



**THE DATASHEET OF
IPD038N06N3GATMA1**



OptiMOS[®] 3 Power-Transistor
Features

- Excellent gate charge $\times R_{DS(on)}$ product (FOM)
- Very low on-resistance $R_{DS(on)}$
- N-channel, normal level
- for sync. rectification, drives and dc/dc SMPS
- Avalanche rated
- Very low on-resistance $R_{DS(on)}$
- Qualified according to JEDEC¹⁾ for target applications
- Pb-free plating; RoHS compliant

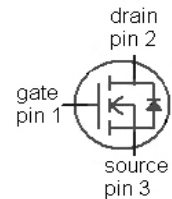
Product Summary

| | | |
|------------------|-----|------------|
| V_{DS} | 60 | V |
| $R_{DS(on),max}$ | 3.8 | m Ω |
| I_D | 90 | A |



previous engineering
sample code:
IPD04xN06N

| | |
|----------------|---------------|
| Type | IPD038N06N3 G |
| | |
| Package | PG-TO252-3 |
| Marking | 038N06N |



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

| Parameter | Symbol | Conditions | Value | Unit |
|---|---------------|---|----------|------|
| Continuous drain current | I_D | $V_{GS}=10\text{ V}, T_C=25\text{ °C}$ | 90 | A |
| | | $V_{GS}=10\text{ V}, T_C=100\text{ °C}$ | 90 | |
| Pulsed drain current ²⁾ | $I_{D,pulse}$ | $T_C=25\text{ °C}$ | 360 | |
| Avalanche current, single pulse ³⁾ | I_{AS} | $T_C=25\text{ °C}$ | 90 | |
| Avalanche energy, single pulse | E_{AS} | $I_D=90\text{ A}, R_{GS}=25\ \Omega$ | 165 | mJ |
| Gate source voltage | V_{GS} | | ± 20 | V |

¹⁾ J-STD20 and JESD22

²⁾ See figure 3 for more detailed information

³⁾ See figure 13 for more detailed information

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

| Parameter | Symbol | Conditions | Value | Unit |
|-------------------------------------|-----------------------|--------------------|-------------|------|
| Power dissipation | P_{tot} | $T_C=25\text{ °C}$ | 188 | W |
| Operating and storage temperature | T_j, T_{stg} | | -55 ... 175 | °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_{thJC} | | - | - | 0.8 | K/W |
| SMD version, device on PCB | R_{thJA} | minimal footprint | - | - | 75 | |
| | | 6 cm ² cooling area ⁴⁾ | - | - | 50 | |

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

| | | | | | | |
|----------------------------------|-----------------------------|---|----|-----|-----|---------------|
| Drain-source breakdown voltage | $V_{(\text{BR})\text{DSS}}$ | $V_{\text{GS}}=0\text{ V}, I_{\text{D}}=1\text{ mA}$ | 60 | - | - | V |
| Gate threshold voltage | $V_{\text{GS(th)}}$ | $V_{\text{DS}}=V_{\text{GS}}, I_{\text{D}}=90\text{ }\mu\text{A}$ | 2 | 3 | 4 | |
| Zero gate voltage drain current | I_{DSS} | $V_{\text{DS}}=60\text{ V}, V_{\text{GS}}=0\text{ V}, T_j=25\text{ °C}$ | - | 0.1 | 1 | μA |
| | | $V_{\text{DS}}=60\text{ V}, V_{\text{GS}}=0\text{ V}, T_j=125\text{ °C}$ | - | 10 | 100 | |
| Gate-source leakage current | I_{GSS} | $V_{\text{GS}}=20\text{ V}, V_{\text{DS}}=0\text{ V}$ | - | 10 | 100 | nA |
| Drain-source on-state resistance | $R_{\text{DS(on)}}$ | $V_{\text{GS}}=10\text{ V}, I_{\text{D}}=90\text{ A}$ | - | 3.1 | 3.8 | m Ω |
| Gate resistance | R_{G} | | - | 1.3 | - | Ω |
| Transconductance | g_{fs} | $ V_{\text{DS}} >2 I_{\text{D}} R_{\text{DS(on)max}}, I_{\text{D}}=90\text{ A}$ | 60 | 120 | - | 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} | $V_{GS}=0\text{ V}, V_{DS}=30\text{ V},$ $f=1\text{ MHz}$ | - | 8000 | - | pF |
| Output capacitance | C_{oss} | | - | 1700 | - | |
| Reverse transfer capacitance | C_{rss} | | - | 58 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}=30\text{ V}, V_{GS}=10\text{ V},$ $I_D=90\text{ A}, R_G=3.5\ \Omega$ | - | 30 | - | ns |
| Rise time | t_r | | - | 70 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 40 | - | |
| Fall time | t_f | | - | 5 | - | |

