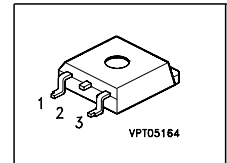


Cool MOS™ Power Transistor
Feature

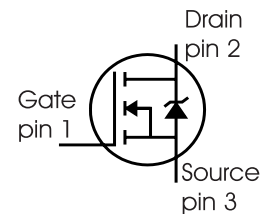
- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme dv/dt rated
- Ultra low effective capacitances
- Improved transconductance
- Qualified according to JEDEC⁰⁾ for target applications

| | | |
|---------------------|------|----------|
| $V_{DS} @ T_{jmax}$ | 560 | V |
| $R_{DS(on)}$ | 0.28 | Ω |
| I_D | 16 | A |

PG-TO263



| Type | Package | Ordering Code | Marking |
|------------|----------|---------------|---------|
| SPB16N50C3 | PG-TO263 | Q67040-S4642 | 16N50C3 |


Maximum Ratings

| Parameter | Symbol | Value | | Unit |
|--|---------------------|------------|--|------------------|
| | | SPB | | |
| Continuous drain current $T_C = 25\text{ }^\circ\text{C}$ $T_C = 100\text{ }^\circ\text{C}$ | I_D | 16 10 | | A |
| Pulsed drain current, t_p limited by T_{jmax} | $I_{D\text{ puls}}$ | 48 | | A |
| Avalanche energy, single pulse $I_D=8, V_{DD}=50\text{V}$ | E_{AS} | 460 | | mJ |
| Avalanche energy, repetitive t_{AR} limited by T_{jmax} ²⁾ $I_D=16\text{A}, V_{DD}=50\text{V}$ | E_{AR} | 0.64 | | |
| Avalanche current, repetitive t_{AR} limited by T_{jmax} | I_{AR} | 16 | | A |
| Gate source voltage | V_{GS} | ± 20 | | V |
| Gate source voltage AC ($f > 1\text{Hz}$) | V_{GS} | ± 30 | | |
| Power dissipation, $T_C = 25\text{ }^\circ\text{C}$ | P_{tot} | 160 | | W |
| Operating and storage temperature | T_j, T_{stg} | -55...+150 | | $^\circ\text{C}$ |
| Reverse diode dv/dt ⁶⁾ | dv/dt | 15 | | V/ns |

Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---------|-------|------|
| Drain Source voltage slope $V_{DS} = 400\text{ V}$, $I_D = 16\text{ A}$, $T_j = 125\text{ °C}$ | dv/dt | 50 | V/ns |

Thermal Characteristics

| Parameter | Symbol | Values | | | Unit |
|--|----------------|--------|------|------|------|
| | | min. | typ. | max. | |
| Thermal resistance, junction - case | R_{thJC} | - | - | 0.78 | K/W |
| Thermal resistance, junction - case, FullPAK | R_{thJC_FP} | - | - | 3.7 | |
| Thermal resistance, junction - ambient, leaded | R_{thJA} | - | - | 62 | |
| Thermal resistance, junction - ambient, FullPAK | R_{thJA_FP} | - | - | 80 | |
| Soldering temperature, reflow soldering, MSL1 1.6 mm (0.063 in.) from case for 10s ³) | 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 | $V_{(BR)DSS}$ | $V_{GS}=0V$, $I_D=0.25mA$ | 500 | - | - | V |
| Drain-Source avalanche breakdown voltage | $V_{(BR)DS}$ | $V_{GS}=0V$, $I_D=16A$ | - | 600 | - | |
| Gate threshold voltage | $V_{GS(th)}$ | $I_D=675\mu A$, $V_{GS}=V_{DS}$ | 2.1 | 3 | 3.9 | |
| Zero gate voltage drain current | I_{DSS} | $V_{DS}=500V$, $V_{GS}=0V$, $T_j=25\text{ °C}$ $T_j=150\text{ °C}$ | - | 0.1 | 1 | μA |
| Gate-source leakage current | I_{GSS} | $V_{GS}=20V$, $V_{DS}=0V$ | - | - | 100 | |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}=10V$, $I_D=10A$ $T_j=25\text{ °C}$ $T_j=150\text{ °C}$ | - | 0.25 | 0.28 | Ω |
| Gate input resistance | R_G | $f=1MHz$, open drain | - | 1.5 | - | |

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

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|--------------|--|--------|------|------|------|
| | | | min. | typ. | max. | |
| Characteristics | | | | | | |
| Transconductance | g_{fs} | $V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$, $I_D = 10\text{A}$ | - | 14 | - | S |
| Input capacitance | C_{iss} | $V_{GS} = 0\text{V}$, $V_{DS} = 25\text{V}$, $f = 1\text{MHz}$ | - | 1600 | - | pF |
| Output capacitance | C_{oss} | | - | 800 | - | |
| Reverse transfer capacitance | C_{rss} | | - | 30 | - | |
| Effective output capacitance, ⁴⁾ energy related | $C_{o(er)}$ | $V_{GS} = 0\text{V}$, $V_{DS} = 0\text{V to } 400\text{V}$ | - | 64 | - | |
| Effective output capacitance, ⁵⁾ time related | $C_{o(tr)}$ | | - | 124 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD} = 380\text{V}$, $V_{GS} = 0/10\text{V}$, $I_D = 16\text{A}$, $R_G = 4.3\Omega$ | - | 10 | - | ns |
| Rise time | t_r | | - | 8 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 50 | - | |
| Fall time | t_f | | - | 8 | - | |

