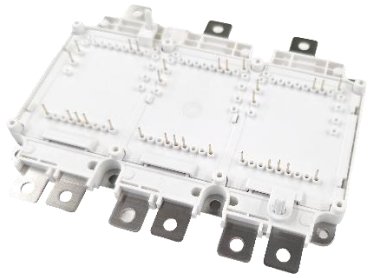
# PRELIMINARY DATASHEET **SCSS0022EVD120m23**

EVD-Type three-phase 1.2kV SiC module



**$V_{DSS}$ = 1200 V**
**$R_{DSon}$ = 2.2 m Ohm @ $I_D$ = 600 A**

- *m23 generation SiC MOSFET chips*
- *Ultra-low $R_{Dson}$*
- *Low switching losses, Qg and Crss*
- *Low inductance module < 9nH*
- *$T_{vj\_op}$ = 175°C*
- *4.2kV DC 1 sec insulation*
- *Compact design*
- *Direct cooled PinFin baseplate*
- *High performance $Si_3N_4$ ceramic substrates*
- *Guiding elements for PCB and cooler assembly*
- *Integrated NTC temperature sensor*
- *RoHS compliant*

## Maximum ratings [1]

| PARAMETER | SYMBOL | CONDITIONS | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| **Drain – source voltage** | $V_{DSS}$ | $V_{GS}$ </= 0 V, $T_{vj}$ = 25 °C | | 1200 | V |
| **Continuous drain and source current** | $I_D$, $I_S$ | $T_F$ = 60 °C, $V_{GS}$ = 18 V, $T_{vj}$ = 175 °C | | 545 | A |
| **Peak drain and source current** | $I_{DM}$, $I_{SM}$ | $t_p$ = 1 ms, limited by $T_{vjmax}$ | | 1200 | A |
| **Gate-source voltage (DC)** | $V_{GSS}$ | | -8 | 22 | V |
| **Gate-source surge voltage** | $V_{GSS\ surge}$ | $t_{surge}$ < 300ns | -10 | 25 | V |
| **Recommended gate voltage** | $V_{GS}$ | | -5 | 18 | V |
| **Surge current** | | | | TBD | A |
| **MOSFET SCSOA** | $t_{psc}$ | $V_{DS}$ = 800 V, $V_{GSon}$ = 18 V, $T_{vj}$ < 175 °C | | TBD | µs |
| **Isolation voltage** | $V_{isol}$ | RMS, 1 s, f = 50 Hz | | 4200 | V |
| **Junction operating temperature** | $T_{vj(op)}$ | | -40 | 175 | °C |
| **Storage temperature** | $T_{stg}$ | | -40 | 125 | °C |
| **Mounting torques for module mounting[2]** | M | Screw M4 baseplate to heatsink | 1.8 | 2.2 | Nm |
| **Max pressure in cooling circuit** | p | $T_{baseplate}$ < 40°C | | 2.5 | bar |
| | | $T_{baseplate}$ > 40°C | | 2.0 | bar |

Scan for latest download

[1] Maximum rated values indicate limits beyond which damage to the device may occur per IEC 60747
[2] For details, please refer to the mounting instructions.

