

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

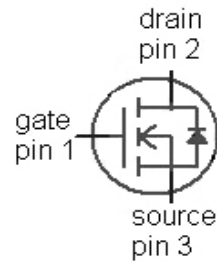
- Ideal for high frequency switching and sync. rec.
- Optimized technology for DC/DC converters
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- N-channel, normal level
- 100% avalanche tested
- Pb-free plating; RoHS compliant
- Qualified according to JEDEC<sup>1)</sup> for target applications

**Product Summary**

|                  |     |    |
|------------------|-----|----|
| $V_{DS}$         | 60  | V  |
| $R_{DS(on),max}$ | 5.7 | mΩ |
| $I_D$            | 60  | A  |



|                |               |
|----------------|---------------|
| <b>Type</b>    | IPA057N06N3 G |
|                |               |
| <b>Package</b> | PG-TO220-3-31 |
| <b>Marking</b> | 057N06N       |


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

| Parameter                                    | Symbol         | Conditions                            | Value       | Unit |
|--|----------------|---------------------------------------|-------------|------|
| Continuous drain current                     | $I_D$          | $T_C=25\text{ °C}^{2)}$               | 60          | A    |
|  |                | $T_C=100\text{ °C}$                   | 43          |      |
| Pulsed drain current <sup>3)</sup>           | $I_{D,pulse}$  | $T_C=25\text{ °C}$                    | 240         |      |
| Avalanche energy, single pulse <sup>4)</sup> | $E_{AS}$       | $I_D=80\text{ A}, R_{GS}=25\text{ Ω}$ | 77          | mJ   |
| Gate source voltage                          | $V_{GS}$       |                                       | ±20         | V    |
| Power dissipation                            | $P_{tot}$      | $T_C=25\text{ °C}$                    | 38          | 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

<sup>2)</sup> Current is limited by bondwire; with an  $R_{thJC}=1.3\text{ K/W}$  the chip is able to carry 108 A.

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

<sup>4)</sup> See figure 13 for more detailed information

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

**Thermal characteristics**

|                                     |            |  |   |   |   |     |
|-------------------------------------|------------|--|---|---|---|-----|
| Thermal resistance, junction - case | $R_{thJC}$ |  | - | - | 4 | K/W |
|-------------------------------------|------------|--|---|---|---|-----|

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

|                                  |               |  |    |     |     |                  |
|----------------------------------|---------------|--|----|-----|-----|------------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=1\text{ mA}$                       | 60 | -   | -   | V                |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=58\text{ }\mu\text{A}$                 | 2  | 3   | 4   |                  |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=60\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$  | -  | 0.1 | 1   | $\mu\text{A}$    |
|                                  |               | $V_{DS}=60\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ °C}$ | -  | 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 | $R_{DS(on)}$  | $V_{GS}=10\text{ V}, I_D=60\text{ A}$                      | -  | 4.6 | 5.7 | $\text{m}\Omega$ |
| Gate resistance                  | $R_G$         |  | -  | 1.2 | -   | $\Omega$         |
| Transconductance                 | $g_{fs}$      | $ V_{DS} >2 I_D R_{DS(on)max}, I_D=60\text{ A}$            | 41 | 82  | -   | S                |

<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            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=30\text{ V},$<br>$f=1\text{ MHz}$                    | - | 5000 | 6600 | pF |
| Output capacitance           | $C_{oss}$    |   | - | 1100 | 1500 |    |
| Reverse transfer capacitance | $C_{rss}$    |   | - | 38   | -    |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=30\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=80\text{ A}, R_G=1.6\ \Omega$ | - | 24   | -    | ns |
| Rise time                    | $t_r$        |   | - | 68   | -    |    |
| Turn-off delay time          | $t_{d(off)}$ |   | - | 32   | -    |    |
| Fall time                    | $t_f$        |   | - | 9    | -    |    |

