

OptiMOS™3 Power-Transistor
Features

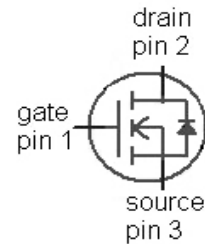
- Optimized technology for synchronous rectification
- Ideal for high frequency switching and DC/DC converters
- Excellent gate charge x $R_{DS(on)}$ product (FOM)
- Very low on-resistance $R_{DS(on)}$
- N-channel, normal level
- 100% avalanche tested
- Pb-free plating; RoHS compliant, halogen free
- Qualified according to JEDEC¹⁾ for target applications

Product Summary

| | | |
|------------------|-----|----|
| V_{DS} | 75 | V |
| $R_{DS(on),max}$ | 2.3 | mΩ |
| I_D | 120 | A |



| Type | IPP023NE7N3 G | IPI023NE7N3 G |
|----------------|---------------|---------------|
| | | |
| Package | PG-TO220-3 | PG-TO262-3 |
| Marking | 023NE7N | 023NE7N |


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

| Parameter | Symbol | Conditions | Value | Unit |
|--|----------------|---|-------------|------|
| Continuous drain current | I_D | $T_C=25\text{ °C}^{2)}$ | 120 | A |
| | | $T_C=100\text{ °C}$ | 120 | |
| Pulsed drain current ²⁾ | $I_{D,pulse}$ | $T_C=25\text{ °C}$ | 480 | |
| Avalanche energy, single pulse ³⁾ | E_{AS} | $I_D=100\text{ A}, R_{GS}=25\text{ }\Omega$ | 1100 | mJ |
| Gate source voltage | V_{GS} | | ± 20 | V |
| Power dissipation | P_{tot} | $T_C=25\text{ °C}$ | 300 | 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 for more detailed information

³⁾ See figure 13 for more detailed information

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

Thermal characteristics

| | | | | | | |
|--|------------|--|---|---|-----|-----|
| Thermal resistance, junction - case | R_{thJC} | | - | - | 0.5 | 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 | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=1\text{ mA}$ | 75 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=273\text{ }\mu\text{A}$ | 2.3 | 3.1 | 3.8 | |
| Zero gate voltage drain current | I_{DSS} | $V_{DS}=75\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$ | - | 0.1 | 1 | μA |
| | | $V_{DS}=75\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ °C}$ | - | 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 | $R_{DS(on)}$ | $V_{GS}=10\text{ V}, I_D=100\text{ A}$ | - | 2.1 | 2.3 | m Ω |
| Gate resistance | R_G | | - | 2.7 | - | Ω |
| Transconductance | g_{fs} | $ V_{DS} >2 I_D R_{DS(on)max}, I_D=100\text{ A}$ | 98 | 195 | - | 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} | $V_{GS}=0\text{ V}, V_{DS}=37.5\text{ V},$ $f=1\text{ MHz}$ | - | 10800 | 14400 | pF |
| Output capacitance | C_{oss} | | - | 2420 | 3220 | |
| Reverse transfer capacitance | C_{rss} | | - | 110 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}=37.5\text{ V},$ $V_{GS}=10\text{ V}, I_D=100\text{ A},$ $R_G=1.6\ \Omega$ | - | 19 | - | ns |
| Rise time | t_r | | - | 26 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 70 | - | |
| Fall time | t_f | | - | 22 | - | |

Gate Charge Characteristics⁵⁾

| | | | | | | |
|-----------------------|---------------|--|---|-----|-----|----|
| Gate to source charge | Q_{gs} | $V_{DD}=37.5\text{ V},$ $I_D=100\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$ | - | 54 | - | nC |
| Gate to drain charge | Q_{gd} | | - | 31 | - | |
| Switching charge | Q_{sw} | | - | 51 | - | |
| Gate charge total | Q_g | | - | 155 | 206 | |
| Gate plateau voltage | $V_{plateau}$ | | - | 5.0 | - | |
| Output charge | Q_{oss} | $V_{DD}=37.5\text{ V}, V_{GS}=0\text{ V}$ | - | 160 | 212 | nC |