## MOSFET[3]

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **Drain-source breakdown voltage** | $V_{(BR)DSS}$ | $V_{GS}$ </= 0 V, $I_D$= 1.5 mA, $T_{vj}$ = -40 .. 25°C | | 1200 | | | V |
| **Static drain-source on-state resistance[4]** | $R_{DS(on)}$ | $I_D$ = 600 A, $V_{GS}$ = 18 V | $T_{vj}$ = 25 °C | | 2.2 | 2.7 | mΩ |
| | | | $T_{vj}$ = 175 °C | | 4 | | mΩ |
| **Zero gate voltage drain current** | $I_{DSS}$ | $V_{DS}$ = 1200 V, $V_{GS}$ = 0 V | $T_{vj}$ = 25 °C | | 6 | 60 | µA |
| | | | $T_{vj}$ = 175 °C | | 60 | | µA |
| **Gate leakage current** | $I_{GSS}$ | $V_{GS}$ = +22 / -10 V | | -300 | | 300 | nA |
| **Gate-emitter threshold voltage** | $V_{GS(th)}$ | $V_{GS}$ = $V_{DS}$, $I_D$ = 30 mA | $T_{vj}$ = 25°C | 2.25 | 2.75 | 3.5 | V |
| | | | $T_{vj}$ = 175°C | | 2 | | V |
| **Gate charge** | $Q_G$ | $I_D$ = 600 A, $V_{DS}$ = 800 V, $V_{GS}$ = -5 V ... 18 V | | | 1.2 | | µC |
| **Input capacitance** | $C_{iss}$ | $V_{DS}$ = 800 V, $V_{GS}$ = 0 V, f = 100 kHz, $T_{vj}$ = 25 °C | | | 35.6 | | nF |
| **Output capacitance** | $C_{oss}$ | | | | 2.4 | | nF |
| **Reverse tansfer capacitance** | $C_{rss}$ | | | | 0.18 | | nF |
| **Internal gate resistor** | $R_{Gint}$ | Per switch | | | 0.4 | | Ω |
| **Turn-on delay time** | $t_{d(on)}$ | $V_{CC}$ = 800 V, $I_D$ = 600 A, $R_G$ = 4 Ω, $V_{GS}$ = -5 / +18 V, $L_s$ =30 nH, inductive load | $T_{vj}$ = 25 °C | | 40 | | ns |
| | | | $T_{vj}$ = 125 °C | | 30 | | ns |
| | | | $T_{vj}$ = 175 °C | | 25 | | ns |
| **Rise time** | $t_r$ | | $T_{vj}$ = 25 °C | | 60 | | ns |
| | | | $T_{vj}$ = 125 °C | | 50 | | ns |
| | | | $T_{vj}$ = 175 °C | | 50 | | ns |
| **Turn-off delay time** | $t_{d(off)}$ | $V_{CC}$ = 800 V, $I_D$ = 600 A, $R_G$ = 7 Ω, $V_{GS}$ = -5 / +18 V, $L_s$ =30 nH, inductive load | $T_{vj}$ = 25 °C | | 370 | | ns |
| | | | $T_{vj}$ = 125 °C | | 430 | | ns |
| | | | $T_{vj}$ = 175 °C | | 460 | | ns |
| **Fall time** | $t_f$ | | $T_{vj}$ = 25 °C | | 70 | | ns |
| | | | $T_{vj}$ = 125 °C | | 70 | | ns |
| | | | $T_{vj}$ = 175 °C | | 70 | | ns |
| **Turn-on switching energy** | $E_{on}$ | $V_{CC}$ = 800 V, $I_D$ = 600 A, $R_G$ = 4 Ω, $V_{GS}$ = -5 / +18 V, $L_s$ = 30 nH, inductive load | $T_{vj}$ = 25 °C | | 34 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 33.5 | | mJ |
| | | | $T_{vj}$ = 175 °C | | 34 | | mJ |
| **Turn-off switching energy** | $E_{off}$ | $V_{CC}$ = 800 V, $I_D$ = 600 A, $R_G$ = 7 Ω, $V_{GS}$ = -5 / +18 V, $L_s$ = 30 nH, inductive load | $T_{vj}$ = 25 °C | | 37 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 40 | | mJ |
| | | | $T_{vj}$ = 175 °C | | 41 | | mJ |
| **Short circuit current** | $I_{SC}$ | $t_{pcs}$ ≤ 1.5 µs, $V_{GE}$ = 18 V, $T_{vj}$ = 175 °C, $V_{CC}$ = 800 V, $V_{DSM\ Chip}$ ≤ 1200 V | | | TBD | | A |

[3] Characteristic values according to IEC 60747-9
[4] Given at chip level

## Body Diode (MOSFET)[5]

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **Drain-source reverse voltage[6]** | $V_{SD}$ | $I_D$ = -600 A, $V_{GS}$ = 18 V | $T_{vj}$ = 25 °C | | 5.4 | | V |
| | | | $T_{vj}$ = 175 °C | | 4.8 | | V |
| **MOSFET peak forward recovery current** | $I_{frm}$ | $V_R$ = 800 V, $I_{SD}$ = 600 A, dI/dt = 12.2 kA/µs, $R_G$ = 4 Ω, $V_{GS}$ = -5 / +18 V, $L_s$ =30 nH, inductive load | $T_{vj}$ = 25 °C | | 216 | | A |
| | | | $T_{vj}$ = 125 °C | | 354 | | A |
| | | | $T_{vj}$ = 175 °C | | 495 | | A |
| **MOSFET forward recovery charge** | $Q_f$ | | $T_{vj}$ = 25 °C | | 9.6 | | µC |
| | | | $T_{vj}$ = 125 °C | | 22.9 | | µC |
| | | | $T_{vj}$ = 175 °C | | 37.7 | | µC |
| **MOSFET forward recovery time** | $t_{fr}$ | | $T_{vj}$ = 25 °C | | 70 | | ns |
| | | | $T_{vj}$ = 125 °C | | 97 | | ns |
| | | | $T_{vj}$ = 175 °C | | 110 | | ns |
| **MOSFET forward recovery energy** | $E_{fr}$ | | $T_{vj}$ = 25 °C | | 6.8 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 15 | | mJ |
| | | | $T_{vj}$ = 175 °C | | 24.1 | | mJ |