Gate Charge Characteristics⁵⁾

| | | | | | | |
|--------------------------|---------------|--|---|-----|---|----|
| Gate to source charge | Q_{gs} | $V_{DD}=30\text{ V}, I_D=90\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$ | - | 42 | - | nC |
| Gate charge at threshold | $Q_{g(th)}$ | | - | 24 | - | |
| Gate to drain charge | Q_{gd} | | - | 9 | - | |
| Switching charge | Q_{sw} | | - | 27 | - | |
| Gate charge total | Q_g | | - | 98 | - | |
| Gate plateau voltage | $V_{plateau}$ | | - | 5.3 | - | V |
| Output charge | Q_{oss} | $V_{DD}=30\text{ V}, V_{GS}=0\text{ V}$ | - | 77 | - | |

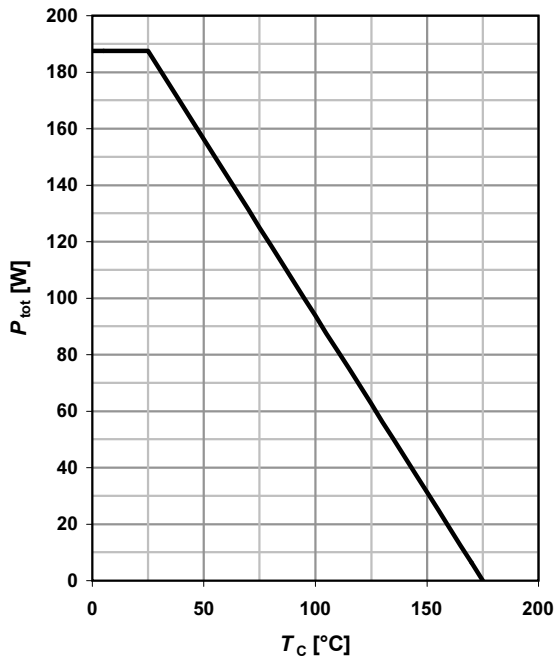
Reverse Diode

| | | | | | | |
|----------------------------------|---------------|---|---|------|-----|----|
| Diode continuous forward current | I_S | $T_C=25\text{ }^\circ\text{C}$ | - | - | 90 | A |
| Diode pulse current | $I_{S,pulse}$ | | - | - | 360 | |
| Diode forward voltage | V_{SD} | $V_{GS}=0\text{ V}, I_F=90\text{ A},$ $T_j=25\text{ }^\circ\text{C}$ | - | 0.95 | 1.2 | V |
| Reverse recovery time | t_{rr} | $V_R=30\text{ V}, I_F=50\text{ A},$ $di_F/dt=100\text{ A}/\mu\text{s}$ | - | 125 | - | ns |
| Reverse recovery charge | Q_{rr} | | - | 110 | - | nC |

