

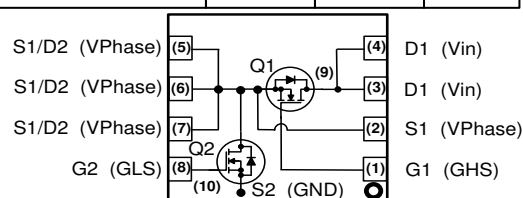
## Power Block

### Features

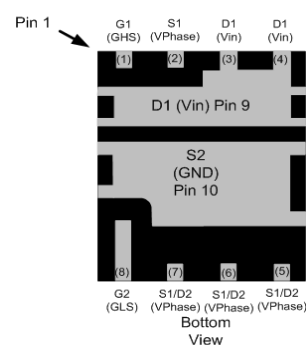
- Dual asymmetric N-channel OptiMOS™5 MOSFET
- Logic level (4.5V rated)
- Pb-free lead plating; RoHS compliant
- Optimized for high performance Buck converter
- Qualified according to JEDEC<sup>1)</sup> for target applications
- Halogen-free according to IEC61249-2-21
- Monolithic integrated Schottky like diode

### Product Summary

|                  |                       | Q1 | Q2   |           |
|------------------|-----------------------|----|------|-----------|
| $V_{DS}$         |                       | 25 | 25   | V         |
| $R_{DS(on),max}$ | $V_{GS}=10\text{ V}$  | 3  | 0.85 | $m\Omega$ |
|                  | $V_{GS}=4.5\text{ V}$ | 4  | 1.2  |           |
| $I_D$            |                       | 50 | 50   | A         |



Top view



| Type       | Package     | Marking |
|------------|-------------|---------|
| BSG0810NDI | PG-TISON8-4 | 0810NDI |

**Maximum ratings**, at  $T_j=25^\circ\text{C}$ , unless otherwise specified <sup>2)</sup>

| Parameter                           | Symbol            | Conditions                                                                | Value       |      | Unit             |
|-------------------------------------|-------------------|---------------------------------------------------------------------------|-------------|------|------------------|
|                                     |                   |                                                                           | Q1          | Q2   |                  |
| Continuous drain current            | $I_D$             | $T_C=70^\circ\text{C}$ , $V_{GS}=10\text{ V}$                             | 50          | 50   | A                |
|                                     |                   | $T_C=70^\circ\text{C}$ , $V_{GS}=4.5\text{ V}$                            | 50          | 50   |                  |
|                                     |                   | $T_A=25^\circ\text{C}$ ,<br>$V_{GS}=4.5\text{ V}^{3)}$                    | 31          | 50   |                  |
|                                     |                   | $T_A=25^\circ\text{C}$ ,<br>$V_{GS}=4.5\text{ V}^{4)}$                    | 19          | 39   |                  |
| Pulsed drain current                | $I_{D,pulse}$     | $T_C=70^\circ\text{C}$                                                    | 160         | 160  |                  |
| Avalanche energy, single pulse      | $E_{AS}$          | Q1: $I_D=10\text{ A}$ ,<br>Q2: $I_D=20\text{ A}$ ,<br>$R_{GS}=25\ \Omega$ | 30          | 90   | mJ               |
| Gate source voltage                 | $V_{GS}$          | $T_j=25^\circ\text{C}$                                                    | $\pm 16$    |      | V                |
| Power dissipation                   | $P_{tot}$         | $T_A=25^\circ\text{C}^{3)}$                                               | 6.25        | 6.25 | W                |
|                                     |                   | $T_A=25^\circ\text{C}^{4)}$                                               | 2.5         | 2.5  |                  |
| Operating and storage temperature   | $T_j$ , $T_{stg}$ |                                                                           | -55 ... 150 |      | $^\circ\text{C}$ |
| IEC climatic category; DIN IEC 68-1 |                   |                                                                           | 55/150/56   |      |                  |

<sup>1)</sup> J-STD20 and JESD22

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

### Thermal characteristics

|                                                      |    |            |                                              |   |   |     |     |
|------------------------------------------------------|----|------------|----------------------------------------------|---|---|-----|-----|
| Thermal resistance, junction - case                  | Q1 | $R_{thJC}$ |                                              | - | - | 4.3 | K/W |
|                                                      | Q2 |            |                                              | - | - | 1.8 |     |
| Thermal resistance, junction - ambient <sup>2)</sup> | Q1 | $R_{thJA}$ | Application specific board <sup>3)</sup>     | - | - | 20  |     |
|                                                      | Q2 |            |                                              | - | - |     |     |
|                                                      | Q1 |            | 6 cm <sup>2</sup> cooling area <sup>4)</sup> | - | - | 50  |     |
|                                                      | Q2 |            |                                              | - | - |     |     |

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

### Static characteristics

|                                           |    |                     |                                                            |                  |     |     |               |
|-------------------------------------------|----|---------------------|------------------------------------------------------------|------------------|-----|-----|---------------|
| Drain-source breakdown voltage            | Q1 | $V_{(BR)DSS}$       | $V_{GS}=0\text{ V}, I_D=1\text{ mA}$                       | 25 <sup>6)</sup> | -   | -   | V             |
|                                           | Q2 |                     |                                                            |                  |     |     |               |
| Breakdown voltage temperature coefficient | Q1 | $dV_{(BR)DSS}/dT_j$ | $I_D=10\text{ mA}$ , referenced to 25 °C                   | -                | 15  | -   | mV/K          |
|                                           | Q2 |                     |                                                            |                  |     |     |               |
| Gate threshold voltage                    | Q1 | $V_{GS(th)}$        | $V_{DS}=V_{GS}, I_D=250\text{ }\mu\text{A}$                | 1.2              | 1.6 | 2   | V             |
|                                           | Q2 |                     |                                                            |                  |     |     |               |
| Zero gate voltage drain current           | Q1 | $I_{DSS}$           | $V_{DS}=25\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$  | -                | -   | 1   | $\mu\text{A}$ |
|                                           | Q2 |                     |                                                            | -                | -   | 500 |               |
|                                           | Q1 |                     | $V_{DS}=20\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ °C}$ | -                | -   | 100 | mA            |
|                                           | Q2 |                     |                                                            | -                | 3   | -   |               |
| Gate-source leakage current               | Q1 | $I_{GSS}$           | $V_{GS}=16\text{ V}, V_{DS}=0\text{ V}$                    | -                | -   | 100 | nA            |
|                                           | Q2 |                     |                                                            |                  |     |     |               |
| Drain-source on-state resistance          | Q1 | $R_{DS(on)}$        | $V_{GS}=4.5\text{ V}, I_D=20\text{ A}$                     | -                | 3.2 | 4.0 | m $\Omega$    |
|                                           | Q2 |                     |                                                            | -                | 1.0 | 1.1 |               |
|                                           | Q1 |                     | $V_{GS}=10\text{ V}, I_D=20\text{ A}$                      | -                | 2.4 | 3.0 |               |
|                                           | Q2 |                     |                                                            | -                | 0.7 | 0.9 |               |
| Gate resistance                           | Q1 | $R_G$               |                                                            | -                | 0.7 | 1.2 | $\Omega$      |
|                                           | Q2 |                     |                                                            | -                | 0.8 | 1.3 |               |
| Transconductance                          | Q1 | $g_{fs}$            | $ V_{DS} >2 I_D R_{DS(on)max}, I_D=20\text{ A}$            | 47               | 94  | -   | S             |
|                                           | Q2 |                     |                                                            | 55               | 110 | -   |               |

