

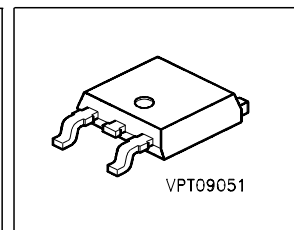
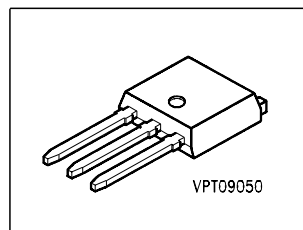
## SIPMOS® Power Transistor

### Features

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

### Product Summary

|                                  |              |      |          |
|----------------------------------|--------------|------|----------|
| Drain source voltage             | $V_{DS}$     | 55   | V        |
| Drain-Source on-state resistance | $R_{DS(on)}$ | 0.04 | $\Omega$ |
| Continuous drain current         | $I_D$        | 20   | A        |



| Type      | Package     | Ordering Code   | Packaging     | Pin 1 | Pin 2 | Pin 3 |
|-----------|-------------|-----------------|---------------|-------|-------|-------|
| SPD21N05L | P-TO252     | Q67040-S4137    | Tape and Reel | G     | D     | S     |
| SPU21N05L | P-TO251-3-1 | Q67040-S4131-A2 | Tube          |       |       |       |

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

| Parameter                                                                                                                                      | Symbol         | Value       | Unit              |
|------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------|-------------------|
| Continuous drain current<br>$T_C = 25^\circ\text{C}$<br>$T_C = 100^\circ\text{C}$                                                              | $I_D$          | 20<br>14    | A                 |
| Pulsed drain current<br>$T_C = 25^\circ\text{C}$                                                                                               | $I_{Dpulse}$   | 80          |                   |
| Avalanche energy, single pulse<br>$I_D = 20\text{ A}$ , $V_{DD} = 25\text{ V}$ , $R_{GS} = 25\ \Omega$                                         | $E_{AS}$       | 90          | mJ                |
| Avalanche energy, periodic limited by $T_{jmax}$                                                                                               | $E_{AR}$       | 5.5         |                   |
| Reverse diode $dv/dt$<br>$I_S = 20\text{ A}$ , $V_{DS} = 40\text{ V}$ , $di/dt = 200\text{ A}/\mu\text{s}$ ,<br>$T_{jmax} = 175^\circ\text{C}$ | $dv/dt$        | 6           | kV/ $\mu\text{s}$ |
| Gate source voltage                                                                                                                            | $V_{GS}$       | $\pm 20$    | V                 |
| Power dissipation<br>$T_C = 25^\circ\text{C}$                                                                                                  | $P_{tot}$      | 55          | W                 |
| Operating and storage temperature                                                                                                              | $T_j, T_{stg}$ | -55... +175 | $^\circ\text{C}$  |
| IEC climatic category; DIN IEC 68-1                                                                                                            |                | 55/175/56   |                   |

## Thermal Characteristics

| Parameter                                      | Symbol     | Values |      |      | Unit |
|------------------------------------------------|------------|--------|------|------|------|
|                                                |            | min.   | typ. | max. |      |
| Characteristics                                |            |        |      |      |      |
| Thermal resistance, junction - case            | $R_{thJC}$ | -      | -    | 2.7  | 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 $T_j = 25^\circ\text{C}$ , 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>$I_D = 40\text{ }\mu\text{A}$                                                                                                                                 | $V_{GS(th)}$  | 1.2    | 1.6            | 2            |               |
| 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>$V_{GS} = 4.5\text{ V}$ , $I_D = 14\text{ A}$<br>$V_{GS} = 10\text{ V}$ , $I_D = 14\text{ A}$                                                                          | $R_{DS(on)}$  | -<br>- | 0.057<br>0.034 | 0.07<br>0.04 | $\Omega$      |

