

**OptiMOS™3 Power-Transistor**
**Features**

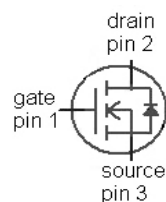
- Fast switching MOSFET for SMPS
- Optimized technology for DC/DC converters
- Qualified according to JEDEC<sup>1)</sup> for target applications
- N-channel, logic level
- Excellent gate charge  $\times R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- Avalanche rated
- Pb-free plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

**Product Summary**

|                  |     |            |
|------------------|-----|------------|
| $V_{DS}$         | 30  | V          |
| $R_{DS(on),max}$ | 4.2 | m $\Omega$ |
| $I_D$            | 70  | A          |



| Type    | IPP042N03L G                                                                        | IPB042N03L G                                                                        |
|---------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|         |  |  |
| Package | PG-TO220-3-1                                                                        | PG-TO263-3                                                                          |
| Marking | 042N03L                                                                             | 042N03L                                                                             |



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

| Parameter                                     | Symbol        | Conditions                                                                                                                  | Value    | Unit              |
|-----------------------------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------|----------|-------------------|
| Continuous drain current                      | $I_D$         | $V_{GS}=10\text{ V}$ , $T_C=25\text{ }^{\circ}\text{C}$                                                                     | 70       | A                 |
|                                               |               | $V_{GS}=10\text{ V}$ , $T_C=100\text{ }^{\circ}\text{C}$                                                                    | 70       |                   |
|                                               |               | $V_{GS}=4.5\text{ V}$ , $T_C=25\text{ }^{\circ}\text{C}$                                                                    | 70       |                   |
|                                               |               | $V_{GS}=4.5\text{ V}$ , $T_C=100\text{ }^{\circ}\text{C}$                                                                   | 62       |                   |
| Pulsed drain current <sup>2)</sup>            | $I_{D,pulse}$ | $T_C=25\text{ }^{\circ}\text{C}$                                                                                            | 400      |                   |
| Avalanche current, single pulse <sup>3)</sup> | $I_{AS}$      | $T_C=25\text{ }^{\circ}\text{C}$                                                                                            | 70       |                   |
| Avalanche energy, single pulse                | $E_{AS}$      | $I_D=50\text{ A}$ , $R_{GS}=25\text{ }\Omega$                                                                               | 60       | mJ                |
| Reverse diode $dv/dt$                         | $dv/dt$       | $I_D=70\text{ A}$ , $V_{DS}=24\text{ V}$ ,<br>$di/dt=200\text{ A}/\mu\text{s}$ ,<br>$T_{j,max}=175\text{ }^{\circ}\text{C}$ | 6        | kV/ $\mu\text{s}$ |
| Gate source voltage                           | $V_{GS}$      |                                                                                                                             | $\pm 20$ | V                 |

<sup>1)</sup> J-STD20 and JESD22

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

| Parameter                           | Symbol                | Conditions                       | Value       | Unit               |
|-------------------------------------|-----------------------|----------------------------------|-------------|--------------------|
| Power dissipation                   | $P_{\text{tot}}$      | $T_c=25\text{ }^{\circ}\text{C}$ | 79          | W                  |
| Operating and storage temperature   | $T_j, T_{\text{stg}}$ |                                  | -55 ... 175 | $^{\circ}\text{C}$ |
| IEC climatic category; DIN IEC 68-1 |                       |                                  | 55/175/56   |                    |

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

#### Thermal characteristics

|                                     |                   |                                              |   |   |     |     |
|-------------------------------------|-------------------|----------------------------------------------|---|---|-----|-----|
| Thermal resistance, junction - case | $R_{\text{thJC}}$ |                                              | - | - | 1.9 | K/W |
| SMD version, device on PCB          | $R_{\text{thJA}}$ | minimal footprint                            | - | - | 62  |     |
|                                     |                   | 6 cm <sup>2</sup> cooling area <sup>4)</sup> | - | - | 40  |     |

