

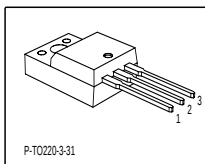
## Cool MOS™ Power Transistor

### Feature

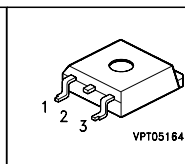
- New revolutionary high voltage technology
- Worldwide best  $R_{DS(on)}$  in TO 220
- Ultra low gate charge
- Periodic avalanche rated
- Extreme  $dv/dt$  rated
- Ultra low effective capacitances
- Improved transconductance
- P-TO-220-3-31: Fully isolated package (2500 VAC; 1 minute)

|              |      |          |
|--------------|------|----------|
| $V_{DS}$     | 800  | V        |
| $R_{DS(on)}$ | 0.29 | $\Omega$ |
| $I_D$        | 17   | A        |

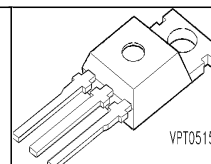
P-TO220-3-31



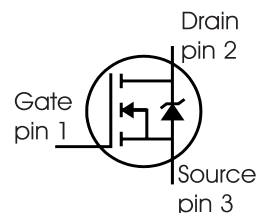
P-TO263-3-2



P-TO220-3-1



| Type       | Package      | Ordering Code | Marking |
|------------|--------------|---------------|---------|
| SPP17N80C3 | P-TO220-3-1  | Q67040-S4353  | 17N80C3 |
| SPB17N80C3 | P-TO263-3-2  | Q67040-S4354  | 17N80C3 |
| SPA17N80C3 | P-TO220-3-31 | Q67040-S4441  | 17N80C3 |



### Maximum Ratings

| Parameter                                                                                                           | Symbol              | Value      |                                      | Unit |
|---------------------------------------------------------------------------------------------------------------------|---------------------|------------|--------------------------------------|------|
|                                                                                                                     |                     | SPP_B      | SPA                                  |      |
| Continuous drain current<br>$T_C = 25\text{ °C}$<br>$T_C = 100\text{ °C}$                                           | $I_D$               | 17<br>11   | 17 <sup>1)</sup><br>11 <sup>1)</sup> | A    |
| Pulsed drain current, $t_p$ limited by $T_{jmax}$                                                                   | $I_{D\text{ puls}}$ | 51         | 51                                   | A    |
| Avalanche energy, single pulse<br>$I_D=3.4\text{A}$ , $V_{DD}=50\text{V}$                                           | $E_{AS}$            | 670        | 670                                  | mJ   |
| Avalanche energy, repetitive $t_{AR}$ limited by $T_{jmax}$ <sup>2)</sup><br>$I_D=17\text{A}$ , $V_{DD}=50\text{V}$ | $E_{AR}$            | 0.5        | 0.5                                  |      |
| Avalanche current, repetitive $t_{AR}$ limited by $T_{jmax}$                                                        | $I_{AR}$            | 17         | 17                                   | A    |
| Gate source voltage                                                                                                 | $V_{GS}$            | $\pm 20$   | $\pm 20$                             | V    |
| Gate source voltage AC ( $f > 1\text{Hz}$ )                                                                         | $V_{GS}$            | $\pm 30$   | $\pm 30$                             |      |
| Power dissipation, $T_C = 25\text{ °C}$                                                                             | $P_{tot}$           | 208        | 42                                   | W    |
| Operating and storage temperature                                                                                   | $T_j, T_{stg}$      | -55...+150 |                                      | °C   |

## Maximum Ratings

| Parameter                                                                                           | Symbol  | Value | Unit |
|-----------------------------------------------------------------------------------------------------|---------|-------|------|
| Drain Source voltage slope<br>$V_{DS} = 640\text{ V}$ , $I_D = 17\text{ A}$ , $T_j = 125\text{ °C}$ | $dv/dt$ | 50    | V/ns |

## Thermal Characteristics

| Parameter                                                                                         | Symbol               | Values |      |      | Unit |
|---------------------------------------------------------------------------------------------------|----------------------|--------|------|------|------|
|                                                                                                   |                      | min.   | typ. | max. |      |
| Thermal resistance, junction - case                                                               | $R_{thJC}$           | -      | -    | 0.6  | K/W  |
| Thermal resistance, junction - case, FullPAK                                                      | $R_{thJC\text{ FP}}$ | -      | -    | 3.6  |      |
| 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   |      |
|                                                                                                   |                      | -      | 35   | -    |      |
| Soldering temperature,<br>1.6 mm (0.063 in.) from case for 10s <sup>4)</sup>                      | $T_{sold}$           | -      | -    | 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              | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}$ , $I_D=0.25\text{ mA}$                                                 | 800    | -    | -    | V             |
| Drain-Source avalanche<br>breakdown voltage | $V_{(BR)DS}$  | $V_{GS}=0\text{ V}$ , $I_D=17\text{ A}$                                                    | -      | 870  | -    |               |
| Gate threshold voltage                      | $V_{GS(th)}$  | $I_D=1000\text{ }\mu\text{A}$ , $V_{GS}=V_D$                                               | 2.1    | 3    | 3.9  |               |
| Zero gate voltage drain current             | $I_{DSS}$     | $V_{DS}=800\text{ V}$ , $V_{GS}=0\text{ V}$ ,<br>$T_j=25\text{ °C}$<br>$T_j=150\text{ °C}$ | -      | 0.5  | 25   | $\mu\text{A}$ |
|                                             |               |                                                                                            | -      | -    | 250  |               |
| Gate-source leakage current                 | $I_{GSS}$     | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$                                                 | -      | -    | 100  | nA            |
| Drain-source on-state resistance            | $R_{DS(on)}$  | $V_{GS}=10\text{ V}$ , $I_D=11\text{ A}$<br>$T_j=25\text{ °C}$<br>$T_j=150\text{ °C}$      | -      | 0.25 | 0.29 | $\Omega$      |
|                                             |               |                                                                                            | -      | 0.78 | -    |               |
| Gate input resistance                       | $R_G$         | $f=1\text{ MHz}$ , open drain                                                              | -      | 0.7  | -    |               |

