

# MOSFET

## OptiMOS™ 5 Power-Transistor, 40 V

### Features

- Battery powered application
- LV motor drives
- Very low on-resistance  $R_{DS(on)}$
- 100% avalanche tested
- Superior thermal resistance
- N-channel
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21
- 175 °C rated

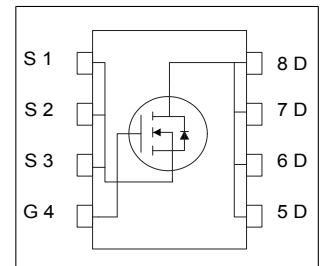
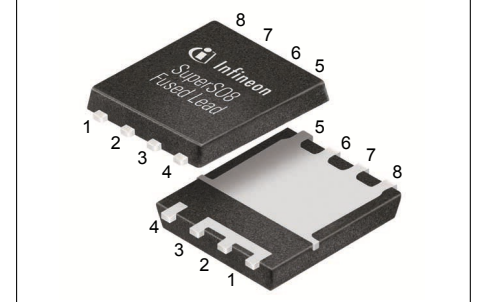
### Product validation

Fully qualified according to JEDEC for Industrial Applications

**Table 1 Key Performance Parameters**

| Parameter        | Value | Unit       |
|------------------|-------|------------|
| $V_{DS}$         | 40    | V          |
| $R_{DS(on),max}$ | 1.7   | m $\Omega$ |
| $I_D$            | 193   | A          |
| $Q_{oss}$        | 54    | nC         |
| $Q_G(0V..10V)$   | 51    | nC         |

TDSON-8 FL (enlarged source interconnection)



| Type / Ordering Code | Package    | Marking  | Related Links |
|----------------------|------------|----------|---------------|
| ISC017N04NM5         | TDSON-8 FL | 17N04NM5 | -             |

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## 1 Maximum ratings

at  $T_A=25\text{ °C}$ , unless otherwise specified

**Table 2 Maximum ratings**

| Parameter                                    | Symbol         | Values |      |                                | Unit | Note / Test Condition   |
|--|----------------|--------|------|--------------------------------|------|---|
|  |                | Min.   | Typ. | Max.                           |      |   |
| Continuous drain current <sup>1)</sup>       | $I_D$          | -      | -    | 193<br>137<br>178<br>126<br>31 | A    | $V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_C=100\text{ °C}$<br>$V_{GS}=7\text{ V}$ , $T_C=25\text{ °C}$<br>$V_{GS}=7\text{ V}$ , $T_C=100\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_A=25\text{ °C}$ ,<br>$R_{THJA}=50\text{ °C/W}^2)$ |
| Pulsed drain current <sup>3)</sup>           | $I_{D,pulse}$  | -      | -    | 772                            | A    | $T_C=25\text{ °C}$  |
| Avalanche energy, single pulse <sup>4)</sup> | $E_{AS}$       | -      | -    | 220                            | mJ   | $I_D=50\text{ A}$ , $R_{GS}=25\text{ }\Omega$   |
| Gate source voltage                          | $V_{GS}$       | -20    | -    | 20                             | V    | -   |
| Power dissipation                            | $P_{tot}$      | -      | -    | 115<br>3.0                     | W    | $T_C=25\text{ °C}$<br>$T_A=25\text{ °C}$ , $R_{THJA}=50\text{ °C/W}^2)$   |
| Operating and storage temperature            | $T_j, T_{stg}$ | -55    | -    | 175                            | °C   | IEC climatic category; DIN IEC 68-1:<br>55/175/56   |

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter  | Symbol     | Values |      |      | Unit | Note / Test Condition |
|--|------------|--------|------|------|------|-----------------------|
|  |            | Min.   | Typ. | Max. |      |                       |
| Thermal resistance, junction - case, bottom      | $R_{thJC}$ | -      | -    | 1.3  | °C/W | -                     |
| Thermal resistance, junction - case, top         | $R_{thJC}$ | -      | -    | 20   | °C/W | -                     |
| Device on PCB,<br>6 cm <sup>2</sup> cooling area | $R_{thJA}$ | -      | -    | 50   | °C/W | -                     |

<sup>1)</sup> Rating refers to the product only with datasheet specified absolute maximum values, maintaining case temperature at 25°C. For higher Tcase please refer to Diagram 2. De-rating will be required based on the actual environmental conditions.

<sup>2)</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.