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

#### Static characteristics

|                                                |                             |                                                                                        |    |     |     |               |
|------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------|----|-----|-----|---------------|
| Drain-source breakdown voltage                 | $V_{(\text{BR})\text{DSS}}$ | $V_{\text{GS}}=0\text{ V}, I_{\text{D}}=1\text{ mA}$                                   | 30 | -   | -   | V             |
| Gate threshold voltage                         | $V_{\text{GS(th)}}$         | $V_{\text{DS}}=V_{\text{GS}}, I_{\text{D}}=250\text{ }\mu\text{A}$                     | 1  | -   | 2.2 |               |
| Zero gate voltage drain current                | $I_{\text{DSS}}$            | $V_{\text{DS}}=30\text{ V}, V_{\text{GS}}=0\text{ V}, T_j=25\text{ }^{\circ}\text{C}$  | -  | 0.1 | 1   | $\mu\text{A}$ |
|                                                |                             | $V_{\text{DS}}=30\text{ V}, V_{\text{GS}}=0\text{ V}, T_j=125\text{ }^{\circ}\text{C}$ | -  | 10  | 100 |               |
| Gate-source leakage current                    | $I_{\text{GSS}}$            | $V_{\text{GS}}=20\text{ V}, V_{\text{DS}}=0\text{ V}$                                  | -  | 10  | 100 | nA            |
| Drain-source on-state resistance <sup>5)</sup> | $R_{\text{DS(on)}}$         | $V_{\text{GS}}=4.5\text{ V}, I_{\text{D}}=30\text{ A}$                                 | -  | 4.8 | 6   | m $\Omega$    |
|                                                |                             | $V_{\text{GS}}=10\text{ V}, I_{\text{D}}=30\text{ A}$                                  | -  | 3.5 | 4.2 |               |
| Gate resistance                                | $R_{\text{G}}$              |                                                                                        | -  | 1.5 | -   | $\Omega$      |
| Transconductance                               | $g_{\text{fs}}$             | $ V_{\text{DS}} >2 I_{\text{D}} R_{\text{DS(on)max}}, I_{\text{D}}=30\text{ A}$        | 44 | 87  | -   | S             |

<sup>2)</sup> See figure 3 for more detailed information

<sup>3)</sup> See figure 13 for more detailed information

<sup>4)</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.

<sup>5)</sup> Measured from drain tab to source pin

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

**Dynamic characteristics**

|                              |              |                                                                                 |   |      |      |    |
|------------------------------|--------------|---------------------------------------------------------------------------------|---|------|------|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=15\text{ V},$<br>$f=1\text{ MHz}$                    | - | 2900 | 3900 | pF |
| Output capacitance           | $C_{oss}$    |                                                                                 | - | 1100 | 1500 |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                                                 | - | 60   | -    |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=15\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=30\text{ A}, R_G=1.6\ \Omega$ | - | 7.4  | -    | ns |
| Rise time                    | $t_r$        |                                                                                 | - | 5.6  | -    |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                                                 | - | 28   | -    |    |
| Fall time                    | $t_f$        |                                                                                 | - | 4.4  | -    |    |

**Gate Charge Characteristics<sup>5)</sup>**

|                              |               |                                                                             |   |     |   |    |
|------------------------------|---------------|-----------------------------------------------------------------------------|---|-----|---|----|
| Gate to source charge        | $Q_{gs}$      | $V_{DD}=15\text{ V}, I_D=30\text{ A},$<br>$V_{GS}=0\text{ to }4.5\text{ V}$ | - | 8.8 | - | nC |
| Gate charge at threshold     | $Q_{g(th)}$   |                                                                             | - | 4.7 | - |    |
| Gate to drain charge         | $Q_{gd}$      |                                                                             | - | 4.2 | - |    |
| Switching charge             | $Q_{sw}$      |                                                                             | - | 8.3 | - |    |
| Gate charge total            | $Q_g$         |                                                                             | - | 18  | - |    |
| Gate plateau voltage         | $V_{plateau}$ |                                                                             | - | 3.0 | - |    |
| Gate charge total            | $Q_g$         | $V_{DD}=15\text{ V}, I_D=30\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$  | - | 38  | - | nC |
| Gate charge total, sync. FET | $Q_{g(sync)}$ | $V_{DS}=0.1\text{ V},$<br>$V_{GS}=0\text{ to }4.5\text{ V}$                 | - | 16  | - |    |
| Output charge                | $Q_{oss}$     | $V_{DD}=15\text{ V}, V_{GS}=0\text{ V}$                                     | - | 28  | - |    |

