

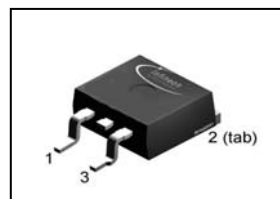
## OptiMOS<sup>®</sup> 2 Power-Transistor

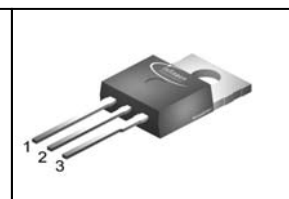
### Features

- Ideal for high-frequency dc/dc converters
- Qualified according to JEDEC<sup>1)</sup> for target application
- N-channel - Logic level
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- Superior thermal resistance
- 175 °C operating temperature
- dv/dt rated

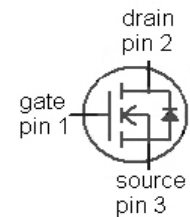
### Product Summary

|                                |     |    |
|--------------------------------|-----|----|
| $V_{DS}$                       | 25  | V  |
| $R_{DS(on),max}$ (SMD version) | 4.6 | mΩ |
| $I_D$                          | 80  | A  |

**P-TO263-3-2**

**P-TO262-3-1**

**P-TO220-3-1**


| Type       | Package     | Ordering Code | Marking |
|------------|-------------|---------------|---------|
| IPB05N03LA | P-TO263-3-2 | Q67042-S4141  | 05N03LA |
| IPI05N03LA | P-TO262-3-1 | Q67042-S4142  | 05N03LA |
| IPP05N03LA | P-TO220-3-1 | Q67042-S4143  | 05N03LA |



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

| Parameter                           | Symbol            | Conditions                                                                                           | Value       | Unit  |
|-------------------------------------|-------------------|------------------------------------------------------------------------------------------------------|-------------|-------|
| Continuous drain current            | $I_D$             | $T_C=25\text{ °C}^{2)}$                                                                              | 80          | A     |
|                                     |                   | $T_C=100\text{ °C}$                                                                                  | 76          |       |
| Pulsed drain current                | $I_{D,pulse}$     | $T_C=25\text{ °C}^{3)}$                                                                              | 385         |       |
| Avalanche energy, single pulse      | $E_{AS}$          | $I_D=72\text{ A}$ , $R_{GS}=25\text{ Ω}$                                                             | 190         | mJ    |
| Reverse diode dv/dt                 | dv/dt             | $I_D=80\text{ A}$ , $V_{DS}=20\text{ V}$ ,<br>$di/dt=200\text{ A/μs}$ ,<br>$T_{j,max}=175\text{ °C}$ | 6           | kV/μs |
| Gate source voltage <sup>4)</sup>   | $V_{GS}$          |                                                                                                      | ±20         | V     |
| Power dissipation                   | $P_{tot}$         | $T_C=25\text{ °C}$                                                                                   | 94          | W     |
| Operating and storage temperature   | $T_J$ , $T_{stg}$ |                                                                                                      | -55 ... 175 | °C    |
| IEC climatic category; DIN IEC 68-1 |                   |                                                                                                      | 55/175/56   |       |

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

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

### Thermal characteristics

|                                     |            |                                              |   |   |     |     |
|-------------------------------------|------------|----------------------------------------------|---|---|-----|-----|
| Thermal resistance, junction - case | $R_{thJC}$ |                                              | - | - | 1.6 | K/W |
| SMD version, device on PCB          | $R_{thJA}$ | minimal footprint                            | - | - | 62  |     |
|                                     |            | 6 cm <sup>2</sup> cooling area <sup>5)</sup> | - | - | 40  |     |

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

### Static characteristics

|                                  |               |                                                                     |     |     |     |               |
|----------------------------------|---------------|---------------------------------------------------------------------|-----|-----|-----|---------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$                             | 25  | -   | -   | V             |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}$ , $I_D=50\text{ }\mu\text{A}$                       | 1.2 | 1.6 | 2   |               |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=25\text{ V}$ , $V_{GS}=0\text{ V}$ ,<br>$T_j=25\text{ °C}$  | -   | 0.1 | 1   | $\mu\text{A}$ |
|                                  |               | $V_{DS}=25\text{ V}$ , $V_{GS}=0\text{ V}$ ,<br>$T_j=125\text{ °C}$ | -   | 10  | 100 |               |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$                          | -   | 1   | 100 | nA            |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=4.5\text{ V}$ , $I_D=55\text{ A}$                           | -   | 6.5 | 8.1 | m $\Omega$    |
|                                  |               | $V_{GS}=4.5\text{ V}$ , $I_D=55\text{ A}$ ,<br>SMD version          | -   | 6.2 | 7.8 |               |
|                                  |               | $V_{GS}=10\text{ V}$ , $I_D=55\text{ A}$                            | -   | 4.1 | 4.9 |               |
|                                  |               | $V_{GS}=10\text{ V}$ , $I_D=55\text{ A}$ ,<br>SMD version           | -   | 3.8 | 4.6 |               |
| Gate resistance                  | $R_G$         |                                                                     | -   | 1   | -   | $\Omega$      |
| Transconductance                 | $g_{fs}$      | $ V_{DS} >2 I_D R_{DS(on)max}$ ,<br>$I_D=55\text{ A}$               | 43  | 86  | -   | S             |

<sup>2)</sup> Current is limited by bondwire; with an  $R_{thJC}=1.6\text{ K/W}$  the chip is able to carry 108 A.