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

|                       |               |  |   |     |    |    |
|-----------------------|---------------|--|---|-----|----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=30\text{ V}, I_D=80\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$ | - | 28  | -  | nC |
| Gate to drain charge  | $Q_{gd}$      |  | - | 6   | -  |    |
| Switching charge      | $Q_{sw}$      |  | - | 19  | -  |    |
| Gate charge total     | $Q_g$         |  | - | 61  | 82 |    |
| Gate plateau voltage  | $V_{plateau}$ |  | - | 5.6 | -  | V  |
| Output charge         | $Q_{oss}$     | $V_{DD}=30\text{ V}, V_{GS}=0\text{ V}$                                    | - | 50  | 66 | nC |

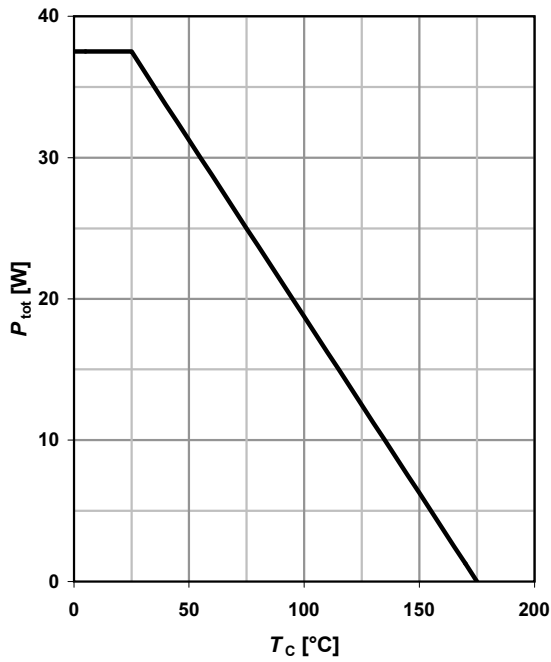
**Reverse Diode**

|                                  |               |   |   |     |     |    |
|----------------------------------|---------------|---|---|-----|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ }^\circ\text{C}$  | - | -   | 60  | A  |
| Diode pulse current              | $I_{S,pulse}$ |   | - | -   | 240 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=60\text{ A},$<br>$T_j=25\text{ }^\circ\text{C}$   | - | 0.9 | 1.2 | V  |
| Reverse recovery time            | $t_{rr}$      | $V_R=30\text{ V}, I_F=80\text{ A},$<br>$di_F/dt=100\text{ A}/\mu\text{s}$ | - | 52  | -   | ns |
| Reverse recovery charge          | $Q_{rr}$      |   | - | 59  | -   | nC |