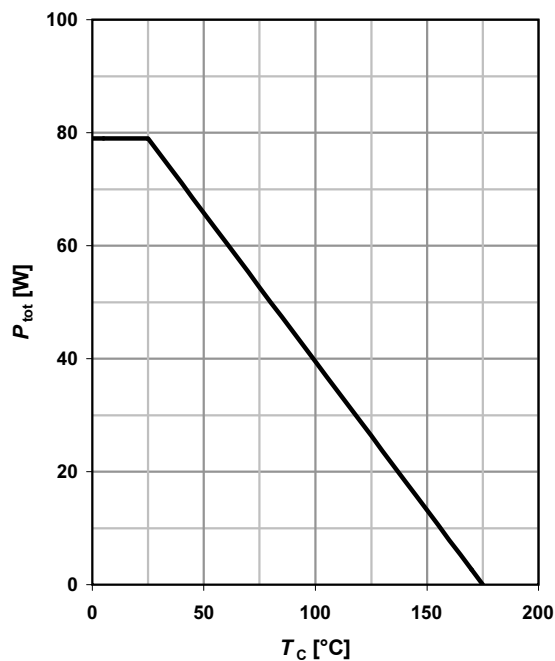
**Reverse Diode**

|                                  |               |                                                                   |   |      |     |    |
|----------------------------------|---------------|-------------------------------------------------------------------|---|------|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ °C}$                                                | - | -    | 70  | A  |
| Diode pulse current              | $I_{S,pulse}$ |                                                                   | - | -    | 400 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=30\text{ A},$<br>$T_j=25\text{ °C}$       | - | 0.85 | 1.1 | V  |
| Reverse recovery charge          | $Q_{rr}$      | $V_R=15\text{ V}, I_F=I_S,$<br>$di_F/dt=400\text{ A}/\mu\text{s}$ | - | -    | 20  | nC |

<sup>5)</sup> See figure 16 for gate charge parameter definition

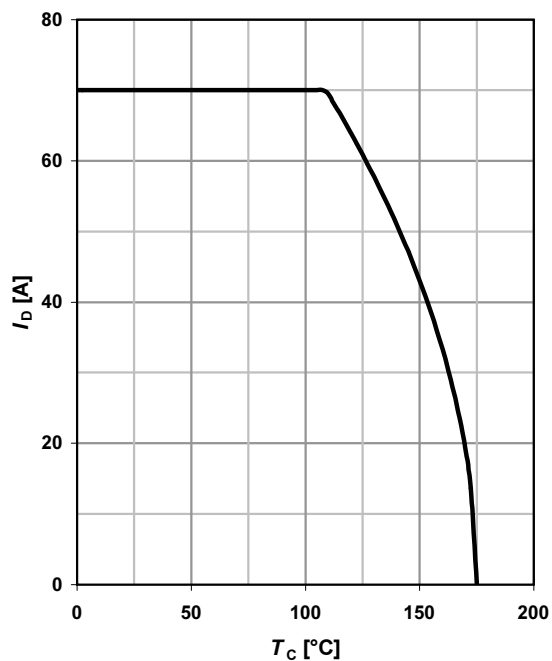
## 1 Power dissipation

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



## 2 Drain current

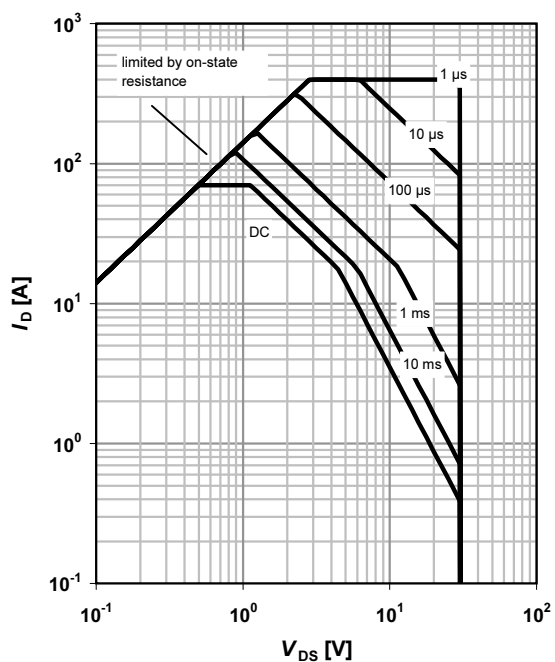
$$I_D = f(T_C); V_{GS} \geq 10 \text{ V}$$