<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>$V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$ , $I_D = 14$ A        | $g_{fs}$     | 7      | 14   | -    | S    |
| Input capacitance<br>$V_{GS} = 0$ V, $V_{DS} = 25$ V, $f = 1$ MHz                       | $C_{iss}$    | -      | 560  | 700  | pF   |
| Output capacitance<br>$V_{GS} = 0$ V, $V_{DS} = 25$ V, $f = 1$ MHz                      | $C_{oss}$    | -      | 170  | 215  |      |
| Reverse transfer capacitance<br>$V_{GS} = 0$ V, $V_{DS} = 25$ V, $f = 1$ MHz            | $C_{rss}$    | -      | 95   | 120  |      |
| Turn-on delay time<br>$V_{DD} = 30$ V, $V_{GS} = 4.5$ V, $I_D = 20$ A,<br>$R_G = 10$ Ω  | $t_{d(on)}$  | -      | 15   | 25   | ns   |
| Rise time<br>$V_{DD} = 30$ V, $V_{GS} = 4.5$ V, $I_D = 20$ A,<br>$R_G = 10$ Ω           | $t_r$        | -      | 35   | 55   |      |
| Turn-off delay time<br>$V_{DD} = 30$ V, $V_{GS} = 4.5$ V, $I_D = 20$ A,<br>$R_G = 10$ Ω | $t_{d(off)}$ | -      | 15   | 25   |      |
| Fall time<br>$V_{DD} = 30$ V, $V_{GS} = 4.5$ V, $I_D = 20$ A,<br>$R_G = 10$ Ω           | $t_f$        | -      | 15   | 25   |      |

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

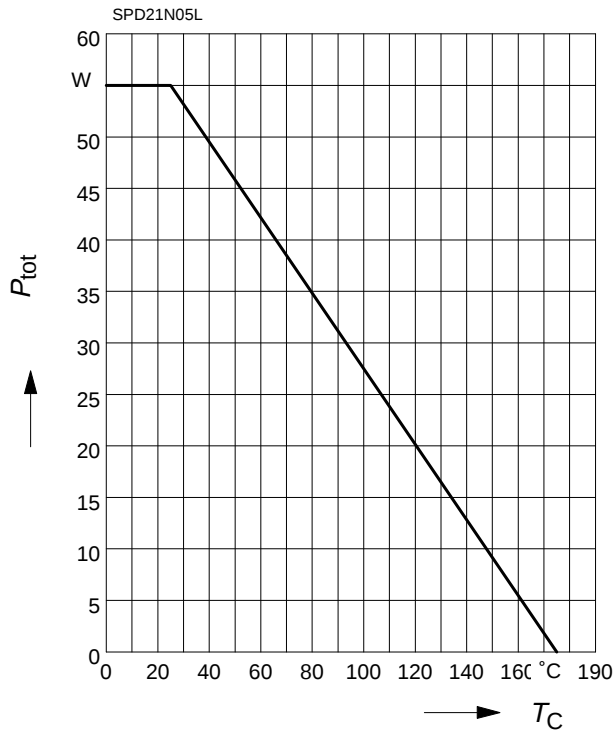
| Parameter                                                                                              | Symbol                 | Values |      |      | Unit |
|--------------------------------------------------------------------------------------------------------|------------------------|--------|------|------|------|
|                                                                                                        |                        | min.   | typ. | max. |      |
| Dynamic Characteristics                                                                                |                        |        |      |      |      |
| Gate to source charge<br>$V_{DD} = 40\text{ V}$ , $I_D = 20\text{ A}$                                  | $Q_{gs}$               | -      | 3    | 4.5  | nC   |
| Gate to drain charge<br>$V_{DD} = 40\text{ V}$ , $I_D = 20\text{ A}$                                   | $Q_{gd}$               | -      | 10   | 15   |      |
| Gate charge total<br>$V_{DD} = 40\text{ V}$ , $I_D = 20\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$ | $Q_g$                  | -      | 24   | 36   |      |
| Gate plateau voltage<br>$V_{DD} = 40\text{ V}$ , $I_D = 20\text{ A}$                                   | $V_{(\text{plateau})}$ | -      | 4.06 | -    | V    |

**Reverse Diode**

|                                                                                                     |          |   |      |      |               |
|-----------------------------------------------------------------------------------------------------|----------|---|------|------|---------------|
| Inverse diode continuous forward current<br>$T_C = 25\text{ }^{\circ}\text{C}$                      | $I_S$    | - | -    | 20   | A             |
| Inverse diode direct current, pulsed<br>$T_C = 25\text{ }^{\circ}\text{C}$                          | $I_{SM}$ | - | -    | 80   |               |
| Inverse diode forward voltage<br>$V_{GS} = 0\text{ V}$ , $I_F = 40\text{ A}$                        | $V_{SD}$ | - | 1.12 | 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>$V_R = 30\text{ V}$ , $I_F = I_S$ , $di_F/dt = 100\text{ A}/\mu\text{s}$ | $Q_{rr}$ | - | 0.12 | 0.18 | $\mu\text{C}$ |

