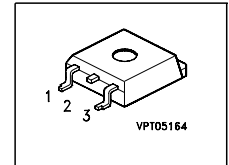


**Cool MOS™ Power Transistor**
**Feature**

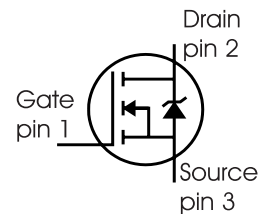
- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme dv/dt rated
- High peak current capability
- Improved transconductance
- Qualified according to JEDEC<sup>0)</sup> for target applications

|                     |     |          |
|---------------------|-----|----------|
| $V_{DS} @ T_{jmax}$ | 650 | V        |
| $R_{DS(on)}$        | 0.6 | $\Omega$ |
| $I_D$               | 7.3 | A        |

PG-TO263



| Type       | Package  | Ordering Code | Marking |
|------------|----------|---------------|---------|
| SPB07N60C3 | PG-TO263 | Q67040-S4394  | 07N60C3 |


**Maximum Ratings**

| Parameter   | Symbol              | Value      |  | Unit             |
|---|---------------------|------------|--|------------------|
|   |                     | SPB        |  |                  |
| Continuous drain current<br>$T_C = 25\text{ }^\circ\text{C}$<br>$T_C = 100\text{ }^\circ\text{C}$                 | $I_D$               | 7.3<br>4.6 |  | A                |
| Pulsed drain current, $t_p$ limited by $T_{jmax}$   | $I_{D\text{ puls}}$ | 21.9       |  | A                |
| Avalanche energy, single pulse<br>$I_D=5.5\text{A}, V_{DD}=50\text{V}$  | $E_{AS}$            | 230        |  | mJ               |
| Avalanche energy, repetitive $t_{AR}$ limited by $T_{jmax}$ <sup>2)</sup><br>$I_D=7.3\text{A}, V_{DD}=50\text{V}$ | $E_{AR}$            | 0.5        |  |                  |
| Avalanche current, repetitive $t_{AR}$ limited by $T_{jmax}$  | $I_{AR}$            | 7.3        |  | A                |
| Gate source voltage static  | $V_{GS}$            | $\pm 20$   |  | V                |
| Gate source voltage AC ( $f > 1\text{Hz}$ )   | $V_{GS}$            | $\pm 30$   |  |                  |
| Power dissipation, $T_C = 25\text{ }^\circ\text{C}$   | $P_{tot}$           | 83         |  | W                |
| Operating and storage temperature   | $T_j, T_{stg}$      | -55...+150 |  | $^\circ\text{C}$ |
| Reverse diode dv/dt <sup>6)</sup>   | dv/dt               | 15         |  | V/ns             |

**Maximum Ratings**

| Parameter  | Symbol  | Value | Unit |
|--|---------|-------|------|
| Drain Source voltage slope<br>$V_{DS} = 480\text{ V}$ , $I_D = 7.3\text{ A}$ , $T_j = 125\text{ °C}$ | $dv/dt$ | 50    | V/ns |

**Thermal Characteristics**

| Parameter   | Symbol               | Values |      |      | Unit |
|---|----------------------|--------|------|------|------|
|   |                      | min.   | typ. | max. |      |
| Thermal resistance, junction - case   | $R_{thJC}$           | -      | -    | 1.5  | K/W  |
| Thermal resistance, junction - case, FullPAK  | $R_{thJC\text{ FP}}$ | -      | -    | 3.9  |      |
| Thermal resistance, junction - ambient, leaded  | $R_{thJA}$           | -      | -    | 62   |      |
| Thermal resistance, junction - ambient, FullPAK   | $R_{thJA\text{ FP}}$ | -      | -    | 80   |      |
| SMD version, device on PCB:<br>@ min. footprint<br>@ 6 cm <sup>2</sup> cooling area <sup>3)</sup> | $R_{thJA}$           | -      | -    | 62   |      |
| Soldering temperature, reflow soldering, MSL1<br>1.6 mm (0.063 in.) from case for 10s             | $T_{sold}$           | -      | -    | 260  | °C   |

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

| Parameter                                   | Symbol        | Conditions   | Values |      |      | Unit          |
|---|---------------|--|--------|------|------|---------------|
|   |               |  | min.   | typ. | max. |               |
| Drain-source breakdown voltage              | $V_{(BR)DSS}$ | $V_{GS}=0\text{V}$ , $I_D=0.25\text{mA}$   | 600    | -    | -    | V             |
| Drain-Source avalanche<br>breakdown voltage | $V_{(BR)DS}$  | $V_{GS}=0\text{V}$ , $I_D=7.3\text{A}$   | -      | 700  | -    |               |
| Gate threshold voltage                      | $V_{GS(th)}$  | $I_D=350\mu\text{A}$ , $V_{GS}=V_{DS}$   | 2.1    | 3    | 3.9  |               |
| Zero gate voltage drain current             | $I_{DSS}$     | $V_{DS}=600\text{V}$ , $V_{GS}=0\text{V}$ ,<br>$T_j=25\text{ °C}$<br>$T_j=150\text{ °C}$ | -      | 0.5  | 1    | $\mu\text{A}$ |
| Gate-source leakage current                 | $I_{GSS}$     | $V_{GS}=30\text{V}$ , $V_{DS}=0\text{V}$   | -      | -    | 100  |               |
| Drain-source on-state resistance            | $R_{DS(on)}$  | $V_{GS}=10\text{V}$ , $I_D=4.6\text{A}$<br>$T_j=25\text{ °C}$<br>$T_j=150\text{ °C}$     | -      | 0.54 | 0.6  | $\Omega$      |
| Gate input resistance                       | $R_G$         | $f=1\text{MHz}$ , open drain   | -      | 0.8  | -    |               |

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

| Parameter   | Symbol       | Conditions  | Values |      |      | Unit |
|---|--------------|---|--------|------|------|------|
|   |              |   | min.   | typ. | max. |      |
| <b>Characteristics</b>  |              |   |        |      |      |      |
| Transconductance  | $g_{fs}$     | $V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$ ,<br>$I_D = 4.6\text{A}$  | -      | 6    | -    | S    |
| Input capacitance   | $C_{iss}$    | $V_{GS} = 0\text{V}$ , $V_{DS} = 25\text{V}$ ,<br>$f = 1\text{MHz}$   | -      | 790  | -    | pF   |
| Output capacitance  | $C_{oss}$    |   | -      | 260  | -    |      |
| Reverse transfer capacitance                                  | $C_{rss}$    |   | -      | 16   | -    |      |
| Effective output capacitance, <sup>4)</sup><br>energy related | $C_{o(er)}$  | $V_{GS} = 0\text{V}$ ,<br>$V_{DS} = 0\text{V to } 480\text{V}$  | -      | 30   | -    |      |
| Effective output capacitance, <sup>5)</sup><br>time related   | $C_{o(tr)}$  |   | -      | 55   | -    |      |
| Turn-on delay time  | $t_{d(on)}$  | $V_{DD} = 380\text{V}$ , $V_{GS} = 0/13\text{V}$ ,<br>$I_D = 7.3\text{A}$ , $R_G = 12\Omega$ ,<br>$T_j = 125^\circ\text{C}$ | -      | 6    | -    | ns   |
| Rise time   | $t_r$        |   | -      | 3.5  | -    |      |
| Turn-off delay time   | $t_{d(off)}$ |   | -      | 60   | 100  |      |
| Fall time   | $t_f$        |   | -      | 7    | 15   |      |