## 3 Safe operating area

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

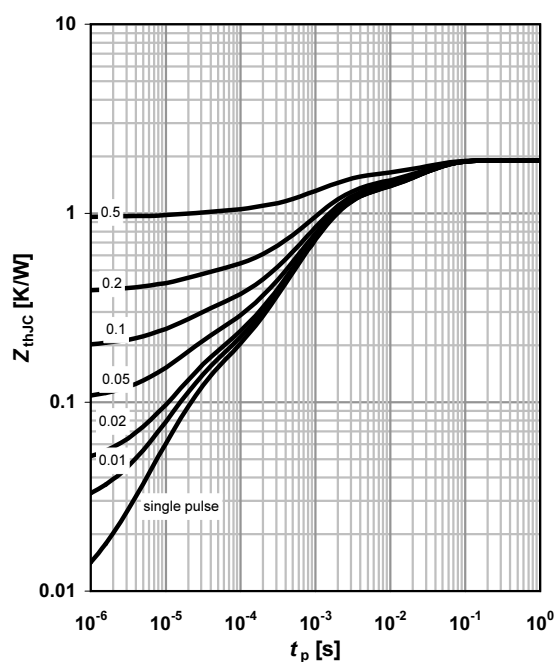
parameter:  $t_p$



## 4 Max. transient thermal impedance

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

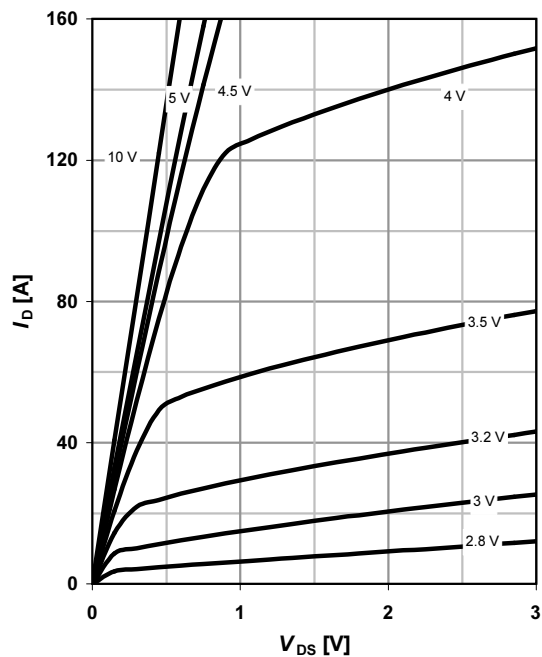
parameter:  $D = t_p/T$



### 5 Typ. output characteristics

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

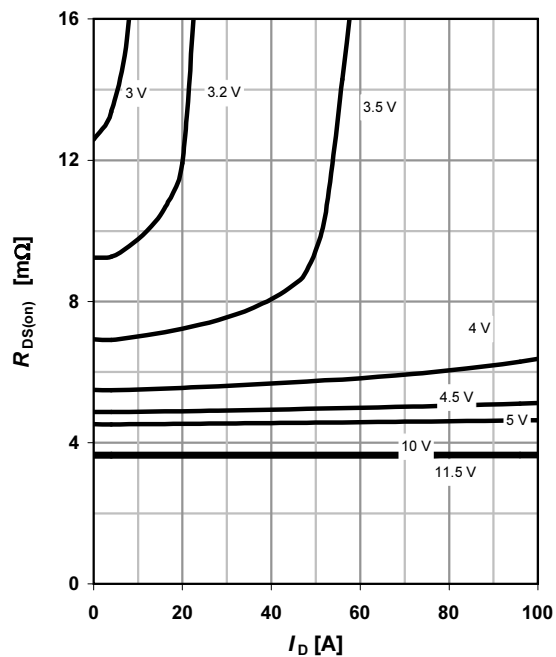
parameter:  $V_{GS}$



### 6 Typ. drain-source on resistance

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

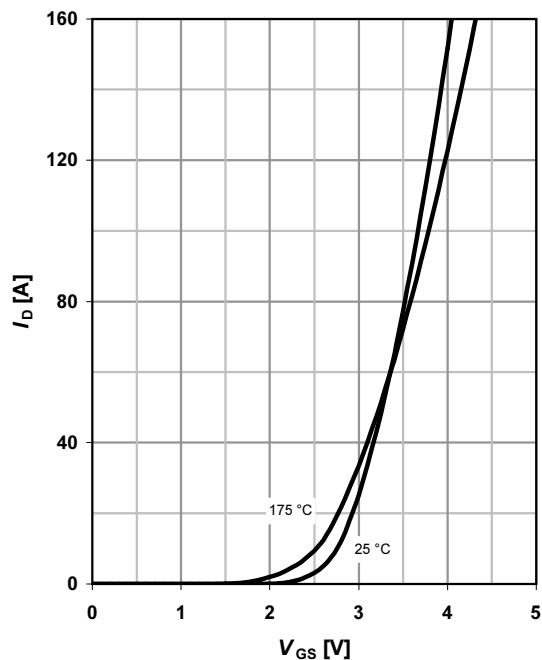
parameter:  $V_{GS}$



### 7 Typ. transfer characteristics

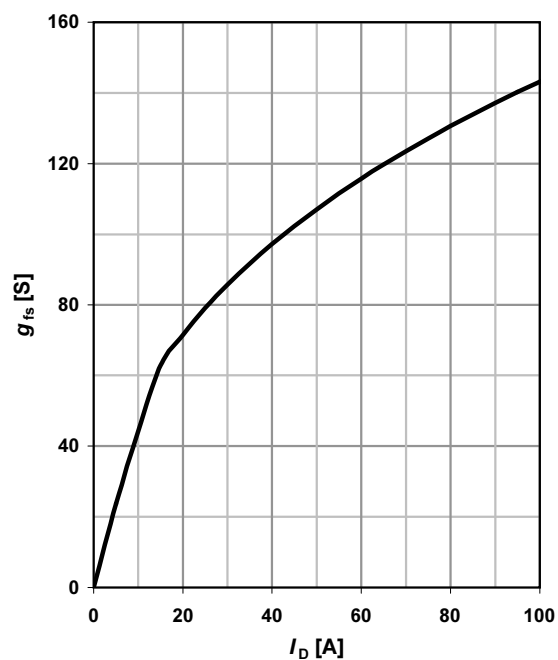
$$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$$