## Electrical Characteristics

| Parameter                                                     | Symbol       | Conditions                                                                                       | Values |      |      | Unit |
|---------------------------------------------------------------|--------------|--------------------------------------------------------------------------------------------------|--------|------|------|------|
|                                                               |              |                                                                                                  | min.   | typ. | max. |      |
| Transconductance                                              | $g_{fs}$     | $V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$ ,<br>$I_D = 11A$                                   | -      | 15   | -    | S    |
| Input capacitance                                             | $C_{iss}$    | $V_{GS} = 0V$ , $V_{DS} = 25V$ ,<br>$f = 1MHz$                                                   | -      | 2320 | -    | pF   |
| Output capacitance                                            | $C_{oss}$    |                                                                                                  | -      | 1250 | -    |      |
| Reverse transfer capacitance                                  | $C_{rss}$    |                                                                                                  | -      | 60   | -    |      |
| Effective output capacitance, <sup>5)</sup><br>energy related | $C_{o(er)}$  | $V_{GS} = 0V$ ,<br>$V_{DS} = 0V$ to 480V                                                         | -      | 59   | -    |      |
| Effective output capacitance, <sup>6)</sup><br>time related   | $C_{o(tr)}$  |                                                                                                  | -      | 124  | -    |      |
| Turn-on delay time                                            | $t_{d(on)}$  | $V_{DD} = 400V$ , $V_{GS} = 0/10V$ ,<br>$I_D = 17A$ ,<br>$R_G = 4.7\Omega$ , $T_j = 125^\circ C$ | -      | 25   | -    | ns   |
| Rise time                                                     | $t_r$        |                                                                                                  | -      | 15   | -    |      |
| Turn-off delay time                                           | $t_{d(off)}$ |                                                                                                  | -      | 72   | 82   |      |
| Fall time                                                     | $t_f$        |                                                                                                  | -      | 6    | 9    |      |

## Gate Charge Characteristics

|                       |                 |                                                        |   |    |     |    |
|-----------------------|-----------------|--------------------------------------------------------|---|----|-----|----|
| Gate to source charge | $Q_{gs}$        | $V_{DD} = 640V$ , $I_D = 17A$                          | - | 12 | -   | nC |
| Gate to drain charge  | $Q_{gd}$        |                                                        | - | 46 | -   |    |
| Gate charge total     | $Q_g$           | $V_{DD} = 640V$ , $I_D = 17A$ ,<br>$V_{GS} = 0$ to 10V | - | 91 | 177 |    |
| Gate plateau voltage  | $V_{(plateau)}$ | $V_{DD} = 640V$ , $I_D = 17A$                          | - | 6  | -   | V  |

<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>Soldering temperature for TO-263: 220°C, reflow

<sup>5</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%  $V_{DSS}$ .

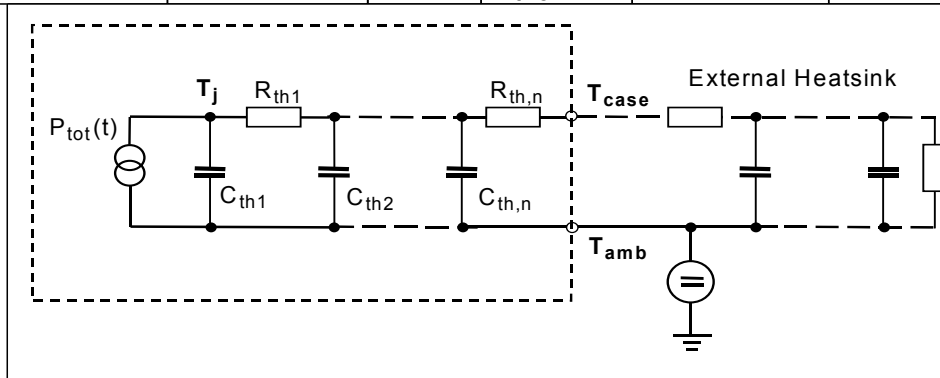
<sup>6</sup> $C_{o(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

## Electrical Characteristics

| Parameter                                     | Symbol       | Conditions                        | Values |      |      | Unit                   |
|-----------------------------------------------|--------------|-----------------------------------|--------|------|------|------------------------|
|                                               |              |                                   | min.   | typ. | max. |                        |
| Inverse diode continuous forward current      | $I_S$        | $T_C=25^{\circ}\text{C}$          | -      | -    | 17   | A                      |
| Inverse diode direct current, pulsed          | $I_{SM}$     |                                   | -      | -    | 51   |                        |
| Inverse diode forward voltage                 | $V_{SD}$     | $V_{GS}=0\text{V}$ , $I_F=I_S$    | -      | 1    | 1.2  | V                      |
| Reverse recovery time                         | $t_{rr}$     | $V_R=400\text{V}$ , $I_F=I_S$ ,   | -      | 550  | -    | ns                     |
| Reverse recovery charge                       | $Q_{rr}$     | $di_F/dt=100\text{A}/\mu\text{s}$ | -      | 15   | -    | $\mu\text{C}$          |
| Peak reverse recovery current                 | $I_{rrm}$    |                                   | -      | 51   | -    | A                      |
| Peak rate of fall of reverse recovery current | $di_{rr}/dt$ | $T_j=25^{\circ}\text{C}$          | -      | 1200 | -    | $\text{A}/\mu\text{s}$ |

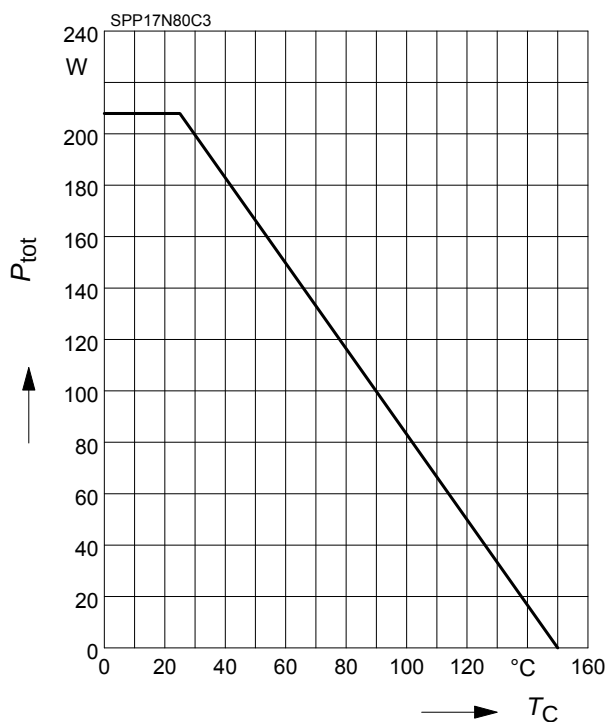
## Typical Transient Thermal Characteristics

