

## OptiMOS™ - 6 Power-Transistor



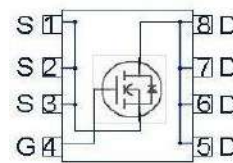
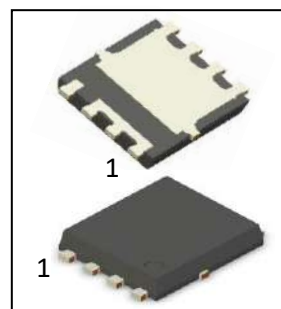
### Product Summary

|                  |     |            |
|------------------|-----|------------|
| $V_{DS}$         | 40  | V          |
| $R_{DS(on),max}$ | 4.0 | m $\Omega$ |
| $I_D$            | 60  | A          |

### Features

- OptiMOS™ - power MOSFET for automotive applications
- N-channel - Enhancement mode - Logic Level
- AEC Q101 qualified
- MSL1 up to 260°C peak reflow
- 175°C operating temperature
- Green Product (RoHS compliant)
- 100% Avalanche tested

### PG-TDSON-8



| Type            | Package    | Marking  |
|-----------------|------------|----------|
| IAUC60N04S6L039 | PG-TDSON-8 | 6N04L039 |

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

| Parameter                                    | Symbol         | Conditions                                         | Value        | Unit             |
|----------------------------------------------|----------------|----------------------------------------------------|--------------|------------------|
| Continuous drain current <sup>1)</sup>       | $I_D$          | $T_C=25^\circ\text{C}$ , $V_{GS}=10\text{V}$       | 60           | A                |
|                                              |                | $T_C=100^\circ\text{C}$ , $V_{GS}=10\text{V}^{2)}$ | 54           |                  |
| Pulsed drain current <sup>2)</sup>           | $I_{D,pulse}$  | $T_C=25^\circ\text{C}$                             | 240          |                  |
| Avalanche energy, single pulse <sup>2)</sup> | $E_{AS}$       | $I_D=12\text{A}$ , $R_{G,min}=25\Omega$            | 48.0         | mJ               |
| Avalanche current, single pulse              | $I_{AS}$       | $R_{G,min}=25\Omega$                               | 12           | A                |
| Gate source voltage                          | $V_{GS}$       | -                                                  | $\pm 16$     | V                |
| Power dissipation                            | $P_{tot}$      | $T_C=25^\circ\text{C}$                             | 42           | W                |
| Operating and storage temperature            | $T_j, T_{stg}$ | -                                                  | -55 ... +175 | $^\circ\text{C}$ |

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

### Thermal characteristics<sup>2)</sup>

|                                        |            |                                              |   |   |     |     |
|----------------------------------------|------------|----------------------------------------------|---|---|-----|-----|
| Thermal resistance, junction - case    | $R_{thJC}$ | -                                            | - | - | 3.6 | K/W |
| Thermal resistance, junction - ambient | $R_{thJA}$ | 6 cm <sup>2</sup> cooling area <sup>3)</sup> | - | - | 50  |     |

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

#### Static characteristics

|                                  |               |                                                     |     |      |      |            |
|----------------------------------|---------------|-----------------------------------------------------|-----|------|------|------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0V, I_D=1mA$                                | 40  | -    | -    | V          |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=14\mu A$                        | 1.2 | 1.6  | 2.0  |            |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=40V, V_{GS}=0V, T_j=25^\circ\text{C}$       | -   | -    | 1    | $\mu A$    |
|                                  |               | $V_{DS}=40V, V_{GS}=0V, T_j=125^\circ\text{C}^{2)}$ | -   | -    | 5    |            |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=16V, V_{DS}=0V$                             | -   | -    | 100  | nA         |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=4.5V, I_D=30A$                              | -   | 4.71 | 5.90 | m $\Omega$ |
|                                  |               | $V_{GS}=10V, I_D=30A$                               | -   | 3.28 | 4.02 |            |

