



IPB120N06N G

IPP120N06N G



## OptiMOS<sup>®</sup> Power-Transistor

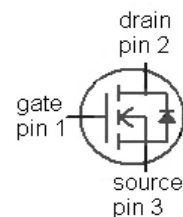
### Features

- For fast switching converters and sync. rectification
- N-channel enhancement - normal level
- 175 °C operating temperature
- Avalanche rated
- Pb-free lead plating, RoHS compliant

### Product Summary

|                             |      |            |
|-----------------------------|------|------------|
| $V_{DS}$                    | 60   | V          |
| $R_{DS(on),max}$ SMDversion | 11.7 | m $\Omega$ |
| $I_D$                       | 75   | A          |

| Type    | IPP120N06N G   | IPB120N06N G   |
|---------|--|--|
|         |  |  |
| Package | P-TO220-3-1  | P-TO263-3-2  |
| Marking | 120N06N  | 120N06N  |



Maximum ratings, at  $T_j=25\text{ °C}$ , unless otherwise specified

| Parameter                           | Symbol            | Conditions  | Value       | Unit               |
|-------------------------------------|-------------------|---|-------------|--------------------|
| Continuous drain current            | $I_D$             | $T_C=25\text{ °C}$  | 75          | A                  |
|                                     |                   | $T_C=100\text{ °C}$   | 53          |                    |
| Pulsed drain current                | $I_{D,pulse}$     | $T_C=25\text{ °C}^{1)}$   | 300         |                    |
| Avalanche energy, single pulse      | $E_{AS}$          | $I_D=75\text{ A}$ , $R_{GS}=25\text{ }\Omega$   | 280         | mJ                 |
| Reverse diode $dv/dt$               | $dv/dt$           | $I_D=75\text{ A}$ , $V_{DS}=48\text{ V}$ ,<br>$di/dt=200\text{ A}/\mu\text{s}$ ,<br>$T_{j,max}=175\text{ °C}$ | 6           | kV/ $\mu\text{s}$  |
| Gate source voltage                 | $V_{GS}$          |   | $\pm 20$    | V                  |
| Power dissipation                   | $P_{tot}$         | $T_C=25\text{ °C}$  | 158         | W                  |
| Operating and storage temperature   | $T_j$ , $T_{stg}$ |   | -55 ... 175 | $^{\circ}\text{C}$ |
| IEC climatic category; DIN IEC 68-1 |                   |   | 55/175/56   |                    |

<sup>1)</sup> See figure 3



| Parameter                           | Symbol     | Conditions                                   | Values |      |      | Unit |
|-------------------------------------|------------|--|--------|------|------|------|
|                                     |            |  | min.   | typ. | max. |      |
| <b>Thermal characteristics</b>      |            |  |        |      |      |      |
| Thermal resistance, junction - case | $R_{thJC}$ |  | -      | -    | 0.95 | K/W  |
| SMD version, device on PCB          | $R_{thJA}$ | minimal footprint                            | -      | -    | 62   |      |
|                                     |            | 6 cm <sup>2</sup> cooling area <sup>2)</sup> | -      | -    | 40   |      |

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

### Static characteristics

|                                  |               |  |     |      |      |               |
|----------------------------------|---------------|--|-----|------|------|---------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=1\text{ mA}$                                   | 60  | -    | -    | V             |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=94\text{ }\mu\text{A}$                             | 1.2 | 3    | 2    |               |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=60\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ }^\circ\text{C}$  | -   | 0.01 | 1    | $\mu\text{A}$ |
|                                  |               | $V_{DS}=60\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ }^\circ\text{C}$ | -   | 1    | 100  |               |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=20\text{ V}, V_{DS}=60\text{ V}$                               | -   | 10   | 100  | nA            |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=10\text{ V}, I_D=75\text{ A}$                                  | -   | 9.9  | 12   | m $\Omega$    |
|                                  |               | $V_{GS}=10\text{ V}, I_D=75\text{ A},$<br>SMD version                  | -   | 9.6  | 11.7 |               |
| Gate resistance                  | $R_G$         |  | -   | 2    | -    | $\Omega$      |
| Transconductance                 | $g_{fs}$      | $ V_{DS} >2 I_D R_{DS(on)max},$<br>$I_D=75\text{ A}$                   | 36  | 72   | -    | S             |

<sup>2)</sup> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70  $\mu\text{m}$  thick) copper area for drain connection. PCB is vertical in still air.



| Parameter | Symbol | Conditions | Values |      |      | Unit |
|-----------|--------|------------|--------|------|------|------|
|           |        |            | min.   | typ. | max. |      |

