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Power management
Guide 2019

Content

Introduction

More than 25 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 MOSFETs, IGBTs and customized power modules, diodes and protection devices, AC-DC converters and controllers, DC-DC converters, linear voltage regulators and analog ICs, battery management ICs, digital controllers and STM32 microcontrollers, MOSFET and IGBT gate drivers. Moreover, ST offers a variety of high performance sensors as well as wireless and wired connectivity ICs 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 HEMT (High Electron Mobility Transistor) 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

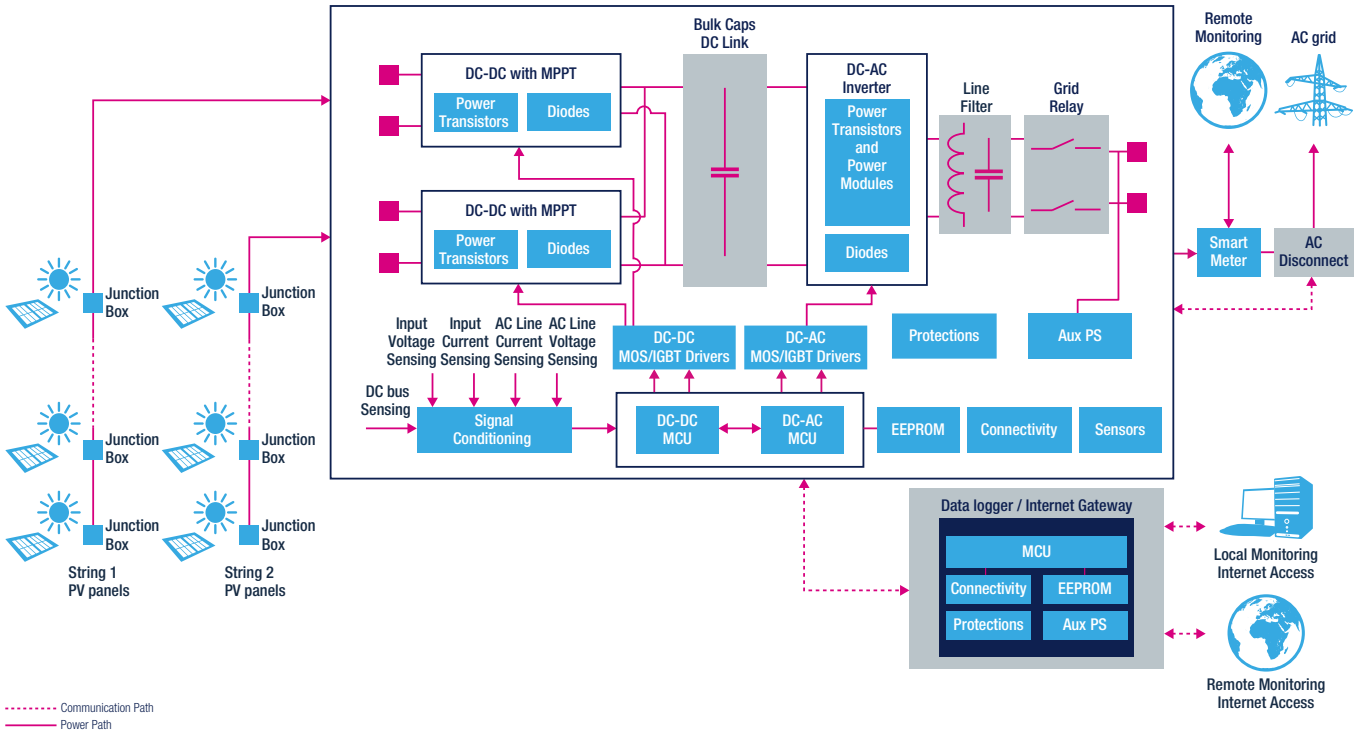
ENERGY GENERATION AND DISTRIBUTION

Solar Centralized Generation - Solar Inverters (String and Central)

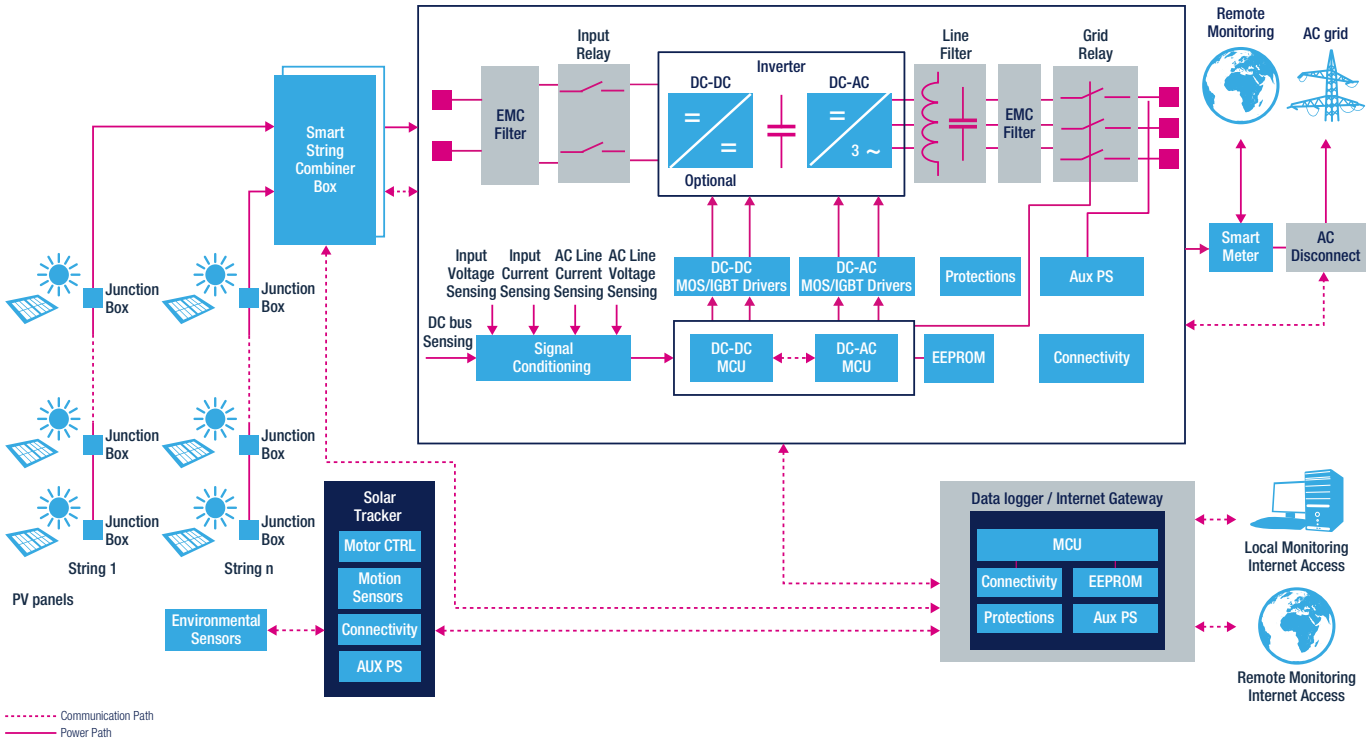
String and central inverter are the most common power conversion systems used for grid-connected solar applications. They comprise a DC-DC conversion stage, to adapt voltage levels and implement the Maximum Power Point tracking (MPPT) function to maximize energy transfer from the panel, and a DC-AC conversion 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 MOSFFETs	IGBTs	Power Modules	Diodes
Inverter Power Stage	600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V MDmesh DM6 ST*60DM6 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	600 V Ultrafast STTH*06 STTH*R06 1200 V Ultrafast STTH*12 SiC Diodes STPSC*065 STPSC*12
	MCUs	**MOSFET and IGBT Gate Drivers**	**Protections**	**Connectivity**
Inverter Driving & Control stage	STM32F334 STM32F1 STM32F3 STM32F4 STM32F7 STM32H7 STM32G4	HV HB Gate Drivers L649* Isolated Gate Drivers STGAP* Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1	TVS for power rail surge protection SMA6F, SMB15F series	Bluetooth Low Energy Power Line Transceivers Ethernet Transceivers USB
	MCUs	**EEPROM**	**Protections**	**Connectivity**
Data Logger/Internet Gateway	STM32F0 STM32G0 STM32F1 STM32F3	Standard Serial EEPROM	ESD and High Speed Port (HSP) series for Ethernet and USB protection	Bluetooth Low Energy Power Line Transceivers Ethernet Transceivers USB
	Motor CTRL	**Motion Sensors**	**Enviromental Sensors**	**Connectivity**
Solar Tracker	3-phase Field Oriented Control (FOC)	Accelerometer IIS3DHHC, LIS2DW12, IIS2DH Magnetometer-IIS2MDC eCompass-ISM303DAC 6 axis IMU-ISM330DLC	Pressure - LPS22HB Temperature - STLM20 Temperature - STTS751 Humidity - HTS221	Bluetooth Low Energy USB

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

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. In a micro inverter there is 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 micro inverters in the installation are collected by a concentrator and dispatched to a local or remote monitoring and control access point.

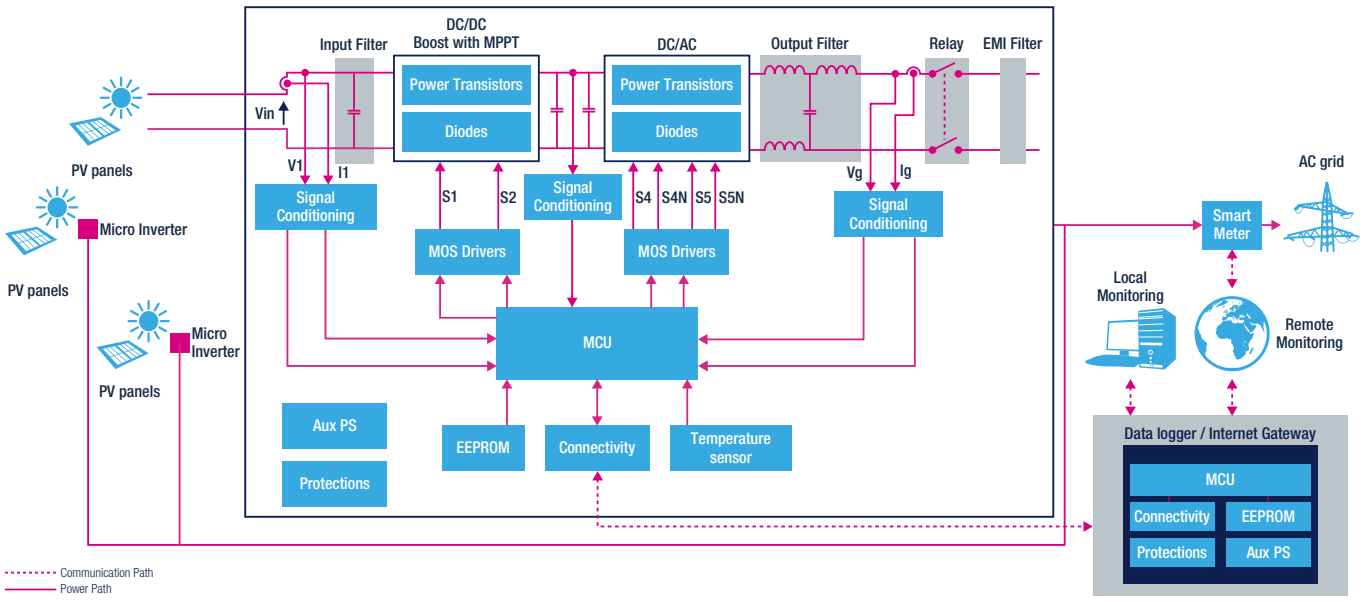
Our solution includes MDmesh and STripFET power MOSFETs, high-voltage, galvanically isolated gate drivers, high-voltage silicon-carbide (SiC) diodes together with high-performance STM32 microcontrollers - providing a set of dedicated peripherals to help implement complex power conversion control algorithms.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

ST'S PRODUCT OFFERING FOR MICROINVERTER

	Power MOSFFETs	Diodes	Protections	Signal Conditioning
Microinverter Power Stage	80 V-100 V STripFET F7 ST*N8F7, ST*N10F7 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 800 V-900 V MDmesh K5 ST*80K5, ST*90K5 SiC MOSFET SCT*N65G2	600 V Ultrafast STTH*R06 1200 V Ultrafast STTH*S12 SiC Diodes STPSC*065 STPSC*12	TVS for power rail surge protection SMA6F, SMB15F series	Precision Op Amps (<50 MHz) TS*, TSV*, LMV* Current Sensing TSC*
	MCUs	**MOSFET and IGBT Gate Drivers**	**Sensors**	**Connectivity**
Microinverter Driving & Control stage	STM32F334 STM32F1 STM32F3 STM32F4 STM32F7 STM32H7 STM32G4	HV HB Gate Drivers L649* Isolated Gate Drivers STGAP* Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1	Temperature - STLM20 Temperature - STTS751 Temperature - LM135 **Protections** ESD and High Speed Port (HSP) series for Ethernet and USB protection	Bluetooth Low Energy Power Line Transceivers Ethernet Transceivers USB **EEPROM** Standard Serial EEPROM
	MCUs	**EEPROM**	**Protections**	**Connectivity**
Data Logger/Internet Gateway	STM32F0 STM32G0	Standard Serial EEPROM	ESD and High Speed Port (HSP) series for Dataline ESD and EOS protection	RS232, RS485 Power Line Transceivers Ethernet Transceivers USB

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

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 each photovoltaic panel so they all operate at their maximum power point. 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.

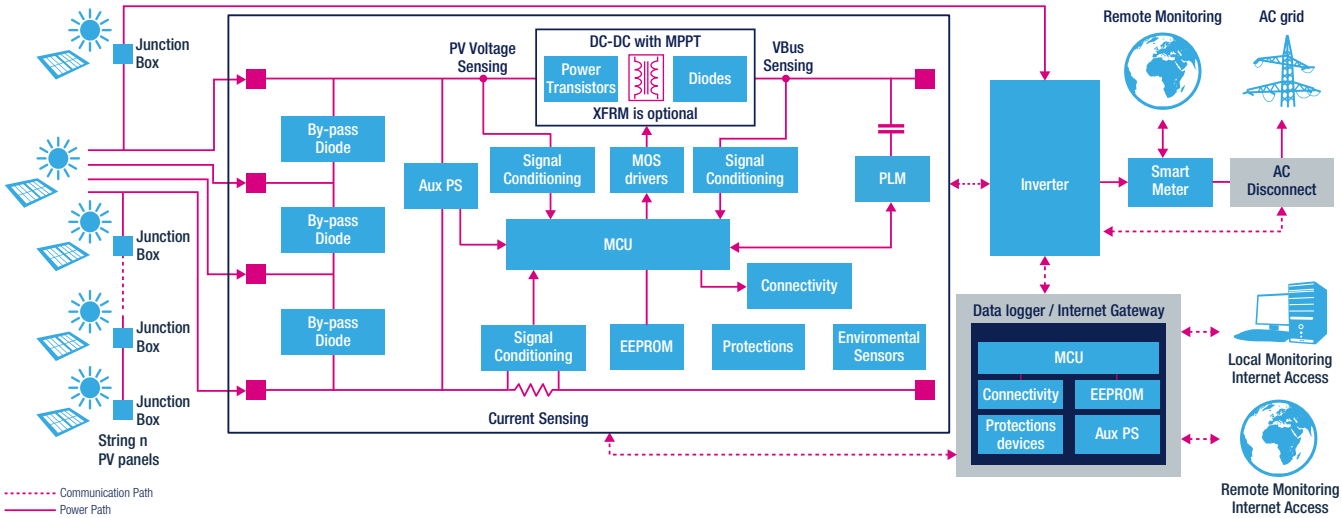
We provide high-performance STM32 microcontrollers as well as high-efficiency STripFET F7 MOSFTEs, Diodes, SiC MOSFETs and trench-gate field-stop IGBTs,field-stop IGBTs, galvanically-isolated gate drivers and power line communication solutions to help achieve superior efficiency and reliability for the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

ST'S PRODUCT OFFERING FOR POWER OPTIMIZER

	MCUs	Power MOSFETs	Gate Drivers	By Pass Diodes	Diodes	Protections	Connectivity
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 rail surge protection SMA6F, SMB15F series	Bluetooth Low Energy Power Line Transceivers **Signal Conditioning** Precision Op Amps (<50 MHz) TS*, TSV*, LMV* Current Sensing TSC*
	MCUs	**Power MOSFETs**		**IGBTs**	**Diodes**	**Protections**	**Connectivity**
Inverter	STM32F334 STM32F1 STM32F3 STM32F4 STM32F7 STM32H7 STM32G4	SiC MOSFETs SCT*N120 SCT*N120G2	Isolated Gate Drivers STGAP* Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1	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	600 V Ultrafast STTH*06 STTH*R06 SiC Diodes STPSC*065 STPSC*12	TVS for power rail surge protection SMA6F, SMB15F series ESD and High Speed Port (HSP) series for Ethernet and USB protection	Bluetooth Low Energy Power Line Transceivers Ethernet Transceivers USB
	MCUs	**EEPROM**				**Protections**	**Connectivity**
Data Logger/ Internet Gateway	STM32F0 STM32G0	Standard Serial EEPROM				ESD and High Speed Port (HSP) series for Dataline ESD and EOS protection	Bluetooth Low Energy Power Line Transceivers USB

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

Typical Block Diagram



Energy Distribution - Home & Commercial Battery Storage Systems

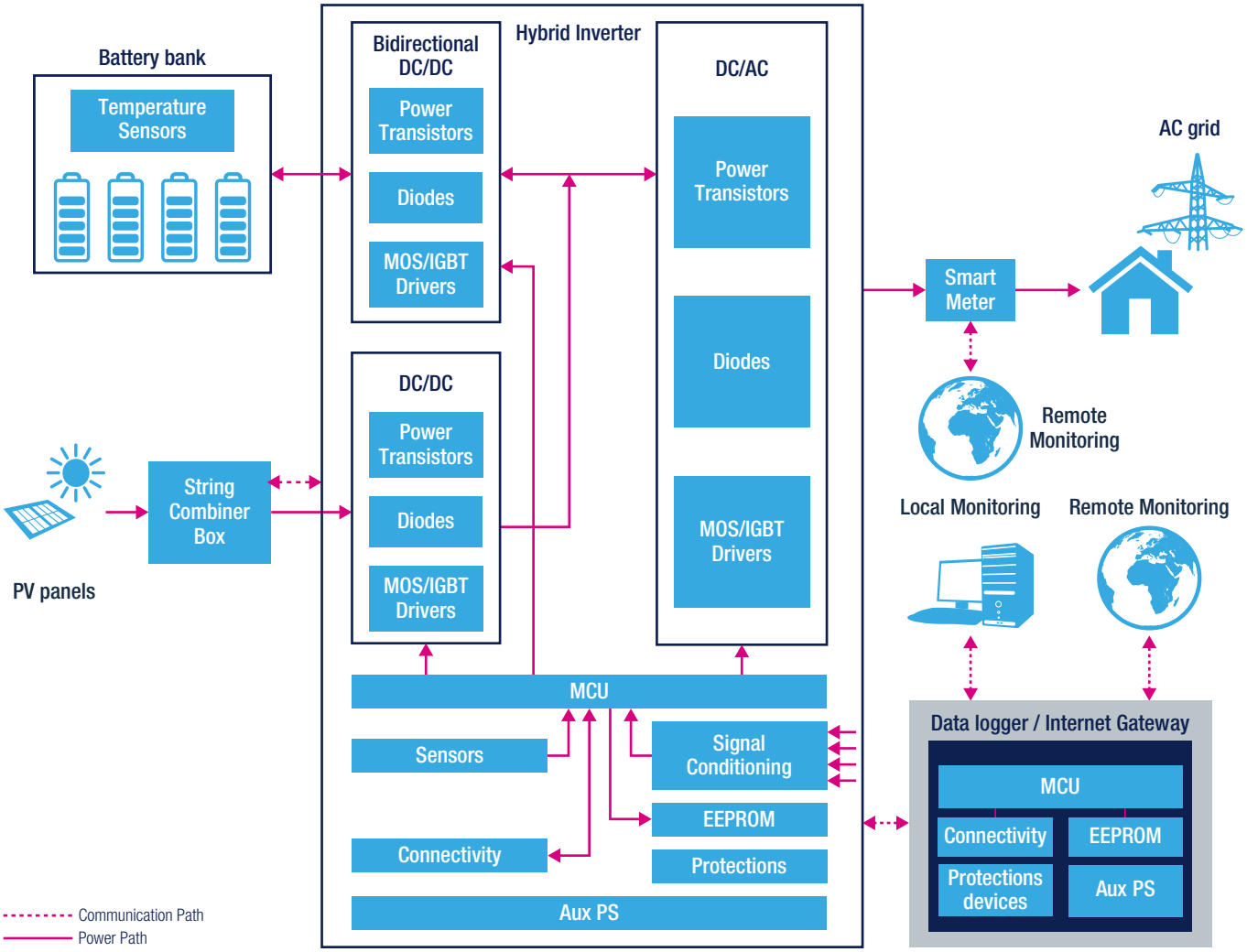
The adoption of energy storage devices, whose reserve capacity can be used for balancing purposes, peak-load shaving or to shift loads, is increasingly widespread in energy distribution networks.

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).

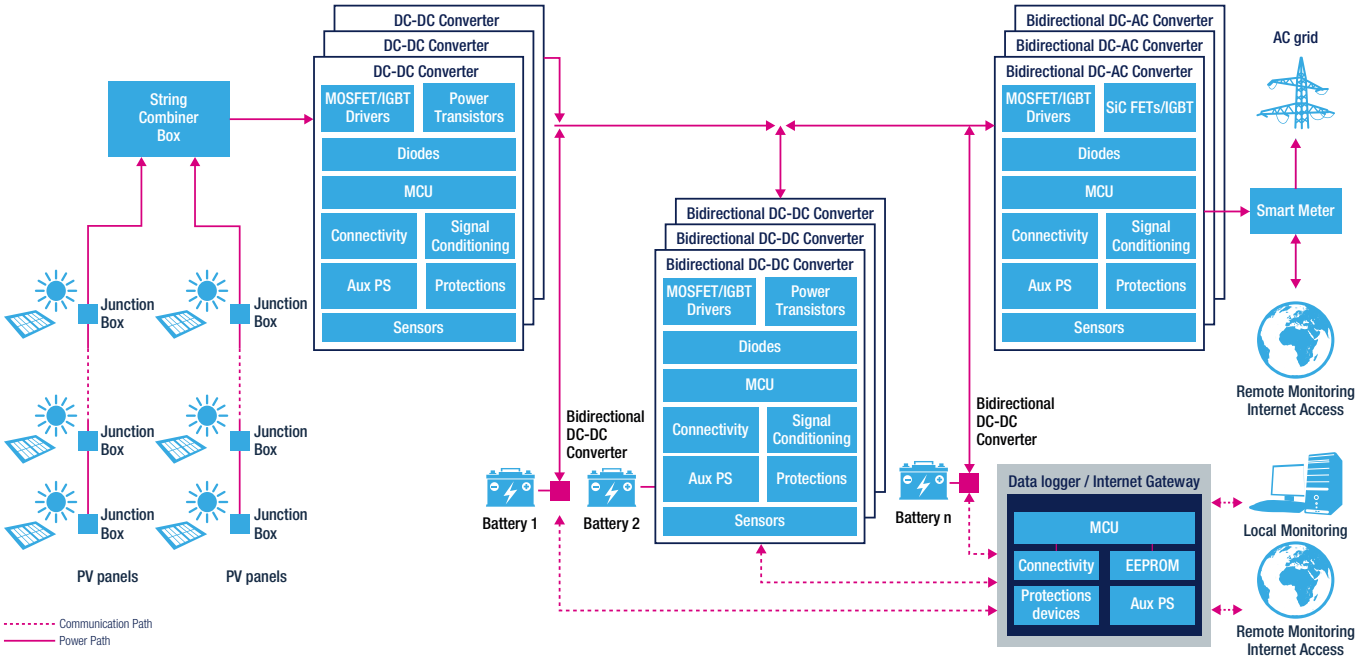
Interacting with the grid, the batteries and potentially with solar panels, the power converters at the heart of these systems must operate with high-efficiency and superior reliability over time.

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	Diodes	MOSFET and IGBT Gate Drivers	Protections
DC-DC Converter & Bidirectional DC-DC Converter **Power Stage**	40 V-100 V STripFET F7[1] ST*N4F7, ST*N6F7, ST*N8F7, ST*N10F7 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 MDmesh DM6 ST*60DM6 800 V to 1200 V MDmesh K5 ST*80K5, ST*9*K5 ST*105K5, ST*120K5 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	600 V Ultrafast STTH*06 STTH*R06 800 V to 1200 V Ultrafast STTH*08 STTH*10 STTH*12 SiC Diodes STPSC*065 STPSC*12	HV HB Gate Drivers L649* Isolated Gate Drivers STGAP* Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1	TVS for power rail surge protection SMA6F, SMB15F series ESD and High Speed Port (HSP) series for Ethernet and USB protection
	MCUs	**Signal Conditioning**	**EEPROM**	**Sensors**	**Connectivity**
System **Control Stage**	STM32F334 STM32F1 STM32F3 STM32F4 STM32G4	Precision Op Amps (<50 MHz) TS*, TSV*, LMV* Current Sensing TSC*	Standard Serial EEPROM	Temperature STLM20 STTS751 LM135Z	RS485-RS232 Interfaces Power Line Transceivers Ethernet Transceivers USB
	MCUs	**Protections**	**EEPROM**	**Connectivity**	
Data Logger/ Internet Gateway	STM32F0 STM32G0 STM32F1 STM32F3	ESD and High Speed Port (HSP) series for Dataline ESD and EOS protection	Standard Serial EEPROM	RS485-RS232 Interfaces Power Line Transceivers Bluetooth Low Energy Ethernet Transceivers USB RF SuBGHz Transceivers[2] (including SigFox & LoRA)	

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

POWER SUPPLIES

Auxiliary SMPS

Many appliances and equipment require the availability of an auxiliary power source (SMPS) that works separately from the main power supply to support, for instance, stand-by operation. Power ratings can vary from a few to a few 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 quasi-resonant 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.

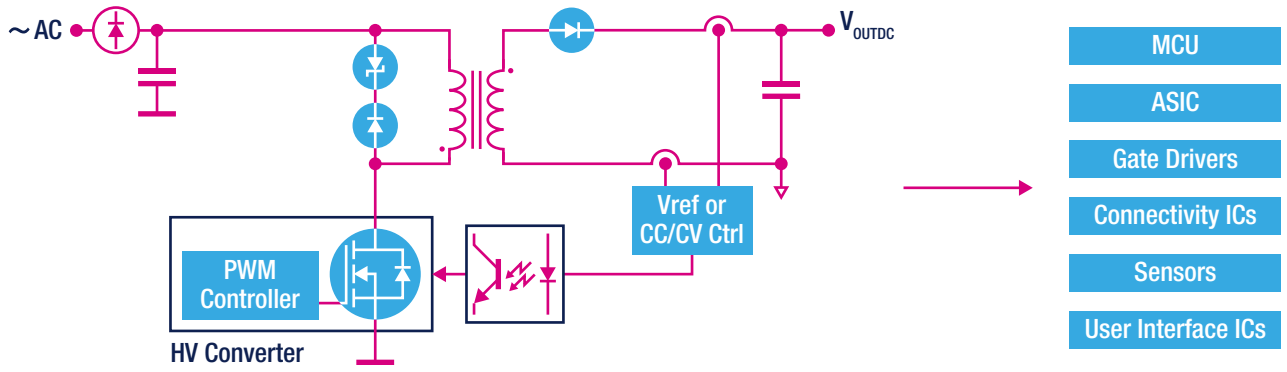
In the 20 to 75 W power range, the need to meet increasingly tight efficiency and stand-by requirements for auxiliary power supplies has pushed the use of quasi-resonant topologies replacing more mainstream fixed frequency based designs.

ST'S RECOMMENDED PRODUCTS FOR ISOLATED AUXILIARY SMPS

		HV converters		Offline controllers	HV Power MOSFETs	MOSFET Protection	Clamping diodes	Voltage Ref CC/CV Ctrl	Output diodes	LDO
Isolated flyback	PSR-CV					SMA6F, SMB15F series	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*, SEA*	Schottky, FERD STPS* FERD*45 FERD*50 FERD*60 FER*100	Low Dropout (LDO) Linear Regulators LDF LDFM LDK220 LDK320 LDL212
	Regulation with optocoupler	VIPer*5 VIPer*7 VIPer*8	VIPer0P VIPer*1 VIPer*6 VIPer122 ALTAIR*	STCH02 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					

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

Typical configuration for isolated auxiliary power supply



MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

STEVAL-VP26K01F

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

STEVAL-ISA181V1

12 V / 600 mA flyback converter with Zero Power remote control

STEVAL-ISA184V1

5 V/1.2 A ,12 V/750 mA double output flyback converter

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.

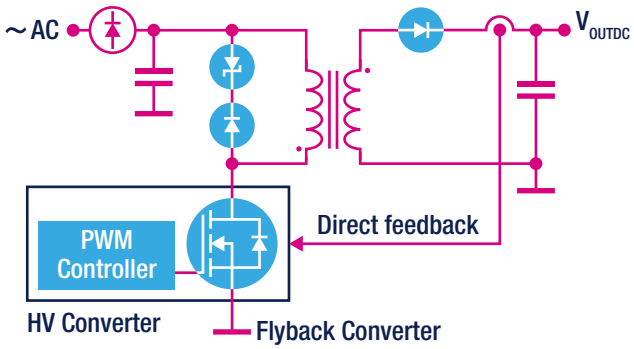
A buck – step-down – topology can be used to generate a positive output with respect to the common terminal and a buck-boost when the output voltage needs to be negative. A non-isolated flyback converter is the alternative when a higher output power is required.

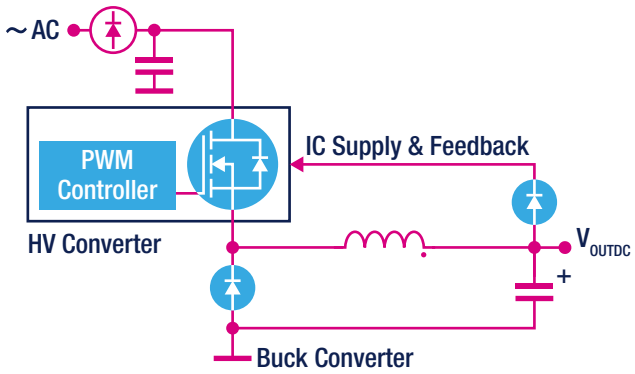
ST'S RECOMMENDED PRODUCTS FOR NON-ISOLATED AUXILIARY SMPS

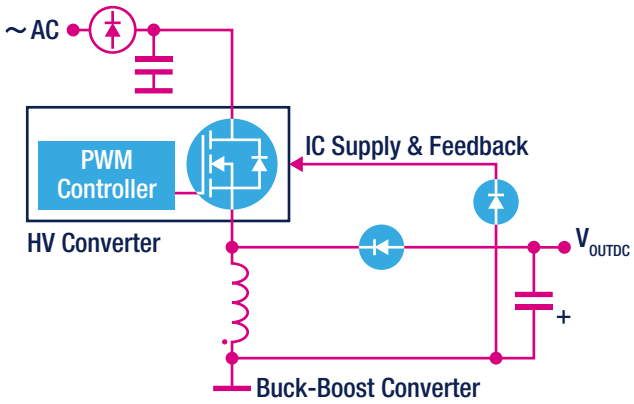
<table>
<tr><th></th><th>HV converters</th><th>VIPER Protection</th><th>Clamping diodes</th><th>Output diodes</th><th>LDO</th></tr>
<tr><td>Buck</td><td rowspan="3">VIPer0P
VIPer*1
VIPer*6
VIPer122</td><td></td><td></td><td>600 V Ultrafast STTH*06
800 V to 1200 V Ultrafast
STTH*08
STTH*10</td><td rowspan="3">Low Dropout (LDO) Linear Regulators
LDF, LDFM, LDK220, LDK320, LDL212</td></tr>
<tr><td>Buck-boost</td><td></td><td></td></tr>
<tr><td>Non-isolated flyback</td><td>SMA6F, SMB15F series</td><td>600 V Ultrafast STTH*06
800 V to 1200 V Ultrafast
STTH*08
STTH*10
STTH*12</td><td>Schottky, FERD
STPS*
FERD*45, FERD*50,
FERD*60, FER*100</td></tr>
</table>

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

Typical configurations for non isolated auxiliary power supply







MAIN EVALUATION BOARDS

STEVAL-ISA115V1
12 V, 150 mA
buck converter

STEVAL-ISA178V1
5 V / 0.2 A buck converter

STEVAL-ISA195V1
5 V / 0.36 A
buck converter

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

Smart Chargers and Adapters

Today, many device charging technologies and standards designed to ensure interoperability and improve convenience and ease of use are available , including wireless charging, quick charge and USB Type-C and Power Delivery.

ST can help engineers design charging solutions that meet requirements set by the mainstream standards – as well as proprietary charging protocols – with innovative converter architectures enabling best-in-class energy efficiency and power density as well as ensuring the lowest possible stand-by power.

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) 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.

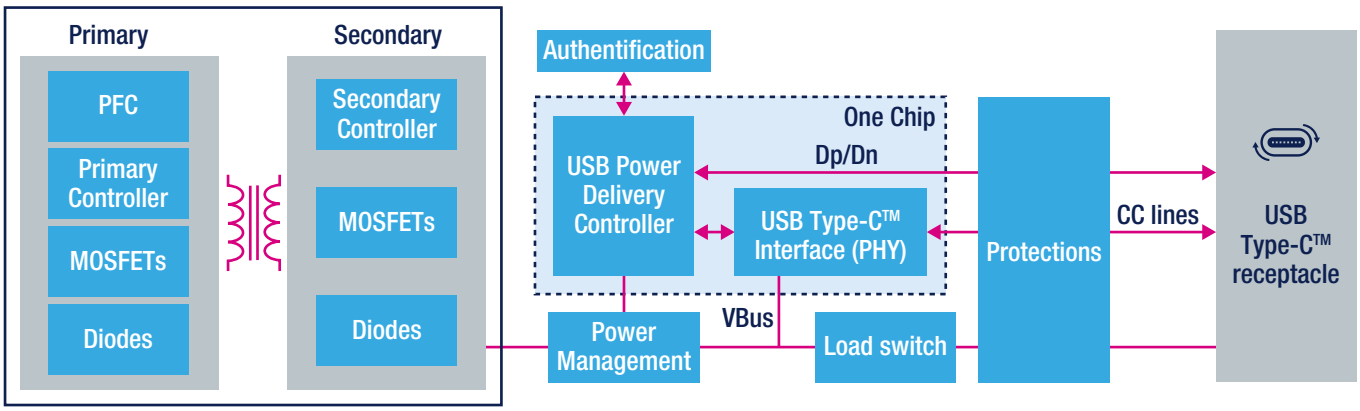
Designers of USB Type-C™ and Power Delivery compliant adapters and wall chargers can benefit from stand-alone controllers, from STM32 microcontrollers and their associated protocol stack, our STSAFE secure element as well as a specifically developed range of protection and filtering devices.

