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

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

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

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

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

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

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

ENERGY GENERATION AND DISTRIBUTION

Solar Centralized Generation - Solar Inverters (String and Central)

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

We offer a broad range of silicon-carbide (SiC) power MOSFETs - with the industry's highest operating junction temperature -600 V-650 V MDmesh DM6, 600 V-650 V MDmesh DM2, 600 V V series STV*120DF3, STV*120DF2, STV*120DF1 and STV*120DF0. The latest 1200 V H series STG*H65DFB2, STG*H65DFO. We also offer a variety of SiC MOSFETs STC*N65G2, SCT*N120, ST*60DM6, ST*65DM6, ST*60DM2, ST*65DM2.

ST’s product offering for String and Central Solar Inverter

Typical Block Diagram for Central Inverter

Typical Block Diagram for String Inverter

ST's product offering for String and Central Solar Inverter

<table>
<thead>
<tr>
<th>Power MOSFETs</th>
<th>Power Modules</th>
<th>Diodes &amp; Disconnect</th>
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<tbody>
<tr>
<td>600 V-650 V VDMesh DMK, STV<em>120DF3, STV</em>120DF2, STV<em>120DF1, STV</em>120DF0</td>
<td>A6PACK Power Modules STP500, STP1000, STP1500</td>
<td>600 V Ultrafast STTP06, STTP08, STTP10</td>
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<tr>
<td>600 V VDMesh DMZ, STV<em>60DF2, STV</em>60DF1, STV*60DF0</td>
<td>A7F5000DM2, A7F2500DM2, A7F5120DM2, A7F5120DM1, A7F3120DM1, A7F3120DM0</td>
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<tr>
<td>600 V VDMesh DMW, STV<em>60DF2, STV</em>60DF1, STV*60DF0</td>
<td>A7F5000DM2, A7F2500DM2, A7F5120DM2, A7F5120DM1, A7F3120DM1, A7F3120DM0</td>
<td>100 V Power Schottky STF10100</td>
</tr>
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Inverter Power Stage DC-DC and DC-AC

<table>
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Inverter Driving & Control stage

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Data Logger/Internet Gateway

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Solar Tracker

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</tbody>
</table>
Solar Distributed Generation - Microinverter

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

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

### ST's product offering for Microinverter

<table>
<thead>
<tr>
<th>Microinverter Power Stage</th>
<th>Diodes</th>
<th>Protections</th>
<th>Signal Conditioning</th>
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</thead>
<tbody>
<tr>
<td>Solar Distributed Generation - Microinverter</td>
<td>600 V Ultrafast ST7H*1056</td>
<td>ST7H*1056</td>
<td>TVS for Power MOSFET and Power Rail Surge Protection (SMAF, SNAF, SMI15F series)</td>
</tr>
<tr>
<td>Solar Distributed Generation - Microinverter</td>
<td>1200 V Ultrafast ST7H*12</td>
<td>TVS for Power Rail Surge Protection (SMAF, SNAF, SMI15F series)</td>
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</tr>
<tr>
<td>Solar Distributed Generation - Microinverter</td>
<td>100 V Power Schottky STPS1*100</td>
<td>TVS for Power Rail Surge Protection (SMAF, SNAF, SMI15F series)</td>
<td></td>
</tr>
</tbody>
</table>

**Typical Block Diagram**

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 1-V point which ensures maximum power generation. This results in an improved energy yield of the overall solar system compared to traditional string or central inverter based architectures.

Power optimizers can help minimize a system’s design constraints as well as improve reliability and safety – by helping ensure compliance with the latest NEC 2017 regulations that require rapid shut-down in the event of grid disconnection, while at the same time reducing maintenance costs. We provide high-performance STM32 microcontrollers as well as high-efficiency STripFET F7 LV Power MOSFETs, Diodes, SiC MOSFETs and trench-gate field-stop IGBTs, galvanically-isolated gate drivers and power line communication solutions to help achieve superior efficiency and reliability for power optimizer based architectures.

### ST's product offering for Power Optimizer

<table>
<thead>
<tr>
<th>Power Optimizer</th>
<th>MCUs</th>
<th>Power MOSFETs</th>
<th>Gate Drivers</th>
<th>By Pass (Gates)</th>
<th>SoC</th>
<th>Protections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Distributed Generation - Power Optimizer</td>
<td>STM32F0</td>
<td>STPSC*H12</td>
<td>STM32F0</td>
<td>45 V</td>
<td>STM32F0</td>
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<tr>
<td>Solar Distributed Generation - Power Optimizer</td>
<td>STM32F2</td>
<td>STPSC*065</td>
<td>STM32F2</td>
<td>45 V</td>
<td>STM32F2</td>
<td></td>
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<tr>
<td>Solar Distributed Generation - Power Optimizer</td>
<td>STM32F3</td>
<td>STPSC*H65DFB</td>
<td>STM32F3</td>
<td>45 V</td>
<td>STM32F3</td>
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<tr>
<td>Solar Distributed Generation - Power Optimizer</td>
<td>STM32F4</td>
<td>STPSC*H120DF2</td>
<td>STM32F4</td>
<td>45 V</td>
<td>STM32F4</td>
<td></td>
</tr>
</tbody>
</table>

**Typical Block Diagram**
Energy Distribution - Home & Commercial Battery Storage Systems

The adoption of energy storage devices, whose reserve capacity can be used for balancing purposes, peak-load shaving or to shift loads, is increasingly widespread in energy distribution networks. Two use cases are particularly important: the use in residential or commercial buildings to help reduce consumers’ electricity bills by helping develop high-efficiency commercial battery storage systems.

- **Two use cases are particularly important:**
  1. **Residential or Commercial Building Use Case:** Helps reduce consumers’ electricity bills by charging schedules of the increasing number of electric vehicles (EV).
  2. **Commercial Building Use Case:** Balancing purposes, peak-load shaving or to shift loads, is increasingly widespread in energy distribution networks.

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

- **PV panels**
- **Power Conditioning**
- **Temperature Sensors**
- **Remote Monitoring**
- **Internet Access**

**Typical Block Diagram - Home Battery Storage System**

- **Battery Bank**
- **Combiner Box**
- **String Box**
- **MOS/IGBT Drivers**
- **Drivers**
- **Diodes**
- **Connectivity**
- **MCUs**
- **Signal Conditioning**
- **EPROM**
- **Sensors**
- **Protection Devices**
- **Aux PS**
- **Data Logger / Internet Gateway**
- **ST's product offering for Home & Commercial Battery Storage Systems**

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

- **Power MOSFETs**
- **IGBTs**
- **Power Modules**
- **MOSFET and IGBT Gate Drivers**
- **Diodes & Discretes**

**MOSFETs and IGBTs**

- **STG*M120DF3**
- **STG*M65DF2**
- **STG*V60DF**
- **STG*10F7**
- **STG*105K5, STG*120K5**

**IGBTs**

- **STG*H65DFB2**
- **STG*H120DF2**
- **STG*60DF**
- **STG*06F7**
- **STG*60M6, STG*65M6**

**Power Modules**

- **A1P15512MS, A1P15512MS**
- **A1P15512MS, A1P15512MS**
- **A1P15512MS, A1P15512MS**
- **A1P15512MS, A1P15512MS**
- **A1P15512MS, A1P15512MS**

**Diodes & Discretes**

- **STZ*, TSV*, TS9*, LMV***
- **ST*N4F7, ST*N6F7, ST*N8F7**
- **600 V-650 V MDmesh DM2**
- **600 V-650 V MDmesh M6**
- **ST*60DM6, ST*65DM6**

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

**Typical Block Diagram - Commercial Battery Storage System**

- **DC-DC Converter**
- **Power MOSFETs**
- **IGBTs**
- **Power Modules**
- **MOSFET and IGBT Gate Drivers**
- **Diodes & Discretes**

**Power Modules**

- **A1P15512MS, A1P15512MS**
- **A1P15512MS, A1P15512MS**
- **A1P15512MS, A1P15512MS**
- **A1P15512MS, A1P15512MS**
- **A1P15512MS, A1P15512MS**

**MOSFET and IGBT Gate Drivers**

- **A1P15512MS, A1P15512MS**
- **A1P15512MS, A1P15512MS**
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POWER SUPPLIES

Auxiliary SMPS

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

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

Isolated Auxiliary SMPS

In the power range up to 20 W, ST helps the designers of high-power-density and cost-effective isolated auxiliary power supplies with higher switching frequencies solutions to minimize transformer and output capacitor size. The power stage is managed by an off-line controller coupled with HV power MOSFETs.

ST’s recommended products for Isolated Auxiliary SMPS

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

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

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

ST’s recommended products for Non-Isolated Auxiliary SMPS

- Typical configurations for Non-Isolated Auxiliary Power Supply
- Main application boards

Note: * is used as a wildcard character for related part number
### Smart Chargers and Adapters

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

The new slim and reversible USB Type-C™ connector with USB Power Delivery (PD) feature provides up to 100 W (20 V, 5 A) and more enabling a faster and more efficient charging solution. Having considerably expanded the capability of USB devices, these connectors are now widely found in wall chargers and adapters. Designers of USB Type-C™ and Power Delivery compliant adapters and wall chargers can benefit from the MasterGaN series, an advanced power system-in-package integrating a gate driver and two e-mode GaN transistors in half-bridge configuration, from stand-alone controllers, from STMicroelectronics microcontrollers and their associated protocol stack, our STSAFE secure element as well as a specifically developed range of protection and filtering devices.