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

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

### 3 Electrical characteristics

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

**Table 4 Static characteristics**

| Parameter                        | Symbol        | Values |            |            | Unit          | Note / Test Condition   |
|----------------------------------|---------------|--------|------------|------------|---------------|---|
|                                  |               | Min.   | Typ.       | Max.       |               |   |
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | 40     | -          | -          | V             | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$   |
| Gate threshold voltage           | $V_{GS(th)}$  | 2.2    | -          | 3.4        | V             | $V_{DS}=V_{GS}$ , $I_D=60\text{ }\mu\text{A}$   |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | 0.1<br>10  | 1<br>100   | $\mu\text{A}$ | $V_{DS}=40\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$<br>$V_{DS}=40\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ °C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | 10         | 100        | nA            | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$  |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 1.3<br>1.5 | 1.7<br>2.0 | m $\Omega$    | $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$<br>$V_{GS}=7\text{ V}$ , $I_D=50\text{ A}$   |
| Gate resistance                  | $R_G$         | -      | 0.9        | 1.3        | $\Omega$      | -   |
| Transconductance                 | $g_{fs}$      | -      | 210        | -          | S             | $ V_{DS} \geq 2 I_D /R_{DS(on)max}$ , $I_D=50\text{ A}$   |

**Table 5 Dynamic characteristics**

| Parameter                                  | Symbol       | Values |      |      | Unit | Note / Test Condition  |
|--|--------------|--------|------|------|------|--|
|  |              | Min.   | Typ. | Max. |      |  |
| Input capacitance                          | $C_{iss}$    | -      | 3700 | 4800 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=20\text{ V}$ , $f=1\text{ MHz}$                                      |
| Output capacitance <sup>1)</sup>           | $C_{oss}$    | -      | 1690 | 2200 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=20\text{ V}$ , $f=1\text{ MHz}$                                      |
| Reverse transfer capacitance <sup>1)</sup> | $C_{rss}$    | -      | 130  | 230  | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=20\text{ V}$ , $f=1\text{ MHz}$                                      |
| Turn-on delay time                         | $t_{d(on)}$  | -      | 10   | -    | ns   | $V_{DD}=20\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Rise time                                  | $t_r$        | -      | 5    | -    | ns   | $V_{DD}=20\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Turn-off delay time                        | $t_{d(off)}$ | -      | 20   | -    | ns   | $V_{DD}=20\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Fall time                                  | $t_f$        | -      | 6    | -    | ns   | $V_{DD}=20\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |

**Table 6 Gate charge characteristics<sup>2)</sup>**

| Parameter                          | Symbol        | Values |      |      | Unit | Note / Test Condition   |
|------------------------------------|---------------|--------|------|------|------|---|
|                                    |               | Min.   | Typ. | Max. |      |   |
| Gate to source charge              | $Q_{gs}$      | -      | 16   | -    | nC   | $V_{DD}=20\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge at threshold           | $Q_{g(th)}$   | -      | 11   | -    | nC   | $V_{DD}=20\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge <sup>1)</sup> | $Q_{gd}$      | -      | 9    | 14   | nC   | $V_{DD}=20\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Switching charge                   | $Q_{sw}$      | -      | 15   | -    | nC   | $V_{DD}=20\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total <sup>1)</sup>    | $Q_g$         | -      | 51   | 67   | nC   | $V_{DD}=20\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate plateau voltage               | $V_{plateau}$ | -      | 4.2  | -    | V    | $V_{DD}=20\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total, sync. FET       | $Q_{g(sync)}$ | -      | 46   | -    | nC   | $V_{DS}=0.1\text{ V}$ , $V_{GS}=0\text{ to }10\text{ V}$                    |
| Output charge                      | $Q_{oss}$     | -      | 54   | -    | nC   | $V_{DD}=20\text{ V}$ , $V_{GS}=0\text{ V}$                                  |

<sup>1)</sup> Defined by design. Not subject to production test.

<sup>2)</sup> See "Gate charge waveforms" for parameter definition

**Table 7 Reverse diode**

| Parameter                        | Symbol        | Values |      |      | Unit | Note / Test Condition  |
|----------------------------------|---------------|--------|------|------|------|--|
|                                  |               | Min.   | Typ. | Max. |      |  |
| Diode continuous forward current | $I_S$         | -      | -    | 115  | A    | $T_C=25\text{ °C}$   |
| Diode pulse current              | $I_{S,pulse}$ | -      | -    | 772  | A    | $T_C=25\text{ °C}$   |
| Diode forward voltage            | $V_{SD}$      | -      | 0.83 | 1    | V    | $V_{GS}=0\text{ V}, I_F=50\text{ A}, T_j=25\text{ °C}$               |
| Reverse recovery time            | $t_{rr}$      | -      | 52   | -    | ns   | $V_R=20\text{ V}, I_F=50\text{ A}, di_F/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge          | $Q_{rr}$      | -      | 59   | -    | nC   | $V_R=20\text{ V}, I_F=50\text{ A}, di_F/dt=100\text{ A}/\mu\text{s}$ |

