# Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>3</td>
</tr>
<tr>
<td>Applications</td>
<td>4</td>
</tr>
<tr>
<td>Energy generation and distribution</td>
<td>4</td>
</tr>
<tr>
<td>Power supplies</td>
<td>10</td>
</tr>
<tr>
<td>Wearable Devices - Power Management</td>
<td>29</td>
</tr>
<tr>
<td>LED lighting and controls</td>
<td>30</td>
</tr>
<tr>
<td>Electro-Mobility</td>
<td>37</td>
</tr>
<tr>
<td>Industrial power &amp; tools</td>
<td>44</td>
</tr>
<tr>
<td>Major home appliances</td>
<td>47</td>
</tr>
<tr>
<td>Software tools</td>
<td>49</td>
</tr>
<tr>
<td>Products</td>
<td>50</td>
</tr>
<tr>
<td>AC-DC conversion ICs</td>
<td>50</td>
</tr>
<tr>
<td>Battery management ICs (wired and wireless)</td>
<td>56</td>
</tr>
<tr>
<td>DC-DC switching conversion ICs</td>
<td>58</td>
</tr>
<tr>
<td>Digital power controllers and microcontrollers</td>
<td>60</td>
</tr>
<tr>
<td>Diodes and rectifiers (silicon and SiC)</td>
<td>64</td>
</tr>
<tr>
<td>Hot-swap power management</td>
<td>66</td>
</tr>
<tr>
<td>IGBTs</td>
<td>68</td>
</tr>
<tr>
<td>Intelligent power switches</td>
<td>71</td>
</tr>
<tr>
<td>LED drivers</td>
<td>72</td>
</tr>
<tr>
<td>Linear voltage regulators</td>
<td>77</td>
</tr>
<tr>
<td>LNB supplies</td>
<td>78</td>
</tr>
<tr>
<td>Photovoltaic ICs</td>
<td>79</td>
</tr>
<tr>
<td>Power MOSFETs (silicon and SiC)</td>
<td>80</td>
</tr>
<tr>
<td>Power over ethernet ICs</td>
<td>83</td>
</tr>
<tr>
<td>Protection devices</td>
<td>84</td>
</tr>
<tr>
<td>STDRIVE MOSFET and IGBT gate drivers</td>
<td>86</td>
</tr>
<tr>
<td>USB Type-C and power delivery controllers</td>
<td>87</td>
</tr>
</tbody>
</table>
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>Inverter Power Stage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>600 V-650 V MDmesh DM2 ST<em>60DM2, ST</em>65DM2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>600 V MDmesh DM6 ST*60DM6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>650 V MDmesh M5 ST*65M5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1200 V MDmesh K5 ST*N120K5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SiC MOSFETs SCT* N65G2, SCT<em>N120, SCT</em>N120G2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>600 V V series STG*V60DF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>650 V HB series STG*H65DFB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>650 V HB2 series STG*H65DFB2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>650 V M series STG*M65DF2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1200 V H series STG*H120DF2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1200 V M series STG*M120DF3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Inverter Driving & Control stage |
| STM32F334 |
| STM32F1 |
| STM32F3 |
| STM32F4 |
| STM32F7 |
| STM32H7 |
| STM32G4 |

| MOSFET and IGBT Gate Drivers |
| HV HB Gate Drivers L649* |
| Isolated Gate Drivers STGAP* |
| Multiple LS Gate Drivers PM8034 |
| Single LS Gate Drivers PM88*1 |

| Protections |
| TVS for power rail surge protection SMA6F, SMB15F series |

| Connectivity |
| Bluetooth Low Energy |

| Inverter Power Stage |
| 600 V Ultrafast STTH*06 |
| 1200 V Ultrafast STTH*12 |
| SiC Diodes STPS*C065 |
| STPS*C12 |

| Data Logger/Internet Gateway |
| STM32F0 |
| STM32G0 |
| STM32F1 |
| STM32F3 |

| MCUs |
| STM32F0 |
| STM32G0 |
| STM32F1 |
| STM32F3 |

| Motion Sensors |
| 3-phase Field Oriented Control (FOC) |
| Accelerometer IIS3DHHC, IIS2DWH12, IIS2DH |
| Magnetometer IIS2MDAC eCompass ISM303DAC |
| 6-axis IMU ISM330DLC |

| Environmental Sensors |
| Pressure - LPS22HB |
| Temperature - STLM20 |
| Temperature - STTS751 |
| Humidity - HTS221 |

| Communication Path |
| Power Path |

Note: * is used as a wildcard character for related part number.
Solar Distributed Generation - Microinverter

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

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

ST’S PRODUCT OFFERING FOR MICROINVERTER

<table>
<thead>
<tr>
<th>Microinverter Power Stage</th>
<th>Diodes</th>
<th>Protections</th>
<th>Signal Conditioning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power MOSFETs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80 V-100 V StripFET F7</td>
<td>600 V Ultrafast STH*906</td>
<td>TVS for power rail surge protection SMA6F, SMB15F series</td>
<td></td>
</tr>
<tr>
<td>80 V-650 V MDmesh DM2</td>
<td>1200 V Ultrafast STH*512</td>
<td>Precision Op Amps (&lt;50 MHz) TS*, TSV*, LMV*</td>
<td></td>
</tr>
<tr>
<td>ST<em>N8F7, ST</em>N10F7</td>
<td>SiC Diodes STPSC*065</td>
<td>Current Sensing TSC*</td>
<td></td>
</tr>
<tr>
<td>600 V-650 V MDmesh DM2</td>
<td>STPSC*12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST<em>60DM2, ST</em>65DM2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>800 V-900 V MDmesh K5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST<em>90K5, ST</em>90K5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SiC MOSFET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIC MOSFET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCT*N65G2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Diodes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>600 V Ultrafast STH*906</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1200 V Ultrafast STH*512</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SiC Diodes STPSC*065</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STPSC*12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Protections</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TVS for power rail surge protection SMA6F, SMB15F series</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precision Op Amps (&lt;50 MHz) TS*, TSV*, LMV*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Sensing TSC*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ST’S PRODUCT OFFERING FOR MICROINVERTER

<table>
<thead>
<tr>
<th>Microinverter Driving &amp; Control stage</th>
<th>Sensors</th>
<th>Connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MCUs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32F334</td>
<td>HV HB Gate Drivers STGAP*</td>
<td>Bluetooth Low Energy Power Line Transceivers</td>
</tr>
<tr>
<td>STM32F1</td>
<td>Isolated Gate Drivers</td>
<td>Power Line Transceivers USB</td>
</tr>
<tr>
<td>STM32F3</td>
<td>Multiple LS Gate Drivers PM8834</td>
<td></td>
</tr>
<tr>
<td>STM32F4</td>
<td>Single LS Gate Drivers PM88*1</td>
<td></td>
</tr>
<tr>
<td>STM32F7</td>
<td>Temperature - STLM20</td>
<td></td>
</tr>
<tr>
<td>STM32H7</td>
<td>Temperature - SST51</td>
<td></td>
</tr>
<tr>
<td>STM32G4</td>
<td>Temperature - LM135</td>
<td></td>
</tr>
<tr>
<td><strong>Sensors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature - STLM20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature - SST51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature - LM135</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Connectivity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bluetooth Low Energy Power Line Transceivers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Line Transceivers USB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ST’S PRODUCT OFFERING FOR MICROINVERTER

<table>
<thead>
<tr>
<th>Data Logger/Internet Gateway</th>
<th>Protections</th>
<th>Connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MCUs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32F0</td>
<td>ESD and High Speed Port (HSP) series for Data-line ESD and EOS protection</td>
<td>RS232, RS485 Power Line Transceivers</td>
</tr>
<tr>
<td>STM32G0</td>
<td></td>
<td>Ethernet Transceivers USB</td>
</tr>
<tr>
<td><strong>EEPROM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Serial EEPROM</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Protections</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESD and High Speed Port (HSP) series for Data-line ESD and EOS protection</td>
<td>RS232, RS485 Power Line Transceivers</td>
<td></td>
</tr>
</tbody>
</table>

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

Typical Block Diagram

[Diagram showing the components and connections of a microinverter system, including PV panels, micro inverters, signal conditioning, power transistors, diodes, power stages, protections, and connectivity points to local and remote monitoring.]
Solar Distributed Generation - Power Optimizer

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

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

We provide high-performance STM32 microcontrollers as well as high-efficiency STripFET F7 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>By Pass Diodes</th>
<th>Diodes</th>
<th>Protections</th>
<th>Connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>STM32F334</td>
<td>STM32F34</td>
<td>60 V to 100 V STripFET F7</td>
<td>HV HB Gate Drivers L649*</td>
<td>30 V to 45 V Power Schottky STPS<em>30, STPS</em>45</td>
<td>100 V to 200 V Power Schottky STPS<em>100, STPS</em>200</td>
<td>TVS for power rail surge protection SMA6F, SMB15F series</td>
<td>Bluetooth Low Energy Power Line Transceivers</td>
</tr>
<tr>
<td>STM32F0</td>
<td>STM32F34</td>
<td>ST*N6F7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32G0</td>
<td>STM32F34</td>
<td>ST*N8F7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32F3</td>
<td>STM32F34</td>
<td>ST*N10F7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32G4</td>
<td>ST*N10F7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inverter</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>STM32F34</td>
<td>SIC MOSFETs SCT*N120</td>
<td>Isolated Gate Drivers STGAP*</td>
<td>600 V V series STG*60DF</td>
<td>600 V Ultrafast STH*R06</td>
<td>TVS for power rail surge protection SMA6F, SMB15F series</td>
</tr>
<tr>
<td>STM32F1</td>
<td>STM32F34</td>
<td></td>
<td>Multiple LS Gate Drivers PM8834</td>
<td>650 V HB series STG*H65DFB</td>
<td>SIC Diodes STPSC*065</td>
<td>ESD and High Speed Port (HSP) series for Ethernet and USB protection</td>
</tr>
<tr>
<td>STM32F3</td>
<td>STM32F34</td>
<td>SCT*N120G2</td>
<td></td>
<td>650 V M series STG*G65MDF2</td>
<td>STPSC*12</td>
<td></td>
</tr>
<tr>
<td>STM32F4</td>
<td>STM32F34</td>
<td></td>
<td></td>
<td>1200 V H series STG*H120DF2</td>
<td>STPSC*12</td>
<td></td>
</tr>
<tr>
<td>STM32F7</td>
<td>STM32F34</td>
<td></td>
<td></td>
<td>1200 V M series STG*M120DF3</td>
<td>STPSC*12</td>
<td></td>
</tr>
<tr>
<td>STM32H7</td>
<td>STM32F34</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32G4</td>
<td>STM32F34</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</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>STM32F0</td>
<td>STM32F0</td>
<td>Standard Serial EEPROM</td>
<td>ESD and High Speed Port (HSP) series for Datalog and EOS protection</td>
<td>Bluetooth Low Energy Power Line Transceivers USB</td>
</tr>
<tr>
<td>STM32G0</td>
<td>STM32G0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

### Typical Block Diagram

[Diagram of solar distributed generation system with power optimizers, showing components such as photovoltaic panels, power optimizers, inverters, data loggers, and internet gateways, with connections and flow of power and data.]
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

---

Battery bank

Temperature Sensors

AC grid

Smart Meter

Remote Monitoring

Local Monitoring

Remote Monitoring

Data logger / Internet Gateway

MCU

Sensors

Signal Conditioning

EEPROM

Protection devices

Aux PS

---

PV panels

String Combiner Box

Bidirectional DC/DC

Power Transistors

Diodes

MOS/IGBT Drivers

---

DC/DC

Power Transistors

Diodes

MOS/IGBT Drivers

---

Hybrid Inverter

Power Transistors

Diodes

MOS/IGBT Drivers

---

DC/AC

---

MCU

Connectivity

EEPROM

Protection devices

Aux PS

---

Communication Path

Power Path
### ST’s Product Offering for Home & Commercial Battery Storage Systems

