Power management guide

Contents

Introduction

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

When designing a power management system or sub-system, regardless of whether it is an energy generation or distribution system, a power supply or an 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 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.

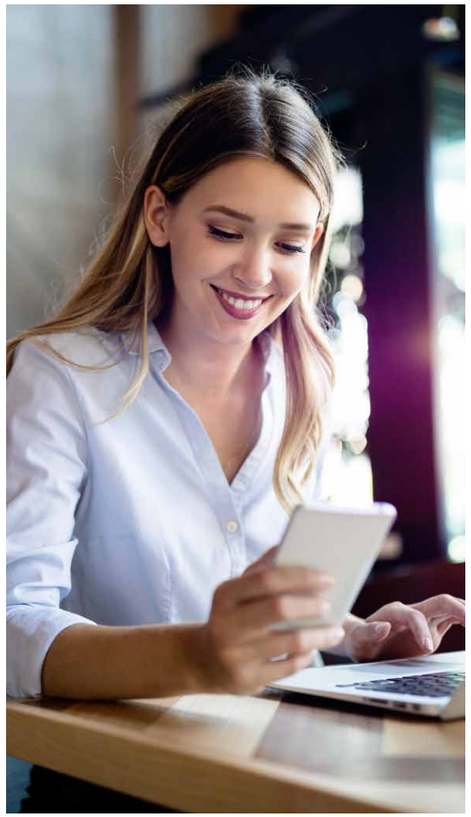
The technological innovation, which persists at the core of ST strategy for more than 30 years, is the reason why ST today can offer an extensive range of cutting-edge products for power and energy management. ST portfolio includes higher-efficiency power technologies such as:

- Silicon carbide power discretes
- PowerGaN transistors
- GaN power ICs
- HV and LV power MOSFET and IGBTs
- Customized power modules
- Diodes and thyristors
- Protection devices and filters
- AC-DC converters and controllers
- DC-DC converters
- Linear voltage regulators
- Analog ICs
- Battery management ICs
- STM32 microcontrollers
- MOSFET and IGBT gate drivers

ST provides a selection of new GaN power, devices which represent a major step forward in power electronics by providing high-frequency operation with increased efficiency and higher power density than traditional solutions.

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

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



Applications

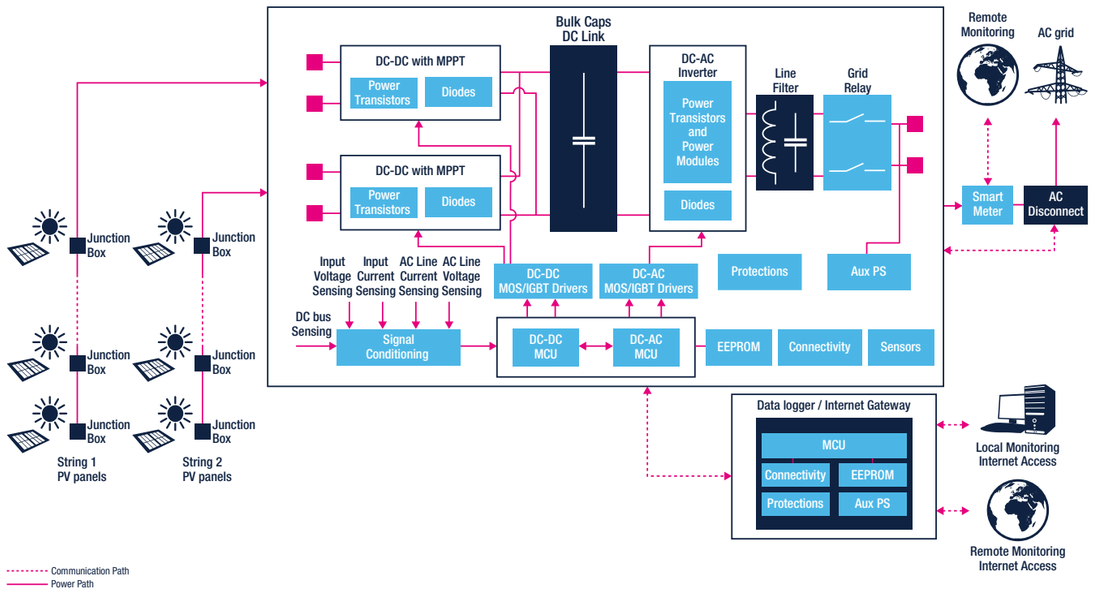
ENERGY GENERATION AND DISTRIBUTION

Solar centralized generation - solar inverters (string and central)

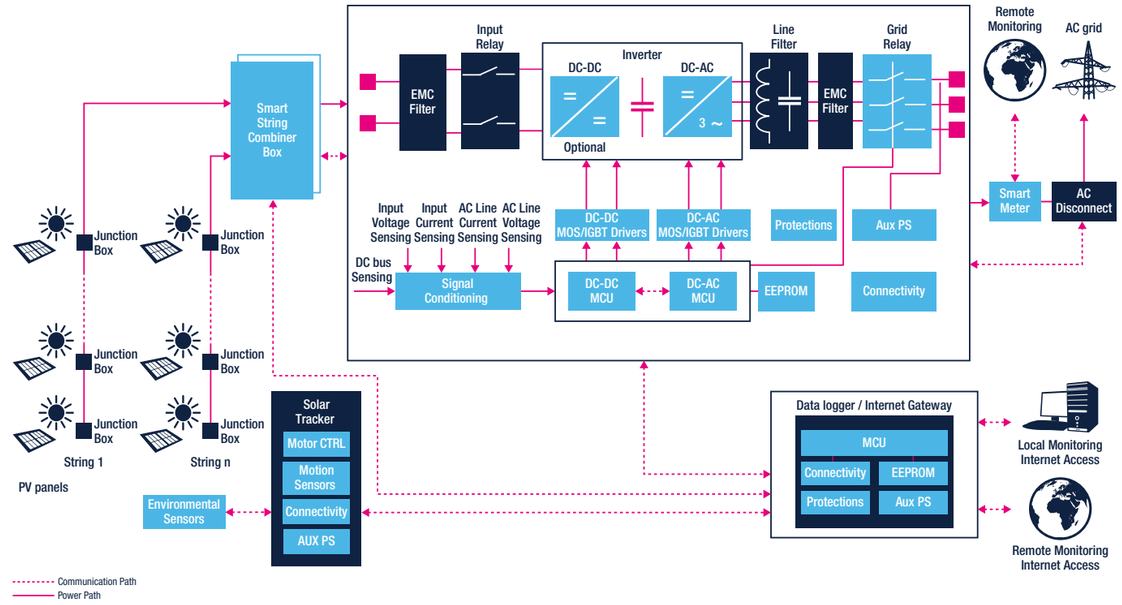
String and central inverters are the most common power conversion systems used for grid-connected solar applications. They comprise a DC-DC conversion stage to adapt voltage levels and implement the maximum power point tracking (MPPT) function to maximize energy transfer from the panel, and a DC-AC conversion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

We offer a broad range of silicon-carbide (SiC) power MOSFETs - with the industry's highest operating junction temperature of 200 °C - and trench-gate field-stop IGBTs, which are also integrated in our high-efficiency ACEPACK power modules. Together with galvanically-isolated gate drivers and high-performance STM32 microcontrollers, our solutions 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 product offering for string and central solar inverter

	Power MOSFFETs	IGBTs	Power modules	Diodes and discretes
Inverter power stage DC-DC and DC-AC	600 V MDmesh DM9 ST*60N*DM9 600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V- 650 V MDmesh M9, ST*60N*M9, ST*65N*M9 650 V MDmesh M5 ST*65M5 1200 V MDmesh K5 ST*N120K5 650 V - 1200 V - 1700 V SiC MOSFETs SCT*65G3AG, SCT*N65G2, SCT*120G3AG, SCT*N120G2, SCT*N170	600 V V series STG*V60DF 650 V HB series STG*H65DFB 650 V HB2 series STG*H65DFB2 1200 V H series STG*H120DF2 1200 V M series STG*M120DF3	ACEPACK Power modules A1P50S65M2 A1P25S12M3 A1P35S12M3 A2P75S12M3 A2F12M12W2-F1 A1F25M12W2-F1 A2U12M12W2-F2 **Thyristors SCRs** Thyristors SCRs for grid relay TN6050HP-12WY, TM8050H-8W	600 V Ultrafast STTH*06 STTH*R06 1200 V Ultrafast STTH*12 100 V power Schottky STPS*100 SiC diodes STPSC*065 STPSC*H12 TVS for power MOSFET and IGBT protection SMA4F, SMA6F, SMB15F series
	MCUs	**MOSFET and IGBT gate drivers**	**Protections**	**Connectivity**
Inverter driving and control stage	STM32F334 STM32G4 STM32H7 STM32F3 STM32F4 STM32F7	HV HB gate drivers L649* Isolated gate drivers STGAP* Multiple LS gate drivers PM8834 **LDO** L78xx, LD1117, LD39200, ST730/2 **DC-DC** L6983, L6982, L6981	TVS for power rail surge protection SMAJ, SM6T, SM15T, SMC30J, SMC50J series ESD and high speed port series for Ethernet and USB protection	Zigbee, Thread STM32WB Bluetooth Low Energy BlueNRG, STM32WB, STM32WBA5 Power Line transceivers ST8500, ST7580 RS-422 and RS-485 ST3485*, STR485* Isolated interfaces for wired connectivity STISO62x
	MCUs	**EEPROM**	**Protections**	
Data logger/internet Gateway	STM32F0 STM32G0 STM32F1 STM32F3	Standard serial EEPROM	ESD and high Speed Port series for Ethernet and USB protection	
	Motor CTRL	**Motion sensors**	**Environmental sensors**	**Connectivity**
Solar tracker	3-phase field oriented control (FOC)	Accelerometer IIS3DHHC, IIS2DH, IIS2ICLX Magnetometer-IIS2MDC eCompass-ISM303DAC 6 axis IMU-ISM330DLC, ISM330DHCX	Pressure - LPS22HH Temperature - STTS22H	Bluetooth Low Energy BlueNRG, STM32WB, STM32WBA5

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

Our solution includes MDmesh and STripFET power MOSFETs, high-voltage, galvanically isolated gate drivers, high-voltage silicon carbide (SiC) diodes, together with high-performance STM32 microcontrollers featuring 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.

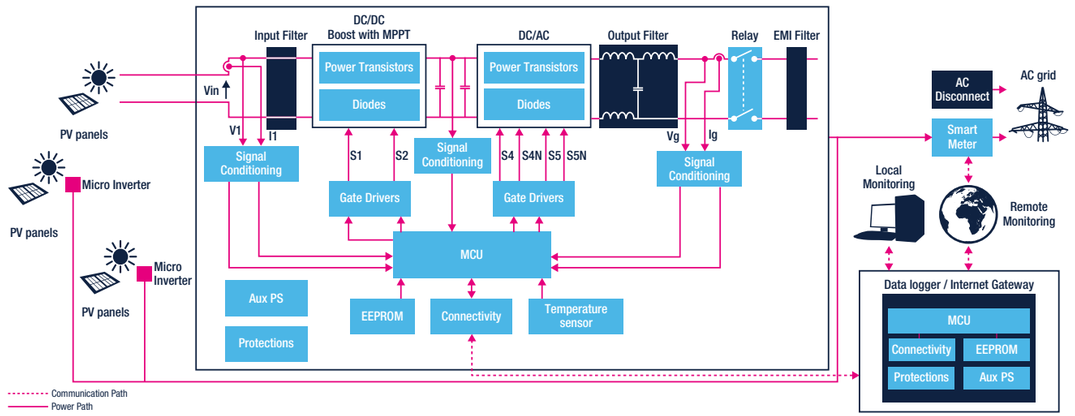
ST product offering for microinverter

	Power MOSFFETs	Diodes	Protections	Signal conditioning
Microinverter power stage	60 V-100 V STripFET F7 ST*N6F7, ST*N8F7, ST*N10F7 600 V MDmesh DM9 ST*60N*DM9 600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V- 650 V MDmesh M9 ST*60N*M9, ST*65N*M9 600 V MDmesh M6 ST*60M6 650 V MDmesh M5 ST*65M5 800 V MDmesh K6 ST*80*K6 800 V-900 V MDmesh K5 ST*80K5, ST*90K5 650 V SiC MOSFETs SCT*65G3AG, SCT*N65G2	600 V Ultrafast STTH*R06 1200 V Ultrafast STTH*S12 100 V power Schottky STPS*100 SiC diodes STPSC*065 STPSC*H12 100 V Trench Schottky STPST*100	TVS for power MOSFET and power rail surge protection SMAJ, SM6T, SM15T series **Thyristors SCRs and triacs** Thyristors SCRs and triacs for grid relay TN815-800B, TN1515-600B, T1635H-8G, T2550-12G	Precision Op Amps (<50 MHz) TSZ*, TSV7*, TSB*, TSX*, TSU*, TSV* Current sensing TSC*

	MCUs	MOSFET and IGBT gate drivers	Sensors	EEPROM
Microinverter Driving and control stage	STM32F334 STM32G4 STM32H7 STM32F3 STM32F4 STM32F7	HV HB gate drivers L638*, L639*, L649* Isolated gate drivers STGAP* Multiple LS gate drivers PM8834 Single LS gate drivers PM88*1	Pressure - LPS22HH temperature - STTS22H **Protections** TVS for power rail surge protection SMAJ, SM6T, SM15T, SMC30J, SMC50J series	Standard serial EEPROM **Connectivity** Zigbee, Thread STM32WB[1] Bluetooth Low Energy BlueNRG, STM32WB, STM32WBA5 Power Line transceivers ST8500, ST7580 RS-422, RS-485 and RS-232 ST3485*, STR485*, ST3232* Isolated interfaces for wired connectivity STISO62x
	MCUs	**EEPROM**	**Protections**	
Data Logger/ Internet Gateway	STM32F0 STM32G0	Standard serial EEPROM	ESD and high Speed Port (HSP) series for Dataline ESD and EOS protection	

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

Typical block diagram



Solar distributed generation - power optimizer

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

Power optimizers can help minimize system 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 reducing maintenance costs.

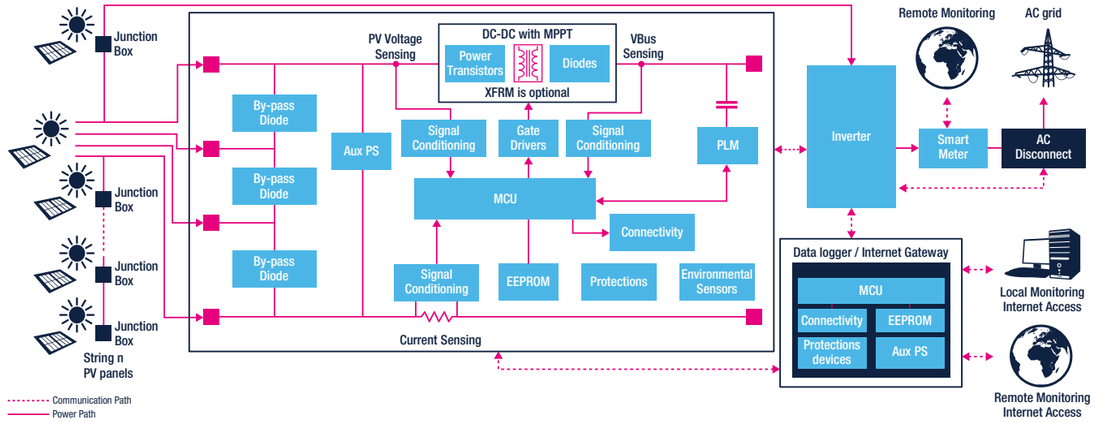
We provide high-performance STM32 microcontrollers and high-efficiency STripFET F7 LV power MOSFETs, diodes, SiC MOSFETs and trench gate field-stop IGBTs, galvanically-isolated gate drivers, and power line communication solutions to help achieve superior efficiency and reliability for power optimizer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

ST product offering for power optimizer

	MCUs	Power MOSFETs	Gate drivers	By pass diodes	Diodes	Protections	Signal conditioning
Power optimizer	STM32F334 STM32F0 STM32G0 STM32F3 STM32G4	60 V to 100 V STripFET F7 ST*N6F7 ST*N8F7 ST*N10F7	HV HB gate drivers L649* Isolated gate drivers STGAP* Multiple LS gate drivers PM8834 Single LS gate drivers PM88*1	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*100 100 V Trench Schottky STPST*100	TVS for power MOSFET and IGBT protection SMAJ, SM6T, SM15T, SMC30J, SMC50J series TVS for power rail surge protection SMAJ, SM6T, SM15T, SMC30J, SMC50J series ESD protection for I/O interfaces	Precision Op Amps (<50 MHz) TSZ*, TSV7*, TSB*, TSX*, TSU*, TSV* Current sensing TSC* **Connectivity** Zigbee, Thread STM32WB[1] Bluetooth Low Energy, BlueNRG STM32WB, STM32WBA5 Power Line transceivers ST8500, ST7580 Isolated interfaces for wired connectivity STISO62x
	MCUs	**Power MOSFETs**		**IGBTs**	**Diodes**		
Inverter	STM32F334 STM32G4 STM32H7 STM32F3 STM32F4 STM32F7	650 V - 1200 V SiC MOSFETs SCT*65G3AG SCT*N65G2 SCT*120G3AG SCT*N120G2 SCT*N120		600 V V series STG*V60DF 650 V HB series STG*H65DFB 650 V HB2 series STG*H65DFB2 1200 V H series STG*H120DF2 1200 V M series STG*M120DF3	600 V Ultrafast STTH*06 STTH*R06 SiC diodes STPSC*065 STPSC*H12		
	MCUs	**EEPROM**				**Protections**	
Data Logger/ Internet Gateway	STM32F0 STM32G0	Standard serial EEPROM				ESD and high Speed Port series for Dataline ESD and EOS protection	

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

Typical block diagram



Energy distribution - home and commercial battery storage systems

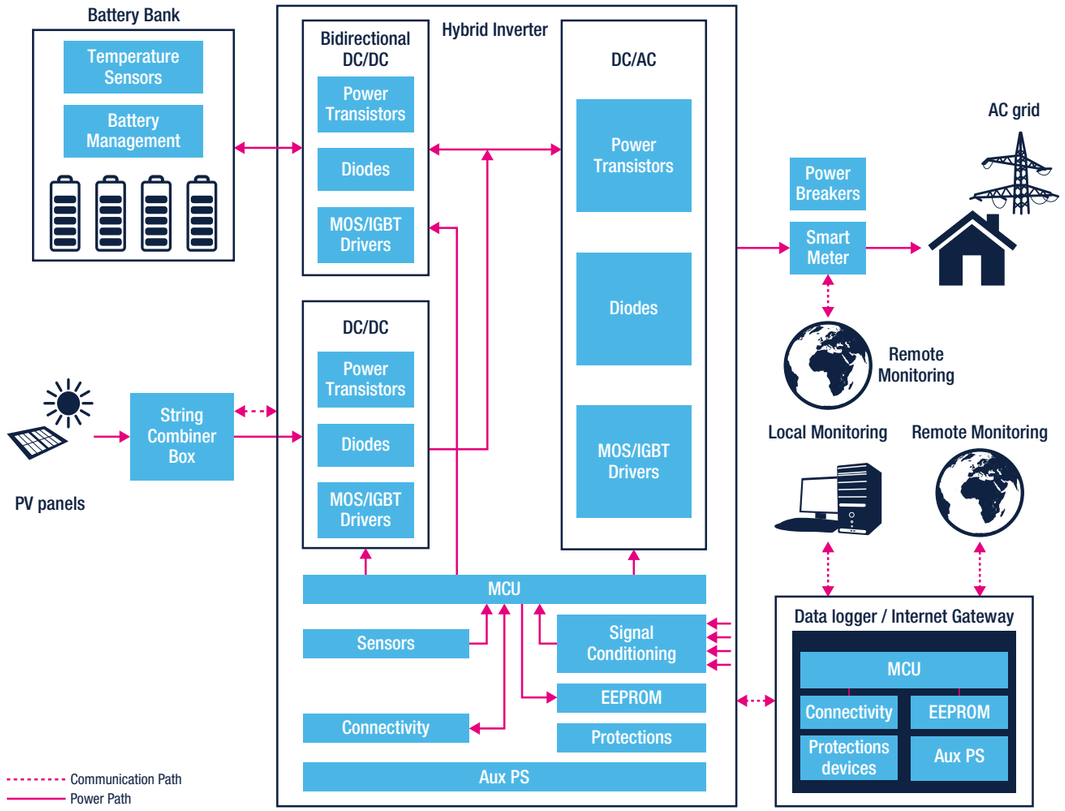
The adoption of energy storage devices, whose reserve capacity can be used for balancing purposes, peak-load shaving, or to shift loads, is increasingly widespread in energy distribution networks.

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

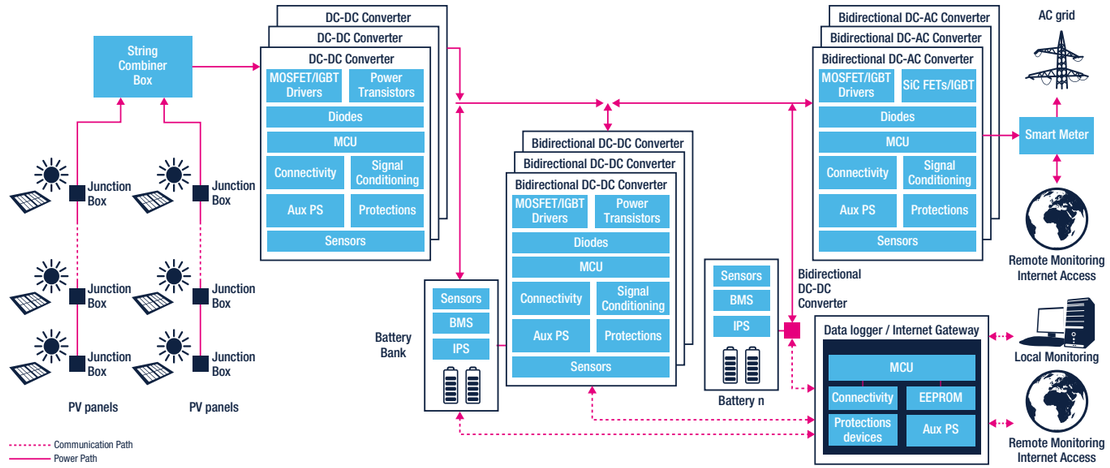
By interacting with the grid, batteries, and potentially solar panels, power converters at the heart of these systems must operate with high-efficiency and superior reliability over time.

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

Typical block diagram - home battery storage system



Typical block diagram - commercial battery storage system



ST product offering for home and commercial battery storage systems

	Power MOSFETs	IGBTs	Power modules	MOSFET and IGBT gate drivers	Diodes and discretes
DC-DC converter and bidirectional **DC-DC converter** **Power stage**	40 V-100 V STripFET F7[1] ST*N4F7, ST*N6F7, ST*N8F7, ST*N10F7 600 V MDmesh DM9 ST*60N*DM9 600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V-650 V MDmesh M9 ST*60N*M9, ST*65N*M9 600 V-650 V MDmesh M6 ST*60M6, ST*65M6 600 V-650 V MDmesh M2 ST*60M2, ST*65M2 800 V MDmesh K6 ST*80*K6 800 V to 1200 V MDmesh K5 ST*80K5, ST*9*K5 ST*105K5, ST*120K5 650 V to 1700 V SiC MOSFETs SCT*65G3AG, SCT*N65G2, SCT*120G3AG, SCT*N120G2, SCT*N120, SCT*N170		ACEPACK Power modules A1P50S65M2 A1P25S12M3 A1P35S12M3 A2P75S12M3 A2F12M12W2-F1 A1F25M12W2-F1 A2U12M12W2F1	HV HB gate drivers L649* Isolated gate drivers STGAP* Multiple LS gate drivers PM8834 Single LS gate drivers PM88*1	600 V Ultrafast STTH*06 STTH*R06 800 V to 1200 V Ultrafast STTH*08 STTH*10 STTH*12 SiC diodes STPSC*065 STPSC*H12 TVS for power MOSFET and IGBT protection and for power rail surge protection SMA4F, SMA6F, SMB15F, series
DC-AC converter **Power stage**		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	**Thyristors SCRs** Thyristors SCRs for power breakers TS110-8 X0115	**LDO** LD1117xx, ST730/2, L78xx **DC-DC converters** L6983, L6982, L6981	
	MCUs	**Signal conditioning**	**EEPROM**	**Sensors**	**Connectivity**
System **Control stage**	STM32F334 STM32G4 STM32H7 STM32F3 STM32F4 STM32F7	Precision Op Amps (<50 MHz) TSZ*, TSV7*, TSB*, TSX*, TSU*, TSV* Current sensing TSC*	Standard serial EEPROM **Protections** TVS for power rail surge protection SMAJ, SM6T, SM15T, and ESD series	Pressure - LPS22HH temperature - STTS22H **BMS** L9961, L9963E, L9963T **IPS** IPS2050H, IPS2050H-32, IPS1025H, IPS1025H-32, IPS4260L	Power Line transceivers ST8500, ST7580 RS-485 and RS-232 STR485*, ST3232* Isolated interfaces for wired connectivity STISO62x
	MCUs	**Protections**	**EEPROM**	**Connectivity**	
Data Logger/ Internet Gateway	STM32F0 STM32G0 STM32F1 STM32F3	ESD and high Speed Port series for Dataline ESD and EOS protection	Standard serial EEPROM	Power Line transceivers ST8500, ST7580 Bluetooth Low Energy BlueNRG, STM32WB, STM32WBA5 RS-485 and RS-232 STR485*, ST3232* Sub-1GHz RF transceivers[2] S2-LP, SPIRIT1 Sub-1GHz wireless MCU[2] STM32WL Zigbee, Thread, STM32WB Isolated interfaces for wired connectivity STISO62x	

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

INDUSTRIAL POWER AND TOOLS

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 MOSFET 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.

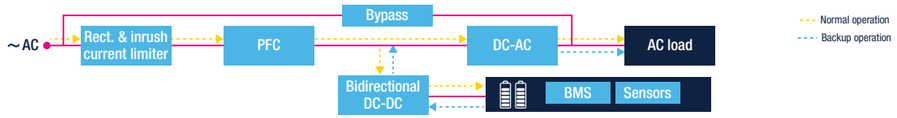
ST product offering for uninterruptable power supplies (UPS)

	SCRs and TRIACs	Diodes		SCRs and TRIACs
Rect. and inrush current limiter	High Temp. SCR TN*015H-6, TN*050H-8, TN*050H-12W, TN1605H-8x High Temp. triacs T1635T	Bridge rectifier diodes STBR*08, STBR*12	**Bypass**	Standard SCR TYN6*, TYN8*, TYN10*, TYN12* High Temp. SCR TN5050H-12WY Standard and Snubberless Triacs T2550-12, TPDV*

	MCUs and digital controllers	Power MOSFETs	IGBTs	Diodes	Op-amp V/I sensing	Protections
PFC	MCUs STM32F0, STM32G0, STM32F301, STM32F334, STM32G4 Digital controllers STNRG388A	600 V- 650 V MDmesh M9 ST*60N*M9, ST*65N*M9 600 V MDmesh M6 ST*60M6 600 V-650 V MDmesh M2 ST*60M2, ST*65M2 650 V MDmesh M5 ST*65M5 650 V - 1200 V SiC MOSFETs SCT*65G3AG, SCT*N65G2, SCT*120G3AG, SCT*N120G2, SCT*N120 650 V Power GaN SGT*65AL	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 1200 V Ultrafast STTH*12 SiC diodes STPSC*065 STPSC*H12	Precision Op Amps (<50 MHz) TSZ*, TSV7*, TSB*, TSX*, TSU*, TSV* **MOSFET and IGBT gate drivers** LS gate drivers PM8834, PM88*1 HV HB gate drivers for GaNs STDRIVEG600* HV HB gate drivers L649* Isolated gate drivers STGAP*	TVS for power MOSFET protection SMAJ, SM6T, SM15T series
	MCUs	**Power MOSFETs**	**Power modules**	**Diodes**	**MOSFET and IGBT gate drivers**	
Bidirectional DC-DC	STM32F334 STM32G4 STM32F4 STM32F7 STM32H7	60 V-100 V STripFET F7 ST*N6F7, ST*N8F7, ST*N10F7 600 V-650 V MDmesh DM9 ST*60N*DM9, ST*65N*DM9 600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V- 650 VMDmesh M9 ST*60N*M9, ST*65N*M9 600 V MDmesh M6 ST*60M6 600 V-650 V MDmesh M2 ST*60M2, ST*65M2 650 V-1200 V SiC MOSFETs SCT*65G3AG, SCT*N65G2, SCT*120G3AG, SCT*N120G2 650 V Power GaN SGT*65AL	A2F12M12W2-F1 A1F25M12W2-F1 A2U12M12W2F1 A1P50S65M2 A1P25S12M3 A1P35S12M3 A2P75S12M3	600 V Ultrafast STTH*06 STTH*R06 800 V to 1200 V Ultrafast STTH*08 STTH*10 STTH*12 SiC diodes STPSC*065 STPSC*H12	HV HB gate drivers L649* Isolated gate drivers STGAP* HV HB gate drivers L649* Isolated gate drivers STGAP*	
		IGBTs	**Post regulation**			**BMS**
DC-AC stage		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*M120DF	DC-DC converters L698*, L7983, L7985, L7986, L7987* Low dropout (LDO) linear regulators LDF, LDFM, LDK220, LDK320, LDK715, LDL212	**Battery management**	L9961, L9963E, L9963T **Sensors** Temperature - STTS22H Humidity - HTS221

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

Typical block diagram for online UPS with double conversion stage



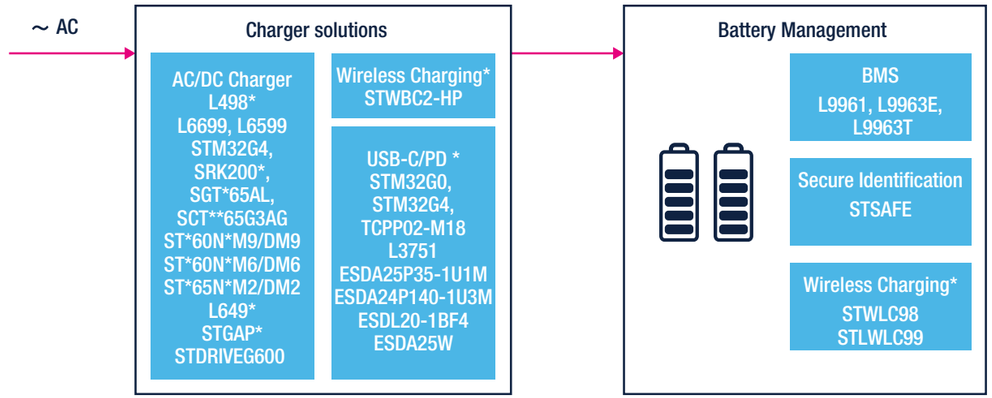
Industrial battery chargers

Industrial battery charger solutions target at highly efficient charging operation, enhanced battery lifetime and protection of Li-ion batteries used in different applications such as cordless power tools, garden tools, AGV and service robots, light electric vehicle (LEV) including e-bike, e-scooter, e-rickshaw, e-microcars, e-golf-cart, and e-forklift.

Specifically for cordless power tools, bidirectional power converters are more and more required to replace with one single power supply the two converters, one typically used to generate the AC voltage and one to recharge the battery pack. The use of a single converter will reduce the space required for the power electronics and will make this space available to increase the number of cells in the battery pack. In this way the UPS operating time will be extended.

ST takes into account the different needs of this wide range of use cases, which can features sophisticated or cost-optimized BOM, for hobby or professional use, by offering scalable solutions thanks to its wide portfolio of power discrete and modules, digital and analog controllers, combined with gate drivers and analog.

Typical configuration for Single-Phase architecture for Low/Medium power welding



* For more detailed information, please refer to the application section

Main application boards and reference designs

STDES-2KW5CH48V

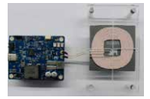
2.5 kW - 48 V battery charger reference design for industrial light electric vehicles (LEVs)

STEVAL-DPSTPFC1

3.6 kW PFC Totem-Pole with digital inrush current limiter

STEVAL-DPSLLCK1

3 kW Full Bridge LLC resonant digital power supply



STEVAL-WBC2TX70[1]

Qi-compatible wireless power transmitter for 70 W applications

STEVAL-WLC99RX[1]

Qi-compatible wireless power receiver for 70 W applications

* 1 available in Q1 2024

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.

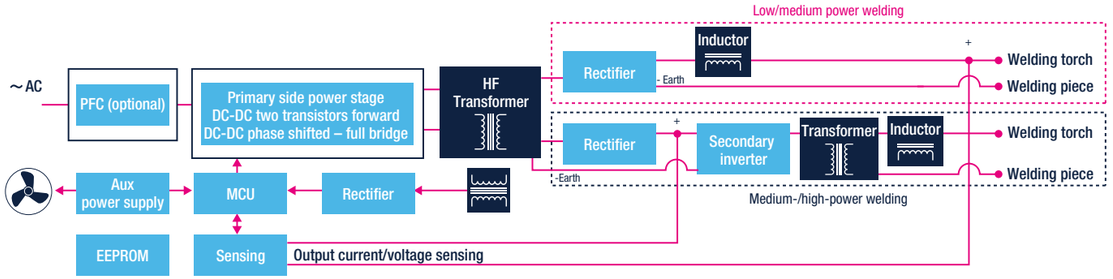
The main requirements in an SMPS for welding are high efficiency and reliability, as well as power density to enable lighter and more compact designs.

