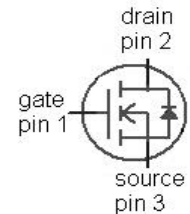


OptiMOS[®] 2 Power-Transistor
Features

- N-channel, logic level
- Excellent gate charge x $R_{DS(on)}$ product (FOM)
- Very low on-resistance $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC¹⁾ for target application
- Ideal for high-frequency switching and synchronous rectification

Product Summary

| | | |
|------------------|-----|------------|
| V_{DS} | 100 | V |
| $R_{DS(on),max}$ | 12 | m Ω |
| I_D | 69 | A |



| Type | IPP12CN10L G | IPS12CN10L G |
|----------------|--------------|---------------|
| | | |
| Package | PG-TO220-3 | PG-TO251-3-11 |
| Marking | 12CN10L | 12CN10L |

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

| Parameter | Symbol | Conditions | Value | Unit |
|-------------------------------------|-------------------|---|-------------|-------------------|
| Continuous drain current | I_D | $T_C=25\text{ °C}$ | 69 | A |
| | | $T_C=100\text{ °C}$ | 49 | |
| Pulsed drain current ²⁾ | $I_{D,pulse}$ | $T_C=25\text{ °C}$ | 276 | |
| Avalanche energy, single pulse | E_{AS} | $I_D=69\text{ A}$, $R_{GS}=25\ \Omega$ | 150 | mJ |
| Reverse diode dv/dt | dv/dt | $I_D=69\text{ A}$, $V_{DS}=80\text{ V}$, $di/dt=100\text{ A}/\mu\text{s}$, $T_{j,max}=175\text{ °C}$ | 6 | kV/ μs |
| Gate source voltage ³⁾ | V_{GS} | | ± 20 | V |
| Power dissipation | P_{tot} | $T_C=25\text{ °C}$ | 125 | W |
| Operating and storage temperature | T_j , T_{stg} | | -55 ... 175 | °C |
| IEC climatic category; DIN IEC 68-1 | | | 55/175/56 | |

¹⁾ J-STD20 and JESD22

²⁾ see figure 3

³⁾ $T_{j,max}=150\text{ °C}$ and duty cycle $D=0.01$ for $V_{gs}<-5\text{ V}$

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

Thermal characteristics

| | | | | | | |
|--|------------|--|---|---|-----|-----|
| Thermal resistance, junction - case | R_{thJC} | | - | - | 1.2 | K/W |
| Thermal resistance, junction - ambient | R_{thJA} | minimal footprint | - | - | 62 | |
| | | 6 cm ² cooling area ⁴⁾ | - | - | 40 | |

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

Static characteristics

| | | | | | | |
|----------------------------------|---------------|---|-----|------|------|---------------|
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}$, $I_D=1\text{ mA}$ | 100 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}$, $I_D=83\text{ }\mu\text{A}$ | 1.2 | 1.84 | 2.4 | |
| Zero gate voltage drain current | I_{DSS} | $V_{DS}=80\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$ | - | 0.1 | 1 | μA |
| | | $V_{DS}=80\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=125\text{ °C}$ | - | 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 | $R_{DS(on)}$ | $V_{GS}=4.5\text{ V}$, $I_D=34.5\text{ A}$, (TO220) | - | 11.7 | 15.8 | m Ω |
| | | $V_{GS}=10\text{ V}$, $I_D=69\text{ A}$, (TO220) | - | 9.9 | 12 | |
| | | $V_{GS}=4.5\text{ V}$, $I_D=34.5\text{ A}$, (TO251) | - | 11.7 | 15.8 | |
| | | $V_{GS}=10\text{ V}$, $I_D=69\text{ A}$, (TO251) | - | 9.9 | 11.8 | |
| Gate resistance | R_G | | - | 1.3 | - | Ω |
| Transconductance | g_{fs} | $ V_{DS} >2 I_D R_{DS(on)max}$, $I_D=69\text{ A}$ | 57 | 113 | - | S |

⁴⁾ Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm² (one layer, 70 μm 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} | $V_{GS}=0\text{ V}, V_{DS}=50\text{ V},$ $f=1\text{ MHz}$ | - | 4210 | 5600 | pF |
| Output capacitance | C_{oss} | | - | 528 | 702 | |
| Reverse transfer capacitance | C_{rss} | | - | 29 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}=50\text{ V}, V_{GS}=10\text{ V},$ $I_D=34.5\text{ A}, R_G=1.6\ \Omega$ | - | 14 | - | ns |
| Rise time | t_r | | - | 9 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 39 | - | |
| Fall time | t_f | | - | 5 | - | |