<sup>2)</sup> Remark: only one of both transistors active

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

### Dynamic characteristics

|                              |    |              |                                                                                                          |   |      |      |    |
|------------------------------|----|--------------|----------------------------------------------------------------------------------------------------------|---|------|------|----|
| Input capacitance            | Q1 | $C_{iss}$    | $V_{GS}=0\text{ V},$<br>$V_{DS}=12\text{ V}, f=1\text{ MHz}$                                             | - | 770  | 1040 | pF |
|                              | Q2 |              |                                                                                                          | - | 2300 | 3100 |    |
| Output capacitance           | Q1 | $C_{oss}$    |                                                                                                          | - | 390  | 520  |    |
|                              | Q2 |              |                                                                                                          | - | 1400 | 1900 |    |
| Reverse transfer capacitance | Q1 | $C_{rss}$    |                                                                                                          | - | 33   | -    |    |
|                              | Q2 |              |                                                                                                          | - | 110  | -    |    |
| Turn-on delay time           | Q1 | $t_{d(on)}$  | $V_{IN}=12\text{ V},$<br>$V_{DRV}=5\text{ V},$<br>$F_{SW}=500\text{ KHz},$<br>$I_{OUT}=30\text{ A}^{5)}$ | - | 4.3  | -    | ns |
|                              | Q2 |              |                                                                                                          | - | 5.1  | -    |    |
| Rise time                    | Q1 | $t_r$        |                                                                                                          | - | 4.7  | -    |    |
|                              | Q2 |              |                                                                                                          | - | 4.0  | -    |    |
| Turn-off delay time          | Q1 | $t_{d(off)}$ |                                                                                                          | - | 4.3  | -    |    |
|                              | Q2 |              |                                                                                                          | - | 8    | -    |    |
| Fall time                    | Q1 | $t_f$        |                                                                                                          | - | 1.4  | -    |    |
|                              | Q2 |              |                                                                                                          | - | 2.4  | -    |    |

### Gate Charge Characteristics

|                       |    |               |                                                                                  |   |     |     |    |
|-----------------------|----|---------------|----------------------------------------------------------------------------------|---|-----|-----|----|
| Gate to source charge | Q1 | $Q_{gs}$      | $V_{DD}=12\text{ V},$<br>$I_D=20\text{ A},$<br>$V_{GS}=0\text{ to }4.5\text{ V}$ | - | 2.2 | -   | nC |
| Gate to drain charge  |    | $Q_{gd}$      |                                                                                  | - | 1.6 | -   |    |
| Gate charge total     |    | $Q_g$         |                                                                                  | - | 5.6 | 8.4 |    |
| Gate plateau voltage  |    | $V_{plateau}$ |                                                                                  | - | 2.9 | -   | V  |
| Gate to source charge | Q2 | $Q_{gs}$      |                                                                                  | - | 5.9 | -   | nC |
| Gate to drain charge  |    | $Q_{gd}$      |                                                                                  | - | 4.2 | -   |    |
| Gate charge total     |    | $Q_g$         |                                                                                  | - | 16  | 25  |    |
| Gate plateau voltage  |    | $V_{plateau}$ |                                                                                  | - | 2.6 | -   | V  |
| Output charge         | Q1 | $Q_{oss}$     | $V_{DD}=12\text{ V}, V_{GS}=0\text{ V}$                                          | - | 8   | -   | nC |
|                       | Q2 |               |                                                                                  | - | 26  | -   |    |

<sup>3)</sup> 8 Layers copper 70µm thickness. PCB in still air

<sup>4)</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.

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

### Reverse Diode

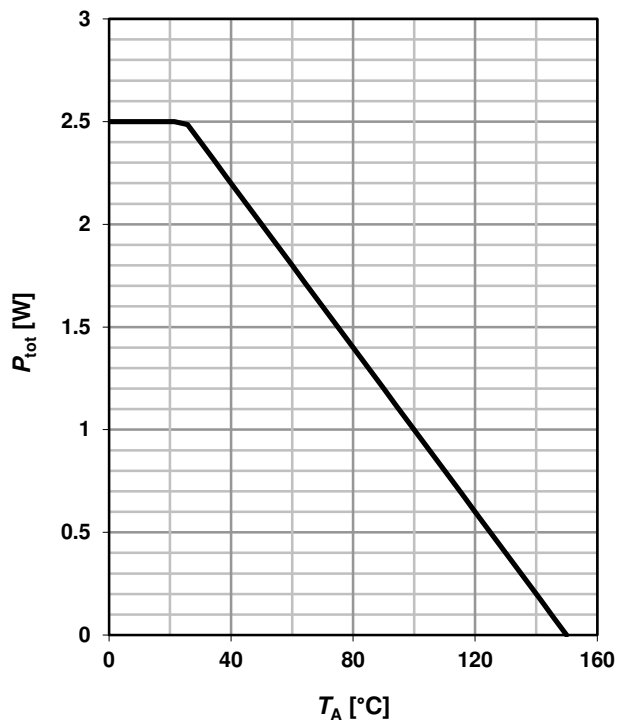
|                                  |    |               |                                                                           |   |      |     |    |
|----------------------------------|----|---------------|---------------------------------------------------------------------------|---|------|-----|----|
| Diode continuous forward current | Q1 | $I_S$         | $T_C=25\text{ }^{\circ}\text{C}$                                          | - | -    | 29  | A  |
|                                  | Q2 |               |                                                                           |   |      | 50  |    |
| Diode pulse current              | Q1 | $I_{S,pulse}$ |                                                                           | - | -    | 160 |    |
|                                  | Q2 |               |                                                                           | - | -    | 160 |    |
| Diode forward voltage            | Q1 | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=20\text{ A},$<br>$T_j=25\text{ }^{\circ}\text{C}$ | - | 0.85 | 1   | V  |
|                                  | Q2 |               | $V_{GS}=0\text{ V}, I_F=11\text{ A},$<br>$T_j=25\text{ }^{\circ}\text{C}$ | - | 0.49 | 0.7 |    |
| Reverse recovery charge          | Q1 | $Q_{rr}$      | $V_R=12\text{ V}, I_F=I_S,$<br>$di_F/dt=100\text{ A}/\mu\text{s}$         | - | 10   | -   | nC |
|                                  | Q2 |               |                                                                           |   |      |     |    |

<sup>5)</sup> For more information see application note n° TBD

<sup>6)</sup> The device can withstand a pulse of not more than 30V for a duration of up to 2ns at a frequency of 600KHz with maximum buck converter input voltage  $V_{IN}=16\text{ V}$

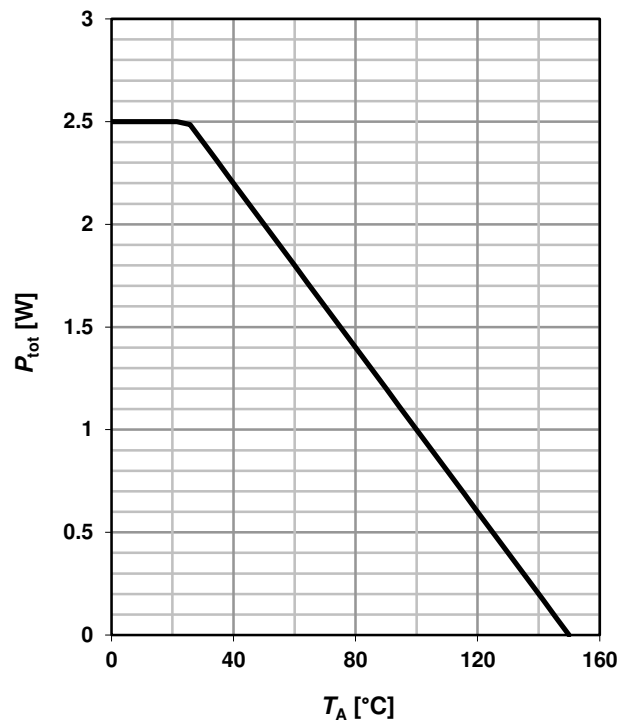
### 1 Power dissipation (Q1)