### 4 Electrical characteristics diagrams

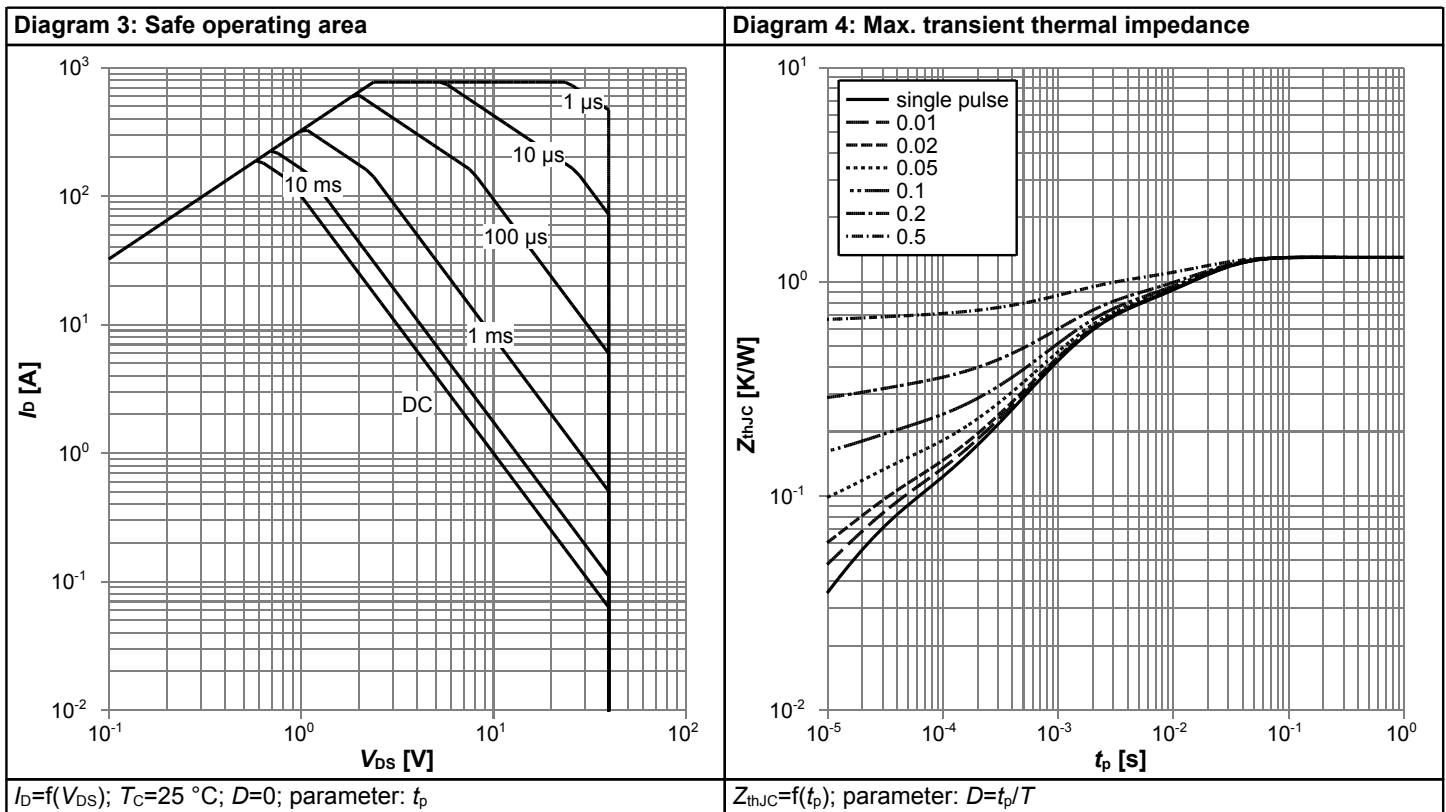
