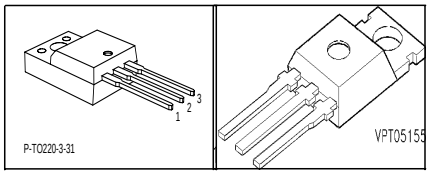
## Cool MOS™ Power Transistor

| | | |
|---|---|---|
| $V_{DS}$ | 800 | V |
| $R_{DS(on)}$ | 0.45 | Ω |
| $I_D$ | 11 | A |

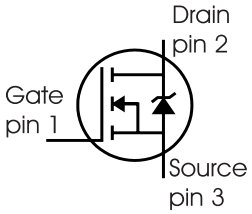
### Feature

- New revolutionary high voltage technology
- 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

PG-TO220-3-31 PG-TO220




| Type | Package | Ordering Code | Marking |
|---|---|---|---|
| SPP11N80C3 | PG-TO220 | Q67040-S4438 | 11N80C3 |
| SPA11N80C3 | PG-TO220-3-31 | SP000216320 | 11N80C3 |




### Maximum Ratings

| Parameter | Symbol | Value | | Unit |
|---|---|---|---|---|
| | | SPP | SPA | |
| Continuous drain current | $I_D$ | | | A |
| $T_C$ = 25 °C | | 11 | 11[1)] | |
| $T_C$ = 100 °C | | 7.1 | 7.1[1)] | |
| Pulsed drain current, $t_p$ limited by $T_{jmax}$ | $I_{D\ puls}$ | 33 | 33 | A |
| Avalanche energy, single pulse | $E_{AS}$ | 470 | 470 | mJ |
| $I_D$=2.2A, $V_{DD}$=50V | | | | |
| Avalanche energy, repetitive $t_{AR}$ limited by $T_{jmax}$[2)] | $E_{AR}$ | 0.2 | 0.2 | |
| $I_D$=11A, $V_{DD}$=50V | | | | |
| Avalanche current, repetitive $t_{AR}$ limited by $T_{jmax}$ | $I_{AR}$ | 11 | 11 | 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 | $P_{tot}$ | 156 | 41 | 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, $I_D$ = 11 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 | $R_{thJC}$ | - | - | 0.8 | 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, wavesoldering<br>1.6 mm (0.063 in.) from case for 10s [3] | $T_{sold}$ | - | - | 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, $I_D$=11A | - | 870 | - | |
| Gate threshold voltage | $V_{GS(th)}$ | $I_D$=680µA, $V_{GS}$=$V_{DS}$ | 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 | 20 | |
| | | $T_j$=150°C | - | - | 200 | |
| 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, $I_D$=7.1A | | | | Ω |
| | | $T_j$=25°C | - | 0.39 | 0.45 | |
| | | $T_j$=150°C | - | 1.1 | - | |
| Gate input resistance | $R_G$ | $f$=1MHz, open drain | - | 0.7 | - | |

## Electrical Characteristics

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| Transconductance | $g_{fs}$ | $V_{DS}\geq 2*I_D*R_{DS(on)max}$, $I_D$=7.1A | - | 7.5 | - | S |
| Input capacitance | $C_{iss}$ | $V_{GS}$=0V, $V_{DS}$=25V, $f$=1MHz | - | 1600 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 800 | - | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 40 | - | |
| Effective output capacitance,[4] energy related | $C_{o(er)}$ | $V_{GS}$=0V, $V_{DS}$=0V to 480V | - | 44.3 | - | |
| Effective output capacitance,[5] time related | $C_{o(tr)}$ | | - | 33.9 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$=400V, $V_{GS}$=0/10V, $I_D$=11A, $R_G$=7.5Ω | - | 25 | - | ns |
| Rise time | $t_r$ | | - | 15 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 72 | 82 | |
| Fall time | $t_f$ | | - | 7 | 10 | |

## Gate Charge Characteristics

| | | | | | | |
|---|---|---|---|---|---|---|
| Gate to source charge | $Q_{gs}$ | $V_{DD}$=640V, $I_D$=11A | - | 6 | - | nC |
| Gate to drain charge | $Q_{gd}$ | | - | 25 | - | |
| Gate charge total | $Q_g$ | $V_{DD}$=640V, $I_D$=11A, $V_{GS}$=0 to 10V | - | 50 | 60 | |
| Gate plateau voltage | $V_{(plateau)}$ | $V_{DD}$=640V, $I_D$=11A | - | 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] Soldering temperature for TO-263: 220°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% $V_{DSS}$.

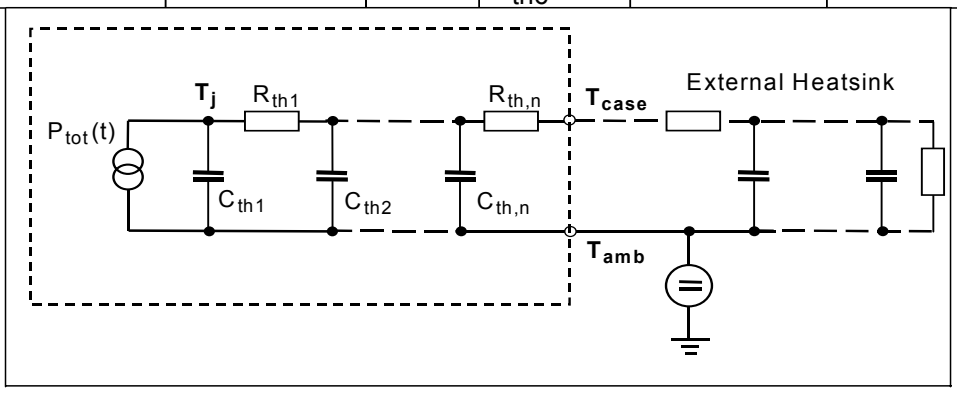
[5] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.