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

<table>
<thead>
<tr>
<th>Type-C and USB-PD Controllers</th>
<th>Power Stage Primary Side</th>
<th>Power Stage Secondary Side</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Controller</strong></td>
<td><strong>Isolated Smart GaNs</strong></td>
<td><strong>LV MOSFETs</strong></td>
</tr>
<tr>
<td>PFC</td>
<td>STUSB1600</td>
<td>Protected</td>
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<tr>
<td><strong>Secondary Controller</strong></td>
<td><strong>LV MOSFETs</strong></td>
<td></td>
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<tr>
<td>STUSB4500L</td>
<td>Protected</td>
<td></td>
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<tr>
<td>STUSB4500</td>
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<tr>
<td>STSAFE-A</td>
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</tbody>
</table>

**Programmable Solutions**

- **MCUs**
  - STM32D5, STM32D4, STM32L5
  - STUSB1800
  - STUSB1800
- **Type-C Controller/Interface**
  - STUSB4700
  - STUSB4710
  - STUSB4761

**Applications**

- **Type-C Power Delivery 3.0 adapter reference design with certified standalone controller**
  - EVAL-SCS001V1
  - EVAL-SCS002V1
  - EVAL-SCS003V1

**Typical configuration**

**Primary Controller**

- Integrated Smart GaNs
- HV MOSFETs
- Diodes

**Secondary Controller**

- Integrated Smart GaNs
- HV MOSFETs
- Diodes

**Protection**

- USB Power Delivery Controller
- USB Type-C™ Interface (PHY)
- VBusinals and VBus signals
- Load switch

**Main application boards and reference designs**

- **EVALMASTERGAN**
  - STEVAL-ISC004V1
  - STEVAL-ISC005V1
  - STEVAL-ISC006V1
- **EVALSTCH03-45WPD**
  - STEVAL-SCS002V1
  - STEVAL-SCS003V1
- **STEVAL-USBP027S**
  - STEVAL-SCS004V1
  - STEVAL-SCS005V1
- **X-NUCLEO-SRC1M1**
  - STEVAL-SCS006V1
  - STEVAL-SCS007V1
- **X-NUCLEO-SNK1M1**
  - STEVAL-SCS008V1
  - STEVAL-SCS009V1

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

Note: 1 available in Q4 2021

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**Typical block diagram with Certified Source and Sink Standalone Controllers**

- **Source port**
  - USB Type-C™ receptacle
  - DC/DC
  - SRC path
  - Vbus path
  - Power supply

- **Sink port (high power up to 100 W (20 Vbus))**
  - USB Type-C™ receptacle
  - Vbus path
  - Sink port

**Main application boards and reference designs**

- **STUSB4710A USB Power Delivery evaluation board**
  - STEVAL-ISC004V1
  - STEVAL-ISC005V1
  - STEVAL-ISC006V1
- **USBCP01-M12**
  - USBCP02-M18
  - USBCP03-M20
- **TCPP01-M12**
  - TCPP02-M18
  - TCPP03-M20

**Power Supply**

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

**Consumer device**

- Standalone controller
- USB Type-C Power Delivery Dual Role Power expansion board based on TOPV03-M12

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**Note:**

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

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  - Vbus path
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- **Sink port (high power up to 100 W (20 Vbus))**
  - USB Type-C™ receptacle
  - Vbus path
  - Sink port

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- **STUSB4710A USB Power Delivery evaluation board**
  - STEVAL-ISC004V1
  - STEVAL-ISC005V1
  - STEVAL-ISC006V1
- **USBCP01-M12**
  - USBCP02-M18
  - USBCP03-M20
- **TCPP01-M12**
  - TCPP02-M18
  - TCPP03-M20

**Power Supply**

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

**Consumer device**

- Standalone controller
- USB Type-C Power Delivery Dual Role Power expansion board based on TOPV03-M12

**Note:**

- * is used as a wildcard character for related part number
- 1 available in Q4 2021
Adapters for Tablets, Notebook and All-in-One (AIO) Computers

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

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

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

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

#### Power MOSFETs

- **600 V-650 V**
  - MDmesh M2
    - ST165M2, ST165M2, ST166M2-EP
  - MDmesh M6
    - ST65M6, ST65M6, ST65M6-EP
  - MDmesh M5
    - ST65M5

- **600 V-650 V**
  - Ultrafast
    - ST60F7, ST65F7, ST65F7-EP
  - Ultrafast
    - ST60M6, ST60M6-EP

- **600 V-650 V**
  - MasterGan
    - ST60M5
  - VIPer
    - VIPer0, VIPer222, VIPer222
  - SRK
    - SRK2000A, SRK2001, SRK2001A

- **12 V-150 W**
  - CC-MOSFET
    - STTH*L06, STTH*06, STTH15AC06*

- **19 V-90 W**
  - PFC and HB LLC digital combo controller
    - TM PFC and HB LLC digital combo controller
  - EVLCMB1-AIO210W

- **12 V-400 W**
  - PFC and LLC digital combo controller
    - TM PFC and HB LLC digital combo controller
  - EVLCMB1-400W

#### Isolation Stage

- **Flyback Controllers**
  - Flyback Controllers
    - Flyback Controllers
    - Flyback Controllers
  - Flyback Controllers
  - Flyback Controllers
  - Flyback Controllers

- **MOSFET Protection**
  - MOSFET Protection
  - MOSFET Protection
  - MOSFET Protection

- **DC-DC Converters**
  - DC-DC Converters
  - DC-DC Converters
  - DC-DC Converters

- **Voltage Reference**
  - Voltage Reference
  - Voltage Reference
  - Voltage Reference

- **Low Dropout (LDO)**
  - Low Dropout (LDO)
  - Low Dropout (LDO)

- **Linear Regulators**
  - Linear Regulators
  - Linear Regulators

- **Analog/Digital combo controller**
  - Analog/Digital combo controller
  - Analog/Digital combo controller

- **Alternative to LLC Converter**
  - Alternative to LLC Converter
  - Alternative to LLC Converter

#### Application boards and reference designs

- **EVL100W-009**
  - 10 V - 90 W adapter based on TM PFC and LLC analog controller
  - EVL100W-009

- **EVLSTN100G011-150**
  - 12 V - 150 W power supply based on TM PFC and LLC analog controller
  - EVLSTN100G011-150

- **EVL300W-0010**
  - 12 V - 100 W adapter based on TM PFC and LLC analog controller
  - EVL300W-0010

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

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

**AEK-PDW-L964V1**

**AEK-MCU-C4MLIT1**

**AEK-USB-2TYPEC1**
Wireless Charging

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

In a wireless battery charging system, power is transferred by electromagnetic induction (inductive power transfer) between a transmitting pad (TX) and the battery powered device (RX), such as a smartphone, smartwatch, or sports watch. The power transmitter unit controls the current in the transmitting coil to transfer the correct amount of power as required by the receiver unit that continuously provides this information to the transmitter by modulating the transmitter carrier frequency through controlled resistive or capacitive load insertion. Generating the correct amount of power guarantees the highest level of end-to-end efficiency and helps limit the device’s operating temperature.

ST has a wide range of wireless charger IC solutions including transmitters and receivers providing low stand-by power, accurate foreign objects detection (FOD) and reverse charging features. Moreover, easy to use reference designs and evaluation boards enables customization with ST Super Charge protocol for personal electronics, chargers that are Qi compliant for both Baseline Power Profile (BPP) and Extended Power Profile (EPP). In order to prevent unwanted damage to any NFC ST has a wide range of wireless charger IC solutions including transmitters and receivers providing low stand-by power, of end-to-end energy efficiency and helps limit the device’s operating temperature.

ST’s recommended products for Wireless Charging

- **Transmitters**
  - STWLC68
  - STWLC88
  - STB30F4, BAR46
- **Secondary Coils**
  - ST25R3911B
  - ST25R3912
  - ST25R3916

ST’s recommended products for Desktop PC’s Power Supply

The requirements for the standard ATX PC power market are a small form factor with better performance. An intelligent control scheme that enables the adaption of load variation to minimize power consumption, together with optimized power semiconductors, is the key in meeting market demands. The smart analog and digital controllers, such as the STCRM1 and the STN8RG011, the high-voltage MDmesh™ Power MOSFETs used for the PFC and DC-DC stages, the low-voltage STripFET Power MOSFETs for synchronous rectification, and SiC MOSFETs (STPS*) help designers develop the best PC power supply solutions to improve efficiency. ST’s DC-DC converters guarantee high power density for the post-regulation.

**ST’s recommended products for Desktop PC’s Power Supply**

- **Power MOSFETs**
  - 600 V MOSFETs
  - STWBC2-MP1
  - STWBC2-HP1
  - STWBC2-LP1
  - 500 V MOSFETs
  - STWLC68
  - STWLC88
  - STB30F4, BAR46

- **Power Supplies**
  - 5 V - 400 W adapter based on CCM PFC
  - EVL400W-EUPL7
  - 12 V - 400 W adapter based on CCM PFC
  - EVL60635-250W

- **Diodes**
  - STTH*L06, STTH*06, STTH15AC06*
  - 600 V-650 V MDmesh DM6
  - STPS*, FERD*45, FERD*50, FERD*60,
  - TVS for Power Rail Surge Protection
  - SMA4F, SMA6F, SMB15F series

- **Controllers**
  - FCP & LLC Controllers
  - LLC Analog Controllers
  - Asymmetrical HB Controllers
  - SR Analog Controllers
  - STM32F334, STM32G4
  - STM32G0

- **Protections**
  - Low Dropout (LDO)
  - Linear Regulators
  - Precision Op Amps (<50 MHz)
  - Multiple LS Gate Drivers
  - SR Multiple LS Gate Drivers

**Typical Block Diagram**

- **Power Supply**
  - Power Supply
  - Front-End DC-DC Stage
  - DC-AC Power Stage
  - Primary Cell
  - Secondary Cell
  - Rectification
  - Battery
  - Wireless Power RX Controllers

- **Transmitter**
  - Transmitter
  - STWBC2

- **Receiver**
  - Receiver
  - STWBC2

- **Main application boards and reference designs**
  - STEVAL-IBS6W8TX
  - STEVAL-IBS6WA
  - STEVAL-IBS6WRX

- **NFC Readers**
  - ST25R3911B-DISCO
  - ST25R3916-DISCO

**Typical configuration**

- **Main application boards and reference designs**
  - EVL60635-250W
  - EVL4984-350W
  - EVL400W-EUPL7
Server & Telecom Power

AC-DC PSU & DC-DC power distribution

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

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

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

AC-DC PSU & DC-DC power distribution

Typical Block Diagram for Server PSU

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

Main application boards and reference designs

- STEVAL-ISA147V3: 500 W fully digital AC-DC power supply (D-SMPS)
- STEVAL-ISA172V2: 2 kW fully digital AC-DC power supply (D-SMPS)
- STEVAL-DPSLLCK1: 3 kW full bridge LLC resonant digital power supply
- EVLSTNRG-1kW: 1 kW high efficiency DC-DC power supply with multi-phase interleaved converter
- STEVAL-DPSTFPC1: 3 kW high efficiency DC-DC power supply with digital inrush current limiter
**Power Distribution for Modern Data Center**

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

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

We offer a wide range of high-efficiency regulated and unregulated DC-DC conversion solutions including STB, STC, HSTC for 48 V to 12V intermediate bus conversion. Moreover we offer 12V to Point of Load conversion including multi-phase digital controller and Smart Power Stages (SPS) to support the most recent INTEL and AMD CPU specifications. Finally, ST offers direct conversion solutions, from 48V to the point of load, based on the Power Stamp Alliance (PSA) products.

**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**
SSD Power Management

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

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

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

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

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

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

Full programmability via high speed serial interfaces as I2C and PMBus® allows configurability to fit different application requirements.