**Gate Charge Characteristics**

|                       |                 |   |   |     |    |    |
|-----------------------|-----------------|---|---|-----|----|----|
| Gate to source charge | $Q_{gs}$        | $V_{DD} = 480\text{V}$ , $I_D = 7.3\text{A}$  | - | 3   | -  | nC |
| Gate to drain charge  | $Q_{gd}$        |   | - | 9.2 | -  |    |
| Gate charge total     | $Q_g$           | $V_{DD} = 480\text{V}$ , $I_D = 7.3\text{A}$ ,<br>$V_{GS} = 0 \text{ to } 10\text{V}$ | - | 21  | 27 |    |
| Gate plateau voltage  | $V_{(plateau)}$ | $V_{DD} = 480\text{V}$ , $I_D = 7.3\text{A}$  | - | 5.5 | -  | V  |

<sup>0</sup>J-STD20 and JESD22

<sup>1</sup>Limited only by maximum temperature

<sup>2</sup>Repetitive avalanche causes additional power losses that can be calculated as  $P_{AV} = E_{AR} \cdot f$ .

<sup>3</sup>Device on 40mm\*40mm\*1.5mm epoxy PCB FR4 with 6cm<sup>2</sup> (one layer, 70 μm thick) copper area for drain connection. PCB is vertical without blown air.

<sup>4</sup> $C_{o(er)}$  is a fixed capacitance that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

<sup>5</sup> $C_{o(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

<sup>6</sup> $I_{SD} \leq I_D$ ,  $di/dt \leq 400\text{A}/\mu\text{s}$ ,  $V_{DClink} = 400\text{V}$ ,  $V_{peak} < V_{BR, DSS}$ ,  $T_j < T_{j,max}$ .

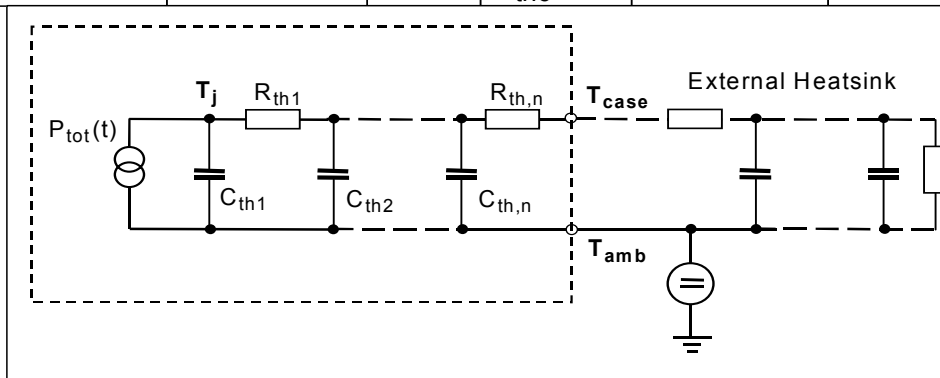
Identical low-side and high-side switch.

**Electrical Characteristics**

| Parameter                                     | Symbol       | Conditions                        | Values |      |      | Unit                   |
|---|--------------|-----------------------------------|--------|------|------|------------------------|
|   |              |                                   | min.   | typ. | max. |                        |
| Inverse diode continuous forward current      | $I_S$        | $T_C=25^\circ\text{C}$            | -      | -    | 7.3  | A                      |
| Inverse diode direct current, pulsed          | $I_{SM}$     |                                   | -      | -    | 21.9 |                        |
| Inverse diode forward voltage                 | $V_{SD}$     | $V_{GS}=0\text{V}, I_F=I_S$       | -      | 1    | 1.2  | V                      |
| Reverse recovery time                         | $t_{rr}$     | $V_R=480\text{V}, I_F=I_S,$       | -      | 400  | 600  | ns                     |
| Reverse recovery charge                       | $Q_{rr}$     | $di_F/dt=100\text{A}/\mu\text{s}$ | -      | 4    | -    | $\mu\text{C}$          |
| Peak reverse recovery current                 | $I_{rrm}$    |                                   | -      | 28   | -    | A                      |
| Peak rate of fall of reverse recovery current | $di_{rr}/dt$ | $T_j=25^\circ\text{C}$            | -      | 800  | -    | $\text{A}/\mu\text{s}$ |

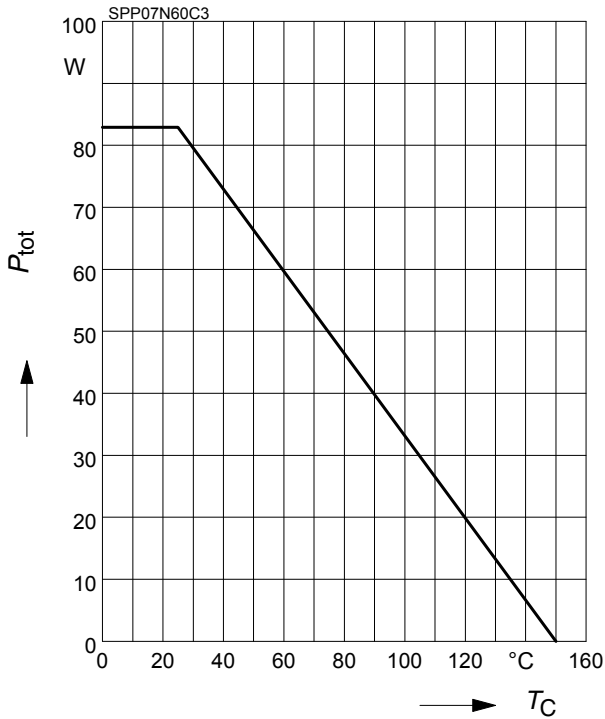
**Typical Transient Thermal Characteristics**

| Symbol    | Value |  | Unit | Symbol    | Value     |  | Unit |
|-----------|-------|--|------|-----------|-----------|--|------|
|           | SPB   |  |      |           | SPB       |  |      |
| $R_{th1}$ | 0.024 |  | K/W  | $C_{th1}$ | 0.00012   |  | Ws/K |
| $R_{th2}$ | 0.046 |  |      | $C_{th2}$ | 0.0004578 |  |      |
| $R_{th3}$ | 0.085 |  |      | $C_{th3}$ | 0.000645  |  |      |
| $R_{th4}$ | 0.308 |  |      | $C_{th4}$ | 0.001867  |  |      |
| $R_{th5}$ | 0.317 |  |      | $C_{th5}$ | 0.004795  |  |      |
| $R_{th6}$ | 0.112 |  |      | $C_{th6}$ | 0.045     |  |      |