## Power Dissipation

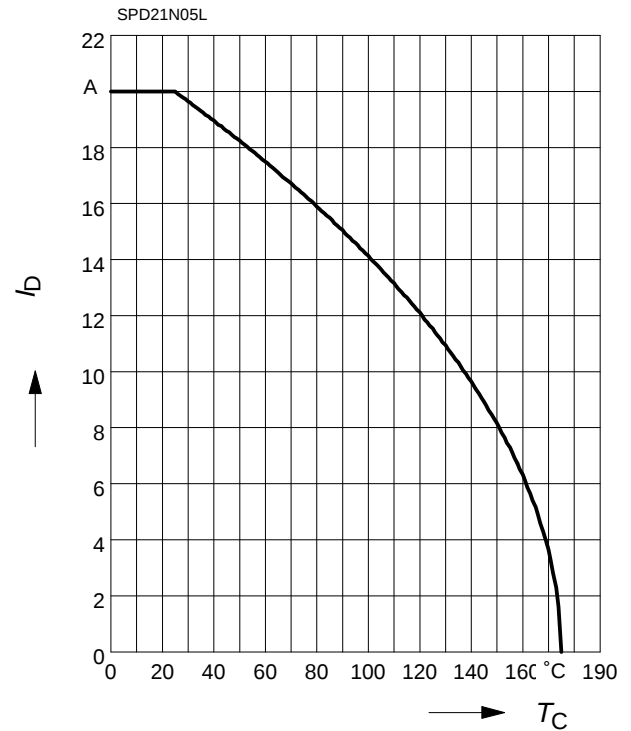
$$P_{\text{tot}} = f(T_C)$$



## Drain current

$$I_D = f(T_C)$$

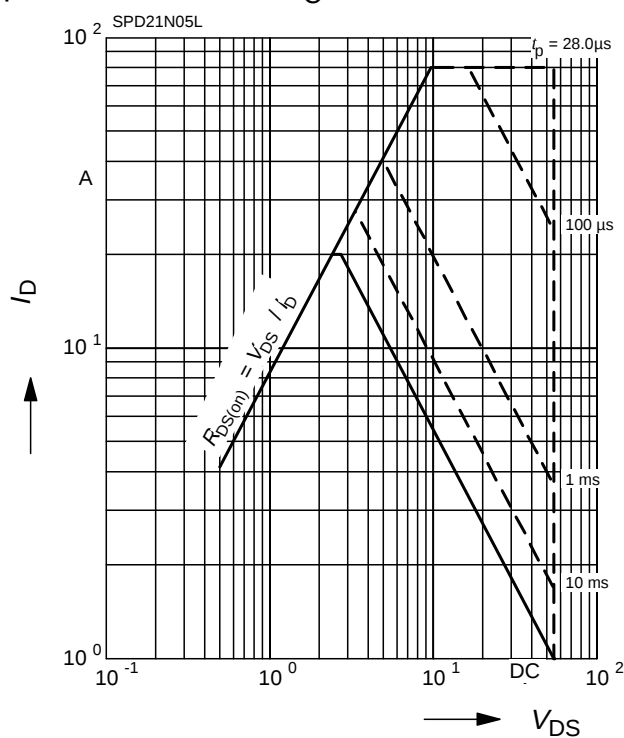
parameter:  $V_{\text{GS}} \geq 10 \text{ V}$