#### Power MOSFETs & IGBTs
- **40 V-100 V** TripFET F7
- **600 V-650 V** MDmesh M2
- **600 V-650 V** MDmesh M6
- **600 V-650 V** MDmesh DM2
- **800 V to 1200 V** MDmesh K5
- **SiC MOSFETs**
  - SCT*N65G2
  - SCT*N120
  - SCT*N120G2
- **SiC Diodes**
  - STPSC*065
  - STPSC*12

#### DC-DC Converter
- **Power Stage**
  - 40 V-100 V TripFET F7
  - 600 V-650 V MDmesh M2
  - 600 V-650 V MDmesh M6
  - 600 V-650 V MDmesh DM2
  - 800 V to 1200 V MDmesh K5
  - **SiC MOSFETs**
    - SCT*N65G2
    - SCT*N120
    - SCT*N120G2

#### DC-AC Converter
- **Power Stage**
  - 600 V Ultrafast
  - 800 V to 1200 V Ultrafast

#### Power Transistors & Drivers
- **MOSFET/IGBT Drivers**
- **Power Modules**
- **Diodes**

#### Protections
- **SiC Gate Drivers**
- **TVS for power rail surge protection**
- **ESD and High Speed Port (HSP) series**

#### MCU
- **System**
  - STM32F3
  - STM32F4
  - STM32G4
- **Control Stage**
  - Precision Op Amps
  - Current Sensing

#### Connectors
- **Data Logger/Internet Gateway**
  - ESD and High Speed Port (HSP) series for Dataline ESD and EOS protection
- **Smart Meter**
- **Remote Monitoring Internet Access**

### Note:
- * is used as a wildcard character for related part number
- 1 only for bidirectional DC-DC converter
- 2 only for commercial battery storage systems
POWER SUPPLIES

Auxiliary SMPS

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

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

Isolated Auxiliary SMPS

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

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

ST’S RECOMMENDED PRODUCTS FOR ISOLATED AUXILIARY SMPS

<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>Voltage Ref</th>
<th>Output diodes</th>
<th>LDO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulation with optocoupler</td>
<td>VIPer<em>5, VIPer</em>7, VIPer*8</td>
<td>STCH02, STCH03, L566B, L566BH, L565</td>
<td>800 V to 1700 V MDmesh K5 ST<em>80K5, ST</em>9K5, ST<em>105K5, ST</em>120K5, ST<em>150K5, ST</em>12N170K5</td>
<td>SMA6F, SMB15F series</td>
<td>600 V Ultrafast STTH<em>06 800 V to 1200 V Ultrafast STTH</em>08 STTH<em>10 STTH</em>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></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</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Low Dropout (LDO) Linear Regulators LDF LDFM LDK220 LDL320 LDL212</td>
</tr>
</tbody>
</table>

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

Typical configuration for isolated auxiliary power supply

<table>
<thead>
<tr>
<th>MCU</th>
<th>ASIC</th>
<th>Gate Drivers</th>
<th>Connectivity ICs</th>
<th>Sensors</th>
<th>User Interface ICs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

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

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

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

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

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

ST’S RECOMMENDED PRODUCTS FOR NON-ISOLATED AUXILIARY SMPS

<table>
<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></td>
<td>600 V Ultrafast STH*06</td>
<td>Low Dropout (LDO) Linear</td>
</tr>
<tr>
<td>Buck-boost</td>
<td>VIPer*1</td>
<td>VIPer*6</td>
<td>SMA6F, SMB15F series</td>
<td>800 V to 1200 V Ultrafast STH<em>08 STH</em>10</td>
<td>Regulators</td>
</tr>
<tr>
<td>Non-isolated flyback</td>
<td>VIPer122</td>
<td></td>
<td></td>
<td>600 V Ultrafast STH*06</td>
<td>LDF, LDFM, LDK220, LDK320, LDL212</td>
</tr>
</tbody>
</table>

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

Typical configurations for non isolated auxiliary power supply

1. Direct feedback
   - HV Converter
   - Flyback Converter
   - PWM Controller
   - IC Supply & Feedback
   - V_outDC

2. Buck-Boost Converter
   - HV Converter
   - Buck-Boost Converter
   - PWM Controller
   - IC Supply & Feedback
   - V_outDC

MAIN EVALUATION BOARDS

- STEVAL-ISA115V1
  12 V, 150 mA buck converter

- STEVAL-ISA178V1
  5 V / 0.2 A buck converter

- STEVAL-ISA195V1
  5 V / 0.36 A buck converter

- STEVAL-ISA196V1
  5 V / 1.2 A non-isolated flyback converter
Smart Chargers and Adapters

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

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

USB Type-C™ PD Adapters and Quick Chargers

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

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

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

<table>
<thead>
<tr>
<th>Type-C and USB-PD Controllers</th>
<th>Programmable Solutions</th>
<th>Authentification &amp; Secure MCUs</th>
<th>Protections</th>
<th>Type C Port Protection</th>
<th>LDO</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCUs</td>
<td>Type-C Controller/ Interface</td>
<td>Auto-Run Solutions</td>
<td>VrM</td>
<td>High surge current compact protection (Vbus)</td>
<td>Single and multi lines protection for MCUs Communication Channel (CC) and Side Band Use (SBU)</td>
</tr>
<tr>
<td>STM32G0, STM32G4, STM32L5</td>
<td>STUSB1600 STUSB1700 STUSB4700 STUSB4710 STUSB4761</td>
<td>STSAFE-A</td>
<td>20 V</td>
<td>ESDA25P35-1U1M ESDA24P140-1U1M</td>
<td>ESDL20-1B2F4 ESDA25W</td>
</tr>
<tr>
<td>STM32F0, STM32F3</td>
<td>STUSB1602A</td>
<td></td>
<td>15 V</td>
<td>ESDA17P100-1U2M ESDA15P50-1U1M</td>
<td>ESDL17P20-1U1M</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9 V</td>
<td>ESDA13P70-1U1M</td>
<td>ESDL121-1BU2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5 V</td>
<td>ESDA7P120-1U1M</td>
<td>ESDZV053-1BU2 ESD051-1F4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ST715</td>
<td>LDK320</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>STSAFE-A</td>
<td>Load Switch</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>STELPD01*</td>
<td></td>
</tr>
</tbody>
</table>

Note: * available in Q3 2019

Typical configuration

MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

- STEVAL-USBDP45C: 45 W USB Type-C™ Power Delivery 3.0 adapter reference design
- STM32G071B-DISCO: STM32G0 world’s 1st USB PD 3.0 MCU and its full ecosystem
- STEVAL-SMACH15V1: 15 W 5 V output USB adapter evaluation board
- STEVAL-USBC2DP: USB Type-C™ to DisplayPort™ adapter
Typical block diagram with certified source and sink auto-run controllers

Source port

USB Type-C receptacle

STUSB47

DC/DC

SRC path

V_{bus}

Power supply

auto-run PD controller

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

USB Type-C receptacle

STUSB45

Load

SINK path

V_{bus}

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 PRODUCTS FOR TABLETS, NOTEBOOK AND AIO ADAPTERS**

<table>
<thead>
<tr>
<th>PFC Block</th>
<th>Power MOSFETs</th>
<th>Diodes &amp; Discretes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TM Analog Controllers</strong>&lt;br&gt; L6562A*, L6563*, L6564*&lt;br&gt; <strong>CCM Analog Controllers</strong>&lt;br&gt; L4981*, L4984D</td>
<td>600 V-650 V MDmesh M2&lt;br&gt; ST<em>60M2, ST</em>65M2, ST<em>60M2-EP&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</em>65M5</td>
<td>600 V Ultrafast for TM&lt;br&gt; STH<em>06, STH</em>06, STH15AC06*&lt;br&gt; 600 V Ultrafast for CCM&lt;br&gt; STH<em>06, STH</em>T06</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><strong>HV Converters for Flyback VIPerPlus</strong>&lt;br&gt; SSR: VIPer*, VIPer5, VIPer7, VIPer<em>8&lt;br&gt; PSR: VIPerP, VIPer</em>, VIPer12 VIPer<em>6, ALTAIR</em>&lt;br&gt; <strong>Flyback Controllers</strong>&lt;br&gt; STCH02, STCH03, L6566A, L6566B, L6565&lt;br&gt; PFC &amp; LLC&lt;br&gt; Combo Controllers&lt;br&gt; STCMB1, STNRGB011&lt;br&gt; <strong>LLC Analog Controllers</strong>&lt;br&gt; L6599*, L6699&lt;br&gt; <strong>SR Analog Controllers</strong>&lt;br&gt; SRK1000, SRK1001 for Flyback&lt;br&gt; SRK2000A, SRK2001, SRK2001A for LLC</td>
<td>800 V to 950 V MDmesh K5&lt;br&gt; ST<em>80K5, ST</em>89K5&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-650 V MDmesh M6&lt;br&gt; ST</em>60M6, ST<em>65M6&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>60DM6&lt;br&gt; 40 V-100 V STripFET F7&lt;br&gt; ST<em>N4F7, ST</em>N6F7, ST<em>N8F7, ST</em>N10F7</td>
<td>Output Diodes for Flyback&lt;br&gt; Schottky, FERD, STPS*, FERD<em>45, FERD</em>50, FERD<em>60, FERD</em>100&lt;br&gt; Clamping Diodes for Flyback&lt;br&gt; 600 V to 1000 V Ultrafast&lt;br&gt; STH<em>06, STH</em>08, STH<em>10&lt;br&gt; Output Diodes for LLC&lt;br&gt; Schottky, FERD&lt;br&gt; STPS</em>, FERD<em>45, FERD</em>50, FERD<em>60, FERD</em>100&lt;br&gt; MOSFET protection for Flyback&lt;br&gt; SMA6F, SMB15F series</td>
</tr>
</tbody>
</table>

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

**Typical Block Diagram with PFC Front-End**

**MAIN EVALUATION BOARDS AND REFERENCE DESIGNS**

- **STEVAL-ISA170V1**<br> 12 V - 150 W resonant converter with synchronous rectification
- **EVLCB1-90WADP**<br> 19 V - 90 W adapter based on TM PFC and HB LLC analog combo controller
- **EVLSTNRG011-150**<br> 12 V - 150 W power supply based TM PFC and HB LLC digital combo controller
- **EVLCB1-AIO210W**<br> 12 V - 210 W adapter based on TM PFC and HB LLC analog combo controller
**Wireless Charging**

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

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

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

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

<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>Receiver</td>
<td>STWLC33, STM32F0</td>
<td></td>
<td></td>
<td>SMM4F, SMA6F series</td>
<td>BAT30F4, BAR46</td>
</tr>
</tbody>
</table>

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

**Typical Block Diagram**

![Typical Block Diagram](image)

**MAIN EVALUATION BOARDS AND REFERENCE DESIGNS**

- **Transmitters**
  - STEVAL-IB045V1: 2.5 W wireless charger transmitter evaluation kit
  - STEVAL-IB044V1: Qi MP-A10 15 W wireless charger TX evaluation kit
  - STEVAL-IB047V1: Qi 3-coil 15 W wireless charger TX evaluation kit
  - EVALSTWBC-EP: Qi MP-A15 15W wireless charger TX evaluation kit

- **receivers**
  - STEVAL-IB042V1: Dual mode wireless power evaluation board for Qi receiver and Qi-based transmitter

- **NFC Readers**
  - ST25R3911B-DISCO: ST25R3911B based NFC Reader Discovery Board
  - ST25R3916-DISCO: ST25R3916 based NFC Universal Device Discovery Board
**Desktop PCs Power Supply**