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 product offering for industrial welding

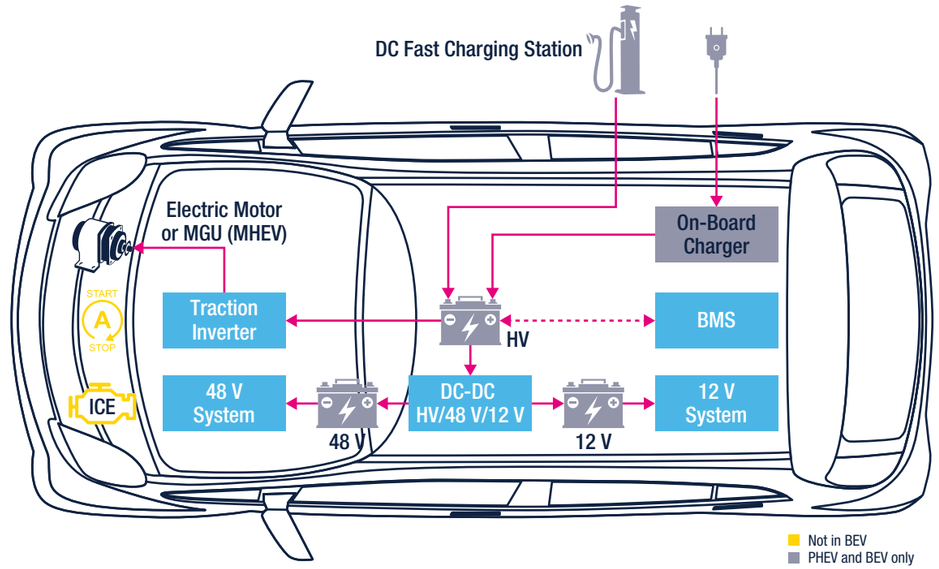
	MCUs and digital controllers	MOSFET/IGBT gate drivers	IGBTs and power modules	Power MOSFETs	Diodes and protections
PFC	MCUs STM32F0 STM32G0 STM32F301 STM32F334 STM32G4 Digital controllers STNRG388A	Single LS gate drivers PM88*1, TD35* Multiple LS gate drivers PM8834 Isolated gate drivers STGAP* HV HB gate drivers L649* HV HB gate drivers for GaNs STDRIVEG600*	600 V V series STG*V60F 650 V HB series STG*HP65FB 650 V HB2 series STG*HP65FB2 1200 V H series STG*H120F2	600 V- 650 V MDmesh M9 ST*60N*M9, ST*65N*M9 600 V MDmesh M6 ST*60M6 600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 650 V MDmesh M5 ST*65M5 650 V-1200 V SiC MOSFETs SCT*65G3AG, SCT*N65G2, SCT*120G3AG, SCT*N120G2 650 V Power GaN SGT*65AL	600 V Ultrafast STTH*W06, STTH*R06, STTH*T06 1200 V Ultrafast STTH*S12 SiC diodes STPSC*065, STPSC*H12 TVS for power rail surge protection SM*T, SMC30J, SMC50J series
DC-DC TTF (low/medium power)	STM32F334 STM32G4 STM32F301 STM32F1 STM32F3		600 V V series STG*V60DF 650 V HB series STG*H65DFB 650 V HB2 series STG*H65DFB2 1200 V H series STG*H120DF2 ACEPACK Power modules customized modules	650 V MDmesh M9 ST*65N*M9 600 V MDmesh M6 ST*60M6 600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 800 V to 1200 V MDmesh K5 ST*80K5, ST*9*K5, ST*105K5, ST*120K5 600 V-650 V MDmesh DM9 ST*60N*DM9, ST*65N*DM9 600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 950 V to 1050 V MDmesh DK5 ST*95DK5, ST*105DK5 650 V-1200 V SiC MOSFETs SCT*65G3AG, SCT*N65G2, SCT*120G3AG, SCT*N120G2 650 V Power GaN SGT*65AL	600 V Ultrafast STTH*R06, STTH*06 1000-1200 V Ultrafast STTH*10, STTH*12 TVS for power rail surge protection SM*T, SMC30J, SMC50J series
DC-DC PS-FB (medium/high power)		Isolated gate drivers STGAP* HV HB gate drivers L649* HV HB gate drivers for GaNs STDRIVEG600*			
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 M6 ST*60M6, ST*65M6 600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 600 V MDmesh DM6 ST*60DM6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2	200 V to 400 V Ultrafast STTH*W02, STTH*W03, STTH*W04 Power Schottky high temperature STTH*10, STTH*12 TVS for power rail surge protection SM*T, SMC30J, SMC50J series

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



ELECTRO-MOBILITY

Key applications



Solutions

ST 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 and SF development tools – Sample kits, evaluation kits, product selectors

Smart driving

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www.st.com/electro-mobility

Battery management system (BMS)
Charging station
DC-DC converter
Small electric vehicles
Electric traction (Main inverter)
Mild hybrid 48 V systems
On board charger (OBC)
Acoustic vehicle alerting system (AVAS)
HV battery disconnect and fire-off system
Vehicle control unit (VCU)

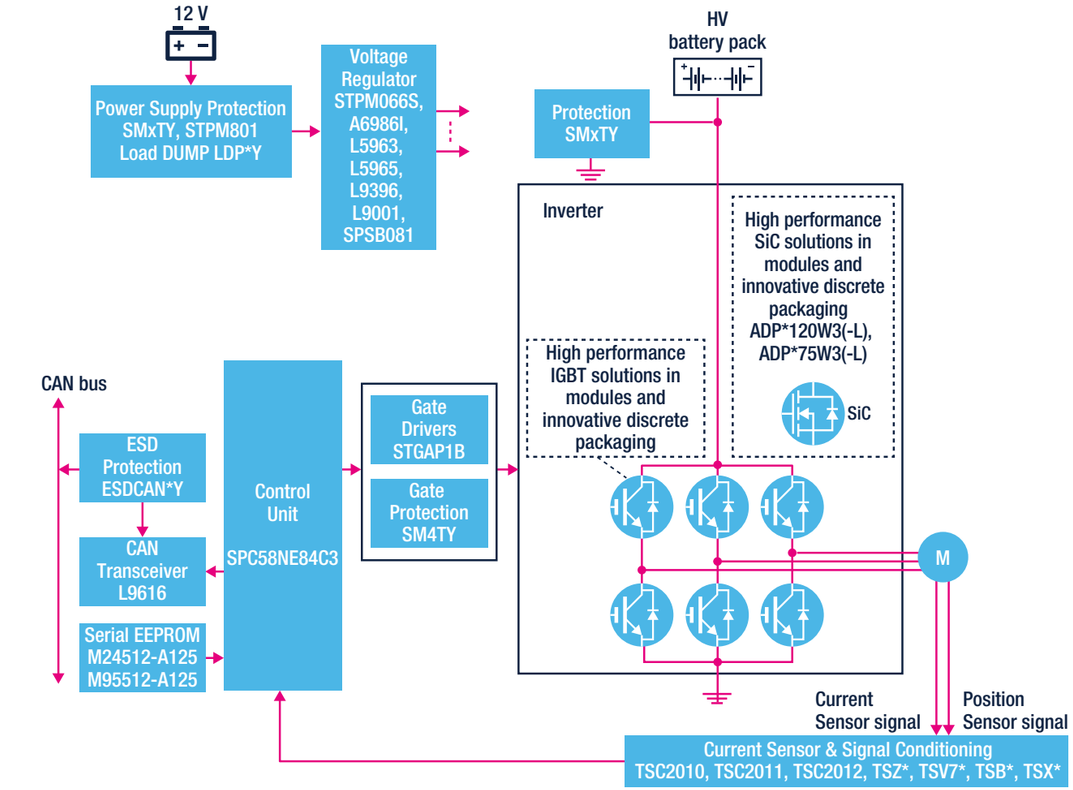
Main traction inverter

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

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

To help developers increase inverter power efficiency and reduce size and weight, ST has a wide portfolio of discrete semiconductors, including AEC-Q101 qualified silicon and silicon carbide (SiC) MOSFETs and diodes, as well as IGBTs. These are complemented by AEC-Q100 qualified galvanically isolated IGBT and MOSFET gate drivers and SPC5 32-bit automotive microcontrollers for implementing scalable, cost-effective, and energy-efficient solutions. Furthermore, ST offers a compact and high-power-density solutions with the 750 V and 1200 V ACEPACK DRIVE power modules based on SiC Gen3 technology.

Typical block diagram - main inverter



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

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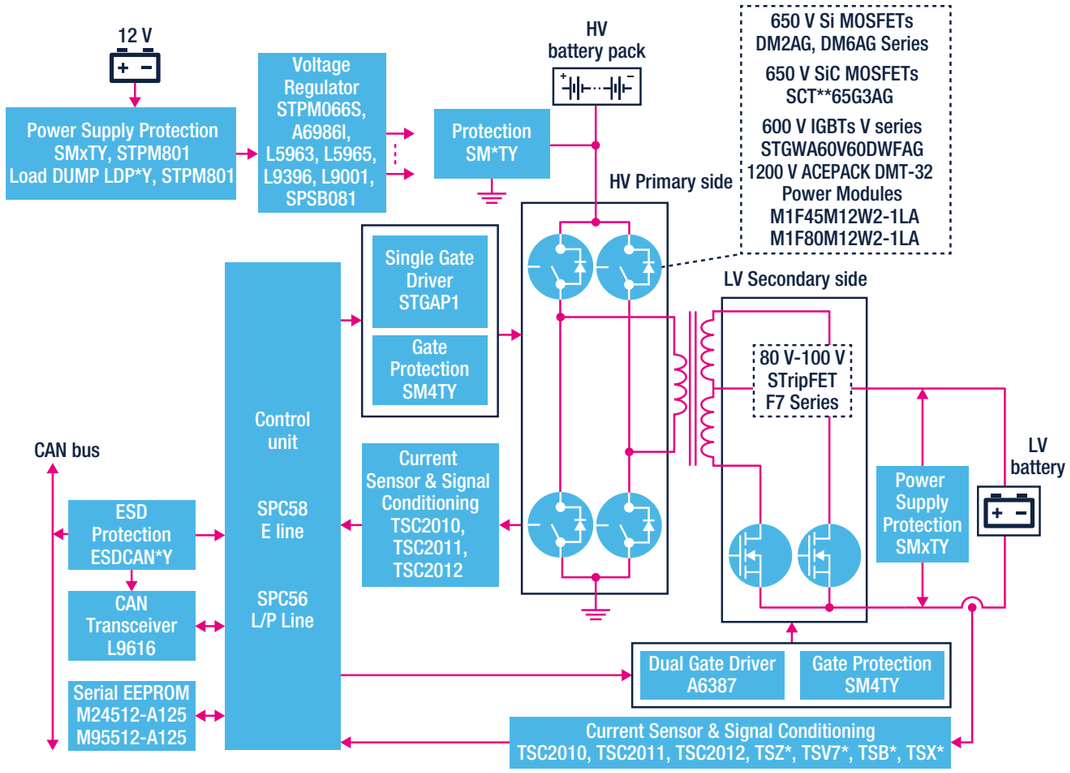
www.st.com/main-inverter-electric-traction

Bidirectional DC-DC converter

Electric vehicles (EV) use two different power systems, a high-voltage battery (200 to 800 V_{DC}) for traction and a low-voltage (12/48 V) one for supplying all the electric appliances in the vehicle. Traditionally, the low-voltage battery was charged from the alternator, but in today's vehicles, it gets its power from the high-voltage battery pack. However, in specific electric car architectures, this low-voltage battery should be ready to help recharge the high-voltage battery pack in order to provide energy for cranking the car. This means that the DC-DC converter must be bidirectional, and very efficient and highly reliable.

ST has a wide offer of discrete semiconductors including AEC-Q101 qualified silicon and silicon carbide (SiC) MOSFETs and diodes, as well as IGBTs. These are complemented by AEC-Q100 qualified galvanically isolated IGBT and MOSFET gate drivers and SPC5 32-bit automotive microcontrollers to enable scalable, cost-effective, and energy-efficient solutions. ST product portfolio has been enlarged with power module family AQG-324 compliant, by including ACEPACK DMT-32, ACEPACK 1 and ACEPACK 2 with SiC power switches

Typical block diagram - 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

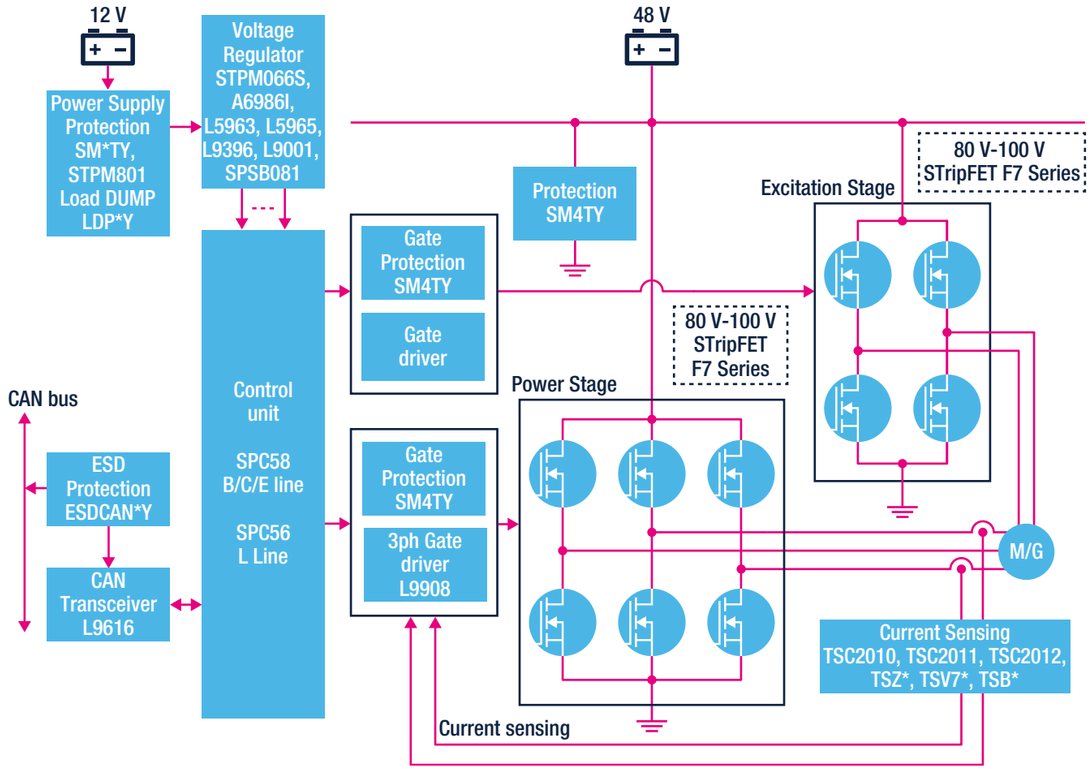
48 V start-stop system

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

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

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

Typical block diagram - 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

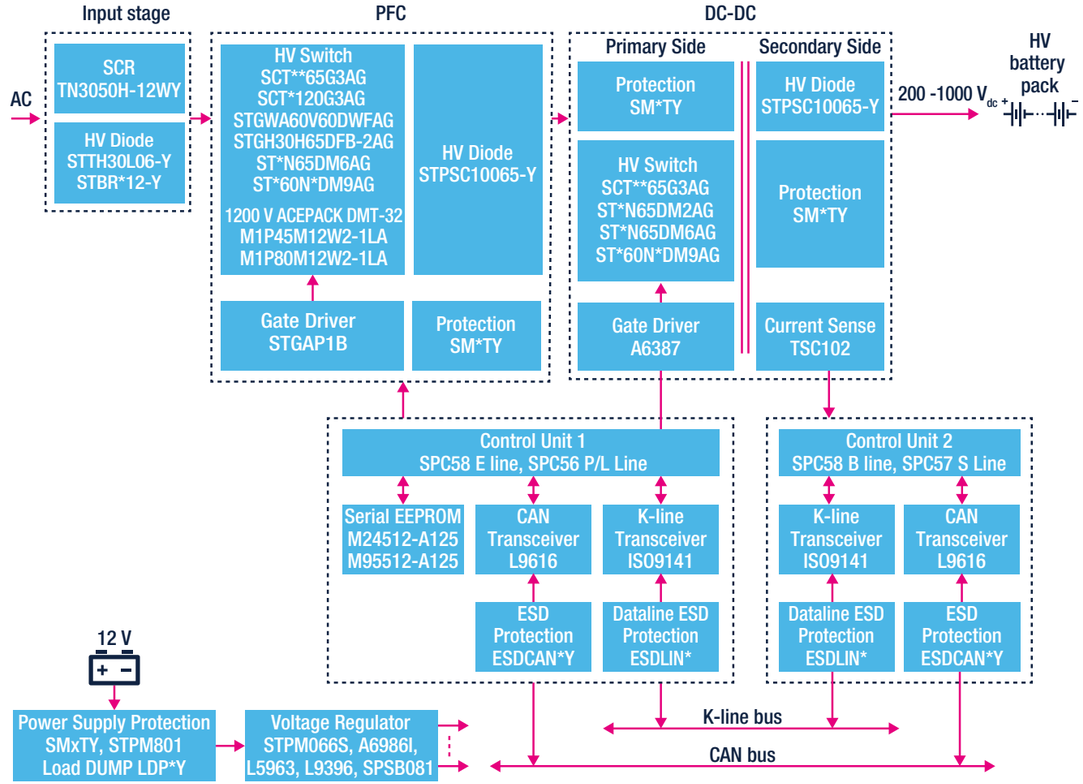
On-Board charger (OBC)

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 of private or public charging stations.

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

ST has a wide offer of discrete semiconductors, including AEC-Q101 qualified silicon and silicon-carbide (SiC) MOSFETs and diodes, as well as IGBTs. These are complemented by AEC-Q100 qualified galvanically isolated IGBT and MOSFET gate drivers and SPC5 32-bit automotive microcontrollers for implementing these challenging converters.
ST product portfolio has been enlarged with power module family AQG-324 compliant, by including ACEPACK DMT-32 with SiC power switches

Typical block diagram - OBC



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

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www.st.com/on-board-charger

Battery management

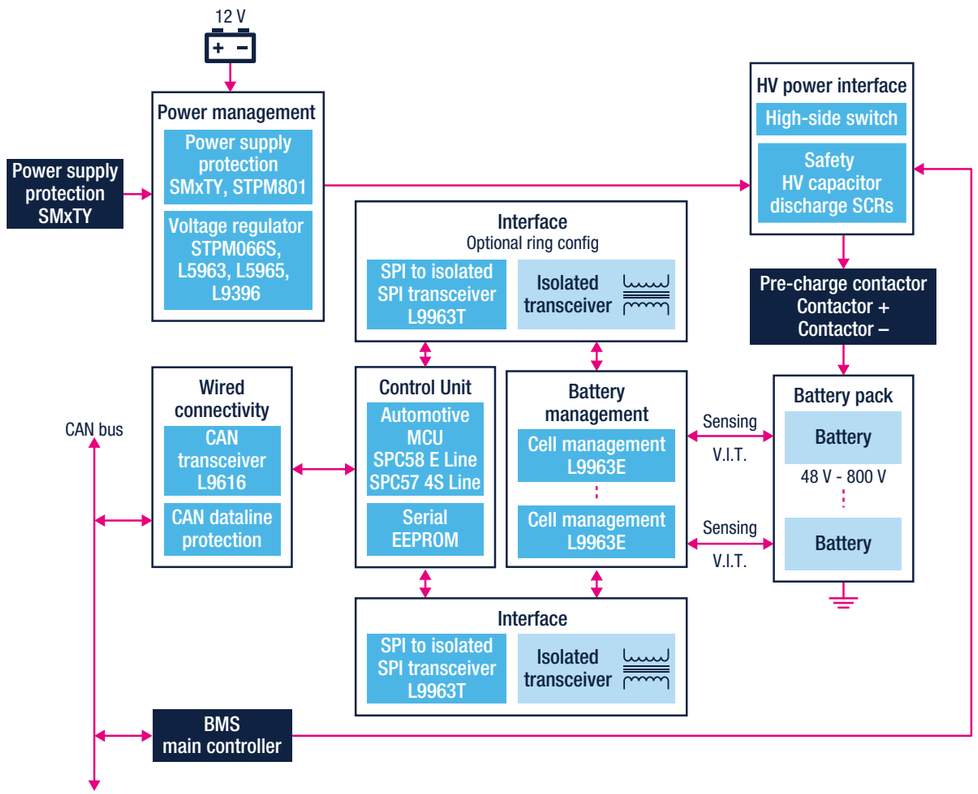
Automotive battery management system (BMS) must be able to meet critical features such as voltage, temperature and current monitoring, battery state of charge (SoC), and cell balancing of lithium-ion (Li-ion) batteries.

Indeed, the main functions of a battery management system for electric vehicles are:

- **Battery protection** in order to prevent operations outside its safe operating area
- **Battery monitoring** by estimating the battery pack state of charge (SoC) and state of health (SoH) during charging and discharging
- **Battery optimization** thanks to cell balancing that improves the battery life and capacity, thus optimizing the driving range for hybrid (HEV), plug-in (PHEV) and full electric vehicles (BEV)
- **Battery thermal management** to drive resistive loads to maintain optimal temperature of battery pack in any environmental condition and so optimize efficiency and lifetime

A discharge circuit is present using an HV power MOSFET (MDmesh K5 AG) working in linear mode to discharge the battery in case of malfunctioning or accident. Battery thermal management is improved by using IGBT 1200 V MS series (GWA40MS120DF4AG) ST25R NFC Reader and ST25D NFC dynamic tags will help fulfill government requirements in certain countries to track batteries for light electric vehicles (like EV motorbikes) and exchange data between the battery and the vehicle.

Typical block diagram - automotive battery management system (BMS)



Main application boards

AEK-POW-BMS63EN
Battery management system module

AEK-COM-ISOSPI1
SPI to isolated SPI dongle for BMS

FIND OUT MORE

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

DC Fast charging Station

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

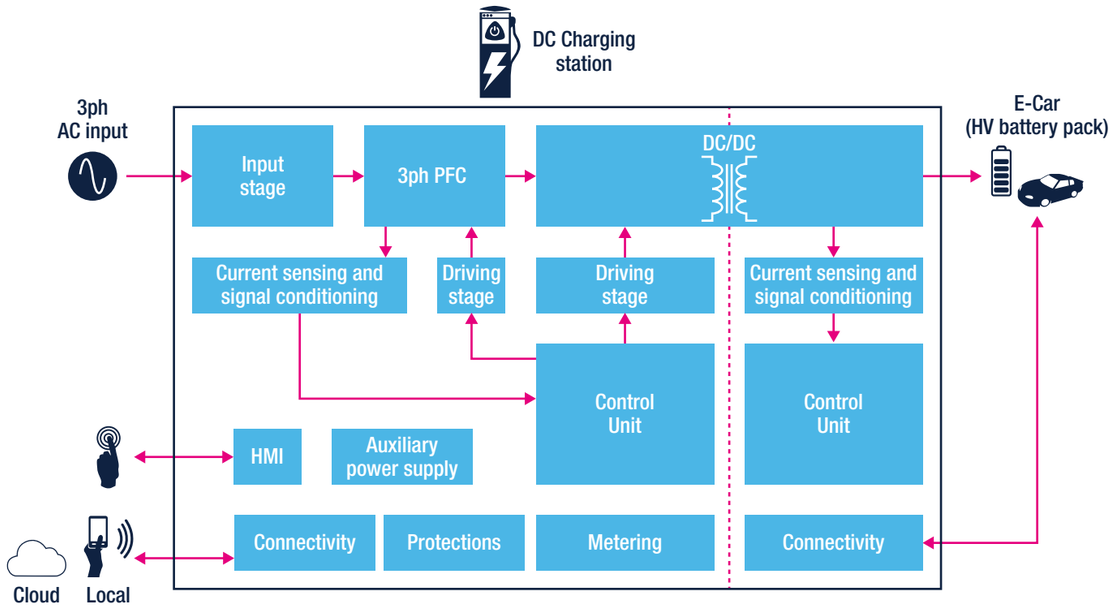
While architectures based on renewable sources and battery storage technologies to take charging stations off-grid are emerging, mainstream solutions are fed from the grid, and a converter, in the range of 150 kW or more, has a 3-phase input power factor correction (PFC) stage and an isolated DC-DC converter. 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.

ST25R NFC readers will help compliance with rules in certain countries to accept credit cards following the EMVCo standard or accept closed-loop payment and even track charging in private environments.

We also provide eDesignSuite - Digital power workbench SW design tool.

Typical block diagram - DC fast charging station



Main application boards and reference designs

STDES-PFCBIDIR

15 kW, three-phase, three-level active front-end (AFE) bidirectional converter

STDES-DABBIDIR

25 kW dual active Bridge (DAB) bidirectional power converter for EV charging and BESS

STDES-VRECTFD

15 kW, three-level, three-phase Vienna rectifier with digital control for power factor correction

STDES-30KWVRECT

30 kW Vienna PFC rectifier reference design with digital control

ST product offering for DC Fast charging Station

			Input stage	3ph PFC	DC-DC 1^ side	DC-DC 2^ side	Control units 1^ side	Control units 2^ side	Driving stage	Current sensing and signal conditioning	Aux SMPS	HMI	Metering	Connectivity 1^ side	Connectivity 2^ side
Rectifiers	SiC series - 650 V			•		•									
	SiC series - 1200 V			•		•									
	Ultrafast RQ series - 600 V			•	•	•									
	Ultrafast R series - 600 V			•	•						•				
	STBR series - 800 V/1200 V		•	•											
	Schottky series - 40/45/60/100 V										•				
Thyristors	TN series - 1200 V		•												
	TYN series - 1200 V		•												
	TM8050H series - 800 V		•												
	TN3050H, TN*050HP series -1200 V		•												
TVS protections	SM4TY, SM6TY, SM15TY, SM30TY, SM50TY			•	•	•					•				
HMI ESD protections	ESDAxxY series, EMIF06-1005MX12Y											•			
Power MOSFETs	SiC series - 650 V/1200 V			•	•										
	M5 series - 650 V			•											
	M6 series - 600 V			•	•										
	DM6 series - 600 V/650 V				•										
	DM2 series - 600 V/650 V				•										
	K5 series - 1200 V			•							•				
	M9 series - 600 V/650 V			•	•										
	DM9 series - 600 V/650 V				•										
IGBTs	H series - 1200 V			•											
	HB series - 650 V			•	•										
	HB2 series - 650 V			•	•										
	V series - 600 V			•	•										
ACEPACK power modules	A2F12M12W2-F1, A2U12M12W2-F2, A1F25M12W2-F1			•	•										
MCUs (32bit)	STM32F334, STM32G4, STM32F3			•	•		•								
	STM32F0, STM32F1, STM32G0					•		•							
Gate drivers	L6491								•						
	STGAP2*								•						
Iso Sigma-Delta ADC	ISOSD61, ISOSD61L									•					
Current sense amplifiers	TSC102, TSC2010, TSC2011, TSC2012, TSZ*, TSV7*, TSB*, TSX*, TSU*, TSV*			•						•					
HV converters	VIPer*7, VIPer*6, VIPer26K										•				
Offline controllers	L6566BH, STCH03										•				
Voltage regulators	STPM066S, L5965, L9396, A6986I, A798*, A698*, SPSB081										•				
	L798*, L698*										•				
CAN transceivers	L9616														•
CAN ESD protections	ESDCAN*Y series								•				•		•
Power line transceivers	ST2100													•	•
	ST7540, ST7580, ST8500													•	
Bluetooth Low energy Transceiver	SoC and wireless MCUs	BlueNRG-* STM32WB5* STM32WBA5												•	
	STM32 wireless module	STM32WB5MMG STM32WB1MM												•	
	Modules	BlueNRG-M0, BlueNRG-M2												•	
NFC/RFID	Dynamic tags	M24SR, ST25DV-I2C												•	•
	Readers	ST25R												•	•
Metering ICs	STPM32, STPM33, STPM34, STPMS2, STIS0621												•		
LED array drivers	LED1642, STP08, STP16, LED77*, LED8102S, LED1202, STLED316S											•			

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

POWER SUPPLIES

Auxiliary SMPS

Appliances and equipment often require a switch-mode power supply (SMPS) that works separately from the main power supply to support auxiliary functions like standby operation. Power ratings can vary from a few watts to tens of watts for these auxiliary supplies, which can be either isolated or non-isolated. To ensure good performance, engineers must choose the power topology including fixed frequency or 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 100 W, with an extremely low total standby 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 tools, as well as eDesignSuite SW design tool to help engineers develop high-efficiency and compact auxiliary power supply solutions.

Isolated auxiliary SMPS

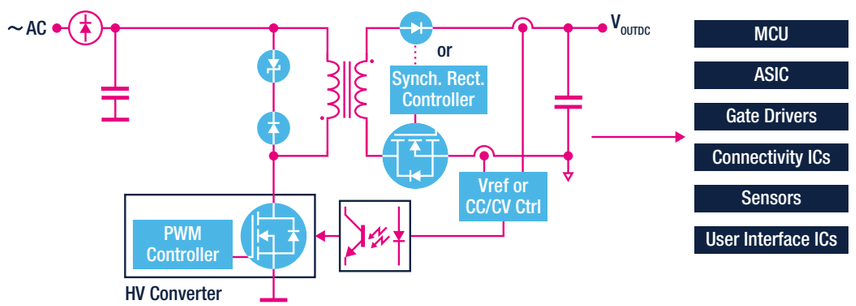
ST helps the designers of high-power-density and cost-effective isolated auxiliary power supplies with higher switching frequency solutions to minimize transformer and output capacitor size.
In the 20 to 100 W power range, the need to meet increasingly tight efficiency and standby requirements for auxiliary power supplies has pushed the use of quasi-resonant topologies in place of more mainstream fixed-frequency-based designs. The power stage is managed by a high-voltage converter.

ST recommended products for isolated auxiliary SMPS

		HV converters		Offline controllers	HV Power MOSFETs	MOSFET protection	Voltage Ref CC/CV Ctrl	Output diodes	Synch Rect	LDO
Isolated flyback	**PSR-CV**		VIPer0P VIPer*1 VIPer*6 VIPer122 VIPer222 ALTAIR*	HVLED101, HVLED001*	800 V MDmesh K6 ST*80*K6 800 V to 1700 V MDmesh K5 ST*80K5, ST*9*K5, ST*105K5, ST*120K5, ST*150K5, ST*12N170K5 650 V SiC MOSFETs SCT*65G3AG, SCT*N65G2 650 V Power GaN SGT*65AL	Power MOSFET protection SMAJ, SM6T, SM15T series Reverse blocking diodes 600 V Ultrafast STTH*06 800 V to 1200 V Ultrafast STTH*08 STTH*10 STTH*12		Schottky, FERD STPS* FERD*45 FERD*50 FERD*60 FER*100 100 V Trench Schottky STPST*100	SR controllers SRK1000*, SRK1001, SRK1004 LV Power MOSFETs 40 V-100 V STripFET F7 ST*N4F7, ST*N6F7, ST*N8F7, ST*N10F7	Low dropout (LDO) linear regulators LDF LDFM LDK220 LDK320 LDL212 ST730 ST732
	Regulation with optocoupler	VIPer*5 VIPer*7 VIPer*8 VIPerGaN50 VIPerGaN65 VIPerGaN100		STCH03 L6566B L6566BH L6565			Voltage reference T*431 T*432 Voltage and current Ctrl TSM*, SEA05*			

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

Typical configuration for isolated auxiliary power supply up to 100 W



Main application boards and reference designs

STEVAL-VP26K01F
Three outputs, isolated SSR flyback converter with extended input voltage range for Smart meter and power Line communication

STEVAL-VP318L1F
15 V/1.2 A isolated SSR flyback converter

EVAL-STCH03-45W
45 W/12 V QR flyback with adaptive synchronous rectification

EVLVIPGAN50FL
15 V - 50 W QR SSR flyback with HV GaN converter and synchronous rectification

Non-Isolated auxiliary SMPS

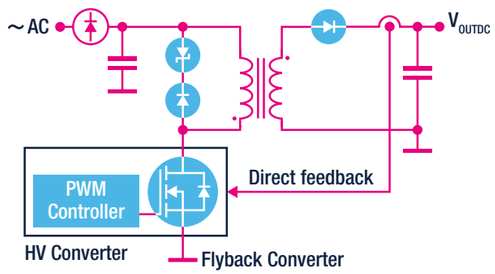
In a number of applications, the reference of the secondary circuit is connected to the same reference as the primary; that is, the AC mains. In such cases, an off-line non-isolated auxiliary power supply can be used to provide a regulated DC voltage using an inductor or low-cost transformer, with simplified 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.

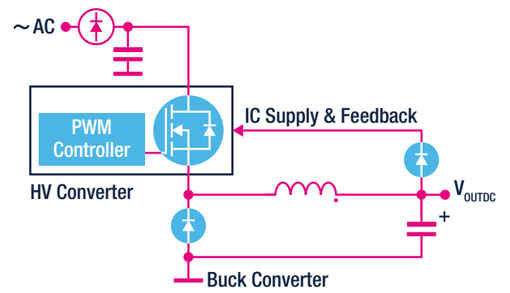
ST recommended products for Non-Isolated auxiliary SMPS

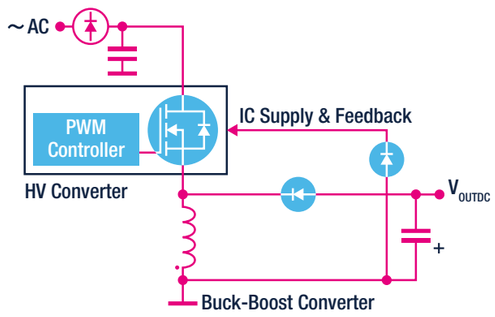
	HV converters	VIPer protection	Reverse blocking diodes	Output diodes	LDO
Buck	VIPer0P VIPer*1 VIPer*6 VIPer122 VIPer222			600 V Ultrafast STTH*06 800 V to 1200 V Ultrafast STTH*08 STTH*10	Low dropout (LDO) linear regulators LDF, LDFM, LDK220, LDK320, LDL212, ST730, ST732
Buck-boost					
Non-isolated flyback		SMAJ, SM6T, SM15T series	600 V Ultrafast STTH*06 800 V to 1200 V Ultrafast STTH*08 STTH*10 STTH*12	Schottky, FERD STPS* FERD*45, FERD*50, FERD*60, FER*100 100 V Trench Schottky STPST*100	

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

Typical configurations for Non-Isolated auxiliary power supply







Main application boards

STEVAL-VP12201B
15 V/200 mA buck converter

STEVAL-VP319X1B
5 V/600 mA buck converter

STEVAL-VP22201B
5 V/0.36 A buck converter

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

Smart chargers and adapters

USB Type-C® PD adapters and quick chargers

The new slim and reversible USB Type-C connector with USB power delivery (PD) feature provides up to 240 W (48 V, 5 A) enabling a faster and more efficient charging solution.

Designers of USB Type-C and power delivery compliant adapters and wall chargers can benefit from the ST-ONE digital controller, the MasterGaN series, from STM32 MCUs as well as a dedicated range of protection devices. Customers can also choose from the VIPerGaN series, which can provide up to 100 W power.

