

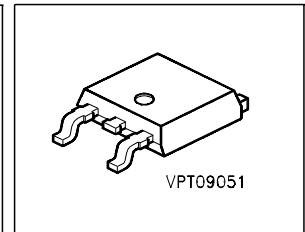
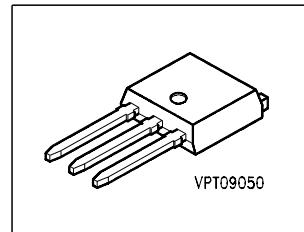
## SIPMOS® Power Transistor

### Features

- N channel
- Enhancement mode
- Avalanche rated
- dv/dt rated
- 175°C operating temperature

### Product Summary

|                                  |              |       |          |
|----------------------------------|--------------|-------|----------|
| Drain source voltage             | $V_{DS}$     | 55    | V        |
| Drain-Source on-state resistance | $R_{DS(on)}$ | 0.115 | $\Omega$ |
| Continuous drain current         | $I_D$        | 9.2   | A        |



| Type     | Package | Ordering Code   | Packaging     | Pin 1 | Pin 2 | Pin 3 |
|----------|---------|-----------------|---------------|-------|-------|-------|
| SPD09N05 | P-TO252 | Q67040-S4136-A2 | Tape and Reel | G     | D     | S     |
| SPU09N05 | P-TO251 | Q67040-S4130-A2 | Tube          |       |       |       |

### Maximum Ratings, at $T_j = 25\text{ °C}$ , unless otherwise specified

| Parameter                                                                                                     | Symbol         | Value       | Unit              |
|---------------------------------------------------------------------------------------------------------------|----------------|-------------|-------------------|
| Continuous drain current<br>$T_C = 25\text{ °C}$<br>$T_C = 100\text{ °C}$                                     | $I_D$          | 9.2<br>6.5  | A                 |
| Pulsed drain current<br>$T_C = 25\text{ °C}$                                                                  | $I_{Dpulse}$   | 37          |                   |
| Avalanche energy, single pulse<br>$I_D = 9.2\text{ A}$ , $V_{DD} = 25\text{ V}$ , $R_{GS} = 25\text{ }\Omega$ | $E_{AS}$       | 35          | J                 |
| Avalanche energy, periodic limited by $T_{jmax}$                                                              | $E_{AR}$       | 2.4         |                   |
| Reverse diode dv/dt<br>$I_S = 9.2\text{ A}$ , $V_{DS} = 40\text{ V}$ , $di/dt = 200\text{ A}/\mu\text{s}$     | dv/dt          | 6           | kV/ $\mu\text{s}$ |
| Gate source voltage                                                                                           | $V_{GS}$       | $\pm 20$    | V                 |
| Power dissipation<br>$T_C = 25\text{ °C}$                                                                     | $P_{tot}$      | 24          | W                 |
| Operating and storage temperature                                                                             | $T_j, T_{stg}$ | -55... +175 | °C                |
| IEC climatic category; DIN IEC 68-1                                                                           |                | 55/175/56   |                   |

**Thermal Characteristics**

| Parameter                                      | Symbol     | Values |      |      | Unit |
|------------------------------------------------|------------|--------|------|------|------|
|                                                |            | min.   | typ. | max. |      |
| Characteristics                                |            |        |      |      |      |
| Thermal resistance, junction - case            | $R_{thJC}$ | -      | -    | 6.25 | K/W  |
| Thermal resistance, junction - ambient, leded  | $R_{thJA}$ | -      | -    | 100  |      |
| SMD version, device on PCB:                    | $R_{thJA}$ |        |      |      |      |
| @ min. footprint                               |            | -      | -    | 75   |      |
| @ 6 cm <sup>2</sup> cooling area <sup>1)</sup> |            | -      | -    | 50   |      |