ST'S RECOMMENDED PRODUCTS FOR USB TYPE-C POWER DELIVERY SUBSYSTEM

Type-C and USB-PD Controllers			Authencitcation & Secure MCUs	Protections				LDO
Programmable Solutions		Auto-Run Solutions		Vrm	High surge current compact protection (V_{BUS})	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	
MCUs	Type-C Controller/ interface							
STM32G0, STM32G4, STM32L5		STUSB1600 STUSB1700 STUSB4700 STUSB4710 STUSB4761	STSAFE-A	20 V	ESDA25P35-1U1M ESDA24P140-1U1M	ESDL20-1BF4 ESDA25W	TCPP01-M12	ST715 LDK320
STM32F0 STM32F3	STUSB1602A			15 V	ESDA17P100-1U2M ESDA15P50-1U1M	ESDA17P20-1U1M		Load Switch
				9 V	ESDA13P70-1U1M	ESDL121-1BU2		
				5 V	ESDA7P120-1U1M	ESDZV053-1BU2 ESD051-1F4		STELPD01*

Note: * available. in Q3 2019

Typical configuration



MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

STEVAL-USBPD45C

45 W USB Type-C™ Power Delivery 3.0 adapter reference design

STM32G071B-DISCO

STM32G0 world's 1st USB PD 3.0 MCU and its full ecosystem

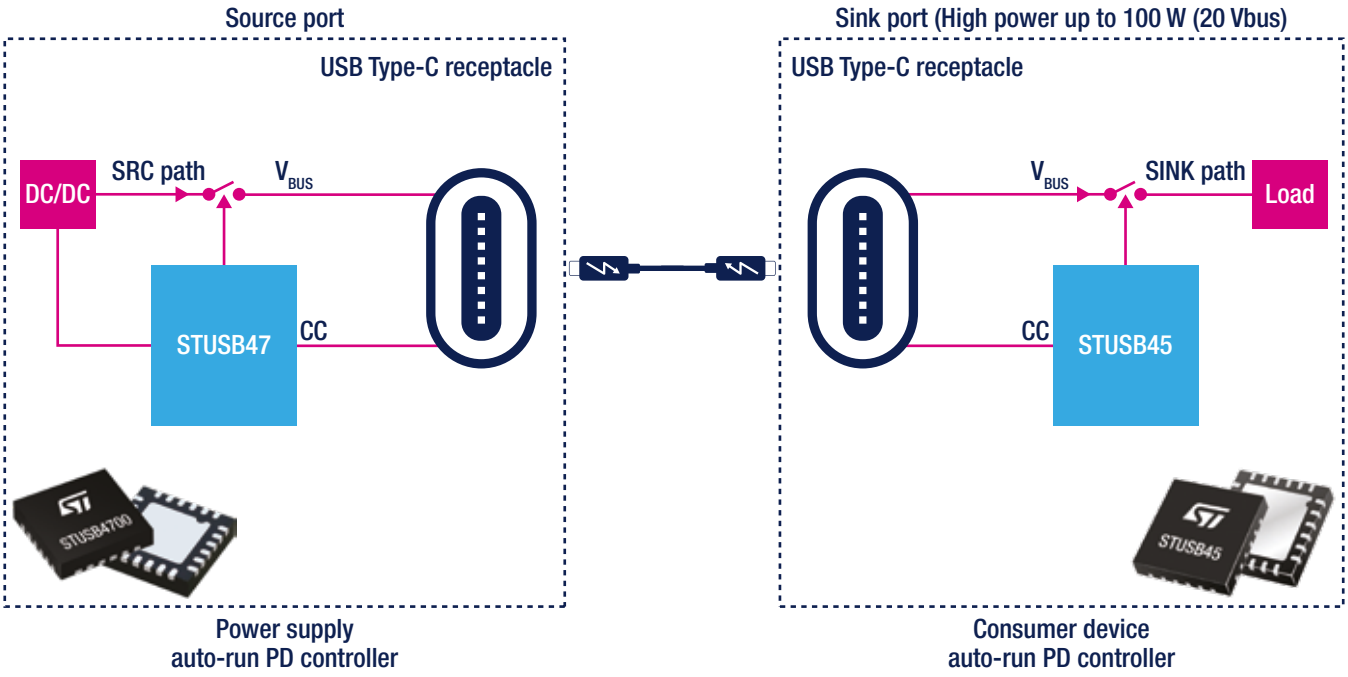
STEVAL-SMACH15V1

15 W 5 V output USB adapter evaluation board

STEVAL-USBC2DP

USB Type-C™ to DisplayPort™ adapter

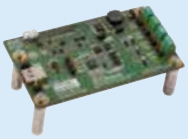
Typical block diagram with certified source and sink auto-run controllers



MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

STEVAL-ISC004V1

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



STEVAL-ISC005V1

STUSB4500 USB Power Delivery controller evaluation board

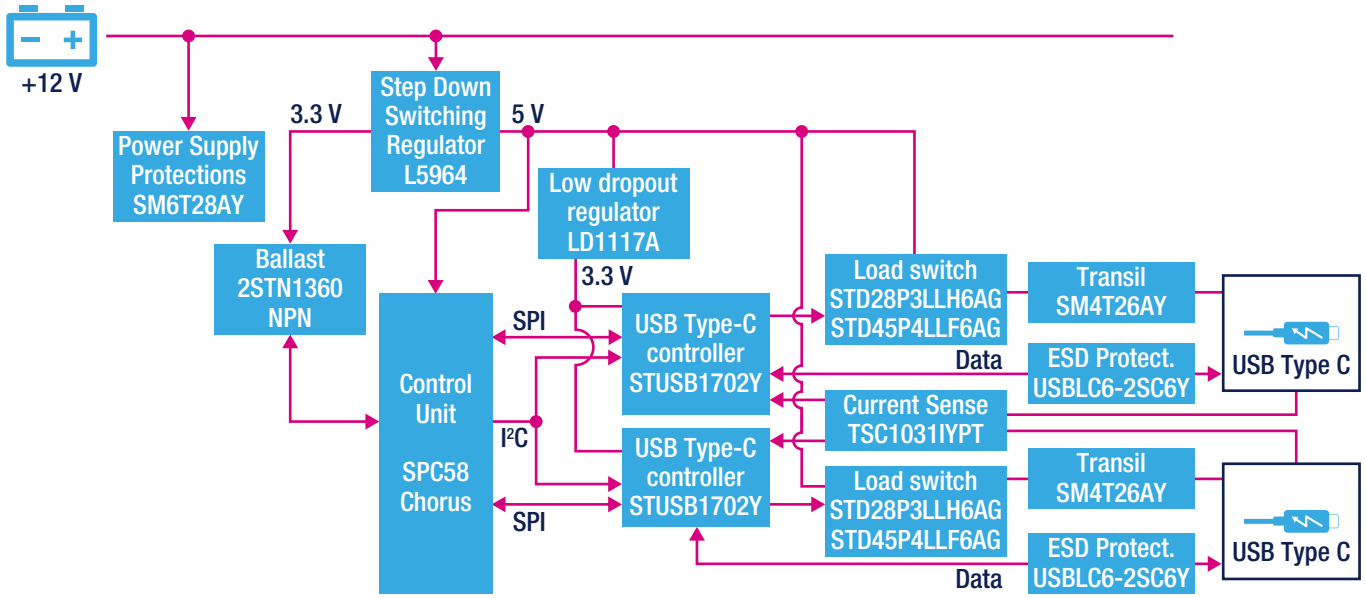
EVAL-SCS001V1

STUSB4500 reference design

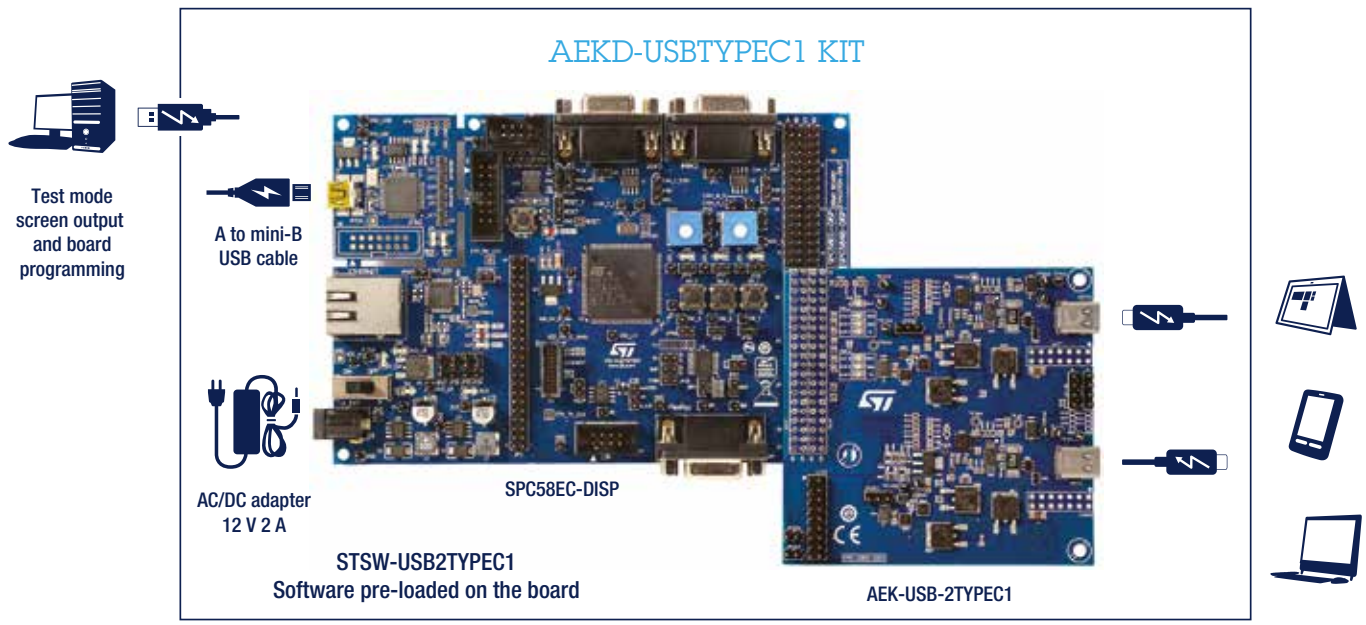
Automotive-grade USB Type-C and Power Delivery solution

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

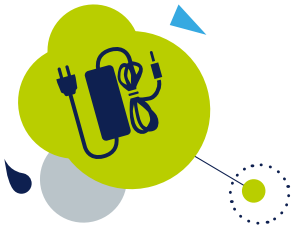


MAIN EVALUATION TOOLS



Note: AEK-POW-L5964V1 power supply board coming soon

Adapters for Tablets, Notebook and AIO



Power AC-DC adapters for notebooks and tablets need to be as small, thin and lightweight as possible while providing ultra-low stand-by power with high efficiency at all load conditions and excellent EMI performance.

A typical high-efficiency design includes a power factor corrector (PFC) working in transition mode (TM) followed by a fly-back, or half-bridge LLC resonant stage. For low power applications (<75 W), the mainstream architecture is based on a single stage flyback converter.

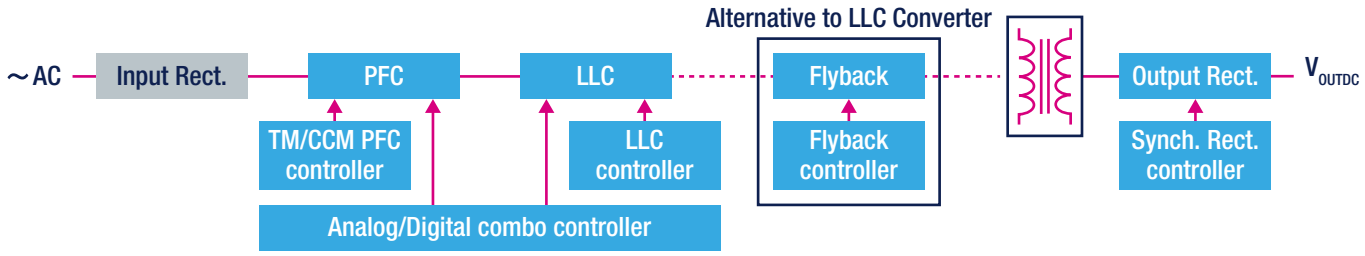
ST offers a broad range of high-voltage MDmesh™ and low-voltage STripFET power MOSFETs as well as standard and field-effect rectifiers (FERD). Our offer also includes a range of PFC, PWM primary controllers, synchronous rectification controllers, and single-chip analog and digital combo controllers.

ST'S RECOMMENDED PRODUCTS FOR TABLETS, NOTEBOOK AND AIO ADAPTERS

	Controllers	Power MOSFETs	Diodes & Discretes	
PFC Block	TM Analog Controllers L6562A*, L6563*, L6564* CCM Analog Controllers 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	**Power MOSFETs**	**Diodes & Discretes**	**Voltage Reference, CC/CV Ctrl**
Isolation Stage	HV Converters for Flyback VIPerPlus SSR: VIPer*5, VIPer*7, VIPer*8 PSR: VIPer0P, VIPer*1, VIPer122 VIPer*6, ALTAIR* Flyback Controllers STCH02, 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	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	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*, SEA* **Post Regulation** DC-DC Converters ST1S*, ST1S40, ST1S50 Low Dropout (LDO) Linear Regulators ST715 LDK320

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

Typical Block Diagram with PFC Front-End



MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

STEVAL-ISA170V1

12 V - 150 W resonant converter with synchronous rectification

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 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

Wireless Charging

Wireless chargers are expected to become ubiquitous in hotels, airports, cafes and other public places as they enable to top up 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 - or dongle (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.

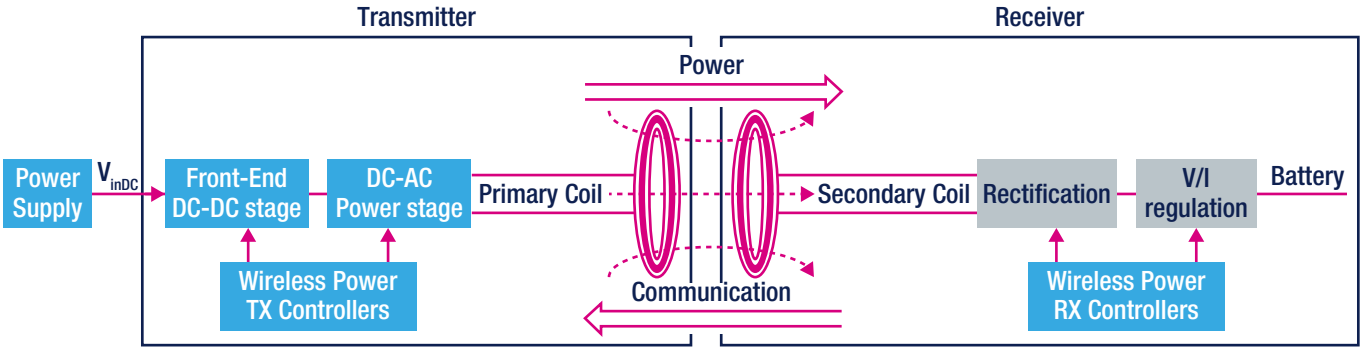
We have a range of wireless battery charging solutions including transmitters and receivers providing low stand-by power and foreign objects detection (FOD) feature. In order to prevent unwanted damage to any NFC Cards that might be close to the wireless charging source during operation, it is recommended 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.

ST'S RECOMMENDED PRODUCTS FOR WIRELESS CHARGING

	Wireless charging controllers, MCUs	Gate drivers	Power MOSFETs	Protections	Diodes	NFC reader
Transmitter	STWBC, STWBC-EP, STWBC-MC, STWBC-WA, STM32F0, STM32F334, STM32G4	L6743B	STL10N3LLH5, STL8DN6LF3, ST*N2VH5, STL8DN10LF3, STL6N3LLH6, STL10N3LLH5		STPS*L30 STPS*45/60/100 FERD*45/60/100	ST25R3911B ST25R3912 ST25R3913 ST25R3916
Receiver	STWLC33, STM32F0			SMM4F, SMA6F series	BAT30F4, BAR46	

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

Typical Block Diagram



MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

Transmitters

STEVAL-ISB045V1

2.5 W wireless charger transmitter evaluation kit

STEVAL-ISB044V1

Qi MP-A10 15 W wireless charger TX evaluation kit

STEVAL-ISB047V1

Qi 3-coil 15 W wireless charger TX evaluation kit

EVALSTWBC-EP

Qi MP-A15 15W wireless charger TX evaluation kit

Receivers

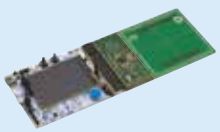
STEVAL-ISB042V1

Dual mode wireless power evaluation board for Qi receiver and Qi-based transmitter

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.

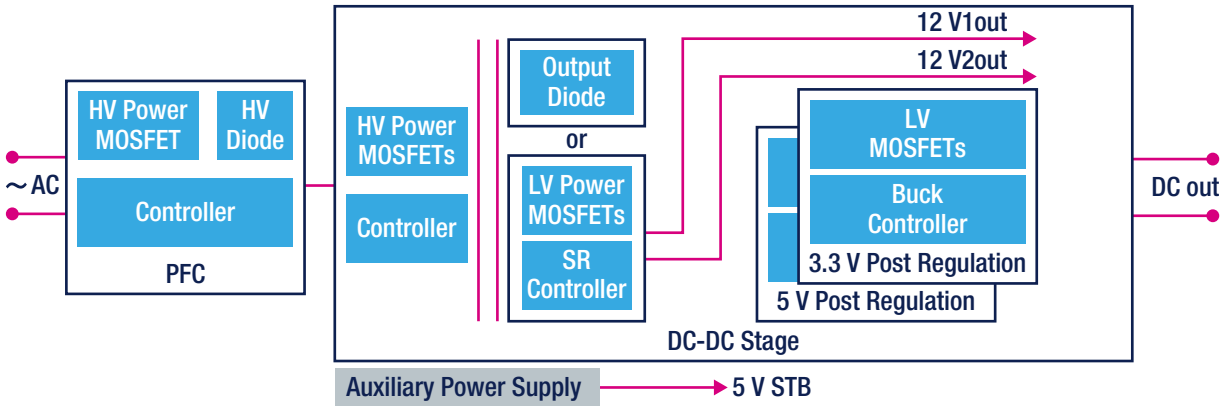
An intelligent control scheme that enables the adaption of load variation to minimize power consumption, together with optimized power semiconductors, is the key in meeting market demands. The smart analog and digital controllers, such as the STCMB1 and the STNRG011, the high-voltage MDmesh™ MOSFETs used for the PFC and DC-DC stages, the low-voltage STripFET 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* CCM Analog Controllers L4981*, L4984D MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG, STNRGPF01, STNRGPF12	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) TS*, TSV*, LMV* **MOSFET and IGBT Gate Drivers** Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1
	Controllers	**Power MOSFETs**	**Diodes**	**E-Fuse**
Isolation DC-DC Stage	PFC & LLC Combo Controllers STCMB1, STNRG011 LLC Analog Controllers L6599*, L6699 Asymmetrical HB Controllers L6591 MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG SR Analog Controllers SRK2000A, SRK2001, SRK2001A for LLC	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	Output Diodes Schottky, FERD STPS* FERD*45, FERD*50, FERD*60, FERD*100 **Voltage Reference** T*431, T*432 **LDO** Low Dropout (LDO) Linear Regulators LDF, LDFM, LDK320, LDL212	STEF01 STEF05 STEF12 **MOSFET and IGBT Gate Drivers** HV HB Gate Drivers L649* Isolated Gate Drivers STGAP* SR Multiple LS Gate Drivers PM8834
	Controllers	**Power MOSFETs**		
Post Regulation	L6726A, L673*, PM6680	STL90N3LLH6		

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

Typical configuration



MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

EVL6563S-250W

250 W transition-mode PFC pre-regulator

EVL400W-EUPL7

12 V - 400 W SMPS for adapters and ATX power supplies Desktop and AIO

Server & Telecom Power

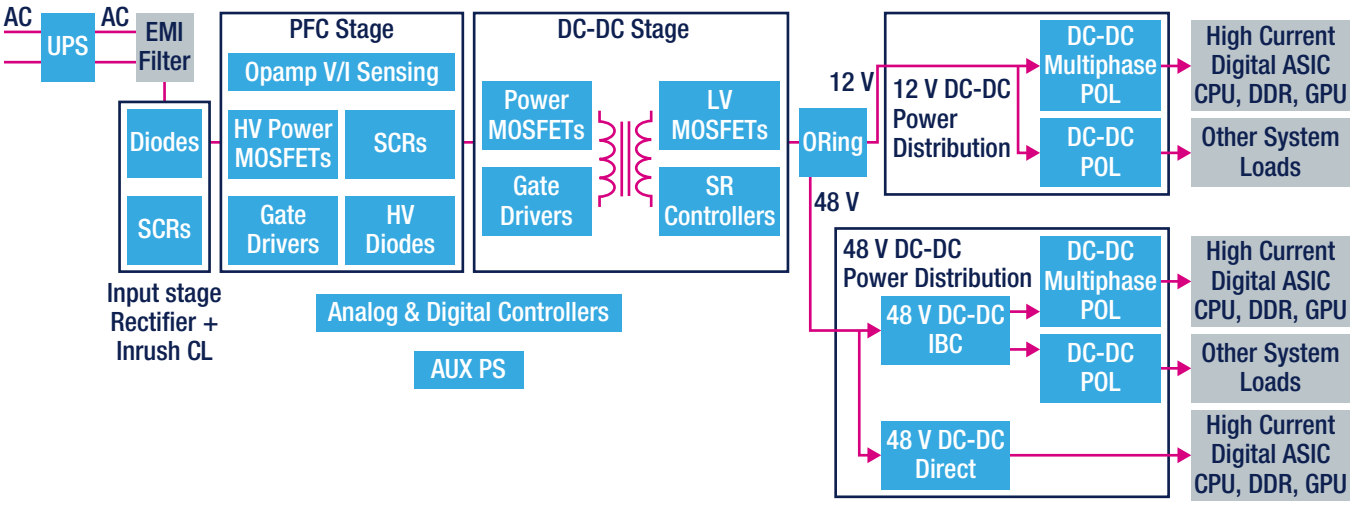
AC-DC PSU & DC-DC power distribution

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 frontend AC-DC stage to the backend DC-DC power distribution, needs to deliver the best performance in term 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 all the 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

Input Stage (Rect. & inrush current limiter)		**SCRs** High Temp. SCR TN*015H-6, TN*050H-8, TN*050H-12W High Temp. SCR TN*050H-12W	**Diodes & Discretes** Bridge Rectifier Diodes STBR*12	
	Controllers		**Diodes & Discretes**	**MOSFET and IGBT Gate Drivers**
PFC Block	CCM Analog Controllers L4981*, L4984D MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG, STNRGPF01, STNRGPF12	**Power MOSFETs** 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	600 V Ultrafast for CCM STTH*R06 STTH*T06 STTH*L06 SiC Diodes STPSC*065	HV HB Gate Drivers L649* Isolated Gate Drivers STGAP* Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1
			Opamp V/I Sensing	**E-Fuse**
			Precision Op Amps (<50 MHz) TS*, TSV*, LMV*	STEF01 STEF05 STEF12
	Controllers	**Power MOSFETs**	**Diodes**	
Isolation DC-DC Stage	LLC Analog Controllers L6599A, L6699 Asym. HB Analog Controllers L6591 MCUs & Digital Controllers STM32F334, STM32G4,STNRG 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 MDmesh DM6 ST*60DM6 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	
			LDO	**MOSFET and IGBT Gate Drivers**
			Low Dropout (LDO) Linear Regulators LDF, LDFM, LD39050, LD39100, LD39200, LDL112, LDL212, LD59100	HV HB Gate Drivers L649* Isolated Gate Drivers STGAP* SR Multiple LS Gate Drivers PM8834 SR HV HB Gate Drivers L649*

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

MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

STEVAL-ISA147V3

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

STEVAL-ISA172V2

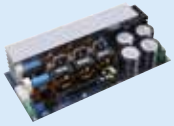
2 kW fully digital AC-DC power supply (D-SMPS)

EVLSTNRG-1kW

1 kW SMPS digitally controlled multi-phase interleaved converter

STEVAL-IPFC12V1

2 kW two-channel digitally controlled interleaved PFC with digital inrush current limiter



STEVAL-IPFC01V1

3 kW three-channel digitally controlled interleaved PFC

STEVAL-DPSLLCK1

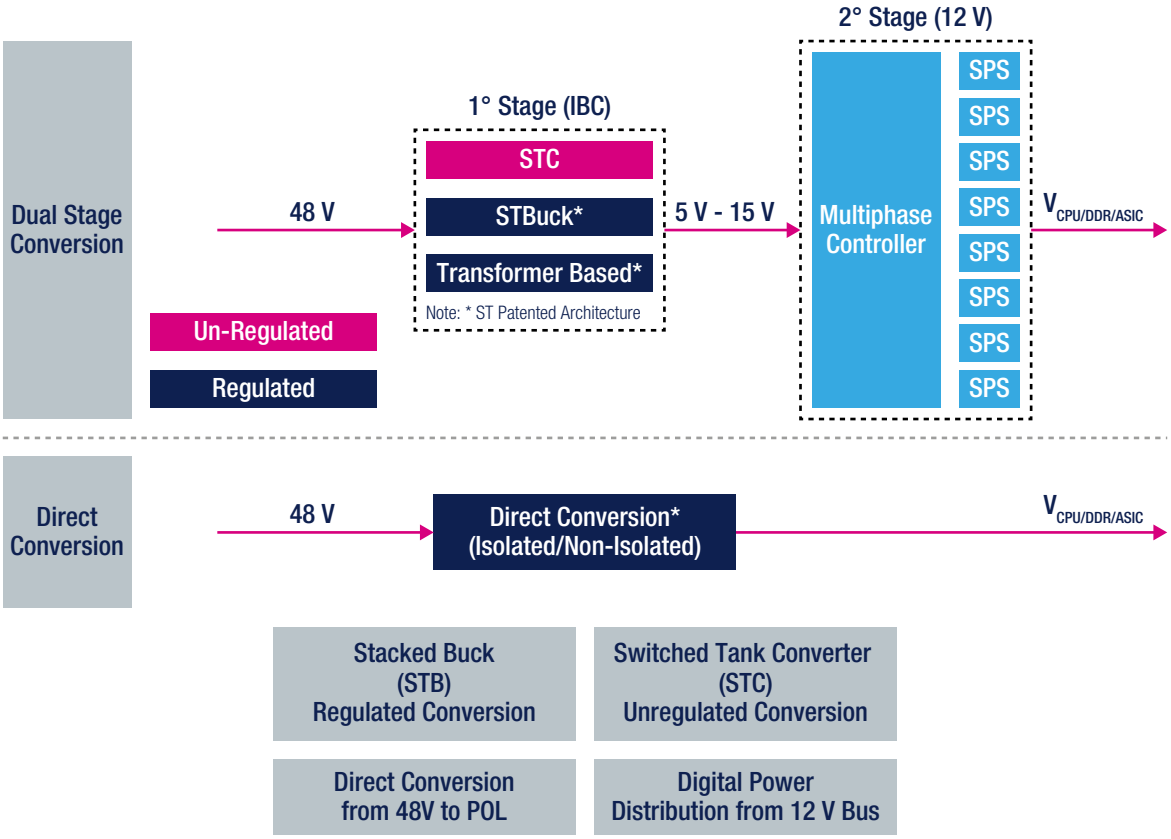
3 kW Full Bridge LLC resonant digital power supply evaluation kit

Power Distribution for Modern Data Center

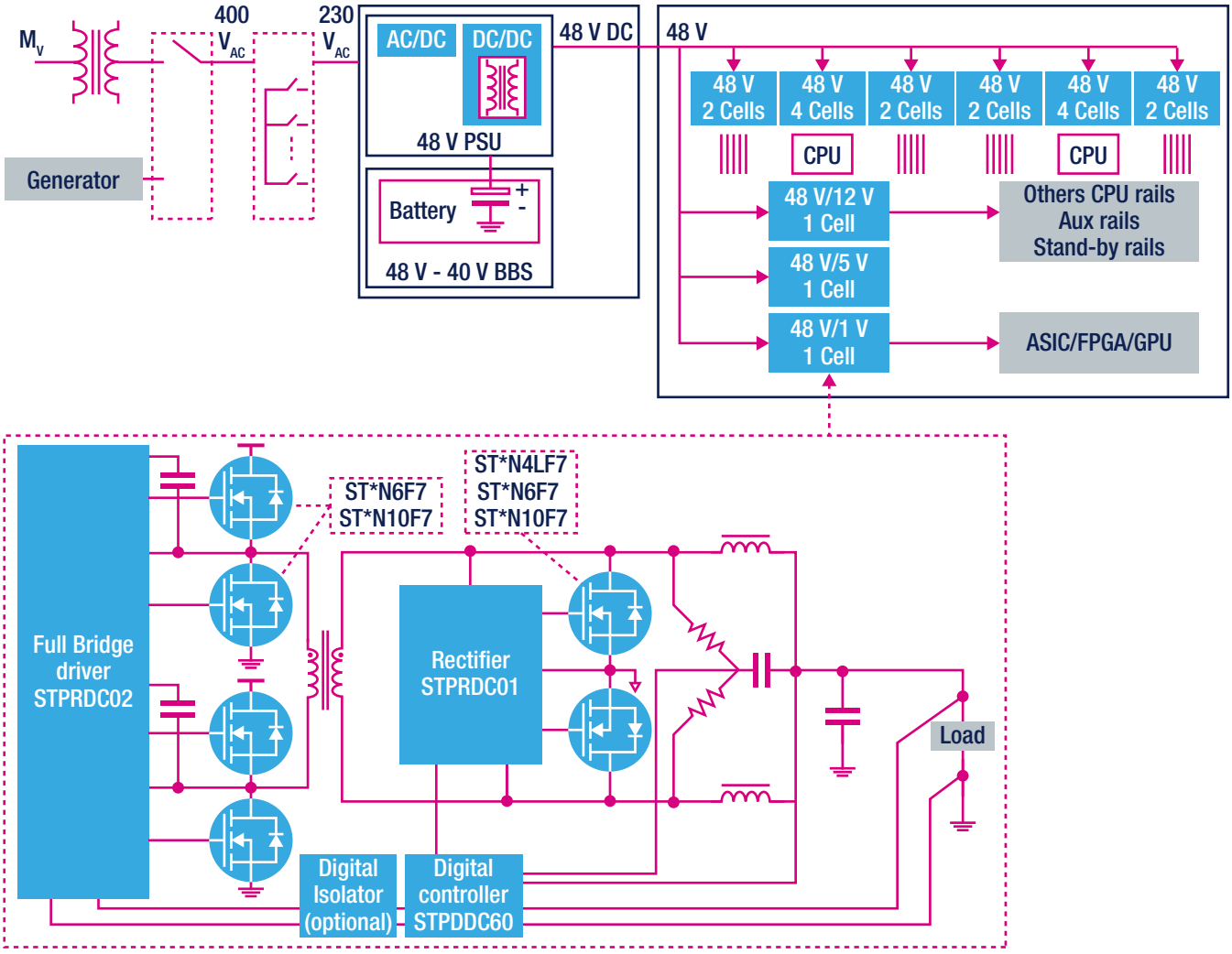
To support the evolution and expansion of Cloud services, the Internet of Things and mobile apps, the demand for data centers is growing exponentially with more powerful CPUs and extended memory banks making efficiency and power density a daunting challenge along with enhanced reliability. In a typical 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 the Power Stamp Alliance (PSA) for direct conversion from the 48 V rail. Innovative power distributions architectures include also 48 V to 12 V intermediate bus converters, both in regulated and unregulated version.

We offer a range of high-efficiency DC-DC conversion solutions including an isolated, single-stage direct 48 V to the Point-of-Load (PoL) resonant, conversion solution for CPUs and DDR memories based on the Power Stamp Alliance (PSA) product footprint and compliant with Intel VR13 and VR12.5 specifications. We support also hybrid architectures where the transition to 48 V is implemented though intermediate 12 V conversion, with innovative high efficiency solutions.