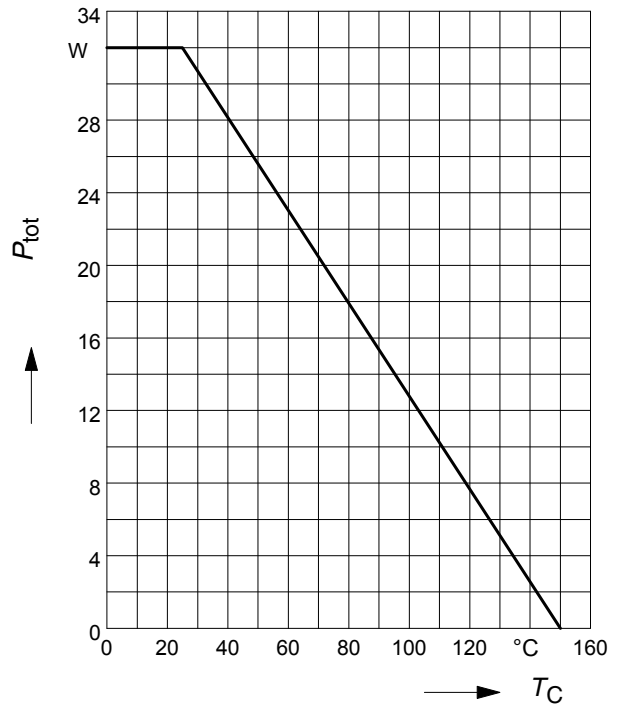
**1 Power dissipation**

$P_{tot} = f(T_C)$



**2 Power dissipation FullPAK**

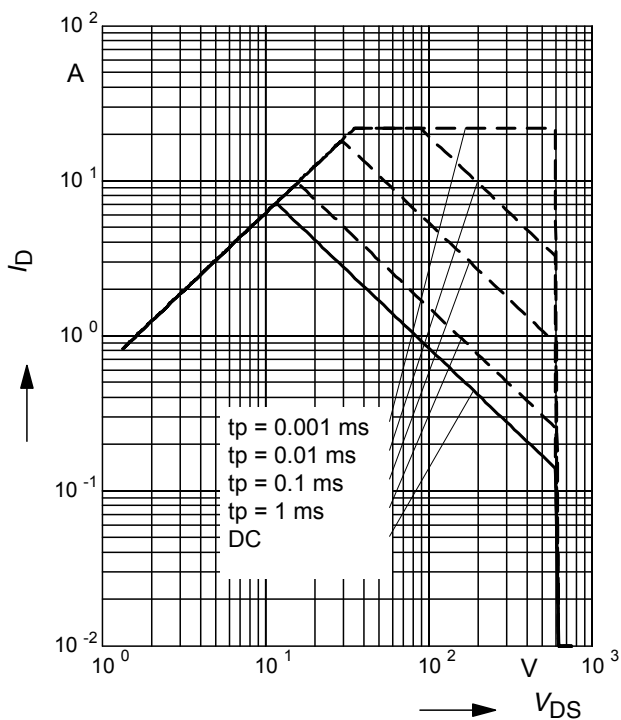
$P_{tot} = f(T_C)$



**3 Safe operating area**

$I_D = f(V_{DS})$

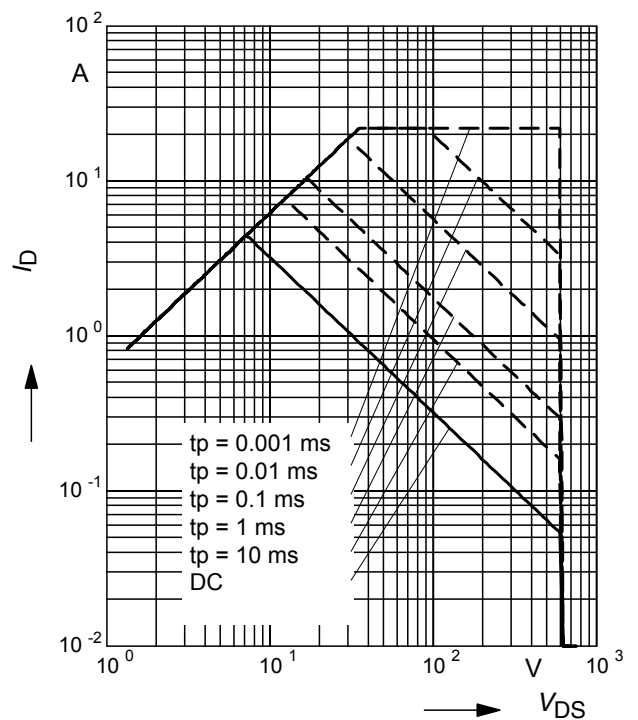
parameter :  $D = 0$  ,  $T_C = 25^\circ\text{C}$



**4 Safe operating area FullPAK**

$I_D = f(V_{DS})$

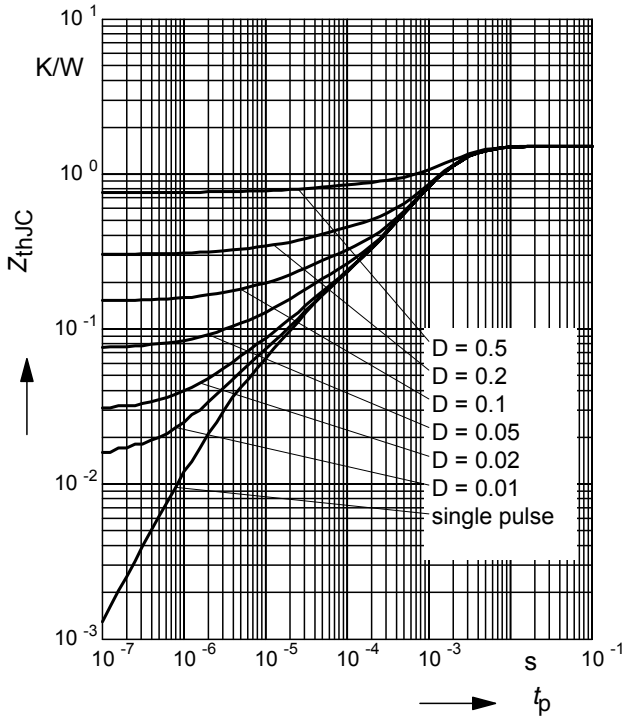
parameter:  $D = 0$  ,  $T_C = 25^\circ\text{C}$



