...more discrete power

Power & Analog program

European Multi System Market Competence Center
...more discrete power

- **MOSFETs**
  - SuperMESH / MDMesh technologies
  - Fast Recovery Diode (FRED)
  - Package evolution

- **IGBTs**

- **AC SWITCH**

- **RECTIFIERS**
  - POWER SCHOTTKY
  - BIPOLAR AND ULTRAFAST
• MOSFETs
  • SuperMESH / MDMesh technologies
  • Fast Recovery Diode (FRED)
  • Package evolution

• IGBTs

• AC SWITCH

• RECTIFIERS
  • POWER SCHOTTKY
  • BIPOLAR AND ULTRAFAST
## SuperMESH and MDMESH

### Different technologies to cover different needs

<table>
<thead>
<tr>
<th>Performances</th>
<th>SuperMESH - “NK…Z” Series: STANDARD HV Tech.</th>
<th>MDmesh™ and MDmesh II™ Series: ENHANCED Tech.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Outstanding RDS(on) x Area reduction</td>
<td>• Extremely low ON-Resistance</td>
<td></td>
</tr>
<tr>
<td>• Back to Back Zener Diode for higher ESD capability</td>
<td>• Superior dynamic performances</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Excellent dV/dt</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Minimized Gate resistance (Rg)</td>
<td></td>
</tr>
</tbody>
</table>

| Benefit | • High reliability & ruggedness |
|         | • Price competitiveness |
|         | • Improved system efficiency |
|         | • Smaller heat-sinks |

| Portfolio | Massive product range from 300V to 1500V |
|           | Complete product range at 200, 500V, 600V, 650V |

<table>
<thead>
<tr>
<th>Versions</th>
<th>Also with Fast REcovery Diode</th>
</tr>
</thead>
</table>

**MDmesh**: Massively Driven Mesas

**MDmesh II**: Massively Driven Mesas II

**SuperMESH**: Super High Speed Inductors

**SuperMESH II**: Super High Speed Inductors II

**MDmesh™** and **MDmesh II™**: Massively Driven Mesas™

**SuperMESH** and **SuperMESH II**: Super High Speed Inductors
High voltage series – figure of merit

- **RDS(on)**: at least three-fold cut
  - conduction-losses reduction

- **Qg**: a third the size of Std MOS
  - switching-losses reduction

- **RDS(on)*Area**: > 20% average improvement

- **RDS(ON)*Qg**: equivalent to former technologies (“NB”)

- **ESD capability**: increased through G-S Zener Diode
**ST MOSFETs in MDmesh™ I & MDmesh™ II Technologies**

### MDmesh I

**Features**
- Very low RDS(on)
- Low input capacitance and gate charge
- Vth range: 3V<Vth<5V
- Best-in-class in dynamic dv/dt
- Fast Recovery Diode version (FDmesh I)

**Benefits**
- Extremely low conduction losses
- Extremely low switching losses: improved system efficiency and smaller heat-sinks
- High avalanche ruggedness
- Reduced switching losses during intrinsic diode recovery phase

### MDmesh II

**Features**
- Extremely low RDS(on) up to 40% Rds(on) reduction
- Low input capacitance and gate charge
- Vth range: 2V<Vth<4V
- Best-in-class in dynamic dv/dt
- Fast Recovery Diode version (FDmesh II)

**Benefits**
- Extremely low conduction losses
- Extremely low switching losses: improved system efficiency and smaller heat-sinks
- Driver losses reduction and **driving optimization**: higher currents at lower Vgs and high noise immunity
- **High avalanche ruggedness**
STxyyNM60ND’s are ST’s most recent Power MOSFETs, which belong to the new FDmesh II fast recovery diode series; Thanks to their competitive conduction, switching performances and faster diode recovery phase, they’re particularly suited for hard switching full bridge topologies in primary side sections of SMPS for Servers and also for Solar Inverters.

Benefits

- **Low conduction losses**
- **Low switching losses, high switching speed and reduced driving losses**
- **High avalanche capability**

**Features**

- The worldwide best RDS(on)*area amongst the fast recovery diode devices
- Low input and output capacitances and gate charge
- Extremely high dv/dt

<table>
<thead>
<tr>
<th>VDS (V)</th>
<th>$R_{DS(on)}$ (max)</th>
<th>P/N</th>
<th>$I_{D}$ (cont)</th>
<th>Package</th>
<th>Actual Status</th>
<th>Forecasted Full Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>220/160</td>
<td>STx21NM60ND STx25NM60ND</td>
<td>17/21</td>
<td>TO-220, TO-220FP, TO-247, I2PAK, D2PAK</td>
<td>Sample availability</td>
<td>Q2 ’08</td>
</tr>
<tr>
<td>600</td>
<td>60</td>
<td>STW55NM60ND</td>
<td>51</td>
<td>TO-247</td>
<td>Sample availability</td>
<td>Q2 ’08</td>
</tr>
</tbody>
</table>

FDmesh™ II for SMPS - The new FAST recovery diode series

ST guarantees the same $t_{r}(\text{typ}) = 140\text{ns}$ in smaller die

Vdd= 60V, $I_{d} = 10\text{A/div}$; $dI/dt=100\text{A/us}$; $t= 10\text{ns/div}$

www.st.com/pmos
SuperMESH3 K3 series: vanguard HV planar MOSFET

**MDmesh**
- Low ON-Resistance

**SuperMESH**
- High UIS ruggedness
- High $B_{Vdss}$

**SuperMESH3**
- Reduced ON-Resistance
- Improved dynamic figures
- Good UIS ruggedness
- Additional margin GUARANTEED in $B_{Vdss}$

The right trade-off Price/Performances

SOON ON YOUR APPLICATION
## SuperMESH3 STPzzNyyK3 Electrical Features

### NEW STD in the HV Market

### Fast DIODE available

<table>
<thead>
<tr>
<th>Absolute Maximum Ratings</th>
<th>“NK...Z”</th>
<th>SuperMESH 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{DSS}$</td>
<td>500V, 600V, 700V</td>
<td>$525V$, $620V$, $720V$</td>
</tr>
<tr>
<td>$V_{DSS}$</td>
<td>800V, 900V, 1000V</td>
<td>$850V$, $950V$, $1050V$</td>
</tr>
<tr>
<td>$V_{GS}$</td>
<td>±30V</td>
<td>±30V</td>
</tr>
<tr>
<td>Diode $dv/dt, di/dt$</td>
<td>4.5V/ns, 200A/µs</td>
<td>9 V/ns, 200A/µs</td>
</tr>
<tr>
<td>$V_{th}$</td>
<td>3V±4.5V</td>
<td>3V±4.5V</td>
</tr>
</tbody>
</table>