## Electrical Characteristics

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| Inverse diode continuous forward current | $I_S$ | $T_C$=25°C | - | - | 11 | A |
| Inverse diode direct current, pulsed | $I_{SM}$ | | - | - | 33 | |
| Inverse diode forward voltage | $V_{SD}$ | $V_{GS}$=0V, $I_F$=$I_S$ | - | 1 | 1.2 | V |
| Reverse recovery time | $t_{rr}$ | $V_R$=640V, $I_F$=$I_S$ , d$i_F$/d$t$=100A/µs | - | 550 | - | ns |
| Reverse recovery charge | $Q_{rr}$ | | - | 10 | - | µC |
| Peak reverse recovery current | $I_{rrm}$ | | - | 33 | - | A |
| Peak rate of fall of reverse recovery current | $di_{rr}/dt$ | $T_j$=25°C | - | 1000 | - | A/µs |

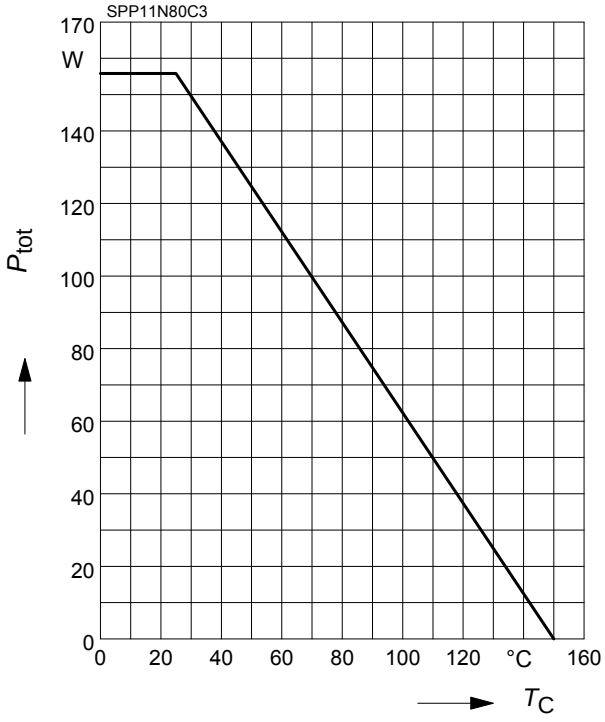
## Typical Transient Thermal Characteristics

| Symbol | Value | | Unit | Symbol | Value | | Unit |
|---|---|---|---|---|---|---|---|
| | SPP | SPA | | | SPP | SPA | |
| $R_{th1}$ | 0.012 | 0.012 | K/W | $C_{th1}$ | 0.0002493 | 0.0002493 | Ws/K |
| $R_{th2}$ | 0.023 | 0.023 | | $C_{th2}$ | 0.0009399 | 0.0009399 | |
| $R_{th3}$ | 0.043 | 0.043 | | $C_{th3}$ | 0.001298 | 0.001298 | |
| $R_{th4}$ | 0.154 | 0.176 | | $C_{th4}$ | 0.003617 | 0.003617 | |
| $R_{th5}$ | 0.175 | 0.371 | | $C_{th5}$ | 0.009186 | 0.00802 | |
| $R_{th6}$ | 0.071 | 2.522 | | $C_{th6}$ | 0.074 | 0.412 | |