**Dynamic characteristics**

|                              |              |   |   |      |      |    |
|------------------------------|--------------|---|---|------|------|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=30\text{ V},$<br>$f=1\text{ MHz}$                    | - | 1600 | 2100 | pF |
| Output capacitance           | $C_{oss}$    |   | - | 460  | 610  |    |
| Reverse transfer capacitance | $C_{rss}$    |   | - | 120  | 180  |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=30\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=75\text{ A}, R_G=6.2\ \Omega$ | - | 14   | 20   | ns |
| Rise time                    | $t_r$        |   | - | 27   | 40   |    |
| Turn-off delay time          | $t_{d(off)}$ |   | - | 34   | 50   |    |
| Fall time                    | $t_f$        |   | - | 26   | 39   |    |

**Gate Charge Characteristics<sup>3)</sup>**

|                          |               |  |   |     |    |    |
|--------------------------|---------------|--|---|-----|----|----|
| Gate to source charge    | $Q_{gs}$      | $V_{DD}=30\text{ V}, I_D=75\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$ | - | 9   | 12 | nC |
| Gate charge at threshold | $Q_{g(th)}$   |  | - | 5   | 6  |    |
| Gate to drain charge     | $Q_{gd}$      |  | - | 21  | 32 |    |
| Switching charge         | $Q_{sw}$      |  | - | 26  | 38 |    |
| Gate charge total        | $Q_g$         |  | - | 46  | 62 |    |
| Gate plateau voltage     | $V_{plateau}$ |  | - | 5.8 | -  | V  |
| Output charge            | $Q_{oss}$     | $V_{DD}=30\text{ V}, V_{GS}=10\text{ V}$                                   | - | 30  | 40 |    |

**Reverse Diode**

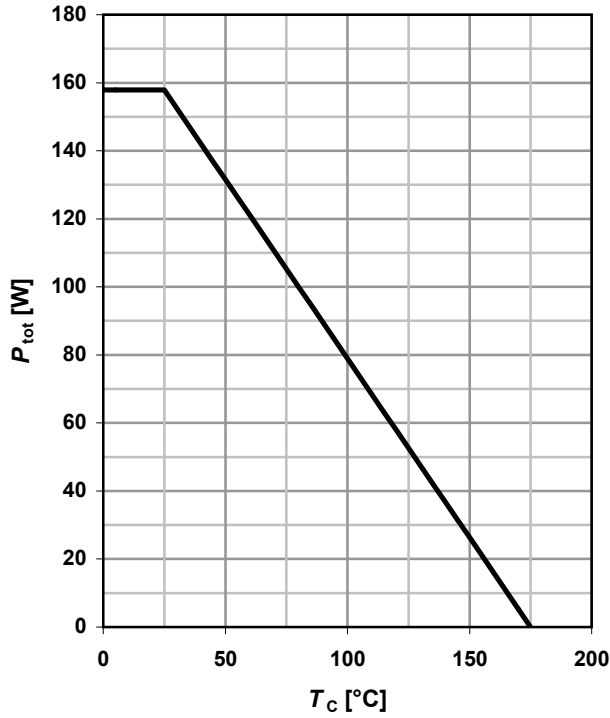
|                                  |               |   |   |    |     |    |
|----------------------------------|---------------|---|---|----|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ }^\circ\text{C}$  | - | -  | 75  | A  |
| Diode pulse current              | $I_{S,pulse}$ |   | - | -  | 300 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=75\text{ A},$<br>$T_J=25\text{ }^\circ\text{C}$ | - | 1  | 1.3 | V  |
| Reverse recovery time            | $t_{rr}$      | $V_R=30\text{ V}, I_F=I_S,$<br>$di_F/dt=100\text{ A}/\mu\text{s}$       | - | 45 | 60  | ns |
| Reverse recovery charge          | $Q_{rr}$      |   | - | 64 | 80  | nC |