**Electrical Characteristics**, at  $T_j = 25\text{ °C}$ , unless otherwise specified

| Parameter                                                                                                                                                                                                  | Symbol        | Values |          |          | Unit          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|----------|----------|---------------|
|                                                                                                                                                                                                            |               | min.   | typ.     | max.     |               |
| Static Characteristics                                                                                                                                                                                     |               |        |          |          |               |
| Drain-source breakdown voltage<br>$V_{GS} = 0\text{ V}$ , $I_D = 0.25\text{ mA}$                                                                                                                           | $V_{(BR)DSS}$ | 55     | -        | -        | V             |
| Gate threshold voltage, $V_{GS} = V_{DS}$<br>$I_D = 10\text{ }\mu\text{A}$                                                                                                                                 | $V_{GS(th)}$  | 2.1    | 3        | 4        |               |
| Zero gate voltage drain current<br>$V_{DS} = 50\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_j = 25\text{ }^\circ\text{C}$<br>$V_{DS} = 50\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ | $I_{DSS}$     | -<br>- | 0.1<br>- | 1<br>100 | $\mu\text{A}$ |
| Gate-source leakage current<br>$V_{GS} = 20\text{ V}$ , $V_{DS} = 0\text{ V}$                                                                                                                              | $I_{GSS}$     | -      | 10       | 100      |               |
| Drain-Source on-state resistance<br>$V_{GS} = 10\text{ V}$ , $I_D = 6.5\text{ A}$                                                                                                                          | $R_{DS(on)}$  | -      | 0.093    | 0.115    | $\Omega$      |

<sup>1)</sup> Device on 40mm\*40mm\*1.5mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70 $\mu\text{m}$  thick) copper area for drain connection. PCB is vertical without blown air.

**Electrical Characteristics**, at  $T_j = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified

| Parameter                                                                                      | Symbol       | Values |      |      | Unit |
|------------------------------------------------------------------------------------------------|--------------|--------|------|------|------|
|                                                                                                |              | min.   | typ. | max. |      |
| Dynamic Characteristics                                                                        |              |        |      |      |      |
| Transconductance<br>$V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$ , $I_D = 6.5$ A              | $g_{fs}$     | 3      | 4.5  | -    | S    |
| Input capacitance<br>$V_{GS} = 0$ V, $V_{DS} = 25$ V, $f = 1$ MHz                              | $C_{iss}$    | -      | 215  | 270  | pF   |
| Output capacitance<br>$V_{GS} = 0$ V, $V_{DS} = 25$ V, $f = 1$ MHz                             | $C_{oss}$    | -      | 75   | 95   |      |
| Reverse transfer capacitance<br>$V_{GS} = 0$ V, $V_{DS} = 25$ V, $f = 1$ MHz                   | $C_{rss}$    | -      | 45   | 60   |      |
| Turn-on delay time<br>$V_{DD} = 30$ V, $V_{GS} = 10$ V, $I_D = 9.2$ A,<br>$R_G = 50$ $\Omega$  | $t_{d(on)}$  | -      | 15   | 25   | ns   |
| Rise time<br>$V_{DD} = 30$ V, $V_{GS} = 10$ V, $I_D = 9.2$ A,<br>$R_G = 50$ $\Omega$           | $t_r$        | -      | 20   | 30   |      |
| Turn-off delay time<br>$V_{DD} = 30$ V, $V_{GS} = 10$ V, $I_D = 9.2$ A,<br>$R_G = 50$ $\Omega$ | $t_{d(off)}$ | -      | 30   | 45   |      |
| Fall time<br>$V_{DD} = 30$ V, $V_{GS} = 10$ V, $I_D = 9.2$ A,<br>$R_G = 50$ $\Omega$           | $t_f$        | -      | 25   | 40   |      |