Gate Charge Characteristics

| | | | | | | |
|-----------------------|-----------------|---|---|----|---|----|
| Gate to source charge | Q_{gs} | $V_{DD} = 380\text{V}$, $I_D = 16\text{A}$ | - | 7 | - | nC |
| Gate to drain charge | Q_{gd} | | - | 36 | - | |
| Gate charge total | Q_g | $V_{DD} = 380\text{V}$, $I_D = 16\text{A}$, $V_{GS} = 0\text{ to } 10\text{V}$ | - | 66 | - | |
| Gate plateau voltage | $V_{(plateau)}$ | $V_{DD} = 380\text{V}$, $I_D = 16\text{A}$ | - | 5 | - | V |

⁰J-STD20 and JESD22

¹Limited only by maximum temperature

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

³Soldering temperature for TO-263: $220\text{ }^\circ\text{C}$, reflow

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

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

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

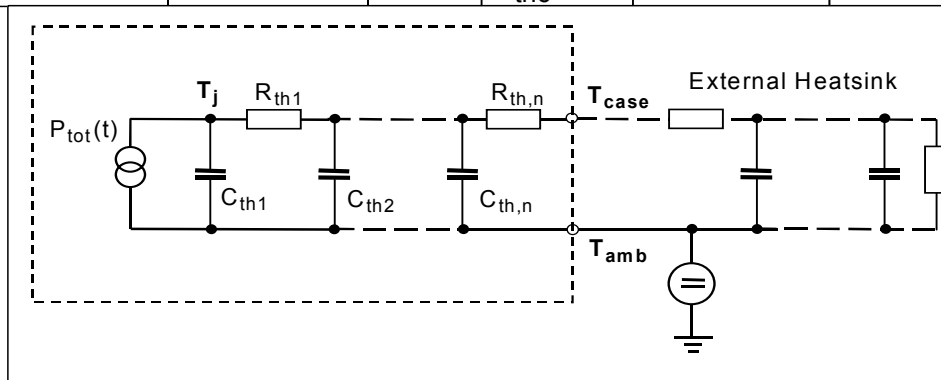
Identical low-side and high-side switch.

Electrical Characteristics

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|--------------|-----------------------------------|--------|------|------|------------------------|
| | | | min. | typ. | max. | |
| Inverse diode continuous forward current | I_S | $T_C=25^\circ\text{C}$ | - | - | 16 | A |
| Inverse diode direct current, pulsed | I_{SM} | | - | - | 48 | |
| Inverse diode forward voltage | V_{SD} | $V_{GS}=0\text{V}, I_F=I_S$ | - | 1 | 1.2 | V |
| Reverse recovery time | t_{rr} | $V_R=380\text{V}, I_F=I_S,$ | - | 420 | - | ns |
| Reverse recovery charge | Q_{rr} | $di_F/dt=100\text{A}/\mu\text{s}$ | - | 7 | - | μC |
| Peak reverse recovery current | I_{rrm} | | - | 40 | - | A |
| Peak rate of fall of reverse recovery current | di_{rr}/dt | $T_j=25^\circ\text{C}$ | - | 1100 | - | $\text{A}/\mu\text{s}$ |

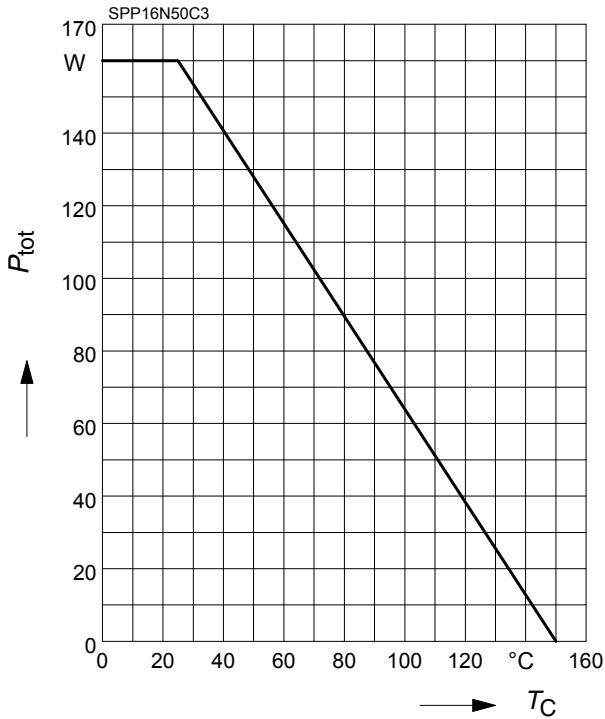
Typical Transient Thermal Characteristics

| Symbol | Value | | Unit | Symbol | Value | | Unit |
|-----------|-------|--|------|-----------|-----------|--|------|
| | SPB | | | | SPB | | |
| R_{th1} | 0.012 | | K/W | C_{th1} | 0.0002495 | | Ws/K |
| R_{th2} | 0.023 | | | C_{th2} | 0.0009406 | | |
| R_{th3} | 0.043 | | | C_{th3} | 0.001298 | | |
| R_{th4} | 0.149 | | | C_{th4} | 0.00362 | | |
| R_{th5} | 0.17 | | | C_{th5} | 0.009484 | | |
| R_{th6} | 0.069 | | | C_{th6} | 0.077 | | |