<sup>3)</sup> See figure 16 for gate charge parameter definition



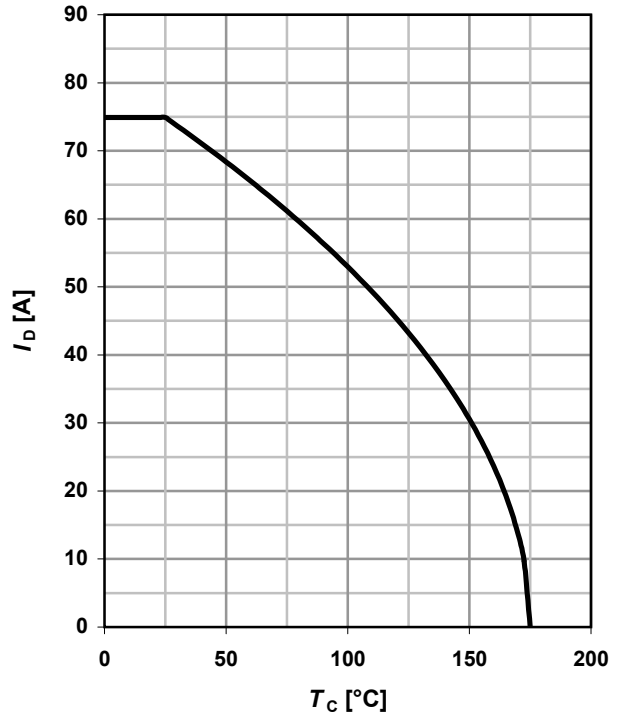
**1 Power dissipation**

$P_{tot}=f(T_C)$



**2 Drain current**

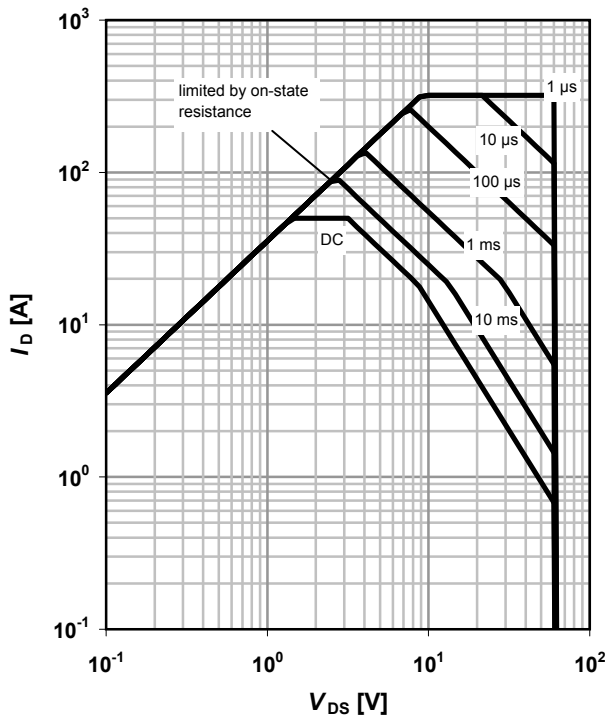
$I_D=f(T_C); V_{GS} \geq 10\text{ V}$



**3 Safe operating area**

$I_D=f(V_{DS}); T_C=25\text{ °C}; D=0$

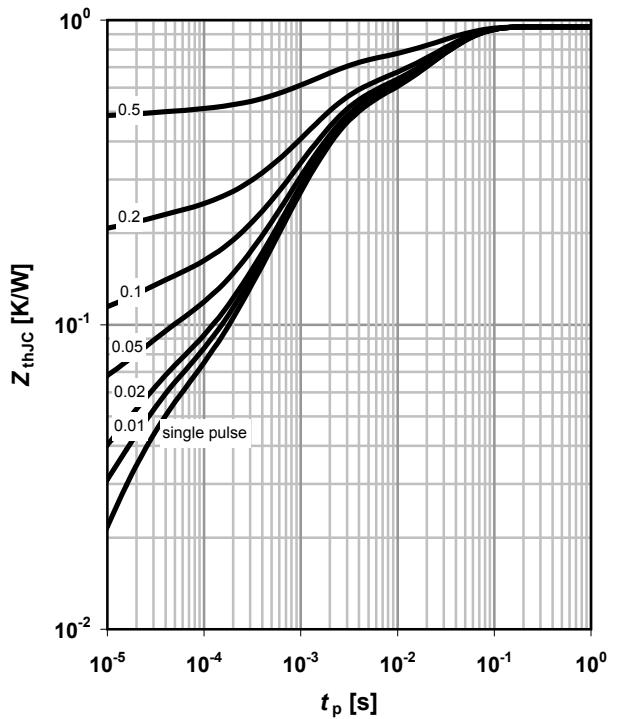
parameter:  $t_p$



**4 Max. transient thermal impedance**

$Z_{thJC}=f(t_p)$

parameter:  $D=t_p/T$

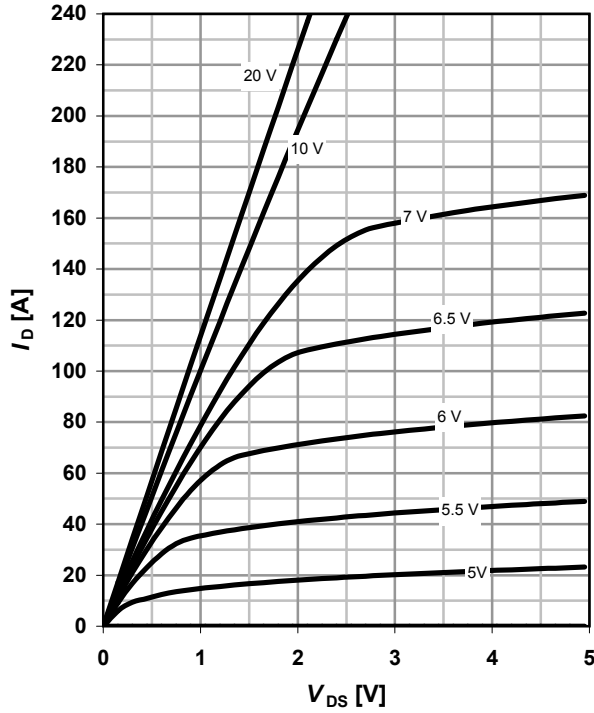




