances and ATMs  
LED7706, LED7707, LED7708, STCS\*

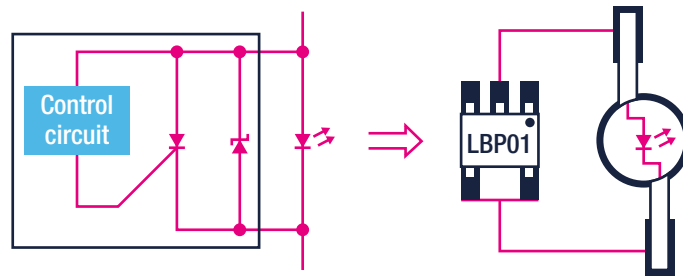


Wearables  
STLED524

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

## LED bypass protection

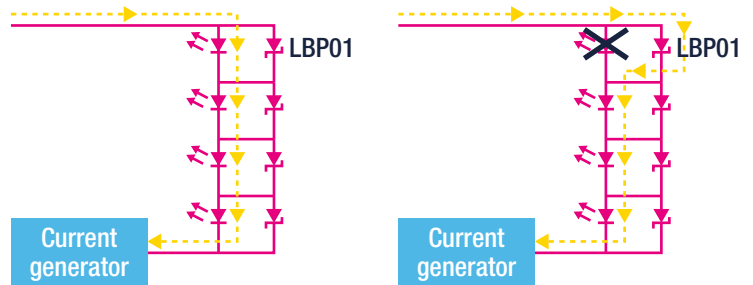
The **LBP01 series** of LED bypass protection devices are bypass switches that can be connected in parallel with 1 or 2 LEDs. In the event of a LED failure, this device shunts the current through other LEDs. It also provides overvoltage protection against surges as defined in IEC 61000-4-2 and IEC 61000-4-5



### lbp01 get reliable your led application

#### LBP01

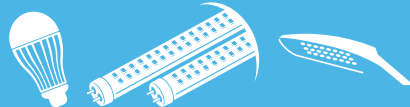
- Keep LED strings on in case of LED open mode failure
- Reduced maintenance cost
- Increase lifetime of the lighting system



### MAIN APPLICATIONS



Display panels



Residential, commercial, architectural and street lighting



Emergency lighting



Traffic signals

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



# LINEAR VOLTAGE REGULATORS

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

- for the highest efficiency design - (from 0.3 to 20  $\mu$ A for 50 mA to 2 A) or dynamic performance for the best transient response, power supply ripple rejection (up to 92 dB at 1 kHz) and low noise (as low as 6.3  $\mu$ Vrms). All this coupled with a choice of the smallest form factor packages for size-conscious applications such as a 0.47 x 0.47 mm STSTAMP™ package.



			Ultra-low dropout	Low Iq	Low noise, high PSRR
STLQ015	LDK120/130	LD39015	●	●	●
STLQ50	LD040L	LD59030	●	●	●
ST/LDK715	LDK220	LD39020/30	●	●	●
ST1L08	LDK320	ST730/2	●	●	●
LD56100	LD56050	LD39050/100/49100	●	●	●
LDBL20	LDCL015	LD57100	●	●	●
LDFM/LDF	LDLN015	LD39115J	●	●	●
LD59100	LDL112	LD39130S	●	●	●
STLQ020	LDL212	LD39200	●	●	●
LDLN025/30	LD59015	LD59150	●	●	●
L5050	L5150	L5300	●	●	●
L99VR01	L4949	L4995	●	●	●

### 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 wearables

LD39115, LD39130, LD39020/30, ST1L08, LDBL20, LD59015, LDLN025/30, STLQ020, LD56030, LD56050, LD56100, LD57100, L99VR01



### Healthcare

STLQ015, STLQ020, ST715, LD39130



### Home appliances

LDK220/320, LDF, LDFM, LDL212, ST730/2



### Automotive ADAS, ECU

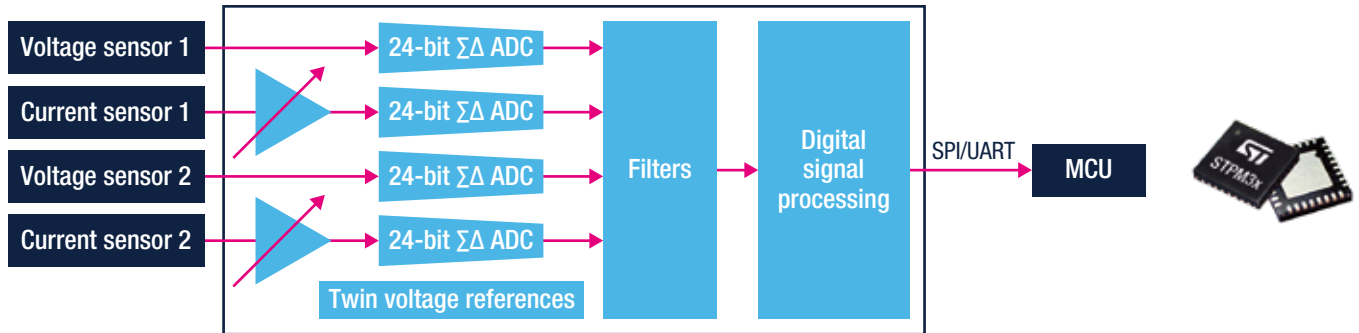
LDK130, LD39100, LD59150, LD040L, L5050, L5150, L99VR01, L4949, L4995, L5300

[www.st.com/linear-regulators](http://www.st.com/linear-regulators)

## METERING ICs

**STPM32, STPM33, STPM34** are high accuracy AFE (Analog Front End) for DC and AC energy measurement, offering high accuracy down to extremely low current typical of home appliances in stand-by. A full set of on-board features provides high system integration and enable on-chip power quality monitoring, reducing smart-meter cost of ownership, and contributing to a fast and easy design to dramatically reduce manufacturing time and cost.

### STPM34: 4 independent channels block diagram



### KEY FEATURES

- Up to 4 independent 24 bits 2<sup>nd</sup> order  $\Sigma\Delta$  ADC with PGA Integrated DSP for “turn-key energy parameters calculations
- Built-in twin independently temperature compensated voltage references
- Double LED output programmable for active and reactive energy pulses generation
- Applicable to Class 0.2 meters
- < 0.1% active power accuracy over a dynamic range of 5000:1
- 3.6 kHz Bandwidth
- Very fast single point calibration
- AC and DC measurement
- Multiple sensors support: Shunt, current transformer, Rogowsky coils
- Multiple host interfaces 5 and 3 wires SPI, UART
- I, V bit stream available to host controller for customer own processing
- Case removal and Neutral Anti-tamper detection
- Exceeds 50-60 Hz EN 50470-x, IEC 62053-2x, ANSI12.2x

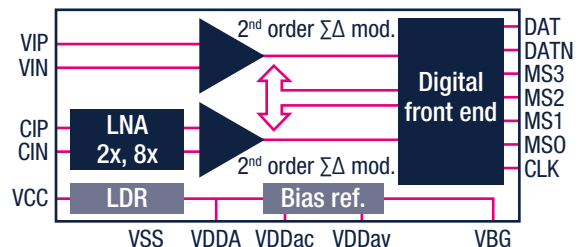
## STPMS2

The STPMS2, also called smart-sensor, is a dual SD modulator with embedded PGA. In combination with a microcontroller that embeds DFSDM filters allows you to position the A/D conversion (STPMS2) very close to the current transducers, so minimizing noise capture from the analog tracks. Once converted, the SD streaming of voltage and current are multiplexed and transferred through a single-wire data line to the mcu.