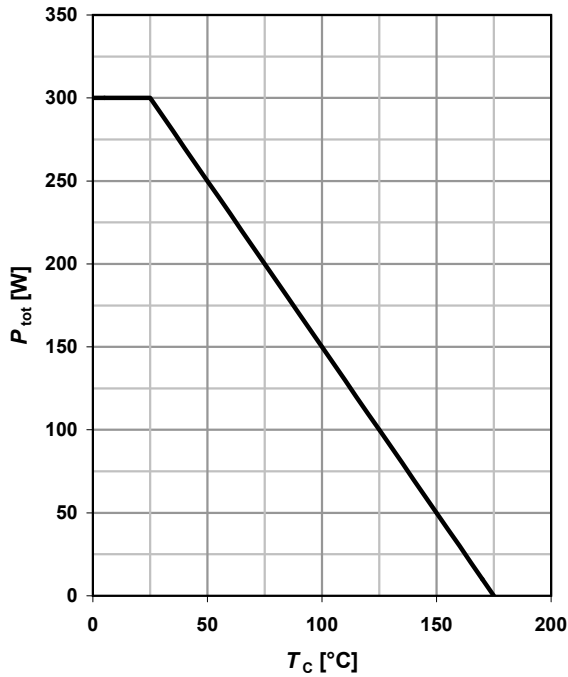
Reverse Diode

| | | | | | | |
|----------------------------------|---------------|--|---|-----|-----|----|
| Diode continuous forward current | I_S | $T_C=25\text{ }^\circ\text{C}$ | - | - | 120 | A |
| Diode pulse current | $I_{S,pulse}$ | | - | - | 480 | |
| Diode forward voltage | V_{SD} | $V_{GS}=0\text{ V}, I_F=100\text{ A},$ $T_j=25\text{ }^\circ\text{C}$ | - | 0.9 | 1.2 | V |
| Reverse recovery time | t_{rr} | $V_R=37.5\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$ | - | 72 | - | ns |
| Reverse recovery charge | Q_{rr} | | - | 129 | - | nC |