**5 Typ. output characteristics**

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

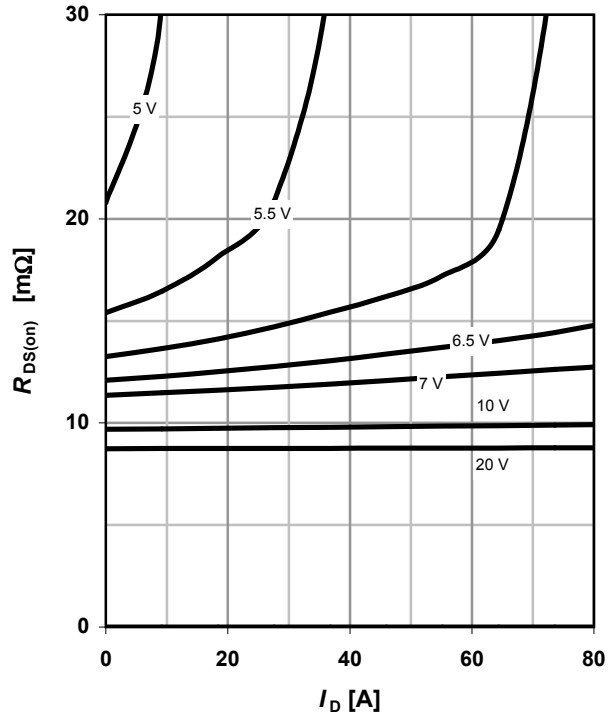
parameter:  $V_{GS}$



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

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

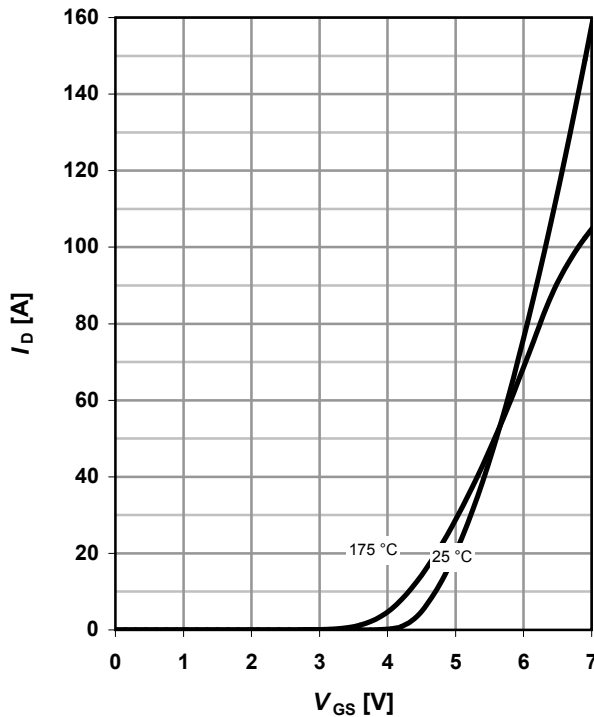
parameter:  $V_{GS}$



**7 Typ. transfer characteristics**

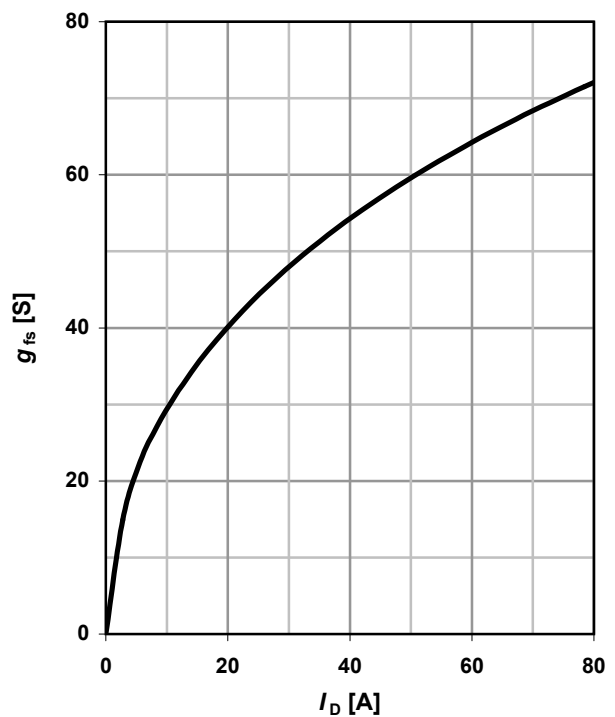
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter:  $T_j$



