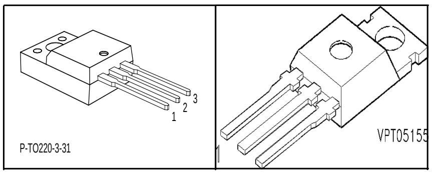
# Cool MOS™ Power Transistor

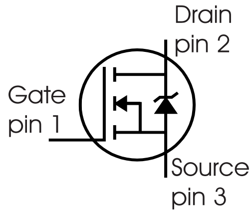
| | | |
|---|---|---|
| $V_{DS}$ | 800 | V |
| $R_{DS(on)}$ | 0.29 | Ω |
| $I_D$ | 17 | A |

PG-TO220-3-31 PG-TO220




## Feature

- New revolutionary high voltage technology
- Worldwide best $R_{DS(on)}$ in TO 220
- Ultra low gate charge
- Periodic avalanche rated
- Extreme d*v*/d*t* rated
- Ultra low effective capacitances
- Improved transconductance
- PG-TO-220-3-31: Fully isolated package (2500 VAC; 1 minute)
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC[0)] for target applications




| Type | Package | Ordering Code | Marking |
|---|---|---|---|
| SPP17N80C3 | PG-TO220 | Q67040-S4353 | 17N80C3 |
| SPA17N80C3 | PG-TO220-3-31 | SP000216353 | 17N80C3 |

## Maximum Ratings

| Parameter | Symbol | Value | | Unit |
|---|---|---|---|---|
| | | SPP | SPA | |
| Continuous drain current<br>$T_C$ = 25 °C<br>$T_C$ = 100 °C | $I_D$ | <br>17<br>11 | <br>17[1)]<br>11[1)] | A |
| Pulsed drain current, $t_p$ limited by $T_{jmax}$ | $I_{D\ puls}$ | 51 | 51 | A |
| Avalanche energy, single pulse<br>$I_D$=3.4A, $V_{DD}$=50V | $E_{AS}$ | 670 | 670 | mJ |
| Avalanche energy, repetitive $t_{AR}$ limited by $T_{jmax}$[2)]<br>$I_D$=17A, $V_{DD}$=50V | $E_{AR}$ | 0.5 | 0.5 | |
| Avalanche current, repetitive $t_{AR}$ limited by $T_{jmax}$ | $I_{AR}$ | 17 | 17 | A |
| Gate source voltage | $V_{GS}$ | ±20 | ±20 | V |
| Gate source voltage AC (f >1Hz) | $V_{GS}$ | ±30 | ±30 | |
| Power dissipation, $T_C$ = 25°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 V, $I_D$ = 17 A, $T_j$ = 125 °C | d*v*/d*t* | 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 | $R_{thJC\_FP}$ | - | - | 3.6 | |
| Thermal resistance, junction - ambient, leaded | $R_{thJA}$ | - | - | 62 | |
| Thermal resistance, junction - ambient, FullPAK | $R_{thJA\_FP}$ | - | - | 80 | |
| SMD version, device on PCB: | $R_{thJA}$ | | | | |
| @ min. footprint | | - | - | 62 | |
| @ 6 cm$^2$ cooling area 3) | | - | 35 | - | |
| Soldering temperature, wavesoldering<br>1.6 mm (0.063 in.) from case for 10s 4) | $T_{sold}$ | - | - | 260 | °C |

**Electrical Characteristics,** at $T_j$=25°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 | 800 | - | - | V |
| Drain-Source avalanche breakdown voltage | $V_{(BR)DS}$ | $V_{GS}$=0V, $I_D$=17A | - | 870 | - | |
| Gate threshold voltage | $V_{GS(th)}$ | $I_D$=1000µA, $V_{GS}$=$V_{DS}$ | 2.1 | 3 | 3.9 | |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$=800V, $V_{GS}$=0V, | | | | µA |
| | | $T_j$=25°C | - | 0.5 | 25 | |
| | | $T_j$=150°C | - | - | 250 | |
| Gate-source leakage current | $I_{GSS}$ | $V_{GS}$=20V, $V_{DS}$=0V | - | - | 100 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}$=10V, $I_D$=11A | | | | Ω |
| | | $T_j$=25°C | - | 0.25 | 0.29 | |
| | | $T_j$=150°C | - | 0.78 | - | |
| Gate input resistance | $R_G$ | *f*=1MHz, open drain | - | 0.7 | - | |

**Electrical Characteristics**

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| Transconductance | $g_{fs}$ | $V_{DS}$≥2*$I_D$*$R_{DS(on)max}$, $I_D$=11A | - | 15 | - | S |
| Input capacitance | $C_{iss}$ | $V_{GS}$=0V, $V_{DS}$=25V, $f$=1MHz | - | 2320 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 1250 | - | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 60 | - | |
| Effective output capacitance,[5) ] energy related | $C_{o(er)}$ | $V_{GS}$=0V, $V_{DS}$=0V to 480V | - | 59 | - | |
| Effective output capacitance,[6)] time related | $C_{o(tr)}$ | | - | 124 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$=400V, $V_{GS}$=0/10V, $I_D$=17A, $R_G$=4.7Ω, $T_j$=125°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**

| Parameter | Symbol | Conditions | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| 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, $V_{GS}$=0 to 10V | - | 91 | 177 | |
| Gate plateau voltage | $V_{(plateau)}$ | $V_{DD}$=640V, $I_D$=17A | - | 6 | - | V |

[0]J-STD20 and JESD22

[1]Limited only by maximum temperature

[2]Repetitve avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR}*f$.

[3]Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm² (one layer, 70 µm thick) copper area for drain connection. PCB is vertical without blown air.