## Safe operating area

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

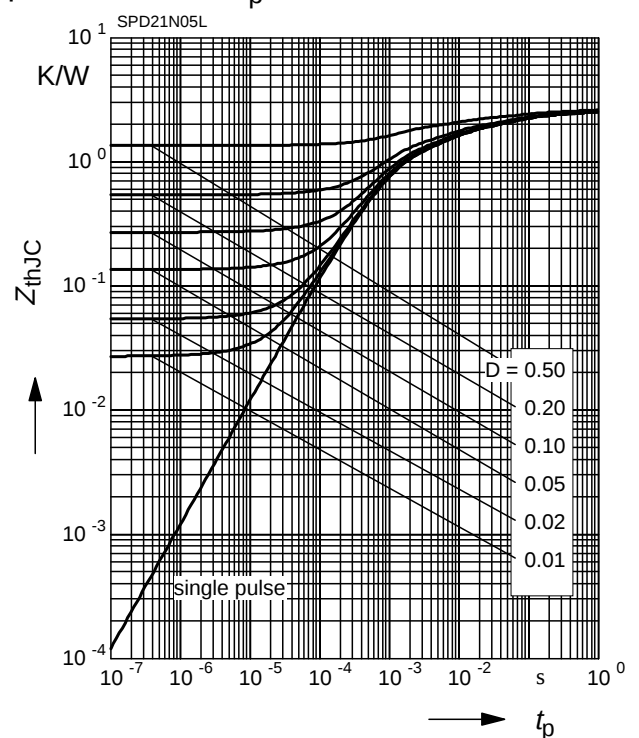
parameter:  $D = 0$ ,  $T_C = 25^{\circ}\text{C}$