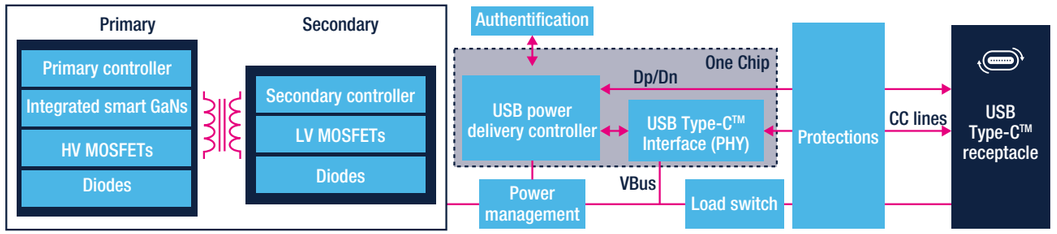
ST recommended products for USB Type-C power delivery smart chargers and adapters

Power stage primary side				Fully integrated controller	Power stage secondary side		
Primary Controller	Integrated Smart GaNs	HV MOSFET	Diodes		Secondary Controller	LV MOSFET	Diodes
PFC L656* Isolation stage VIPerGaN50 VIPerGaN65 VIPerGaN100 STCH03 L6599*,L6699	MASTERGAN1 MASTERGAN2 MASTERGAN3 MASTERGAN4 MASTERGAN5 MasterGaN1L MasterGaN4L	650 V Power GaN SGT*65AL 600 V-650 V MDmesh M9 ST*60N*M9, ST*65N*M9 600 V MDmesh M6 ST*60M6 600- 650 V MDmesh M2 ST*N60M2, ST*N65M2 650 V MDmesh M5 ST*65M5	600 V Ultrafast for TM STTH*L06, STTH*06	ST-ONE ST-ONEHP ST-ONEMP	SR analog controllers SRK1000, SRK1001, SRK1004 for flyback SRK2000A, SRK2001, SRK2001A for LLC	100 V STripFET F7 ST*N10F7	Output diodes for flyback Schottky STPS*, FERD FERD*45, FERD*50, FERD*60, FERD*100 Output diodes for LLC Schottky STPS*, FERD FERD*45, FERD*50, FERD*60, FERD*100

Type-C and USB-PD controllers				Protections				LDO/ DC-DC
Programmable solutions			Standalone solutions	Type C Port protection Over voltage protection for USB-C and PD 3.0 controllers	Vrm	High surge current compact protection (V_{BUS})	Single and multi lines protection for MCUs communication channel (CC) and side band use (SBU)	
Fully integrated controller	MCUs	Type-C Controller/ interface						
ST-ONE ST-ONEHP ST-ONEMP	STM32F0 STM32F3	STUSB1602A	STUSB1600 STUSB1700 STUSB4500L STUSB4500 STUSB4700 STUSB4710 STUSB4761		5 V	ESDA7P120-1U1M	ESDA6V1L ESD051-1F4	STPD01 L6983/2/1 LDK320 ST730/2
					9 V	ESDA13P70-1U1M	ESDL20-1BF4 ESDA25W	
	STM32 with UCPD STM32G0, STM32G4, STM32L5		No need	TCPP01-M12 TCPP02-M18 TCPP03-M20	15 V	ESDA17P100-1U2M ESDA15P50-1U1M	ESDL20-1BF4 ESDA25W	Load switch
	All STM32 and STM (5 V only)		No need	TCPP01-M12 for sink TCPP02-M18 for source	20 V	ESDA25P35-1U1M ESDA24P140-1U3M	ESDL20-1BF4 ESDA25W	
					20 V	ESDA25P35-1U1M ESDA24P140-1U3M	No need as already integrated in TCPP product	STELPD01

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

Typical configuration



Main application boards and reference designs

EVLONE65W

65 W USB Type-C power delivery reference design with integrated GaN

EVLONE140W

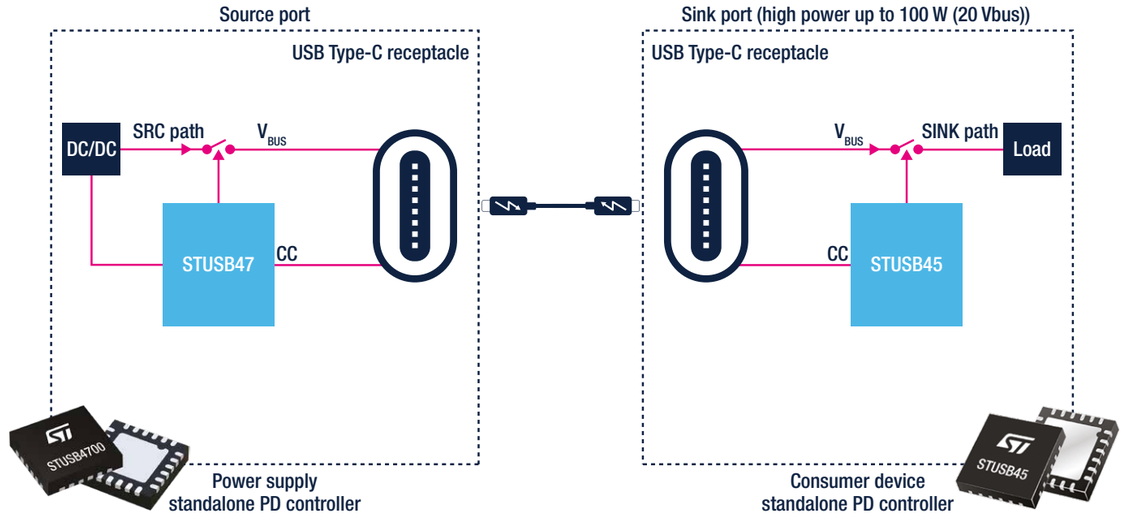
140 W USB-PD 3.1 EPR certified reference design with integrated controller and GaN

EVLONEMP

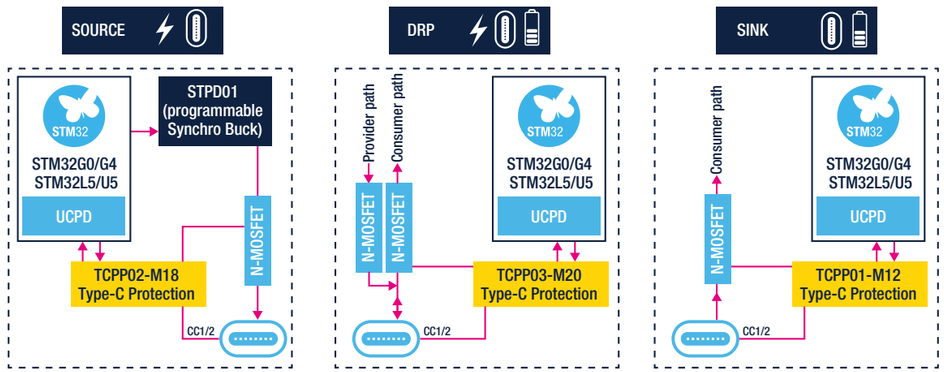
Very high density board- 65 W multi-port (USB Type-C and USB Type-A) power delivery with integrated GaN

EVLVIPGAN50PD/65PD/100PD

45 W/ 65 W/100 W USB PD 3.0 adapter with GaN HV converter



Block diagrams with certified source, Sink, and DRP with STM32 having UCPD controller



Main application boards and reference designs

STEVAL-ISC004V1

STUSB4710A USB power delivery evaluation board (with on-board DC-DC)

STEVAL-2STPD01

USB Type-C power delivery dual port adapter

EVAL-SCS001/2V1

SINK USB-PD reference design
(EVAL-SCS001V1: migration from DC barrel)
(EVAL-SCS002V1: migration from USB micro-B)

X-NUCLEO-SRC1M1

USB Type-C power delivery source expansion board based on TCPP02-M18

X-NUCLEO-SNK1M1

USB Type-C™ power delivery SINK expansion board based on TCPP01-M12

X-NUCLEO-DRP1M1

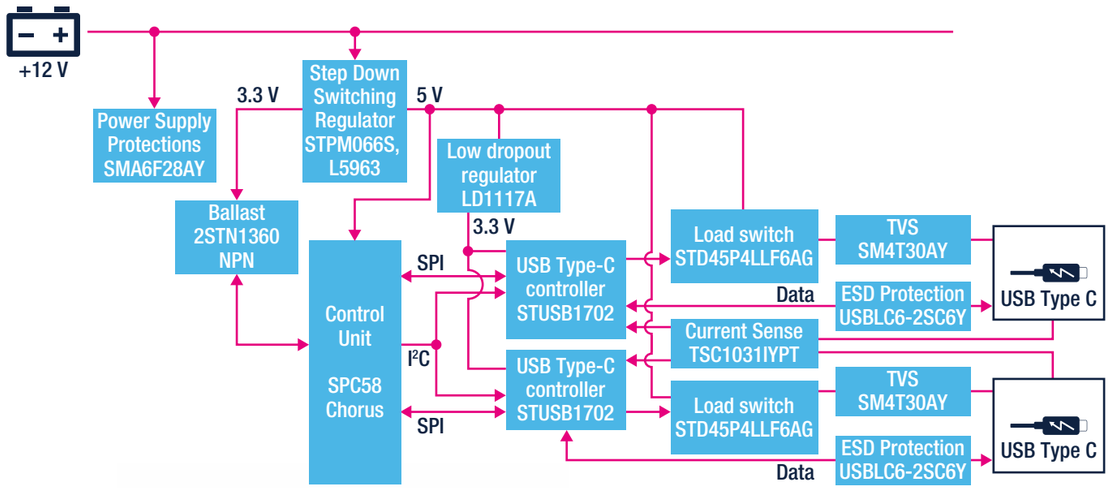
USB Type-C power delivery dual role power expansion board based on TCPP03-M20

Automotive-grade USB Type-C and power delivery solution

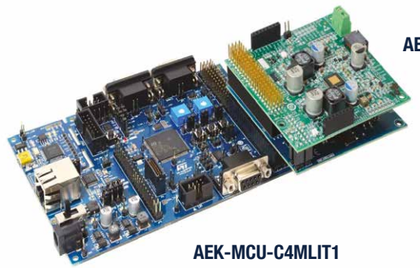
The USB Type-C and USB power delivery specifications allow smarter connectivity with fewer cables, less connectors and universal chargers.

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

Typical block diagram for automotive grade USB power delivery



Complete USB power delivery version 3.0 including software stack available in AutoDevKit



AEK-POW-L5964V1

AEK-MCU-C4MLIT1

AEK-USB-2TYPEC1

AutoDevKit

Digitally controlled dual-channel DC-DC suitable for USB power delivery 3.0

KEY FEATURES

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

Adapters for tablets, notebook, and all-in-one (AIO) computers

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

A typical high-efficiency design includes a flyback or an active clamp flyback stage with synchronous rectification, and for higher power, a power factor corrector (PFC) working in transition mode (TM) followed by a flyback, forward, or half-bridge LLC resonant stage with synchronous rectification.

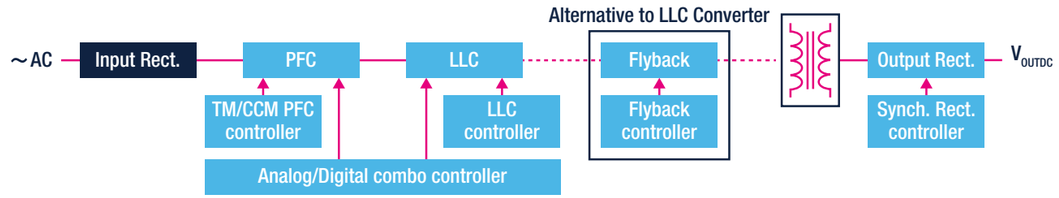
ST has recently introduced GaN power ICs and offers a broad range of high-voltage MDmesh and low-voltage STripFET power MOSFETs, as well as standard and field-effect rectifiers (FERD). Our offering also includes a range of PFC, PWM primary controllers, synchronous rectification controllers, and single-chip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

ST recommended products for tablets, notebook and AIO adapters

	Controllers	Power MOSFETs	Diodes	
PFC Block	TM analog controllers L6562A*, L6563*, L6564* CCM analog controllers L4985, L4986, L4981*, L4984D	650 V Power GaN SGT*65AL 600 V-650 V MDmesh M9 ST*60N*M9, ST*65N*M9 600 V MDmesh M6 ST*60M6 600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 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 and controllers	**GaN power ICs**	**Diodes and protections**	**Voltage reference, CC/CV Ctrl**
Isolation stage	Fully integrated Controller for active clamp flyback (ACF) ST-ONE, ST-ONEHP HV converters for flyback SSR: VIPer*5, VIPer*7, VIPer*8 PSR: VIPer0P, VIPer*1, VIPer122, VIPer222, VIPer*6, ALTAIR* Flyback controllers STCH03, L6566A, L6566B, L6565 PFC and LLC combo controllers STCMB1, STNRG011, STNRG011A LLC analog controllers L6599*, L6699 SR analog controllers SRK1000, SRK1001, SRK1004 for flyback SRK2000A, SRK2001, SRK2001A for LLC	High voltage GaN converters VIPerGaN50, VIPerGaN65, VIPerGaN100 Integrated Smart GaNs 600 V MASTERGAN* **Power MOSFETs** 650 V Power GaN SGT*65AL 600 V MDmesh DM9 ST*60N*DM9 600 V MDmesh DM6 ST*60DM6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V MDmesh M6 ST*60M6, 600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 800 V MDmesh K6 ST*80*K6 800 V to 950 V MDmesh K5 ST*80K5, ST*9*K5 40 V-100 V STripFET F7 ST*N4F7, ST*N6F7, ST*N8F7, ST*N10F7	100 V Trench Schottky STPST*100 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 SM6T, SM15T series	Voltage reference T*431, T*432 Voltage and current Ctrl TSM*, SEA05* **Post regulation** DC-DC converters L6983/2/1, ST1PS03/2/1, ST1S40 Low dropout (LDO) linear regulators ST715 LDK320 ST715 ST730 ST732

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

Typical block diagram with PFC front-end



Main application boards and reference designs

EVLMG1-250WLLC
250 W resonant DC-DC converter based on LLC analog controller and integrated smart GaNs

EVL011A150ADP
12 V - 150 W power supply based on TM PFC and HB LLC digital combo controller

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

EVL400W-80PL
12 V - 400 W adapter based on CCM PFC and HB LLC analog controller

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

Wireless charging

In a wireless battery charging system, power is transferred by electromagnetic induction (inductive power transfer) between a transmitting pad (TX) and a 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, which continuously provides this information to the transmitter by modulating the transmitter carrier frequency through controlled resistive or capacitive load insertion. Generating the correct amount of power guarantees the highest level of end-to-end energy efficiency and helps limit the device's operating temperature.

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

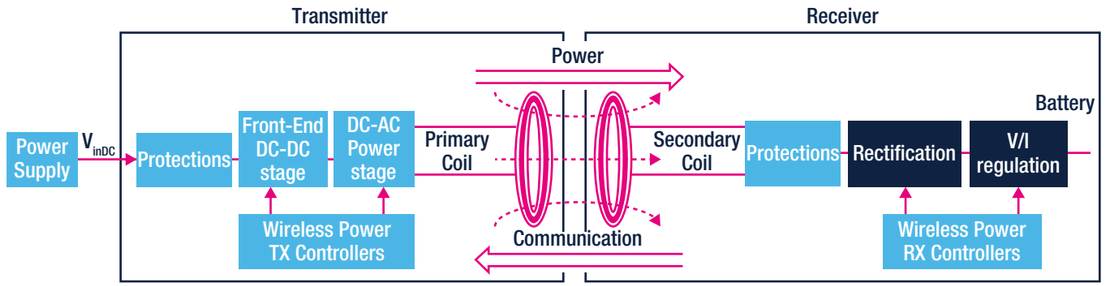
ST also offers evaluation and development tools and reference designs to help develop high-efficiency and compact wireless chargers that are Qi compliant for both baseline power profile (BPP) and extended power profile (EPP). Moreover, easy to evaluation tools enables customization with ST Super Charge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

ST recommended products for wireless charging

	Wireless charging ICs	Battery charger ICs	MCUs	Power MOSFETs	Protections	Diodes	NFC reader
Transmitter	STWBC86 STWBC2-HP		STM32G0 STM32F334 STM32G4	60 V STripFET F7 STL20N6F7	TVS SMAJ, SM6T, SM15T series USB Port Protection TCPP01-M12	STPS*L30 STPS*45/60/100 FERD*45/60/100	ST25R3911B ST25R3912 ST25R3916B ST25R3917B
Receiver	STWLC38 STWLC98 STWLC99	STBC02			ESDALC14V2-1U2	BAT30F4, BAR46	

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

Typical block diagram



Main application boards and reference designs

2.5W Solutions

STDES-WBC86WTX

Qi-compatible wireless power transmitter for 2.5 W applications

STDES-WLC38TWS

Qi-compatible wireless power receiver for 2.5 W applications

STDES-WLC38WA

Qi-compatible wireless power receiver for 2.5 W applications

5 W -15 W solutions

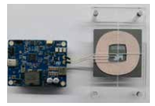
STEVAL-WBC86TX

Qi-compatible wireless power transmitter for BPP 5 W applications

STEVAL-WLC38RX

Qi-compatible wireless power receiver for BPP 5W, EPP 15 W applications

50 W solutions



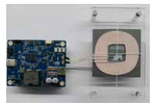
STEVAL-WBC2TX50

Qi-compatible wireless power transmitter for 50 W applications

STEVAL-WLC98RX

Qi-compatible wireless power receiver for 50 W applications

70 W Solutions



STEVAL-WBC2TX70

Qi-compatible wireless power transmitter for 70 W applications

STEVAL-WLC99RX

Qi-compatible wireless power receiver for 70 W applications

1: available in Q4 2023 2: available in Q1 2024

Desktop PC power supply

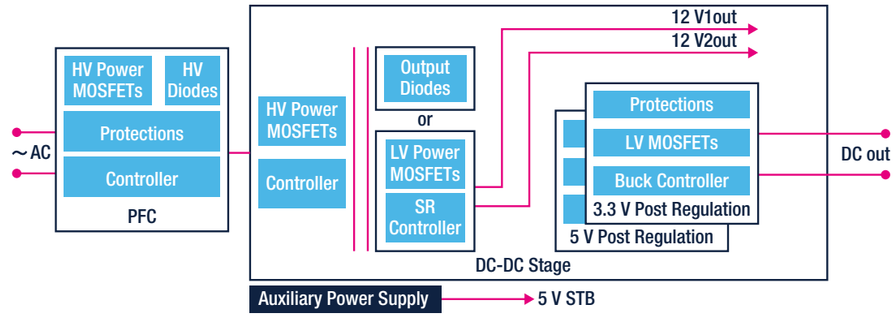
The requirements for the standard ATX PC power market are small form factor with better performance.
An intelligent control scheme that enables adaption to load variation to minimize power consumption, together with optimized power semiconductors, are key to meeting market demands. Smart analog and digital controllers such as the STCMB1 and the STNRG011, GaN power ICs such as the MASTERGAN series and the GaN drivers, high-voltage MDmesh power MOSFETs, low-voltage STripFET power MOSFETs, and SiC diodes (STPSC*) help designers develop the best PC power supply solutions to improve efficiency. ST DC-DC converters guarantee high power density for the post-regulation.

ST recommended products for desktop PC's power supply

	Controllers	Power MOSFETs	Diodes and discretes	Op-amp V/I sensing
PFC Block	TM analog controllers L6562A*, L6563*, L6564* CCM analog controllers L4985, L4986, L4981*, L4984D MCUs and digital controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG388A	600 V- 650 V MDmesh M9 ST*60N*M9, ST*65N*M9 600 V MDmesh M6 ST*60M6, 600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 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 TVS for power rail surge protection SMAJ40CA-TR	Precision Op Amps (<50 MHz) TSZ*, TSV7*, TSB*, TSX*, TSU*, TSV* **MOSFET and IGBT gate drivers** Multiple LS gate drivers PM8834 Single LS gate drivers PM88*1
	Controllers	**Power MOSFETs**	**Diodes**	**eFuses**
Isolation DC-DC stage	PFC and LLC Combo controllers STCMB1, STNRG011, STNRG011A LLC analog controllers L6599*, L6699 Asymmetrical HB controllers L6591 MCUs and digital controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG388A SR analog controllers SRK2000A, SRK2001, SRK2001A for LLC	650 V Power GaN SGT*65AL 600 V-650 V MDmesh DM9 ST*60N*DM9, ST*65N*DM9 600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V- 650 V MDmesh M9 ST*60N*M9, ST*65N*M9 600 V MDmesh M6 ST*60M6 600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 650 V Power GaN SGT*65AL 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 **Protections** TVS for power MOSFET and power rail surge protection SMAJ, SM6T, SM15T series **LDO** Low dropout (LDO) linear regulators LDF, LDFM, LDK320, LDL212, LD39200, LD1117, LD56100	STEF01 STEF05-STEF05S STEF12-STEF12S STEF12H60M **MOSFET and IGBT gate drivers** Integrated smart GaNs 600 V MASTERGAN* HV HB gate drivers for GaNs STDRIVEG600 HV HB gate drivers L649* Isolated gate drivers STGAP* SR multiple LS gate drivers PM8834
	Controllers	**Power MOSFETs**	**Voltage reference**	
Post regulation	L6726A, PM6680	STL90N3LLH6	T*431, T*432, TS33*	

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

Typical configuration



Main application boards and reference designs

EVL011A150ADP

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

EVL4986-350W

Low-THD 350 W CCM-PFC pre-regulator

EVL4985-350W

Low-THD 350 W CCM-PFC pre-regulator

EVL400W-80PL

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

Server and telecom power

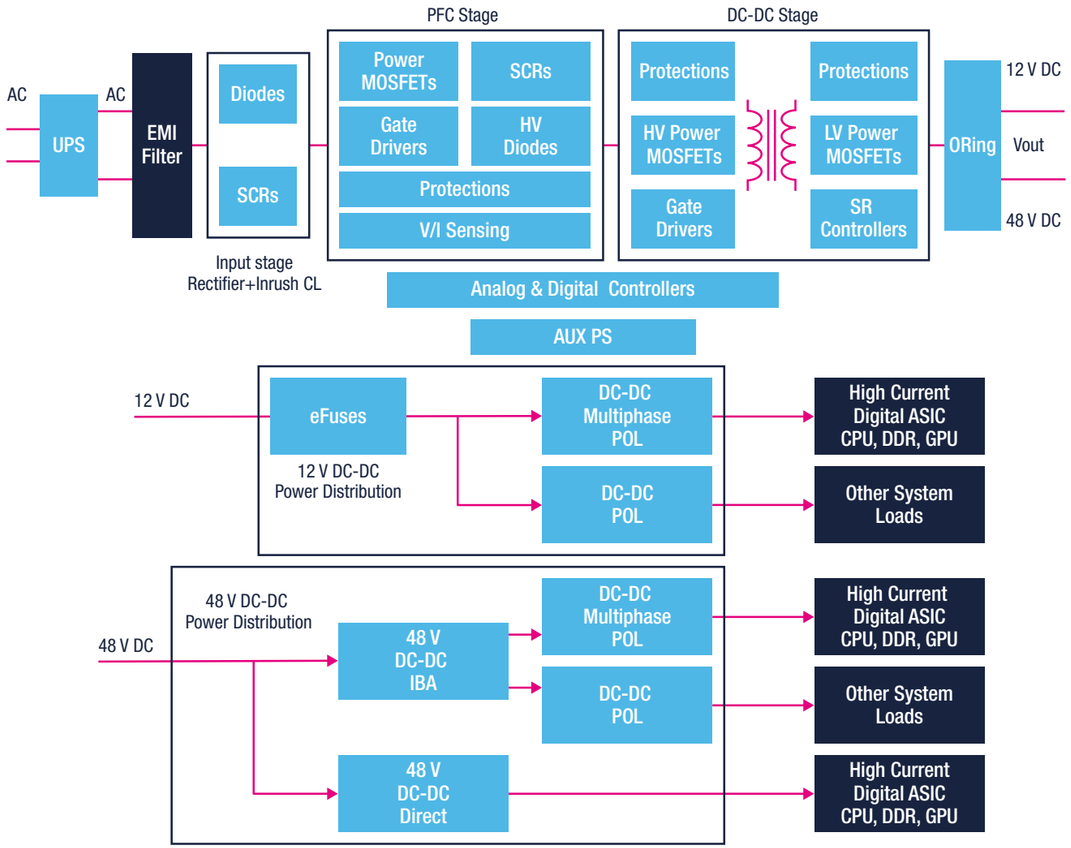
AC-DC PSU and DC-DC power distribution

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

In telecom system power, the use of complex digital ASICs for managing growing data traffic is pushing the power envelope higher. 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 extensive product and solution coverage, and eDesignSuite SW design tool to ensure the most optimized power design across the entire distribution chain. Our digital and analog controllers combined with MOSFETs and drivers are key ingredients for implementing the most efficient and most dense AC-DC power delivery. On the back-end DC-DC power distribution, ST offers advanced solutions for Point-of-Load conversion and an innovative DC-DC conversion from a 48 V DC supply.

Typical block diagram for server PSU



ST product offering for server and telecom AC-DC PSU

Input stage (Rect. and inrush current limiter)		**SCRs**	**Diodes**	
		High Temp. SCR TN*015H-6, TM8050H-8, TN*050H-12	Bridge rectifier diodes STBR*08, STBR*12	
	Controllers		**Diodes and protections**	**MOSFET and IGBT gate drivers**
PFC Block	CCM analog controllers L4985, L4986, L4981*, L4984D MCUs and digital controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG388A	**Power MOSFETs** 650 V Power GaN SGT*65AL 600 V- 650 V MDmesh M9, ST*60N*M9, ST*65N*M9 600 V MDmesh M6 ST*60M6 600 V-650 V MDmesh M2 ST*60M2, ST*65M2 650 V MDmesh M5 ST*65M5 650 V SiC MOSFETs SCT**65G3AG, SCT*N65G2	600 V Ultrafast for CCM STTH*R06 STTH*T06 SiC diodes STPSC*065 TVS for power MOSFET and power rail surge protection SMAJ, SM6T, SM15T, series **V/I sensing** Isolated Sigma-Delta ADC ISOSD61, ISOSD61L Precision Op Amps (<50 MHz) TSZ*, TSV7*, TSB*, TSX*, TSU*, TSV*	HV HB gate drivers for GaNs STDRIVEG600 HV HB gate drivers L649* Isolated gate drivers STGAP* Multiple LS gate drivers PM8834 Single LS gate drivers PM88*1
	Controllers	**Power MOSFETs**	**Diodes and protections**	**MOSFET and IGBT gate drivers**
Isolation DC-DC stage	LLC analog controllers L6599A, L6699 Asym. HB analog controllers L6591 MCUs and digital controllers STM32F334, STM32G4, STNRG388A SR analog controllers SRK2000A, SRK2001, SRK2001A	650 V Power GaN SGT*65AL 600 V-650 V MDmesh DM9 ST*60N*DM9, ST*65N*DM9 600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 650 V SiC MOSFETs SCT**65G3AG, SCT*N65G2 SR 60 V-100 V STripFET F7 ST*N6F7, ST*N8F7, ST*N10F7 **DC-DC** L3751	Output diodes for LLC Schottky, FERD STPS* FERD*45, FERD*50, FERD*60 TVS for power MOSFET and power rail surge protection SMAJ, SM6T, SM15T, series **LDO** Low dropout (LDO) linear regulators LDF, LDFM, LD39050, LD39100, LD39200, LDL112, LDL212, LD49100, LD59100, LD57100	HV HB gate drivers for GaNs STDRIVEG600 HV HB gate drivers L649* Isolated gate drivers STGAP* SR multiple LS gate drivers PM8834 SR HV HB gate drivers L649* **eFuses** STEF01 STEF05-STEF05S STEF12-STEF12S STEF12H60M

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

Main application boards and reference designs

STEVAL-TTPPFC01
2 kW ZVS Interleaved totem pole PFC with digital control

STEVAL-ISA147V3
500 W fully digital AC-DC power supply (D-SMPS)

STEVAL-ISA172V2
2 kW fully digital AC-DC power supply (D-SMPS)

STEVAL-DPSLLCK1
3 kW Full Bridge LLC resonant digital power supply

STEVAL-DPSG474
Digital power control board

STDES-3KWTLCP
3 kW telecom rectifier reference design with Totem-Pole PFC and LLC converter

STEVAL-DPSTPFC1
3.6 kW PFC Totem-Pole with digital inrush current limiter

EVL4986A-1KWBL
Low THD-High efficiency, 1 KW bridgeless CCM-PFC

Power distribution for modern data center

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

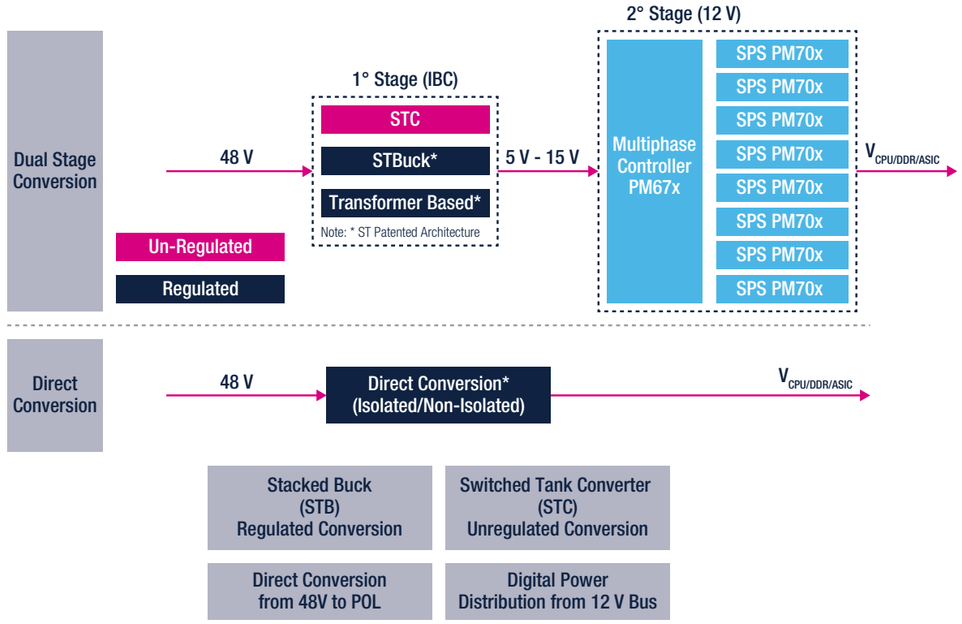
In the newest architecture, a 48 V DC rail is generated from the AC-DC power supply unit, which is then converted to provide the number of DC rails needed to supply the various loads and circuits in the server. This conversion must meet stringent efficiency targets requiring innovative architectures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

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

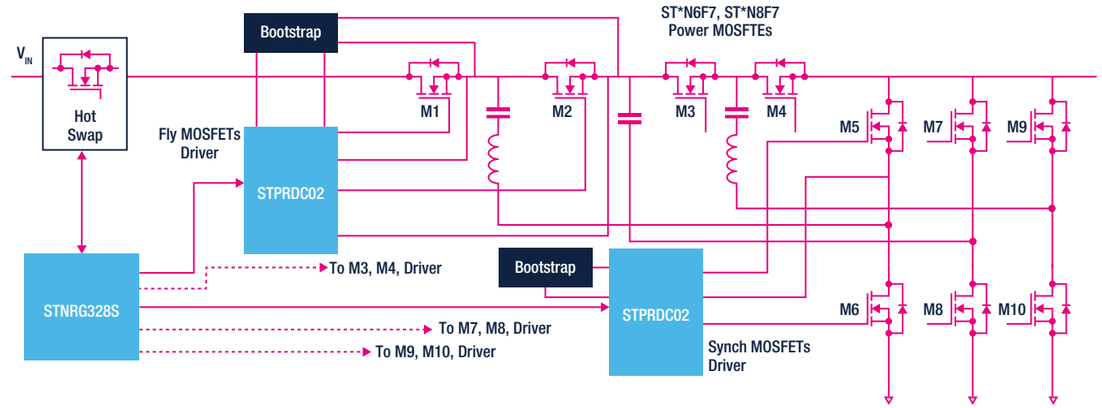
Moreover, we offer 12 V to point of load conversion, including multi-phase digital controller and smart power stages (SPS) to support the most recent INTEL and AMD CPU specifications.

Finally, ST offers direct conversion solutions, from 48 V to point-of-load, based on the power stamp alliance (PSA) products.