Gate Charge Characteristics⁵⁾

| | | | | | | |
|-----------------------|---------------|--|---|-----|---|----|
| Gate to source charge | Q_{gs} | $V_{DD}=50\text{ V}, I_D=69\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$ | - | 16 | - | nC |
| Gate to drain charge | Q_{gd} | | - | 10 | - | |
| Switching charge | Q_{sw} | | - | 13 | - | |
| Gate charge total | Q_g | | - | 58 | - | |
| Gate plateau voltage | $V_{plateau}$ | | - | 3.7 | - | |
| Output charge | Q_{oss} | $V_{DD}=50\text{ V}, V_{GS}=0\text{ V}$ | - | 54 | - | nC |

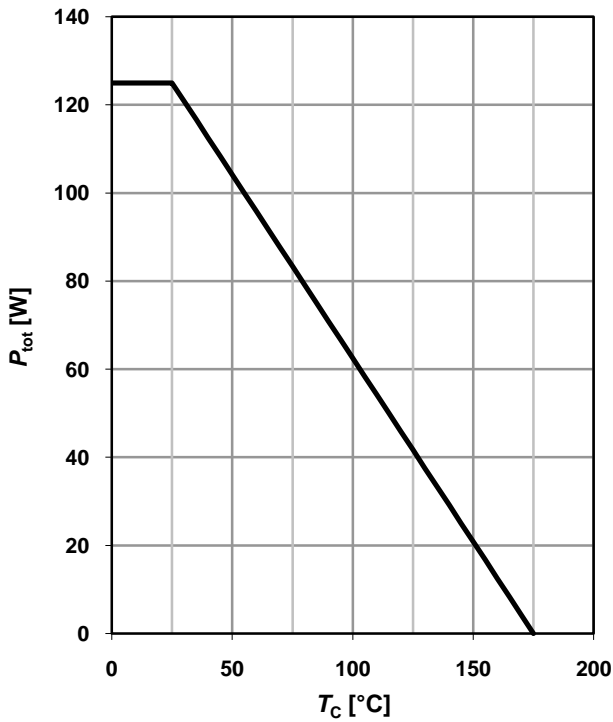
Reverse Diode

| | | | | | | |
|----------------------------------|---------------|---|---|-----|-----|----|
| Diode continuous forward current | I_S | $T_C=25\text{ }^\circ\text{C}$ | - | - | 69 | A |
| Diode pulse current | $I_{S,pulse}$ | | - | - | 276 | |
| Diode forward voltage | V_{SD} | $V_{GS}=0\text{ V}, I_F=69\text{ A},$ $T_j=25\text{ }^\circ\text{C}$ | - | 1 | 1.2 | V |
| Reverse recovery time | t_{rr} | $V_R=50\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$ | - | 101 | - | ns |
| Reverse recovery charge | Q_{rr} | | - | 193 | - | nC |