### KEY FEATURES

- Two 2<sup>nd</sup> order SD modulators
- 0.1% active energy max. error over 1:2500 dynamic range
- Standards supported: EN 50470-1, EN 50470-3, IEC 62053-21, IEC 62053-22, IEC 62053-23, ANSI C12.1-2001, ANSI C12.10-1997, ANSI C12.20-2002
- Fast digital calibration
- Allows the use of multiple shunts

### STPMS2



### MAIN APPLICATIONS



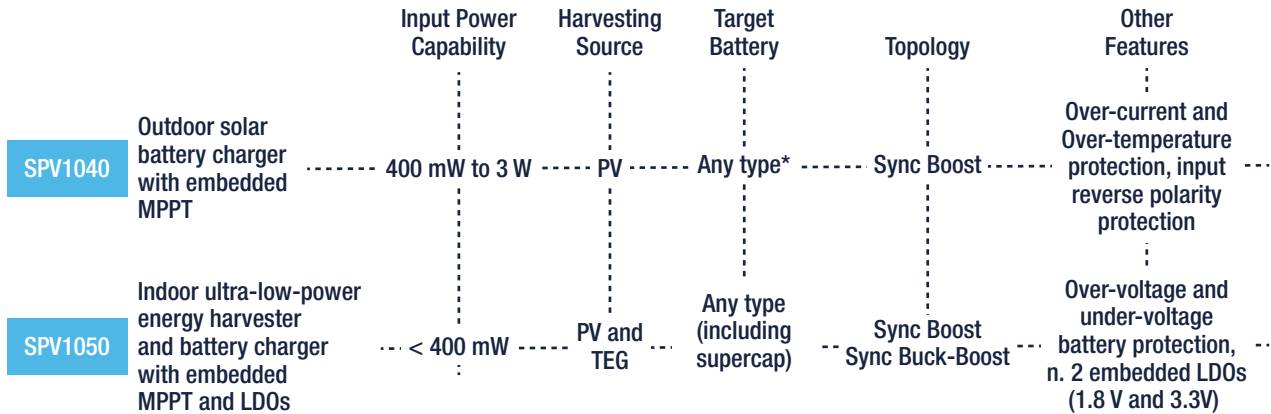
# PHOTOVOLTAIC ICs

## DC-DC converters with embedded MPPT algorithm

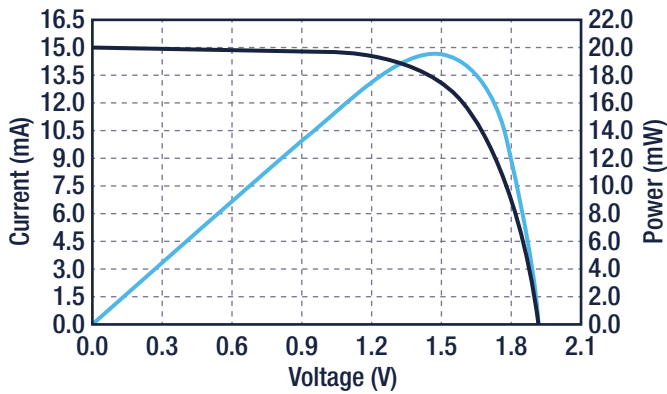
The maximum power point tracking (MPPT) algorithm maximizes the power output by photovoltaic panels according to temperature and solar irradiation conditions.

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

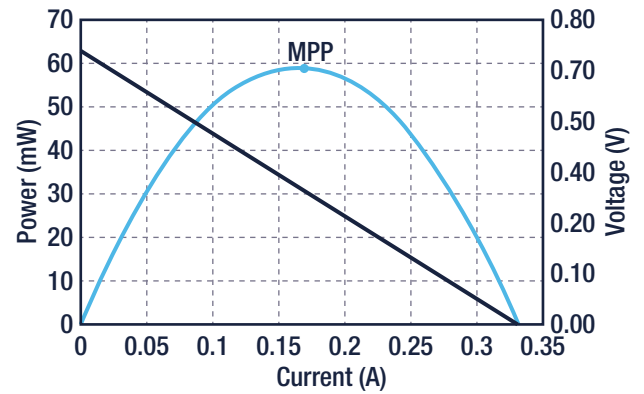
The SPV1050 is an ultra-low-power battery charger and energy harvester (from photovoltaic cells or a thermo-electric generators) that guarantees a very fast charge of supercapacitors and any type of battery including thin-film solid-state batteries. It is specifically designed to work in indoor environments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



Solar curves



Thermo-electric generator (TEG)



### MAIN APPLICATIONS



Smartphones, digital cameras, and camcorders  
SPV1040



Fitness, climate, home and factory automation monitoring  
SPV1050

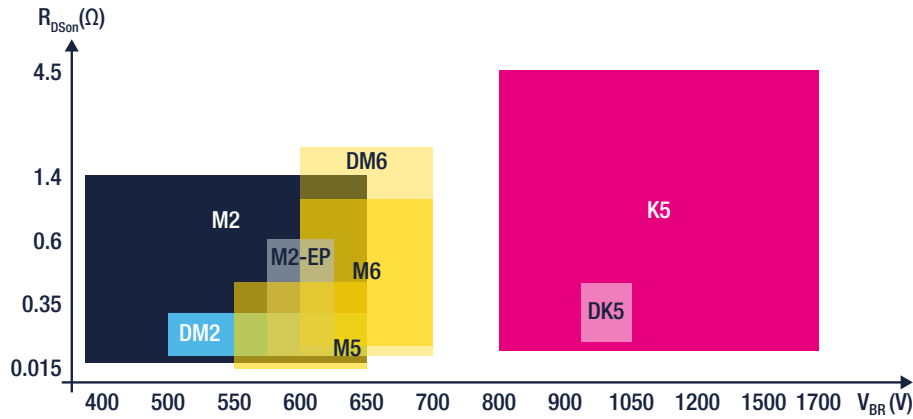
Note: \* A CC-CV battery charger is needed to apply lithium batteries charging profile

[www.st.com/photovoltaic-ics](http://www.st.com/photovoltaic-ics)  
[www.st.com/mppt-dcdc-converters](http://www.st.com/mppt-dcdc-converters)

# POWER MOSFETs

## High-voltage power MOSFETs

ST's **HV Power 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 Power MOSFET for your design.



### K5 series

ST\*N\*K5

- Very low RDS(on)
- Small Qg and capacitance
- Small packages
- Suited for hard switching topologies

### M5 series

ST\*N\*M5

- Extremely low RDS(on)
- High switching speed
- Suited for hard switching topologies

### M2/M2-EP series

ST\*N\*M2

ST\*N\*M2-EP

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

### DK5 Series

ST\*N\*DK5

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

### M6 series

ST\*N\*M6

- Lower RDS(on) x area vs previous generation
- Extremely low gate charge (Qg)
- Optimized capacitances profile for better efficiency @ light load
- Optimized threshold voltage (VTH) and gate resistance (RG) values for soft switching