Power Delivery for Modern Data Center

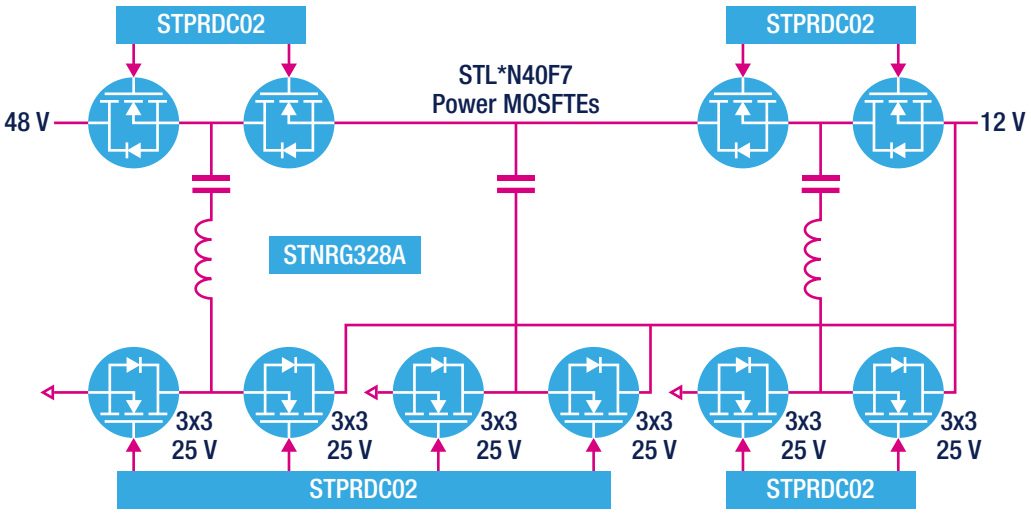


Typical Configuration for 48 V Isolated Direct Conversion

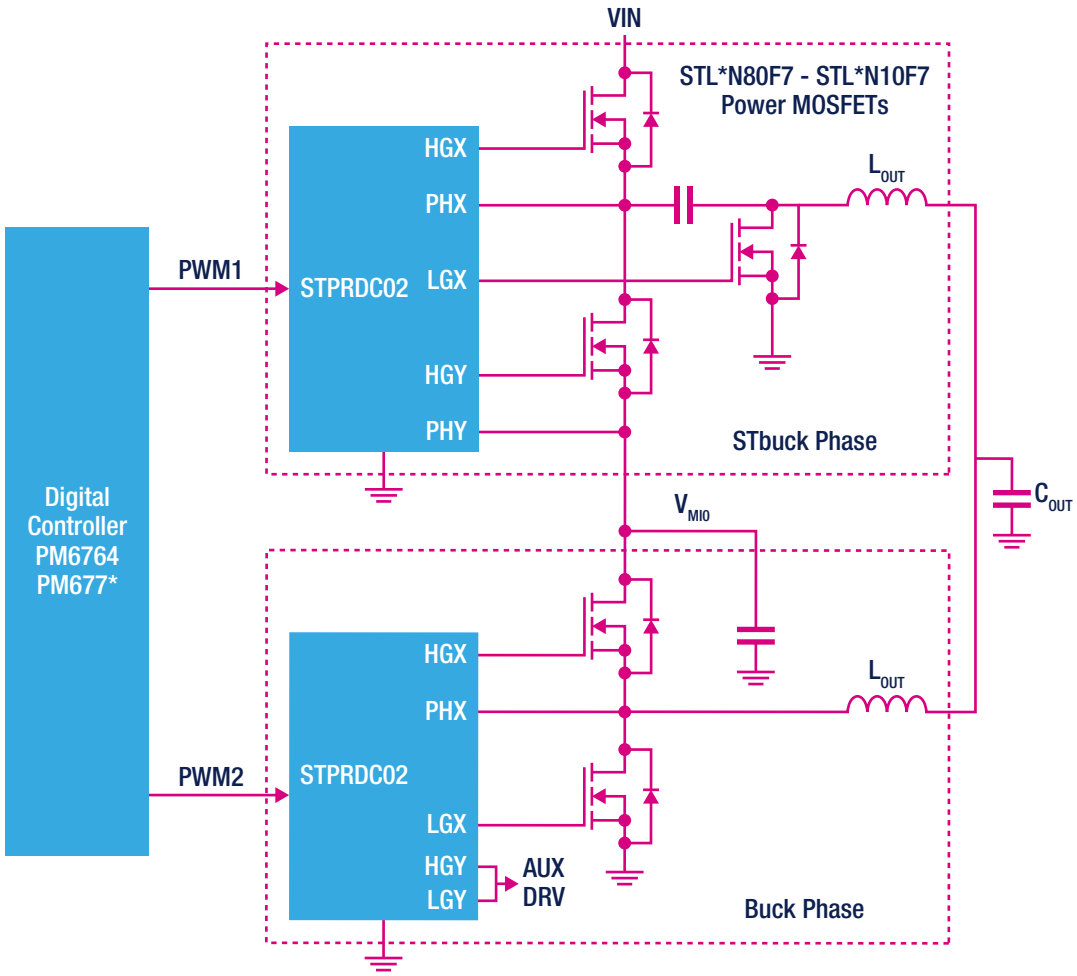


Note: * is used as a wildcard character for related part number

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

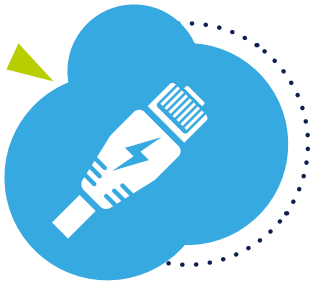


Note: * is used as a wildcard character for related part number

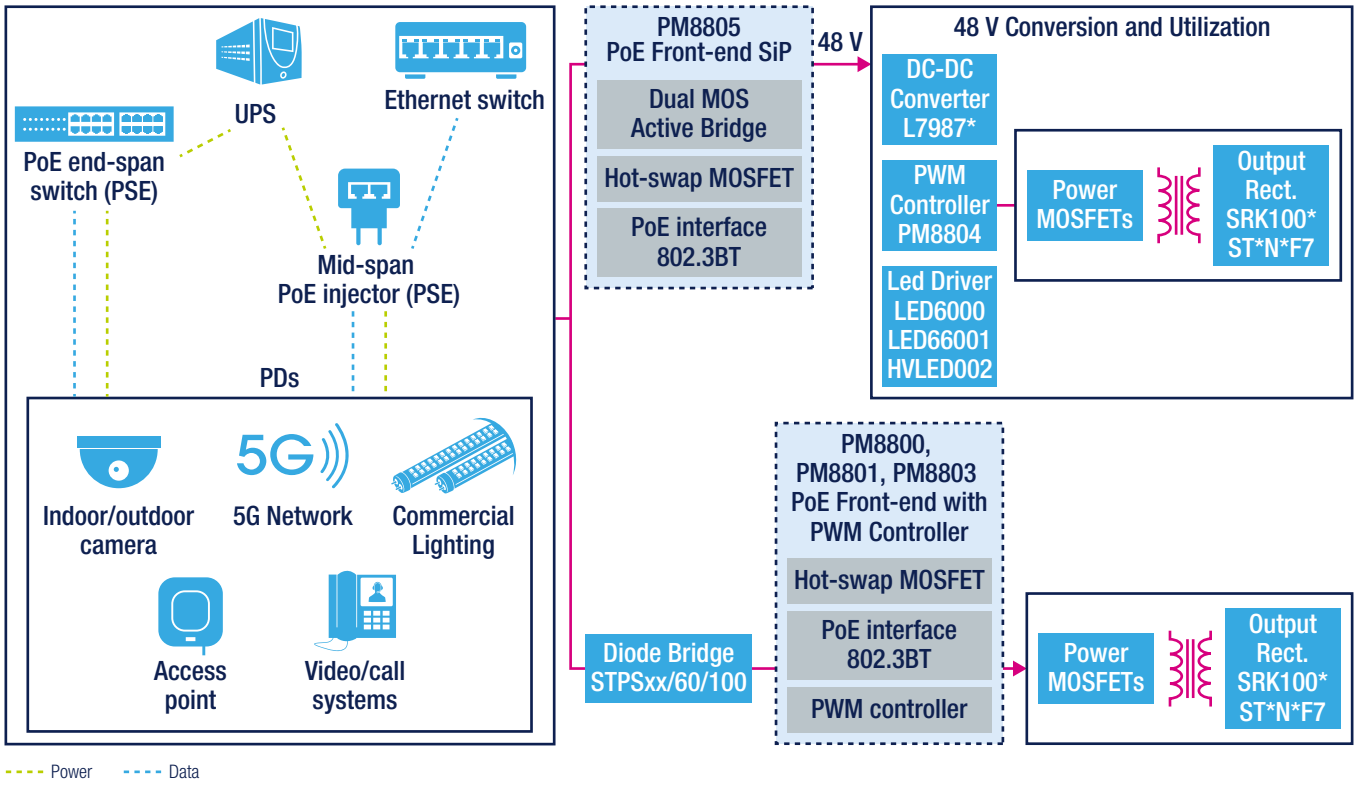
Power over Ethernet (PoE)

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 biagram for PoE Power Management



MAIN EVALUATION 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

LED TV Power Supply

In addition to their outstanding image quality, new generation TVs gain attention for their slim silhouette and high energy efficiency, for which the TV's power supply is a key factor. The power supply unit (PSU) requires a low profile to maintain the TV's slim appearance and advanced silicon devices to ensure high efficiency.

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.

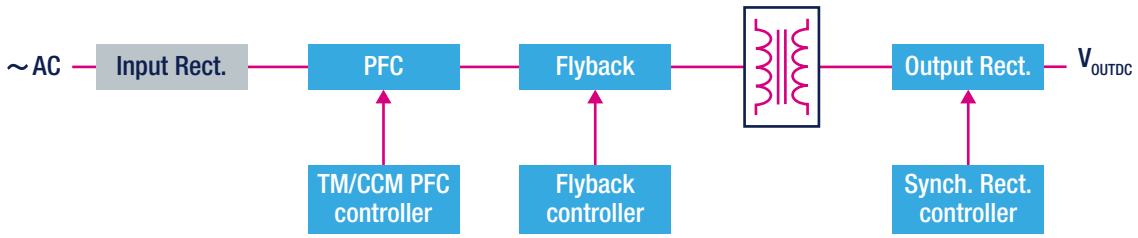
ST offers a broad portfolio of high-voltage MDmesh™ and low-voltage STripFET™ power MOSFETs, field-effect rectifier diodes (FERD), Schottky and Ultrafast diodes, a full range of protection ICs as well as dedicated analog and digital switching controllers who allow avoiding the auxiliary power thanks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

ST'S RECOMMENDED PRODUCTS FOR LED TV POWER SUPPLY

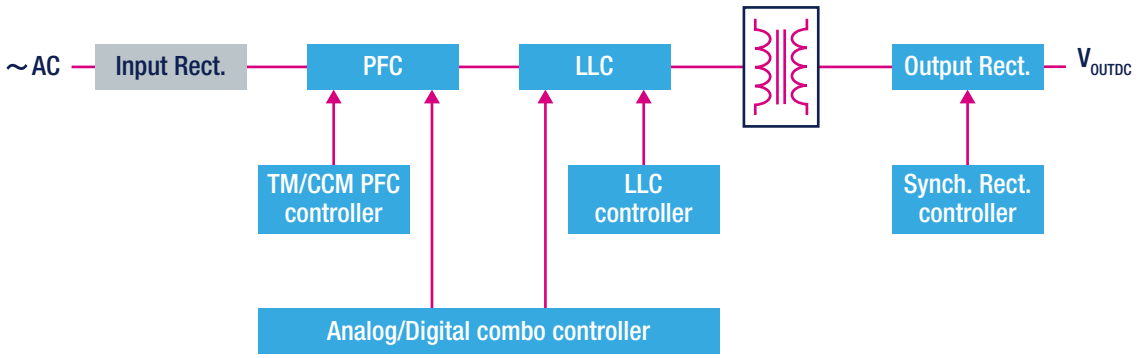
	Controllers	Power MOSFETs	Diodes & Discretes	Opamp V/I Sensing
PFC Block	TM Analog Controllers L6562A*, L6563*, L6564* CCM Analog Controllers L4981*, L4984D MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG, STNRGPF01, STNRGPF12	600 V-650 V MDmesh M2 ST*60M2, ST*65M2, 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) TS*, TSV*, LMV* **MOSFET and IGBT Gate Drivers** Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1
	Controllers	**Power MOSFETs**	**Diodes & Discretes**	**MOSFET and IGBT Gate Drivers**
Isolation Stage	Flyback Controllers L6566A, L6566B, L6565, L6668, STCH02, STCH03 PFC & LLC Combo Controllers STCMB1, STNRG011 LLC Analog Controllers L6599*, L6699 Asymmetrical HB Controllers L6591 MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG SR Analog Controllers SRK1000, SRK1001 for Flyback SRK2000A, SRK2001, SRK2001A for LLC	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 Flyback Schottky, FERD, Ultrafast STPS*, FERD*, STTH* 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	HV HB Gate Drivers L649* Isolated Gate Drivers STGAP* SR Multiple LS Gate Drivers PM8834 SR HV HB Gate Drivers L649*
			Voltage Reference	**DC-DC Conversion**
			T*431, T*432	ST1S12, ST1S3*, ST1S4*, ST1S50

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

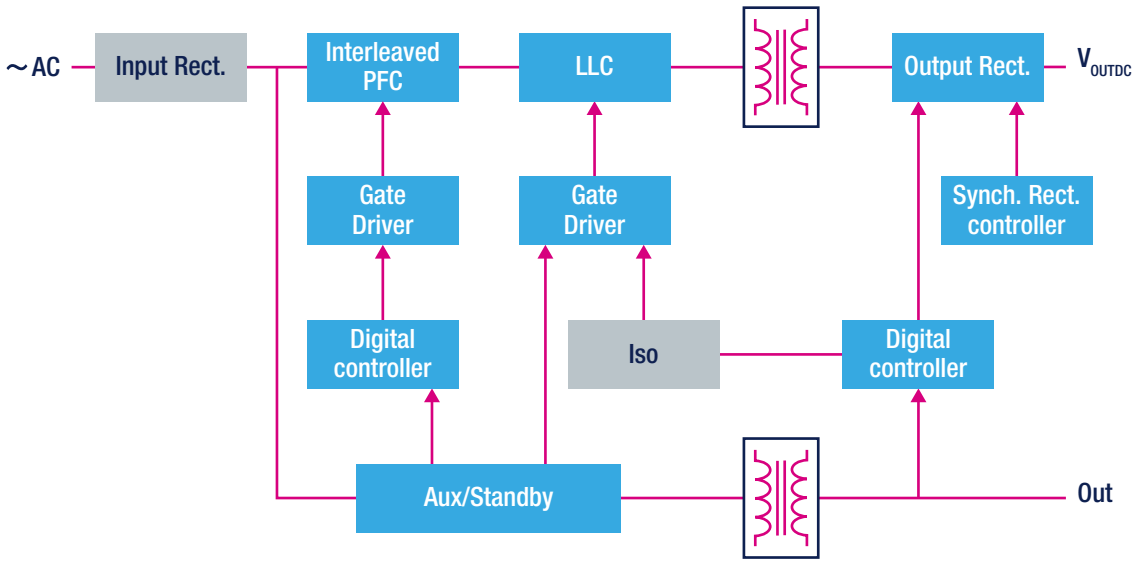
Typical Block Diagram for Analog Control Solutions for Small Pannel Size



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 EVALUATION BOARDS AND REFERENCE DESIGNS

EVL185W-LEDTV

185 W power supply with PFC and standby supply for LED TV

EVLCMB1-90WADP

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

EVLSTNRG011-150

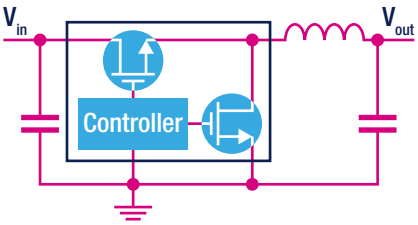
12 V - 150 W power supply based on TM PFC and HB LLC digital combo controller

DC-DC Conversion

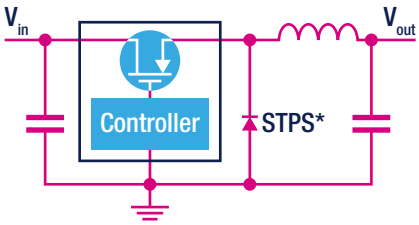
A DC-DC switching converter is used to locally supply any component or part of a system with the desired DC voltage and current. Depending on the application's relationship between the input and output voltage, engineers have to choose the best power topology – buck, boost, buck-boost or inverting, with 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 their choice, the right semiconductor products are key to meet their 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 to DC converters.

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

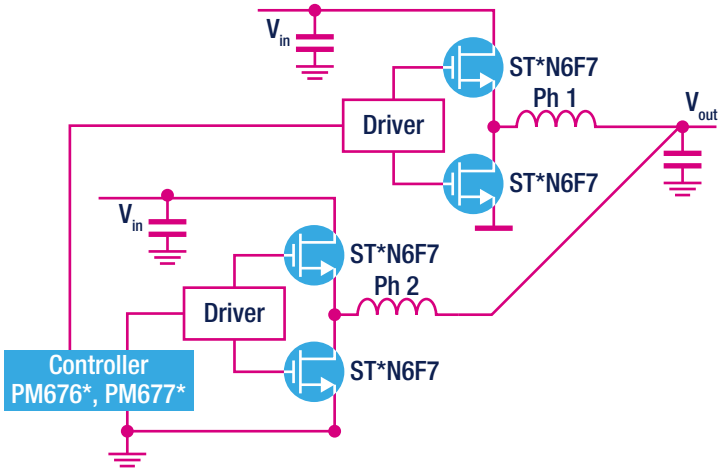


Synchronous buck converter



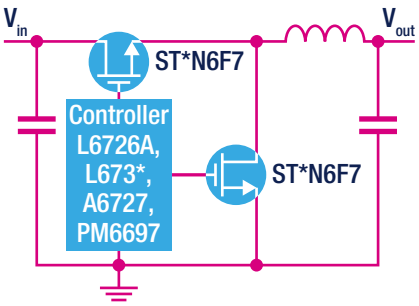
Asynchronous buck converter

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



Multi-phase Buck controller

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



Single-phase buck controller

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

MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

STEVAL-ISA152V1

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

STEVAL-ISA159V1

Synch. Buck 36 Vin,
3.3 Vout - 400 mA

STEVAL-ISA160V1

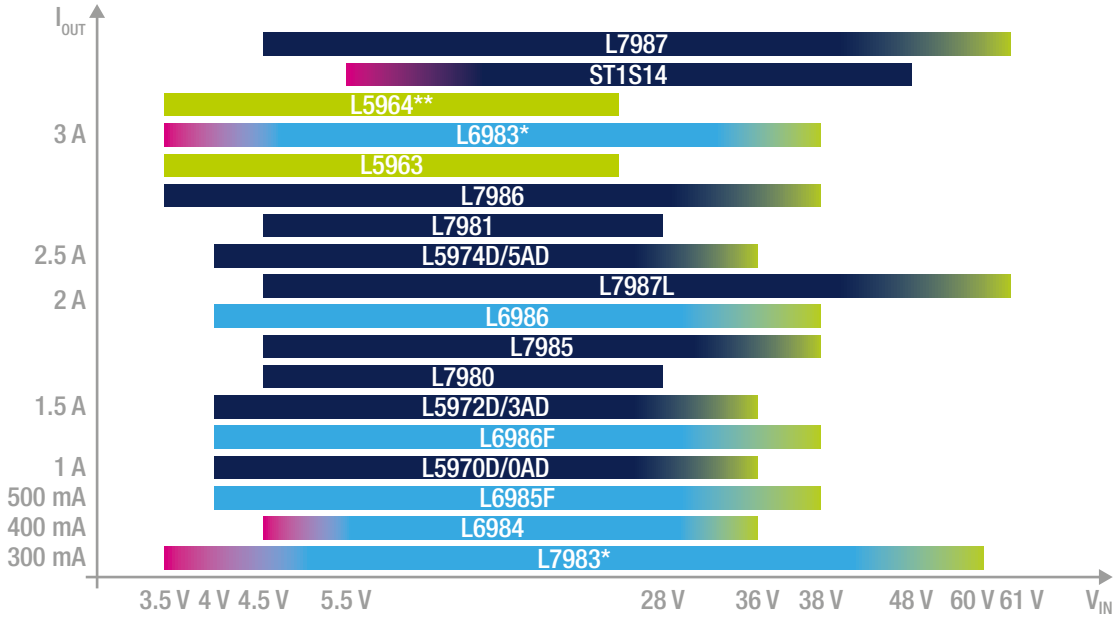
Synch. Buck 3.3 Vin,
1.2 Vout-3 A Iout, Auto. Grade

STEVAL-ISA205V1

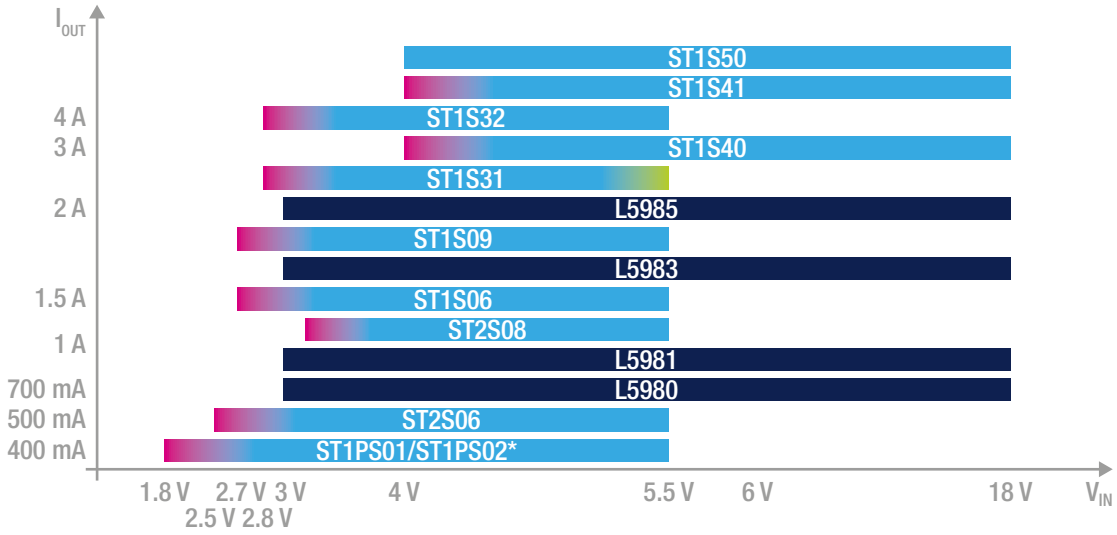
Synch. Buck 12 Vin,
3.3 Vout-2 A Iout, Auto. Grade

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

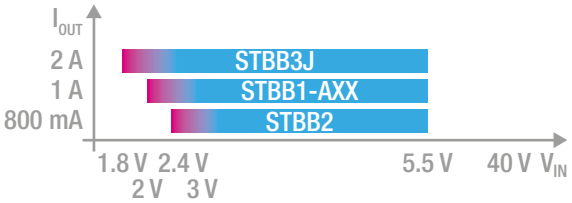
24 V Bus



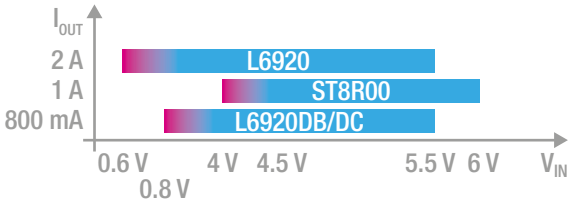
Post-Regulation (<24 V)



Buck-Boost



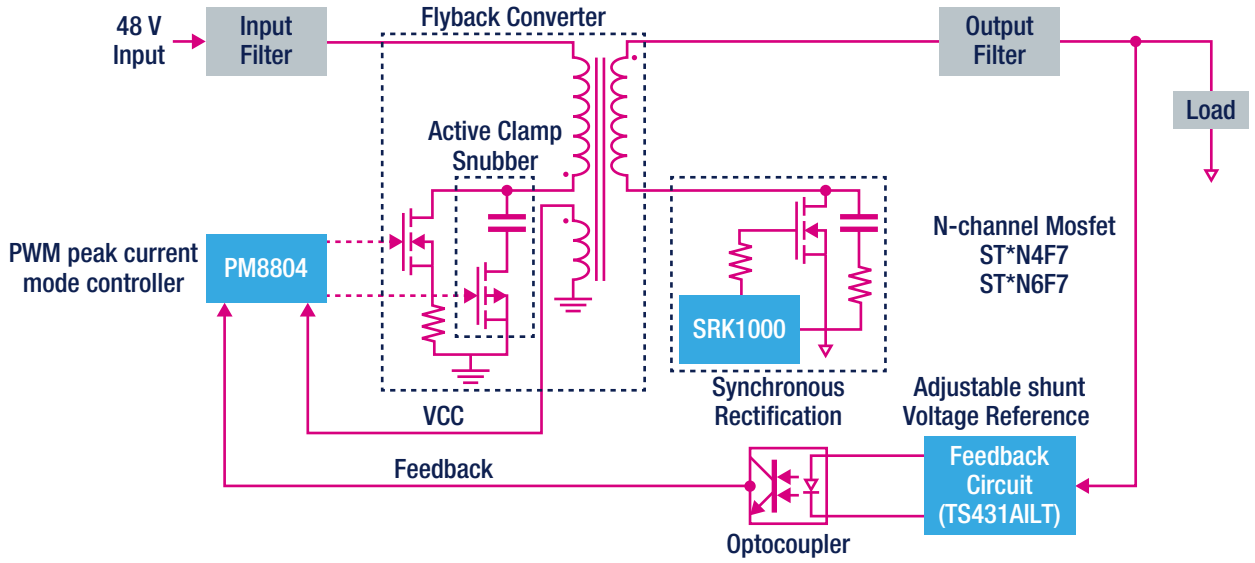
Boost



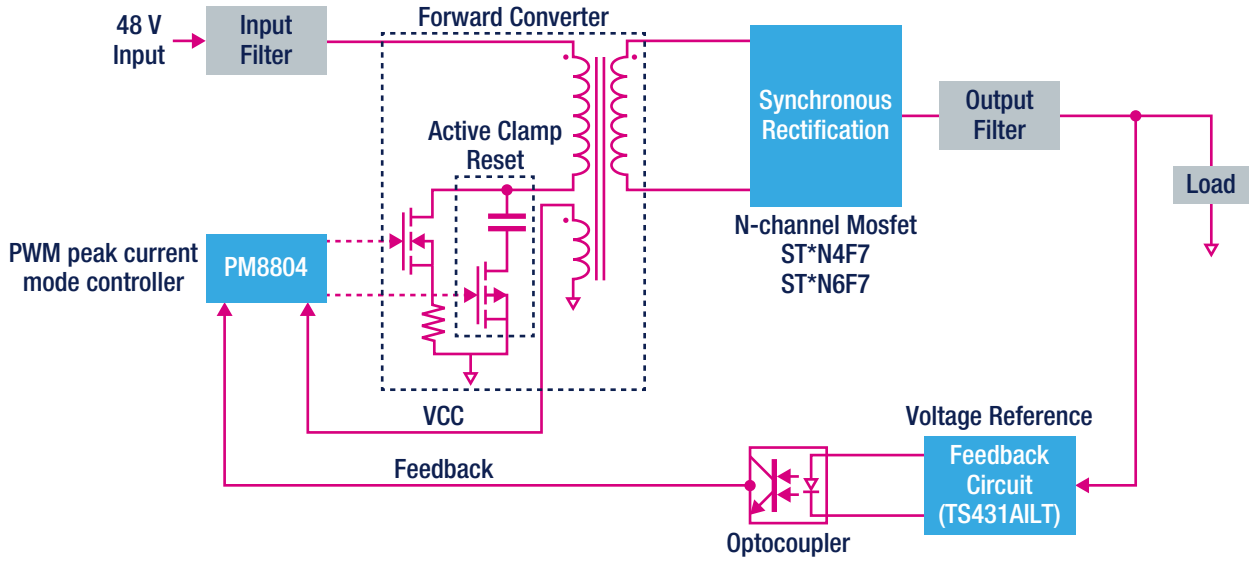
Asynchronous Automotive Synchronous Compact BOM

Note: * full production in H2 2019 ** dual, parallel up to 7A

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-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%

STEVAL-ISA203V1*

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

Note: * available in Q3 2019

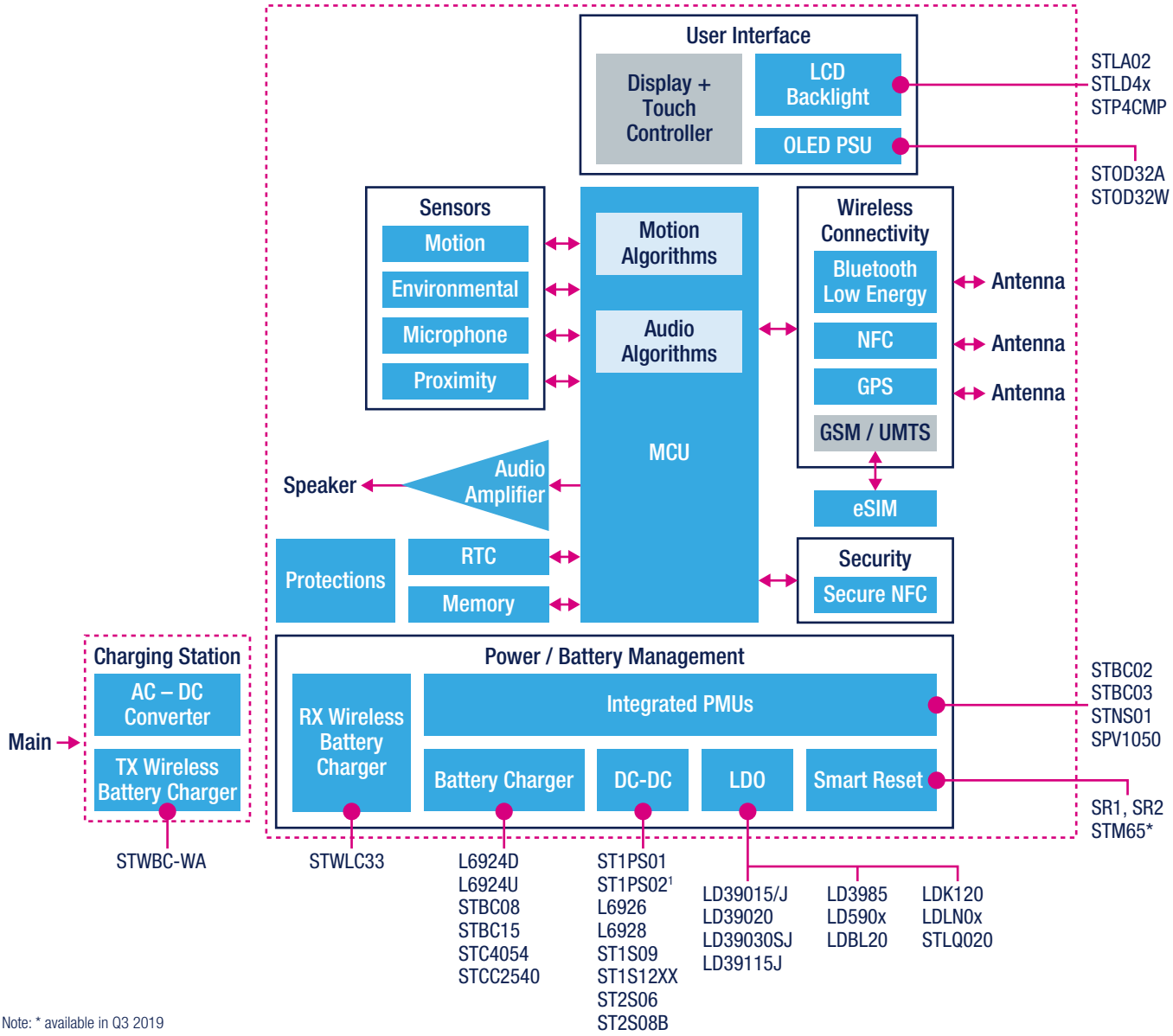
Note: * is used as a wildcard character for related part number

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 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 the needs of developers of 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



Note: * available in Q3 2019

MAIN EVALUATION BOARDS

STEVAL-1PS01AJR/1PS01EJR/ 1PS01BJR*/1PS01GJR*

Evaluation board based on the ST1PS01EJR 400 mA nano-quiescent synchronous step-down converter

STEVAL-LDO001V1

Quad high performance LDO evaluation board based on LDBL20, LDLN025, LD39130S and STLQ020

Note: * available in Q3 2019

LED LIGHTING AND CONTROLS

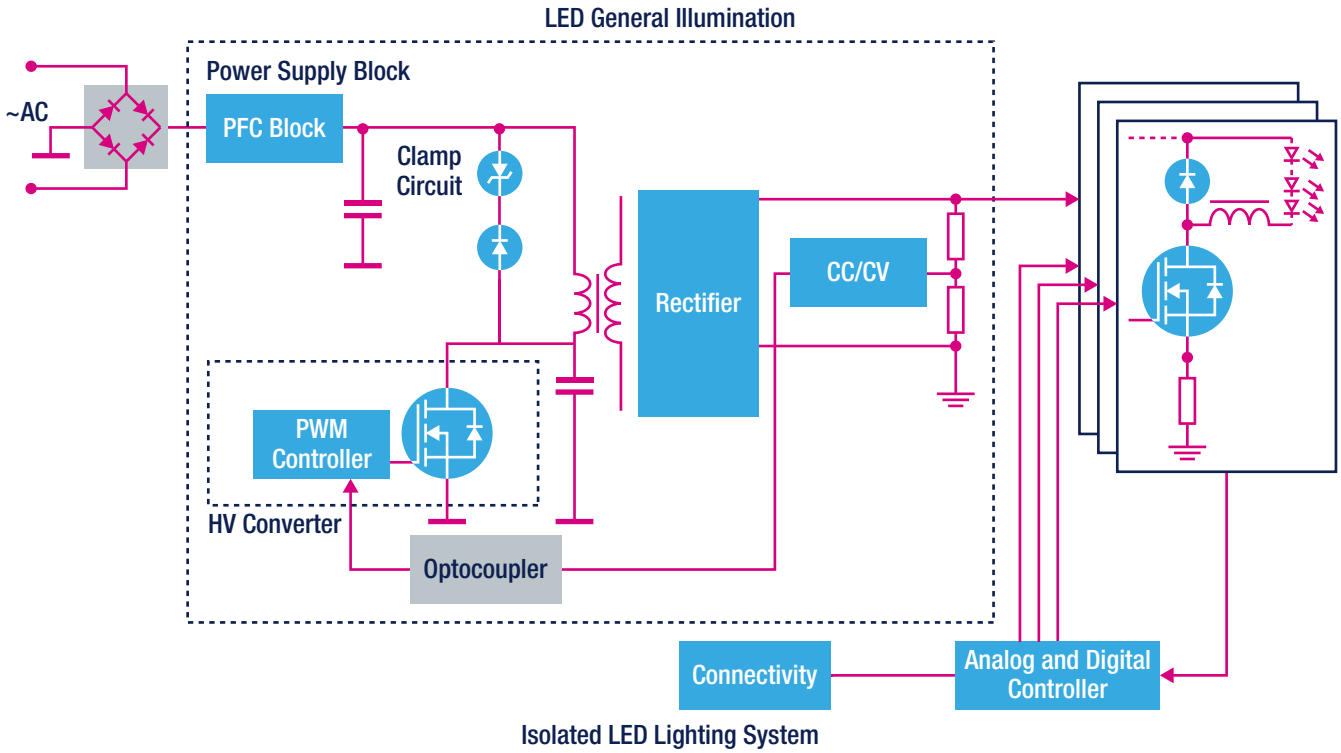
LED General Illumination

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 has to do with AC-DC and DC-DC conversion – designed using non-isolated, isolated, single stage or multi-stage topologies – that has to ensure high efficiency and reliability obtained at a competitive cost point.