Typical Block Diagram for SSD Power Management
Power over Ethernet (PoE)

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

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

Typical block diagram for PoE Power Management

Main application boards and reference designs

STEVAL-POE001V1
Power Over Ethernet (PoE) - IEEE 802.3at compliant interface

STEVAL-POE002V1
5 V/9 A, synchronous flyback converter, Power over Ethernet (PoE) IEEE 802.3at compliant reference design

STEVAL-POE003V1
5 V/9 A, active clamp forward converter, Power Over Ethernet (PoE) IEEE 802.3at compliant reference design

STEVAL-POE005V1
12 V/9 A, active clamp forward converter, Power Over Ethernet (PoE) IEEE 802.3at compliant reference design

STEVAL-POE006V1
3.3/20 A, active clamp forward converter, Power Over Ethernet (PoE) IEEE 802.3at compliant reference design

Note: * is used as a wildcard character for omitted part numbers | 1 available in Q4 2021
LED TV Power Supply

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

To achieve these stringent requirements, PSUs typically have a Power Factor Corrector (PFC) stage and use advanced topologies, like half-bridge LLC (HB-LLC) resonant. ST offers a broad portfolio of high-voltage MDmesh™ and low-voltage STripFET™ power MOSFETs, field-effect rectifier diodes (FERD), Schottky and Ultrafast diodes, a full range of protection ICs as well as dedicated analog and digital switching controllers which negate the necessity of auxiliary power by consuming very low power at no load. In addition, STM32 microcontrollers enable developers to exploit the full potential of digital PSU implementations.

ST's recommended products for LED TV Power Supply

### PFC Block
- **Controllers**: TM Analog Controllers
  - L6562A*, L6563*, L6564*
  - CCM Analog Controllers
  - L6565, L6566, L6567, L6568
- **Power MOSFETs**: 600 V-650 V MDmesh M2
  - ST60M2, ST65M2
- **Diodes**: 600 V Ultrafast for TM
  - STTH*02, STTH*03, STTH*06
- **Switching Rectifiers**: LLC
  - ST60M6, ST65M6
  - ST60M8, ST65M8
- **Gate Drivers**: Gate Driver
  - PM8834

### Isolation Stage
- **Flyback Controllers**: L6566A, L6566B, L6567, L6568, ST6543
- **PFC & LLC Combiners**: STCMB1, STNRG011
- **LLC Analog Controllers**: L6565, L6566, L6567
- **Asymmetrical HB Controllers**: L6565
- **SR Analogue Controllers**: SRK1000, SRK1001 for Flyback
- **Integrated Smart Gates**: 600 V MASTERGW™
- **Power MOSFETs**: 600 V-650 V MDmesh M2
  - ST60M2, ST65M2
  - ST60M6, ST65M6
- **Digital & Protections**: Output Diodes for Flyback
  - Schottky, FERD, Ultrafast
  - STPS*, STTH*
  - Clamping Diodes for Flyback
  - 600 V to 1000 V Ultrafast
  - STP05, STP10
- **Voltage Reference**: DC-DC Conversion
  - T*431, T*432

### Main application boards and reference designs

- **EVLMCG1-250W LLC**: 250 W Resonant LLC-DC Converter based on STCMB1 digital controller and GaN
- **EVLCMB1-AIO210W**: 12 V - 210 W adapter based on TM PFC and HB LLC analog combo controller
- **EVLSTNG011-150**: 12 V - 150 W power supply board on STCMB1 digital controller for LED TV
- **EVLMG1-250W LLC**: 250 W Resonant LLC-DC Converter based on STCMB1 digital controller and GaN
- **EVLSTNG011-150**: 12 V - 150 W power supply board on TM PFC and HB LLC digital controller
DC-DC Conversion

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

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

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

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

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

Main application boards and reference designs

ST’s product offering for Switching Converters (DC-DC)
Typical 48 V, up to 65 W Pout, Synchronous Flyback configuration

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

Main evaluation boards

STEVAL-ISA203V1
- Input Voltage range: 42 - 56 V DC
- Switching Frequency: 200 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: 200 kHz
- Output: Power - 100 W
- Voltage - 5 V DC
- Current - up to 20 A
- Peak Efficiency > 94%

Main application boards and reference designs

STEVAL-1PS01AJR/1PS01DJR/1PS01EJR
Evaluation board based on the ST1PS01 400 mA nano-quiescent synchronous step-down converter with digital voltage selection

STEVAL-1PS02B
Evaluation board based on the ST1PS2 400 mA nano-quiescent synchronous step-down converter with digital voltage selection and AUX switch

STEVAL-LDO001V1
Quad high performance LDO evaluation board based on LDBC02, LDBC03, ST1PS03 and ST1PS04

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

WEARABLE DEVICES - POWER MANAGEMENT

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

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

Typical Block Diagram of Smart Watch
MEDICAL POWER SUPPLY

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

Typical Block Diagram of Medical Power Supply for Artificial Ventilators

Main application boards and reference designs

EVL6563S-100W
100 W transition-mode PFC pre-regulator

EVLSTNRG011-150
12 V to 150 W power supply based on TiM PFC and HeLLC digital controller

STEVAL-L7983ADJ
12/24 V 3 A step down DC-DC converter (VR = 12 to 36 V)
**LED LIGHTING AND CONTROLS**

**LED General Illumination**

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

Modern applications include a range of connectivity features to implement remote monitoring and control, making LED lighting a pillar of the smart home, smart building and smart city environment. ST’s portfolio includes a variety of RF transceivers, 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, 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.

**Typical Block Diagram**

![LED General Illumination Diagram](image-url)

**ST’s product offering for LED General Illumination**

- **Controllers**
  - TM Analog Controllers
  - L6402
  - L6604
  - L6804
  - L6884
  - L6894
  - L6896
  - L6898
  - L6899

- **Power MOSFETs**
  - 800 V to 1200 V MDmesh K5
  - 55 V to 95 V MDmesh M6

- **Diodes**
  - 600 V Ultrafast for TM
  - 400 V Ultrafast for LLC

- **MOSFET and IGBT Gate Drivers**
  - STEVAL-ILL078V1

- **Diode and Connector Management**
  - 800 V to 950 V MDmesh K5
  - 55 V to 95 V MDmesh M6

- **Control/Driver Converters**
  - HVLED0100A, HVLED0201A, HVLED0207, HVLED03
  - HV Converters

- **HV Power Supplies**
  - HV Power Supplies
  - HVLED001B, HVLED002, HVLED003

- **HV Converters**
  - HV Converters

- **DC-DC LED Drivers**
  - STEVAL-LLL012V1

- **LED Controls**
  - STEVAL-LL012V1

- **Bluetooth Low Energy (BLE Mesh)**
  - BLED 5 5 SoC
  - Bluetooth 5.1, 5.0, Bluetooth 4.2

- **BLE/NRF Module**

- **Sub-Hz**
  - 868 MHz

- **Antennas**
  - SMA4F, SMA6F, SMB15F series

- **Sub-GHz**
  - 868 MHz

- **Sub-GHz Wireless**
  - 868 MHz

- **Sub-GHz Module**

- **Sub-GHz Transceivers**
  - SPI, SPI

- **Sub-GHz Transmitters**
  - SPI, SPI

- **Sub-GHz Transmitters**
  - SPI, SPI

- **Sub-GHz Transmitters**
  - SPI, SPI

- **Sub-GHz Transmitters**
  - SPI, SPI

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  - SPI, SPI

- **Sub-GHz Transmitters**
  - SPI, SPI

- **Sub-GHz Transmitters**
  - SPI, SPI
LED Street Lighting

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

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

Typical Block Diagram

Power Supply

LED Driver

Voltage and Current Controller

Temperature Sensor

Connectivity (Wired/Wireless)

Solar DC-DC Converter

12 V

3.3 V

Mains enable

Control Unit

ST's product offering for LED Street Lighting

<table>
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<th>Controllers</th>
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<th>Diodes &amp; Protections</th>
<th>MOSFET and IGBT Gate Drivers</th>
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<td>HY/HB Gate Drivers for GaNs STG36NK060</td>
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<td>Isolated Gate Drivers STlage</td>
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<tr>
<td>LLC/CC Controllers L6999*, L6699*</td>
<td></td>
<td>SRK2000A, SRK2001, SRK3001A for LLC</td>
<td></td>
</tr>
<tr>
<td>MCUs &amp; Digital Controllers STM32FL, STM32G0, STM32G2, STM32F0, STM32H7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flyback and inverse buck converters.</td>
<td>ST8823*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEVAL-LLL008V1</td>
<td></td>
<td>STEVAL-ILL053V2</td>
<td></td>
</tr>
<tr>
<td>100 W - 1.4 A constant current LED Driver with Sub-10kHz convertor for DC Flyback and inverse buck converters.</td>
<td>L6962*, L6693*, L6694*</td>
<td>L6964*</td>
<td></td>
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<tr>
<td>STEVAL-LLL008V1</td>
<td>75 W - 1.2 A constant current LED Driver (CC/CC) with Sub-10kHz convertor</td>
<td>L6699*</td>
<td></td>
</tr>
<tr>
<td>STEVAL-LLL008V1</td>
<td>75 W - 1.2 A constant current LED Driver with Sub-10kHz convertor</td>
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<tr>
<td>STEVAL-LLL008V1</td>
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<td></td>
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<tr>
<td>STEVAL-LLL008V1</td>
<td>75 W - 1.2 A constant current LED Driver with Sub-10kHz convertor</td>
<td></td>
<td></td>
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<tr>
<td>STEVAL-LLL666V2</td>
<td>100 W LED street lighting with DALI2.0 communication interface using the STEVAL-LLL008V1 for isolated constant current LED driver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EVL100LED-STCH03</td>
<td>80 W - 1.3 A customised constant current loop LED driving board for LED street lighting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STML01</td>
<td>100 V - 1.25 A constant current LED Driver with Sub-10kHz convertor</td>
<td></td>
<td></td>
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<tr>
<td>STT576</td>
<td>100 V - 1.25 A constant current LED Driver with Sub-10kHz convertor</td>
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<tr>
<td>LML152</td>
<td>100 V - 1.3 A constant current LED Driver with Sub-10kHz convertor</td>
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<td>CMOS</td>
<td>80 V - 1.25 A constant current LED Driver with Sub-10kHz convertor</td>
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<tr>
<td>Power Line Transceivers STT7570, ST7580, ST7590</td>
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<tr>
<td>Power Line Transceivers STT7570, ST7580, ST7590</td>
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</tr>
<tr>
<td>Digital Conditioning</td>
<td></td>
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</tbody>
</table>