### DM2 & DM6 series

ST\*N\*DM2

ST\*N\*DM6

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

## MAIN APPLICATIONS



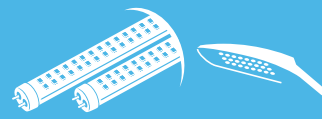
Adapters

K5, M5, M2, M2-EP, M6



Solar inverters, welding, HEVs, and UPS

K5, M5, DM2, DM6, DK5



Residential, commercial, architectural and street lighting

K5, DK5



Server/Telecoms

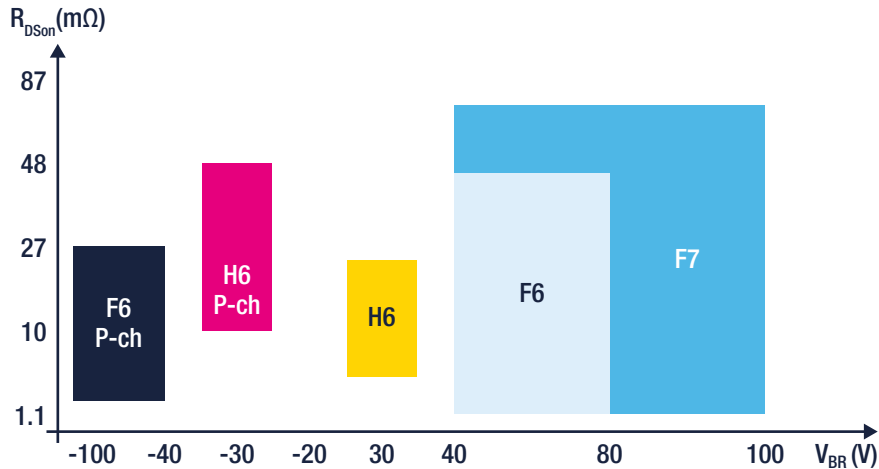
M5, M2, M2-EP, DM2

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

## Low-voltage power MOSFETs

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

ST's **STripFET™** low-voltage MOSFETs support a wide voltage range for synchronous rectification, UPS, motor control, SMPS, power-over-Ethernet (PoE), inverter, automotive and other applications in a wide range of miniature and high-power packages: DPAK, D2PAK, SOT-223, TO-220, TO-220FP, TO-247, PowerFLAT (5 x 6)/(3.3 x 3.3)/(2 x 2), SO-8 and SOT23-6L.



### H6 series

ST\*N\*H6

- Very good RDS(on)
- Soft diode recovery
- Suited for OR-ing, square-wave HB, battery management

### F6 series

ST\*N\*F6

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

### F7 series

ST\*N\*F7

- Extremely low RDS(on)
- Optimized body diode (low Qrr) and intrinsic capacitance for an excellent switching performance
- Proper Crss/Ciss ratio for best-in-class EMI performance
- Outstanding performance for motor control and synchronous rectification



## MAIN APPLICATIONS



Small motor control and USB battery chargers

F6



HDD, power tools, STB, and game consoles

H6



Server/Telecoms and SMPS

F7



UPS, e-bikes, and fans

F6, F7



Solar inverters, forklifts, and EHV's

F7

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

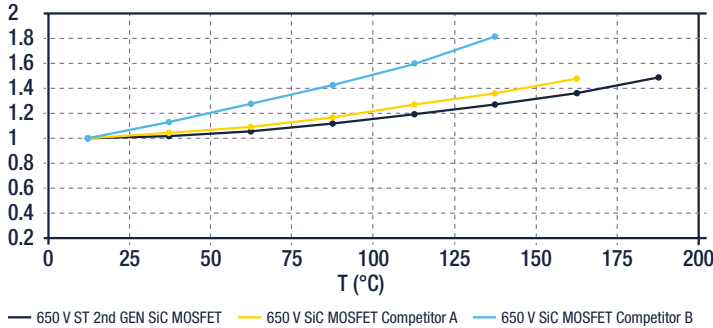
## SiC MOSFETs

Based on the advanced and innovative properties of wide bandgap materials, ST's **silicon carbide (SiC) MOSFETs** feature very low  $R_{DS(on)}$  per area for the new 650 V/1200 V Gen2 product families, combined with excellent switching performance, translating into more efficient and compact designs.

ST is among the first companies to produce high-voltage SiC MOSFETs. These new families feature 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.

ST's SiC Mosfet 650 V - Normalized  $R_{DS(on)}$  vs Temperature



### Sic mosfets, the real breakthrough in high voltage switching

SCT\*N120G2

SCT\*N65G2

SCT\*N170

- VBR = 1700 V (SCT\*N170), 1200 V (SCT\*N120G2), 650 V (SCT\*N65G2)
- 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\*N65G2)



### SIC MOSFETS MAIN BENEFITS

- Smaller form factor and higher power density
- Reduced size/cost of passive components
- Higher system efficiency
- Reduced cooling requirements and heatsink size

### THROUGH-HOLE EXTENDED PACKAGE RANGE

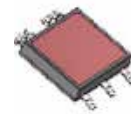


HiP247 LL™



HiP247-4L

### SURFACE MOUNT EXTENDED PACKAGE RANGE



ACEPACK™ SMIT



POWER FLAT 8x8

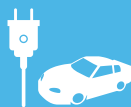


Bare die business available upon customer request

### MAIN APPLICATIONS



Motor drive & factory automation



HEVs / EVs  
(Traction Inverter, OBC, DC/DC)



Charging station



UPS & Data center  
Power supply



Solar inverters

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



## POWER MODULE – ACEPACK™ PACKAGES OPTIONS

ST’s ACEPACK power modules come with diverse topologies that address industrial applications such as motor drives, solar inverters, charging stations, UPS, welding tools and power converter solutions, while they are also suitable for electric vehicle power applications like on-board chargers (OBC), electric traction drives and power converter solutions.

These highly reliable and compact power modules, featuring an embedded NTC thermistor, offer the best compromise between conduction and switching losses, maximizing the efficiency of any converter system in hard-switching circuitries for an application range from few kW to hundreds of kW. For a flexible and stable mounting, PressFIT and additional soldered pin options are provided. These power modules implement power semiconductor switches based on ST’s state-of-the-art SiC MOSFET and IGBT technologies.

### ACEPACK 1

Up to 15 kW



### ACEPACK 2

Up to 30 kW



#### KEY FEATURES

- Very low Stray inductance
- 2.5 kVrms electrical isolation
- Pin out flexibility
- Custom configurations
- Optimized thermal behavior
- Different DBC Options (Al2O3–AlN)
- Press-fit and solder pin options

#### CONFIGURATIONS

- CIB
- Six-pack
- Three level Boost
- Four Pack
- Half Brige
- Customized configurations

### ACEPACK DRIVE

120 kW to 280 kW



#### KEY FEATURES

- AMB substrate for enhanced thermal dissipation
- 3 different bus bar configuration options
- Extremely low energies dissipation
- Direct Cooled Cu Base Plate with pin fins

#### CONFIGURATIONS

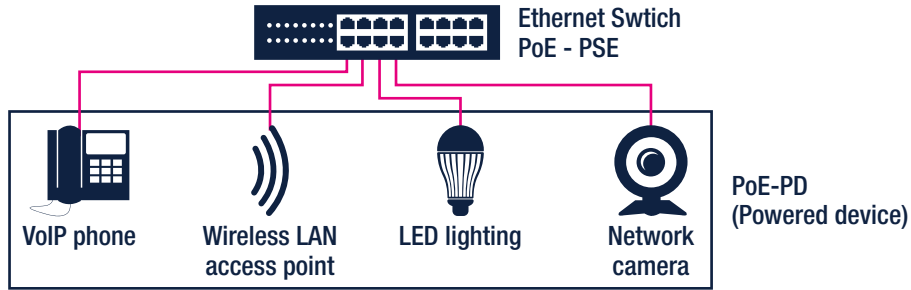
- Six-pack





## 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 802.3bt specification.



### 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

#### 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

#### PM8804

- PWM current mode controller
- Double Gate Driver
- Support Isolated Active Forward Converter
- Input voltage up to 75 VDC
- Embedded start-up (20 mA)
- Slope compensation
- Programmable fixed frequency (up to 1 MHz)

#### PM8805

- IEEE 802.3bt PoE-PD interface
- System in Package
- Dual Active bridges
- HotSwap MOSFET
- Compact package (10 times smaller than discrete BOM) with high thermal performances
- 100 W capability