## Package properties [7]

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **Thermal resistance junction to fluid** | $R_{th(j-f)}$ | Per switch, Coolant 50% glycol, 50% water, 10 l/min, dp < 90 mbar | | | 0.097 | | K/W |
| **Comparative tracking index** | CTI | | | 400 | | | |
| **Module stray inductance** | $L_{s\,CE}$ | Per switch | | | 8.5 | | nH |
| **Resistance, terminal chip** | $R_{CC'+EE'}$ | Per switch | $T_{vj}$ = 25 °C | | 0.5 | | mΩ |
| | | | $T_{vj}$ = 125 °C | | | | mΩ |
| | | | $T_{vj}$ = 175 °C | | | | mΩ |
| **Material of module baseplate** | | Ni + Cu<br>Nickel plated Cu baseplate | | | | | |
| **Internal isolation** | | $Si_3N_4$<br>Basic insulation (class 1, IEC 61140) | | | | | |

[5] Characteristic values according to IEC 60747-8
[6] Given at chip level
[7] Package and mechanical properties according to IEC 60747-15

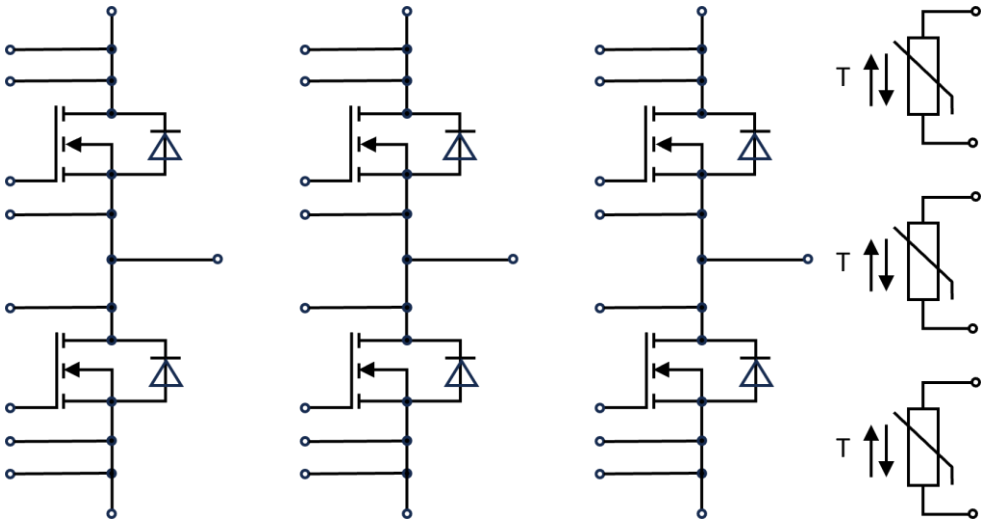
## Mechanical properties

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **Dimensions** | L x W x H | Typical | | 152 x 62 x 17 | | | $mm^3$ |
| **Clearance distance in air** | da | According to IEC 60664-1 and EN 50124-1 | Terminal to base: | 4.5 | | | mm |
| | | | Terminal to terminal: | 4.5 | | | mm |
| **Surface creepage distance** | ds | According to IEC 60664-1 and EN 50124-1 | Terminal to base: | 9.0 | | | mm |
| | | | Terminal to terminal: | 9.0 | | | mm |
| **Mass** | m | | | | 720 | | g |