[4]Soldering temperature for TO-263: 220°C, reflow

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

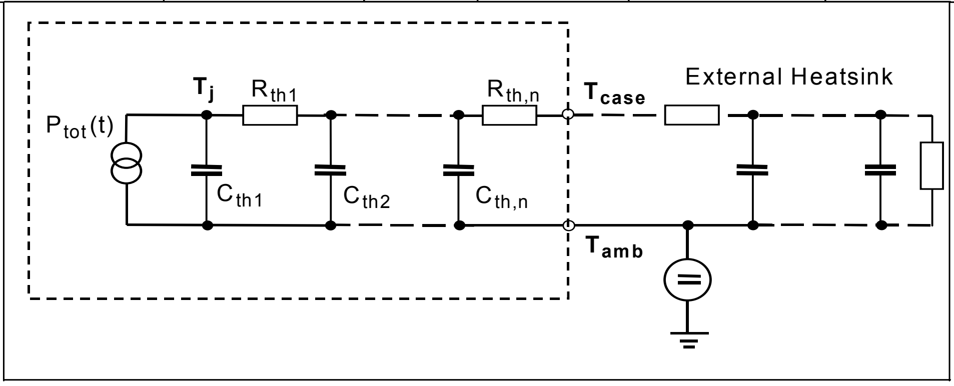
[6]$C_{o(tr)}$ is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.

**Electrical Characteristics**

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

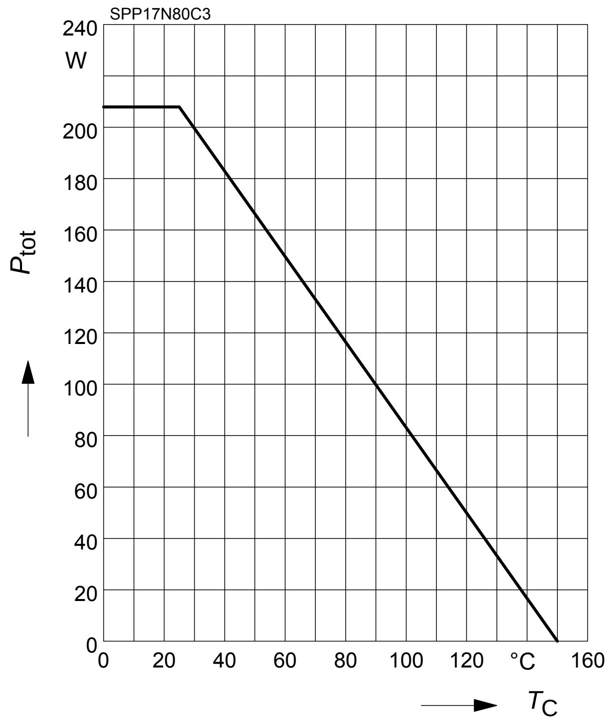
**Typical Transient Thermal Characteristics**

| Symbol | Value | | Unit | Symbol | Value | | Unit |
|---|---|---|---|---|---|---|---|
| | SPP | SPA | | | SPP | 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 | |