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

### Dynamic characteristics<sup>2)</sup>

|                              |              |                                                       |   |     |      |    |
|------------------------------|--------------|-------------------------------------------------------|---|-----|------|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0V, V_{DS}=25V,$<br>$f=1MHz$                  | - | 907 | 1179 | pF |
| Output capacitance           | $C_{oss}$    |                                                       | - | 259 | 337  |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                       | - | 20  | 30   |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=20V, V_{GS}=10V,$<br>$I_D=60A, R_G=3.5\Omega$ | - | 2   | -    | ns |
| Rise time                    | $t_r$        |                                                       | - | 1   | -    |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                       | - | 7   | -    |    |
| Fall time                    | $t_f$        |                                                       | - | 3   | -    |    |

### Gate Charge Characteristics<sup>2)</sup>

|                       |               |                                                      |   |     |     |    |
|-----------------------|---------------|------------------------------------------------------|---|-----|-----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=32V, I_D=60A,$<br>$V_{GS}=0 \text{ to } 10V$ | - | 2.9 | 3.9 | nC |
| Gate to drain charge  | $Q_{gd}$      |                                                      | - | 3.1 | 4.7 |    |
| Gate charge total     | $Q_g$         |                                                      | - | 15  | 20  |    |
| Gate plateau voltage  | $V_{plateau}$ |                                                      | - | 3.2 | -   | V  |

### Reverse Diode

|                                                |               |                                             |   |     |     |    |
|------------------------------------------------|---------------|---------------------------------------------|---|-----|-----|----|
| Diode continuous forward current <sup>2)</sup> | $I_S$         | $T_C=25^\circ C$                            | - | -   | 60  | A  |
| Diode pulse current <sup>2)</sup>              | $I_{S,pulse}$ |                                             | - | -   | 240 |    |
| Diode forward voltage                          | $V_{SD}$      | $V_{GS}=0V, I_F=30A,$<br>$T_j=25^\circ C$   | - | 0.8 | 1.1 | V  |
| Reverse recovery time <sup>2)</sup>            | $t_{rr}$      | $V_R=20V, I_F=50A,$<br>$di_F/dt=100A/\mu s$ | - | 31  | -   | ns |
| Reverse recovery charge <sup>2)</sup>          | $Q_{rr}$      |                                             | - | 18  | -   | nC |

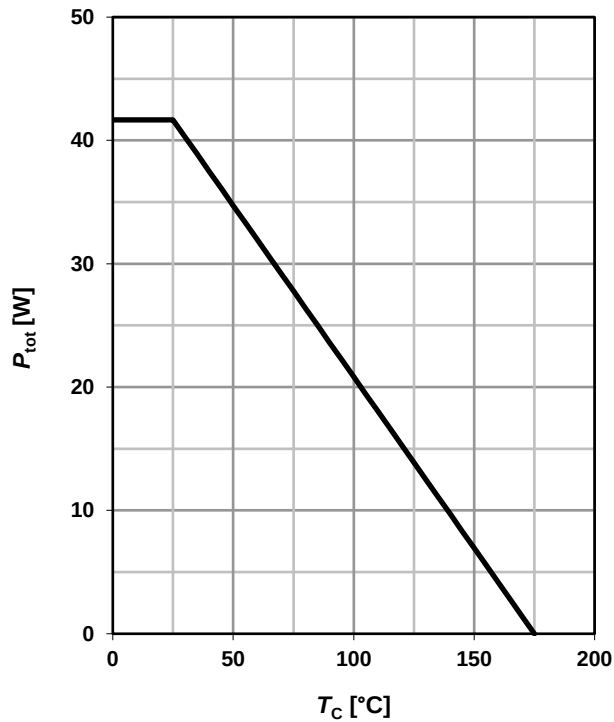
<sup>1)</sup> Current is limited by package; with an  $R_{thJC} = 3.6 \text{ K/W}$  the chip is able to carry 76 A at 25°C.

<sup>2)</sup> The parameter is not subject to production test- verified by design/characterization.

<sup>3)</sup> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.