**5 Transient thermal impedance**

$Z_{thJC} = f(t_p)$

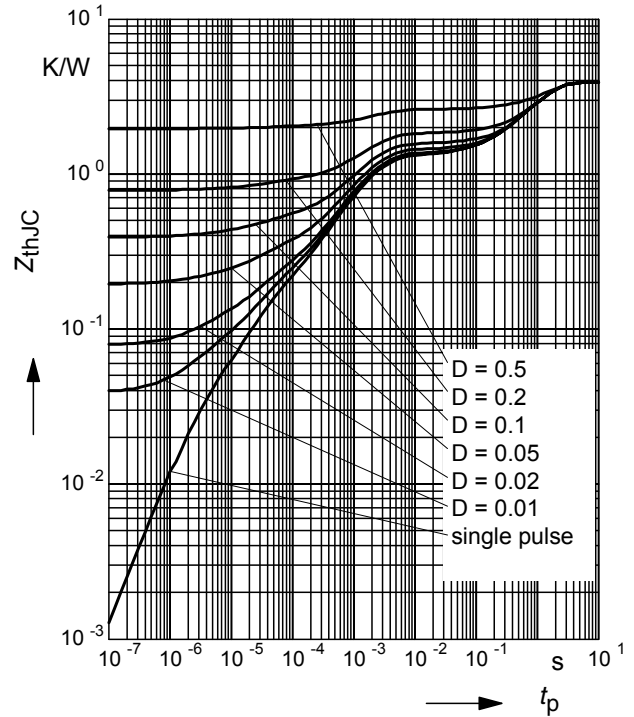
parameter:  $D = t_p/T$



**6 Transient thermal impedance FullPAK**

$Z_{thJC} = f(t_p)$

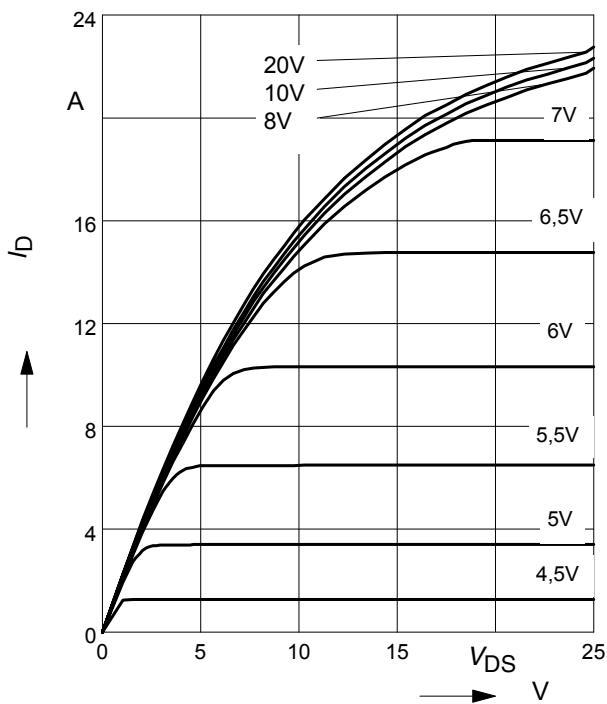
parameter:  $D = t_p/t$



**7 Typ. output characteristic**

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

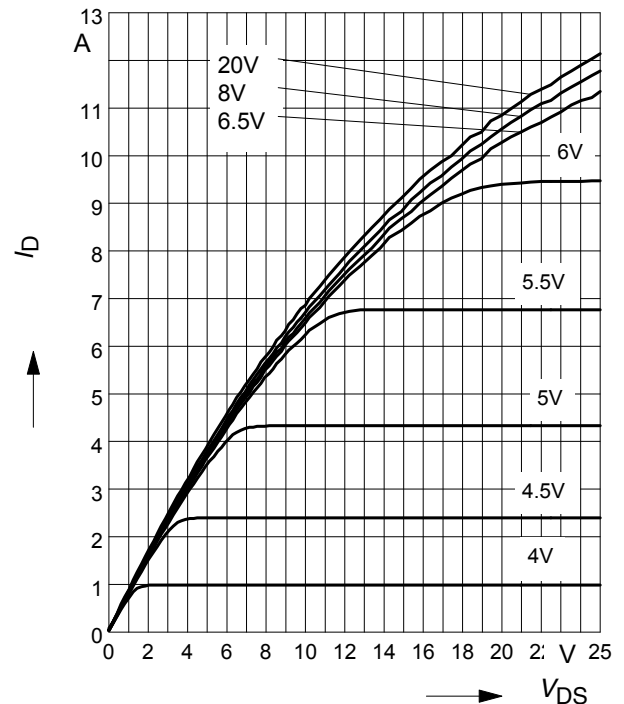
parameter:  $t_p = 10 \mu s, V_{GS}$



**8 Typ. output characteristic**

$I_D = f(V_{DS}); T_j = 150^\circ C$

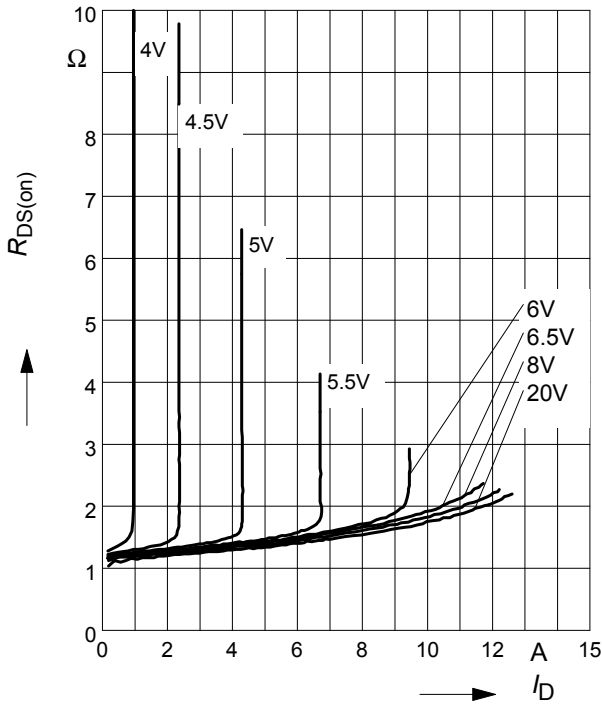
parameter:  $t_p = 10 \mu s, V_{GS}$



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

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

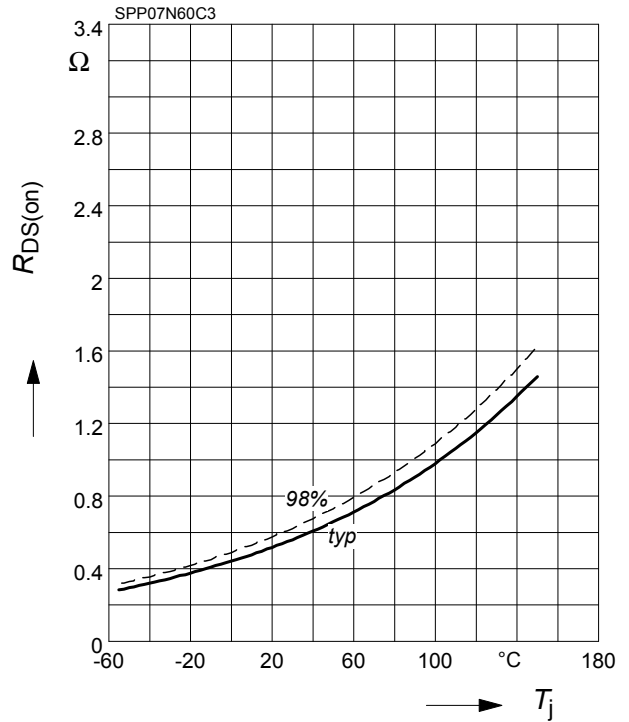
parameter:  $T_j = 150^\circ\text{C}$ ,  $V_{GS}$



**10 Drain-source on-state resistance**

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

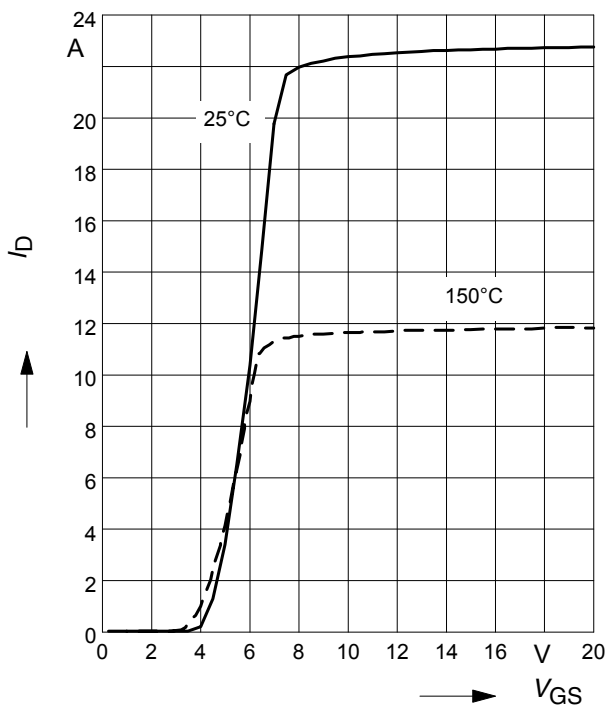
parameter:  $I_D = 4.6\text{ A}$ ,  $V_{GS} = 10\text{ V}$