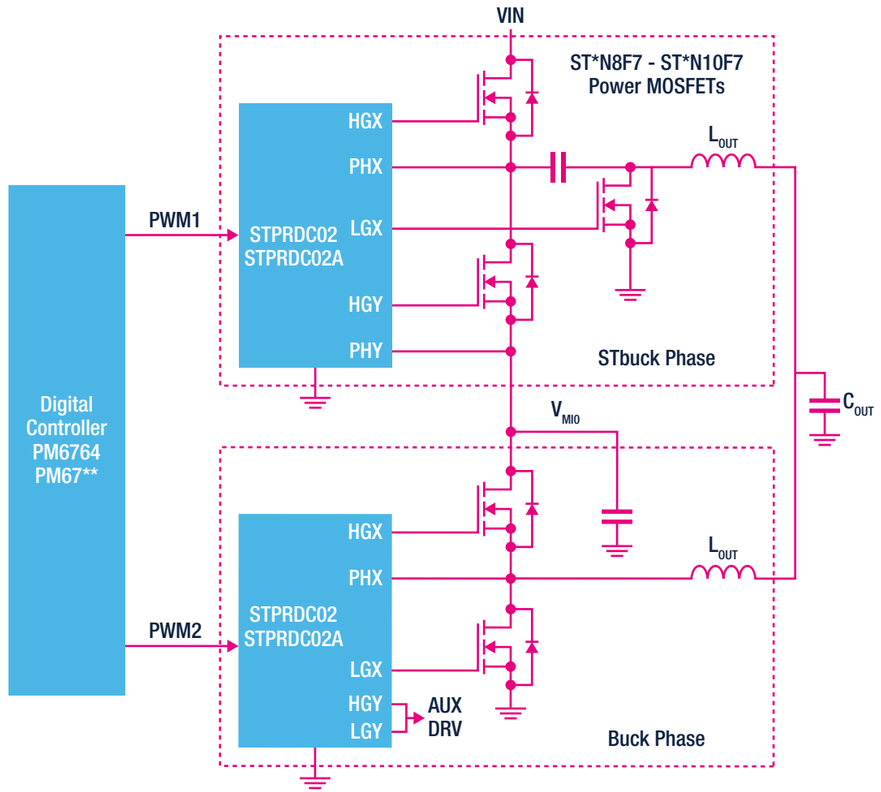
Power delivery for modern data center



Typical configuration for switched-tank converter (STC) system - 48 V to 12 V non isolated unregulated IBC

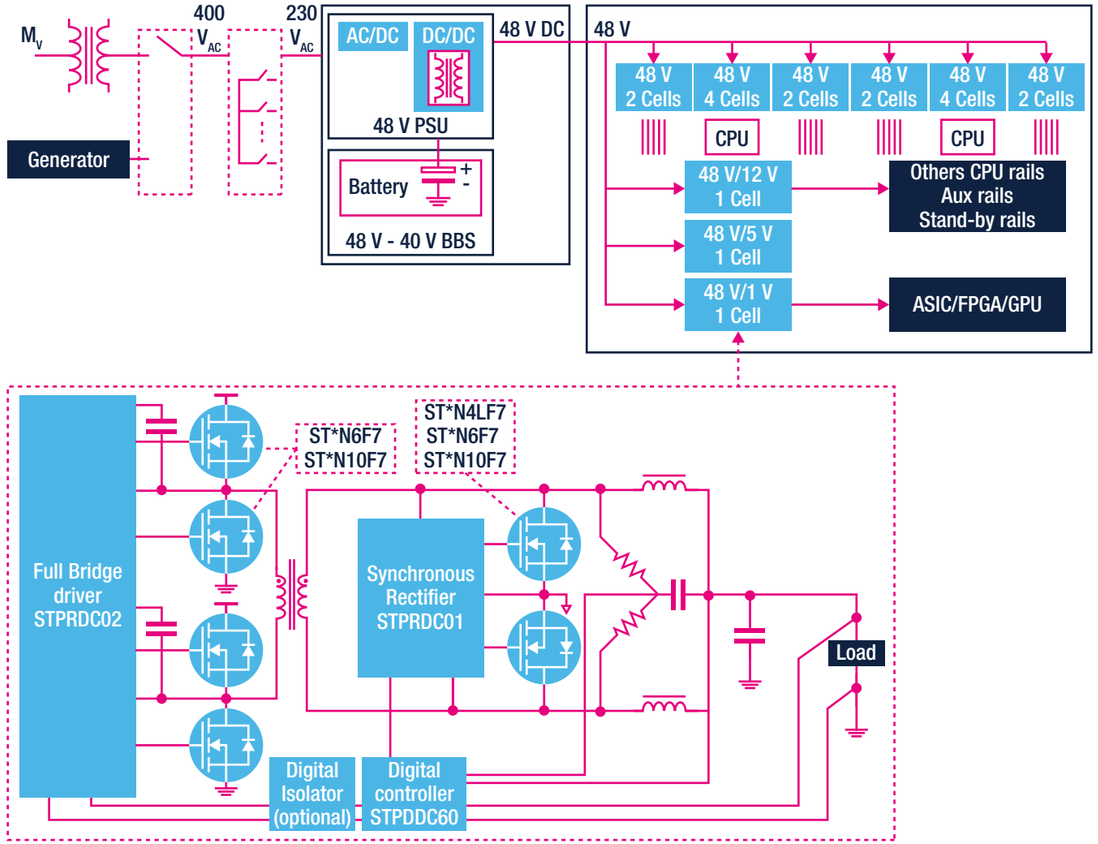


Typical configuration for STBUCK - 48 V to 12 V non isolated regulated IBC



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

Typical configuration for 48 V isolated direct conversion



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

SSD power management

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

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

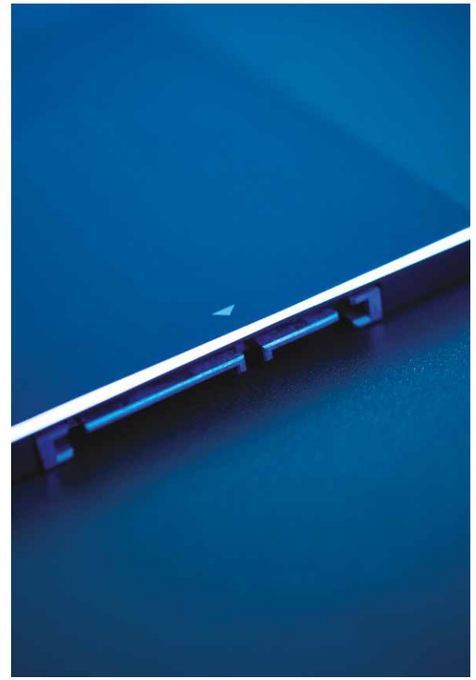
The ST device family is ideal for designing advanced power management solutions for microcontroller, DDR, flash memory, on SSD server and consumer applications.

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

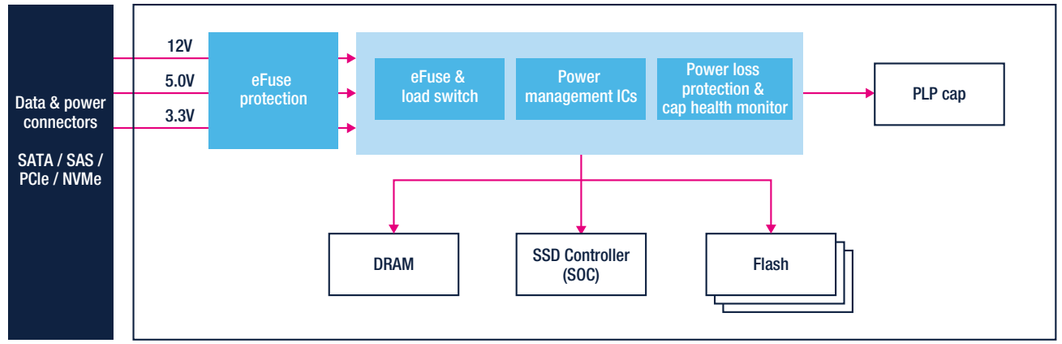
Electronic fuses (eFuses) for 3.3, 5 and 12 V located at the power connector minimize system down-time by protecting the SSD and the host from failures.

High switching frequency eases the design of compact applications, while specific control techniques ensure best-in-class efficiency at heavy and light load operation.

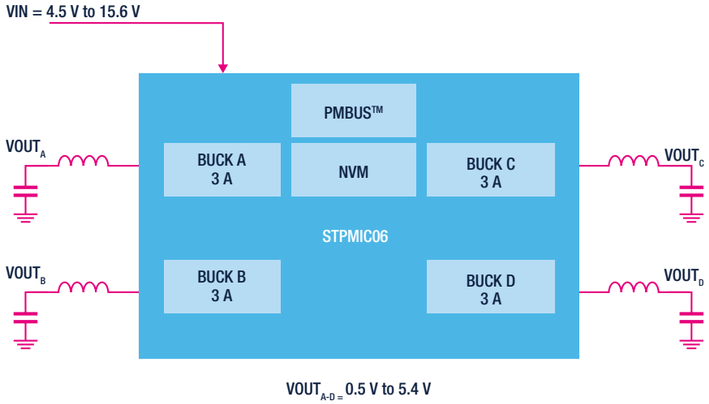
Full programmability via high speed serial interfaces like I²C and PMBus® allows configurability for different application requirements.



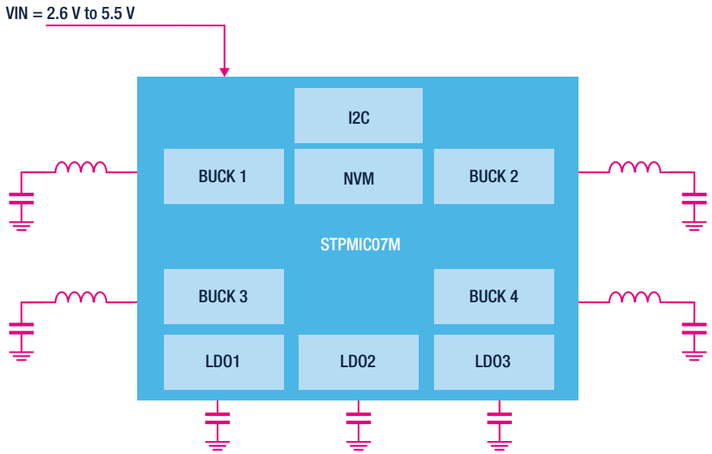
Typical block diagram for SSD power management



STPMIC06



STPMIC07M

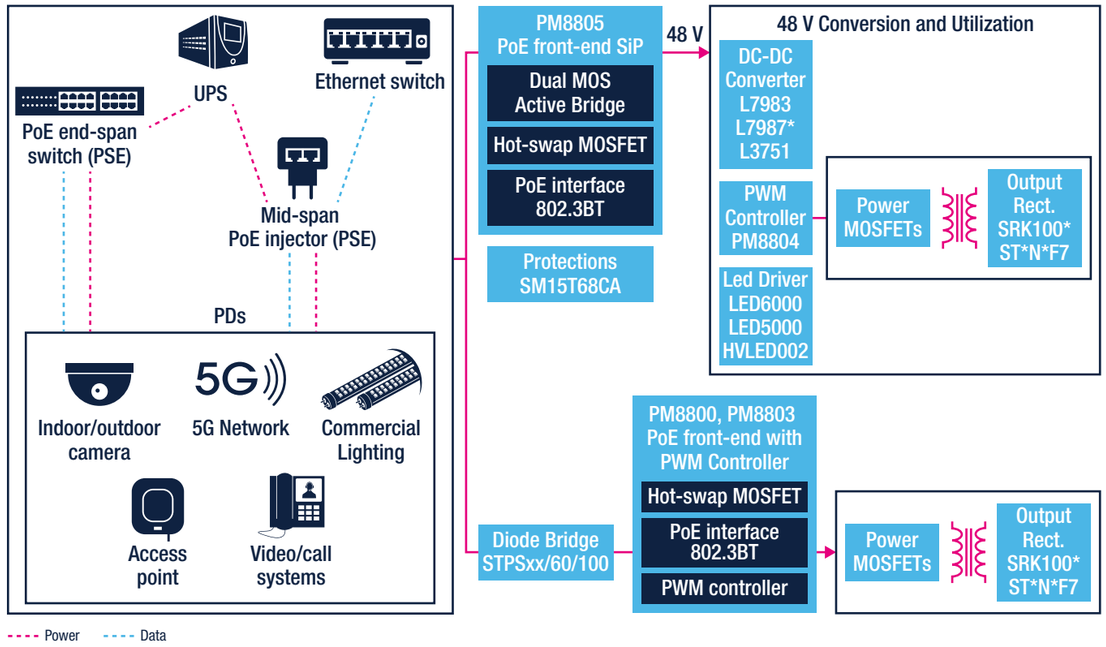


Power over Ethernet (PoE)

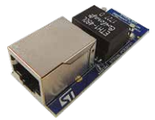
Power over Ethernet (PoE) is a widely adopted technology used to transfer power and supply the powered device (PD), including wireless access points, VoIP phones over an RJ-45 cable also carrying data as described in the IEEE 802.3 standard, and its evolutions including IEEE 802.3bt, IEEE 802.3at, and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

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

Typical block diagram for PoE power management



Main application boards and reference designs



STEVAL-POE001V1
Power over Ethernet (PoE) - IEEE 802.3bt compliant interface

STEVAL-POE002V1
5 V/8 A, synchronous flyback converter, power over Ethernet (PoE) IEEE 802.3bt compliant reference design

STEVAL-POE003V1
5 V/20 A, active clamp forward converter, power over Ethernet (PoE) - IEEE 802.3bt compliant reference design

STEVAL-POE005V1
12 V/8 A, active clamp forward converter, power over Ethernet (PoE) IEEE 802.3bt compliant reference design

STEVAL-POE006V1
3.3 V/20 A, active clamp forward converter, power over Ethernet (PoE) IEEE 802.3bt compliant reference design

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

LED TV power supply

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

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

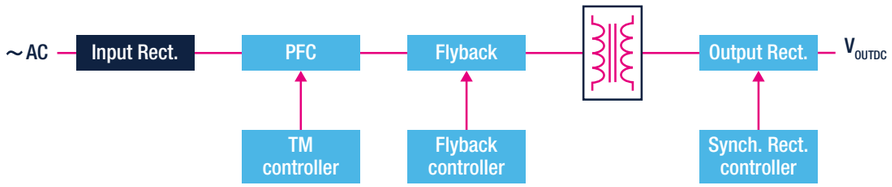
ST offers a broad portfolio of high-voltage MDmesh and low-voltage STripFET power MOSFETs, field-effect rectifier diodes (FERD), Schottky and Ultrafast diodes, a full range of protection ICs, as well as dedicated analog and digital switching controllers, which negate the necessity of auxiliary power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

ST recommended products for LED TV power supply

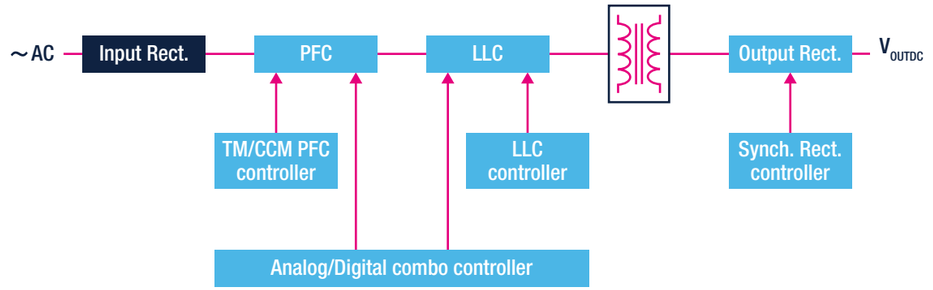
Input rectifier	**SCR** High Temp. SCR TN*015H-6, TM8050H-8, TN*050H-12			
	Controllers	**Power MOSFETs**	**Diodes**	**Op-amp V/I sensing**
PFC Block	TM analog controllers L6562A*, L6563*, L6564* CCM analog controllers L4985, L4986, L4981*, L4984D MCUs and digital controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG388A	650 V Power GaN SGT*65AL 600 V-650 V MDmesh M9 ST*60N*M9, ST*65N*M9 600 V MDmesh M6 ST*60M6 600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 650 V MDmesh M5 ST*65M5	600 V Ultrafast for TM STTH*L06 STTH*06 STTH15AC06* 600 V Ultrafast for CCM STTH*R06 STTH*T06 SiC diodes STPSC*065	Precision Op Amps (<50 MHz) TSZ*, TSV7*, TSB*, TSX*, TSU*, TSV* **MOSFET and IGBT gate drivers** Multiple LS gate drivers PM8834 Single LS gate drivers PM88*1
	Controllers	**GaN power ICs**	**Diodes and protections**	**MOSFET and IGBT gate drivers**
Isolation stage	Flyback controllers L6566A, L6566B, L6565, L6668, STCH03 PFC and LLC Combo controllers STCMB1, STNRG011, STNRG011A LLC analog controllers L6599*, L6699 Asymmetrical HB controllers L6591 MCUs and digital controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG388A SR analog controllers SRK1000, SRK1001, SRK1004 for flyback SRK2000A, SRK2001, SRK2001A for LLC	Integrated Smart GaNs 600 V MASTERGAN HV HB gate drivers for GaNs STDRIVEG600 **Power MOSFETs** 650 V Power GaN SGT*65AL 600 V-650 V MDmesh DM9 ST*60N*DM9, ST*65N*DM9 600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 650 V MDmesh M9 ST*65N*M9 600 V MDmesh M6 ST*60M6 600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 800 V MDmesh K5 ST*N80K5 800 V MDmesh K6 ST*80N*K6 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*100 100 V Trench Schottky STPST*100 MOSFET protection for flyback SMAJ, SM6T, SM15T series **Voltage reference** T*431, T*432	HV HB gate drivers L649* Isolated gate drivers STGAP* SR multiple LS gate drivers PM8834 SR HV HB gate drivers L649* Isolated interfaces for wired connectivity STISO62x **Post regulation** DC-DC converters L698*, L7983, ST1S40 Low dropout (LDO) linear regulators LD1117xx, ST730/2, LD39100, LD49100, LDQ40

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

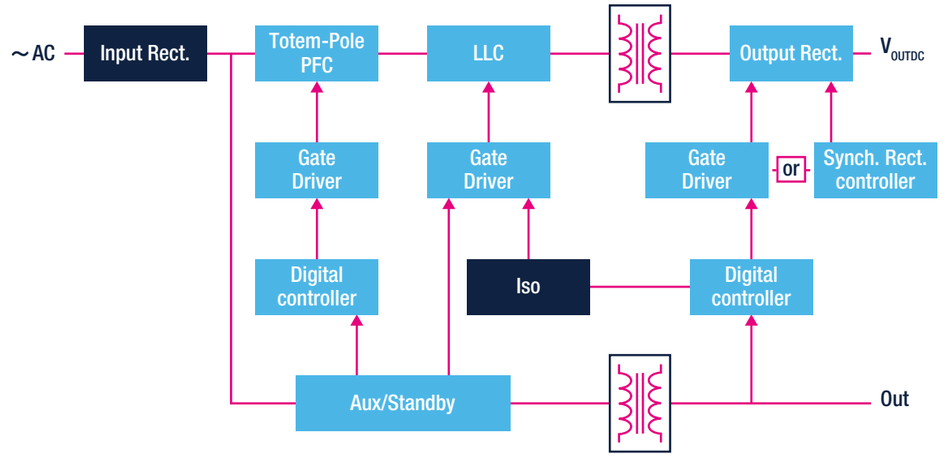
Typical block diagram for analog control solutions for small panel size



Typical block diagram: Analog control solutions with no Aux supply, for small/medium panel size



Typical block diagram for digital control solutions for medium/large panel size



Main application boards and reference designs

EVLMG1-250WLLC

250 W resonant DC-DC converter based on LLC analog controller and GaN

STEVAL-NRG011TV

200 W power supply based on STNRG011 digital combo for LED TV

STEVAL-DPSTPFC1

3.6 kW PFC Totem-Pole with digital inrush current limiter

EVLCMB1-90WADP

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

STEVAL-SCR002V1

Inrush current limiter for 1 kW AC-DC

EVL400W-80PL

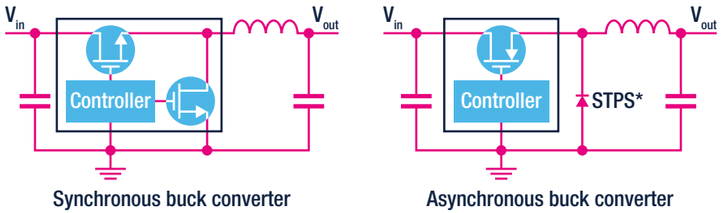
12 V - 400 W adapter based on CCM PFC and HB LLC analog controller

DC-DC conversion

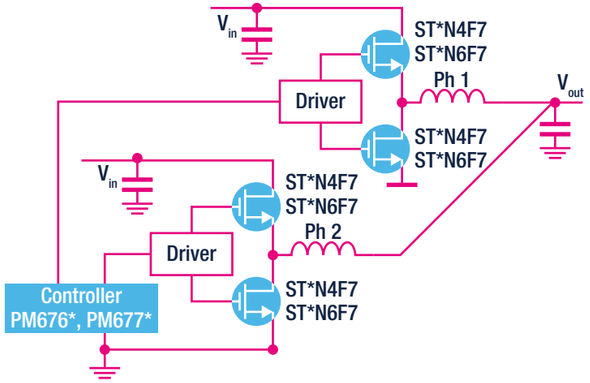
A DC-DC switching converter is used to locally supply any component or part of a system with the desired DC voltage and current. Depending on the application's relationship between the input and output voltage, engineers have to choose the best power topology: buck, boost, buck-boost or inverting, with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

ST broad product portfolio includes highly-integrated DC-DC converters and PWM controllers, power MOSFETs and rectifiers, protection ICs, and 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 eDesignSuite, which that helps engineers design high-efficiency DC-DC converters.

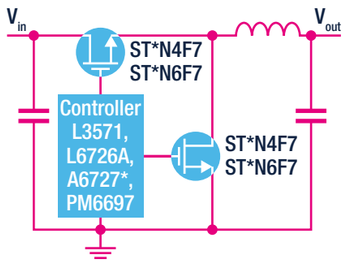
Typical buck configuration: up to 61 Vin/3 A Iout



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



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



Main application boards and reference designs

STEVAL-L7983ADJ

Synch. buck up to 60 Vin, 12 Vout - 0.3 A Iout

STEVAL-L6983IV1

38 V, 10 W synchronous iso-buck converter

STEVAL-1PS03A

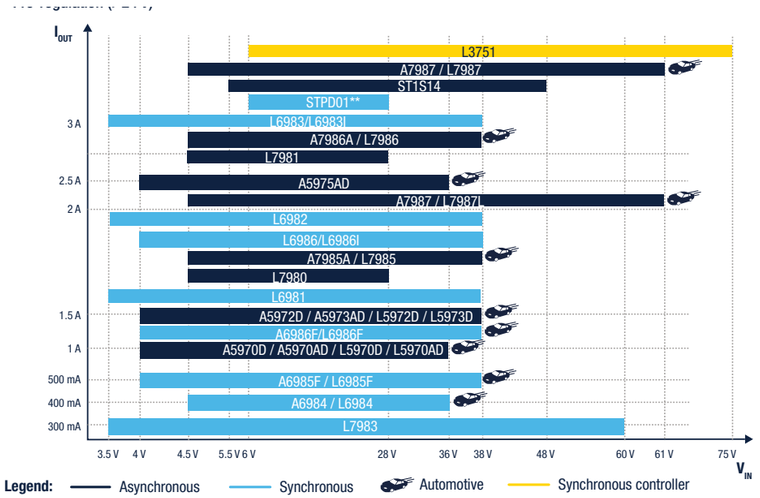
Synch. Buck with load switch, 5.5 Vin, dynamic voltage selection up to 3.3 V - 400 mA

STEVAL-L3751V12

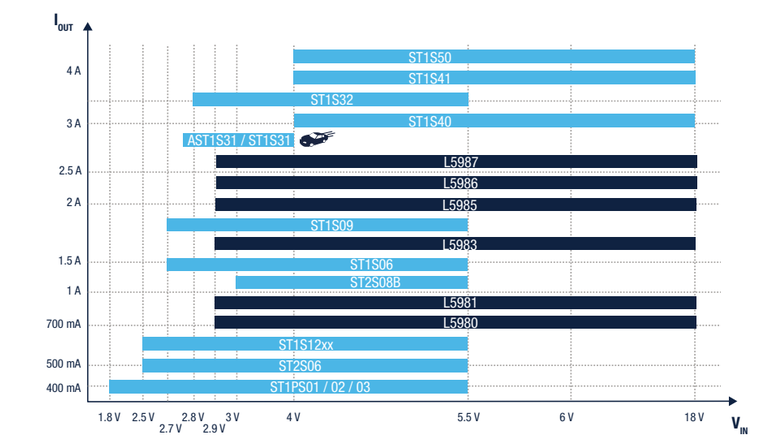
75 V 15 A DC-DC converter buck regulator

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

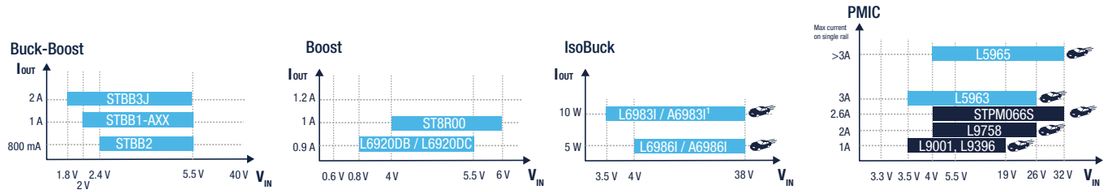
ST product offering for switching converters (DC-DC)



Note: * under development, ** for USB PD, up to 60 W output power (20 V, 3 A)

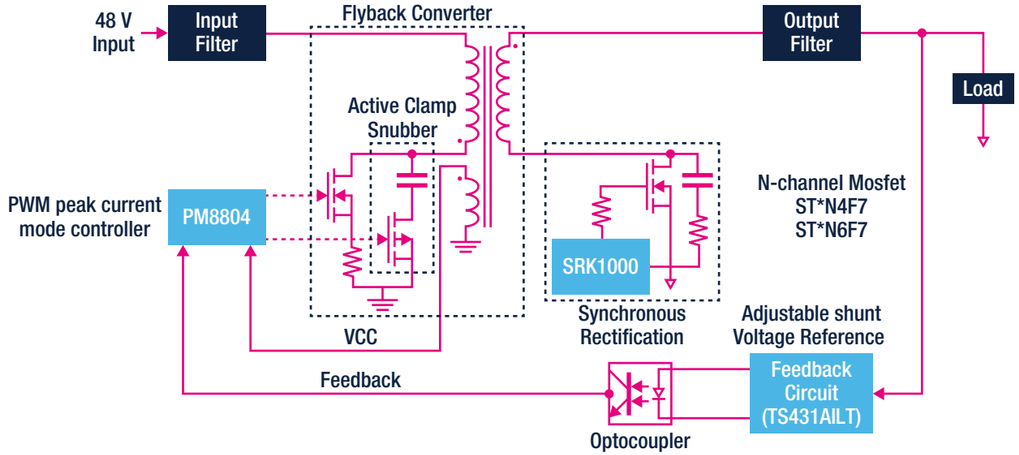


Note: * under development

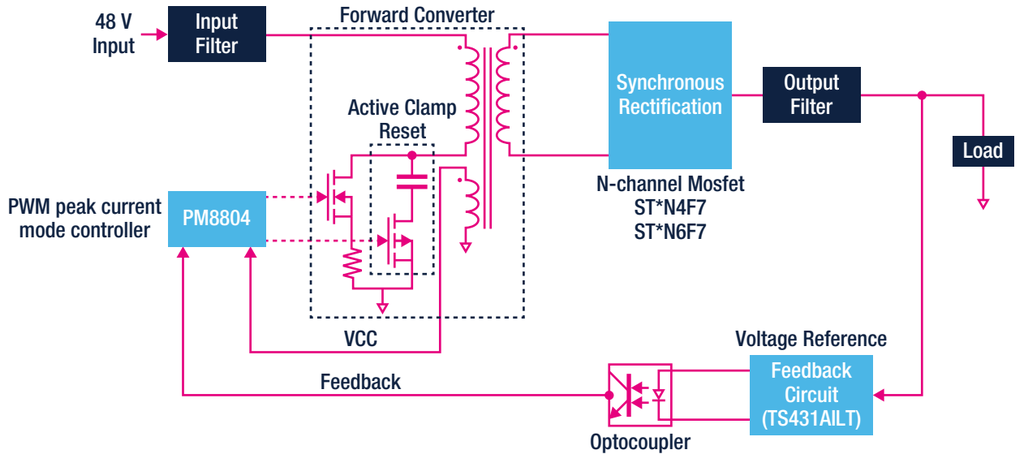


Note: [1] available in Q4 2023

Typical 48 Vin, up to 65 W Pout, synchronous flyback configuration



Typical 48 Vin, > 65 W Pout, active clamp forward configuration



Main evaluation boards

STEVAL-ISA203V1

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

STEVAL-ISA204V1

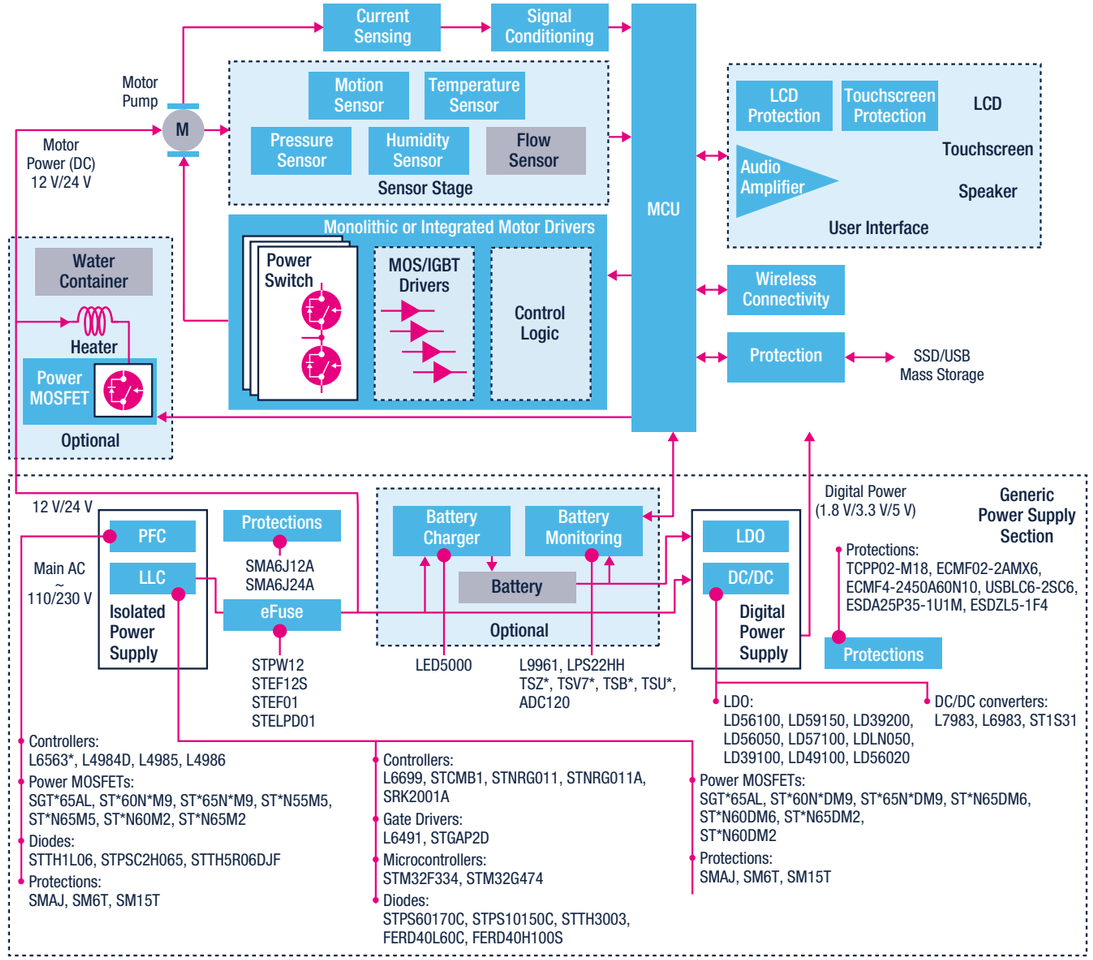
- Input voltage range: 42 - 56 V DC
- Switching frequency - 250 kHz
- Output:
- Power - 100 W
- Voltage - 5 V DC
- Current - up to 20 A
- Peak efficiency > 94%

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

Medical power supply

The mission critical nature of medical devices demands high quality, reliable, and safe products. Our goal is to consistently deliver products that meet this criteria and help our customers meet this goal. Medical power supplies are a crucial part of the equipment, usually you with open frame, enclosed, fanless, and configurable models, as well as wall-mount adapters and DC-DC modules. Often, the backup battery is part of the power supply to guarantee continuity of operation when the main supply is interrupted.

