ST Power Discrete for Power Management

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Power Discrete Technical Marketing Manager
STMicroelectronics
Focus, Technology leadership and System understanding

**Industrial**
- Energy Storage
- LED lighting
- Motor Control
- Photovoltaic
- SMPS

**Automotive**
- Charging Station
- DC-DC Converter
- Electronic Ignition
- On-board Charger
- Traction inverter

ST Power Discrete Solution and major Markets Focus

- **MDmesh™**
  - 300V to 1700V

- **STripFET™**
  - -100V to 100V

- **SiC MOSFET**
  - 650V, 1200V

- **Bipolar**
  - 15V to 1700V

- **IGBT**
  - 600V, 650V, 1200V, 1250V

- **SLLIMM™**
  - 500V, 600V

- **ACEPACK™**
  - 650V, 1200V

- **SiC**
  - 600V, 1200V
Business Directions

PC/GAMING/CONSUMER SMPS
Server / DT / NB / Batt Charger
Gaming / Display

HIGH PERFORMANCE
μ-Inverters
Power Storage (Smart Home/Industry)

SERVER/CLOUD & TELECOM
M/B DC-DC Conversion
System in Package (SIP)

MOTOR DRIVES & WELDING
Industrial / Home Appliance
Welding

CAR ELECTRIFICATION
EV CHARGERS
OBC / DC-DC / Inverters

MEDICAL
ICD’s (Implantable Cardiac Defibrillator)

LIGHTING
Indoor / Outdoor Lighting
LED Drivers

AUTOMOTIVE
IGNITION, INJECTION
CHARGING STATION
Power Transistor Division
Power Product Portfolio

From Discrete to Power Modules, ST leads the innovation

**Discrete & Drivers & SIP**
Typical Power: 10 W ÷ 5k W

**SLLIMM™ IPM**
Typical Power: 20 W ÷ 3 kW

**ACEPACK™ Power Modules**
Typical Power: 3 kW ÷ 30 kW

*Ideal solutions for* Industrial & Robotic Drives, Home Appliances, Welding, Pumps, Fans & Blowers, Air Conditioning
High Voltage MOSFET Technology Roadmap
(Fast Diode)

- **MDmesh™**

- **EV Chargers/HF Induction Melting/Plasma Generator**
  - 1050V
  - 950V
  - 800V
  - 650V
  - 600V
  - 500V
  - 400V
  - 300V
  - 250V

- **ZVS/ FB-HB LLC Resonant**

- **EV /UPS/ Motor Drives**

- **AG Qualification**

- **2013 - 2016**
  - DM2
  - 650V
  - 600V

- **2018 - 2019**
  - DM6
  - 800V

- **2020 - 2021**
  - DK5
  - 1050V

- **2017 - 2020**
  - DM8
  - 950V

- **< 2010**
  - FDI
  - 250V

- **2013**
  - FDI

- **2016**
  - FDII

- **2017**
  - FDII Improved

- **2018**
  - DM2

- **2019**
  - DM6

- **2020**
  - DK6
# SuperJunction Mdmesh™

M5, M2, M2-EP, M6, DM2/DM6 & K5 Technologies

## Products & Applications

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<th><strong>M5:</strong></th>
<th>leading technology for high end hard switch</th>
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| **Key Features** |• Industry’s one of the lower $R_{DS(on)}$ in the Market  
• High switching speed  
• 650V $BV_{dss}$ rated |
| **Benefits** |• highest efficiency in the application  
• Smaller form factor of final system  
• Especially targeted for High Power hard switching (PFC, Boost, TTF, Flyback) |

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<th><strong>M6/ M2 / M2 EP:</strong></th>
<th>best for LLC and Middle power application</th>
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| **Key Features** |• Up to 30% lower $Q_g$ (equivalent die size)  
• 400 – 700V $BV_{dss}$ rated  
• Back-to-Back G-S zener protected |
| **Benefits** |• Reduced switching losses through optimized ($Q_g$) ($C_{iss}$, $C_{oss}$)  
• Enhanced immunity vs ESD & $V_{gs}$ spikes in the application  
• Especially targeted for HB LLC, TTF, Flyback..)  
• M2 EP Tailored for Very High Frequency Converters ($f > 150$ kHz) |

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<th><strong>DM2/ DM6 (Fast Diode):</strong></th>
<th>Best F/B ZVS</th>
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| **Key Features** |• Integrated fast body diode  
• Softer commutation behavior  
• Back-to-Back G-S zener protected |
| **Benefits** |• Reduced switching losses through optimized ($Q_g$) ($C_{iss}$, $C_{oss}$)  
• High peak diode $dV/dt$ capabilities  
• Best use in Full Bridge ZVS |

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<th><strong>K5:</strong></th>
<th>Best in class Very High Voltage</th>
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| **Key Features** |• Extremely good $R_{DS(on)}$ at very high $BV_{dss}$  
• High switching speed  
• From 800 till 1500V $BV_{dss}$ rated  
• 950 V and 1050 V integrated fast body diode |
| **Benefits** |• High efficiency with lower design complexity  
• Especially targeted for flyback LED topologies and high voltage range in the application |
- Especially targeted for resonant topologies (LLC) and high-medium PFC
- Optimized Vth (3.25 V min, 4.75 V max, 4V typ) and Rg values for soft switching
- 600V, 650V, 700V BVdss rated
- Low conduction and even more reduced switching losses in soft switching
- Extremely low Qg vs previous series and optimized Capacitances profile for light load conditions;
- Easy to drive

Chargers, Adapters, SilverBox, LED lighting, Server, Telecom, Solar, UPS, LCD TV

ST x yy N 60 M6
The new electrical characteristics, in addition to the very low Gate charge typical of \textit{MDmesh}\textsuperscript{TM} \textit{M2} families, lead to \textbf{very high efficiency} thanks to the new capacitances profile.