525V,

STD7N52DK3: < 1.15Ω in DPAK, TO-220, TO-220FP @ 525V in development (SuperFREDmesh3)

STD7N52K3: < 0.98Ω in DPAK, TO-220 @ 525V in development

STD6N52K3: < 1.2Ω in DPAK @ 525V in development

620V,

STx17N62K3: < 0.38Ω in TO-247, TO-220, TO-220FP @ 620V eng. Samples

STx10N62K3 <0.75Ω in TO-220, TO-220FP @ 620V (samples available)

STx6N62K3: < 1.28Ω in DPAK, TO-220, TO-220FP @ 620V in production

STx5N62DK3: < 1.6Ω in DPAK, TO-220, TO-220FP @ 620V in development (SuperFREDmesh3)

STx3N62K3: < 2.5Ω in DPAK, D2PAK, IPA TO-220/FP @ 620V eng. samples

### Features

- HIGHER VDSS
- LOWER ON-RESISTANCE: 20% $RD_{SON}$ REDUCTION
- IMPROVED DYNAMIC PERFORMANCES (lower $Q_g$ and $C_{iss}$, $Crss$)
- REDUCED RECOVERY TIME $T_{rr}$ VERSUS STANDARD
- IMPROVED DIODE REVERSE RECOVERY CHARACTERISTICS

### Benefits

- HIGHER MARGIN & RUGGEDNESS
- LOWER CONDUCTION LOSSES
- LOWER SWITCHING LOSSES
- HIGHER SAFETY MARGIN
**STx6N62K3 – Dynamic characterization**

<table>
<thead>
<tr>
<th></th>
<th>Ciss</th>
<th>Coss</th>
<th>Crss</th>
</tr>
</thead>
<tbody>
<tr>
<td>SuperMESH3</td>
<td>712</td>
<td>112</td>
<td>8</td>
</tr>
<tr>
<td>SuperMESH (similar Rdson)</td>
<td>920</td>
<td>114</td>
<td>21</td>
</tr>
</tbody>
</table>

**Features**
- Lower Gate Charge

**Benefits**
- Lower Switching losses
- Lower gate driving losses

**Conditions**: $V_{ds}=25\text{V}$; $f=1\text{MHz}$; $V_{gs}=0\text{V}$; $T_j=25^\circ\text{C}$

**SuperMESH3** Vs equivalent SuperMESH

**FASTER Vds switch!!!**
1500V Series Expansion

• The target market for the 7Ω, 12Ω and 2.7Ω on-resistance devices is primarily industrial, in particular for all applications that require high input voltage:
  – 3-phase auxiliary power supplies
  – Motor driving
  – Welding
  – Metering

New range features and benefit
• Total compatibility, no need to redesign the application
• High reliability makes each solution easier and stronger
• Wide choice of packages
• Lowest on-resistance per area for low power dissipation
• Avalanche ruggedness
• Gate charge minimized
• Very low intrinsic capacitances
• High speed switching

1500V Product Range

<table>
<thead>
<tr>
<th>Part number</th>
<th>V_DSS [V]</th>
<th>I_D [A]</th>
<th>R_DSS(on) @ 10V [Ω]</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>STW4N150</td>
<td>1500</td>
<td>4</td>
<td>&lt;7</td>
<td>TO-247</td>
</tr>
<tr>
<td>STP4N150</td>
<td></td>
<td></td>
<td></td>
<td>TO-220</td>
</tr>
<tr>
<td>STFV4N150</td>
<td></td>
<td></td>
<td></td>
<td>TO-220FH</td>
</tr>
<tr>
<td>STW3N150</td>
<td>2.5</td>
<td>2.5</td>
<td>&lt;12</td>
<td>TO-247</td>
</tr>
<tr>
<td>STP3N150</td>
<td></td>
<td></td>
<td></td>
<td>TO-220</td>
</tr>
<tr>
<td>STFV3N150</td>
<td></td>
<td></td>
<td></td>
<td>TO-220FH</td>
</tr>
<tr>
<td>STW9N150</td>
<td>8</td>
<td>8</td>
<td>&lt;2.7</td>
<td>TO-247</td>
</tr>
</tbody>
</table>
## Power MOSFET: Series IDENTIFICATION

### STzzNXyy Technology

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ST</td>
<td>P</td>
<td>20</td>
<td>NM</td>
<td>60</td>
<td>D</td>
</tr>
<tr>
<td>ST</td>
<td>P</td>
<td>20</td>
<td>NM</td>
<td>60</td>
<td>D</td>
</tr>
<tr>
<td>ST</td>
<td>P</td>
<td>21</td>
<td>NM</td>
<td>60</td>
<td>N</td>
</tr>
<tr>
<td>ST</td>
<td>P</td>
<td>21</td>
<td>NM</td>
<td>60</td>
<td>ND</td>
</tr>
</tbody>
</table>

- **MDmesh I**: $500V \leq B_{VDSS} \leq 800V$
  - $3V \leq V_{th} \leq 5V$
- **MDmesh II**: $500V \leq B_{VDSS} \leq 650V$
  - $2V \leq V_{th} \leq 4V$
- **FDmesh I**: $500V \leq B_{VDSS} \leq 600V$
  - $3V \leq V_{th} \leq 5V$
- **FDmesh II**: $B_{VDSS} = 600V$
  - $3V \leq V_{th} \leq 5V$
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• MOSFETs
  • SuperMESH / MDMesh technologies
  • Fast Recovery Diode (FRED)
  • Package evolution

• IGBTs

• AC SWITCH

• RECTIFIERS
  • POWER SCHOTTKY
  • BIPOLAR AND ULTRAFAST
Every time we connect two devices in Half bridge or in full bridge configuration and we drive an inductive load, then an hard switch situation requires a FRED FET for two reasons:

1) Power losses reduction through $Q_{rr}$ minimization;

2) Better system reliability through more $dV/dt$ immune devices.