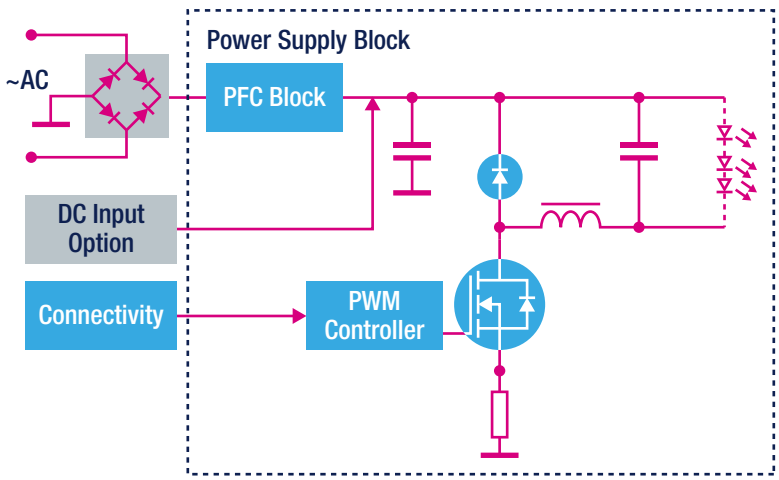
Modern applications include a range of connectivity features to implement remote monitoring and control, making the LED lighting a pillar of the smart home, smart building and smart city environment.

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 & Discretes	MOSFET and IGBT Gate Drivers
PFC Block	TM Analog Controllers L6562*, L6563*, L6564* CCM Analog Controllers L4981*, L4984D MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STLUX, STNRG	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
	Controllers & Converters	**Power MOSFETs**	**Diodes & Discretes**	**Voltage Reference, CC/CV Ctrl**
Isolation Stage	Offline LED Drivers HVLED001B, HVLED001A, HVLED007, HVLED8* HV Converters VIPer0P, VIPer*1, VIPer*6, VIPer122, VIPer*5, VIPer*7, VIPer*8 LLC Analog Controllers L6599*, L6699 PFC & LLC/LCC Combo Controllers STCMB1, STNRG011 MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STM8S, STLUX, STNRG SR Analog Controllers SRK1000, SRK1001 for Flyback SRK2000A, SRK2001, SRK2001A for LLC	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 60 V-100 V STripFET F7 ST*N6F7, ST*N8F7, ST*N10F7	Output Diodes for Flyback Schottky, FERD, Ultrafast STPS*, FERD*, STTH* Clamping Diodes for Flyback 600 V to 1000 V Ultrafast STTH*06, STTH*08, STTH*10 Output Diodes for LLC/LCC 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*, SEA* **MOSFET and IGBT Gate Drivers** HV HB Gate Drivers L649* Isolated Gate Drivers STGAP* Multiple LS Gate Drivers PM8834
Multiple strings management	Offline LED Drivers HVLED002 MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM8S, STLUX, STNRG	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*N6F7, ST*N10F7	Schottky Diodes STPS* FERD Diodes FERD* ≥ 200 V Ultrafast Diodes STTH* **DC-DC LED Drivers** LED5000, LED6000	HV HB Gate Drivers L649*, L6395 Single LS Gate Drivers PM88*1 Multiple LS Gate Drivers PM8834
	Bluetooth Low Energy (BLE)		**Sub 1GHz RF**	
Wireless Connectivity	BLE 5.0 SoC BlueNRG-2 BLE 4.2 SoC BlueNRG-1 Baluns BALF-NRG-0*D3, BALF-NRG-02J5 Wireless MCUs BLE 5.0 STM32WB	Certified Modules SPBTLE-1S, SPBTLE-RF, SPBTLE-RF0	Sub-1GHz transceivers S2-LP, SPIRIT1 MCUs STM32F0, STM32G0, STM32L0 Baluns BALF-SPI-0*D3, BALF-SPI2-0*D3	Certified Modules SPSGRF (868 and 915 MHz) SPSGRFC (433, 868 and 915 MHz)

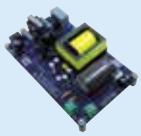
Note: * is used as a wildcard character for related part number

MAIN EVALUATION BOARDS

EVLHVLED815W15
15 W HPF LED driver with PSR

STEVAL-ILL083V1
10 W Smart home lighting with BLE

STEVAL-ILL069V2
35 W Analog power supply (CVout) for LED driving



STEVAL-ILL070V4
35 W, analog power supply (CC/CV) for single string led driver

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

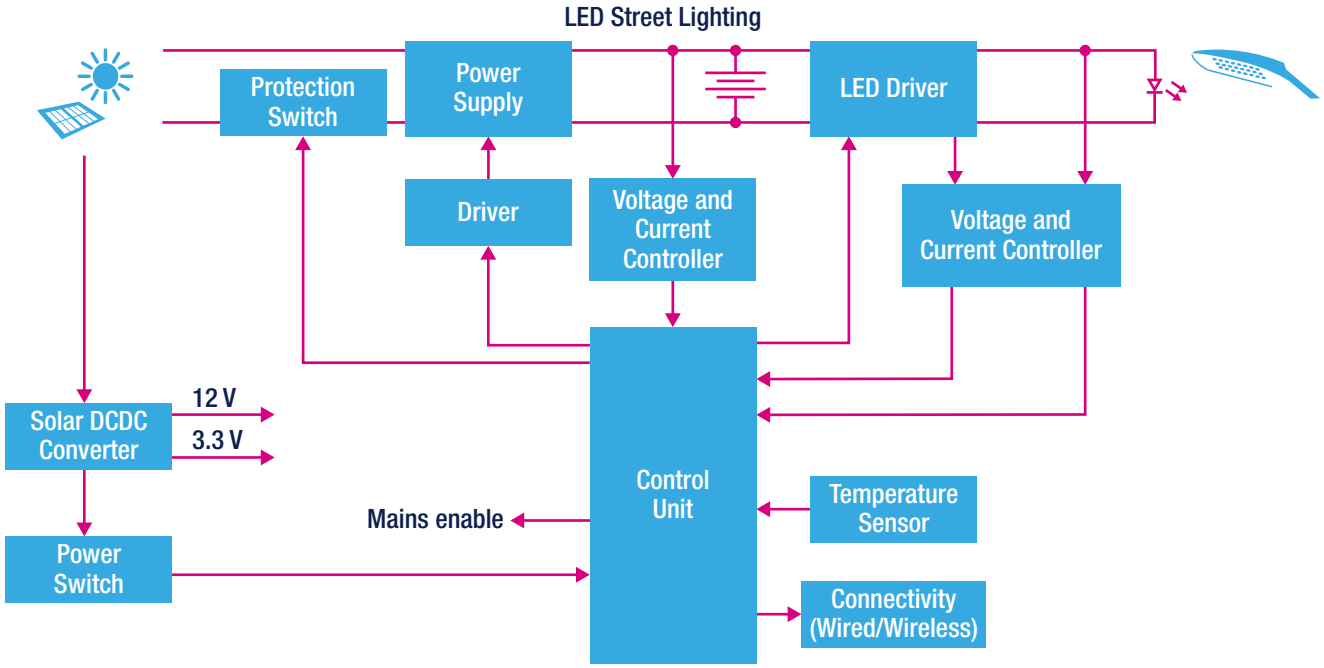
STEVAL-LLL004V1
75 W digitally controlled non isolated constant current LED driver

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 EVALUATION BOARDS

STEVAL-ILL066V2
100 W LED street lighting with STLUX digital controller

STEVAL-ILL053V2
48 V - 130 W high efficiency converter with PFC for LED street lighting

STEVAL-ILL074V1/V2
60 W Analog power supply in QR/FOT mode (CVout) for LED driving

STEVAL-ILL085V1
70 W, analog power supply low THD (CC/CV) for led driver

STEVAL-LLL006V1*
75 W LED driver (CC/CV) with Sub 1GHz Connectivity

STEVAL-LLL004V1
75 W digitally controlled non isolated constant current LED driver

EVL150W-HVSL
150 V - 150 W LED driver featuring TM PFC and LCC resonant converter with STCMB1 combo controller

EVL6699-HVSL
150 V - 150 W LED driver featuring TM PFC and LCC resonant converter with L6699

Note: * available in Q2 2019

ST'S PRODUCT OFFERING FOR LED STREET LIGHTING

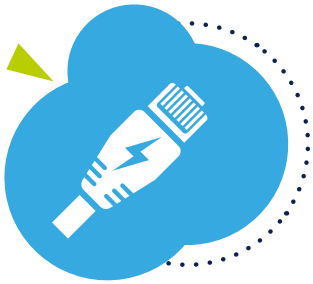
	Controllers	Power MOSFETs	Diodes & Discretes	MOSFET and IGBT Gate Drivers
Power Supply	TM PFC Analog Controllers L6562*, L6563*, L6564* CCM PFC Analog Controllers L4981*, L4984D Offline LED drivers HVLED001B, HVLED001A, HVLED007 PFC & LLC/LCC Combo Controllers STCMB1, STNRG011 LLC/LCC Controllers L6599A*, L6699 MCUs & Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STLUX, STNRG SR Analog Controllers SRK1000, SRK1001 for Flyback SRK2000A, SRK2001, SRK2001A for LLC	800 V to 1050 V MDmesh K5 ST*80K5, ST*9*K5, ST*105K5 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 SiC MOSFET SCT*N65G2 60 V-100 V STripFET F7 ST*N6F7, ST*N8F7, ST*N10F7	600 V Ultrafast for TM PFC STTH*L06, STTH*06, STTH15AC06* 600 V Ultrafast for CCM PFC STTH*R06, STTH*T06 SiC Diodes STPSC*065 Output Diodes for Flyback Schottky, FERD, Ultrafast STPS*, FERD*, STTH* Clamping Diodes for Flyback 600 V to 1000 V Ultrafast STTH*06, STTH*08, STTH*10 Output Diodes for LLC/LCC Schottky, FERD STPS* , FERD*45, FERD*50, FERD*60, FERD*100 MOSFET Protection for Flyback SMA4F, SMB15F series	Single LS Gate Drivers PM88*1 Multiple LS Gate Drivers PM8834 HV HB Gate Drivers L649* Isolated Gate Drivers STGAP* **Voltage Reference, CC/CV Ctrl** Voltage Reference T*431, T*432 Voltage and Current Ctrl TSM*, SEA
	Controllers	**DC-DC Buck LED Drivers**	**DC-DC Boost LED Drivers**	**LED Array Drivers**
LED Driver	Offline LED drivers HVLED002	LED5000 LED6000	LED6001	STP04CM05, LED8102S
	Temperature Sensors	**Control Unit**	**Protection Switch**	**Diodes and discretes**
Sensing, Processing, Control, LED Bypass	STLM20 STTS751 LM135Z	MCUs STM32F0, STM32G0	60 V-100 V STripFET F7 ST*N6F7, ST*N8F7, ST*N10F7	LBP01
	Wired - Power Line Communication	**Wireless - Sub 1 GHz RF**	**Wireless - Sigfox**	**Wireless - LoRA**
Connectivity	Power Line Transceivers ST7570, ST7580, ST7590	Sub-1GHz transceivers S2-LP, SPIRIT1 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 transceivers S2-LP MCUs STM32L0, STM32L4 Baluns BALF-SPI2-01D3 Embedded Software STSW-S2LP-SFX-DK Secure MCUs STSAFE-A100	MCUs STM32L0, STM32L1, STM32L4 Embedded Software I-CUBE-LRWAN Secure MCUs STSAFE-A100

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

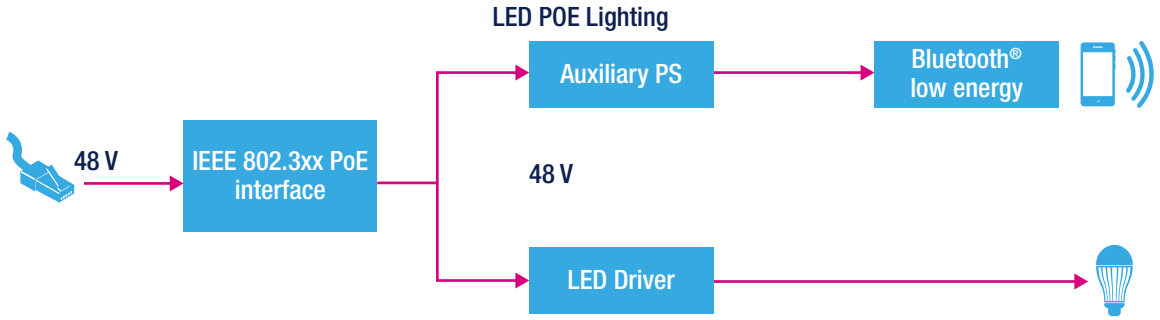
LED POE Lighting

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	
IEEE 802.3bt PM8805 IEEE 802.3at PM8803, PM8801 IEEE 802.3af PM8800A	TVS for power rail surge protecion SMA4F, SMB15F	Buck L7987L	Buck LED6000 Boost LED6001 Inverse Buck HVLED002	60 V-100 V STripFET F7 ST*N6F7, ST*N8F7, ST*N10F7 Schottky Diodes STPS*

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

MAIN EVALUATION BOARDS

STEVAL-POEL45W1

45 W PoE powered LED lighting with BLE control

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.

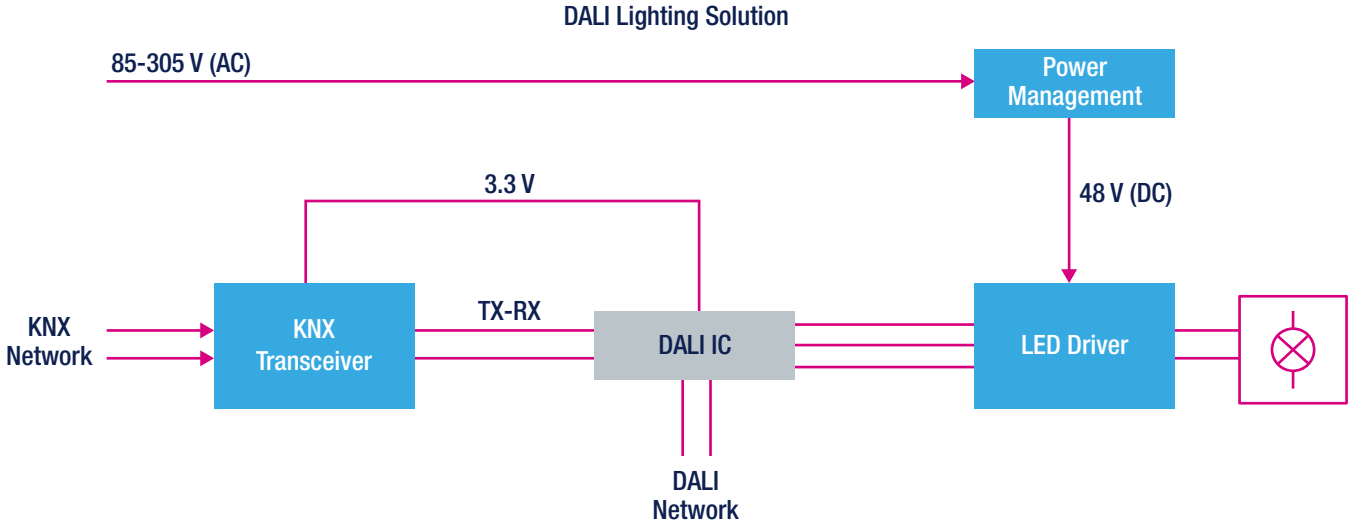
ST's long-term partnerships with major lighting suppliers combined with our leadership in discrete and integrated power devices enable us to offer high efficiency and cost-optimized solutions for all types of lighting applications and their control – both wired (e.g. Powerline) or wireless (RF) – for 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 Development Tools STSW-STLUXLIB02, STSW-STLUXSMED02	MCUs STM32F1, STM32L1, STM8 Embedded Software STSW-DALI002, STSW-DALI001, STSW-STM8025	Refer to LED General Illumination section	STKNX

MAIN EVALUATION 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

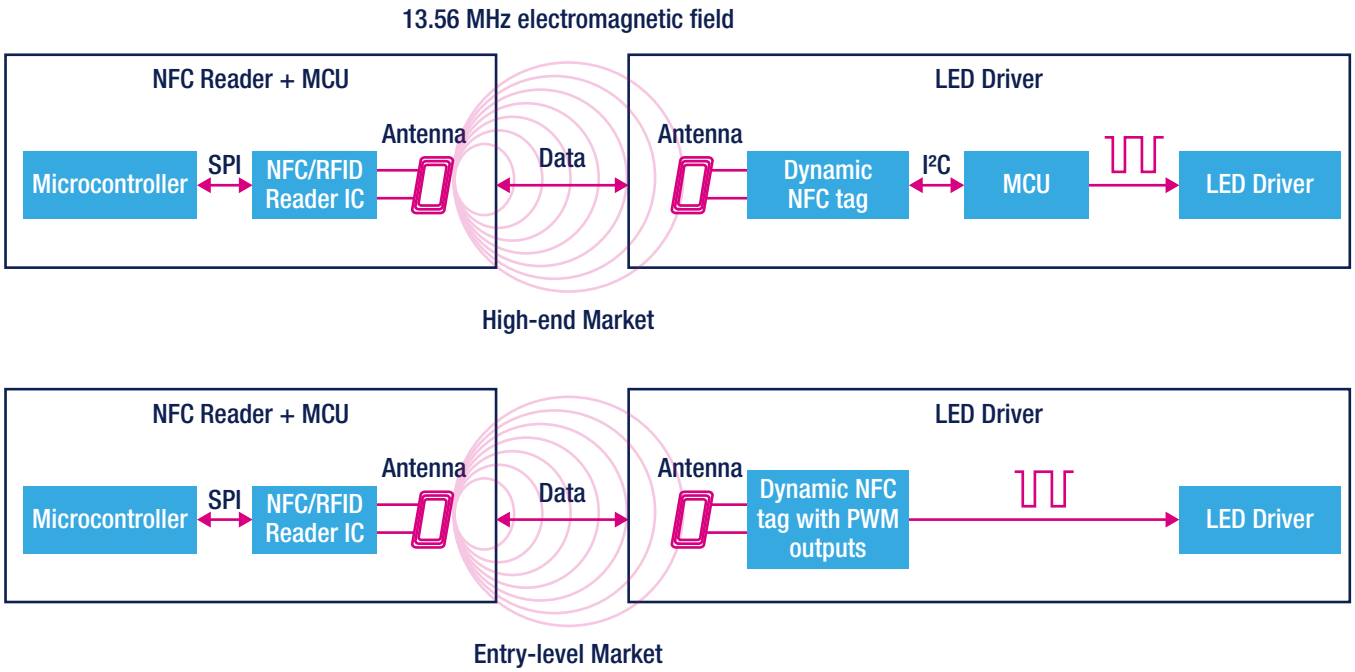
LED Wireless Programming

Today's smart LED bulbs let users control features including brightness and color. These properties are controlled though 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

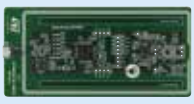


ST'S PRODUCT OFFERING FOR LED WIRELESS PROGRAMMING

	NFC/RFID Reader IC	Microcontrollers	
NFC Reader + MCU	ST25R	STM8S STM32F0. STM32G0	
	Dynamic NFC Tag	**MCUs and Digital Controllers**	**LED Driver**
LED Driver for high-end market	ST25DV-I²C Series	STM8S STM32F0, STM32G0 STM32F3, STM32F334, STM32G4 STLUX	HVLED001*, HVLED002 LED600*, LED5000, LED2000 STP04/08/16/24
	Dynamic NFC Tag with PWM Output		**LED Driver**
LED Driver for entry-level market	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 EVALUATION BOARDS



ST25R3911B-DISCO

Discovery kit for ST25R3911B high performance HF reader/NFC

ST25DV-PWM-eSET

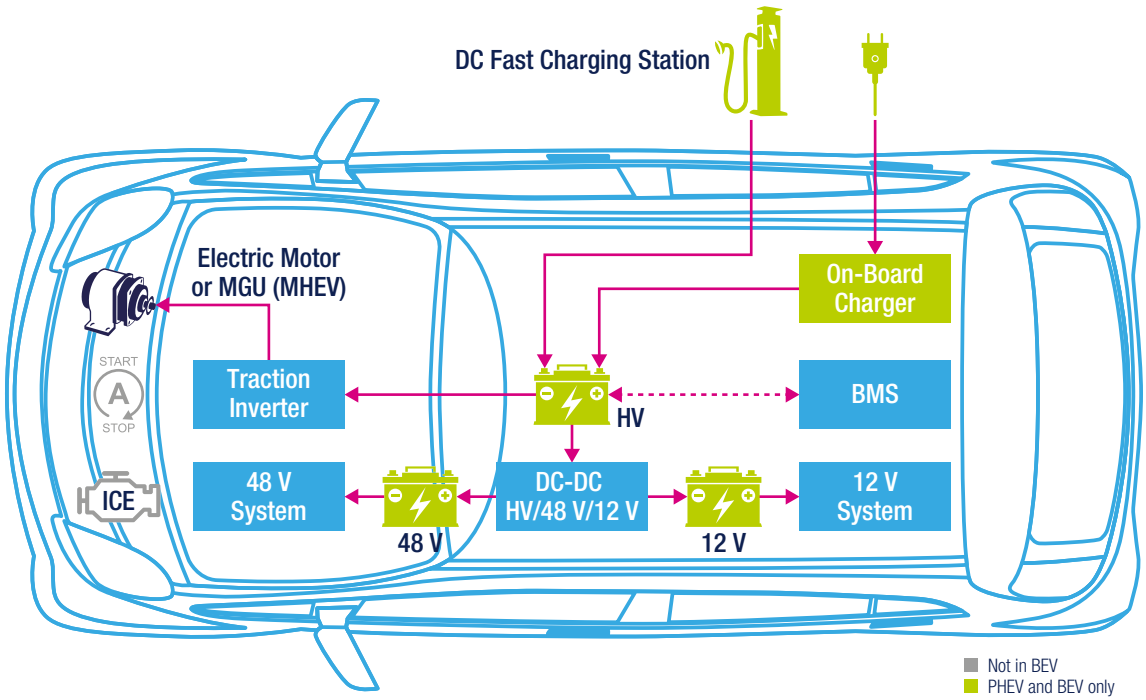
Discovery kit for the ST25DV-PWM NFC/RFID tag IC

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				

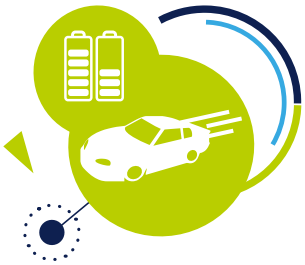
Smart Driving

FIND OUT MORE

www.st.com/electro-mobility

Battery Management System (BMS)
Charging Station
DC-DC Converter
Electric 2-wheelers
Electric Traction (Main Inverter)
Mild Hybrid 48 V Systems
On Board Charger (OBC)

Traction Main Inverter

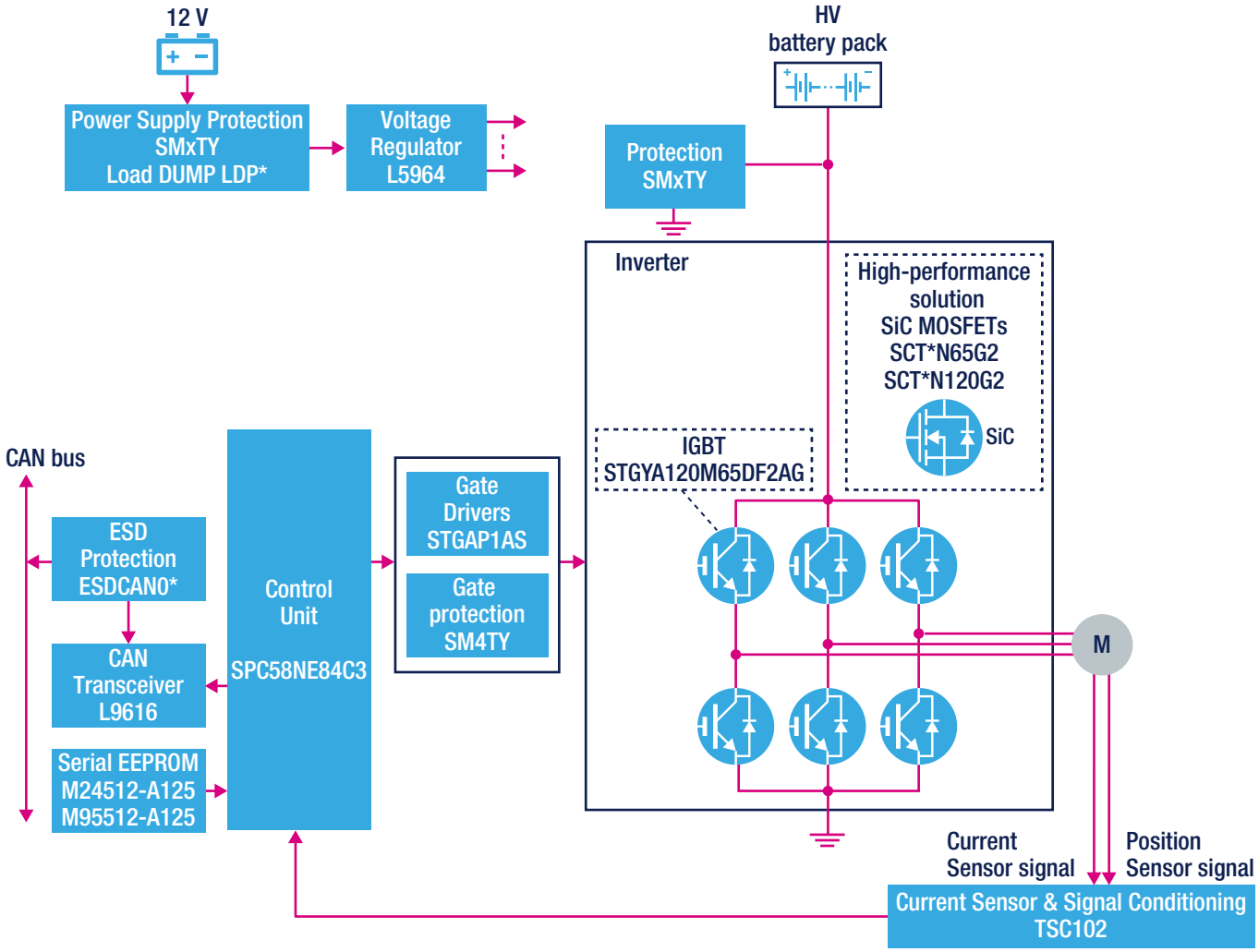


The traction inverter converts energy from the vehicle's battery to drive the electrical engine. This key component has a direct impact on road performance, driving range and reliability of the vehicle due to its generated power traction and its weight and size.

Subject to intense heat and vibration in the vehicle, these converters must be able to handle high power and currents along with associated Electro Magnetic Compatibility (EMC) challenges. Fail-safe operation needs to be assured to ensure reliability 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 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 scalable, cost-effective and energy-efficient solutions.

Main Inverter



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

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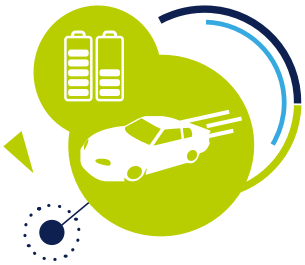
www.st.com/main-inverter-electric-traction

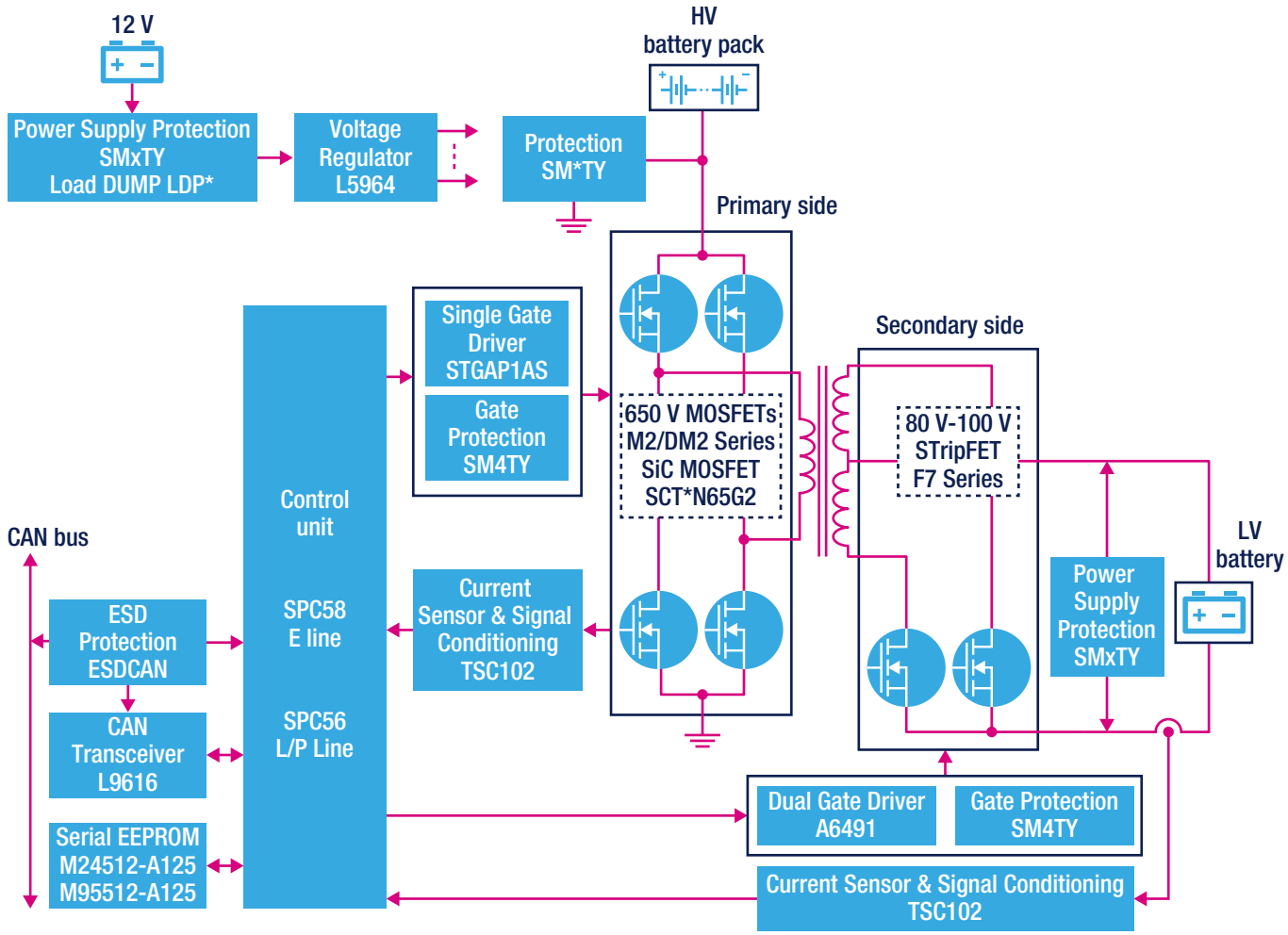
Bidirectional DC/DC Converter



Electric vehicles (EV) use two different power systems; a high-voltage battery (200 to 800 Vdc) for traction and a low-voltage (12/48V) 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-Q101qualified 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 microcontrollersto enable scalable, cost-effective and energy-efficient solutions for implementing these challenging converters.

Bidirectional DC/DC Converter



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

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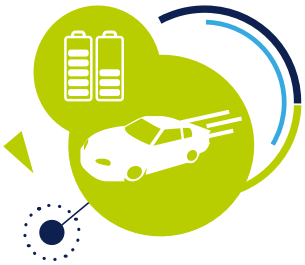
www.st.com/bidirectional-dc/dc-converter

48 V Start-Stop System

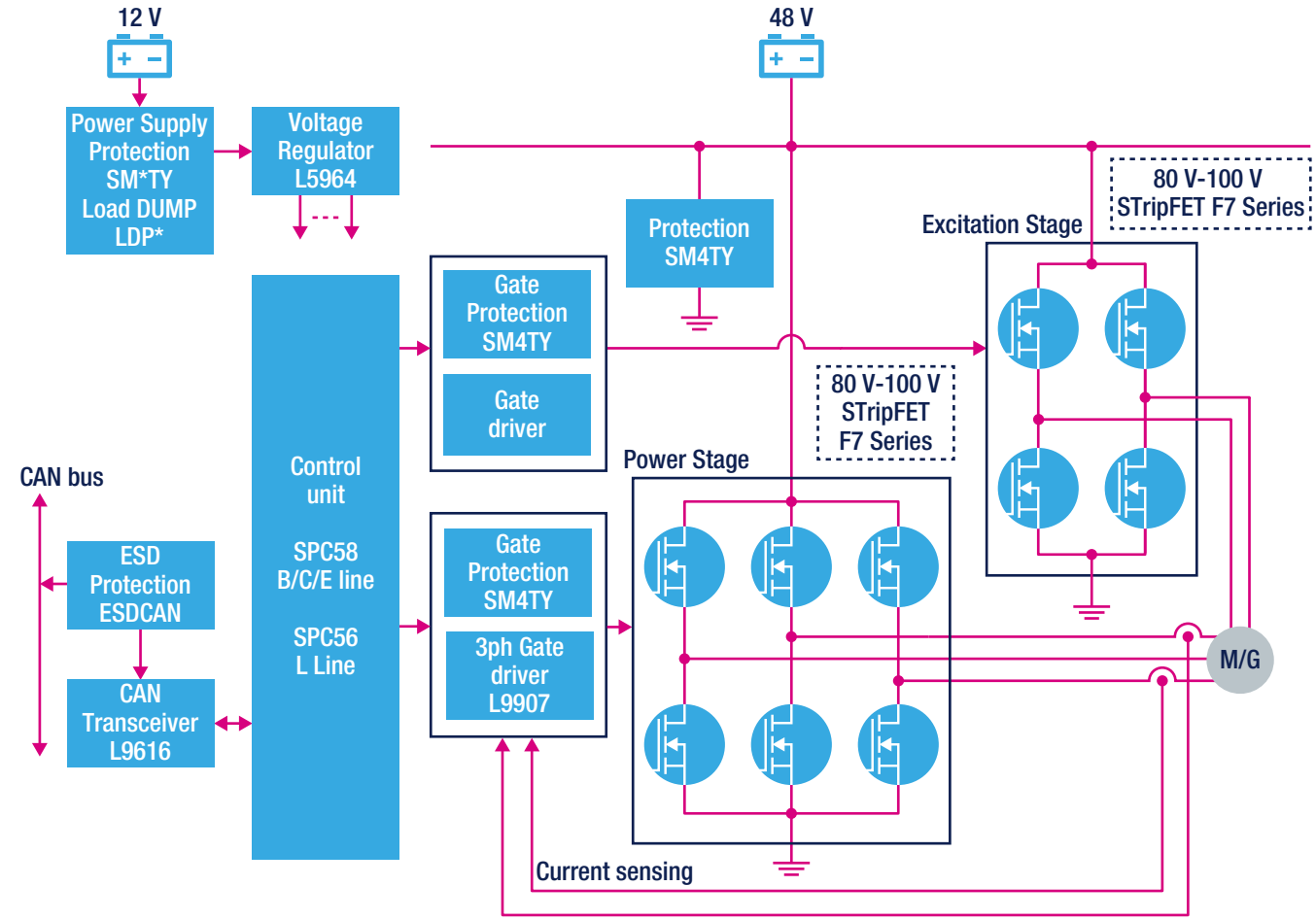
A Start-Stop system automatically shuts down and restarts the internal combustion engine to reduce the amount of idle time, thereby improving fuel economy and reducing CO2 emissions. This is especially useful in urban traffic environments where vehicles can spend significant amounts of time in traffic.