Typical block diagram of a medical power supply for artificial ventilators



Main application boards and reference designs

EVL6564-100W

100 W transition-mode PFC pre-regulator

EVLSTNRG011-150
EVL011A150ADP

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

STEVAL-L7983ADJ

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

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

LED LIGHTING AND CONTROLS

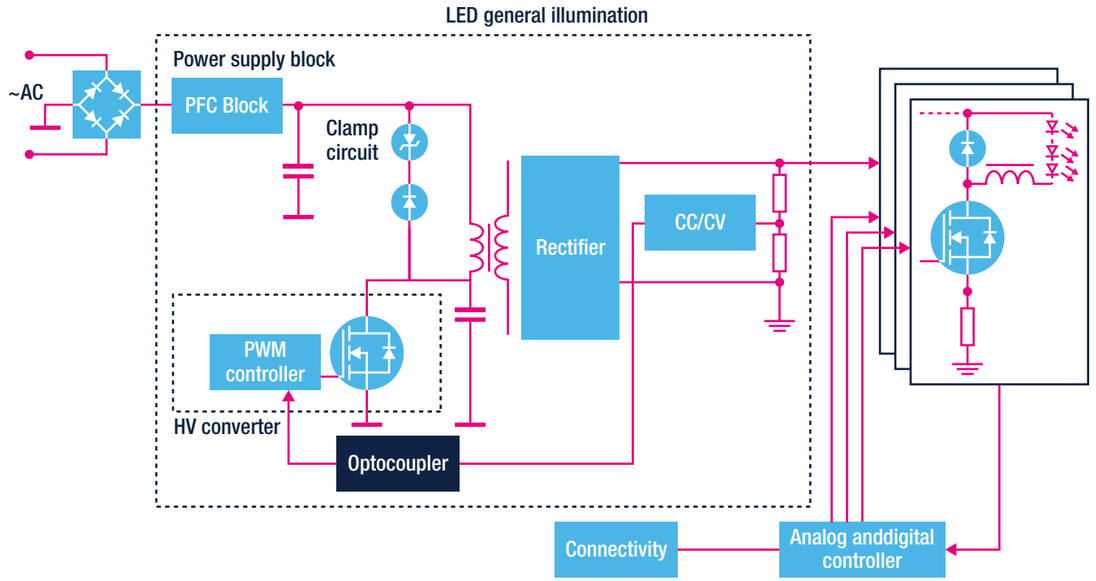
LED general illumination

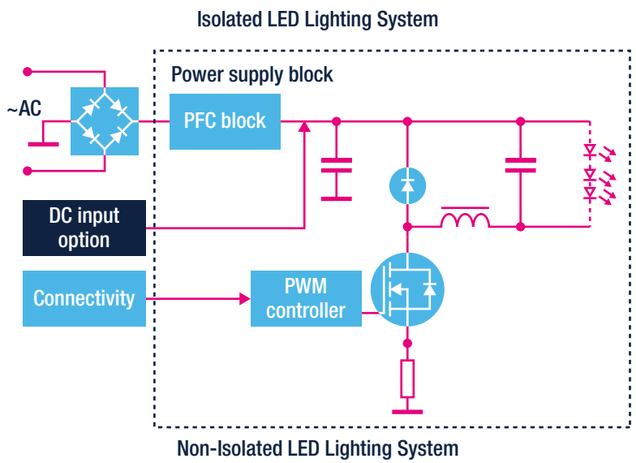
LED lamps and bulbs can have a number of different form-factors, depending on the specific use, size, and dimensions of the application, including retrofit bulbs, high-bay lights, low-bay lights and emergency lights. Driving a string of LEDs involves AC-DC and DC-DC conversion designed using non-isolated,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

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

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

Typical block diagram





ST product offering for LED general illumination

	Controllers	Power MOSFETs	Diodes	MOSFET and IGBT gate drivers
PFC Block	TM analog controllers L6562*, L6563*, L6564* CCM analog controllers L4985, L4986, L4981*, L4984D MCUs and digital controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STLUX, STNRG388A	600 V MDmesh M6 ST*60M6 600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 800 V MDmesh K6 ST*80*K6 800 V to 1200 V MDmesh K5 ST*80K5, ST*9*K5, ST*105K5, ST*120K5 650 V SiC MOSFETs SCT**65G3AG, SCT*N65G2 650 V Power GaN SGT*65AL	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 Multiple LS gate drivers PM8834
	Controllers and converters	**Power MOSFETs**	**Diodes and discretes**	**Voltage reference, CC/CV Ctrl**
Isolation stage	Offline LED drivers HVLED101, HVLED001A/B, HVLED007, HVLED8* HV converters VIPer0P, VIPer*1, VIPer*6, VIPer122, VIPer222, VIPer*5, VIPer*7, VIPer*8 LLC analog controllers L6599*, L6699 PFC and LLC/LCC Combo controllers STCMB1, STNRG011, STNRG011A, STNRG012 MCUs and digital controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STM8S, STLUX, STNRG388A SR analog controllers SRK1000, SRK1001, SRK1004 for flyback SRK2000A, SRK2001, SRK2001A for LLC	600 V MDmesh DM6 ST*60DM6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 950 V MDmesh DK5 ST*95DK5 650 V MDmesh M9 ST*65N*M9 600 V MDmesh M6 ST*60M6, 600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 650 V Power GaN SGT*65AL 800 V MDmesh K6 ST*80*K6 800 V to 950 V MDmesh K5 ST*80K5, ST*9*K5 60 V-100 V STripFET F7 ST*N6F7, ST*N8F7, ST*N10F7 **Integrated Smart GaNs** 600 V MASTERGAN*	Clamping diodes for flyback 600 V to 1000 V Ultrafast STTH*06, STTH*08, STTH*10 100 V Trench Schottky STPST*100 Output diodes for flyback Schottky, FERD, Ultrafast STPS*, FERD*, STTH* Output diodes for LLC/LCC Schottky, FERD STPS* FERD*45, FERD*50, FERD*60, FERD*100 MOSFET protection for flyback SMAJ, SM6T, SM15T series SCR protection switch TNx015H-6”	Voltage reference T*431, T*432 Voltage and current Ctrl TSM*, SEA05* **Signal conditioning** TSZ*, TSV7*, TSB*, TSX*, TSU*, TSV* **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 and digital controllers STM32F0, STM32G0, STM32F334, STM32G4, STM8S, STLUX, STNRG388A	650 V Power GaN SGT*65AL STripFET F7 ST*N4F7, ST*N6F7, ST*N10F7	Schottky diodes STPS* FERD diodes FERD* ≥ 200 V Ultrafast diodes STTH* **DC-DC LED drivers** LED5000, LED6000, ST1CC40, LED2000, LED2001	HV HB gate drivers L649*, L6395 Single LS gate drivers PM88*1 Multiple LS gate drivers PM8834

	Bluetooth Low Energy (BLE MESH)		2.4 GHz Multi Standard (ZigBee, Thread, 802.15.4)		Sub-1GHz
Wireless connectivity	Bluetooth LE 5.3 BlueNRG-1, BlueNRG-2 BlueNRG-LP, BlueNRG-LPS BLE network processor BlueNRG-2N Baluns BALF-NRG-0*D3 Dual core MCUs BLE 5.4 STM32WB IPD (Integrated passive device) MLPF-WB55-01E3, MLPF-WB55-02E3, MLPF-WB-01E3, MLPF-WB-01D3, MLPF-WB-02D3	BlueNRG modules BlueNRG-M0 BlueNRG-M2 STM32 wireless module STM32WB5MMG, STM32WB1MM	2.4 GHz application processors: Dual core: STM32WB Single core: STM32WBA5	STM32 wireless module STM32WB5MMG, STM32WB1MM	Sub-1GHz wireless MCU STM32WL Sub-1GHz transceivers S2-LP, SPIRIT1 MCUs STM32F0, STM32G0, STM32L0 Baluns BALF-SPI-0*D3, BALF-SPI2-0*D3, BALFHB-WL-0xD3, BALFLB-WL-0xD3

Main application boards

EVLHV101PSR50W
EVLHV101SSR50W

50 W converter based on quasi resonant HPF flyback controller with primary side/secondary side regulation

EVLHVLED007W35F

35 W LED driver with very low THD, based on transition mode flyback converter (CVout)

EVAL-PSR01B-35W
EVAL-SSR01B-35W

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

EVAL-IBD002-35W

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

STEVAL-LLL012V1

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

STEVAL-ILL078V1

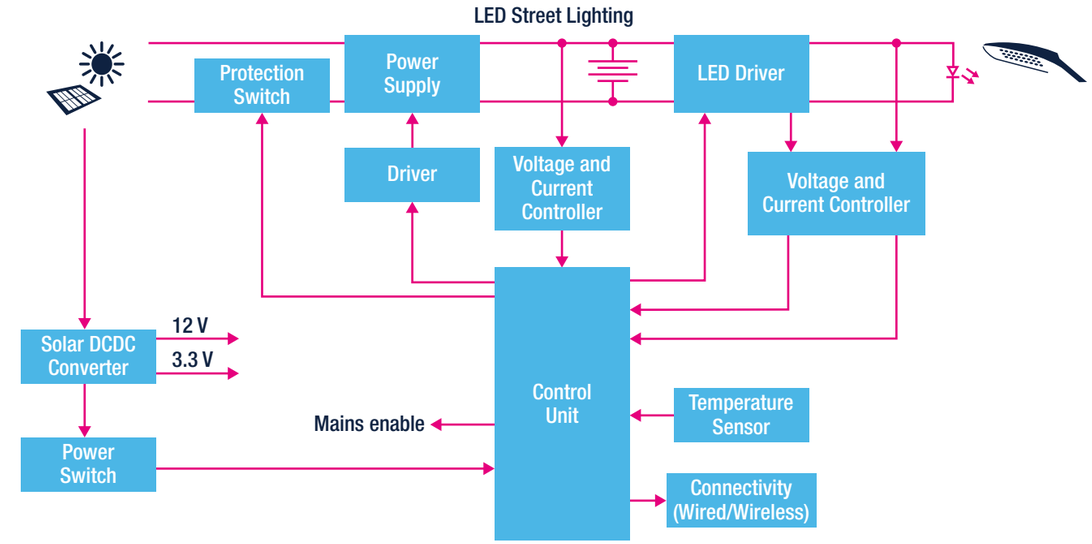
1A, up to 60 V Vin, buck LED driver with digital dimming

LED street lighting

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

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

Typical block diagram



Main application boards

EVLMG4-500WIBUCK

High power inverse buck for dimmable LED application with GaN

EVL012V

200 W LED driver (CC/CV) with digital combo controller

STEVAL-LLL004V1

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

EVL80WLED-STCH03

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

EVL150W-HVSL

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

EVL6699-HVSL

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

STEVAL-ILL066V2

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

STEVAL-LLL009V1

300 W very high AC input voltage LED driver with digital power control

ST product offering for LED street lighting

	Controllers	Power MOSFETs	Diodes and protections	MOSFET and IGBT gate drivers
Power supply	TM PFC analog controllers L6562*, L6563*, L6564* CCM PFC analog controllers L4985, L4986, L4981*, L4984D Offline LED drivers HVLED101, HVLED001B, HVLED001A, HVLED007 PFC and LLC/LCC Combo controllers STCMB1, STNRG011, STNRG011A, STNRG012 LLC/LCC controllers L6599A*, L6699 MCUs and digital controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STLUX, STNRG388A SR analog controllers SRK1000, SRK1001, SRK1004 for flyback SRK2000A, SRK2001, SRK2001A for LLC	600 V MDmesh DM6 ST*60DM6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 600 V MDmesh M6 ST*60M6 600 V-650 V MDmesh M2 ST*60M2, ST*65M2, ST*60M2-EP 800 V MDmesh K6 ST*80*K6 950 V MDmesh DK5 ST*95DK5 800 V to 1050 V MDmesh K5 ST*80K5, ST*9*K5, ST*105K5 650 V SiC MOSFETs SCT**65G3AG, SCT*N65G2 650 V Power GaN SGT*65AL 60 V-100 V STripFET F7 ST*N6F7, ST*N8F7, ST*N10F7 **GaN power ICs** Integrated Smart GaNs 600 V MASTERGAN*	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 SMAJ, SM6T, SM15T series SCR protection switch TNx015H-6	HV HB gate drivers for GaNs STDRIVEG600 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*, SEA05* **Signal conditioning** TSZ*, TSV7*, TSB*, TSX*, TSU*, TSV*
	Controllers	**DC-DC Buck LED drivers**	**DC-DC boost LED drivers**	**LED array drivers**
LED driver	Offline LED drivers HVLED002	LED5000, LED6000, ST1CC40, LED2000, LED2001	LED6001, LED7707, LED7708	STP04/08/16/24, STCS*, 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-1GHz**	**Wireless - Sigfox**	**Wireless - LoRa**
Connectivity	Power Line transceivers ST7570, ST7580	Sub-1GHz wireless MCU STM32WL Sub-1GHz transceivers S2-LP, SPIRIT1 MCUs STM32F0, STM32G0, STM32L0 Balun BALF-SPI-0*D3, BALF-SPI2-0*D3, BALFHB-WL-0xD3, BALFLB-WL-0xD3	Sub-1GHz wireless MCU STM32WL Sub-1GHz transceivers S2-LP MCUs STM32L0, STM32L4 Baluns BALF-SPI2-01D3 BALFHB-WL-0xD3 BALFLB-WL-0xD3 Secure MCUs STSAFE-A100	LoRa wireless MCU STM32WL Embedded software I-CUBE-LRWAN Secure MCUs STSAFE-A100

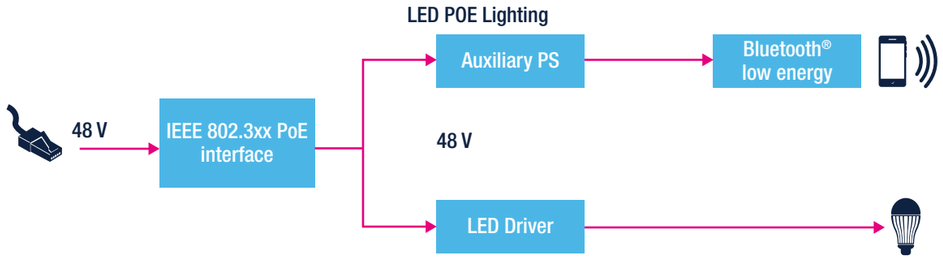
Note: * is used as a wildcard character for related part number

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 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 and optimized DC-DC conversion solutions for supplying LEDs.

Typical block diagram



ST product offering for LED PoE lighting

PoE interface	Protections	Auxiliary power supply	LED driver		Bluetooth LE
IEEE 802.3bt PM8805 IEEE 802.3at PM8803 IEEE 802.3af PM8800A	TVS for power rail surge protection SMAJ, SM15T	Buck Converter L7983 L7987L	Buck LED6000, LED5000 Inverse Buck HVLED002	60 V-100 V STripFET F7 ST*N6F7, ST*N8F7, ST*N10F7 Schottky diodes STPS*	Bluetooth Low Energy SoC, wireless MCUs, modules BlueNRG-*, STM32WB*

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

Main application boards

STEVAL-POEL45W1
45 W PoE powered LED lighting with BLE control

STEVAL-ILL078V1
1 A, up to 60 V Vin, buck LED driver board based on the LED6000

STEVAL-ILL056V1
3 A Buck LED driver board based on the LED5000

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.

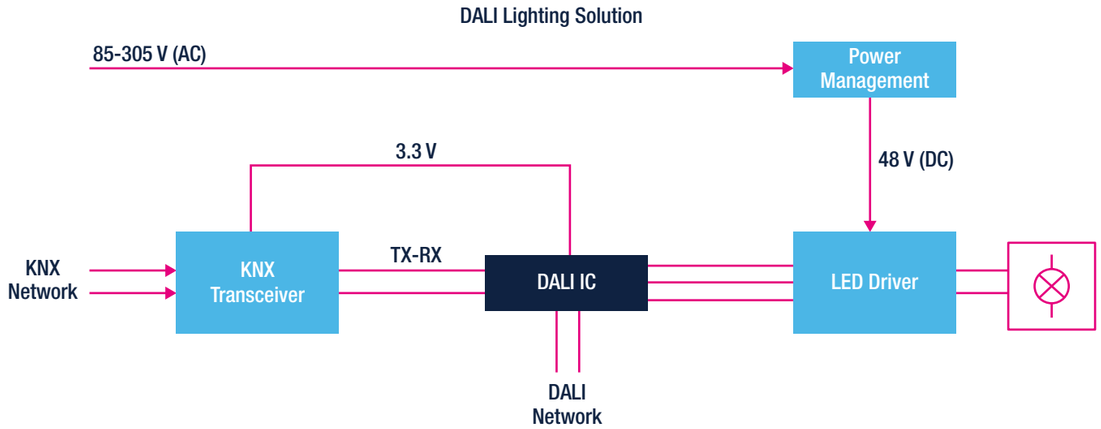
ST long-term partnerships with major lighting suppliers combined with our leadership in discrete and integrated power devices enable us to offer high efficiency and cost-optimized solutions for all types of lighting applications and their control, both wired (e.g. powerline) or wireless (RF), for industrial, 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 has been updated for 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 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	TVS protection on KNX bus SMAJ40CA-TR STKNX

Main application boards

STEVAL-ILL066V2

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

STEVAL-ILM001V1

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

EVALKITSTKNX

Miniature transceiver STKNX evaluation and development kit

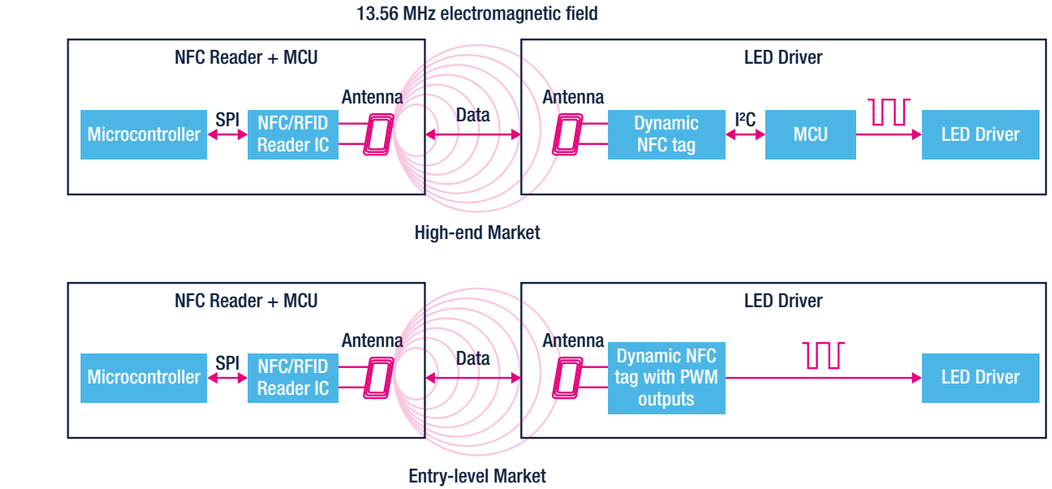
LED wireless programming

Today's smart LED bulbs let users control features including brightness and color. These properties are controlled through the driver and can be programmed and modified at any time during manufacturing, distribution, installation, or maintenance.

The use of NFC technology enables wireless programming using a smartphone, tablet, or portable RFID/NFC reader, without having to power up the LED driver and brings enhanced flexibility and energy savings in addition to reducing development time and cost.

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

Typical block diagram of LED wireless programming



ST product offering for LED wireless programming

	NFC/RFID reader IC	Protections	Microcontrollers	
NFC reader + MCU	ST25R	Antenna protection Reader: ESDZV18-1BF4 Tag: USBULC6-2M6	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	HVLED101, 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			HVLED101, HVLED001*, HVLED002 LED600*, LED5000, LED2000 STP04/08/16/24, LED12/16/24*, LED8102S

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

Main application boards

ST25R3911B-DISCO

Discovery kit for ST25R3911B high performance HF reader/NFC

ST25DV-PWM-eSET

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

ST25DV64KC-DISCO

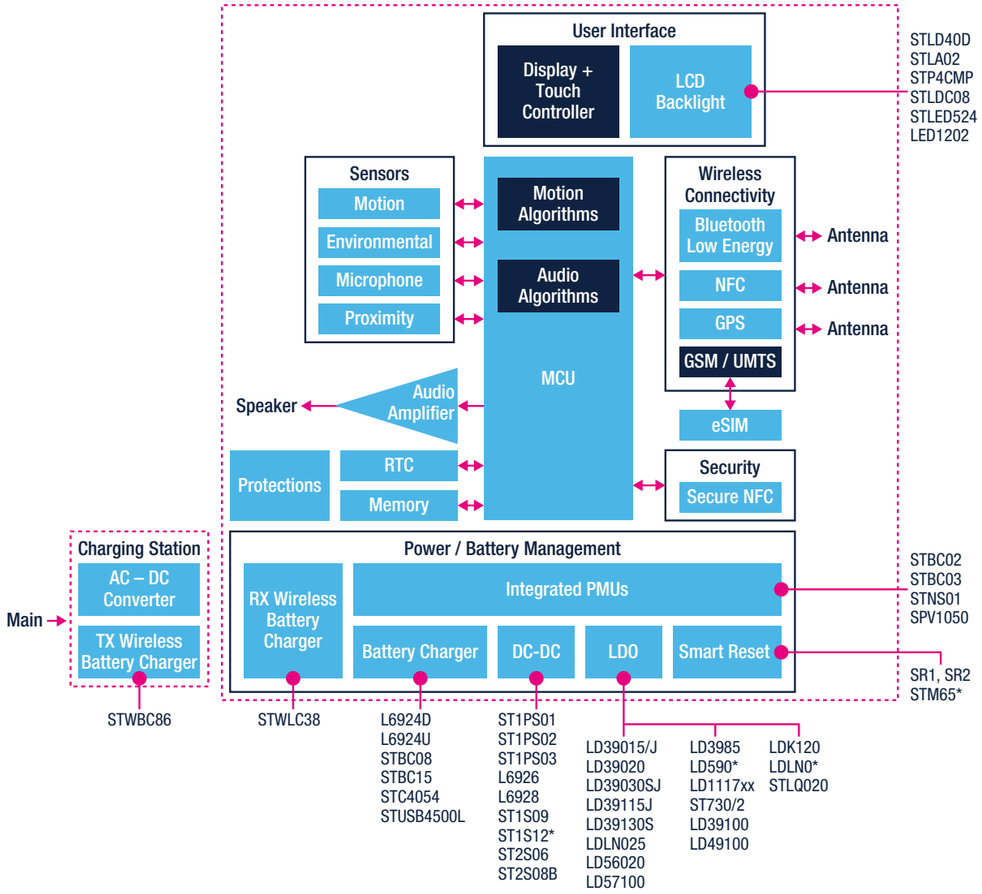
Discovery kit for the ST25DV64KC dynamic NFC/RFID tag

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 user states and conditions, have low power consumption, and the right level of performance to make them convenient and easy to use. ST products for wearable devices are designed to meet the needs of the most demanding systems with a portfolio covering smart watches, fitness trackers, heart-rate monitors, sports equipment, and a variety of other wearable devices. Our portfolio includes digital processing, sensors, connectivity, security, and power management solutions that can make the difference in a challenging and competitive market.

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

Typical block diagram of a smart watch



Main application boards and reference designs

STEVAL-1PS01AJR/DJR/EJR

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

STEVAL-1PS02B

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

STEVAL-1PS03A

Evaluation board based on ST1PS03AQTR 400 mA nano-quiescent synchronous step-down converter with load switch

STEVAL-QUADV01

Evaluation board based on the stepdown regulators L6981, L7983, ST1PS03, and the ST730 LDO

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

MAJOR HOME APPLIANCES

Refrigeration, washing, drying, and miscellaneous equipment

The white goods market requires low-cost and high-energy-efficiency solutions. The refrigeration, washing, drying, and miscellaneous (air conditioner, water heater) equipment are some of the major home appliance applications that ST is able to satisfy with various power products and high-performance STM32 microcontrollers, along with complementary gate drivers (L638* and L649*). High-efficiency PFC is guaranteed using our SiC diodes (STPSC*), new high-voltage MDmesh MOSFETs, or field stop trench-gate IGBTs. 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 STDRIVE601 3-phase gate drivers. High robustness against inrush current is ensured by new SCRs in the front-end stage. The STPW programmable electronic power breaker family provides a convenient and integrated solution for quickly and safely disconnecting a faulty load from a 12 V bus.

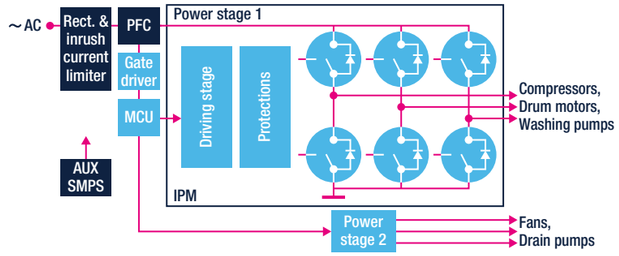
ST product offering for refrigeration, washing, drying, and miscellaneous equipment

	SCRs and TRIACs	Diodes		LED drivers		HV converters
Rect. and inrush current limiter	High Temp. SCR TN*015H-6, TN1610H-6, TN*050H-12W, TN1605H-8x High temperature T-Series and 8H-Triacs Txx35T-8 and Txx35H-8	Bridge rectifier diodes STBR*08, STBR*12	**User Interface**	LED array drivers STP04/08/16/24 LED12/16/24* STLED3165S STLED524 STCS*, LED8102S	**AUX SMPS**	VIPerPlus

	MCUs and digital controllers	IGBTs	Diodes	Op-amp V/I sensing	Power MOSFETs	Power breakers
PFC	MCUs STM32F0, STM32G0, STM32F103, STM32F301, STM32F334, STM32G4, STM32F4 Digital controllers STNRG388A	600 V V series STG*V60F 650 V HB series STG*HP65FB 650 V HB2 series STG*HP65FB2	STTH*AC06 STTH*R06 STPSC*065 DLF	Precision Op Amps (<50 MHz) TSZ*, TSV7*, TSB*, TSX*, TSU*, TSV* **MOSFET and IGBT gate drivers** Multiple LS gate drivers PM8834 Single LS gate drivers PM88*1	650 V MDmesh M9 ST*65N*M9 600 V-650 V MDmesh M6 ST*60M6, ST*65M6 600 V-650 V MDmesh M2 ST*60M2, ST*65M2 650 V MDmesh M5 ST*65M5 650 V SiC MOSFETs SCT**65G3AG, SCT*N65G2	STPW12 **Protections** TVS for power rail SMAJ, SM6T, SM15T, SMC30J, SMC50J series
	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 **AC switches and triacs** ACST*	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* **Protections** TVS for power rail surge protection SMAJ, SM6T, SM15T, SMC30J, SMC50J series	600 V MDmesh DM9 ST*60N*DM9 600 V-650 V MDmesh DM6 ST*60DM6, ST*65DM6 600 V-650 V MDmesh DM2 ST*60DM2, ST*65DM2 650 V SiC MOSFETs SCT**65G3AG, SCT*N65G2	DC-DC converters L698*, L7985, L7986, ST1S4*, ST1S50 Low dropout (LDO) linear regulators LDF, LDFM, LDK220, LDK320, LDK715, LDL212

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

Typical configuration



Main application boards

STEVAL-IHT008V1

1 kW, digital inrush current limiter based on Triac

STEVAL-IPM*

300 W to 3 kW power board based on SLLIMM™

Induction cooking

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

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

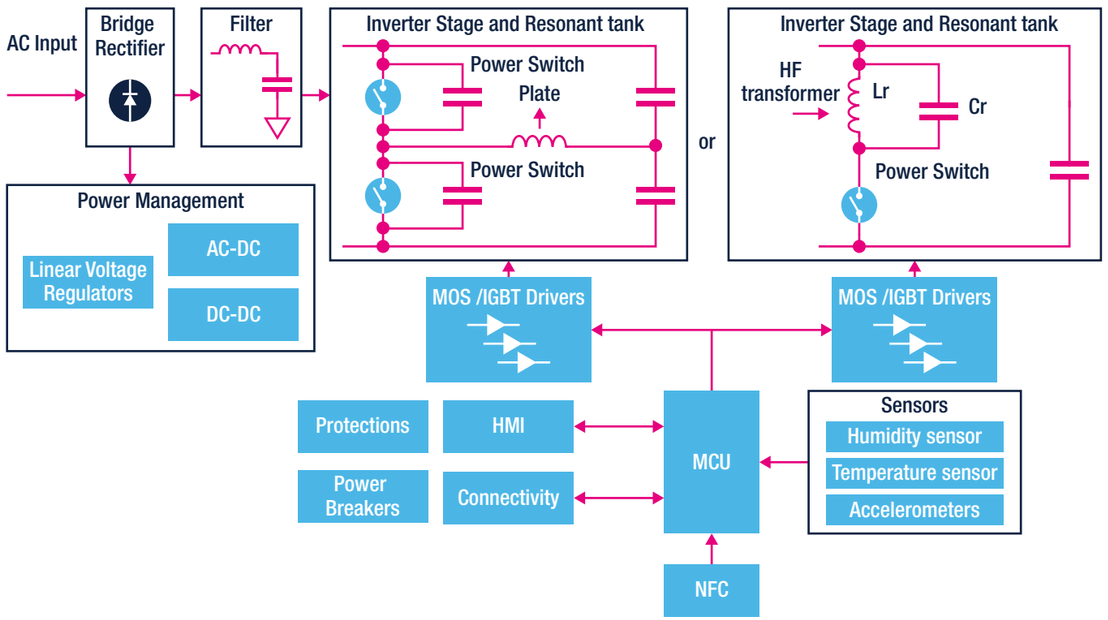
ST product offering for induction cooking

	MCUs	IGBTs	Gate drivers	Sensors	NFC
Single-switch quasi-resonant (voltage resonance)	STM8 STM32G0 STM32F0 STM32F301	1250 V IH series STG*IH125DF 1350 V IH2 series STG*IH135DF2	Multiple LS gate drivers PM8834 Single LS gate drivers PM88*1	Environmental sensors temperature - STLM20 temperature - STTS751 Motion sensors accelerometer - IIS3DHHC Proximity sensors ToF - VL53L*, VL6180*	ST25R3916, ST25R3918
	MCUs	**IGBTs**	**Gate drivers**		**Connectivity**
HB series resonant (current resonance)	STM32F0, STM32G0, STM32F303, STM32G4	600 V HB series STG*H60DLFB 650 V IH series STG*IH65DF	HV HB gate drivers L649* Isolated gate drivers STGAP*		Bluetooth Low Energy SoC, wireless MCUs, modules BlueNRG-*, STM32WB*, STM32WBA5

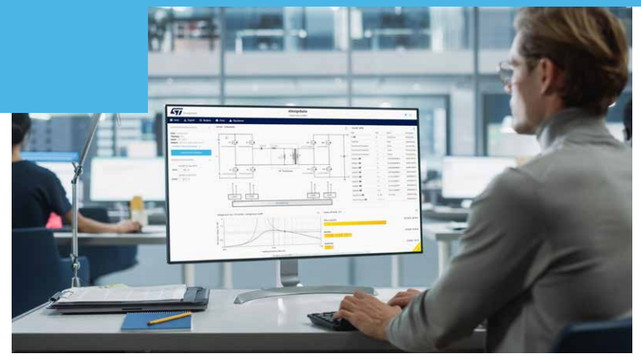
	MCUs	LED drivers		AC-DC	DC-DC	LDO	Power breakers
User interface (front panel)	STM8, STM32F0, STM32G0, STM32F4, STM32F7	LED array drivers STLED316S, STLED524, STP04/08/16/24, LED1642GW, LED8102S, LED12/16/24*	**Power management**	VIPerPlus	L698*, L7983, L7985, L7986, L7987*	LDF, LDFM, LDK220, LDK320, LDK715, LDL212, ST730, ST732	STPW12

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

Topology example



Software tools



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

eDesignSuite - power management design center

eDesignSuite is a comprehensive and flexible suite of design aid utilities and engineering tools that streamlines development of winning solutions with a wide range of ST products meeting user application requirements. Explore the advanced features of our power management design center, an on-line design tool that smartly helps designers of power management systems and subsystems accelerating the engineering development process (select, evaluate, refine, and prototype) for a large and growing number of ICs and discrete devices in our broad portfolio. The software tool supports a variety of switching power converters in power supply, digital power, LED lighting, and battery charger applications, simplifying the design path from user specification to circuit analysis and customization. The main features of the tool are automatic proposal for complete solution or fully customizable design, fully annotated and interactive schematics, complete and interactive bill of materials, main current and voltage simulations, efficiency curves, Bode stability and power-loss data, and fully interactive transformer design.

POWER SUPPLY DESIGN TOOL

- SMPS design, by topology, by type, and by product
- PFC design with analog control
- Supports various PCB configurations

LED LIGHTING DESIGN TOOL

- Handles AC-DC and DC-DC design in common topologies
- Displays interactive and annotated schematic
- Provides current/voltage graphs, Bode plots, efficiency curves and power-loss data

DIGITAL POWER WORKBENCH

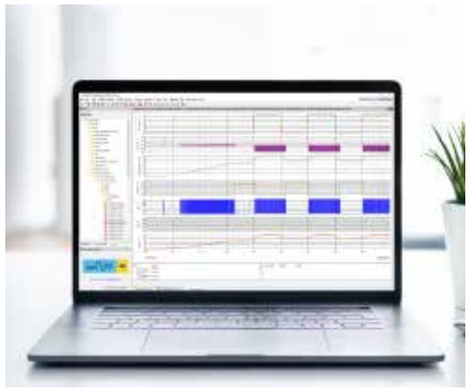
- Provides a step-by-step optimized design of power section and control loop
- Generates the STM32Cube embedded software package for custom applications and allows firmware project generation, compatible with multiple STM32 IDEs

POWER TREE DESIGNER

- Characterize each node in the tree
- Check for consistency
- Design each individual node

eDSim

eDSim is a fast and powerful electrical simulation tool for SMPS and analog ICs integrated in the eDesignSuite tool. It features enhanced accuracy and higher convergence speed for SMPS, enabling a simulation time 10-50x faster than the classic analog SPICE simulators. Design your analog circuit using the eDesignSuite engine, display a preview with full annotated schematic and BOM, and then run the electrical simulation through eDSim to get fast and accurate simulations and reliable design validation, thus reducing the effort and risks related to hardware prototyping. With the eDSim tool, you can also create your schematic from scratch using ST models or simulate your SMPS and analog ICs from a list of predefined ST application schematics-test benches, that you can partially modify according to your needs.



Products

GALLIUM NITRIDE (GaN) POWER ICs and discrete

Integrated smart GaNs - MASTERGAN

Gallium nitride (GaN) is revolutionizing the power engineering world by enabling higher speed, efficiency, and power density than ever before possible with silicon MOSFETs. Integrating GaN transistors and gate drivers, our advanced MASTERGAN system-in-package offer high efficiency due to their optimized gate drive layout, high power density, and increased switching frequency due to minimal parasitic effects, translating in a number of benefits for fast chargers, USB PD adapters, LED lighting drivers, TV power supplies, and server/telecom power designs.

KEY FEATURES AND BENEFITS

- QFN 9 x 9 x 1 mm package
- Embedded gate driver easily supplied by the integrated bootstrap diode
- Overtemperature protection
- Extended 3.3 to 15 V input range with hysteresis and pull-down
- Accurate internal timing match
- Interlocking function
- -40 to 125 °C operating temperature range
- High switching frequency >1 MHz
- No investment to learn GaN required
- Fast time-to-market

Part number	General description	Output current max (A) @25 °C	High side $R_{DS(on)}$ (mΩ)	Low side $R_{DS(on)}$ (mΩ)	Supported topologies
MASTERGAN1	High power density 600 V half-bridge high voltage driver with two 650 V enhancement mode GaN HEMT	10	150	150	Resonant, ACF
MASTERGAN2		6.5	225	150	ACF
MASTERGAN3		4	450	225	ACF
MASTERGAN4		6.5	225	225	Resonant, ACF, inverse buck
MASTERGAN5		4	450	450	Resonant, ACF
MASTERGAN1L		10	150	150	Resonant, ACF
MASTERGAN4L		10	225	225	Resonant, ACF

STDRIVE GaN drivers - STDRIVEG600

The GaN driver devices are 600 V half-bridge gate drivers for enhancement mode GaN FETs or N-channel power MOSFETs. This single chip with integrated bootstrap diode allows designers to implement GaN performance advantages and simplify design and bill-of-material requirements at the same time.

KEY FEATURES AND BENEFITS

- Highest robustness, efficiency, and integration
- Up to 20 V gate driver
- Voltage rail to 600 V
- 5.5 A / 6 A source/sink currents
- 45 ns short propagation delay
- Integrated bootstrap diode
- Separate ON-OFF outputs for easier tuning
- 3.3 V / 5 V logic inputs
- UVLO on Vcc and VBOOT
- Thermal shutdown
- Interlocking function
- Shut-down pin
- SO16 narrow package

Part number	General description	Package
STDRIVEG600	High voltage and high-speed half-bridge gate driver for GaN transistors	SO-16
STDRIVEG600TR		SO-16
STDRIVEG600W		Wafer

MAIN APPLICATIONS

SMPS · USB PD Adapter · UPS · Solar · LED lighting

High-voltage GaN converters – VIPerGaN series

The high-voltage power converters series is enriched by the introduction of GaN HEMT (high-electron-mobility transistor) technology, in a small QFN5x6 package. The VIPerGaN series offers excellent design opportunities for compact and light fast chargers, adapters, and power supplies up to 100 W with a wide input range.

Part number	Package	R_{ON} @ 25C	Max GaN HEMT transient voltage	Max P_{OUT} @ 85-265 V_{AC}	Max P_{OUT} @ 185-265 V_{AC}
VIPERGAN50TR	QFN 5x6 with exposed pad	0.45 Ω	850 V	50 W	75 W
VIPERGAN65TR		0.26 Ω	850 V	65 W	85 W
VIPERGAN100TR		0.26 Ω	850 V	75 W*	100 W

*100 W with a PFC in the front-end

KEY FEATURES AND BENEFITS

- Quasi-resonant (QR) flyback controller
- 650 V E-mode power GaN transistor (850 V transient voltage)
- Minimal standby power consumptions
- Embedded sense FET
- Dynamic blanking time and adjustable valley synchronization delay
- Output OVP protection
- Input voltage feedforward compensation for mains independent OPP variation
- Brown-in and brown-out
- Input OVP protection
- Embedded thermal shutdown
- Frequency jitter for EMI suppression

MAIN APPLICATIONS

USB PD adapter · Air conditioning · TV power supply · Home appliances

PowerGaN

ST is expanding its STPOWER power transistor family with the PowerGaN G-HEMT (intrinsically normally-off devices). **gallium nitride (GaN)** is a wide-bandgap semiconductor material capable of supporting higher voltages than traditional silicon without compromising on-resistance and thus reducing conduction losses. Products developed in gallium nitride technology can be switched much more efficiently, resulting in significant switching loss reduction. These devices feature higher frequency operation with improved power density to allow the reduction of the size of passive components in power conversion applications.