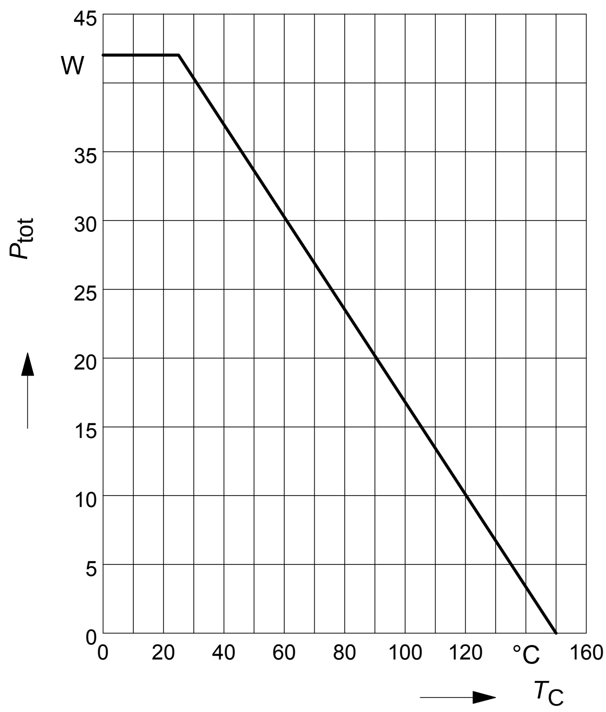
## 1 Power dissipation

$P_{tot} = f(T_C)$




## 2 Power dissipation FullPAK

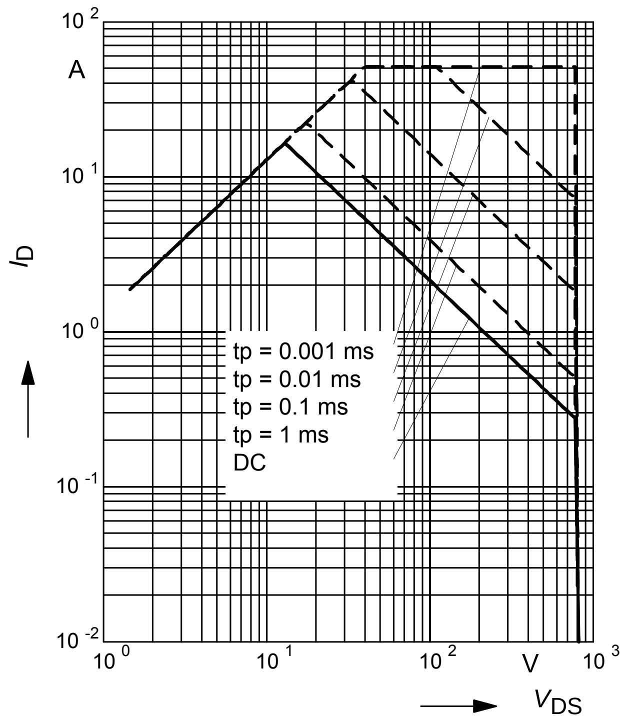
$P_{tot} = f(T_C)$




## 3 Safe operating area

$I_D = f(V_{DS})$

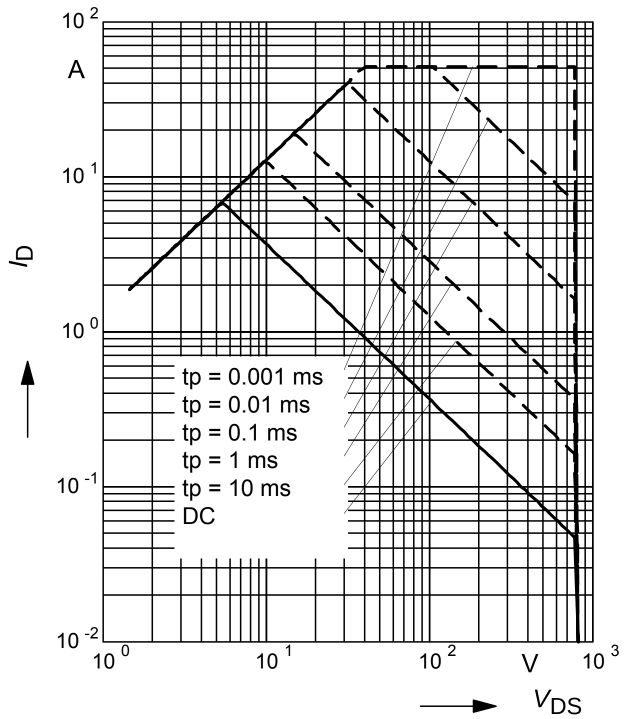
parameter : $D = 0$ , $T_C$=25°C




## 4 Safe operating area FullPAK

$I_D = f(V_{DS})$

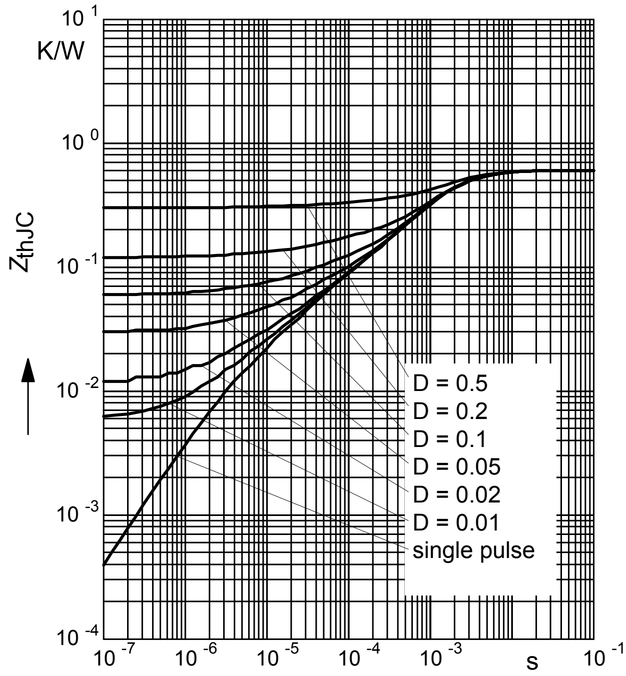
parameter: $D = 0$, $T_C$ = 25°C



**5 Transient thermal impedance**

$Z_{thJC} = f(t_p)$

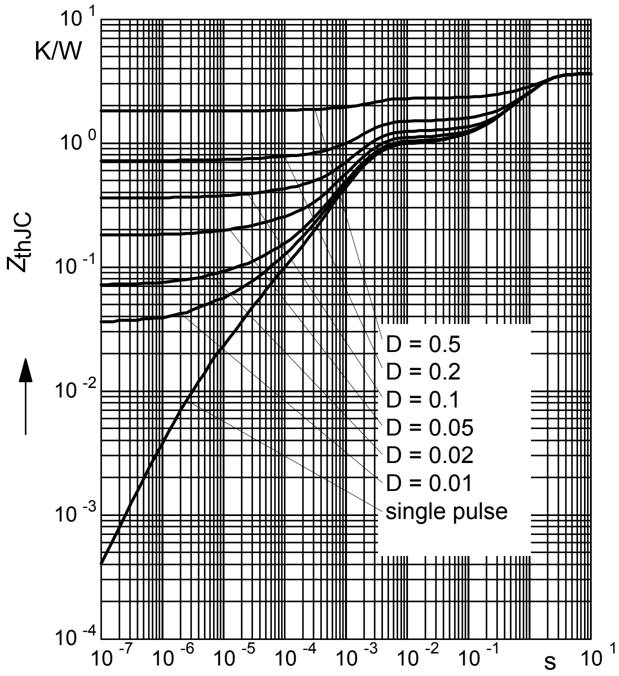
parameter: $D = t_p/T$




**6 Transient thermal impedance FullPAK**

$Z_{thJC} = f(t_p)$

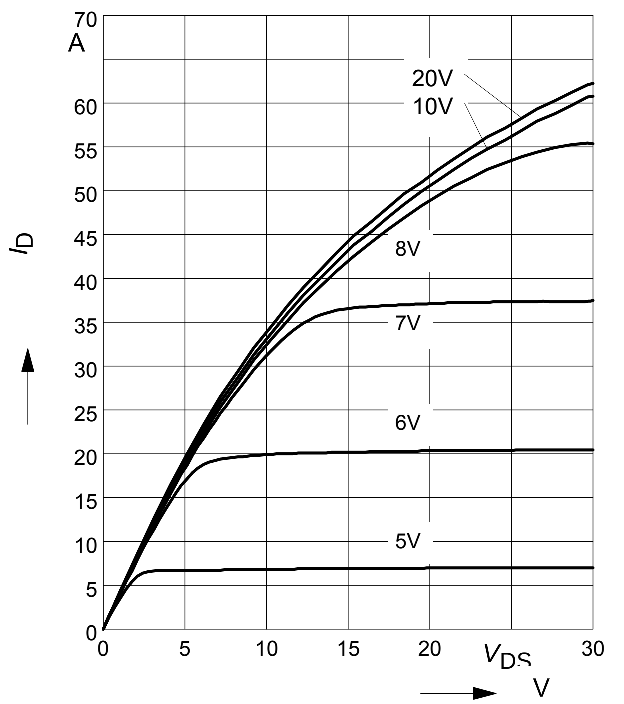