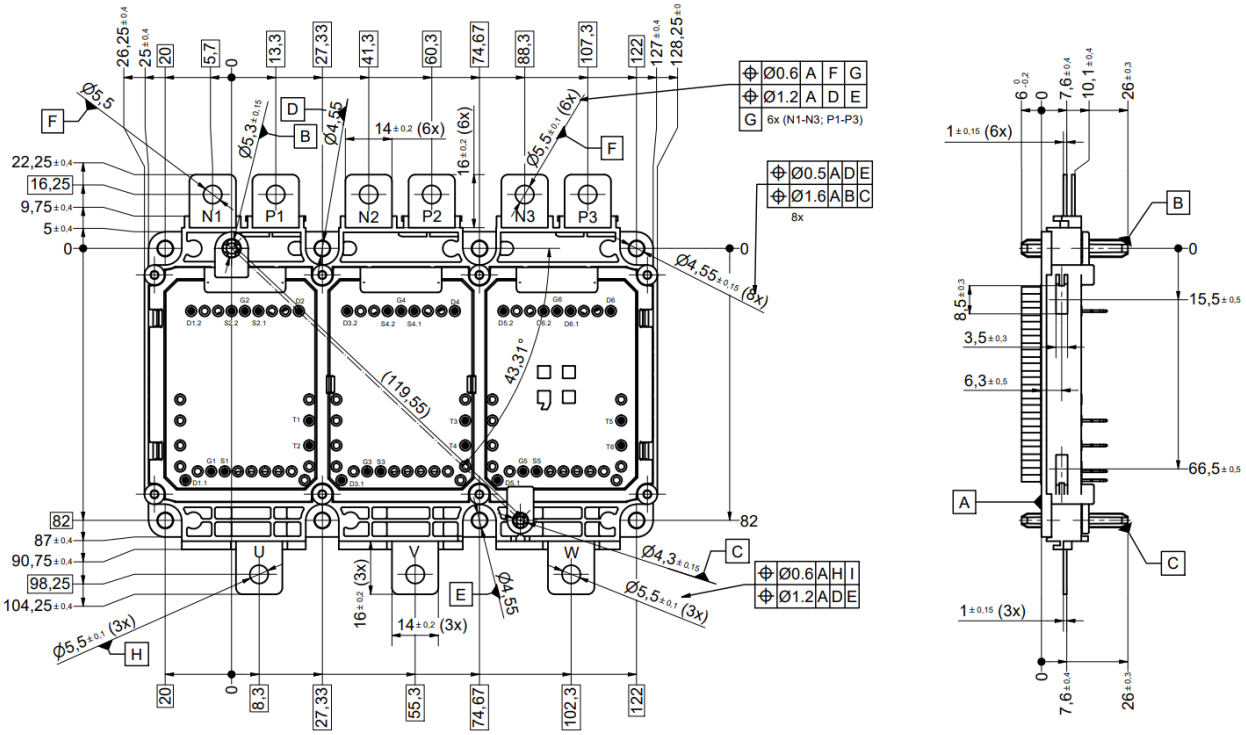
## NTC Thermistor

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| **Rated resistance** | $R_{25}$ | $T_C$ = 25 °C | | 5 | | kΩ |
| **R100** | $R_{100}$ | $T_C$ = 100 °C | 468 | | 518 | Ω |
| **B-value** B | $B_{25/50}$ | $R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298.15K))]$ | | 3375 | | K |
| **B-value** B | $B_{25/50}$ | $R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298.15K))]$ | | 3411 | | K |
| **Rated resistance** | $B_{25/100}$ | $R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298.15K))]$ | | 3433 | | K |