### Main standards



### Power over Ethernet power supply protection

#### PEP01-5841

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

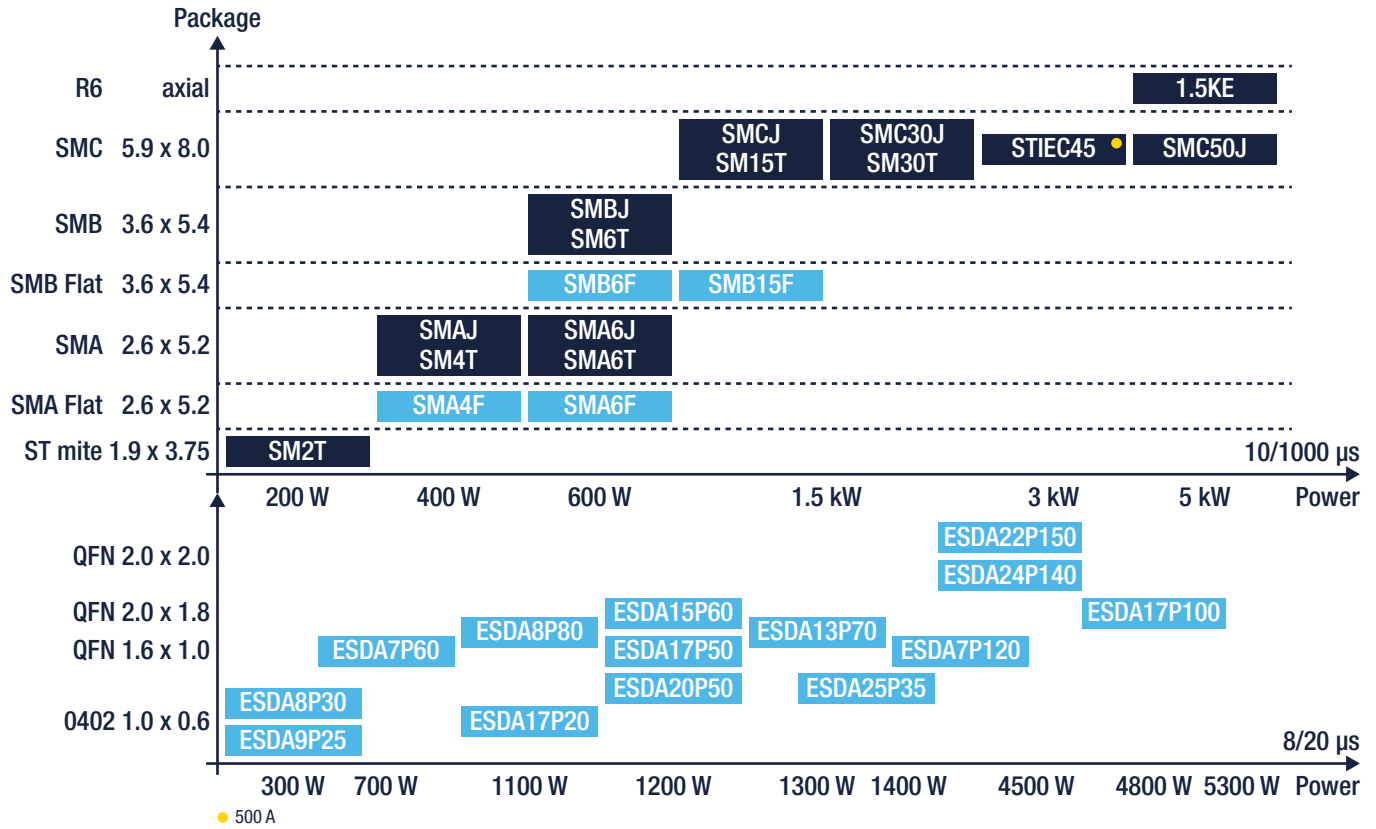
[www.st.com/PoE](http://www.st.com/PoE)

# PROTECTION DEVICES

## TVS

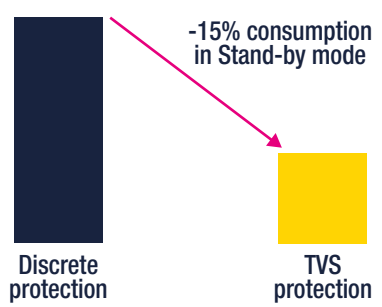
The **TVS Transient Voltage Suppressor** is an avalanche diode specially designed to clamp over voltages and dissipate high transient energy. TVS are power devices to protect applications against Electrical Over-Stress (EOS), specifically against surge events as defined by IEC 61000-4-5.

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

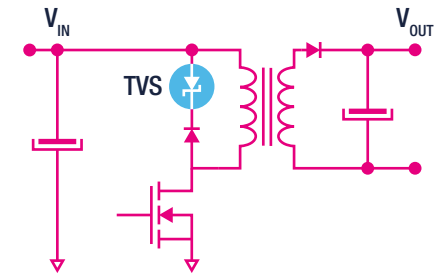


### TVS Transil series against repetitive overvoltage in high temperature conditions

- TVS**
- 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



### MOSFET Protection with TVS



#### MAIN APPLICATIONS

Adapters

Smart metering

Solar inverters

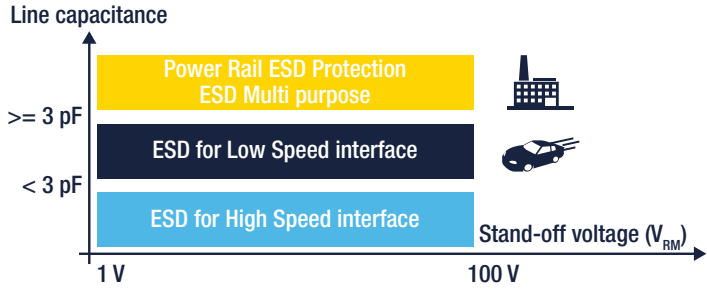
Residential, commercial, architectural and street lighting

[www.st.com/eos8-20-protection](http://www.st.com/eos8-20-protection)

## ESD protection

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

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



## Power delivery Protections

Ultimate TVS protection for USB fast-charging ports

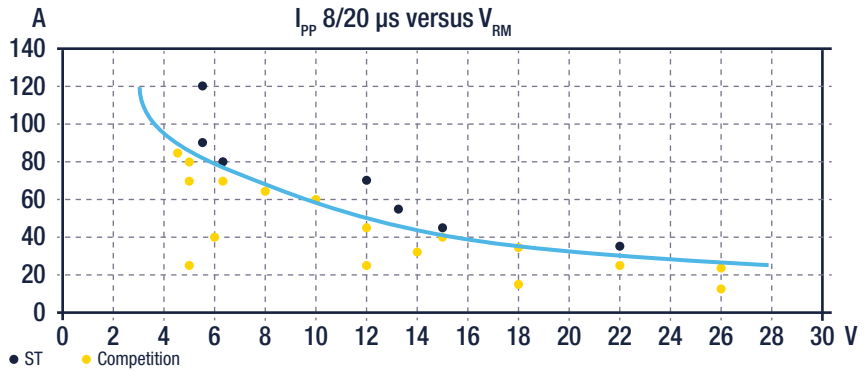
### ESDAxxP

Strong and thin protection, the ESDAxxP series helps to stop damages due to the surge events

### KEY FEATURES & BENEFITS

- Complete voltage range: 5 to 22 V
- High 8/20  $\mu$ s surge protection capability from 25 to 160 A peak pulse current
- 4 small, thin packages:
  - ST1610x (1.6 x 1.0 mm)
  - QFN (2.0 x 1.8 mm)
  - QFN (2.0 x 2.0 mm)
  - SOD882T (1.0 x 0.6 mm)
- High-power, miniature protection
- Saves PCB real-estate
- Highest peak pulse current in the market