$$P_{\text{tot}} = f(T_A)^{(4)}$$



### 2 Power dissipation (Q2)

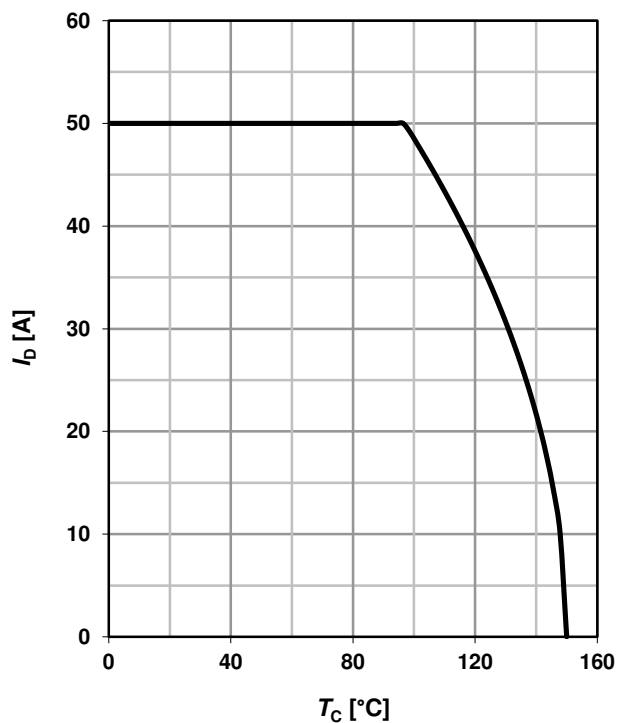
$$P_{\text{tot}} = f(T_A)^{(4)}$$



### 3 Drain current (Q1)

$$I_D = f(T_C)$$

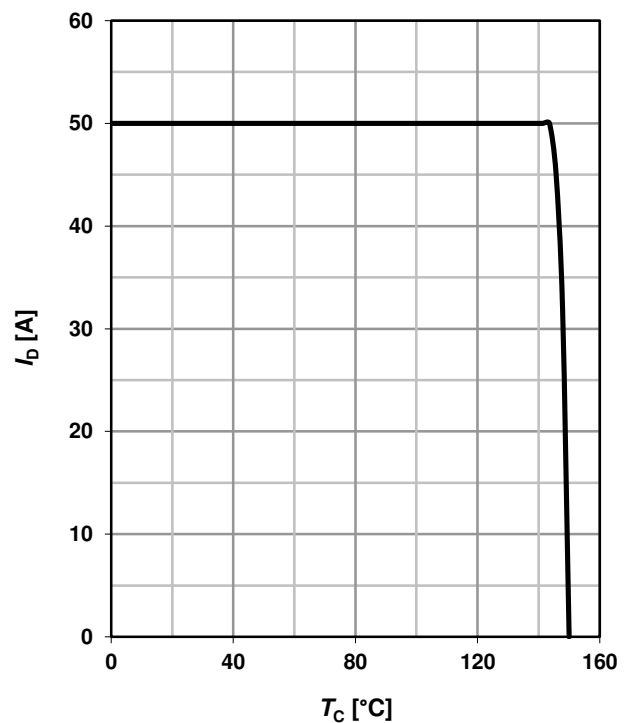
parameter:  $V_{GS} \geq 10$  V



### 4 Drain current (Q2)

$$I_D = f(T_C)$$

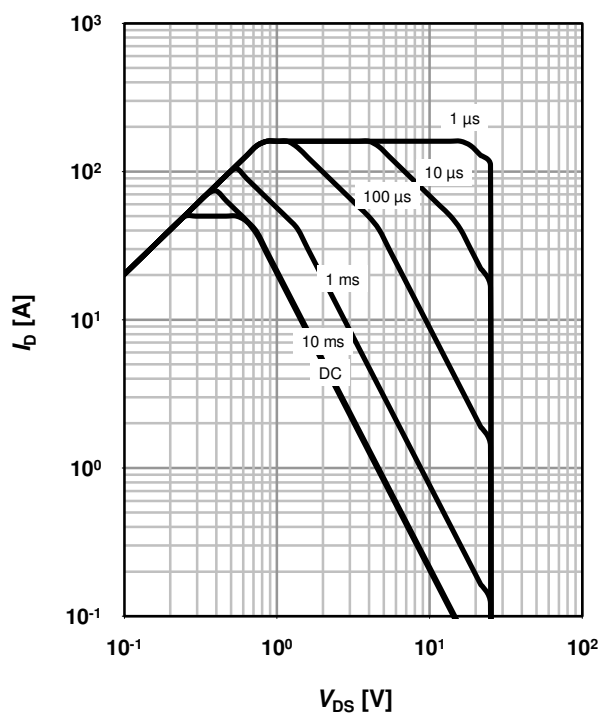
parameter:  $V_{GS} \geq 10$  V



## 5 Safe operating area (Q1)

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

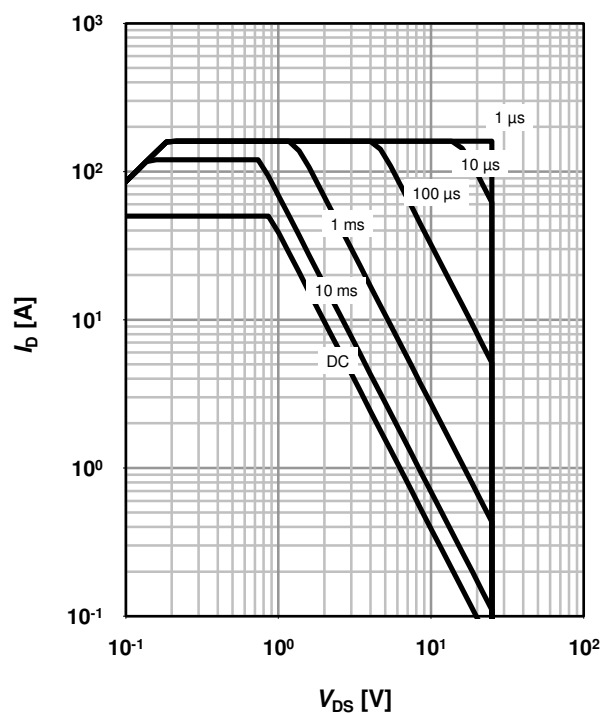
parameter:  $t_p$



## 6 Safe operating area (Q2)

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

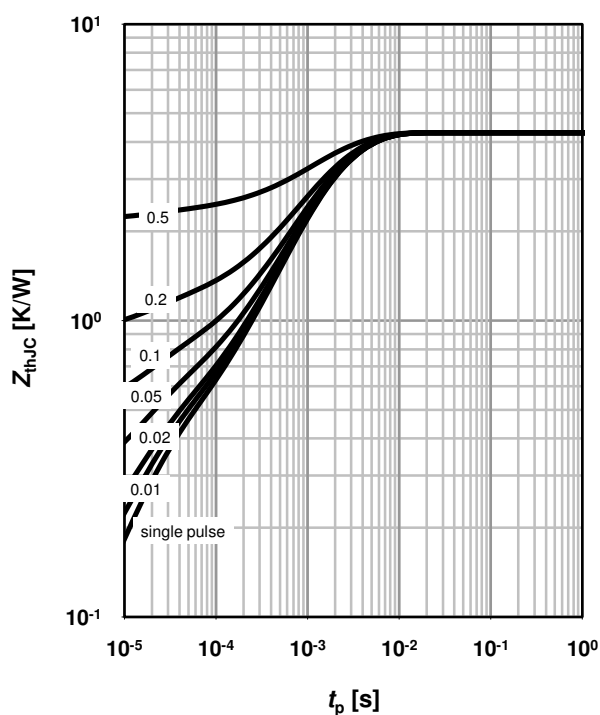
parameter:  $t_p$