⁵⁾ See figure 16 for gate charge parameter definition

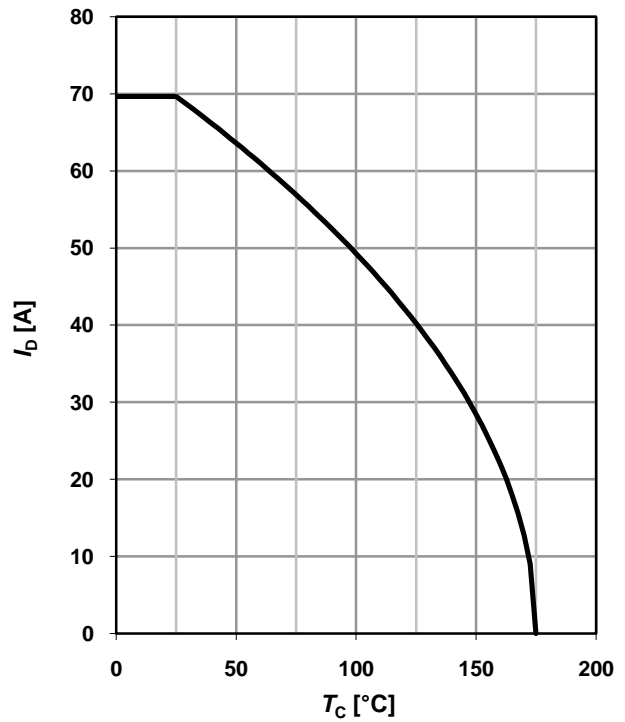
1 Power dissipation

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



2 Drain current

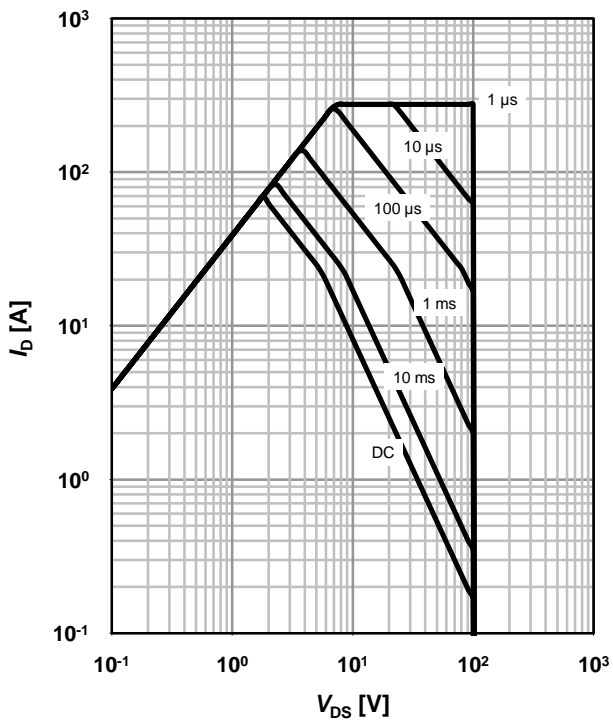
$$I_D=f(T_C); V_{GS} \geq 10 \text{ V}$$