**11 Typ. transfer characteristics**

$$I_D = f(V_{GS}); V_{DS} \geq 2 \times I_D \times R_{DS(on)max}$$

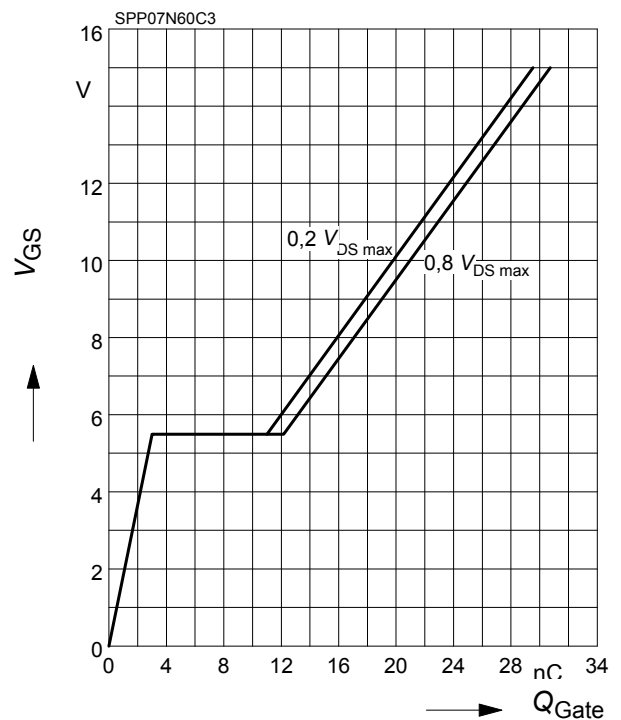
parameter:  $t_p = 10\ \mu\text{s}$



**12 Typ. gate charge**

$$V_{GS} = f(Q_{Gate})$$

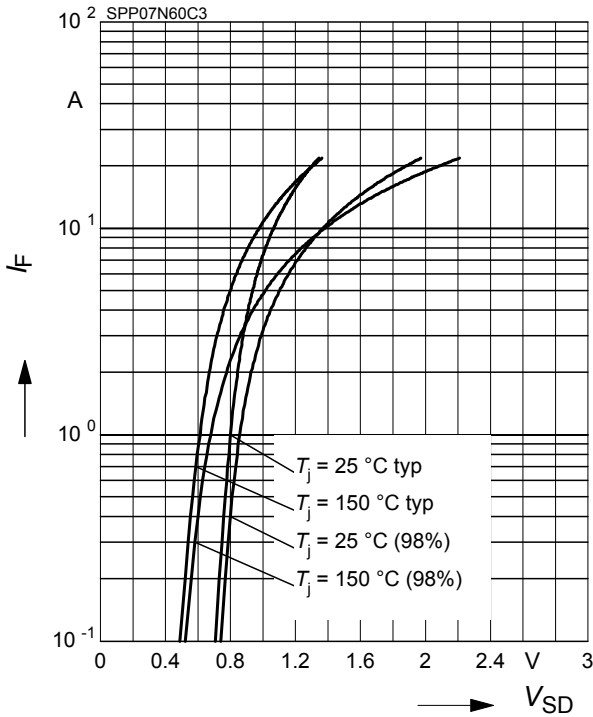
parameter:  $I_D = 7.3\text{ A pulsed}$



**13 Forward characteristics of body diode**

$I_F = f(V_{SD})$

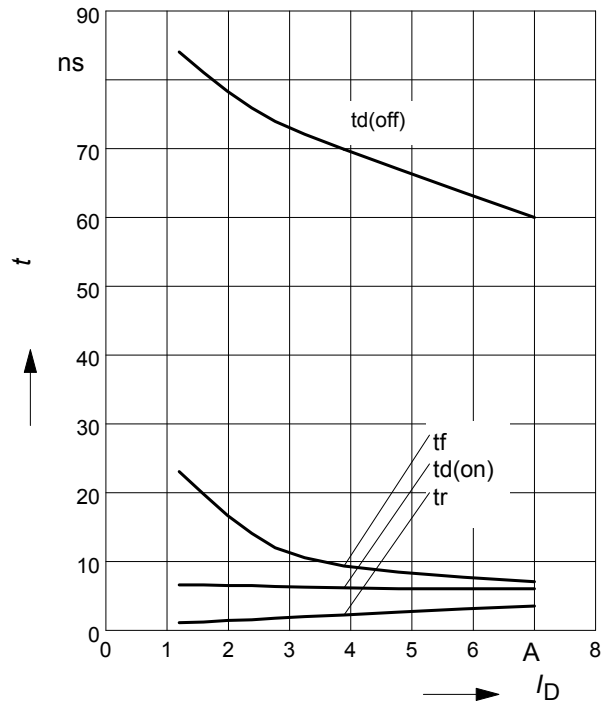
parameter:  $T_j$ ,  $t_p = 10 \mu s$



**14 Typ. switching time**

$t = f(I_D)$ , inductive load,  $T_j = 125^\circ C$