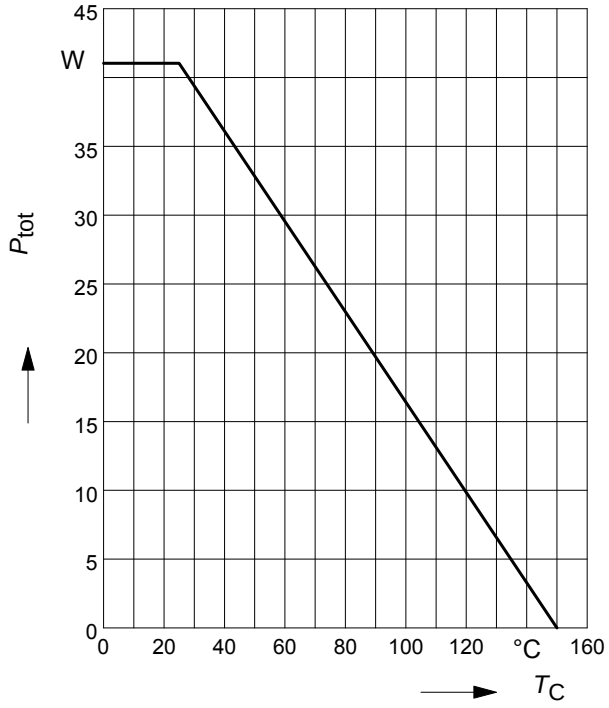
## 1 Power dissipation

$P_{tot} = f(T_C)$




## 2 Power dissipation FullPAK

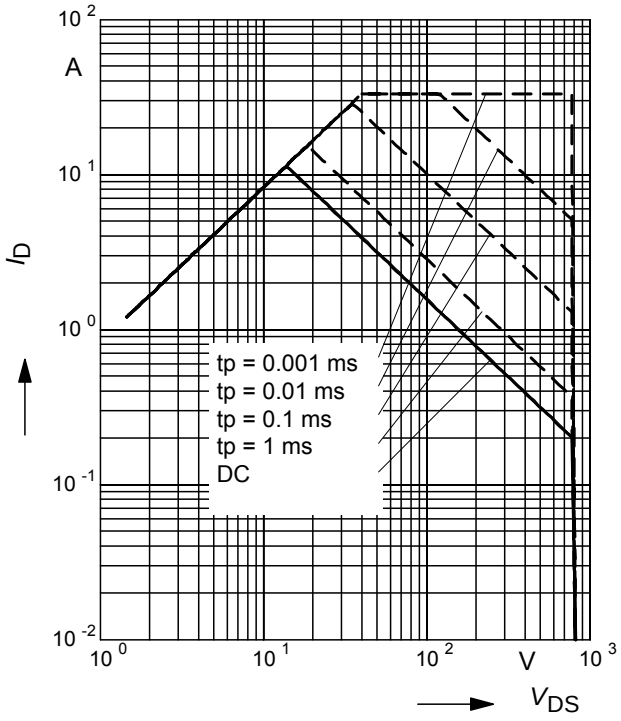
$P_{tot} = f(T_C)$




## 3 Safe operating area

$I_D = f(V_{DS})$

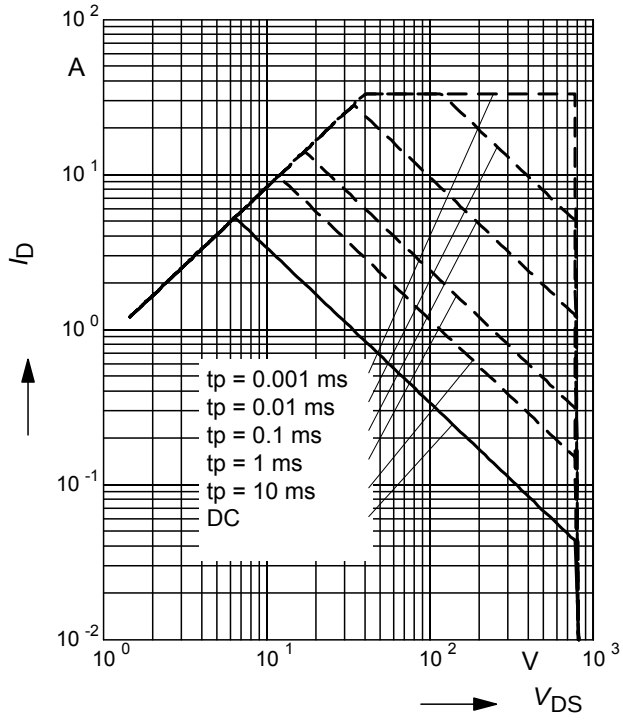
parameter : $D = 0$ , $T_C$=25°C




## 4 Safe operating area FullPAK

$I_D = f(V_{DS})$

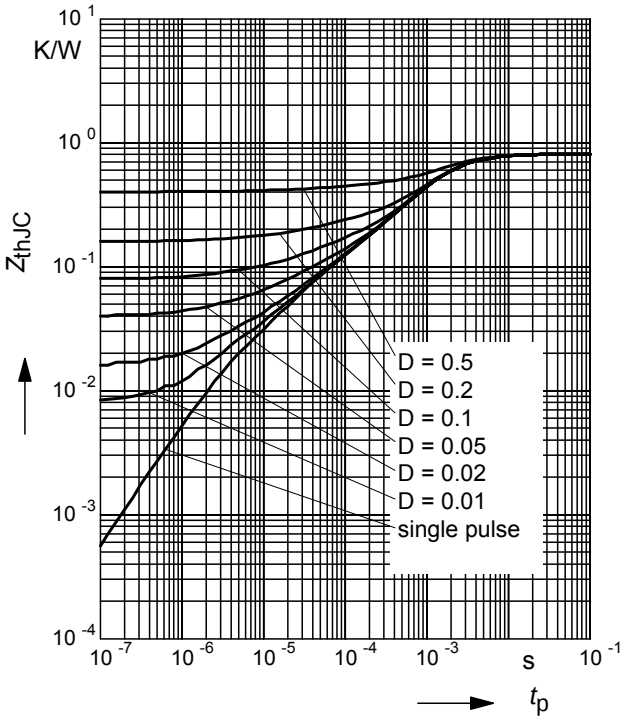
parameter: $D = 0$, $T_C = 25°C$



## 5 Transient thermal impedance

$Z_{thJC} = f(t_p)$

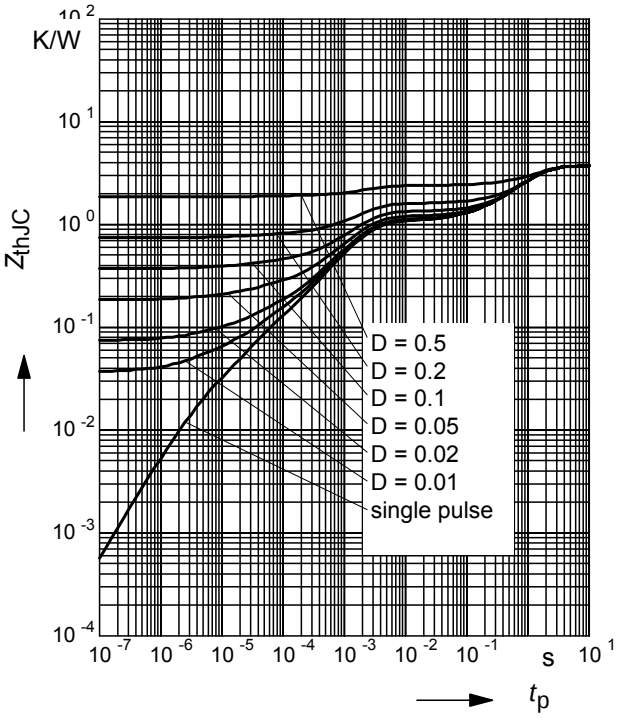
parameter: $D = t_p/T$




## 6 Transient thermal impedance FullPAK

$Z_{thJC} = f(t_p)$

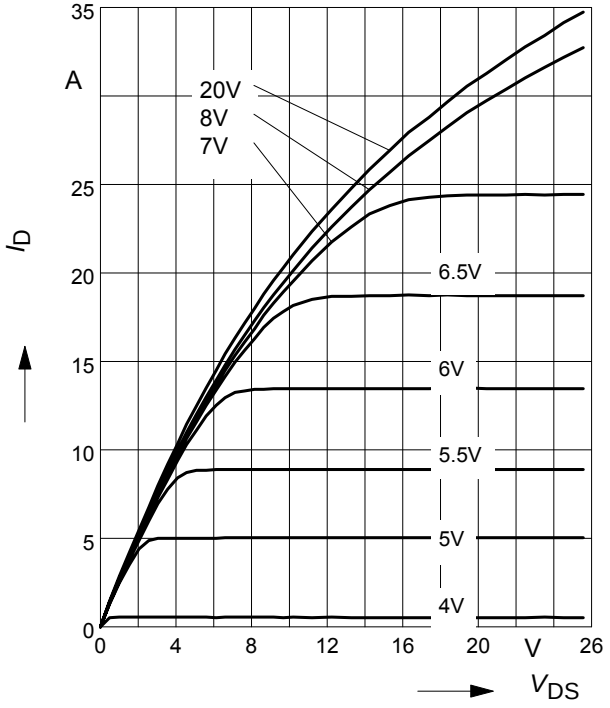
