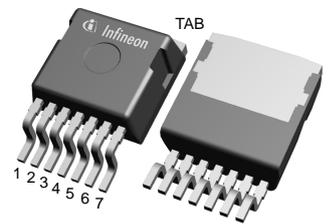


Final datasheet

CoolSiC™ 1200 V SiC Trench MOSFET : Silicon Carbide MOSFET

Features

- $V_{DS} = 1200\text{ V}$ at $T_{vj} = -55...175^\circ\text{C}$
- $I_{DC} = 205\text{ A}$ at $T_C = 25^\circ\text{C}$
- $R_{DS(on)} = 8.7\text{ m}\Omega$ at $V_{GS} = 20\text{ V}$, $T_{vj} = 25^\circ\text{C}$
- New performance-optimized chip technology (Gen1p) with improved $R_{DS(on)}^* \text{ A}$
- Best in class switching energy for lower switching losses and reduced cooling efforts
- Lowest device capacitances for higher switching speeds and higher power density
- A combination of low C_{rSS}/C_{iSS} ratio and high $V_{GS(th)}$ to avoid parasitic turn-on and enable unipolar gate driving
- Reduced total gate charge Q_G for lower driving power and losses
- Increased recommended turn-on voltage ($V_{GS(on)} = 20\text{ V}$) for lower $R_{DS(on)}$
- .XT die attach technology for best in class thermal performance
- Low package stray inductance for faster and cleaner switching
- Sense (Kelvin) source pin for better gate control and reduced switching losses
- Creepage distance of 5.8 mm (material group II) to fit 800 V applications
- SMT package for automated assembly and reduced system costs



Potential applications

- On-board charger
- DC/DC converter
- Auxiliary drives

Product validation

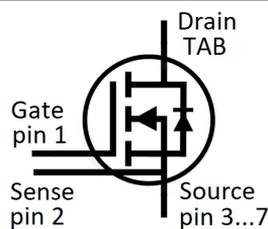
- Qualified for Automotive Applications. Product Validation according to AEC-Q100/101

Description

Pin definition:

- Pin 1 - Gate
- Pin 2 - Kelvin sense contact
- Pin 3...7 - Source
- Tab - Drain

Note: The source and sense pins are not exchangeable, their exchange might lead to malfunction



| Type | Package | Marking |
|----------------|----------------|---------|
| AIMBG120R010M1 | PG-TO263-7-U01 | AS10MM1 |

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1 Package

1 Package

Table 1 Characteristic values

| Parameter | Symbol | Note or test condition | Values | | | Unit |
|---|---------------|------------------------|--------|------|------|------|
| | | | Min. | Typ. | Max. | |
| Storage temperature | T_{stg} | | -55 | | 150 | °C |
| Soldering temperature | T_{sold} | | | | 260 | °C |
| MOSFET/body diode thermal resistance, junction-case ¹⁾ | $R_{th(j-c)}$ | | | 0.13 | 0.17 | K/W |

1) not subject to production test - verified by design/characterization

2 MOSFET

Table 2 Maximum rated values

| Parameter | Symbol | Note or test condition | Values | Unit | |
|--|-----------|---|-----------------------|------|---|
| Drain-source voltage ¹⁾ | V_{DSS} | $T_{vj} = -55...175\text{ °C}$ | 1200 | V | |
| Continuous DC drain current for $R_{th(j-c,max)}$, limited by $T_{vj(max)}$ ²⁾ | I_{DDC} | $V_{GS} = 20\text{ V}$ | $T_c = 25\text{ °C}$ | 205 | A |
| | | | $T_c = 100\text{ °C}$ | 150 | |
| Peak drain current, t_p limited by $T_{vj(max)}$ ²⁾ | I_{DM} | $V_{GS} = 20\text{ V}$ | 540 | A | |
| Gate-source voltage, max. transient voltage ³⁾ | V_{GS} | $t_p \leq 0.5\ \mu\text{s}, D < 0.01$ | -10...25 | V | |
| Gate-source voltage, max. static voltage ³⁾ | V_{GS} | | -5...23 | V | |
| Avalanche energy, single pulse | E_{AS} | $I_D = 70\text{ A}, V_{DD} = 50\text{ V}, L = 0.26\text{ mH}$ | 625 | mJ | |
| Power dissipation, limited by $T_{vj(max)}$ ²⁾ | P_{tot} | | $T_c = 25\text{ °C}$ | 882 | W |
| | | | $T_c = 100\text{ °C}$ | 441 | |

1) Tested at $T_{vj} = 25\text{ °C}$, verified by design/characterization over full temperature range

2) not subject to production test - verified by design/characterization

3) **Important note:** The selection of positive and negative gate-source voltages impacts the long-term behavior of the device. The design guidelines described in Application Note AN2018-09 must be considered to ensure sound operation of the device over the planned lifetime.

