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## Applications
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- Power supplies
- Wearable Devices - Power Management
- LED lighting and controls
- Electro-Mobility
- Industrial power & tools
- Major home appliances

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- Battery management ICs (wired and wireless)
- DC-DC switching conversion ICs
- Digital power controllers and microcontrollers
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- Hot-swap power management
- IGBTs
- Intelligent power switches
- LED drivers
- Linear voltage regulators
- LNB supplies
- Photovoltaic ICs
- Power MOSFETs (silicon and SiC)
- Power over ethernet ICs
- Protection devices
- STDRIVE MOSFET and IGBT gate drivers
- USB Type-C and power delivery controllers
Introduction

More than 25 years of technology innovation in power management directly resulting in value creation for our customers, from products to system solutions

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

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

The technological innovation that has been at the core of ST’s strategy for more than 25 years is the reason why ST today can offer an extensive range of cutting-edge products for power and energy management. ST’s portfolio includes higher-efficiency power technologies such as silicon carbide power discretes, HV and LV power MOSFETs, IGBTs and customized power modules, diodes and protection devices, AC-DC converters and controllers, DC-DC converters, linear voltage regulators and analog ICs, battery management ICs, digital controllers and STM32 microcontrollers, MOSFET and IGBT gate drivers. Moreover, ST offers a variety of high performance sensors as well as wireless and wired connectivity ICs to complement the latest smart power electronics applications with additional sensor-driven features and monitoring functions.

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

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

Solar Centralized Generation - Solar Inverters (String and Central)

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

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

Typical Block Diagram for String Inverter
## ST’S PRODUCT OFFERING FOR STRING AND CENTRAL SOLAR INVERTER

<table>
<thead>
<tr>
<th>Power MOSFETs</th>
<th>IGBTs</th>
<th>Power Modules</th>
<th>Diodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>600 V-650 V MDmesh DM2, ST<em>60DM2, ST</em>65DM2</td>
<td>600 V V series, STG*60DF</td>
<td>600 V Ultrafast, STTH<em>06, STTH</em>R06</td>
<td>600 V Ultrafast, STTH<em>06, STTH</em>R06</td>
</tr>
<tr>
<td>650 V MDmesh M5, ST*65M5</td>
<td>650 V HB series, STG*65DFB</td>
<td>1200 V Ultrafast, STTH*12</td>
<td>1200 V Ultrafast, STTH*12</td>
</tr>
<tr>
<td>1200 V MDmesh K5, ST*N120K5</td>
<td>650 V HB2 series, STG*65DFB2</td>
<td>SiC Diodes, STPS<em>C065, STPS</em>C12</td>
<td>SiC Diodes, STPS<em>C065, STPS</em>C12</td>
</tr>
<tr>
<td>SiC MOSFETs</td>
<td>650 V M series, STG*M65DF2</td>
<td>ACEPACK Power Modules</td>
<td>ACEPACK Power Modules</td>
</tr>
<tr>
<td>SCT*N65G2</td>
<td>1200 V H series, STG*H120DF2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCT*N120</td>
<td>1200 V V series, STG*M120DF3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCT*N120G2</td>
<td>1200 V M series, STG*M120DF3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Inverter Power Stage

- **MCUs**: STM32F334, STM32F1, STM32F4, STM32F7, STM32H7, STM32G4
- **MOSFET and IGBT Gate Drivers**: HV HB Gate Drivers L649*, Isolated Gate Drivers STGAP*, Multiple LS Gate Drivers PM834, Single LS Gate Drivers PM88*1

### Inverter Driving & Control stage

- **MCUs**: STM32 Mainstream MCUs
- **EEPROM**: Standard Serial EEPROM

### Data Logger/Internet Gateway

- **MCUs**: STM32F0, STM32G0, STM32F1, STM32F3
- **Motion Sensors**: Accelerometer IIIS30HHC, LIS2DH12, LIS2DHC
- **Environmental Sensors**: Pressure - LPS22HB, Temperature - STLM20, Humidity - HTS221

### Solar Tracker

- **MCUs**: STM32F0, STM32G0, STM32F1, STM32F3
- **Motion Sensors**: Accelerometer IIIS30HHC, LIS2DH12, LIS2DHC
- **Environmental Sensors**: Pressure - LPS22HB, Temperature - STLM20, Humidity - HTS221

### Note

* is used as a wildcard character for related part number.

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**Typical Block Diagram for Central Inverter**

![Typical Block Diagram for Central Inverter](image-url)
Solar Distributed Generation - Microinverter

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

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

ST’S PRODUCT OFFERING FOR MICROINVERTER

<table>
<thead>
<tr>
<th>Power MOSFETs</th>
<th>Diodes</th>
<th>Protections</th>
<th>Signal Conditioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 V-100 V STripFET F7</td>
<td>600 V Ultrafast STTH*906</td>
<td>TVS for power rail surge</td>
<td>Precision Op Amps (&lt;50 MHz)</td>
</tr>
<tr>
<td>ST<em>N8F7, ST</em>N10F7</td>
<td>1200 V Ultrafast STTH*S12</td>
<td>S7MA6F, S7MB15F series</td>
<td>T*, TSV*, LMV*</td>
</tr>
<tr>
<td>600 V-650 V MDmesh DM2</td>
<td>SiC Diodes STPSC*065</td>
<td>ESD and</td>
<td>Current Sensing TSC*</td>
</tr>
<tr>
<td>ST<em>60DM2, ST</em>65DM2</td>
<td>STPSC*12</td>
<td>High Speed Port (HSP) series</td>
<td></td>
</tr>
<tr>
<td>800 V-900 V MDmesh K5</td>
<td></td>
<td>for Ethernet and USB protection</td>
<td></td>
</tr>
<tr>
<td>ST<em>80K5, ST</em>90K5</td>
<td></td>
<td></td>
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<tr>
<td>SiC MOSFET STCN65G2</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Microinverter Power Stage</th>
<th>MOSFET and IGBT Gate Drivers</th>
<th>Sensors</th>
<th>Connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>STM32F334</td>
<td>HV HB Gate Drivers L649*</td>
<td>Temperature - STLM20</td>
<td>Bluetooth Low Energy</td>
</tr>
<tr>
<td>STM32F1</td>
<td>Isolated Gate Drivers ST54*</td>
<td>Temperature - STTS751</td>
<td>Power Line Transceivers</td>
</tr>
<tr>
<td>STM32F3</td>
<td>Multiple LS Gate Drivers</td>
<td>Temperature - LM135</td>
<td>USB</td>
</tr>
<tr>
<td>STM32F4</td>
<td>PM8834</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32H7</td>
<td>Single LS Gate Drivers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32G4</td>
<td>PM881*</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Microinverter Driving &amp; Control stage</th>
<th>Protocols</th>
<th>Protocols</th>
<th>Protocols</th>
</tr>
</thead>
<tbody>
<tr>
<td>STM32 Mainstream MCUs</td>
<td>TVS series for power rail protection</td>
<td>Standard Serial EEPROM</td>
<td>Supportive Protocols</td>
</tr>
<tr>
<td>STM32F0</td>
<td>RS232, RS485, Power Line Transceivers</td>
<td>Ethernet Transceivers</td>
<td>USB</td>
</tr>
<tr>
<td>STM32G0</td>
<td>ESD and High Speed Port (HSP) series for Dataline ESD and EOS protection</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Typical Block Diagram
Solar Distributed Generation - Power Optimizer

In architectures based on the use of power optimizers, the maximum power point tracking (MPPT) function is performed at the level of each photo-voltaic panel so they all operate at their maximum power point. This results in an improved energy yield of the overall solar system compared to traditional string or central inverter based architectures.

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

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

**ST’S PRODUCT OFFERING FOR POWER OPTIMIZER**

<table>
<thead>
<tr>
<th>Power Optimizer</th>
<th>MCUs</th>
<th>Power MOSFETs</th>
<th>Gate Drivers</th>
<th>Diodes</th>
<th>Protections</th>
<th>Connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>STM32F334</td>
<td>60 V to 100 V</td>
<td>STripFET F7</td>
<td>HV HB Gate Drivers L649*</td>
<td>100 V to 200 V</td>
<td>SMA6F, SMB15F series</td>
<td>Bluetooth Low Energy</td>
</tr>
<tr>
<td>STM32F0</td>
<td>ST*N6F7</td>
<td>ST*N8F7</td>
<td>ST*N10F7</td>
<td>Power Schottky STPS<em>30 STPS</em>45 Power Schottky STPS<em>100 STPS</em>200</td>
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</tr>
<tr>
<td>STM32G0</td>
<td>ST*N120G2</td>
<td>Multiple LS Gate Drivers PM8834</td>
<td>45 V FERD FERD<em>45 100 V FERD FERD</em>100</td>
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<tr>
<td>STM32F3</td>
<td>STGAP*</td>
<td>Single LS Gate Drivers PM88*1</td>
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<td>STM32F4</td>
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<td>STM32F7</td>
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<tr>
<td>STM32H7</td>
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<tr>
<td>STM32G4</td>
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<table>
<thead>
<tr>
<th>Inverter</th>
<th>MCUs</th>
<th>Power MOSFETs</th>
<th>IGBTs</th>
<th>Diodes</th>
<th>Protections</th>
<th>Connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>STM32F334</td>
<td>600 V to 45 V</td>
<td>STG<em>V60DF 45 V FERD FERD</em>45</td>
<td>600 V Ultrafast STTH<em>06 STTH</em>06 SIC Diodes STPS<em>065 STPS</em>12</td>
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</tr>
<tr>
<td>STM32F1</td>
<td>STG<em>H65DFB 650 V HB series STG</em>H65DFB2 650 V M series STG<em>M65DF2 1200 V M series STG</em>M120DF3</td>
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<td>STM32F3</td>
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<td>STM32F7</td>
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<td>STM32H7</td>
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<tr>
<td>STM32G4</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Logger/Internet Gateway</th>
<th>MCUs</th>
<th>EEPROM</th>
<th>Protections</th>
<th>Connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>STM32 Mainstream MCUs</td>
<td>Standard Serial EEPROM</td>
<td>ESD and High Speed Port (HSP) series for DataLine ESD and EOS protection</td>
<td>Bluetooth Low Energy</td>
<td></td>
</tr>
<tr>
<td>STM32F0</td>
<td></td>
<td></td>
<td>Power Line Transceivers USB</td>
<td></td>
</tr>
<tr>
<td>STM32G0</td>
<td></td>
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</tbody>
</table>

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

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

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

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

Interacting with the grid, the batteries and potentially with solar panels, the power converters at the heart of these systems must operate with high-efficiency and superior reliability over time. We can provide a range of power discretes including silicon-carbide (SiC) and silicon power transistors, ACEPACK power modules, silicon-carbide (SiC) and silicon diodes, isolated gate drivers and high-performance STM32 microcontrollers as well as energy metering ICs to help develop high-efficiency commercial battery storage systems.

Typical Block Diagram - Home Battery Storage System
ST’S PRODUCT OFFERING FOR HOME & COMMERCIAL BATTERY STORAGE SYSTEMS

<table>
<thead>
<tr>
<th>Power Stage</th>
<th>DC-DC Converter</th>
<th>Diodes</th>
<th>MOSFET and IGBT Gate Drivers</th>
<th>Protections</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC-AC Converter</td>
<td>MOSFET/IGBT Drivers</td>
<td>Power Transistors</td>
<td>Datasheet</td>
<td>Datasheet</td>
</tr>
<tr>
<td>Power Stage</td>
<td>Diodes</td>
<td>Connectors</td>
<td>Signal Conditioning</td>
<td>Protection</td>
</tr>
<tr>
<td>DC-AC Converter</td>
<td>Power Stage</td>
<td>Diodes</td>
<td>MOSFET and IGBT Gate Drivers</td>
<td>Protections</td>
</tr>
<tr>
<td>System Control Stage</td>
<td>MCU</td>
<td>Signal Conditioning</td>
<td>EEPROM</td>
<td>Sensors</td>
</tr>
<tr>
<td>Data Logger/Internet Gateway</td>
<td>MCU</td>
<td>Protocols</td>
<td>EEPROM</td>
<td>Connectivity</td>
</tr>
</tbody>
</table>

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

Diagram showing typical block diagram of a commercial battery storage system.
POWER SUPPLIES

Auxiliary SMPS

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

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

Isolated Auxiliary SMPS

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

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

ST’S RECOMMENDED PRODUCT FOR ISOLATED AUXILIARY SMPS

<table>
<thead>
<tr>
<th>Isolated flyback</th>
<th>HV converters</th>
<th>Offline controllers</th>
<th>HV Power MOSFETs</th>
<th>MOSFET Protection</th>
<th>Clamping diodes</th>
<th>Voltage Ref CC/CV Ctrl</th>
<th>Output diodes</th>
<th>LDO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulated with optocoupler</td>
<td>PSR-CV</td>
<td>VIPer5, VIPer7, VIPer8</td>
<td>STCH02, STCH03, L6566B, L6565</td>
<td>800 V to 1700 V MDmesh K5, ST80K5, ST9K5, ST105K5, ST120K5, ST150K5, ST12N170K5</td>
<td>SMA6F, SMB15F series</td>
<td>600 V Ultrafast STTH<em>06, 800 V to 1200 V Ultrafast STTH</em>08, STTH<em>08, STTH</em>10, STTH*12</td>
<td>Voltage Reference T<em>431 T</em>432, Voltage and Current Ctrl TSM*, SEA*</td>
<td>Schottky, FERD STPS*, FERD<em>45, FERD</em>50, FERD<em>60, FERD</em>100, Low Dropout (LDO) Linear Regulators LDF LDFM LDK220 LDK320 LDL212</td>
</tr>
</tbody>
</table>

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

Typical configuration for isolated auxiliary power supply

![Typical configuration for isolated auxiliary power supply](image)

MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

- **STEVAL-VP26K01F**
  - Three outputs, isolated flyback converter with extended input voltage range for Smart Meter and Power Line Communication

- **STEVAL-ISA181V1**
  - 12 V / 600 mA flyback converter with Zero Power remote control

- **STEVAL-ISA184V1**
  - 5 V/1.2 A, 12 V/750 mA double output flyback converter
Non Isolated Auxiliary SMPS

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

A buck – step-down – topology can be used to generate a positive output with respect to the common terminal and a buck-boost – or step-down/up – 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 PRODUCT FOR NON-ISOLATED AUXILIARY SMPS**

<table>
<thead>
<tr>
<th></th>
<th>HV converters</th>
<th>VIPER Protection</th>
<th>Clamping diodes</th>
<th>Output diodes</th>
<th>LDO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buck</td>
<td></td>
<td>VIPer0P</td>
<td>SJST*6</td>
<td>600 V Ultrafast STTH*06</td>
<td>Low Dropout (LDO) Linear Regulators</td>
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<tr>
<td></td>
<td></td>
<td>VIPer*1</td>
<td>SJST*8</td>
<td>800 V to 1200 V Ultrafast STTH*08</td>
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<tr>
<td></td>
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<td>VIPer*6</td>
<td>SM6F, SMB15F series</td>
<td>800 V to 1200 V Ultrafast STTH*10</td>
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<tr>
<td></td>
<td></td>
<td>VIPer122</td>
<td></td>
<td>Schottky, FERD STPS*</td>
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<td>FERD<em>45, FERD</em>50, FERD<em>60, FERD</em>100</td>
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<td>Buck-boost</td>
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<tr>
<td>Non-isolated flyback</td>
<td></td>
<td>SMA6F, SMB15F series</td>
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</tr>
</tbody>
</table>

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

Typical configurations for non isolated auxiliary power supply

**MAIN EVALUATION BOARDS**

- **STEVAL-ISA115V1**
  - 12 V, 150 mA buck converter
- **STEVAL-ISA178V1**
  - 5 V / 0.2 A buck converter
- **STEVAL-ISA195V1**
  - 5 V / 0.36 A buck converter
- **STEVAL-ISA196V1**
  - 5 V / 1.2 A non-isolated flyback converter
Smart Chargers and Adapters
Today, many device charging technologies and standards designed to ensure interoperability and improve convenience and ease of use are available, including wireless charging, quick charge and USB Type-C and Power Delivery.
ST can help engineers design charging solutions that meet requirements set by the mainstream standards—as well as proprietary charging protocols—with innovative converter architectures enabling best-in-class energy efficiency and power density as well as ensuring the lowest possible stand-by power.