**Electrical Characteristics**, at  $T_j = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified

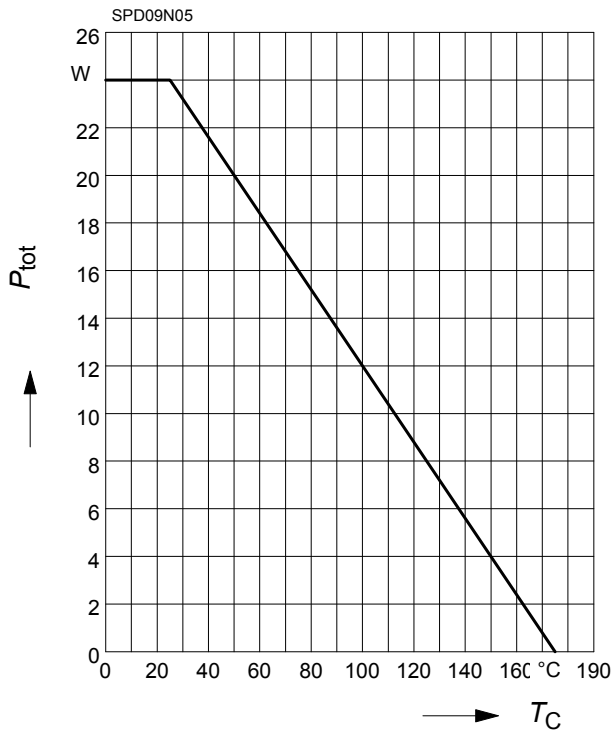
| Parameter                                                                                               | Symbol          | Values |      |      | Unit |
|---------------------------------------------------------------------------------------------------------|-----------------|--------|------|------|------|
|                                                                                                         |                 | min.   | typ. | max. |      |
| Dynamic Characteristics                                                                                 |                 |        |      |      |      |
| Gate to source charge<br>$V_{DD} = 40\text{ V}$ , $I_D = 9.2\text{ A}$                                  | $Q_{gs}$        | -      | 1.3  | 2    | nC   |
| Gate to drain charge<br>$V_{DD} = 40\text{ V}$ , $I_D = 9.2\text{ A}$                                   | $Q_{gd}$        | -      | 3.5  | 5.25 |      |
| Gate charge total<br>$V_{DD} = 40\text{ V}$ , $I_D = 9.2\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$ | $Q_g$           | -      | 7    | 11   |      |
| Gate plateau voltage<br>$V_{DD} = 40\text{ V}$ , $I_D = 9.2\text{ A}$                                   | $V_{(plateau)}$ | -      | 5.9  | -    | V    |

**Reverse Diode**

|                                                                                                     |          |   |       |      |               |
|-----------------------------------------------------------------------------------------------------|----------|---|-------|------|---------------|
| Inverse diode continuous forward current<br>$T_C = 25\text{ }^{\circ}\text{C}$                      | $I_S$    | - | -     | 9.2  | A             |
| Inverse diode direct current, pulsed<br>$T_C = 25\text{ }^{\circ}\text{C}$                          | $I_{SM}$ | - | -     | 37   |               |
| Inverse diode forward voltage<br>$V_{GS} = 0\text{ V}$ , $I_F = 18.5\text{ A}$                      | $V_{SD}$ | - | 1.05  | 1.8  | V             |
| Reverse recovery time<br>$V_R = 30\text{ V}$ , $I_F = I_S$ , $di_F/dt = 100\text{ A}/\mu\text{s}$   | $t_{rr}$ | - | 50    | 75   | ns            |
| Reverse recovery charge<br>$V_R = 30\text{ V}$ , $I_F = I_S$ , $di_F/dt = 100\text{ A}/\mu\text{s}$ | $Q_{rr}$ | - | 0.085 | 0.13 | $\mu\text{C}$ |