Typical is to use such devices in lighting application (Ballast), SMPS like servers in ZVS configurations, motor control etc, etc....
**Fast recovery diode (FRED) technology**

**Drastic reduction of** $t_{rr}$ **and** $Q_{rr}$

**Indicated for ZVT bridges**

Available for both ST HV technologies:

- **MDmesh + FRED = FDmesh (NM..D)**
- **SuperMESH + FRED = SuperFREDmesh (NK…ZD)**

**New SuperFREDmesh (NK..ZD): improvement in**

<table>
<thead>
<tr>
<th>Device</th>
<th>Voltage (V)</th>
<th>Resistance (Ohm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STF4NK50ZD</td>
<td>500</td>
<td>2.7</td>
</tr>
<tr>
<td>STF5NK52ZD</td>
<td>520</td>
<td>1.22</td>
</tr>
<tr>
<td>STW29NK50ZD</td>
<td>500</td>
<td>0.16</td>
</tr>
<tr>
<td>STE45NK80ZD</td>
<td>800</td>
<td>0.13</td>
</tr>
<tr>
<td>STE40NK90ZD</td>
<td>900</td>
<td>0.17</td>
</tr>
</tbody>
</table>

**New**

- **4.5V/ns SuperMESH**
- **15V/ns MDmesh**
- **15V/ns SuperFREDmesh**
STx5NK52ZD - SuperFREDmesh™ for BLDC motors

Features
- Extremely high dv/dt capability
- Reduced on-resistance
- Very low intrinsic capacitances
- Zener gate protection
- 100% avalanche tested
- Good manufacturing reliability
- Improved ESD capability
- Wide variety of popular packages

• Improving efficiency
• Conserving energy
• High reliability

Standard Power MOSFET and the new STx5NK52ZD while driving a BLDC motor.
- Switching losses during turn-on were reduced by 65%.

Comparison between Power MOSFETs while driving BLDC motors (Q1, Q3 and Q5)

<table>
<thead>
<tr>
<th>Part number</th>
<th>Technology</th>
<th>$E_{on}$ [μJ]</th>
<th>$E_{off}$ [μJ]</th>
<th>Tmp. [°C]</th>
</tr>
</thead>
<tbody>
<tr>
<td>STx4NK50ZD</td>
<td>STD MOSFET</td>
<td>165.11</td>
<td>7.6</td>
<td>56</td>
</tr>
<tr>
<td>STx5NK52ZD</td>
<td>SuperFREDmesh</td>
<td>58.8</td>
<td>7.1</td>
<td>48</td>
</tr>
</tbody>
</table>

Product Range

<table>
<thead>
<tr>
<th>Part number</th>
<th>$V_{DSS}$ [V]</th>
<th>$I_D$ [A]</th>
<th>$R_{DS(on)}$ @ 10V [Ω]</th>
<th>Status</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>STx5NK52ZD</td>
<td>520</td>
<td>4.4</td>
<td>&lt;1.5</td>
<td>Prod</td>
<td>DPAK</td>
</tr>
<tr>
<td>STx5NK52ZD-1</td>
<td>520</td>
<td>4.4</td>
<td>&lt;1.5</td>
<td>Prod</td>
<td>IPAK</td>
</tr>
<tr>
<td>STB5NK52ZD-1</td>
<td>500</td>
<td>3</td>
<td>&lt;2.7</td>
<td>TO-220</td>
<td>TO-220</td>
</tr>
<tr>
<td>STP5NK52ZD</td>
<td>500</td>
<td>3</td>
<td>&lt;2.7</td>
<td>Prod</td>
<td>IPAK, TO-220, TO-220FP</td>
</tr>
</tbody>
</table>
**Fast recovery diode (FRED) technology**

- **FDmesh vs. MDmesh**

  ![Diagram showing comparison between FDmesh and MDmesh](image)

- **FDmesh vs. best competitor**

  ![Graph showing comparison between FDmesh and best competitor](image)

STW30NM60 shows better trr, Qrr, Irm and dv/dt versus competition at same di/dt test condition.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>STW30NM60D</td>
<td>100</td>
<td>31</td>
<td>13.5</td>
<td>147</td>
<td>161</td>
<td>1087</td>
</tr>
<tr>
<td>Best competitor</td>
<td>100</td>
<td>22</td>
<td>15</td>
<td>161</td>
<td>178</td>
<td>1335</td>
</tr>
</tbody>
</table>

*Typ @ 25 degree*  

<table>
<thead>
<tr>
<th>Device</th>
<th>Irrm (A)</th>
<th>trr (ns)</th>
<th>Qrr (µC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STW26NM60</td>
<td>30.5</td>
<td>450</td>
<td>7</td>
</tr>
<tr>
<td>STW30NM60D</td>
<td>11.5</td>
<td>240</td>
<td>1.4</td>
</tr>
<tr>
<td>STP9NK60Z</td>
<td>14.5</td>
<td>480</td>
<td>3.5</td>
</tr>
<tr>
<td>STP9NK60ZD</td>
<td>9.6</td>
<td>194</td>
<td>0.9</td>
</tr>
</tbody>
</table>
Introducing MDmesh V

• ST is a pioneer in super junction HV MOSFET technology.
• MDmesh V is the latest HV power MOSFET family: 650V devices with the best known RDS(on) available in the most popular packages.
• Main applications include:
  – SMPS (computers, very high efficiency notebook adaptors, telecommunications)
  – Lighting (electrical ballast, HID)
  – Display (TV, monitors)
  – Solar Converters
## Introducing MDmesh V