USB Type-C™ PD Adapters and Quick Chargers
The new slim and reversible USB Type-C™ connector with USB Power Delivery (PD) feature provides up to 100 W (20 V, 5 A) enabling a faster and more efficient charging solution. Having considerably expanded the capability of USB devices, these connectors are now widely found in wall chargers and adapters.
Designers of USB Type-C™ and Power Delivery compliant adapters and wall chargers can benefit from stand-alone controllers, from STM32 microcontrollers and their associated protocol stack, our STSAFE secure element as well as a specifically developed range of protection and filtering devices.

ST’S RECOMMENDED PRODUCT FOR USB TYPE-C POWER DELIVERY SUBSYSTEM

<table>
<thead>
<tr>
<th>Type-C and USB-PD Controllers</th>
<th>Autentication &amp; Secure MCUs</th>
<th>High surge current compact protection (Vbus)</th>
<th>Single and multi lines protection for MCUs Communication Channel (CC) and Side Band Use (SBU)</th>
<th>Over voltage protection for USB-C and PD 3.0 controllers</th>
<th>LDO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programmable Solutions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCUs</td>
<td>Type-C Controller/</td>
<td>Vrm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interface</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEVAL-USBPD45C</td>
<td>45 W USB Type-C™ Power</td>
<td>STEVAL-SMACH15V1</td>
<td>STEVAL-USBC2DP</td>
<td>STSAFE-A</td>
<td></td>
</tr>
<tr>
<td>STEVAL-SMACH15V1</td>
<td>Delivery adapter reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEVAL-USBC2DP</td>
<td>design</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Typical configuration

<table>
<thead>
<tr>
<th>Primary</th>
<th>Secondary</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFC</td>
<td>USB Power Delivery Controller</td>
</tr>
<tr>
<td>Primary Controller</td>
<td>USB Type-C™ Interface (PHY)</td>
</tr>
<tr>
<td>MOSFETs</td>
<td>Protocols</td>
</tr>
<tr>
<td>Diodes</td>
<td></td>
</tr>
</tbody>
</table>

Note: * available in Q3 2019

MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

STEVAL-USBD045C
45 W USB Type-C™ Power Delivery adapter reference design

STM32G071B-DISCO
STM32G0 world’s 1st USB PD 3.0 MCU and its full ecosystem

STEVAL-SMACH15V1
15 W 5 output USB adapter evaluation board

STEVAL-USBC2DP
USB Type-C™ to DisplayPort™ adapter
Typical block diagram with certified source and sink auto-run controllers

Source port

USB Type-C receptacle

DC/DC

SRC path

V_{bus}

STUSB47

Power supply
auto-run PD controller

Sink port (High power up to 100 W (20 Vbus))

USB Type-C receptacle

V_{bus}

SINK path

Load

STUSB45

Consumer device
auto-run PD controller

MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

STEVAL-ISC004V1
STUSB4710A USB Power Delivery controller evaluation board (with on-board DC-DC)

STEVAL-ISC005V1
STUSB4500 USB Power Delivery controller evaluation board

EVAL-SCS001V1
STUSB4500 reference design
Automotive-grade USB Type-C and Power Delivery solution

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

Typical Block Diagram for Automotive grade USB Power Delivery

MAIN EVALUATION TOOLS

Note: AEK-POW-L5964V1 power supply board coming soon
Adapters for Tablets, Notebook and AIO

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

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

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

ST’S RECOMMENDED PRODUCT FOR TABLETS, NOTEBOOK AND AIO ADAPTERS

<table>
<thead>
<tr>
<th>Controllers</th>
<th>Power MOSFETs</th>
<th>Diodes &amp; Discretes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PFC Block</strong></td>
<td>600 V-650 V MDmesh M2</td>
<td>600 V Ultrafast for TM</td>
</tr>
<tr>
<td>TM Analog Controllers</td>
<td>ST<em>60M2, ST</em>65M2, ST*60M2-EP</td>
<td>STTH<em>L06, STTH</em>06, STTH15AC06*</td>
</tr>
<tr>
<td>L6562A*, L6563*, L6564*</td>
<td>600 V-650 V MDmesh M6</td>
<td>600 V Ultrafast for CCM</td>
</tr>
<tr>
<td>CCM Analog Controllers</td>
<td>ST<em>60M6, ST</em>65M6</td>
<td>STTH<em>906, STTH</em>T06</td>
</tr>
<tr>
<td>L4981*, L4984D</td>
<td>650 V MDmesh M5</td>
<td></td>
</tr>
<tr>
<td>ST*65M5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Isolation Stage</th>
<th>Power MOSFETs</th>
<th>Diodes &amp; Discretes</th>
</tr>
</thead>
<tbody>
<tr>
<td>HV Converters &amp; Controllers</td>
<td>800 V to 950 V MDmesh K5</td>
<td>Output Diodes for Flyback</td>
</tr>
<tr>
<td>SSR: VIPerPlus</td>
<td>ST*80K5, ST**9K5</td>
<td>Schottky, FERD, STPS*,</td>
</tr>
<tr>
<td>VIPer<em>5, VIPer</em>7, VIPer*8</td>
<td>600 V-650 V MDmesh M2</td>
<td>FERD<em>45, FERD</em>50,</td>
</tr>
<tr>
<td>PSR: VIPer0P</td>
<td>ST<em>60M2, ST</em>65M2, ST*60M2-EP</td>
<td>FERD<em>60, FERD</em>100</td>
</tr>
<tr>
<td>VIPer12 VIPer6, ALTAIR*</td>
<td>600 V-650 V MDmesh M6</td>
<td>Clamping Diodes for Flyback</td>
</tr>
<tr>
<td>Flyback Controllers</td>
<td>ST60M6, ST*65M6</td>
<td>600 V to 1000 V Ultrafast</td>
</tr>
<tr>
<td>STCH02, STCH03, L6566A, L6566B, L6565</td>
<td>600 V-650 V MDmesh DM2</td>
<td>STTH<em>906, STTH</em>08, STTH*10</td>
</tr>
<tr>
<td>PFC &amp; LLC</td>
<td>ST60DM2, ST*65DM2</td>
<td>Output Diodes for LLC</td>
</tr>
<tr>
<td>Combo Controllers</td>
<td>600 V MDmesh DM6</td>
<td>Schottky, FERD</td>
</tr>
<tr>
<td>STCMB1, STNRG011</td>
<td>ST*60DM6</td>
<td>STPS*</td>
</tr>
<tr>
<td>LLC Analog Controllers</td>
<td>40 V-100 V STripFET F7</td>
<td>FERD<em>45, FERD</em>50,</td>
</tr>
<tr>
<td>L6599*, L6599</td>
<td>ST<em>N4F7, ST</em>N6F7, ST<em>N8F7, ST</em>N10F7</td>
<td>FERD<em>60, FERD</em>100</td>
</tr>
<tr>
<td>SR Analog Controllers</td>
<td>MOSFET protection for Flyback</td>
<td></td>
</tr>
<tr>
<td>SRK1000, SRK1001 for Flyback</td>
<td>SMA6F, SMB15F series</td>
<td></td>
</tr>
<tr>
<td>SRK2000A, SRK2001, SRK2001A for LLC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Typical Block Diagram with PFC Front-End

Alternative to LLC Converter

~ AC  Input Rect.  PFC  TM/CCM PFC controller  Output Rect.  V_{OUTDC}

LLC  Analog/Digital combo controller

Flyback  LLC controller

Flyback controller  Synch. Rect. controller

MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

| STEVAL-ISA170V1 | EVLCMB1-90WADP | EVLSTNRG011-150 | EVLCMB1-AIO210W |
| 12 V - 150 W resonant converter with synchronous rectification | 19 V - 90 W adapter based on TM PFC and HB LLC analog combo controller | 12 V - 150 W power supply based TM PFC and HB LLC digital combo controller | 12 V - 210 W adapter based on TM PFC and HB LLC analog combo controller |
Wireless Charging

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

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

We have a range of wireless battery charging solutions including transmitters and receivers providing low stand-by power and foreign objects detection (FOD) feature. In order to prevent unwanted damage to any NFC Cards that might be close to the wireless charging source during operation, it is recommended to add an NFC Reader. The NFC Reader is able to detect the presence of the NFC Card or Tag (ST Reader ICs can detect Type A, B, F, or V NFC Cards), and therefore instruct the operating system to stop transmitting power. ST also offers evaluation and development tools and reference designs to help develop high-efficiency and compact wireless chargers that are Qi compliant.

**ST’S RECOMMENDED PRODUCT FOR WIRELESS CHARGING**

<table>
<thead>
<tr>
<th>Wireless charging controllers, MCUs</th>
<th>Gate drivers</th>
<th>Power MOSFETs</th>
<th>Protections</th>
<th>Diodes</th>
<th>NFC reader</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STWBC, STW8C-EP, STW8C-MC, STW8C-WA, STM32F0, STM32F334, STM32G4</td>
<td>L6743B</td>
<td>STL10N2LLH5, STL10N2LLH5, ST6N3LLH6, ST710N3LLH5, ST60N1LLF3, ST60N1LLF3</td>
<td>STP5xL30, STP5xx45/60/100</td>
<td>SMM4F, SMA6F series, BAT30F4, BAR46</td>
<td>ST25R3911B, ST25R3912, ST25R3913, ST25R3916</td>
</tr>
<tr>
<td>Receiver</td>
<td>STWLC33, STM32F0</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

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

**Typical Block Diagram**

**Main Evaluation Boards and Reference Designs**

<table>
<thead>
<tr>
<th>Transmitters</th>
<th>Receivers</th>
<th>NFC readers</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEVAL-ISB045V1</td>
<td>STEVAL-ISB042V1</td>
<td>ST25R3911B-DISCO</td>
</tr>
<tr>
<td>2.5 W wireless charger transmitter evaluation kit</td>
<td>Dual mode wireless power evaluation board for Qi receiver and Qi-based transmitter</td>
<td>ST25R3911B based NFC Reader Discovery Board</td>
</tr>
<tr>
<td>STEVAL-ISB044V1</td>
<td>STEVAL-ISB047V1</td>
<td>EVALSTWBC-EP</td>
</tr>
<tr>
<td>Qi MP-A10 15 W wireless charger TX evaluation kit</td>
<td>Qi 3-coil 15 W wireless charger TX evaluation kit</td>
<td>Qi MP-A15 15W wireless charger TX evaluation kit</td>
</tr>
<tr>
<td>STEVAL-ISB045V2</td>
<td>ST25R3916-DISCO</td>
<td>ST25R3916-DISCO</td>
</tr>
<tr>
<td>Qi MP-A10 15 W wireless charger TX evaluation kit</td>
<td>ST25R3911B based NFC Reader Discovery Board</td>
<td>ST25R3916 based NFC Universal Device Discovery Board</td>
</tr>
</tbody>
</table>
Desktop PCs Power Supply

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

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

ST’S RECOMMENDED PRODUCT FOR DESKTOP PC’S POWER SUPPLY

<table>
<thead>
<tr>
<th>Controllers</th>
<th>Power MOSFETs</th>
<th>Diodes &amp; Discretes</th>
<th>Opamp V/I Sensing</th>
</tr>
</thead>
<tbody>
<tr>
<td>TM Analog Controllers</td>
<td>600 V-650 V MDmesh M2</td>
<td>600 V Ultrafast for TM</td>
<td>Precision Op Amps (&lt;50 MHz)</td>
</tr>
<tr>
<td>L6562A*, L6563*, L6564*</td>
<td>ST<em>60M2, ST</em>65M2, ST*60M2-EP</td>
<td>STTH<em>L06, STTH</em>06, STTH15AC06*</td>
<td>TS*, TSV*, LMV*</td>
</tr>
<tr>
<td>CCM Analog Controllers</td>
<td>600 V-650 V MDmesh M6</td>
<td>600 V Ultrafast for CCM</td>
<td>MOSFET and IGBT Gate Drivers</td>
</tr>
<tr>
<td>L4981*, L4984D</td>
<td>ST<em>60M6, ST</em>65M6</td>
<td>STTH<em>R06, STTH</em>T06</td>
<td>Multiple LS Gate Drivers</td>
</tr>
<tr>
<td>MCUs &amp; Digital Controllers</td>
<td>650 V MDmesh M5</td>
<td>SIC Diodes</td>
<td>PM8834</td>
</tr>
<tr>
<td>STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG, STNRGP01, STNRGP12</td>
<td>ST*65M5</td>
<td>STPSC*065</td>
<td>Single LS Gate Drivers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Controllers</th>
<th>Power MOSFETs</th>
<th>Diodes</th>
<th>E-Fuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFC &amp; LLC Combo Controllers</td>
<td>600 V-650 V MDmesh M2</td>
<td>Output Diodes Schottky, FERD STPS*</td>
<td>STEF01</td>
</tr>
<tr>
<td>STCMB1, STNRG011</td>
<td>ST<em>60M2, ST</em>65M2, ST*60M2-EP</td>
<td>FERD<em>45, FERD</em>50, FERD<em>60, FERD</em>100</td>
<td>STEF05</td>
</tr>
<tr>
<td>LLC Analog Controllers</td>
<td>600 V-650 V MDmesh M6</td>
<td></td>
<td>STEF12</td>
</tr>
<tr>
<td>L6599*, L6699</td>
<td>ST<em>60M6, ST</em>65M6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asymmetrical HB Controllers</td>
<td>600 V-650 V MDmesh DM2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L6591</td>
<td>ST<em>60DM2, ST</em>65DM2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCUs &amp; Digital Controllers</td>
<td>600 V MDmesh DM6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG</td>
<td>ST*60DM6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR Analog Controllers</td>
<td>40 V-100 V StriFET F7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Typical configuration

MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

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

EVL400W-EUPL7
12 V - 400 W SMPS for adapters and ATX power supplies Desktop and AIO
Server & Telecom Power

AC-DC PSU & DC-DC power distribution

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

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

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

Typical Block Diagram for Server PSU
## ST’S PRODUCT OFFERING FOR SERVER AND TELECOM AC-DC PSU

<table>
<thead>
<tr>
<th>Input Stage (Rect. &amp; inrush current limiter)</th>
<th>SCRs</th>
<th>Diodes &amp; Discretes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controllers</td>
<td></td>
<td>Bridge Rectifier Diodes&lt;br&gt;STBR*12</td>
</tr>
<tr>
<td>CCM Analog Controllers&lt;br&gt;L4981*, L4984D</td>
<td></td>
<td>Diodes &amp; Discretes&lt;br&gt;600 V Ultrafast for CCM&lt;br&gt;STTH<em>R06, STTH</em>T06, STTH*L06</td>
</tr>
<tr>
<td>LLC&lt;br&gt;Analog Controllers&lt;br&gt;L6599A, L6699</td>
<td></td>
<td>MOSFET and IGBT Gate Drivers&lt;br&gt;HV HB Gate Drivers&lt;br&gt;L649*</td>
</tr>
<tr>
<td>Asym. HB&lt;br&gt;Analog Controllers&lt;br&gt;L6591</td>
<td></td>
<td>Isolated Gate Drivers&lt;br&gt;STGAP*</td>
</tr>
<tr>
<td>MCU &amp; Digital Controllers&lt;br&gt;STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG, STNRGPF01, STNRGPF12</td>
<td>High Temp. SCR&lt;br&gt;TN<em>05H-6, TN</em>050H-8, TN<em>050H-12W&lt;br&gt;High Temp. SCR&lt;br&gt;TN</em>050H-12W</td>
<td>Multiple LS Gate Drivers&lt;br&gt;PM8834</td>
</tr>
<tr>
<td>SR Analog Controllers&lt;br&gt;SRK2000A, SRK2001, SRK2001A</td>
<td>Power MOSFETs&lt;br&gt;600 V-650 V MDmesh M2&lt;br&gt;ST<em>60M2, ST</em>65M2&lt;br&gt;600 V-650 V MDmesh M6&lt;br&gt;ST<em>60M6, ST</em>65M6&lt;br&gt;650 V MDmesh M5&lt;br&gt;ST*65M5</td>
<td>Single LS Gate Drivers&lt;br&gt;PM88*1</td>
</tr>
<tr>
<td>Controllers</td>
<td></td>
<td>Diodes&lt;br&gt;600 V-650 V MDmesh M2&lt;br&gt;ST<em>60M2, ST</em>65M2, ST<em>60M2-EP&lt;br&gt;600 V MDmesh M6&lt;br&gt;ST</em>60M6&lt;br&gt;600 V-650 V MDmesh DM2&lt;br&gt;ST<em>60DM2, ST</em>65DM2&lt;br&gt;600 V MDmesh DM6&lt;br&gt;ST<em>65DM6&lt;br&gt;SR 60 V-100 V StripFET F7&lt;br&gt;ST</em>N6F7, ST<em>N8F7, ST</em>N10F7</td>
</tr>
<tr>
<td>Power MOSFETs</td>
<td></td>
<td>LDO&lt;br&gt;Low Dropout (LDO) Linear Regulators&lt;br&gt;LDF, LDFM, LD39050, LD39100, LD39200, LDL112, LDL212, LDL312&lt;br&gt;SR 60 V-100 V StripFET F7&lt;br&gt;ST<em>N6F7, ST</em>N8F7, ST*N10F7</td>
</tr>
<tr>
<td>Diodes</td>
<td></td>
<td>MOSFET and IGBT Gate Drivers&lt;br&gt;HV HB Gate Drivers&lt;br&gt;L649*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Isolated Gate Drivers&lt;br&gt;STGAP*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SR Multiple LS Gate Drivers&lt;br&gt;PM8834</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SR HV HB Gate Drivers&lt;br&gt;L649*</td>
</tr>
</tbody>
</table>

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

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### MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

- **STEVAL-ISA147V3**: 500 W fully digital AC-DC power supply (D-SMPS)
- **STEVAL-ISA172V2**: 2 kW fully digital AC-DC power supply (D-SMPS)
- **EVLSTNRG-1kW**: 1 kW SMPS digitally controlled multi-phase interleaved converter
- **STEVAL-IPFC12V1**: 2 kW two-channel digitally controlled interleaved PFC with digital inrush current limiter
- **STEVAL-IPFC01V1**: 3 kW three-channel digitally controlled interleaved PFC
- **STEVAL-DPSLLCK1**: 3 kW Full Bridge LLC resonant digital power supply evaluation kit
Power Distribution for Modern Data Center

To support the evolution and expansion of Cloud services, the Internet of Things and mobile apps, the demand for data centers is growing exponentially with more powerful CPUs and extended memory banks making efficiency and power density a daunting challenge along with enhanced reliability. In a typical architecture, a 48 V DC rail is generated from the AC-DC power supply unit that will then be converted to provide the number of DC rails needed to supply the variety of loads and circuits in the server. This conversion must meet stringent efficiency targets requiring innovative architectures like those developed by the Power Stamp Alliance (PSA) for direct conversion from the 48 V rail. Innovative power distributions architectures include also 48 V to 12 V intermediate bus converters, both in regulated and unregulated version.

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

Power Delivery for Modern Data Center

<table>
<thead>
<tr>
<th>Power Conversion Type</th>
<th>1° Stage (IBC)</th>
<th>2° Stage (12 V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual Stage Conversion</td>
<td>48 V</td>
<td>5 V - 15 V</td>
</tr>
<tr>
<td>Direct Conversion</td>
<td>48 V</td>
<td>V_CPU/DDR/ASIC</td>
</tr>
</tbody>
</table>

- Direct Conversion* (Isolated/Non-Isolated)
- Stacked Buck (STB) Regulated Conversion
- Switched Tank Converter (STC) Unregulated Conversion
- Direct Conversion from 48V to POL
- Digital Power Distribution from 12 V Bus

Note: * ST Patented Architecture
Typical Configuration for 48 V Isolated Direct Conversion

Note: * is used as a wildcard character for related part number
Typical Configuration for Switched-Tank Converter (STC) System - 48 V to 12 V non-isolated unregulated IBC

- STPRDC02
- STL*N40F7 Power MOSFETs
- STNRG328A

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

- STPRDC02
- STL*N80F7 - STL*N10F7 Power MOSFETs
- Digital Controller PM6764 PM677*

Note: * is used as a wildcard character for related part number
**Power over Ethernet (PoE)**

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

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

**Typical block diagram for PoE Power Management**

![Typical block diagram for PoE Power Management](image)

**MAIN EVALUATION BOARDS AND REFERENCE DESIGNS**

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

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

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

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

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

*Note: * is used as a wildcard character for related part number.
LED TV Power Supply

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

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

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

### ST’S RECOMMENDED PRODUCT FOR LED TV POWER SUPPLY

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<th>Controllers</th>
<th>Power MOSFETs</th>
<th>Diodes &amp; Discretes</th>
<th>Opamp V/I Sensing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PFC Block</strong></td>
<td>600 V-650 V MDmesh M2, ST<em>60M2, ST</em>65M2, ST*60M2-EP</td>
<td>600 V Ultrafast for TM STTH<em>L06, STTH</em>06, STTH1S06*</td>
<td>Precision Op Amps (&lt;50 MHz) TS*, TSV*, LMV*</td>
</tr>
<tr>
<td>TM Analog Controllers L6562A*, L6563*, L6564*</td>
<td>600 V-650 V MDmesh M6 ST<em>60M6, ST</em>65M6</td>
<td>600 V Ultrafast for CCM STTH<em>R06, STTH</em>T06</td>
<td>STOF3065</td>
</tr>
<tr>
<td>CCM Analog Controllers L4981*, L4084D</td>
<td>650 V MDmesh M5 ST*65M5</td>
<td>SIC Diodes</td>
<td></td>
</tr>
<tr>
<td>MCUs &amp; Digital Controllers STM32F0, STM32F00, STM32F301, STM32F334, STM32G4, STNRG, STNRGPF01, STNRGPF12</td>
<td>600 V-650 V MDmesh M2, ST<em>60M2, ST</em>65M2, ST*60M2-EP</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Isolation Stage</strong></td>
<td>600 V-650 V MDmesh M6 ST<em>60M6, ST</em>65M6</td>
<td>600 V Ultrafast for CCM STTH<em>R06, STTH</em>T06</td>
<td>STOF3065</td>
</tr>
<tr>
<td>Flyback Controllers L6566A, L6566B, L6566S, L6668, STCH02, STCH03</td>
<td>600 V-650 V MDmesh M6 ST<em>60M6, ST</em>65M6</td>
<td>SIC Diodes</td>
<td></td>
</tr>
<tr>
<td>PFC &amp; LLC Combo Controllers STCMB1, STNRG011</td>
<td>600 V-650 V MDmesh DM2 ST<em>60DM2, ST</em>65DM2</td>
<td>STOF3065</td>
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<tr>
<td>LLC Analog Controllers L6599*, L6699</td>
<td>600 V-650 V MDmesh DM6 ST*60DM6</td>
<td>SIC Diodes</td>
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<tr>
<td>Asymmetrical HB Controllers L6591</td>
<td>60 V-100 V STripFET F7 ST<em>N8F7, ST</em>N10F7</td>
<td>STOF3065</td>
<td></td>
</tr>
<tr>
<td>MCUs &amp; Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG</td>
<td>600 V-650 V MDmesh M2, ST<em>60M2, ST</em>65M2, ST*60M2-EP</td>
<td>SIC Diodes</td>
<td></td>
</tr>
<tr>
<td>SR Analog Controllers SRK1000, SRK1001 for Flyback SRK2000A, SRK2001, SRK2001A for LLC</td>
<td>600 V-650 V MDmesh M6 ST<em>60M6, ST</em>65M6</td>
<td>STOF3065</td>
<td></td>
</tr>
<tr>
<td>SR Multiple LS Gate Drivers PM88*1</td>
<td>60 V-100 V STripFET F7 ST<em>N8F7, ST</em>N10F7</td>
<td>SIC Diodes</td>
<td></td>
</tr>
</tbody>
</table>

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

**Typical Block Diagram for Analog Control Solutions for Small Pannell Size**

```
~ AC → Input Rect. → PFC → Flyback → Output Rect. → V_{out/DC}
```

- TM/CCM PFC controller
- Flyback controller
- Synch. Rect. controller
**MAIN EVALUATION BOARDS AND REFERENCE DESIGNS**

**EVL185W-LEDTV**
185 W power supply with PFC and standby supply for LED TV

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

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

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

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

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

![Diagram of typical buck configuration]

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

![Diagram of typical multi-phase configuration]

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

![Diagram of typical single phase discrete configuration]

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

MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

<table>
<thead>
<tr>
<th>Evaluation Board</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEVAL-ISA152V1</td>
<td>Asynch. buck up to 60 Vin, 3.3 Vout - 3 A Iout</td>
</tr>
<tr>
<td>STEVAL-ISA159V1</td>
<td>Synch. Buck 36 Vin, 3.3 Vout - 400 mA</td>
</tr>
<tr>
<td>STEVAL-ISA160V1</td>
<td>Synch. Buck 3.3 Vin, 1.2 Vout-3 A Iout, Auto. Grade</td>
</tr>
<tr>
<td>STEVAL-ISA205V1</td>
<td>Synch. Buck 12 Vin, 3.3 Vout-2 A Iout, Auto. Grade</td>
</tr>
</tbody>
</table>
ST’s product offering for Switching Converters (DC-DC)

24 V Bus

I_{OUT} vs. V_{IN} chart showing various models and their operating current and voltage ranges.

Post-Regulation (<24 V)

I_{OUT} vs. V_{IN} chart showing various models and their operating current and voltage ranges.

Buck-Boost

I_{OUT} vs. V_{IN} chart showing various models and their operating current and voltage ranges.

Boost

I_{OUT} vs. V_{IN} chart showing various models and their operating current and voltage ranges.