Main application boards

- **STEVAl-LLL008V1**: 100 W - 1.4 A constant current LED Driver with Sub-10kHz convertor for DC Flyback and inverse buck converters.
- **STEVAl-LLL008V1**: 75 W - 1.2 A constant current LED Driver (CC/CC) with Sub-10kHz convertor.
- **STEVAl-LLL008V1**: 75 W - 1.2 A constant current LED Driver with Sub-10kHz convertor.
- **STEVAl-LLL008V1**: 75 W - 1.2 A constant current LED Driver with Sub-10kHz convertor.
- **STEVAl-LLL666V2**: 100 W LED street lighting with DALI2.0 communication interface using the STEVAL-LLL008V1 for isolated constant current LED driver.
- **EVL100LED-STCH03**: 80 W - 1.3 A customised constant current loop LED driving board for LED street lighting.
- **EVL150W-HVSL**: 150 W - 1 A LED driver featuring TM PPC and LLC resonant controller with STM8811 combo controller.
- **EVL6699-HVSL**: 150 W - 1 A LED driver featuring TM PPC and LLC resonant controller with STM8811 combo controller.
- **STEVAl-LLL008V1**: 75 W - 1.2 A constant current LED Driver with isolated constant current LED driver.
- **STEVAl-LLL008V1**: 75 W - 1.2 A constant current LED Driver with isolated constant current LED driver.
- **STEVAl-LLL008V1**: 75 W - 1.2 A constant current LED Driver with isolated constant current LED driver.
- **STEVAl-LLL666V2**: 100 W LED street lighting with DALI2.0 communication interface using the STEVAL-LLL008V1 for isolated constant current LED driver.
- **EVL150W-HVSL**: 150 W - 1 A LED driver featuring TM PPC and LLC resonant controller with STM8811 combo controller.
- **EVL6699-HVSL**: 150 W - 1 A LED driver featuring TM PPC and LLC resonant controller with STM8811 combo controller.
- **STEVAl-LLL008V1**: 75 W - 1.2 A constant current LED Driver with isolated constant current LED driver.
- **STEVAl-LLL008V1**: 75 W - 1.2 A constant current LED Driver with isolated constant current LED driver.
- **STEVAl-LLL666V2**: 100 W LED street lighting with DALI2.0 communication interface using the STEVAL-LLL008V1 for isolated constant current LED driver.
LED POE Lighting

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

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

Typical Block Diagram

ST’s product offering for LED POE Lighting

<table>
<thead>
<tr>
<th>PoE interface</th>
<th>Protection</th>
<th>Auxiliary Power Supply</th>
<th>LED Driver</th>
<th>Bluetooth LE</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE 802.3at</td>
<td>TVS for Power Rail Surge Protection SMB409, SMB410F</td>
<td>Buck Converter L7983, L7987, Inverse Buck L7981302</td>
<td>60 V-100 V STripFET F7 STW8987, STW8987, STW8987</td>
<td>Bluetooth Low Energy 5.1, Wireless MCUs, Modules BlueNRG®, STM32WB*</td>
</tr>
<tr>
<td>IEEE 802.3af</td>
<td>PM8805</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEEE 802.3bt</td>
<td>PM8803</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEEE 802.3at</td>
<td>PM8805A</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Lighting Controls

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

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

DALI Lighting Solution

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

Typical Block Diagram for DALI Lighting System

ST’s product offering for Lighting Controls

<table>
<thead>
<tr>
<th>LED Driver</th>
<th>Power Management</th>
<th>KNX Transceiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Controllers</td>
<td>STLUX</td>
<td>Digital Controllers</td>
</tr>
<tr>
<td>Development Tools</td>
<td>STW-STRUX010, STW-STRUX012, STW-STRUX013</td>
<td></td>
</tr>
<tr>
<td>Embedded Software</td>
<td>STW-DALI001, STW-DALI002, STW-DALI003</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TVS Protection on KNX Bus S0A400A-TR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STKNX</td>
</tr>
</tbody>
</table>

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

Main application boards

STEVAL-ILL066V2 100 W LED street lighting evaluation board with DALI 2 communication interface using the STLUX066A digital controller
STEVAL-ILM001V1 Plug-in hardware module for the STM32-DK0501F1 module for DALI communication
LED Wireless Programming

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

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

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

Typical Block Diagram of LED Wireless Programming

ST’s product offering for LED Wireless Programming

<table>
<thead>
<tr>
<th>NFC/RFID Reader IC</th>
<th>Protections</th>
<th>Microcontrollers</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST2GR</td>
<td>Dynamic NFC Tag Readers</td>
<td>STM8S</td>
</tr>
<tr>
<td>LED Driver for high-end market</td>
<td>ST25DV-FC Series</td>
<td>STM32F1, STM32G0</td>
</tr>
<tr>
<td>LED Driver for entry-level market</td>
<td>ST25DV-PWM Series</td>
<td>STM32F3, STM32G0</td>
</tr>
<tr>
<td>STP04/08/16/24</td>
<td>LED Driver</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dynamic NFC Tag with PWM Outputs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High-end Market</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Entry-level Market</td>
<td></td>
</tr>
</tbody>
</table>

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

Main application boards

- USBULC6-2M6: Discovery kit for ST25DV-PWM high performance HF module NFC
- ST25DV-PWM-eSET: Discovery kit for ST25DV-PWM NFC RFID tag IC
- ST25DV-DISCOVERY: Discovery kit for ST25DV-FC Dynamic NFC RFID tag IC

ELECTRO-MOBILITY

Key applications

Solutions

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

- SiC MOSFETs and Diodes
- Transceivers
- Signal Conditioning
- Power Management
- Power MOSFETs and IGBTs
- Power Diodes and thyristors
- EOS and ESD Protection
- BCD Integrated and Isolated Drivers
- 32-bit Automotive Microcontrollers
- HW & SF Development Tools – Sample Kits, Evaluation Kits, Product Selectors

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www.st.com/electro-mobility

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

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

The traction inverter converts energy from the vehicle’s battery to drive the electrical engine. This key component has a direct impact on a vehicle’s road performance, driving range and reliability, which also depends on the inverter’s weight and size. Subject to all the possible stress found in a road vehicle from heat and vibrations, these converters must be able to handle high power and currents along with the associated Electro Magnetic Compatibility (EMC) challenges as well as provide fail-safe operation to ensure dependability and safety for the driver and passengers.

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

Bidirectional DC/DC Converter

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

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

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

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

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

Typical Block Diagram - Start-Stop system

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On-Board Charger (OBC)

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

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

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

Typical Block Diagram - OBC

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FIND OUT MORE

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

FIND OUT MORE

www.st.com/on-board-charger
Battery Management

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

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

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

Typical Block Diagram - Automotive Battery Management System (BMS)
DC Fast Charging Station

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

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

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

Typical Block Diagram - DC Fast Charging Station

<table>
<thead>
<tr>
<th>Input stage</th>
<th>3ph PFC</th>
<th>DC/DC Control unit</th>
<th>Driving stage</th>
<th>Current sensing &amp; signal conditioning</th>
<th>Aux. SMPS, HMI, Metering</th>
<th>Connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>3ph AC input</td>
<td>3ph PFC</td>
<td>DC/DC Control Unit</td>
<td>Driving stage</td>
<td>Current sensing &amp; signal conditioning</td>
<td>Connectivity</td>
<td>1^ side</td>
</tr>
</tbody>
</table>

Main application boards and reference designs

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

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

- **STEVAL-DPSTPFC1**
  3.6 kW PFC token pole with digital output current sensor

ST's product offering for DC Fast Charging Station

<table>
<thead>
<tr>
<th>Recifiers</th>
<th>ST series - 650 V •</th>
<th>ST series - 1200 V •</th>
<th>Ultrafast R series - 600 V •</th>
<th>Ultrafast R series - 600 V •</th>
<th>STM series - 800/1200V •</th>
<th>STM series - 800/600/100V •</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyristors</td>
<td>Thy series - 1200 V •</td>
<td>Thy series - 600 V •</td>
<td>Thy series - 600/1200 V •</td>
<td>Thy series - 600/1200 V •</td>
<td>Thy series - 800 V •</td>
<td>Thy series - 800/1200 V •</td>
</tr>
<tr>
<td>TVS protections</td>
<td>OMMTY, SMS7TY, SMS15TY, SMS30TY •</td>
<td>OMMTY, SMS7TY, SMS15TY, SMS30TY •</td>
<td>OMMTY, SMS7TY, SMS15TY, SMS30TY •</td>
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<td>HMI ESD protections</td>
<td>ESDSyst series, ENSP6,1005ERX127 •</td>
<td>ESDSyst series, ENSP6,1005ERX127 •</td>
<td>ESDSyst series, ENSP6,1005ERX127 •</td>
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<td>ESDSyst series, ENSP6,1005ERX127 •</td>
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<tr>
<td>Power MOSFETs</td>
<td>STBR series - 800V/1200V •</td>
<td>STBR series - 800V/1200V •</td>
<td>STBR series - 800V/1200V •</td>
<td>STBR series - 800V/1200V •</td>
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<td>IGBTs</td>
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<td>STBR series - 800V/1200V •</td>
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<td>ACEPACK Power Modules</td>
<td>Customized modules •</td>
<td>Customized modules •</td>
<td>Customized modules •</td>
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<tr>
<td>MCUs (32bit)</td>
<td>STM32F334, STM32G4, STM32F3 • • •</td>
<td>STM32F334, STM32G4, STM32F3 • • •</td>
<td>STM32F334, STM32G4, STM32F3 • • •</td>
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<tr>
<td>Gate drivers</td>
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<td>L6918 •</td>
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<td>L6918 •</td>
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<tr>
<td>Memories (EEPROM)</td>
<td>M24**, M69** •</td>
<td>M24**, M69** •</td>
<td>M24**, M69** •</td>
<td>M24**, M69** •</td>
<td>M24**, M69** •</td>
<td>M24**, M69** •</td>
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<td>Isolated Sigma-Delta ADC</td>
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<td>STSS21P1 •</td>
<td>STSS21P1 •</td>
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<td>CAN transceivers</td>
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<td>Power line transceivers</td>
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<td>STM2150 •</td>
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<td>Bluetooth Low Energy Transceiver</td>
<td>STM32x Wireless Module</td>
<td>STM32x Wireless Module</td>
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<tr>
<td>NFC/RFID</td>
<td>STW180 •</td>
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<td>Motion sensors</td>
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<td>STM32P2, STM33, STM34, STM36, STM38, STM39, STM3101 •</td>
<td>STM32P2, STM33, STM34, STM36, STM38, STM39, STM3101 •</td>
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<td>STM32P2, STM33, STM34, STM36, STM38, STM39, STM3101 •</td>
<td>STM32P2, STM33, STM34, STM36, STM38, STM39, STM3101 •</td>
</tr>
</tbody>
</table>

Note: * is used as a wildcard character for related part number
INDUSTRIAL POWER & TOOLS

Industrial Welding

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

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

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

ST’s product offering for Industrial Welding

<table>
<thead>
<tr>
<th>ST’s product offering for Industrial Welding</th>
<th>Primary Side Power Stage</th>
<th>Secondary Inverter</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFC (optional)</td>
<td>PFC power stage</td>
<td>Controller</td>
</tr>
<tr>
<td>Primary Current sensing</td>
<td>Primary Current sensing</td>
<td>- Earth</td>
</tr>
<tr>
<td>Auxiliary Power Supply</td>
<td>Rectifier</td>
<td>Working Piece</td>
</tr>
<tr>
<td>MCU</td>
<td>Rectifier +</td>
<td>Transformer +</td>
</tr>
<tr>
<td>PFC (optional)</td>
<td>Power Switch</td>
<td>STG*V60DF</td>
</tr>
<tr>
<td>Power Switch</td>
<td>Clamping Diode</td>
<td>STG*H65DFB</td>
</tr>
<tr>
<td>Power Switch</td>
<td>Clamping Diode</td>
<td>STG*H65DFB2</td>
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Typical configuration for Single-Phase Architecture for Low/Medium Power Welding

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

Note: * is used as a wildcard character for related part number
Uninterruptible Power Supplies (UPS)

Uninterruptible Power Supplies (UPS) ensure continuity of supply by converting the DC voltage from a battery or battery bank to an AC voltage with the requested amplitude and frequency in case of power outages. Depending on application requirements, an UPS can be built with a simple on-off configuration or with a double conversion online method for high-end, medium- or high-power UPSs. This also improves the quality of the power supplied to sensitive loads including computers, servers, smart industry machines, instrumentation and telecommunication equipment. We offer high-performance discrete devices including high- and low-voltage power MOSFETs, IGBTs, thyristors and silicon-carbide (SiC) diodes and power MOSFETs as well as galvanically-isolated and high-voltage gate drivers, PFC controllers and high-performance STM32 microcontrollers to enable high-efficiency, high-reliability UPS designs.