<table>
<thead>
<tr>
<th>$V_{DS}$ [V]</th>
<th>$R_{DS(on)}$ (max) [Ω]</th>
<th>MDmesh V P/N</th>
<th>Id [A]</th>
<th>Package</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.022</td>
<td>650</td>
<td>STY112N65M5</td>
<td>93</td>
<td>MAX247</td>
<td>Samples April '09</td>
</tr>
<tr>
<td>0.038</td>
<td>650</td>
<td>STW77N65M5</td>
<td>66</td>
<td>TO-247</td>
<td>Samples April '09</td>
</tr>
<tr>
<td>0.079</td>
<td>650</td>
<td>STx42N65M5</td>
<td>33</td>
<td>TO-220/TO-220FP/D²PAK/I²PAK/TO-247</td>
<td>Production</td>
</tr>
<tr>
<td>0.098</td>
<td>650</td>
<td>STx35N65M5</td>
<td>27</td>
<td>TO-220/TO-220FP/D²PAK/I²PAK/TO-247</td>
<td>Samples April '09</td>
</tr>
<tr>
<td>0.119</td>
<td>650</td>
<td>STx32N65M5</td>
<td>24</td>
<td>TO-220/TO-220FP/D²PAK/I²PAK/TO-247</td>
<td>Samples April '09</td>
</tr>
<tr>
<td>0.139</td>
<td>650</td>
<td>STx30N65M5</td>
<td>21</td>
<td>TO-220/TO-220FP/D²PAK/I²PAK/TO-247</td>
<td>Samples June '09</td>
</tr>
<tr>
<td>0.179</td>
<td>650</td>
<td>STx21N65M5</td>
<td>17.5</td>
<td>TO-220/TO-220FP/D²PAK/I²PAK/TO-247</td>
<td>Samples June '09</td>
</tr>
<tr>
<td>0.299</td>
<td>650</td>
<td>STx16N65M5</td>
<td>12</td>
<td>TO-220/TO-220FP/DPAK/IPAK</td>
<td>Production</td>
</tr>
<tr>
<td>0.375</td>
<td>650</td>
<td>STx12N65M5</td>
<td>9</td>
<td>TO-220/TO-220FP/DPAK/IPAK</td>
<td>Samples June '09</td>
</tr>
</tbody>
</table>
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- MOSFETs
  - SuperMESH / MDMesh technologies
  - Fast Recovery Diode (FRED)
  - Package evolution
- IGBTs
- AC SWITCH
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  - BIPOLAR AND ULTRAFAST
Advances in packaging need to be developed in tandem with silicon technology improvements.

The PolarPAK package, with its superior thermal handling capability, represents a remarkable evolution in assembly technology allowing designers to increase efficiency and power density.

**FEATURES**
- Top / bottom heat dissipation paths
- Fully encapsulated silicon
- Same footprint of standard packages
- Low profile (0.8 mm)
- Superior thermal performance

**BENEFITS**
- Low operating temperature
- Good die protection and easy handling manufacturability
- Enabled end products density increase
- Twice current handling capability than standard packages with same footprint
- Customer’s flexibility by designing with multi-sources

<table>
<thead>
<tr>
<th>Part Number</th>
<th>$V_{DS}$ [V]</th>
<th>$R_{DS(on)}$ typ/max [mΩ] @4.5V</th>
<th>$R_{DS(on)}$ typ/max [mΩ] @10V</th>
<th>Qg typ @4.5V [nC]</th>
<th>Rthj-c Top typ/max °C/W Drain</th>
<th>Rthj-c Bottom typ/max °C/W Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>STK850</td>
<td>30</td>
<td>2.9/3.5</td>
<td>2.4/2.9</td>
<td>24</td>
<td>0.8/1</td>
<td>2.2/2.7</td>
</tr>
<tr>
<td>STK800</td>
<td>30</td>
<td>7/9.8</td>
<td>6/7.8</td>
<td>11</td>
<td>1/1.2</td>
<td>2.8/3.4</td>
</tr>
</tbody>
</table>
MOSFET nomenclature

Channel Polarity
- N = N-channel
- P = P-channel
- NS or PS = N-ch or P-ch plus Schottky diode (electrically connected, monolithic included)
- DN or DP = Dual N-ch or dual P-ch
- DNS or DPS = N-ch or P-ch plus Schottky diode (not electrically connected)
- N...P = Complementary pair
- N...N = Two different N-channel dice

Breakdown voltage divided by 10 with the exception of non 10 multiples

Special features
- L = Logic level 10 V drive optimized
- LL = Logic level 4.5 V drive optimized
- V = Supor logic level (2.5 V to 2.7 V drive)
- D = Fast recovery diode
- T = Temperature sensing
- C = Current sensing
- Z = Clamped by zener diodes

Indicative current range

Package types:
- C = TSSOP8
- T = SOT23-6L
- NL = SOT-223
- SJ = PowerSO-8
- U = IPAK (*D...1" for older types)
- I = IPAK (*B...1" for older types)
- IS = ISPAK
- S = SO-8
- DB = DPAK (*D...T4" for older types)
- DR = DPAK (*B...T4" for older types)
- V = PowerSD-10
- QP = TO-92
- P = TO-220
- F = TO-220FP
- W = TO-247
- Y = Max247
- E = ISOTOP
- Z = PPAK

Technology (optional):
- E = STripFET I
- F = STripFET II
- H = STripFET III
- F3 = STripFET III (from 33 to 100 V)
- H5 = STripFET V
- F6 = STripFET II + Schottky diode
- HS = STripFET III + Monolithic Schottky diode
- S = PowerMESH medium voltage
- C = PowerMESH II
- K...Z = SuperMESH
- K3 = SuperMESH 3
- M = MDmesh
- M...N = MDmesh II
- M3 = MDmesh III
...more discrete power

- **MOSFETs**
  - SuperMESH / MDMesh technologies
  - Fast Recovery Diode (FRED)
  - Package evolution
- **IGBTs**
- **AC SWITCH**
- **RECTIFIERS**
  - POWER SCHOTTKY
  - BIPOLAR AND ULTRAFAST
IGBTs – applications

- Lighting
- Motor Control
- Induction Cooking
- UPS
- SMPS
- Welding
IGBTs nomenclature

**Package Type:**
- D...T4 = DPAK (Tape & Reel)
- B...T4 = D²PAK (Tape & Reel)
- D...-1 = IPAK
- B...-1 = I²PAK
- P = TO-220
- P...FP = TO-220FP
- F = TO-220FP for new products
- W = TO-247
- Y = Max247
- E = ISOTOP
- S = SO-8

**Special Features**
- L = Logic Level
- Z = Fully Clamped
- S = Low Drop,
  (freq < 1 KHz; Vcesat < 1.5 V)
- H = " " " 60 KHz
- K = " " " 60 KHz Short-circuit Proof
- V = " " " 60 KHz High Power
- D = Co-Packaged Freewheeling Diode

**TECHNOLOGY (OPTIONAL)**
- B = PowerMESH™
- C = PowerMESH plus electron irradiation

**Channel Polarity**
- Old system: \( I_C = \text{test condition for } V_{CESat} \)
- New system: \( I_C = \text{collector current @ 100 °C} \)