## Transient thermal impedance

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

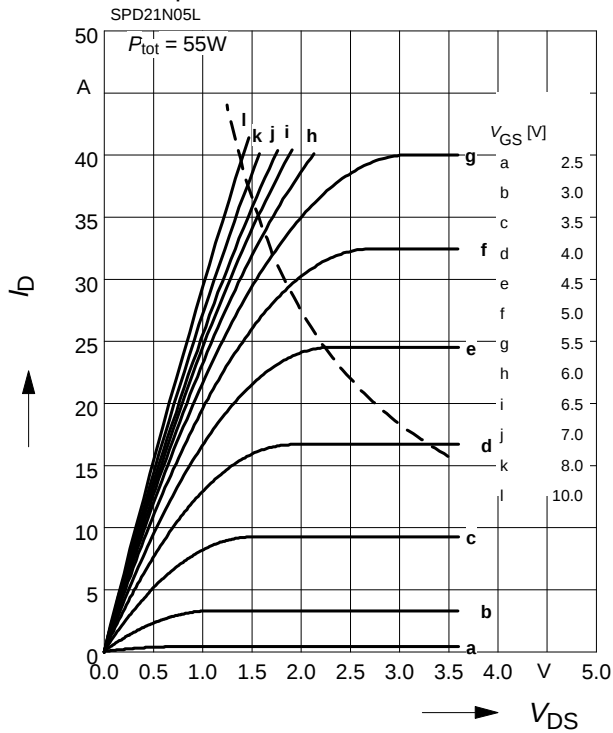
parameter:  $D = t_p / T$



### Typ. output characteristics

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

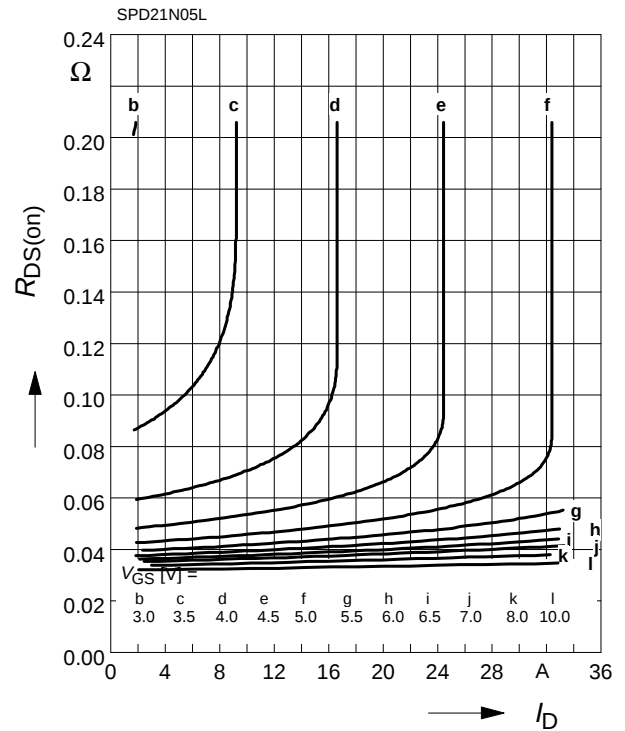
parameter:  $t_p = 80 \mu s$



### Typ. drain-source-on-resistance

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

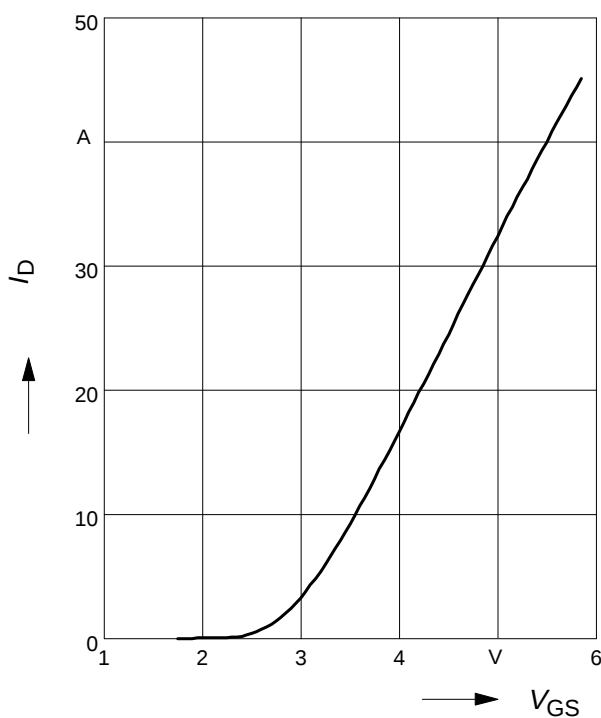
parameter:  $V_{GS}$



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

parameter:  $t_p = 80 \mu s$

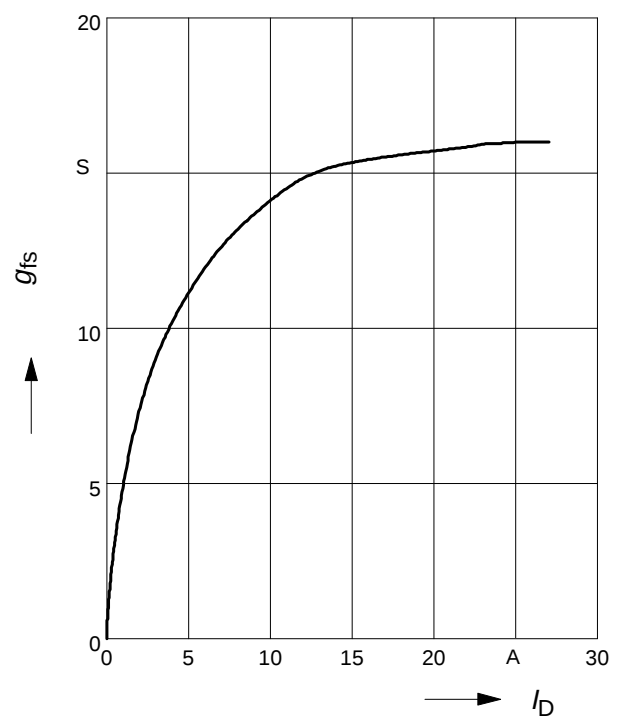
$$V_{DS} \geq 2 \times I_D \times R_{DS(on)max}$$