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

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

### ST’S RECOMMENDED PRODUCTS FOR DESKTOP PC’S POWER SUPPLY

<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><strong>PFC Block</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TM Analog Controllers L6562A*, L6563*, L6564*</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>06, STTH</em>06, STTH15AC06*</td>
<td>Precision Op Amps (&lt;50 MHz) T*, TSV*, LMV*</td>
</tr>
<tr>
<td>CCM Analog Controllers L4981*, L4984D</td>
<td>600 V-650 V MDmesh M6 ST<em>60M6, ST</em>65M6</td>
<td>600 V Ultrafast for CCM STTH<em>06, STTH</em>06</td>
<td>MOSFET and IGBT Gate Drivers Multiple LS Gate Drivers PM8834</td>
</tr>
<tr>
<td>MCUs &amp; Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG, STNRGP01, STNRGP12</td>
<td>650 V MDmesh M5 ST*65M5</td>
<td>JC Diodes STPSC*065</td>
<td>Single LS Gate Drivers PM88*1</td>
</tr>
<tr>
<td><strong>Isolation DC-DC Stage</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PFC &amp; LLC Combo Controllers STCMB1, STNRG011</td>
<td>600 V-650 V MDmesh M2 ST<em>60M2, ST</em>65M2, ST*60M2-EP</td>
<td>Output Diodes Schottky, FERD STPS* FERD<em>45, FERD</em>50, FERD<em>60, FERD</em>100</td>
<td></td>
</tr>
<tr>
<td>LLC Analog Controllers L6599*</td>
<td>600 V-650 V MDmesh M6 ST<em>60M6, ST</em>65M6</td>
<td>Diodes STEF01</td>
<td></td>
</tr>
<tr>
<td>Asymmetrical HB Controllers L6591</td>
<td>600 V-650 V MDmesh DM2 ST<em>60DM2, ST</em>65DM2</td>
<td>STEF06</td>
<td></td>
</tr>
<tr>
<td>MCUs &amp; Digital Controllers STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG</td>
<td>600 V MDmesh DM6 ST*60DM6</td>
<td>STEF12</td>
<td></td>
</tr>
<tr>
<td>SR Analog Controllers SRK2000A, SRK2001, SRK2001A for LLC</td>
<td>40 V-100 V StriPFEt F7 ST*10F7</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Post Regulation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controllers L6726A, L673*, PM6680</td>
<td>ST9L0N3LLH6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Note: * is used as a wildcard character for related part number</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 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></td>
</tr>
<tr>
<td>CCM Analog Controllers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L4981*, L4984D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCU &amp; Digital Controllers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32F0, STM32G0, V3, STM32F301, STM32F334, STM32G4, STN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy Regulators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STNRG, STNRGPF01, STNRGPF12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCR Block</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Temp, SCR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TN<em>15H-6, TN</em>50H-8, TN*50H-12W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Temp, SCR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TN*50H-12W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power MOSFETs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600 V-650 V MDMesh M2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST<em>60M2, ST</em>65M2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600 V-650 V MDMesh M6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST<em>60M6, ST</em>65M6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>650 V MDMesh M5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST*65M5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIC MOSFETs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST*65G2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diodes &amp; Discretes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge Rectifier Diodes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STBR*12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diodes &amp; Discretes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOSFET and IGBT Gate Drivers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HV HB Gate Drivers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L649*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Island Gate Drives</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STGAP*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple IS Gate Drivers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM8834</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single IS Gate Drivers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM881*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opamp V/I Sensing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-Fuse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precision Op Amps (&lt;50 MHz)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TS*, TSV*, LMV*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controllers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power MOSFETs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600 V-650 V MDMesh M2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST<em>60M2, ST</em>65M2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600 V-650 V MDMesh M6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST<em>60M6, ST</em>65M6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>650 V MDMesh M5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST*65M5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIC MOSFETs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST*65G2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diodes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Diodes for LLC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schottky, FERD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STPS*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FERD<em>45, FERD</em>50, FERD*60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LDO Voltage Regulators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Dropout (LDO)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear Regulators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LDF, LDFM, LD39050, LD39100, LD39200, LDL112, LDL212, LDL3100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR Multiple IS Gate Drivers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM8834</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR HV HB Gate Drivers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L649*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

---

### MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

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

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

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

Power Delivery for Modern Data Center
Typical Configuration for 48 V Isolated Direct Conversion

Generator

- AC/DC
- DC/DC
- 48 V PSU
- Battery
- 48 V - 40 V BBS

48 V
- 2 Cells
- 4 Cells
- 48 V 2 Cells
- 48 V 4 Cells
- 48 V 2 Cells
- Others CPU rails
- Aux rails
- Stand-by rails
- ASIC/FPGA/GPU

- 48 V/12 V 1 Cell
- 48 V/5 V 1 Cell
- 48 V/1 V 1 Cell

Full Bridge driver
STPRDC02

Rectifier
STPRDC01

Digital Isolator (optional)
STPDCC60

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

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

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

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

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

Typical block diagram for PoE Power Management

MAIN EVALUATION BOARDS AND REFERENCE DESIGNS

<table>
<thead>
<tr>
<th>Board Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEVAL-POE001V1</td>
<td>Power Over Ethernet (PoE) - IEEE 802.3bt compliant interface</td>
</tr>
<tr>
<td>STEVAL-POE002V1</td>
<td>5 V/8 A, synchronous flyback converter, Power over Ethernet (PoE) IEEE 802.3bt compliant reference design</td>
</tr>
<tr>
<td>STEVAL-POE003V1</td>
<td>5 V/20 A, active clamp forward converter, Power Over Ethernet (PoE) IEEE 802.3bt compliant reference design</td>
</tr>
<tr>
<td>STEVAL-POE005V1</td>
<td>12 V/8 A, active clamp forward converter, Power Over Ethernet (PoE) IEEE 802.3bt compliant reference design</td>
</tr>
<tr>
<td>STEVAL-POE006V1</td>
<td>3.3 V/20 A, active clamp forward converter, Power Over Ethernet (PoE) IEEE 802.3bt compliant reference design</td>
</tr>
</tbody>
</table>

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

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

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

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

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

<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><strong>PFC Block</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TM Analog Controllers</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 STTH15A06*</td>
<td>Precision Op Amps (&lt;50 MHz) TS*, TSV*, LMV*</td>
</tr>
<tr>
<td>CCM Analog Controllers</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>06</td>
<td>MOSFET and IGBT Gate Drivers</td>
</tr>
<tr>
<td>MCUs &amp; Digital Controllers</td>
<td>600 V-650 V MDmesh M5 ST*65M5</td>
<td></td>
<td>Multiple LS Gate Drivers PM8834</td>
</tr>
<tr>
<td><strong>Isolation Stage</strong></td>
<td></td>
<td></td>
<td>Single LS Gate Drivers PM8831</td>
</tr>
<tr>
<td>Flyback Controllers</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>Combo Controllers</td>
<td>600 V-650 V MDmesh M6 ST<em>60M6, ST</em>65M6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LLC Analog Controllers</td>
<td>600 V-650 V MDmesh DM2 ST<em>60DM2, ST</em>65DM2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asymmetrical HB Controllers</td>
<td>600 V-650 V MDmesh DM6 ST*60DM6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCUs &amp; Digital Controllers</td>
<td>60 V-100 V STripFET F7 ST<em>N6F7 ST</em>N8F7 ST*N10F7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR Analog Controllers SRK1000, SRK1001 for Flyback SRK2000A, SRK2001, SRK2001A for LLC</td>
<td>Output Diodes for Flyback Schottky, FERD, Ultrafast STPS*, FERD*, STTH*</td>
<td>Clamping Diodes for Flyback 600 V to 1000 V Ultrafast STTH<em>06, STTH</em>08, STTH*10</td>
<td>HV HB Gate Drivers L649*</td>
</tr>
<tr>
<td>STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG, STNRGP01, STNRGPF12</td>
<td>600 V-650 V MDmesh M2 ST<em>60M2, ST</em>65M2, ST*60M2-EP</td>
<td>Output Diodes for LLC Schottky, FERD STPS* FERD<em>45, FERD</em>50, FERD<em>60, FERD</em>100</td>
<td>Isolated Gate Drivers STGAP*</td>
</tr>
<tr>
<td>STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG</td>
<td>600 V-650 V MDmesh M6 ST<em>60M6, ST</em>65M6</td>
<td>MOSFET protection for Flyback SMA6F, SMIS15F series</td>
<td>SR Multiple LS Gate Drivers PM8834</td>
</tr>
<tr>
<td>SR Analog Controllers SRK1000, SRK1001 for Flyback SRK2000A, SRK2001, SRK2001A for LLC</td>
<td>600 V-650 V MDmesh DM2 ST<em>60DM2, ST</em>65DM2</td>
<td></td>
<td>SR HV HB Gate Drivers L649*</td>
</tr>
<tr>
<td>STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STNRG</td>
<td>60 V-100 V STripFET F7 ST<em>N6F7 ST</em>N8F7 ST*N10F7</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Voltage Reference</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>T<em>431, T</em>432</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ST1S12, ST1S3*, ST1S4*, ST1S50</td>
</tr>
</tbody>
</table>

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

---

Typical Block Diagram for Analog Control Solutions for Small Pannel Size

```
~ AC ~ Input Rect. PFC Flyback Output Rect. \( V_{outDC} \)

TM/CCM PFC controller Flyback controller Synch. Rect. controller
```
**Typical Block Diagram: Analog Control Solutions with no Aux supply, for Small/Medium Panel Size**

```
~ AC  Input Rect.  PFC  LLC  Output Rect.  V_{OUTDC}
```

- TM/CCM PFC controller
- LLC controller
- Synch. Rect. controller

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

```
~ AC  Input Rect.  Interleaved PFC  LLC  Output Rect.  V_{OUTDC}
```

- Gate Driver
- Gate Driver
- 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

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

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

---

**MAIN EVALUATION BOARDS AND REFERENCE DESIGNS**

- **STEVAL-ISA152V1**
  - Asynch. buck up to 60 Vin, 3.3 Vout - 3 A Iout

- **STEVAL-ISA159V1**
  - Synch. Buck 36 Vin, 3.3 Vout - 400 mA

- **STEVAL-ISA160V1**
  - Synch. Buck 3.3 Vin, 1.2 Vout-3 A Iout, Auto. Grade

- **STEVAL-ISA205V1**
  - Synch. Buck 12 Vin, 3.3 Vout-2 A Iout, Auto. Grade

---

Note: * is used as a wildcard character for related part number
ST's product offering for Switching Converters (DC-DC)

24 V Bus

Post-Regulation (<24 V)

Buck-Boost

Boost

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

48 V Input  
<table>
<thead>
<tr>
<th>Input Filter</th>
<th>Flyback Converter</th>
<th>Output Filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWM peak current mode controller</td>
<td>PM804</td>
<td></td>
</tr>
</tbody>
</table>

Active Clamp Snubber  
N-channel Mosfet  
ST*N4F7  
ST*N6F7  
Adjustable shunt Voltage Reference  
Feedback Circuit (TS431AILT)

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

48 V Input  
<table>
<thead>
<tr>
<th>Input Filter</th>
<th>Forward Converter</th>
<th>Output Filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWM peak current mode controller</td>
<td>PM804</td>
<td></td>
</tr>
</tbody>
</table>

Active Clamp Reset  
N-channel Mosfet  
ST*N4F7  
ST*N6F7  
Voltage Reference  
Feedback Circuit (TS431AILT)

MAIN EVALUATION BOARDS

STEVAL-ISA203V1*  
- Input Voltage range: 42 - 56 V DC  
- Switching Frequency - 250 kHz  
- Output:  
  - Power - 100 W  
  - Voltage - 5 V DC  
  - Current - up to 20 A  
- Peak Efficiency > 94%

Note: * available in Q3 2019

STEVAL-ISA204V1  
- 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%

Note: * used as a wildcard character for related part number
WEARABLE DEVICES - POWER MANAGEMENT

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

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

Typical Block Diagram of Smart Watch

Main Evaluation Boards

STEVAL-1PS01AJR/1PS01EJR/1PS01BJR*/1PS01GJR*
Evaluation board based on the ST1PS01EJR 400 mA nano-quiet synchronous step-down converter

Note: * available in Q3 2019

STEVAL-LDO001V1
Quad high performance LDO evaluation board based on LD8L20, LD4N025, LD391305 and STLQ020