| Symbol    | Value   |         | Unit | Symbol    | Value     |           | Unit |
|-----------|---------|---------|------|-----------|-----------|-----------|------|
|           | SPP_B   | SPA     |      |           | SPP_B     | SPA       |      |
| $R_{th1}$ | 0.00812 | 0.00812 | K/W  | $C_{th1}$ | 0.0003562 | 0.0003562 | Ws/K |
| $R_{th2}$ | 0.016   | 0.016   |      | $C_{th2}$ | 0.001337  | 0.001337  |      |
| $R_{th3}$ | 0.031   | 0.031   |      | $C_{th3}$ | 0.001831  | 0.001831  |      |
| $R_{th4}$ | 0.114   | 0.16    |      | $C_{th4}$ | 0.005033  | 0.005033  |      |
| $R_{th5}$ | 0.135   | 0.324   |      | $C_{th5}$ | 0.012     | 0.008657  |      |
| $R_{th6}$ | 0.059   | 2.522   |      | $C_{th6}$ | 0.092     | 0.412     |      |



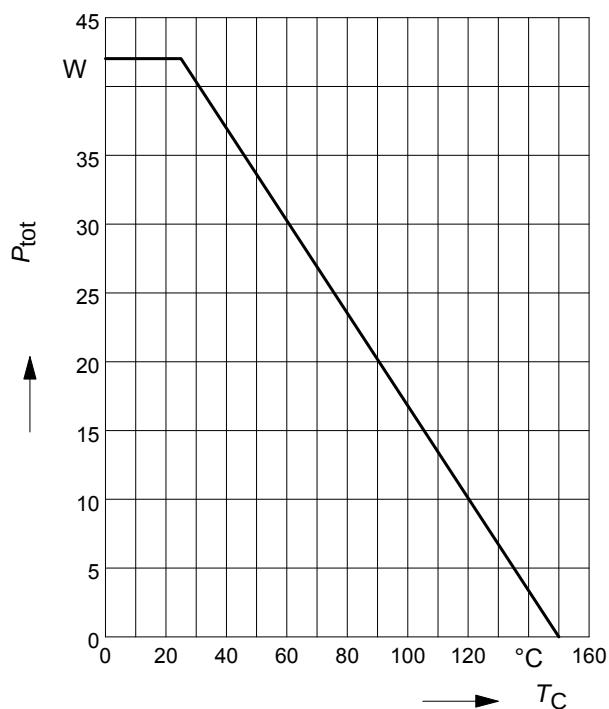
### 1 Power dissipation

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



### 2 Power dissipation FullPAK

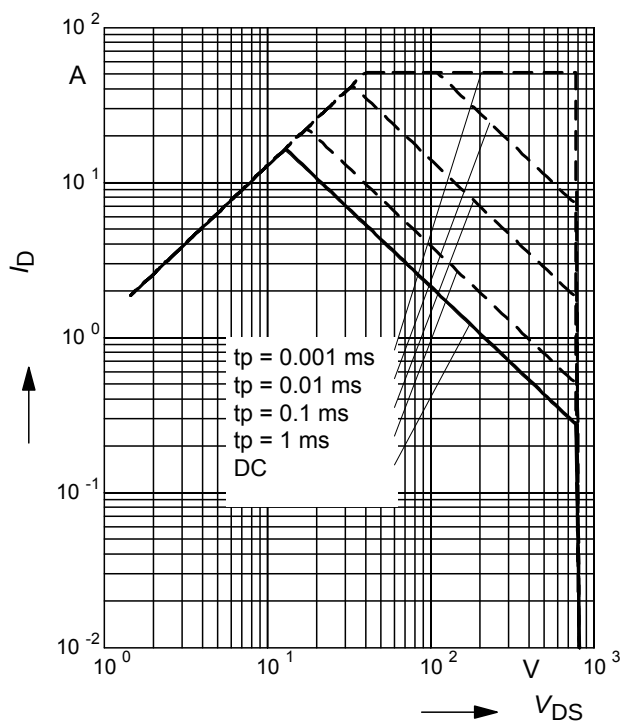
$$P_{\text{tot}} = f(T_C)$$



### 3 Safe operating area

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

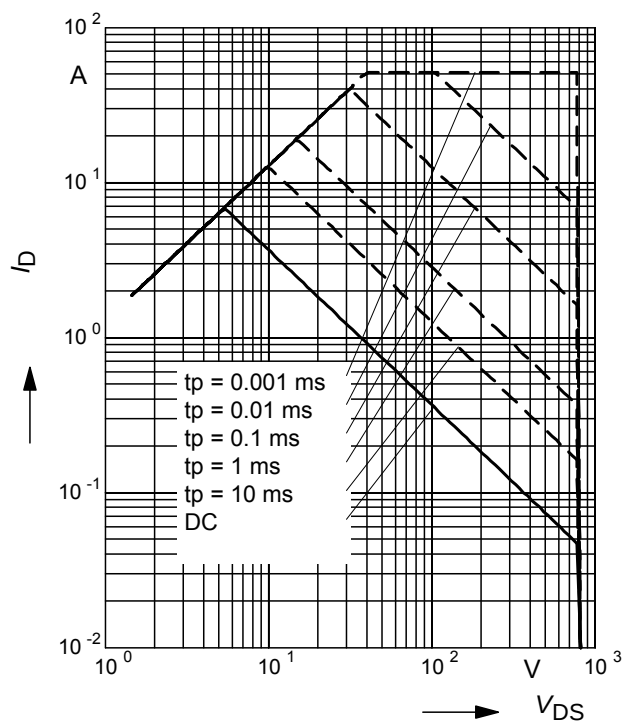
parameter :  $D = 0$  ,  $T_C = 25^\circ\text{C}$