⁵⁾ See figure 16 for gate charge parameter definition

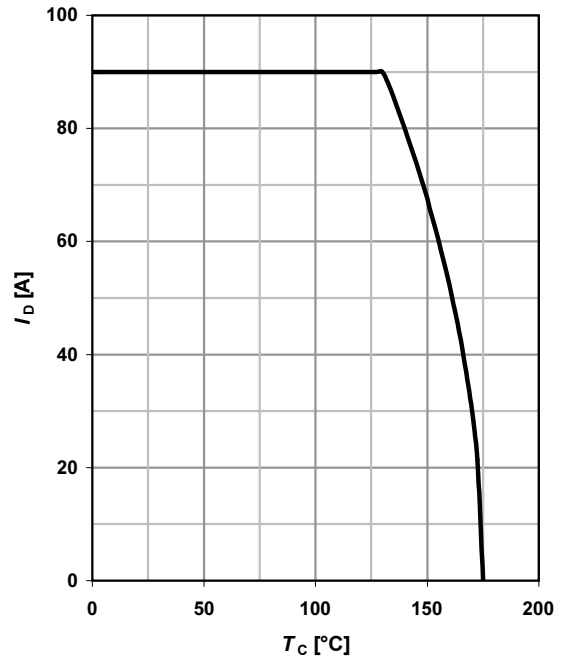
1 Power dissipation

$P_{tot}=f(T_C)$



2 Drain current

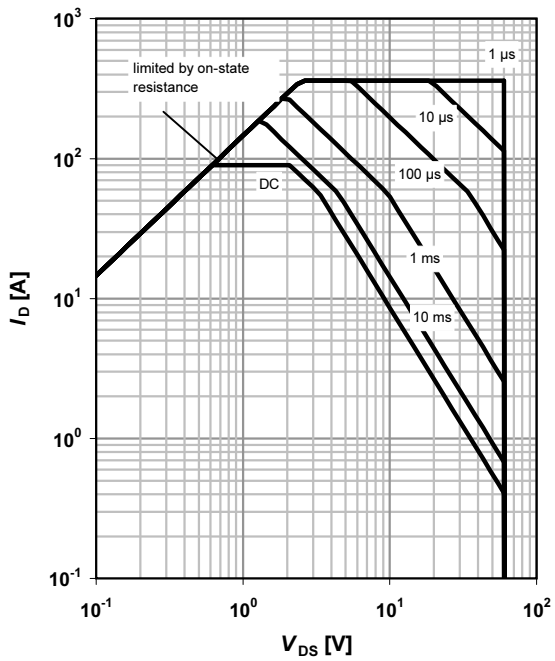
$I_D=f(T_C); V_{GS} \geq 10\text{ V}$



3 Safe operating area

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

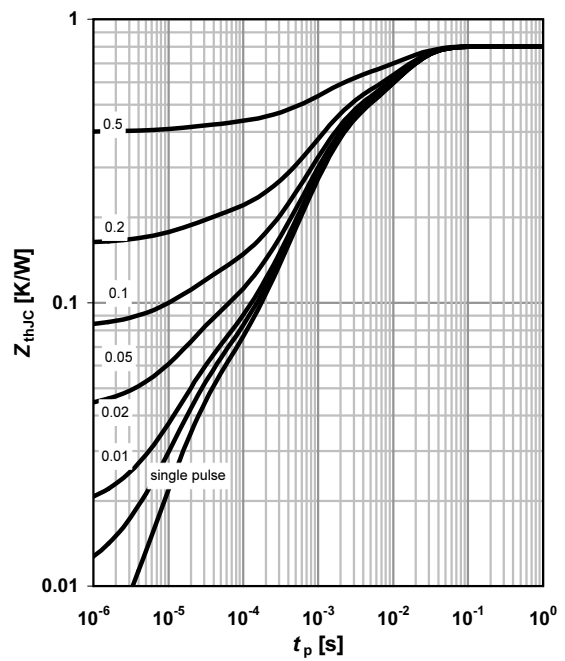
parameter: t_p



4 Max. transient thermal impedance

$Z_{thJC}=f(t_p)$

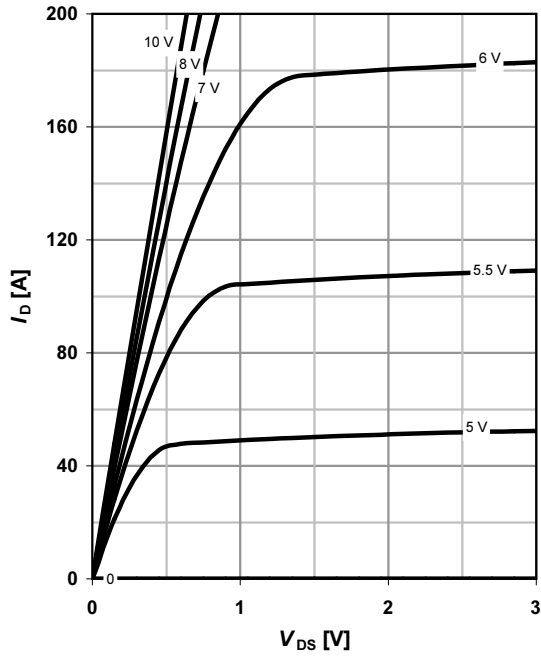