Note: * available in Q3 2019
LED LIGHTING AND CONTROLS

LED General Illumination

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

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

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

Typical Block Diagram
### ST’S PRODUCT OFFERING FOR LED GENERAL ILLUMINATION

<table>
<thead>
<tr>
<th>PFC Block</th>
<th>Controllers &amp; Converters</th>
<th>Controllers &amp; Discretes</th>
<th>MOSFET and IGBT Gate Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TM Analog Controllers</td>
<td>600 V-650 V MDmesh M2</td>
<td>Single LS Gate Drivers</td>
</tr>
<tr>
<td></td>
<td>L6562*, L6563*, L6564*</td>
<td>ST<em>60M2, ST</em>65M2, ST*60M2-EP</td>
<td>PM88*1</td>
</tr>
<tr>
<td></td>
<td>CCM Analog Controllers</td>
<td>600 V-650 V MDmesh M6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L4981*, L4984D</td>
<td>ST<em>60M6, ST</em>65M6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MCUs &amp; Digital Controllers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STLR, STNRG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolation Stage</td>
<td>Offline LED Drivers</td>
<td>800 V to 950 V MDmesh K5</td>
<td>Voltage Reference, CC/CV Ctrl</td>
</tr>
<tr>
<td></td>
<td>HVLED001B, HVLED001A, HVLED007, HVLED8*</td>
<td>ST<em>80K5, ST</em>9K5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HV Converters</td>
<td>600 V-650 V MDmesh M2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VIPerOP, VIPer<em>1, VIPer</em>6, VIPer122, VIPer<em>5, VIPer</em>7, VIPer*8</td>
<td>ST<em>60M2, ST</em>65M2, ST*60M2-EP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LLC Analog Controllers</td>
<td>600 V-650 V MDmesh M6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L6599*, L6699</td>
<td>ST<em>60M6, ST</em>65M6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PFC &amp; LLC/LCC Combo Controllers</td>
<td>600 V-650 V MDmesh DM2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>STCM51, STN5G011</td>
<td>ST<em>60DM2, ST</em>65DM2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MCUs &amp; Digital Controllers</td>
<td>600 V-650 V MDmesh DM6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STLR, STNRG</td>
<td>ST*60DM6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SR Analog Controllers</td>
<td>60 V-100 V STripFET F7</td>
<td></td>
</tr>
<tr>
<td>Multiple strings</td>
<td>Offline LED Drivers</td>
<td>ST<em>N6F7, ST</em>N8F7, ST*N10F7</td>
<td></td>
</tr>
<tr>
<td>management</td>
<td>HVLED002</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MCUs &amp; Digital Controllers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STLR, STNRG</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SR Analog Controllers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SRK1000, SRK1001 for Flyback</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SRK2000A, SRK2001, SRK2001A for LLC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wireless Connectivity</td>
<td>BLE 5.0 SoC</td>
<td>600 V-650 V MDmesh M2</td>
<td>Schottky Diodes STPS*</td>
</tr>
<tr>
<td></td>
<td>BlueNRG-2</td>
<td>ST<em>60M2, ST</em>65M2, ST*60M2-EP</td>
<td>FERD Diodes FERD*</td>
</tr>
<tr>
<td></td>
<td>BLE 4.2 SoC</td>
<td>600 V-650 V MDmesh M6</td>
<td>≥ 200 V Ultrafast Diodes</td>
</tr>
<tr>
<td></td>
<td>BlueNRG-1</td>
<td>ST<em>60M6, ST</em>65M6</td>
<td>STTR*</td>
</tr>
<tr>
<td></td>
<td>Baluns</td>
<td>STripFET F7</td>
<td>DC-DC LED Drivers</td>
</tr>
<tr>
<td>Bluetooth Low Energy (BLE)</td>
<td>Certified Modules</td>
<td>Sub-1GHz transceivers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BLE 5.0 SoC</td>
<td>SBTLE-1S, SBTLE-RF</td>
<td>S2-SP, SPIRIT1</td>
</tr>
<tr>
<td></td>
<td>BlueNRG-2</td>
<td>SBTLE-RF0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BLE 4.2 SoC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BlueNRG-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Baluns</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wireless MCUs BLE 5.0</td>
<td></td>
<td>Certified Modules</td>
</tr>
<tr>
<td></td>
<td>STM32WB</td>
<td></td>
<td>SPSGFR (868 and 915 MHz)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SPSGRF (433, 868 and 915 MHz)</td>
</tr>
</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/CV) for single string led driver
- **STEVAL-ILL077V1**: 60 W, digital multiple-string LED driver
- **STEVAL-LLL004V1**: 75 W digitally controlled non isolated constant current LED driver
LED Street Lighting

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

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

Typical Block Diagram

MAIN EVALUATION BOARDS

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

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

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

Note: * available in Q2 2019
# ST'S PRODUCT OFFERING FOR LED STREET LIGHTING

## Controllers

<table>
<thead>
<tr>
<th>Power Supply</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TM PFC Analog Controllers</td>
<td>TM PFC Analog Controllers</td>
<td>TM PFC Analog Controllers</td>
<td>TM PFC Analog Controllers</td>
</tr>
<tr>
<td>L6562*, L6563*, L6564*</td>
<td>L4981*, L4984D</td>
<td>Offline LED drivers</td>
<td>HVLED001B, HVLED001A, HVLED007</td>
</tr>
<tr>
<td>CCM PFC Analog Controllers</td>
<td>CCM PFC Analog Controllers</td>
<td>Combo Controllers</td>
<td>STCB1, STNRC011</td>
</tr>
<tr>
<td>L6599A*, L6699</td>
<td>LLC/LCC Controllers</td>
<td>LLC/LCC Controllers</td>
<td>L6599A*, L6699</td>
</tr>
<tr>
<td>MCUs &amp; Digital Controllers</td>
<td>MCUs &amp; Digital Controllers</td>
<td>MCUs &amp; Digital Controllers</td>
<td>STM32F0, STM32G0, STM32F301, STM32F334, STM32G4, STLUX, STNRG</td>
</tr>
<tr>
<td>STM32F0, STM32G0</td>
<td>STM32F0, STM32G0</td>
<td>STM32F0, STM32G0</td>
<td>STM32F0, STM32G0</td>
</tr>
<tr>
<td>SR Analog Controllers</td>
<td>SR Analog Controllers</td>
<td>SR Analog Controllers</td>
<td>SRK1000, SRK1001 for Flyback</td>
</tr>
</tbody>
</table>

## Power MOSFETs

<table>
<thead>
<tr>
<th>Power Supply</th>
<th>Power MOSFETs</th>
<th>Power MOSFETs</th>
<th>Power MOSFETs</th>
</tr>
</thead>
<tbody>
<tr>
<td>800 V to 1050 V MDmesh K5</td>
<td>800 V to 1050 V MDmesh K5</td>
<td>800 V to 1050 V MDmesh K5</td>
<td>800 V to 1050 V MDmesh K5</td>
</tr>
<tr>
<td>ST<em>60K5, ST</em>9K5, ST*105K5</td>
<td>ST<em>60K5, ST</em>9K5, ST*105K5</td>
<td>ST<em>60K5, ST</em>9K5, ST*105K5</td>
<td>ST<em>60K5, ST</em>9K5, ST*105K5</td>
</tr>
<tr>
<td>600 V - 650 V MDmesh M2</td>
<td>600 V - 650 V MDmesh M2</td>
<td>600 V - 650 V MDmesh M2</td>
<td>600 V - 650 V MDmesh M2</td>
</tr>
<tr>
<td>ST<em>60M2, ST</em>65M2, ST*105M2-EP</td>
<td>ST<em>60M2, ST</em>65M2, ST*105M2-EP</td>
<td>ST<em>60M2, ST</em>65M2, ST*105M2-EP</td>
<td>ST<em>60M2, ST</em>65M2, ST*105M2-EP</td>
</tr>
<tr>
<td>600 V - 650 V MDmesh M6</td>
<td>600 V - 650 V MDmesh M6</td>
<td>600 V - 650 V MDmesh M6</td>
<td>600 V - 650 V MDmesh M6</td>
</tr>
<tr>
<td>ST<em>60M6, ST</em>65M6</td>
<td>ST<em>60M6, ST</em>65M6</td>
<td>ST<em>60M6, ST</em>65M6</td>
<td>ST<em>60M6, ST</em>65M6</td>
</tr>
<tr>
<td>600 V MDmesh DM2</td>
<td>600 V MDmesh DM2</td>
<td>600 V MDmesh DM2</td>
<td>600 V MDmesh DM2</td>
</tr>
<tr>
<td>ST<em>60DM2, ST</em>65DM2</td>
<td>ST<em>60DM2, ST</em>65DM2</td>
<td>ST<em>60DM2, ST</em>65DM2</td>
<td>ST<em>60DM2, ST</em>65DM2</td>
</tr>
<tr>
<td>60 V - 100 V StripFET F7</td>
<td>60 V - 100 V StripFET F7</td>
<td>60 V - 100 V StripFET F7</td>
<td>60 V - 100 V StripFET F7</td>
</tr>
<tr>
<td>ST<em>N6F7, ST</em>N8F7, ST*N10F7</td>
<td>ST<em>N6F7, ST</em>N8F7, ST*N10F7</td>
<td>ST<em>N6F7, ST</em>N8F7, ST*N10F7</td>
<td>ST<em>N6F7, ST</em>N8F7, ST*N10F7</td>
</tr>
</tbody>
</table>

## Diodes & Discretes

<table>
<thead>
<tr>
<th>Power Supply</th>
<th>Diodes &amp; Discretes</th>
<th>Diodes &amp; Discretes</th>
<th>Diodes &amp; Discretes</th>
</tr>
</thead>
<tbody>
<tr>
<td>600 V Ultrafast for TM PFC</td>
<td>600 V Ultrafast for TM PFC</td>
<td>600 V Ultrafast for TM PFC</td>
<td>600 V Ultrafast for TM PFC</td>
</tr>
<tr>
<td>STTH<em>L06, STTH</em>06, STTH15AC06*</td>
<td>STTH<em>R06, STTH</em>T06</td>
<td>SiC Diodes</td>
<td>STPS*C06S</td>
</tr>
<tr>
<td>600 V Ultrafast for CCM PFC</td>
<td>600 V Ultrafast for CCM PFC</td>
<td>600 V Ultrafast for CCM PFC</td>
<td>600 V Ultrafast for CCM PFC</td>
</tr>
<tr>
<td>STTH<em>06, STTH</em>08, STTH*10</td>
<td>STPS*, FERD*, STH*</td>
<td>Output Diodes for Flyback</td>
<td>Schottky, FERD, Ultrafast</td>
</tr>
<tr>
<td>Clamping Diodes for Flyback</td>
<td>Clamping Diodes for Flyback</td>
<td>Clamping Diodes for Flyback</td>
<td>Clamping Diodes for Flyback</td>
</tr>
<tr>
<td>600 V to 1000 V Ultrafast</td>
<td>600 V to 1000 V Ultrafast</td>
<td>600 V to 1000 V Ultrafast</td>
<td>600 V to 1000 V Ultrafast</td>
</tr>
<tr>
<td>STH<em>06, STH</em>08, STH*10</td>
<td>STH<em>06, STH</em>08, STH*10</td>
<td>STH<em>06, STH</em>08, STH*10</td>
<td>STH<em>06, STH</em>08, STH*10</td>
</tr>
<tr>
<td>Output Diodes for LLC/LCC</td>
<td>Output Diodes for LLC/LCC</td>
<td>Output Diodes for LLC/LCC</td>
<td>Output Diodes for LLC/LCC</td>
</tr>
<tr>
<td>Schottky, FERD</td>
<td>Schottky, FERD</td>
<td>Schottky, FERD</td>
<td>Schottky, FERD</td>
</tr>
<tr>
<td>STPS*, FERD<em>45, FERD</em>50, FERD<em>60, FERD</em>100</td>
<td>STPS*, FERD<em>45, FERD</em>50, FERD<em>60, FERD</em>100</td>
<td>STPS*, FERD<em>45, FERD</em>50, FERD<em>60, FERD</em>100</td>
<td>STPS*, FERD<em>45, FERD</em>50, FERD<em>60, FERD</em>100</td>
</tr>
<tr>
<td>MOSFET Protection for Flyback</td>
<td>MOSFET Protection for Flyback</td>
<td>MOSFET Protection for Flyback</td>
<td>MOSFET Protection for Flyback</td>
</tr>
<tr>
<td>SMA44F, SMB15F series</td>
<td>SMA44F, SMB15F series</td>
<td>SMA44F, SMB15F series</td>
<td>SMA44F, SMB15F series</td>
</tr>
</tbody>
</table>