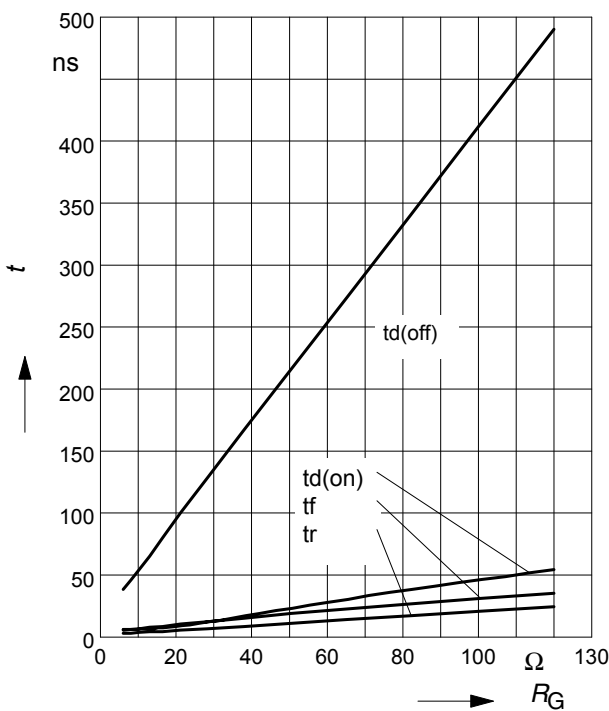
par.:  $V_{DS} = 380V$ ,  $V_{GS} = 0/+13V$ ,  $R_G = 12\Omega$



**15 Typ. switching time**

$t = f(R_G)$ , inductive load,  $T_j = 125^\circ C$

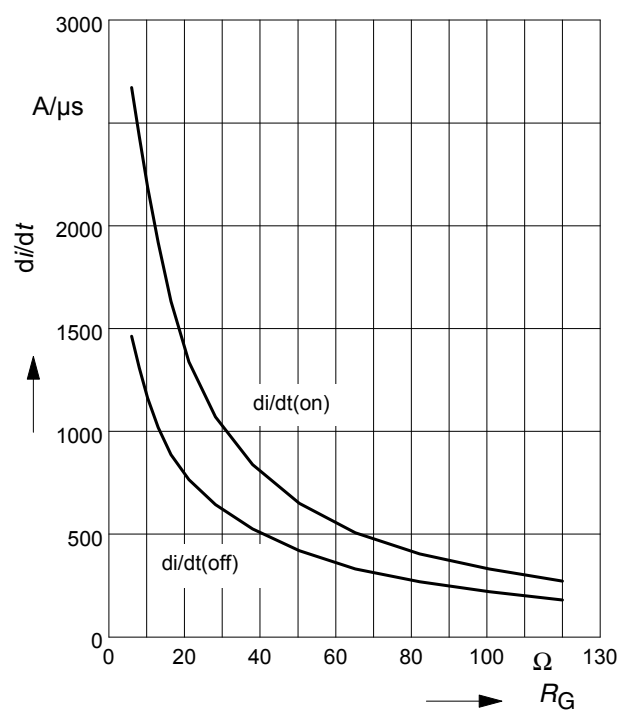
par.:  $V_{DS} = 380V$ ,  $V_{GS} = 0/+13V$ ,  $I_D = 7.3 A$



**16 Typ. drain current slope**

$di/dt = f(R_G)$ , inductive load,  $T_j = 125^\circ C$

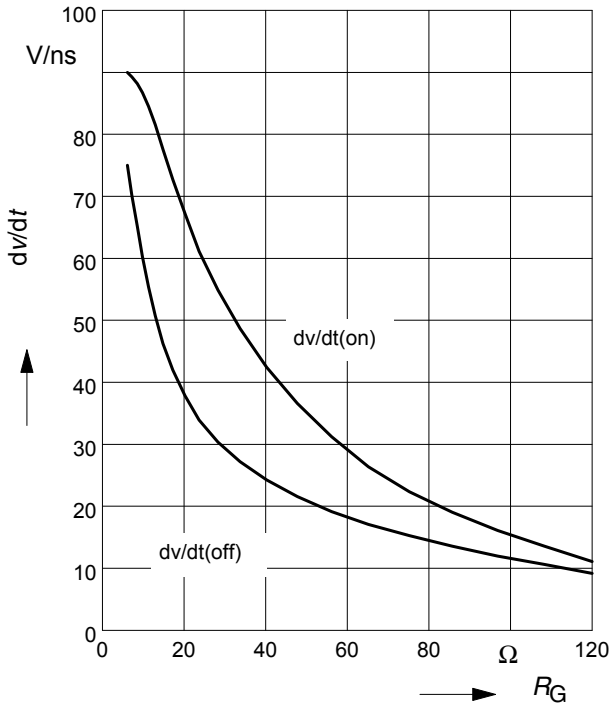
par.:  $V_{DS} = 380V$ ,  $V_{GS} = 0/+13V$ ,  $I_D = 7.3A$