Part number	VDS	RDS(on) max	ID	Series
SGT65R65AL	650 V	65 mΩ	25 A	G-HEMT
SGT120R65AL	650 V	120 mΩ	15 A	G-HEMT

KEY FEATURES AND BENEFITS

- Better figure-of-merit (RDS xQG) vs silicon technology
- Low capacitances
- Unbeatable recovery charge Qrr
- Vey low parasitic inductance package technology
- Reduced conduction losses
- Excellent efficiency in hard switching—high frequency topologies
- Reduced power losses and passive device size

MAIN APPLICATIONS

Smart chargers and adapters · Server and telecom power · OBC · Energy generation and distribution · Led lighting

AC-DC CONVERSION ICs

ST-ONE all-in-one digital controller for USB-PD adapters

ST-ONE (single USB port) and **ST-ONEMP** (multiple USB port) are the world's first digital controllers embedding ARM Cortex M0+ core, an offline programmable controller with synchronous rectification, and USB PD PHY in a single package. Such a system is specifically designed to control ZVS non-complementary active clamp flyback converters to create high-power-density chargers and adapters with USB-PD interface. The device includes an active clamp flyback controller and its HV startup on the primary side, a microcontroller, and all the peripherals required to control the conversion and the USB-PD communication on the secondary side. The two sides are connected through an embedded galvanically isolated dual communication channel. By using a novel non-complementary control technique and specifically designed power modes, the device enables high efficiency and low no load power consumption.

The device is delivered with pre-loaded firmware that handles both the power conversion and the communication protocols for USB-PD including optional PPS and electronically marked cable management.

KEY FEATURES AND BENEFITS

- All-in-one digital controller for USB-PD chargers up to 100 W
- ZVS active clamp flyback + synchronous rectification
- USB-PD 3.1 PPS interface and integrated 24 V USB-PD PHY
- >94 % peak efficiency soft switching topology
- >1 Mhz operation with MasterGaN and planar transformers
- Small weight and size solution with >30 W/inch3 power density
- 32bit Cortex M0+ core with 64 kB embedded flash memory
- >6.4 kV reinforced galvanically isolated dual communication channel

MAIN APPLICATIONS

Tablet AC chargers

Smartphone AC chargers

Power adapter for laptops and desktops

Wall plug USB-C chargers

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

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

High-voltage converters

ST **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 from a few watts to a few tens of watts.

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

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

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

VIPerPlus

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

Flyback Primary side regulation		Flyback Secondary side regulation			Buck Converter Up to 600 mA Output Current	
VIPer01-11-31	VIPer122-222	VIPer01-11-31	VIPer122-222	VIPer28-38	VIPer01-11-31	VIPer122-222
VIPer26K	VIPer06-16-26	VIPer26K	VIPer06-16-26	VIPer25-35	VIPer26K	VIPer06-16-26
Altair04-05	VIPer0P	VIPer27-37	VIPer0P	VIPer122-222		VIPer0P

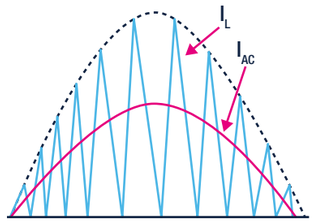
MAIN APPLICATIONS

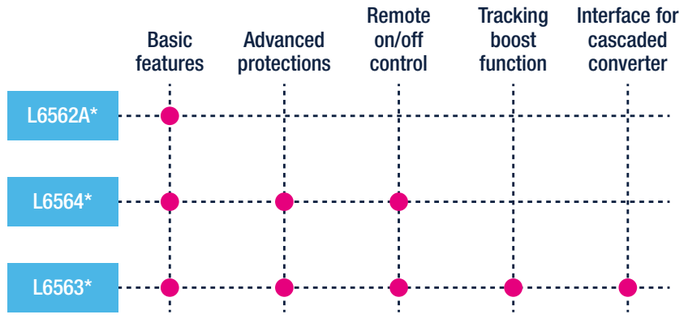
PFC controllers

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 wide-range-mains operation.

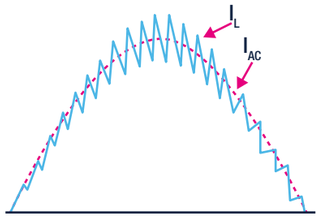
These devices embed advanced protection features, which make the SMPS more robust and compact, requiring fewer external components. These features include output overvoltage, brown-out, feedback disconnection, and boost inductor saturation protection. The high-voltage start-up capability present in the 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
- **L4985A/B** — Quasi-fixed frequency, peak-current mode
- **L4986A/B** — Quasi-fixed frequency, peak-current mode, adjustable PGOOD

MAIN APPLICATIONS

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

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

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

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 portfolio of advanced controllers includes a variety of **primary controllers** intended to fit high-performance applications. Very high efficiency is achieved with single-ended topologies at a fixed switching frequency or with quasi-resonant operation. The new STCH03 offline constant-current primary-side regulation controller (PSR-CC) guarantees very low power consumption at no load condition. For high-power, high-current applications, ST offers controllers for half-bridge resonant and asymmetrical half-bridge topologies. The STCMB1 and STNRG011 combo controllers with high-voltage start-up, Xcap discharge circuit, and PFC and resonant driving stages, guarantee high performance and high integration with a smaller pinout. The new STNRG012 is specifically designed to support LED lighting and industrial applications requiring DC source management, with additional THD optimizer function.

Flyback controllers

STCH03

- Offline quasi-resonant controller in SO-8 package
- Constant-current primary-side regulation mode (PSR-CC) or constant-voltage regulation with optocoupler
- Advanced burst mode operation (< 10 mW consumption @ no load)
- UVP, autorestart/latched OVP and internal OTP
- 650 V HV start up

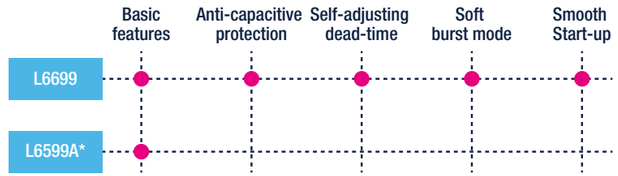
L6566*

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

L6565

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

HB-LLC resonant controllers



Analog combo controller (PFC+LLC/LCC)

STCMB1

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

Asymmetrical half-bridge controller

L6591

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

MAIN APPLICATIONS

Tablets and smartphones
L6565, L6566*, STCH03

Laptops
L6565, L6566*, STCH03, STCMB1

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

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

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

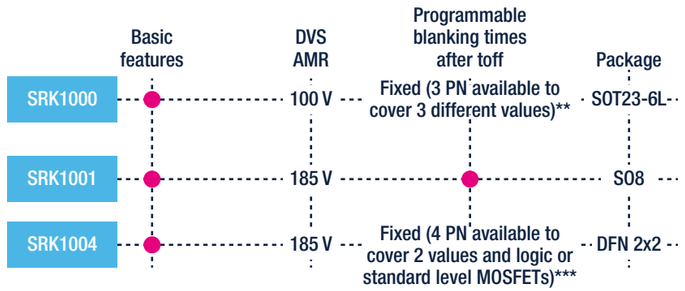
Note: * is used as a wildcard character for related part number

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



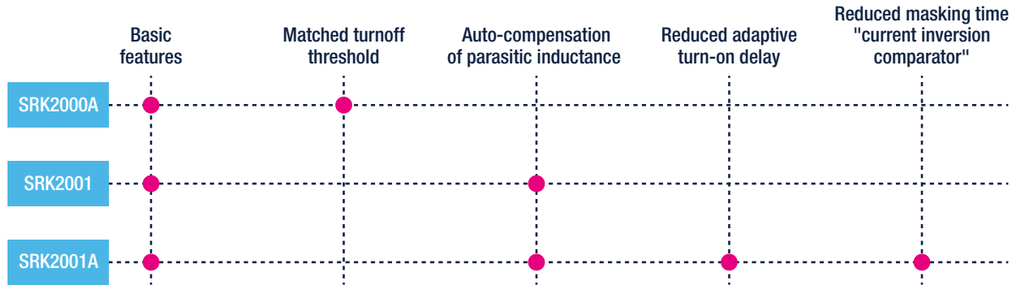
**Three options available: SRK1000 (0.5 µs), SRK1000A (2 µs), SRK1000B (3 µs)

*** A and B for logic level MOSFETs or GANs, C and D for standard level MOSFETs
A and C with turn off delay of 25ms, B and D with turn off delay of 150 ms

SYNCHRONOUS RECTIFICATION BENEFITS

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

SR controllers for LLC resonant



MAIN APPLICATIONS

High-power adapters and TVs
SRK1000, SRK1001, SRK1004

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

Signal conditioning

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

Operational amplifiers

TSZ181, TSZ182

- Operating voltage 2.2 to 5.5 V
- 5 V zero-drift amplifier
- Input offset voltage 25 µV max
- Temperature up to 175 °C
- Gain bandwidth 3 MHz

TSV772/TSV782

- Operating voltage 2.0 to 5.5 V
- Rail-to-rail input and output
- Vio max 200 µV
- Gain bandwidth 20/30 MHz

TSB711/2, TSB7191/2

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

TSV791/2

- Operating voltage 1.8 to 5.5 V
- Rail-to-rail input and output
- Vio max 200 µV
- Gain bandwidth 50 MHz

Current sense amplifiers

TSC103

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

TSC200

- Operating voltage -16 to 80 V
- Amplification gain x20
- Comparator +Vref embedded
- Package SO8, MiniSO8

TSC2010/1/2

- Bi-directional
- Operating voltage - 20 to 70 V
- Amplification gain x20 x60 x100
- Offset voltage ± 200 µV max
- 2.7 to 5.5 V supply voltage
- Gain error 0.3% max
- Packages MiniSO8 SO8

TSC21*

- Bi-directional
- Operating voltage -0.3 to 26 V
- Amplification gain x50 x75 x100 x200 x500 x1000
- Offset voltage ±35 µV max
- Gain error 1% max
- Packages QFN10, SC70-6

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

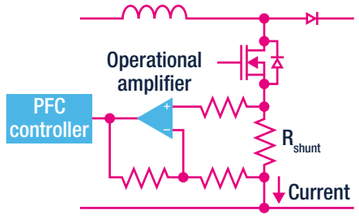
TS3011

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

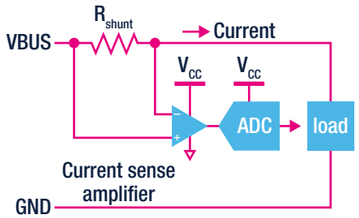
MAIN APPLICATIONS

Wireless battery charger transmitters
Server/Telecom
Solar
UPS
Lighting
Factory automation

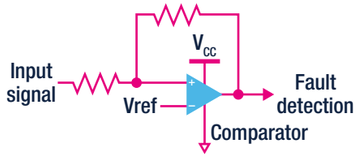
Typical application schematic for low-side current measurement in a PFC



Typical application schematic for high-side current measurement



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



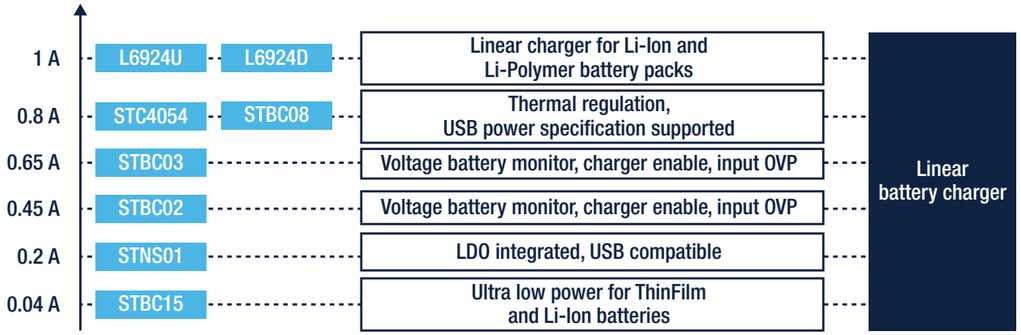
www.st.com/opamps
www.st.com/current-sense-amplifiers
www.st.com/comparators

BATTERY MANAGEMENT ICs

Battery chargers and battery monitoring ICs

ST **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 10 mA up to 1.0 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 peak of load control
- Charging current up to 40 mA (set by dedicated pins)
- 250 nA quiescent current
- Multiple floating voltages management (4.0 to 4.4 V) set by digital pins.
- Shelf mode 4 nA

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

STC3115

- OptimGauge algorithm for STC3115
- OptimGauge+ algorithm for SCT3117

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, STBC03
- Smartphones — STBCFG01, STC3115, SCT3117

Wireless charging ICs

ST fully covers wireless charging applications with **dedicated ICs for both transmitter and receiver**. The STWBC, compatible with Qi standard, and the STWBC86 dedicated to wearable applications, make up the ST wireless power transmitters (Tx) family. The receiver family (Rx) consists of the STWLC38 dedicated to Qi compliant consumer applications, the STWLC86, and the STWLC98 for higher power applications.

STCHARGE

Wireless charger transmitter ICs

STWBC2-HP STWBC86

STWBC2-HP

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

STWBC86

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

Wireless charger receiver ICs

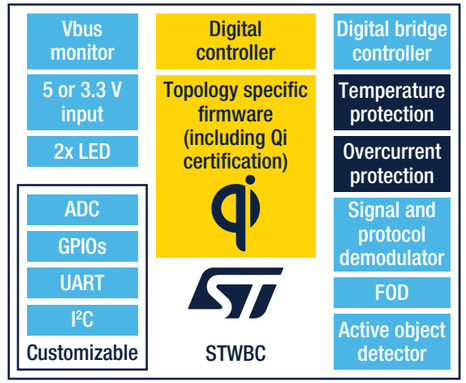
STWLC38 STWLC98 STWLC99

STWLC38

- Qi 1.3 compatible
- Supports up to 15 W Rx for Qi extended power profile
- Supports up to 5 W Rx for Qi baseline power profile
- Supports up to 5 W in Tx mode (coil dependent)
- ARC (adaptive rectifier configuration) mode for enhanced spatial freedom

STWLC98/99

- Qi 1.3 compatible
- Supports up to 70 W (STWLC98) /100 W (STWLC98) Rx
- Supports up to 15 W (STWLC98) /25 W (STWLC99) in Tx mode (coil dependent)
- Embedded OS for Qi 1.3 standalone certification
- ARC (adaptive rectifier configuration) mode for enhanced spatial freedom
- ARM 32-bit Cortex™-M3 core up to 64 MHz (STWLC98)
- ARM 32-bit Cortex™-M0+ core up to 64 MHz (STWLC99)
- Optimized device size (STWLC98)



Common features

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

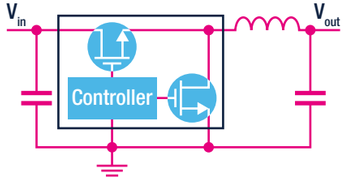
MAIN APPLICATIONS

- Wireless charger transmitters — STWBC2-HP, STWBC86
- Smartphones, tablets, and laptops — STWLC38, STWLC98, STWLC99, STWBC86, STWBC2-HP
- Wireless applications — STWLC98, STWLC99, STWBC2-HP
- Wearables and hearables — STWLC38, STWBC86

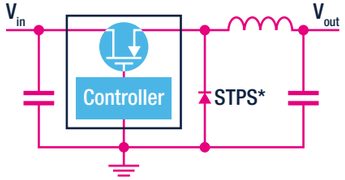
DC-DC SWITCHING CONVERSION ICs

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 consists 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, and storage, etc.) and server/telecom applications.



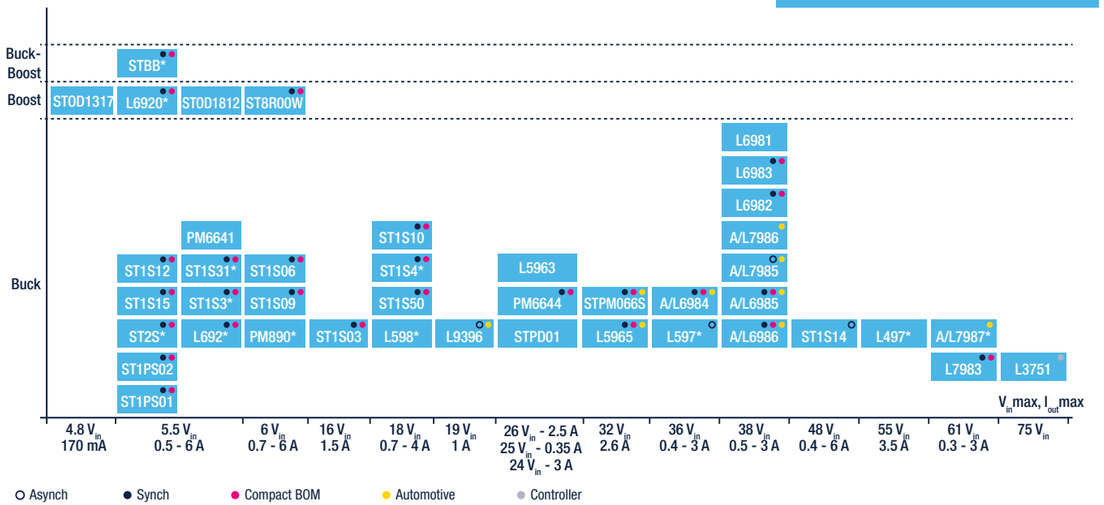
Synchronous buck converter



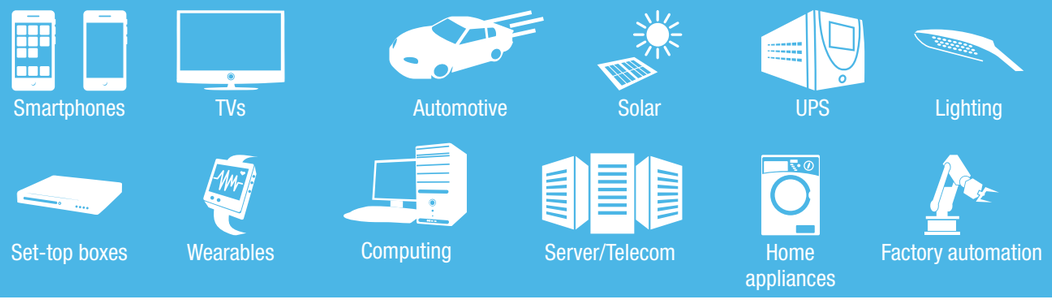
Asynchronous buck converter

DC-DC CONVERTERS MAIN FEATURES

- Up to 61 VIN/3 A
- Synchronization capability
- Internal compensation
- Low consumption
- Adjustable fsw
- Internal soft start
- Low quiescent current



MAIN APPLICATIONS



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

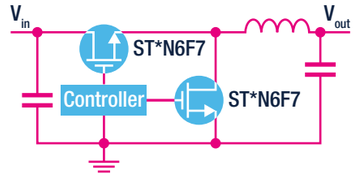
Note: * is used as a wildcard character for related part number

DC-DC controllers

ST offers a wide portfolio of **DC-DC switching controllers** for server and telecom applications according to market requirements: single-phase controllers with embedded drivers, advanced single-phase controllers with embedded non-volatile memory (NVM), and our newest controllers with or without SPS (Smart power stage) compatibility, as well as multiphase digital controllers for CPU and DDR memory power supplies. The newest L3751 controller ensures high reliability in industrial applications with high Vdrop and robotics with potential high voltage spikes due to inductive loads

Single-phase Buck controllers

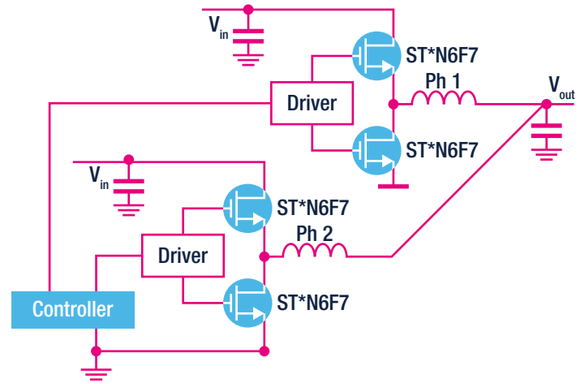
L6726A	Single-phase cost effective PWM controller
A6727*	Single-phase cost effective PWM controller for automotive applications
PM6680	Dual-output PWM controller up to 36 Vin
L3751	Wide 6 to 75 V input voltage synchronous buck controller



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

Single-phase buck-boost controller

STPM802	Single-phase synchronous buck-boost controller

MAIN APPLICATIONS

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

Highly integrated power management IC for micro-processor units

STPMIC1, a high performance fully integrated power management IC, is the ideal companion chip of the **STM32MP1 microprocessor** series, being also optimized for power applications requiring low power and high efficiency. The STPMIC1 integrates buck and boost converters, linear regulators with sink/source capability, power switches specifically designed to supply all required power rails for the STM32MP1 and for other components on the board such as DDR, flash memory, Wi-Fi, and Bluetooth connectivity ICs, providing a total system solution.

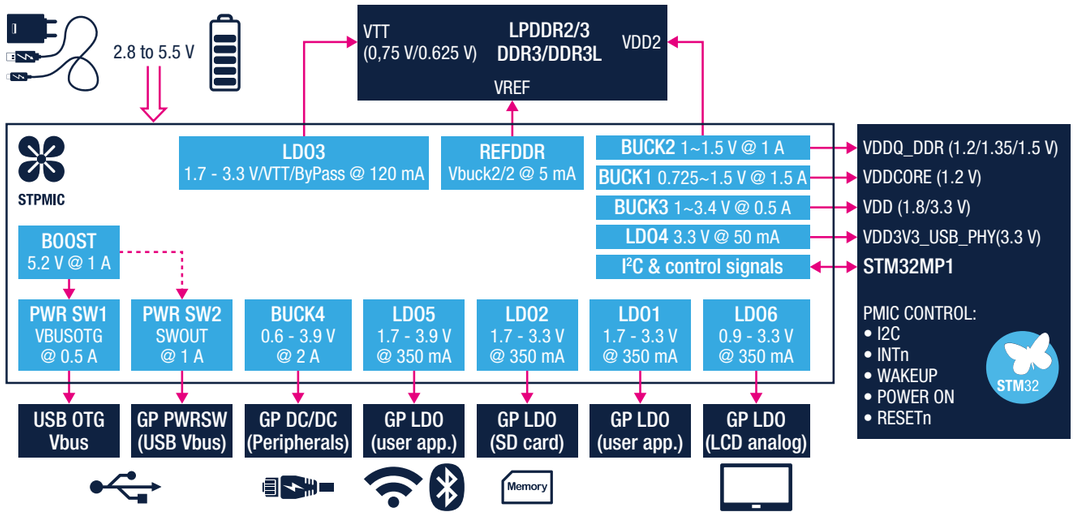
STPMIC

STPMIC1 versions

	5 V power supply application		Battery power supply application		Custom application, no output turned ON		5 V power supply application		Battery power supply application	
	STPMIC1A		STPMIC1B		STPMIC1C		STPMIC1D		STPMIC1E	
	Default output voltage (V)	Rank	Default output voltage (V)	Rank	Default output voltage (V)	Rank	Default output voltage (V)	Rank	Default output voltage (V)	Rank
LDO1	1.8	0	1.8	0	1.8	0	1.8	0	1.8	0
LDO2	1.8	0	2.9	2	1.8	0	1.8	0	1.8	0
LDO3	1.8	0	1.8	0	1.8	0	1.8	0	1.8	0
LDO4	3.3	3	3.3	3	3.3	0	3.3	3	3.3	3
LDO5	2.9	2	2.9	2	1.8	0	3.3	2	2.9	2
LDO6	1.0	0	1.0	0	1.0	0	1.0	0	1.0	0
REFDDR	0.55	0	0.55	0	0.55	0	0.55	0	0.55	0
BOOST	5.2	N/A	5.2	N/A	5.2	N/A	5.2	N/A	5.2	N/A
BUCK1	1.2	2	1.2	2	1.1	0	1.2	3	1.2	3
BUCK2	1.1	0	1.1	0	1.1	0	1.1	0	1.1	0
BUCK3	**3.3**	1	**1.8**	1	1.2	0	**3.3**	1	**1.8**	1
BUCK4	3.3	2	3.3	2	1.15	0	1.2	2	1.2	2

Rank = 0: rail not autom. turned ON
Rank = 1: rail autom. turned ON after 7 ms
Rank = 2: rail autom. turned ON after further 3 ms
Rank = 3: rail autom. turned ON after further 3 ms

STPMIC1 and STM32MP1



MAIN APPLICATIONS

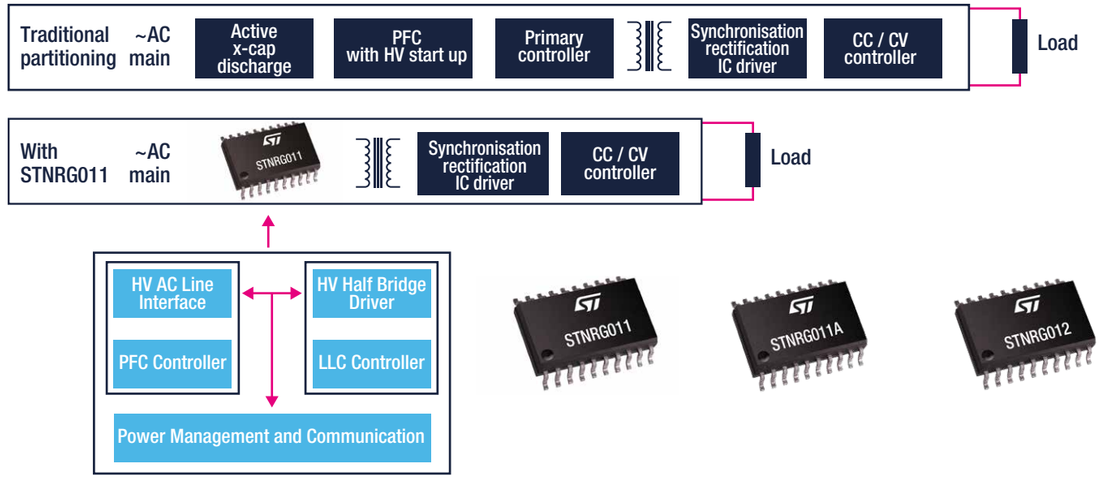
Home automation
Industrial control
POS terminals
Networking
Medical monitoring

DIGITAL POWER CONTROLLERS AND MICROCONTROLLERS

STNRG digital power controllers

The high level of integration of today's latest features and functions make **STNRG011**, **STNRG11A,** and **STNRG012** ideal for SMPS and lighting applications required to comply with the most stringent energy-saving regulations and guarantees high reliability, safety, and BOM optimization. Configurable through an intuitive GUI, ST STNRG digital controllers provide high-end performance and flexibility and do not require any firmware implementation. All the key application parameters of the device are stored in an internal NVM, allowing wide configurability and calibration.

Simplified 2-stage digital SMPS design with high performance and low component count



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

STNRG011 **STNRG011A** **STNRG012**

- Onboard 800 V startup circuit, line sense and X-cap discharge compliant with IEC 62368-1, for reduced standby power (STNRG011 only)
- DC source management with no X-cap discharge (STNRG012 only)
- THD optimizer for LED lighting applications (STNRG012 only)
- Enhanced fixed on time multi-mode TM PFC controller
- Time-shift control of resonant half-bridge
- ROM memory for SW digital algorithms
- NVM memory for programmable key application parameters
- Advanced OLP - over load management (STNRG011A only)

MAIN APPLICATIONS

- TV power supply and All-in-One STNRG011, STNRG011A
- High power adapters STNRG011, STNRG011A
- LED lighting STNRG012
- Industrial and medical equipment STNRG012
- Emergency lighting STNRG012

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 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 with 32-bit ARM® Cortex®-M4 core running at 170 MHz continues the STM32F3 series, keeping leadership in analog, leading to cost reduction at the application level and a simplification of the application design.

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

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

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

STM32G0

- Cortex®-M0 core
- Very low power consumption
- Timer frequency up to 128 Mhz resolution (8 ns)
- 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 (217 ps 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 (25 ns from fault input to PWM stop)

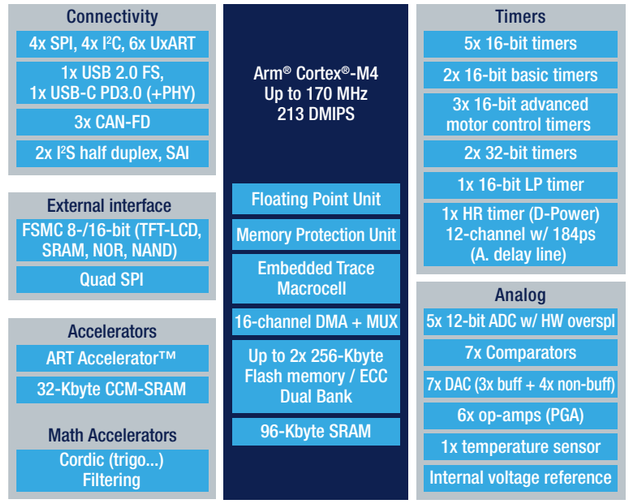
STM32G474

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

STM32H743

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

STM32G474 block diagram



MAIN APPLICATIONS

- Energy generation and distribution
- Welding
- Commercial, architectural street lighting
- Server/ Telecom
- UPS

www.st.com/stm32 **STM32 digital power ecosystem**

Automotive microcontrollers for in-car digital power

SPC5 automotive microcontrollers are suited for in-car digital power applications, such as traction inverters, on-board chargers, bidirectional DC-DC, and battery management systems.

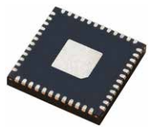
SPC58 E-line combines real-time behavior with ISO26262 ASIL-D safety.
The embedded hardware security module (HSM) ensures protection against cyber security attacks.
The generic time module (GTM) completes the peripheral set by delivering a high-performance timer, synchronization units, embedded hardware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

Networking

ETHERNET

LOCAL INTERCONNECT NETWORK

CAN FD

OPEN ALLIANCE

FlexRay™

Scalability

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

ASIL D

Secure and Safety

Evita Medium/Full

HIS

ISO 26262

MAIN APPLICATIONS

Vehicle security

Software over-the-air

Parking services

Remote assistance

Maintenance free

Safety

HEV

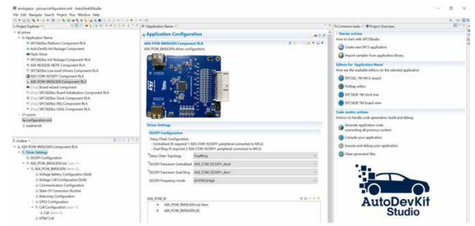
AUTODEVKIT AUTOMOTIVE DEVELOPMENT KIT ENABLES FASTER ECU PROTOTYPING

AutoDevKit

AutoDevKit is a fast-growing toolset for automotive and transportation application development. It allows design engineers to quickly and easily prototype with hardware, firmware, and software, and includes extensive community support.

Our ecosystem offers a wide selection of automotive MCUs and devices covering several automotive applications:

- BMS
- Delivery/logistic robots
- AI on standard MCUs
- Internal and external lighting
- Power distribution
- Audio generation and AVAS
- Motor control: door control, side mirror, tailgate, seat adjustment
- HVAC, ventilation, air quality
- USB Type-C power delivery



Once the MCU platform and the functions needed for the application have been selected, the developer can customize existing demo codes using high-level programming, without needing to deal with complex technical details.

Automatic pin configuration and a visual procedure enable easy board assembly with the correct wiring, and the embedded debug allows quick prototyping.

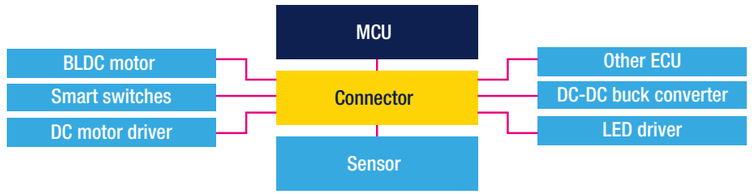
The AutoDevKit ecosystem includes:

- MCU discovery and functional boards
- System solution and demonstrators
- STSW software

AutoDevKit ecosystem

MCU boards | Connector boards | Functional boards

Solution/demonstrator KIT



MCU + connector + functional boards

Find out more at www.st.com/autodevkit
Software download www.st.com/autodevkitsw

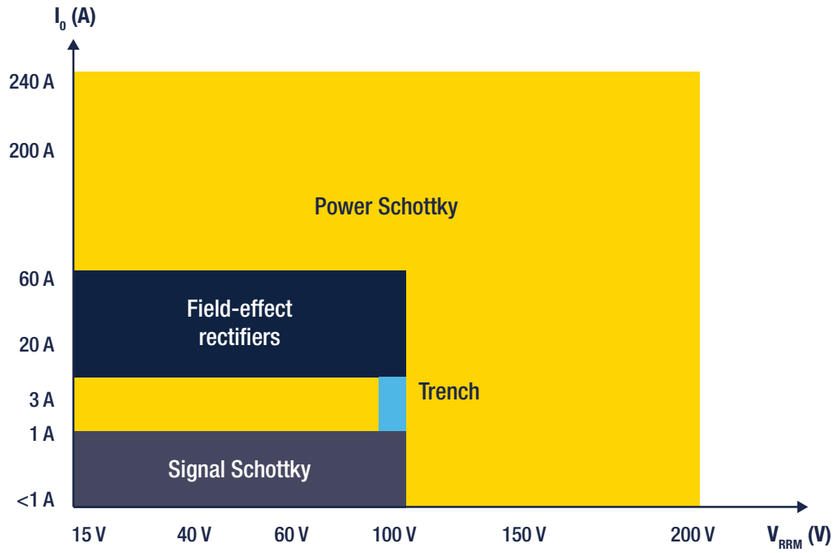
Community

Video introduction

Brochure

DIODES AND RECTIFIERS

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



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
STPST*	Power Schottky trench rectifier for high frequency for miniature switched mode power supplies

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

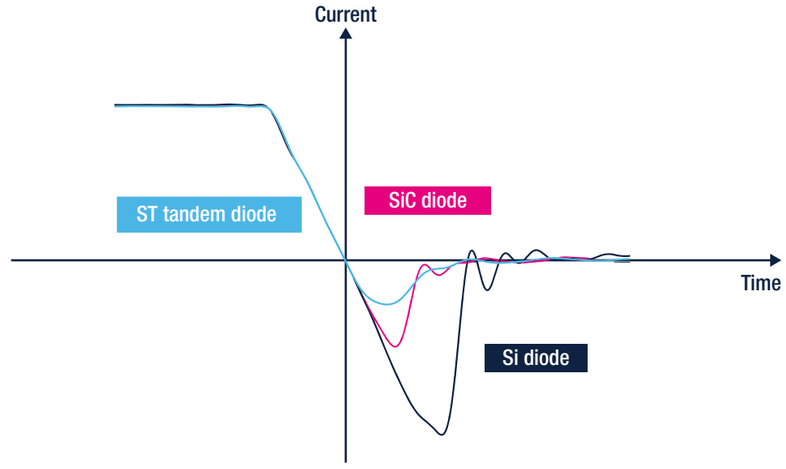
Note: * is used as a wildcard character for related part number

SiC diodes

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

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

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



SiC diodes provide zero recovery time with negligible switching losses

SIC DIODES BENEFITS

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

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

STPSC*065 STPSC*H12

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

STPST Trench diodes

The trench diode design perpetuates the ST move towards ever increasing compactness in power systems. It covers applications from tiny appliance adaptors (STPST8H100SF takes a mere 30 mm² footprint) to automotive power actuators (-SFY suffix for this 8 Amps). Together with the D2PAK and PSMC surface mount power housing, the slimmer 1 mm SOD123Flat, SOF128Flat, and SMB Flat packages give access to the newer, leaner circuit modules.