parameter: $D = t_p/t$




**7 Typ. output characteristic**

$I_D = f(V_{DS})$; $T_j$=25°C

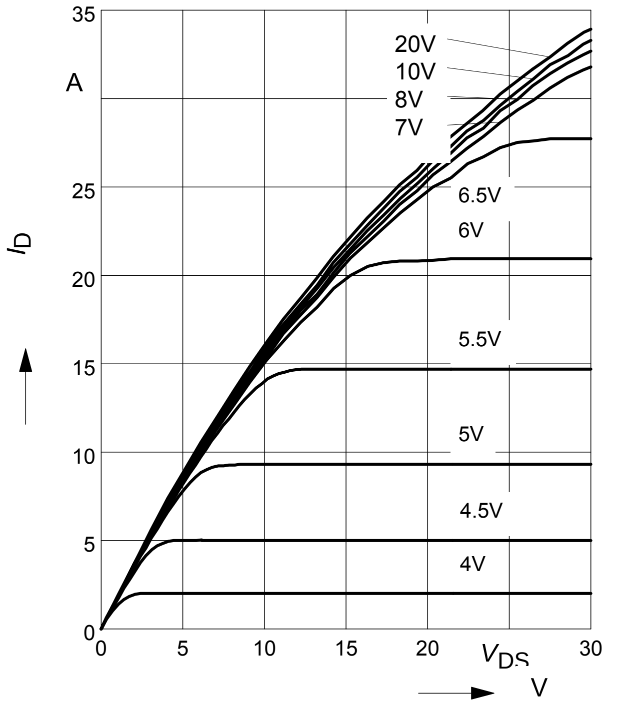
parameter: $t_p$ = 10 µs, $V_{GS}$




**8 Typ. output characteristic**

$I_D = f(V_{DS})$; $T_j$=150°C

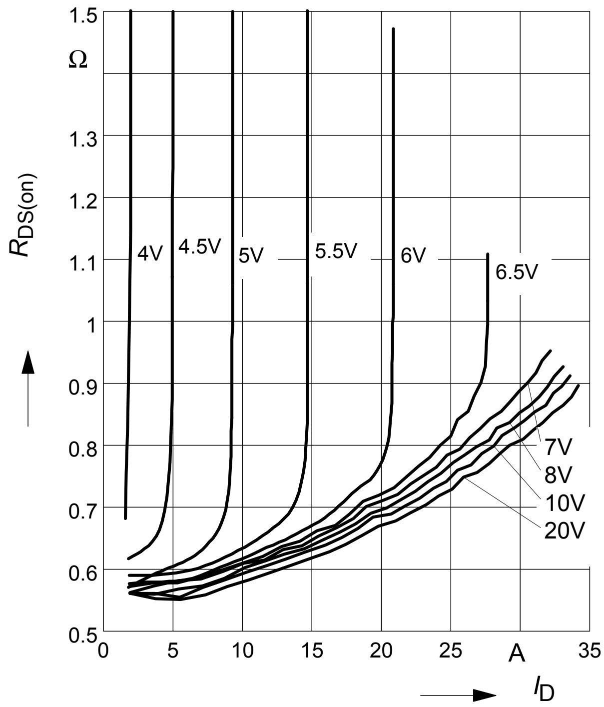
parameter: $t_p$ = 10 µs, $V_{GS}$



### 9 Typ. drain-source on resistance

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

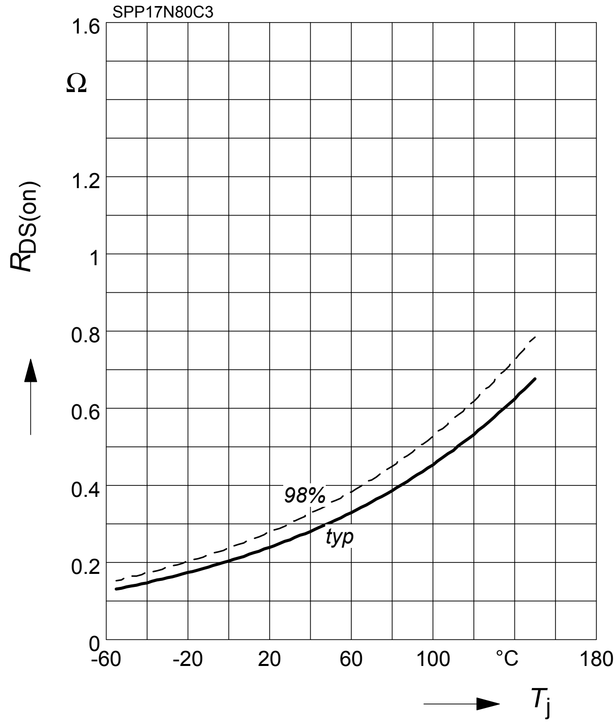
parameter: $T_j$=150°C, $V_{GS}$




### 10 Drain-source on-state resistance

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

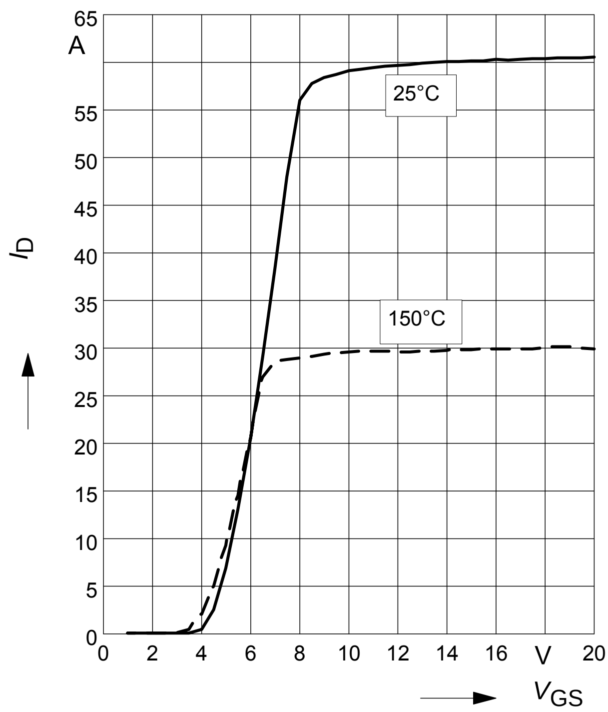
parameter : $I_D$ = 11 A, $V_{GS}$ = 10 V