**V_{CE} VOLTAGE divided by 10**
### IGBTs nomenclature

<table>
<thead>
<tr>
<th></th>
<th>“NB” technology</th>
<th>“NC” technology</th>
<th>“NC” technology Ultra fast W series</th>
<th>“NC_S” Medium Frequency series</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Typical V(_{CE\text{sat}})</strong></td>
<td>2.4 Volt</td>
<td>1.9 Volt</td>
<td>2.0 Volt</td>
<td>1.55 Volts</td>
</tr>
<tr>
<td><strong>Fall Time @ (T_J = 25^\circ C)</strong></td>
<td>~ 120ns</td>
<td>~ 75ns</td>
<td>~ 32ns</td>
<td>~ 210 ns</td>
</tr>
<tr>
<td></td>
<td>~ 255ns</td>
<td>~ 130ns</td>
<td>~ 55ns</td>
<td>~ 280 ns</td>
</tr>
<tr>
<td><strong>(E_{\text{Off}}) @ (T_J = 25^\circ C)</strong></td>
<td>680 mJ</td>
<td>370 mJ</td>
<td>205 mJ</td>
<td>~ 850 µJ</td>
</tr>
<tr>
<td></td>
<td>1290 mJ</td>
<td>770 mJ</td>
<td>368 mJ</td>
<td>~ 1120 µJ</td>
</tr>
<tr>
<td><strong>Typical UIS</strong></td>
<td>20A</td>
<td>28.4A</td>
<td>31A</td>
<td>27 A</td>
</tr>
<tr>
<td><strong>Cross Conduction</strong></td>
<td>Yes Crss/Ciss High</td>
<td>No Crss/Ciss Low</td>
<td>No Crss/Ciss Low</td>
<td>No Crss/Ciss Low</td>
</tr>
</tbody>
</table>
## IGBTs – voltage vs. application

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Application</th>
<th>Low Drop IGBT:</th>
<th>Low frequency IGBT:</th>
<th>High frequency e.g. Induction motor control, UPS, AC drives, Induction cookers</th>
<th>Very High frequency e.g. Welding, HF Ballast, PFC, power supply, Induction cookers</th>
</tr>
</thead>
<tbody>
<tr>
<td>600V</td>
<td>Very Low frequency e.g. HID, LF, PDP</td>
<td>STGxxNB60Sx</td>
<td>STGxxNC60Sx</td>
<td>Very Fast IGBT: STGxxNC60H(K)x STGxxNC60Vx</td>
<td>Ultra Fast IGBT: STGxxNC60Wx</td>
</tr>
<tr>
<td>1200V</td>
<td>Very Low frequency IGBT:</td>
<td>STGxxNB120Sx</td>
<td>STGxxNC120Hx</td>
<td>Very Fast IGBT: STGxxNC120Vx</td>
<td>Ultra Fast IGBT: STGxxNC120Wx</td>
</tr>
</tbody>
</table>
New Complete 600V “H” and “K” series for Motor Control and HA

✓ Complete IGBT product portfolio

• STGx30NC60S*: Medium Frequency IGBT 30A@100°C
• STGx19NC60S*: Medium Frequency IGBT 20A@100°C
• STGW39NC60VD (STGW39NC60KD*): Fast IGBT (Short Circuit rugged, tsc=5µs) 40A@100°C
• STGW20NC60VD (STGW30NC60KD*): Fast IGBT (Short Circuit rugged, tsc=5µs) 30A@100°C
• STGx19NC60HD (STGx19NC60KD*): Fast IGBT (Short Circuit rugged, tsc=5µs) 20A@100°C
• STGx7NC60HD (STGx14NC60KD): Fast IGBT (Short Circuit rugged, tsc=5µs) 14A@100°C
• STGx10NC60HD (STGx10NC60KD): Fast IGBT (Short Circuit rugged, tsc=5µs) 10A@100°C
• STGx6NC60HD: Fast IGBT (Short Circuit rugged, tsc=5µs) 6A@100°C
• STGx8NC60HD (STGx8NC60KD): Fast IGBT (Short Circuit rugged, tsc=5µs) 8A@100°C

✓ Main Features

• Very low collector emitter saturation voltage, Vce(sat)
• PT Technology: Vce(sat) decreases with Temperature Optimized Cres/Cies ratio
• Very low current fall time, Tfall and Eoff
• Ruggedness

✓ Customer Benefit

• Minimizing the total conduction losses, higher system efficiency
• No cross conduction susceptibility
• Minimizing turn-off switching losses
• Higher reliability
Higher Power Induction Cooking Systems

**IGBTs Offering**

<table>
<thead>
<tr>
<th>Very Fast IGBT</th>
<th>Ultra Fast IGBT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STGW20NC60VD</strong></td>
<td><strong>STGW30NC60WD</strong></td>
</tr>
<tr>
<td>TO-247, 600V, $V_{CE(SAT)}= 1.85V$, $I_c=30A @100^\circ C$</td>
<td>TO-247, 600V, $V_{CE(SAT)}= 2.1V$, $I_c=30A @100^\circ C$</td>
</tr>
<tr>
<td><strong>STGW39NC60VD</strong></td>
<td><strong>STGW40NC60WD</strong></td>
</tr>
<tr>
<td>TO-247, 600V, $V_{CE(SAT)}= 1.95V$, $I_c=40A @100^\circ C$</td>
<td>TO-247, 600V, $V_{CE(SAT)}= 2.3V$, $I_c=40A @100^\circ C$</td>
</tr>
<tr>
<td><strong>STGY40NC60VD</strong></td>
<td><strong>STGY50NC60WD</strong></td>
</tr>
<tr>
<td>Max247, 600V, $V_{CE(SAT)}= 2.0V$, $I_c=50A @100^\circ C$</td>
<td>TO-247, 600V, $V_{CE(SAT)}= 2.4V$, $I_c=50A @100^\circ C$</td>
</tr>
</tbody>
</table>
Single switch Induction Cooking Systems