## 7 Max. transient thermal impedance (Q1)

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

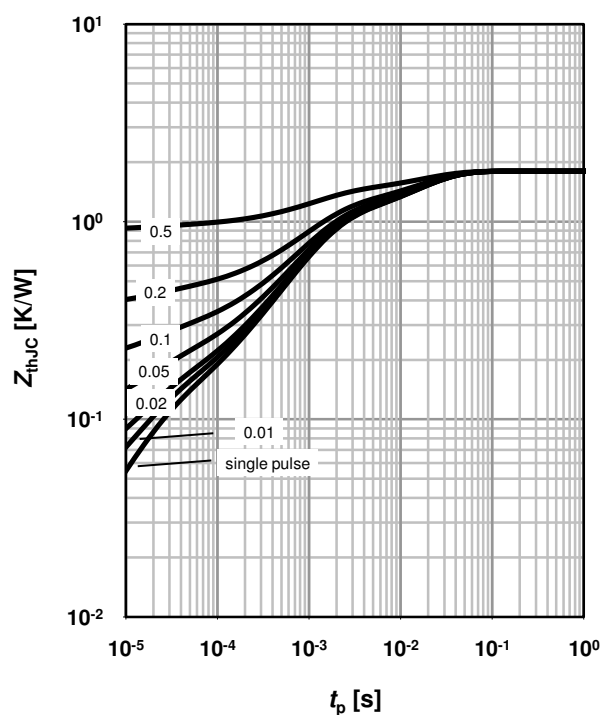
parameter:  $D = t_p/T$



## 8 Max. transient thermal impedance (Q2)

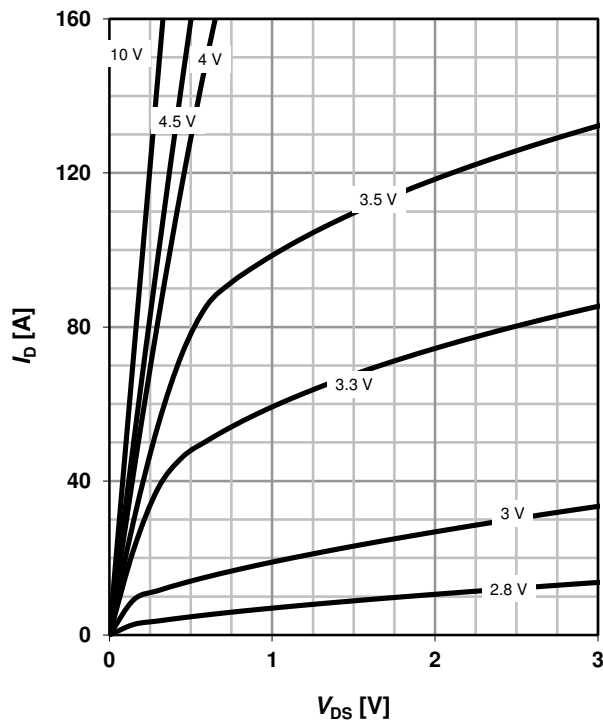
$$Z_{thJC} = f(t_p)$$

parameter:  $D = t_p/T$



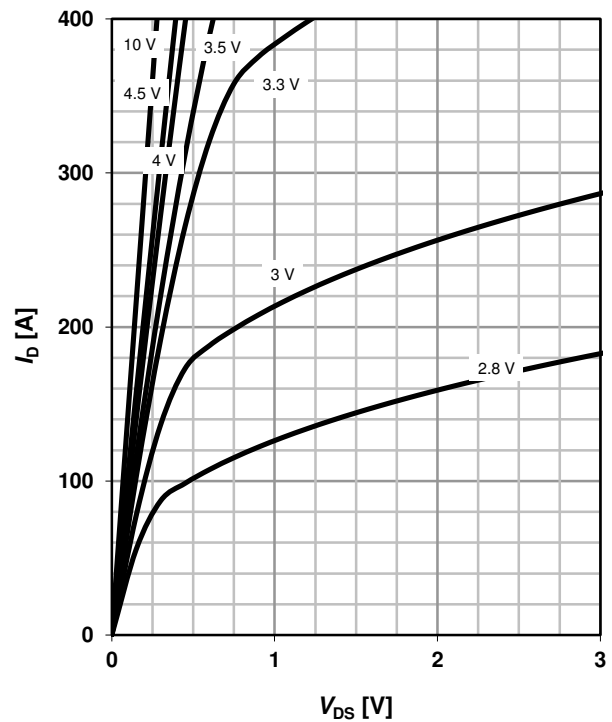
### 9 Typ. output characteristics (Q1)

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

parameter:  $V_{GS}$ 


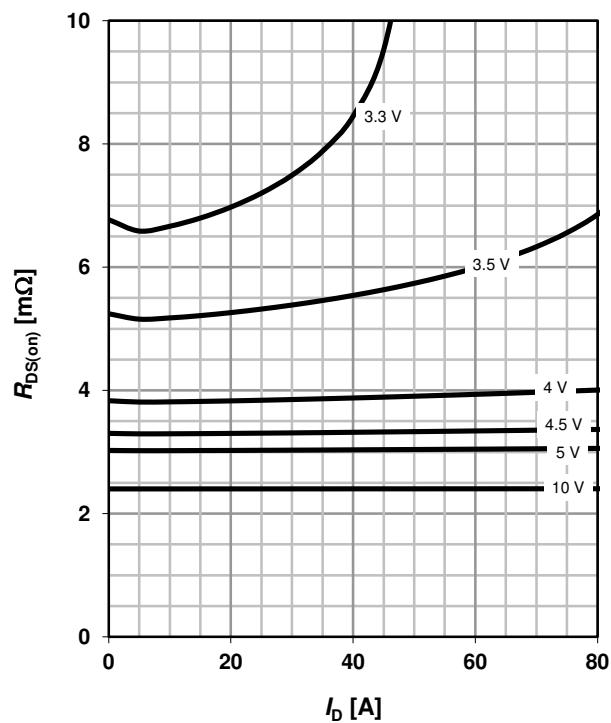
### 10 Typ. output characteristics (Q2)

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

parameter:  $V_{GS}$ 


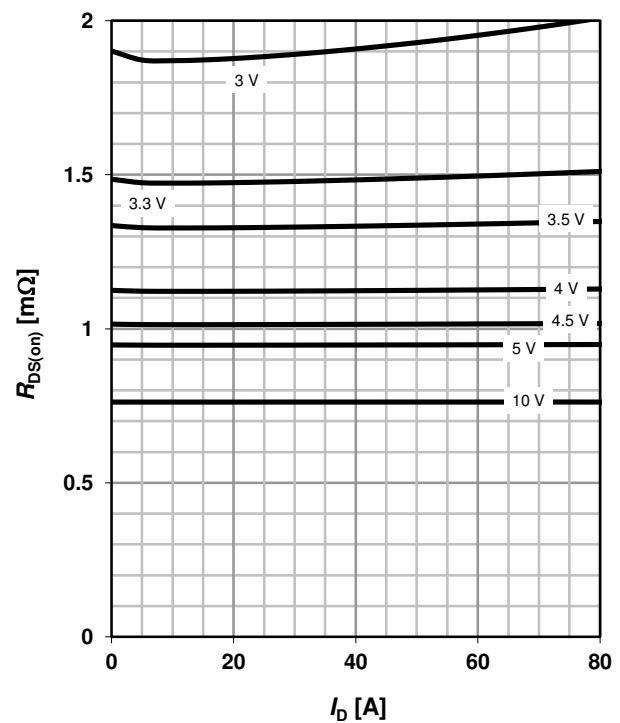
### 11 Typ. drain-source on resistance (Q1)