## Peak pulse current performance



Type	STM32	5 V - 15 W	9 - 27 W	15 - 45 W	20 V - 100 W	
All	With or without STM32	D+/D-	ESDAXLC5-1U2			
		SSRx/SSTx	ESDZX051-1BF4/ESDZX031-1BF4*/ESDZX165-1BF4*/ESDZX051-2BU3			
		CC1/CC2	ESDZV5-1BF4	ESDALC14-1BF4	ESDZV18-1BF4	ESDZV201-1BF4 ESDL20-1BF4
		SBU1/SBU1	ESDA6V1L	ESDA14V2L	ESDA25L	ESDA25L
		Vbus	ESDA7P60-1U1M ESDA7P120-1U1M ESDA8P30-1T2 ESDA8P80-1U1M ESDA9P25-1T2 SMA4F6.0A	ESDA13P70-1U1M ESDA15P60-1U1M SMA4F10A	ESDA17P20-1F2 ESDA17P50-1U1M ESDA17P100-1U2M SMA4F18A	ESDA22P150-1U3M ESDA24P140-1U3M ESDA25P35-1U1M SMA4F22A
Sink	With STM32	TCPP01-M12 <sup>1</sup>				
Source		TCPP02-M18 <sup>1</sup>				
DRP		TCPP03-M20 <sup>1</sup>				

Note: 1 available in Q4 2021

## MAIN APPLICATIONS



Tablets, smartphones, and digital cameras



Healthcare



I/O microcontrollers and signal conditioning



Factory automation  
Human machine interface (HMI)



Smart metering

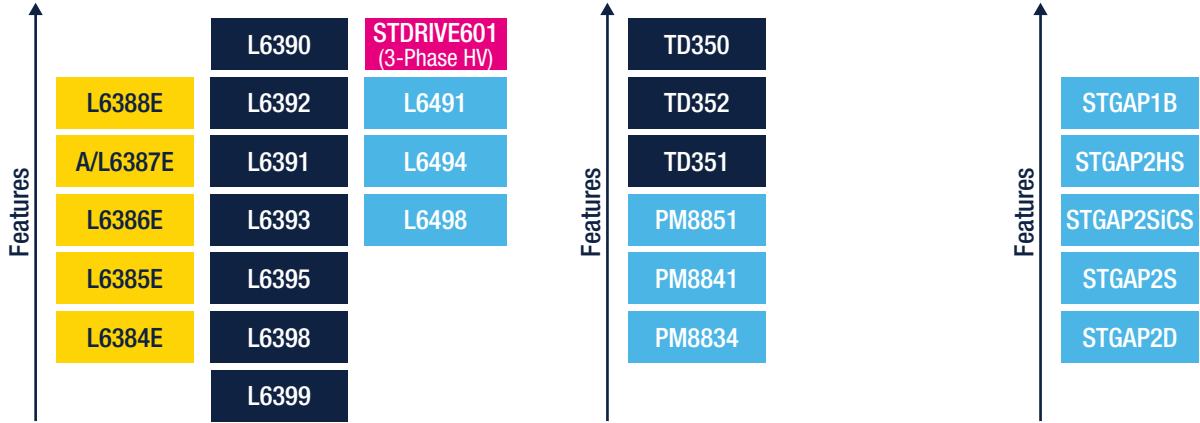
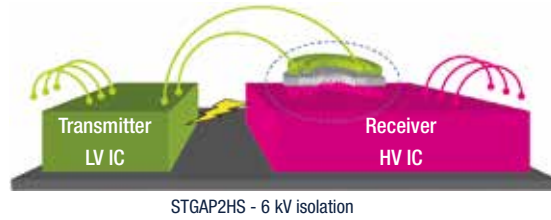


SIM cards, Ethernet, and HDMI/DVI ports

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

# STDRIVE MOSFET AND IGBT GATE DRIVERS

ST's **power MOSFET and IGBT gate drivers** include integrated high-voltage half-bridge, single and multiple low-voltage gate drivers. Robustness and reliability, system integration and flexibility: that's ST's gate driver offer to you. In particular the STDRIVE families L639\*, L649\* and STGAP series offer smart functionalities to protect and simplify application implementation and usage.



### 600 V gate drivers

Half bridge

- 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)
- Extended temperature range (A version)

3-Phase

- Best In Class for propagation delay 85 ns
- 200 mA/350 mA sink / source driver current capability
- Integrated bootstrap diode

### Low side gate drivers

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



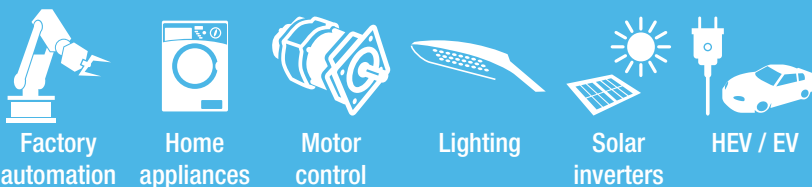
### Galvanically-isolated single and dual gate drivers

- Up to 6 kV isolation (STGAP2HS)
- High voltage rail up to 1.7 kV
- Up to 5 A source/sink driver current capability
- 2 Level turn-off (STGAP1B)
- Miller clamp, negative gate supply
- Optimized for SiC MOSFET driving (STGAP2SiCS)

### STDRIVEG600 - High voltage half-bridge gate driver for GaN transistors

- dV/dt immunity ±200 V/ns
- Driver current capability:
  - 1.3/2.4 A source/sink typ @ 25 °C, 6 V
  - 5.5/6 A source/sink typ @ 25 °C, 15 V
- Separated turn on and turn off gate driver pins
- 45 ns propagation delay with tight matching
- 3.3 V, 5 V TTL/CMOS inputs with hysteresis
- Interlocking function
- UVLO on low-side and high-side sections

### MAIN APPLICATIONS



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



# THYRISTORS

Available in through-hole and surface-mount packages, ST's **high-temperature Silicon Controlled Rectifiers SCR** provide designers with more headroom for heatsink reduction or more compactness. In addition, the voltage surge immunity is fully specified at 150 °C, ensuring designs are precise and secure. These 12 to 80 A SCRs are ideal for use in charging stations, solid-state relays, inrush current limiters, motor starters, SMPS, UPS, and renewable-energy junction boxes. The 1200 V automotive-grade thyristor makes AC/DC converters safe by limiting the inrush current and providing insulation against AC line over-voltages.



**Automotive Grade SCR AECQ101 qualified**

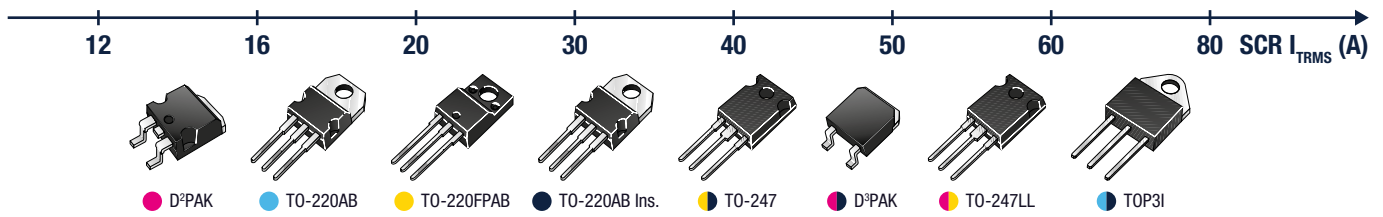
<b>TN3050H-12</b> 30 A, 1200 V	<b>TN4050H-12</b> 40 A, 1200 V	<b>TN6050HP-12</b> 60 A, 1200 V
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**Medium Power SCR**

<b>TN4050-12</b> 50 A, 1200 V	<b>TN6050-12</b> 50 A, 1200 V	<b>TM8050H-8</b> 80 A, 800 V
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**High Temperature SCR**

<b>TN1205H-6</b> 12 A, 600 V	<b>TN1605H-6</b> <b>TN1610H-6</b> 12 A, 600 V	<b>TN2010H-6</b> <b>TN2015H-6</b> 20 A, 600 V	<b>TN3015H-6</b> 30 A, 600 V	<b>TN4015H-6</b> 40 A, 600 V	<b>TN5015H-6</b> 50 A, 600 V
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## MAIN APPLICATIONS



AC/DC Conversion SMPS & PSU



UPS



EV on-board charger



Motor Control

**T-series TRIACs** 6-25 A are becoming an all-load device with its 800 V capability. EMC immunity and commutation are twice those of standard devices leading to not only the capability of a larger range of acceptable resistive, inductive loads or complex ones. The new 2500 V RMS insulated packages in TO-220 Ins ceramic insulator version of the T-series or D<sup>2</sup>PAK SMD adapt to high thermal performance or automated manufacture design.