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

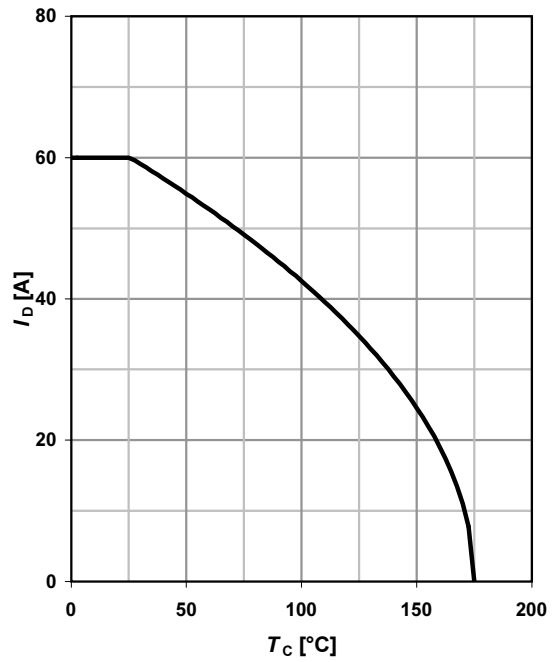
**1 Power dissipation**

$P_{tot}=f(T_C)$



**2 Drain current**

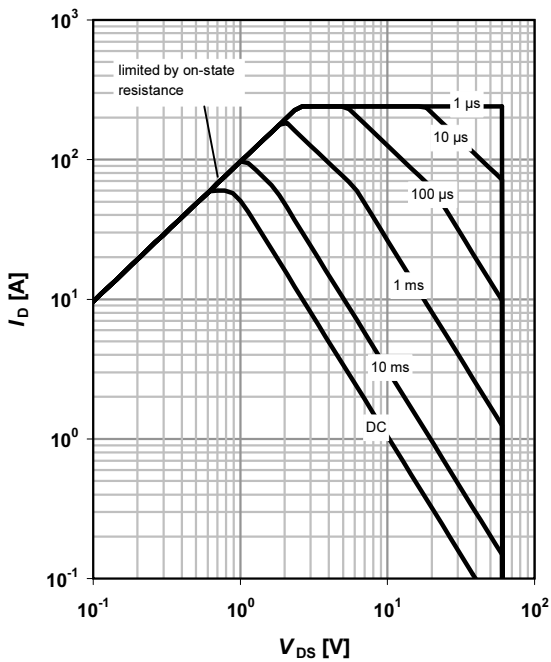
$I_D=f(T_C); V_{GS} \geq 10 V$



**3 Safe operating area**

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

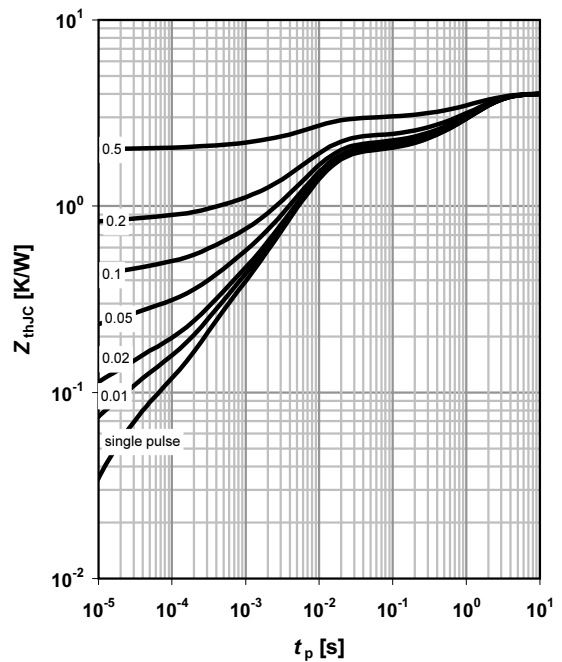
parameter:  $t_p$



**4 Max. transient thermal impedance**

$Z_{thJC}=f(t_p)$

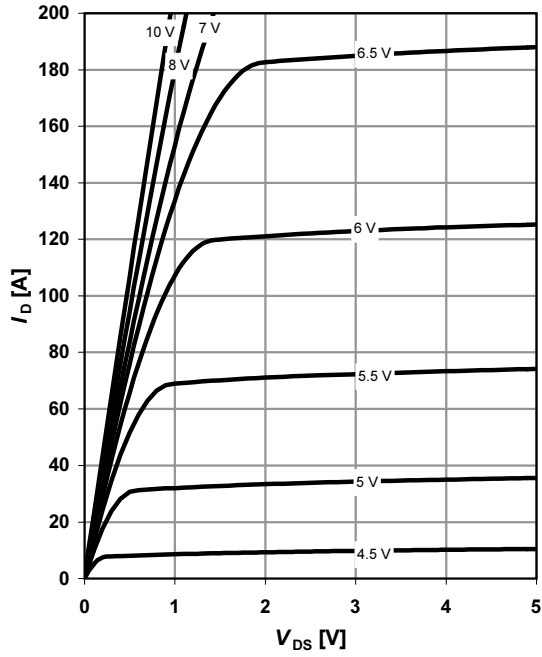