### 4 Safe operating area FullPAK

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

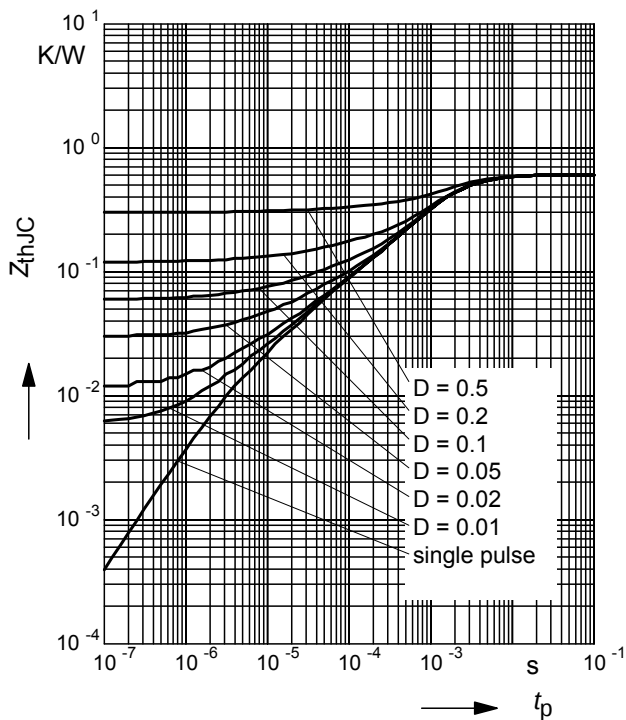
parameter:  $D = 0$  ,  $T_C = 25^\circ\text{C}$



## 5 Transient thermal impedance

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

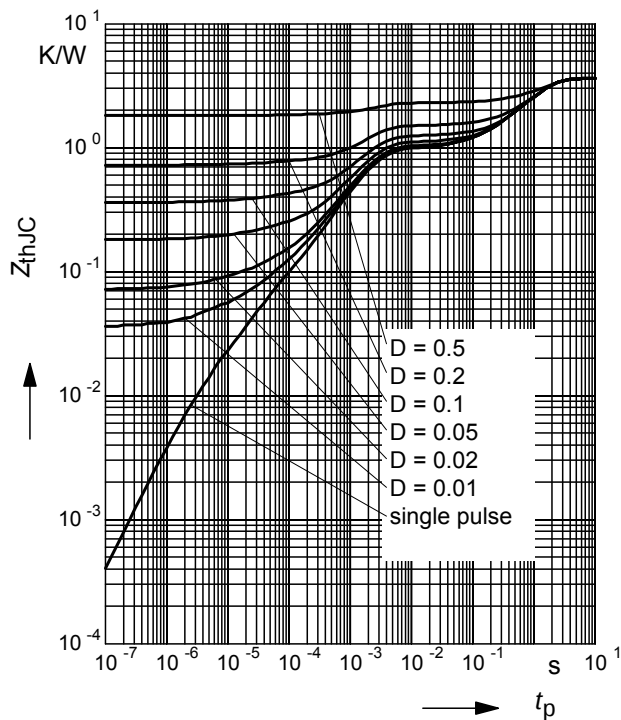
parameter:  $D = t_p/T$



## 6 Transient thermal impedance FullPAK

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

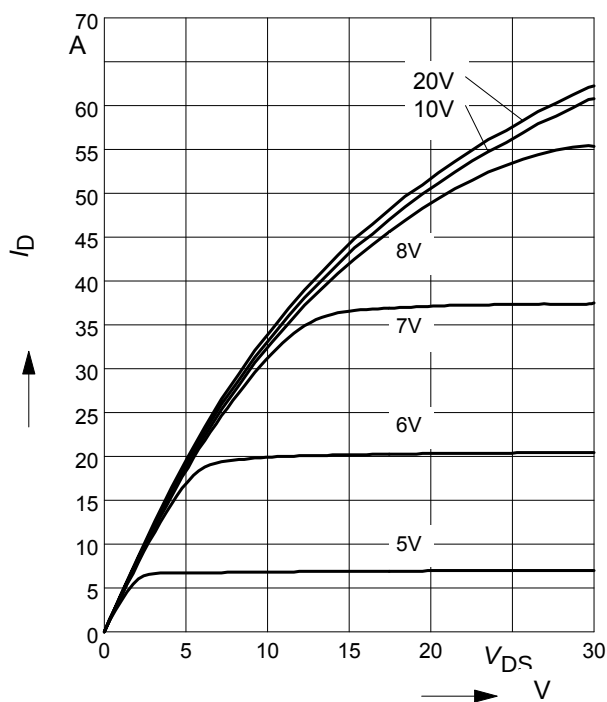
parameter:  $D = t_p/t$



## 7 Typ. output characteristic

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

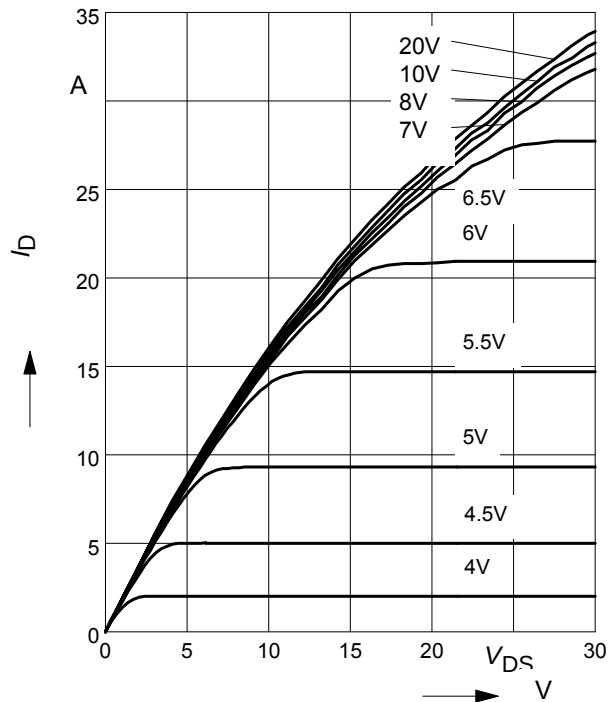
parameter:  $t_p = 10 \mu\text{s}, V_{GS}$