Legend:
- Asynchronous
- Automotive
- Synchronous
- Compact BOM

Note: * full production in H2 2019  ** dual, parallel up to 7A
Typical 48 Vin, up to 65 W Pout, Flyback configuration

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

**STEVAL-ISA203V1**

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

Typical 48Vin, > 65 W Pout, Forward configuration

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

**STEVAL-ISA204V1**

Note: * available in Q3 2019
WEARABLE DEVICES - POWER MANAGEMENT

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

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

Typical Block Diagram of Smart Watch

MAIN EVALUATION BOARDS

STEVAL-1PS01AJR/1PS01EJR/1PS01GJR*
Evaluation board based on the ST1PS01EJR 400 mA nano-quiescent synchronous step-down converter

STEVAL-LDO001V1
Quad high performance LDO evaluation board based on LD8L20, LD4025, LD39130S and STL0020

Note: * available in Q3 2019
LED LIGHTING AND CONTROLS

LED General Illumination

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

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

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

Typical Block Diagram

---

*Image of block diagrams for isolated and non-isolated LED lighting systems*
### ST’S PRODUCT OFFERING FOR LED GENERAL ILLUMINATION

#### Controllers

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<tr>
<th>Controllers &amp; Converters</th>
<th>Power MOSFETs</th>
<th>Diodes &amp; Discretes</th>
<th>MOSFET and IGBT Gate Drivers</th>
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<td>TM Analog Controllers</td>
<td>60 V-650 V MDMesh M2</td>
<td>600 V Ultrast for TM</td>
<td>Single Gate Drivers</td>
</tr>
<tr>
<td>L6562*, L6563*, L6564*</td>
<td>ST<em>80M2, ST</em>85M2, ST*80M2-EP</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
<td>PM88*1</td>
</tr>
<tr>
<td>CCM Analog Controllers</td>
<td>600 V-650 V MDMesh M6</td>
<td>600 V Ultrast for CCM</td>
<td></td>
</tr>
<tr>
<td>L4981*, L4984D</td>
<td>ST<em>80M6, ST</em>85M6</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
<td></td>
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<tr>
<td>MCUs &amp; Digital Controllers</td>
<td>600 V-650 V MDMesh M6</td>
<td>600 V Ultrast for CCM</td>
<td></td>
</tr>
<tr>
<td>STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STLUX, STNRG</td>
<td>SIC MOSFET</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
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</tr>
<tr>
<td>STPSC*065</td>
<td>STPSC*065</td>
<td></td>
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</tr>
<tr>
<td>SR Analog Controllers</td>
<td>80 V to 950 V MDMesh K5</td>
<td>600 V Ultrast for CCM</td>
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<tr>
<td>SRK1000, SRK1001</td>
<td>ST<em>80K5, ST</em>9K5</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
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<tr>
<td>SR Analog Controllers</td>
<td>600 V-650 V MDMesh M2</td>
<td>600 V Ultrast for CCM</td>
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<tr>
<td>SRK2001, SRK2001A</td>
<td>ST<em>80M2, ST</em>85M2, ST*80M2-EP</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
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</tr>
<tr>
<td>SR Analog Controllers</td>
<td>600 V-650 V MDMesh M6</td>
<td>600 V Ultrast for CCM</td>
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<tr>
<td>SR Analog Controllers</td>
<td>ST<em>80M6, ST</em>85M6</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
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<tr>
<td>SR Analog Controllers</td>
<td>600 V-650 V MDMesh M6</td>
<td>600 V Ultrast for CCM</td>
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<tr>
<td>SR Analog Controllers</td>
<td>ST<em>80M6, ST</em>85M6</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
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<tr>
<td>SR Analog Controllers</td>
<td>600 V-650 V MDMesh M6</td>
<td>600 V Ultrast for CCM</td>
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<tr>
<td>SR Analog Controllers</td>
<td>ST<em>80M6, ST</em>85M6</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
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<tr>
<td>SR Analog Controllers</td>
<td>600 V-650 V MDMesh M6</td>
<td>600 V Ultrast for CCM</td>
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<tr>
<td>SR Analog Controllers</td>
<td>ST<em>80M6, ST</em>85M6</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
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<td>SR Analog Controllers</td>
<td>60 V-100 V StripFET F7</td>
<td>600 V Ultrast for CCM</td>
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<tr>
<td>SR Analog Controllers</td>
<td>ST<em>N6F7, ST</em>N8F7, ST*N10F7</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
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<th>Diodes &amp; Discretes</th>
<th>Voltage Reference, CC/CV Ctrl</th>
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</tr>
<tr>
<td>HVLED0001B, HVLED0001, HVLED007, HVLED8*</td>
<td>ST<em>80K5, ST</em>9K5</td>
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<td>T<em>431, T</em>432</td>
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<tr>
<td>HV Converters</td>
<td>600 V-650 V MDMesh M2</td>
<td>Clamping Diodes for Flyback</td>
<td>Voltage and Current Ctrl</td>
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<tr>
<td>VIPer<em>OP, VIPer</em>1, VIPer<em>6, VIPer122, VIPer</em>5, VIPer<em>7, VIPer</em>8</td>
<td>ST<em>80M2, ST</em>85M2, ST*80M2-EP</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
<td>TSM*, SEA*</td>
</tr>
<tr>
<td>LLC Analog Controllers</td>
<td>600 V-650 V MDMesh M6</td>
<td>Output Diodes for DC-DC LED Drivers</td>
<td></td>
</tr>
<tr>
<td>L6599*, L6699</td>
<td>ST<em>80M6, ST</em>85M6</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
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<tr>
<td>PFC &amp; LLC/LCC</td>
<td>600 V-650 V MDMesh M6</td>
<td>Output Diodes for DC-DC LED Drivers</td>
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<tr>
<td>Combo Controllers</td>
<td>ST<em>80M6, ST</em>85M6</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
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<tr>
<td>STCM81, STNRG0011</td>
<td>600 V-650 V MDMesh M6</td>
<td>Output Diodes for DC-DC LED Drivers</td>
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<tr>
<td>MCUs &amp; Digital Controllers</td>
<td>600 V-650 V MDMesh M6</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
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<tr>
<td>SR Analog Controllers</td>
<td>600 V-650 V MDMesh M6</td>
<td>Output Diodes for DC-DC LED Drivers</td>
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<td>SR Analog Controllers</td>
<td>600 V-650 V MDMesh M6</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
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<tr>
<td>SR Analog Controllers</td>
<td>800 V to 950 V MDMesh M6</td>
<td>Output Diodes for DC-DC LED Drivers</td>
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<tr>
<td>SR Analog Controllers</td>
<td>STH<em>06F7, ST</em>N8F7, ST*N10F7</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
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#### Multiple strings management

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<thead>
<tr>
<th>Controllers &amp; Converters</th>
<th>Power MOSFETs</th>
<th>Diodes &amp; Discretes</th>
<th>DC-DC LED Drivers</th>
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<tr>
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<td>LED5000, LED6000</td>
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<td>HVLED0002</td>
<td>ST<em>80M2, ST</em>85M2, ST*80M2-EP</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
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</tr>
<tr>
<td>MCUs &amp; Digital Controllers</td>
<td>600 V-650 V MDMesh M6</td>
<td>Output Diodes for DC-DC LED Drivers</td>
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<tr>
<td>Multiple strings</td>
<td>60 V-100 V StripFET F7</td>
<td>STH<em>06, STH</em>08, STH15AC06*</td>
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<tr>
<td>management</td>
<td>ST<em>N6F7, ST</em>N8F7, ST*N10F7</td>
<td>Output Diodes for DC-DC LED Drivers</td>
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</tr>
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</table>

#### Bluetooth Low Energy (BLE)

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<th>Sub-1GHz RF</th>
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<td>BlueNRG-2</td>
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<td>BLE 4.2 SoC</td>
<td>MCUs</td>
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<td>BlueNRG-1</td>
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<td>Baluns</td>
<td>Baluns</td>
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<td>Wireless MCUs BLE 5.0</td>
<td>Certified Modules</td>
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<td>SPSGRF (868 and 915 MHz)</td>
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<td></td>
<td>SPSGRFC (433, 868 and 915 MHz)</td>
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</tbody>
</table>

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

### MAIN EVALUATION BOARDS

- **EVLHVLED815W15**: 15 W HPF LED driver with PSR
- **STEVAL-ILL083V1**: 10 W Smart home lighting with BLE
- **STEVAL-ILL069V2**: 35 W Analog power supply (CV(out)) for LED driving
- **STEVAL-ILL070V4**: 35 W, analog power supply (CC/CC) for single string LED driver
- **STEVAL-ILL077V1**: 60 W, digital multiple-string LED driver
- **STEVAL-LLL004V1**: 75 W digitally controlled non isolated constant current LED driver
LED Street Lighting
Street lighting installations have evolved from basic energy-hungry illumination spots to central devices enabling a set of services, such as presence and traffic level monitoring and incident detection surveillance, while optimizing illumination levels to specific road and weather conditions to support administrations transforming cities in Smart Cities.

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

Typical Block Diagram

MAIN EVALUATION BOARDS

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

STEVAL-LLL006V2
75 W LED driver (CC/CV) with Sub 1GHz Connectivity

STEVAL-LLL006V1*
75 W LED driver (CC/CV) featuring TM PFC and LCC resonant converter with STCMB1 combo controller

EVL150W-HVSL
150 V - 150 W LED driver featuring TM PFC and LCC resonant converter with L6699

Note: * available in Q2 2019
# ST’s Product Offering for LED Street Lighting

## Power Supply

<table>
<thead>
<tr>
<th>Controllers</th>
<th>Power MOSFETs</th>
<th>Diodes &amp; Discretes</th>
<th>MOSFET and IGBT Gate Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>TM PFC Analog Controllers L6562*, L6563*, L6564*</td>
<td>800 V to 1050 V MDmesh K5</td>
<td>600 V Ultrafast for TM PFC STTH<em>L06, STTH</em>06, STTH15AC06*</td>
<td>Single LS Gate Drivers PM681*</td>
</tr>
<tr>
<td>CCM PFC Analog Controllers L4981*, L4984D</td>
<td>ST<em>80K5, ST</em>9K5, ST*105K5</td>
<td>600 V Ultrafast for CCM PFC STTH<em>R06, STTH</em>T06</td>
<td>HV HB Gate Drivers L649*</td>
</tr>
<tr>
<td>Offline LED drivers HVLED001B, HVLED001A, HVLED007</td>
<td>600 V-650 V MDmesh M2</td>
<td>SiC Diodes STPS*065</td>
<td>Isolated Gate Drivers STGAP*</td>
</tr>
<tr>
<td>PFC &amp; LLC/LCC Combo Controllers STCMB1, STN9G011</td>
<td>600 V-650 V MDmesh M6</td>
<td>Output Diodes for Flyback Schottky, FERD, Ultrafast STPS*, FERD*, STTH*</td>
<td>Multiple LS Gate Drivers PM8834</td>
</tr>
<tr>
<td>LLC/LCC Controllers L6599A*, L6699</td>
<td>600 V-650 V MDmesh DM2</td>
<td>Clamping Diodes for Flyback 600 V to 1000 V Ultrafast STTH<em>06, STTH</em>08, STTH*10</td>
<td>Voltage Reference CC/CC V</td>
</tr>
<tr>
<td>MCUs &amp; Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STLUX, STN9G</td>
<td>600 V MDmesh DM6</td>
<td>Output Diodes for LLC/LCC Schottky, FERD STPS*, FERD<em>45, FERD</em>50, FERD<em>60, FERD</em>100</td>
<td>Voltage Reference T<em>431, T</em>432</td>
</tr>
<tr>
<td>SR Analog Controllers SRK1000, SRK1001 for Flyback</td>
<td>60 V-100 V StripFET F7</td>
<td>MOSFET Protection for Flyback SMA4F, SMB15F series</td>
<td>Voltage and Current Ctrl TSM*, SEA</td>
</tr>
</tbody>
</table>

## LED Driver

<table>
<thead>
<tr>
<th>Controllers</th>
<th>DC-DC Buck LED Drivers</th>
<th>DC-DC Boost LED Drivers</th>
<th>LED Array Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offline LED drivers HVLED002</td>
<td>LED5000</td>
<td>LED6001</td>
<td>STP04CM05, LED8102S</td>
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<tr>
<td></td>
<td>LED6000</td>
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</tbody>
</table>

## Temperature Sensors

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<thead>
<tr>
<th>Controllers</th>
<th>DC-DC Buck LED Drivers</th>
<th>DC-DC Boost LED Drivers</th>
<th>LED Array Drivers</th>
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</thead>
<tbody>
<tr>
<td>STLM20</td>
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<td>STP04CM05, LED8102S</td>
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<tr>
<td>STTS751</td>
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<tr>
<td>LM135Z</td>
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</tbody>
</table>

## Sensing, Processing, Control, LED Bypass

<table>
<thead>
<tr>
<th>Controllers</th>
<th>DC-DC Buck LED Drivers</th>
<th>DC-DC Boost LED Drivers</th>
<th>LED Array Drivers</th>
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</thead>
<tbody>
<tr>
<td>STLM20</td>
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<td>STP04CM05, LED8102S</td>
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<td>STTS751</td>
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<td>LM135Z</td>
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</table>

## Connectivity

<table>
<thead>
<tr>
<th>Controllers</th>
<th>DC-DC Buck LED Drivers</th>
<th>DC-DC Boost LED Drivers</th>
<th>LED Array Drivers</th>
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<tbody>
<tr>
<td>Power Line Transceivers ST7570, ST7580, ST7590</td>
<td>Sub-1GHz transceivers S2-LP, SPIRIT1</td>
<td>Sub-1GHz transceivers S2-LP</td>
<td>MCUs STM32L0, STM32G0, STM32G4, STM32L4, STM32L5</td>
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<tr>
<td></td>
<td>MCUs STM32F0, STM32G0, STM32L0</td>
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<td>BALuns BALF-SP12-01D3</td>
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<td>BALun BALF-SP12-01D3</td>
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<td>Embedded Software I-CUBE-LRWAN</td>
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<tr>
<td></td>
<td>Certified Modules SPSGRC (868 and 915 MHz)</td>
<td></td>
<td>Secure MCUs STSAFE-A100</td>
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<td></td>
<td>SPSGRC (433, 868 and 915 MHz)</td>
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</table>

Note: * is used as a wildcard character for related part number.
**LED POE Lighting**

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

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

**Typical Block Diagram**

```
MAIN EVALUATION BOARDS

STEVAP-POEL45W1
45 W PoE powered LED lighting with BLE control
```

**ST'S PRODUCT OFFERING FOR LED POE LIGHTING**

<table>
<thead>
<tr>
<th>PoE Interface</th>
<th>Protections</th>
<th>Auxiliary Power Supply</th>
<th>LED Driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE 802.3bt</td>
<td>TVS for power rail surge protection SMA4W, SMB15F</td>
<td>Buck L7987L</td>
<td>60 V-100 V STripFET F7 ST<em>N6F7, ST</em>N8F7, ST<em>N10F7 Schottky Diodes STPS</em></td>
</tr>
<tr>
<td>PM8805, PM8804</td>
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<tr>
<td>IEEE 802.3at</td>
<td></td>
<td>Boost LED6001 Inverse Buck HVLED002</td>
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<tr>
<td>PM8803, PM8801</td>
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<tr>
<td>IEEE 802.3af</td>
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<tr>
<td>PM8800A</td>
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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**

![Typical Block Diagram for DALI Lighting System](image)