3 Safe operating area

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

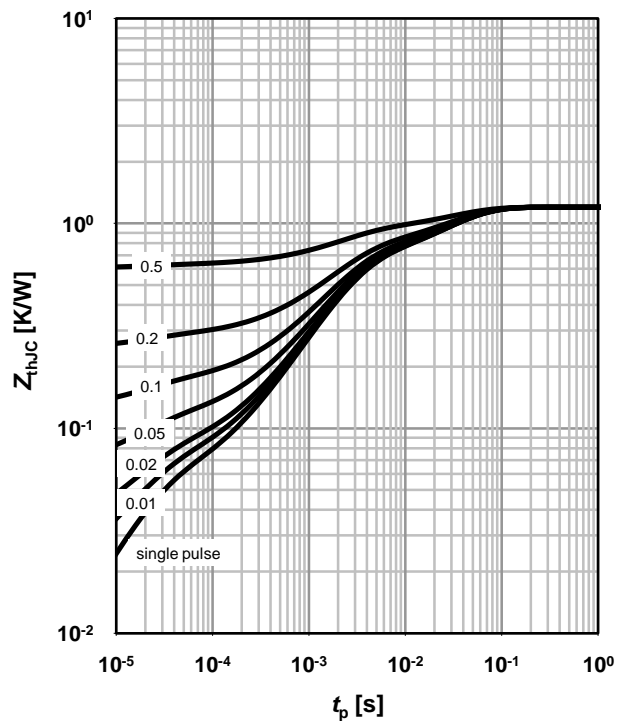
parameter: t_p



4 Max. transient thermal impedance

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

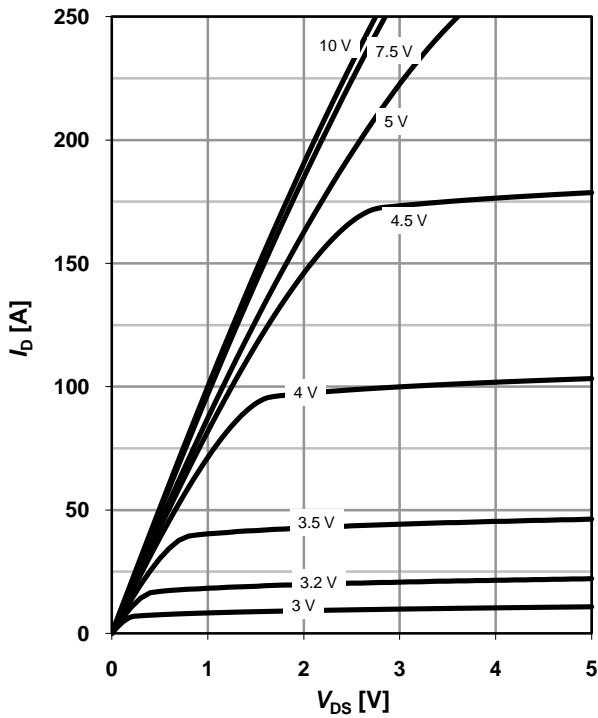
parameter: $D=t_p/T$



5 Typ. output characteristics

$I_D = f(V_{DS}); T_j = 25\text{ °C}$

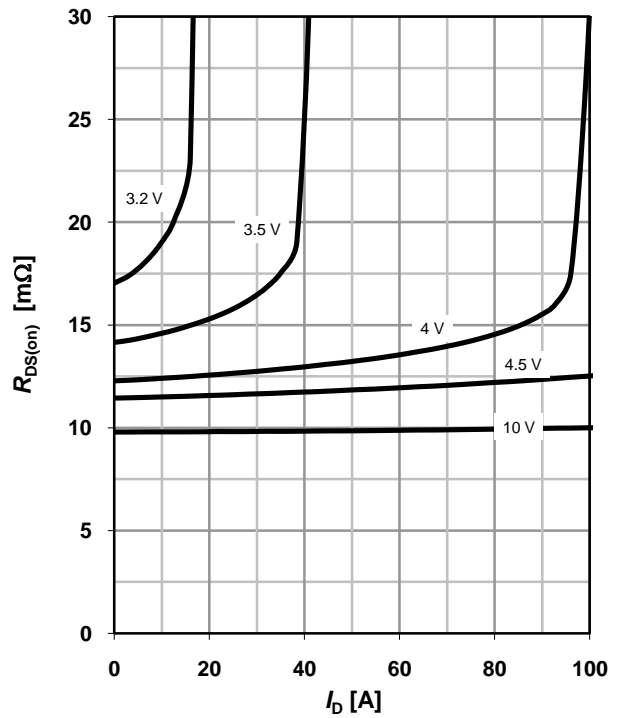
parameter: V_{GS}



6 Typ. drain-source on resistance

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

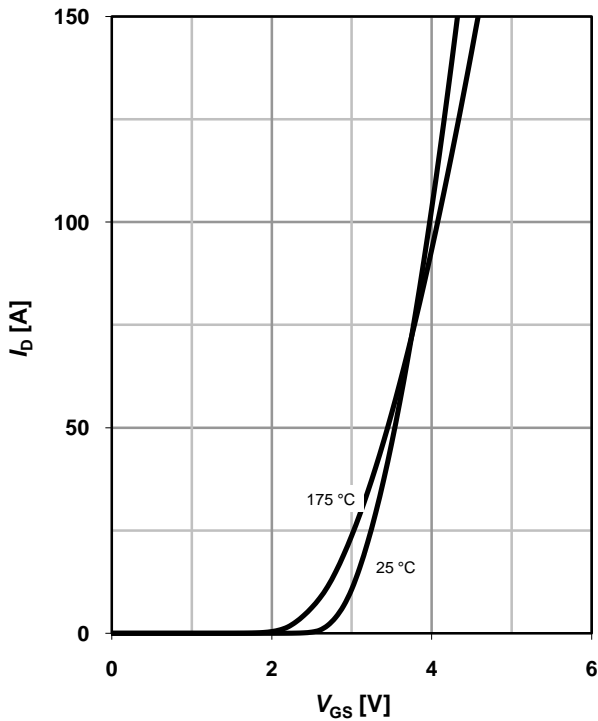
parameter: V_{GS}



7 Typ. transfer characteristics

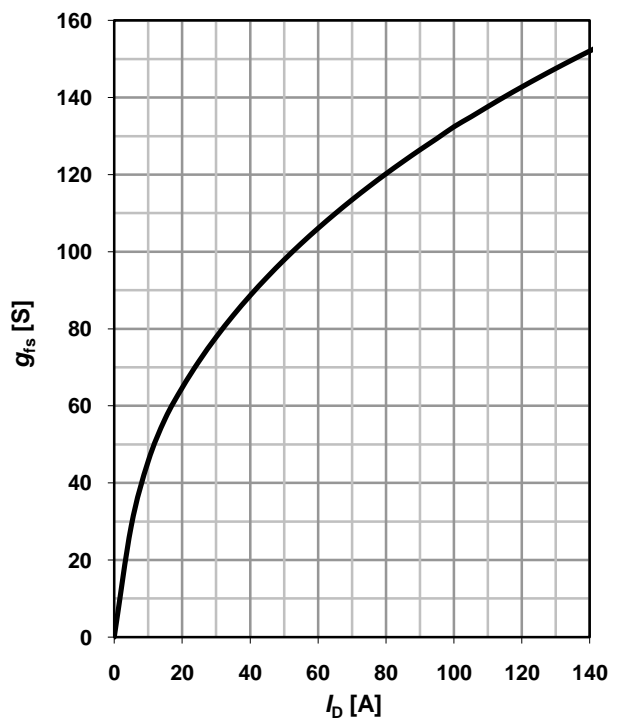
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter: T_j