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MAJOR HOME APPLIANCES

Refrigeration, Washing, Drying and Miscellaneous Equipment

The white goods market requires low-cost and high-energy-efficiency solutions. The solutions, refrigeration, washing and drying of the miscellaneous (Air conditioner, water heater) equipment are some of the major home appliance applications that ST, thanks to its wide product portfolio, is able to satisfy with suitable and dedicated power products and high-performing STM32 microcontrollers combined with suitable and dedicated power products and high-performing STM32 microcontrollers (TMS320) and auxiliary gate drivers (STGAP*). Using SiC diodes (STGAP*), new high-voltage MDmesh MOSFETs of suitable field-stop trench-gate IGBTs, high-efficiency PFC is guaranteed. To reduce the 3-phase inverter design effort, ST offers the SLL ingredient family (small low-loss intelligent module) of highly-integrated, high-efficiency intelligent power modules (IPM) integrating the power stage (both on IGBT and Mosfet discrete), driving network and protections. Another approach for designing a 3-phase inverter is based on the use of six discrete IGBTs/MOSFETs with the new 3-phase gate drivers STDRIVE601. High reliability against the inrush current is ensured by new SCRs in the front-end stage, ST7M programmable electronic power breaker family provides a convenient, integrated solution for quickly and safely disconnecting a faulty load from a 12 V bus.

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

ST’s product offering for Refrigeration, Washing, Drying and Miscellaneous Equipment ensures high performance and energy efficiency solutions. The market requires low-cost and high-energy-efficiency solutions, especially in the home appliance applications such as air conditioners, water heaters, and other miscellaneous equipment. ST’s wide product portfolio enables the company to provide suitable power products and high-performing STM32 microcontrollers combined with auxiliary gate drivers (STGAP*). Using SiC diodes, high-voltage MDmesh MOSFETs or suitable field-stop trench-gate IGBTs, high-efficiency PFC is guaranteed. To reduce the 3-phase inverter design effort, ST offers the SLL ingredient family (small low-loss intelligent module) of highly-integrated, high-efficiency intelligent power modules (IPM) integrating the power stage (both on IGBT and Mosfet discrete), driving network and protections. Another approach for designing a 3-phase inverter is based on the use of six discrete IGBTs/MOSFETs with the new 3-phase gate drivers STDRIVE601. High reliability against the inrush current is ensured by new SCRs in the front-end stage, ST7M programmable electronic power breaker family provides a convenient, integrated solution for quickly and safely disconnecting a faulty load from a 12 V bus.

Typical block diagram for Online UPS with double conversion stage

~ AC → Rect. & inrush current limiter → PFC → DC-DC → DC-AC → AC load

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

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

We have specifically developed trench-gate field-stop IGBTs and diodes that, together with a selection of high-voltage gate drivers and high-performance STM32 microcontrollers, are ideal for high-efficiency converters. ST also offers environmental sensors and the LED and LCD display drivers, touchscreen controllers and proximity 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 cords less intrusive.

ST’s product offering for Induction Cooking

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ST’s product offering for Induction Cooking

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<tr>
<th>Topology example</th>
<th>User interface (front panel)</th>
<th>Power management</th>
<th>DC-DC</th>
<th>AC-DC</th>
<th>LED drivers</th>
<th>MCDs</th>
<th>AC-DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge Rectifier</td>
<td>STM8, STM32F0, STM32F07, STM32F07</td>
<td>Linear Voltage Regulators</td>
<td>AC-DC</td>
<td>DC-DC</td>
<td>AC-DC</td>
<td>MCDs</td>
<td>AC-DC</td>
</tr>
<tr>
<td>Inverter Stage and Resonant tank</td>
<td>STLED2163, STLED2164, ST2LED2165</td>
<td>MOS / IGBT Drivers</td>
<td>Single LS Gate Drivers</td>
<td>PMB6034</td>
<td>Single LS Gate Drivers</td>
<td>PMB603</td>
<td>Inverter Stage and Resonant tank</td>
</tr>
<tr>
<td>Power Switch</td>
<td>STM32F047, STM32F047</td>
<td>Power Switch</td>
<td>Plate</td>
<td>Power Switch</td>
<td>or</td>
<td>Power Switch</td>
<td></td>
</tr>
<tr>
<td>Inverter Stage and Resonant tank</td>
<td>STM25R3916, STM25R3918</td>
<td>Sensors</td>
<td>NFC</td>
<td>NFC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HF transformer</td>
<td>L6987, ST1514, L7985, L7986, L7989</td>
<td>Motor Sensors</td>
<td>Accelerometer</td>
<td>ST25R3916, ST25R3918</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Power Switch | L6987, ST1514, L7985, L7986, L7989 | Power Management | eDesignSuite

eDesignSuite

eDesignSuite is a comprehensive and flexible suite of design aid utilities and engineering tools, that streamlines development of winning solutions with a wide range of ST products meeting user’s application requirements. Explore the advanced features of our Power Management Design Center, an on-line design tool that smartly helps designers of power management systems and subsystems accelerating the engineering development process - select-evaluate-refine and prototyping - for a large and growing number of ICs and Discrete in our broad portfolio. The software tool supports a variety of switching power converters, in power supply, digital power, LED lighting and battery charger applications, making easy the design path from user’s specification to circuit’s analysis and customization. The main features of the tool are: automatic proposal for complete solution or fully customized 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.

SMART SELECTOR & CALCULATOR

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

CIRCUIT SIMULATOR

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

THERMO-ELECTRICAL COMPONENT SIMULATOR

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

Software tools

eDesignSuite

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

Discover more!
PFC controllers

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

**MAIN APPLICATIONS**

- **Adapters and TVs**: L6562A*, L6563*, L6564*, L4885, L4886
- **Commercial and street lighting**: L6562A*, L6563*, L6564*, L4885, L4898, L4898*, L4894D
- **Desktop PCs and Server**: L4985, L4986, L4981*, L4984D

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

- 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, autostart/stop, OVP and internal OTP
- 650 V HV start up

Multi-mode digital 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 PFC controller
  - Self-adjusting dead-time and ant-capacitive mode for LLC
  - Time-shift control of resonant half-bridge

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

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

Asymmetrical half-bridge controller

- L6591
  - PFC interface
  - Brown out
  - 700 V start-up voltage

Key Features and Benefits

- 600 V system-in-package integrating half-bridge gate driver and high voltage power GaN transistors:
  - 600 V half-bridge high voltage driver with two 650 V enhancement mode GaN HEMTs
  - 800 V start-up voltage
  - Enhanced fixed on time TM PFC controller
  - Time-shift control of resonant half-bridge
  - ROM memory for SW digital algorithms
  - NVM memory for programmable key application parameters

Main Applications

- Tablets and smartphones
  - L6565, L6566*, STCH03
- Laptops
  - L6565, L6566*, STCH03, STCMB1, STNRG011
- High-power adapters and TVs
  - L6591, L6599, STCMB1, STNRG011
- Desktop PCs, commercial and street lighting
  - L6599*, L6699, STCMB1, STNRG011, STNRG012

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

**TS2181, TS2182**
- Operating voltage 2.2 to 5.5 V
- 5 V zero-drift amplifier
- Input offset voltage 25 µV max
- Temperature up to 150 °C
- Gain bandwidth 3 MHz

**TS7711/2, TS7719/2**
- Operating voltage 2.2 to 5.5 V (TS7711) and 2.7 to 36 V (TS7719)
- 96 V amplifier
- Input offset voltage 300 µV max
- Gain bandwidth 6 MHz (unity gain stable) or 22 MHz

**TS792**
- 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

**TSC101**
- Operating voltage 2.8 to 30 V
- Surviving voltage on shunt -0.3 to 60 V
- Amplification gain x20 x50 x100
- Package SOT23-6L

**TSC2010/1/2**
- Bi-directional
- Operating voltage -20 to 70 V
- Amplification gain x20 x50 x100
- Offset voltage ±200 µV max
- Gain error 0.3% max
- Packages MINI-5 L20

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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

High-power adapters and TVs
SRK1000, SRK1001

Desktop PCs and Server/Telecoms
SRK2000A, SRK2001, SRK2001A

**SR Controllers for Flyback**

<table>
<thead>
<tr>
<th>Basic features</th>
<th>DVS AMR</th>
<th>Programmable blanking times after toff</th>
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<tbody>
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<td>SRK1000</td>
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Wireless battery charger transmitters
Server/Telecom
Solar
UPS
Lighting
Factory automation

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

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.

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**Synchronous rectification benefits**

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

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Server/Telecom
Solar
UPS
Lighting
Factory automation

**www.st.com/opamps**
**www.st.com/current-sense-amplifiers**
**www.st.com/comparators**
Wireless charging ICs
ST fully covers wireless charging applications with dedicated ICs for both transmitter and receiver. The STWBC, STWBC-EP and STWBC-MC, compatible with Qi standard, and the STWBC-WA, dedicated to wearable applications, make up ST’s wireless power transmitters (Tx) family. The receiver family (Rx) consists of the STWLC98 dedicated to Qi compliant consumer applications.