**8 Typ. forward transconductance**

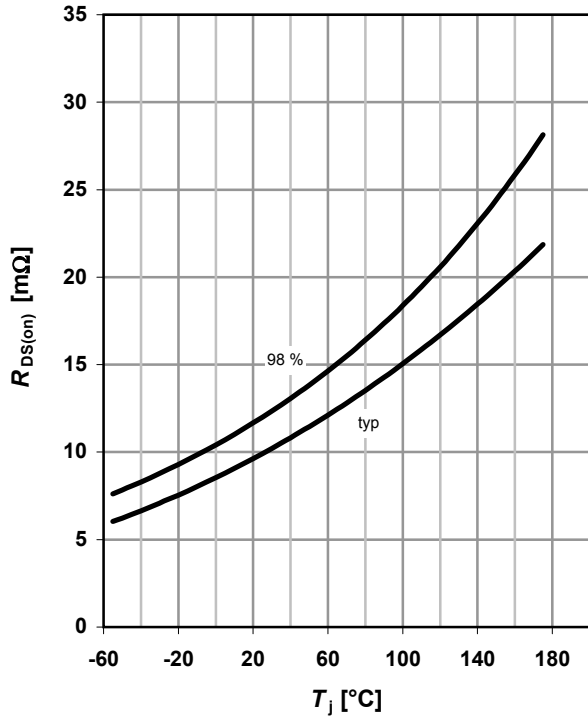
$g_{fs} = f(I_D); T_j = 25\text{ }^\circ\text{C}$





**9 Drain-source on-state resistance**

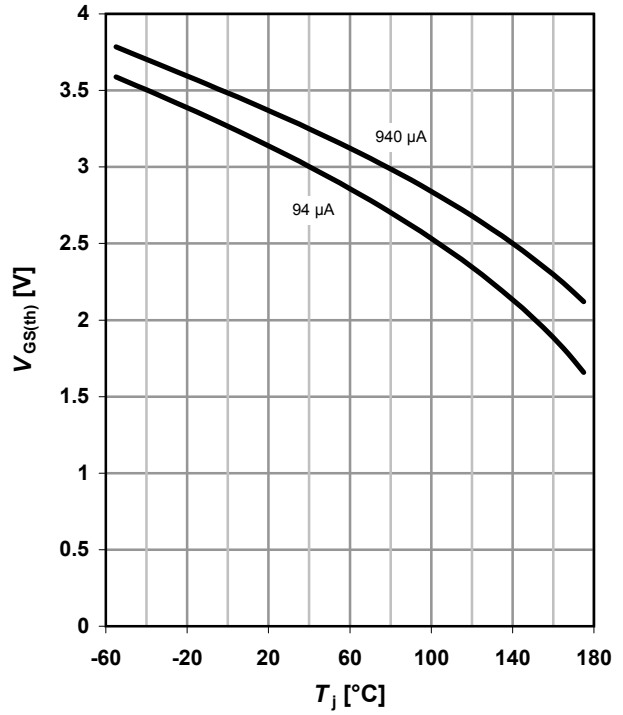
$R_{DS(on)}=f(T_j); I_D=75\text{ A}; V_{GS}=10\text{ V}$