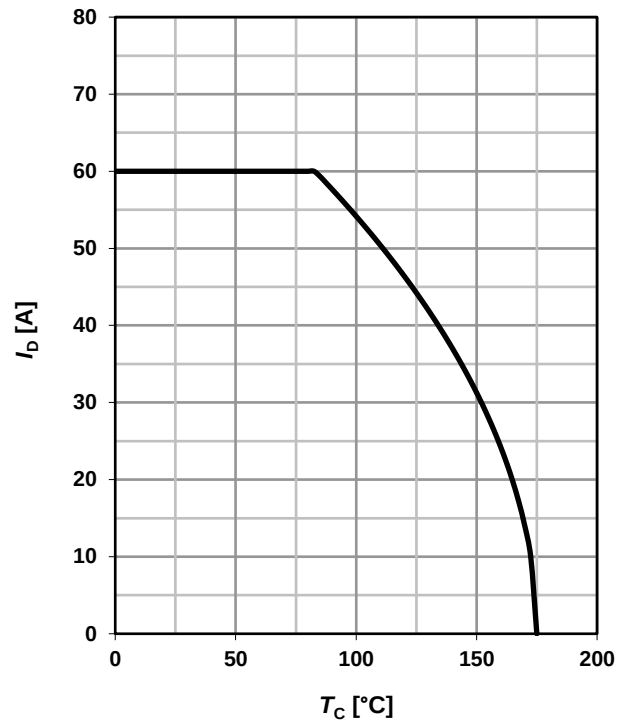
### 1 Power dissipation

$$P_{\text{tot}} = f(T_C); V_{\text{GS}} = 10 \text{ V}$$



### 2 Drain current

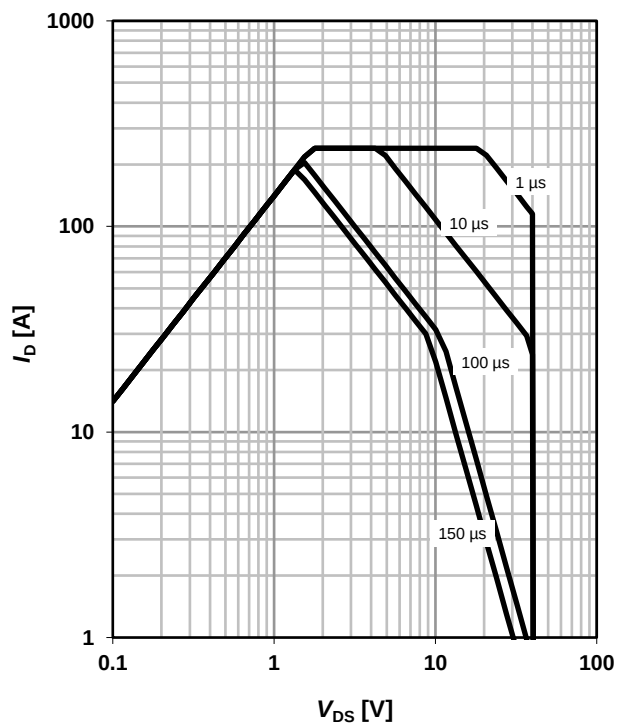
$$I_D = f(T_C); V_{\text{GS}} = 10 \text{ V}$$