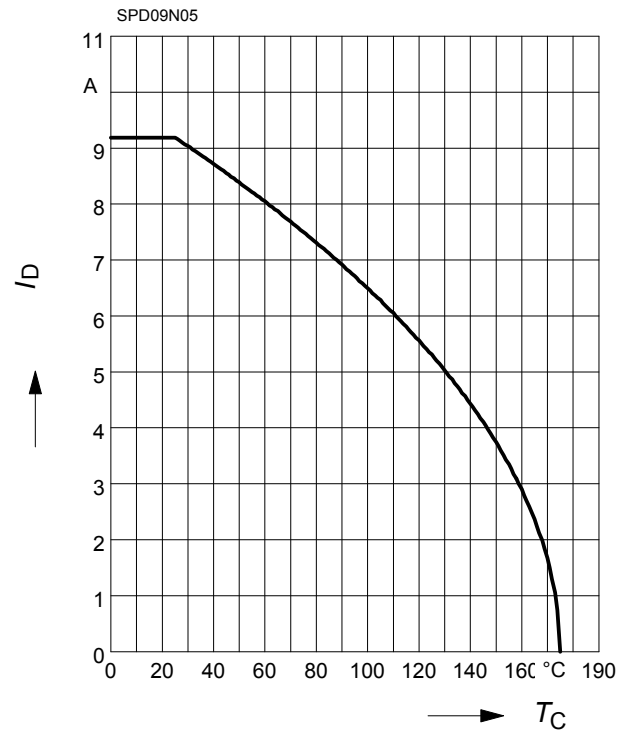
**Power Dissipation**

$$P_{\text{tot}} = f(T_C)$$


**Drain current**

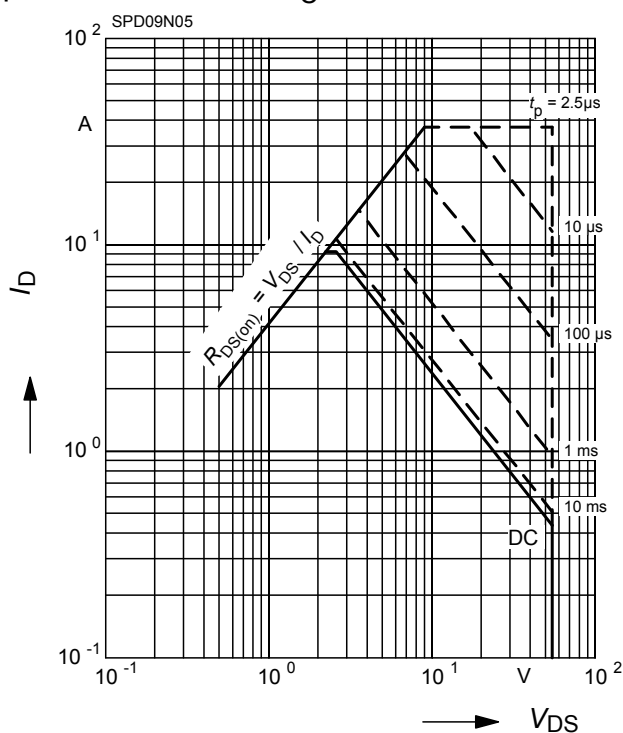
$$I_D = f(T_C)$$

parameter:  $V_{GS} \geq 10 \text{ V}$


**Safe operating area**

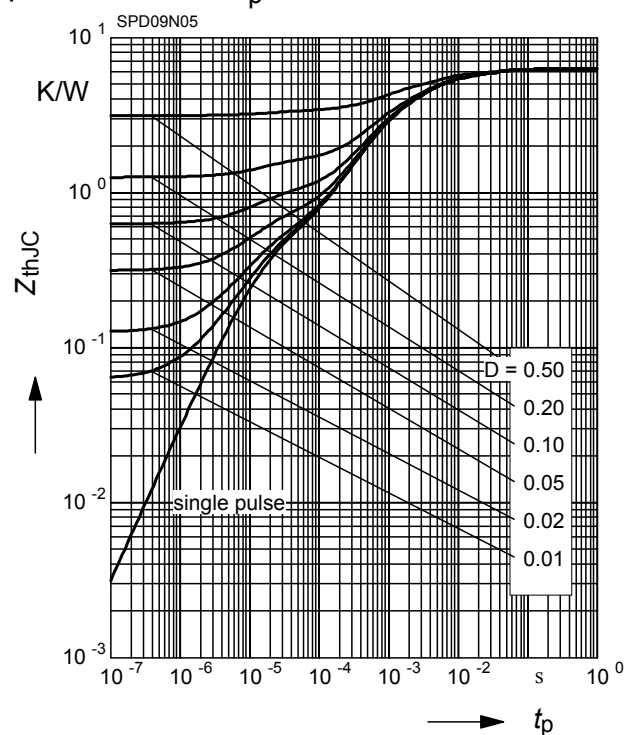
$$I_D = f(V_{DS})$$