**10 Typ. gate threshold voltage**

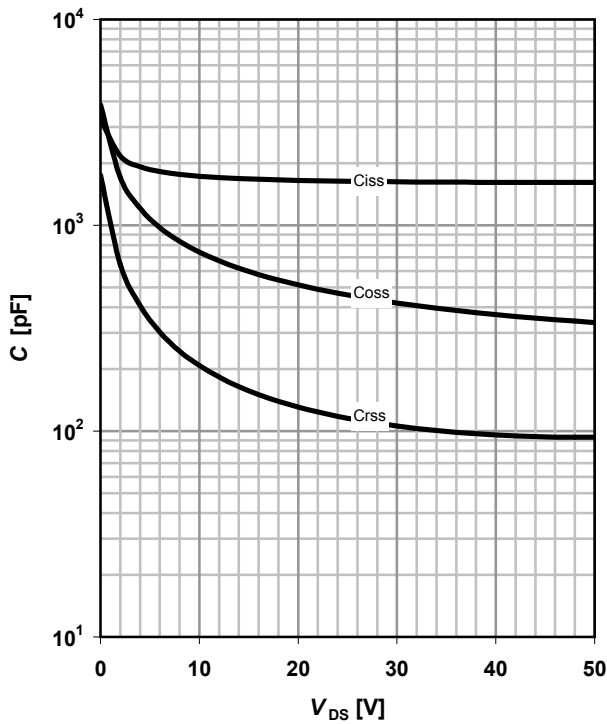
$V_{GS(th)}=f(T_j); V_{GS}=V_{DS}$

parameter:  $I_D$



**11 Typ. capacitances**

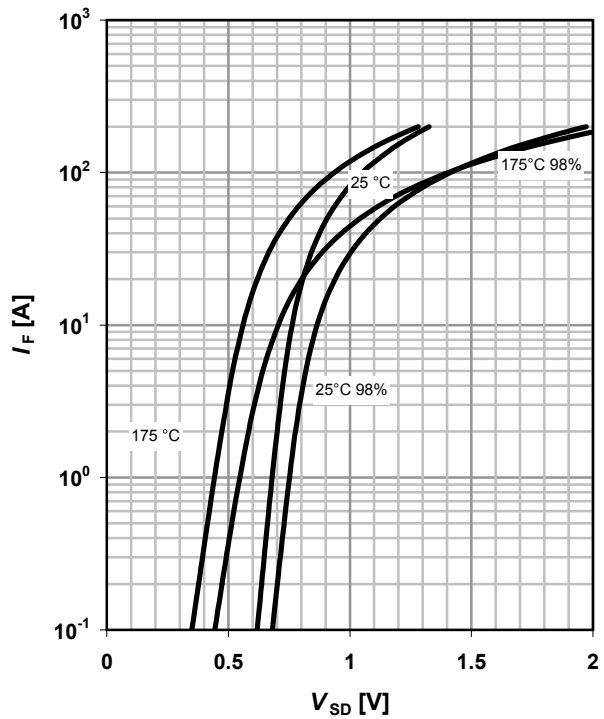
$C=f(V_{DS}); V_{GS}=0\text{ V}; f=1\text{ MHz}$