### Typ. forward transconductance

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

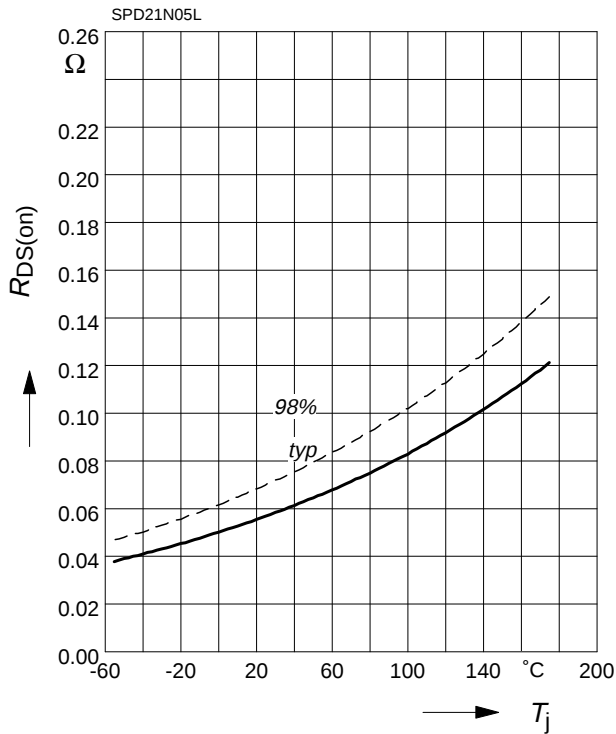
parameter:  $g_{fs}$



### Drain-source on-resistance

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

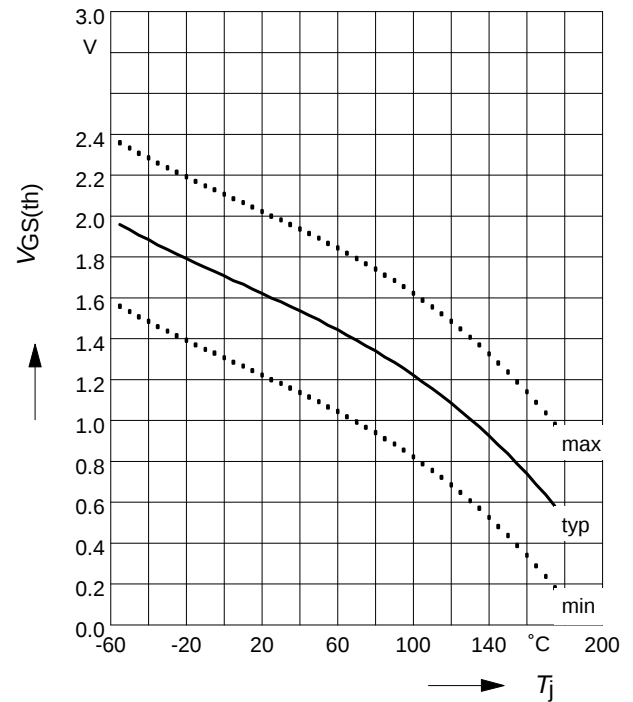
parameter :  $I_D = 14 \text{ A}$ ,  $V_{GS} = 4.5 \text{ V}$



### Gate threshold voltage

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

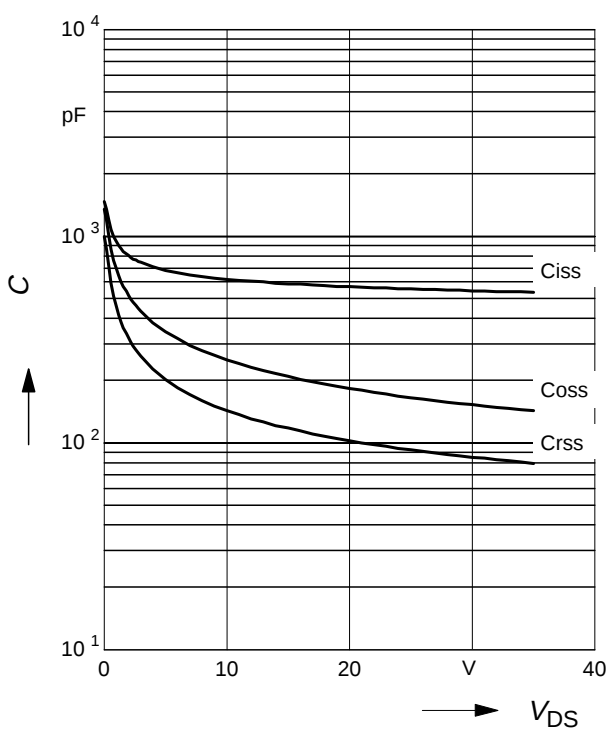
parameter :  $V_{GS} = V_{DS}$ ,  $I_D = 40 \mu\text{A}$