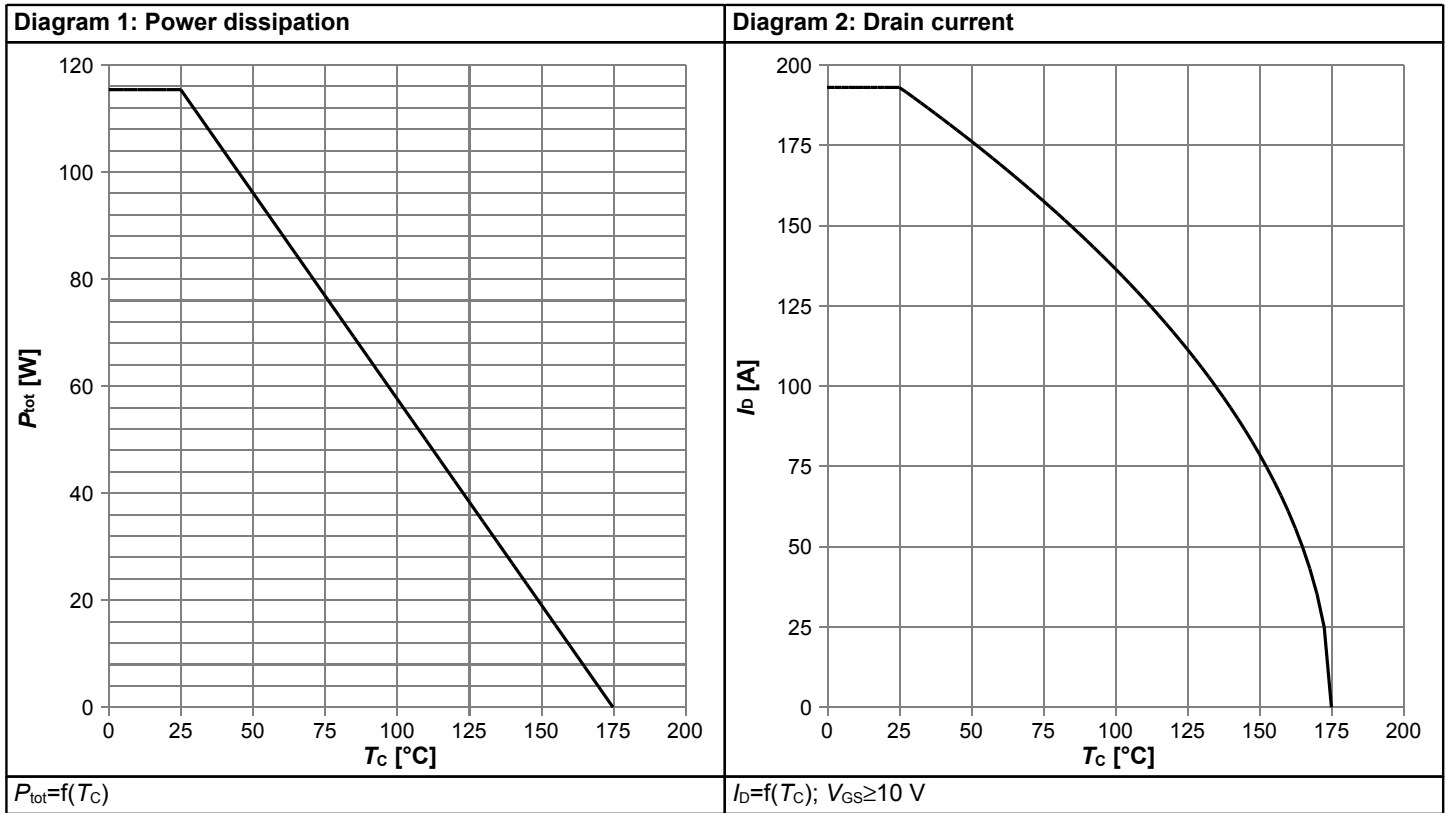
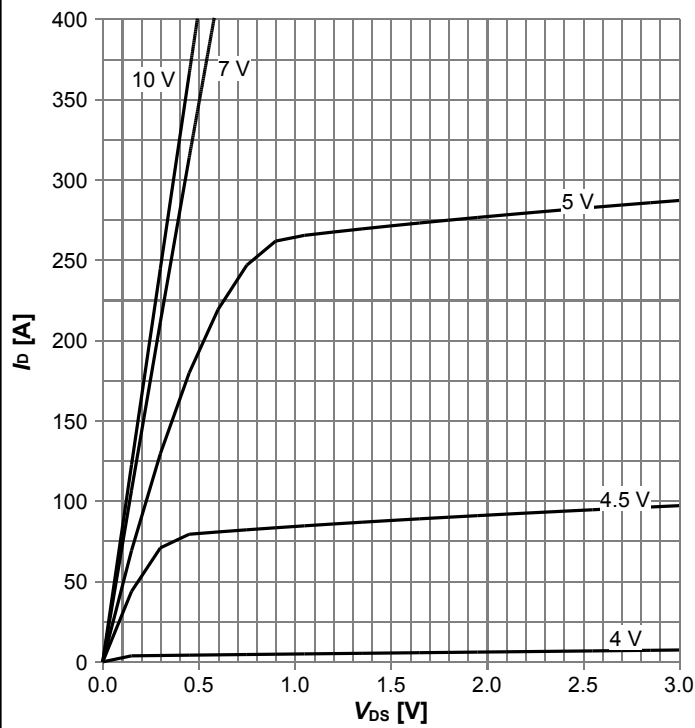
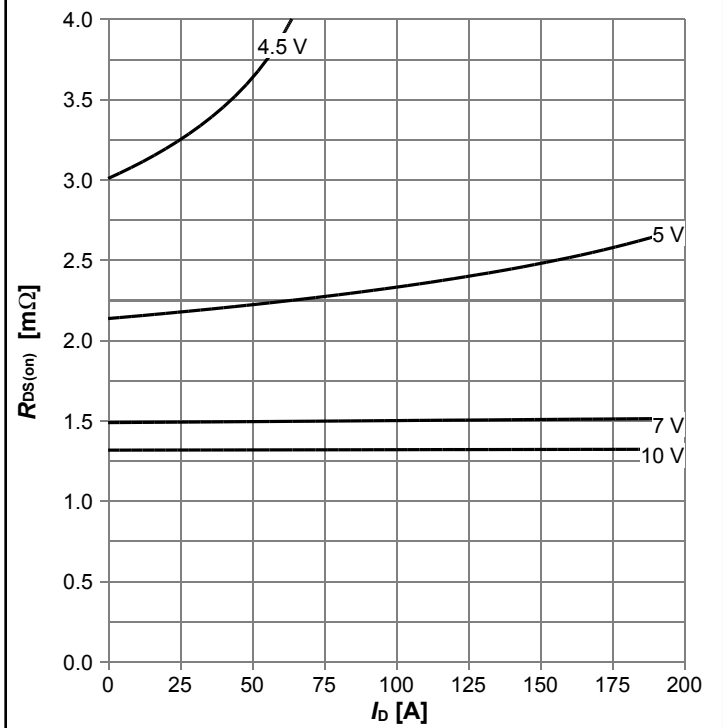