MAIN APPLICATIONS

Solar inverters
STPSC*065, STPSC*H12

HEV
STPSC*065

UPS
STPSC*065, STPSC*H12

Charging Station
STPSC*065, STPSC*H12

Server/Telecoms and PFC
STPSC*065, STPSC*H12

www.st.com/sic-diodes

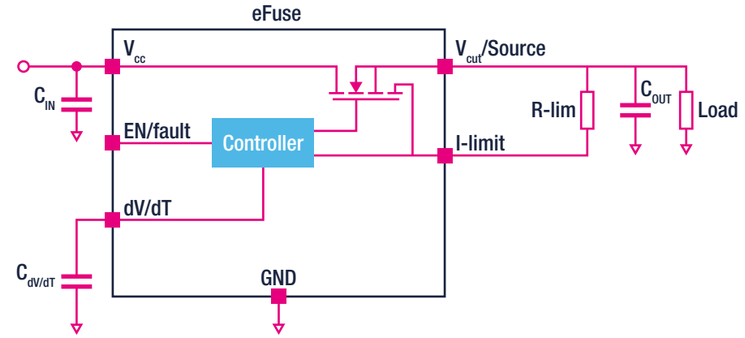
Note: * is used as a wildcard character for related part number

eFuses AND HOT-SWAP ICs

eFuses

eFuses are electronic fuses that can replace larger conventional fuses or other protections, 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 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.

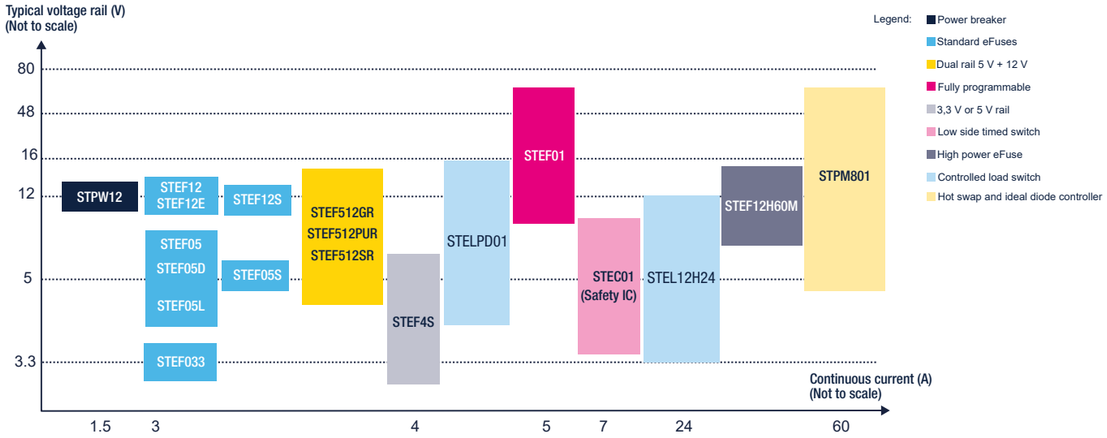


eFuse MAIN FEATURES

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

www.st.com/efuse

eFuses, a smart offer for a lots applications



MAIN APPLICATIONS

Home appliances
STEF05, STEF01, STEF12, STEF12S

Server and data storage
STEF033, STEF05, STEF05L, STEF4S, STEF12, STEF05S, STEF12S, STEF512, STEF512SR, STEL12H24

USB connections
STEF05, STEF05L, STEF05S, STELPD01

Factory automation
STEF01, STEF12, STEF12S, STELPD01

Set-top boxes
STEF12, STEF12S

Power breakers

Connected in series to the power rail, ST **power breakers** are able to disconnect the electronic circuitry when 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.

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

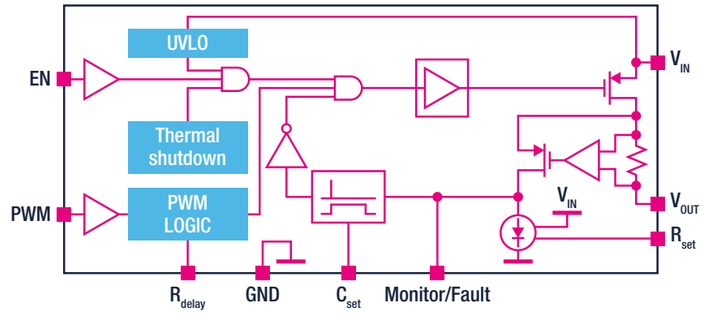
Inserted between the power rail and the load, STPW power breakers contain a low-resistance (50 mΩ) power switch and precision circuitry for sensing the load power. If the user-programmed limit is exceeded, the switch turns off and a signal on the dedicated monitor/fault pin informs the host system. In 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 for standards such as the UL 60730 specifications for abnormal operation. This integrated solution effectively replaces discrete circuitry or a combination of ICs such as a current-sense amplifier or a hot-swap controller plus MOSFET switches, by offering improved accuracy and saving board space and bill of materials for each load protected.

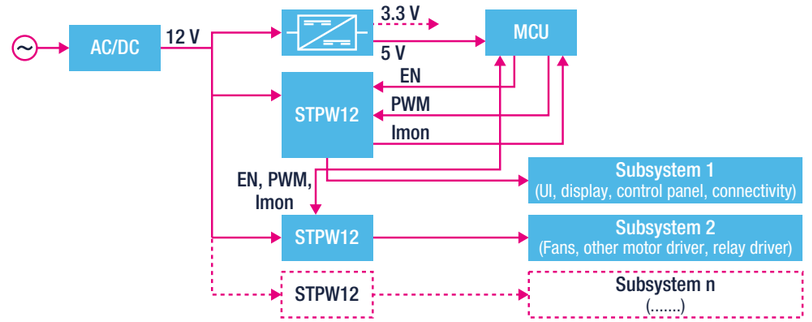
Power breakers

STPW12

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



Typical home appliance block diagram for STPW12



MAIN APPLICATIONS

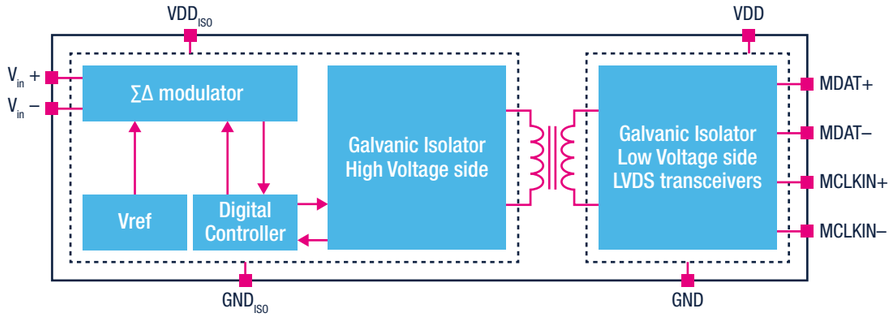
Home appliances
STPW12

Air conditioning
STPW12

Factory automation
STPW12

GALVANIC ISOLATED SIGMA-DELTA ADC

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



KEY FEATURES

- 2nd order 16-bit Sigma-Delta modulator
- ±320 mV full scale differential input signal Range
- Up to 25 MHz external clock input for easier synchronization
- Up to 50 kHz bandwidth
- 86 dB typical SNR
- - 83 dB typical THD
- 30 kV/µs typical common-mode transient immunity
- 6 kV VPEAK highest allowable over-voltage (V_{IOTM})
- 6 kV VPEAK maximum surge insulation voltage (V_{IOSM})
- 1.2 kV V_{PEAK} maximum working insulation voltage (V_{IORM})
- Flexible interface options: Low voltage differential signaling (LVDS) and single ended (TTL/CMOS) options
- –40 °C to +125 °C extended industrial temperature range
- SO-16 wide package

Product table

Part number	Version	Input Range	Max. clock frequency	Resolution	SNR	Isolation	CMTI	Package and packing
ISOSD61	TTL/CMOS	±320 mV	25 MHz	16-bit	86 dB	1.2 kV Viorm	30 kV/us	SO16W tray
ISOSD61TR	TTL/CMOS							SO16W tape and reel
ISOSD61L	LVDS							SO16W tray
ISOSD61LTR	LVDS							SO16W tape and reel

MAIN APPLICATIONS

Servo drive

Factory automation

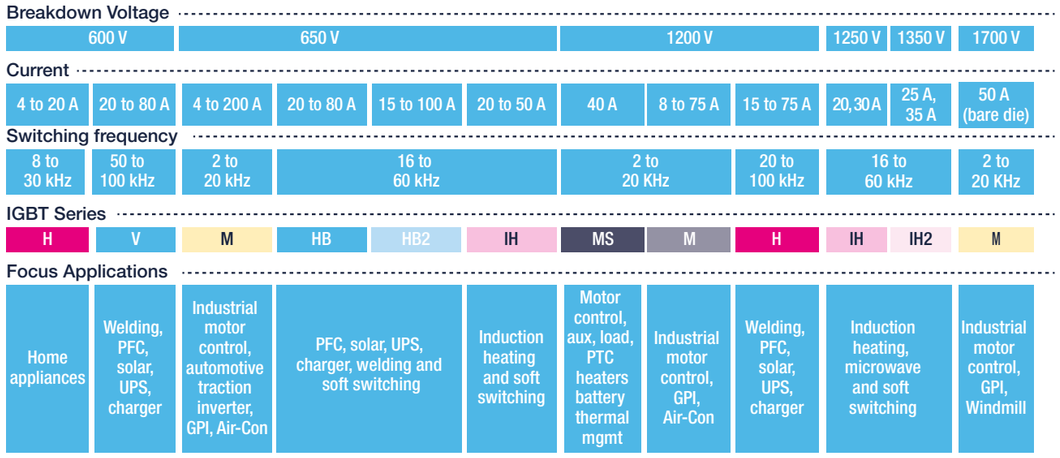
EV charging station

Server and telecom power

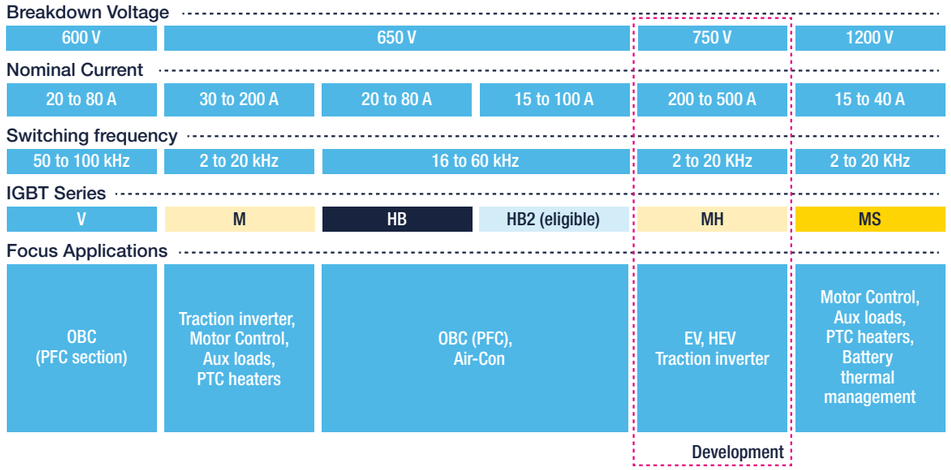
IGBTs

ST offers a comprehensive portfolio of **IGBTs (insulated gate bipolar transistors)** ranging from 600 to 1700 V in trench gate field-stop (TGFS) technologies.
Featuring an optimal trade-off between switching performance and on-state behavior (variant), ST 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, and fast chargers.

Industrial



Automotive



H series

STG*H*

H* - 600 V family
- 3 µs of short-circuit capability
- Low saturation voltage
- Minimal collector turn-off
- Series optimized for home appliance applications

H - 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

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

M series

STG*M*

650 V family
- 6 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/IH2 series

STG*IH*

650 V IH family
- Very low $V_{CE(sat)}$: 1.5 V @ ICN
- Very low Eoff
- Low drop forward voltage diode
- Designed for soft commutation application only

1250 V IH family - 1350 V IH2 family
- Minimized tail current
- Very low drop freewheeling diode
- Tailored for single-switch topology

MH series

STG*MH*

- Increased BV robustness and current density
- Low $V_{CE(sat)}$ = 1.3 V (typ.) @ IC = 300A
- Integrated Kelvin and current sensing option
- Enhanced switching performances
- Dice top and back metallization suitable for high performance linking
- High current and temperature fully tested
- Rebuilt wafers for customized modules

MS series

STG*MS*

- Designed for automotive application
- 8 µs of short-circuit withstanding time @ V_{CC}=800 V, V_{GE}=15 V,T_J-start=150 °C
- Maximum continuous operating junction temperature: T_J=175 °C
- Low $V_{CE(sat)}$ = 1.95 V (typ.) @ IC = 40A

MAIN APPLICATIONS

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

www.st.com/igbt

INTELLIGENT POWER MODULE - SLLIMM

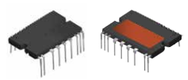
The **SLLIMM**, small low-loss intelligent molded module, is the ST family of compact, high efficiency, dual-in-line **intelligent power modules (IPM)** with extra optional features. This family includes different solutions in terms of package (SMD, through hole, full molded, and DBC) and silicon technology (IGBT, MOSFET, and superjunction MOSFET). Optimally balancing conduction and switching energy with an outstanding robustness and EMI behavior makes the new products ideal to enhance the efficiency of compressors, pumps, fans, and any motor drives working up to 20 kHz in hard switching circuitries and for an application power range from 10 W to 7 KW.

KEY FEATURES

- 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

KEY BENEFITS

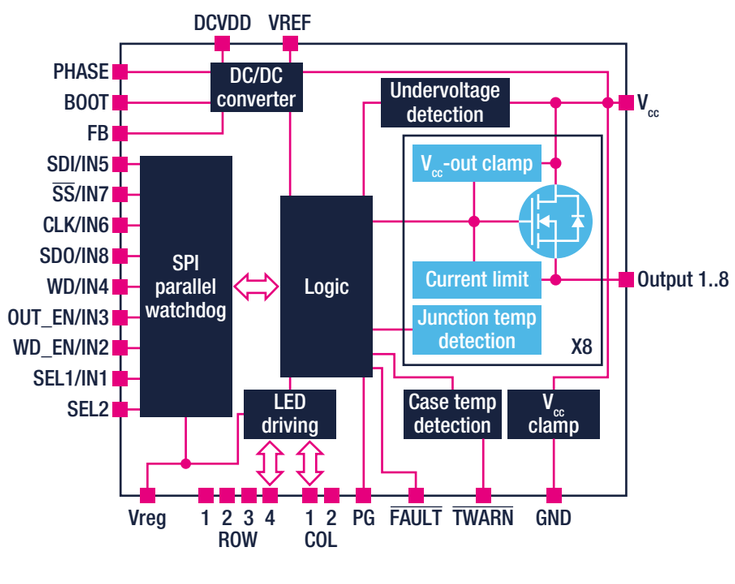
- Integrated and efficient solution
- Easy to drive through microcontroller
- Higher robustness and reliability
- Plug'n play solution

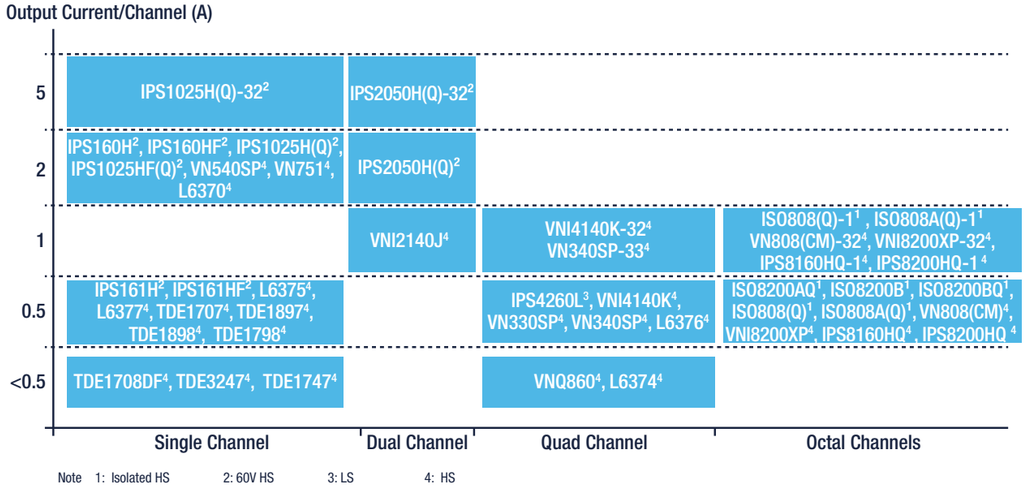
SLLIMM nano series	SLLIMM 2nd series	SLLIMM high power series
600 V IGBT 600 V SJ-MOSFET 500 V MOSFET 1 up to 8 A	600 V IGBT 600 V SJ-MOSFET 8 up to 35 A	IGBT 650 V, 50 A 1200 V, 10 A
		
Power rating: 10 to 600 W	Power rating: 300 W to 3 kW	Power rating: 3 to 7 kW

www.st.com/igbt

INTELLIGENT POWER SWITCHES

STMicroelectronics offers **intelligent power switches (IPS)** for low- and high-side configurations. ST 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.
The devices are designed using ST latest technologies for state-of-the-art solutions in any application field.





Note 1: Isolated HS 2: 60V HS 3: LS 4: HS

IPS MAIN FEATURES

- Logic
- Driving
- Protections
- Diagnostic
- Power stage
- Isolation

...all in a single chip

www.st.com/ips

MAIN APPLICATIONS

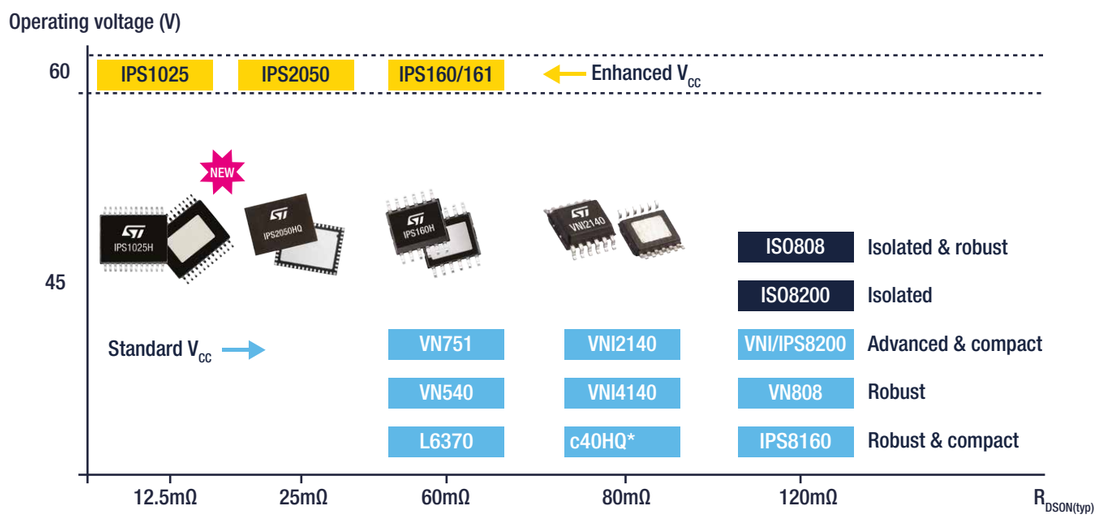
Factory automation

Vending machines

Renewable energy

Lighting for building automation

Industrial power switches–high-side
Positioning by operating voltage and on-resistance

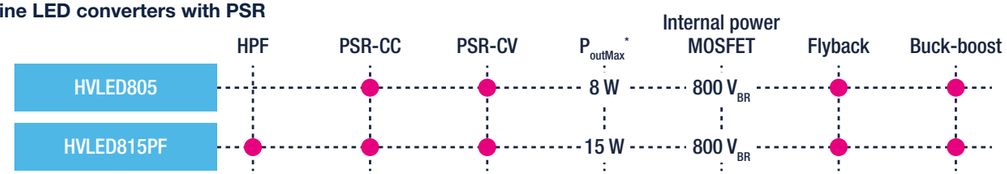


LED DRIVERS

Offline LED drivers

Dedicated **LED drivers** operating from the AC mains ensure highly accurate LED control to provide a high level of light quality and avoid flickering. By combining state-of-the-art low-voltage technology for the controller and 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, HVLED001B, and HVLED101 controllers are also available for high power needs working in constant-voltage (PSR-CV) primary-side regulation; a dimming function is also available. For both families (HVLED converters and controllers), the primary-side regulation cuts bill-of-material costs, while also simplifying design and reducing the space occupied by LED control circuitry.

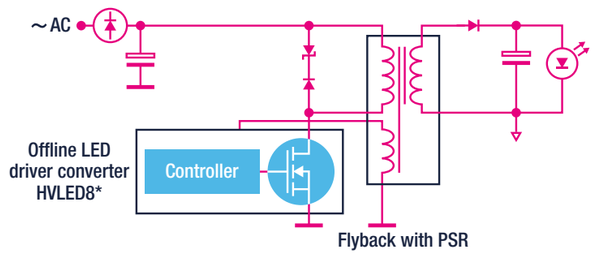
Offline LED converters with PSR



Offline LED controllers with PSR

Offline LED controllers

Topology example



MAIN APPLICATIONS

Residential lighting
HVLED815PF

Commercial and street lighting
HVLED001A, HVLED001B, HVLED007, HVLED101

www.st.com/led

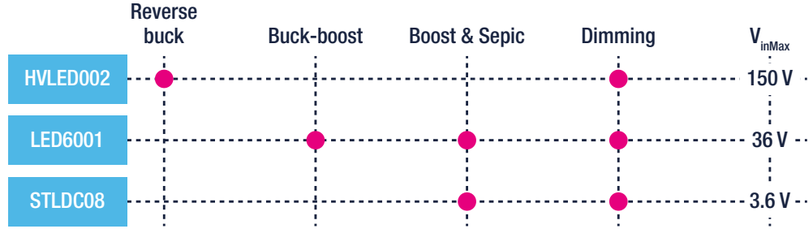
Note: * output power for European input voltage 230 Vac

DC-DC LED drivers

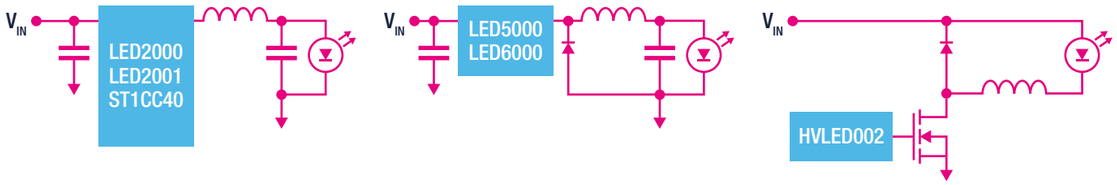
ST monolithic buck switching regulators offer input voltage capability up to 61 V and deliver output currents up to 4 A with high switching frequency. They enable simple, efficient, and cost-effective solutions for driving high-brightness LEDs. They also feature dedicated circuitry for dimming. Boost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

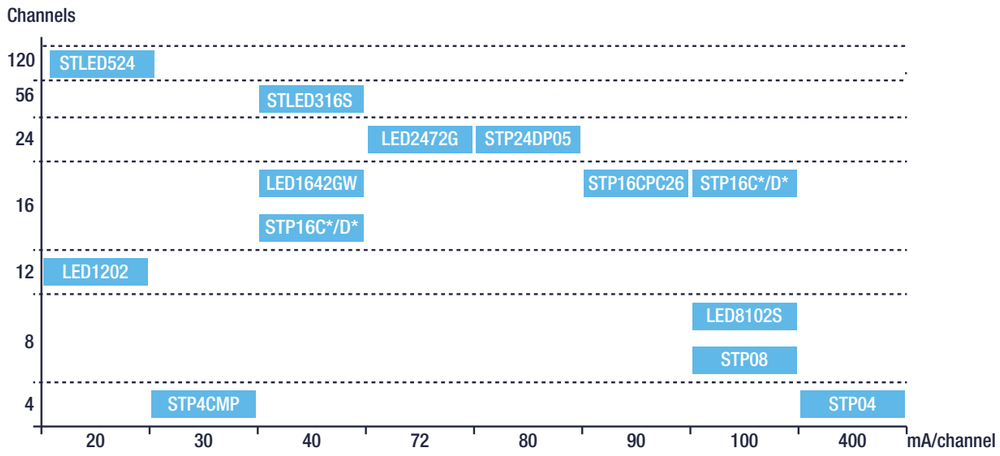
Emergency lighting
LED6001, ST1CC40

Commercial and architectural lighting
LED5000, LED6000, LED6001, HVLED002

www.st.com/led

LED array drivers

ST **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)

5x24 matrix drivers

- 20 mA/dot
- Adjustable luminance for each LED (dot)

12/16 channel drivers

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

4/8 channel drivers

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

16 digit, 56 LED matrix

- 40 mA current capability
- 16 key-scanning (8 x 2 matrix)
- 3-wire serial bus interface

MAIN APPLICATIONS

Traffic signals
LED8102S, LED2472G, STP24DP05, STP04

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

Home appliances
LED8102S, STP16, STP08, LED1642GW, STP4CMP, STLED524

Special lighting
STP04, LED1642GW, LED2472G, LED8102S

Smartphones / wearable
STLED524, LED1202

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

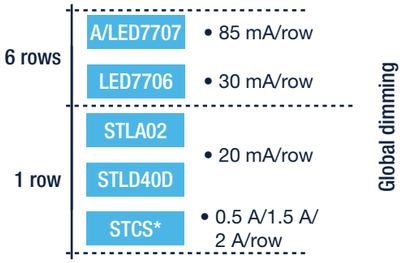
www.st.com/led

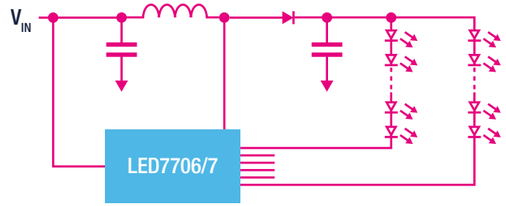
LED row drivers

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

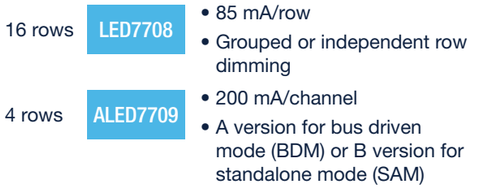
ST offers both single- and multi-channel high-efficiency boost LED drivers featuring a wide dimming range, low noise, and small footprint. They also embed protection functions such as overvoltage and overcurrent protection, thermal shutdown, and LED-array protection.

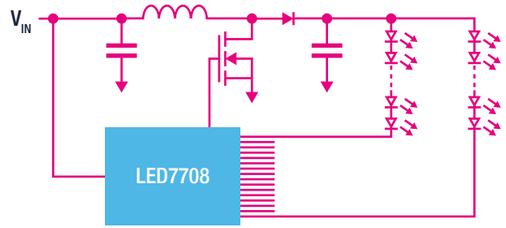
LED row driver converters





LED row driver controllers





MAIN APPLICATIONS

Smartphones
STLA02, STLD40D

Keyboard and accessories
STLA02*

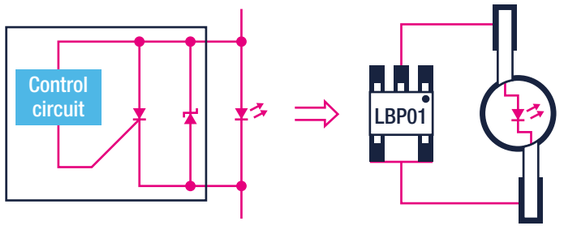
Home appliances and ATMs
LED7706, LED7707, LED7708, STCS*

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

www.st.com/led

LED bypass protection

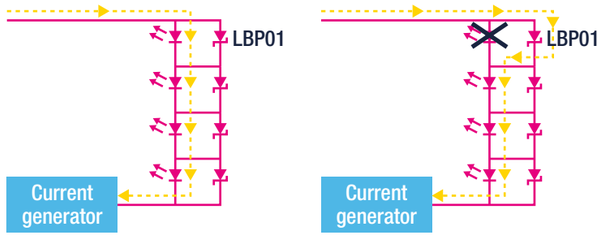
The **LBP01 series** of LED bypass protection devices are bypass switches that can be connected in parallel with 1 or 2 LEDs. In the event of an LED failure, this device shunts the current through other LEDs. It also provides overvoltage protection against surges as defined in IEC 61000-4-2 and IEC 61000-4-5



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 street lighting

Emergency lighting

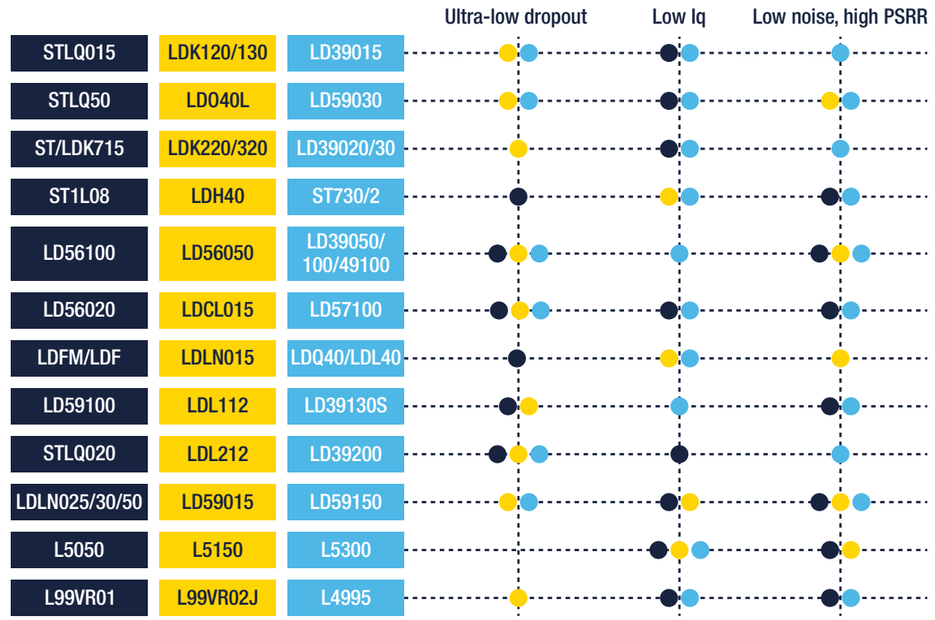
Traffic signals

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 ultralow 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). This is coupled with a range of the smallest form factor packages for size-conscious applications, such as a 0.47 x 0.47 mm STSTAMP package.

LDO



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, LD59015, LDLN025/30 /50, STLQ020, LD56030, LD56050, LD56100, LD57100, L99VR01, L99VR02J, LD56020

Healthcare
STLQ015, STLQ020, ST715, LD39130, LD56020

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

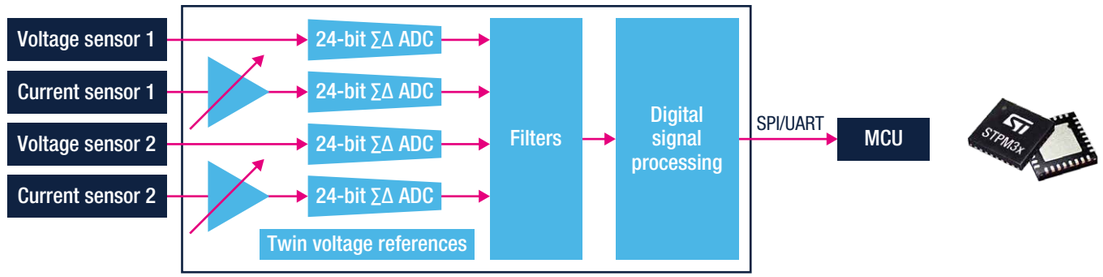
Automotive ADAS, ECU
LDK130, LD39100, LD59150, LDO40L, L5050, L5150, L99VR01, L99VR02J, L4995, L5300, LD49100

www.st.com/linear-regulators

METERING ICs

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

STPM34: 4 independent channels block diagram



KEY FEATURES

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

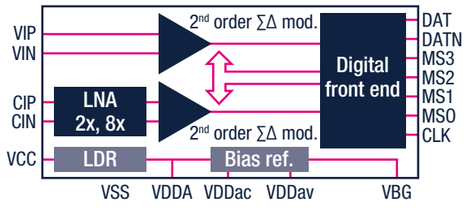
STPMS2

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

KEY FEATURES

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

STPMS2



MAIN APPLICATIONS

Energy metering · EV charging · Lighting · Smart plug · Servers power monitor · Solar charging

PHOTOVOLTAIC ICs

DC-DC converters with embedded MPPT algorithm

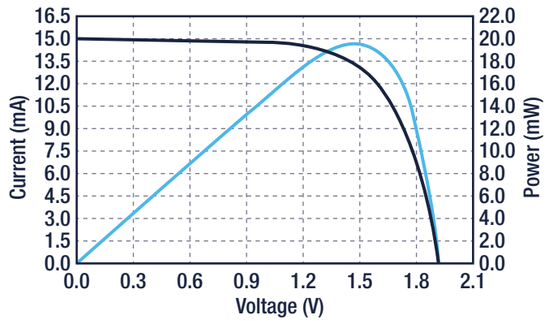
The maximum power point tracking (MPPT) algorithm maximizes the power output by photovoltaic panels according to temperature and solar irradiation conditions.