parameter: $D = t_p/t$




## 7 Typ. output characteristic

$I_D = f(V_{DS})$; $T_j$=25°C

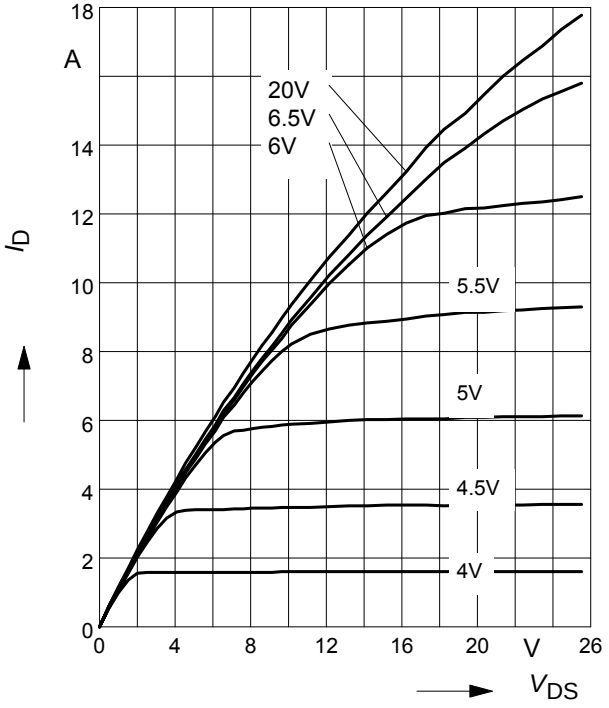
parameter: $t_p$ = 10 µs, $V_{GS}$




## 8 Typ. output characteristic

$I_D = f(V_{DS})$; $T_j$=150°C

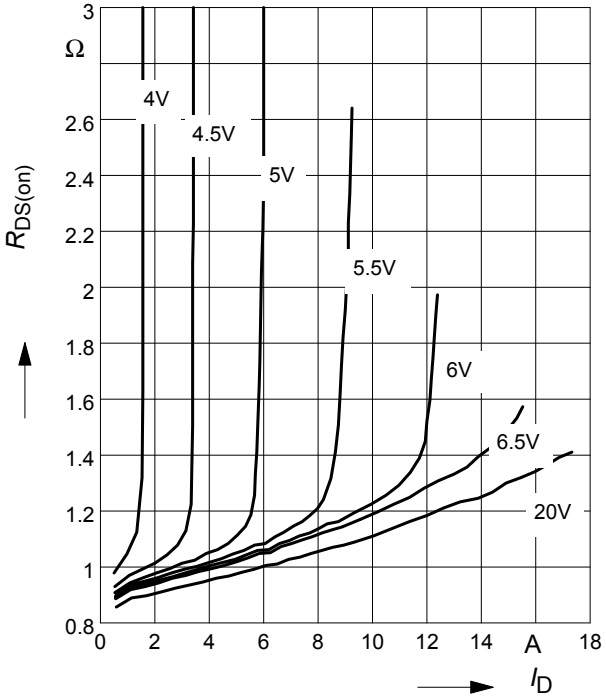
parameter: $t_p$ = 10 µs, $V_{GS}$



## 9 Typ. drain-source on resistance

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

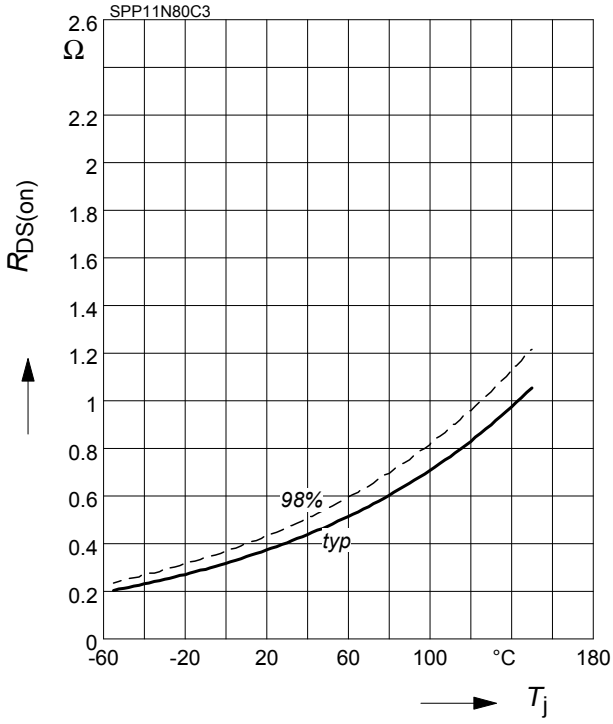
parameter: $T_j$=150°C, $V_{GS}$




## 10 Drain-source on-state resistance

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

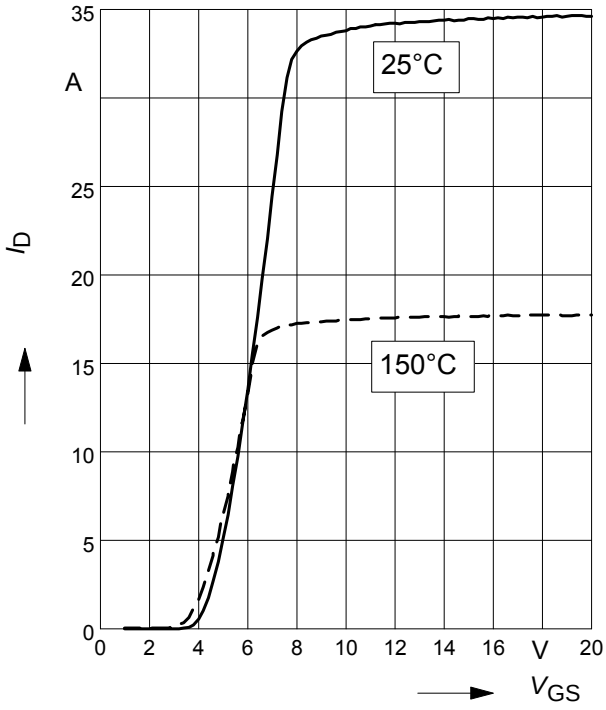
parameter : $I_D$ = 7.1 A, $V_{GS}$ = 10 V