Part number	Package					$I_T$ (RMS) max. (A)	$V_{DRM}/V_{RRM}$ (V)	$V_{DRM}/V_{RRM}$ max. (V)	$I_{GT}$ max. (mA)	$I_{TSM}$ max. (A)	dV/dt @ Tj 150 °C min. (V/μs)	(di/dt)c @ Tj 150 °C min. (A/ms)
	TO-220AB	TO-220AB Ins.	TO-220FPAB	I <sup>2</sup> PAK	D <sup>2</sup> PAK							
T635T-8	T		FP			6	150	800	35	45	1000	3 <sup>2</sup>
T835T-8	T	I	FP		G	8				60		4 <sup>2</sup>
T1235T-8	T	I	FP	R	G	12				90		8 <sup>2</sup>
T1635T-8	T	I	FP		G	16				120		12 <sup>2</sup>
T2035T-8					G	20				160		21 <sup>2</sup>
T2535T-8	T	I			G	25				200		18 <sup>2</sup>

Optimized for Industrial, Building and Residential appliances and based on ST's new high temperature technology, our 800 V **8H Triacs** can work at 150 °C without compromise. Enabling designers to maximize current density or reduce the heatsink size by up to 50%, these triacs are the right choice to run in very hot, confined environments and improve the reliability of systems such as light control, compact heater, starter or solid-state relay.

Part number	Package			$I_T$ (RMS) A max	T <sub>j</sub> °C max	$V_{DRM}/V_{RRM}$ V max	$I_{GT}$ mA max	$I_{TSM}$ A max	dV/dt V/μs @ 150 °C min	(di/dt)c A/ms @ 10 V/μs, @ 150 °C min
	TO-220AB	TO-220AB Ins.	D <sup>2</sup> PAK							
T835H-8	T	I	G	8	150	800	35	80	2000	8
T1235H-8	T	I	G	12				120		12
T1635H-8	T	I	G	16				160		16
T2035H-8	T		G	20				200		20
T3035H-8	T	I	G	30				270		25

## MAIN APPLICATIONS



Home appliances



Air conditioning



Lighting



Heating

# USB TYPE-C™ AND POWER DELIVERY CONTROLLERS

With an extensive technology and IPs portfolio, ST provide a range of **USB-IF certified solutions for USB type-C and Power Delivery** to support implementations in a variety of sink, source and dual role devices. From USB-Type-C interfaces and PD Controllers to Authentication, ST complements the portfolio with Power Management ICs, full range of **protection** for data and power lines protection. ST's solutions cover from **Type-C port interface ICs to USB PD controllers**, and offer, a wide flexibility with hard wired and MCU to fit different use cases and every power ratings.

## Standalone solutions

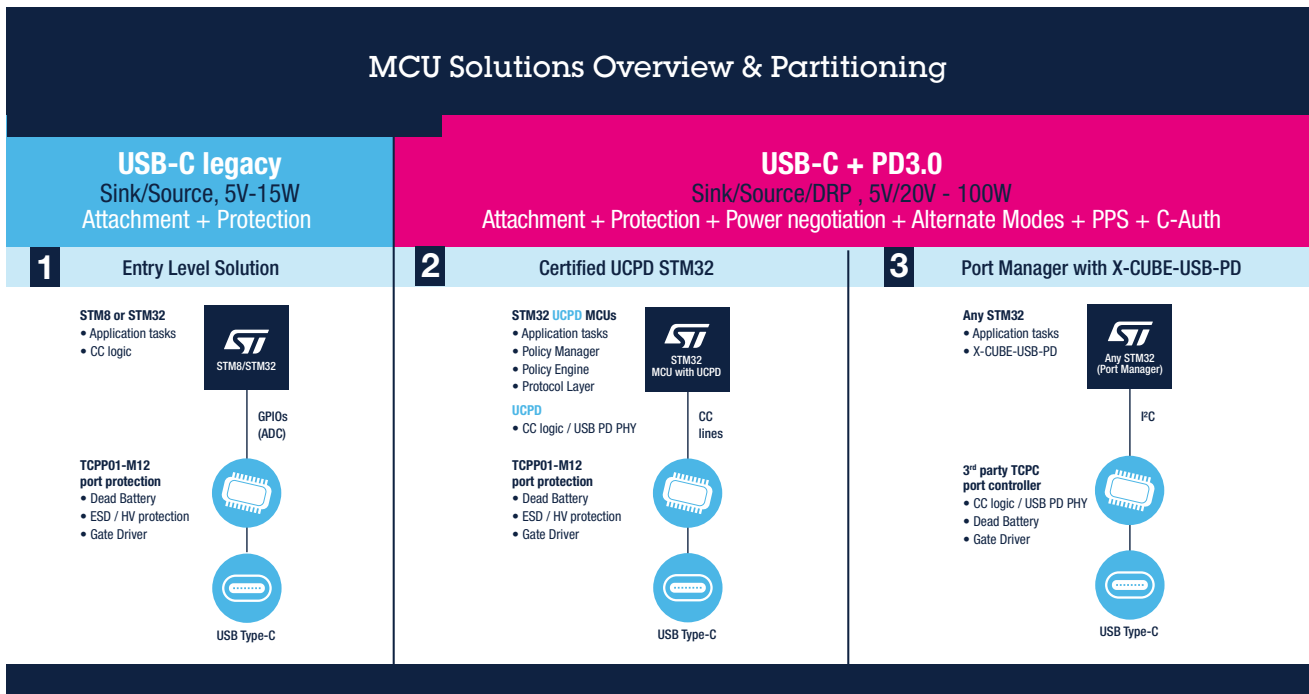
STUSB Controllers cover power path applications with optimized partitioning from USB Type-C™ Interface for 15 W device to Power delivery PHY and BMC Driver ICs companion chip of STM32 based solution to standalone Full Hardware USB PD Controller optimized for AC adapters up to 100 W.

## MCU based solutions

Our STM32 solutions will help you to manage the complexity of implementing USB Type-C™ and Power Delivery technology ensuring that your embedded application supports the latest use cases. ST ecosystem for USB Type-C™ reduces the acquisition cost of a technology that requires expertise in different areas such as connectivity, power management, data communication and authentication.

Combining middleware, configuration and debugging tools, as well as hardware development platforms, our MCU-based solutions are specifically designed to address this challenge and offer great flexibility to implement USB Type-C™ and Power Delivery (PD).

A companion Type-C Port Protection device **TCPP01-M12** is proposed for advanced protection of the USB-C connector line in sink applications, such as CC and Vbus line. For source applications like power adapters, TCPP02-M18 is recommended (mass-production Q4-2020). For Dual Role Port applications (DRP), TCPP03-M20 is recommended (mass-production Q4-2020).