parameter:  $D = 0$ ,  $T_C = 25^\circ\text{C}$


**Transient thermal impedance**

$$Z_{\text{thJC}} = f(t_p)$$

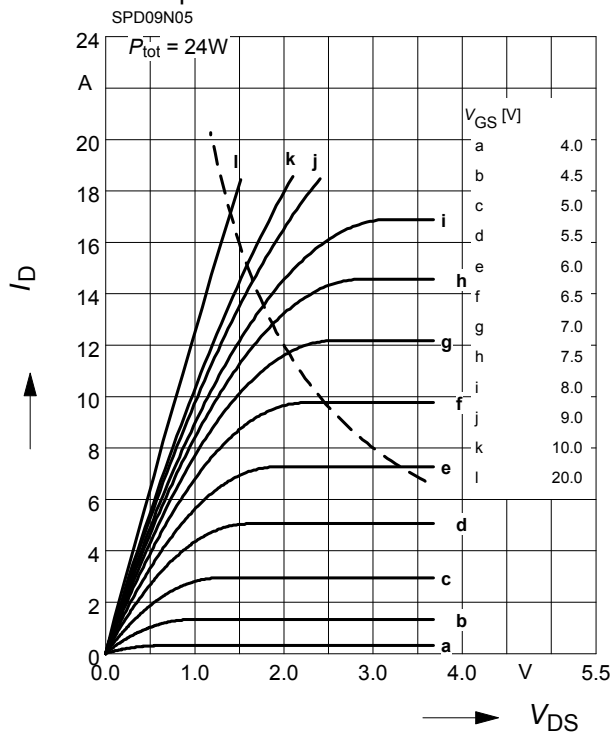
parameter:  $D = t_p/T$



**Typ. output characteristic**

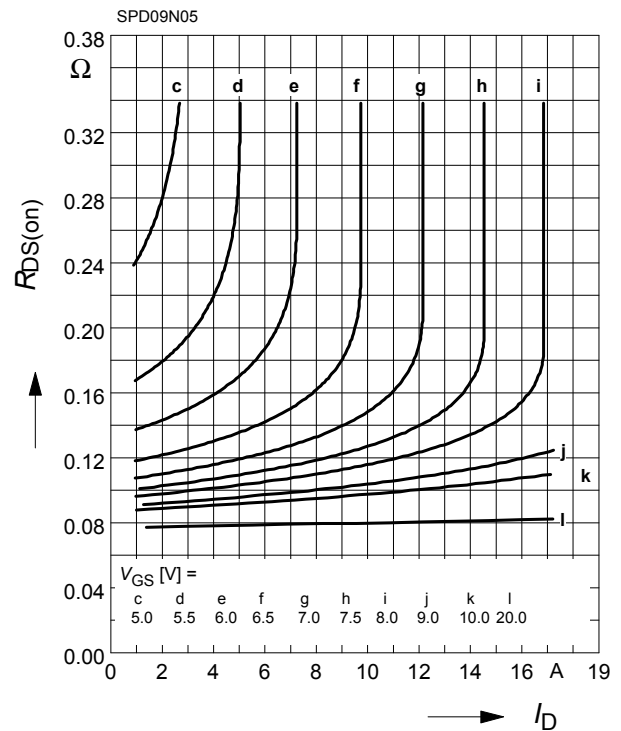
$$I_D = f(V_{DS}); T_j = 25^\circ\text{C}$$