### 11 Typ. transfer characteristics

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

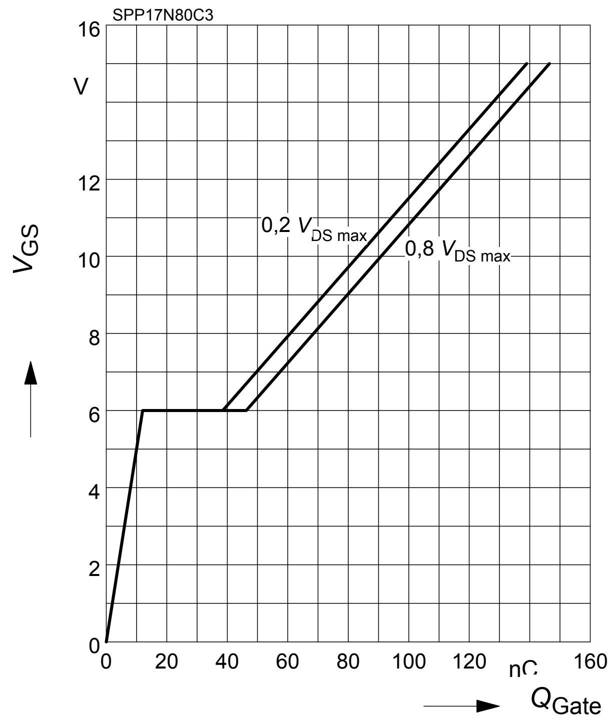
parameter: $t_p$ = 10 µs




### 12 Typ. gate charge

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

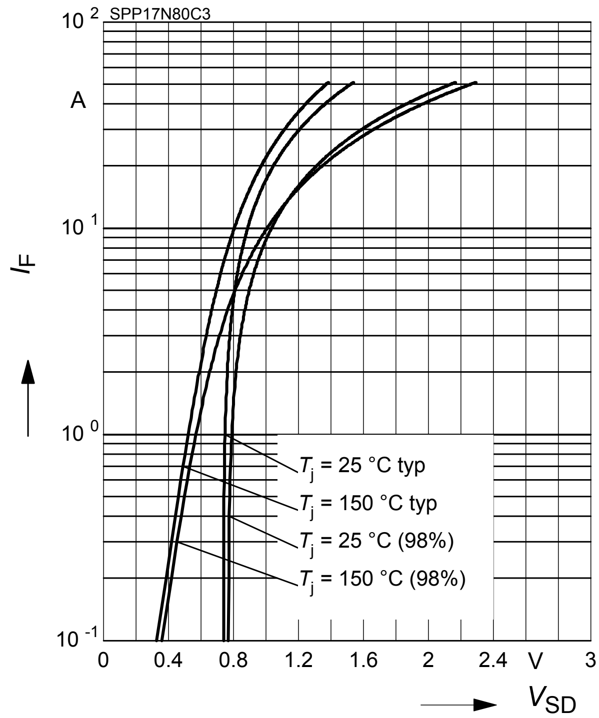
parameter: $I_D$ = 17 A pulsed



### 13 Forward characteristics of body diode

$I_F = f(V_{SD})$

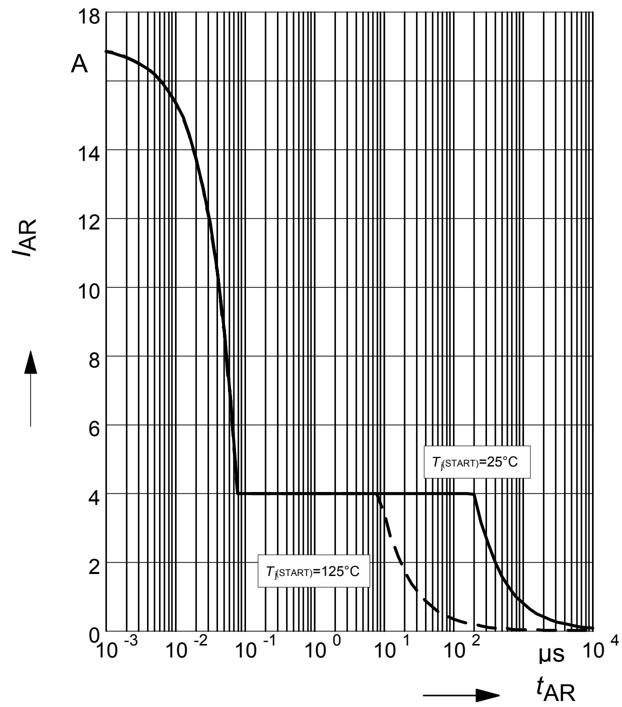
parameter: $T_j$ , $t_p$ = 10 µs




### 14 Avalanche SOA

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

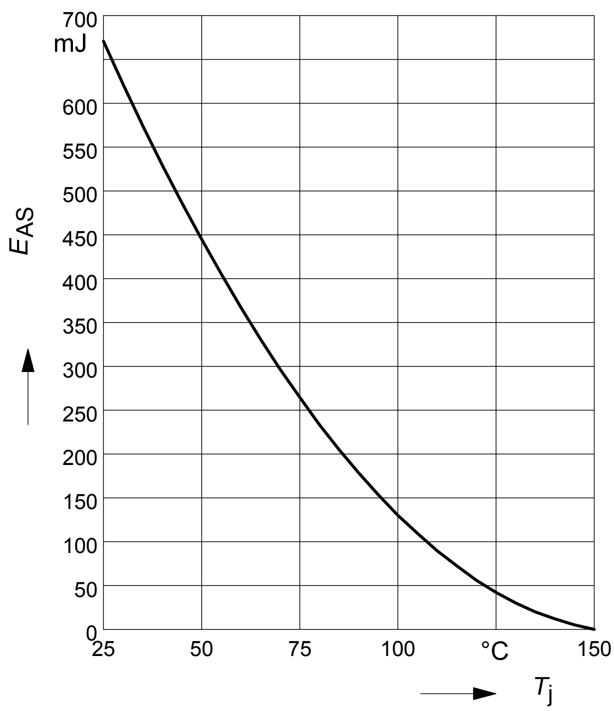
par.: $T_j \leq$ 150 °C




### 15 Avalanche energy

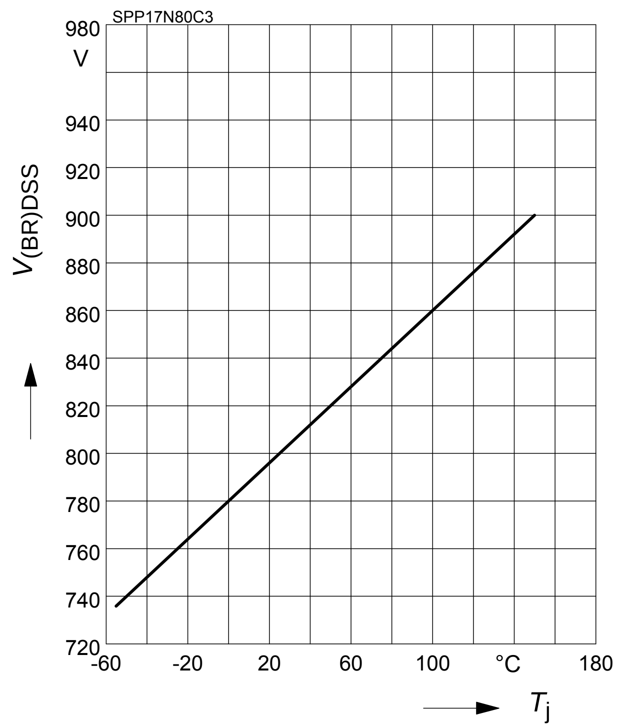
$E_{AS} = f(T_j)$

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




### 16 Drain-source breakdown voltage

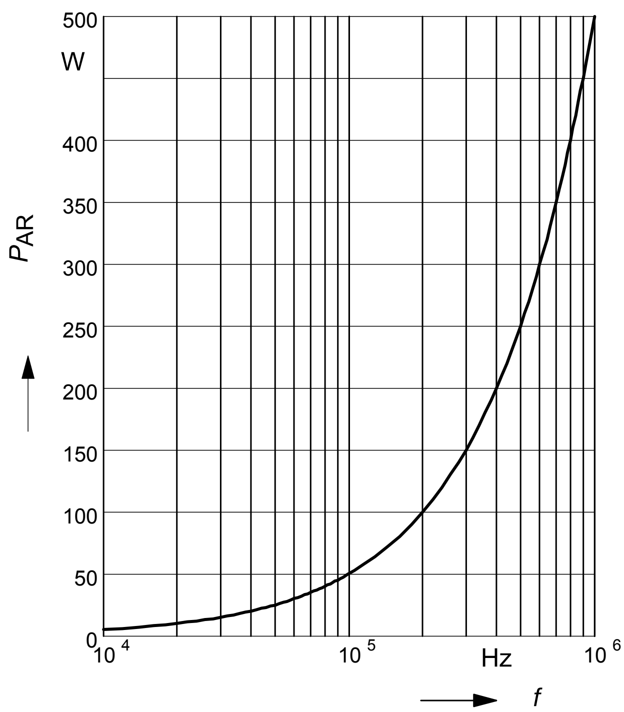