## Voltage Reference, CC/CV Ctrl

<table>
<thead>
<tr>
<th>Voltage Reference, CC/CV Ctrl</th>
<th>Voltage Reference, CC/CV Ctrl</th>
<th>Voltage Reference, CC/CV Ctrl</th>
<th>Voltage Reference, CC/CV Ctrl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Reference</td>
<td>Voltage Reference</td>
<td>Voltage Reference</td>
<td>Voltage Reference</td>
</tr>
<tr>
<td>T<em>431, T</em>432</td>
<td>Voltage Reference</td>
<td>Voltage Reference</td>
<td>Voltage Reference</td>
</tr>
<tr>
<td>Voltage and Current Ctrl</td>
<td>Voltage and Current Ctrl</td>
<td>Voltage and Current Ctrl</td>
<td>Voltage and Current Ctrl</td>
</tr>
<tr>
<td>TSM*, SEA</td>
<td>TSM*, SEA</td>
<td>TSM*, SEA</td>
<td>TSM*, SEA</td>
</tr>
</tbody>
</table>

## Connectors

<table>
<thead>
<tr>
<th>Connectors</th>
<th>Connectors</th>
<th>Connectors</th>
<th>Connectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Line Transceivers</td>
<td>Power Line Transceivers</td>
<td>Power Line Transceivers</td>
<td>Power Line Transceivers</td>
</tr>
<tr>
<td>ST7570, ST7580, ST7590</td>
<td>ST7570, ST7580, ST7590</td>
<td>ST7570, ST7580, ST7590</td>
<td>ST7570, ST7580, ST7590</td>
</tr>
</tbody>
</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

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 SMA4F, SMB15F</td>
<td>Buck L7987L</td>
<td>Buck LED6000 60 V-100 V StripFET F7 ST<em>N6F7, ST</em>N8F7, ST*N10F7</td>
</tr>
<tr>
<td>IEEE 802.3at</td>
<td></td>
<td></td>
<td>Boost LED6001 Schottky Diodes STPS*</td>
</tr>
<tr>
<td>IEEE 802.3af</td>
<td></td>
<td></td>
<td>Inverse Buck HVLED002</td>
</tr>
<tr>
<td>PM8805</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM8803, PM8801</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM8800A</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

MAIN EVALUATION BOARDS

STEVAL-POEL45W1

45 W PoE powered LED lighting with BLE control
Lighting Controls

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

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

DALI Lighting Solution

Digital Addressable Lighting Interface (DALI) is a trademark for a network-based technology used to effectively control lighting in building automation. Originally defined in IEC 60929 standards, it’s updated in IEC 62386 which includes LED device types.

We provide a range of analog and digital controllers including the STLUX family and the STM32 microcontrollers to implement the AC-DC and DC-DC power converter and run the DALI protocol.

Typical Block Diagram for DALI Lighting System

![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>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Controllers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STLUX</td>
<td></td>
<td>STKNX</td>
</tr>
<tr>
<td>Development Tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STSW-STLUXLB02,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STSW-STLUXSMED02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32F1, STM32L1,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Embedded Software</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STSW-DALIO002,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STSW-DALIO001,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STSW-STM8025</td>
<td>Refer to LED General Illumination section</td>
<td></td>
</tr>
<tr>
<td>Power Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.3 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>85-305 V (AC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48 V (DC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DALI Network</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DALI IC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TX-RX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KNX Transceiver</td>
<td></td>
<td></td>
</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 through the driver and can be programmed and modified at any time during manufacturing, distribution, installation or maintenance.

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

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

Typical Block Diagram of LED Wireless Programming

![Typical Block Diagram](image)

ST’S PRODUCT OFFERING FOR LED WIRELESS PROGRAMMING

<table>
<thead>
<tr>
<th>NFC Reader + MCU</th>
<th>Microcontrollers</th>
<th>LED Driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST25R</td>
<td>STM8S</td>
<td>HVLED001*, HVLED002</td>
</tr>
<tr>
<td></td>
<td>ST32F0, ST32G0</td>
<td>LED600*, LED5000, LED2000, STP04/08/16/24</td>
</tr>
<tr>
<td>Dynamic NFC Tag</td>
<td>ST25DV-‘IC Series</td>
<td>STP04/08/16/24, LED12/16/24*, LED8102S</td>
</tr>
<tr>
<td>LED Driver for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>high-end market</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic NFC Tag</td>
<td>ST25DV-PWM Series</td>
<td></td>
</tr>
<tr>
<td>LED Driver for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>entry-level market</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

MAIN EVALUATION BOARDS

- **ST25R3911B-DISCO**: Discovery kit for ST25R3911B high performance HF reader/NFC
- **ST25DV-PWM-eSET**: Discovery kit for the ST25DV-PWM NFC/RFID tag IC
- **ST25DV-DISCOVERY**: Discovery kit for ST25DV04 Dynamic NFC/RFID tag IC
ELECTRO-MOBILITY

Key applications

SOLUTIONS

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

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

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

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
**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)

**FIND OUT MORE**

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

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

OBC

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</th>
<th>ST's Product Offering</th>
<th>Input stage</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>Rectifiers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1^ side 2^ side</td>
</tr>
<tr>
<td>SiC series - 600/650 V</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SiC series - 1200 V</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ultrafast RQ series - 600 V</td>
<td></td>
<td>● ●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ultrafast R series - 600 V</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STBR series - 1200 V</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schottky series - 40/45/60/100 V</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thyristors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TN series - 1200 V</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TYN series - 1200 V</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TM8050H series - 800 V</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TN3050H, TN5050H series - 1200 V</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TVS protections</td>
<td>SM4TY, SM6TY, SM15TY, SM30TY</td>
<td>● ● ● ●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power MOSFETs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SiC series - 650/1200 V</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M5 series - 650 V</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M6 series - 600/650 V</td>
<td></td>
<td>● ●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM6 series - 600/650 V</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM2 series - 600/650 V</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K5 series - 1200 V</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IGBTs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H series - 1200 V</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HB series - 650 V</td>
<td></td>
<td>● ●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HB2 series - 650 V</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V series - 600V</td>
<td></td>
<td>● ●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACEPACK Power Modules</td>
<td>Customized modules</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCUs (32bit)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32F334, STM32G4, STM32F3</td>
<td></td>
<td>● ● ●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32F0, STM32F1, STM32G0</td>
<td></td>
<td>● ●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate drivers</td>
<td>L6491</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STGAP1AS</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memories (EEPROM)</td>
<td>M24**, M95**</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current sense amplifiers</td>
<td>TSC102</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HV converters</td>
<td>VIPer06, VIPer16, VIPer26, VIPer26K</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offline controllers</td>
<td>L6566BH, STCH02, STCH03</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage regulators</td>
<td>L5963, L5964, L798*, L698*</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAN transceivers</td>
<td>L9616</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAN ESD protections</td>
<td>ESDCAN Series</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power line transceivers</td>
<td>ST2100</td>
<td>● ●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST7540, ST7580, ST8500</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bluetooth Low Energy Transceiver</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modules</td>
<td>SPBTLE-1S, SPBTLE-RF, SPBTLE-RFO</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NFC/RFID</td>
<td>Dynamic tags</td>
<td>M245R, ST25DV-I2C</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Readers</td>
<td>ST25R</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metering ICs</td>
<td>STPM32, STPM33, STPM34</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LED array drivers</td>
<td>LED1642, STP08, STP16, LED77*, LED8102S</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Industrial Welding

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

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

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

ST’S PRODUCT OFFERING FOR INDUSTRIAL WELDING

<table>
<thead>
<tr>
<th>PFC</th>
<th>MCUs &amp; Digital Controllers</th>
<th>MOSFET/IGBT Gate Drivers</th>
<th>IGBTs</th>
<th>Power MOSFETs</th>
<th>Diodes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MCUs</td>
<td>Single LS Gate Drivers PM88*/1, TD35*/</td>
<td>600 V V series STG*V60F</td>
<td>600 V-650 V MDMesh M2 ST<em>60M2, ST</em>65M2, ST*60M2-EP</td>
<td>600 V Ultrafast STTH<em>W06, STTH</em>R06, STTH*T06</td>
</tr>
<tr>
<td></td>
<td>STM32F0</td>
<td>Multiple LS Gate Drivers PM8834</td>
<td>650 V HB series STG*H65FB</td>
<td>600 V-650 V MDMesh M6 ST<em>60M6, ST</em>65M6</td>
<td>1200 V Ultrafast STTH*S12</td>
</tr>
<tr>
<td></td>
<td>STM32G0</td>
<td>Isolated Gate Drivers STGAP*</td>
<td>650 V HB2 series STG*H65FB2</td>
<td>650 V MDMesh M5 ST*65M5</td>
<td>SiC Diodes STPSC<em>065, STPSC</em>12</td>
</tr>
<tr>
<td></td>
<td>STM32F301</td>
<td>HV HB Gate Drivers L649*</td>
<td>1200 V H series STG*H120F2</td>
<td>650 V-1200 V SiC MDFETs SCT<em>N65G2, SCT</em>N120</td>
<td></td>
</tr>
<tr>
<td></td>
<td>STM32F334</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>STM32F34</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>STM32G4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>STM32F3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Digital Controllers STNRGPF01, STNRGPF12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| DC-DC | DC-DC | Secondary | Inverter | PS-FB | STGAP* | HV HB Gate Drivers L649* | STG*V60F | 600 V V series | STG*H65FB | 650 V HB series | STG*H65FB2 | 650 V HB2 series | STG*H120F2 | 600 V-650 V MDMesh M2 ST*60M2, ST*65M2, ST*60M2-EP | 600 V-650 V MDMesh M6 ST*60M6, ST*65M6 | 650 V MDMesh M5 ST*65M5 | 650 V-1200 V SiC MDFETs SCT*N65G2, SCT*N120 |
| TTF | PS-FB | STGAP* | HV HB Gate Drivers L649* | STG*V60F | 600 V V series | STG*H65FB | 650 V HB series | STG*H65FB2 | 650 V HB2 series | STG*H120F2 | 600 V-650 V MDMesh M2 ST*60M2, ST*65M2, ST*60M2-EP | 600 V-650 V MDMesh M6 ST*60M6, ST*65M6 | 650 V MDMesh M5 ST*65M5 | 650 V-1200 V SiC MDFETs SCT*N65G2, SCT*N120 |
|     |     |     |                            |       | 600 V-650 V MDMesh M2 ST*60M2, ST*65M2, ST*60M2-EP | 600 V-650 V MDMesh M6 ST*60M6, ST*65M6 | 650 V MDMesh M5 ST*65M5 | 650 V-1200 V SiC MDFETs SCT*N65G2, SCT*N120 |
|     |     |     |                            |       | 600 V-650 V MDMesh M2 ST*60M2, ST*65M2, ST*60M2-EP | 600 V-650 V MDMesh M6 ST*60M6, ST*65M6 | 650 V MDMesh M5 ST*65M5 | 650 V-1200 V SiC MDFETs SCT*N65G2, SCT*N120 |
|     |     |     |                            |       | 200 V to 400 V Ultrafast STTH*W02, STTH*W03, STTH*W04, STTH240F0 | Power Schottky High Temperature STTH*10, STTH*12 |

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

- PFC (optional)
  - PFC power stage
  - Controller

Primary Side Power Stage
- Power Switch
- Clamping Diode
- MOS/IGBT Drivers

HF Transformer
- Rectifier
- Inductor
- + Welding Torch
- - Earth

Auxiliary Power Supply
- MCU
- EEPROM
- Sensing

Output Current / Voltage sensing

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

- PFC (optional)
  - PFC power stage
  - Controller

Primary Side Power Stage
- Power Switch
- Power Switch
- Power Switch
- Power Switch
- MOS/IGBT Drivers