**QR Systems Main characteristic**

**IH Cooker**
- STD Systems run @ 30kHz (ZVS with snubber)

**IGBTs Offering**

STGW33IH120D
1200V/30A, in TO247
New 1200V IGBT for high frequency application

PFC
UPS
SPS Server/Workstation
Telecom Power System

<table>
<thead>
<tr>
<th>P/N</th>
<th>Vce(sat) typ @100°C [V]</th>
<th>Ic @25°C [A]</th>
<th>Ic @100°C [A]</th>
<th>BVce [V]</th>
</tr>
</thead>
<tbody>
<tr>
<td>STGW30NC120HD</td>
<td>2.1</td>
<td>60</td>
<td>30</td>
<td>1200</td>
</tr>
<tr>
<td>STGW33IH120D</td>
<td>2.1</td>
<td>60</td>
<td>30</td>
<td>1200</td>
</tr>
</tbody>
</table>
New Ultra Fast IGBTs for Welding

Target Requested:
- Operating frequency: > 60 kHz
- Lower Switching Losses
- $I_C = 30A$ to $60A$ nominal
- Freewheeling diode requested

Requirement:
Needs the best compromise in terms of conduction and switching losses: $E_{TS}$ vs. $V_{CESAT}$ trade-off!!

<table>
<thead>
<tr>
<th>P/N</th>
<th>BV$_{CES}$ (V)</th>
<th>$I_C$ @ 100°C (A)</th>
<th>$V_{CE(SAT)}$ @ $V_{GE} = 15V$, $I_C = 20A$ (V)</th>
<th>$T_{FALL}$ (ns)</th>
<th>Integrated Diode</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>STGW30NC60WD</td>
<td>600</td>
<td>30</td>
<td>&lt;2.5</td>
<td>40</td>
<td>Yes</td>
<td>TO-247</td>
</tr>
<tr>
<td>STGW40NC60WD</td>
<td>600</td>
<td>40</td>
<td>&lt;2.5</td>
<td>40</td>
<td>Yes</td>
<td>TO-247</td>
</tr>
<tr>
<td>STGW50NC60W</td>
<td>600</td>
<td>50</td>
<td>&lt;2.5</td>
<td>40</td>
<td>No</td>
<td>TO-247</td>
</tr>
</tbody>
</table>
• **MOSFETs**
  - SuperMESH / MDMesh technologies
  - Fast Recovery Diode (FRED)
  - Package evolution

• **IGBTs**

• **AC SWITCH**

• **RECTIFIERS**
  - POWER SCHOTTKY
  - BIPOLAR AND ULTRAFAST
Evolution of ACSwitch

Immunity & Robustness

Design easiness & reliability

Triacs

Snubberless Triacs

ACS

TVS removal

Driving stage removal

Snubber removal
The ACS/ACST embeds an integrated crowbar protection.

- The surge energy is dissipated through the load, and not through a varistor.
- ACST & ACS successfully withstand voltage surges up to 2kV (IEC61000-4-5).
From ACST to ACS

ACS FOR LOW POWER ACTUATORS

- DIRECT MCU DRIVE
- HIGH NOISE IMMUNITY

ACST FOR HIGH CURRENTS LOADS

OVERVOLTAGE PROTECTION

REFERENCE FOR COMMON TAB

GATE INTERFACE
# From ACST to ACS

<table>
<thead>
<tr>
<th>BENEFITS</th>
<th>DRAWBACKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only 1 additional component</td>
<td>Protection not constant with VDR ageing</td>
</tr>
<tr>
<td>Accuracy</td>
<td>2 components cost</td>
</tr>
<tr>
<td>Auto protected switch</td>
<td>None</td>
</tr>
</tbody>
</table>

![Diagram of ACST to ACS transition](image)
Evolution of ACSwitch
Evolution of ACSwitch

• **New 600V ACS family**
  – **Wet** appliances (Washing machines, dishwashers, dryers)
  – **Hot** appliances (Ovens, cooking ranges, coffee machines)
  – **Cold** appliances (Refrigerators, freezers, air conditioners)

**Benefits**

- Gate drive consumption decreased by 50%
- No need of external protection snubber nor varistor
- Enables equipment to meet IEC 61000-4-5
- Reduces component count up to 80%
- T up to 125°C
- Interfaces directly with the microcontroller
- Common package tab connection allows connection of several ACS on same cooling pad

**AC switches typical application**
**Vertical axis washer with AC switch devices**
Centralized loads control

Single switch ACS102/108

For decentralized power section

0.8A, 500V AC Switch in TO92 & SOT223

Switch array ACS302

For centralized & compact power section

3 x 0.2A, 500 V AC Switch in SO20

WATER VALVES
DRAIN PUMP
DISPENSER

AC MAINS
• **800 V**
  - Avoids premature firing

• **IH= 10 mA**
  - Inductive loads compatible

• **(di/dt)c= 0.5 A/ms**
  - Designed for pumps

• **Standards**
  - Immunity and robustness
designed for IEC 61000-4-X
  and IEC 60335-1
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Test conditions</th>
<th>Temp</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{T(RMS)}$</td>
<td>full cycle</td>
<td>$T_c = 104^\circ C$</td>
<td>MAX</td>
<td>10</td>
</tr>
<tr>
<td>$I_{TSM}$</td>
<td>20ms</td>
<td>$T_j$ initial = $25^\circ C$</td>
<td>MAX</td>
<td>100</td>
</tr>
<tr>
<td>$dI/dt$</td>
<td>$f = 120$Hz</td>
<td>$T_j = 125^\circ C$</td>
<td>MAX</td>
<td>100</td>
</tr>
<tr>
<td>$I_{GT}$</td>
<td>$V_{OUT} = 12$V, $RL = 33\Omega$</td>
<td>$T_j = 25^\circ C$</td>
<td>MAX</td>
<td>10</td>
</tr>
<tr>
<td>$dV/dt$</td>
<td>$V_{OUT}$ $67%$ $V_{DRM}$, gate open</td>
<td>$T_j = 125^\circ C$</td>
<td>MIN</td>
<td>200</td>
</tr>
<tr>
<td>$(dV/dt)c$</td>
<td>$(dV/dt)c = 15$V/\mu s $\leftrightarrow$ Logic Level</td>
<td>$T_j = 125^\circ C$</td>
<td>MIN</td>
<td>4.4</td>
</tr>
<tr>
<td>Snubberless</td>
<td></td>
<td></td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