parameter: $D=t_p/T$



5 Typ. output characteristics

$I_D = f(V_{DS}); T_j = 25\text{ °C}$

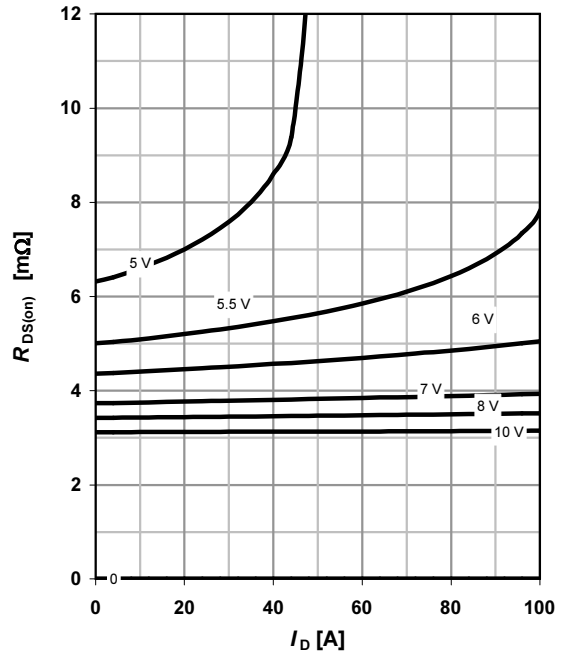
parameter: V_{GS}



6 Typ. drain-source on resistance

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

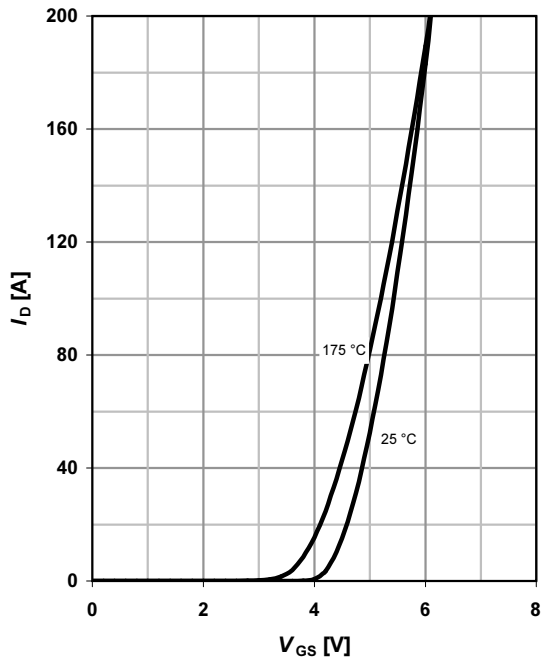
parameter: V_{GS}



7 Typ. transfer characteristics

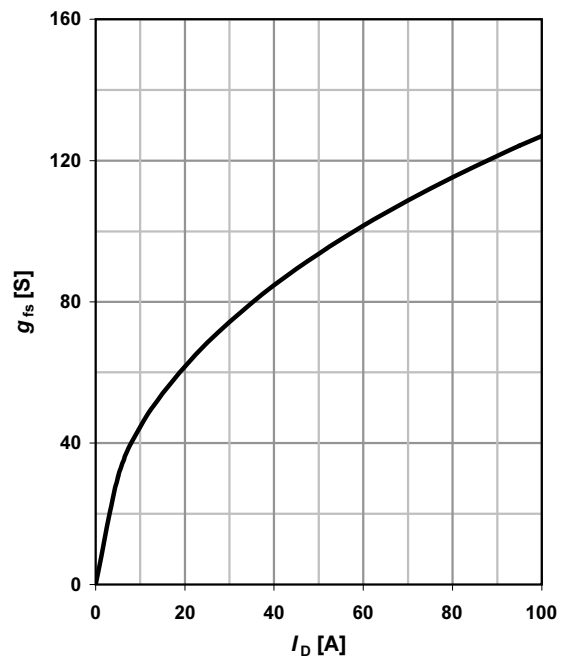
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter: T_j