parameter:  $D=t_p/T$



**5 Typ. output characteristics**

$I_D = f(V_{DS}); T_j = 25\text{ °C}$

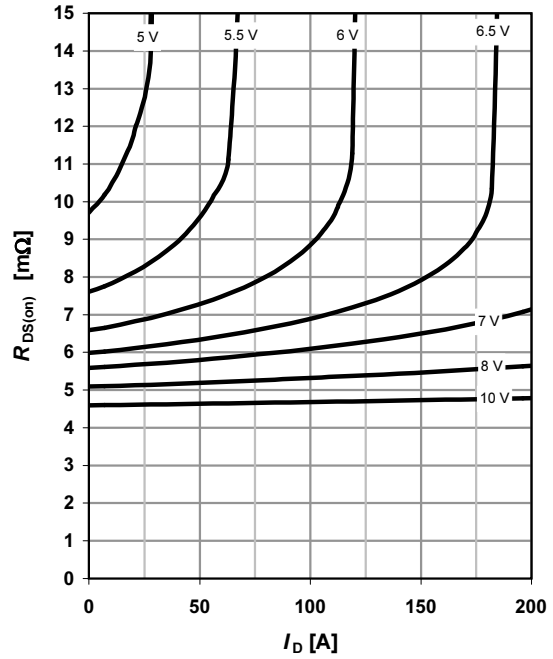
parameter:  $V_{GS}$



**6 Typ. drain-source on resistance**

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

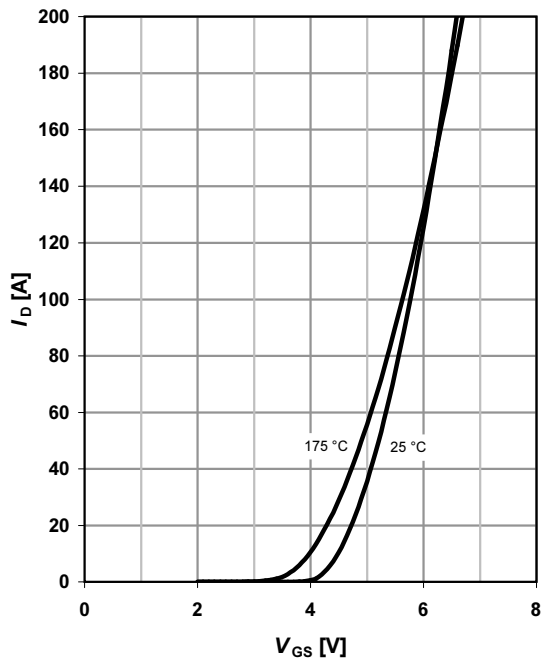
parameter:  $V_{GS}$



**7 Typ. transfer characteristics**

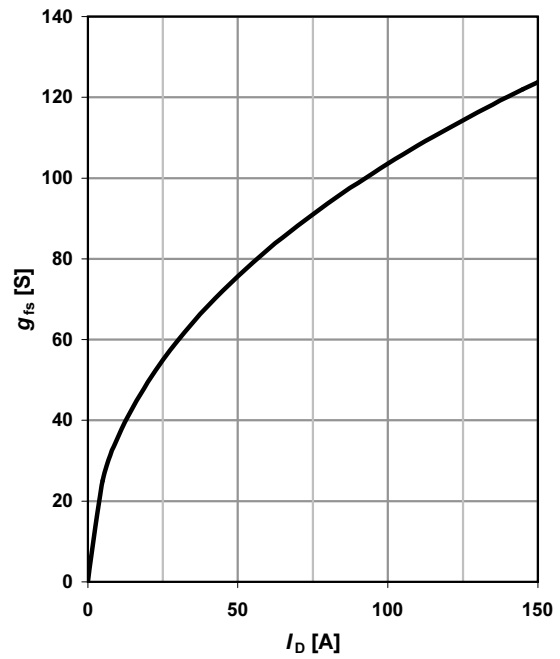
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter:  $T_j$