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

<sup>4)</sup>  $T_{j,max}=150\text{ °C}$  and duty cycle  $D<0.25$  for  $V_{GS}<-5\text{ V}$

<sup>5)</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            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=15\text{ V},$<br>$f=1\text{ MHz}$                          | - | 2413 | 3110 | pF |
| Output capacitance           | $C_{oss}$    |                                                                                       | - | 921  | 1225 |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                                                       | - | 112  | 167  |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=15\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=20\text{ A}, R_G=2.7\text{ }\Omega$ | - | 11   | 17   | ns |
| Rise time                    | $t_r$        |                                                                                       | - | 27   | 38   |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                                                       | - | 32   | 45   |    |
| Fall time                    | $t_f$        |                                                                                       | - | 4.6  | 6.9  |    |

### Gate Charge Characteristics<sup>6)</sup>

|                              |               |                                                                           |   |     |     |    |
|------------------------------|---------------|---------------------------------------------------------------------------|---|-----|-----|----|
| Gate to source charge        | $Q_{gs}$      | $V_{DD}=15\text{ V}, I_D=40\text{ A},$<br>$V_{GS}=0\text{ to }5\text{ V}$ | - | 8.1 | 11  | nC |
| Gate charge at threshold     | $Q_{g(th)}$   |                                                                           | - | 3.9 | 5.0 |    |
| Gate to drain charge         | $Q_{gd}$      |                                                                           | - | 5.3 | 8.0 |    |
| Switching charge             | $Q_{sw}$      |                                                                           | - | 10  | 14  |    |
| Gate charge total            | $Q_g$         |                                                                           | - | 19  | 25  |    |
| Gate plateau voltage         | $V_{plateau}$ |                                                                           | - | 3.4 | -   |    |
| Gate charge total, sync. FET | $Q_{g(sync)}$ | $V_{DS}=0.1\text{ V},$<br>$V_{GS}=0\text{ to }5\text{ V}$                 | - | 17  | 22  | nC |
| Output charge                | $Q_{oss}$     | $V_{DD}=15\text{ V}, V_{GS}=0\text{ V}$                                   | - | 20  | 27  |    |

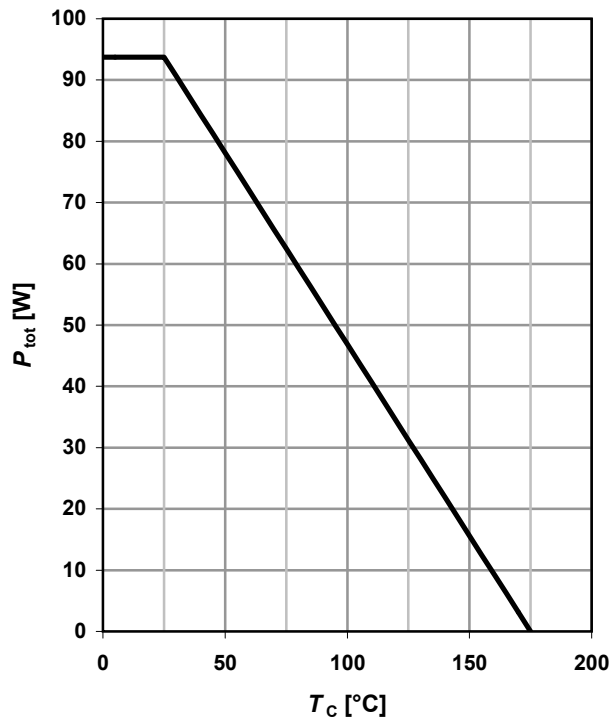
### Reverse Diode

|                                  |               |                                                                         |   |      |     |    |
|----------------------------------|---------------|-------------------------------------------------------------------------|---|------|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ }^\circ\text{C}$                                          | - | -    | 80  | A  |
| Diode pulse current              | $I_{S,pulse}$ |                                                                         | - | -    | 385 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=80\text{ A},$<br>$T_J=25\text{ }^\circ\text{C}$ | - | 0.97 | 1.2 | V  |
| Reverse recovery charge          | $Q_{rr}$      | $V_R=15\text{ V}, I_F=I_S,$<br>$di_F/dt=400\text{ A}/\mu\text{s}$       | - | -    | 10  | nC |