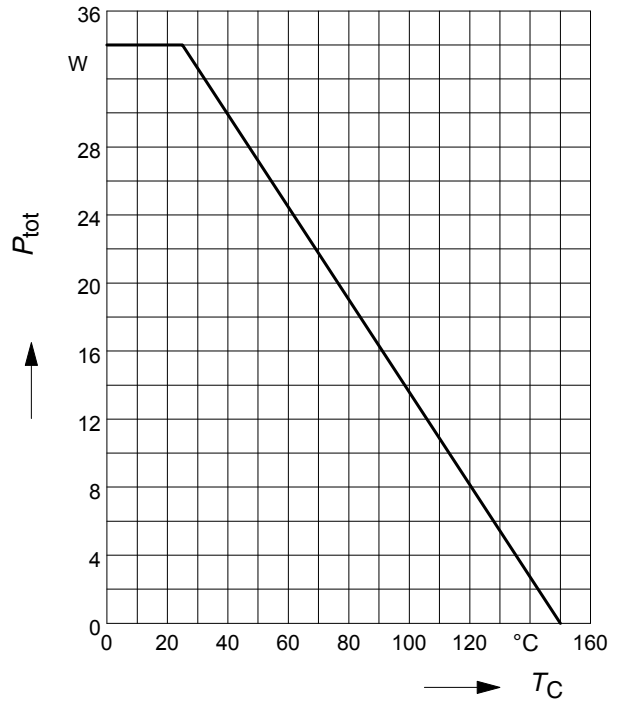
1 Power dissipation

$P_{tot} = f(T_C)$



2 Power dissipation FullPAK

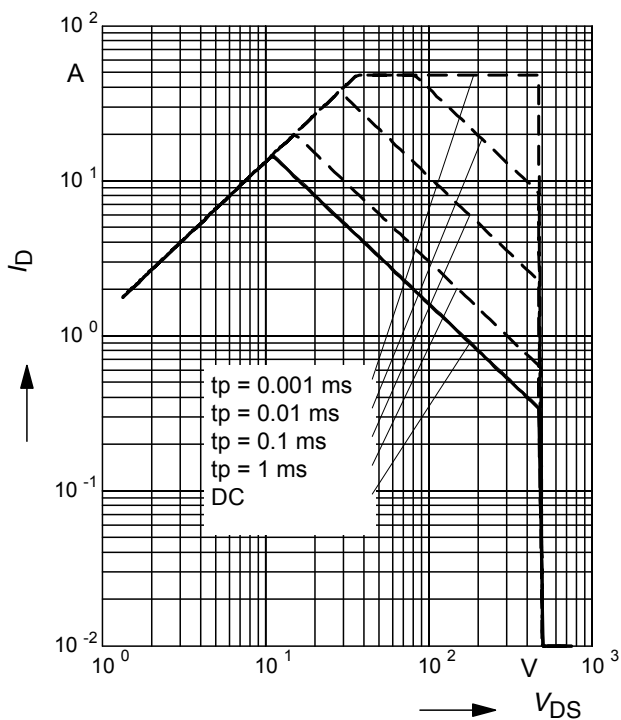
$P_{tot} = f(T_C)$



3 Safe operating area

$I_D = f(V_{DS})$

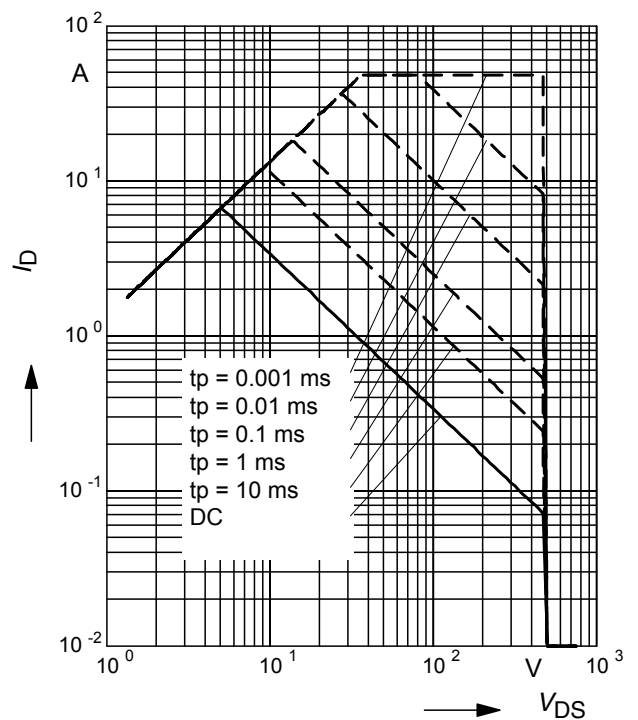
parameter : $D = 0$, $T_C = 25^\circ\text{C}$