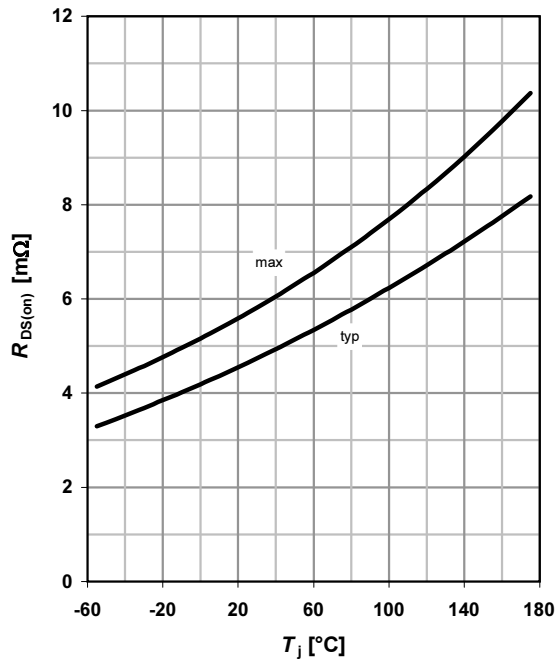
**8 Typ. forward transconductance**

$g_{fs} = f(I_D); T_j = 25\text{ °C}$



**9 Drain-source on-state resistance**

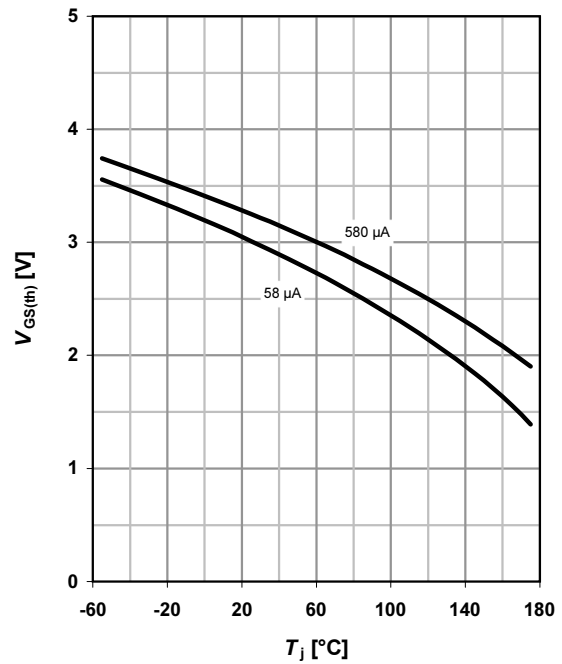
$R_{DS(on)} = f(T_j); I_D = 60 \text{ A}; V_{GS} = 10 \text{ V}$



**10 Typ. gate threshold voltage**

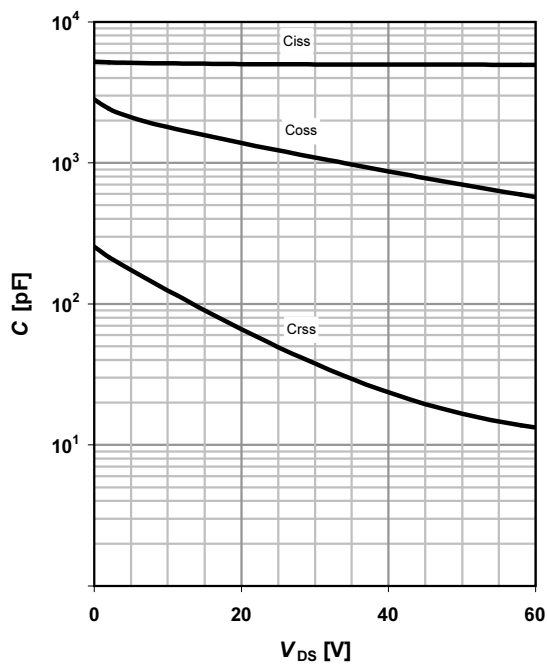
$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$

parameter:  $I_D$



**11 Typ. capacitances**

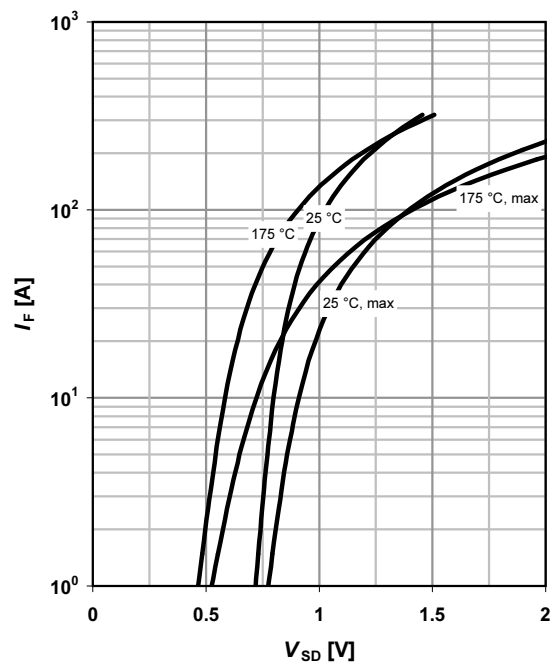
$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$