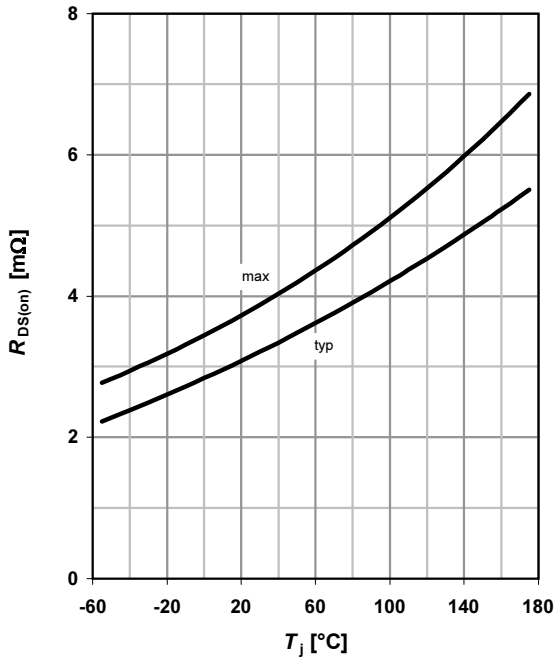
8 Typ. forward transconductance

$g_{fs} = f(I_D); T_j = 25\text{ °C}$



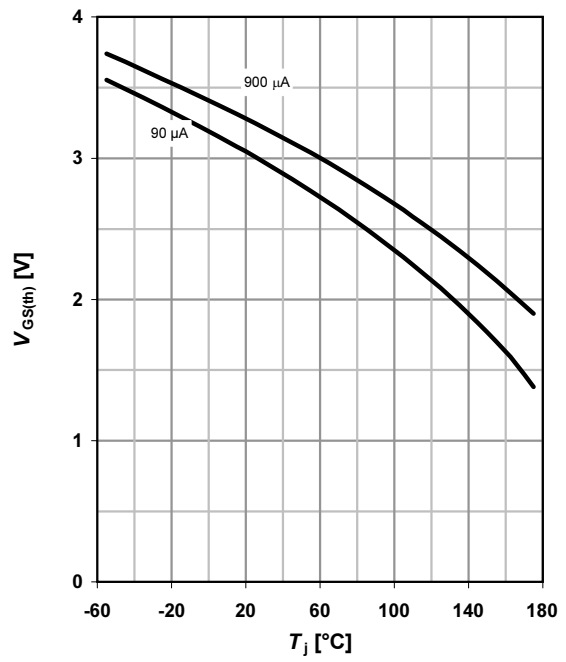
9 Drain-source on-state resistance

$R_{DS(on)} = f(T_j); I_D = 90 \text{ A}; V_{GS} = 10 \text{ V}$



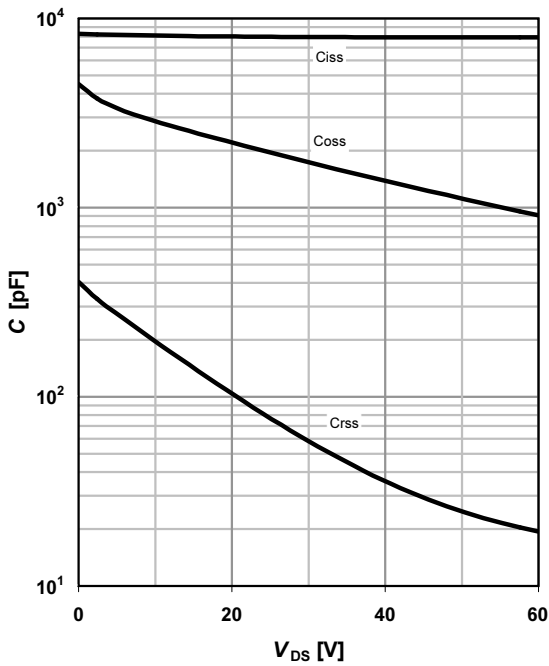
10 Typ. gate threshold voltage

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



11 Typ. capacitances

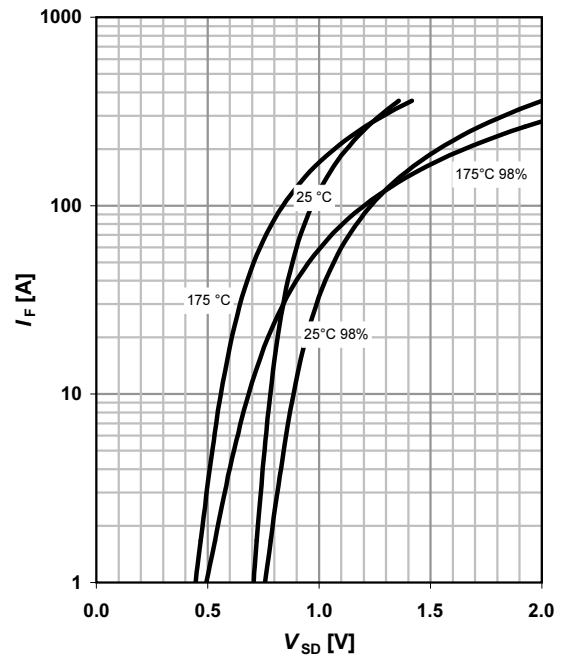
$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$