## 11 Typ. transfer characteristics

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

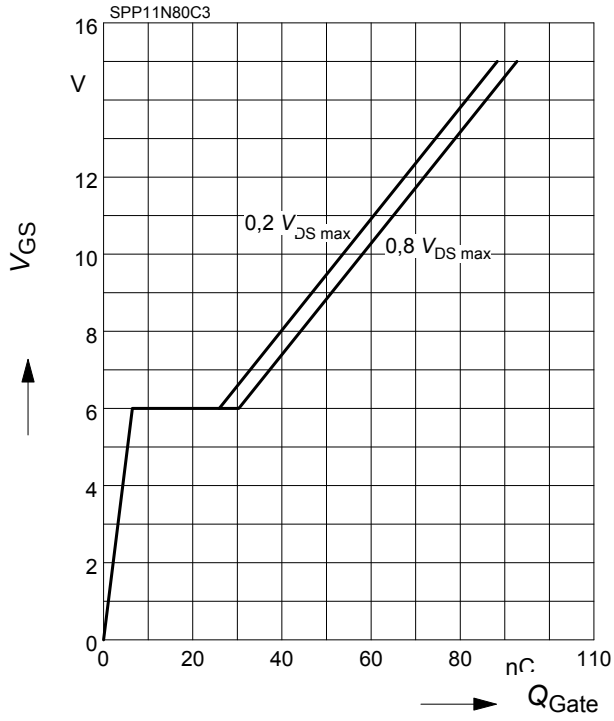
parameter: $t_p$ = 10 µs




## 12 Typ. gate charge

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

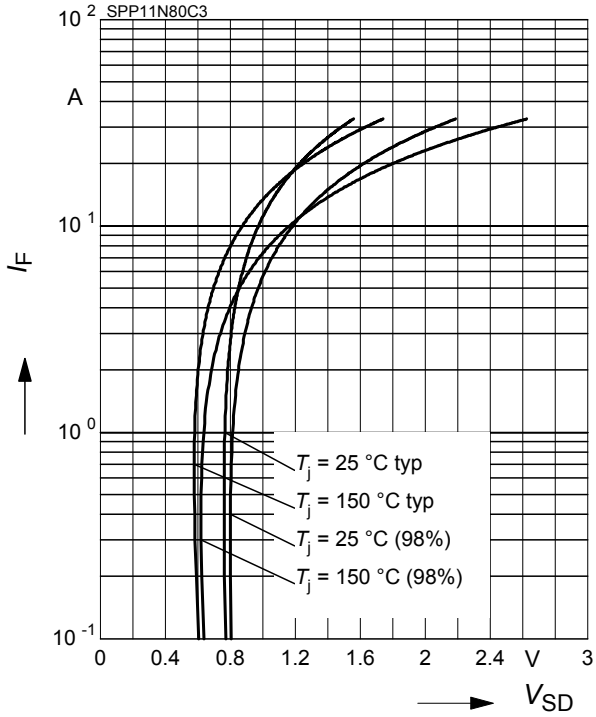
parameter: $I_D$ = 11 A pulsed



## 13 Forward characteristics of body diode

$I_F = f(V_{SD})$

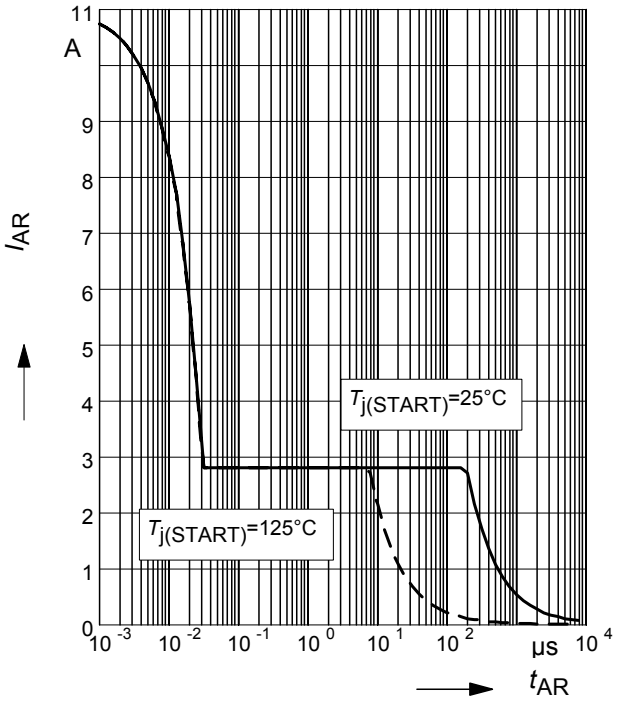
parameter: $T_j$ , tp = 10 µs




## 14 Avalanche SOA

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

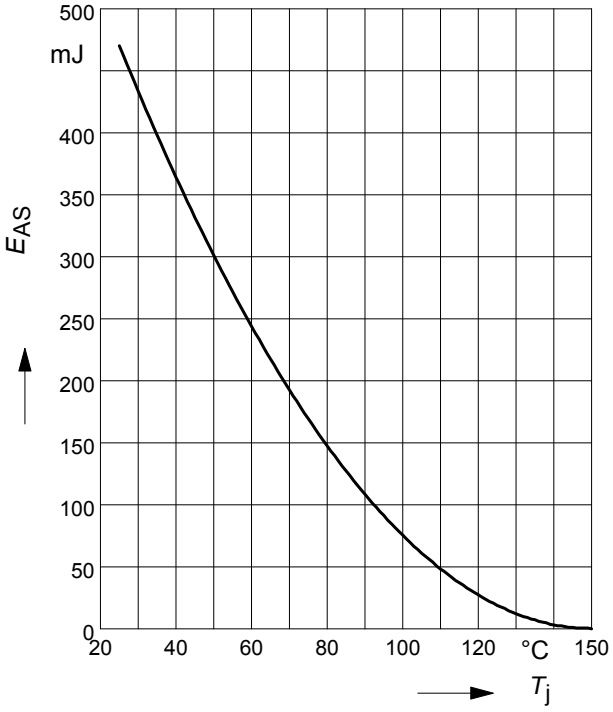
par.: $T_j \leq 150$ °C