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

parameter:  $V_{GS}$ 


### 12 Typ. drain-source on resistance (Q2)

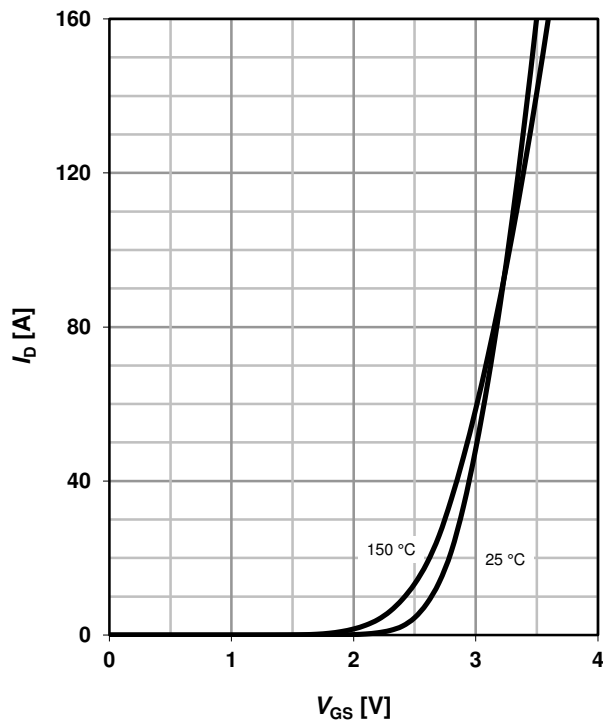
 $R_{DS(on)} = f(I_D); T_j = 25^\circ\text{C}$ 

parameter:  $V_{GS}$ 


### 13 Typ. transfer characteristics (Q1)

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

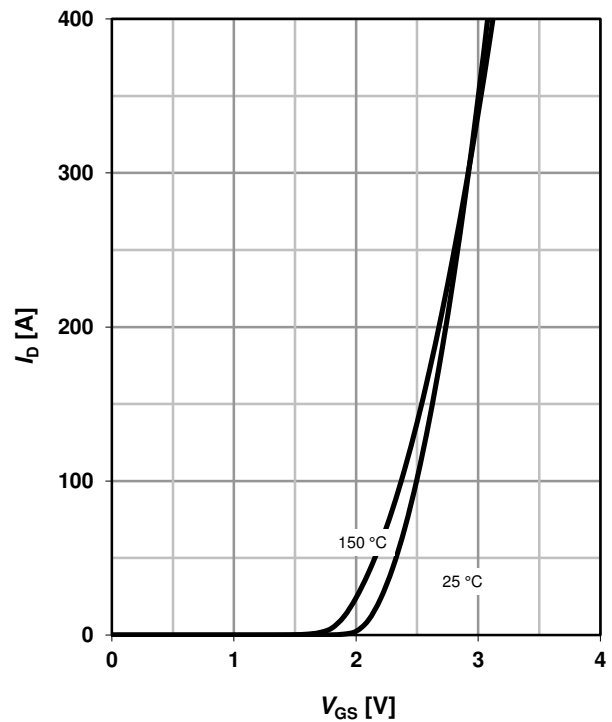
parameter:  $T_j$



### 14 Typ. transfer characteristics (Q2)

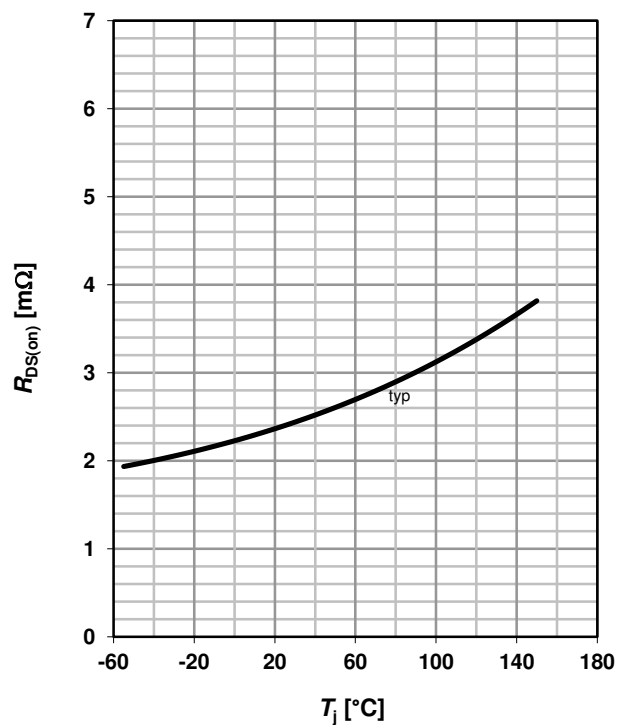
$$I_D = f(V_{GS}); |V_{DS}| > 2 |I_D| R_{DS(on)max}$$

parameter:  $T_j$



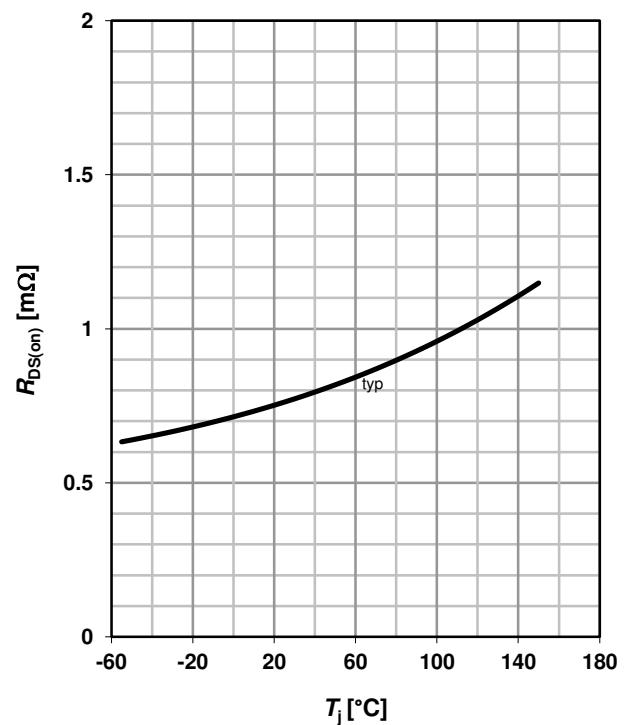
### 15 Drain-source on-state resistance (Q1)

$$R_{DS(on)} = f(T_j); I_D = 20 \text{ A}; V_{GS} = 10 \text{ V}$$



### 16 Drain-source on-state resistance (Q2)

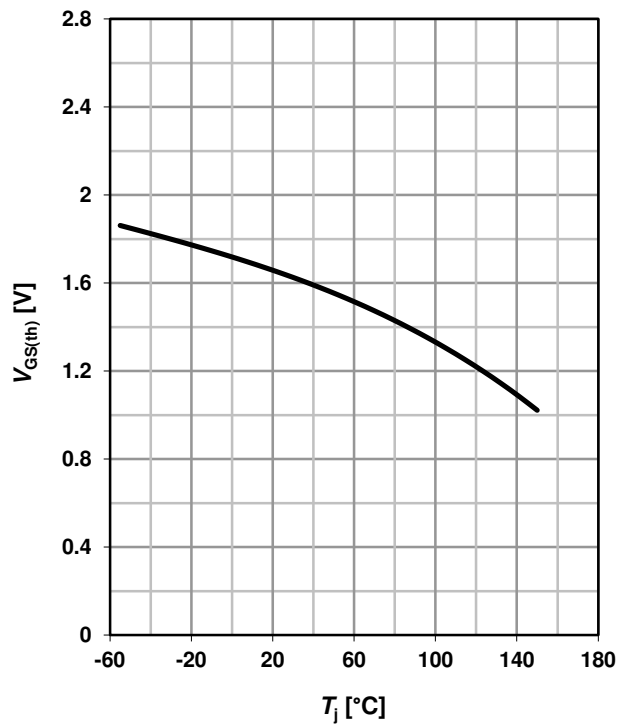
$$R_{DS(on)} = f(T_j); I_D = 20 \text{ A}; V_{GS} = 10 \text{ V}$$