HF Transformer
- Rectifier
- + Secondary Inverter
- - Earth

Auxiliary Power Supply
- MCU
- EEPROM
- Sensing

Welding Torch
- Inductor
- Transformer
- Working Piece

Output Current / Voltage 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)

<table>
<thead>
<tr>
<th>SCR &amp; TRIACs</th>
<th>Diodes</th>
<th>Bypass</th>
<th>SCR &amp; TRIACs</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCUs &amp; Digital Controllers</td>
<td>Power MOSFETs</td>
<td>IGBTs</td>
<td>Diodes</td>
</tr>
<tr>
<td>PFC Block</td>
<td>600 V-650 V MDmesh M2 ST<em>60M2, ST</em>65M2 600 V-650 V MDmesh M6 ST<em>60M6, ST</em>65M6 650 V MDmesh M5 ST<em>65M5 SiC MOSFET SCT</em>65G62</td>
<td>600 V V series STG<em>60DF 650 V HB series STG</em>65DFB 650 V HB2 series STG<em>65DFB2 1200 V H series STG</em>H120DF2</td>
<td>600 V Ultrafast for CCM STTH<em>06 STTH</em>06 SiC Diodes STPSC<em>065 STPSC</em>12</td>
</tr>
<tr>
<td>MCUs</td>
<td>600 V-650 V MDmesh M2 ST<em>60M2, ST</em>65M2 600 V-650 V MDmesh M6 ST<em>60M6, ST</em>65M6 600 V-650 V MDmesh DM2 ST<em>60DM2, ST</em>65DM2 600 V MDmesh DM6 ST*60DM6</td>
<td>600 V V series STG<em>60DF 650 V HB series STG</em>65DFB 650 V HB2 series STG<em>65DFB2 1200 V H series STG</em>H120DF2</td>
<td>600 V Ultrafast STTH*06</td>
</tr>
<tr>
<td>Charge Controller</td>
<td>Power MOSFETs</td>
<td>IGBTs</td>
<td>Diodes</td>
</tr>
<tr>
<td>STM32F334 STM32F324 STM32F4 STM32F7</td>
<td>600 V-650 V MDmesh M2 ST<em>60M2, ST</em>65M2 600 V-650 V MDmesh M6 ST<em>60M6, ST</em>65M6 600 V-650 V MDmesh DM2 ST<em>60DM2, ST</em>65DM2 600 V MDmesh DM6 ST*60DM6</td>
<td>600 V V series STG<em>60DF 650 V HB series STG</em>65DFB 650 V HB2 series STG<em>65DFB2 1200 V H series STG</em>H120DF2</td>
<td>1200 V Ultrafast STTH<em>12 SiC Diodes STPSC</em>065 STPSC*12</td>
</tr>
<tr>
<td>DC-AC Stage</td>
<td>MOSFET and IGBT Gate Drivers</td>
<td>Post Regulation</td>
<td></td>
</tr>
<tr>
<td>DC-DC Stage</td>
<td>Multiple LS Gate Drivers PM8834 Single LS Gate Drivers PM88*1</td>
<td>DC-DC Converters L698*, ST1514, L7985, L7986, L7987* Low Dropout (LDO) Linear Regulators LDF, LDFM, LDK220, LDK320, LDK715, LDDL212</td>
<td></td>
</tr>
</tbody>
</table>

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

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

Refrigeration, washing, drying and miscellaneous equipment

The white goods market requires low-cost and high-energy-efficiency solutions. The refrigeration, washing, drying and the miscellaneous (Air conditioner, water heater) equipment are some of the major home appliance applications that ST, thanks to 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

<table>
<thead>
<tr>
<th>SCR &amp; TRIACs</th>
<th>Diodes</th>
<th>LED Drivers</th>
<th>HV Converters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rect. &amp; inrush current limiter</td>
<td>Bridge Rectifier Diodes</td>
<td>User Interface</td>
<td>AUX SMPS</td>
</tr>
<tr>
<td>SCRs &amp; TRIACs</td>
<td>Diodes</td>
<td>LED Array Drivers</td>
<td>ViPerPlus</td>
</tr>
<tr>
<td>High Temp. SCR</td>
<td></td>
<td>STP04/08/16/24 LED12/16/24*</td>
<td></td>
</tr>
<tr>
<td>TN<em>015H-6, TN1610H-6, TN</em>050H-12W</td>
<td>STBR*12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard SCR: TN815, TN*15-600B</td>
<td>User Interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Temp. Triacs: TN<em>015H-6, TN1610H-6, TN</em>050H-12W</td>
<td>STP04/08/16/24 LED12/16/24*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MCUs & Digital Controllers | IGBTs | Diodes | Opamp V/I Sensing | Power MOSFETs | Power Breakers |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PFC Block</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCUs</td>
<td>IGBTs</td>
<td>Diodes</td>
<td>Power MOSFETs</td>
<td>Power Breakers</td>
<td></td>
</tr>
<tr>
<td>STM32F0, STM32G0, STM32F103, STM32F334, STM32G4, STM32F4</td>
<td>600 V H series STG*H60DF</td>
<td>STH<em>AC06 STH</em>R06 STPSC*065 DLF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32F0, STM32G0, STM32F103, STM32F334, STM32G4, STM32F4</td>
<td>560 V HB series STG*H95FB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>650 V HB2 series STG*H95FB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital Controllers</td>
<td>STNRG, STNRGPF01, STNRGPF12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MCUs | IGBTs | IPM | MOSFET and IGBT Gate Drivers | Power MOSFETs | Post Regulation |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3Ph Inverter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compressor, Drum Motor, Fan, Pumps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STM32F0, STM32G0, STM32F103, STM32F334, STM32G4, STM32F4</td>
<td>600 V H series STG*H60DF</td>
<td>IPM for compressor and drum motor STGIPQ<em>60T-H STIPQ</em>M60T-H STGIP<em>M60T-H STGIP</em>M60T-H STGIP<em>M60T-H STGIP</em>M60T-H</td>
<td>3-Phase HV Gate Driver STDRIVE601</td>
<td>600 V-650 V MDmesh DM2 ST<em>60DM2, ST</em>65DM2</td>
<td>DC-DC Converters L698*, ST1S14, L7985, L7986, ST1S54, ST1S50</td>
</tr>
<tr>
<td>650 V M series STG*M65DF2</td>
<td>IPM for fan and pumps STIPNS<em>M50T-H STGIPNS</em>H60T-H</td>
<td>600 V-650 V MDmesh DM6 ST<em>60DM6 ST</em>65DM6</td>
<td>600 V MDmesh M5</td>
<td>ST*65M5</td>
<td></td>
</tr>
<tr>
<td>600 V-650 V MDmesh DM2 ST<em>60DM2, ST</em>65DM2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>600 V-650 V MDmesh DM6 ST<em>60DM6 ST</em>65DM6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>600 V-650 V MDmesh DM2 ST<em>60DM2, ST</em>65DM2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Typical configuration

~ AC Rect. & inrush current limiter PFC Gate driver MCU AUX SMPS Power stage 1 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>Single-switch quasi-resonant (voltage resonance)</th>
<th>MCUs</th>
<th>IGBTs</th>
<th>MOSFET and IGBT Gate Drivers</th>
<th>Sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>STM8* STM32F100</td>
<td></td>
<td></td>
<td>Multiple LS Gate Drivers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1250 V IH series STG*H125DF</td>
<td>Single LS Gate Drivers PM8834</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HV HB Gate Drivers L649*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Isolated Gate Drivers STGAP*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Enviromental Sensors</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Humidity - HTS221</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Temperature - STLM20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Temperature - STTS751</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Motion Sensors Accelerometer</td>
<td>II53DHHC</td>
</tr>
<tr>
<td>HB series resonant (current resonance)</td>
<td>STM32F0, STM32G0 STM32F100</td>
<td>600 V HB series STG*H60DLFB</td>
<td>Multiple LS Gate Drivers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>650 V IH series STG*H65DF</td>
<td>Single LS Gate Drivers PM881*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HV HB Gate Drivers L649*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Isolated Gate Drivers STGAP*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Enviromental Sensors</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Humidity - HTS221</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Temperature - STLM20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Temperature - STTS751</td>
<td></td>
</tr>
<tr>
<td>User interface (front panel)</td>
<td>STM8, STM32F0, STM32G0, STM32F4<em>9, STM32F7</em></td>
<td>LED Array Drivers STP04/08/16/24, LED1642GW, LED8102S, LED12/16/24*</td>
<td>Multiple LS Gate Drivers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LED Array Drivers</td>
<td>Single LS Gate Drivers PM881*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HV HB Gate Drivers L649*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Isolated Gate Drivers STGAP*</td>
<td></td>
</tr>
<tr>
<td>User interface (front panel)</td>
<td>STM8, STM32F0, STM32G0, STM32F4<em>9, STM32F7</em></td>
<td>LED Array Drivers STP04/08/16/24, LED1642GW, LED8102S, LED12/16/24*</td>
<td>Multiple LS Gate Drivers</td>
<td></td>
</tr>
<tr>
<td>User interface (front panel)</td>
<td></td>
<td></td>
<td>LED Array Drivers</td>
<td>Single LS Gate Drivers PM881*</td>
</tr>
<tr>
<td>User interface (front panel)</td>
<td></td>
<td></td>
<td>HV HB Gate Drivers L649*</td>
<td></td>
</tr>
<tr>
<td>User interface (front panel)</td>
<td></td>
<td></td>
<td>Isolated Gate Drivers STGAP*</td>
<td></td>
</tr>
<tr>
<td>User interface (front panel)</td>
<td></td>
<td></td>
<td>Enviromental Sensors</td>
<td></td>
</tr>
<tr>
<td>User interface (front panel)</td>
<td></td>
<td></td>
<td>Humidity - HTS221</td>
<td></td>
</tr>
<tr>
<td>User interface (front panel)</td>
<td></td>
<td></td>
<td>Temperature - STLM20</td>
<td></td>
</tr>
<tr>
<td>User interface (front panel)</td>
<td></td>
<td></td>
<td>Temperature - STTS751</td>
<td></td>
</tr>
<tr>
<td>User interface (front panel)</td>
<td></td>
<td></td>
<td>Motion Sensors Accelerometer</td>
<td>II53DHHC</td>
</tr>
</tbody>
</table>

Topology example

AC Input
Bridge Rectifier
Filter
Power Management
Linear Voltage Regulators
AC-DC
DC-DC
Power Switch
Inverter Stage and Resonant tank
MOS /IGBT Drivers
HMI
Connectivity
MCU
Sensors
Humidity sensor
Temperature sensor
Accelerometers

MAIN EVALUATION BOARD

Board available on request
1.8 kW, quasi-resonant induction cooking system
eDesignSuite

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

**Smart Simulator and System Design Engine**

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

**Smart Selector**

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

**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
PWM controller + HV power MOSFET in the same package

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

<table>
<thead>
<tr>
<th>Different features for different controllers</th>
<th>VIPer0P</th>
<th>VIPer11</th>
<th>VIPer122</th>
<th>VIPer25</th>
<th>VIPer26</th>
<th>VIPer26K(1050)</th>
<th>VIPer27</th>
<th>VIPer28</th>
<th>VIPer37</th>
<th>VIPer38</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero-Power Mode</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VIPer series 1 Low VCC voltage</td>
<td>VIPer01</td>
<td></td>
<td>VIPer12</td>
<td></td>
<td></td>
<td>VIPer25</td>
<td>VIPer26K</td>
<td></td>
<td>VIPer35</td>
<td></td>
</tr>
<tr>
<td>Minimal BoM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VIPer series 5 Quasi-resonant</td>
<td>VIPer16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>VIPer37</td>
<td></td>
</tr>
<tr>
<td>Smart Features</td>
<td>VIPer17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>VIPer28</td>
<td>VIPer26</td>
<td></td>
<td></td>
<td>VIPer38</td>
</tr>
<tr>
<td>VIPer series 7 Brown-out</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>VIPer27</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VIPer series 8 Peak power</td>
<td></td>
<td></td>
<td>VIPer26</td>
<td>VIPer26K</td>
<td>VIPer37</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Altair PSR CC/CV</td>
<td></td>
<td></td>
<td>VIPer26K</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flyback Converter 85-265 Vac</td>
<td>4 W</td>
<td>5 W</td>
<td>6 W</td>
<td>8 W</td>
<td>10 W</td>
<td></td>
<td>12 W</td>
<td>15 W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buck Converter</td>
<td>4 W</td>
<td>5 W</td>
<td>6 W</td>
<td>8 W</td>
<td>10 W</td>
<td></td>
<td>12 W</td>
<td>15 W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max R_{DSON} / I_{LIM}</td>
<td>30 Ω/350 mA</td>
<td>27 Ω/450 mA</td>
<td>24 Ω/400 mA</td>
<td>20 Ω/400 mA</td>
<td>14 Ω/700 mA</td>
<td>7 Ω/700 mA</td>
<td>4.5 Ω/1 A</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>PFC controllers</th>
<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>TM PFC controllers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCM PFC controllers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</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, X-cap 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 ant-capacitive 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