## 15 Avalanche energy

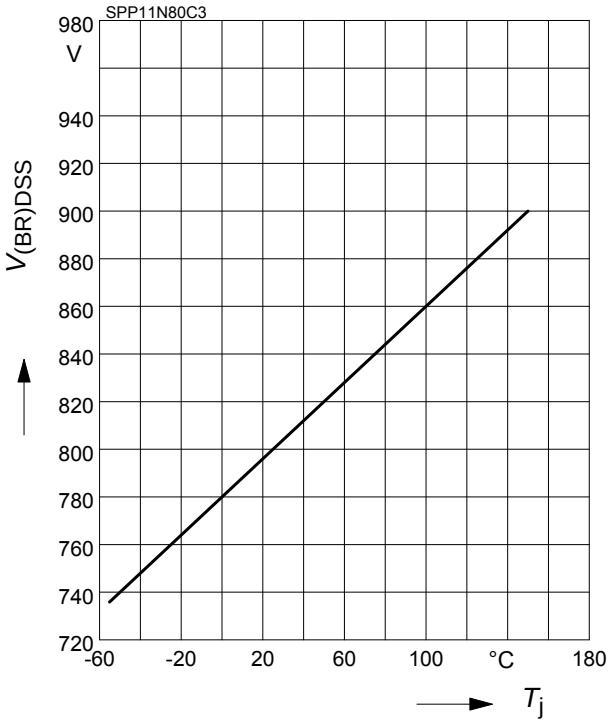
$E_{AS} = f(T_j)$

par.: $I_D$ = 2.2 A, $V_{DD}$ = 50 V




## 16 Drain-source breakdown voltage

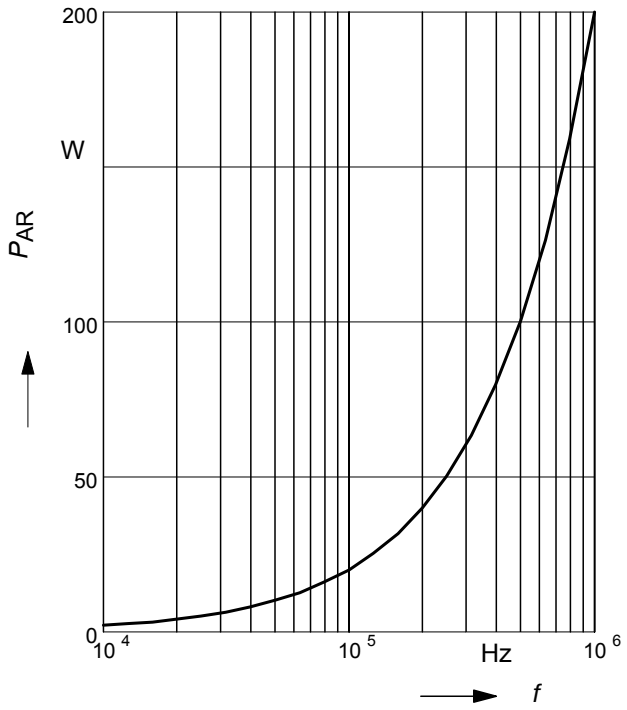
$V_{(BR)DSS} = f(T_j)$



## 17 Avalanche power losses

$P_{AR} = f(f)$

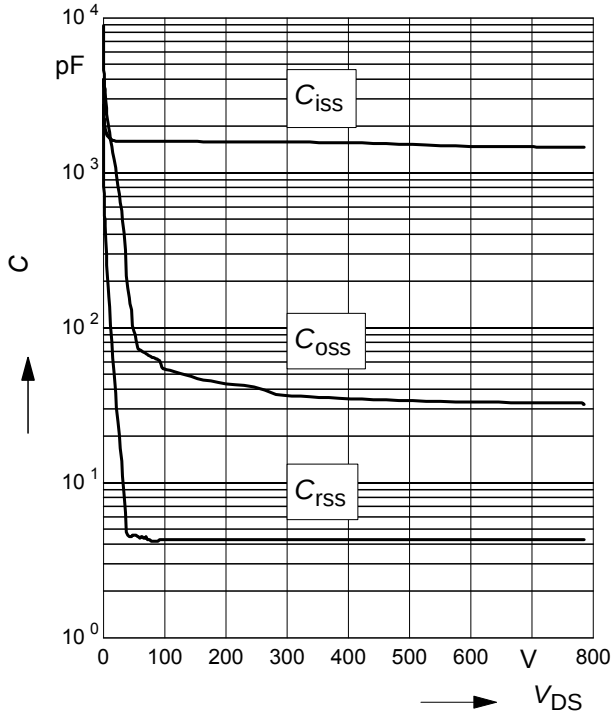
parameter: $E_{AR}$=0.2mJ




## 18 Typ. capacitances

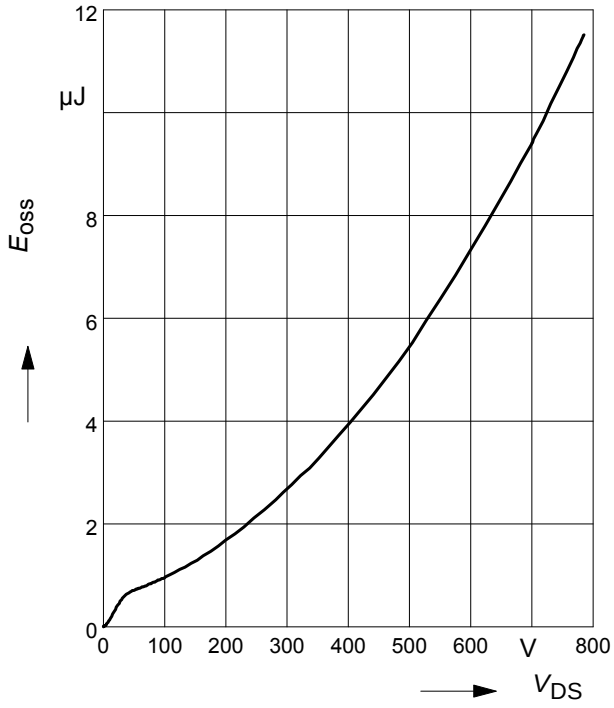
$C = f(V_{DS})$

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

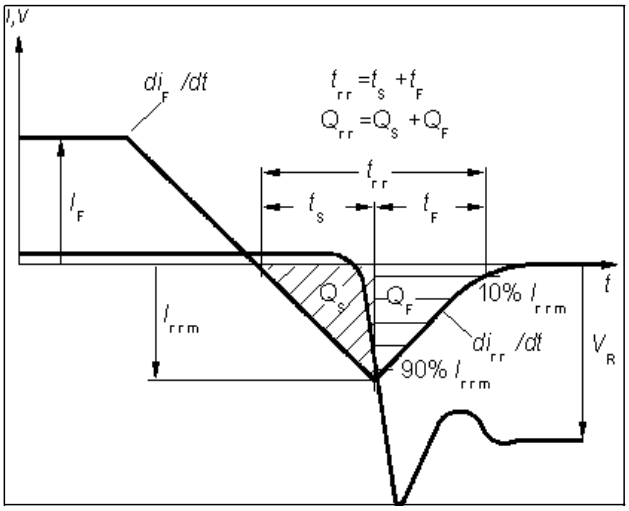



## 19 Typ. $C_{oss}$ stored energy

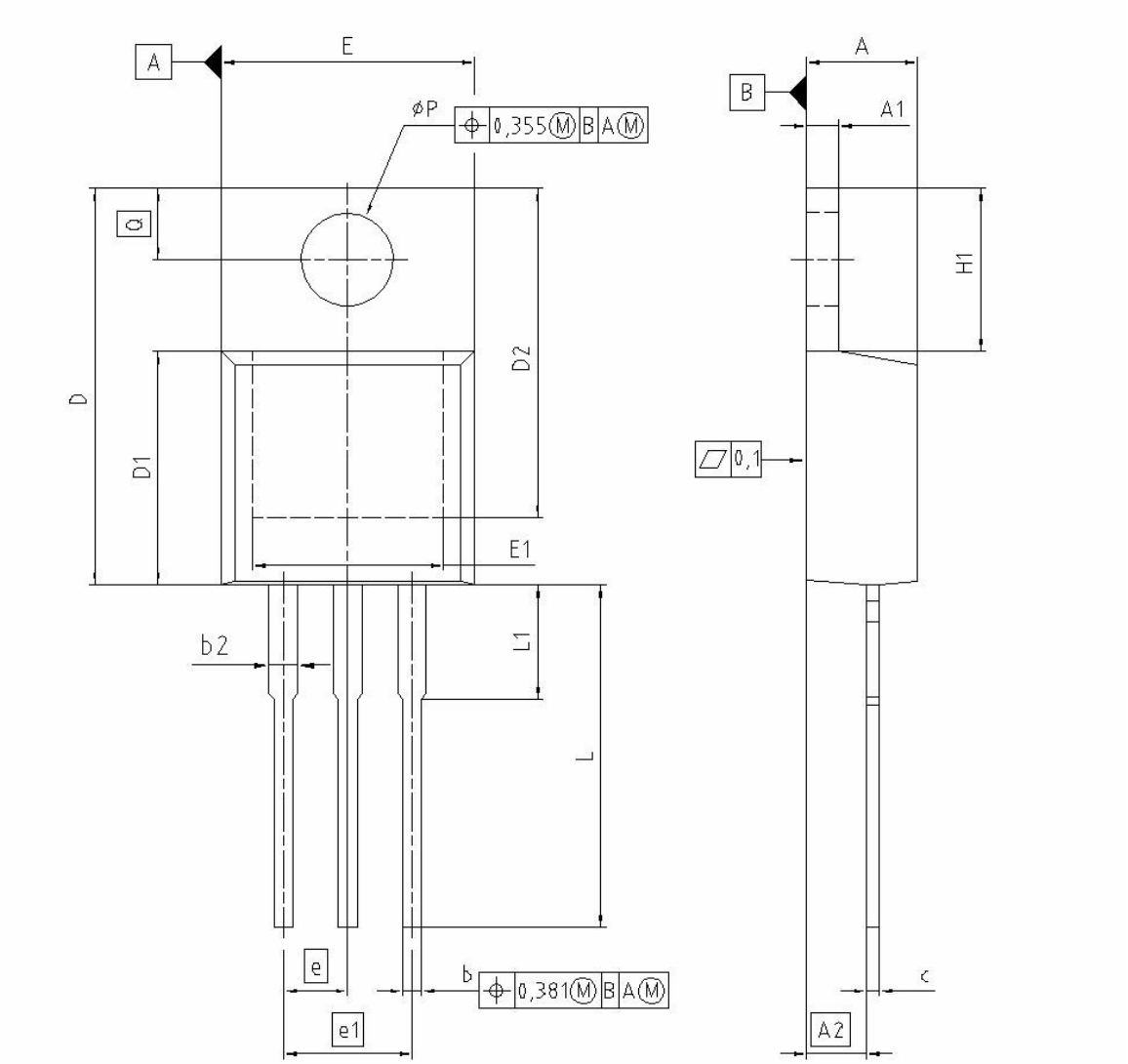