4 Safe operating area FullPAK

$I_D = f(V_{DS})$

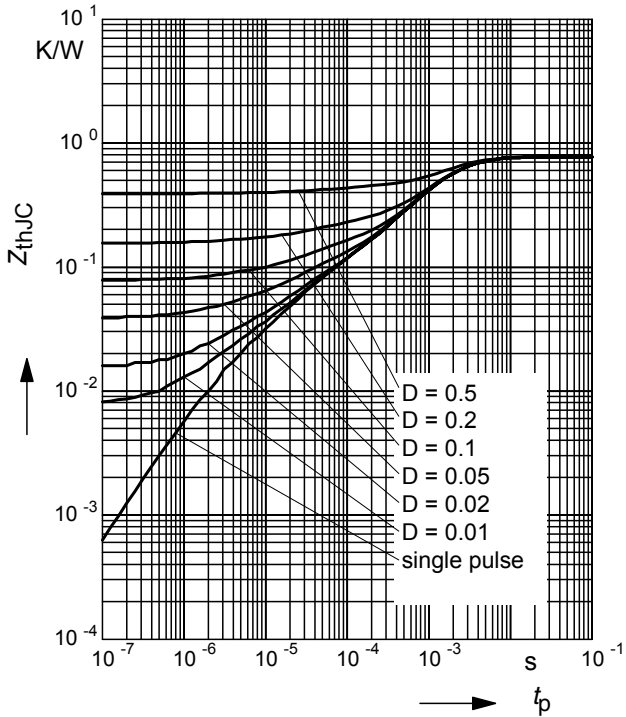
parameter: $D = 0$, $T_C = 25^\circ\text{C}$