<table>
<thead>
<tr>
<th>Basic features</th>
<th>DVS AMR</th>
<th>Programmable blanking times after toff</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SRK1000</strong></td>
<td>100 V</td>
<td>Fixed (3 PN available to cover 3 different values)**</td>
<td>SOT23-6L</td>
</tr>
<tr>
<td><strong>SRK1001</strong></td>
<td>185 V</td>
<td></td>
<td>SO8</td>
</tr>
</tbody>
</table>

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

SR controllers for LLC resonant

| Basic features | Matched turnoff threshold | Auto-compensation of parasitic inductance | Reduced adaptive turn-on delay | Reduced masking time "current inversion comparator"
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SRK2000A</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SRK2001</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SRK2001A</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>SEA01</th>
<th>SEA05</th>
<th>SEA05L</th>
<th>TSM10*</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Advanced CC/CV controller with online digital trimming</td>
<td>• Advanced CC/CV controller (SEA05)</td>
<td>• Advanced CC/CV controller with efficient LED pilot lamp driver (SEA05L)</td>
<td>• Compact solution</td>
</tr>
<tr>
<td>• 0.1% voltage reference precision up to 36 Vcc</td>
<td>• 0.5% voltage reference precision up to 36 Vcc</td>
<td>• 0.5% voltage reference precision up to 36 Vcc</td>
<td>• Easy compensation</td>
</tr>
<tr>
<td>• 200 µA low quiescent current</td>
<td>• Low quiescent current: 200 µA (SEA05), 250 µA (SEA05L)</td>
<td>• Current sense threshold 50 mV (SEA05)</td>
<td>• 0.5 and 1% voltage reference precision</td>
</tr>
</tbody>
</table>

MAIN APPLICATIONS

Adapters
Battery chargers
Residential, commercial and street lighting

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

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

### 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</th>
<th>IC</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2 A</td>
<td>STBCFG01</td>
<td>Switching battery charger &amp; voltage mode fuel gauge, 500 mA OTG</td>
</tr>
<tr>
<td>1 A</td>
<td>L6924U</td>
<td>Linear charger for Li-Ion and Li-Polymer battery packs</td>
</tr>
<tr>
<td>0.8 A</td>
<td>STC4054</td>
<td>Thermal regulation, USB power specification supported</td>
</tr>
<tr>
<td>0.65 A</td>
<td>STB03</td>
<td>LDO integrated, USB compatible, Power path</td>
</tr>
<tr>
<td>0.45 A</td>
<td>STB02</td>
<td>LDO integrated, USB compatible, Power path, Swire</td>
</tr>
<tr>
<td>0.2 A</td>
<td>STNS01</td>
<td>Ultra low power for ThinFilm and Li-Ion batteries</td>
</tr>
<tr>
<td>0.04 A</td>
<td>STB15</td>
<td></td>
</tr>
</tbody>
</table>

**STBC02/STB03**
- Embed a linear battery charger, a 150 mA LDO, 2 SPDT load switches and a protection circuit module
- STB02 embeds a smart reset/watchdog and a single wire interface for IC control
- Use a CC/CV algorithm with programmable (only STB02) fast charge, precharge and termination current

**STB15**
- Microbatteries charging and monitoring circuit
- Charging current up to 40 mA (set by dedicated pin)
- 150 nA quiescent current

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

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

**STC3117**

**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, STB02, sSTB03

**Smartphones**
- STBCFG01, STC3115, SCT3117
Wireless charging ICs
ST fully covers wireless charging applications with dedicated ICs for both transmitter and receiver. The STWBC and STWBC-EP, compatible with Qi standard, and the STWBC-WA, dedicated to wearable applications, make up ST’s wireless power transmitters (Tx) family. The receiver family (Rx) consists of the STWLC33 dedicated to Qi compliant consumer applications.

Wireless power transmitters

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

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

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

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

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

Wireless power receivers

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

MAIN APPLICATIONS

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

- **Tablets and smartphones**
  - STWLC33

- **Wearables**
  - STWBC-WA
DC-DC SWITCHING CONVERSION ICs

DC-DC converters

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

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
- **PM6687**: 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
**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**
  - 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**
  - Digital controller fully configurable through GUI for fast and easy design, does not require writing any firmware
  - Mixed signal architecture
  - 3-channel interleaved boost PFC (STNRGPF01)

- **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*
  - STNRGPF01, STNRGPF12

- **HEV charging stations**
  - STNRG*, STNRGPF01, STNRGPF12

- **UPS**
  - STNRG*
  - STNRGPF01, STNRGPF12

- **Factory automation**
  - STNRG*, STNRGPF01, STNRGPF12

- **Commercial, architectural and street lighting**
  - STLUX*
  - **www.st.com/stlux**
  - **www.st.com/stnrg**

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

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

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

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

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

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

---

**STM32G0**

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

**STM32F334**

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

**STM32G474**

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

**STM32H743**

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

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>Core</th>
<th>SPC58 E Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triple</td>
<td>3x e200z4d @ 180 MHz</td>
</tr>
<tr>
<td>eFlash Code</td>
<td>4 MB to 6 MB</td>
</tr>
<tr>
<td>Timers</td>
<td>GTM3</td>
</tr>
<tr>
<td>Safety</td>
<td>ASIL-D</td>
</tr>
<tr>
<td>Advanced Networking</td>
<td>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 | CAN FD | OPEN ALLIANCE |

Scalability

| Up to: 3 cores, 200 HMZ, 10 MB flash |

Secure & Safety

| 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.
DIODES AND RECTIFIERS

Silicon diodes

ST offers Schottky and ultrafast silicon rectifier solutions for all market requirements. ST’s latest developments include M series, based on Schottky technology, with improved avalanche rating and the integration of higher currents in low-profile PSMC (TO-277A) and PowerFLAT™ packages. Our range of small-signal Schottky diodes with flip-chip and SOD-923 devices helps meet the most stringent space-saving requirements, especially for portable communication equipment.

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

Field-effect rectifiers (FERD)

- **FERD** - Low voltage diodes, for high efficiency and high power density applications
- **STPS** - Power Schottky diodes for low voltage general purpose applications
- **STTH** - Ultrafast high voltage diodes for general purpose application

Power Schottky diodes

- **STTH** - Ultrafast bipolar rectifiers

Ultrafast rectifiers

- **STTH** - Ultrafast high voltage diodes for general purpose application

MAIN APPLICATIONS

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

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

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

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

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

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

Our range of 1200 V silicon-carbide (SiC) JBS (Junction Barrier Schottky) diodes meet designers’ needs for superior efficiency, low weight, small size, and improved thermal characteristics for performance-oriented applications. Offering the best-in-class forward voltage (lowest VF) and state-of-the-art robustness, our 1200 V SiC diodes provide extra freedom to achieve high efficiency and reliability with lower current rating and therefore lower cost, while reducing operating temperature and extending application lifetime. The 1200 V SiC diode family covers current ratings from 2 to 40 A, including automotive-qualified devices, in surface-mount PowerFlat 8x8 HV, D²PAK HV and DPAK HV (high-voltage) and D²PAK, or through-hole TO-220AC and TO-247LL (long-lead) packages.

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

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

STPSC*065, STPSC*13

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

MAIN APPLICATIONS

Solar inverters
STPSC*065, STPSC*12

HEV
STPSC*065

UPS
STPSC*065, STPSC*12

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

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

www.st.com/sic-diodes
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 lot of applications

Note 1: product in development, contact ST sales office
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

**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>Voltage</th>
<th>600 V</th>
<th>650 V</th>
<th>1200 V</th>
<th>1250 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>5 to 20 A</td>
<td>20 to 80 A</td>
<td>4 to 200 A</td>
<td>20 to 80 A</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>8 to 30 kHz</td>
<td>50 to 100 kHz</td>
<td>2 to 20 kHz</td>
<td>16 to 60 kHz</td>
</tr>
</tbody>
</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 $T_J = 150$ °C
    - Low turn-off losses
    - Up to 100 kHz as switching frequency

**V series**

- STG*V60°F
  - High $f_{sw}$ series
  - Tail less switching off
  - Very low turn-off switching losses
  - Soft and very fast recovery antiparallel diode
  - Up to 100 kHz in hard switching topologies

**M series**

- STG*M*
  - 650 V family
    - 6 µs of min short-circuit capability @ starting $T_J = 150$ °C
    - Wide safe operating area (SOA)
    - Very soft and fast recovery antiparallel diode
    - Suitable for any inverter system up to 20 kHz
    - AEC-Q101 qualified devices
  - 1200 V family
    - 10 µs of min short-circuit capability @ starting $T_J = 150$ °C
    - Freewheeling diode tailored for target application
    - Suitable for any inverter system up to 20 kHz
HB series
STG*H*B
- Low saturation voltage
- Minimal tail current turn-off
- Different diode option
- Optimum trade-off between conduction and switching losses
- Low thermal resistance
- 4 leads package available
- Very high robustness in final application
- Automotive eligible

HB2 series
STG*H*FB2
- Very low saturation voltage
- Reduced gate charge
- Different diode option
- Optimum trade-off between conduction and switching losses
- Low thermal resistance
- 4 leads package available
- High efficiency in final application
- Automotive eligible

IH series
STG*IH*
650 V family
- Very low $V_{CE(sat)}$: 1.5 V @ $I_{ON}$
- Very low $E_{off}$
- Low drop forward voltage diode
- Designed for soft commutation application only

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

S series
STG*S120DF3
- 10 µs of short-circuit 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

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

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

www.st.com/igbt
Intelligent power module - SLLIMM™

The SLLIMM, small low-loss intelligent molded module, is the ST’s family of compact, high efficiency, dual-in-line intelligent power modules (IPM), with optional extra features. This family includes different solutions in terms of package (SMD, through hole, full molded and DBC) and silicon technology (IGBT, MOSFET and Super Junction MOSFET). 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

---

**SLLIMM nano series**

- 600 V IGBT
- 500 V MOSFET
- 1 up to 3 A

- NDIP (TH)
- NSDIP (SMD)
- 12.45 x 29.15 x 3.10 mm

**SLLIMM nano 2nd series**

- 600 V IGBT
- 600 V SJ-MOSFET
- 3 up to 8 A

- N2DIP (TH)
- 12.45 x 32.15 x 4.10 mm

**SLLIMM 2nd series**

- 600 V IGBT
- 600 V SJ-MOSFET
- 8 up to 35 A

- SDIP2F-26L
- SDIP2B-26L
- 24 x 38 x 3.5 mm

---

**MAIN APPLICATIONS**

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

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

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

### IPS MAIN FEATURES
- Logic
- Driving
- Protections
- Diagnostic
- Power stage
  ...all an a single chip

### Output Current/Channel (A)

<table>
<thead>
<tr>
<th>Single Channel</th>
<th>Dual Channel</th>
<th>Quad Channel</th>
<th>Octal Channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>IPS160H, VN540, VN751, L6370</td>
<td>VNI2140J</td>
<td>VNI808(CM)-32, VNI8200XP-32</td>
</tr>
<tr>
<td>1</td>
<td>IPS161H, L6375, L6377, TDE1707, TDE1897, TDE1898</td>
<td>IPS4260L', VNI4140K, L6376, VN330SP, VN340SP</td>
<td>VN808(CM), VNI8200XP, ISO8200AQ, ISO8200B, ISO8200BQ</td>
</tr>
<tr>
<td>0.5</td>
<td>TDE1708, TDE3247, TDE1787, TDE1747</td>
<td>VNI860, L6374</td>
<td></td>
</tr>
<tr>
<td>&lt;0.5</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