Table 3 Recommended values

| Parameter | Symbol | Note or test condition | Values | Unit |
|-----------------------------------|---------------|------------------------|--------|------|
| Recommended turn-on gate voltage | $V_{GS(on)}$ | | 20 | V |
| Recommended turn-off gate voltage | $V_{GS(off)}$ | | 0 | V |

Table 4 Characteristic values

| Parameter | Symbol | Note or test condition | Values | | | Unit | |
|--|--------------|--|--|------|------|------|----|
| | | | Min. | Typ. | Max. | | |
| Drain-source on-state resistance | $R_{DS(on)}$ | $I_D = 93\text{ A}$ | $T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 20\text{ V}$ | | 8.7 | 11.3 | mΩ |
| | | | $T_{vj} = 100\text{ °C}$, $V_{GS(on)} = 20\text{ V}$ | | 12.2 | | |
| | | | $T_{vj} = 175\text{ °C}$, $V_{GS(on)} = 20\text{ V}$ | | 17.3 | | |
| | | | $T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 18\text{ V}$ | | 9.5 | | |
| Gate-source threshold voltage | $V_{GS(th)}$ | $I_D = 30\text{ mA}$, $V_{DS} = V_{GS}$ (tested after 1 ms pulse at $V_{GS} = 20\text{ V}$) | $T_{vj} = 25\text{ °C}$ | 3.7 | 4.4 | 5.1 | V |
| | | | $T_{vj} = 175\text{ °C}$ | | 3.6 | | |
| Zero gate-voltage drain current | I_{DSS} | $V_{DS} = 1200\text{ V}$, $V_{GS} = 0\text{ V}$ | $T_{vj} = 25\text{ °C}$ | | 0.6 | 90 | μA |
| | | | $T_{vj} = 175\text{ °C}$ | | 10 | | |
| Gate leakage current | I_{GSS} | $V_{DS} = 0\text{ V}$ | $V_{GS} = 25\text{ V}$ | | | 100 | nA |
| | | | $V_{GS} = -10\text{ V}$ | | | -100 | |
| Forward transconductance | g_{fs} | $I_D = 93\text{ A}$, $V_{DS} = 20\text{ V}$ | | 56.8 | | S | |
| Short-circuit withstand time ²⁾ | t_{SC} | $V_{DD} \leq 800\text{ V}$, $V_{DS,peak} < 1200\text{ V}$, $T_{vj(start)} = 25\text{ °C}$, $R_{G,ext} = 2\text{ }\Omega$ | $V_{GS(on)} = 20\text{ V}$ | | 1.5 | | μs |
| | | | $V_{GS(on)} = 18\text{ V}$ | | 2 | | |
| | | | $V_{GS(on)} = 15\text{ V}$ | | 2.5 | | |
| Internal gate resistance | $R_{G,int}$ | $f = 1\text{ MHz}$, $V_{AC} = 25\text{ mV}$ | | 2.4 | | Ω | |
| Input capacitance | C_{iss} | $V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$ | | 5703 | | pF | |
| Output capacitance | C_{oss} | $V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$ | | 268 | | pF | |
| Reverse transfer capacitance | C_{riss} | $V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$ | | 16 | | pF | |
| C_{oss} stored energy | E_{oss} | $V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$ | | 107 | | μJ | |
| Total gate charge | Q_G | $V_{DD} = 800\text{ V}$, $I_D = 93\text{ A}$, $V_{GS} = 0/20\text{ V}$, turn-on pulse | | 178 | | nC | |
| Plateau gate charge | $Q_{GS(pl)}$ | $V_{DD} = 800\text{ V}$, $I_D = 93\text{ A}$, $V_{GS} = 0/20\text{ V}$, turn-on pulse | | 48 | | nC | |
| Gate-to-drain charge | Q_{GD} | $V_{DD} = 800\text{ V}$, $I_D = 93\text{ A}$, $V_{GS} = 0/20\text{ V}$, turn-on pulse | | 30 | | nC | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD} = 800\text{ V}$, $I_D = 93\text{ A}$, $V_{GS} = 0/20\text{ V}$, $R_{G,ext} = 2\text{ }\Omega$, $L_\sigma = 20\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$ | $T_{vj} = 25\text{ °C}$ | | 15 | | ns |
| | | | $T_{vj} = 175\text{ °C}$ | | 14 | | |

(table continues...)