**ST’S PRODUCT OFFERING FOR LIGHTING CONTROLS**

<table>
<thead>
<tr>
<th>LED Driver</th>
<th>Power Management</th>
<th>KNX Transceiver</th>
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</thead>
<tbody>
<tr>
<td>Digital Controllers</td>
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<tr>
<td>STLUX</td>
<td></td>
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<tr>
<td>Development Tools</td>
<td></td>
<td></td>
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<tr>
<td>STSW-STLUXLIB02, STSW-STLUXSMED02</td>
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<td></td>
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<tr>
<td>MCU</td>
<td></td>
<td></td>
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<tr>
<td>STM32F1, STM32L1, STM8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Embedded Software</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STSW-DALI002, STSW-DALI001, STSW-STM8025</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refer to LED General Illumination section</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STKNX</td>
<td></td>
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</tr>
</tbody>
</table>

**MAIN EVALUATION BOARDS**

- **STEVAL-ILL066V2**
  100 W LED street lighting evaluation board with DALI2.0 communication interface using the STLUX385A digital controller

- **STEVAL-ILM001V1**
  Plug-in hardware module for the STM8S-DISCOVERY interface for DALI communication
LED Wireless Programming

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

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

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

Typical Block Diagram of LED Wireless Programming

### ST’S PRODUCT OFFERING FOR LED WIRELESS PROGRAMMING

<table>
<thead>
<tr>
<th>NFC/RFID Reader IC</th>
<th>Microcontrollers</th>
<th>LED Driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFC Reader + MCU</td>
<td>ST25R</td>
<td>ST8M8S</td>
</tr>
<tr>
<td>Dynamic NFC Tag</td>
<td></td>
<td>STM32F0, STM32G0</td>
</tr>
<tr>
<td>LED Driver for high-end market</td>
<td>ST25DV-PWM Series</td>
<td>STM88</td>
</tr>
<tr>
<td>Dynamic NFC Tag with PWM Output</td>
<td></td>
<td>STM32F0, STM32G0, STM32F3, STM32F334, STM32G4, STLUX</td>
</tr>
<tr>
<td>LED Driver for entry-level market</td>
<td>ST25DV-PWM Series</td>
<td>HVLED001*, HVLED002, LED600*, LED5000, LED2000, STP04/08/16/24</td>
</tr>
</tbody>
</table>

* is used as a wildcard character for related part number

### MAIN EVALUATION BOARDS

- **ST25R3911B-DISCO**
  Discovery kit for ST25R3911B high performance HF reader/NFC

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

- **ST25DV-DISCOVERY**
  Discovery kit for ST25DV04 Dynamic NFC/RFID tag IC
ELECTRO-MOBILITY

Key applications

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

SOLUTIONS

Find out more:

www.st.com/electro-mobility

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

FIND OUT MORE
**Traction Main Inverter**

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

Subject to intense heat and vibration in the vehicle, these converters must be able to handle high power and currents along with associated Electro Magnetic Compatibility (EMC) challenges. Fail-safe operation needs to be assured to ensure reliability and safety for the driver and passengers.

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

---

**Main Inverter**

![Diagram of Traction Main Inverter](image)

- **Power Supply Protection**: SMxTY Load DUMP LDP*
- **Voltage Regulator**: L5964
- **Protection**: SMxTY
- **Inverter**: STGYA120M65DF2AG
- **Gate Drivers**: STGAP1AS
- **Gate protection**: SM4TY
- **Control Unit**: SPC58NE84C3
- **ESD Protection**: ESDCAN0*
- **CAN Transceiver**: L9616
- **Serial EEPROM**: M24512-A125 M95512-A125
- **Current Sensor & Signal Conditioning**: TSC102

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

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**FIND OUT MORE**

[www.st.com/main-inverter-electric-traction](www.st.com/main-inverter-electric-traction)
Bidirectional DC/DC Converter

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

ST has a wide offer of discrete semiconductors including AEC-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 microcontrollersto enable scalable, cost-effective and energy-efficient solutions for implementing these challenging converters.

Bidirectional DC/DC Converter

FIND OUT MORE

www.st.com/bidirectional-dc/dc-converter
48 V Start-Stop System

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

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

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

Start-Stop system

**12 V**
- Power Supply Protection SM*TY
- Load DUMP LDP

**48 V**
- Voltage Regulator L5964
- Protection SM4TY

**80 V-100 V**
- STripFET F7 Series

**CAN bus**
- ESD Protection ESDCAN
- CAN Transceiver L9616

**Control unit**
- SPC58 B/C/E line
- SPC56 L Line

**Gate Protection SM4TY**
- Gate driver

**Excitation Stage**
- Gate Protection SM4TY
- 3ph Gate driver L9907

**Power Stage**
- Current sensing

**Overall System**
- Excitation Stage
- Power Stage
- Control unit

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

FIND OUT MORE

www.st.com/48v-start-stop-system
**On-Board Charger (OBC)**

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

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

ST has a wide offer of discrete semiconductors including AEC-Q101qualified silicon and silicon-carbide (SiC) MOSFETs and diodes as well as IGBTs. These are complemented by AEC-Q100 qualified galvanically isolated IGBT and MOSFET gate drivers and SPC5 32-bit automotive microcontrollers for implementing these challenging converters.

---

**FIND OUT MORE**

www.st.com/on-board-charger
**DC Fast Charging Station**

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

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

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

**Typical Block Diagram**
## ST’s Product Offering for DC Fast Charging Station

<table>
<thead>
<tr>
<th>Component Type</th>
<th>Input stage</th>
<th>3ph PFC</th>
<th>DC/DC</th>
<th>Control units</th>
<th>Driving stage</th>
<th>Current sensing &amp; signal conditioning</th>
<th>Aux SMPS</th>
<th>HMI</th>
<th>Metering</th>
<th>Connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rectifiers</strong></td>
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<tr>
<td>SiC series - 600/650 V</td>
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<td>SiC series - 1200 V</td>
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<td>Ultrast RQ series - 600 V</td>
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<td>Ultrast R series - 600 V</td>
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<td>STBR series - 1200 V</td>
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<td>Schottky series - 40/45/60/100 V</td>
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<td>TN series - 1200 V</td>
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<td>TYN series - 1200 V</td>
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<td>TM8050H series - 800 V</td>
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<td>TN3050H, TN5050H series - 1200 V</td>
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<td>SM4TY, SM6TY, SM15TY, SM30TY</td>
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<tr>
<td>SiC series - 650/1200 V</td>
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**Note:** * is used as a wildcard character for related part number
**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></th>
<th>MCUs &amp; Digital Controllers</th>
<th>MOSFET/IGBT Gate Drivers</th>
<th>IGBTs</th>
<th>Power MOSFETs</th>
<th>Diodes</th>
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<tr>
<td><strong>PFC</strong></td>
<td>MCUs</td>
<td>Single LS Gate Drivers</td>
<td>600 V V series</td>
<td>600 V-650 V MDmesh M2</td>
<td>600 V Ultrafast</td>
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<td>STG*60DF</td>
<td>ST<em>60M2, ST</em>65M2, ST*60M2-EP</td>
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<td>STG*H65FB</td>
<td>ST<em>60M6, ST</em>65M6</td>
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<td>STTH*S12</td>
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<td>650 V HB2 series</td>
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<td>STPSC<em>065, STPSC</em>12</td>
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<td>HV HB Gate Drivers</td>
<td>1200 V H series</td>
<td>650 V-1200 V SiC MOSFETs</td>
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<td>STTH*S12</td>
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</table>

Note: * is used as a wildcard character for related part number.
Typical configuration for Single-Phase architecture for low/medium power welding

- PFC (optional)
- AC
- PFC power stage
- Controller
- Bus Voltage
- Power Switch
- Clamping Diode
- MOS/IGBT Drivers
- HF Transformer
- Rectifier
- Inductor
- - Earth
- Welding Torch
- Working Piece
- Primary Current sensing
- Output Current / Voltage sensing
- Auxiliary Power Supply
- MCU
- EEPROM
- Sensing

Typical configuration for Single and Three-phase architectures for medium/high power welding

- PFC (optional)
- AC
- PFC power stage
- Controller
- Bus Voltage
- Power Switch
- Power Switch
- Power Switch
- Power Switch
- MOS/IGBT Drivers
- HF Transformer
- Rectifier
- Rectifier
- Primary Current sensing
- Secondary Inverter
- Transformer
- Welding Torch
- Inductor
- Working Piece
- Output Current / Voltage sensing
- Auxiliary Power Supply
- MCU
- EEPROM
- Sensing
## Uninterruptable Power Supplies (UPS)

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

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

### ST’S PRODUCT OFFERING FOR UNINTERRUPTABLE POWER SUPPLIES (UPS)

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<th>Diodes</th>
<th>Bypass</th>
<th>SCRs &amp; TRIACs</th>
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<tr>
<td>MCUs &amp; Digital Controllers</td>
<td>Power MOSFETs</td>
<td>IGBTs</td>
<td>Diodes</td>
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<td>PFC Block</td>
<td>600 V-650 V MDmesh M2 ST<em>60M2, ST</em>65M2</td>
<td>600 V V series STG*60DF</td>
<td>600 V Ultrafast for CCM STTH<em>106 STTH</em>106</td>
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Note: * is used as a wildcard character for related part number

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

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

<table>
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**Normal operation** - *Backup operation*
MAJOR HOME APPLIANCES

Refrigeration, washing, drying and miscellaneous equipment

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

**ST’S PRODUCT OFFERING FOR REFRIGERATION, WASHING, DRYING AND MISCELLANEOUS EQUIPMENT**

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<thead>
<tr>
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<th>Diodes</th>
<th>LED Drivers</th>
<th>HV Converters</th>
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<tr>
<td>Rect. &amp; inrush current limiter</td>
<td>Bridge Rectifier Diodes</td>
<td>User Interface</td>
<td>AUX SMPS</td>
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<tr>
<td>High Temp. SCR</td>
<td>STBR*12</td>
<td>LED Array Drivers</td>
<td>ViPerPlus</td>
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<tr>
<td>TN<em>015H-6, TN1610H-6, TN</em>05OH-12W</td>
<td>STYR*12</td>
<td>STP04/08/16/24</td>
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<tr>
<td>Standard SCR: TN815, TN*15-600B</td>
<td>High Temp. Triacs: T1635T</td>
<td>LED12/16/24*</td>
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<td>AUX 12/24/26*</td>
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<th>IGBTs</th>
<th>Opamp V/I Sensing</th>
<th>Power MOSFETs</th>
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<td>MCUs</td>
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<tr>
<td>STM32F0, STM32G0, STM32F103, STM32F334, STM32G4, STM32F4</td>
<td>600 V V series STG*V60F</td>
<td>Precision Op Amps (&lt;50 MHz)</td>
<td>600 V-650 V MDMesh M2</td>
<td>STPW05, STPW12</td>
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<td>650 V HB series STG*P65FB</td>
<td>TS*, TSV*, LMV*</td>
<td>600 V-650 V MDMesh M6</td>
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<td>650 V HB2 series STG*P65F2B</td>
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<td>650 V MDMesh M5</td>
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<td>STNRG, STNRGPF01, STNRGPF12</td>
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<td>High Temp. SCR</td>
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<td>AUX SMPS</td>
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<td>STT*AC06</td>
<td>LED Array Drivers</td>
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<td>STTH*R06</td>
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<td>STPSC*065 DLF</td>
<td>LED12/24*</td>
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<td>AUX 12/24/26*</td>
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<tr>
<th>MCUs</th>
<th>IGBTs</th>
<th>MOSFET and IGBT Gate Drivers</th>
<th>Power MOSFETs</th>
<th>Post Regulation</th>
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<td>3Ph Inverter</td>
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<tr>
<td>STG*H60DF</td>
<td>3-Phase HV Gate Driver</td>
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<td>DC-DC Converters</td>
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<tr>
<td>STG*H60DF</td>
<td>STDRIVE601</td>
<td>L698*, ST1S14, L7986, ST1S34, ST1S50</td>
<td>Low Dropout (LDO) Linear Regulators</td>
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<tr>
<td>STG*H60DF</td>
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<td>LDF, LDFM, LDK220, LDK320, LDK715, LDL212</td>
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<tr>
<td>650 V M series STG*M65DF2</td>
<td>HV HB Gate Drivers</td>
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<td></td>
<td>L649*</td>
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<tr>
<td>650 V M series STG*M65DF2</td>
<td>Isolated Gate Drivers</td>
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<tr>
<td>IPM for fan and pumps</td>
<td>STGAP*</td>
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<tr>
<td>STIPS*M50-H</td>
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<tr>
<td>STIPS*M60</td>
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<tr>
<td>STGIPQ*60T-H</td>
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<td>STGIPQ*60T-H</td>
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<td>STIPNS*M50T-H</td>
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<td>STPSC*065 DLF</td>
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<td>STPWM</td>
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<td>STPW05</td>
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<td>STPW12</td>
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</tbody>
</table>

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

**Typical configuration**

### ~ AC

- **Rect. & inrush current limiter**
- **GATE DRIVER**
- **MCU**
- **AUX SMPS**
- **PFC**

**Power stage 1**

- **Driving stage**
- **Compressors, Drum motors, Washing pumps**

**Power stage 2**

- **Fans, Drain pumps**

**MAIN EVALUATION BOARDS**

- **STEVAL-IHT008V1**
  - 1 kW, digital inrush current limiter based on Triac
- **STEVAL-IPM**
  - 300 W to 3 kW Power board based on SLLIMM™
Induction Cooking

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

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

**ST’S PRODUCT OFFERING FOR INDUCTION COOKING**

<table>
<thead>
<tr>
<th>Topology example</th>
<th>MCUs</th>
<th>IGBTs</th>
<th>MOSFET and IGBT Gate Drivers</th>
<th>Sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Single-switch quasi-resonant (voltage resonance)</strong></td>
<td>STM8*</td>
<td>1250 V IH series STG*IH125DF</td>
<td>Multiple LS Gate Drivers PM8834</td>
<td>Enviromental Sensors Humidity - HTS221</td>
</tr>
<tr>
<td></td>
<td>STM32F100</td>
<td></td>
<td>Single LS Gate Drivers PM88*1</td>
<td>Temperature - STLM20</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td>Motion Sensors Accelerometer IIIS3DHHC</td>
</tr>
<tr>
<td><strong>HB series resonant (current resonance)</strong></td>
<td>STM32F0, STM32G0</td>
<td>600 V HB series STG*IH60DF</td>
<td>HV HB Gate Drivers L649*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>STM32F100</td>
<td>650 V IH series STG*IH65DF</td>
<td>Isolated Gate Drivers STGAP*</td>
<td></td>
</tr>
</tbody>
</table>

**User interface (front panel)**

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

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

**MAIN EVALUATION BOARD**

Board available on request

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

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

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

CONFIGURATORS
STLUX & STNRG SMEDs configurator
- SMED configurator schemes
- Input configuration
- Clock, comparators and ADC settings
- FSM (finite state machine) configuration
- C code generation
- Load register setting on board in a click
AC-DC CONVERSION ICs

High-voltage converters

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

The ViperPlus series (Viper0P, Viper122 and Viper*1, Viper*5, Viper*6, Viper*7, Viper*8 families) features an 800 V avalanche-rugged power MOSFET and leading-edge PWM controller and consumes less than 4 mW for Viper0P, 10 mW for Viper*1 and 30 mW in standby for the others. It also comes with the largest choice of protection schemes and supports different topologies.