12 Forward characteristics of reverse diode

$I_F = f(V_{SD})$

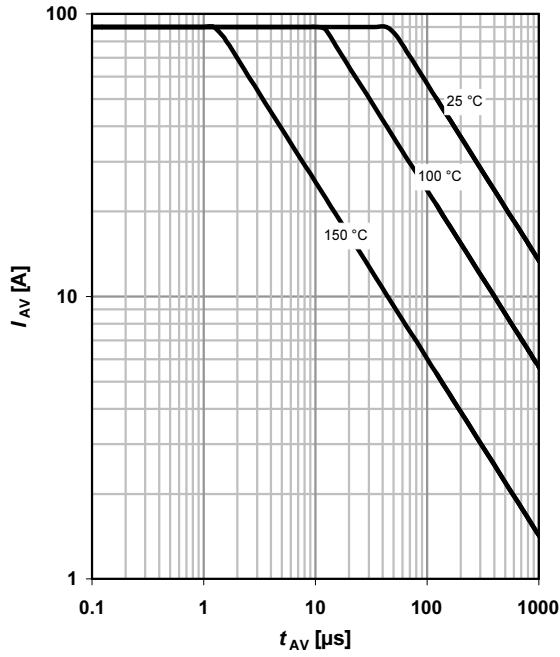
parameter: T_j



13 Avalanche characteristics

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

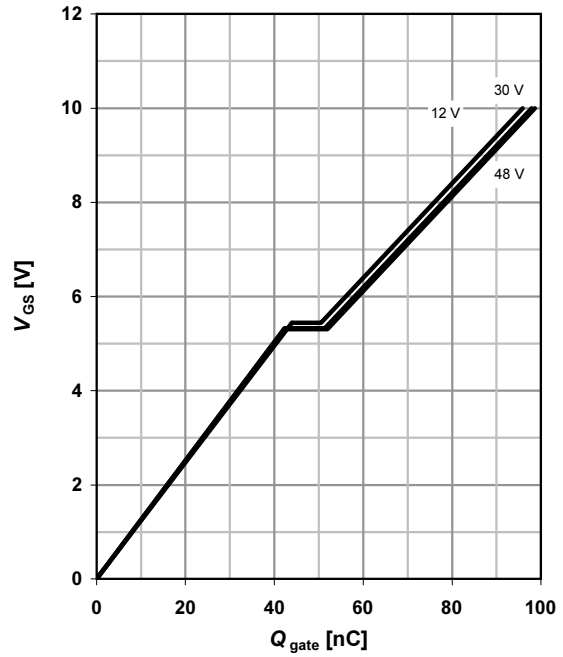
parameter: $T_{j(start)}$



14 Typ. gate charge

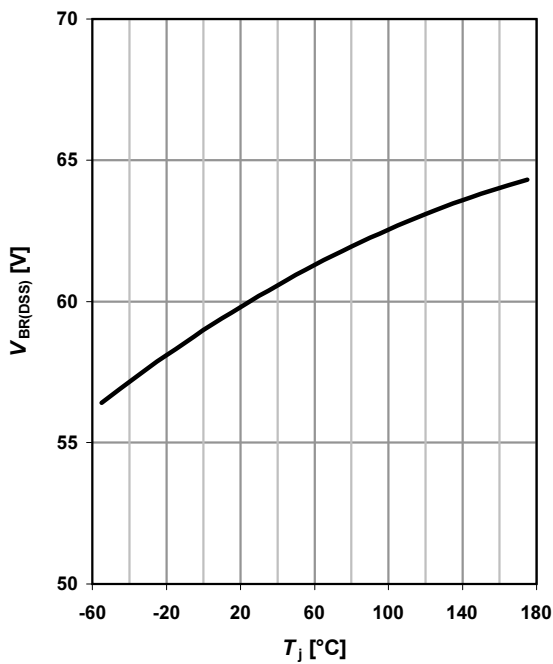
$V_{GS}=f(Q_{gate}); I_D=90 \text{ A pulsed}$