## 8 Typ. output characteristic

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

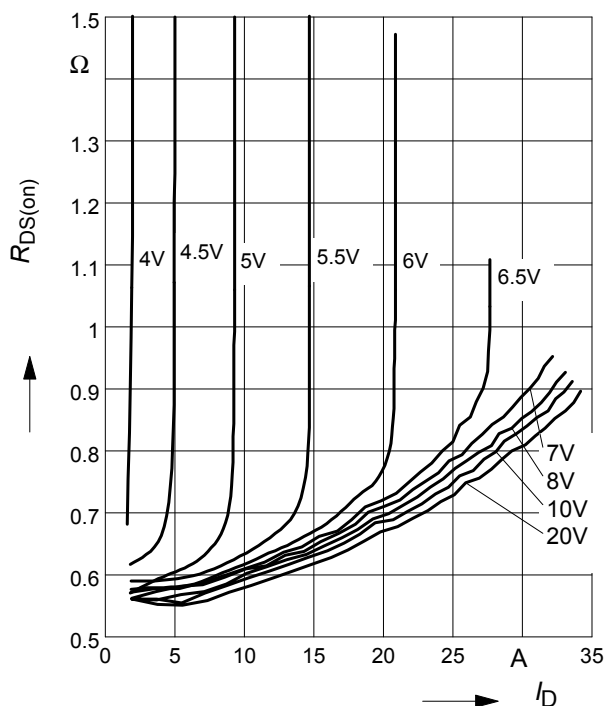
parameter:  $t_p = 10 \mu\text{s}, V_{GS}$



## 9 Typ. drain-source on resistance

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

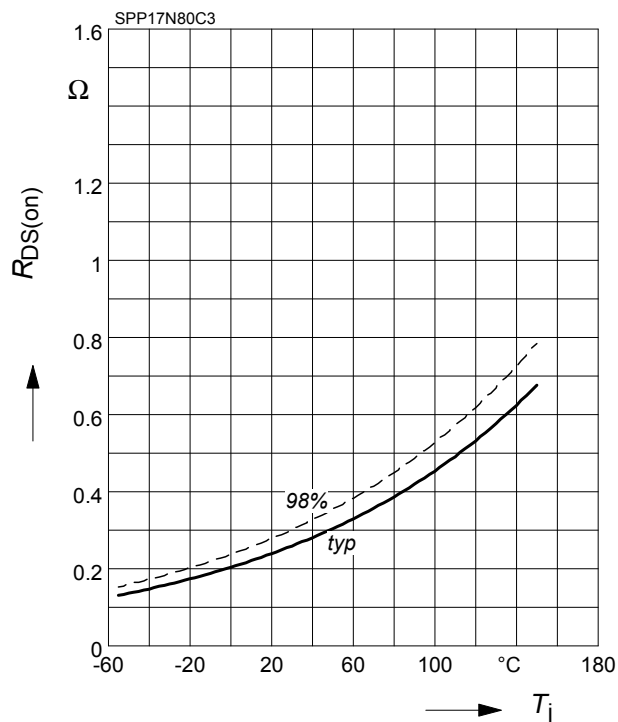
parameter:  $T_j = 150^\circ\text{C}$ ,  $V_{GS}$



## 10 Drain-source on-state resistance

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

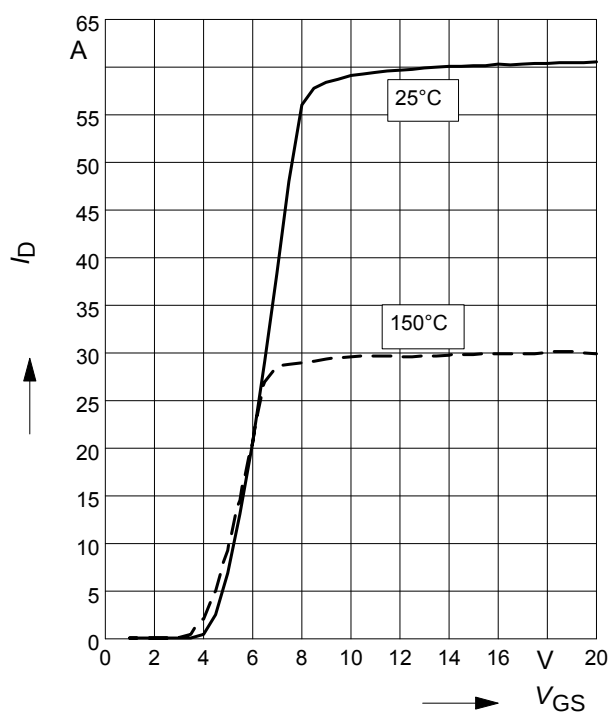
parameter:  $I_D = 11\text{ A}$ ,  $V_{GS} = 10\text{ V}$



## 11 Typ. transfer characteristics

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

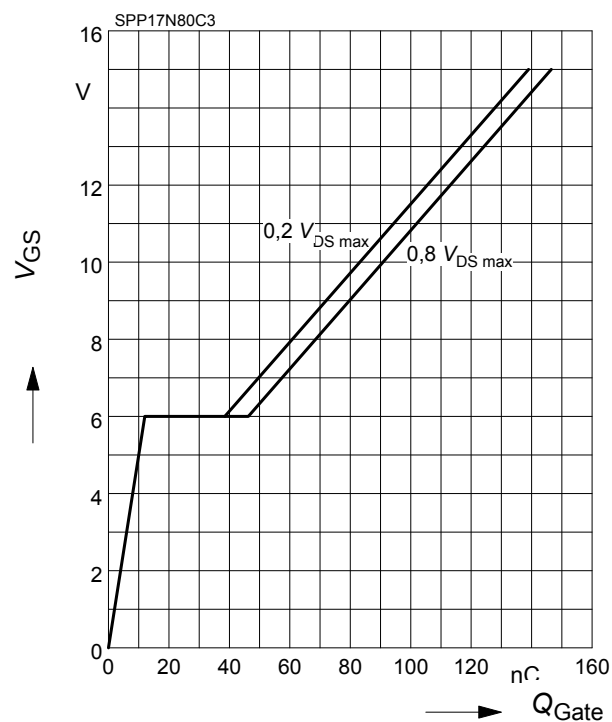
parameter:  $t_p = 10\text{ }\mu\text{s}$