<sup>6)</sup> See figure 16 for gate charge parameter definition

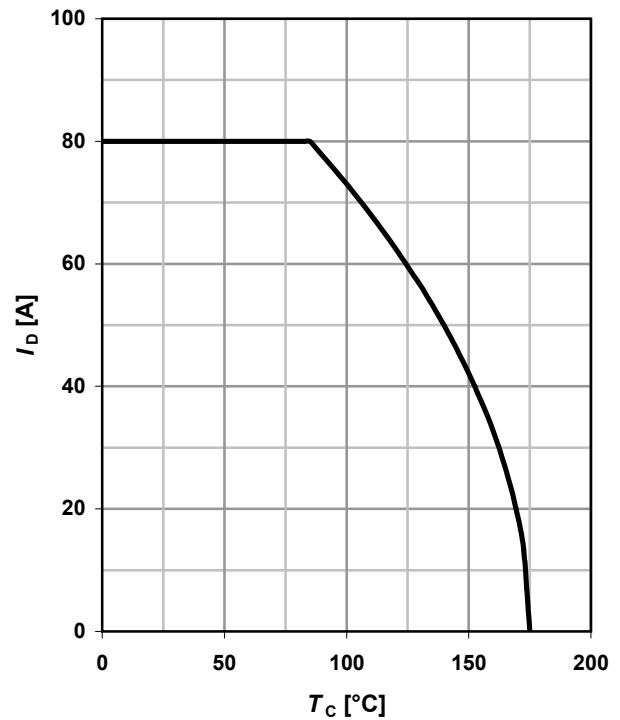
### 1 Power dissipation

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



### 2 Drain current

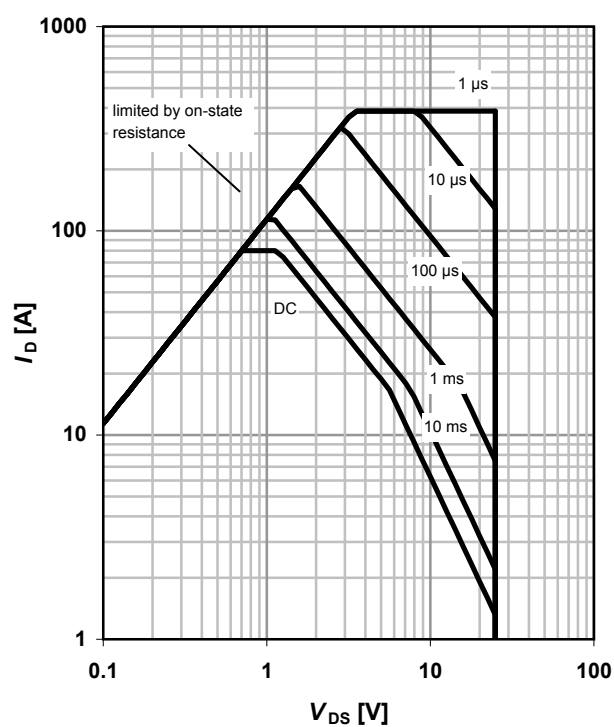
$$I_D = f(T_C); V_{GS} \geq 10 \text{ V}$$