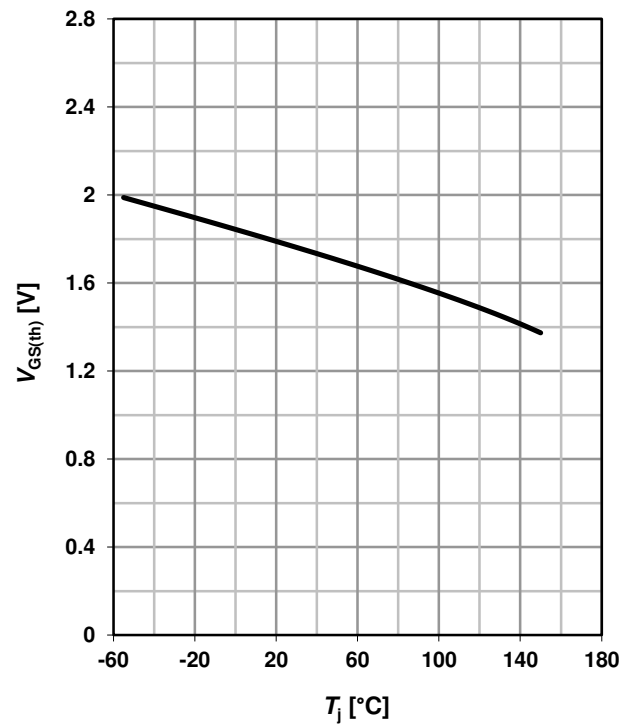
### 17 Typ. gate threshold voltage (Q1)

$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}; I_D = 250 \mu A$$



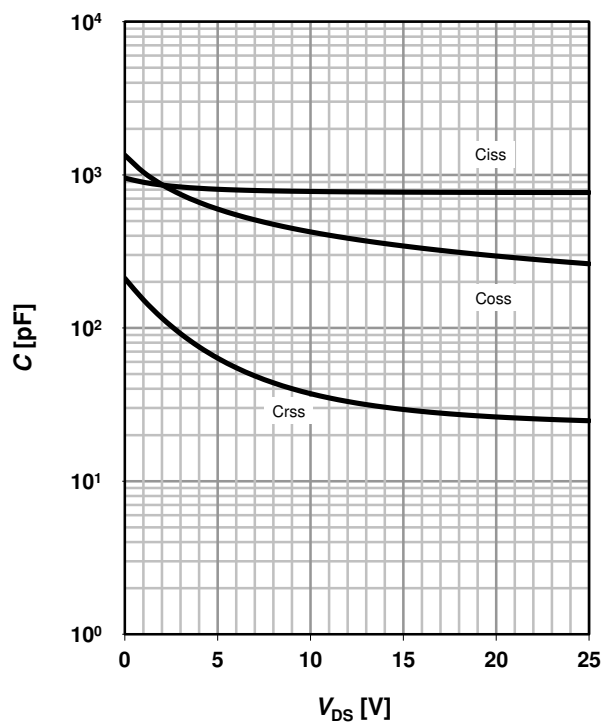
### 18 Typ. gate threshold voltage (Q2)

$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}; I_D = 10 \text{ mA}$$



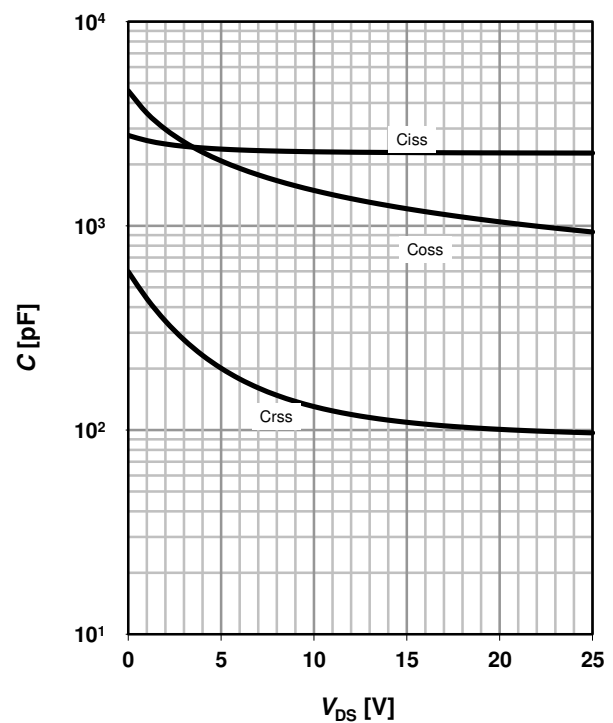
### 19 Typ. capacitances (Q1)

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



### 20 Typ. capacitances (Q2)

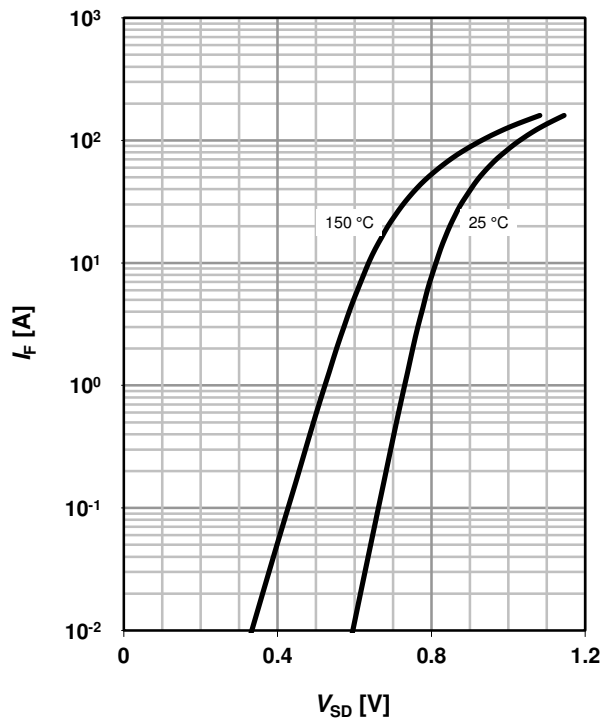
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