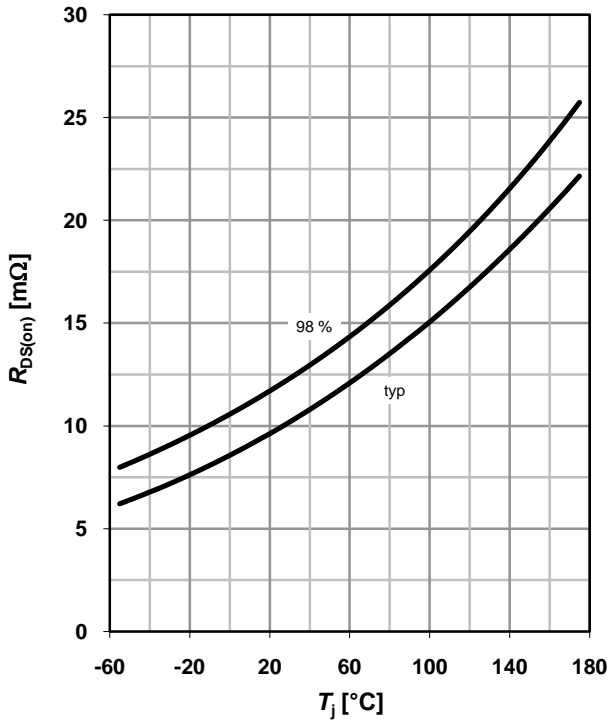
8 Typ. forward transconductance

$g_{fs} = f(I_D); T_j = 25\text{ °C}$



9 Drain-source on-state resistance

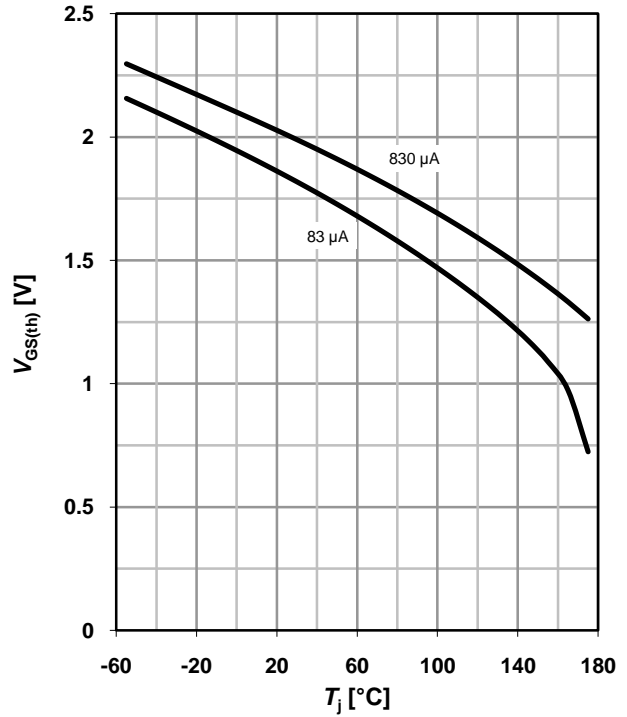
$R_{DS(on)}=f(T_j); I_D=69\text{ A}; V_{GS}=10\text{ V}$