Wireless charger transmitter ICs

<table>
<thead>
<tr>
<th>STWBC2-HP</th>
<th>STWBC2-MP</th>
<th>STWBC86*</th>
</tr>
</thead>
<tbody>
<tr>
<td>STWLC38*</td>
<td>STWLC68</td>
<td>STWLC86*</td>
</tr>
<tr>
<td>STWLC98</td>
<td>STWLC88</td>
<td>STWLC98</td>
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</tbody>
</table>

- STWBC2-HP supports applications up to 70 W
- STWBC2-MP supports applications up to 20 W Rx for Qi Extended Power Profile
- STWBC86* supports up to 15 W Rx for Qi Baseline Power Profile

Wireless charger receiver ICs

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</tr>
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</table>

- STWLC98 supports up to 5 W in Tx mode (coil dependent)
- ARC (Adaptive Rectifier Configuration) mode for enhanced spatial freedom
- ST SuperCharge (STSC) proprietary protocol extension
- Pin-to-pin compatible upgrade with STWLC98

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
- SHI and impedance tracking with OptimGauge+ algorithm (ST IP)
- Charger enable and system reset control for accurate OCV reading

ST’s battery fuel gauge ICs can be located in the battery pack or in the handheld device and integrate functions to monitor the battery voltage, current and temperature. Using a built-in Coulomb counter, these fuel gauge ICs calculate the 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.

- OptimGauge™ algorithm for STC3115
- OptimGauge+™ algorithm for STC3117
- Coulomb counter and voltage gas gauge operations
- Programmable low battery alarm
- Internal temperature sensor

MAIN APPLICATIONS
- Fitness
- Bluetooth accessories
- USB
- Smartphones
- STN501, STB02, STBC03
- STBC02, STBC05
- STBC15
- STWLC68, STWLC86, STWLC88, STWLC98

Note: * available in Q4 2021

ST fully covers wireless charging applications with dedicated ICs for both transmitter and receiver. The STWBC, STWBC-EP and STWBC-MC, compatible with Qi standard, and the STWBC-WA, dedicated to wearable applications, make up ST’s wireless power transmitters (Tx) family. The receiver family (Rx) consists of the STWLC98 dedicated to Qi compliant consumer applications.
DC-DC converters

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

DC-DC converters

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

Single-phase Buck controllers

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

Multi-phase Buck controllers

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

**MAIN APPLICATIONS**

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

<table>
<thead>
<tr>
<th>STPMIC1 versions</th>
<th>Pre-programmed (typ when VIN = 5 V)</th>
<th>Pre-programmed (typ when VIN = battery)</th>
<th>Net pre-programmed (custom application)</th>
<th>Pre-programmed (typ when VIN = 5 V)</th>
<th>Pre-programmed (typ when VIN = battery)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default output Voltage (V)</td>
<td>Rank</td>
<td>Default output Voltage (V)</td>
<td>Rank</td>
<td>Default output Voltage (V)</td>
<td>Rank</td>
</tr>
<tr>
<td>LDO1</td>
<td>1.8</td>
<td>0</td>
<td>1.8</td>
<td>0</td>
<td>1.8</td>
</tr>
<tr>
<td>LDO2</td>
<td>1.8</td>
<td>0</td>
<td>2.9</td>
<td>2</td>
<td>1.8</td>
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<tr>
<td>LDO3</td>
<td>1.8</td>
<td>0</td>
<td>1.8</td>
<td>0</td>
<td>1.8</td>
</tr>
<tr>
<td>LDO4</td>
<td>3.3</td>
<td>3</td>
<td>3.3</td>
<td>3</td>
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<td>LDO5</td>
<td>2.9</td>
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<td>LDO6</td>
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<td>REFDDR</td>
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<td>0</td>
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<td>0</td>
<td>0.55</td>
</tr>
<tr>
<td>BOOST</td>
<td>5.2</td>
<td>N/A</td>
<td>5.2</td>
<td>N/A</td>
<td>5.2</td>
</tr>
<tr>
<td>BUCK1</td>
<td>1.2</td>
<td>2</td>
<td>1.2</td>
<td>2</td>
<td>1.1</td>
</tr>
<tr>
<td>BUCK2</td>
<td>1.1</td>
<td>0</td>
<td>1.1</td>
<td>0</td>
<td>1.1</td>
</tr>
<tr>
<td>BUCK3</td>
<td>3.3</td>
<td>1</td>
<td>1.8</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>BUCK4</td>
<td>3.3</td>
<td>2</td>
<td>3.3</td>
<td>2</td>
<td>1.15</td>
</tr>
</tbody>
</table>

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

STPMIC1 and STM32MP1

**MAIN APPLICATIONS**

- Home automation
- Industrial control
- POS terminals
- Networking
- Medical monitoring
DIGITAL POWER CONTROLLERS AND MICROCONTROLLERS

Digital power controllers

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

Digital controllers tailored for power conversion and lighting applications

STNRG*

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

• STLUX*
  • Digital controller tailored for power conversion
  • Up to 4 comparators with external reference
  • STLUX
  • Digital controller tailored for lighting applications
  • Suitable for primary-side regulation and multi-strings lighting applications
  • DALI 2.0 for remote control and connectivity

STNRG* internal block diagram

STLUX*

STNRG*

MAIN APPLICATIONS

Solar
STNRG388A

HEV charging stations
STNRG388A

UPS
STNRG3839A

Factory automation
STNRG3839A

Commercial, architectural and street lighting
STLUX*

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

www.st.com/stlux

www.st.com/stnrg

STNRG388A

STNRG

STNRG388A

STNRG

STNRG388A

STNRG

STNRG388A

STNRG

STNRG388A

STNRG

STNRG388A

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STNRG
Automotive microcontrollers for in-car digital power

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

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

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

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

**Package Options**
- eTQFP 64-176 (exposed pad)
- QFN 48 (exposed pad)

**Networking**
- Ethernet
- LIN
- CAN-FD
- FlexRay
- 2x Ethernet

**Scalability**
Up to:
- 3 cores, 200 MHz, 10 MB flash

**Secure & Safety**
- ASIL-D
- HSM medium/Full
- Medium/Full
- Evita
- HIS 26262

**MAIN APPLICATIONS**
- Vehicle Security
- Software over-the-air
- Parking Services
- Remote Assistance
- Maintenance free
- Safety
- HEV

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

www.st.com/spc5
SiC diodes

In addition to ensuring compliance with today's most stringent energy efficiency regulations (Energy Star, 80Plus, and European Efficiency), ST's silicon-carbide diodes show four times better dynamic characteristics with 15% less forward voltage (VF) than standard silicon diodes. Silicon-carbide diodes belong to our STPOWER™ family. The efficiency and robustness of solar inverters, motor drives, uninterruptible power supplies and circuits in electrical vehicles are therefore greatly improved by the use of silicon-carbide (SiC) diodes.

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

Note: * is used as a wildcard character for related part number
GALVANIC ISOLATED SIGMA-DELTA ADC

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

KEY FEATURES
- 2nd order 16-bit Sigma-Delta Modulator
- ±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 (VIOTM)
- 6 kV VPEAK Maximum Surge Insulation Voltage (VIOSM)
- 30 kV/μs typical Common-Mode Transient Immunity
- Flexible interface options: Low Voltage Differential Signaling (LVDS) and Single Ended (TTL/CMOS) options
- -40 °C to +125 °C extended industrial temperature range
- 1.2 kV VPEAK Maximum Working Insulation Voltage (VIORM)
- 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

Product table

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Version</th>
<th>Input Range</th>
<th>Max. Clock Frequency</th>
<th>Resolution</th>
<th>SNR</th>
<th>Isolation</th>
<th>CMTI</th>
<th>Package &amp; Packing</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISOSD61</td>
<td>TTL/CMOS</td>
<td>±320 mV</td>
<td>25 MHz</td>
<td>16-bit</td>
<td>86 dB</td>
<td>1.2 kV V/μs</td>
<td>30 kV/μs</td>
<td>SO16W Tray</td>
</tr>
<tr>
<td>ISOSD61TR</td>
<td>TTL/CMOS</td>
<td>LVDS</td>
<td>25 MHz</td>
<td>16-bit</td>
<td>86 dB</td>
<td>1.2 kV V/μs</td>
<td>30 kV/μs</td>
<td>SO16W Tape &amp; Reel</td>
</tr>
<tr>
<td>ISOSD61L</td>
<td>LVDS</td>
<td>±320 mV</td>
<td>25 MHz</td>
<td>16-bit</td>
<td>86 dB</td>
<td>1.2 kV V/μs</td>
<td>30 kV/μs</td>
<td>SO16W Tray</td>
</tr>
<tr>
<td>ISOSD61LTR</td>
<td>LVDS</td>
<td>LVDS</td>
<td>25 MHz</td>
<td>16-bit</td>
<td>86 dB</td>
<td>1.2 kV V/μs</td>
<td>30 kV/μs</td>
<td>SO16W Tape &amp; Reel</td>
</tr>
</tbody>
</table>

MAIN APPLICATIONS
- Servo drive
- Factory automation
- EV charging station
- Server & telecom power
**Power breakers**

Connected in series to the power rail, ST’s power breakers are able to disconnect the electronic circuitry if power consumption exceeds the programmed limit. When this happens, the device automatically opens the integrated power switch, disconnecting the load, and notifies the remote monitoring feature. STMicroelectronics’ STPW programmable electronic power breaker family provides a convenient, integrated solution for quickly and safely disconnecting a faulty load from a 12 V bus.

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

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

**eFuses**

**eFuses** are electronic fuses that can replace larger conventional fuses or other protection, reducing ownership costs in production and in the field. Unlike fuses, they offer complete and flexible management of the fault (overcurrent/overvoltage), without requiring replacement after actuation. They thus help to improve equipment uptime and availability and also reduce maintenance costs and false returns. Compared to traditional protection devices, these new electronic fuses enable versatile and simple programming of protection parameters, such as overcurrent threshold and start-up time.