⁵⁾ See figure 16 for gate charge parameter definition

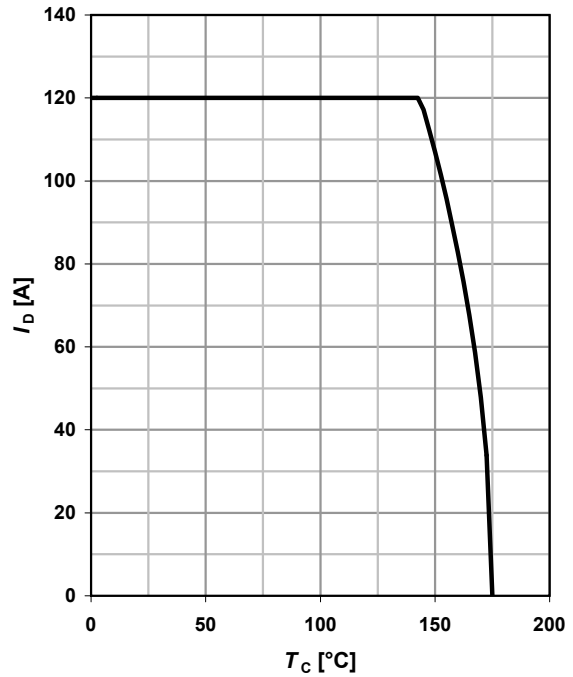
1 Power dissipation

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



2 Drain current

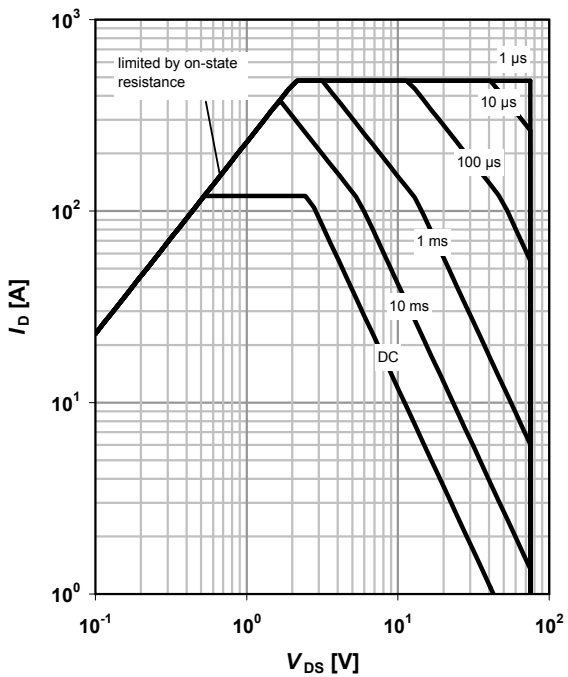
$$I_D = f(T_C); V_{GS} \geq 10 \text{ V}$$