Table 4 (continued) **Characteristic values**

| Parameter | Symbol | Note or test condition | Values | | | Unit |
|------------------------------|--------------|--|---------------------------------------|------|------|------------------|
| | | | Min. | Typ. | Max. | |
| Rise time | t_r | $V_{DD} = 800 \text{ V}, I_D = 93 \text{ A}, V_{GS} = 0/20 \text{ V}, R_{G,ext} = 2 \Omega, L_\sigma = 20 \text{ nH},$ diode: body diode at $V_{GS} = 0 \text{ V}$ | $T_{vj} = 25 \text{ }^\circ\text{C}$ | 17 | | ns |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C}$ | 21 | | |
| Turn-off delay time | $t_{d(off)}$ | $V_{DD} = 800 \text{ V}, I_D = 93 \text{ A}, V_{GS} = 0/20 \text{ V}, R_{G,ext} = 2 \Omega, L_\sigma = 20 \text{ nH},$ diode: body diode at $V_{GS} = 0 \text{ V}$ | $T_{vj} = 25 \text{ }^\circ\text{C}$ | 41 | | ns |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C}$ | 46 | | |
| Fall time | t_f | $V_{DD} = 800 \text{ V}, I_D = 93 \text{ A}, V_{GS} = 0/20 \text{ V}, R_{G,ext} = 2 \Omega, L_\sigma = 20 \text{ nH},$ diode: body diode at $V_{GS} = 0 \text{ V}$ | $T_{vj} = 25 \text{ }^\circ\text{C}$ | 12 | | ns |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C}$ | 12 | | |
| Turn-on energy | E_{on} | $V_{DD} = 800 \text{ V}, I_D = 93 \text{ A}, V_{GS} = 0/20 \text{ V}, R_{G,ext} = 2 \Omega, L_\sigma = 20 \text{ nH},$ diode: body diode at $V_{GS} = 0 \text{ V}$ | $T_{vj} = 25 \text{ }^\circ\text{C}$ | 954 | | μJ |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C}$ | 1279 | | |
| Turn-off energy | E_{off} | $V_{DD} = 800 \text{ V}, I_D = 93 \text{ A}, V_{GS} = 0/20 \text{ V}, R_{G,ext} = 2 \Omega, L_\sigma = 20 \text{ nH},$ diode: body diode at $V_{GS} = 0 \text{ V}$ | $T_{vj} = 25 \text{ }^\circ\text{C}$ | 450 | | μJ |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C}$ | 552 | | |
| Total switching energy | E_{tot} | $V_{DD} = 800 \text{ V}, I_D = 93 \text{ A}, V_{GS} = 0/20 \text{ V}, R_{G,ext} = 2 \Omega, L_\sigma = 20 \text{ nH},$ diode: body diode at $V_{GS} = 0 \text{ V}$ | $T_{vj} = 25 \text{ }^\circ\text{C}$ | 1404 | | μJ |
| | | | $T_{vj} = 175 \text{ }^\circ\text{C}$ | 1831 | | |
| Virtual junction temperature | T_{vj} | | -55 | | 175 | $^\circ\text{C}$ |

Note: Characteristics at $T_{vj} = 25^\circ\text{C}$, unless otherwise specified.

3 Body diode (MOSFET)

Table 5 **Maximum rated values**

| Parameter | Symbol | Note or test condition | Values | Unit | |
|---|-----------|---|------------------------------------|------|---|
| Drain-source voltage ¹⁾ | V_{DSS} | $T_{vj} = -55\dots175 \text{ }^\circ\text{C}$ | 1200 | V | |
| Continuous reverse drain current for $R_{th(j-c,max)}$, limited by $T_{vj(max)}$ ²⁾ | I_{SDC} | $V_{GS} = 0 \text{ V}$ | $T_c = 25 \text{ }^\circ\text{C}$ | 176 | A |
| | | | $T_c = 100 \text{ }^\circ\text{C}$ | 103 | |
| Peak reverse drain current, t_p limited by $T_{vj(max)}$ ²⁾ | I_{SM} | $V_{GS} = 0 \text{ V}$ | 208 | A | |

1) Tested at $T_{vj}=25^\circ\text{C}$, verified by design/characterization over full temperature range