parameter:  $T_J$



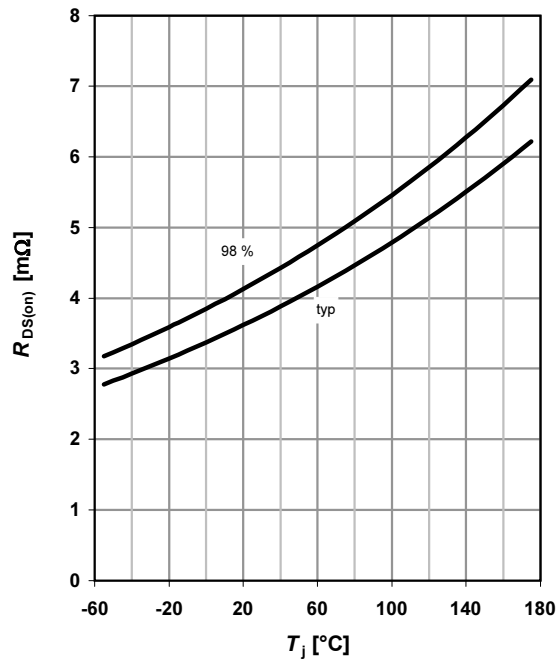
### 8 Typ. forward transconductance

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



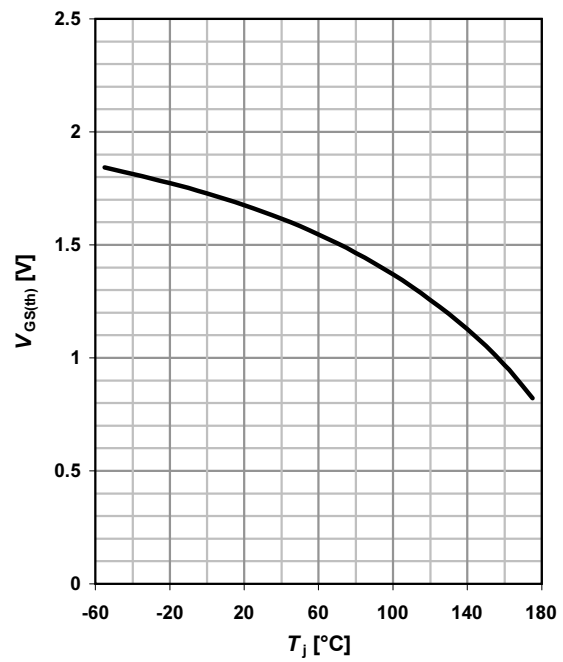
### 9 Drain-source on-state resistance

$$R_{DS(on)} = f(T_j); I_D = 30 \text{ A}; V_{GS} = 10 \text{ V}$$



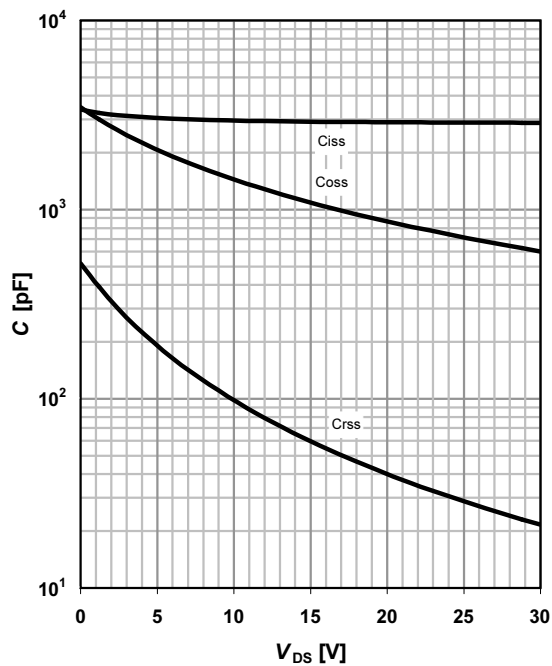
### 10 Typ. gate threshold voltage

$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}; I_D = 250 \mu\text{A}$$



### 11 Typ. capacitances

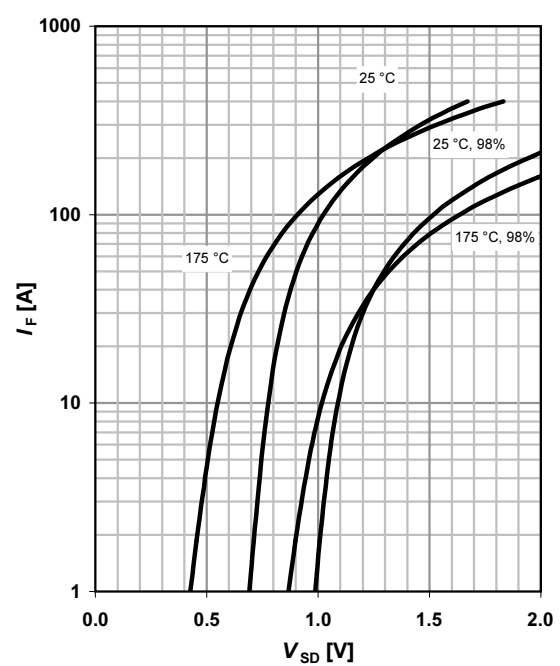
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