Diagram 5: Typ. output characteristics



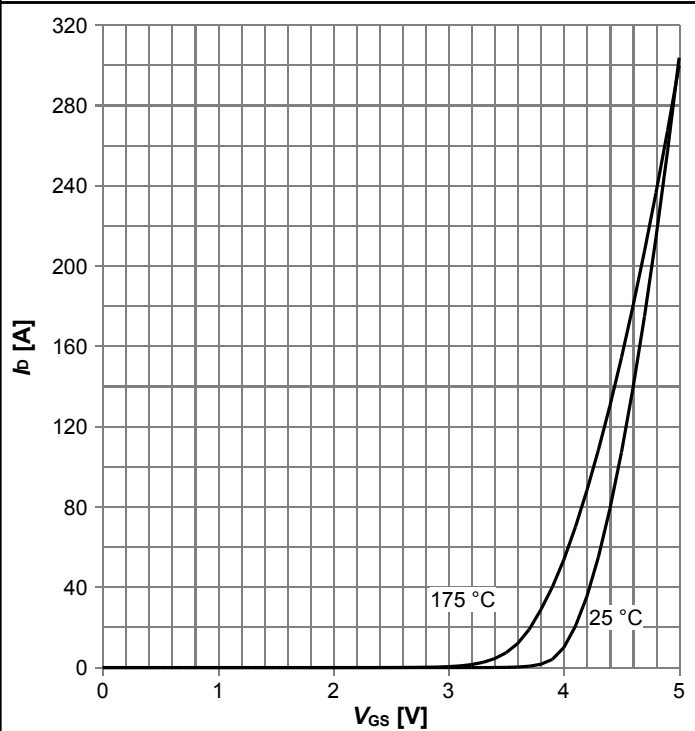
$I_D=f(V_{DS}), T_j=25\text{ }^\circ\text{C};$  parameter:  $V_{GS}$

Diagram 6: Typ. drain-source on resistance



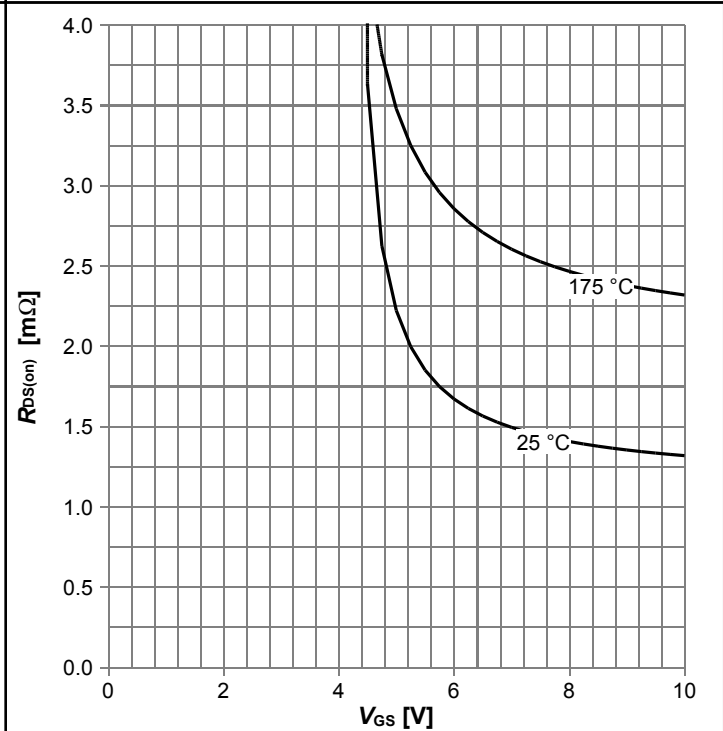
$R_{DS(on)}=f(I_D), T_j=25\text{ }^\circ\text{C};$  parameter:  $V_{GS}$