## 21 Forward characteristics of reverse diode (Q1)

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

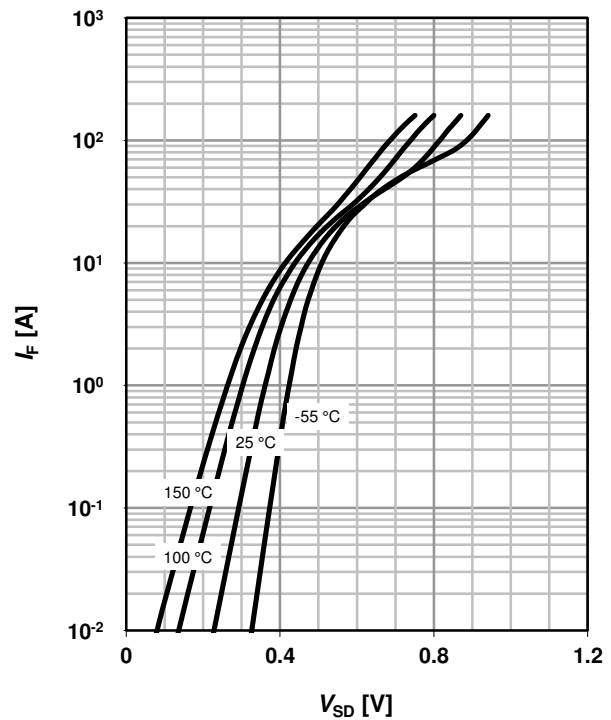
parameter:  $T_j$



## 22 Forward characteristics of reverse diode (Q2)

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

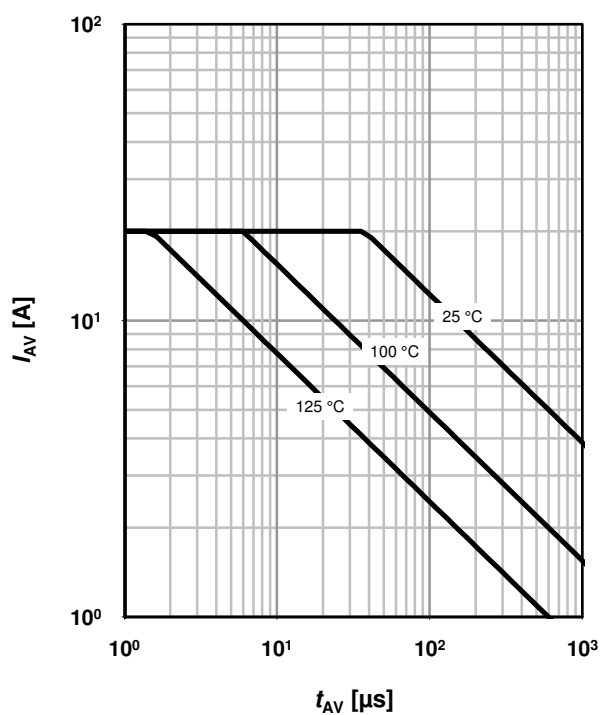
parameter:  $T_j$



## 23 Avalanche characteristics (Q1)

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

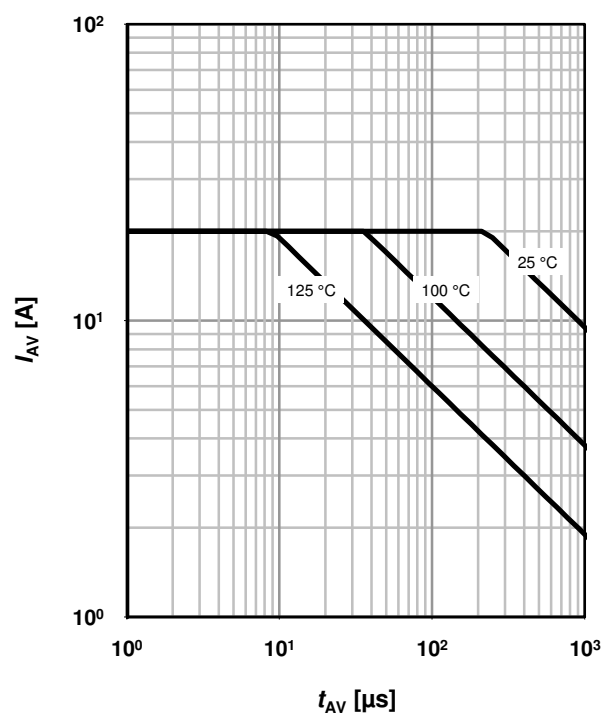
parameter:  $T_{j(start)}$



## 24 Avalanche characteristics (Q2)

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

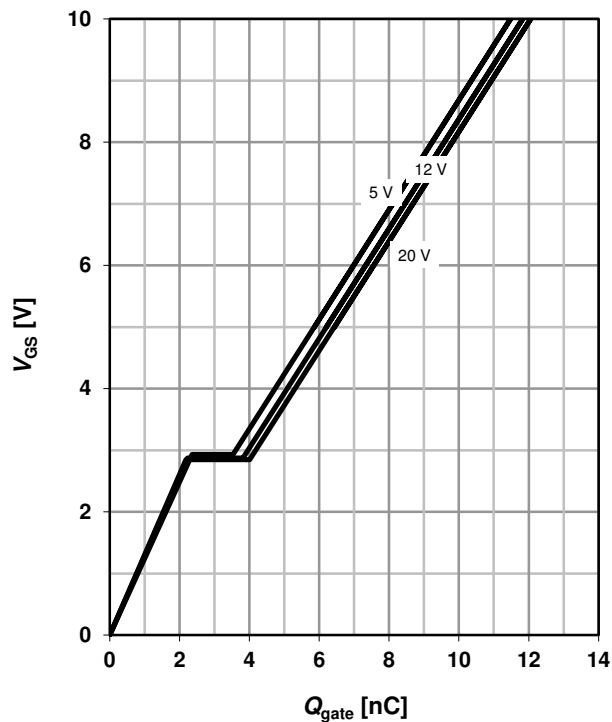
parameter:  $T_{j(start)}$



### 25 Typ. gate charge (Q1)

$$V_{GS}=f(Q_{gate}); I_D=20 \text{ A pulsed}$$

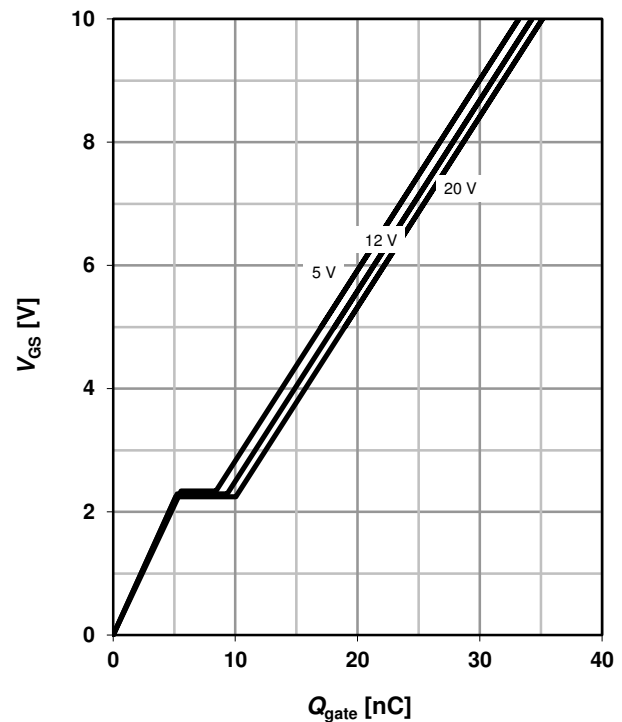
parameter:  $V_{DD}$



### 26 Typ. gate charge (Q2)

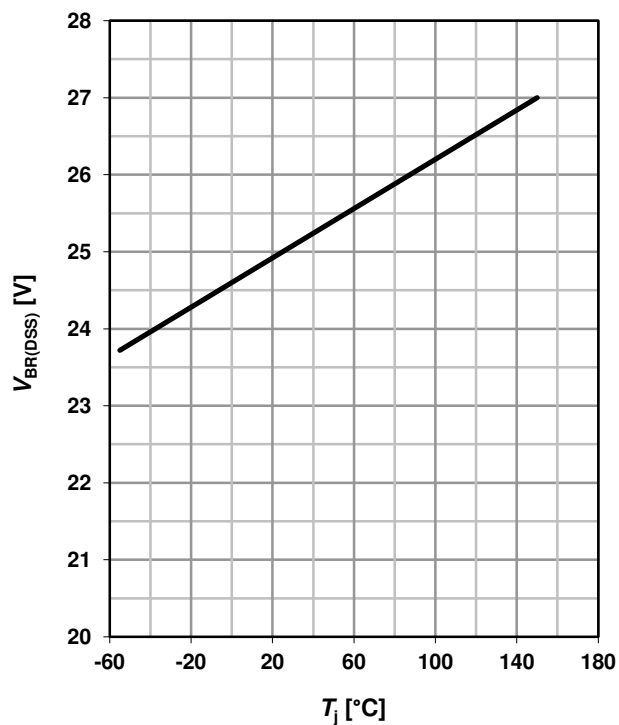
$$V_{GS}=f(Q_{gate}); I_D=20 \text{ A pulsed}$$