$V_{(BR)DSS} = f(T_j)$



**17 Avalanche power losses**

$P_{AR} = f(f)$

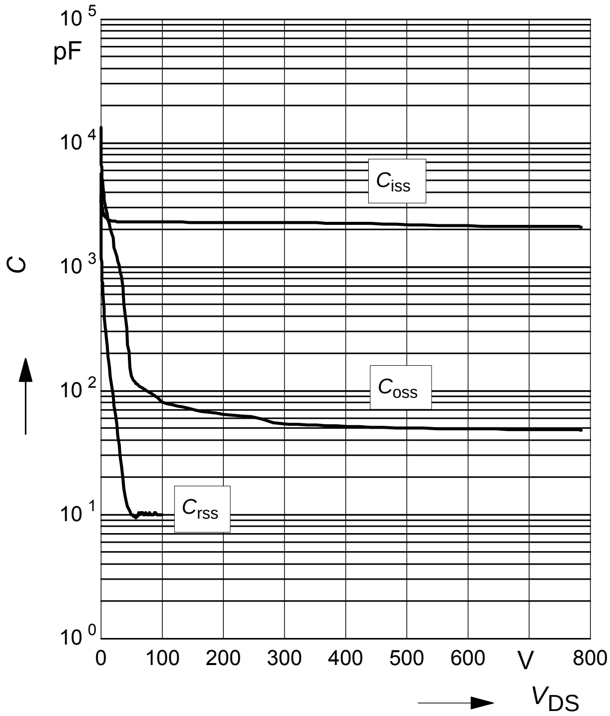
parameter: $E_{AR}$=0.5mJ




**18 Typ. capacitances**

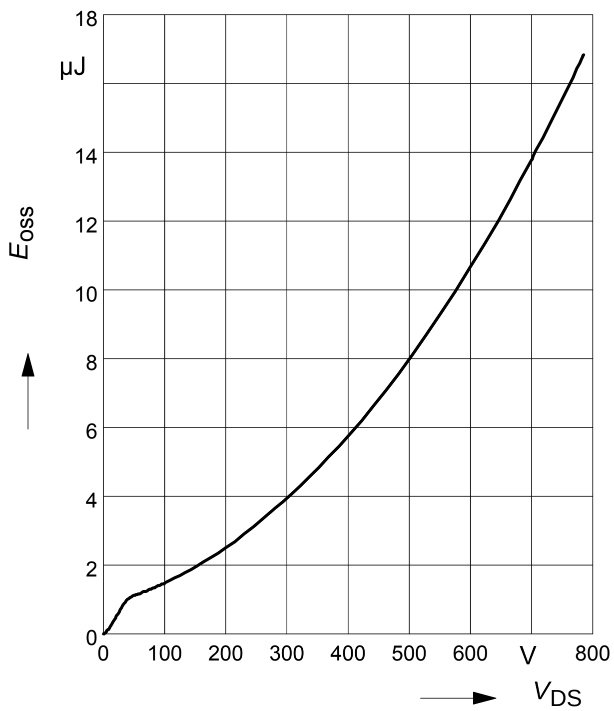
$C = f(V_{DS})$

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

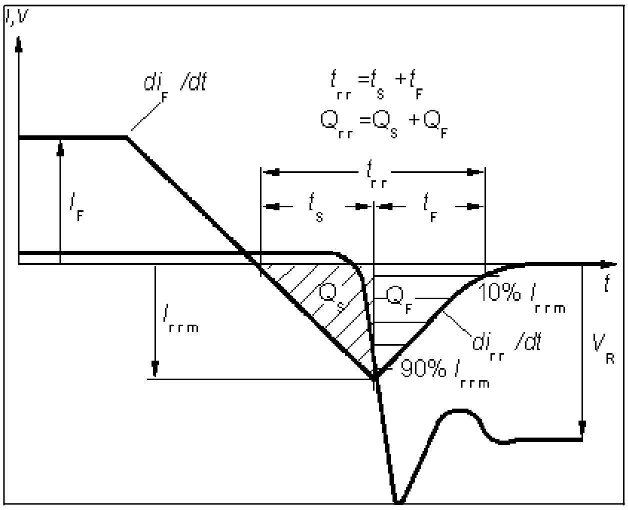



**19 Typ. $C_{oss}$ stored energy**

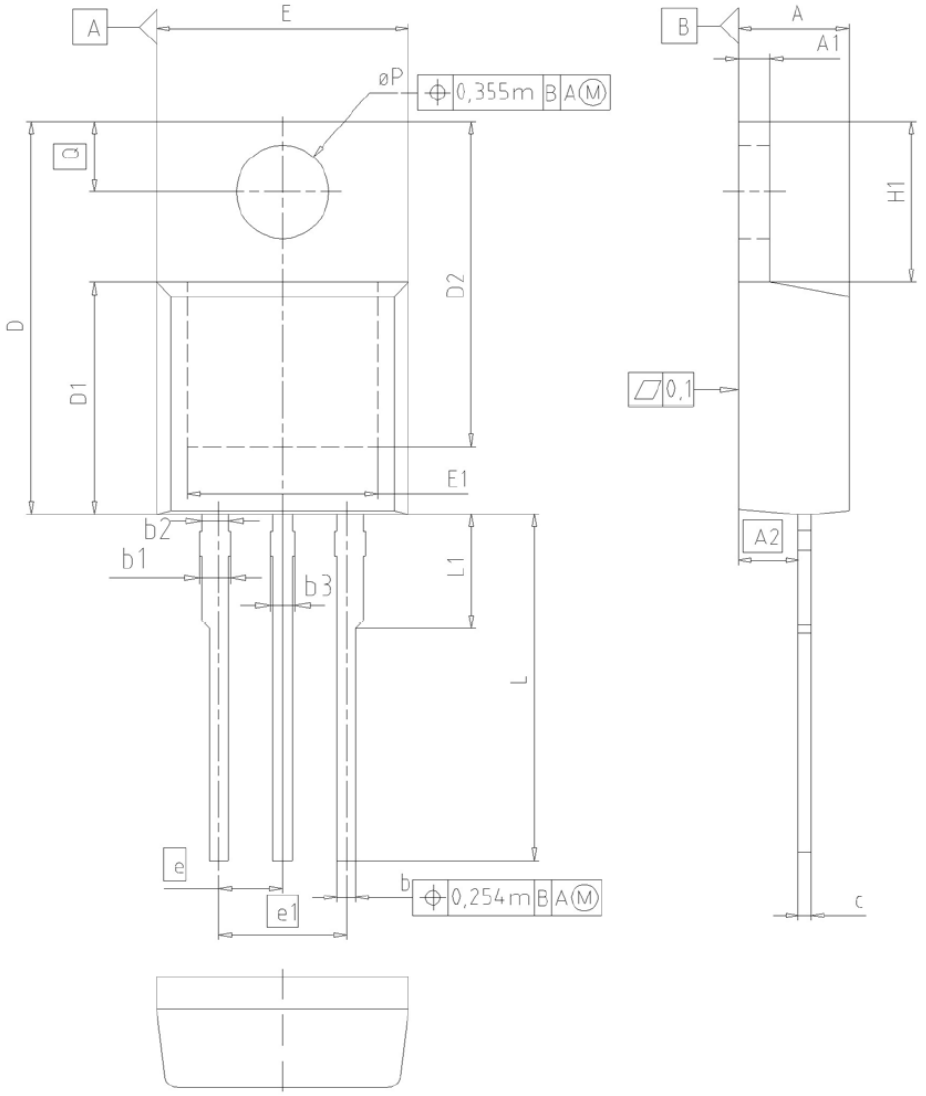
$E_{oss}=f(V_{DS})$



Definition of diodes switching characteristics



PG-TO220-3-1, PG-TO220-3-21




| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| **A** | 4.30 | 4.57 | 0.169 | 0.180 |
| **A1** | 1.17 | 1.40 | 0.046 | 0.055 |
| **A2** | 2.15 | 2.72 | 0.085 | 0.107 |
| **b** | 0.65 | 0.86 | 0.026 | 0.034 |
| **b1** | 0.95 | 1.40 | 0.037 | 0.055 |
| **b2** | 0.95 | 1.15 | 0.037 | 0.045 |
| **b3** | 0.65 | 1.15 | 0.026 | 0.045 |