**Reminder**: Nominal rate of decrease of $10A_{RMS}$: 

$$(di / dt)c = I_{RMS} \cdot \sqrt{2} \cdot (2 \cdot \pi \cdot f) = 4.4 A / ms$$

Non sensitive version is specified at 3 x nominal rate of decrease

⇒ Perfect choice for Universal motor
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Test conditions</th>
<th>Temp</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{T(RMS)}$</td>
<td>full cycle</td>
<td>$T_c = 104^\circ C$</td>
<td>MAX</td>
<td>12</td>
</tr>
<tr>
<td>$I_{TSM}$</td>
<td>20ms</td>
<td>$T_j$ initial = $25^\circ C$</td>
<td>MAX</td>
<td>120</td>
</tr>
<tr>
<td>$dI/dt$</td>
<td>$f = 120$ Hz</td>
<td>$T_j = 125^\circ C$</td>
<td>MAX</td>
<td>100</td>
</tr>
<tr>
<td>$I_{GT}$</td>
<td>$V_{OUT} = 12V$, $RL = 33\Omega$</td>
<td>$T_j = 25^\circ C$</td>
<td>MAX</td>
<td>10</td>
</tr>
<tr>
<td>$dV/dt$</td>
<td>$V_{OUT} = 67%$ VDRM, gate open</td>
<td>$T_j = 125^\circ C$</td>
<td>MIN</td>
<td>200</td>
</tr>
<tr>
<td>$(dV/dt)c$</td>
<td>$(dV/dt)c = 15V/μs \Leftrightarrow$ Logic Level</td>
<td>$T_j = 125^\circ C$</td>
<td>MIN</td>
<td>5.3</td>
</tr>
</tbody>
</table>

Reminder: Nominal rate of decrease of $12A_{RMS}$: 

\[
(dI/dt)c = I_{RMS} \cdot \sqrt{2} \cdot (2 \cdot \pi \cdot f) = 5.3 \text{ A/ } ms
\]

Non sensitive version is specified at 3 x nominal rate of decrease

⇒ Perfect choice for Universal motor
ACST10/12 benefits

- Intrinsic voltage protection by Design
  - ACST self protected structure
  - Validated by functional tests (Inrush, stalled rotor, dl/dt, surge voltage)

- Operating Life Test data from ST
  - Experimental added value verified: 450k cycles Inrush
    - more than 5 cycles per hour during 10 years
    - A relay offers in the range of 80k cycles only on inductive load!

- Easy to design and qualify
  - Just select the best trade-off required in the application:
    - Sensitive version \( I_{GT} = 10 \text{mA} \) to limit power supply size with no compromise with immunity level
    - Strong Immunity with static \( dV/dt > 2,000 \text{ V/μs} \) \( I_{GT} = 35 \text{mA} \)
# ACST10/12 benefits

<table>
<thead>
<tr>
<th>CP</th>
<th>ACST10-7Sx</th>
<th>ACST10-7Cx</th>
<th>ACST12-7Sx</th>
<th>ACST12-7Cx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Rating</td>
<td>10</td>
<td></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Voltage Rating</td>
<td></td>
<td>700</td>
<td></td>
<td></td>
</tr>
<tr>
<td>700 self protection against overvoltage, ( V_{CL} &gt; 850 \text{V} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( I_{GT} ) (mA)</td>
<td>10</td>
<td>35</td>
<td>10</td>
<td>35</td>
</tr>
<tr>
<td>Immunity</td>
<td>200 V/\mu s MIN</td>
<td>2,000 V/\mu s MIN</td>
<td>200 V/\mu s MIN</td>
<td>2,000 V/\mu s MIN</td>
</tr>
<tr>
<td>Commutation</td>
<td>4.4 A/\text{ms Logic Level}</td>
<td>12 A/\text{ms Snubberless}</td>
<td>5.3 A/\text{ms Logic Level}</td>
<td>14 A/\text{ms Snubberless}</td>
</tr>
<tr>
<td>Package offer</td>
<td>TO-220AB</td>
<td>TO-220AB</td>
<td>TO-220AB</td>
<td>D²PAK</td>
</tr>
</tbody>
</table>
High temperature triac

**WHY?**

- AC switching **solution in case of**
  - **High current density** implemented on the PCB
  - **Hot** temperature environments
  - **Heatsink** reduction or **die size** optimization application requirement

- **These requirements are more and more usual in:**
  - **Motor control** application (vacuum cleaner, drum motor, …)
  - **AC actuators** control in small appliances
  - Control of **electric heater** in appliances and industrial applications

- **Propose improved** dynamic performances **vs application requirement.**

- Differentiated from compet **with full specification and** no derating **with the junction temperature** (what you read is what you get)
High temperature triac

Current version of HiTj T1635H-600T

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Test conditions</th>
<th>Quadrant</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{GT}$</td>
<td>$V_T = 12 , V$, $R_L = 33 , \Omega$</td>
<td>II - III</td>
<td>MAX</td>
<td>35 mA</td>
</tr>
<tr>
<td>$dV/dt$</td>
<td>$V_D = 67% , V_{DRM}$, gate open, $T_J = 150^\circ C$</td>
<td>MIN</td>
<td>95 V/µs</td>
<td></td>
</tr>
<tr>
<td>$(dI/dt)_c$</td>
<td>Without snubber, $T_J = 150^\circ C$</td>
<td>MIN</td>
<td>7.1 A/µs</td>
<td></td>
</tr>
</tbody>
</table>

New device HiTj T1635H-6x

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Test conditions</th>
<th>Quadrant</th>
<th>Value (T1635H)</th>
<th>Value (T1650H)</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{GT}$</td>
<td>$V_T = 12 , V$, $R_L = 33 , \Omega$</td>
<td>I - II - III</td>
<td>35 mA</td>
<td>50 mA</td>
<td>mA</td>
</tr>
<tr>
<td>$dV/dt$</td>
<td>$V_D = 67% , V_{DRM}$, gate open</td>
<td>$T_J = 150^\circ C$</td>
<td>1000 V/µs</td>
<td>1500 V/µs</td>
<td>V/µs</td>
</tr>
<tr>
<td>$(dI/dt)_c$</td>
<td>Without snubber, $T_J = 150^\circ C$</td>
<td>MIN</td>
<td>21 A/µs</td>
<td>29 A/µs</td>
<td>A/µs</td>
</tr>
</tbody>
</table>