### 12 Forward characteristics of reverse diode

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

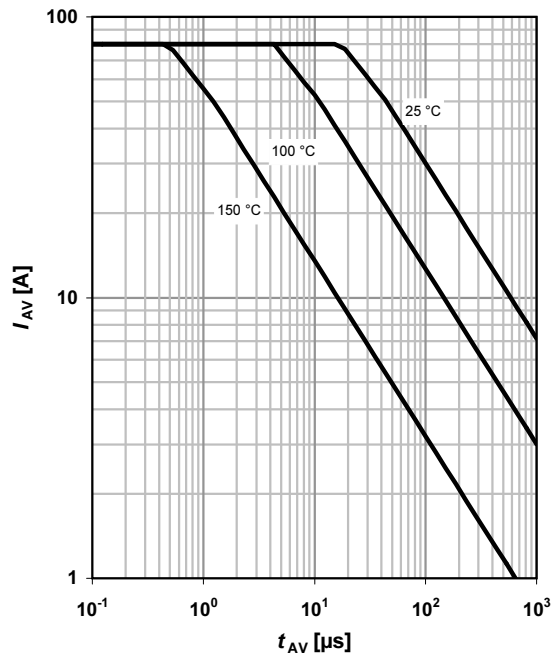
parameter:  $T_j$



### 13 Avalanche characteristics

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

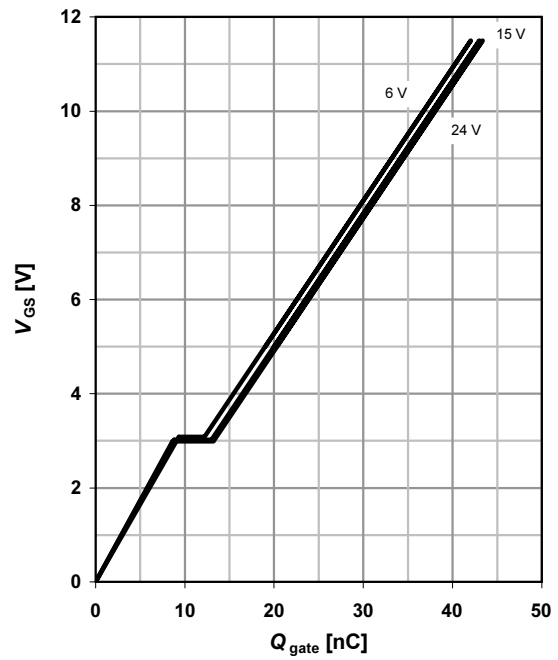
parameter:  $T_{j(\text{start})}$



### 14 Typ. gate charge

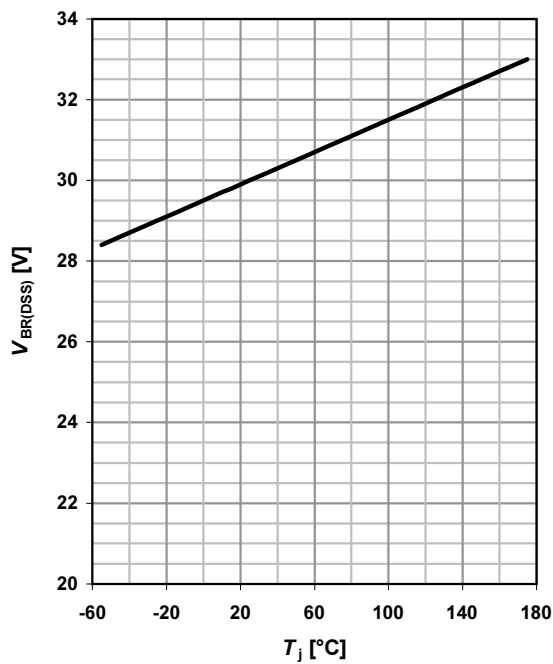
$$V_{GS}=f(Q_{\text{gate}}); I_D=30\ \text{A pulsed}$$