**12 Forward characteristics of reverse diode**

$I_F = f(V_{SD})$

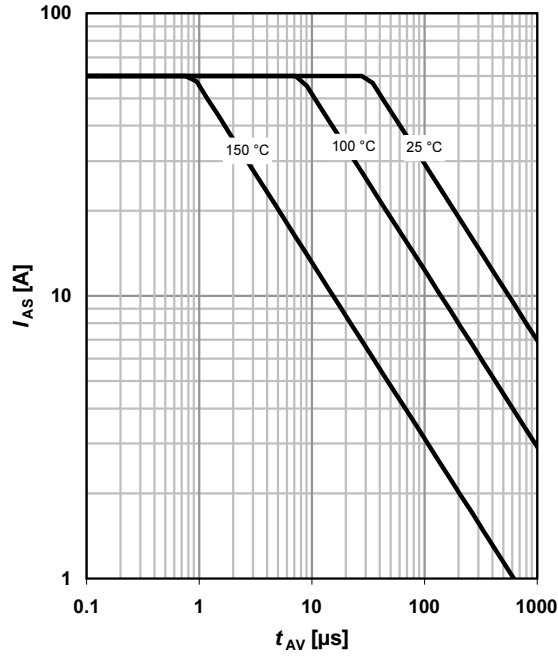
parameter:  $T_j$



**13 Avalanche characteristics**

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

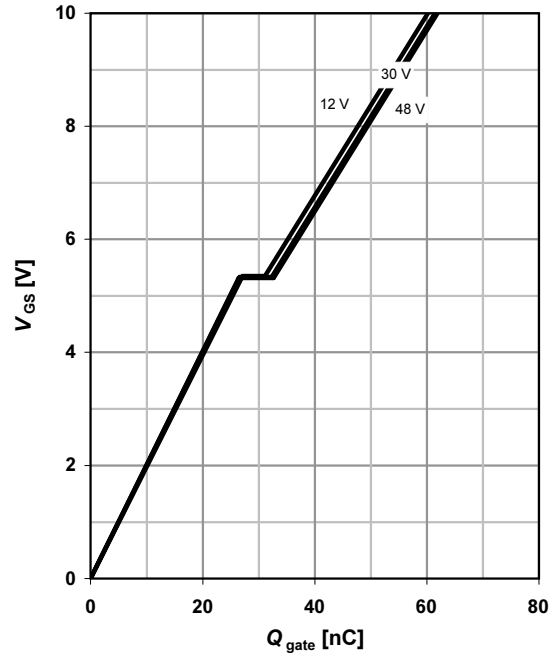
parameter:  $T_{j(start)}$



**14 Typ. gate charge**

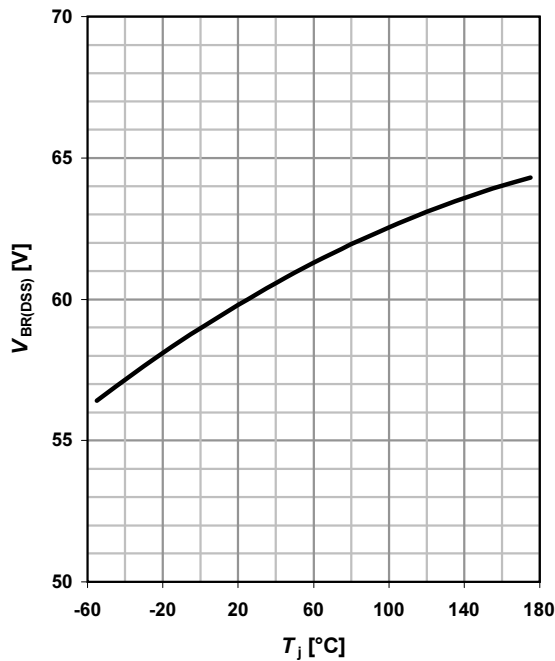
$V_{GS}=f(Q_{gate}); I_D=60 \text{ A pulsed}$