**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

**HOT-SWAP POWER MANAGEMENT**

eFuses, a smart offer for a lot of applications

**MAIN APPLICATIONS**

- **Home appliances**
  - STEF05, STEF01, STEF12, STEF12S
- **Server and Data Storage**
  - STEF033, STEF05, STEF05L, STEF12, STEF05S, STEF12S
- **USB connections**
  - STEF05, STEF05L, STEF05S
- **Factory automation**
  - STEF01, STEF12, STEF12S
- **Set-top boxes**
  - STEF12, STEF12S

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

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

<table>
<thead>
<tr>
<th>Breakdown Voltage</th>
<th>600 V</th>
<th>650 V</th>
<th>1200 V</th>
<th>1250 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>5 to 20 A</td>
<td>20 to 80 A</td>
<td>20 to 80 A</td>
<td>15 to 100 A</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>6 to 20 kHz</td>
<td>10 to 100 kHz</td>
<td>2 to 20 kHz</td>
<td>16 to 60 kHz</td>
</tr>
</tbody>
</table>

**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

**H series**
- **STG'H**
  - 600 V family
    - 3 µs of short-circuit capability
    - Low saturation voltage
    - Minimal collector turn-off
    - Series optimized for home appliance applications
  - 1200 V family
    - 5 µs of short-circuit capability @ starting TJ = 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 TJ = 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 TJ = 150 °C
    - Freewheeling diode tailored for target application
    - Suitable for any inverter system up to 20 kHz

**S series**
- **STG'S120OF3**
  - 10 µs of short-circuit capability @ starting TJ = 150 °C
  - Wide safe operating area (SOA)
  - Soft and fast recovery antiparallel diode
  - Low drop series: very low VCE(sat)
  - Suitable for very low frequency application, up to 8 kHz

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

---

**Focus Applications**

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

---

**MAIN APPLICATIONS**

- **Welding**
- **Solar**
- **UPS**
- **Home appliances**
- **Air conditioning**
- **Motor control**
- **Induction heating**

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

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

IPS MAIN FEATURES
• Logic
• Driving
• Protections
• Diagnostic
• Power stage
• Isolation
...all an on a single chip

MAIN APPLICATIONS
Factory automation
Vending machines
Renewable energy
Lighting for Building Automation

www.st.com/ips
**LED DRIVERS**

**Offline LED drivers**

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

**Offline LED converters with PSR**

<table>
<thead>
<tr>
<th>HPF</th>
<th>PSR-CC</th>
<th>PSR-CV</th>
<th>P_{vin}</th>
<th>Internal power</th>
<th>MOSFET</th>
<th>Flyback</th>
<th>Buck-boost</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVLED805</td>
<td></td>
<td></td>
<td>8 W</td>
<td>800 V_{in}</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HVLED815PF</td>
<td></td>
<td></td>
<td>15 W</td>
<td>800 V_{in}</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Offline LED controllers with PSR**

<table>
<thead>
<tr>
<th>HPF</th>
<th>PSR-CC</th>
<th>PSR-CV</th>
<th>Dimming</th>
<th>Flyback</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVLED001A/HVLED001B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Offline LED controllers**

<table>
<thead>
<tr>
<th>HPF</th>
<th>PSR-CC</th>
<th>PSR-CV</th>
<th>Dimming</th>
<th>Flyback</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVLED007</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Topology example**

![Topology example diagram]

**MAIN APPLICATIONS**

- Residential lighting: HVLED815PF
- Commercial and street lighting: HVLED001A, HVLED001B, HVLED007

**DC-DC LED drivers**

ST’s monolithic buck switching regulators offer input voltage capability up to 61 V and deliver output currents up to 4 A with high switching frequency. They enable simple, efficient and cost-effective solutions for driving high-brightness LEDs. They also feature dedicated circuitry for dimming. Boost regulators provide the necessary high voltages to drive multiple LEDs in series, guaranteeing accurate LED current matching.

**DC-DC LED drivers converters**

<table>
<thead>
<tr>
<th>LED2000</th>
<th>Buck</th>
<th>Buck-boost</th>
<th>I_{vin}</th>
<th>Dimming</th>
<th>V_{vin}</th>
<th>Synchronous</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED2001</td>
<td></td>
<td></td>
<td>3 A</td>
<td></td>
<td>18 V</td>
<td></td>
</tr>
<tr>
<td>ST1CC40</td>
<td></td>
<td></td>
<td>3 A</td>
<td></td>
<td>18 V</td>
<td></td>
</tr>
<tr>
<td>LED5000</td>
<td></td>
<td></td>
<td>3 A</td>
<td></td>
<td>48 V</td>
<td></td>
</tr>
<tr>
<td>LED6000</td>
<td></td>
<td></td>
<td>3 A</td>
<td></td>
<td>61 V</td>
<td></td>
</tr>
</tbody>
</table>

**DC-DC LED drivers controllers**

<table>
<thead>
<tr>
<th>Reverse</th>
<th>Buck</th>
<th>Boost &amp; Sepic</th>
<th>Dimming</th>
<th>V_{vin}</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVLED002</td>
<td></td>
<td></td>
<td></td>
<td>150 V</td>
</tr>
<tr>
<td>LED6001</td>
<td></td>
<td></td>
<td></td>
<td>36 V</td>
</tr>
<tr>
<td>STLDC08</td>
<td></td>
<td></td>
<td></td>
<td>3.6 V</td>
</tr>
</tbody>
</table>

**Topology examples**

![Topology examples diagram]

**MAIN APPLICATIONS**

- Halogen bulbs replacements and home appliances: LED5000, LED6000
- Traffic signals: LED5000, LED5001, ST1CC40, LED6000, LED6001, HVLED002
- Commercial and architectural lighting: LED6000, LED6001, LED6002

Note: * output power for European input voltage 230 Vac
LED row drivers

ST's LED row drivers 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 array drivers

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

Channels

<table>
<thead>
<tr>
<th>Channels</th>
<th>STLED316S</th>
<th>STP16C*/D*</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>LED2472G</td>
<td>STP24DP05</td>
</tr>
<tr>
<td>16</td>
<td>LED1202</td>
<td>STP16C*/D*</td>
</tr>
<tr>
<td>12</td>
<td>STP4CMIP</td>
<td>STP08</td>
</tr>
<tr>
<td>4</td>
<td>STP04</td>
<td></td>
</tr>
</tbody>
</table>

24 channel RGB (8x3) drivers
- Current gain control (LED2472G), constant current (STP24DP05)
- Error detection
- Autopower saving (LED2472G)

12/16 channel drivers
- Current gain control (LED1642GW), constant current (STP16C*/D*)
- Error detection (STP16C*/D*)
- Dot correction (LED1202)
- Autopower saving
- Local dimming (LED1642GW, LED1202), global dimming (STP16C*/D*)

4/8 channel drivers
- Constant current
- Direct I/O (LED8102S)
- Error detection (STP08)
- Global dimming

4 Digit, 66 LED Matrix
- 40 mA Current capability
- 6 Key-scanning (8 x 2 matrix)
- 3-wire serial bus interface

16 Digit, 56 LED Matrix
- 40 mA Current capability
- 6 Key-scanning (8 x 2 matrix)
- 3-wire serial bus interface

5 x 24 matrix
- 20 mA/dot
- Adjustable luminance for each LED (dot)
LED bypass protection
The LBP01 series of LED bypass protection devices are bypass switches that can be connected in parallel with 1 or 2 LEDs. In the event of a LED failure, this device shunts the current through other LEDs. It also provides overvoltage protection against surges as defined in IEC 61000-4-2 and IEC 61000-4-5.

LBP01 get reliable your led application
- Keep LED strings on in case of LED open mode failure
- Reduced maintenance cost
- Increase lifetime of the lighting system

LED bypass protection

MAIN APPLICATIONS
- Display panels
- Residential, commercial, architectural and street lighting
- Emergency lighting
- Traffic signals

www.st.com/lbp01

LINEAR VOLTAGE REGULATORS
ST offers a complete portfolio of industry-standard high-performance regulators for both positive and negative outputs. Among our products, you can find the optimal combination of ultra-low dropout voltage (from 50 to 220 mV for 100 mA to 3 A load current) and low quiescent current - for the highest efficiency design – (from 0.3 to 20 μA for 50 mA to 2 A) or dynamic performance for the best transient response, power supply ripple rejection (up to 92 dB at 1 kHz) and low noise (as low as 6.3 μVrms). All this coupled with a choice of the smallest form factor packages for size-conscious applications such as a 0.47 x 0.47 mm STSTAMP™ package.

Ulta-low dropout • High efficiency in low-/medium-power applications • Best cost/performance trade-off • Large offer for Iout capability and packaging
Low 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
- Healthcare
- Home appliances
- Automotive ADAS, ECU

www.st.com/diagram-regulators
METERING ICs

STP3M2, STP3M3, STP3M4 are high accuracy AFE (Analog Front End) for DC and AC energy measurement, offering high accuracy down to extremely low current typical of home appliances in stand-by. A full set of on-board features provides high system integration and enable on-chip power quality monitoring, reducing smart-meter cost of ownership, and contributing to a fast and easy design to dramatically reduce manufacturing time and cost.

STP3M4: 4 independent channels block diagram

- 24-bit ΣΔ ADC
- Bias ref.
- Topology
- Servers power monitor
- Solar charging
- EV charging

KEY FEATURES
- Up to 4 independent 2nd order ΣΔ 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
- Multiple host interfaces 5 and 3 wires SPI, UART
- 2x, 8x LNA
- Key energy parameters calculations
- Case removal and Neutral Anti-tamper detection
- I, V bit stream available to host controller for customer own processing
- 3.6 kHz Bandwidth
- Very fast single point calibration
- AC and DC measurement
- Multiple sensors support: Shunt, current transformer, Rogowsky coils
- 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
- > 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
- 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
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- AC and DC measurement
- Multiple sensors support: Shunt, current transformer, Rogowsky coils

STP3M2

The STP3M2, also called smart-sensor, is a dual SD module with embedded PGA. In combination with a microcontroller that embeds DFSDM filters allows you to position the A/D conversion (STP3M2) very close to the current transducers, so minimizing noise capture from the analog tracks. Once converted, the stream 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,
- Fast digital calibration
- Allows the use of multiple shunts

MAIN APPLICATIONS
- Energy metering
- EV charging
- Lighting
- Smart plug
- Servers power monitor
- Solar charging
Low-voltage power MOSFETs

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

K5 series
- Very low RDS(on)
- Small Qg and capacitance
- Small packages
- Suited for hard switching topologies

M6 series
- Extremely low RDS(on)
- High switching speed
- Suited for hard switching topologies

M5 series
- Very good RDS(on)
- Soft diode recovery
- Suited for OR-ing, square-wave HB, battery management

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

H6 series
- Very good RDS(on)
- Soft diode recovery
- Suited for OR-ing, square-wave HB, battery management

H5 series
- Extremely low RDS(on)
- High switching speed
- Suited for hard switching topologies

H6 series
- Extremely low RDS(on)
- Optimized for light load conditions
- Tailored for high-frequency applications (M2-EP)
- Suited for hard switching & ZVS/LLC topologies

F7 series
- Wide voltage range
- Soft diode recovery
- Very good RDS(on)
- Suited for load-safety switch, buck and sync rectification

F6 series
- Extremely low RDS(on)
- Optimized body diode (low Qrr) and intrinsic capacitance for an excellent switching performance
- Proper Crss/Ciss ratio for best-in-class EMI performance
- Outstanding performance for motor control and synchronous rectification

DK5 Series
- Lowest trr @ Very High Voltage BVdSS
- High dv/dt capability
- Targeting high power 3-phases industrial equipment

DM2 & DM6 series
- Lower RDS(on) x area vs previous generation
- Extremely low gate charge (Qg)
- Optimized capacitances profile for better efficiency @ light load
- Optimized threshold voltage (VTH) and gate resistance (RG) values for soft switching

Main applications
- UPS, solar inverters, welding, HEVs, and UPS
- Residential, commercial, and street lighting
- Small motor control and USB battery chargers
- HDD, power tools, STB, and game consoles
- Server/Telecoms
- UPS, e-bikes, and fans
- Inverters, forklifts, and EHVs

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’s silicon carbide (SiC) MOSFETs feature very low RDS(on) per area for the new 650 V/1200 V Gen2 product families, combined with excellent switching performance, translating into more efficient and compact designs.