## 12 Typ. gate charge

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

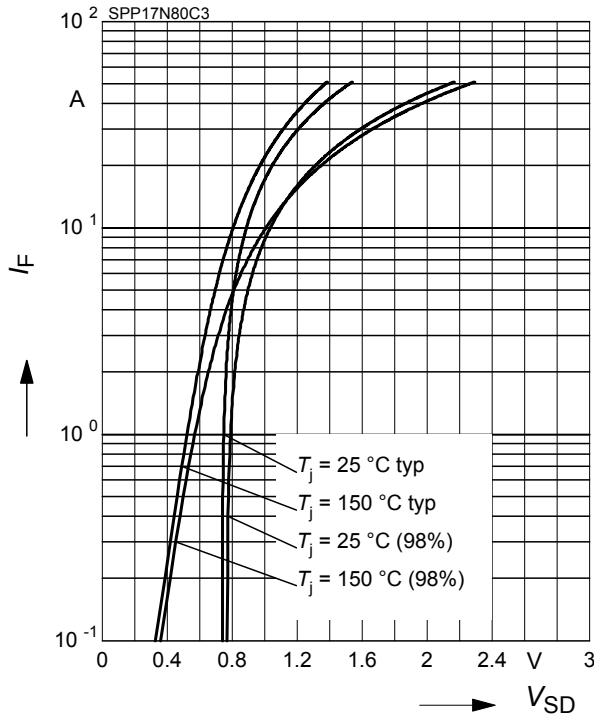
parameter:  $I_D = 17\text{ A}$  pulsed



### 13 Forward characteristics of body diode

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

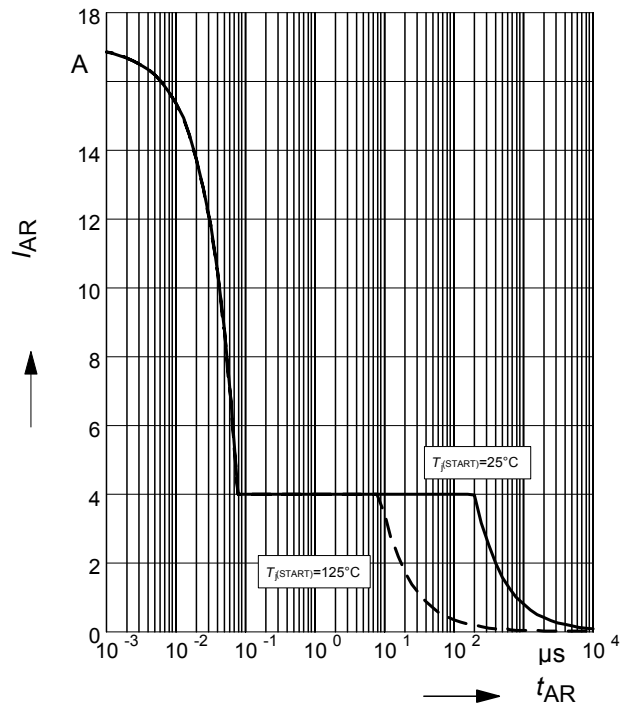
parameter:  $T_j$ ,  $t_p = 10 \mu s$



### 14 Avalanche SOA

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

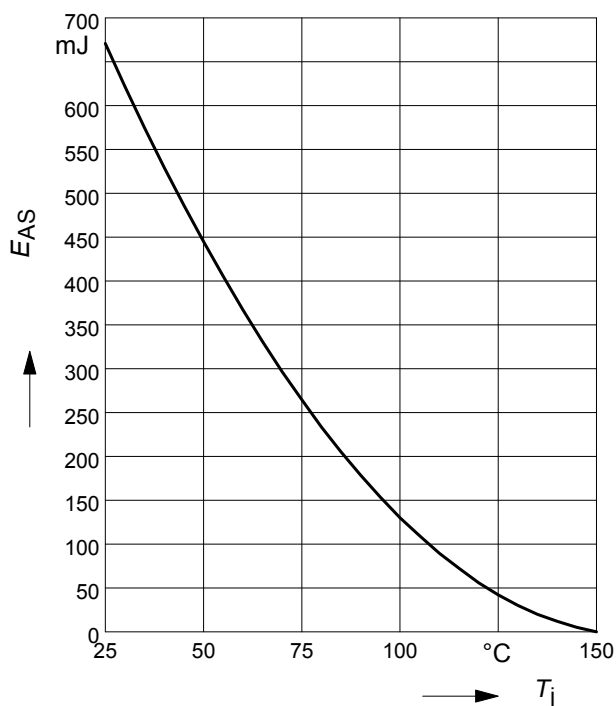
par.:  $T_j \leq 150 \text{ } ^\circ\text{C}$