3 Safe operating area

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

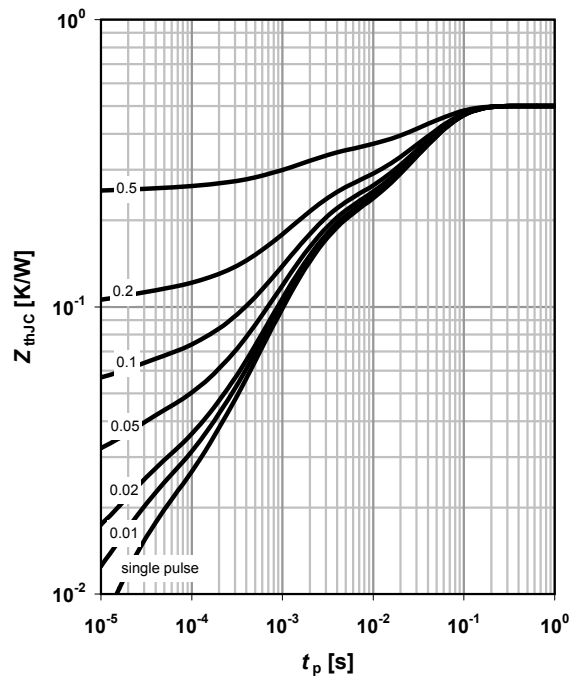
parameter: t_p



4 Max. transient thermal impedance

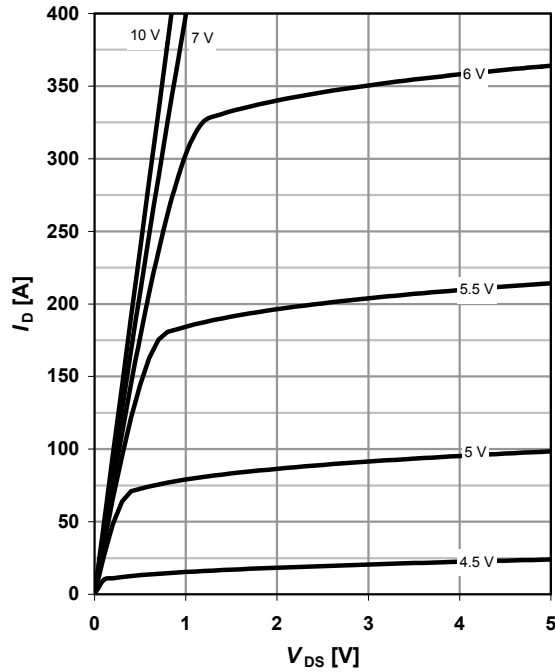
$$Z_{\text{thJC}} = f(t_p)$$

parameter: $D = t_p / T$

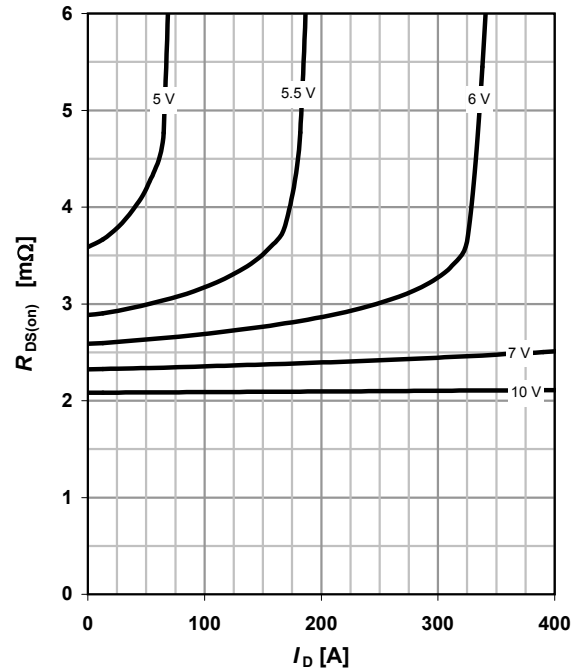


5 Typ. output characteristics

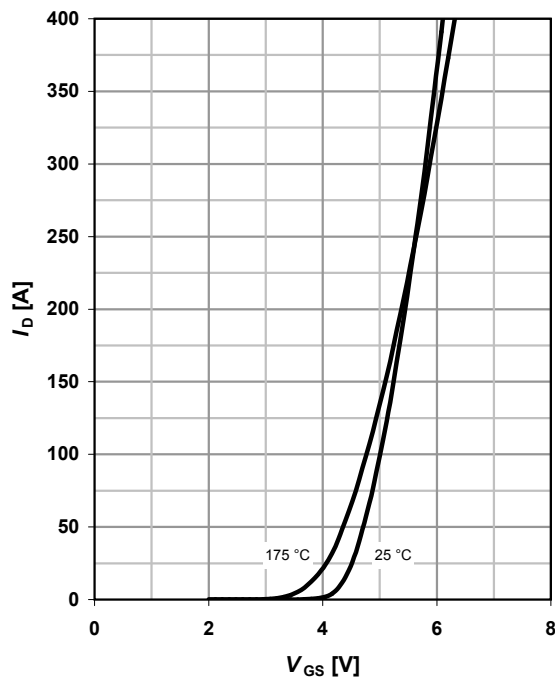
$$I_D = f(V_{DS}); T_j = 25\text{ °C}$$

 parameter: V_{GS}

6 Typ. drain-source on resistance

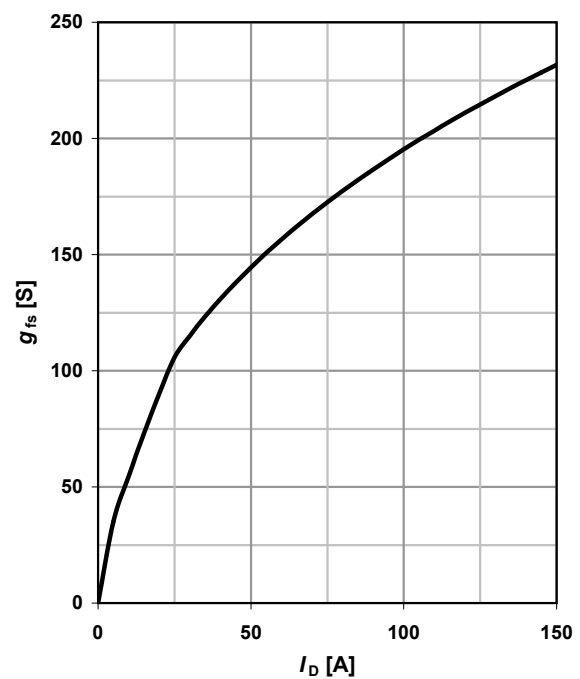
$$R_{DS(on)} = f(I_D); T_j = 25\text{ °C}$$