Note 1: low side switch 2: isolated

### MAIN APPLICATIONS
- Factory automation
- Vending machines
- Renewable energy

www.st.com/ips
Offline LED controllers with PSR

<table>
<thead>
<tr>
<th>HPF</th>
<th>PSR-CC</th>
<th>PSR-CV</th>
<th>( P_{\text{out,Max}} )</th>
<th>Internal power</th>
<th>MOSFET</th>
<th>Flyback</th>
<th>Buck-boost</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVLED805</td>
<td></td>
<td></td>
<td>8 W</td>
<td>800 ( V_{\text{BR}} )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HVLED815PF</td>
<td></td>
<td></td>
<td>15 W</td>
<td>800 ( V_{\text{BR}} )</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Offline LED controllers with PSR

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

Offline LED controllers

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

Topology example

- AC
- Offline LED driver converter HVLED8*
- Controller
- Flyback with PSR

**MAIN APPLICATIONS**

- **Residential lighting**
  - HVLED815PF

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

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>LED2000</th>
<th>Buck</th>
<th>Buck-boost</th>
<th>Dimming</th>
<th>V_{inMax}</th>
<th>Synchronous</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED2001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST1CC40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LED5000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LED6000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### DC-DC LED drivers controllers

<table>
<thead>
<tr>
<th>HVLED002</th>
<th>Reverse buck</th>
<th>Buck-boost</th>
<th>Boost &amp; Sepic</th>
<th>Dimming</th>
<th>V_{inMax}</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED6001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STLDC08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Topology examples

- **Synchronous buck**
- **Asynchronous buck**
- **Reverse buck**

### MAIN APPLICATIONS

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

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

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

- **Emergency lighting**
  LED6001, ST1CC40

- **Commercial and architectural lighting**
  LED5000, LED6000, LED6001, HVLED002
LED array drivers

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

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

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

www.st.com/led

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><strong>Global dimming</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STLA02*</td>
<td>STLD40D</td>
<td>STCS*</td>
</tr>
<tr>
<td>20 mA/row</td>
<td>0.5 A/1.5 A/2 A/row</td>
<td></td>
</tr>
</tbody>
</table>

### LED row driver controllers

<table>
<thead>
<tr>
<th>16 rows</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED7708</td>
</tr>
<tr>
<td>85 mA/row</td>
</tr>
<tr>
<td>Grouped or independent row dimming</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](http://www.st.com/led)
LED bypass protection

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

LBP01 get reliable your led application

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

MAIN APPLICATIONS

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

www.st.com/lbp01
LINEAR VOLTAGE REGULATORS

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

<table>
<thead>
<tr>
<th>Ultra-low dropout</th>
<th>Low Iq</th>
<th>Low noise, high PSRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>STLQ015</td>
<td>LDK120/130</td>
<td>LD39015</td>
</tr>
<tr>
<td>STLQ50</td>
<td>LD040L</td>
<td>LD59030</td>
</tr>
<tr>
<td>ST/LDK715</td>
<td>LDK220</td>
<td>LD39020/30</td>
</tr>
<tr>
<td>ST1L08</td>
<td>LDK320</td>
<td>ST730</td>
</tr>
<tr>
<td>LD56100</td>
<td>LD56050</td>
<td>LD39050</td>
</tr>
<tr>
<td>LDBL20</td>
<td>LDCL015</td>
<td>LD39100</td>
</tr>
<tr>
<td>LDFM/LDF</td>
<td>LDLN015</td>
<td>LD39115J</td>
</tr>
<tr>
<td>LD59100</td>
<td>LDL112</td>
<td>LD39130S</td>
</tr>
<tr>
<td>STLQ020</td>
<td>LDL212</td>
<td>LD39200</td>
</tr>
<tr>
<td>LDLN025/30</td>
<td>LD59015</td>
<td>LD59150</td>
</tr>
<tr>
<td>L5050S</td>
<td>L5150BN</td>
<td>L5300EPT</td>
</tr>
</tbody>
</table>

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
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

<table>
<thead>
<tr>
<th>MAIN APPLICATIONS</th>
<th>SPV1040</th>
<th>SPV1050</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Smartphones, digital cameras, and camcorders</strong></td>
<td><img src="smartphone-icon" alt="" /></td>
<td><img src="camera-icon" alt="" /></td>
</tr>
<tr>
<td><strong>Fitness, climate, home and factory automation monitoring</strong></td>
<td><img src="health-icon" alt="" /></td>
<td><img src="home-icon" alt="" /></td>
</tr>
</tbody>
</table>

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.

K5 series
- ST*N*K5
  - Very low $R_{DSS}$
  - Small Qg and capacitance
  - Small packages available
  - Suited for hard switching topologies

DM2 & DM6 series
- ST*N*DM2
  - Improved trr of intrinsic diode
  - High dv/dt capability
  - Suited for ZVS/LLC topologies
- ST*N*DM6

M2/M2-EP series
- ST*N*M2
  - Extremely low Qg
  - High switching speed
  - Suited for hard switching topologies
- ST*N*M2-EP

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

M5 series
- ST*N*M5
  - Extremely low $R_{DSS}$
  - High switching speed
  - Suited for hard switching topologies

M6 series
- ST*N*M6
  - Lower RDS(on) x area vs previous generation
  - Extremely low gate charge (Qg)
  - Optimized capacitances profile for better efficiency @ light load
  - Optimized threshold voltage (VTH) and gate resistance (RG) values for soft switching

MAIN APPLICATIONS

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

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

Residential, commercial, architectural and street lighting
K5, DK5

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

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

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

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

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

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

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

H6 series

\[ \text{ST}^*N^*H6 \]

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

F6 series

\[ \text{ST}^*N^*F6 \]

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

F7 series

\[ \text{ST}^*N^*F7 \]

- Extremely low \( R_{\text{DS(on)}} \)
- Optimized body diode (low \( Q_{\text{rr}} \)) 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**

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

**SiC MOSFETs, the real breakthrough in high voltage switching**

- $V_{\text{BR}} = 1200$ V (SCT*N120G2), 650 V (SCT*N65G2)
- Low power losses at high temperature
- High operating temperature capability (200 °C)

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

### PoE-PD devices

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

**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)

**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

**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

**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

### Main standards

- **PM8800A**
  - PoE-PD (IEEE 802.3af) 13 W
- **PM8803**
  - PoE-PD (IEEE 802.3at) 25 W
- **PM8805**
  - PoE-PD (IEEE 802.3bt) 71 W

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

TVS Transil series against repetitive overvoltage in high temperature conditions

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

MOSFET Protection with TVS

Main Applications

- Adapters
- Smart metering
- Solar inverters
- Residential, commercial, architectural and street lighting
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
ESDAxxP
Strong and thin protection, the ESDAxxP-1U1M series helps to stop damages due to the surge events

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

Peak pulse current performances
IPP 8/20 µs versus VRM

<table>
<thead>
<tr>
<th>Stand-off voltage (V_{RM})</th>
<th>High surge current compact protection (I_{s,max})</th>
<th>Single and multi lines protection for MCUs Communication Channel (CC) and Side Band Use (SBU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 V</td>
<td>ESDA25P35-1U1M ESDA24P140-1U1M</td>
<td>ESDL20-1BF4 ESDA25W</td>
</tr>
<tr>
<td>15 V</td>
<td>ESDA17P100-1U2M ESDA15P50-1U1M</td>
<td>ESDA17P20-1U1M</td>
</tr>
<tr>
<td>9 V</td>
<td>ESDA13P70-1U1M</td>
<td>ESDL121-1BU2</td>
</tr>
<tr>
<td>5 V</td>
<td>ESDA7P120-1U1M</td>
<td>ESDV053-1BU2 ESDS1-1F4</td>
</tr>
</tbody>
</table>

Note: * is used as a wildcard character for related part number
STDRIVE MOSFET AND IGBT GATE DRIVERS

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

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

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

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

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

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

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

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

Auto-run solutions

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

MCU based solutions

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

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

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

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

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

MAIN APPLICATIONS

- Wearables
- Smartphones
- Battery chargers and AC-DC Power Adapters
- Tablet and Mobile PCs
- Consumer Drones
**STUSB family of standalone (auto-run) USB-C and Power Delivery controllers**

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

---

**STUSB Family: main common functions**

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

---

**STUSB1600**

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

---

**STUSB1700**

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

---

**STUSB1602**

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

---

**STUSB1702**

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

---

**STUSB1602**

- **Role**: Source
- Offers up to 5 programmable PD0s
- Full hardware solution - no software
- Internal and/or external VBUS discharge path
- Very low power consumption
- **PC** interface (optional connection to MCU)

---

**STUSB1702**

- **Role**: Source
- Offers up to 5 programmable PD0s
- Full hardware solution - no software
- Internal and/or external VBUS discharge path
- Very low power consumption
- **PC** interface (optional connection to MCU)

---

**STUSB45**

- **Role**: Sink
- Standalone PD controller with Dead Battery support
- **VBUS** powered (zero power on Vbat)
- **VDD** = (4.1 V - 22 V)
- 28 V short to VBUS protection
- Optional I²C interface for dynamic power management
STM32 USB PD3.0 controllers

Introduced in December 2017, **STM32G0** is the world’s 1st standard USB PD 3.0 microcontroller with a UCPD interface (UCPD stands for USB-Type-C and Power Delivery). This new IP, available in **STM32G0/G4/L5** series, allows to develop USB-C sink, source and dual role devices in a wide range of embedded applications.

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

**STM32G081 block diagram**

<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>Connectivity</td>
</tr>
<tr>
<td>32 kHz ±1 to 64 MHz</td>
<td>2x SPI (i²S)</td>
</tr>
<tr>
<td>Internal RC oscillators</td>
<td>4x USART</td>
</tr>
<tr>
<td>32 kHz (±5%)</td>
<td>(2x with LIN, smartcard, IrDA, modem control)</td>
</tr>
<tr>
<td>+ 16 MHz (±1%)</td>
<td>1x LPUART</td>
</tr>
<tr>
<td>PLL + Prescaler</td>
<td>2x I²C</td>
</tr>
<tr>
<td>Clock control</td>
<td>(SMBus, PMBus, Fast Mode Plus)</td>
</tr>
<tr>
<td>RTC/AWU</td>
<td>USB Power Delivery</td>
</tr>
<tr>
<td>Systick/timer</td>
<td>(incl. BMC + PHY)</td>
</tr>
<tr>
<td>2x watchdogs</td>
<td>Control</td>
</tr>
<tr>
<td>(independent and window)</td>
<td>1x 32-bit timer</td>
</tr>
<tr>
<td>60 I/Os on 64 pins</td>
<td>1x 16-bit Motor C. timer</td>
</tr>
<tr>
<td>Cyclic redundancy check</td>
<td>( f_{\text{MAX}} = 128 \text{ MHz} )</td>
</tr>
<tr>
<td>(CRC)</td>
<td>4 PWM + 3 compl.</td>
</tr>
</tbody>
</table>

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

Our **STM32G071B-DISCO** kit allows to discover and display USB-C power and feature capabilities of any USB-C compliant host. Associated with our professional-grade **STM32CubeMonitor-UCPD** software GUI, the kit acts as a USB PD analyzer and allows customer to debug, configure and inject in one click USB PD3.0 packets while monitoring Vbus voltage and Ibus current between two USB-C devices. Our well-known **STM32 configurator STM32CubeMx** supports easy setting of UCPD.

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

**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**

**Discover and lean**

**Develop**

**Configure & Debug**
Type-C Port Protection

TCPP01-M12

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

KEY FEATURES

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