10 Typ. gate threshold voltage

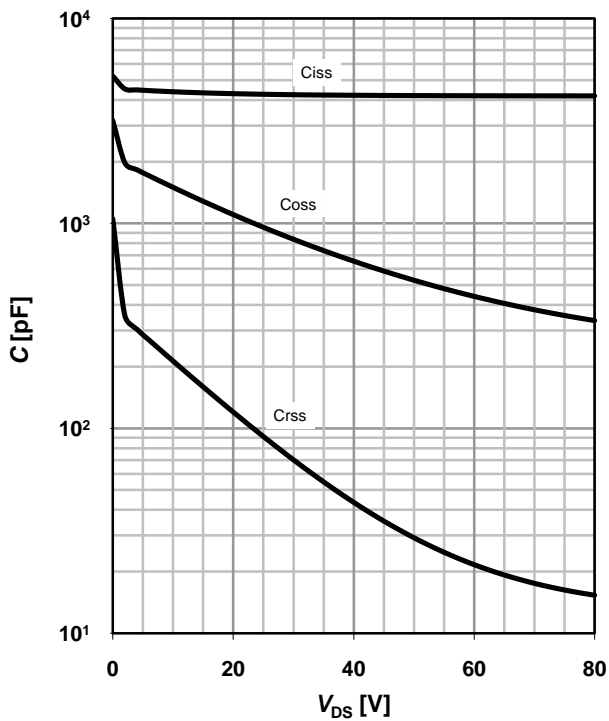
$V_{GS(th)}=f(T_j); V_{GS}=V_{DS}$

parameter: I_D



11 Typ. capacitances

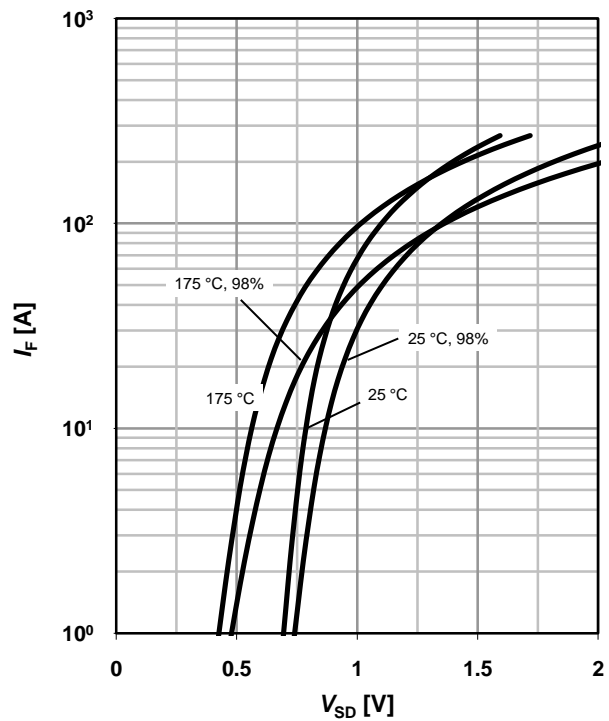
$C=f(V_{DS}); V_{GS}=0\text{ V}; f=1\text{ MHz}$