### 3 Safe operating area

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

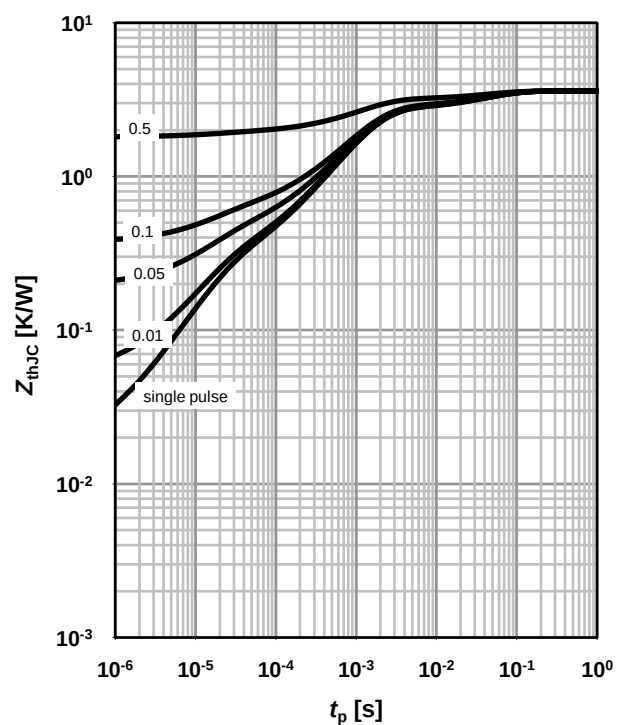
parameter:  $t_p$



### 4 Max. transient thermal impedance

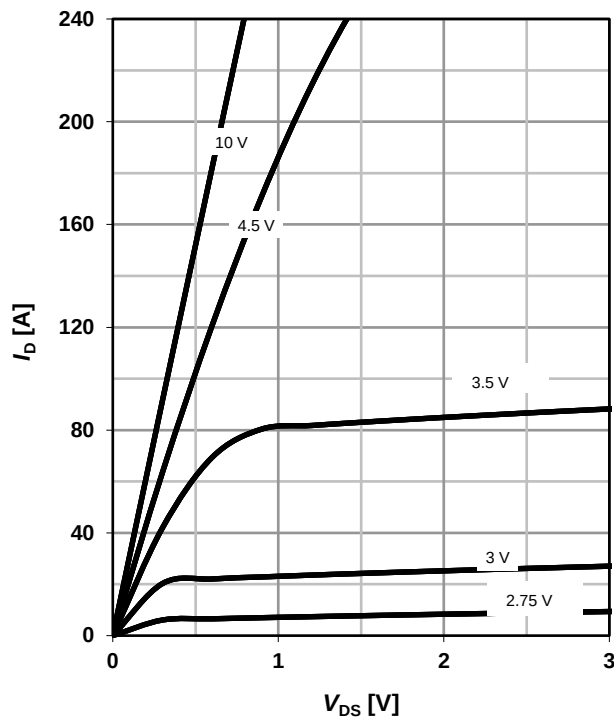
$$Z_{\text{thJC}} = f(t_p)$$

parameter:  $D = t_p/T$



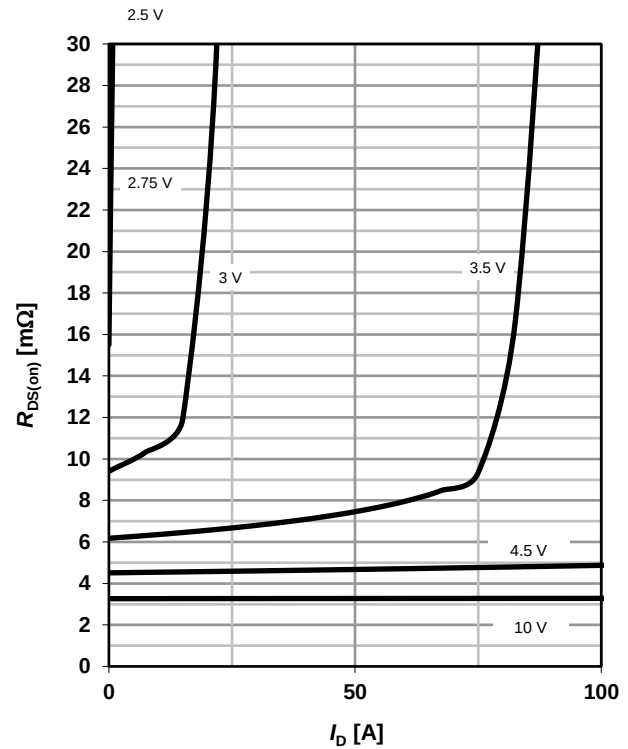
### 5 Typ. output characteristics

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

parameter:  $V_{GS}$ 


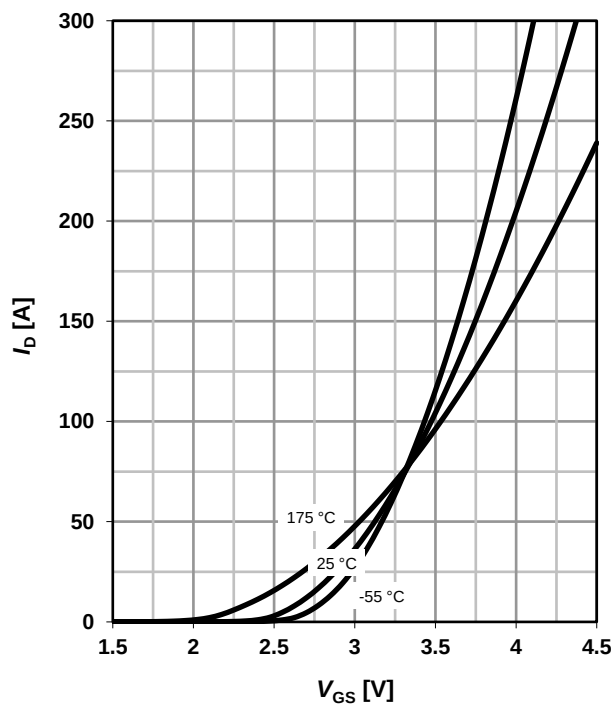
### 6 Typ. drain-source on-state resistance