This requires power electronics that can handle high current during cranking and ensure reliability during engine cycles operating on/off at high temperatures.

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



Start-Stop system



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

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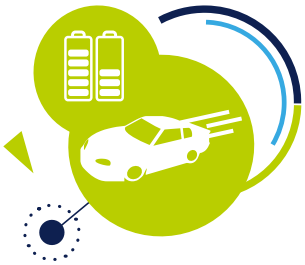
www.st.com/48v-start-stop-system

On-Board Charger (OBC)

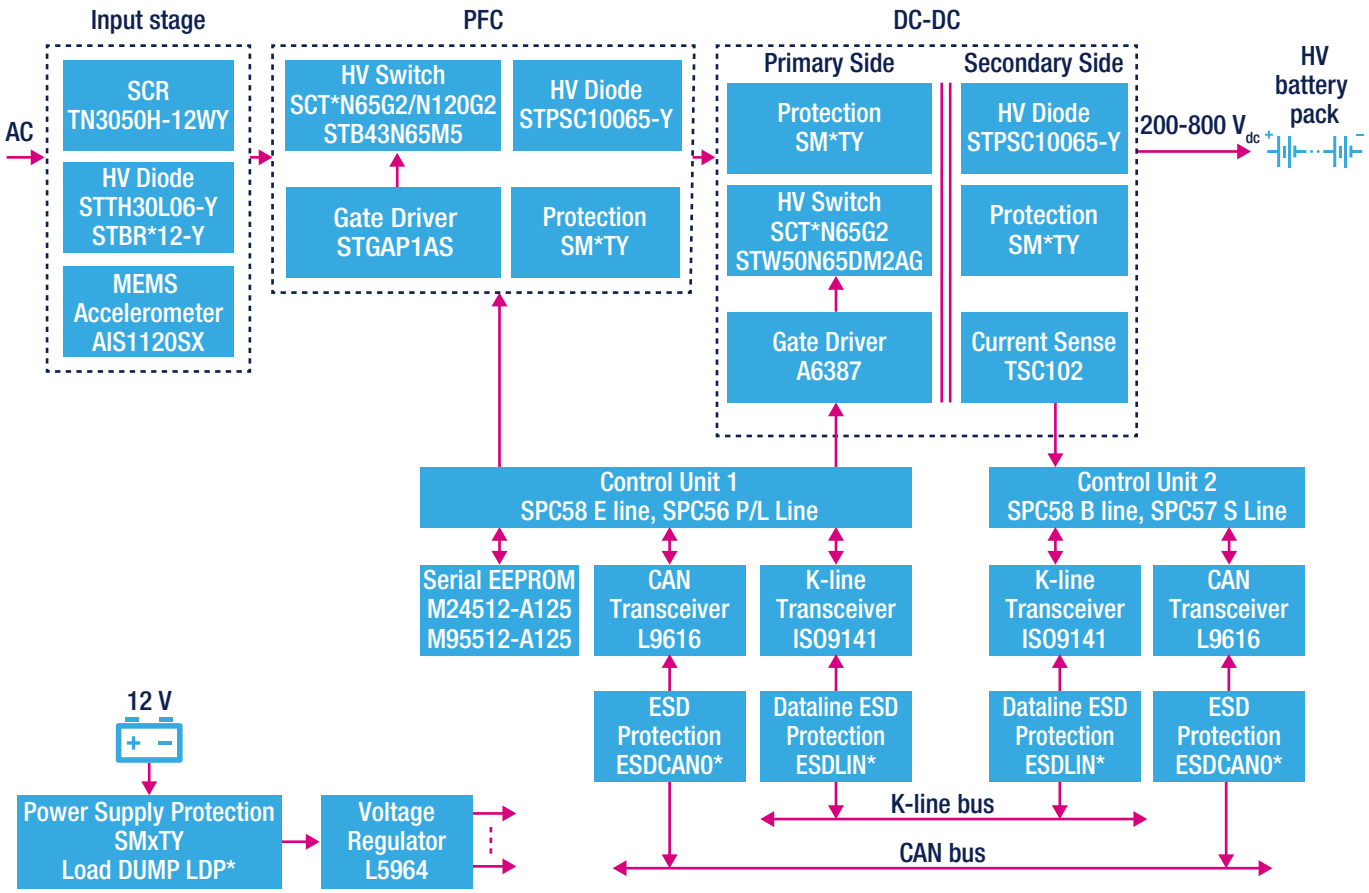


At the heart of any electric (EV) or plug-in hybrid (HEV) vehicle lies the high-voltage (200 to 800 Vdc) battery and its associated charging system. The on-board charger (OBC) provides the means to recharge the battery from the AC mains either at home or from outlets found in private or public charging 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-Q101qualified 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.

OBC



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

FIND OUT MORE

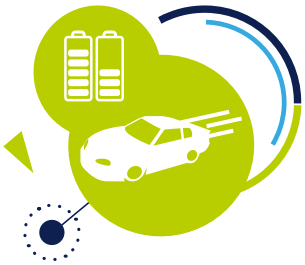
www.st.com/on-board-charger

DC Fast Charging Station

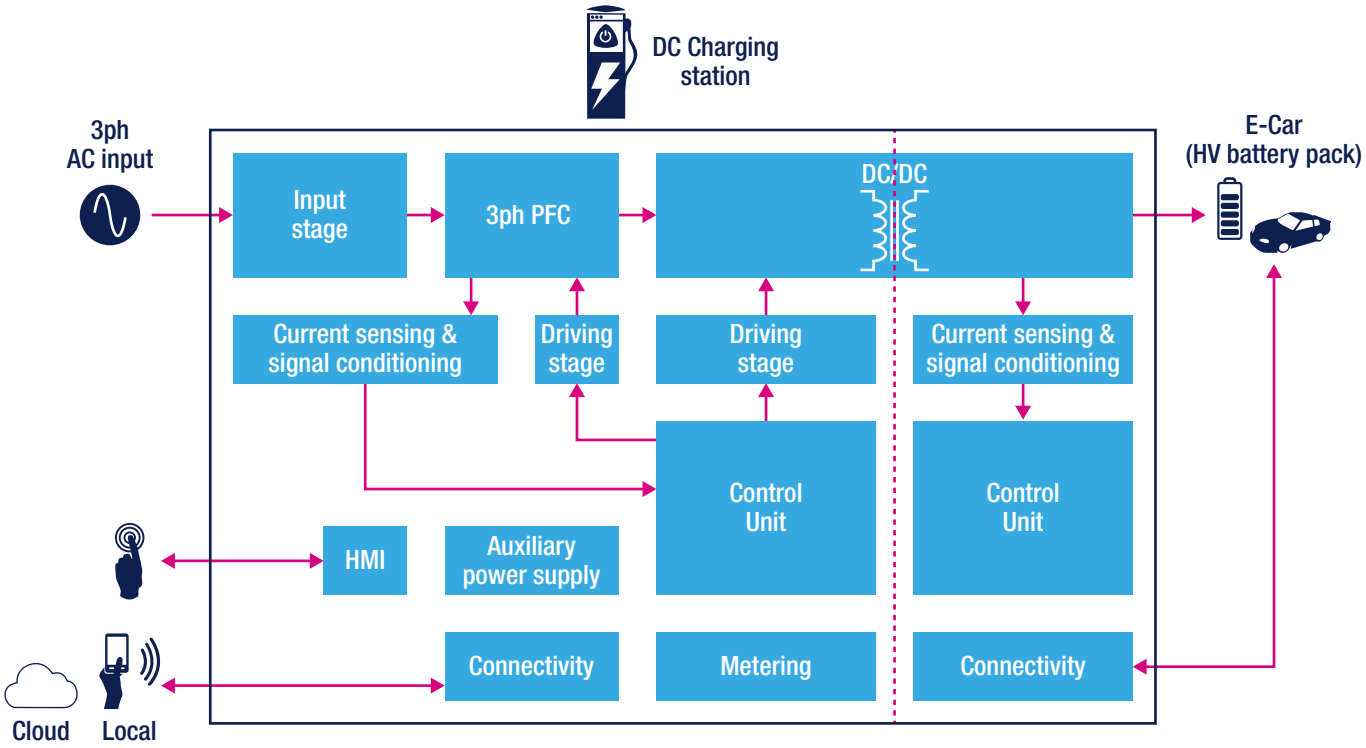
The number of full electric vehicles (EVs) is rapidly growing and, as a result, the charging infrastructure is also expanding, including DC fast charging stations, which have the attractive capability of providing the vehicle with a 100 km driving range in just 10-12 minutes.

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



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 - 600/650 V			•		•									
	SiC series - 1200 V			•		•									
	Ultrafast RQ series - 600 V			•	•	•									
	Ultrafast R series - 600 V			•	•						•				
	STBR series - 1200 V		•	•											
	Schottky series - 40/45/60/100 V										•				
Thyristors	TN series - 1200 V		•												
	TYN series - 1200 V		•												
	TM8050H series - 800 V		•												
	TN3050H, TN5050H series -1200 V		•												
TVS protections	SM4TY, SM6TY, SM15TY, SM30TY			•	•	•					•				
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								•						
	STGAP1AS								•						
Memories (EEPROM)	M24**, M95**						•								
Current sense amplifiers	TSC102			•						•					
HV converters	VIPer06, VIPer16, VIPer26, VIPer26K										•				
Offline controllers	L6566BH, STCH02, STCH03										•				
Voltage regulators	L5963, L5964 L798*, L698*										•				
CAN transceivers	L9616														•
CAN ESD protections	ESDCAN Series								•				•		•
Power line transceivers	ST2100													•	•
	ST7540, ST7580, ST8500													•	
Bluetooth Low Energy Transceiver	ICs	BlueNRG-MS, BlueNRG-1, BlueNRG-2												•	
	Modules	SPBTLE-1S, SPBTLE-RF, SPBTLE-RF0												•	
NFC/RFID	Dynamic tags	M24SR, ST25DV-I2C												•	•
	Readers	ST25R												•	•
Metering ICs	STPM32, STPM33, STPM34												•		
LED arrray drivers	LED1642, STP08, STP16, LED77*, LED8102S											•			

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.

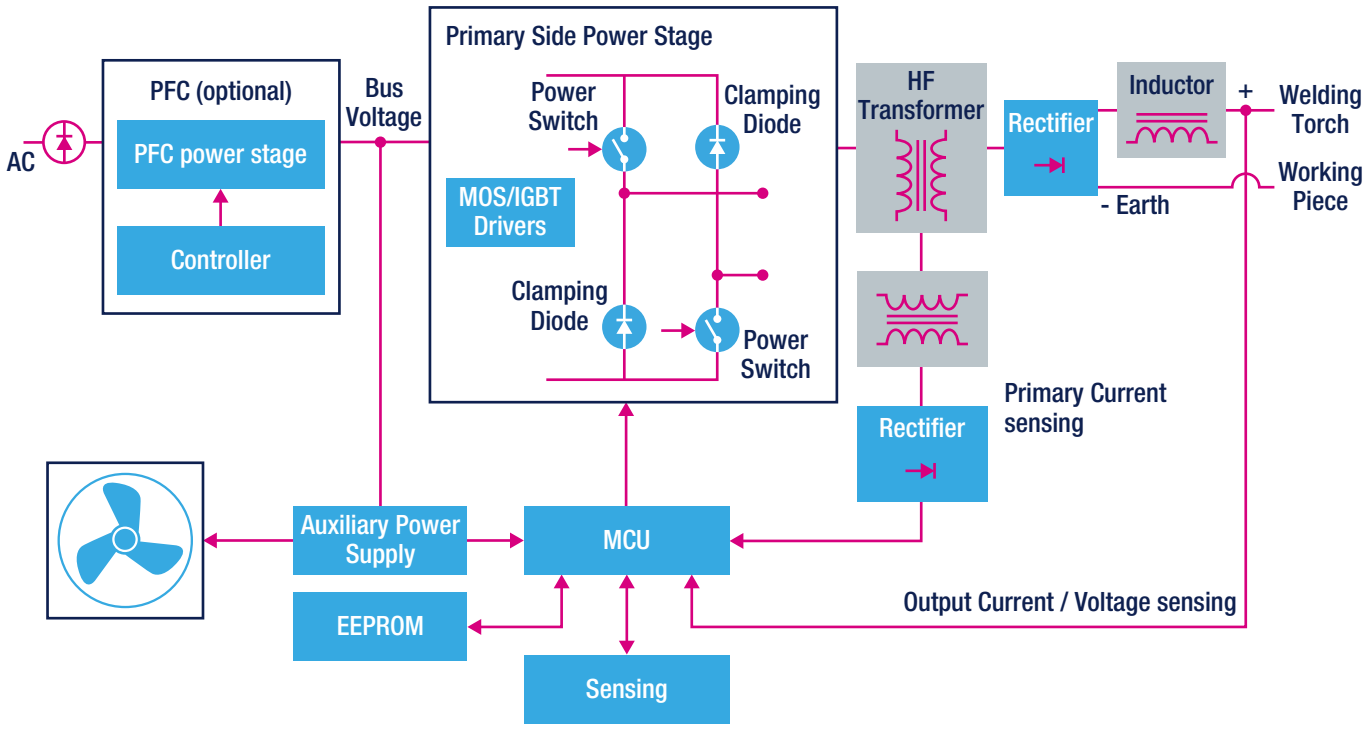
We have a range of power MOSFETS and diodes – both Si and SiC based for higher efficiency – and IGBTs as well as galvanically isolated gate drivers and high-performance 32-bit STM32 microcontrollers to enable compact designs with higher efficiency.

ST'S PRODUCT OFFERING FOR INDUSTRIAL WELDING

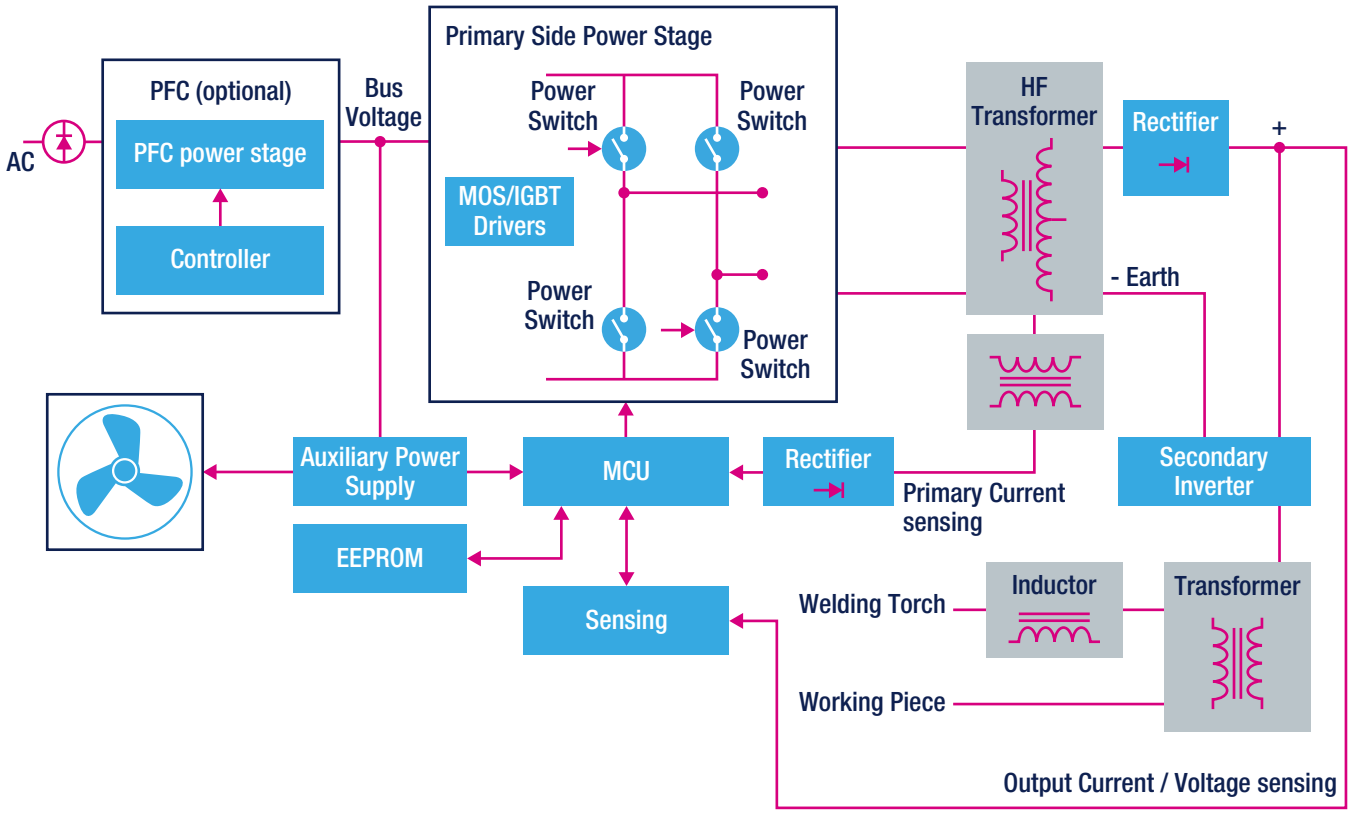
	MCUs & Digital Controllers	MOSFET/IGBT Gate Drivers	IGBTs	Power MOSFETs	Diodes
PFC	MCUs STM32F0 STM32G0 STM32F301 STM32F334 STM32G4 Digital Controllers STNRGPF01, STNRGPF12	Single LS Gate Drivers PM88*1, TD35* Multiple LS Gate Drivers PM8834 Isolated Gate Drivers STGAP* HV HB Gate Drivers L649*	600 V V series STG*V60F 650 V HB series STG*H65FB 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*12
DC-DC TTF	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	650 V MDmesh M5 ST*65M5 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 800 V to 1200 V MDmesh K5 ST*80K5, ST*9*K5, ST*105K5, ST*120K5 650 V-1200 V SiC MOSFETs SCT*N65G2, SCT*N120	600 V Ultrafast STTH*R06, STTH*06 1000-1200 V Ultrafast STTH*10, STTH*12
DC-DC PS-FB					
Secondary Inverter			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

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



Uninterruptable Power Supplies (UPS)

Uninterruptable 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 UNINTERRUPTABLE POWER SUPPLIES (UPS)

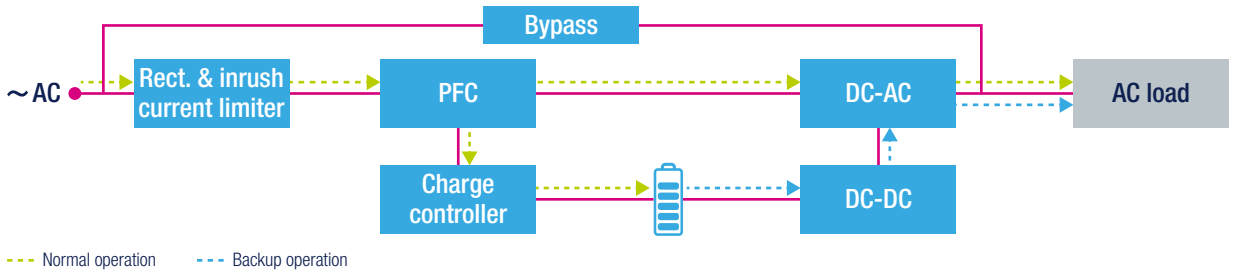
	SCRs & TRIACs	Diodes		SCRs & TRIACs
Rect. & inrush current limiter	High Temp. SCR TN*015H-6, TN*050H-8, TN*050H-12W High Temp. Triacs T1635T	Bridge Rectifier Diodes STBR*12	**Bypass**	Standard SCR TYN6*, TYN8*, TYN10*, TYN12* High Temp. SCR TN5050H-12WY Standard and Snubberless Triacs T2550-12, TPDV*

	MCUs & Digital Controllers	Power MOSFETs	IGBTs	Diodes	Opamp V/I Sensing	
PFC Block	MCUs STM32F0, STM32G0, STM32F301, STM32F334, STM32G4 Digital Controllers STNRG, STNRGPF01, STNRGPF12	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 MOSFET SCT*N65G2	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 Ultrafast for CCM STTH*R06 STTH*T06 SiC Diodes STPSC*065 STPSC*12	Precision Op Amps (<50 MHz) TS*, TSV*, LMV* **MOSFET and IGBT Gate Drivers** Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1	

	MCUs	Power MOSFETs		Diodes	MOSFET and IGBT Gate Drivers	Protections
Charge Controller	STM32F334 STM32G4 STM32F4 STM32F7	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 MDmesh DM6 ST*60DM6		600 V Ultrafast STTH*06 1200 V Ultrafast STTH*12 SiC Diodes STPSC*065 STPSC*12	HV HB Gate Drivers L649* Isolated Gate Drivers STGAP*	TVS for MOSFET Protection SMA4F, SMB15F series
		Power MOSFETs	**IGBTs**		**MOSFET and IGBT Gate Drivers**	**Post Regulation**
DC-AC Stage		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, L7985, L7986, L7987* Low Dropout (LDO) Linear Regulators LDF, LDFM, LDK220, LDK320, LDK715, LDL212
DC-DC Stage		60 V-100 V STripFET F7 ST*N6F7, ST*N8F7, ST*N10F7				

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

Example of high-end configuration (double-conversion system solution)



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 the 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

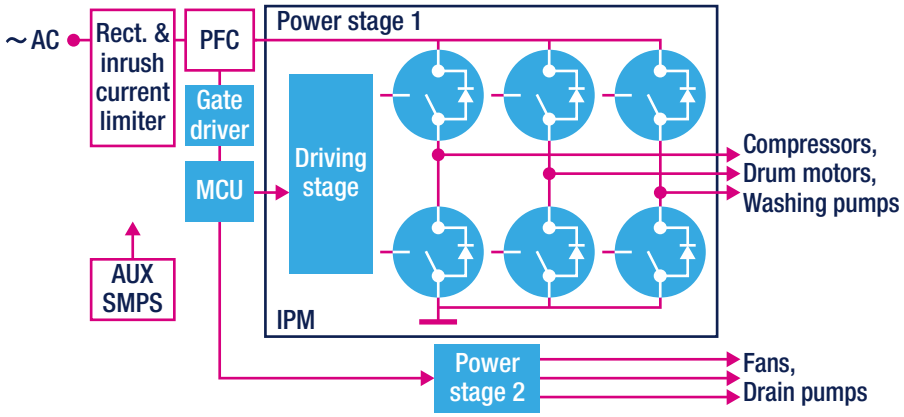
	SCRs & TRIACs	Diodes		LED Drivers		HV Converters
Rect. & inrush current limiter	High Temp. SCR TN*015H-6, TN1610H-6, TN*050H-12W Standard SCR: TN815, TN*15-600B High Temp. Triacs: T1635T	Bridge Rectifier Diodes STBR*12	**User Interface**	LED Array Drivers STP04/08/16/24 LED12/16/24*	**AUX SMPS**	VIPerPlus

	MCUs & Digital Controllers	IGBTs	Diodes	Opamp V/I Sensing	Power MOSFETs	Power Breakers
PFC Block	MCUs STM32F0, STM32G0, STM32F103, STM32F301, STM32F334, STM32G4, STM32F4 Digital Controllers STNRG, STNRGPF01, STNRGPF12	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) TS*, TSV*, LMV* **MOSFET and IGBT Gate Drivers** Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1	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 MOSFET SCT*N65G2	STPW05, STPW12

	MCUs	IGBTs	IPM	MOSFET and IGBT Gate Drivers	Power MOSFETs	Post Regulation
3Ph Inverter **Compressor, Drum Motor, Fan, Pumps**	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*	600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V MDmesh DM6 ST*60DM6 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 EVALUATION BOARDS

STEVAL-IHT008V1

1 kW, digital inrush current limiter based on Triac

STEVAL-IPM*

300 W to 3 kW Power board based on SLLIMM™

Induction 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.

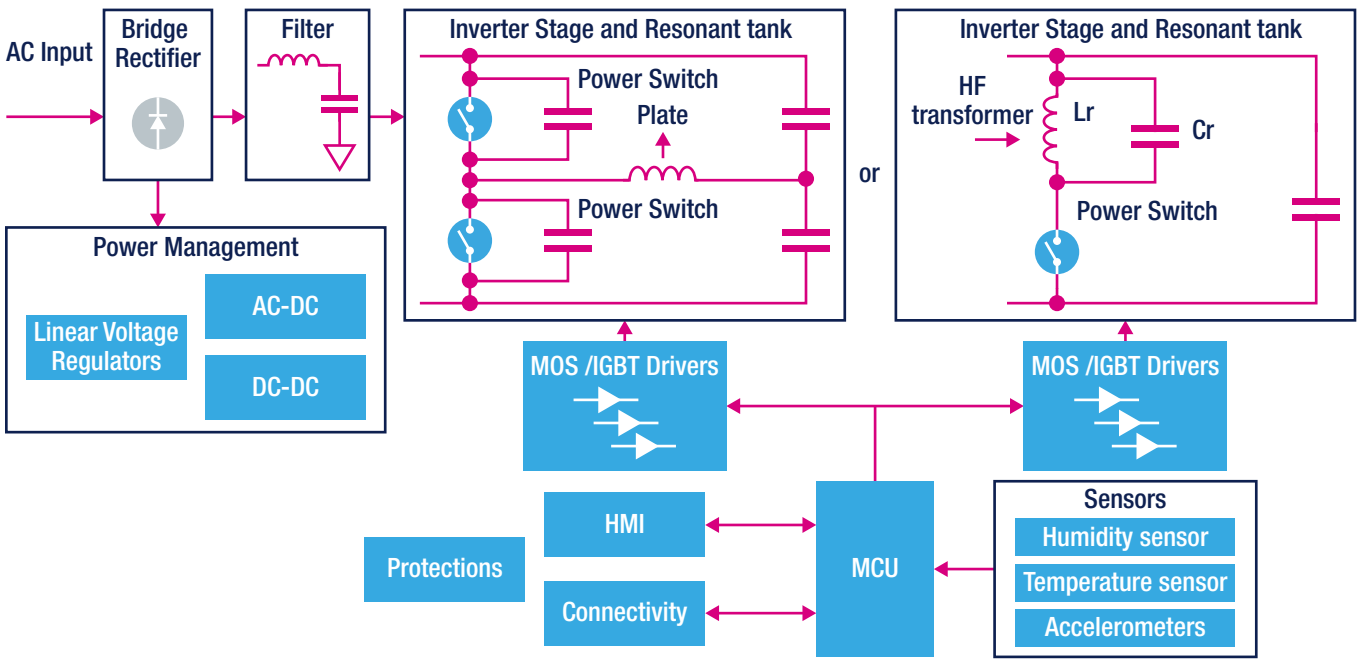
ST'S PRODUCT OFFERING FOR INDUCTION COOKING

	MCUs	IGBTs	MOSFET and IGBT Gate Drivers	Sensors
Single-switch quasi-resonant (voltage resonance)	STM8* STM32F100	1250 V IH series STG*IH125DF	Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1	Enviromental Sensors Humidity - HTS221 Temperature - STLM20 Temperature - STTS751 Motion Sensors Accelerometer IIS3DHHC
	MCUs	**IGBTs**	**MOSFET and IGBT Gate Drivers**	
HB series resonant (current resonance)	STM32F0, STM32G0 STM32F100	600 V HB series STG*H60DLFB 650 V IH series STG*IH65DF	HV HB Gate Drivers L649* Isolated Gate Drivers STGAP*	

	MCUs	LED Drivers		AC-DC	DC-DC	LDO
User interface (front panel)	STM8, STM32F0, STM32G0, STM32F4*9, STM32F7*	LED Array Drivers STP04/08/16/24, LED1642GW, LED8102S, LED12/16/24*	**Power Management**	VIPerPlus	L698*, ST1S14, L7985, L7986, L7987*	LDF, LDFM, LDK220, LDK320, LDK715, LDL212

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

Topology example



MAIN EVALUATION BOARD

Board available on request

1.8 kW, quasi-resonant induction cooking system

Software tools

eDesignSuite

eDesignSuite is an easy-to-use, comprehensive software suite ready to help customers define their needs by transforming their application requirements into satisfactory solutions based on the wide range of ST products. The suite includes a smart simulator and system design engine able to suggest products and topologies for various types of applications (power supply, photovoltaic, battery charger, LED lighting, signal conditioning and RF design); smart selectors to help select the types of products (e.g. diodes) best suited to your application; and configurators to reduce implementation time and efforts for setting product parameters for the specific application (e.g. STLUX & STNRG SMEDs for lighting and power, Workbench for motor control). To discover and test all the features of eDesignSuite, you can visit (after the online registration) **https://my.st.com/analogsimulator/**

SMART SIMULATOR AND SYSTEM DESIGN ENGINE

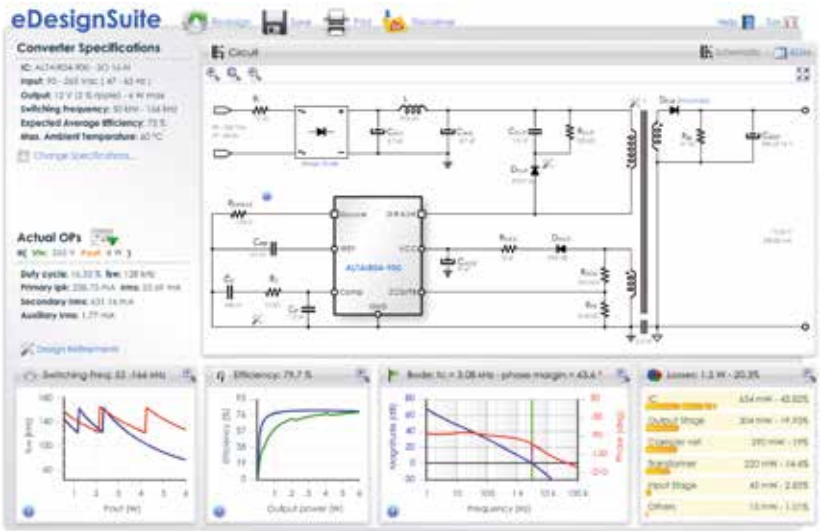
Power conversion and LED lighting

- Automatic proposal for complete solution or fully customizable design
- Fully annotated and interactive schematics
- Complete and interactive bill of materials
- Set of analysis diagrams (main current and voltage simulations, efficiency curves, Bode stability and power-loss data)
- Fully interactive transformer design
- New iPFC design based on STNRGPF01 and STNRGPF12 digital controllers including c code generation

SMART SELECTOR

Diodes

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



Smart simulator and system design engine view

CONFIGURATORS

STLUX & STNRG SMEDs configurator

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

Products

AC-DC CONVERSION ICs

High-voltage converters

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

The **VIPerPlus series** (VIPer0P, VIPer122 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.

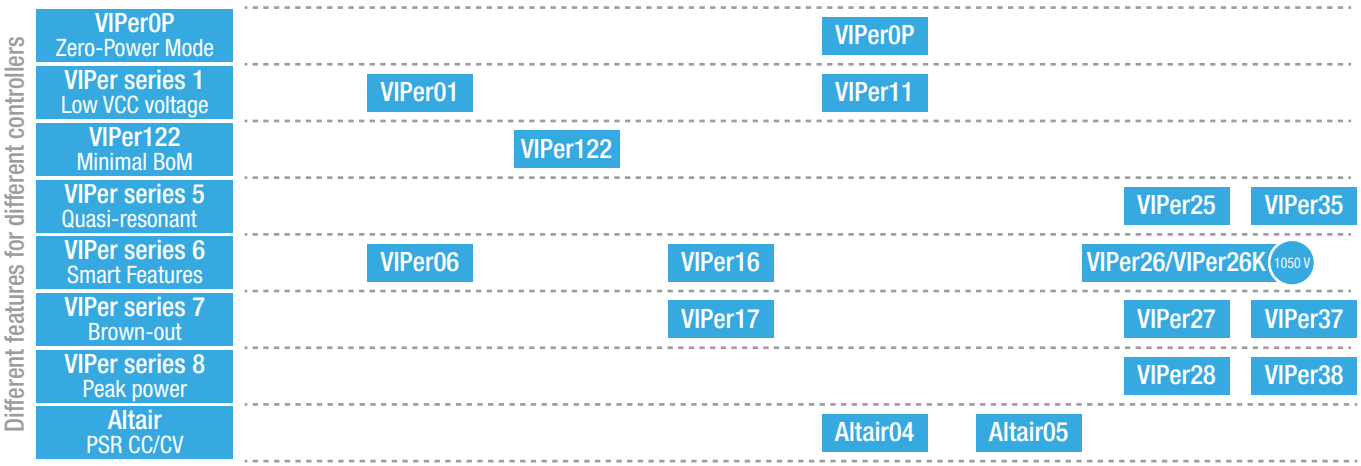
The VIPer26K belongs to VIPer*6 family and integrates a 1050 V avalanche-rugged power MOSFET, suitable for cost effective 1-phase/3-phases smart meters, industrial systems and lighting power supplies.