### 15 Avalanche energy

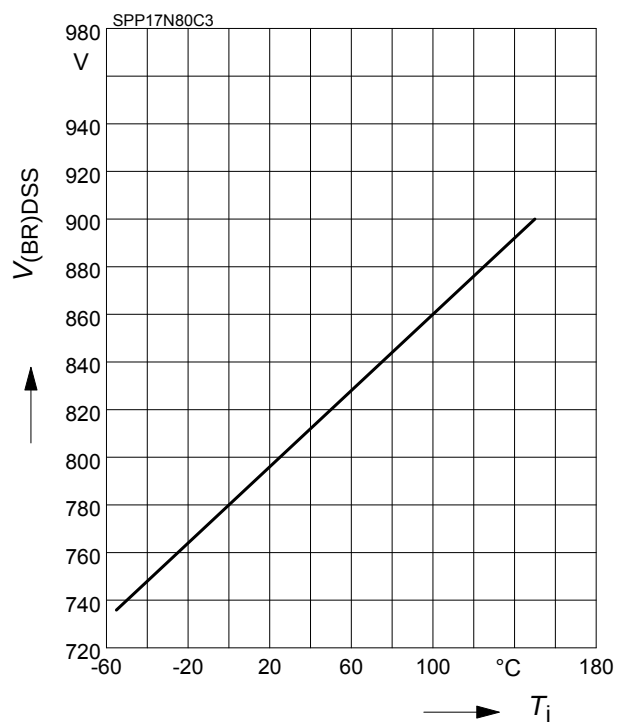
$$E_{AS} = f(T_j)$$

par.:  $I_D = 3.4 \text{ A}$ ,  $V_{DD} = 50 \text{ V}$



### 16 Drain-source breakdown voltage

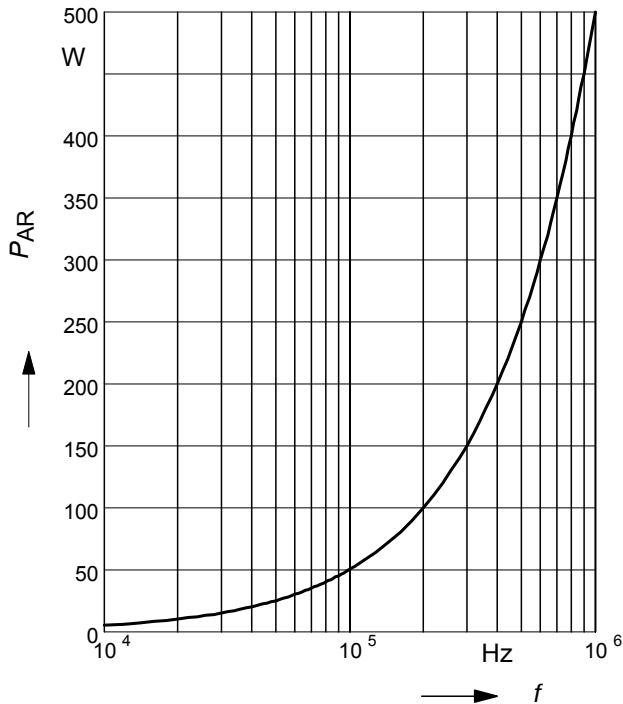
$$V_{(BR)DSS} = f(T_j)$$



### 17 Avalanche power losses

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

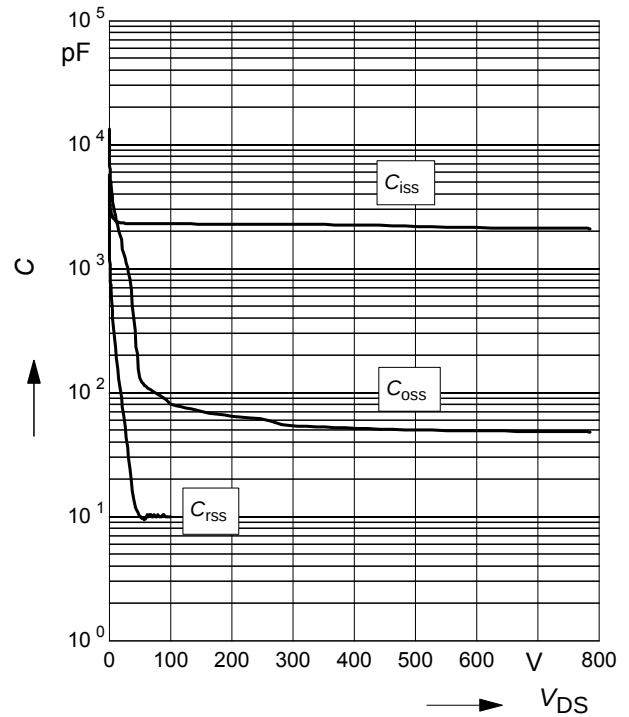
parameter:  $E_{AR}=0.5\text{mJ}$



### 18 Typ. capacitances

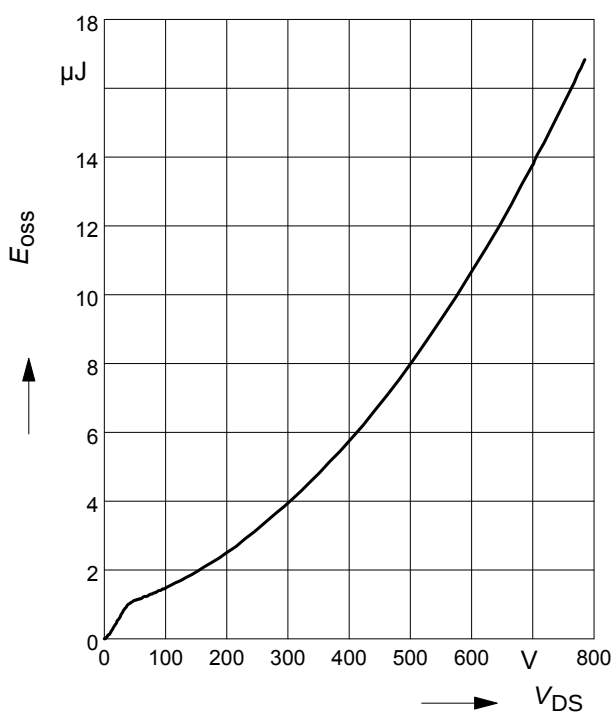
$$C = f(V_{DS})$$

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