## Electrical configuration



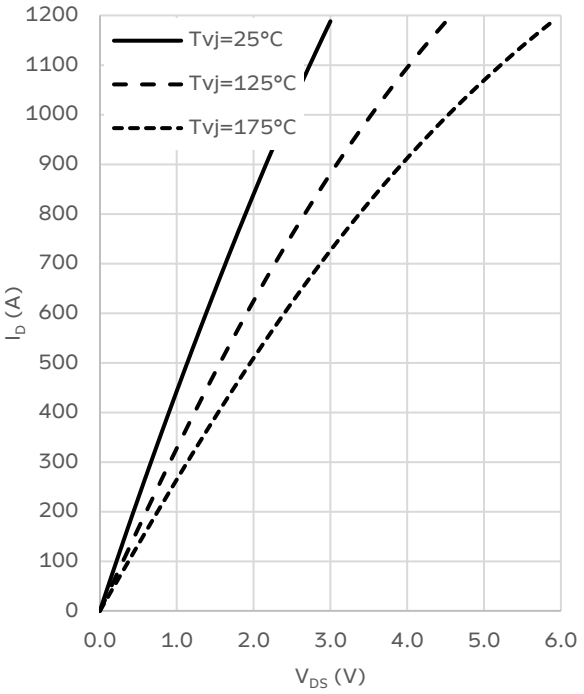

## Outline drawing



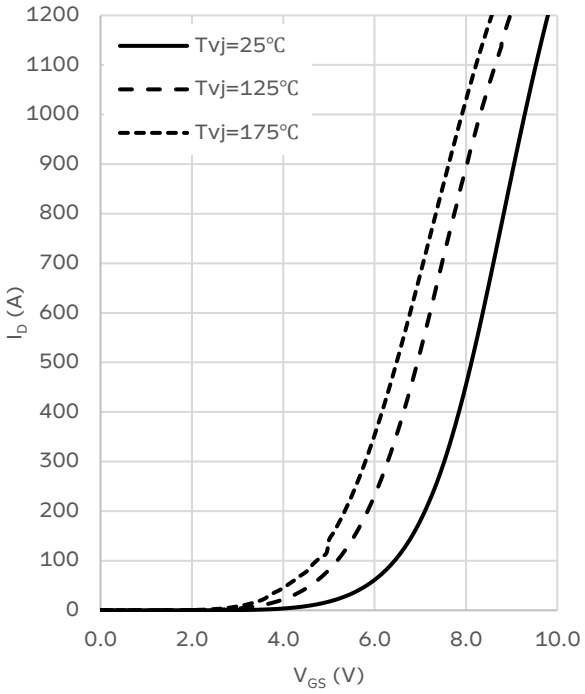

This is an electrostatic sensitive device.
*This product has been designed and qualified for automotive level.*

## Characteristics

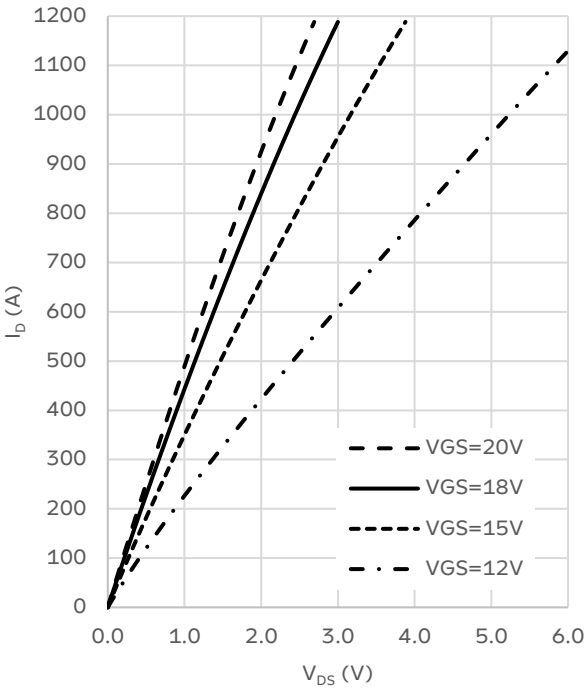
**MOSFET on-state characteristics (typical)**
$I_D = f(V_{DS})$
$V_{GS}$ = 18 V