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.

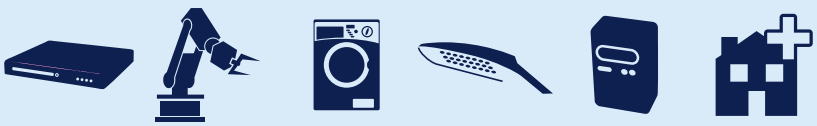
VIPerPLUS

VIPerPLUS & ALTAIR
PWM controller +
HV power MOSFET
in the same package

- Increased robustness using up to 1050 V AR MOSFET
- Extremely low consumption
- Better integration and minimal BoM
- Flexible and easy to use
- Flyback topology supported
  - Regulation with optocoupler using all ICs
  - PSR-CV using VIPer0P, VIPer122, VIPer*1 and VIPer*6
  - PSR-CV/CC tight tolerance using Altair
- Buck & buck-boost topologies supported by VIPer0P, VIPer122, VIPer*1 and VIPer*6



MAIN APPLICATIONS



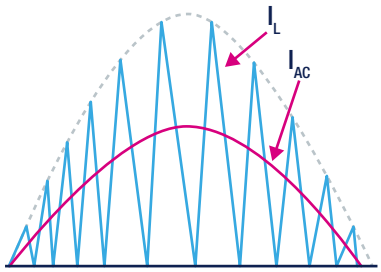
Consumer electronics | Factory automation | Home appliances | Lighting | Smart metering | Smart home

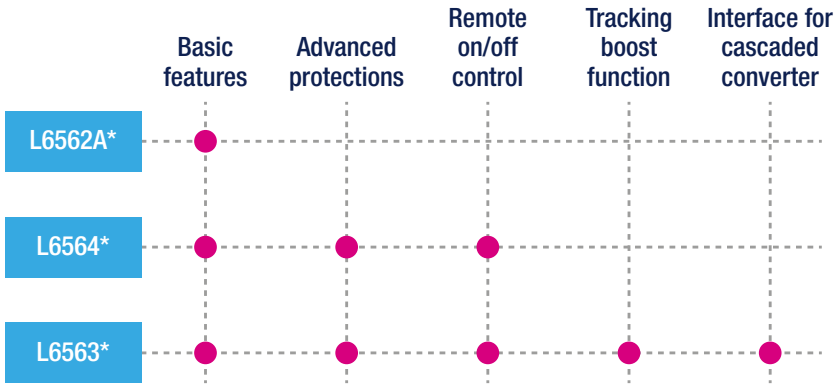
www.st.com/viperplus
www.st.com/ac-dc-converters
www.st.com/high-voltage-ac-dc-converters

PFC controllers

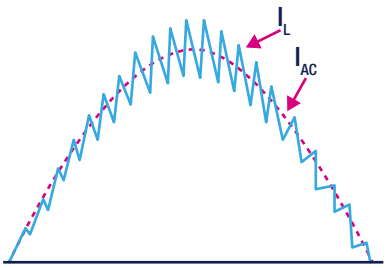
ST **power factor correction (PFC) controllers** operate in transition mode (TM, suitable for P ≤250 W) and continuous current mode (CCM, suitable for P >250 W), and are suitable for a wide-range-mains operation.
These devices embed advanced protection features, which make SMPS more robust and compact, 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





CCM PFC controllers



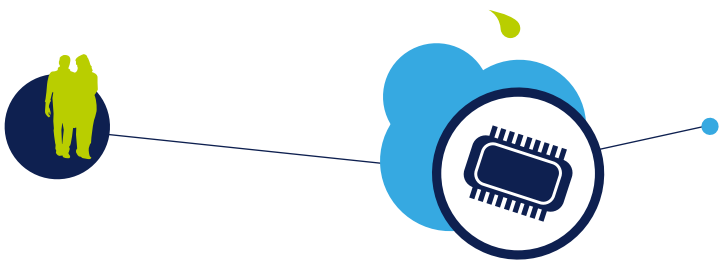
L4984D	Line-modulated, fixed-off-time (LM-FOT) control
L4981A	Fixed frequency, average-current mode
L4981B	Line modulated frequency, average-current mode

MAIN APPLICATIONS

Adapters and TVs
L6562A*, L6563*, L6564*

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

Desktop PCs and Server
L4981*, L4984D



www.st.com/ac-dc-converters
www.st.com/pfc-controllers

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

PWM and resonant controllers

ST's portfolio of advanced controllers includes a variety of **primary controllers** intended to fit high-performance applications. Very high efficiency is achieved with single-ended topologies at a fixed switching frequency or with quasi-resonant operation; the new 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 new 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.

Flyback controllers

STCH02/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 (only for STCH03)
- 650 V HV start up

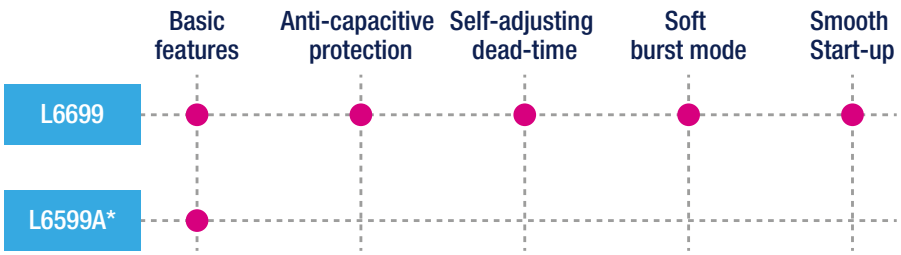
L6566*

- Offline fixed-frequency or quasi-resonant controllers
- Suited for SMPS with PFC front-end (A version)
- Suited for SMPS with 3-phase mains (BH version)
- 700 V start up (A/B version), 840 V start up (BH version)

L6565

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

HB-LLC resonant controllers



Analog combo controller (PFC+LLC/LCC)

STCMB1

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

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

STNRG011

- Onboard 800 V startup circuit, line sense and X-cap discharge compliant with IEC 62368-1, for reduced standby power
- 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*, STCH02, STCH03

Laptops
L6565, L6566*, STCH02, STCH03, STCMB1, STNRG011

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

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

www.st.com/ac-dc-converters
www.st.com/pwm-controllers
www.st.com/resonant-controllers

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

Synchronous rectification controllers

Synchronous rectifiers are used to drive power MOSFETs that replace the rectification diodes in the secondary side of SMPS, thus providing high efficiency especially in low-output-voltage, high-current power supplies.
The product portfolio supports the most common flyback and LLC resonant topologies. The main benefits include high efficiency, space saving, cost reduction and high reliability.

SR Controllers for Flyback

	Basic features	DVS AMR	Programmable blanking times after toff	Package
SRK1000		100 V	Fixed (3 PN available to cover 3 different values)**	SOT23-6L
SRK1001		185 V		SO8

**Three options available: SRK1000 (0.5 µs), SRK1000A (2 µs), SRK1000B (3 µs)

SYNCHRONOUS RECTIFICATION BENEFITS

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

SR controllers for LLC resonant

	Basic features	Matched turnoff threshold	Auto-compensation of parasitic inductance	Reduced adaptive turn-on delay	Reduced masking time "current inversion comparator"
SRK2000A					
SRK2001					
SRK2001A					

MAIN APPLICATIONS

High-power adapters and TVs
SRK1000, SRK1001

Desktop PCs and Server/Telecoms
SRK2000A, SRK2001, SRK2001A

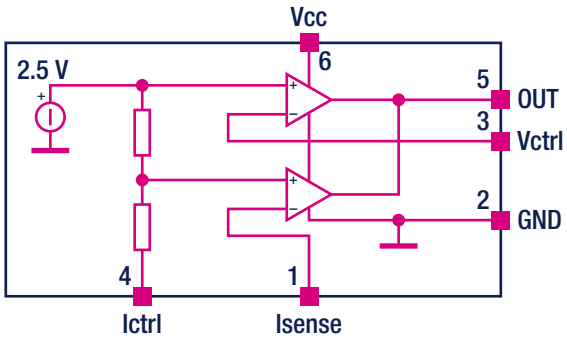
www.st.com/ac-dc-converters
www.st.com/synchronous-rectification-controllers

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

Voltage and current controllers

ST offers a wide range of highly-integrated **voltage controllers** for constant-voltage (CV), constant-current (CC) SMPS applications, such as adapters, battery chargers and LED pilot lamps. They enable a more robust design, safer SMPS, very low power dissipation and low stress for secondary-side components.

SEA05 internal block diagram



CC/CV controllers for chargers, adapters and others

SEA01

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

SEA05 **SEA05L**

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

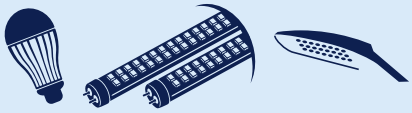
TSM10*

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

MAIN APPLICATIONS


Adapters


Battery chargers


Residential, commercial and street lighting

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

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

Signal conditioning

Signal conditioning devices include **Operational Amplifiers** and **Current Sensing 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

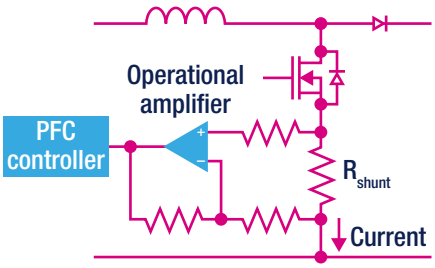
TSZ181, TSZ182

- 5 V zero-drift amplifier
- Input offset voltage 15 µV max
- Gain bandwidth 3 MHz

TSB712, TSB7192

- 36 V amplifier
- Input offset voltage 300 µV max
- Gain bandwidth 6 MHz (unity gain stable) or 22 MHz

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



Current Sensing Amplifiers

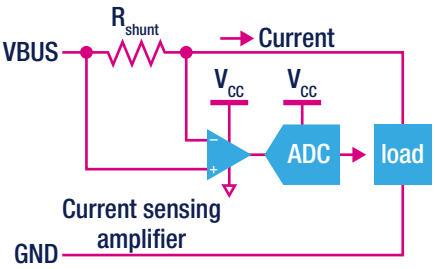
TSC103

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

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

Typical application schematic for high-side current measurement



Comparators

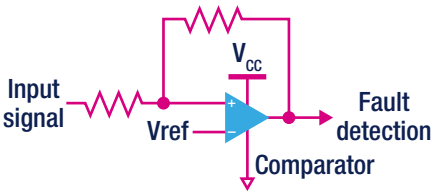
TS3021, TS3022

- Propagation delay: 38 ns
- Low current consumption: 73 µA
- Rail-to-rail inputs
- Push-pull outputs
- Supply operation from 1.8 to 5 V

TS3011

- Propagation delay: 8 ns
- Low current consumption: 470 µA
- Rail-to-rail inputs
- Push-pull outputs
- Supply operation from 2.2 to 5 V

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



MAIN APPLICATIONS


Wireless battery charger transmitters


Server/Telecom


Solar


UPS


Lighting

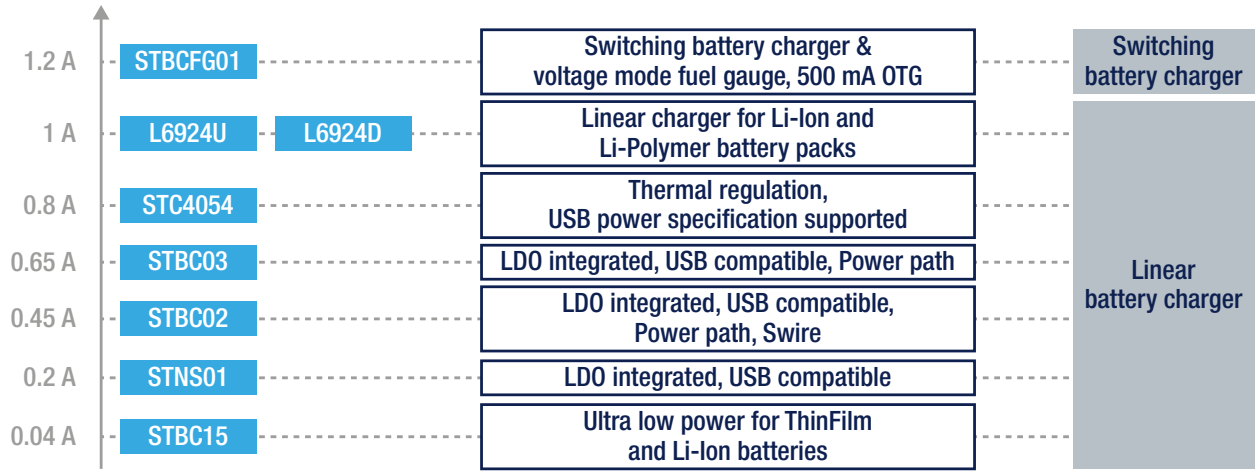

Factory automation

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™ algoritm for STC3115
- OptimGauge+™ algorithm for SCT3117

STC3117

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

FUEL GAUGE ICs MAIN BENEFITS

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

MAIN APPLICATIONS

Bluetooth accessories
STC4054

USB
L6924U, STC4054, STBCFG01

Fitness
STNS01, STBC02, sSTBC03

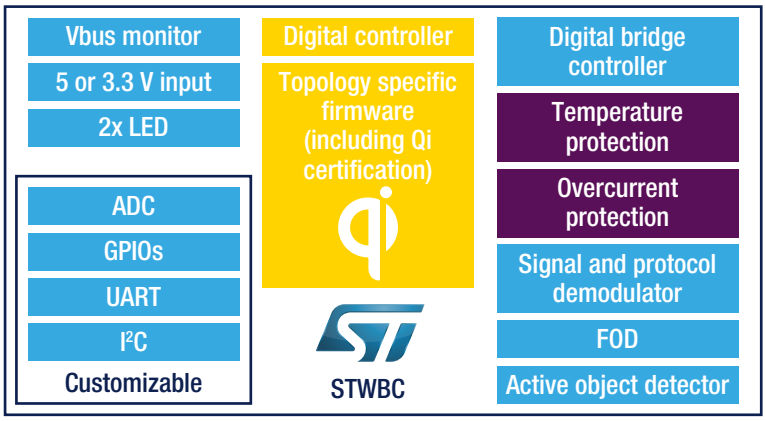
Smartphones
STBCFG01, STC3115, SCT3117

Wireless charging ICs

ST fully covers wireless charging applications with **dedicated ICs for both transmitter and receiver**. The STWBC and STWBC-EP, compatible with Qi standard, and the STWBC-WA, dedicated to wearable applications, make-up ST's wireless power transmitters (Tx) family. The receiver family (Rx) consists of the STWLC33 dedicated to Qi compliant consumer applications.

Wireless power transmitters

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



STWBC
- Supports applications up to 5 W
- Qi A11 certified

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

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

STWBC-MC
- Support multi-coil applications up to 15 W
- Qi extended power certified

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

Wireless power receivers

STWLC33

STWLC33
- Supports up to 15 W output power in RX mode and 5 W in TX mode
- Qi compliant
- Outstanding total system efficiency
- Precise voltage and current measurements for FOD function

MAIN APPLICATIONS

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

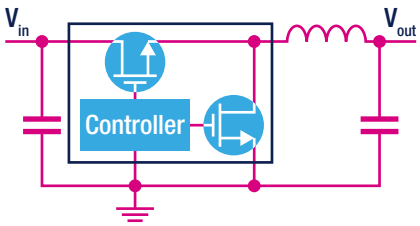
Tablets and smartphones
STWLC33

Wearables
STWBC-WA

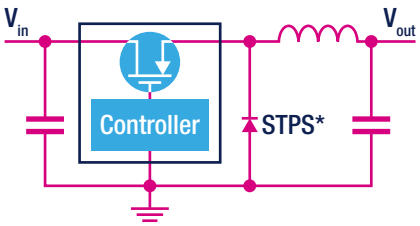
DC-DC SWITCHING CONVERSION ICs

DC-DC converters

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



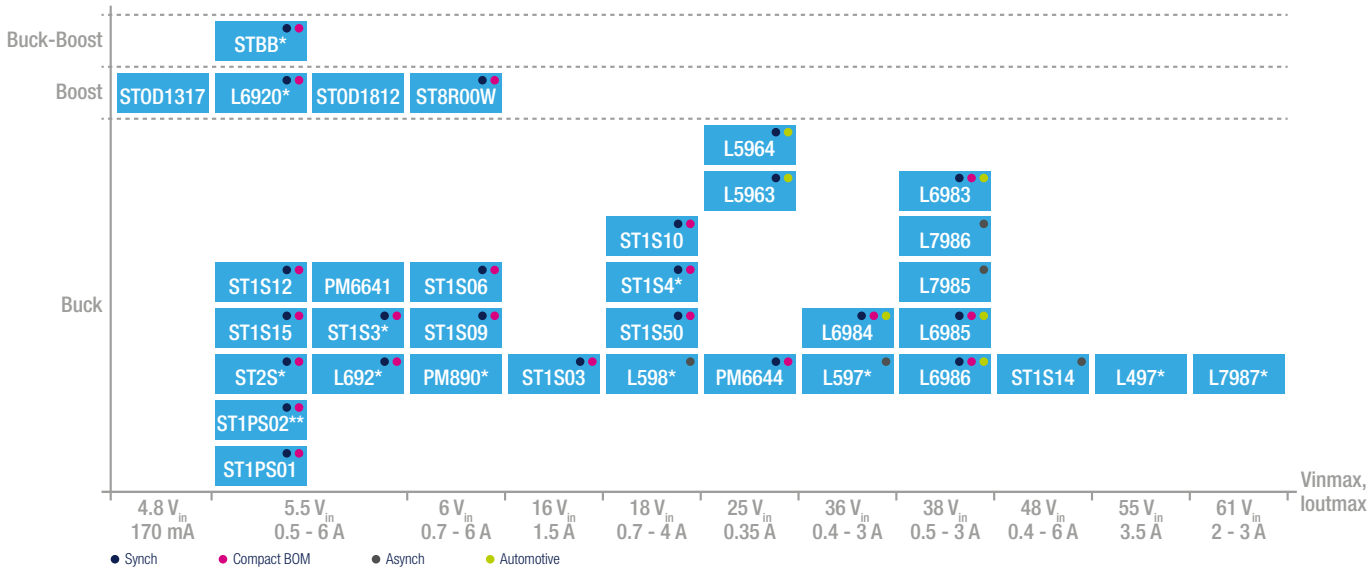
Synchronous buck converter



Asynchronous buck converter

DC-DC CONVERTERS MAIN FEATURES

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



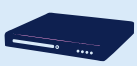
MAIN APPLICATIONS

Smartphones

TVs

Computing

Solar UPS Lighting



Set-top boxes

Wearables

Server/Telecom

Home appliances

Factory automation

www.st.com/dc-dc-switching-converters

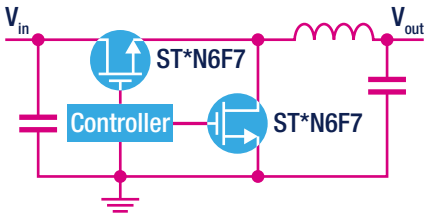
Note: * is used as a wildcard character for related part number ** full production in H2 2019

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

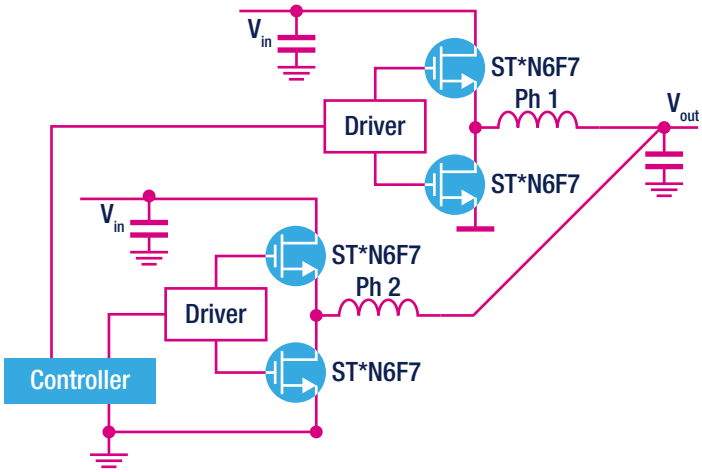
L672*	Single- phase cost effective PWM controller
L673*	Single-phase PWM controller with embedded driver and light load efficiency optimization
PM6697	Analog single-phase controller with SVID with embedded gate driver
PM6680	Dual-output PWM controller up to 36Vin



Single-phase buck controller

Multi-phase Buck controllers

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



Multi-phase Buck controller

MAIN APPLICATIONS

Server | Microserver | Telecoms | PC desktop

www.st.com/dc-dc-switching-converters
www.st.com/single-phase-controllers
www.st.com/multi-phase-controllers

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

DIGITAL POWER CONTROLLERS AND MICROCONTROLLERS

Digital power controllers

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

Digital controllers tailored for power conversion and lighting applications

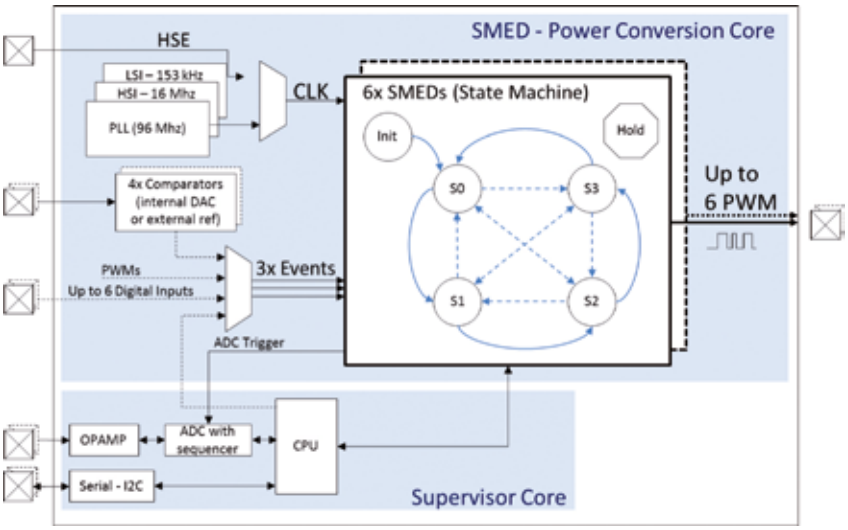
STNRG* STLUX*

Common features

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

STNRG*

- Digital controller tailored for power conversion
- Up to 4 comparators with external reference



STNRG* internal block diagram

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

Digital controller for interleaved CCM boost PFC

STNRGPF01 STNRGPF12

- Digital controller fully configurable through GUI for fast and easy design, does not require writing any firmware
- Mixed signal architecture
- 3-channel interleaved boost PFC (STNRGPF01)
- 2-channel interleaved boost PFC (STNRGPF12)
- Digital inrush current limiter (STNRGPF12)
- Ideal for wide power range above 500 W
- Reduced EMI filter and inductor volume
- Reduced output capacitor RMS current
- Flexible working frequency up to 300 kHz to drive both MOSFETs and IGBTs
- Configurable phase shedding for wide load range high efficiency conversion
- Programmable fast overcurrent and thermal protection (STNRGPF12)
- On-chip UART/I²C digital interfaces for convenient connectivity
- Ideal for outdoor applications with -40 to +105 °C operating range

MAIN APPLICATIONS

Solar
STNRG*

HEV charging stations
STNRGPF01, STNRGPF12

UPS
STNRG*

Factory automation
STNRGPF01, STNRGPF12

Commercial, architectural and street lighting
STLUX*

www.st.com/stlux
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® Cortex®-M7 running at 480 Mhz with precision FPU, DSP and advanced MPU.
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)

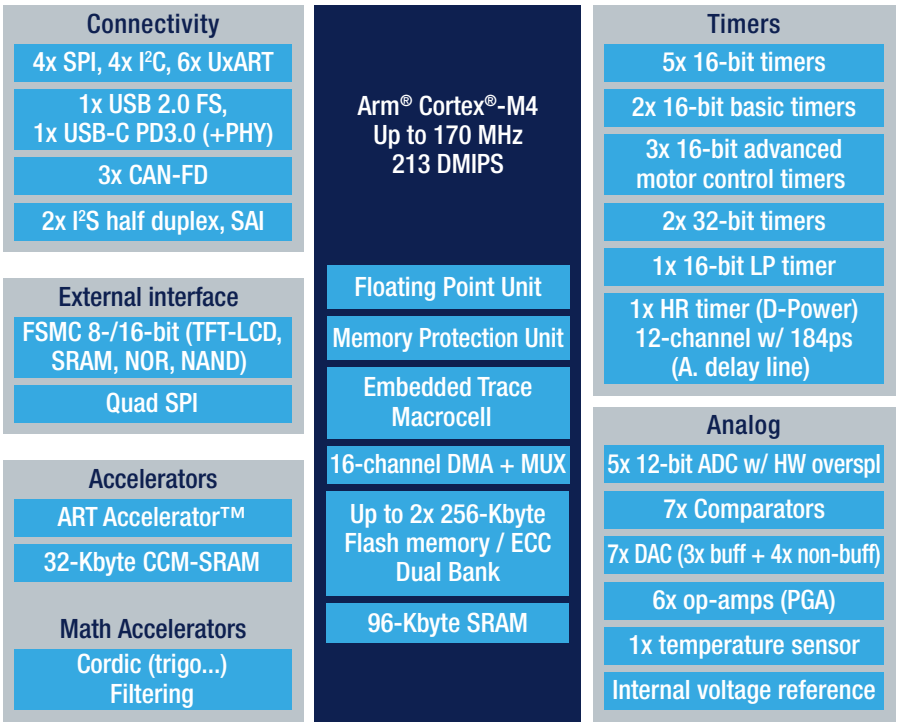
STM32G474

- 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

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)

STM32G474 block diagram



Digital Power Supply and PFC Design Workshop with STM32 MCUs in collaboration with the company partner Biricha (from Q4 2019)

BIRICHA DIGITAL

MAIN APPLICATIONS

Solar | Welding | Commercial, architectural and street lighting | Server/Telecom | Factory automation

www.st.com/stm32

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.

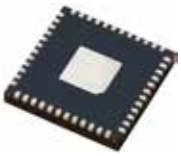
SPC58 E-line combines real-time behavior with ISO26262 ASIL-D safety.
The embedded hardware security module (HSM) ensures protection against cyber security attacks.
The Generic Time Module (GTM) completes the peripheral set by delivering a high-performance timer, synchronization units, embedded hardware 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.

SPC5 E	SPC58 E Line
Core	Triple 3x e200z4d @ 180 MHz
eFlash Code	4 MB to 6 MB
Timers	GTM3
Safety	ASIL-D
Advanced Networking	8x CAN-FD FlexRay 2x Ethernet
Security	HSM medium
ADC	5x 12 bit (SAR) 3x 10 bit (SAR) 6x 16 bit (SigmaDelta)
High Temperature support (165 Tj)	Qualified

Package Options

eTQFP 64-176
(exposed pad)



QFN 48
(exposed pad)

SPC58 Chorus

Networking

ETHERNET

LIN LOCAL INTERCONNECT NETWORK

CAN FD

OPEN ALLIANCE

FlexRay™

Scalability

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

ASIL D

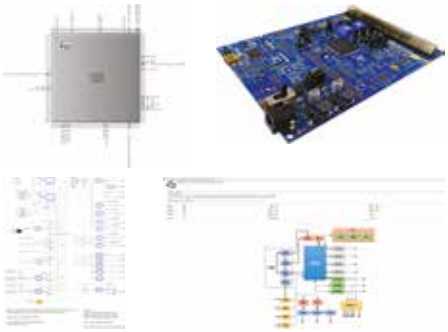
Secure & Safety

EVITA Evita Medium/Full

HIS

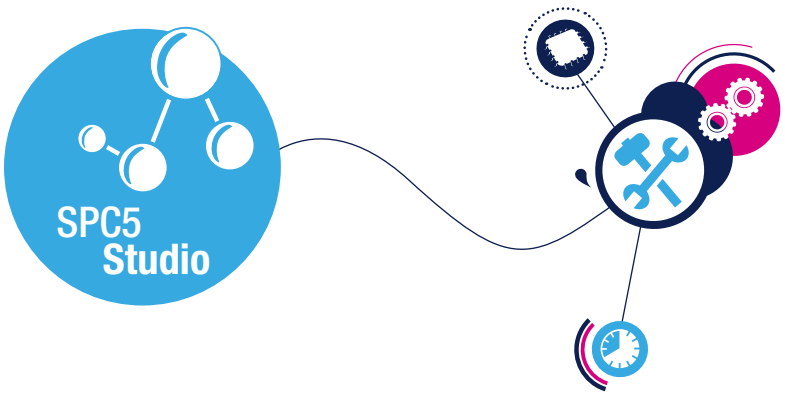
ISO 26262

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

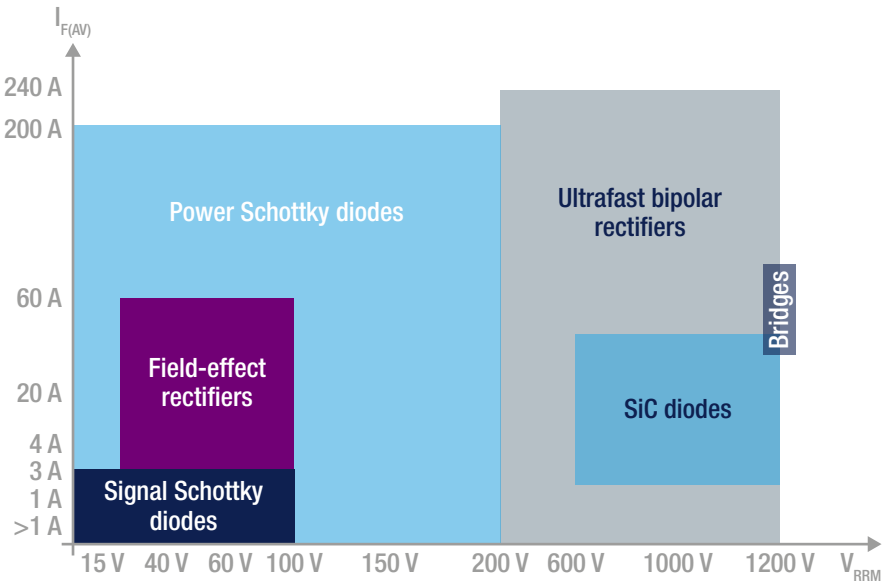


www.st.com/spc5

DIODES AND RECTIFIERS

Silicon diodes

ST offers **Schottky** and **ultrafast silicon rectifier solutions** for all market requirements. ST's latest developments include M series, based on Schottky technology, with improved avalanche rating and the integration of higher currents in low-profile PSMC (TO-277A) and PowerFLAT™ packages.Our range of small-signal Schottky diodes with flip-chip and SOD-923 devices helps meet the most stringent space-saving requirements, especially for portable communication equipment.
For high-efficiency rectification or freewheeling functions, our new field-effect rectifier diodes, **the FERD family**, improve the power density capability of the converters. Power Schottky diodes are also available in thin SOD123Flat and an SOD128Flat packages.



Field-effect rectifiers (FERD)

FERD* — Low voltage diodes, for high efficiency and high power density applications

Power Schottky diodes

STPS* — Power Schottky diodes for low voltage general purpose applications

Ultrafast rectifiers

STTH* — Ultrafast high voltage diodes for general purpose application

MAIN APPLICATIONS


Adapters and TVs


Battery chargers


Solar inverters, welding, HEVs, and UPS


Residential, commercial, architectural and street lighting


PC Desktop and Server/Telecoms


HEV charging stations


Factory automation


Home appliances


Consumer electronics

www.st.com/schottky
www.st.com/ultrafast-rectifiers
www.st.com/field-effect-rectifier-diodes

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

SiC diodes

ST's **silicon carbide diodes** range from 600 to 1200 V – as single and dual diodes – and feature unbeatable reverse recovery characteristics and improved VF. Available in a wide variety of packages, from D²PAK and the new PowerFlat 8x8 HV to TO-247 and the insulated TO-220AB/AC, they offer great flexibility to designers looking for efficiency, robustness and fast time-to-market.

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

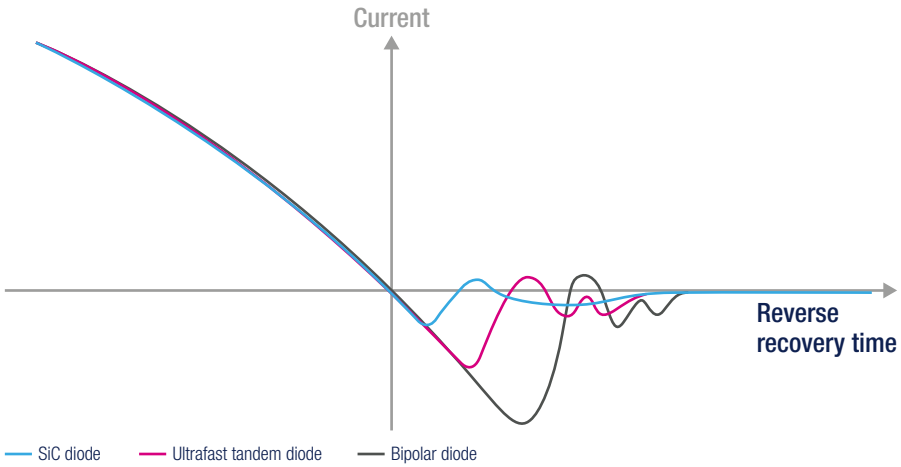
Main characteristics:

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

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

Offering the best-in-class forward voltage (lowest VF) and state-of-the-art robustness, our 1200 V SiC diodes provide extra freedom to achieve high efficiency and reliability with lower current rating and therefore lower cost, while reducing operating temperature and extending application lifetime.

The 1200 V SiC diode family covers current ratings from 2 to 40 A, including automotive-qualified devices, in surface-mount PowerFlat 8x8 HV, D²PAK HV and DPAK HV (high-voltage) and D²PAK, or through-hole TO-220AC and TO-247LL (long-lead) packages.