$E_{oss}=f(V_{DS})$



Definition of diodes switching characteristics



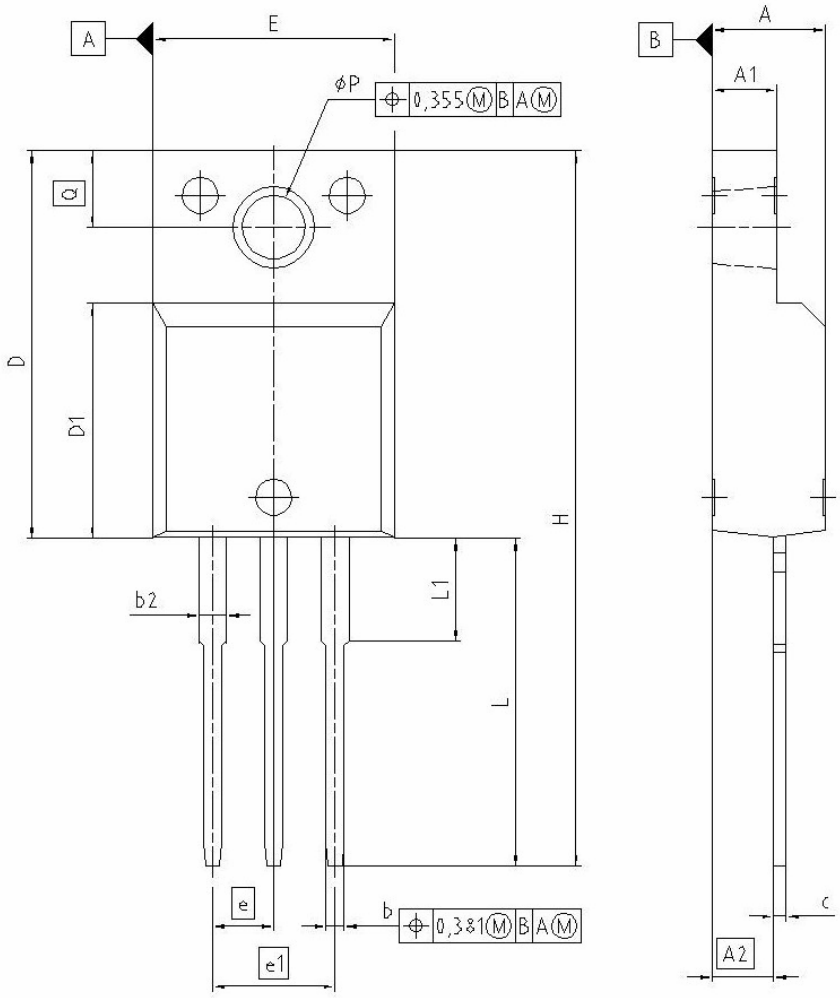
PG-TO220-3-1, PG-TO220-3-21



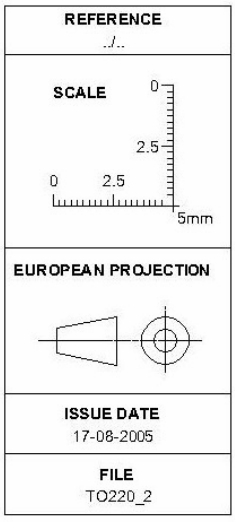

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 4.300 | 4.572 | 0.169 | 0.180 |
| A1 | 1.170 | 1.400 | 0.046 | 0.055 |
| A2 | 2.215 | 2.718 | 0.087 | 0.107 |
| b | 0.650 | 0.864 | 0.026 | 0.034 |
| b2 | 0.635 | 1.778 | 0.025 | 0.070 |
| c | 0.330 | 0.600 | 0.013 | 0.024 |
| D | 14.808 | 15.950 | 0.583 | 0.628 |
| D1 | 8.509 | 9.450 | 0.335 | 0.372 |
| D2 | 12.850 | 13.100 | 0.506 | 0.516 |
| E | 9.700 | 10.363 | 0.382 | 0.408 |
| E1 | 6.500 | 8.600 | 0.256 | 0.339 |
| e | 2.540 | | 0.100 | |
| e1 | 5.080 | | 0.200 | |
| N | 3 | | 3 | |
| H1 | 5.900 | 6.900 | 0.232 | 0.272 |
| L | 13.000 | 14.000 | 0.512 | 0.551 |
| L1 | - | 4.800 | - | 0.189 |
| øP | 3.700 | 3.886 | 0.146 | 0.153 |
| Q | 2.600 | 3.000 | 0.102 | 0.118 |

| |
|---|
| REFERENCE<br>JEDEC TO220 |
| SCALE<br>0 2.5 5mm |
| EUROPEAN PROJECTION |
| ISSUE DATE<br>01-06-2005 |
| FILE<br>TO220_1 |

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 |



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