The Viper26K belongs to Viper*6 family and integrates a 1050 V avalanche-rugged power MOSFET, suitable for cost-effective 1-phase/3-phases smart meters, industrial systems and lighting power supplies.

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

VIPerPLUS & ALTAIR

- Increased robustness using up to 1050 V AR MOSFET
- Extremely low consumption
- Better integration and minimal BoM
- Flexible and easy to use
- Flyback topology supported
- Regulation with optocoupler using all ICs
- PSR-CV using Viper0P, Viper122, Viper*1 and Viper*6
- PSR-CV/CC tight tolerance using Altair
- Buck & buck-boost topologies supported by Viper0P, Viper122, Viper*1 and Viper*6

Different features for different controllers

VIPer0P: Zero-Power Mode, Low VCC voltage, Minimal BoM
VIPer series 1: Low VCC voltage
VIPer122: Minimal BoM
VIPer series 5: Quasi-resonant
VIPer series 6: Smart Features
VIPer series 7: Brown-out
VIPer series 8: Peak power
Altair: PSR CC/CV

Flyback Converter 85-265 Vac
- 4 W: 150 mA
- 5 W: 200 mA
- 6 W: 200 mA
- 8 W: 200 mA
- 10 W: -
- 12 W: 350 mA
- 15 W: -

Buck Converter
- Max $R_{DS(ON)} / I_{MIN}$:
  - 30 $\Omega$/350 mA
  - 27 $\Omega$/450 mA
  - 24 $\Omega$/400 mA
  - 20 $\Omega$/400 mA
  - 14 $\Omega$/700 mA
  - 7 $\Omega$/700 mA
  - 4.5 $\Omega$/1 A

MAIN APPLICATIONS

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

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

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

TM PFC controllers

![TM PFC controllers graph]

<table>
<thead>
<tr>
<th>Basic features</th>
<th>Advanced protections</th>
<th>Remote on/off control</th>
<th>Tracking boost function</th>
<th>Interface for cascaded converter</th>
</tr>
</thead>
<tbody>
<tr>
<td>L6562A*</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>L6564*</td>
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<td>L6563*</td>
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</table>

CCM PFC controllers

![CCM PFC controllers graph]

<table>
<thead>
<tr>
<th>Basic features</th>
<th>Advanced protections</th>
<th>Remote on/off control</th>
<th>Tracking boost function</th>
<th>Interface for cascaded converter</th>
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<td>L4981A</td>
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<td>L4981B</td>
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</table>

MAIN APPLICATIONS

Adapters and TVs
L6562A*, L6563*, L6564*

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

Desktop PCs and Server
L4981*, L4984D

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

www.st.com/ac-dc-converters
www.st.com/pfc-controllers
PWM and resonant controllers

ST’s portfolio of advanced controllers includes a variety of primary controllers intended to fit high-performance applications. Very high efficiency is achieved with single-ended topologies at a fixed switching frequency or with quasi-resonant operation; the new STCH03 offline constant-current primary-side regulation controller (PSR-CC) guarantees very low power consumption at no load condition. For high-power, high-current applications, ST offers controllers for half-bridge resonant and asymmetrical half-bridge topologies. The new STCMB1 and STNRG011 combo controllers including high-voltage start-up, Xcap discharge circuit, PFC and resonant driving stages, guarantee high performance and high integration with a smaller pinout.

**Flyback controllers**

**STCH02/STCH03**
- Offline quasi-resonant controller in SO-8 package
- Constant-current primary-side regulation mode (PSR-CC) or constant-voltage regulation with optocoupler
- Advanced burst mode operation (< 10 mW consumption @ no load)
- UVP, autorestart/latched OVP and internal OTP (only for STCH03)
- 650 V HV start up

**L6566**
- Offline fixed-frequency or quasi-resonant controllers
- Suited for SMPS with PFC front-end (A version)
- Suited for SMPS with 3-phase mains (BH version)
- 700 V start up (A/B version), 840 V start up (BH version)

**L6565**
- Offline quasi-resonant controller
- Constant power vs mains change
- Ultra-low start-up current

**HB-LLC resonant controllers**

**L6699**
- Basic features
- Anti-capacitive protection
- Self-adjusting dead-time
- Soft burst mode
- Smooth Start-up

**L6599A**
- PFC interface
- Brown out
- 700 V start-up voltage

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

**STCMB1**
- 800 V start-up voltage
- Embedded X-cap discharge circuit
- Transition Mode (TM) PFC control method
- Self-adjusting dead-time and antcapacitive mode for LLC

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

**STNRG011**
- Onboard 800 V startup circuit, line sense and X-cap discharge compliant with IEC 62368-1, for reduced standby power
- Enhanced fixed on time multi-mode TM PFC controller
- Time-shift control of resonant half-bridge
- ROM memory for SW digital algorithms
- NVM memory for programmable key application parameters

**Asymmetrical half-bridge controller**

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

**MAIN APPLICATIONS**

**Tablets and smartphones**
L6565, L6566*, STCH02, STCH03

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

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

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

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

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

Synchronous rectifiers are used to drive power MOSFETs that replace the rectification diodes in the secondary side of SMPS, thus providing high efficiency especially in low-output-voltage, high-current power supplies.

The product portfolio supports the most common flyback and LLC resonant topologies. The main benefits include high efficiency, space saving, cost reduction and high reliability.

SR Controllers for Flyback

**Synchronous Rectification Benefits**
- Improved efficiency
- Better thermal performance
- High power density
- Increased reliability

SR Controllers for LLC resonant

**Main Applications**

High-power adapters and TVs
SRK1000, SRK1001

Desktop PCs and Server/Telecoms
SRK2000A, SRK2001, SRK2001A

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

SEA05 internal block diagram

CC/CV controllers for chargers, adapters and others

**SEA01**
- Advanced CC/CV controller with online digital trimming
- 0.1% voltage reference precision up to 36 $V_{cc}$
- 200 $\mu$A low quiescent current

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

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

**TSM10**
- Compact solution
- Easy compensation
- 0.5 and 1% voltage reference precision

MAIN APPLICATIONS

- Adapters
- Battery chargers
- Residential, commercial and street lighting

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

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

### Operational Amplifiers

- **TSZ181, TSZ182**
  - 5 V zero-drift amplifier
  - Input offset voltage 15 µV max
  - Gain bandwidth 3 MHz

- **TSB712, TSB7192**
  - 36 V amplifier
  - Input offset voltage 300 µV max
  - Gain bandwidth 6 MHz (unity gain stable) or 22 MHz

### Current Sensing Amplifiers

- **TSC103**
  - Operating voltage 2.9 to 70 V
  - Surviving voltage on shunt -16 to 75 V
  - Amplification gain x50 x100
  - Package TSSOP8, S08

- **TSC101**
  - Operating voltage 2.8 to 30 V
  - Surviving voltage on shunt -0.3 to 60 V
  - Amplification gain x20 x50 x100
  - Package SOT23-5

### Comparators

- **TS3021, TS3022**
  - Propagation delay: 38 ns
  - Low current consumption: 73 µA
  - Rail-to-rail inputs
  - Push-pull outputs
  - Supply operation from 1.8 to 5 V

- **TS3011**
  - Propagation delay: 8 ns
  - Low current consumption: 470 µA
  - Rail-to-rail inputs
  - Push-pull outputs
  - Supply operation from 2.2 to 5 V

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

- Operational amplifier
- PFC controller
- Vcc
- Current
- 

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

- VBUS
- Current sensing amplifier
- ADC
- Load
- GND

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

- Input signal
- Vref
- Fault detection
- Comparator

### MAIN APPLICATIONS

- Wireless battery charger transmitters
- Server/Telecom
- Solar
- UPS
- Lighting
- Factory automation
BATTERY MANAGEMENT ICs

Battery chargers and battery monitoring ICs

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

Battery chargers

<table>
<thead>
<tr>
<th>Current (A)</th>
<th>Device Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>STBCFG01</td>
<td>Switching battery charger &amp; voltage mode fuel gauge, 500 mA OTG</td>
</tr>
<tr>
<td>1</td>
<td>L6924U</td>
<td>Linear charger for Li-Ion and Li-Polymer battery packs</td>
</tr>
<tr>
<td>0.8</td>
<td>STC4054</td>
<td>Thermal regulation, USB power specification supported</td>
</tr>
<tr>
<td>0.65</td>
<td>STBC03</td>
<td>LDO integrated, USB compatible, Power path</td>
</tr>
<tr>
<td>0.45</td>
<td>STBC02</td>
<td>LDO integrated, USB compatible, Power path, Swire</td>
</tr>
<tr>
<td>0.2</td>
<td>STNS01</td>
<td>Ultra low power for ThinFilm and Li-Ion batteries</td>
</tr>
<tr>
<td>0.04</td>
<td>STBC15</td>
<td></td>
</tr>
</tbody>
</table>

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

- OptimGauge™ algorithm for STC3115
- OptimGauge+™ algorithm for SCT3117
- Coulomb counter and voltage gas gauge operations
- Programmable low battery alarm
- Internal temperature sensor

STC3115

FUEL GAUGE ICs MAIN BENEFITS

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

MAIN APPLICATIONS

Bluetooth accessories
STC4054

USB
L6924U, STC4054, STBCFG01

Fitness
STNS01, STBC02, sSTBC03

Smartphones
STBCFG01, STC3115, SCT3117
Wireless charging ICs

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

Wireless power transmitters

<table>
<thead>
<tr>
<th>STWBC</th>
<th>STWBC-WA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STWBC</strong></td>
<td></td>
</tr>
<tr>
<td>• Supports applications up to 5 W</td>
<td></td>
</tr>
<tr>
<td>• Qi A11 certified</td>
<td></td>
</tr>
<tr>
<td><strong>STWBC-WA</strong></td>
<td></td>
</tr>
<tr>
<td>• Supports applications up to 2.5 W</td>
<td></td>
</tr>
<tr>
<td>• Wireless power transmitter dedicated to wearables</td>
<td></td>
</tr>
<tr>
<td><strong>STWBC-EP</strong></td>
<td></td>
</tr>
<tr>
<td>• Supports application up to 15 W</td>
<td></td>
</tr>
<tr>
<td>• Qi extended power certified</td>
<td></td>
</tr>
<tr>
<td><strong>STWBC-MC</strong></td>
<td></td>
</tr>
<tr>
<td>• Support multi-coil applications up to 15 W</td>
<td></td>
</tr>
<tr>
<td>• Qi extended power certified</td>
<td></td>
</tr>
</tbody>
</table>

Common features

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

Wireless power receivers

<table>
<thead>
<tr>
<th>STWLC33</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STWLC33</strong></td>
</tr>
<tr>
<td>• Supports up to 15 W output power in RX mode and 5 W in TX mode</td>
</tr>
<tr>
<td>• Qi compliant</td>
</tr>
<tr>
<td>• Outstanding total system efficiency</td>
</tr>
<tr>
<td>• Precise voltage and current measurements for FOD function</td>
</tr>
</tbody>
</table>

MAIN APPLICATIONS

- **Wireless battery charger transmitters**
  - STWBC, STWBC-EP, STWBC-MC
- **Tablets and smartphones**
  - STWLC33
- **Wearables**
  - STWBC-WA
DC-DC SWITCHING CONVERSION ICs

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

DC-DC CONVERTERS

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

MAIN APPLICATIONS
- Smartphones
- TVs
- Computing
- Solar
- UPS
- Lighting
- Set-top boxes
- Wearables
- Server/Telecom
- Home appliances
- Factory automation

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

www.st.com/dc-dc-switching-converters
**DC-DC controllers**

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

### Single-phase Buck controllers

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

### Multi-phase Buck controllers

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

---

**MAIN APPLICATIONS**

- **Server**
- **Microserver**
- **Telecoms**
- **PC desktop**

---

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

www.st.com/dc-dc-switching-converters
www.st.com/single-phase-controllers
www.st.com/multi-phase-controllers
DIGITAL POWER CONTROLLERS AND MICROCONTROLLERS

Digital power controllers

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

Digital controllers tailored for power conversion and lighting applications

STNRG*  STLUX*

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

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

STLUX*
- Digital controller tailored for lighting applications
- Suitable for primary-side regulation and multi-strings lighting applications
- DALI 2.0 for remote control and connectivity

Digital controller for interleaved CCM boost PFC

STNRGPF01  STNRGPF12

- Digital inrush current limiter (STNRGPF12)
- Ideal for wide power range above 500 W
- Reduced EMI filter and inductor volume
- Reduced output capacitor RMS current
- Flexible working frequency up to 300 kHz to drive both MOSFETs and IGBTs
- Configurable phase shedding for wide load range high efficiency conversion
- Programmable fast overcurrent and thermal protection (STNRGPF12)
- On-chip UART/I2C digital interfaces for convenient connectivity
- Ideal for outdoor applications with -40 to +105 °C operating range

MAIN APPLICATIONS

Solar STNRG*  HEV charging stations STNRGPF01, STNRGPF12  UPS STNRG*  Factory automation STNRGPF01, STNRGPF12  Commercial, architectural and street lighting STLUX*

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

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

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

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

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

Finally, the STM32H7 series has a 32-bit ARM® Cortex®-M7 running at 480 MHz with precision FPU, DSP and advanced MPU. These MCU specifically address digital power conversion applications such as digital switched-mode power supplies, lighting, welding, solar, wireless charging, motor control and way more.