SIC DIODES BENEFITS

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

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

STPSC*065 **STPSC*13**

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

MAIN APPLICATIONS

Solar inverters
STPSC*065, STPSC*12

HEV
STPSC*065

UPS
STPSC*065, STPSC*12

Server/Telecoms and PFC
STPSC*065, STPSC*12

www.st.com/sic-diodes

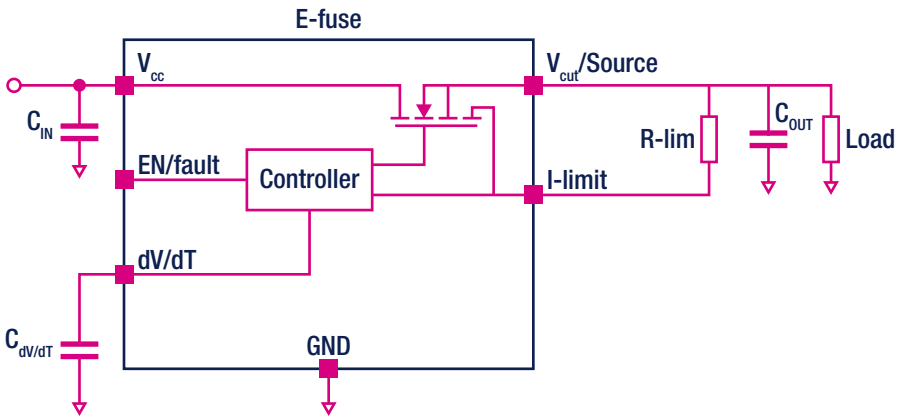
Note: * is used as a wildcard character for related part number

HOT-SWAP POWER MANAGEMENT

E-fuses

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

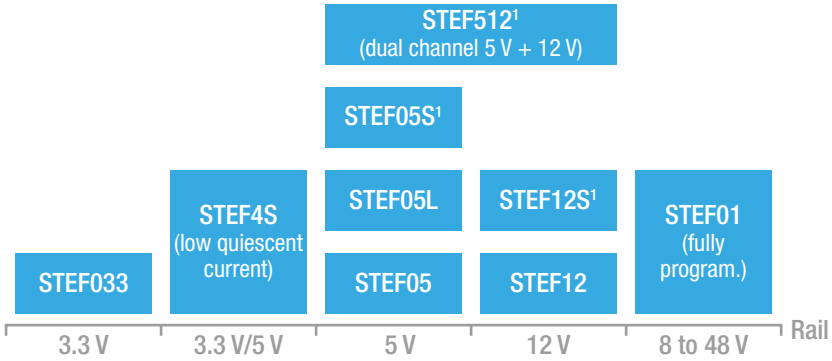
Unlike fuses, they offer complete and flexible management of the fault (overcurrent/overvoltage), without requiring replacement after actuation. They thus help to improve equipment uptime and availability and also reduce maintenance costs and false returns. Compared to traditional protection devices,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



E-FUSE MAIN FEATURES

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

E-fuses, a smart offer for a lots applications



MAIN APPLICATIONS

Home appliances
STEF05, STEF01, STEF12, STEF12S[1]

HD and SSD
STEF033, STEF05, STEF05L, STEF4S, STEF12, STEF05S[1], STEF12S[1], STEF512[1]

USB connections
STEF05, STEF05L, STEF05S[1]

Factory automation
STEF01, STEF12, STEF12S[1]

Set-top boxes
STEF12, STEF12S[1]

Note 1: product in developpent, contact ST sales office

www.st.com/e-fuse

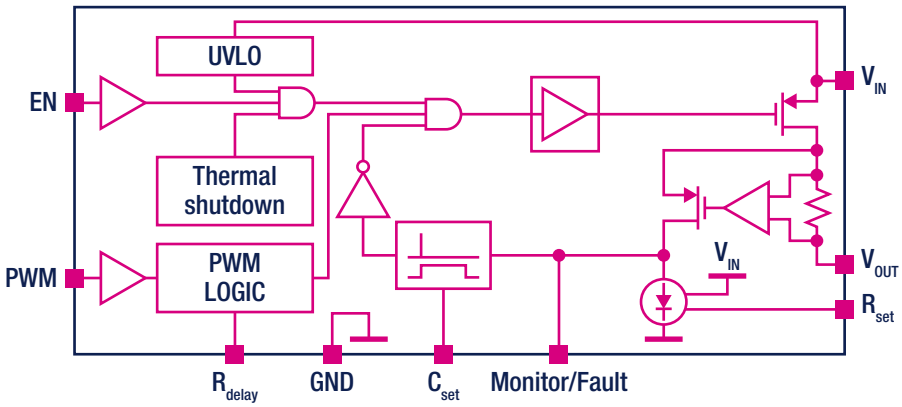
Power breakers

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.

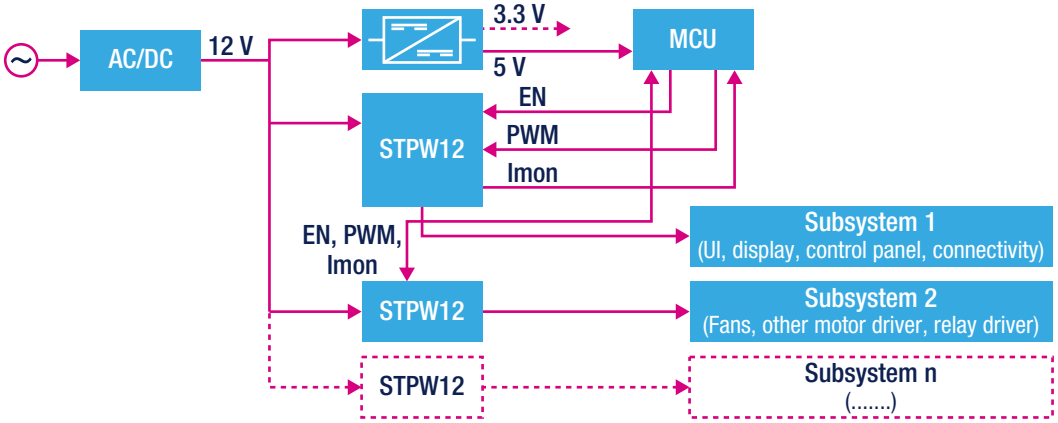
Power breakers

STPW05[1] **STPW12**

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



Typical home appliance block diagram for STPW12



MAIN APPLICATIONS

Home appliances
STPW05[1], STPW12

Air conditioning
STPW05[1], STPW12

Factory automation
STPW05[1], STPW12

Note 1: samples available, contact ST sales office

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	40 A	40 A, 50 A	15 to 75 A	8 to 75 A	15 to 40 A	20 A, 30 A
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
IGBT Series	H	V	M	HB	HB2	IH	S	M	H	IH
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

H series

STG*H*

600 V family

- 3 µs of short-circuit capability
- Low saturation voltage
- Minimal collector turn-off
- Series optimized for home appliance applications

1200 V family

- 5 µs of short-circuit capability @ starting T_J = 150 °C
- Low turn-off losses
- Up to 100 kHz as switching frequency

V series

STG*V60*F

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

M series

STG*M*

650 V family

- 6 µs of min short-circuit capability @ starting T_J = 150 °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 µs of min short-circuit capability @ starting T_J = 150 °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 family

- Very low $V_{CE(sat)}$: 1.5 V @ I_{CN}
- Very low E_{off}
- Low drop forward voltage diode
- Designed for soft commutation application only

1250 V family

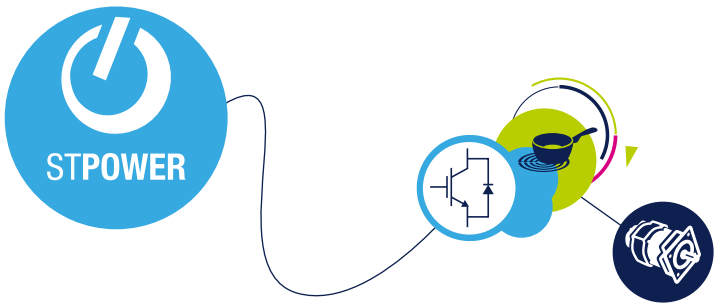
- Minimized tail current
- Very low drop freewheeling diode
- Tailored for single-switch topology

S series

STG*S120DF3

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

MAIN APPLICATIONS



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

www.st.com/igbt

Intelligent power module - SLLIMM™

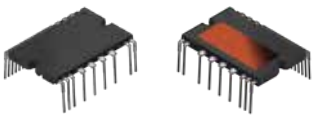
The SLLIMM, small low-loss intelligent molded module, is the ST's family of compact, high efficiency, dualin-line **intelligent power modules (IPM)**, with optional extra features. This family includes different solutions in terms of package(SMD, through hole, full molded and DBC) and silicon technology (IGBT, MOSFET and Super Junction MOSFET). The best compromise between conduction and switching energy with an outstanding robustness and EMI behavior making the new products ideal to enhance the efficiency of compressor, pumps, fans and any motor drives working up to 20 kHz in 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 $V_{CE(sat)}$, Low $R_{DS(on)}$
- 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

SLLIMM nano series	SLLIMM nano 2nd series	SLLIMM 2nd series
600 V IGBT 500 V MOSFET 1 up to 3 A	600 V IGBT 600 V SJ-MOSFET 3 up to 8 A	600 V IGBT 600 V SJ-MOSFET 8 up to 35 A
		
NDIP (TH) NSDIP (SMD) 12.45 x 29.15 x 3.10 mm	N2DIP (TH) 12.45 x 32.15 x 4.10 mm	SDIP2F-26L SDIP2B-26L 24 x 38 x 3.5 mm

10 W — 100 W — 500 W — 3000 W Power

MAIN APPLICATIONS


Fan


Fridge


Washing Machine

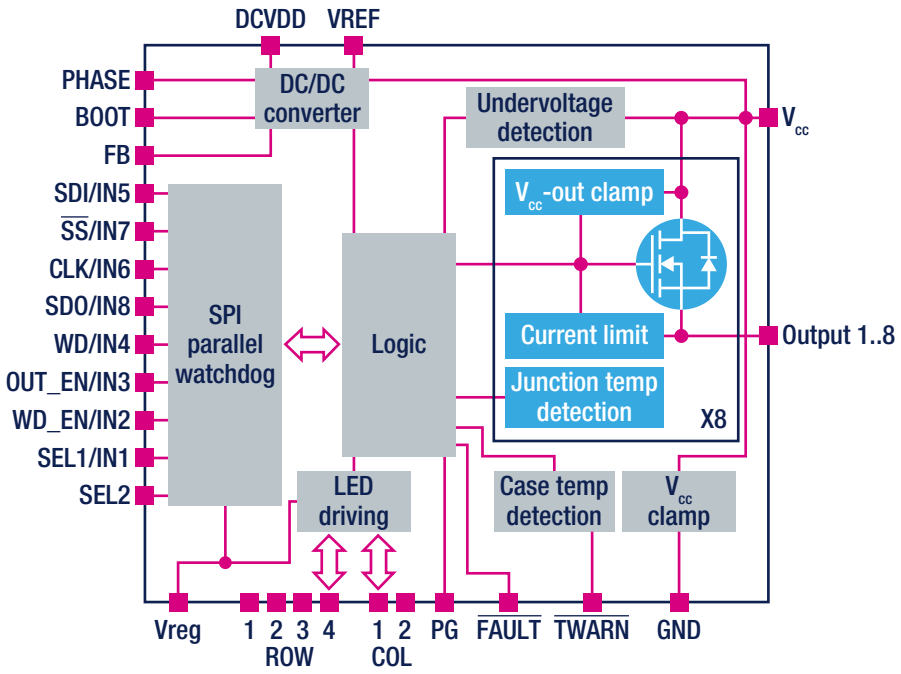

Air conditioning


Motor control

www.st.com/igbt

INTELLIGENT POWER SWITCHES

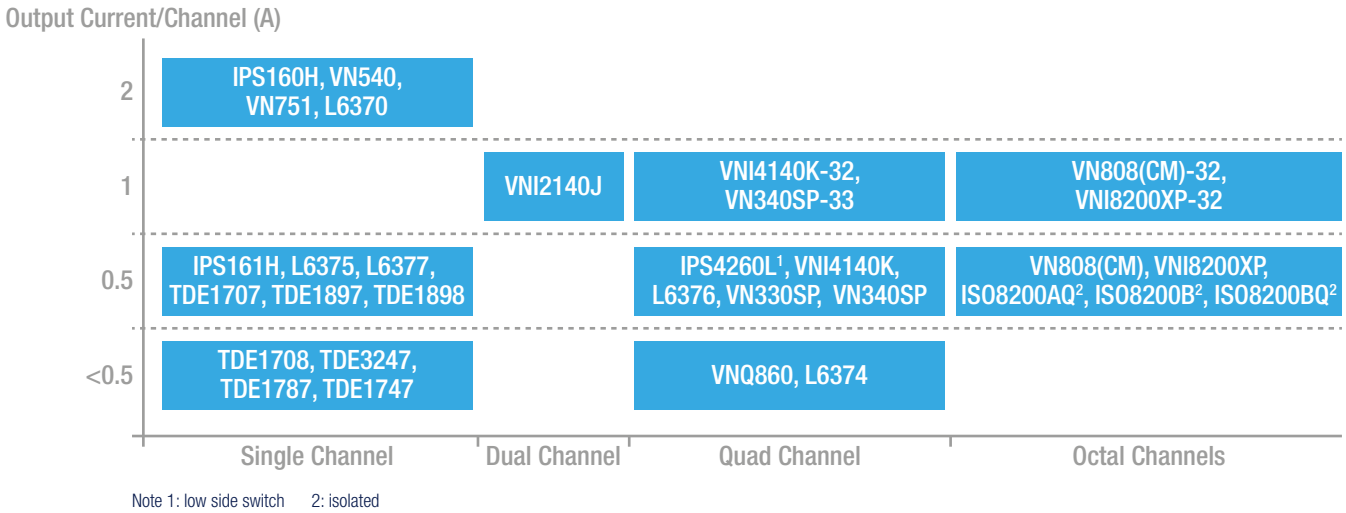
STMicroelectronics offers **intelligent power switches** (IPS) for low- and high-side configurations. ST's IPS feature a supply voltage range from 6 to 60 V, overload and short-circuit protection, current limitation set for industrial applications, different diagnostic types, high-burst, surge and ESD 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

...all an a single chip



Note 1: low side switch 2: isolated

MAIN APPLICATIONS

Factory automation

Vending machines

Renewable energy

www.st.com/ips

LED DRIVERS

Offline LED drivers

Dedicated **LED drivers** operating from the AC mains ensure highly-accurate LEDs managing to provide a high level of light quality and avoid flickering. By combining a state-of-the-art low-voltage technology for the controller and an extremely robust 800 V technology for the power MOSFET in the same package, HVLED8* converters (i.e controller + MOSFET in the same package) feature an efficient, compact and cost-effective solution to drive LEDs directly from the rectified mains. This family of converters works in constant-current / constant-voltage primary-side regulation (PSR-CC/CV). HVLED001A 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

	HPF	PSR-CC	PSR-CV	P_{outMax} [1]	Internal power MOSFET	Flyback	Buck-boost
HVLED805	●	●	●	8 W	800 V_{BR}	●	●
HVLED815PF	●	●	●	15 W	800 V_{BR}	●	●

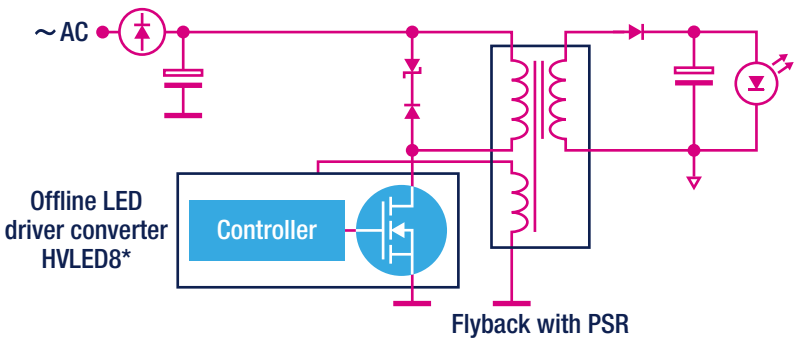
Offline LED controllers with PSR

	HPF	PSR-CC	PSR-CV	Dimming	Flyback
HVLED001A/HVLED001B	●	●	●	●	●

Offline LED controllers

	HPF	PSR-CC	PSR-CV	Dimming	Flyback
HVLED007	●	●	●	●	●

Topology example



MAIN APPLICATIONS

Residential lighting
HVLED815PF

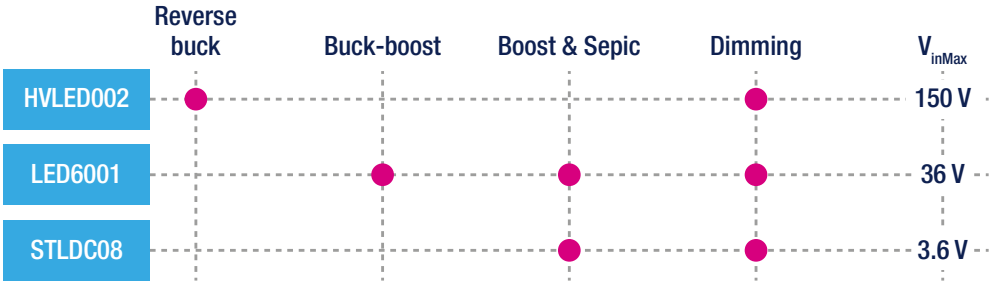
Commercial and street lighting
HVLED001A, HVLED001B, HVLED007

DC-DC LED drivers

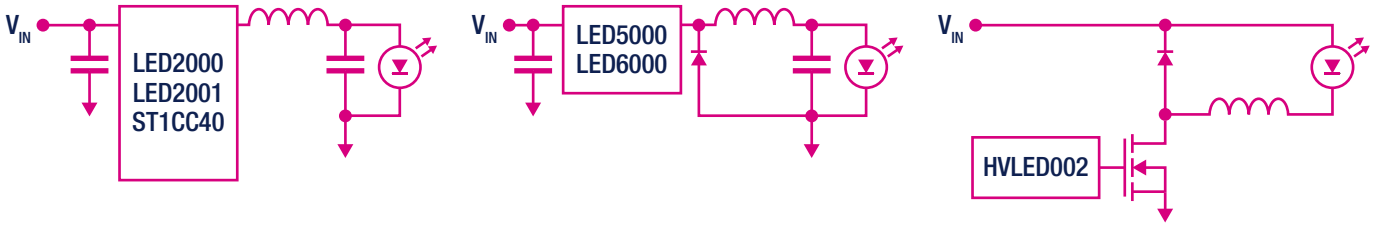
ST's monolithic buck switching regulators offer input voltage capability up to 61 V and deliver output currents up to 4 A with high switching frequency. They enable simple, efficient and cost-effective solutions for driving high-brightness LEDs. They also feature dedicated circuitry for dimming. Boost 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

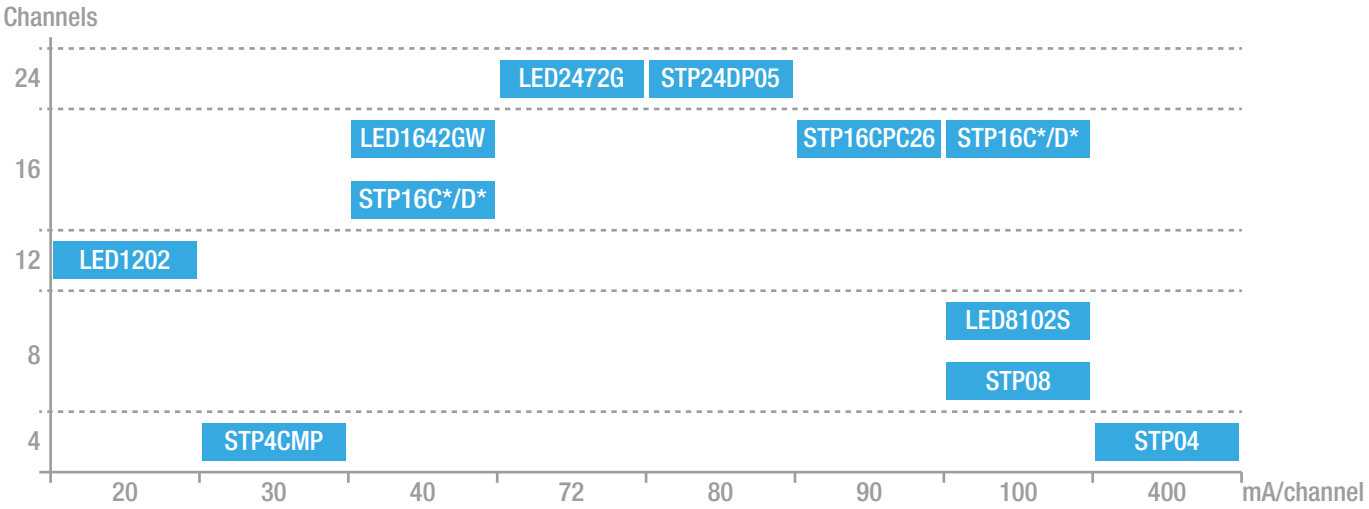
Emergency lighting
LED6001, ST1CC40

Commercial and architectural lighting
LED5000, LED6000, LED6001, HVLED002

www.st.com/led

LED array drivers

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



24 channel RGB (8x3) drivers

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

12/16 channel drivers

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

4/8 channel drivers

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

MAIN APPLICATIONS

Traffic signals
LED8102S, LED2472G, STP24DP05, STP04

Large panel signs
LED1642GW, LED2472G, STP24DP05, STP16, STP08

Home appliances
LED8102S, STP16, STP08, LED1642GW, STP4CMP

Special lighting
STP04, LED1642GW, LED2472G, LED8102S

wearable/ High End consumer
LED1202

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

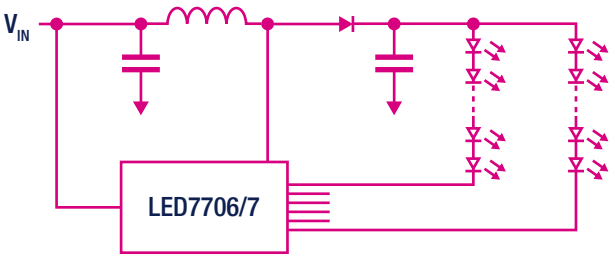
www.st.com/led

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.

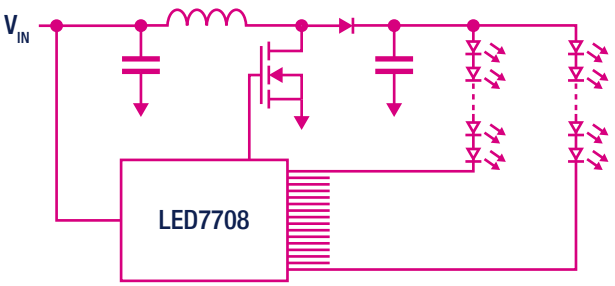
LED row driver converters

6 rows	LED7707	• 85 mA/row	Global dimming
	LED7706	• 30 mA/row	
5 rows	STLED25	• 25 mA/row	
1 row	STLA02*	• 20 mA/row	
	STLD40D		
	STCS*	• 0.5 A/1.5 A/ 2 A/row	



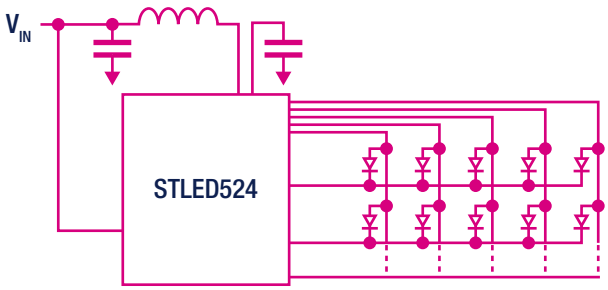
LED row driver controllers

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



LED matrix driver

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



MAIN APPLICATIONS

Smartphones
STLED25, STLD40D

Keyboard and accessories
STLA02*

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

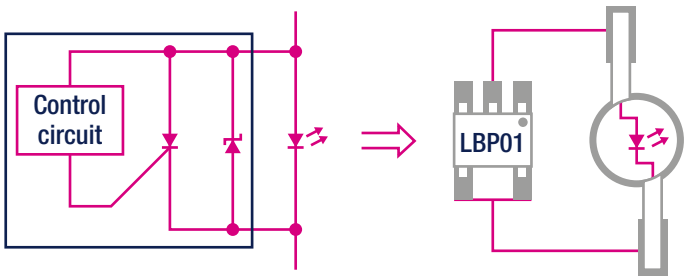
Wearables
STLED524

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

www.st.com/led

LED bypass protection

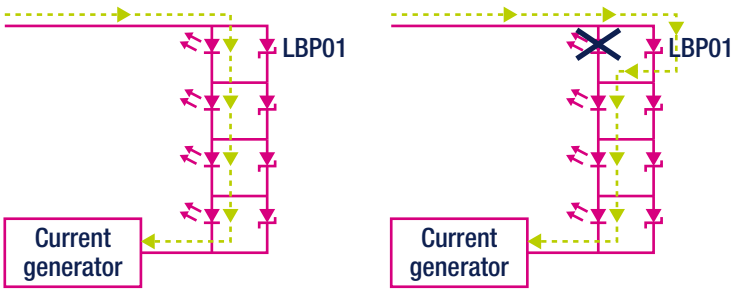
The LBP01 series of LED bypass protection devices are bypass switches that can be connected in parallel with 1 or 2 LEDs. In the event of a LED failure, this device shunts the current through other LEDs. It also provides overvoltage protection against surges as defined in IEC 61000-4-2 and IEC 61000-4-5



LBP01 get reliable your led application

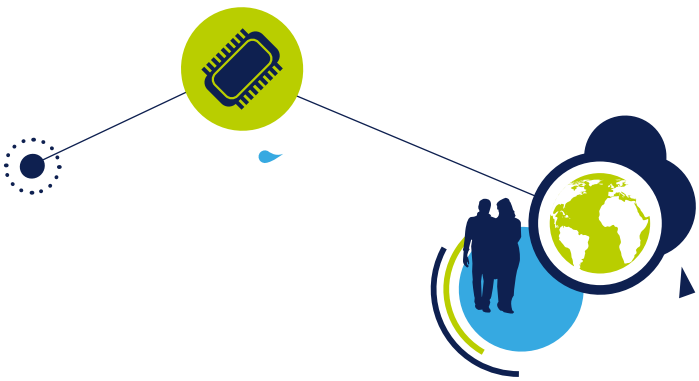
LBP01

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



MAIN APPLICATIONS

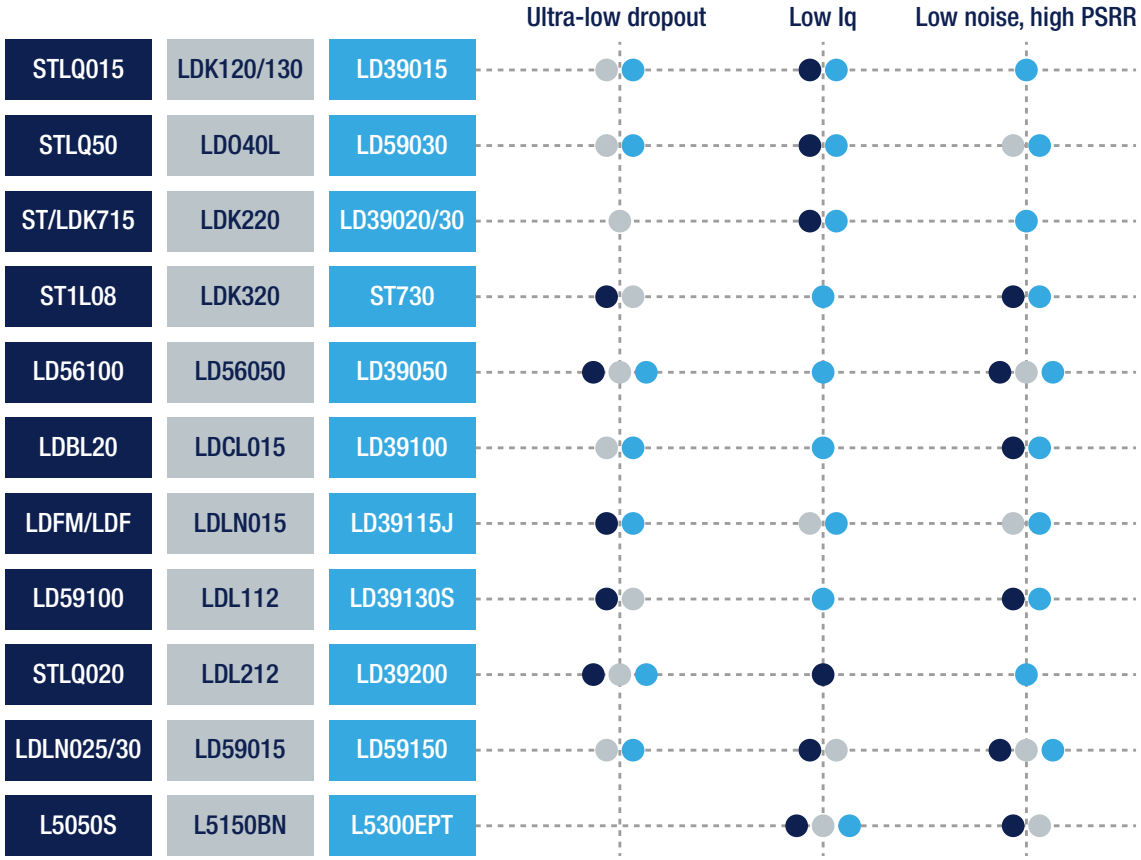
Display panels | Residential, commercial, architectural and street lighting | Emergency lighting | Traffic signals



www.st.com/lbp01

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



Ultra-low dropout

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

Low quiescent current Iq

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

Low noise, high PSRR

- High signal fidelity
- Reduced size of external filter components

MAIN APPLICATIONS

Tablets, smartphones, and wearables
LD39115, LD39130, LD39020/30, ST1L08, LDBL20, LD59015, LDLN025/30, STLQ020, LD56030, LD56050, LD56100

Healthcare
STLQ015, STLQ020, ST715, LD39130

Home appliances
LDK220/320, LDF, LDFM, LDL212

Automotive ADAS, ECU
LDK130, LD39100, LD59150, LDO40L

www.st.com/linear-regulators

LNB SUPPLIES

LNB supplies ICs

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

Single tuner ICs

LNBH25S | LNBH29 | LNBH30

Dual-tuner IC

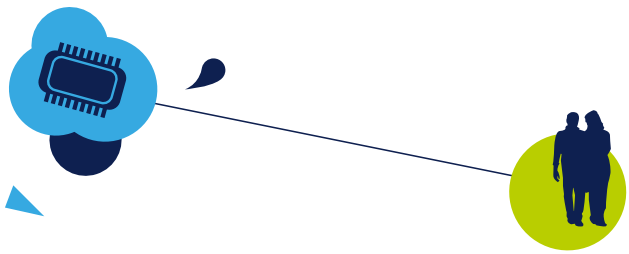
LNBH26S

Main common features

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

MAIN APPLICATIONS

Set-top boxes and PC card satellite receiver



www.st.com/lnb-supplies

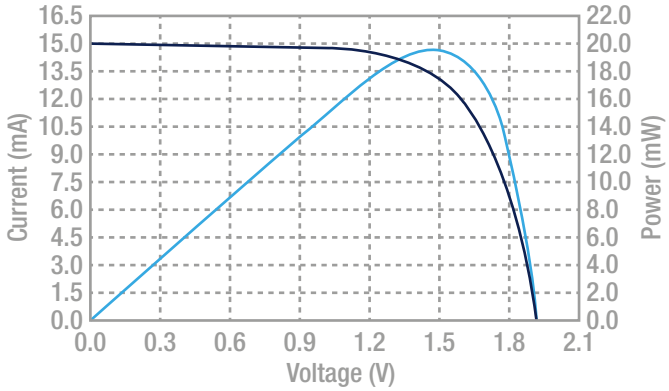
PHOTOVOLTAIC ICs

DC-DC converters with embedded MPPT algorithm

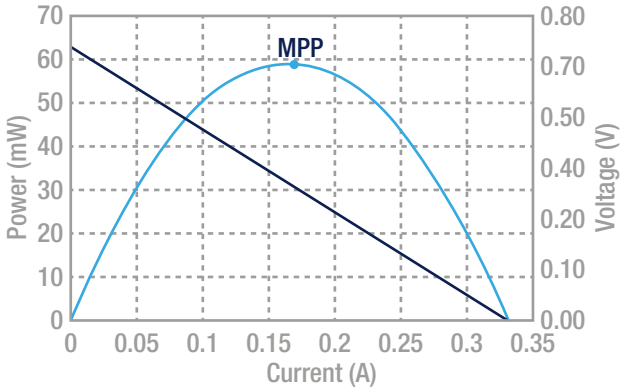
The maximum power point tracking (MPPT) algorithm maximizes the power output by photovoltaic panels according to temperature and solar irradiation conditions.
The SPV1040 is a monolithic DC-DC synchronous boost converter able to harvest the energy generated by even a single solar cell characterized by a very low output voltage. It is especially designed to work in outdoor environments with loads up to about 3 W.
The SPV1050 is an ultra-low-power battery charger and energy harvester (from photovoltaic cells or a thermo-electric generators) that guarantees a very fast charge of supercapacitors and any type of battery including thin-film solid-state batteries. It is specifically designed to work in indoor environments or with very small thermal gradients with loads up to about 350 mW.