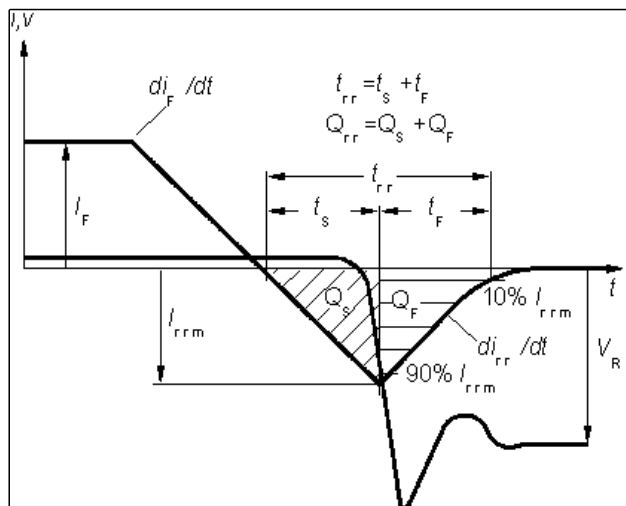


### 19 Typ. $C_{oss}$ stored energy

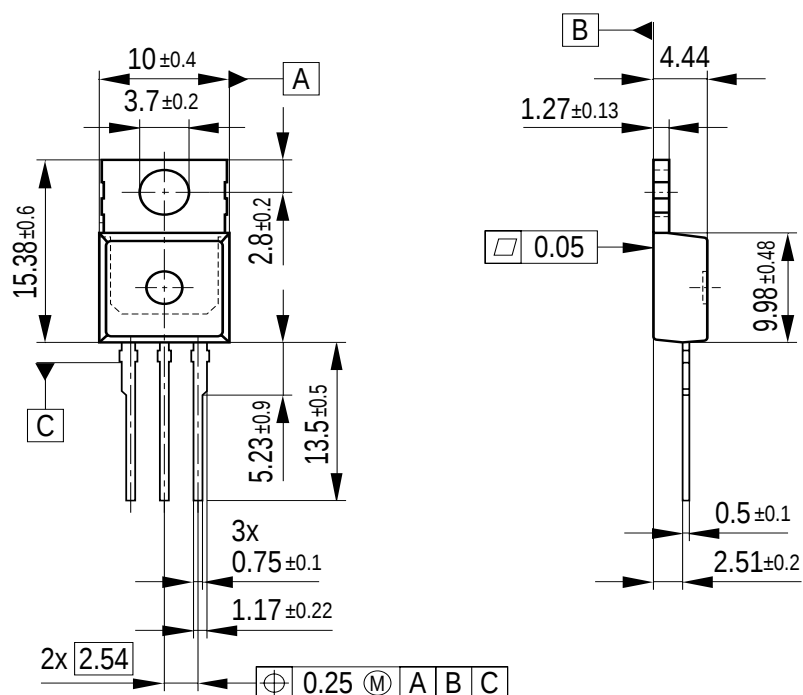
$$E_{oss}=f(V_{DS})$$



## Definition of diodes switching characteristics

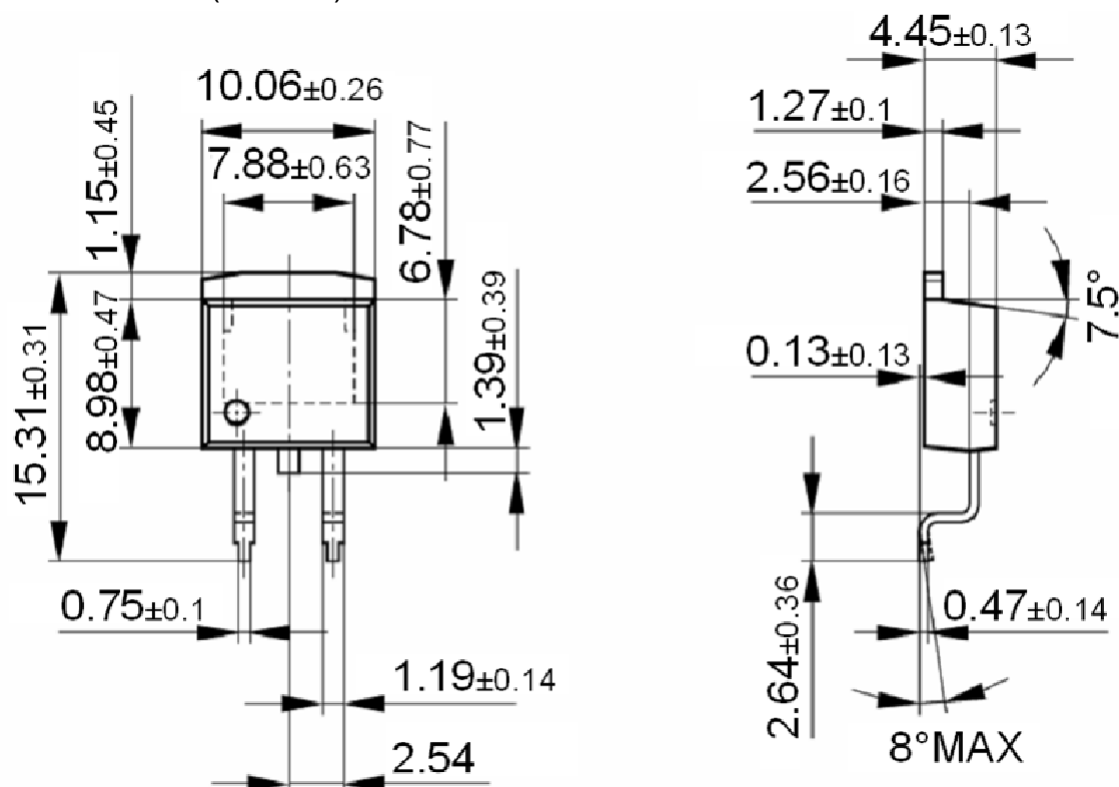


P-TO-220-3-1

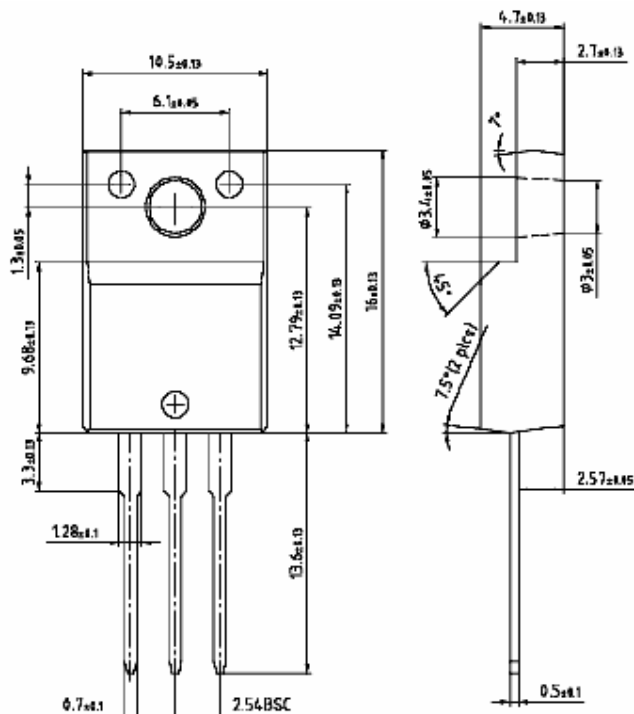


All metal surfaces tin plated, except area of cut.  
Metal surface min. x=7.25, y=12.3

P-TO-263-3-2 (D<sup>2</sup>-PAK)



P-TO-220-3-31 (FullPAK)



Please refer to mounting instructions (application note AN-TO220-3-31-01)

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