parameter:  $V_{DD}$



### 27 Drain-source breakdown voltage (Q1)

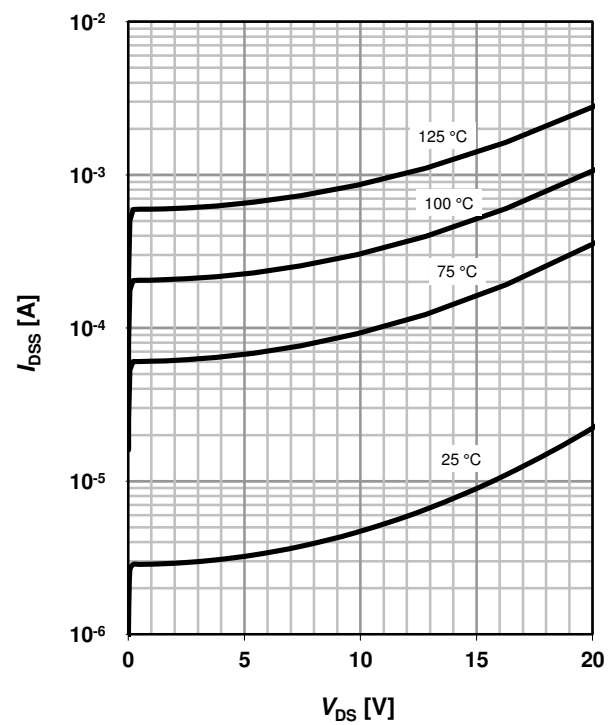
$$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$$



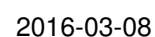
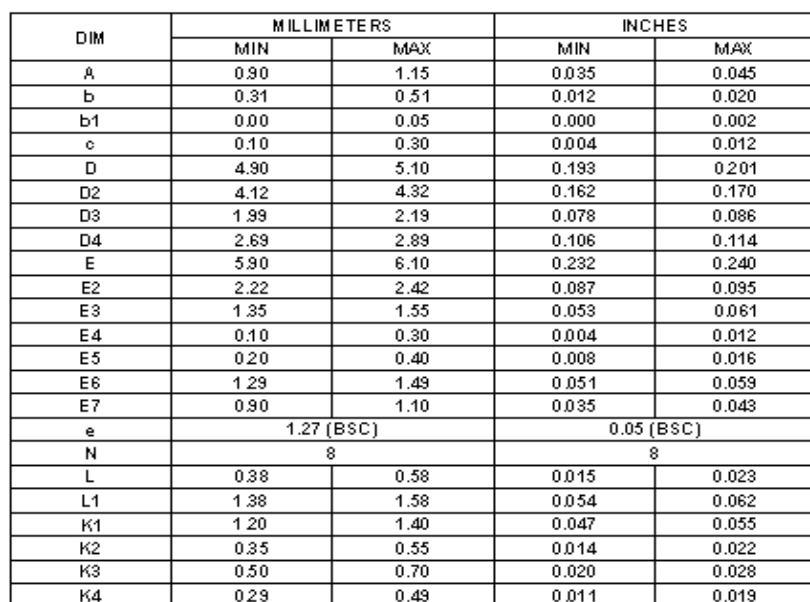
### 28 Typ. drain-source leakage current (Q2)

$$I_{DSS}=f(V_{DS}); V_{GS}=0 \text{ V}$$

parameter:  $T_j$

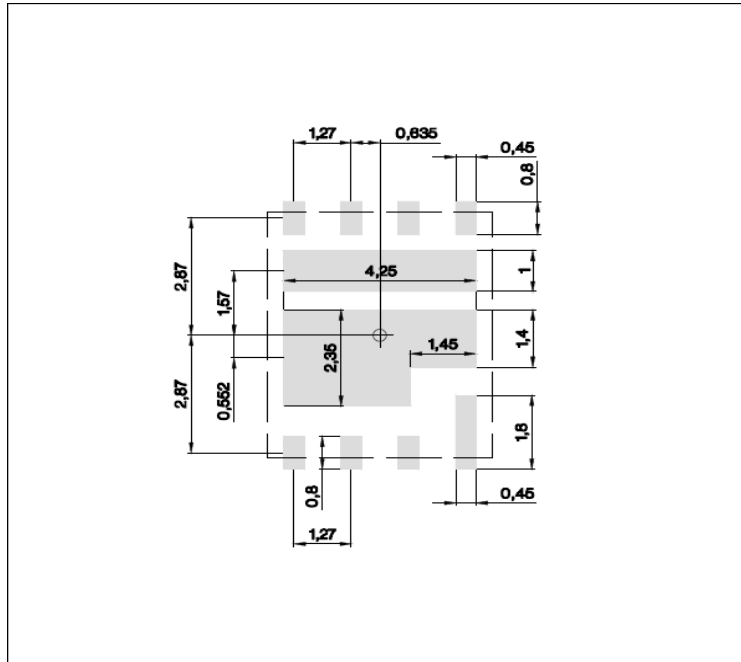


**PG-TISON8-4**

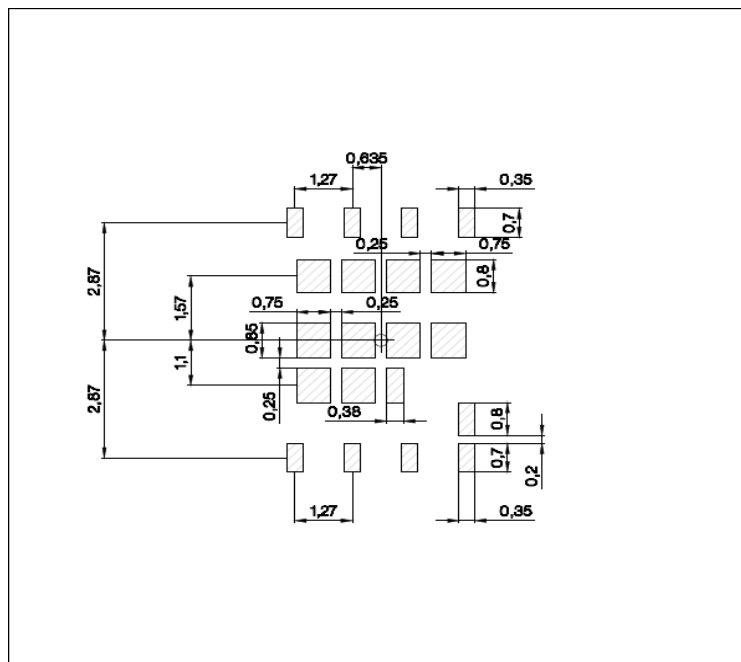


# Boardpads & Apertures

## PG-TISON8-4



■ copper



▨ stencil apertures

All the dimensions in mm

## Revision History

BSG0810NDI

**Revision: 2016-03-24, Rev. 2.1**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.0      | 2015-11-11 | Release of final version                     |
| 2.1      | 2016-03-24 | Update package drawing                       |

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