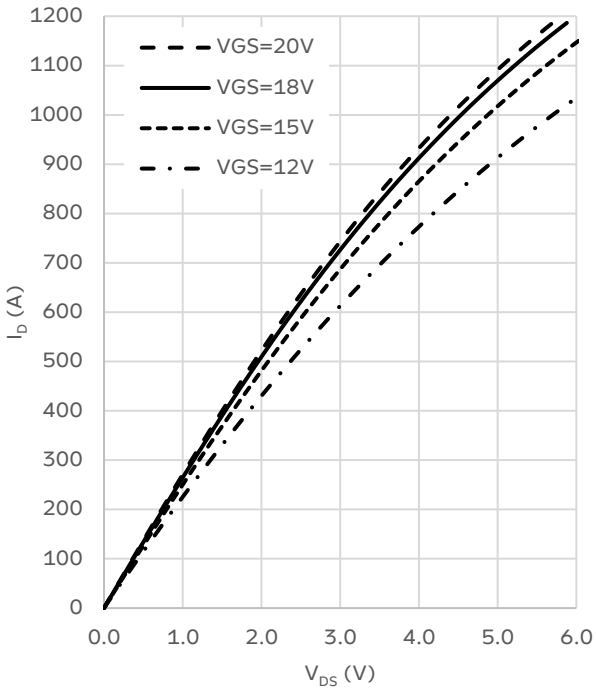

**MOSFET transfer characteristics (typical)**
$I_D = f(V_{GS})$
$V_{DS}$ = 20V




**MOSFET output characteristics (typical)**
$I_D = f(V_{DS})$
$T_{vj}$ = 25 °C

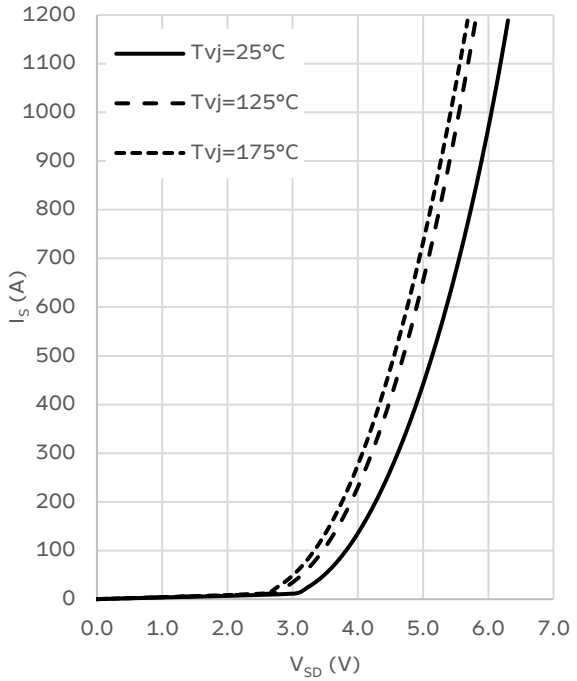



**MOSFET output characteristics (typical)**
$I_D = f(V_{DS})$
$T_{vj}$ = 175 °C

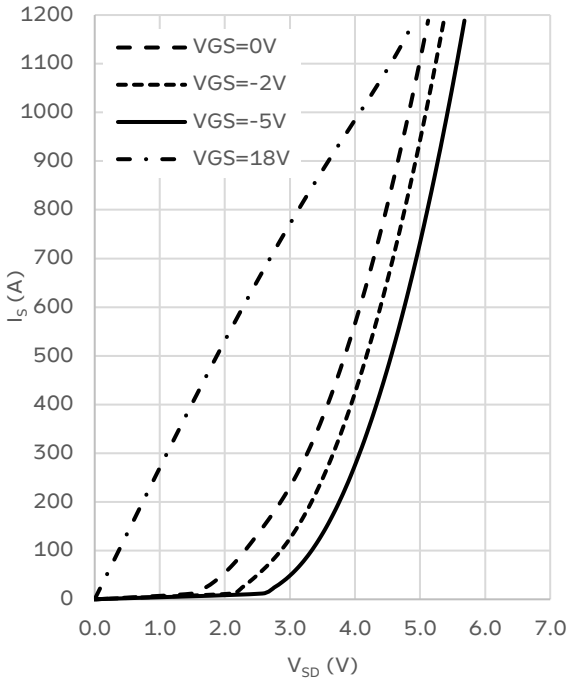


| Switching losses (typical) | Switching times (typical) |
|---|---|
| E = f($I_D$)<br>$V_{DS}$ =800 V, $R_{Gon}$ =4 Ω, $R_{Goff}$ =7 Ω, $V_{GE}$ =-5/+18 V | t = f($I_D$)<br>$V_{DS}$ = 800 V, $R_{Gon}$ =4 Ω, $R_{Goff}$ =7 Ω, $V_{GE}$ =-5/+18 V |
| **Switching losses (typical)** | **Switching times (typical)** |
| E = f($R_G$)<br>$V_{DS}$ =800 V, I =5000 A, $V_{GS}$ =-5/+18 V | t = f($R_G$), $T_{vj}$ = 175 °C<br>$V_{DS}$ =800 V, I =500 A, $V_{GS}$ =-5/+18 V |

**Body diode characteristic (typical)**
$I_S = f(V_{SD})$
$V_{GS}$ = -5 V




**Body diode characteristic (typical)**
$I_S = f(V_{SD})$
$T_{vj}$ = 175 °C




**Diode switching characteristics (typical)**
$E_{rec} = f(I_F)$, $I_{RM} = f(I_F)$
$V_{DC}$ = 800 V, $R_{Gon}$ =4 Ω (MOSFET), $V_{GS}$ =-4/+18 V

**Diode switching characteristics (typical)**
$E_{rec} = f(di/dt)$, $I_{RM} = f(di/dt)$
$V_{DC}$ =800 V, $I_D$ =-600 A, $V_{GS}$ =-5/+18 V (MOSFET)

| Thermal resistance versus flow rate | Transient thermal impedance |
|---|---|
| $R_{th(J-A)}$ =f(dv/dt) | $Z_{th(J-A)}$ =f(t)<br>$T_F$ =50°C |
| *tbd* | *tbd* |