5 Transient thermal impedance

$Z_{thJC} = f(t_p)$

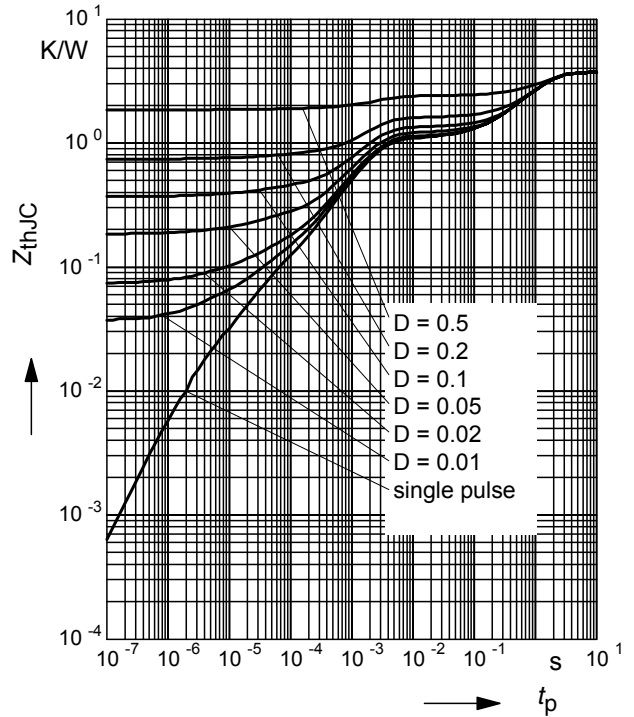
parameter: $D = t_p/T$



6 Transient thermal impedance FullPAK

$Z_{thJC} = f(t_p)$

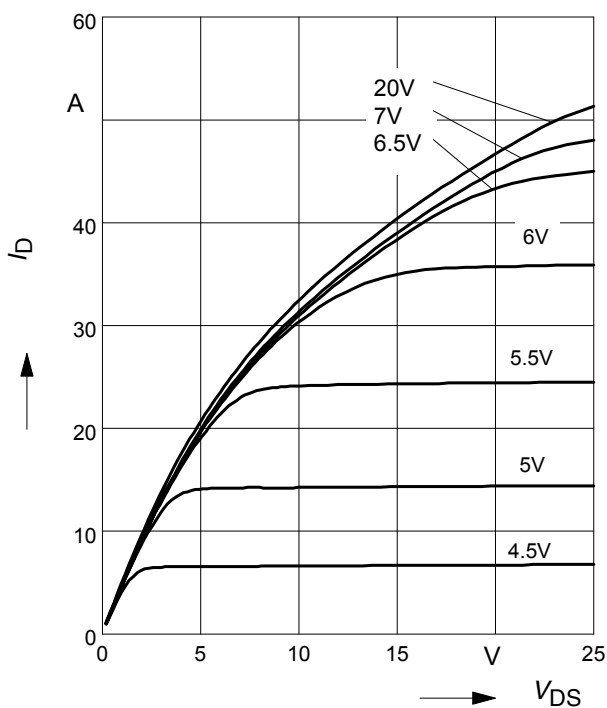
parameter: $D = t_p/t$



7 Typ. output characteristic

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

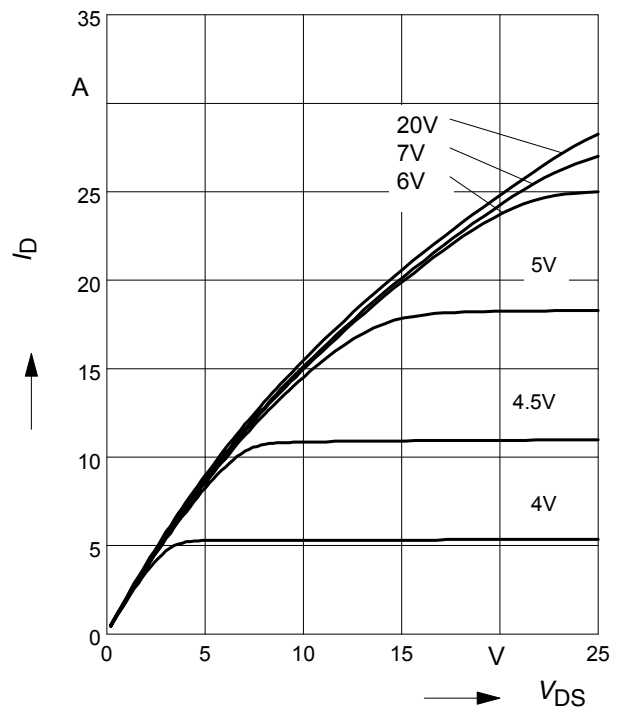
parameter: $t_p = 10 \mu s, V_{GS}$



8 Typ. output characteristic

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

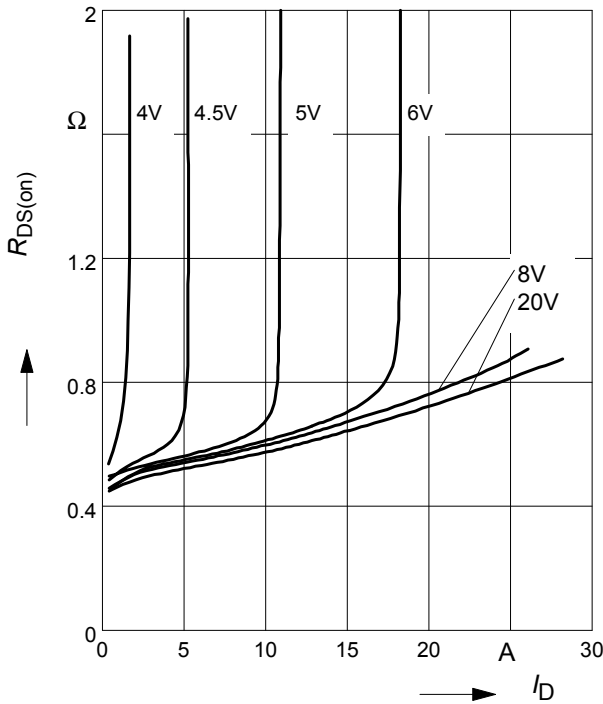
parameter: $t_p = 10 \mu s, V_{GS}$



9 Typ. drain-source on resistance

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

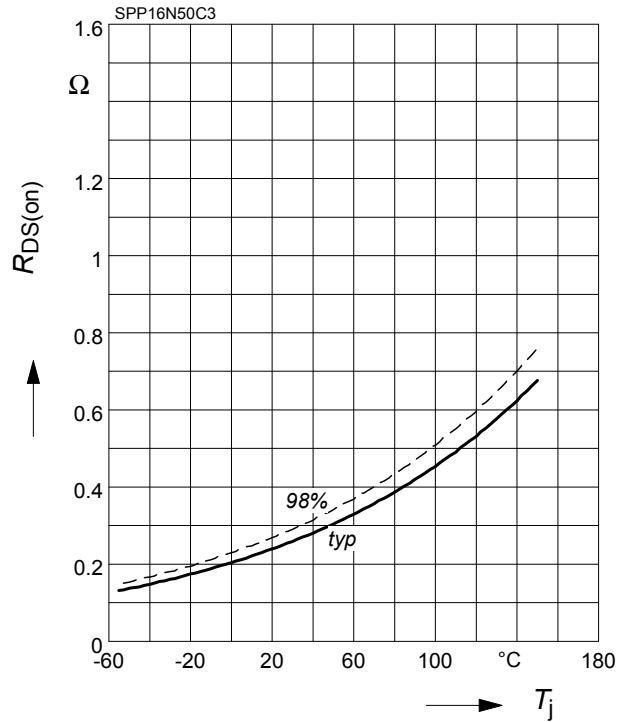
parameter: $T_j = 150^\circ\text{C}$, V_{GS}



10 Drain-source on-state resistance

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

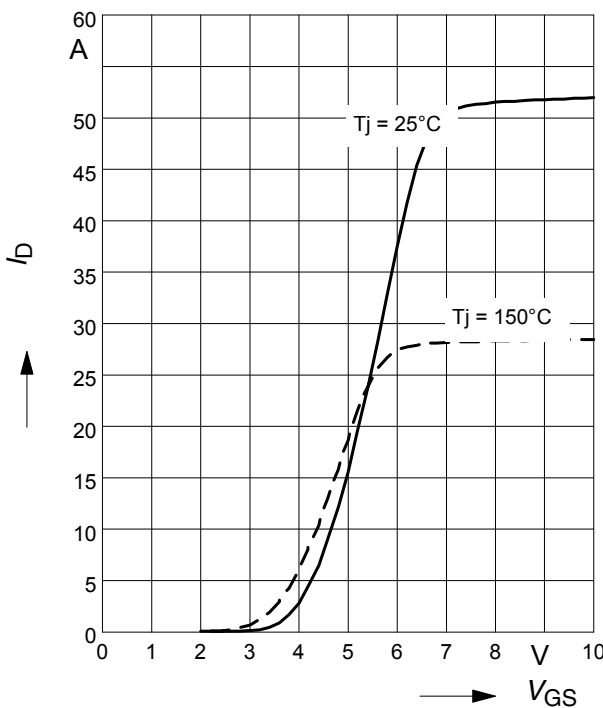
parameter: $I_D = 10\text{ A}$, $V_{GS} = 10\text{ V}$