With ST new High Tj triacs, you can both:
- remove totally the RC snubber circuit
- secure the control of your appli 3 times > before (much bigger design margin)
### High temperature triac

**Current version of HiTj T1635H-600T**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Test conditions</th>
<th>Quadrant</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{GT}$ (1)</td>
<td>$V_n = 12\ V$, $R_l = 33\ \Omega$</td>
<td>II - III</td>
<td>MAX</td>
<td>35</td>
</tr>
<tr>
<td>$dV/dt$ (2)</td>
<td>$V_D = 67% V_{DRM}$, gate open, $T_j = 150^\circ\ C$</td>
<td>MIN</td>
<td>319</td>
<td>V/μs</td>
</tr>
<tr>
<td>$(dl/dt)c$ (2)</td>
<td>Without snubber, $T_j = 150^\circ\ C$</td>
<td>MIN</td>
<td>7.1</td>
<td>A/μs</td>
</tr>
</tbody>
</table>

**New device HiTj T1635H-6x**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Test conditions</th>
<th>Quadrant</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{GT}$ (1)</td>
<td>$V_D = 12\ V$, $R_L = 33\ \Omega$</td>
<td>I − II − III</td>
<td>MAX</td>
<td>35</td>
</tr>
<tr>
<td>$dV/dt$ (2)</td>
<td>$V_D = 67% V_{DRM}$, gate open</td>
<td>MIN</td>
<td>1000</td>
<td>1500</td>
</tr>
<tr>
<td>$(dl/dt)c$ (2)</td>
<td>Without snubber, $T_j = 150^\circ\ C$</td>
<td>MIN</td>
<td>21</td>
<td>28</td>
</tr>
</tbody>
</table>

With ST new High Tj triacs, you can both:
- remove totally the RC snubber circuit
- secure the control of your appli 3 to 4 times > before (much bigger design margin)

\[ dI_{\text{req}} / dt = IT_{\text{RMS}} \cdot \sqrt{2 \cdot (2 \cdot \pi \cdot f)} \]

... & even 4 times better turn-off capability @ $T_j = 150^\circ\ C$
# High temperature triac

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Unit</th>
<th>T10xxH-6y</th>
<th>T12xxH-6y</th>
<th>T16xxH-6y</th>
<th>T20xxH-6T</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{T \text{,(RMS)}}$</td>
<td>A</td>
<td>10</td>
<td>12</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>$V_{DRM} / V_{RRM}$</td>
<td>V</td>
<td></td>
<td>600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{GT}$</td>
<td>mA</td>
<td></td>
<td></td>
<td>either 35 mA or 50 mA</td>
<td></td>
</tr>
<tr>
<td>$T_{J \text{,MAX}}$</td>
<td>°C</td>
<td></td>
<td></td>
<td>150°C</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Package</th>
<th></th>
<th>T10xxH-6y</th>
<th>T12xxH-6y</th>
<th>T16xxH-6y</th>
<th>T20xxH-6T</th>
</tr>
</thead>
<tbody>
<tr>
<td>TO-220AB</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>TO-200AB ins</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>D²PAK</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

New High Tj triacs generation:

- High turn-off capability: up to 4 times the specified $I_{TRMS}$ (nominal)
- High immunity @ 150°C: up to 1500 V/μs
...more discrete power

- **MOSFETs**
  - SuperMESH / MDMesh technologies
  - Fast Recovery Diode (FRED)
  - SAFeFET
  - Package evolution

- **IGBTs**

- **AC SWITCH**

- **RECTIFIERS**
  - POWER SCHOTTKY
  - BIPOLAR AND ULTRAFAST
Silicon Carbide diodes

- **Thanks to:**
  - tiny dynamic reverse recovery current, stable when the junction temperature varies.
  - Forward voltage drop at high temperature and nominal forward current of a SiC diode is 10% lower than that of the Tandem diode.

→ **efficiency and thermal performance improvement**

**APPLICATIONS:** PFC boost converters, freewheeling in motor drives, as well as all industrial applications requiring very high performance.

<table>
<thead>
<tr>
<th>Part number</th>
<th>Current rating</th>
<th>$V_F$ [V]</th>
<th>$Q_G$ [nC]</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>STPSC806D</td>
<td>8</td>
<td>1.7</td>
<td>15</td>
<td>TO-220AC</td>
</tr>
<tr>
<td>STPSC1006D</td>
<td>10</td>
<td>1.7</td>
<td>20</td>
<td>TO-220AC</td>
</tr>
</tbody>
</table>
SiC (Silicon Carbide) diodes

Recovery time improvement

VR= 400V ; IF= 8A ; Tj= 125°C
di/dt= 200A/µs
**RECTIFIERS**

- **Signal & Power Schottky:**
  - Up to 170V
  - Avalanche rated
  - High Temperature
  - Ultra-Low V_F
  - 15-170V Range

- **Ultrafast & Dampers:**
  - Pt doped Dampers
  - 800-1200V U-fast
  - 600V Turbo2
  - 600V Tandem
  - 400V U-fast
  - 300V U-fast
  - New 200V U-fast

**Micropackages**
• Low voltage drop characteristics with negligible or no recovery.
• Broad package offer
• Avalanche specification of all types

Normalized avalanche power derating versus pulse duration

% Power losses

200V Bipolar  170V Schottky
ST offers a complete range of Power Schottky diodes with explicit avalanche specification.

ST Schottky diodes avalanche ratings ensure a precise match for the power converter voltage spikes to be handled.

Choose between efficiency and cost savings:

<table>
<thead>
<tr>
<th>280 W SMPS</th>
<th>Applications improvements examples with Avalanche</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3 V / 10 A</td>
<td>Reference design</td>
</tr>
<tr>
<td>5.0 V / 25 A</td>
<td>STPS6045CW</td>
</tr>
<tr>
<td>12 V / 10 A</td>
<td>STPS20H100CT</td>
</tr>
</tbody>
</table>

- **Efficiency**
  - Nominal
  - +2% Unchanged
- **Diode Cost**
  - Nominal
  - Unchanged
- **SMPS Cost**
  - Nominal
  - Unchanged

- 2% efficiency improvement
- Or up to 2% cost saving
• Complete bipolar and ultrafast families renewal

• New platinum doping process
  – Lower VF
  – Lower leakage current (10 to 100 times)
  – Operating up to 175°C
  – Best $V_F / I_R$ ratio on the market