Parameter:  $t_p = 80 \mu\text{s}$


**Typ. drain-source-on-resistance**

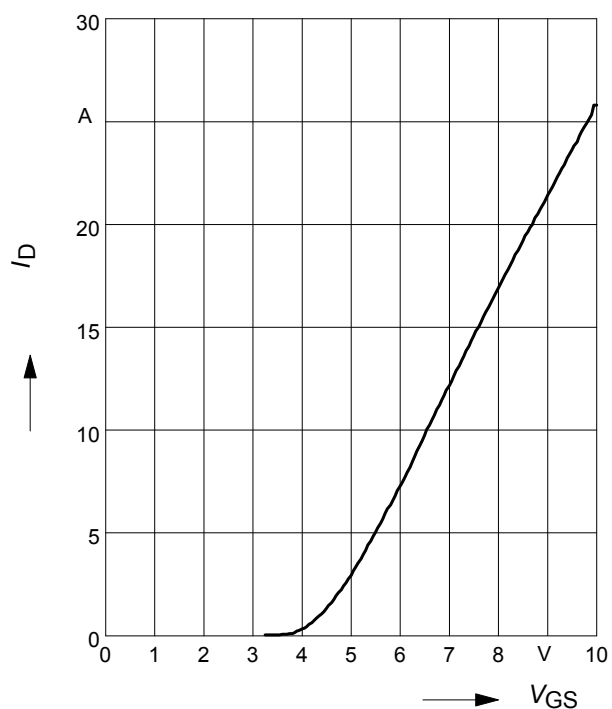
$$R_{DS(\text{on})} = f(I_D)$$

parameter:  $V_{GS}$


**Typ. transfer characteristics  $I_D = f(V_{GS})$** 

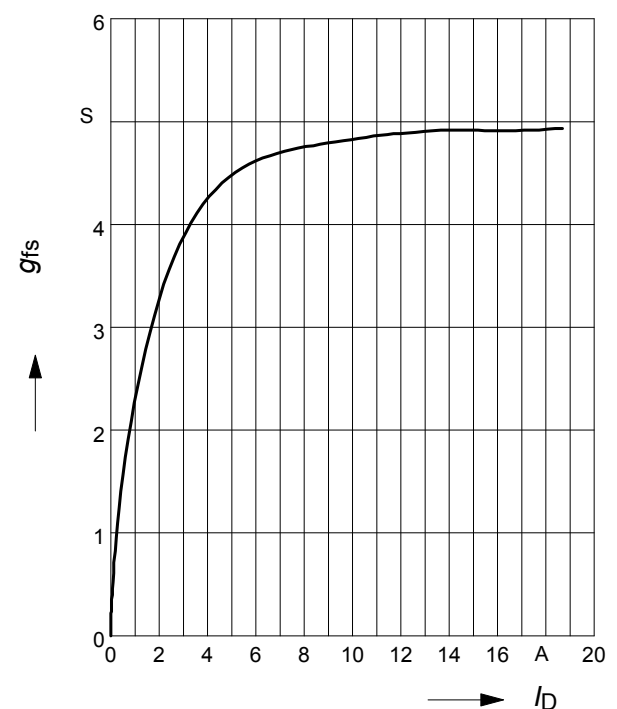
parameter:  $t_p = 80 \mu\text{s}$

$$V_{DS} \geq 2 \times I_D \times R_{DS(\text{on}) \text{ max}}$$


**Typ. forward transconductance**

$$g_{fs} = f(I_D); T_j = 25^\circ\text{C}$$

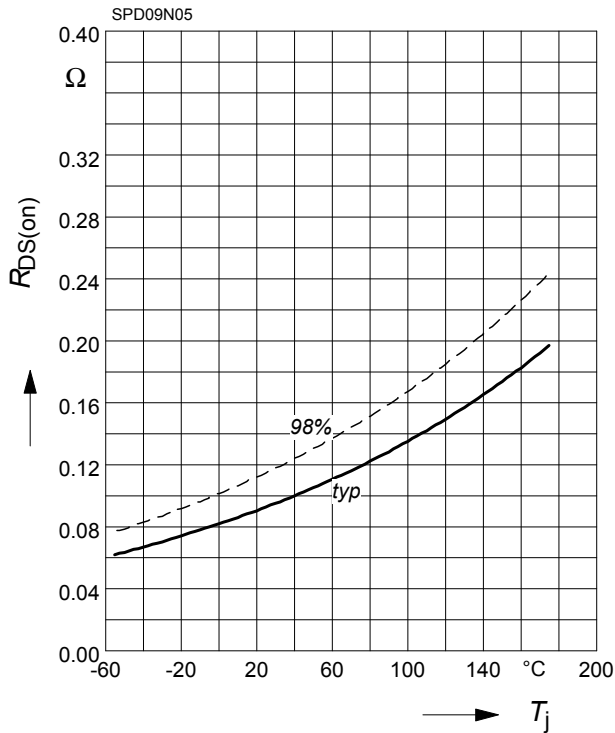
parameter:  $g_{fs}$



### Drain-source on-resistance

$$R_{DS(on)} = f(T_j)$$

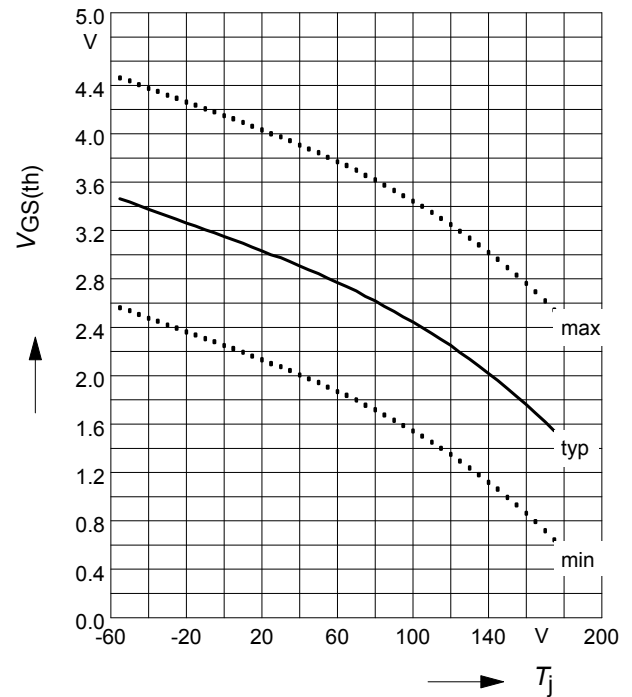
parameter :  $I_D = 6.5 \text{ A}$ ,  $V_{GS} = 10 \text{ V}$