11 Typ. transfer characteristics

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

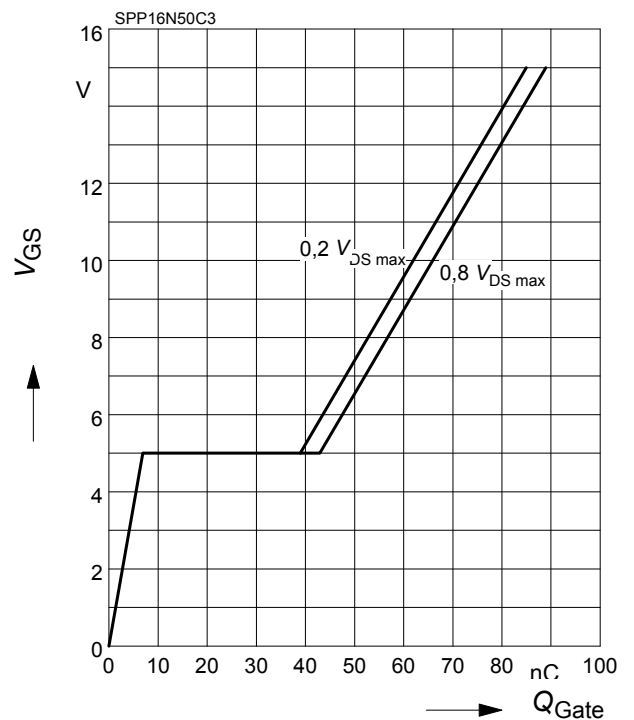
parameter: $t_p = 10\ \mu\text{s}$



12 Typ. gate charge

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

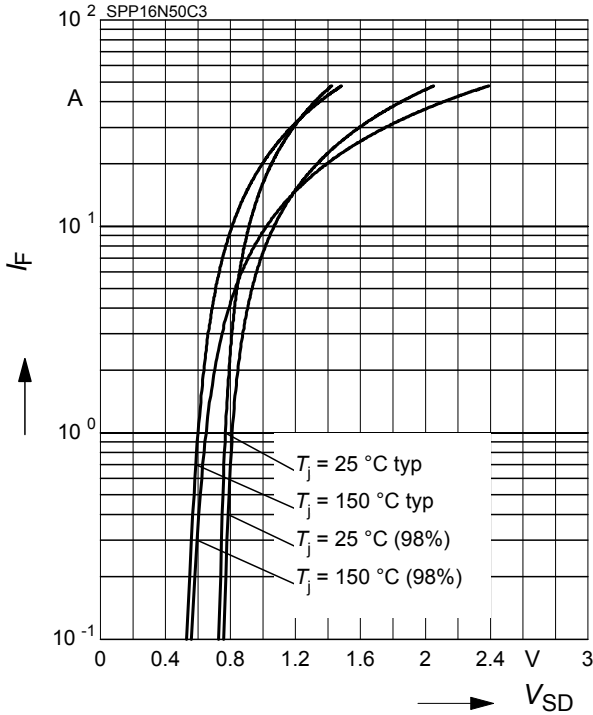
parameter: $I_D = 16\text{ A pulsed}$



13 Forward characteristics of body diode

$I_F = f(V_{SD})$

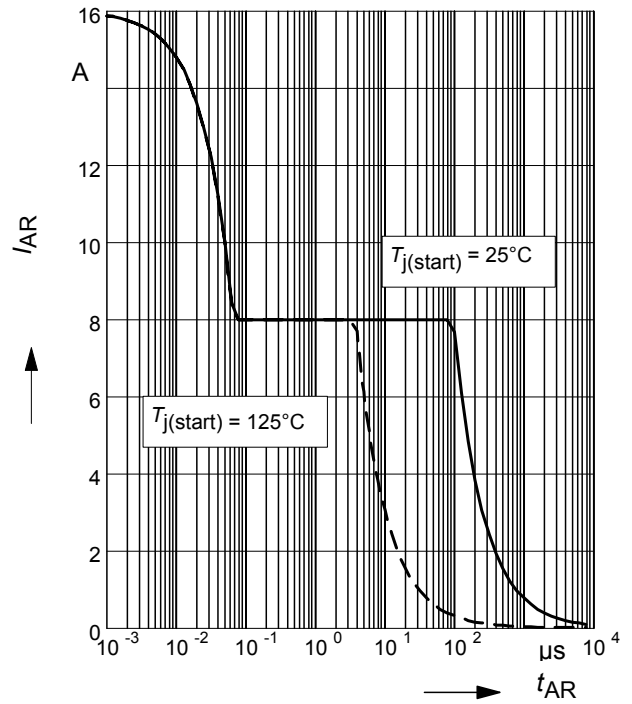
parameter: T_j , $t_p = 10 \mu s$



14 Avalanche SOA

$I_{AR} = f(t_{AR})$

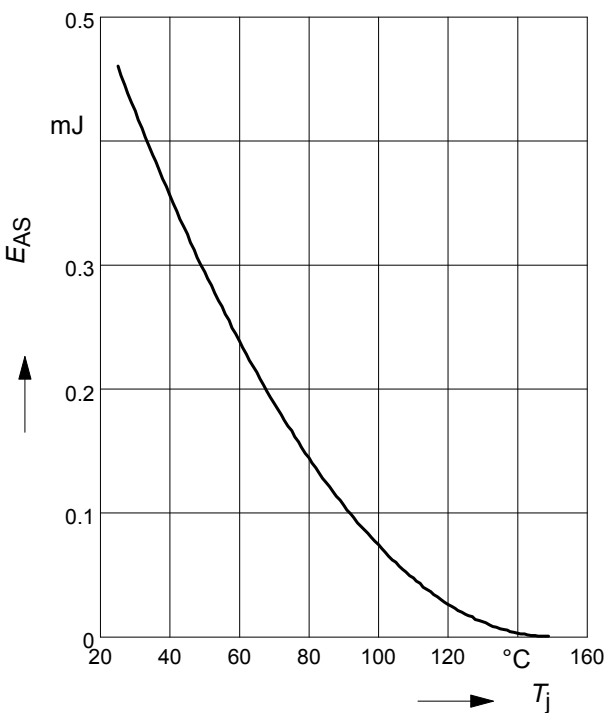
par.: $T_j \leq 150 \text{ °C}$



15 Avalanche energy

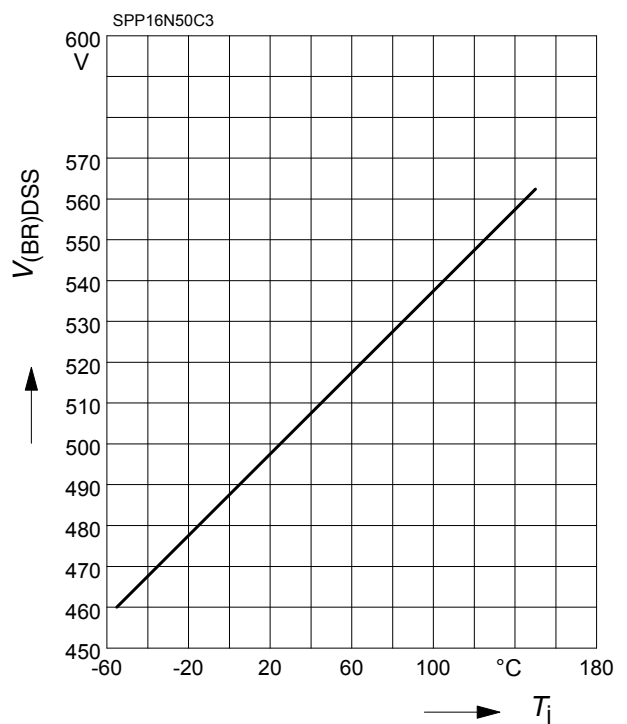
$E_{AS} = f(T_j)$

par.: $I_D = 8$, $V_{DD} = 50 \text{ V}$



16 Drain-source breakdown voltage

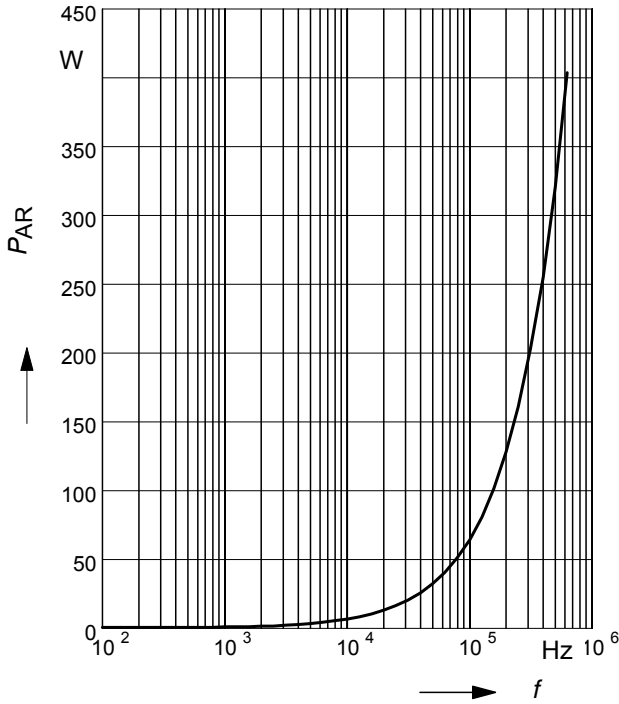
$V_{(BR)DSS} = f(T_j)$



17 Avalanche power losses