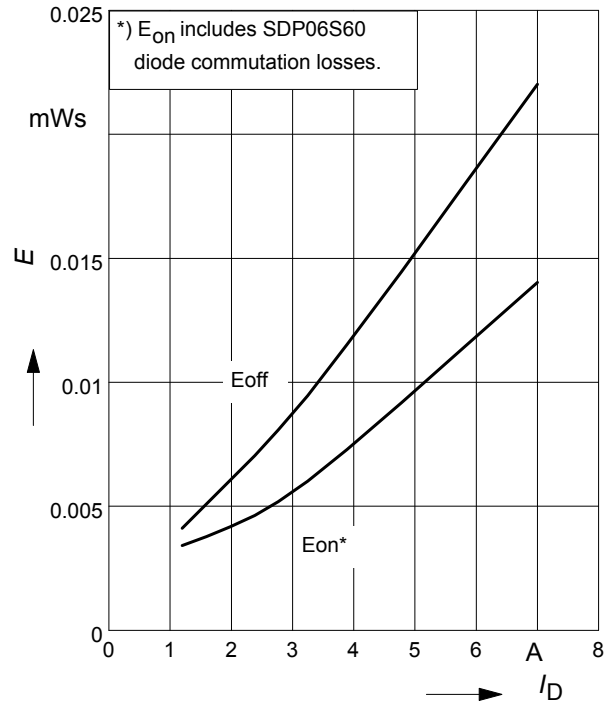
**17 Typ. drain source voltage slope**

$dv/dt = f(R_G)$ , inductive load,  $T_j = 125^\circ\text{C}$   
 par.:  $V_{DS}=380\text{V}$ ,  $V_{GS}=0/+13\text{V}$ ,  $I_D=7.3\text{A}$



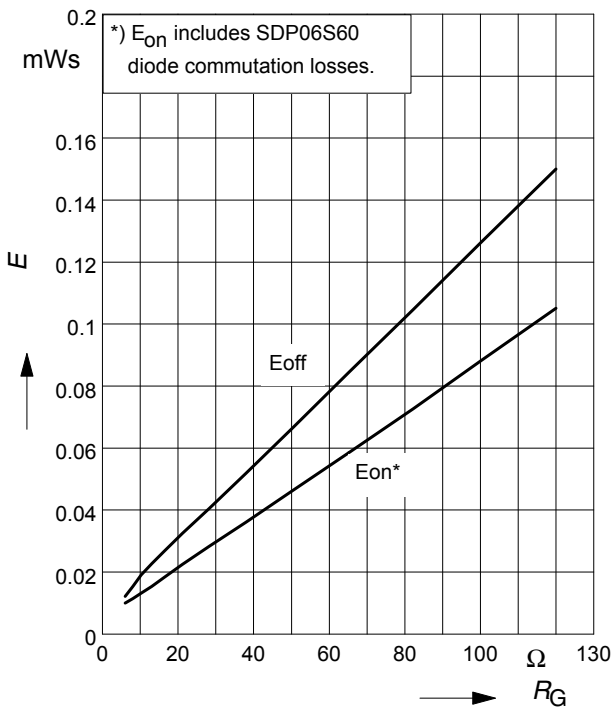
**18 Typ. switching losses**

$E = f(I_D)$ , inductive load,  $T_j=125^\circ\text{C}$   
 par.:  $V_{DS}=380\text{V}$ ,  $V_{GS}=0/+13\text{V}$ ,  $R_G=12\Omega$



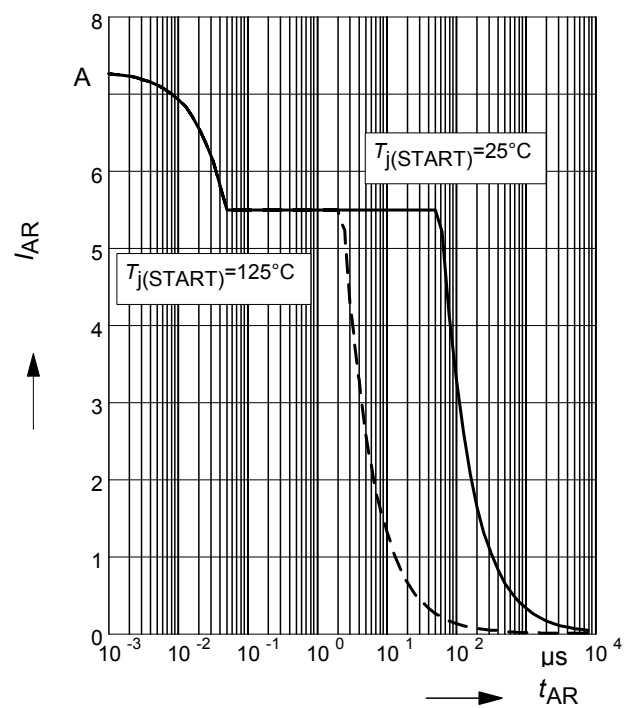
**19 Typ. switching losses**

$E = f(R_G)$ , inductive load,  $T_j=125^\circ\text{C}$   
 par.:  $V_{DS}=380\text{V}$ ,  $V_{GS}=0/+13\text{V}$ ,  $I_D=7.3\text{A}$



**20 Avalanche SOA**

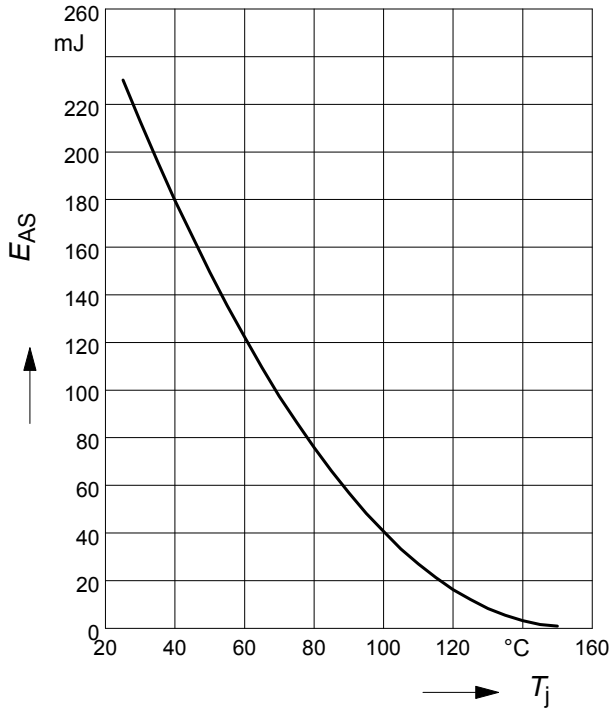
$I_{AR} = f(t_{AR})$   
 par.:  $T_j \leq 150^\circ\text{C}$