Diagram 7: Typ. transfer characteristics



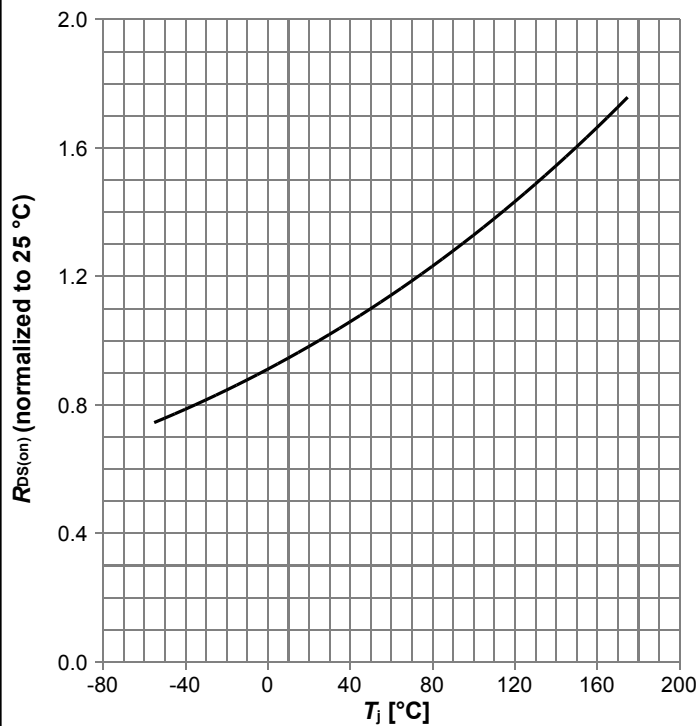
$I_D=f(V_{GS}), |V_{DS}|>2|I_D|R_{DS(on)max};$  parameter:  $T_j$

Diagram 8: Typ. drain-source on resistance



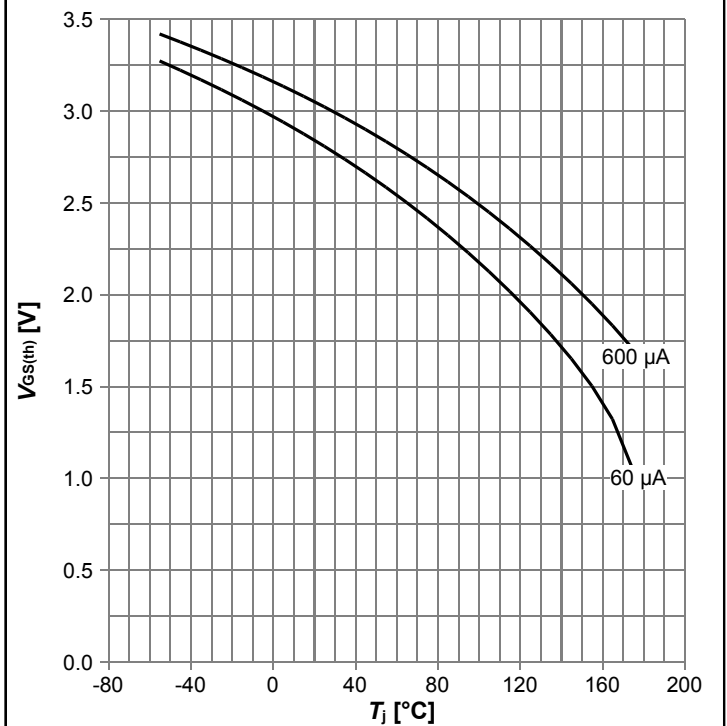
$R_{DS(on)}=f(V_{GS}), I_D=50\text{ A};$  parameter:  $T_j$

Diagram 9: Normalized drain-source on resistance



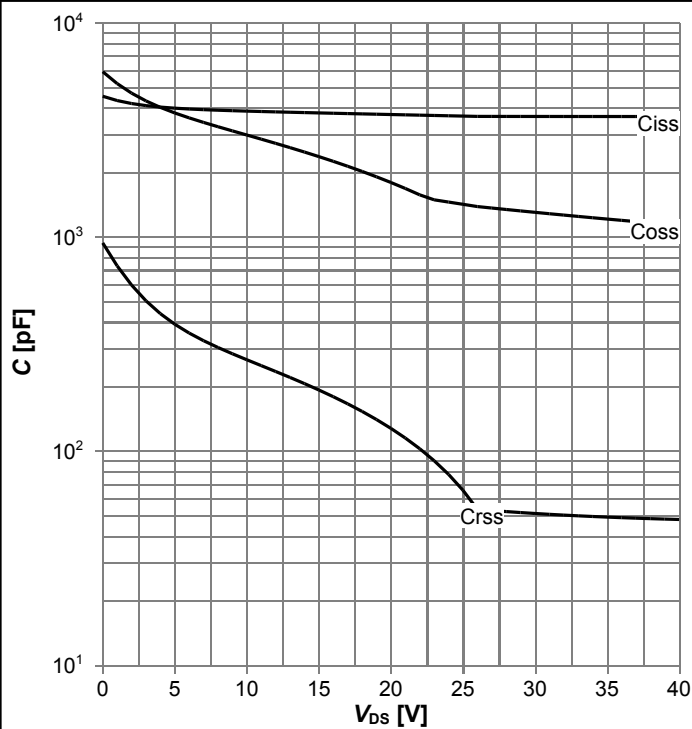
$R_{DS(on)}=f(T_j)$ ,  $I_D=50$  A,  $V_{GS}=10$  V