### Typ. capacitances

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

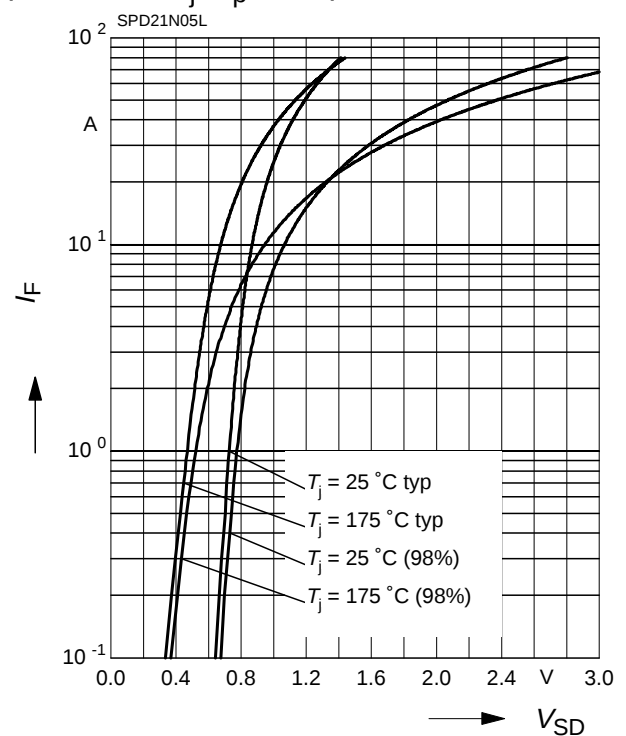
parameter:  $V_{GS} = 0 \text{ V}$ ,  $f = 1 \text{ MHz}$



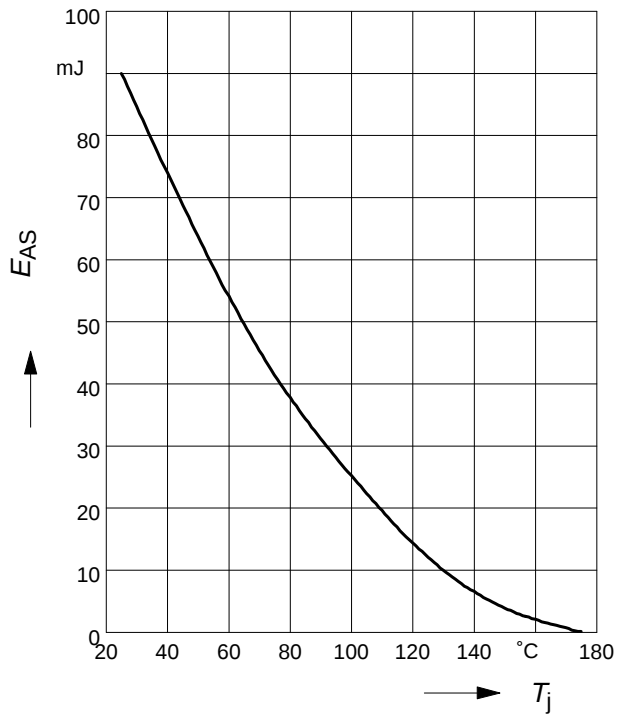
### Forward characteristics of reverse diode

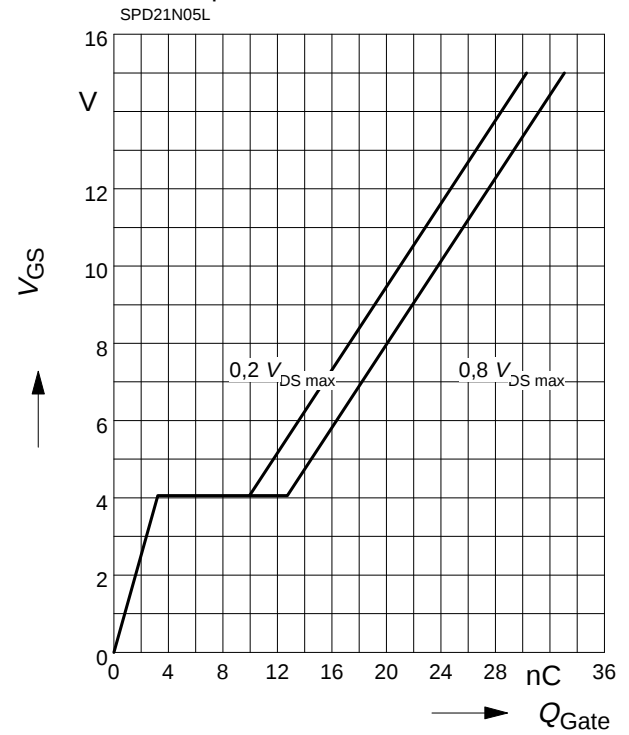
$$I_F = f(V_{SD})$$

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



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

 parameter:  $I_D = 20\text{ A}$ ,  $V_{DD} = 25\text{ V}$ 
 $R_{GS} = 25\ \Omega$ 

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

 parameter:  $I_{D\text{ puls}} = 20\text{ A}$ 

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