## STM32 USB PD3.0 controllers

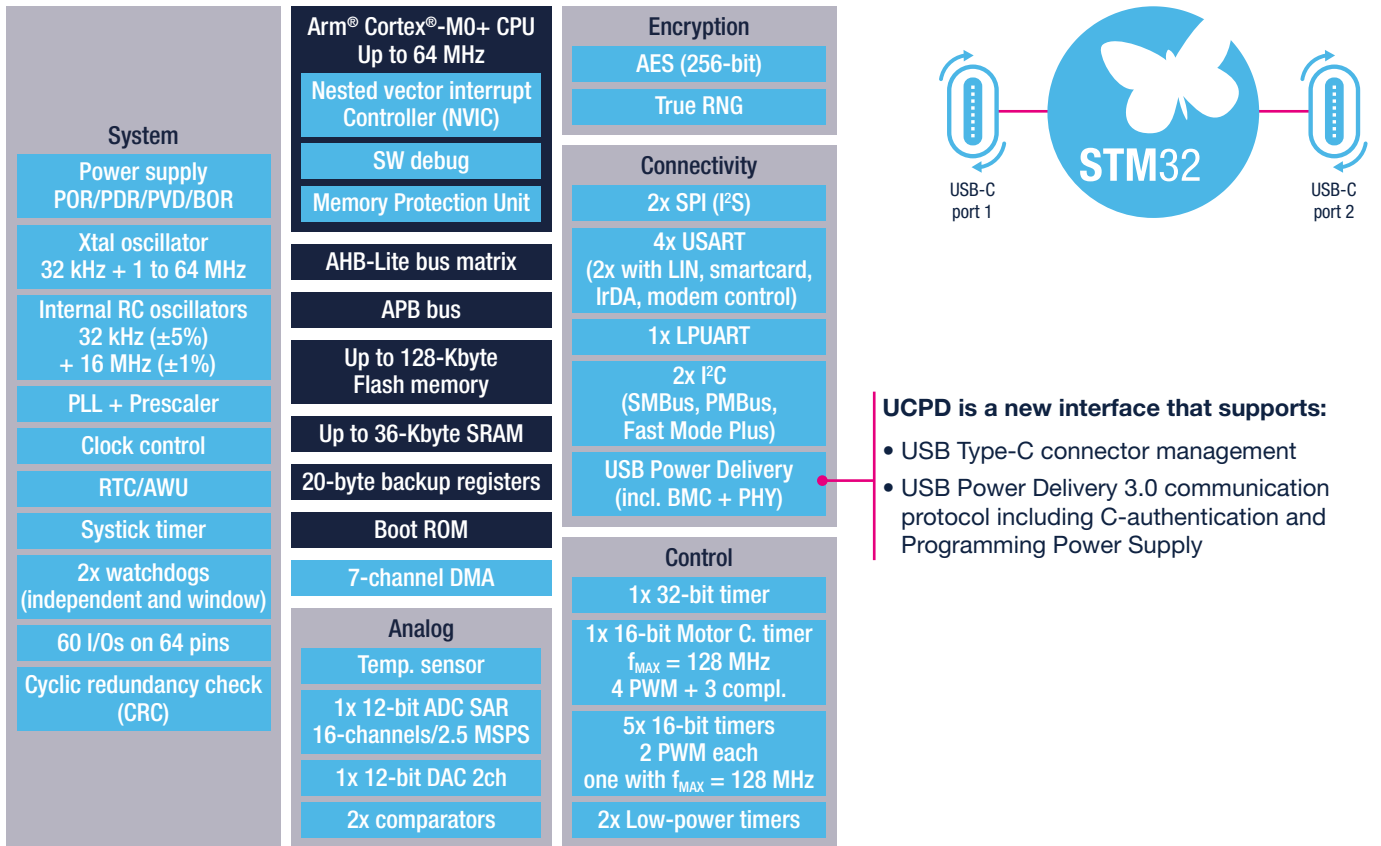
Introduced in December 2017, **STM32G0** is the world's 1st standard USB PD 3.0 microcontroller with a UCPD interface (UCPD stands for USB-Type-C and Power Delivery).

This new IP, available in **STM32G0/G4/L5 series**, allows to develop USB-C sink, source and dual role devices in a wide range of embedded applications.

UCPD enabled STM32G0/G4/L5 provides a high flexibility to migrate embedded applications to USB-C and Power Delivery technology while managing other application environment thanks to the versatile feature set and peripherals available in a traditional MCU. UCPD is certified PD3.0 and support all new features such as C-Authentication and Programming Power Supply (PPS).

[https://www.st.com/content/st\\_com/en/stm32-usb-c.html](https://www.st.com/content/st_com/en/stm32-usb-c.html)

### STM32G081 block diagram



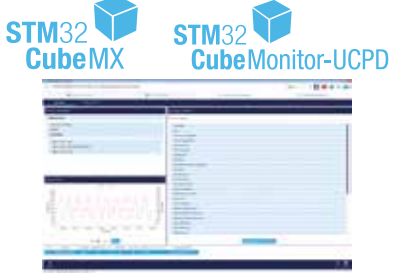


### STM32G0 USB-C Ecosystem: for short time-to-market

Our STM32G071B-DISCO kit allows to discover and display USB-C power and feature capabilities of any USB-C compliant host. Associated with our professional-grade STM32CubeMonitor-UCPD software GUI, the kit acts as a USB PD analyzer and allows customer to debug, configure and inject in one click USB PD3.0 packets while monitoring Vbus voltage and Ibus current between two USB-C devices.

Our well-known STM32 configurator STM32CubeMx supports easy setting of UCPD.

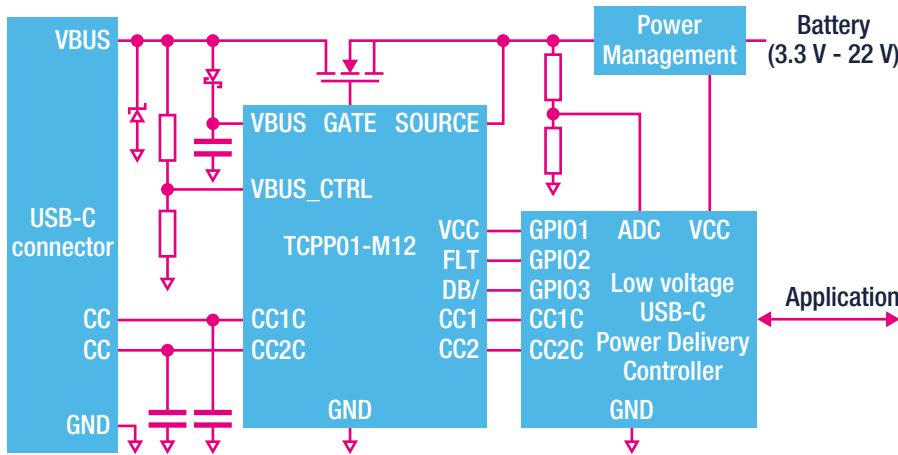
An evaluation board STM32G081B-eval is proposed with two USB-C ports offering 45 W of power with different profiles.

<b>Discover and learn</b>	<b>Develop</b>	<b>Configure &amp; Debug</b>
 STM32G071B-DISCO	 NUCLEO-G071RB STM32G081B-EVAL	 STM32CubeMX STM32CubeMonitor-UCPD

## Type-C Port Protection

### TCPP01-M12

The **TCPP01-M12** (type-C port protection) is a single chip solution for USB type-C port protection that facilitates the migration from USB legacy connectors type-A or type-B to USB type-C connectors. The TCPP01-M12 features 22 V tolerant ESD protection as per IEC61000-4-2 Level 4 on USB type-C connector communication channel (CC) and VBUS lines. To allow fast certification for USB power delivery, the TCPP01-M12 provides overvoltage protection on CC1 and CC2 pins when these pins are subjected to short circuit with the VBUS pin that may happen when removing the USB type-C cable from its receptacle. For sink applications, TCPP01-M12 triggers an externally programmable N-MOSFET overvoltage protection on VBUS pin when a defective power source applies a voltage higher than selected OVP threshold. Also, the TCPP01-M12 integrates a “dead battery” management logic that is compliant with the USB power delivery specification. The VBUS N-MOSFET load driver can also be used in source applications.