### 3 Safe operation area

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

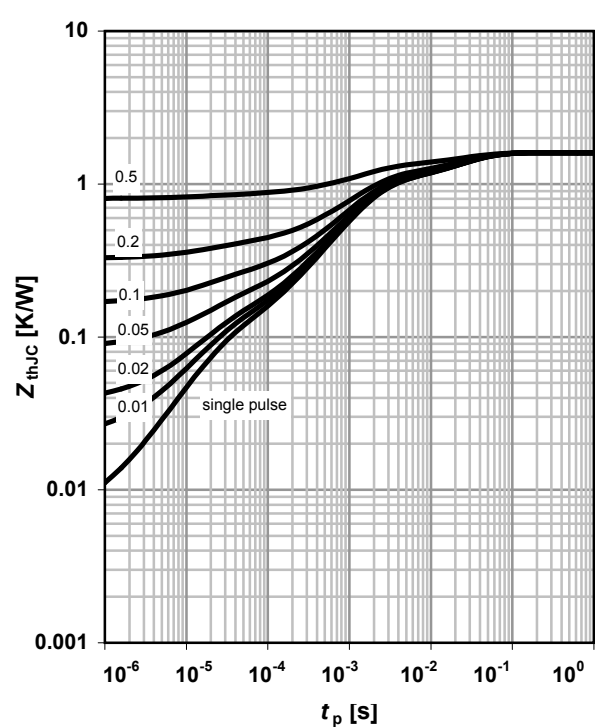
parameter:  $t_p$



### 4 Max. transient thermal impedance

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

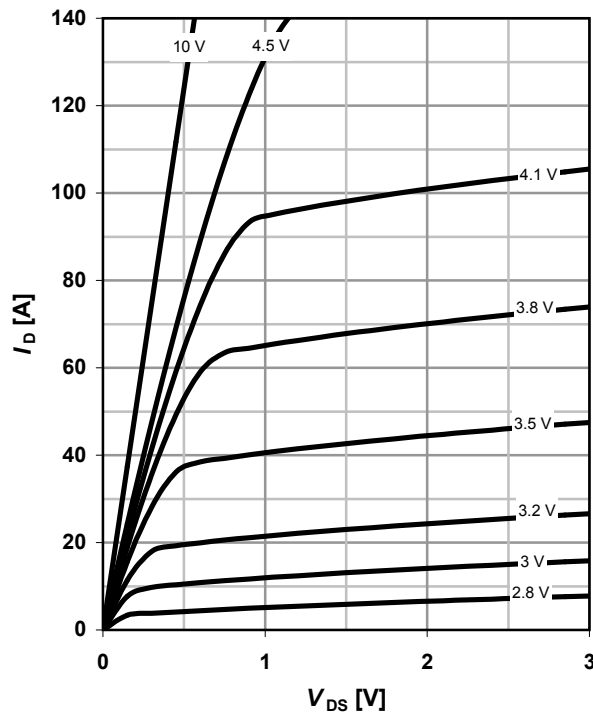
parameter:  $D = t_p/T$



### 5 Typ. output characteristics

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

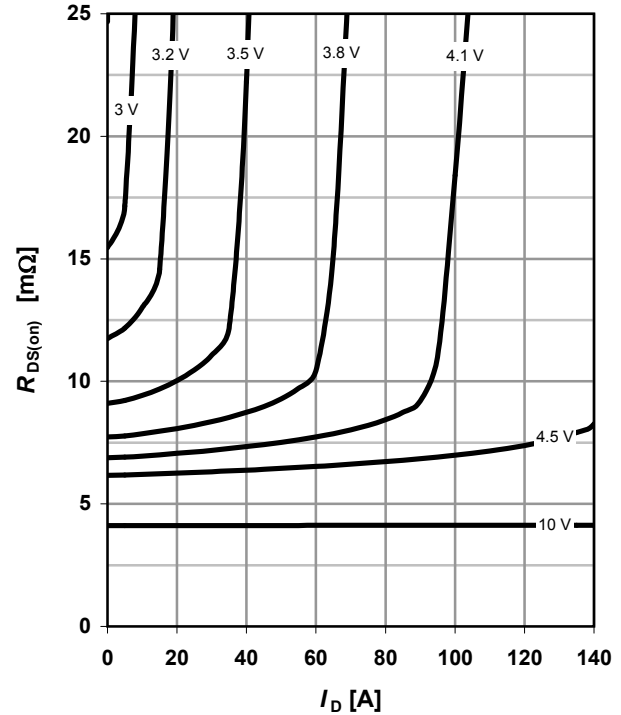
parameter:  $V_{GS}$



### 6 Typ. drain-source on resistance

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

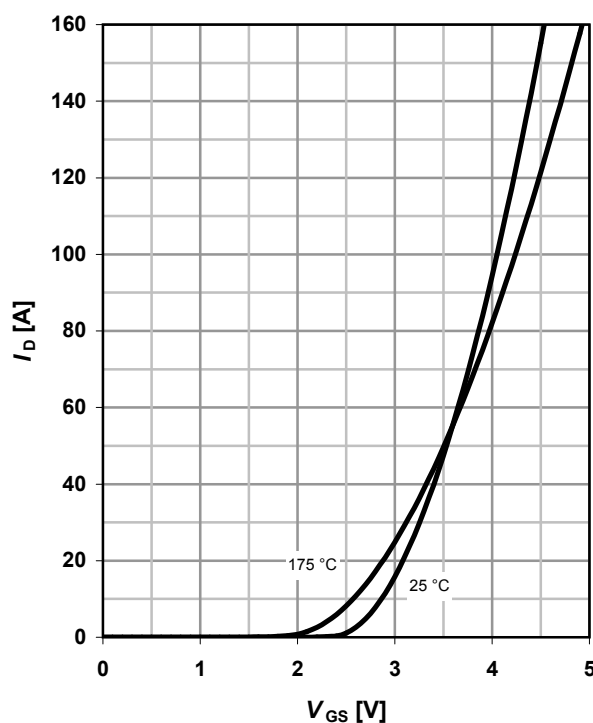
parameter:  $V_{GS}$



### 7 Typ. transfer characteristics

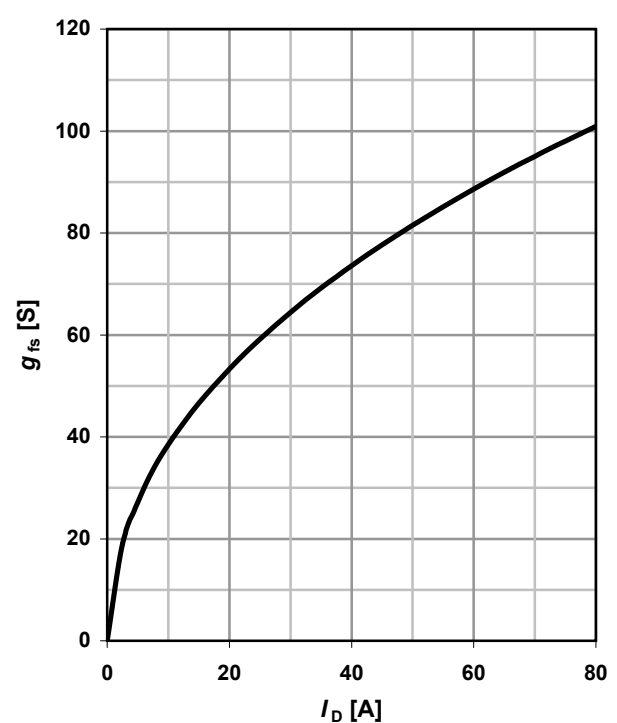
$$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$$