| **c** | 0.33 | 0.60 | 0.013 | 0.024 |
| **D** | 14.81 | 15.95 | 0.583 | 0.628 |
| **D1** | 8.51 | 9.45 | 0.335 | 0.372 |
| **D2** | 12.19 | 13.10 | 0.480 | 0.516 |
| **E** | 9.70 | 10.36 | 0.382 | 0.408 |
| **E1** | 6.50 | 8.60 | 0.256 | 0.339 |
| **e** | 2.54 | | 0.100 | |
| **e1** | 5.08 | | 0.200 | |
| **N** | 3 | | 3 | |
| **H1** | 5.90 | 6.90 | 0.232 | 0.272 |
| **L** | 13.00 | 14.00 | 0.512 | 0.551 |
| **L1** | - | 4.80 | - | 0.189 |
| **øP** | 3.60 | 3.89 | 0.142 | 0.153 |
| **Q** | 2.60 | 3.00 | 0.102 | 0.118 |

**DOCUMENT NO.**
Z8B00003318

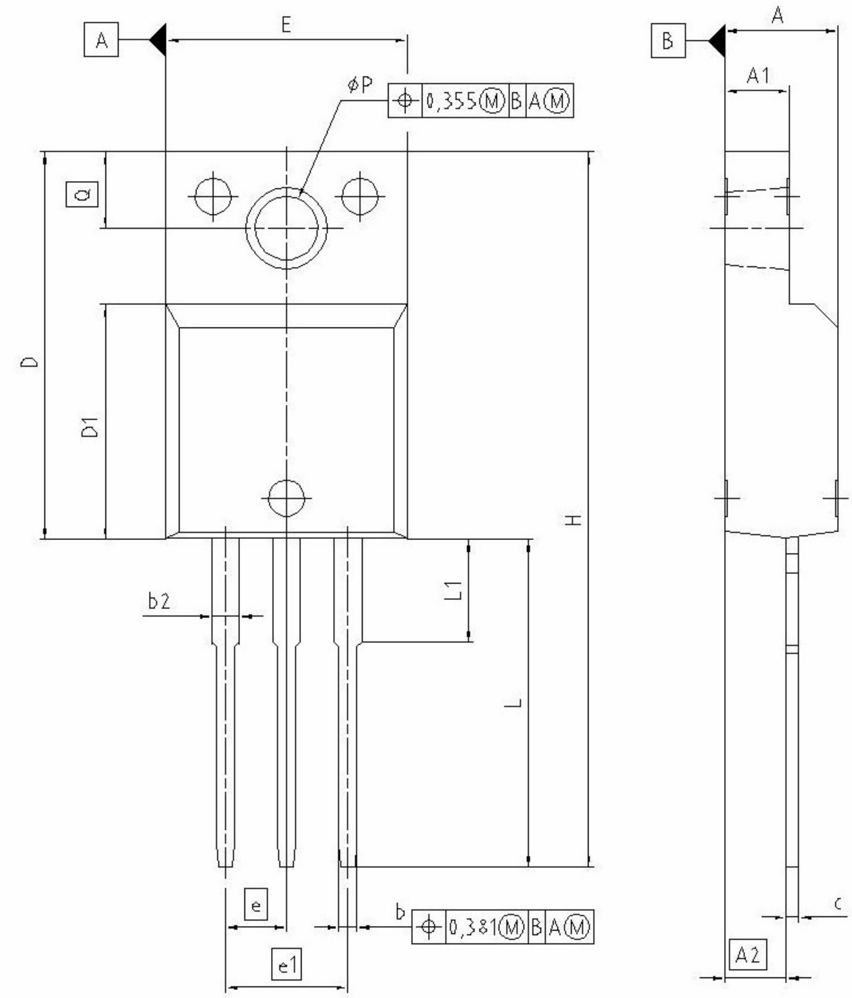
**SCALE** 0 2.5 5mm

**EUROPEAN PROJECTION**

**ISSUE DATE**
23-08-2007

**REVISION**
05

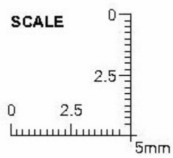
PG-TO220-3-31 (FullPAK)



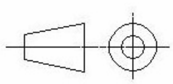

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 4.572 | 4.826 | 0.180 | 0.190 |
| A1 | 2.573 | 2.827 | 0.101 | 0.111 |
| A2 | 2.514 | 2.616 | 0.099 | 0.103 |
| b | 0.649 | 0.776 | 0.025 | 0.030 |
| b2 | 1.143 | 1.509 | 0.045 | 0.059 |
| c | 0.449 | 0.627 | 0.017 | 0.027 |
| D | 15.863 | 16.117 | 0.624 | 0.634 |
| D1 | 9.554 | 9.808 | 0.376 | 0.386 |
| E | 10.373 | 10.627 | 0.408 | 0.418 |
| e | 2.540 | | 0.100 | |
| e1 | 5.080 | | 0.200 | |
| N | 3 | | 3 | |
| H | 29.463 | 29.717 | 1.160 | 1.170 |
| L | 13.473 | 13.727 | 0.530 | 0.540 |
| L1 | 3.175 | 3.429 | 0.125 | 0.135 |
| øP | 2.949 | 3.025 | 0.119 | 0.116 |
| Q | 3.149 | 3.251 | 0.124 | 0.128 |

**REFERENCE**
../..

**SCALE**




**EUROPEAN PROJECTION**



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TO220_2

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