### KEY FEATURES

- ESD protection for CC1, CC2 and VBUS
- Compliant with IEC 61000-4-2 Level 4 ( $\pm 8$  kV contact discharge,  $\pm 15$  kV air discharge)
- Over Voltage Protection on CC lines against short-to-VBUS overvoltage
- Externally programmable Over Voltage Protection on VBUS line
- Integrated VBUS gate driver for external N-MOSFET
- Over Temperature Protection
- Integrated “Dead Battery” management
- Open-drain fault reporting
- Operating junction temperature from  $-40$  °C to  $85$  °C
- ECOPACK®2 compliant

### TCPP03-M20

DRD or DRP applications require careful protection implementation both on the sink power path and the source power path to safely comply with the USB-C Power Delivery specification. **TCPP03-M20** is an MCU companion chip enabling cost-effective USB-C power delivery DRD/DRP implementation. It provides protections and functionalities to safely comply with the USB-C Power Delivery specification.

The device drives external N-MOSFETs on VBUS connector pin in the source and sink power path for over voltage and over current protection. It provides an analog current sense output accessible for an MCU ADC, thus minimizing system cost.

**TCPP03-M20** helps to minimize power consumption during DRP toggling states thanks to its three programmable power modes allowing a power consumption as low as  $3 \mu\text{A}$  maximum, up to  $125$  °C and thanks to enable pin that wake up the MCU.

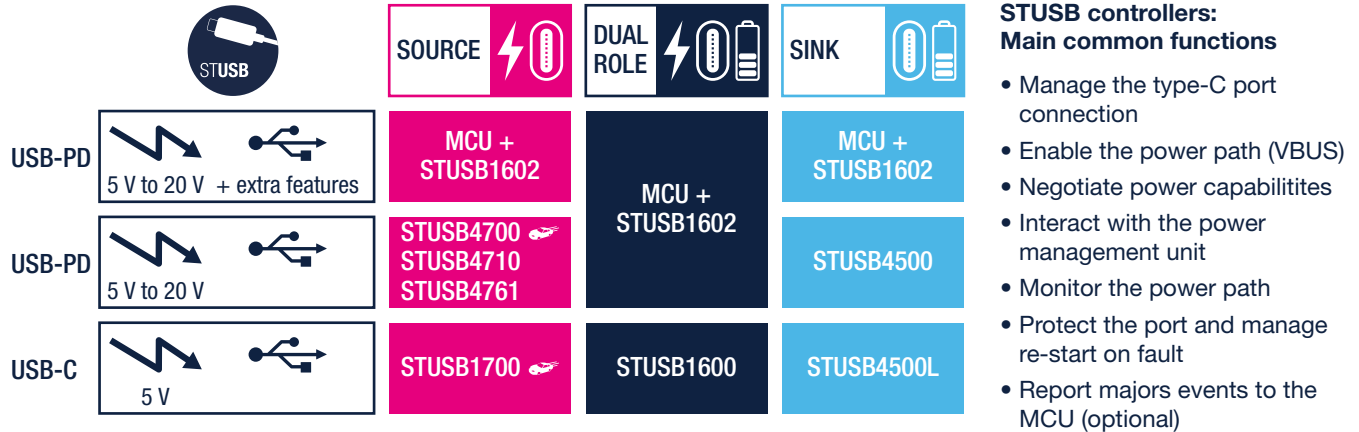
### KEY FEATURES

- Externally programmable VBUS OVP (over voltage protection) and OCP (over current protection) for provider and consumer power paths with fast turn-off
- Two integrated N-MOSFETs gate drivers for VBUS OVP and OCP
- Very low power in “unattached” state during DRP toggling:  $3 \mu\text{A}$  max. at  $125$  °C
- Compliant with PPS (programmable power supply) for fast charging, up to  $100$  W
- Integrated discharge on VBUS and VCONN
- Current sense on VBUS with analog output
- ESD protection for CC1, CC2, compliant with IEC 61000-4-2 Level 4 ( $\pm 8$  kV contact discharge,  $\pm 15$  kV air discharge)
- VCONN OCP and OVP
- Over voltage protection on CC lines against short-to-VBUS
- Over temperature protection ( $150$  °C typ.)



## STUSB family of standalone (auto-run) USB-C and Power Delivery controllers

Being designed with ST's 20 V process technology, **STUSB family** is natively compliant with USB PD electrical requirements. STUSB controller ICs are certified and integrate the mandatory protection and application features for autonomous port management, without the need for external circuitry. STUSB controllers are optimized for power path applications ranging from 15W to 100W, on both SINK and SOURCE sides. Being hardwired, STUSB controllers are fast and predictive to guarantee safety and interoperability while increasing port robustness and minimizing power consumption. Implementation is fast and easy and requires no deep know how of the USB PD standard or advanced software skills. Standalone controllers are powered from VBUS to minimize BOM cost and can fully operate without external MCU support. For more flexibility, an MCU can optionally change main power parameters or read port status, with light software layer.



### STUSB controllers: Main common functions

- Manage the type-C port connection
- Enable the power path (VBUS)
- Negotiate power capabilities
- Interact with the power management unit
- Monitor the power path
- Protect the port and manage re-start on fault
- Report majors events to the MCU (optional)

#### STUSB47xx

- USB PD SOURCE
- Up to 5 programmable PDOs
- Full hardware solution - no software
- Internal and/or external VBUS
- discharge path
- Very low power consumption
- E-marked cable identification (for >3 A support)
- Over-temperature protection

#### STUSB1700

- USB-C 5V SOURCE
- High Voltage protections
- GPIO-controlled current profile (Power sharing, Thermal protection)
- VBUS powered (no LDO needed)
- AEC-Q100 available

#### STUSB1602

- USB PD SOURCE/SINK/DUAL ROLE
- Perfect MCU companion chip ensuring port protection, power path monitoring and management, role advertisement and detection, PD PHY communication
- Ready-to-use software frameworks for fast prototyping of most common application scenario such as: basic source, sink, DRP, dual port, but also more complex use cases, which include optional features of PD3.0, vendor defined, battery or extended messages.
- MCU supported:
  - STSW-STUSB010: STM32F072
  - STSW-STUSB012: STM32F446
  - STSW-STUSB014: STM32G474
  - STSW-STUSB015: STM32L4R5

#### STUSB1600

- USB-C 5V SOURCE/SINK/DUAL ROLE
- High Voltage protections
- Integrated VBUS discharge
- Dead battery support
- Optional interface to MCU (I<sup>2</sup>C + IRQ)

#### STUSB4500

- USB PD SINK
- Dead Battery support
- VBUS powered (ZERO power on VBAT)
- Input Over Voltage protection
- QFN and CSP package available
- SOURCE power profile reporting
- STSW-STUSB002: GUI
- STSW-STUSB003: optional open source software drivers for dynamic power Management
- Mini-dongle: EVAL-SCS001V1

#### STUSB4500L

- USB-C 5V SINK
- Dead battery support
- VBUS powered (ZERO power on VBAT)
- Input Over Voltage protection
- SOURCE power budget reporting
- QFN and CSP package available
- Mini-dongle: EVAL-SCS002V1

# life.augmented



Order code: BRPMGUIDE1021

For more information on ST products and solutions, visit [www.st.com](http://www.st.com)

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