 parameter: V_{GS}

7 Typ. transfer characteristics

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

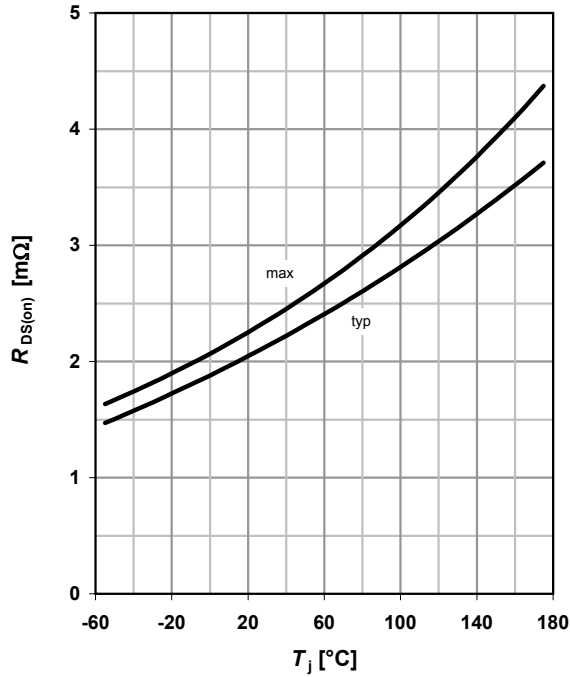
 parameter: T_j

8 Typ. forward transconductance

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



9 Drain-source on-state resistance

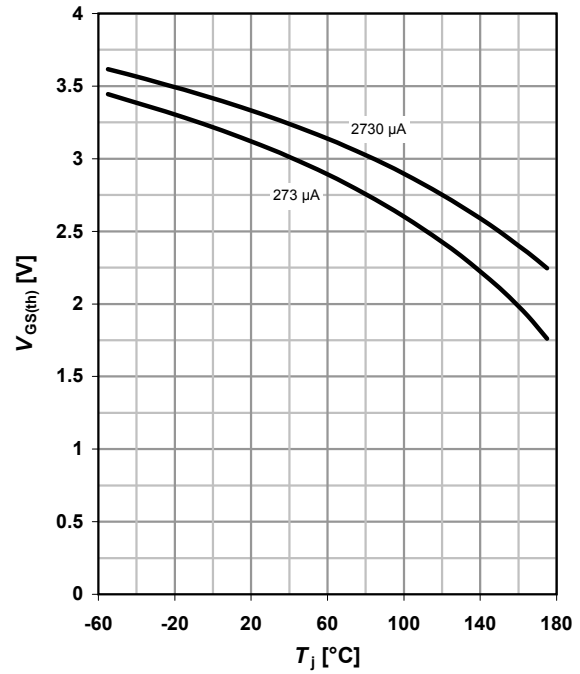
$R_{DS(on)} = f(T_j); I_D = 100 \text{ A}; V_{GS} = 10 \text{ V}$



10 Typ. gate threshold voltage

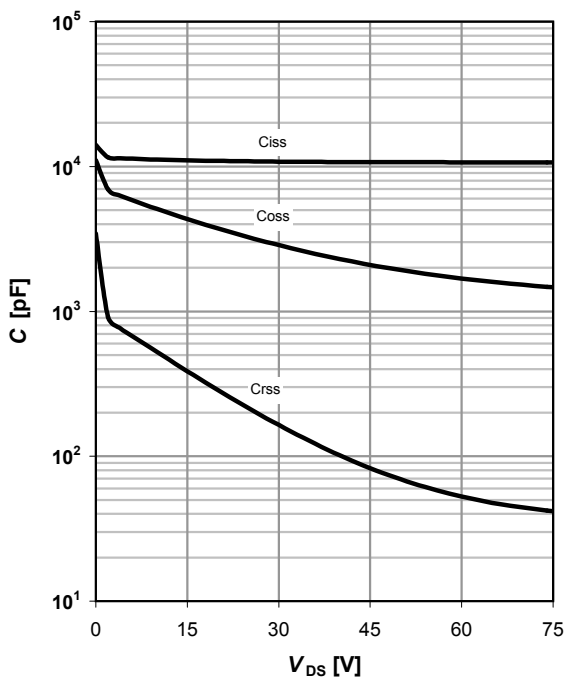
$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$