12 Forward characteristics of reverse diode

$I_F=f(V_{SD})$

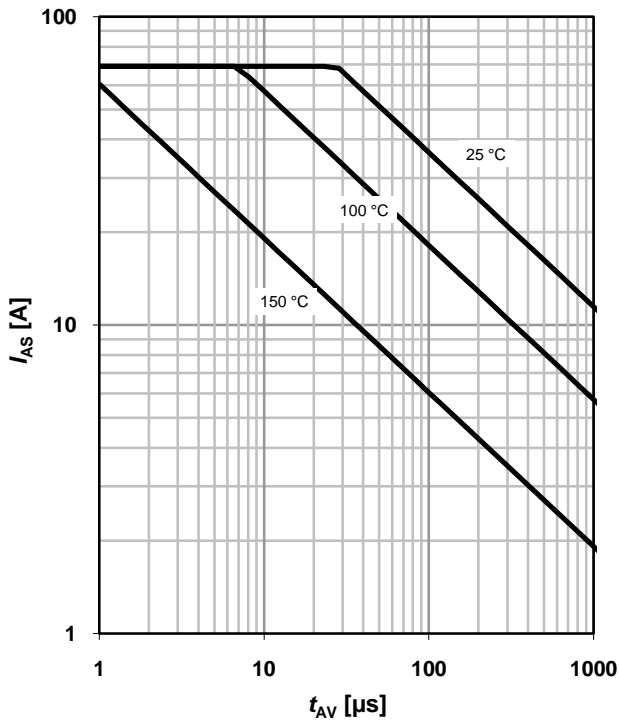
parameter: T_j



13 Avalanche characteristics

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

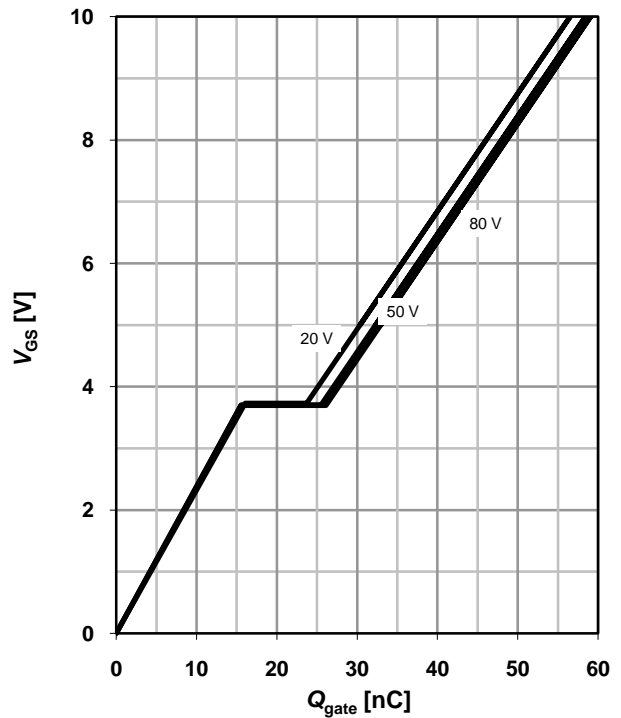
parameter: $T_{j(\text{start})}$



14 Typ. gate charge

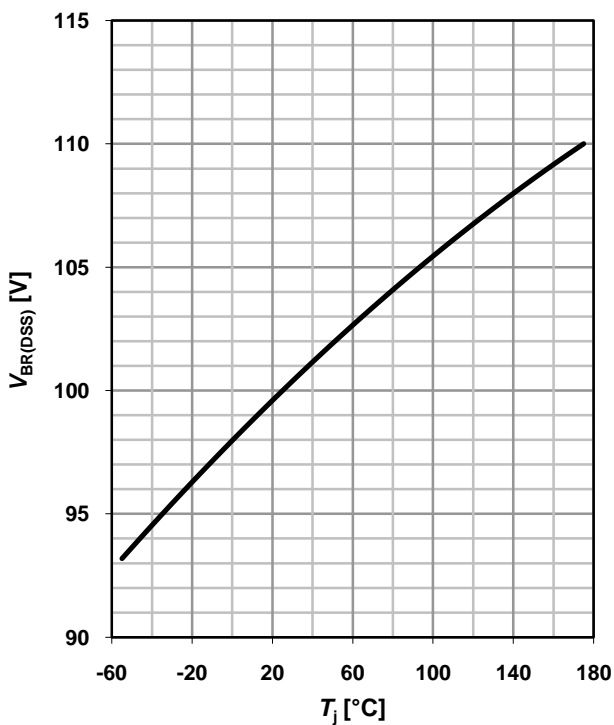
$V_{GS}=f(Q_{\text{gate}}); I_D=69 \text{ A pulsed}$

parameter: V_{DD}

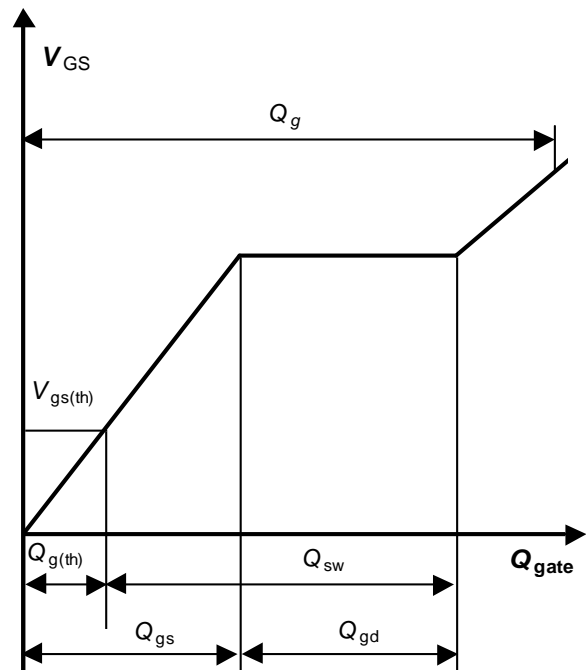


15 Drain-source breakdown voltage

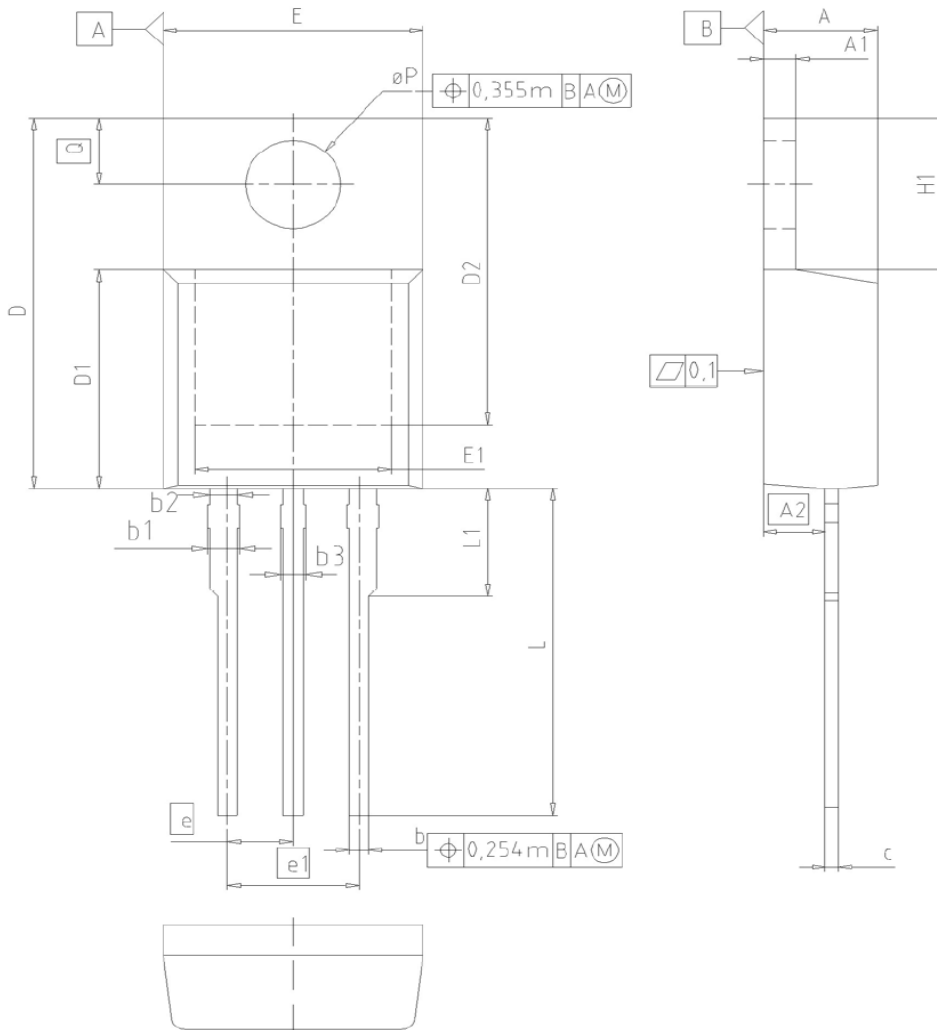
$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$