parameter:  $T_j$



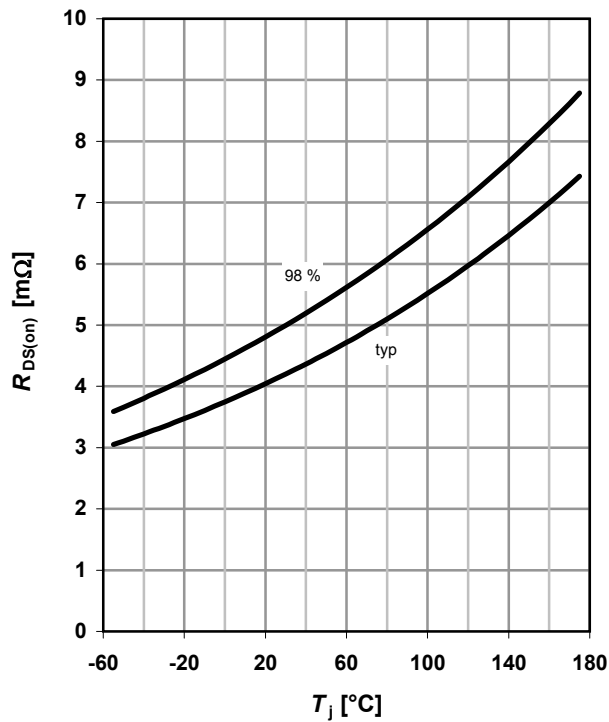
### 8 Typ. forward transconductance

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



## 9 Drain-source on-state resistance

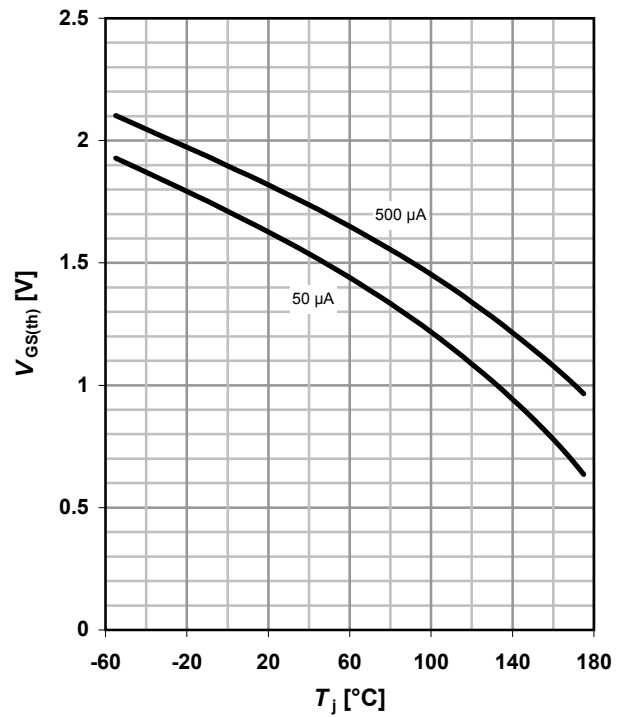
$$R_{DS(on)} = f(T_j); I_D = 55 \text{ A}; V_{GS} = 10 \text{ V}$$



## 10 Typ. gate threshold voltage

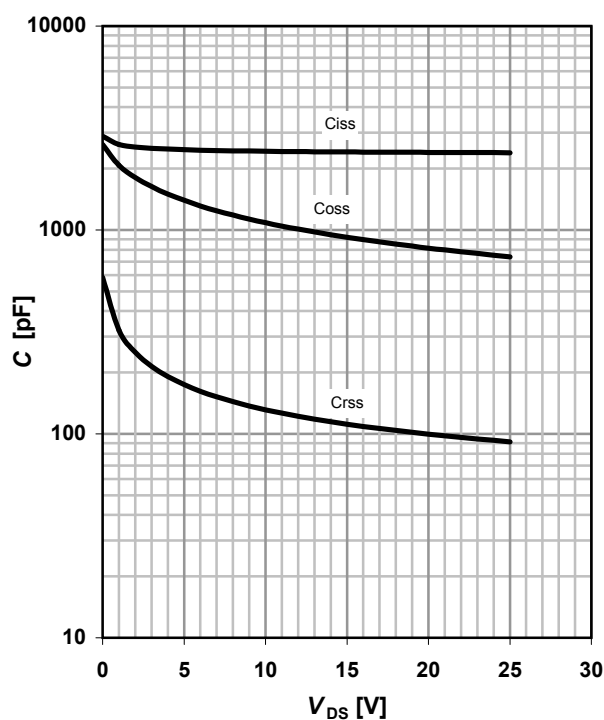
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter:  $I_D$