**12 Forward characteristics of reverse diode**

$I_F=f(V_{SD})$

parameter:  $T_j$

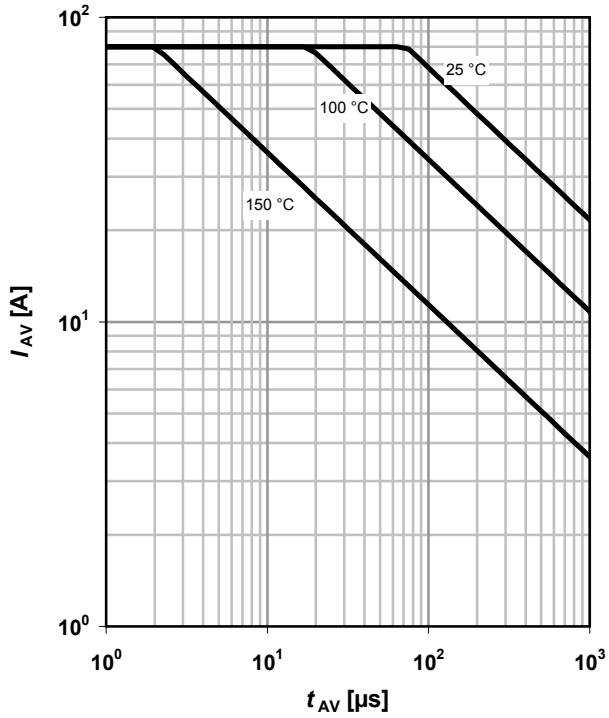




**13 Avalanche characteristics**

$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$

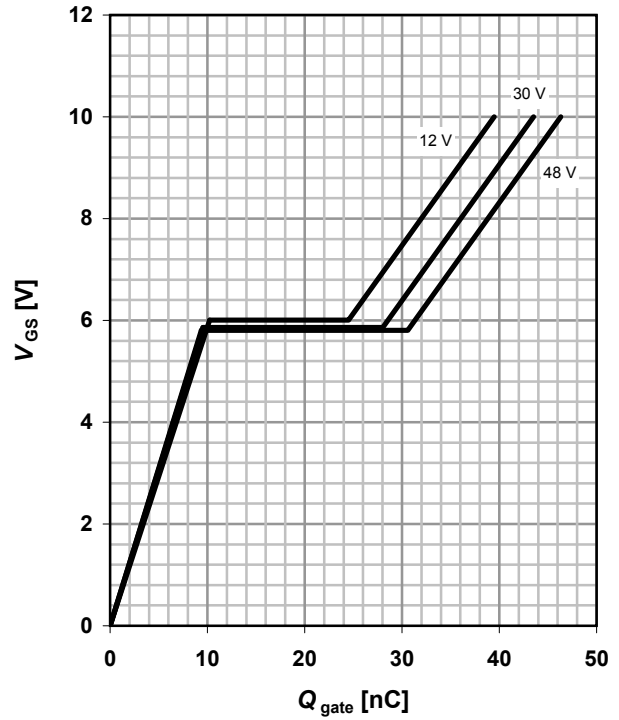
parameter:  $T_{j(\text{start})}$



**14 Typ. gate charge**

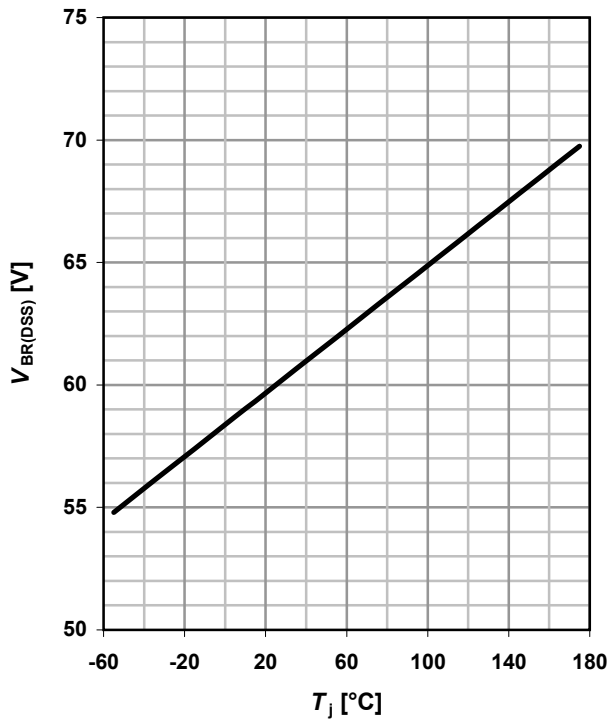
$V_{GS}=f(Q_{gate}); I_D=75 \text{ A pulsed}$

parameter:  $V_{DD}$

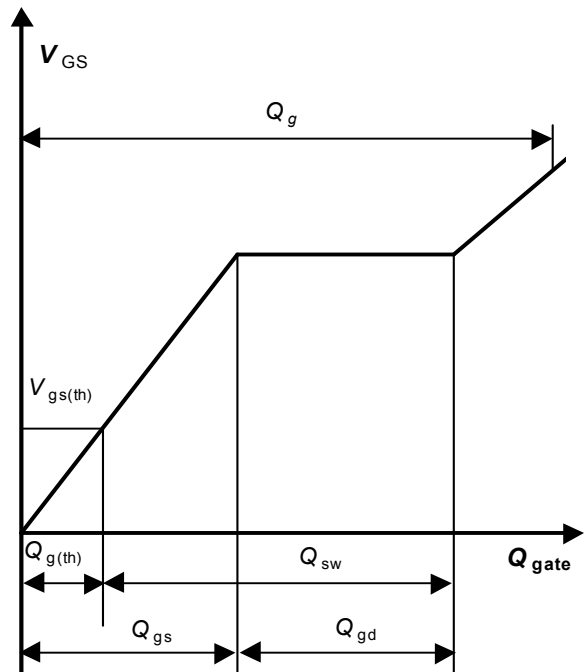


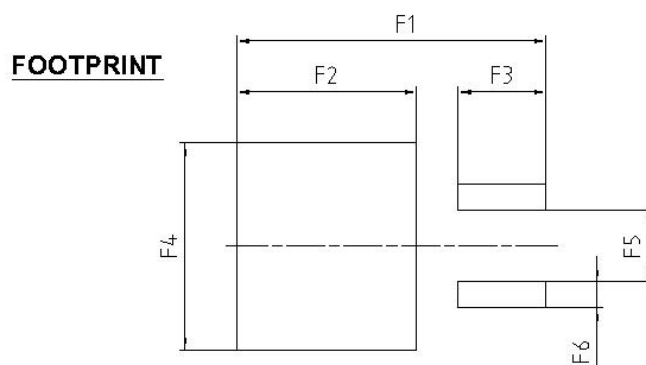
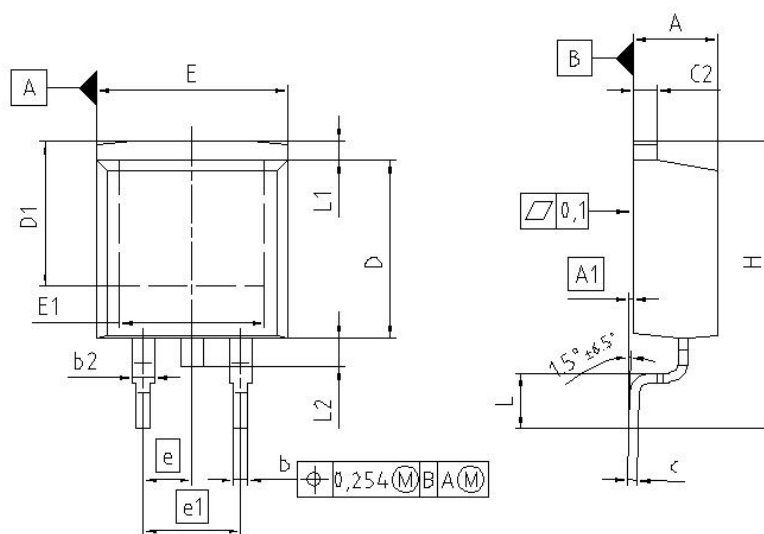
**15 Drain-source breakdown voltage**