parameter: I_D



11 Typ. capacitances

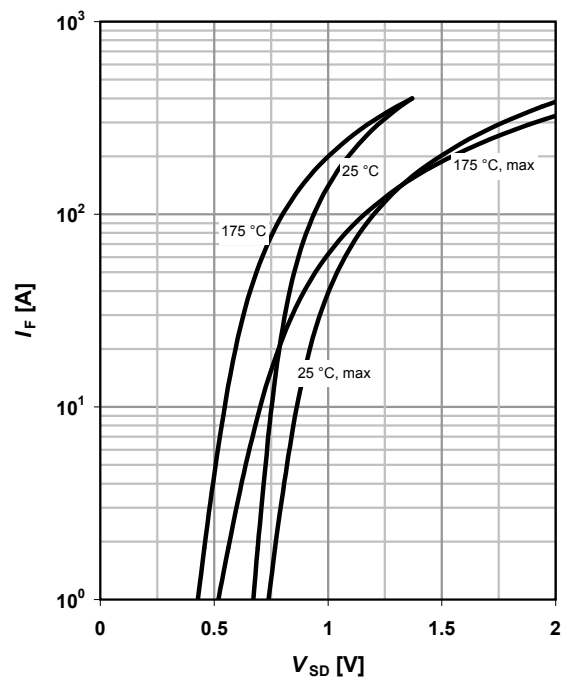
$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$