\textit{MDmesh}\textsuperscript{TM} \textit{M6} features up to 35\% Eoff reduction thus reducing by the same percentage the turn-off switching losses in soft switching converters. Those topologies use strongly the energy stored in the output capacitances.
**KEY FEATURES**

- Up to 35% Eoff reduction: - 35% Turn off loss reduction in hard switching converters.
- Turn-off energy and curve available at datasheet.

**Eoff switching losses**

![Eoff switching losses graph](image)

**Switching-Off Behavior:**

- Power
- $V_{ds}$
- $I_d$

**Output capacitance stored energy**

![Output capacitance stored energy graph](image)
Low Voltage MOSFET
TOP 3 Products Focus

Main Applications:
- USB PD
- DC/DC
- Motor control
- Game console

Main Applications:
- Server
- Datacenter-Telecom
- DC/DC
- Adapter -Battery charger
- Motor control
- LEVc

Main Applications for Automotive:
- EPS
- Blower,
- Wiper
- ABS
- Motor Control
- DC/DC
600V and 650V TFS IGBTs

ST’s new 600 – 650V IGBTs, based on an advanced proprietary trench gate field-stop structure, reveals the world’s best Trade-off Static-Dynamic Characteristics. This revolutionary family also guarantees a max junction temperature (Tj max) of 175°C, increasing device reliability and lifetime.

The Families current rating ranges from 4 to 120 A, with safe parallel operation for even higher power requirements. The new “M”, “H”, “HB” and “V” series, featuring tail-less switching off waveforms and co-packing a very fast freewheeling diode tailored for very low Eon, offers several benefits on large switching frequency applications, from 2 to 100kHz demanding superior efficiency, such as Motor control, Home appliance, Welding, Solar Inverters, Induction Heating, UPS, PFC and SMPS.
The new “M & S” series address the Motor and compressor drives offering the best trade-off performances according to the working operating frequency. 1200V “S” series is dedicated to very low frequency applications, up to 8KHz, while the 1200V “M” Series devices can reach a frequency of 20KHz.

Both series show minimum short-circuit withstand time of 10µs at 150°C.

The 1200V “H” series” is tailored for all the high frequency applications up to 100KHz like Solar, Welding, UPS and so on.
SLLIMMTM in Home Appliance, Motor Control
Features and Benefits

Press FIT and solder pins options, configuration flexibility

Up to 1200V breakdown voltage

Integrated screw clamps

All power switches in a module including NTC

Several current ratings available

Several configurations and low stray inductance

High reliability, robustness, miniaturized

Simplified and stable screwing

Compact design and cost effective system

Very high power density

Main Topologies can be addressed in ACEPACK

PIM / CIB

SIX-PACK

4-PACK

Three Level
ST Rectifiers product range

- **Power Schottky diodes**
- **Field-effect rectifiers**
- **SiC diodes**
- **Ultrafast bipolar rectifiers**

Ranges:
- Current: 1 A, 3 A, 4 A, 60 A, 200 A, 240 A
- Voltage: 15 V, 40 V, 60 V, 100 V, 150 V, 200 V, 600 V, 1000 V, 1200 V
Introduce FERD

**Higher Efficiency**

Positioning performances / price is in between Schottky and Sync. Rectification

- **Reliability**: Where Schottky has risk of thermal runaway, the FERD makes the difference.

**Increase Power Integration**

The smart solution to reduce space

- **Smaller package**
- **BOM cost reduction**

**Improve Thermal performances**

Provide the best in class $V_F/I_R$ trade-off not achievable with Schottky
Thyristor & AC Switch Product Portfolio

The most complete Triac portfolio in the industry

The most innovative broad range SCR portfolio in the industry

- Over voltage proof AC Switch (ACS/ACST)
- High Voltage Triacs (TxxxH)
- H Series (TxxxH)
- Standard & Snubberless™ (BTA/BTB/Txx/Zxx)
- T Series (TxxT)
- Thermal Efficiency
- Sensitive Gate (X, P, TS)
- Standard Gate (TYN, TXN, TN & BTW)
- High Temperature (TNxxH)

Application Robustness

Thermal Efficiency

[Diagrams and images of Thyristor and AC Switch applications]
Available on iOS and Android

- **ST MOSFET Finder**
- **ST IGBT Finder**
- **ST DIODE Finder**
- **ST Thyristor Finder**
Thank you!