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

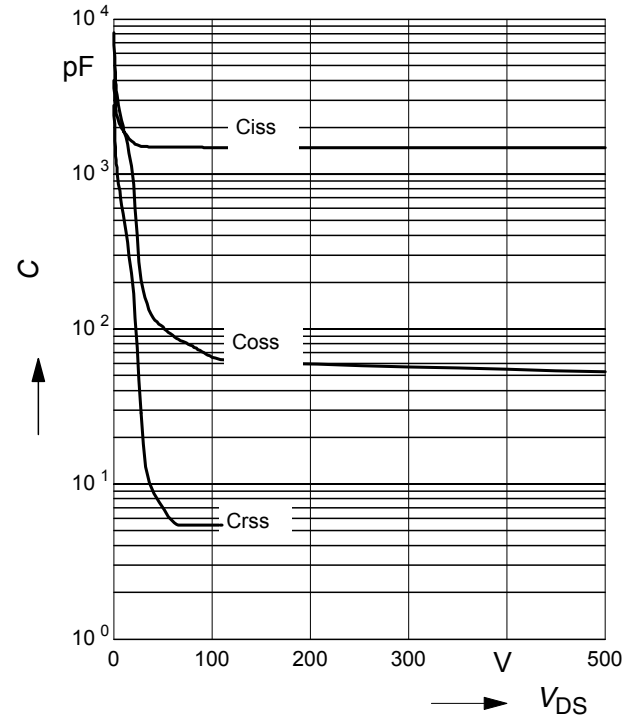
parameter: $E_{AR}=0.64\text{mJ}$



18 Typ. capacitances

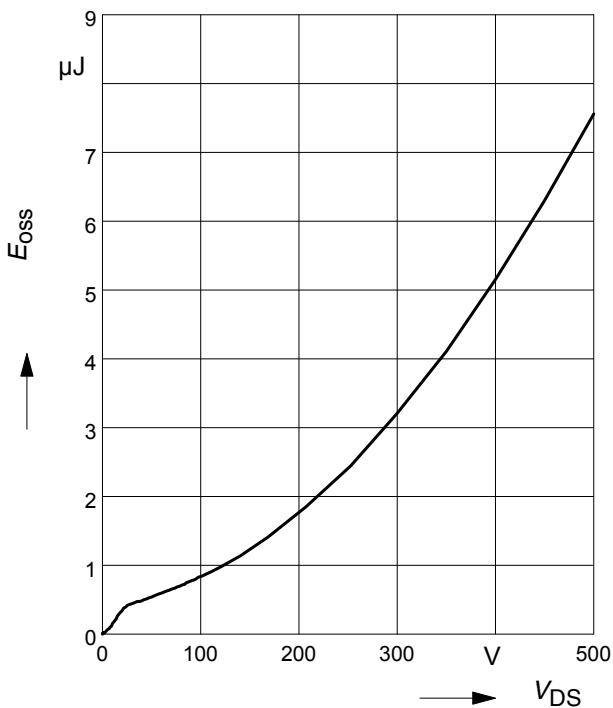
$$C = f(V_{DS})$$

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



19 Typ. C_{oss} stored energy

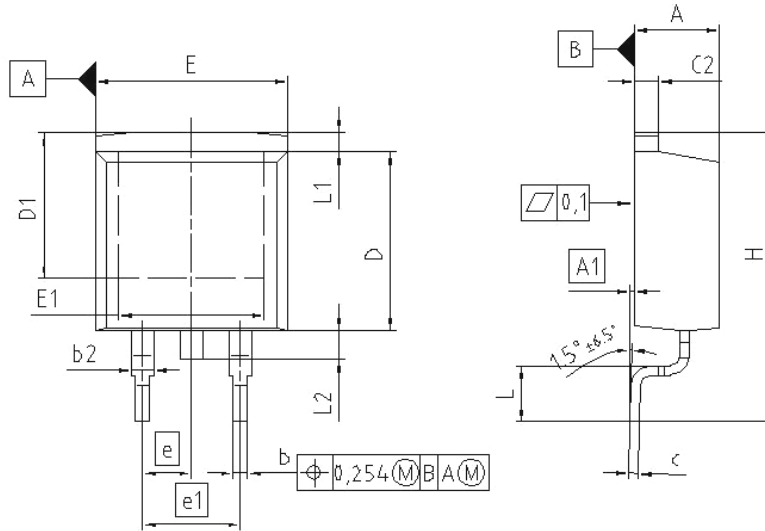
$$E_{oss} = f(V_{DS})$$



Definition of diodes switching characteristics



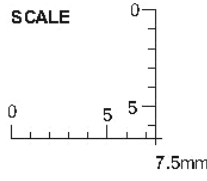
PG-TO263-3-2, PG-TO263-3-5, PG-TO263-3-22



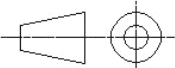
| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|--------|--------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.300 | 4.572 | 0.169 | 0.180 |
| A1 | 0.000 | 0.254 | 0.000 | 0.010 |
| b | 0.650 | 0.850 | 0.026 | 0.033 |
| b2 | 0.950 | 1.321 | 0.037 | 0.052 |