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.

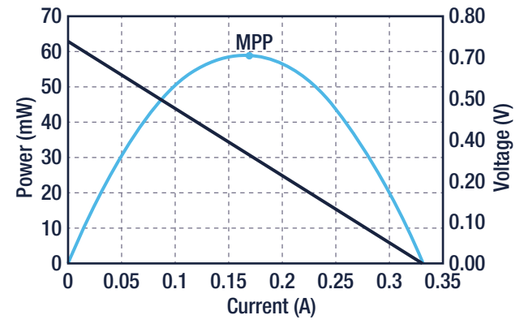
The SPV1050 is an ultra-low-power battery charger and energy harvester (from photovoltaic cells or thermo-electric generators) that guarantees a very fast charge of supercapacitors and any type of battery, including thin-film solid-state batteries. It is specifically designed to work in indoor environments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

		Input 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)	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

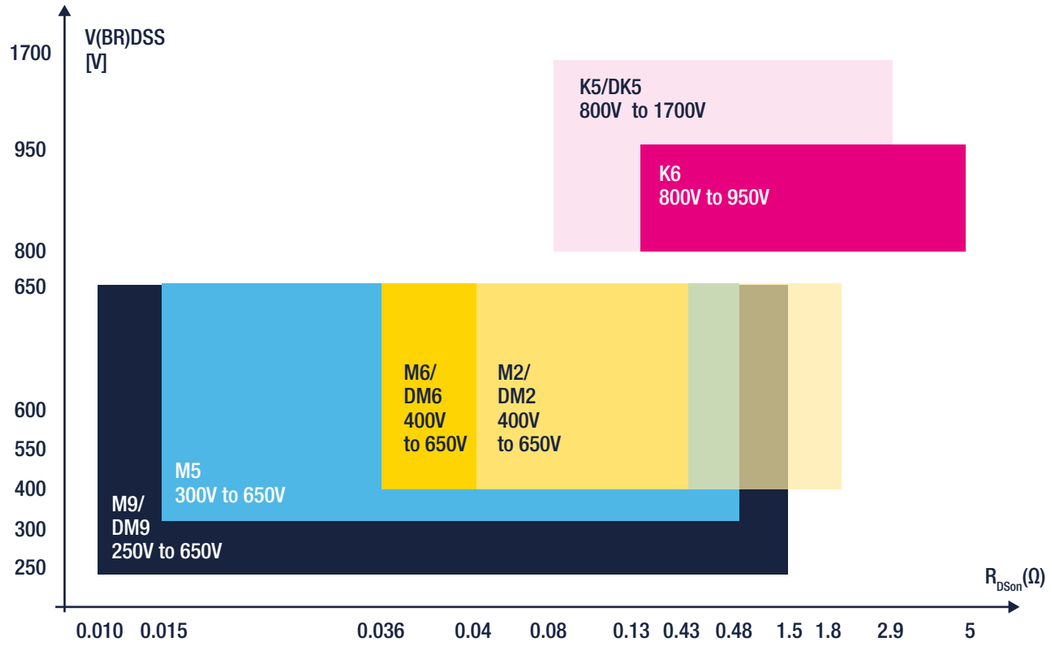
Note: * A CC-CV battery charger is needed to apply lithium batteries charging profile

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

POWER MOSFETs

High-voltage power MOSFETs

The ST **HV power MOSFETs** portfolio offers a broad range of breakdown voltages from 250 to 1700 V with low gate charge and low on-resistance, combined with state-of-the-art packaging. The **MDmesh** high-voltage MOSFET technology has enhanced power-handling capability, resulting in high-efficiency solutions. Supporting applications for a wide voltage range, such as switch mode power supplies, lighting, DC-DC converters, motor control, and automotive applications, ST has the right power MOSFET for your design.



M9 series

ST*N*M9

- Best figure of Merit ($R_{DS(on)}$ x Qg) on the market
- Industry's best $R_{DS(on)}$ for 650 V voltage range
- Lowest Qg
- Higher reverse diode dv/dt and MOSFET dv/dt ruggedness

M5 series

ST*N*M5

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

M6 series

ST*N*M6

- Lower $R_{DS(on)}$ 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

M2/M2-EP series

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

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

DM9 series

ST*N*DM9

- Best figure of Merit ($R_{DS(on)}$ x Qg) on the market
- Improved intrinsic diode reverse recovery time (trr)
- Higher dv/dt and di/dt capability
- Optimized body diode recovery phase and softness

DM6/DM2 series

ST*N*DM6 ST*N*DM2

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

K5 and K6 series

ST*N*K5/6

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

DK5 series

ST*N*DK5

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

MAIN APPLICATIONS

Adapters
K5, M5, M2, M2-EP, M6

Solar inverters, EV charging stations, energy storage systems and UPS
K5, M5, DM2, DM6, DK5

Welding, residential, commercial, and street lighting
K6, K5, DK5

Server/Telecoms
M9, M5, M6, M2, DM9, DM6, DM2

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

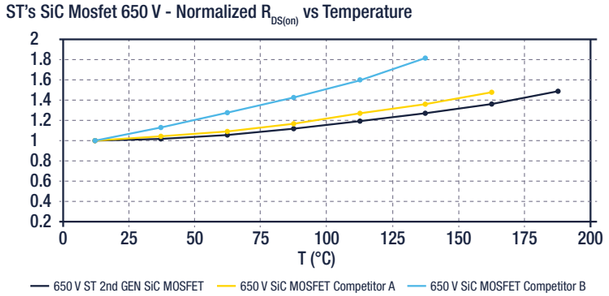
www.st.com/mosfet

SiC MOSFETs

Based on the advanced and innovative properties of wide-bandgap materials, ST **silicon carbide (SiC) MOSFETs** feature very low $R_{DS(on)}$ per area for the 650 V/1200 V Gen2 and the new Gen3 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 and minimal variation with the temperature. These features render the device perfectly suitable for high-efficiency and high-power-density applications.



Sic MOSFETS, the real breakthrough in high voltage switching

SCT*N120G3AG | SCT*N120G2 | SCT*N65G2 | SCT*N170 | SCT**65G3AG

- VBR = 1700 V (SCT*N170), 1200 V (SCT*N1203AG), 1200 V (SCT*N120G2), 650 V (SCT*N65G2), 650 V (SCT**65G3AG)
- 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)

STPOWER

SIC MOSFETS MAIN BENEFITS

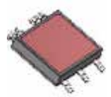
- Smaller form factor and higher power density
- Reduced size/cost of passive components
- Higher system efficiency
- Reduced cooling requirements and heatsink size

THROUGH-HOLE EXTENDED PACKAGE RANGE

HiP247 LL™

HiP247- 4L

SURFACE MOUNT EXTENDED PACKAGE RANGE



ACEPACK™ SMIT

POWER FLAT 8x8

Bare die business available upon customer request

HU3PAK

H2PAK-7

STPAK

MAIN APPLICATIONS

- Motor drive and factory automation
- HEVs / EVs (Traction inverter, OBC, DC-DC)
- Charging station
- UPS and data center power supply
- Solar inverters

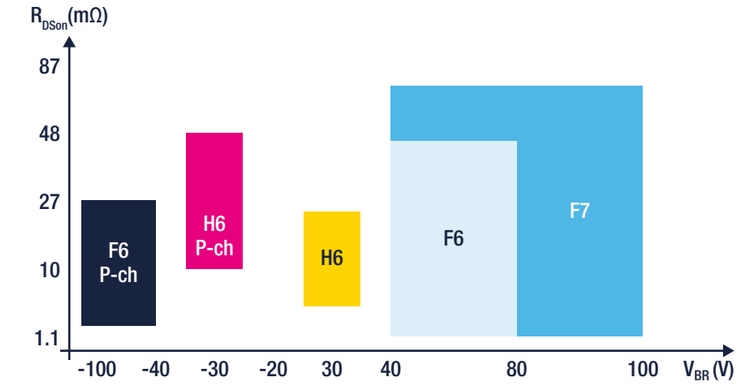
www.st.com/sicmos

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

Low-voltage power MOSFETs

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

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



H6 series

ST*N*H6

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

F6 series

ST*N*F6

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

F7 series

ST*N*F7

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

STPOWER

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

POWER MODULE – ACEPACK PACKAGES OPTIONS

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

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

ACEPACK 1
Up to 15 kW

ACEPACK 2
Up to 30 kW

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

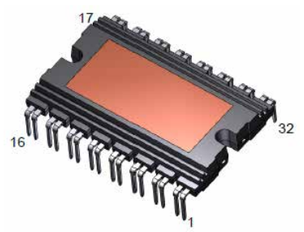
CONFIGURATIONS
- CIB
- Six-pack
- Three level t-type
- Four Pack
- Half brige
- Boost
- Customized configurations

ACEPACK DRIVE
120 kW to 300 kW

KEY FEATURES
- AMB substrate for enhanced thermal dissipation
- 3 different bus bar configuration options
- Extremely low energies dissipation
- Direct cooled Cu base plate with pin fins

CONFIGURATIONS
- Six-pack

ACEPACK DMT-32
up to 22 kW

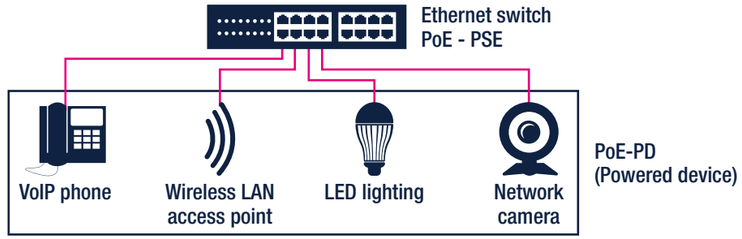


KEY FEATURES
- Designed for automotive applications
- Different DBC options (Al2O3–AlN)
- 2.5 kV insulation voltage
- SiC MOSFET, rectifiers
- Integrated NTC temperature sensor

CONFIGURATIONS
- Six-pack
- Four Pack
- Customized configurations

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 **PoE-PD ICs** are compliant with the more recent IEEE 802.3bt specification.



PoE-PD devices

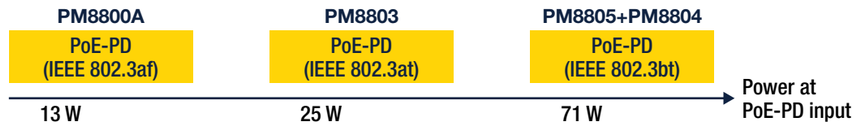
PM8803
- IEEE 802.3at PD interface
- PWM current mode controller with double gate driver
- Integrated 100 V, 0.45 W, 1 A hot-swap MOSFET
- Supports flyback, forward active clamp, and flyback with synchronous rectification topologies

PM8800A
- IEEE 802.3af PD interface
- PWM current mode controller
- Integrated 100 V, 0.5 W, 800 mA hot-swap MOSFET
- Supports both isolated and non-isolated topologies

PM8804
- PWM current mode controller
- Double gate driver
- Support isolated active Forward converter
- Input voltage up to 75 VDC
- Embedded start-up (20 mA)
- Slope compensation
- Programmable fixed frequency (up to 1 MHz)

PM8805
- IEEE 802.3bt PoE-PD interface
- System in Package
- Dual active bridges
- HotSwap MOSFET
- Compact package (10 times smaller than discrete BOM) with high thermal performances
- 100 W capability

Main standards



Power over Ethernet power supply protection

PEP01-5841
- Power supply protection compliant with IEC61000-4-5 level 2: 1 kV
- Allow to use 100 V power MOSFET
- Stand off voltage: 58 V
- Surface mount SO-8 package

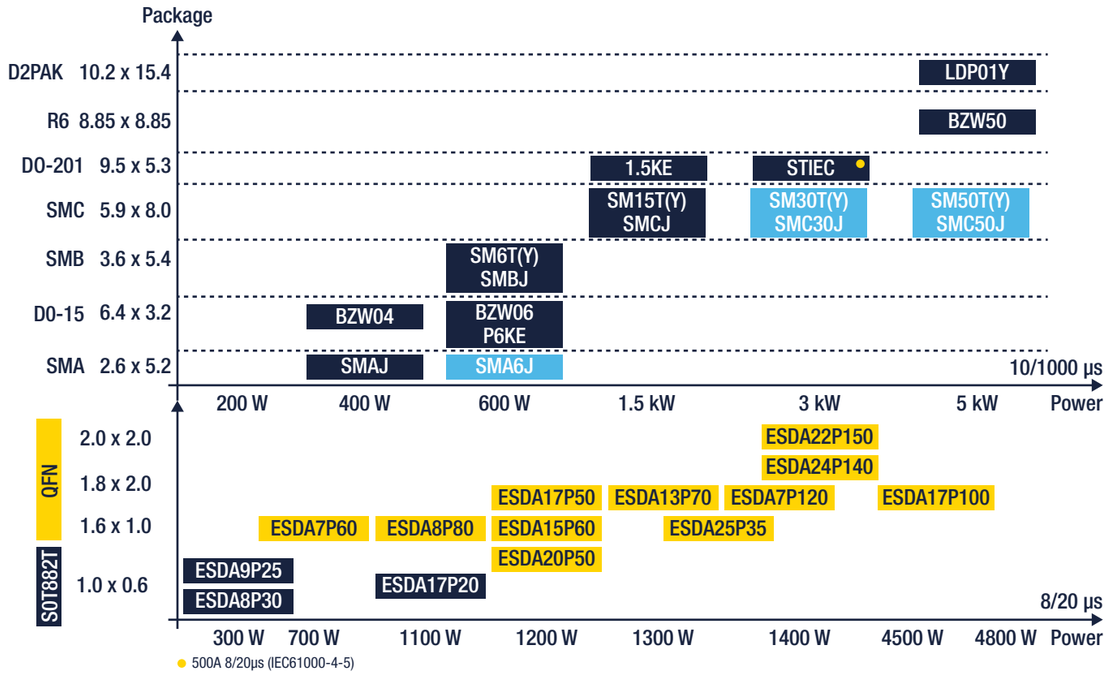
www.st.com/PoE

PROTECTION DEVICES

TVS

The **TVS transient voltage suppressor** is an avalanche diode designed to clamp over-voltages and dissipate high transient energy. TVS are power devices to protect applications against electrical over-stress (EOS), specifically against surge events as defined by IEC 61000-4-5.

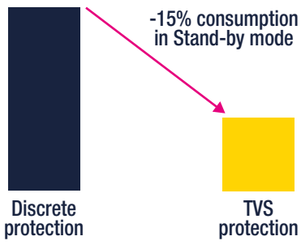
A large choice of package is available to meet application requirements.



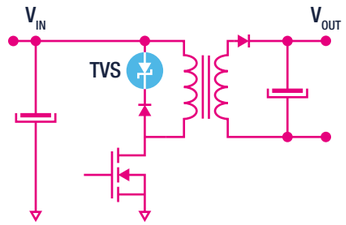
TVS Transil series against repetitive overvoltage in high temperature conditions

TVS

- Clamping voltage characteristics defined at 25 °C, 85 °C and 125 °C
- Stand-off voltage range: from 85 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

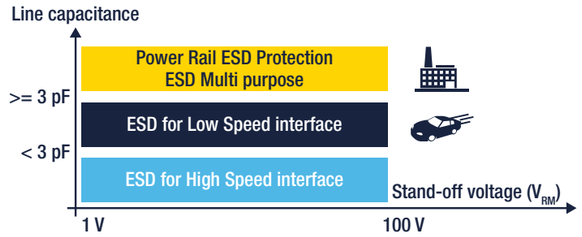
Adapters · Smart metering · Solar inverters · Residential, commercial, architectural, and street lighting

www.st.com/eos8-20-protection

ESD protection

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

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



Power delivery protections

Ultimate TVS protection for USB fast-charging ports

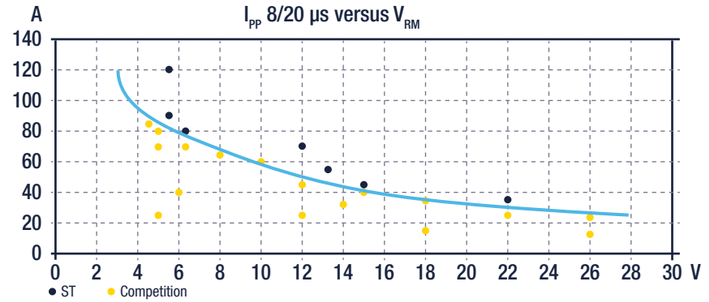
ESDAxxP

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

KEY FEATURES AND BENEFITS

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

Peak pulse current performance



Type	STM32	Pins	5 V - 15 W	9 - 27 W	15 - 45 W	20 V - 100 W
All	With or without STM32	D+/D-	ESDAXLC5-1U2	ESDAXLC5-1U2	ESDAXLC5-1U2	ESDAXLC5-1U2
		SSRx/SSTx	ESDARF02-1BU2CK	ESDARF02-1BU2CK	ESDARF02-1BU2CK	ESDARF02-1BU2CK
		CC1/CC2	ESDZV5-1BF4	ESDALC14-1BF4	ESDZV18-1BF4	ESDZV201-1BF4 ESDL20-1BF4
		SBU1/SBU1	ESDA6V1L	ESDA14V2L	ESDA25L	ESDA25L
		Vbus	ESDA7P60-1U1M ESDA7P120-1U1M ESDA8P30-1T2 ESDA8P80-1U1M ESDA9P25-1T2 SMAJ6.0A	ESDA13P70-1U1M ESDA15P60-1U1M SMAJ10A	ESDA17P20-1F2 ESDA17P50-1U1M ESDA17P100-1U2M SMAJ18A	ESDA22P150-1U3M ESDA24P140-1U3M ESDA25P35-1U1M SMAJ22A
Sink	Yes	TCPP01-M12				
Source		TCPP02-M18				
DRP		TCPP03-M20				

Note: 1 available in Q4 2021

MAIN APPLICATIONS

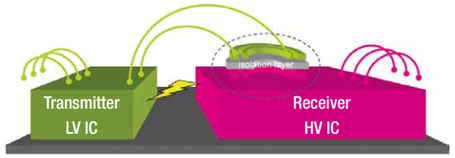
Tablets, smartphones, and digital cameras · Healthcare · I/O microcontrollers and signal conditioning · Factory automation human machine interface (HMI) · Smart metering · SIM cards, Ethernet, and HDMI/DVI ports

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

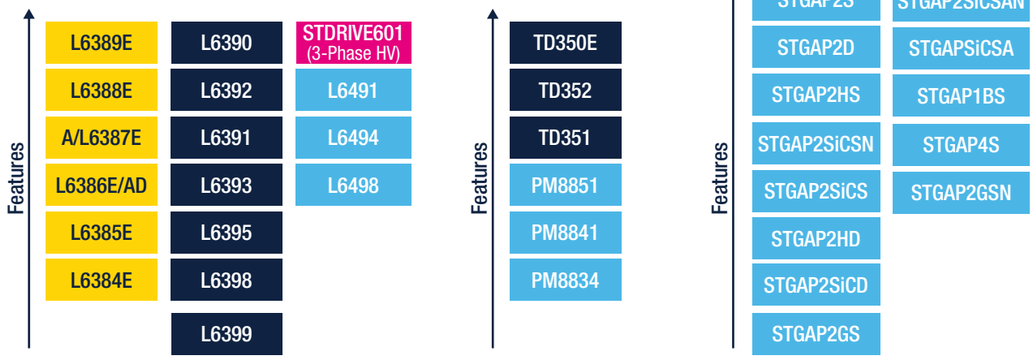
www.st.com/esd-protection

STDRIVE AND STGAP GATE DRIVERS

ST **power MOSFETs and IGBTs gate drivers** include integrated high-voltage half-bridge, single and multiple low-voltage gate drivers. Robustness and reliability, system integration and flexibility. The STGAP series of isolated gate drivers provides galvanic isolation between the input section, which connects to the control part of the system and the MOSFET or IGBT being driven.



STGAP2HS - 6 kV isolation



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 drivers

- Up to 6 kV isolation
- High voltage rail up to 1.7 kV
- Up to 5 A source/sink driver current capability
- 2 Level turn-off (STGAP1B)
- Miller clamp, negative gate supply
- Optimized for SiC and for GaN HEMT (STGAP2GSN, STGAP2GS) MOSFET driving (STGAP2SiCS)

STDRIVEG600 - high voltage half-bridge gate driver for GaN transistors

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

www.st.com/stdrive

MAIN APPLICATIONS

THYRISTORS

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

Automotive Grade SCR AECQ101 qualified

- **TN3050H-12** 30 A, 1200 V
- **TN4050H-12** 40 A, 1200 V
- **TN6050HP-12** 60 A, 1200 V

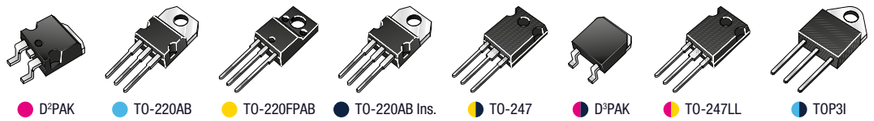
Medium Power SCR

- **TN4050-12** 50 A, 1200 V
- **TN6050-12** 50 A, 1200 V
- **TM8050H-8** 80 A, 800 V

High Temperature SCR

- **TN1205H-6** 12 A, 600 V
- **TN1605H-8** 16A, 800V
- **TN2010H-6** **TN2015H-6** 20 A, 600 V
- **TN3015H-6** 30 A, 600 V
- **TN4015H-6** 40 A, 600 V
- **TN5015H-6** 50 A, 600 V

12 16 20 30 40 50 60 80 SCR I_{TRMS} (A)



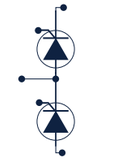
D²PAK · TO-220AB · TO-220FPAB · TO-220AB Ins. · TO-247 · D³PAK · TO-247LL · TOP3I

MAIN APPLICATIONS

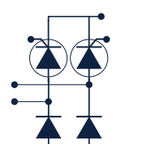
AC-DC conversion SMPS and PSU · UPS · EV on-board charger · Motor control

1200 V high temperature SCRs are now available in Surface Mount packages with top-cooled capability. In discrete package with HU3PAK or in module integration with ACEPACK SMIT package, these products are suitable in all bridge or bridgeless AC-DC converter topologies, where compactness and thermal performances are optimized. Thanks to 150 °C maximum junction temperature, the **1200 V high temperature SCRs** are suitable for industrial and automotive applications in harsh environments.

TN4050HP-12xY
HU3PAK



STTN6050H-12M1Y
ACEPACK SMIT



STTD6050H-12M2Y
ACEPACK SMIT

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

Part number	Package				I_T (RMS) A max	T_j °C max	V_{DRM}/V_{RRM} V max	I_{GT} mA max	I_{TSM} A max	dV/dt V/µs @ 150 °C min	(dI/dt)c A/ms @ 10 V/µs, @ 150 °C min
	TO-220AB	TO-220AB Ins.	D²PAK	TOP3 Ins							
T835H-8	T	I	G		8	150	800	35	80	2000	8
T1235H-8	T	I	G		12				120		12
T1635H-8	T	I	G		16				160		16
T2035H-8	T		G		20				200		20
T3035H-8	T	I	G		30				270		25
T5035H-8				PI	50				500		40

MAIN APPLICATIONS

Home appliances · Air conditioning · Lighting · Heating

USB TYPE-C® AND POWER DELIVERY CONTROLLERS

With an extensive technology and IPs portfolio, ST provide a range of **USB-IF certified solutions for USB Type-C and power delivery** to support implementations in a variety of sink, source, and dual role devices. From USB Type-C interfaces and PD controllers to authentication, ST complements the portfolio with power management ICs, full range of **protection** for data, and power line protection. ST solutions range from **Type-C port interface ICs** to **USB PD controllers** and offer wide flexibility with hard wired and MCUs to fit different use cases and all power ratings.

Standalone solutions

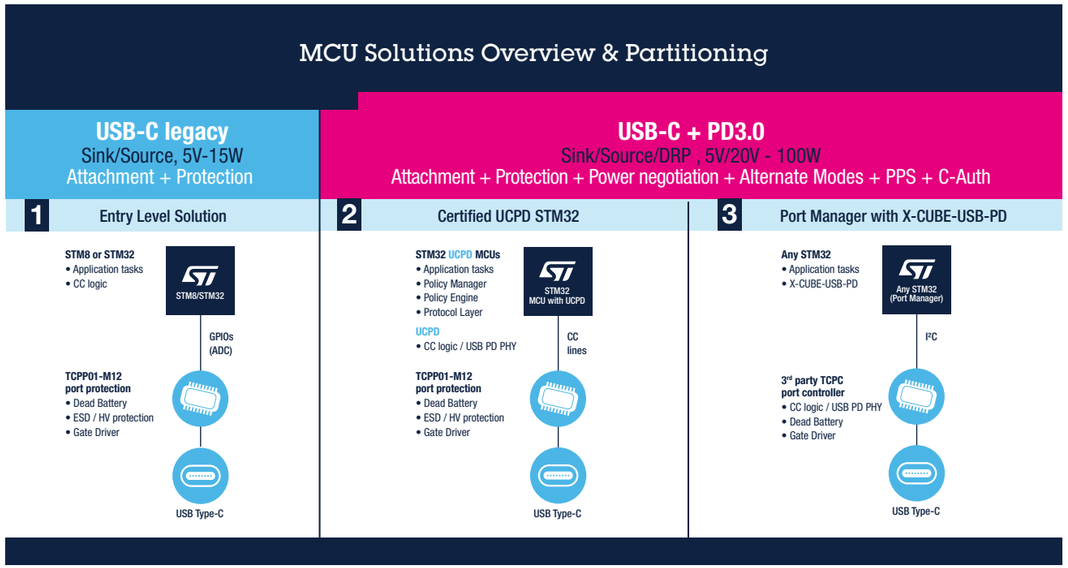
STUSB controllers cover power path applications with optimized partitioning from USB Type-C® interface for 15 W device to power delivery PHY and BMC driver IC companion chip of STM32-based solutions to standalone full hardware USB PD controller optimized for AC adapters up to 100 W.

MCU-based solutions

Our STM32 solutions help you manage the complexity of implementing USB Type-C® and power delivery technology to ensure that your embedded application supports the latest use cases. The ST ecosystem for USB Type-C reduces the acquisition cost of a technology that requires multiple areas of expertise, such as connectivity, power management, data communication, and authentication.

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

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

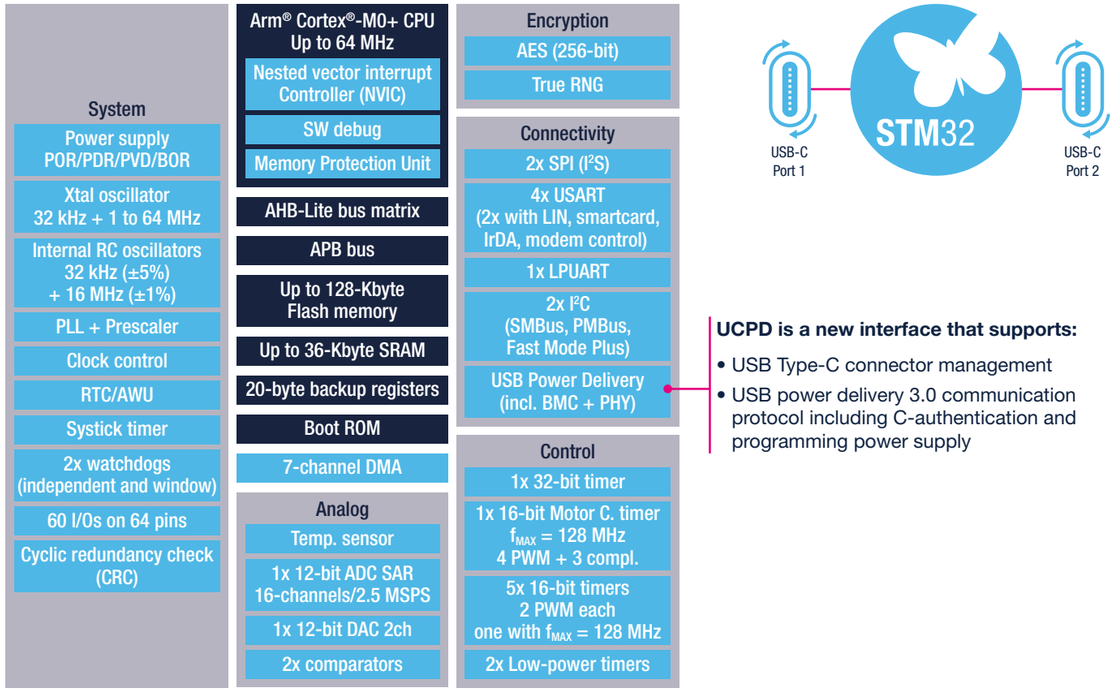


STM32 USB PD3.0 controllers

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 development of 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 environments thanks to the versatile feature set and peripherals available in a traditional MCU. UCPD is certified PD3.0 and supports all new features such as C-Authentication and programming power supply (PPS).

https://www.st.com/content/st_com/en/stm32-usb-c.html

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 enables discovery and display of 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 customers to debug, configure, and inject USB PD3.0 packets in a single click while monitoring Vbus voltage and Ibus current between two USB-C devices.
Our well-known STM32 configurator STM32CubeMx supports easy setting of UCPD.
An STM32G081B-eval evaluation board is proposed with two USB-C ports offering 45 W of power with different profiles.

Discover and lean

STM32G071B-DISCO

Develop

NUCLEO-G071RB

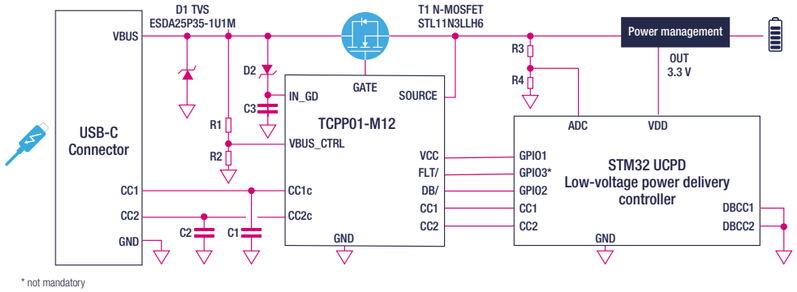
STM32G081B-EVAL

Configure and Debug

STM32 CubeMX STM32 CubeMonitor-UCPD

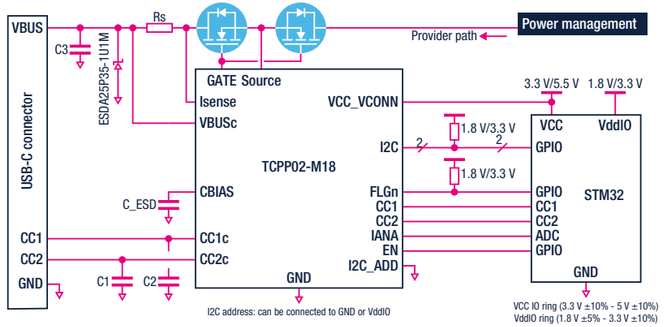
STM32 USB power delivery controller-based solutions

SINK

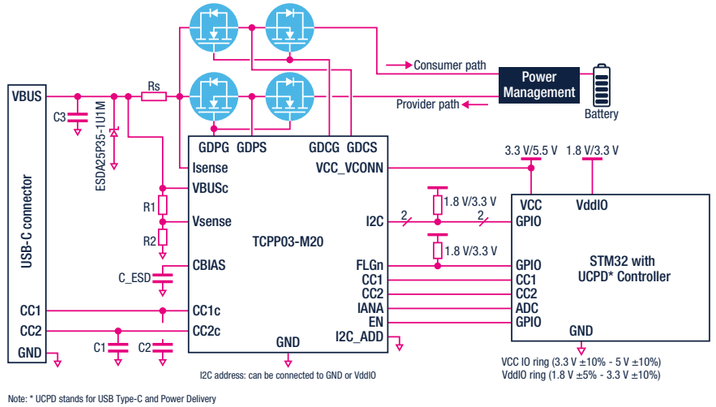


* not mandatory

SOURCE



DUAL ROLE



Note: * UCPD stands for USB Type-C and Power Delivery

KEY FEATURES

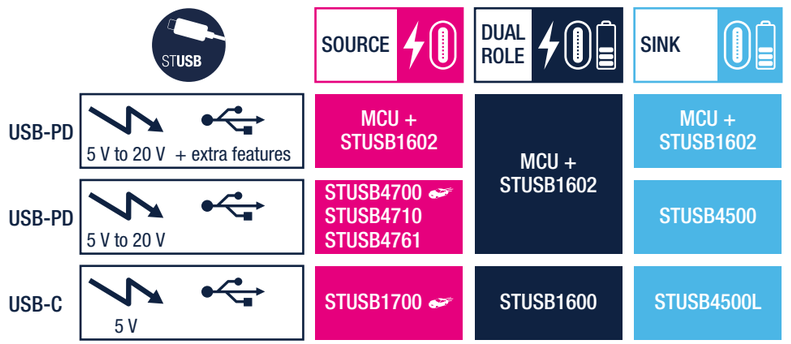
- USB-C power delivery standard 3.1, standard power range (SPR) up to 100 W
- USB-IF certified on X-NUCLEO boards
- Embedded gate drivers for N-MOSFET on consumer and provider paths
- 24 V tolerant on VBUS and CC pins
- Integrated discharge on VBUS and VCONN
- Overvoltage protection on CC lines against short-to-VBUS
- VBUS current sense analog output through amplifier
- 100 mW OCP and 6 V OVP on VCONN
- Integrated “dead battery” management
- Over temperature protection (150 °C typ.)
- I2C communication with two I2C addresses available
- IEC 61000-4-2 level 4 on CC1 and CC2 pins:
  - ±8 kV contact discharge
  - ±15 kV air discharge
- ECOPACK2, and RoHS compliant UL94, V0 molding compound
- Cost-effective solutions for driving USB-C PD when the application uses a microcontroller.

ST PROTECT

LONGEVITY 10 YEARS COMMITMENT

STUSB family of standalone (auto-run) USB-C and power delivery controllers

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



STUSB controllers: Main common functions

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

STUSB47xx

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

STUSB1700

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

STUSB1602

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

STUSB1600

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

STUSB4500

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

STUSB4500L

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

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