parameter: V_{DD}

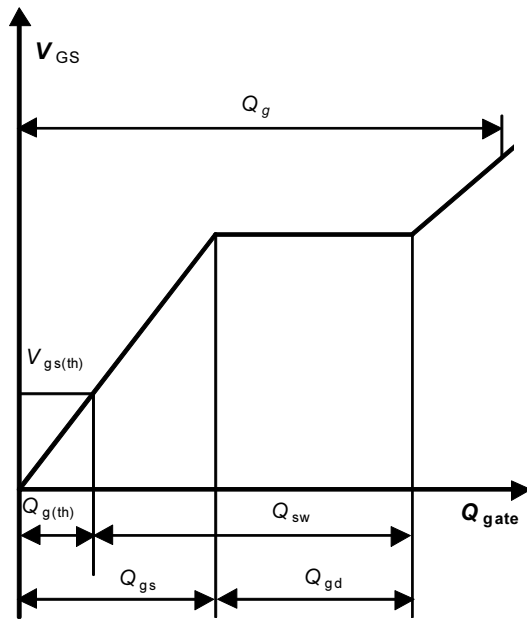


15 Drain-source breakdown voltage

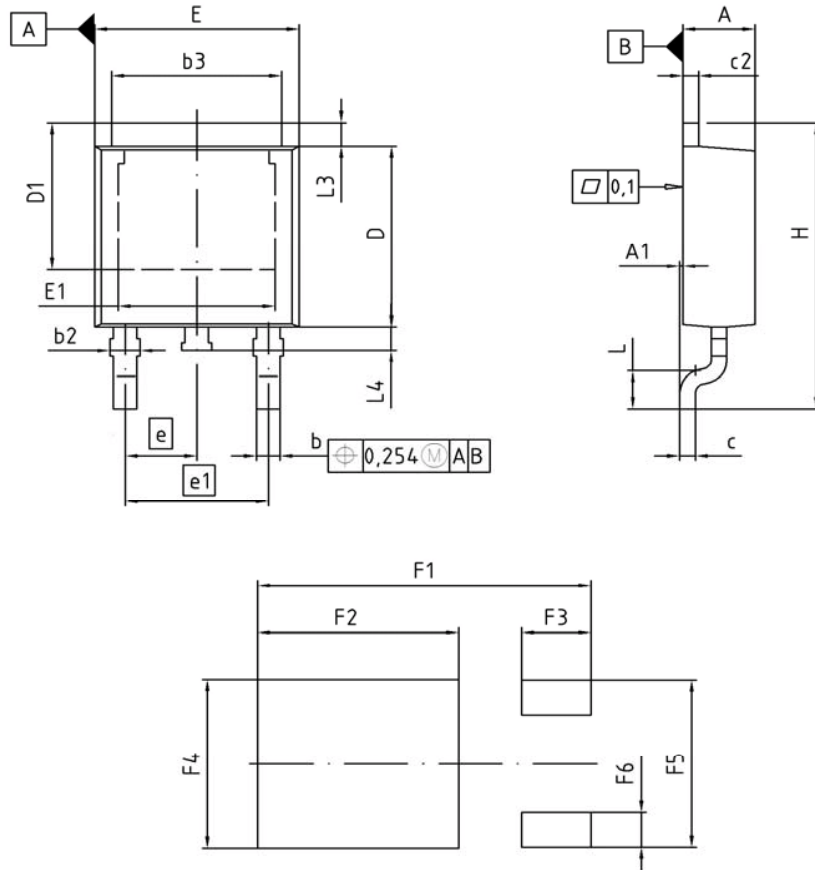
$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$



16 Gate charge waveforms



PG-TO252-3 (D-Pak)



| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|--------|-------|
| | MIN | MAX | MIN | MAX |
| A | 2.16 | 2.41 | 0.085 | 0.095 |
| A1 | 0.00 | 0.15 | 0.000 | 0.006 |
| b | 0.64 | 0.89 | 0.025 | 0.035 |
| b2 | 0.65 | 1.15 | 0.026 | 0.045 |
| b3 | 5.00 | 5.50 | 0.197 | 0.217 |
| c | 0.46 | 0.60 | 0.018 | 0.024 |
| c2 | 0.46 | 0.98 | 0.018 | 0.039 |
| D | 5.97 | 6.22 | 0.235 | 0.245 |
| D1 | 5.02 | 5.84 | 0.198 | 0.230 |
| E | 6.40 | 6.73 | 0.252 | 0.265 |
| E1 | 4.70 | 5.21 | 0.185 | 0.205 |
| e | 2.29 | | 0.090 | |
| e1 | 4.57 | | 0.180 | |
| N | 3 | | 3 | |
| H | 9.40 | 10.48 | 0.370 | 0.413 |
| L | 1.18 | 1.70 | 0.046 | 0.067 |
| L3 | 0.90 | 1.25 | 0.035 | 0.049 |
| L4 | 0.51 | 1.00 | 0.020 | 0.039 |
| F1 | 10.50 | 10.70 | 0.413 | 0.421 |
| F2 | 6.30 | 6.50 | 0.248 | 0.256 |
| F3 | 2.10 | 2.30 | 0.083 | 0.091 |
| F4 | 5.70 | 5.90 | 0.224 | 0.232 |
| F5 | 5.66 | 5.86 | 0.223 | 0.231 |
| F6 | 1.10 | 1.30 | 0.043 | 0.051 |

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