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

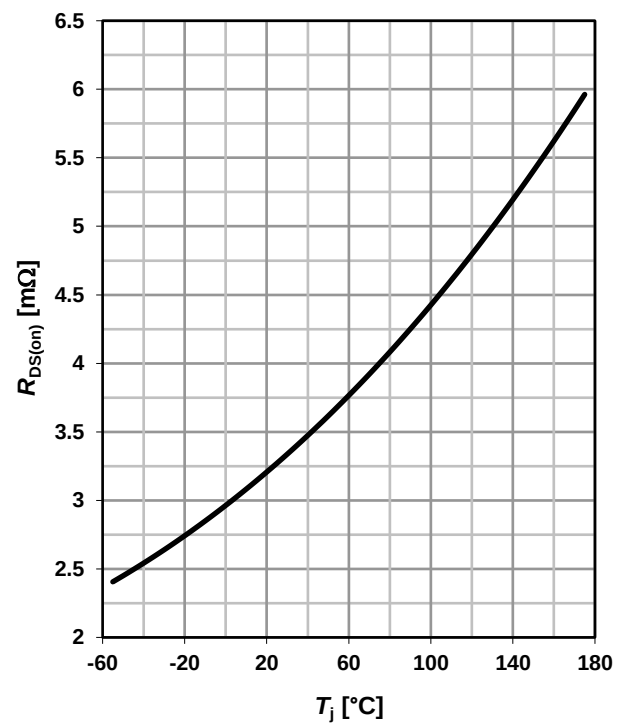
parameter:  $V_{GS}$ 


### 7 Typ. transfer characteristics

 $I_D = f(V_{GS}); V_{DS} = 6\text{ V}$ 

parameter:  $T_j$ 


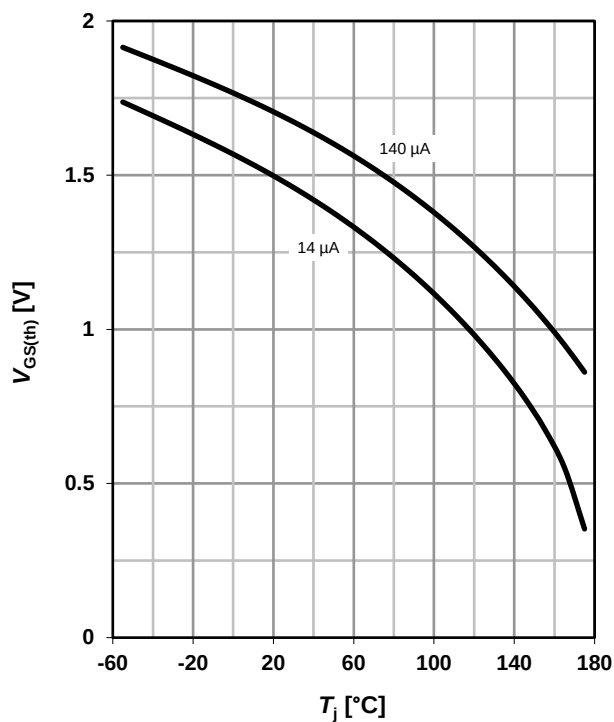
### 8 Typ. drain-source on-state resistance

 $R_{DS(on)} = f(T_j); I_D = 30\text{ A}; V_{GS} = 10\text{ V}$ 


## 9 Typ. gate threshold voltage

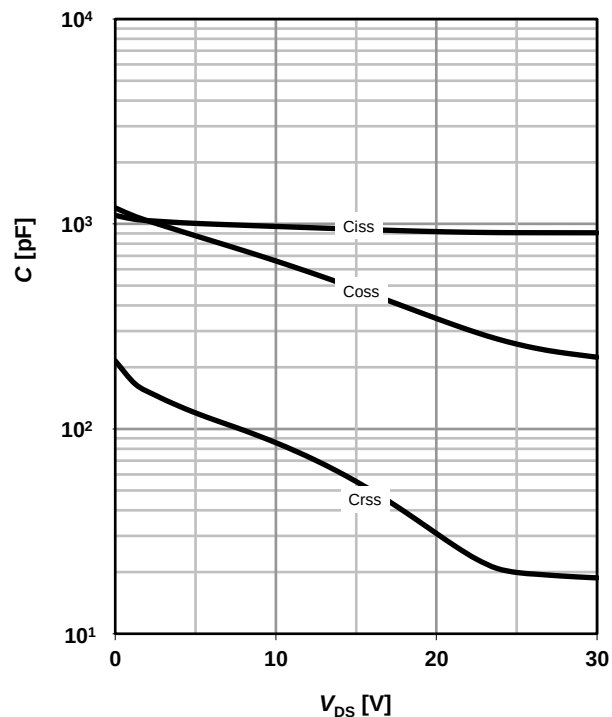
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter:  $I_D$



## 10 Typ. capacitances

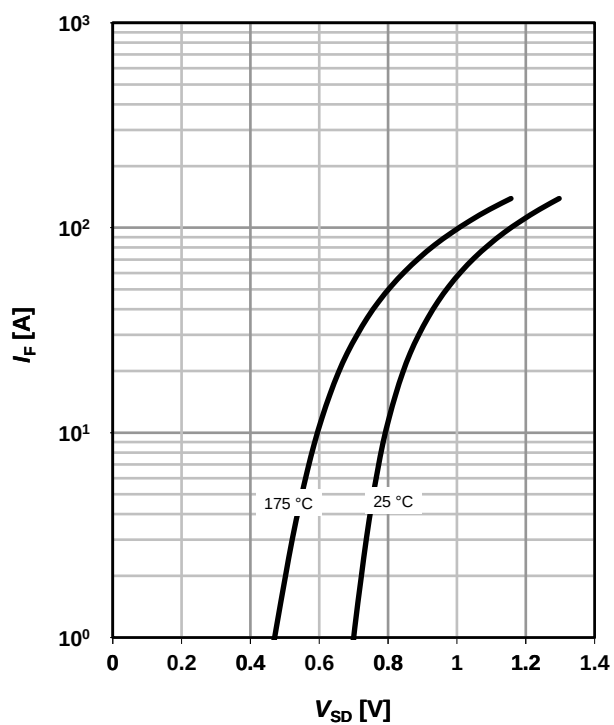
$$C = f(V_{DS}); V_{GS} = 0 V; f = 1 MHz$$