## 11 Typ. Capacitances

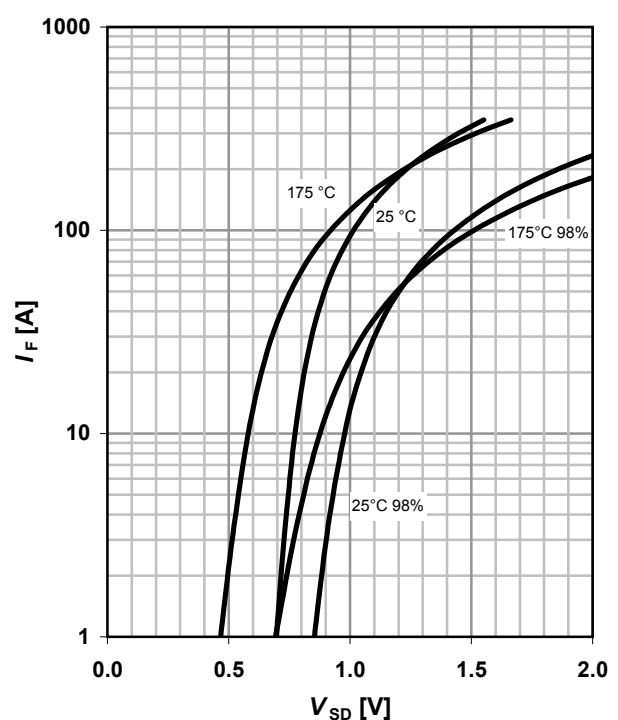
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