| c | 0.330 | 0.650 | 0.013 | 0.026 |
| c2 | 0.170 | 1.400 | 0.046 | 0.055 |
| D | 8.509 | 9.450 | 0.335 | 0.372 |
| D1 | 7.100 | - | 0.280 | - |
| E | 9.800 | 10.312 | 0.386 | 0.406 |
| E1 | 6.500 | - | 0.256 | - |
| e | 2.540 | | 0.100 | |
| e1 | 5.080 | | 0.200 | |
| N | 2 | | 2 | |
| H | 14.605 | 15.875 | 0.575 | 0.625 |
| L | 2.200 | 3.000 | 0.087 | 0.118 |
| L1 | - | 1.600 | - | 0.063 |
| L2 | 1.000 | 1.778 | 0.039 | 0.070 |
| F1 | 16.050 | 16.250 | 0.632 | 0.640 |
| F2 | 9.300 | 9.500 | 0.366 | 0.374 |
| F3 | 4.500 | 4.700 | 0.177 | 0.185 |
| F4 | 10.700 | 10.900 | 0.421 | 0.429 |
| F5 | 3.630 | 3.830 | 0.143 | 0.151 |
| F6 | 1.100 | 1.300 | 0.043 | 0.051 |

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JEDEC TO263

SCALE



EUROPEAN PROJECTION



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