## 11 Typical forward diode characteristics

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

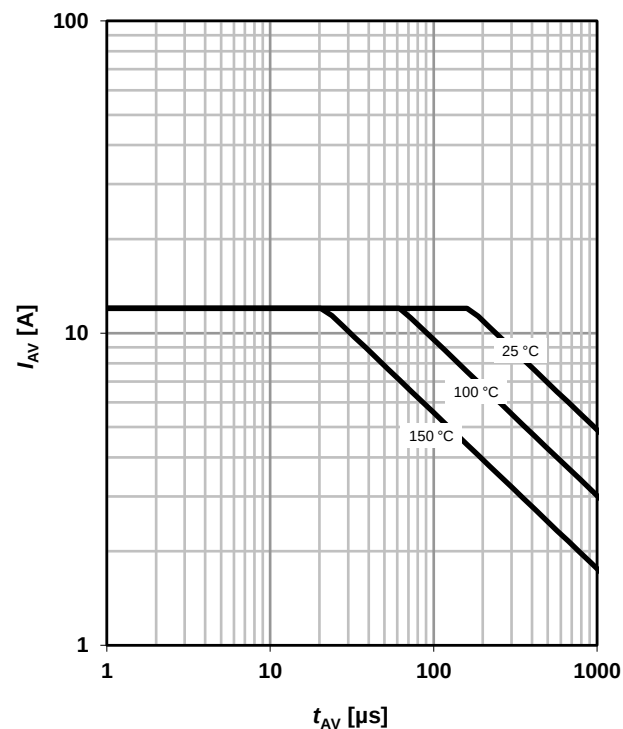
parameter:  $T_j$



## 12 Avalanche characteristics

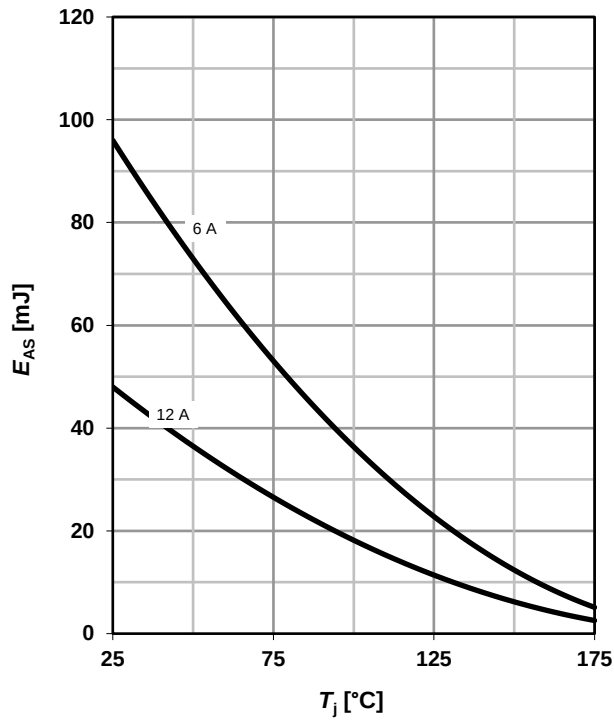
$$I_{AS} = f(t_{AV})$$

parameter:  $T_{j(start)}$



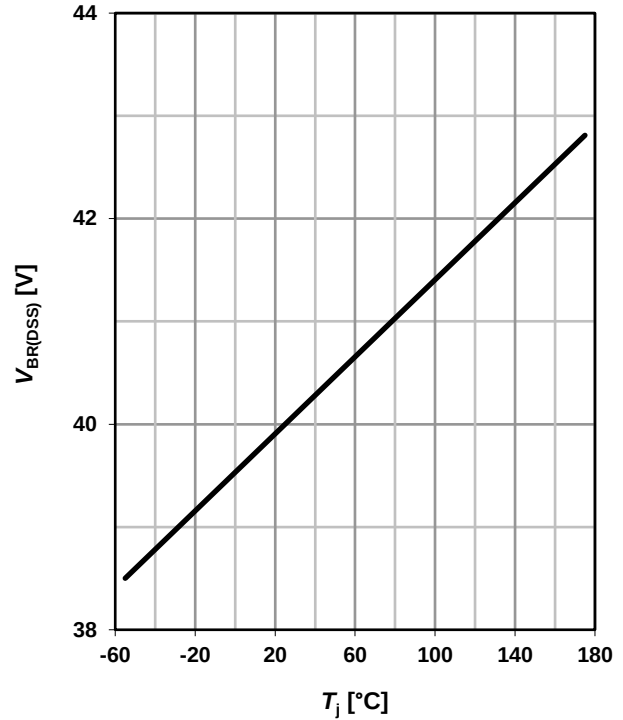
### 13 Avalanche energy

$$E_{AS} = f(T_j)$$



### 14 Drain-source breakdown voltage

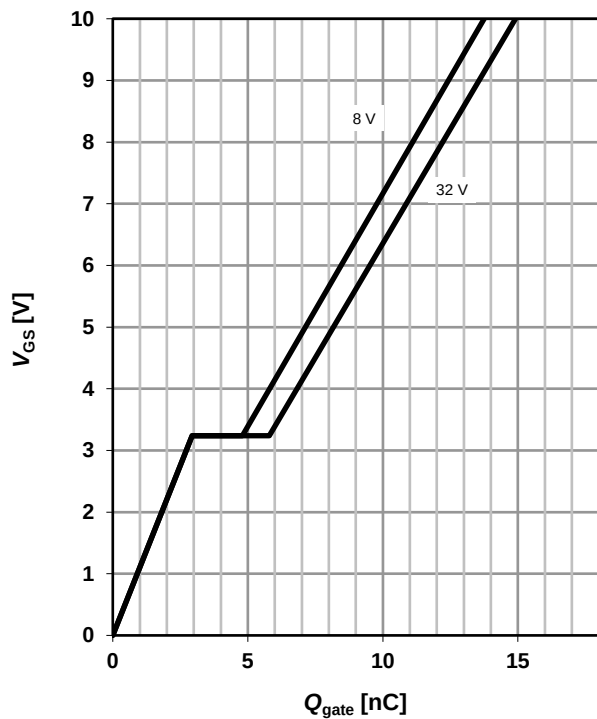
$$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$$