---

### STM32G0
- Cortex®-M0 core
- Very low power consumption
- Timer frequency up to 128 Mhz resolution (8ns)
- High-speed ADCs for precise and accurate control
- More RAM for Flash: up to 36 KB SRAM for 128 KB and 64 KB Flash memory

### STM32F334
- Cortex®-M4 core
- High resolution timer V1 (217ps resolution) with waveform builder and event handler
- 12-bit ADCs up 2.5 Msps conversion time
- Built-in analog peripherals for signal conditioning and protection (25ns from fault input to PWM stop)

### STM32G474
- Cortex®-M4+ core
- High resolution timer V2 (184ps resolution) with waveform builder and event handler
- Mathematical accelerator, digital smps and power factor correction
- High-speed ADCs for precise and accurate control (4Msps)
- Dual bank flash for live upgrade

### STM32H743
- Cortex®-M7 core
- High performance up to 480 MHz
- High resolution timer V1 (2.1ns resolution) for real time control
- High-speed ADCs for precise and accurate control (3.6 Msps)

---

Digital Power Supply and PFC Design Workshop with STM32 MCUs in collaboration with the company partner Biricha (from Q4 2019)
**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>SPC58 E Line</th>
<th>Triple 3x e200z4d @ 180 MHz</th>
</tr>
</thead>
<tbody>
<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>8x 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), 3x 10 bit (SAR), 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
- OPEN ALLIANCE
- FlexRay

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

**Secure & Safety**
- ASIL D
- Evita Medium/Full
- ISO 26262
ST offers a complete ecosystem rich of partners, discovery tools, and the free to download SPC5-Studio IDE containing all peripherals drivers and graphical interface for configuration.
ST offers Schottky and ultrafast silicon rectifier solutions for all market requirements. ST’s latest developments include M series, based on Schottky technology, with improved avalanche rating and the integration of higher currents in low-profile PSMC (TO-277A) and PowerFLAT™ packages. Our range of small-signal Schottky diodes with flip-chip and SOD-923 devices helps meet the most stringent space-saving requirements, especially for portable communication equipment.

For high-efficiency rectification or freewheeling functions, our new field-effect rectifier diodes, the FERD family, improve the power density capability of the converters. Power Schottky diodes are also available in thin SOD123Flat and an SOD128Flat packages.

Field-effect rectifiers (FERD)
- **FERD***: Low voltage diodes, for high efficiency and high power density applications
- **STPS***: Power Schottky diodes for low voltage general purpose applications
- **STTH***: Ultrafast high voltage diodes for general purpose application

Power Schottky diodes

Ultrafast rectifiers

MAIN APPLICATIONS
- Adapters and TVs
- Battery chargers
- Solar inverters, welding, HEVs, and UPS
- Residential, commercial, architectural and street lighting
- PC Desktop and Server/Telecoms
- HEV charging stations
- Factory automation
- Home appliances
- Consumer electronics

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

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

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

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

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

Offering the best-in-class forward voltage (lowest VF) and state-of-the-art robustness, our 1200 V SiC diodes provide extra freedom to achieve high efficiency and reliability with lower current rating and therefore lower cost, while reducing operating temperature and extending application lifetime. The 1200 V SiC diode family covers current ratings from 2 to 40 A, including automotive-qualified devices, in surface-mount PowerFlat 8x8 HV, D²PAK HV and DPAK HV (high-voltage) and D²PAK, or through-hole TO-220AC and TO-247LL (long-lead) packages.

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

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

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

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

MAIN APPLICATIONS

Solar inverters STPSC*065, STPSC*12
HEV STPSC*065
UPS STPSC*065, STPSC*12
Server/Telecoms and PFC STPSC*065, STPSC*12

Note: * is used as a wildcard character for related part number
HOT-SWAP POWER MANAGEMENT

E-fuses

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

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

E-fuses, a smart offer for a lots applications

E-FUSE MAIN FEATURES

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

MAIN APPLICATIONS

Home appliances
STEF05, STEF01, STEF12, STEF12S

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

USB connections
STEF05, STEF05L, STEF05S

Factory automation
STEF01, STEF12, STEF12S

Set-top boxes
STEF12, STEF12S

Note 1: product in development, contact ST sales office

www.st.com/e-fuse
Power breakers

Connected in series to the power rail, ST’s **power breakers** are able to disconnect the electronic circuitry if power consumption exceeds the programmed limit. When this happens, the device automatically opens the integrated power switch, disconnecting the load, and notifies the remote monitoring feature.

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

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

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

### Power breakers

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

### Typical home appliance block diagram for STPW12

```
EN, PWM, Imon
STPW12
STPW12

AC/DC
12 V

5 V
3.3 V

EN, PWM, Imon

STPW12

STPW12

MCU

Subsystem 1
(UI, display, control panel, connectivity)

Subsystem 2
(Fans, other motor driver, relay driver)

Subsystem n
(......)
```

### MAIN APPLICATIONS

- **Home appliances**
  - STPW05, STPW12
- **Air conditioning**
  - STPW05, STPW12
- **Factory automation**
  - STPW05, STPW12

Note 1: samples available, contact ST sales office
**IGBTs**

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

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

---

### Breakdown Voltage

<table>
<thead>
<tr>
<th></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></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 to 20 A</td>
<td>20 to 80 A</td>
<td>20 to 80 A</td>
<td>40 A</td>
<td>40 A, 50 A</td>
</tr>
<tr>
<td>15 to 75 A</td>
<td>8 to 75 A</td>
<td>15 to 40 A</td>
<td>20 A, 30 A</td>
<td></td>
</tr>
</tbody>
</table>

### Switching frequency

<table>
<thead>
<tr>
<th></th>
<th>8 to 30 kHz</th>
<th>50 to 100 kHz</th>
<th>2 to 20 kHz</th>
<th>16 to 60 kHz</th>
<th>Up to 8 kHz</th>
<th>2 to 20 kHz</th>
<th>20 to 100 kHz</th>
<th>16 to 60 kHz</th>
</tr>
</thead>
</table>

### IGBT Series

H series

- STG*H*
  - **600 V family**
    - 3 µs of short-circuit capability
    - Low saturation voltage
    - Minimal collector turn-off
    - Series optimized for home appliance applications
  - **1200 V family**
    - 5 µs of short-circuit capability @ starting $T_J = 150 \, ^\circ C$
    - Low turn-off losses
    - Up to 100 kHz as switching frequency

V series

- STG*V*60°F
  - High $f_{sw}$ series
  - Tail less switching off
  - Very low turn-off switching losses
  - Soft and very fast recovery antiparallel diode
  - Up to 100 kHz in hard switching topologies

M series

- STG*M*
  - **650 V family**
    - 6 µs of min short-circuit capability @
      starting $T_J = 150 \, ^\circ C$
    - Wide safe operating area (SOA)
    - Very soft and fast recovery antiparallel diode
    - Suitable for any inverter system up to 20 kHz
    - AEC-Q101 qualified devices
  - **1200 V family**
    - 10 µs of min short-circuit capability @
      starting $T_J = 150 \, ^\circ C$
    - Freewheeling diode tailored for target application
    - Suitable for any inverter system up to 20 kHz

---

### Focus Applications

**Home appliances (fans, pumps, washing machines and dryers)**

- Welding, high frequency converters
- Industrial motor control, automotive traction inverter, GPI, Air-Con
- High frequency converters, PFC, solar, UPS, charger, welding, induction heating and soft switching
- Induction heating and soft switching
- Industrial motor control, GPI, Air-Con
- PFC, welding, high frequency converters, solar, UPS, charger
- Induction heating, microwave and soft switching

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68
HB series

- 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

- 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

S series

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

IH series

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

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

### MAIN APPLICATIONS

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

Note: * is used as a wildcard character for related part number
Intelligent power module - SLLIMM™

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

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

**KEY BENEFITS**
- Easy to drive through microcontroller
- Higher robustness and reliability
- Plug’n Play solution

---

**MAIN APPLICATIONS**

- Fan
- Fridge
- Washing Machine
- Air conditioning
- Motor control

www.st.com/igbt
INTELLIGENT POWER SWITCHES

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

Devices are designed using ST’s latest technologies, thus offering state-of-the-art solutions in any application field.

IPS MAIN FEATURES

- Logic
- Driving
- Protections
- Diagnostic
- Power stage
...all on a single chip

Output Current/Channel (A)

- IPS160H, VN540, VN751, L6370
- IPS161H, L6375, L6377, TDE1707, TDE1897, TDE1898
- TDE1708, TDE3247, TDE1787, TDE1747

Note 1: low side switch  2: isolated

MAIN APPLICATIONS

- Factory automation
- Vending machines
- Renewable energy

www.st.com/ips
LED DRIVERS

Offline LED converters with PSR

Dedicated LED drivers operating from the AC mains ensure highly-accurate LEDs managing to provide a high level of light quality and avoid flickering. By combining a state-of-the-art low-voltage technology for the controller and an extremely robust 800 V technology for the power MOSFET in the same package, HVLED8 converters (i.e controller + MOSFET in the same package) feature an efficient, compact and cost-effective solution to drive LEDs directly from the rectified mains. This family of converters works in constant-current / constant-voltage primary-side regulation (PSR-CC/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>Model</th>
<th>HPF</th>
<th>PSR-CC</th>
<th>PSR-CV</th>
<th>P_{out}^{\text{Max}}</th>
<th>Internal power MOSFET</th>
<th>Flyback</th>
<th>Buck-boost</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVLED805</td>
<td></td>
<td></td>
<td></td>
<td>8 W</td>
<td>800 V_{BR}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HVLED815PF</td>
<td></td>
<td></td>
<td></td>
<td>15 W</td>
<td>800 V_{BR}</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Offline LED controllers with PSR

<table>
<thead>
<tr>
<th>Model</th>
<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>
<td></td>
</tr>
</tbody>
</table>

### Offline LED controllers

<table>
<thead>
<tr>
<th>Model</th>
<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>
<td></td>
</tr>
</tbody>
</table>

### Topology example

![Topology example diagram](image)

**Controller**

**Offline LED driver converter HVLED8**

**Flyback with PSR**

### MAIN APPLICATIONS

- **Residential lighting**
  - HVLED815PF

- **Commercial and street lighting**
  - HVLED001A, HVLED001B, HVLED007

[www.st.com/led](http://www.st.com/led)
**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></th>
<th>Buck</th>
<th>Buck-boost</th>
<th>Dimming</th>
<th>( V_{in\text{Max}} )</th>
<th>Synchronous</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED2000</td>
<td></td>
<td></td>
<td>3 A</td>
<td>18 V</td>
<td></td>
</tr>
<tr>
<td>LED2001</td>
<td></td>
<td></td>
<td>4 A</td>
<td>18 V</td>
<td></td>
</tr>
<tr>
<td>ST1CC40</td>
<td></td>
<td></td>
<td>3 A</td>
<td>18 V</td>
<td></td>
</tr>
<tr>
<td>LED5000</td>
<td></td>
<td></td>
<td>3 A</td>
<td>48 V</td>
<td></td>
</tr>
<tr>
<td>LED6000</td>
<td></td>
<td></td>
<td>3 A</td>
<td>61 V</td>
<td></td>
</tr>
</tbody>
</table>

### DC-DC LED drivers controllers

<table>
<thead>
<tr>
<th></th>
<th>Reverse buck</th>
<th>Buck-boost</th>
<th>Boost &amp; Sepic</th>
<th>Dimming</th>
<th>( V_{in\text{Max}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVLED002</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>150 V</td>
</tr>
<tr>
<td>LED6001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>36 V</td>
</tr>
<tr>
<td>STLDC08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.6 V</td>
</tr>
</tbody>
</table>

### Topology examples

- **Synchronous buck**
  - \( V_{in} \) input
  - LED2000, LED2001, ST1CC40

- **Asynchronous buck**
  - \( V_{in} \) input
  - LED5000, LED6000

- **Reverse buck**
  - \( V_{in} \) input
  - HVLED002

### MAIN APPLICATIONS

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

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

- **Street lighting**
  - LED5000, LED6000, HVLED002

- **Emergency lighting**
  - LED6001, ST1CC40

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

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

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

Channels

<table>
<thead>
<tr>
<th>Channels</th>
<th>LED2472G</th>
<th>STP24DP05</th>
<th>LED1642GW</th>
<th>STP16C*/D*</th>
<th>LED1202</th>
<th>STP16C*/D*</th>
<th>LED8102S</th>
<th>STP08</th>
<th>STP04</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></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

MAIN APPLICATIONS

Traffic signals
LED8102S, LED2472G, STP24DP05, STP04

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

Home appliances
LED8102S, STP16, STP08, LED1642GW, STP4CMP

Special lighting
STP04, LED1642GW, LED2472G, LED8102S

wearable/High End consumer
LED1202

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

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

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

---

**LED row driver converters**

<table>
<thead>
<tr>
<th>6 rows</th>
<th>5 rows</th>
<th>1 row</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED7707</td>
<td>LED7706</td>
<td>STLED25</td>
</tr>
<tr>
<td>• 85 mA/row</td>
<td>• 30 mA/row</td>
<td>• 25 mA/row</td>
</tr>
<tr>
<td>LED7707</td>
<td>STLA02*</td>
<td>STLD40D</td>
</tr>
<tr>
<td>LED7708</td>
<td>• 20 mA/row</td>
<td>• 0.5 A/1.5 A/2 A/row</td>
</tr>
</tbody>
</table>

**Global dimming**

---

**LED row driver controllers**

<table>
<thead>
<tr>
<th>16 rows</th>
<th>5 x 24 matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED7708</td>
<td>STLED524</td>
</tr>
<tr>
<td>• 85 mA/row</td>
<td>• 20 mA/dot</td>
</tr>
<tr>
<td>• Grouped or independent row dimming</td>
<td>• Adjustable luminance for each LED (dot)</td>
</tr>
</tbody>
</table>

---

**LED matrix driver**

<table>
<thead>
<tr>
<th>5 x 24 matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>STLED524</td>
</tr>
<tr>
<td>• 20 mA/dot</td>
</tr>
<tr>
<td>• Adjustable luminance for each LED (dot)</td>
</tr>
</tbody>
</table>

---

**MAIN APPLICATIONS**

- **Smartphones**
  - STLED25, STLD40D
- **Keyboard and accessories**
  - STLA02*
- **Home appliances and ATMs**
  - LED7706, LED7707, LED7708, STCS*
- **Wearables**
  - STLED524

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

www.st.com/led
**LED bypass protection**

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

**MAIN APPLICATIONS**

- Traffic signals
- Residential, commercial, architectural and street lighting
- Emergency lighting
- Display panels
- Control circuit

**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

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

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

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

### Low quiescent current Iq
- Extending battery life
- Suitable for space-constrained battery-powered applications

### Low noise, high PSRR
- High signal fidelity
- Reduced size of external filter components

---

**MAIN APPLICATIONS**

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

**Healthcare**
STLQ015, STLQ020, ST715, LD39130

**Home appliances**
LDK220/320, LDF, LDFM, LDL212

**Automotive ADAS, ECU**
LDK130, LD39100, LD59150, LD040L

---

www.st.com/linear-regulators
LNB SUPPLIES

LNB supplies ICs

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

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

MAIN APPLICATIONS

Set-top boxes and PC card satellite receiver

www.st.com/lnb-supplies
PHOTOVOLTAIC ICs

DC-DC converters with embedded MPPT algorithm

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

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

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

**MAIN APPLICATIONS**

- Smartphones, digital cameras, and camcorders
  - SPV1040
- Fitness, climate, home and factory automation monitoring
  - SPV1050

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

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

High-voltage power MOSFETs (silicon)

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

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

K5 series

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

DM2 & DM6 series

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

M5 series

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

DK5 Series

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

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

M6 series

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

MAIN APPLICATIONS

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

Solar inverters, welding, HEVs, and UPS
K5, M5, DM2, DM6, DK5

Residential, commercial, architectural and street lighting
K5, DK5

Server/Telecoms
M5, M2, M2-EP, DM2

www.st.com/mosfet
Low-voltage power MOSFETs (silicon)

ST’s LV MOSFET portfolio offers a broad range of breakdown voltages from -100 V to 120 V, with low gate charge and low on-resistance, combined with state-of-the-art packaging.