12 Forward characteristics of reverse diode

$I_F = f(V_{SD})$

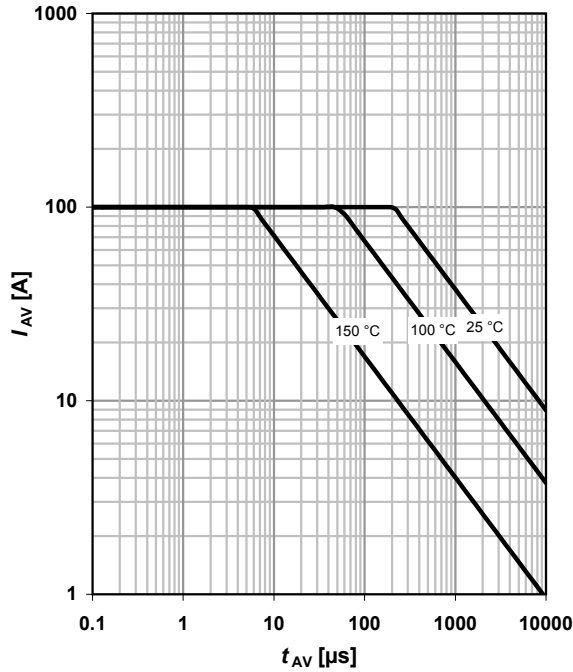
parameter: T_j



13 Avalanche characteristics

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

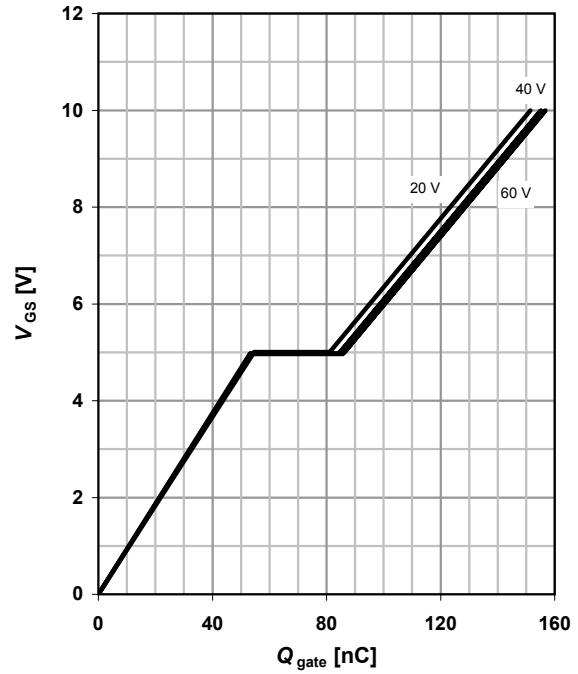
parameter: $T_{j(start)}$



14 Typ. gate charge

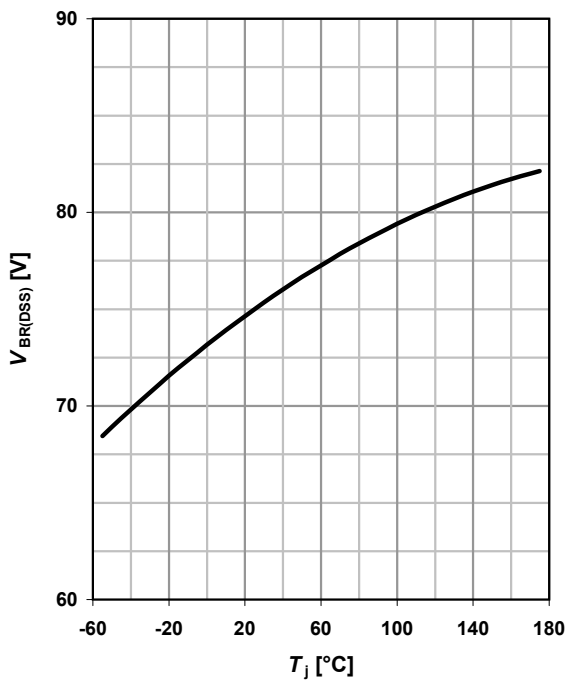
$V_{GS}=f(Q_{gate}); I_D=100$ A pulsed

parameter: V_{DD}



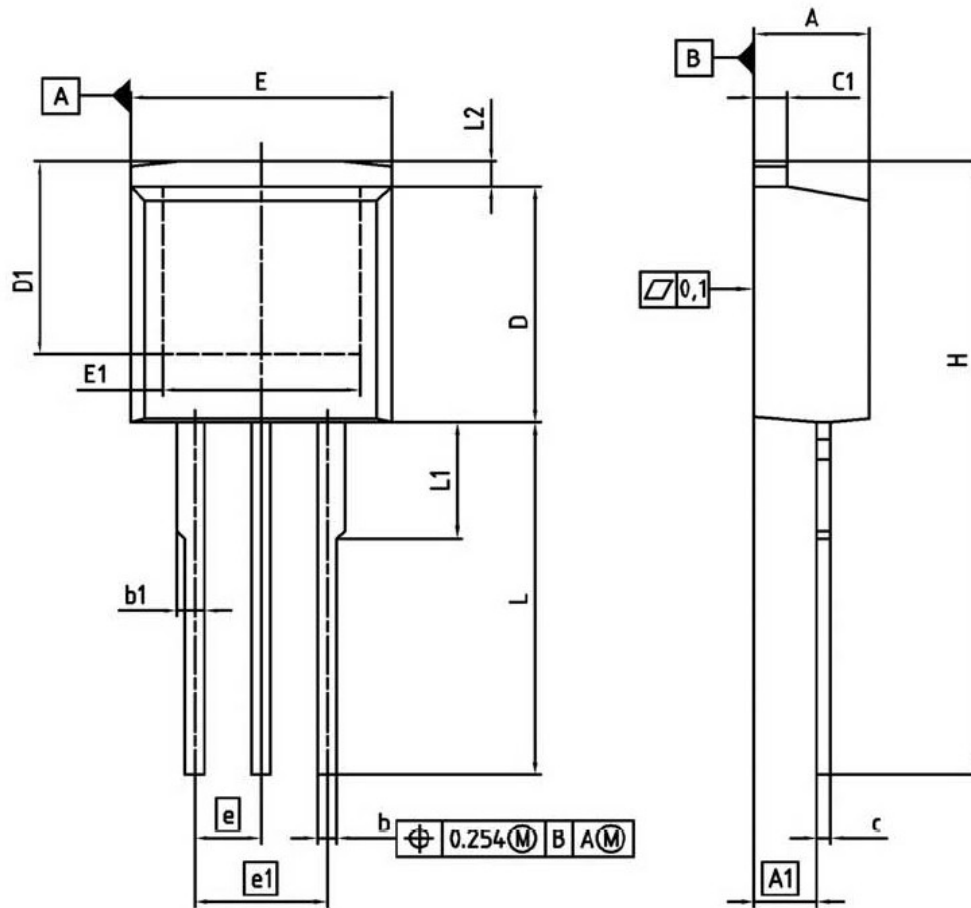
15 Drain-source breakdown voltage

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



16 Gate charge waveforms



PG-TO262-3 (I²-Pak)


| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|--------|--------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.300 | 4.572 | 0.169 | 0.180 |
| A1 | 2.150 | 2.718 | 0.085 | 0.107 |
| b | 0.650 | 0.664 | 0.026 | 0.034 |
| b1 | 0.635 | 1.400 | 0.025 | 0.055 |
| c | 0.330 | 0.600 | 0.013 | 0.024 |
| c1 | 1.170 | 1.400 | 0.046 | 0.055 |
| D | 8.509 | 9.450 | 0.335 | 0.372 |
| D1 | 6.900 | - | 0.272 | - |
| 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 | |
| L | 13.000 | 14.000 | 0.512 | 0.551 |
| L1 | - | 4.800 | - | 0.189 |
| L2 | - | 1.727 | - | 0.068 |

REFERENCE
JEDEC TO262

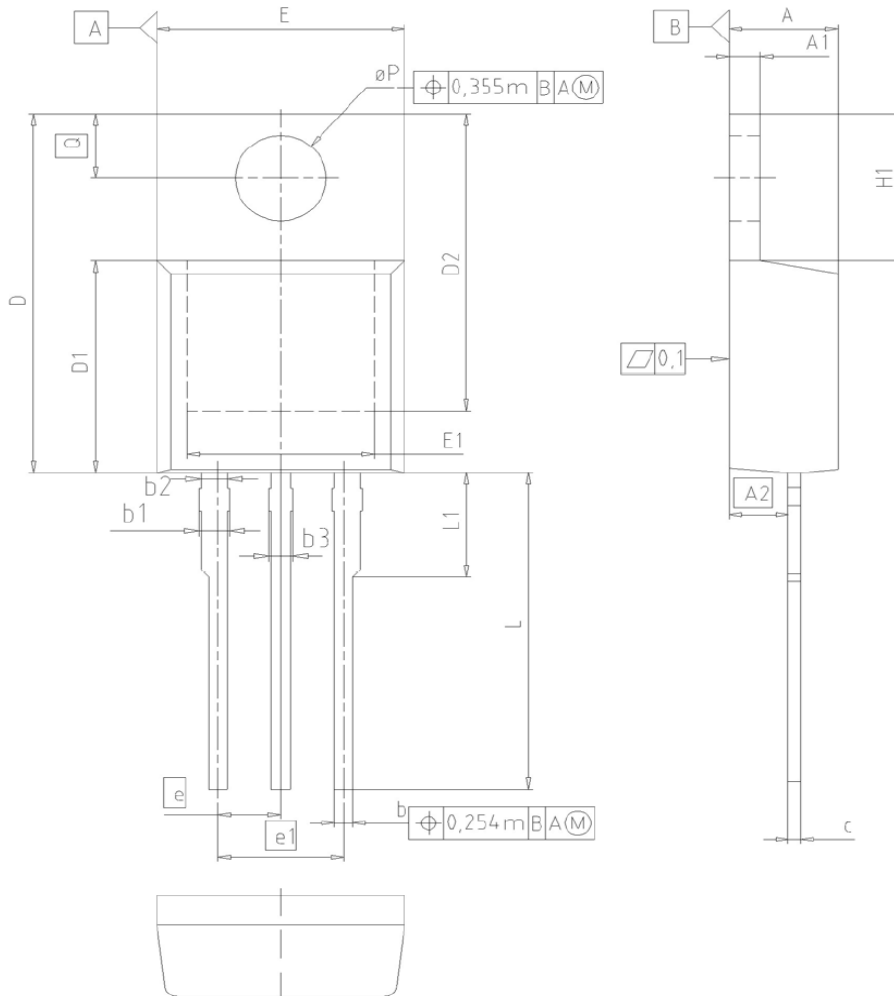
0 2.5 5mm

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TO262_1

PG-TO220-3



| 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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