16 Gate charge waveforms



PG-T0220-3: Outline



| 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 |
| ϕP | 3.60 | 3.89 | 0.142 | 0.153 |
| Q | 2.60 | 3.00 | 0.102 | 0.118 |

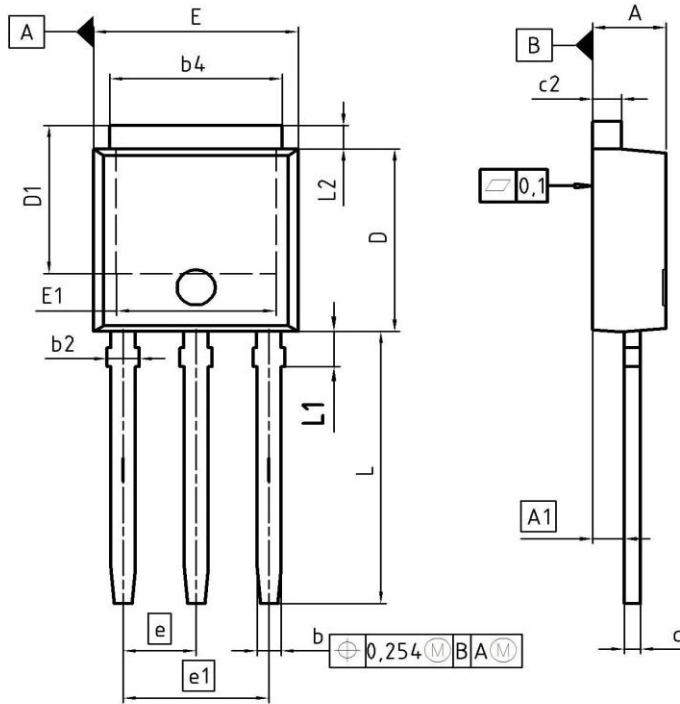
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| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|--------|-------|
| | MIN | MAX | MIN | MAX |
| A | 2.16 | 2.41 | 0.085 | 0.095 |
| A1 | 0.90 | 1.14 | 0.035 | 0.045 |
| b | 0.64 | 0.89 | 0.025 | 0.035 |
| b2 | 0.65 | 1.15 | 0.026 | 0.045 |
| b4 | 4.95 | 5.50 | 0.195 | 0.217 |
| c | 0.46 | 0.60 | 0.018 | 0.024 |
| c2 | 0.46 | 0.89 | 0.018 | 0.035 |
| D | 5.97 | 6.22 | 0.235 | 0.245 |
| D1 | 5.04 | 5.77 | 0.198 | 0.227 |
| E | 6.35 | 6.73 | 0.250 | 0.265 |
| E1 | 4.70 | 5.21 | 0.185 | 0.205 |
| e | 2.29 | | 0.090 | |
| e1 | 4.57 | | 0.180 | |
| N | 3 | | 3 | |
| L | 8.89 | 9.65 | 0.350 | 0.380 |
| L1 | 1.90 | 2.29 | 0.075 | 0.090 |
| L2 | 0.89 | 1.37 | 0.035 | 0.054 |

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