## 12 Forward characteristics of reverse diode

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

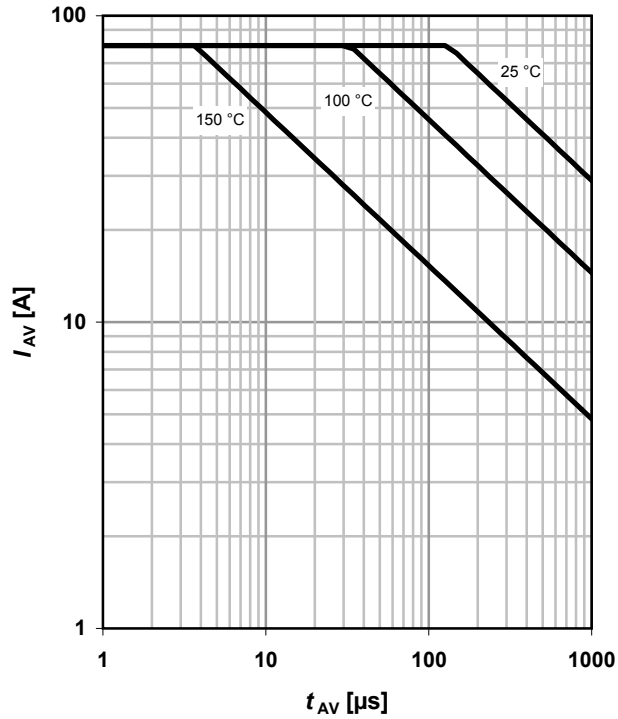
parameter:  $T_j$



### 13 Avalanche characteristics

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

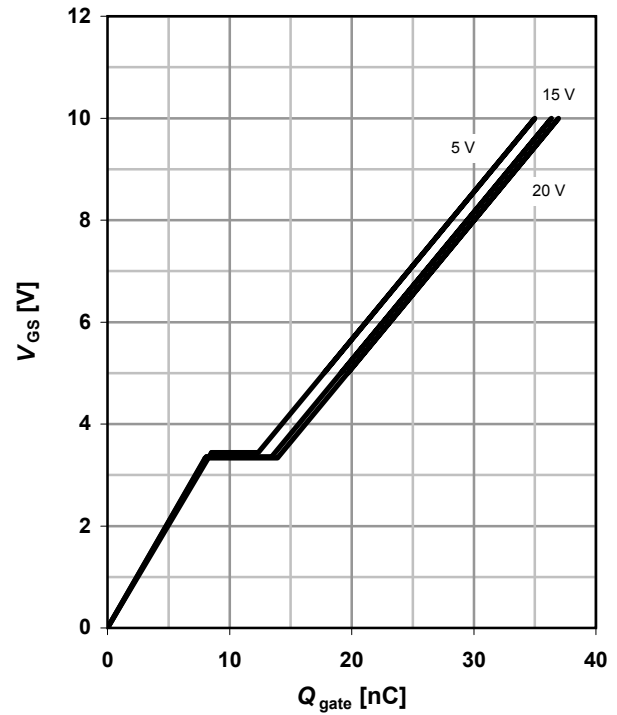
parameter:  $T_{j(\text{start})}$



### 14 Typ. gate charge

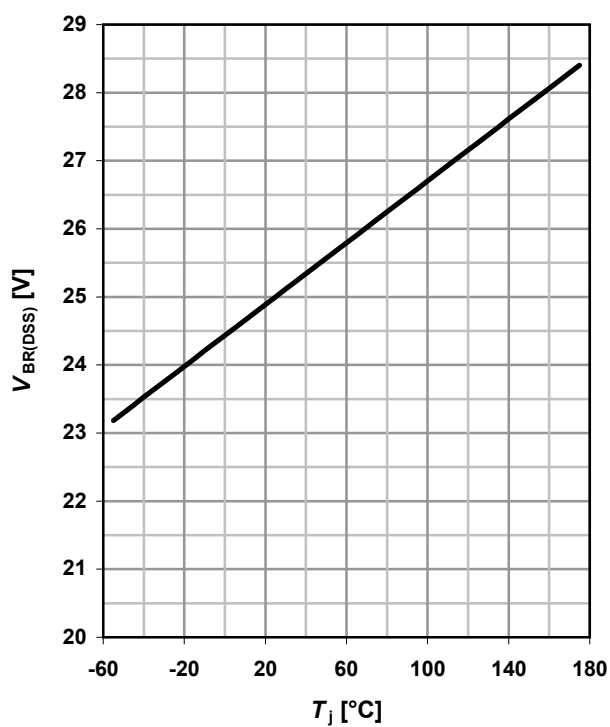
$$V_{GS}=f(Q_{\text{gate}}); I_D=40\ \text{A pulsed}$$