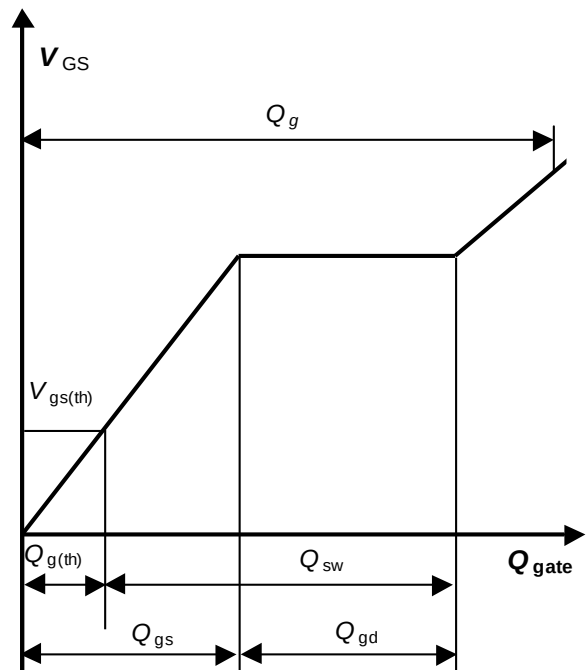
### 15 Typ. gate charge

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

parameter:  $V_{DD}$



### 16 Gate charge waveforms



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Revision History

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| Version | Date | Changes |
|---------|------|---------|
|         |      |         |
|         |      |         |
|         |      |         |
|         |      |         |
|         |      |         |