parameter:  $V_{DD}$



**15 Drain-source breakdown voltage**

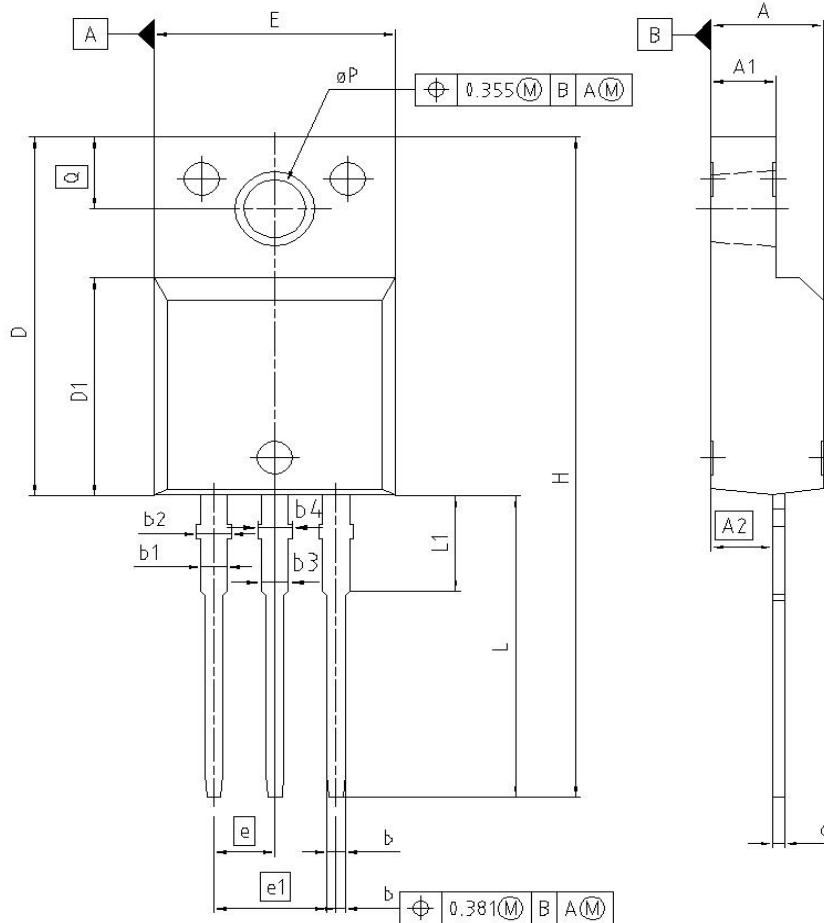
$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$



**16 Gate charge waveforms**



PG-TO220-3-31



| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 4.55        | 4.85  | 0.179  | 0.191 |
| A1  | 2.55        | 2.85  | 0.100  | 0.112 |
| A2  | 2.42        | 2.72  | 0.095  | 0.107 |
| b   | 0.85        | 0.85  | 0.026  | 0.033 |
| b1  | 0.95        | 1.33  | 0.037  | 0.052 |
| b2  | 0.95        | 1.51  | 0.037  | 0.059 |
| b3  | 0.85        | 1.33  | 0.026  | 0.052 |
| b4  | 0.85        | 1.51  | 0.026  | 0.059 |
| c   | 0.40        | 0.63  | 0.016  | 0.025 |
| D   | 15.85       | 16.15 | 0.624  | 0.636 |
| D1  | 9.53        | 9.83  | 0.375  | 0.387 |
| E   | 10.35       | 10.65 | 0.407  | 0.419 |
| e   | 2.54        |       | 0.100  |       |
| e1  | 5.08        |       | 0.200  |       |
| N   | 3           |       | 3      |       |
| H   | 29.45       | 29.75 | 1.159  | 1.171 |
| L   | 13.45       | 13.75 | 0.530  | 0.541 |
| L1  | 3.15        | 3.45  | 0.124  | 0.136 |
| pP  | 2.95        | 3.20  | 0.116  | 0.126 |
| Q   | 3.15        | 3.50  | 0.124  | 0.138 |

|                     |            |
|---------------------|------------|
| REFERENCE           | ...        |
| SCALE               |            |
| EUROPEAN PROJECTION |            |
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