Diagram 10: Typ. gate threshold voltage



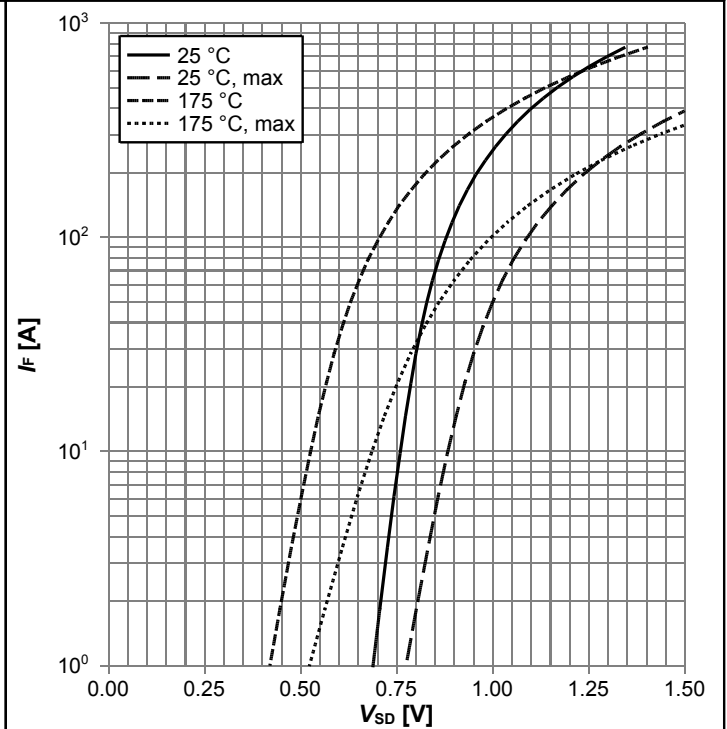
$V_{GS(th)}=f(T_j)$ ,  $V_{GS}=V_{DS}$ ; parameter:  $I_D$

Diagram 11: Typ. capacitances



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

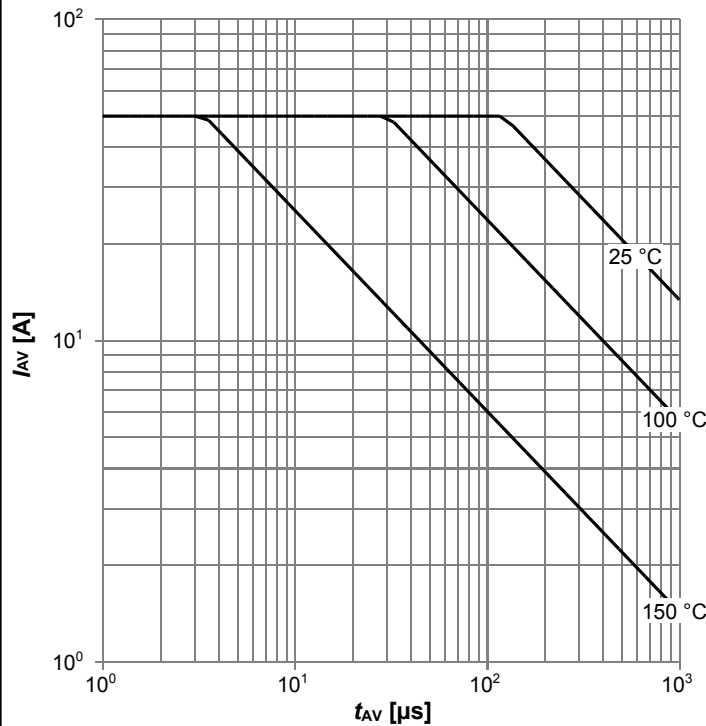
Diagram 12: Forward characteristics of reverse diode