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

H6 series

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

F6 series

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

F7 series

- Extremely low $R_{\text{DS(on)}}$
- Optimized body diode (low $Q_{\text{f}}$) and intrinsic capacitance
- Proper $C_{\text{rss}}/C_{\text{iss}}$ ratio
- Suited for flyback and sync rectification

MAIN APPLICATIONS

- Small motor control and USB battery chargers
  F6
- HDD, power tools, STB, and game consoles
  H6
- Server/Telecoms and SMPS
  F7
- UPS, e-bikes, and fans
  F6, F7
- Solar inverters, forklifts, and EHV
  F7

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 $R_{\text{DS(on)}}$ per area for the new 650 V/1200 V G2 product families, combined with excellent switching performance, translating into more efficient and compact designs.
ST is among the first companies to produce high-voltage SiC MOSFETs. These new families feature the industry’s highest temperature rating of 200 °C for improved thermal design of power electronics systems.
Compared to silicon MOSFETs, SiC MOSFETs also feature significantly reduced switching losses with minimal variation versus the temperature. These features render the device perfectly suitable for high-efficiency and high power density applications.

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

SiC MOSFETs, the real breakthrough in high voltage switching
- $V_{\text{BR}} = 1200$ V (SCT*N120G2), 650 V (SCT*N65G2V)
- Low power losses at high temperature
- High operating temperature capability (200 °C)

SCT*N120G2
SCT*N65G2V

- Body diode with no recovery losses
- Low power losses at high temperatures
- Easy to drive
- Low gate charge (SCT*N65G2V*)

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

INNOVATIVE PACKAGES
- STPAK™
  Multi Sintering Package: Ready for the Next Generation EV Traction Inverters
- HU3PAK™
  Top Side Cooling Package: Ready for Industrial & Automotive High Performance Application

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

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

www.st.com/sicmos
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.

![Ethernet Switch](image)

**PoE-PD devices**

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

**PM8801**
- Sleep mode with LED indicator and Maintain Power Signature
- IEEE 802.3at PD interface + PWM current mode ctrl with double gate driver
- Integrated 100 V, 0.45 W, 640 mA hot-swap MOSFET
- Supports flyback, forward active clamp, and flyback with synchronous rectification topologies

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

**PM8804**
- PWM current mode controller
- Double Gate Driver
- Support Isolated Active Forward Converter
- Input voltage up to 75 VDC
- Embedded start-up (20 mA)
- Slope compensation
- Programmable fixed frequency (up to 1 MHz)

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

**Main standards**

<table>
<thead>
<tr>
<th>PoE-PD (IEEE 802.3af)</th>
<th>PoE-PD (IEEE 802.3at)</th>
<th>PoE-PD (IEEE 802.3bt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 W</td>
<td>25 W</td>
<td>71 W</td>
</tr>
</tbody>
</table>

**Power over Ethernet power supply protection**

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

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

Transil

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

Discrete protection

TVS protection

• Clamping voltage characteristics defined at 25 °C, 85 °C and 125 °C
• Stand-off voltage range: from 85 V to 188 V
• Low leakage current: 0.2 μA at 25 °C
• Maximum operating junction temperatures:
  • SMB and SMC: 150 °C
  • DO-15 and DO-201: 175°C

TVS Transil series against repetitive overvoltage in high temperature conditions

MOSFET Protection with TVS

MAIN APPLICATIONS

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

www.st.com/eos8-20-protection
**ESD protection**

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

**Power delivery Protections**

Ultimate TVS protection for USB fast-charging ports

**ESD**

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

**KEY FEATURES & BENEFITS**

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

**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

**Power Rail ESD Protection**

<table>
<thead>
<tr>
<th>Protection</th>
<th>Stand-off voltage (V_{RTM})</th>
<th>High surge current compact protection (I_{sca})</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ESDL</strong></td>
<td>ESD25P35-1U1M</td>
<td>ESDA25P35-1U1M</td>
</tr>
<tr>
<td></td>
<td>ESD24P140-1U1M</td>
<td>ESDA25W</td>
</tr>
<tr>
<td><strong>ESDA17P</strong></td>
<td>ESDA17P100-1U2M</td>
<td>ESDA15P50-1U1M</td>
</tr>
<tr>
<td></td>
<td>ESDA17P20-1U1M</td>
<td>ESDA17P20-1U1M</td>
</tr>
<tr>
<td><strong>ESDA15P</strong></td>
<td>ESDA13P70-1U1M</td>
<td>ESDA13P70-1U1M</td>
</tr>
<tr>
<td></td>
<td>ESDA17P120-1U1M</td>
<td>ESDA17P120-1U1M</td>
</tr>
<tr>
<td><strong>ESD12V</strong></td>
<td>ESD2V053-1BU2</td>
<td>ESD2V053-1BU2</td>
</tr>
<tr>
<td></td>
<td>ESD2V051-1F4</td>
<td>ESD2V051-1F4</td>
</tr>
</tbody>
</table>

**Peak pulse current performances**

IPP 8/20 µs versus VRM

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

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

**600 V gate drivers**

Half bridge
- 4 A source/sink driver high current capability (L6491)
- Integrated bootstrap diode
- Adjustable deadtime (L6494L)
- Comparator, op amp integrated, smart SD, interlocking and program. DT (L6390)
- Extended temperature range (A version)

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

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

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

**MAIN APPLICATIONS**

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

[www.st.com/stdrive]
USB TYPE-C™ AND POWER DELIVERY CONTROLLERS

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

### Auto-run solutions

<table>
<thead>
<tr>
<th>USB-C Only Protection + Attachment</th>
<th>USB-C Only Protection + Attachment + Alternate Mode (USB 2.0 data)</th>
<th>USB-C + PD Protection + Attachment + PD communication + C-Authentication via USB PD protocol or Alternate Mode PPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>STUSB1600 STUSB1700</td>
<td>STUSB4700/STUSB4710 Provider only STUSB4500 Consumer only</td>
<td>Any STM8 or STM32 with Type-C Port Protection (TCPP01-M12)</td>
</tr>
</tbody>
</table>

### MCU based solutions

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

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

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

1. Using our newest STM32 USB PD3.0 controllers (STM32G0/G4/L5) with built-in “UCPD” interface. Note : UCPD stands for USB-Type-C and Power Delivery interface

2. Using a TCPM / TCPC topology with our X-CUBE-USB-PD middleware stack running on any STM32 as Type-C Port Manager(TCPM) and interfacing with a Type-C Port Controller (STUSB1602 or TCPC from 3rd parties)

### MAIN APPLICATIONS

- Wearables
- Smartphones
- Battery chargers and AC-DC Power Adapters
- Tablet and Mobile PCs
- Consumer Drones
**STUSB Family of Standalone (Auto-Run) USB-C and Power Delivery Controllers**

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

### STUSB1600
- Roles: Source/Sink/Dual Role Power
- OVP, OCP, UVP, short protection
- Integrated VBUS discharge
- Direct interface to MCU through PD + IRQ
- Accessory & dead battery support

### STUSB1700
- Role: Source
- GPIO-controlled current profile (Power sharing, Thermal protection)
- VBUS powered (no LDO needed)
- VDD = (4.1 V - 22 V)
- 28 V short to VBUS protection
- Certification test ID: #1100100

### STUSB1602
- Role (1602): Source/Sink/Dual Role Power
- Role (1702): Source – Auto Grade
- Integrated Type-C PHY + BMC coding
- Perfect companion chip to EC to manage USB Type-C port
- Integrated VCONN switch
- Adjustable current limit (600 mA max)
- OVP, OCP, UVP, short protection
- Integrated VBUS and VCONN discharge path
- PD, SPI + IRQ MCU interface – Dual PD address support
- Accessory & dead battery support

### STUSB1702
- Role: Source
- Offers up to 5 programmable PDOS
- Full hardware solution - no software
- Internal and/or external VBUS discharge path
- Very low power consumption
- PD interface (optional connection to MCU)

### STUSB45
- Role: Sink
- Standalone PD controller with Dead Battery support
- VBUS powered (zero power on Vbat)
- VDD = (4.1 V - 22 V)
- 28 V short to VBUS protection
- Optional PD interface for dynamic power management
STM32 USB PD3.0 controllers

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

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

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

**STM32G081 block diagram**

<table>
<thead>
<tr>
<th>System</th>
<th>Encryption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>AES (256-bit)</td>
</tr>
<tr>
<td>POR/PDR/PVD/BOR</td>
<td>True RNG</td>
</tr>
<tr>
<td>Xtal oscillator</td>
<td></td>
</tr>
<tr>
<td>32 kHz + 1 to 64 MHz</td>
<td></td>
</tr>
<tr>
<td>Internal RC oscillators</td>
<td></td>
</tr>
<tr>
<td>32 kHz (±5%) + 16 MHz</td>
<td></td>
</tr>
<tr>
<td>PLL + Prescaler</td>
<td></td>
</tr>
<tr>
<td>Clock control</td>
<td></td>
</tr>
<tr>
<td>RTC/AWU</td>
<td></td>
</tr>
<tr>
<td>Systick timer</td>
<td></td>
</tr>
<tr>
<td>2x watchdogs</td>
<td></td>
</tr>
<tr>
<td>(independent and window)</td>
<td></td>
</tr>
<tr>
<td>60 I/Os on 64 pins</td>
<td></td>
</tr>
<tr>
<td>Cyclic redundancy check</td>
<td></td>
</tr>
<tr>
<td>(CRC)</td>
<td></td>
</tr>
<tr>
<td>Arm® Cortex®-M0+ CPU</td>
<td></td>
</tr>
<tr>
<td>Up to 64 MHz</td>
<td></td>
</tr>
<tr>
<td>Nested vector interrupt</td>
<td></td>
</tr>
<tr>
<td>Controller (NVIC)</td>
<td></td>
</tr>
<tr>
<td>SW debug</td>
<td></td>
</tr>
<tr>
<td>Memory Protection Unit</td>
<td></td>
</tr>
<tr>
<td>AHB-Lite bus matrix</td>
<td></td>
</tr>
<tr>
<td>APB bus</td>
<td></td>
</tr>
<tr>
<td>Up to 128-Kbyte Flash memory</td>
<td></td>
</tr>
<tr>
<td>Up to 36-Kbyte SRAM</td>
<td></td>
</tr>
<tr>
<td>20-byte backup registers</td>
<td></td>
</tr>
<tr>
<td>Boot ROM</td>
<td></td>
</tr>
<tr>
<td>7-channel DMA</td>
<td></td>
</tr>
<tr>
<td>Analog</td>
<td></td>
</tr>
<tr>
<td>Temp. sensor</td>
<td></td>
</tr>
<tr>
<td>1x 12-bit ADC SAR</td>
<td></td>
</tr>
<tr>
<td>16-channels/2.5 MSPS</td>
<td></td>
</tr>
<tr>
<td>1x 12-bit DAC 2ch</td>
<td></td>
</tr>
<tr>
<td>2x comparators</td>
<td></td>
</tr>
<tr>
<td>Encryption</td>
<td></td>
</tr>
<tr>
<td>USB Power Delivery</td>
<td></td>
</tr>
<tr>
<td>(incl. BMC + PHY)</td>
<td></td>
</tr>
<tr>
<td>Connectivity</td>
<td></td>
</tr>
<tr>
<td>2x SPI (i²S)</td>
<td></td>
</tr>
<tr>
<td>4x USART</td>
<td></td>
</tr>
<tr>
<td>(2x with LIN, smartcard,</td>
<td></td>
</tr>
<tr>
<td>IrDA, modem control)</td>
<td></td>
</tr>
<tr>
<td>1x LPUART</td>
<td></td>
</tr>
<tr>
<td>2x I²C</td>
<td></td>
</tr>
<tr>
<td>(SMBus, PMBus, Fast Mode Plus)</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td></td>
</tr>
<tr>
<td>1x 32-bit timer</td>
<td></td>
</tr>
<tr>
<td>16-bit Motor C. timer</td>
<td></td>
</tr>
<tr>
<td>( f_{\text{MAX}} = 128 \text{ MHz} )</td>
<td></td>
</tr>
<tr>
<td>4 PWM + 3 compl.</td>
<td></td>
</tr>
<tr>
<td>5x 16-bit timers</td>
<td></td>
</tr>
<tr>
<td>2 PWM each</td>
<td></td>
</tr>
<tr>
<td>one with ( f_{\text{MAX}} = 128 \text{ MHz} )</td>
<td></td>
</tr>
<tr>
<td>2x Low-power timers</td>
<td></td>
</tr>
</tbody>
</table>

UCPD is a new interface that supports:

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

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

Our **STM32G071B-DISCO** kit allows to discover and display USB-C power and feature capabilities of any USB-C complaint host. Associated with our professional-grade **STM32CubeMonitor-UCPD** software GUI, the kit acts as a USB PD analyzer and allows customers 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

TCPP01-M12

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

KEY FEATURES

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