parameter:  $V_{DD}$

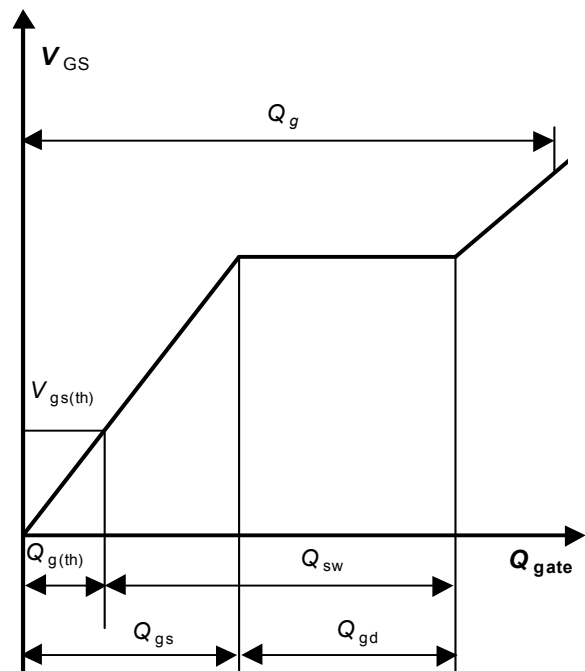


### 15 Drain-source breakdown voltage

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

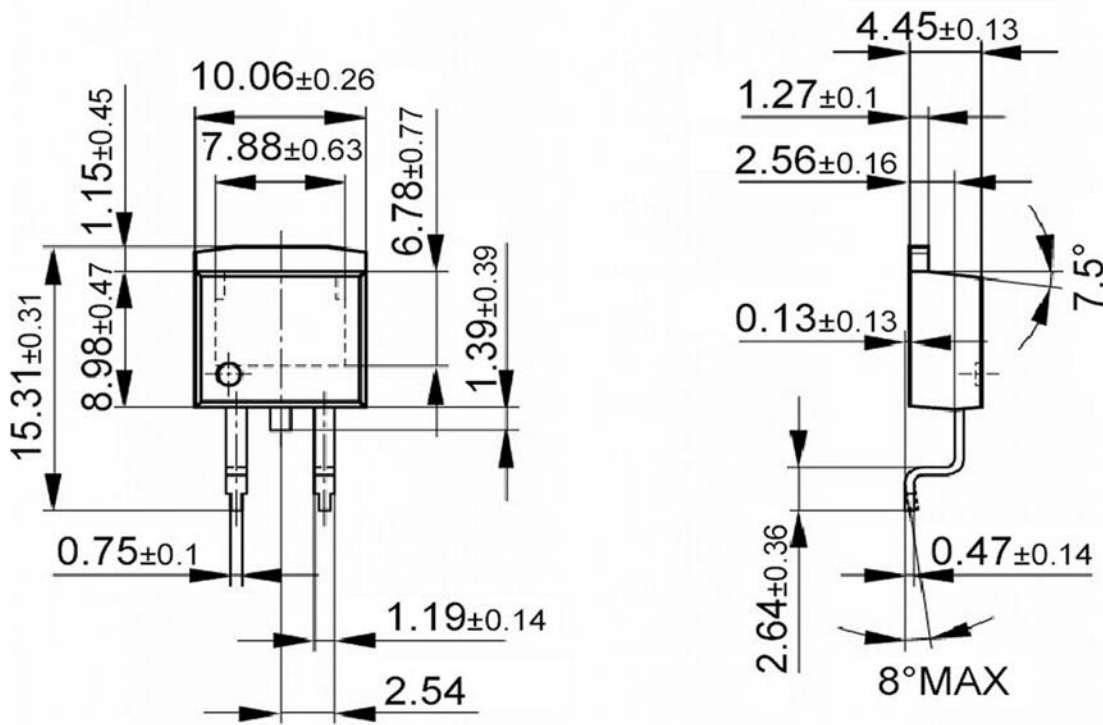


### 16 Gate charge waveforms

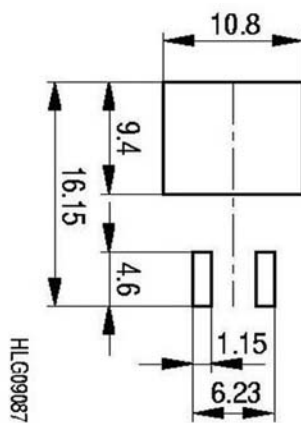


## Package Outline

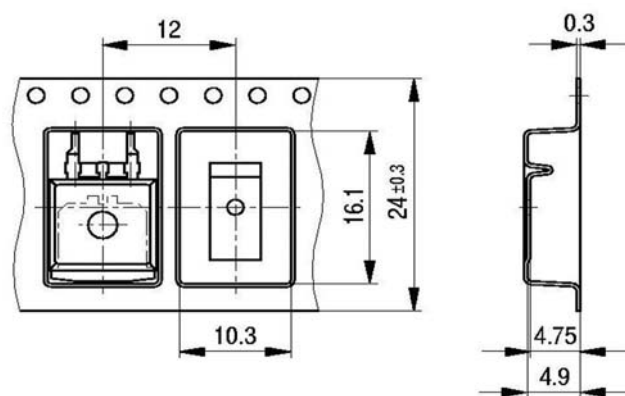
### P-TO263-3-2: Outline



## Footprint



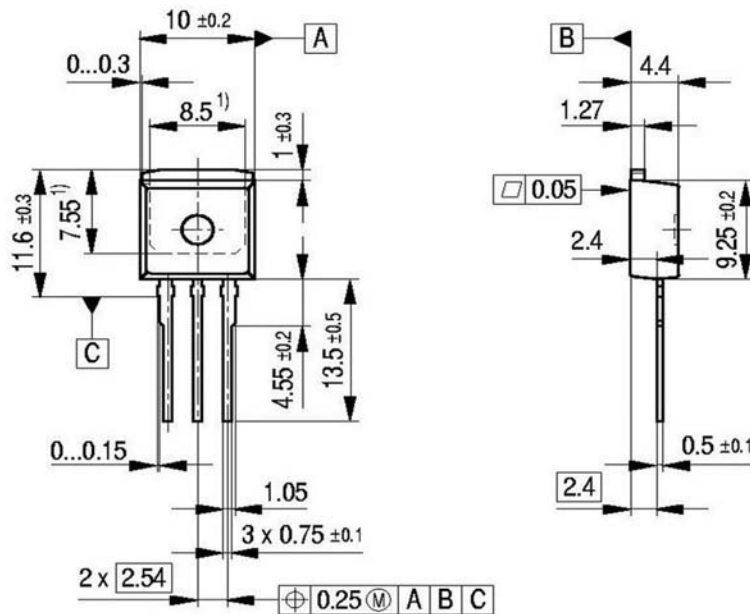
## Packaging



Dimensions in mm



# P-TO262-3-1: Outline

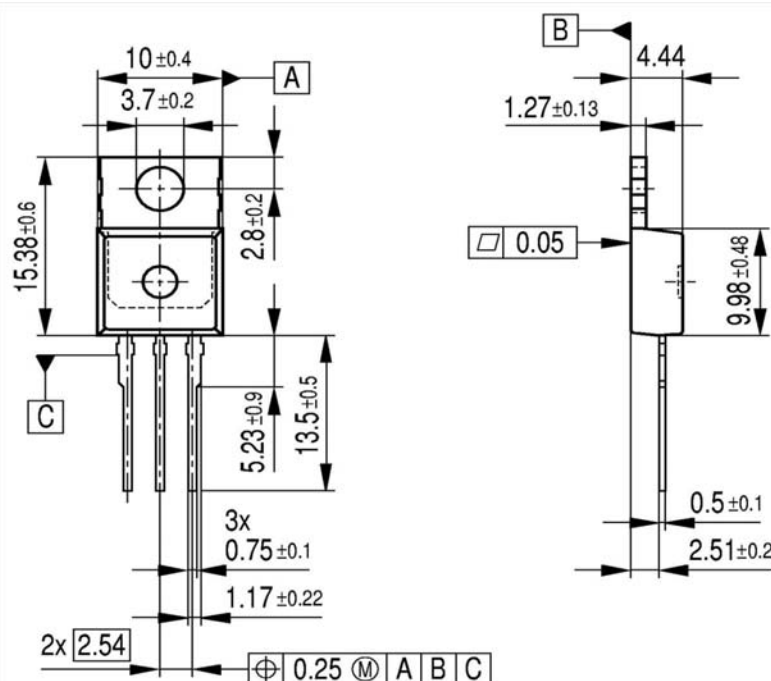


<sup>1)</sup> Typical

Metal surface min. X = 7.25, Y = 6.9

All metal surfaces tin plated, except area of cut.

# P-TO220-3-1: Outline

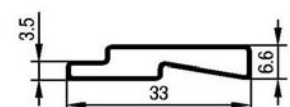


All metal surfaces tin plated, except area of cut.

Metal surface min. x=7.25, y=12.3

Dimensions in mm

## Packaging



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