$I_F=f(V_{SD})$ ; parameter:  $T_j$

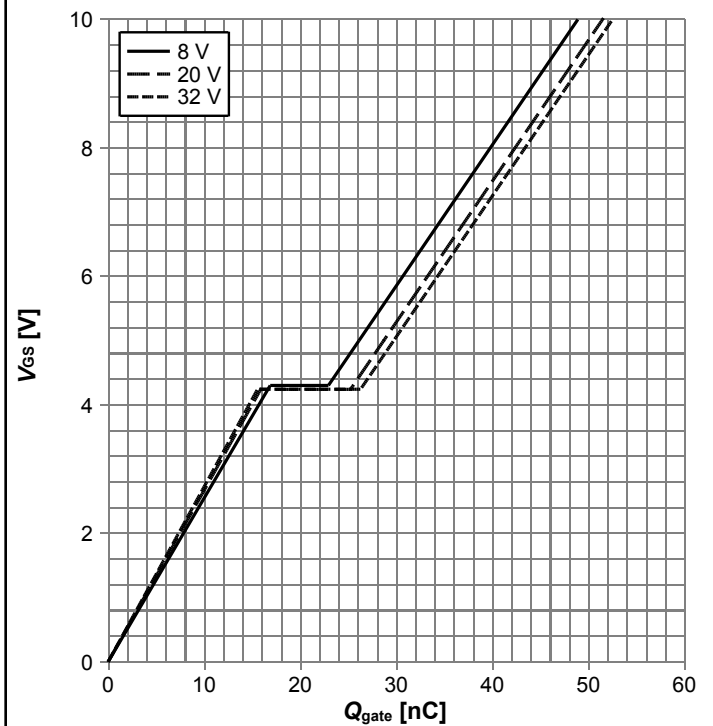


**Diagram 13: Avalanche characteristics**



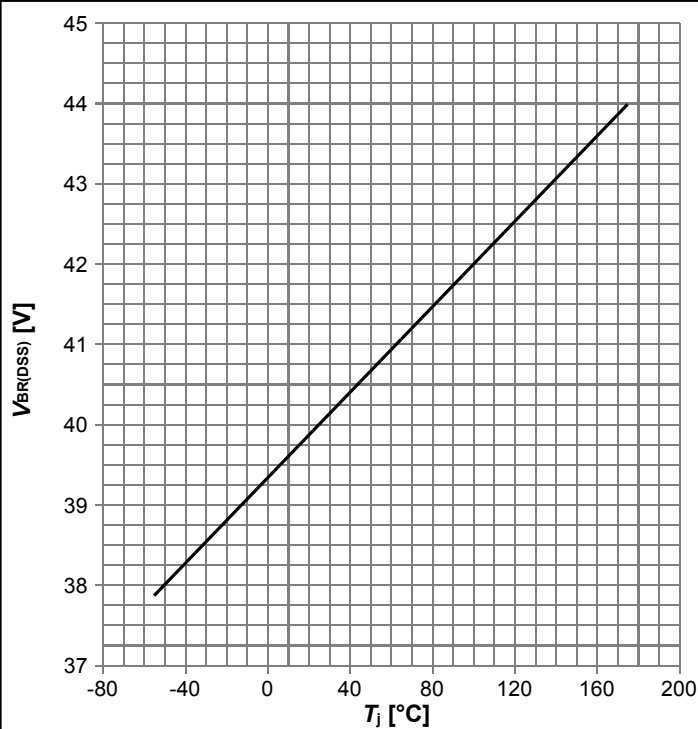
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$ ; parameter:  $T_{j,start}$

**Diagram 14: Typ. gate charge**



$V_{GS}=f(Q_{gate}), I_D=50 \text{ A pulsed}, T_j=25 \text{ °C}$ ; parameter:  $V_{DD}$

**Diagram 15: Drain-source breakdown voltage**



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

**Diagram Gate charge waveforms**



## 5 Package Outlines



| DIM   | MILLIMETERS |      | INCHES      |       |
|-------|-------------|------|-------------|-------|
|       | MIN         | MAX  | MIN         | MAX   |
| A     | 0.90        | 1.10 | 0.035       | 0.043 |
| A3    | 0.25 (REF)  |      | 0.011 (REF) |       |
| b     | 0.34        | 0.54 | 0.013       | 0.021 |
| b1    | 0.02        | 0.22 | 0.001       | 0.009 |
| D     | 5.15 (BSC)  |      | 0.203 (BSC) |       |
| D1    | 5.00 (BSC)  |      | 0.197 (BSC) |       |
| D2    | 3.70        | 4.40 | 0.146       | 0.173 |
| E     | 6.15 (BSC)  |      | 0.242 (BSC) |       |
| E1    | 6.00 (BSC)  |      | 0.236 (BSC) |       |
| E2    | 3.40        | 3.80 | 0.134       | 0.150 |
| e     | 1.27 (BSC)  |      | 0.050 (BSC) |       |
| N     | 8           |      | 8           |       |
| L     | 0.74        | 0.84 | 0.029       | 0.033 |
| M     | 0.45        | 0.66 | 0.018       | 0.026 |
| theta | 8.5°        | 12°  | 8.5°        | 12°   |
| Q     | 3.15        | 3.25 | 0.124       | 0.128 |
| R     | 0.48        | 0.58 | 0.019       | 0.023 |
| aaa   | 0.25        |      | 0.010       |       |
| eee   | 0.08        |      | 0.003       |       |

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REVISION  
01

Figure 1 Outline TDSON-8 FL, dimensions in mm/inches

## Revision History

ISC017N04NM5

**Revision: 2020-03-22, Rev. 2.1**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision)      |
|----------|------------|---|
| 2.0      | 2020-01-30 | Release of final version                          |
| 2.1      | 2020-03-22 | Update condition Id pulse, Features and footnotes |

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