parameter:  $V_{DD}$

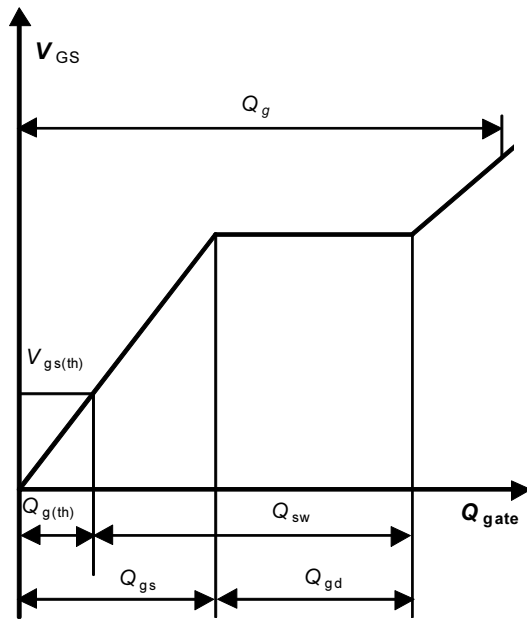


### 15 Drain-source breakdown voltage

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

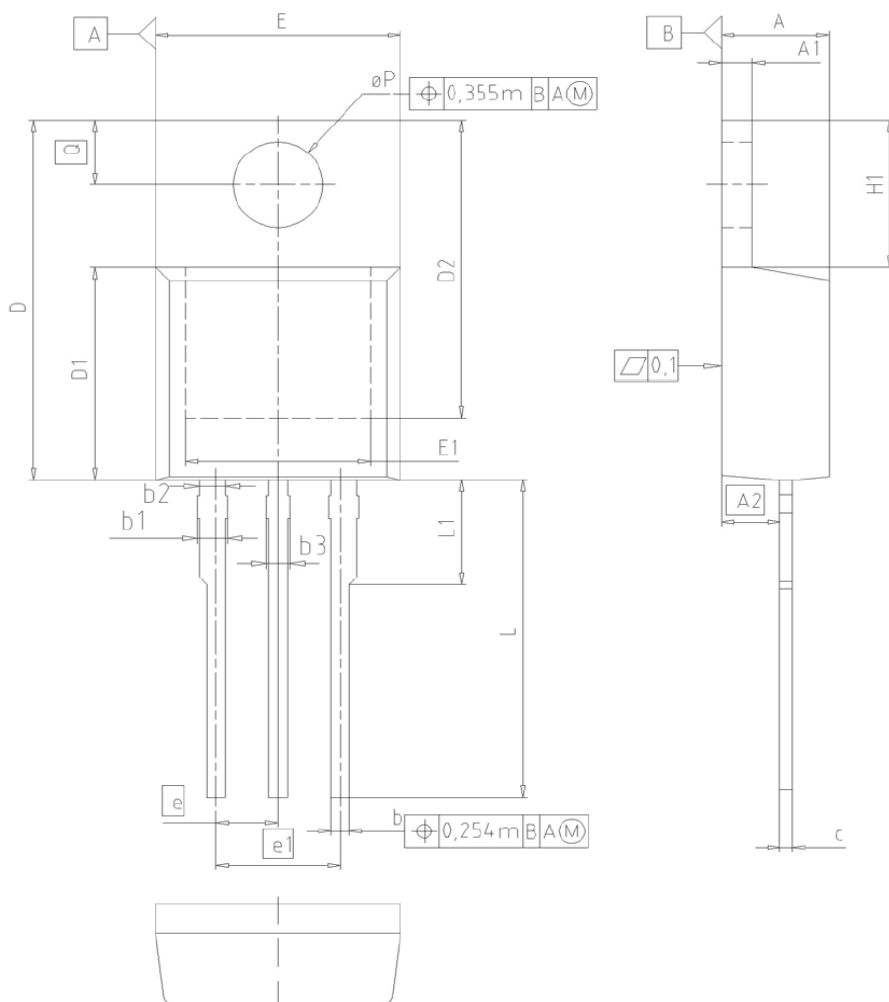


### 16 Gate charge waveforms



## Package Outline

## PG-TO220-3-1

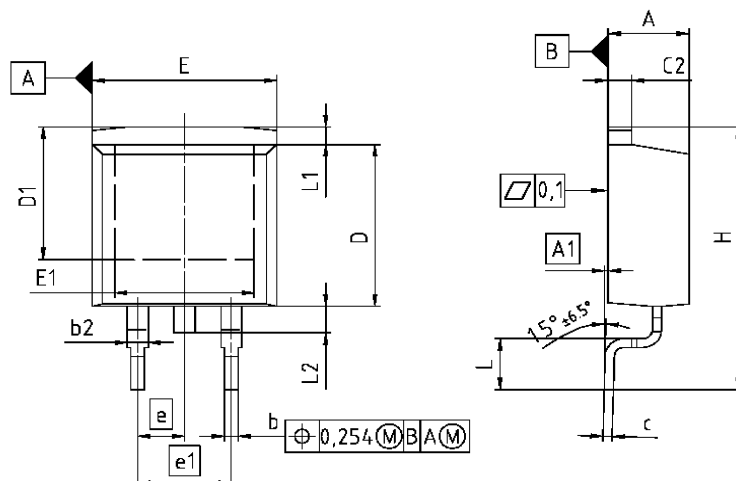


| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 4.30        | 4.57  | 0.169  | 0.180 |
| A1  | 1.17        | 1.40  | 0.046  | 0.055 |
| A2  | 2.15        | 2.72  | 0.085  | 0.107 |
| b   | 0.65        | 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        | 0.80  | 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 |

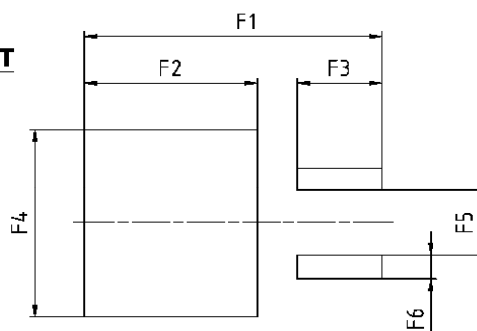
|                                                                                                              |
|--------------------------------------------------------------------------------------------------------------|
| DOCUMENT NO.<br>Z8B00003318                                                                                  |
| SCALE<br>0 2.5 5mm                                                                                           |
| EUROPEAN PROJECTION<br> |
| ISSUE DATE<br>23-08-2007                                                                                     |
| REVISION<br>05                                                                                               |

## Package Outline

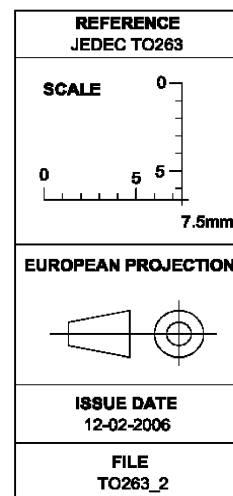
## PG-TO263-3



## FOOTPRINT



| 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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