### Gate threshold voltage

$$V_{GS(th)} = f(T_j)$$

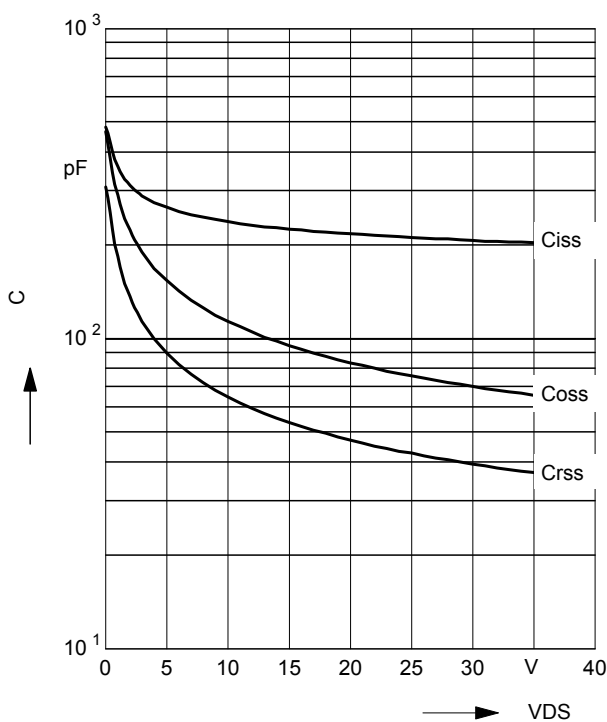
parameter :  $V_{GS} = V_{DS}$ ,  $I_D = 10 \mu\text{A}$



### Typ. capacitances

$$C = f(V_{DS})$$

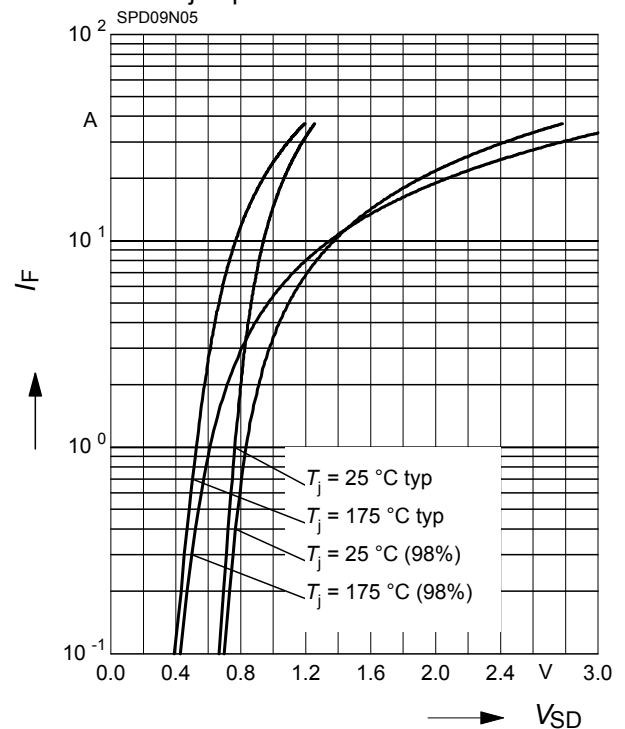
parameter:  $V_{GS} = 0 \text{ V}$ ,  $f = 1 \text{ MHz}$



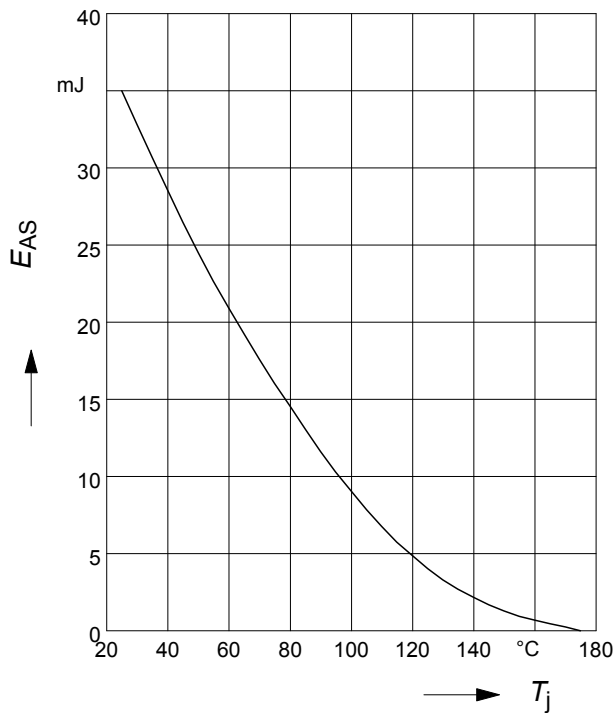
### Forward characteristics of reverse diode