$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$



**16 Gate charge waveforms**



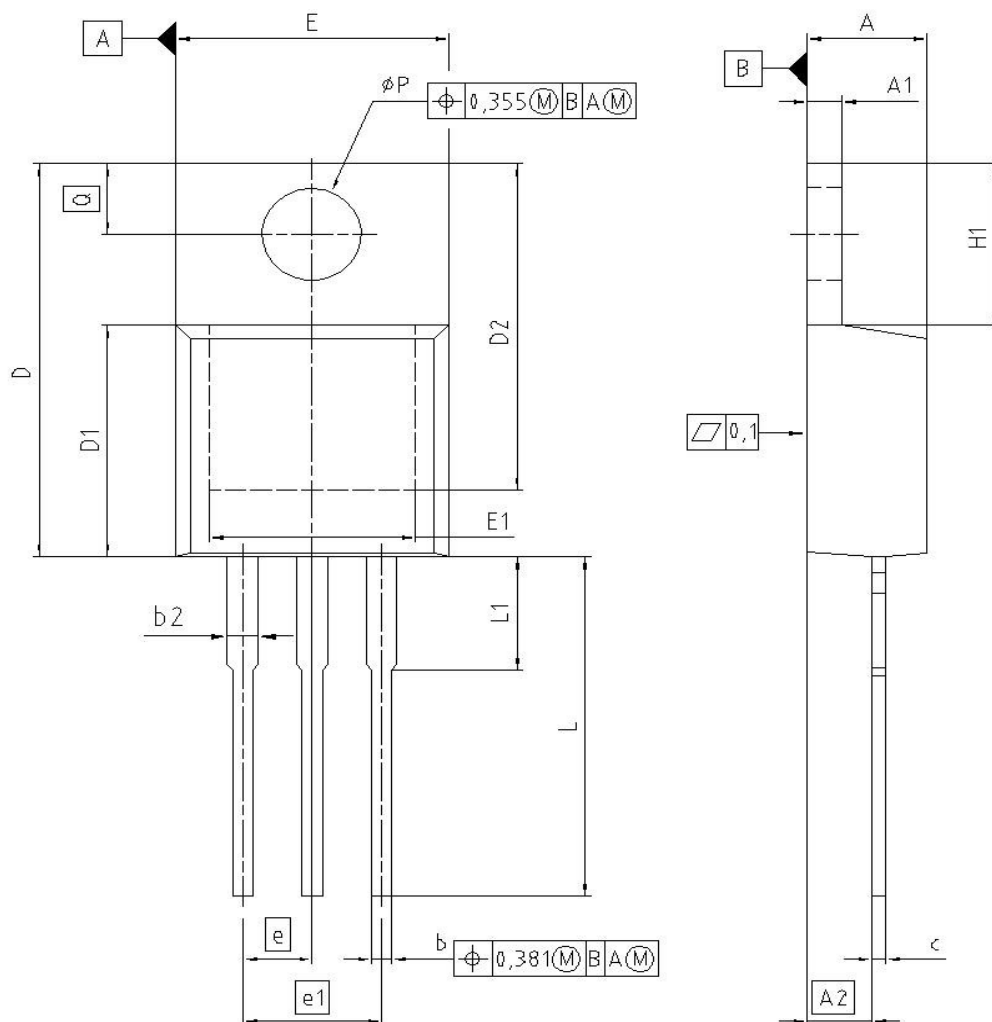
PG-TO-263 (D<sup>2</sup>-Pak)

| 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 |

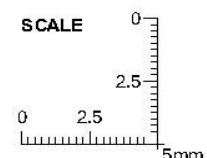
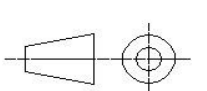
|                                 |
|---------------------------------|
| <b>REFERENCE</b><br>JEDEC TO263 |
| <b>SCALE</b><br>0 5 5 7.5mm     |
| <b>EUROPEAN PROJECTION</b><br>  |
| <b>ISSUE DATE</b><br>12-02-2006 |
| <b>FILE</b><br>TO263_2          |



## PG-TO220-3: Outline



| 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 |
| phi P | 3.700       | 3.886  | 0.146  | 0.153 |
| Q     | 2.600       | 3.000  | 0.102  | 0.118 |

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



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