**21 Avalanche energy**

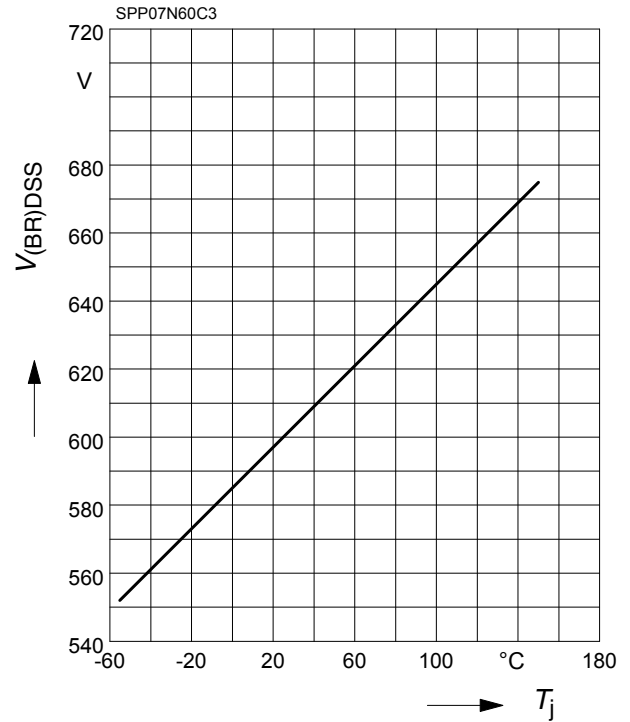
$$E_{AS} = f(T_j)$$

par.:  $I_D = 5.5 \text{ A}$ ,  $V_{DD} = 50 \text{ V}$



**22 Drain-source breakdown voltage**

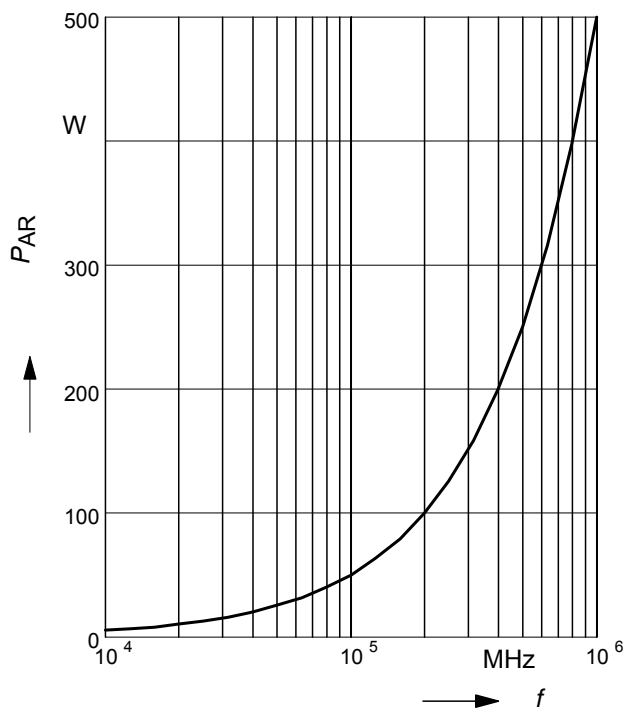
$$V_{(BR)DSS} = f(T_j)$$



**23 Avalanche power losses**

$$P_{AR} = f(f)$$

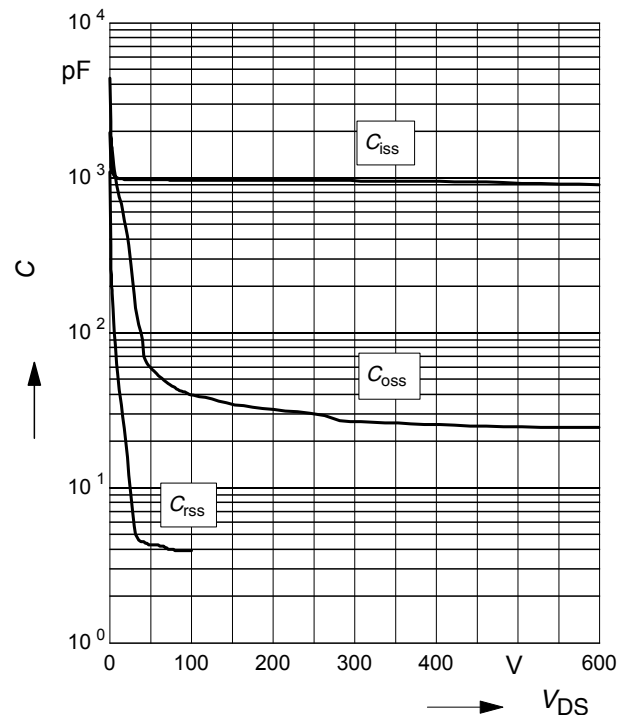
parameter:  $E_{AR} = 0.5 \text{ mJ}$



**24 Typ. capacitances**

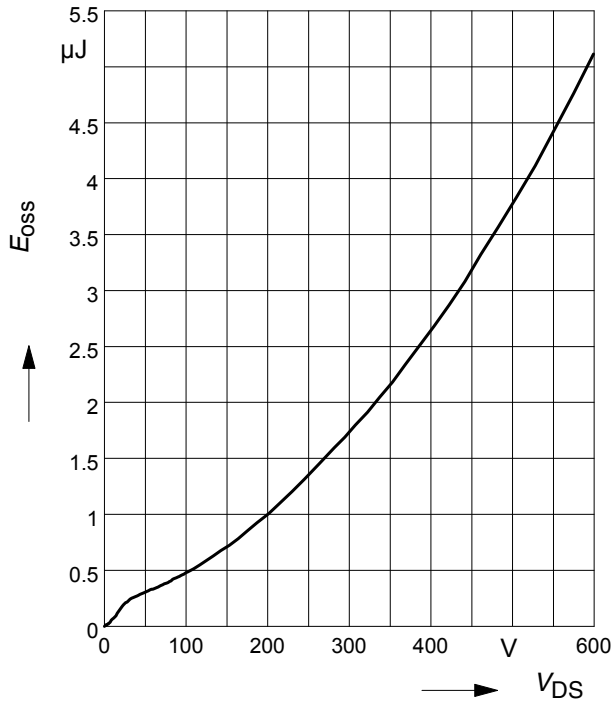
$$C = f(V_{DS})$$

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

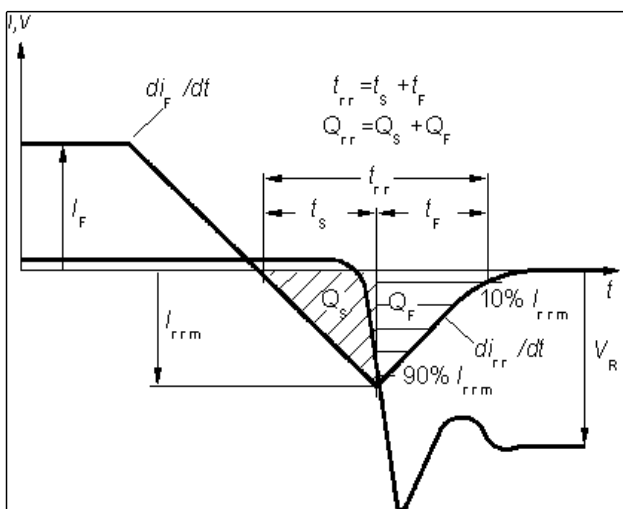


25 Typ.  $C_{OSS}$  stored energy

$$E_{OSS} = f(V_{DS})$$



Definition of diodes switching characteristics





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