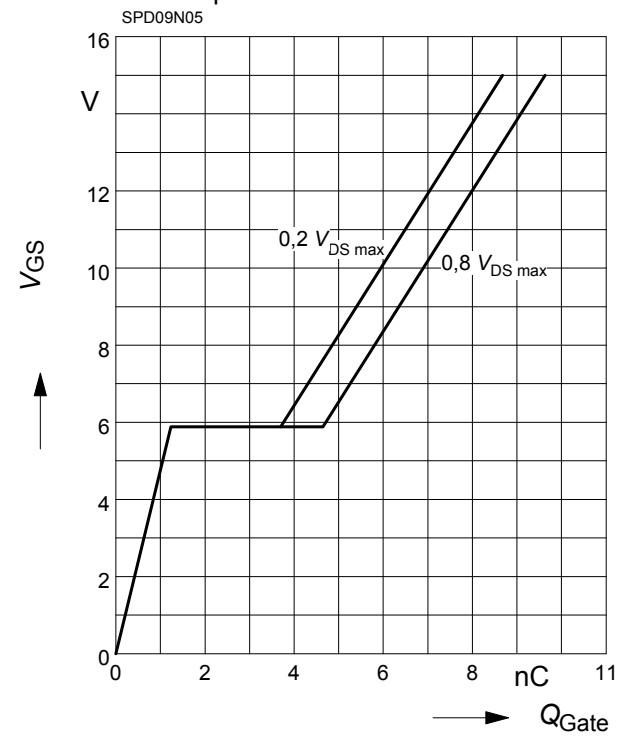
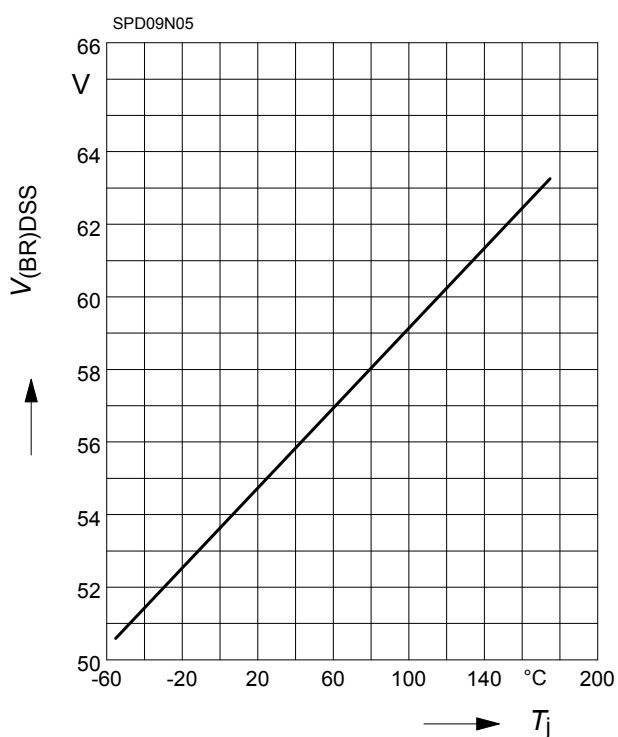
$$I_F = f(V_{SD})$$

parameter:  $T_j$ ,  $t_p = 80 \mu\text{s}$



**Avalanche Energy**  $E_{AS} = f(T_j)$ 

 parameter:  $I_D = 9.2\text{ A}$ ,  $V_{DD} = 25\text{ V}$ 
 $R_{GS} = 25\ \Omega$ 

**Typ. gate charge**
 $V_{GS} = f(Q_{\text{Gate}})$ 

 parameter:  $I_{D\text{ puls}} = 9.2\text{ A}$ 

**Drain-source breakdown voltage**
 $V_{(BR)DSS} = f(T_j)$ 


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