ST is among the first companies to produce high-voltage SiC MOSFETs. These new families feature the industry’s highest temperature rating of 200 °C for improved thermal design of power electronics systems.

Compared to silicon MOSFETs, SiC MOSFETs also feature significantly reduced switching losses with minimal variation versus the temperature. These features render the device perfectly suitable for high-efficiency and high power density applications.

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

SIC MOSFETS MAIN BENEFITS
- VBR = 1700 V (SCT*N170), 1200 V (SCT*N120G2), 650 V (SCT*N65G2)
- Low power losses at high temperature
- High operating temperature capability (200 °C)
- Body diode with no recovery losses
- Low power losses at high temperatures
- Easy to drive
- Low gate charge (SCT*N65G2)

Through-Hole Extended Package Range

Surface Mount Extended Package Range

AcePack™ SMT

Power Flat 8x8

Bare die business available upon customer request

Main Applications

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

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

SiC MOSFETs, the real breakthrough in high voltage switching
POWER OVER ETHERNET ICs

Power over Ethernet (PoE) is a widely adopted technology used to transfer both data and electrical power over an RJ-45 cable. ST offers solutions for PoE applications on the powered devices (PD) side that integrate a standard power over Ethernet (PoE) interface and a current mode PWM controller to simplify the design of the power supply sections of all powered devices. ST’s PoE-PD ICs are compliant with both the more recent IEEE 802.3bt specification.

- 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

- 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

- PoE-PD (IEEE 802.3at)
- PoE-PD (IEEE 802.3bt)

Power over Ethernet power supply protection

- Power supply 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

ST’s ACEPACK power modules come with diverse topologies that address industrial applications such as motor drives, solar inverters, charging stations, UPS, welding tools and power converter solutions, while they are also suitable for electric vehicle power applications like on-board chargers (OBC), electric traction drives and power converter solutions. These highly reliable and compact power modules, featuring an embedded NTC thermistor, offer the best compromise between conduction and switching losses, maximizing the efficiency of any converter system in hard-switching circuits for an application range from few kW to hundreds of kW. For a flexible and stable mounting, PressFIT and additional soldered pin options are provided. These power modules implement power semiconductor switches based on ST’s state-of-the-art SiC MOSFET and IGBT technologies.

ACEPACK 1
- Up to 15 kW
- ACEPACK DRIVE
- 120 kW to 280 kW

ACEPACK 2
- Up to 30 kW

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

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

ACEPACK DRIVE
- 120 kW to 280 kW
ESD protection

Driven by market needs, ST’s ESD protection devices are available as single line devices for flexibility and multi-line arrays for integration in compact application. All 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 & 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

**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

**www.st.com/esd-protection**
STDRIVE MOSFET AND IGBT GATE DRIVERS

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

**600 V gate drivers**
- Half bridge
  - 4 A source/sink driver high current capability (L6491)
  - Integrated bootstrap diode
  - Adjustable deadtime (L6494L)
  - Comparator, op amp integrated, smart SD, interlocking and program. DT (L6390)
  - Extended temperature range (A version)
- 3-Phase
  - Best In Class for propagation delay 85 ns
  - 200 mA/350 mA sink / source driver current capability
  - Integrated bootstrap diode

**Low side drivers**
- 2 level turn-off (TD352)
- Miller clamp (TD351)
- Pulse transf / opto input (TD350)
- Dual independent low side driver (PM8834)
- 4 A source/sink driver high current capability (PM8834)

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

**STDRIVE600 - 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
### T-series TRIACs

- 6-25 A are becoming an all-load device with its 800 V capability.
- EMC immunity and commutation are twice those of standard devices leading to not only the capability of a larger range of acceptable resistive, inductive loads or complex ones.
- The new 2000 V RMS insulated packages in TO-220 Ins ceramic insulator version of the T-series or D2PAK SMD adapt to high thermal performance or automated manufacture design.

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

<table>
<thead>
<tr>
<th>Part number</th>
<th>Package</th>
<th>IT (RMS) max. (A)</th>
<th>VRRM/VDRM (V) max. (V)</th>
<th>Ioff max. (mA)</th>
<th>Ids(on) @ Tj 150 °C min. (A)</th>
<th>dV/dt @ Tj 150 °C min. (V/µs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T635T-8</td>
<td>T</td>
<td>30 A, 1200 V</td>
<td>150</td>
<td>80</td>
<td>8</td>
<td>3²</td>
</tr>
<tr>
<td>T835T-8</td>
<td>I</td>
<td>60 A, 1200 V</td>
<td>100</td>
<td>160</td>
<td>12</td>
<td>12²</td>
</tr>
<tr>
<td>T1235T-8</td>
<td>G</td>
<td>80 A, 1200 V</td>
<td>200</td>
<td>160</td>
<td>20</td>
<td>21²</td>
</tr>
<tr>
<td>T1635T-8</td>
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<td>100 A, 1200 V</td>
<td>200</td>
<td>160</td>
<td>20</td>
<td>18²</td>
</tr>
</tbody>
</table>

### THYRISTORS

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

#### MAIN APPLICATIONS
- Automotive Grade SCR AECQ101 qualified
- Optimized for Industrial, Building and Residential appliances and based on ST’s new high-temperature technology, our 800 V 8H TRIacs can work at 150 °C without compromise. Enabling designers to maximize current density or reduce the heatsink size by up to 50%, these triacs are the right choice to run in very hot, confined environments and improve the reliability of systems such as lighting, compact heater, starter or solid-state relay.

<table>
<thead>
<tr>
<th>Part number</th>
<th>Package</th>
<th>IT (RMS) max. (A)</th>
<th>VRRM/VDRM (V) max. (V)</th>
<th>Ioff max. (mA)</th>
<th>Ids(on) @ Tj 150 °C min. (A)</th>
<th>dV/dt @ Tj 150 °C min. (V/µs)</th>
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<td>TN3050H-12</td>
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<tr>
<td>TN4050H-12</td>
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<td>160</td>
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<th>Part number</th>
<th>Package</th>
<th>IT (RMS) max. (A)</th>
<th>VRRM/VDRM (V) max. (V)</th>
<th>Ioff max. (mA)</th>
<th>Ids(on) Amax</th>
<th>dV/dt Amax @ 150 °C min. (V/µs)</th>
<th>dV/dt Amax @ 10 °C min. (V/µs)</th>
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<td>TN3015H-6</td>
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<tr>
<td>TN3015H-6</td>
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<th>VRRM/VDRM (V) max. (V)</th>
<th>Ioff max. (mA)</th>
<th>Ids(on) Amax</th>
<th>dV/dt Amax @ 150 °C min. (V/µs)</th>
<th>dV/dt Amax @ 10 °C min. (V/µs)</th>
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<td>200</td>
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USB TYPE-C™ AND POWER DELIVERY CONTROLLERS

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

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

MCU based solutions

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

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

A companion Type-C Port Protection device TCP01-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, TCP02-M18 is proposed for advanced protection of the USB-C connector line in source applications with integrated power delivery PHY.

Our STM32G081B-EVAL is proposed with two USB-C ports offering 45 W of power with different profiles. Our well-known STM32 configurator STM32CubeMx supports easy setting of UCPD. Associated with our professional-grade STM32CubeMonitor-UCPD software GUI, the kit acts as a USB PD analyzer and allows to develop USB-C sink, source and dual role devices in a wide range of embedded applications. UCPD enabled STM32G0/G4/5 allows to migrate embedded applications to USB-C and Power Delivery technology while managing other application environment thanks to the versatile feature set and peripherals available in a traditional MCU.

STM32 USB PD3.0 controllers

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

This new IP, available in STM32G0/G4/L5 series, allows to develop USB-C sink, source and dual role devices in a wide range of embedded applications. UCPD enabled STM32G0/G4/5 provides a high flexibility to migrate embedded applications to USB-C and Power Delivery technology while managing other application environment thanks to the versatile feature set and peripherals available in a traditional MCU.

STM32 USB PD3.0 controllers are certified PD3.0 and support all new features such as C-Authentication and Programming Power Supply (PPS).

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

STM32G081 block diagram

STM32 USB-C Ecosystem: for short time-to-market

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

Our well-known STM32 configurator STM32CubeMx supports easy setting of UCPD. An evaluation board STM32G081B-EVAL is proposed with two USB-C ports offering 45 W of power with different profiles.
Type-C Port Protection

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

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

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

- Optional interface to MCU (I2C + IRQ)
- Dead battery support
- QFN and CSP package available
- SOURCE power budget reporting
- Input Over Voltage protection
- OFN and CSP package available
- SOURCE power profile reporting
- STSW-STUSB002: GUI
- STSW-STUSB003: optional open source software drivers for dynamic power Management
- Mini-dongle: EVAL-SCS001V1
- STUSB4500L
- USB-C 5V SINK
- Dead battery support
- QFN and CSP package available
- SOURCE power profile reporting
- Mini-dongle: EVAL-SCS002V1

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

STUSB1602
- USB-C 5V SOURCE
- High Voltage protections
- GPIO-controlled current profile
- Power sharing, Thermal protection
- VBUS powered (no LDO needed)
- AEC-Q100 available
- MCU supported:
  - STSW-STUSB010: STM32F072
  - STSW-STUSB011: STM32F469
  - STSW-STUSB014: STM32G474
  - STSW-STUSB015: STM32L4R5

STUSB1600
- USB-C 5V 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 scenarios 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-STUSB011: STM32F469
  - STSW-STUSB014: STM32G474
  - STSW-STUSB015: STM32L4R5

STUSB4500
- USB PD SINK
- Dead Battery support
- VBUS powered (ZERO power on VBAT)
- Input Over Voltage protection
- OFN and CSP package available
- SOURCE power profile reporting
- STSW-STUSB002: GUI
- STSW-STUSB003: optional open source software drivers for dynamic power Management
- Mini-dongle: EVAL-SCS001V1

STUSB4500L
- USB-C 5V SINK
- Dead battery support
- VBUS powered (ZERO power on VBAT)
- Input Over Voltage protection
- OFN and CSP package available
- Mini-dongle: EVAL-SCS002V1

www.st.com/usb-type-C
life.Enumeration