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

Solar curves



Thermo-electric generator (TEG)



MAIN APPLICATIONS

Smartphones, digital cameras, and camcorders
SPV1040

Fitness, climate, home and factory automation monitoring
SPV1050

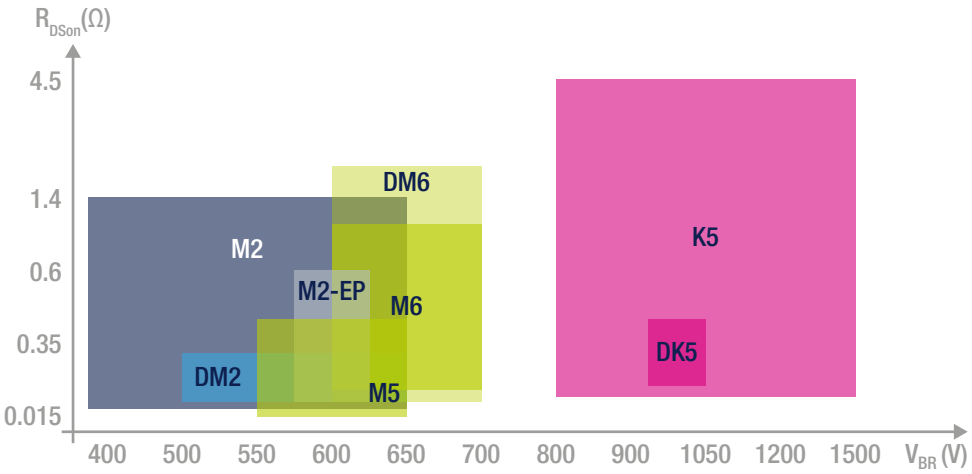
www.st.com/photovoltaic-ics
www.st.com/mppt-dcdc-converters

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

POWER MOSFETs

High-voltage power MOSFETs (silicon)

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



K5 series

ST*N*K5

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

M5 series

ST*N*M5

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

M2/M2-EP series

ST*N*M2 ST*N*M2-EP

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

DM2 & DM6 series

ST*N*DM2 ST*N*DM6

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

DK5 Series

ST*N*DK5

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

M6 series

ST*N*M6

- Lower 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

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

www.st.com/mosfet

Low-voltage power MOSFETs (silicon)

ST's LV **MOSFET** portfolio offers a broad range of breakdown voltages from -100 V to 120 V, with low gate charge and low on-resistance, combined with state-of-the art packaging.
ST's STripFET MOSFETs support a wide voltage range for synchronous rectification, UPS, motor control, SMPS, power-over-Ethernet (PoE), inverter, automotive and other applications in a wide range of miniature and high-power packages: DPAK, D²PAK, SOT-223, TO-220, TO-220FP, TO-247, PowerFLAT (5 x 6)/(3.3 x 3.3)/(2 x 2), SO-8 and SOT23-6L.

H6 series

ST*N*H6

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

F6 series

ST*N*F6

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

F7 series

ST*N*F7

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

MAIN APPLICATIONS

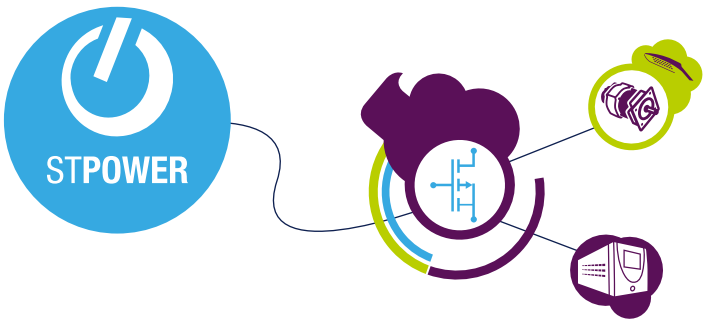
Small motor control and USB battery chargers
F6

HDD, power tools, STB, and game consoles
H6

Server/Telecoms and SMPS
F7

UPS, e-bikes, and fans
F6, F7

Solar inverters, forklifts, and EHVs
F7



www.st.com/mosfet

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

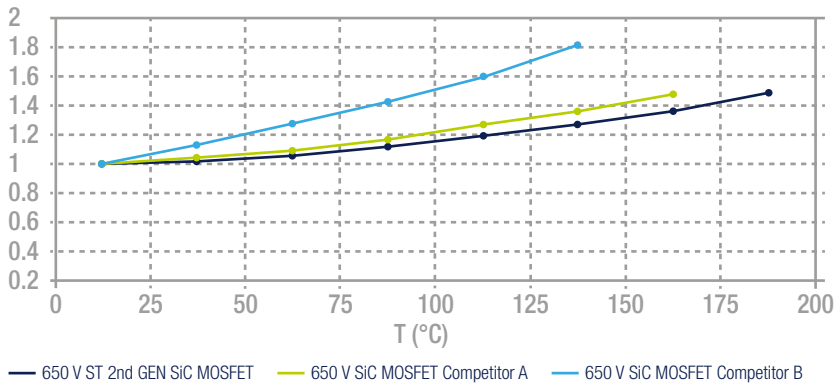
SiC MOSFETs

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 G2 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.

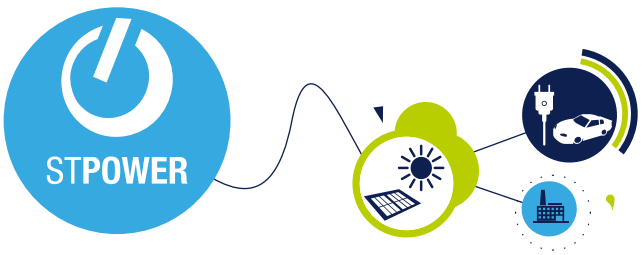
ST's SiC Mosfet 650 V - Normalized $R_{DS(on)}$ vs Temperature



SiC MOSFETs, the real breakthrough in high voltage switching

SCT*N120G2[1] **SCT*N65G2**

- V_{BR} = 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

INNOVATIVE PACKAGES

STPAK™
Multi Sintering Package:
Ready for the Next Generation
EV Traction Inverters

HU3PAK™
Top Side Cooling Package:
Ready for Industrial & Automotive
High Performance Application

MAIN APPLICATIONS

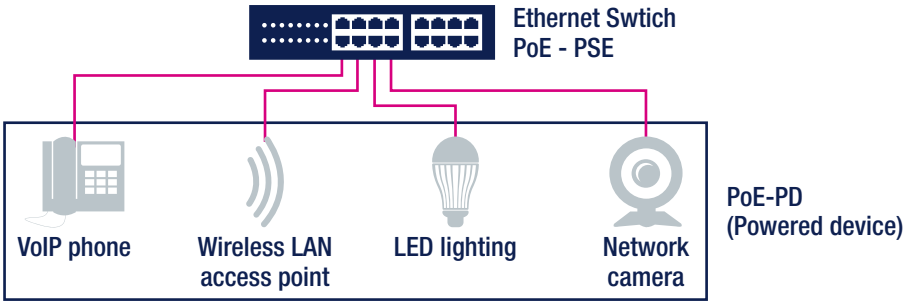
- Motor drive & factory automation
- HEVs / EVs (Traction Inverter, OBC, DC/DC)
- Charging station
- UPS & Data center Power supply
- Solar inverters

www.st.com/sicmos

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

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

PM8801

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

PM8800A

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

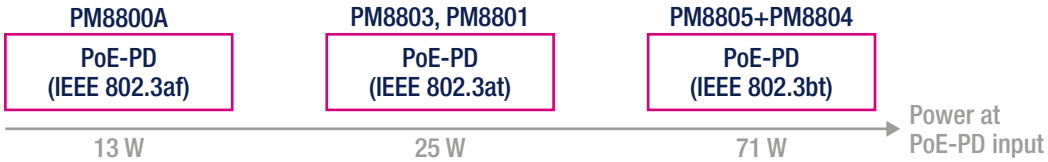
PM8804

- 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

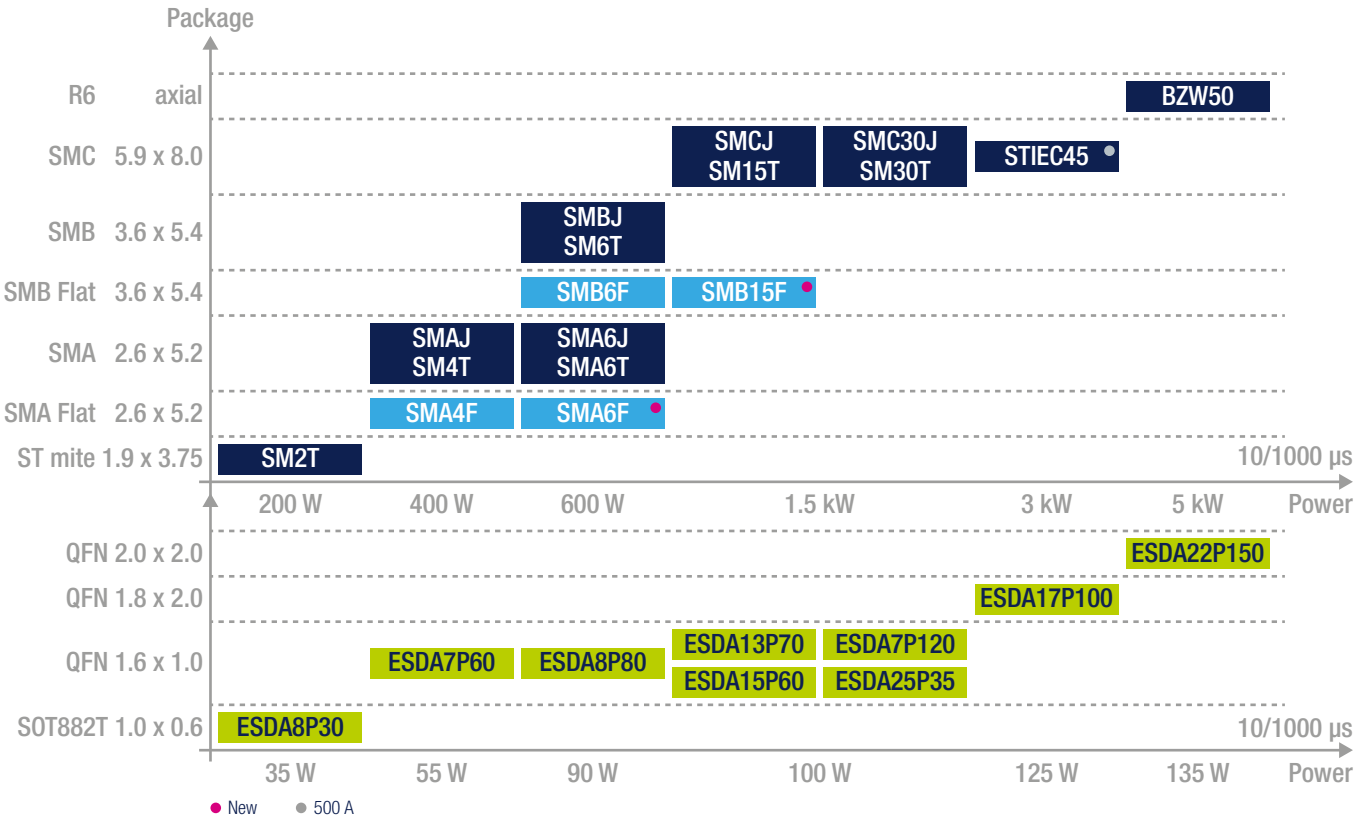
- Power supply protection compliant with IEC61000-4-5 Level 2 : 1 kV
- Allow to use 100 V power MOSFET
- Stand off voltage: 58 V
- Surface mount SO-8 package

www.st.com/PoE

PROTECTION DEVICES

Transil

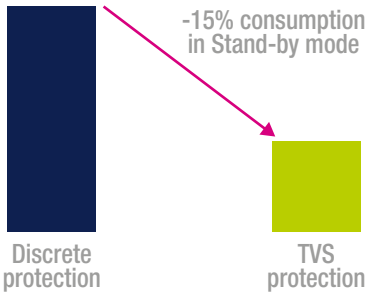
The **Transil** is an avalanche diode specially designed to clamp over voltages and dissipate high transient energy. Transil are power devices to protect applications against Electrical Over-Stress (EOS) and specifically against surge events as defined by IEC 61000-4-5.
A large choice of package is available to meet application requirements.



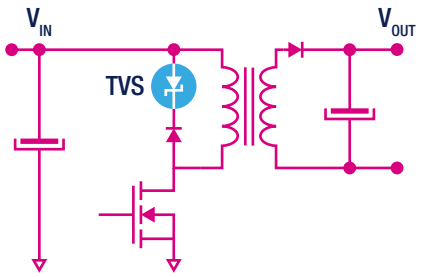
TVS Transil series against repetitive overvoltage in high temperature conditions

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

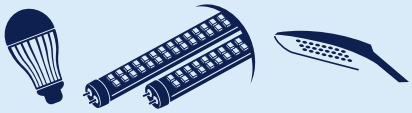


MAIN APPLICATIONS


Adapters


Smart metering

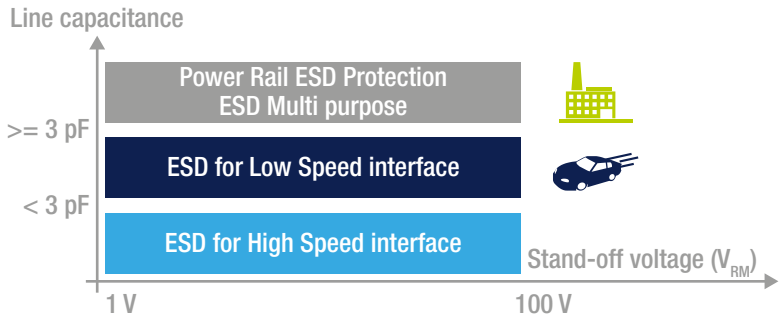

Solar inverters


Residential, commercial, architectural and street lighting

www.st.com/eos8-20-protection

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, bandwith for high speed lines.
A large choice of package is available to meet application requirements.



Power delivery Protections

Ultimate TVS protection for USB fast-charging ports

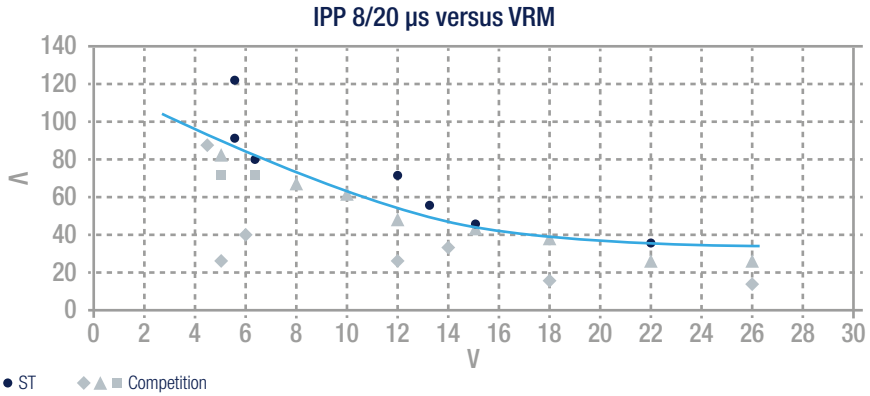
ESDAxxP

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

KEY FEATURES & BENEFITS

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

Peak pulse current performances



	Protection	
Stand-off voltage (V_{RM})	High surge current compact protection (V_{BUS})	Single and multi lines protection for MCUs Communication Channel (CC) and Side Band Use (SBU)
20 V	ESDA25P35-1U1M ESDA24P140-1U1M	ESDL20-1BF4 ESDA25W
15 V	ESDA17P100-1U2M ESDA15P50-1U1M	ESDA17P20-1U1M
9 V	ESDA13P70-1U1M	ESDL121-1BU2
5 V	ESDA7P120-1U1M	ESDZV053-1BU2 ESD051-1F4

MAIN APPLICATIONS

Tablets, smartphones, and digital cameras

Healthcare

I/O microcontrollers and signal conditioning

Factory automation
Human machine interfarce (HMI)

Smart metering

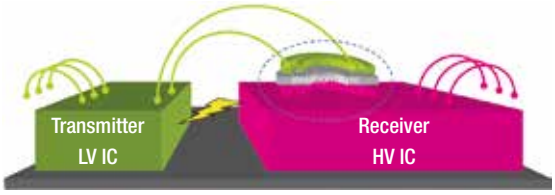
SIM cards, Ethernet,
and HDMI/DVI ports

www.st.com/esd-protection

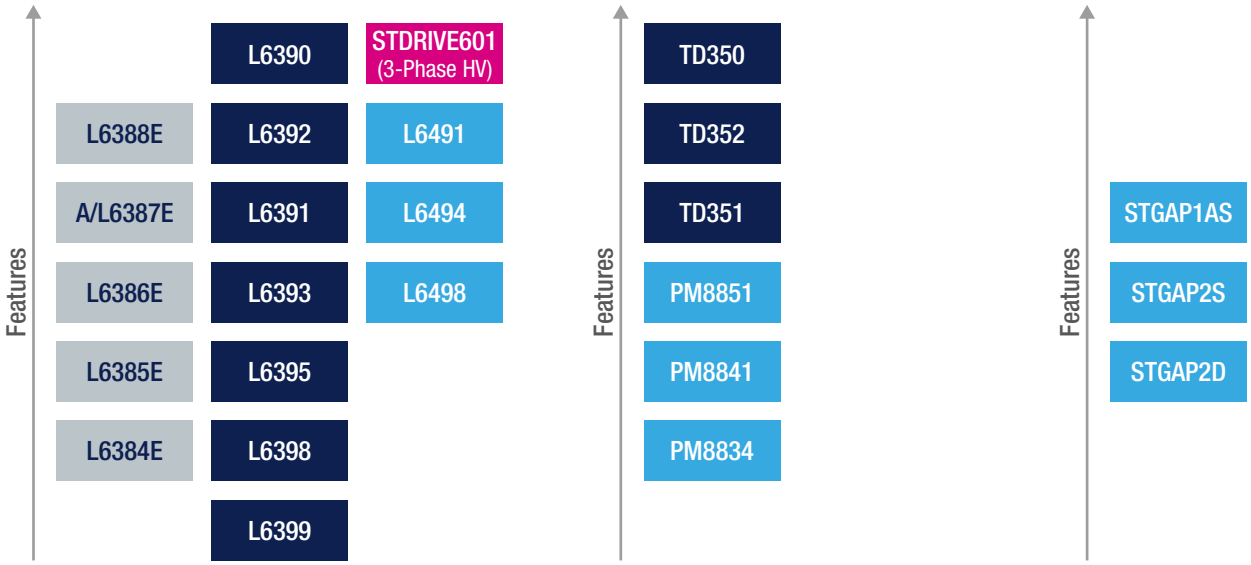
Note: * is used as a wildcard character for related part number

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 you. In particular the STDRIVE families L639*, L649* and STGAP series offer smart functionalities to protect and simplify application implementation and usage.



STGAP2S



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

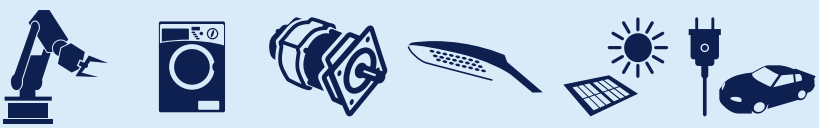
Low side gate drivers

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

Galvanically-isolated single and dual gate driver

- Up 4 kV isolation
- High voltage rail up to 1.7 kV
- Up to 5 A source/sink driver current capability
- 2 Level turn-off (STGAP1AS)
- Miller clamp, negative gate supply
- Optimized for SiC MOSFET driving

MAIN APPLICATIONS

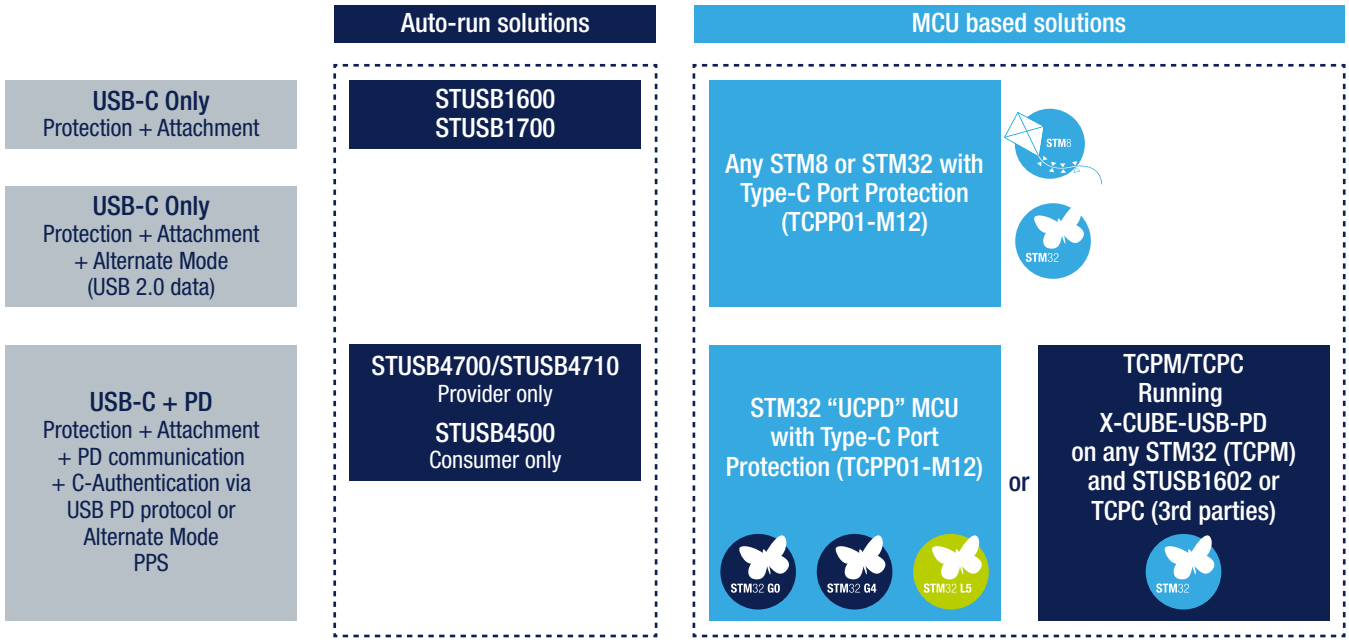


Factory automation | Home appliances | Motor control | Lighting | Solar inverters | HEV / EV

www.st.com/stdrive

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.



Auto-run solutions

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

MCU based solutions

When only USB-C connector management (reversibility, attachment and role management) is required, any STM8 or STM32 can be used to handle this function (see AN 5225).

A companion Type-C Port Protection device **TCPP01-M12** is proposed for advanced protection of the USB-C connector lines such as CC and Vbus lines.

When USB PD protocol is required, two MCU based solutions are possible.

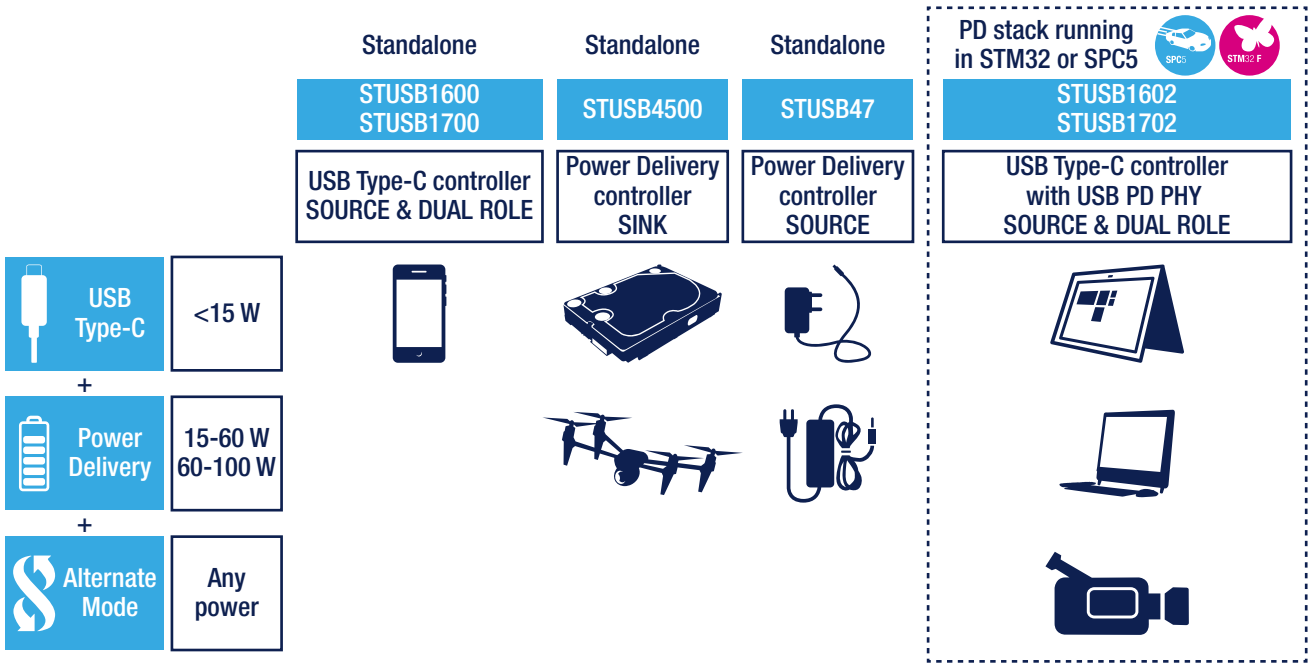
1. Using our newest STM32 USB PD3.0 controllers (STM32G0/G4/L5) with built-in "UCPD" interface. Note : UCPD stands for USB-Type-C and Power Delivery interface
2. Using a **TCPM / TCPC** topology with our X-CUBE-USB-PD middleware stack running on any STM32 as Type-C Port Manager(TCPM) and interfacing with a Type-C Port Controller (STUSB1602 or TCPC from 3rd parties)

MAIN APPLICATIONS

Wearables | Smartphones | Battery chargers and AC-DC Power Adapters | Tablet and Mobile PCs | Consumer Drones

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

STUSB family is manufactured using ST's 20 V process technology, the certified STUSB Family controller IC integrates short-circuit, over-voltage, over-current protection to eliminate the need for external circuitry. Additionally, it offers plug power support (VCONN) with up to 600 mA programmable current capability and, per the USB Power Delivery specification, it integrates Bi-Phase Mark Coded (BMC) Physical Layer (PHY) coding and decoding logic. Integration of such features in a single-chip Type-C™ controller enables fast migration to USB Type-C™, while minimizing MCU-resource requirements compared to alternate solutions. STUSB Family cover all the applications with optimized partitioning from USB Type-C™ Interface for 15 W device to Power delivery PHY and BMC Driver ICs companion chip of STM32 based solution to standalone Full Hardware USB PD Controller optimized for AC adapters.



STUSB Family: main common functions

- Type-C™ attach and cable orientation detection
- VBUS switch gate driver
- VBUS voltage monitoring
- Short-to-VBUS protection on CC pins (22 V) and VBUS pins (28 V)
- Report (optional) of majors events to the Head Unit / MCU (connection, disconnection, power budgets, errors etc...)
- Configurable start-up profiles (embedded FTP memory)

STUSB1600

- Roles: Source/Sink/Dual Role Power
- OVP, OCP, UVP, short protection
- Integrated VBUS discharge
- Direct interface to MCU through I²C + IRQ
- Accessory & dead battery support

STUSB1700

- Role: Source
- GPIO-controlled current profile (Power sharing, Thermal protection)
- VBUS powered (no LDO needed)
- VDD = (4.1 V - 22 V)
- 28 V short to VBUS protection
- Certification test ID: #1100100

STUSB1602 STUSB1702

- Role (1602): Source/Sink/Dual Role Power
- Role (1702): Source – Auto Grade
- Integrated Type-C PHY + BMC coding
- Perfect companion chip to EC to manage USB Type-C port
- Integrated VCONN switch
- Adjustable current limit (600 mA max)
- OVP, OCP, UVP, short protection
- Integrated VBUS and VCONN discharge path
- I²C, SPI + IRQ MCU interface – Dual I²C address support
- Accessory & dead battery support

STUSB47

- Role: Source
- Offers up to 5 programmable PDOs
- Full hardware solution - no software
- Internal and/or external VBUS discharge path
- Very low power consumption
- I²C interface (optional connection to MCU)

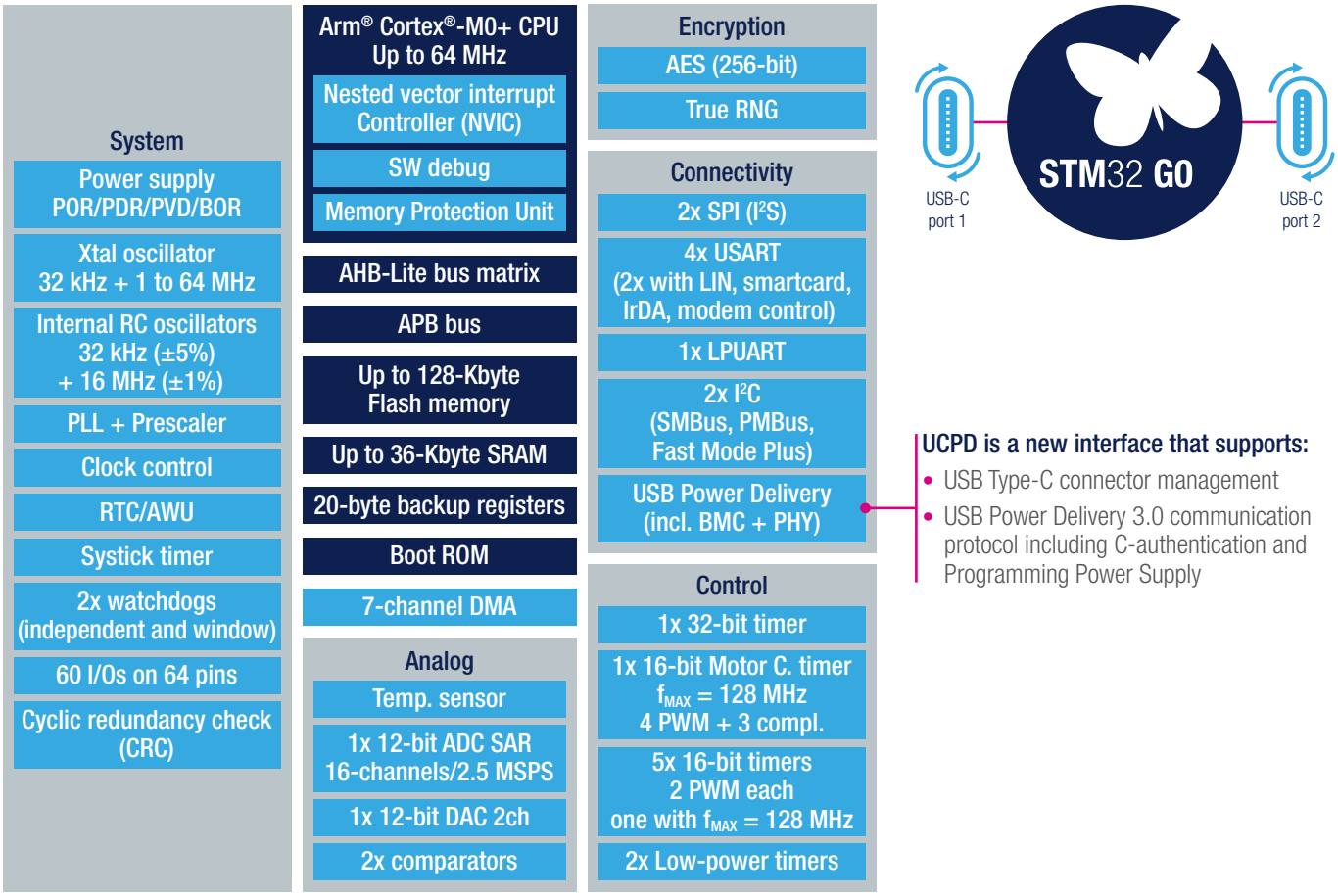
STUSB45

- Role: Sink
- Standalone PD controller with Dead Battery support
- VBUS powered (zero power on Vbat)
- VDD = (4.1 V - 22 V)
- 28 V short to VBUS protection
- Optional I²C interface for dynamic power management

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).

STM32G081 block diagram



UCPD is a new interface that supports:

- USB Type-C connector management
- USB Power Delivery 3.0 communication protocol including C-authentication and Programming Power Supply

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 complaint 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.

Discover and lean

STM32G071B-DISCO

Develop

NUCLEO-G071RB

STM32G081B-EVAL

Configure & Debug

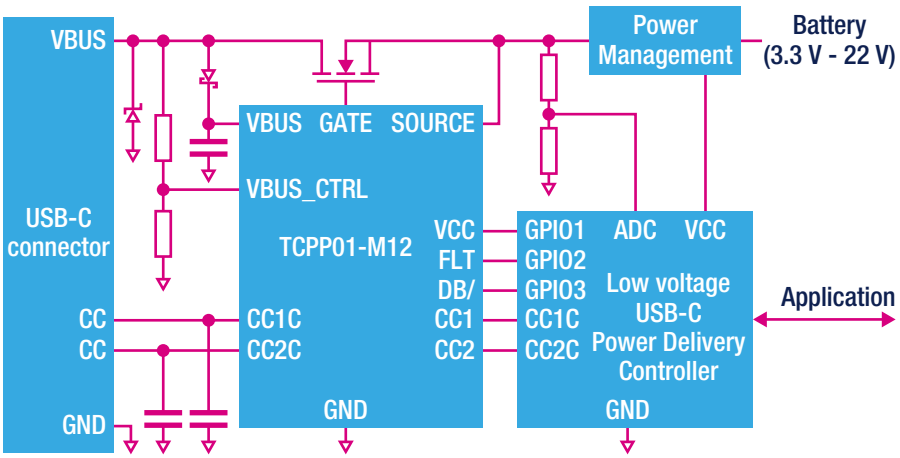
STM32 CubeMX

STM32 CubeMonitor-UCPD

Type-C Port Protection

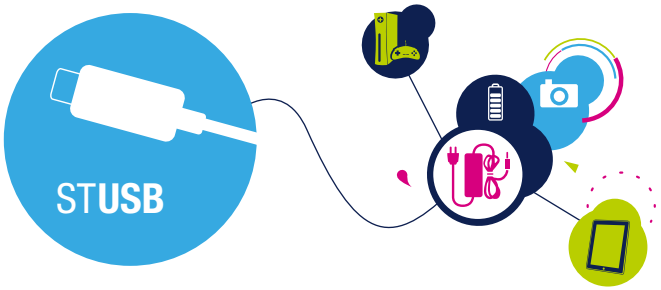
TCPP01-M12

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 V_{BUS} 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 V_{BUS} 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 V_{BUS} 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 V_{BUS} 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 (± 8 kV contact discharge, ±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



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