2) not subject to production test - verified by design/characterization

Table 6 Characteristic values

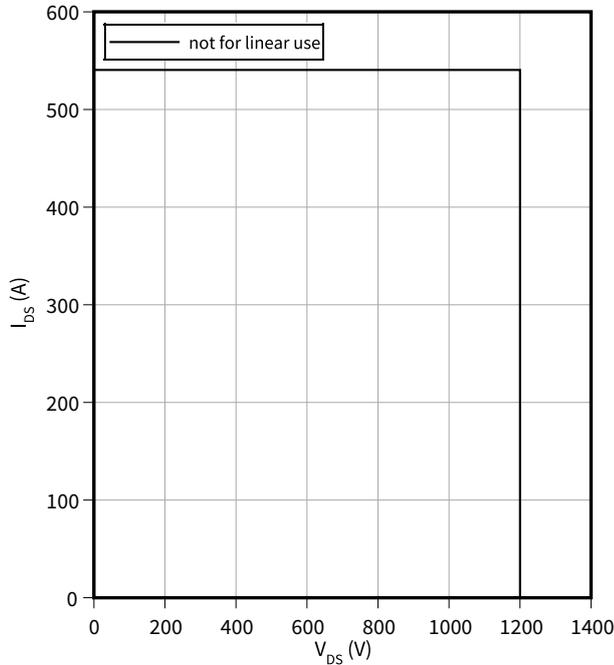
| Parameter | Symbol | Note or test condition | Values | | | Unit | |
|--------------------------------------|-----------|--|---------------------------|------|------|------|----|
| | | | Min. | Typ. | Max. | | |
| Drain-source reverse voltage | V_{SD} | $I_{SD} = 93 \text{ A}, V_{GS} = 0 \text{ V}$ | $T_{vj} = 25 \text{ °C}$ | | 3.9 | 5 | V |
| | | | $T_{vj} = 100 \text{ °C}$ | | 3.8 | | |
| | | | $T_{vj} = 175 \text{ °C}$ | | 3.7 | | |
| MOSFET forward recovery charge | Q_{fr} | $V_{DD} = 800 \text{ V},$ $I_{SD} = 93 \text{ A}, V_{GS} = 0 \text{ V},$ $-di_{SD}/dt = 3000 \text{ A}/\mu\text{s}, Q_{fr}$ includes also Q_C | $T_{vj} = 25 \text{ °C}$ | | 514 | | nC |
| | | | $T_{vj} = 175 \text{ °C}$ | | 987 | | |
| MOSFET peak forward recovery current | I_{frm} | $V_{DD} = 800 \text{ V},$ $I_{SD} = 93 \text{ A}, V_{GS} = 0 \text{ V},$ $-di_{SD}/dt = 3000 \text{ A}/\mu\text{s}, Q_{fr}$ includes also Q_C | $T_{vj} = 25 \text{ °C}$ | | 34 | | A |
| | | | $T_{vj} = 175 \text{ °C}$ | | 42 | | |
| Virtual junction temperature | T_{vj} | | | -55 | | 175 | °C |

4 Characteristics diagrams

Reverse bias safe operating area (RBSOA)

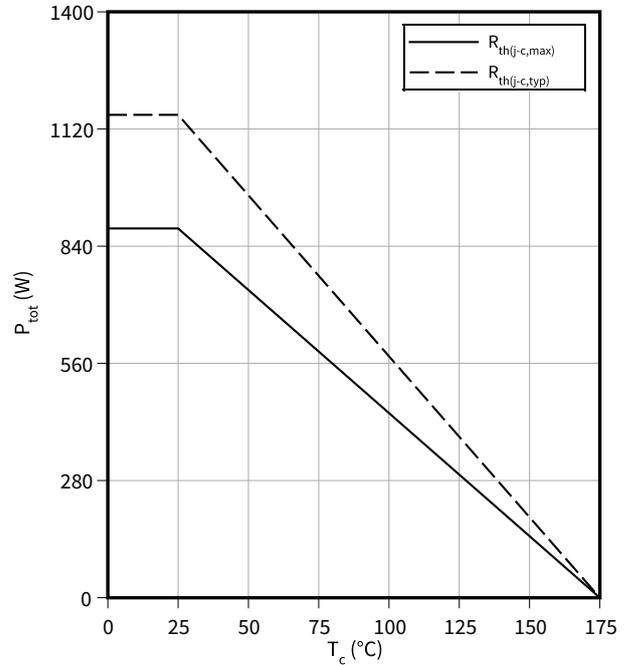
$$I_{DS} = f(V_{DS})$$

$$T_{vj} \leq 175\text{ °C}, V_{GS} = 0/20\text{ V}, T_c = 25\text{ °C}$$



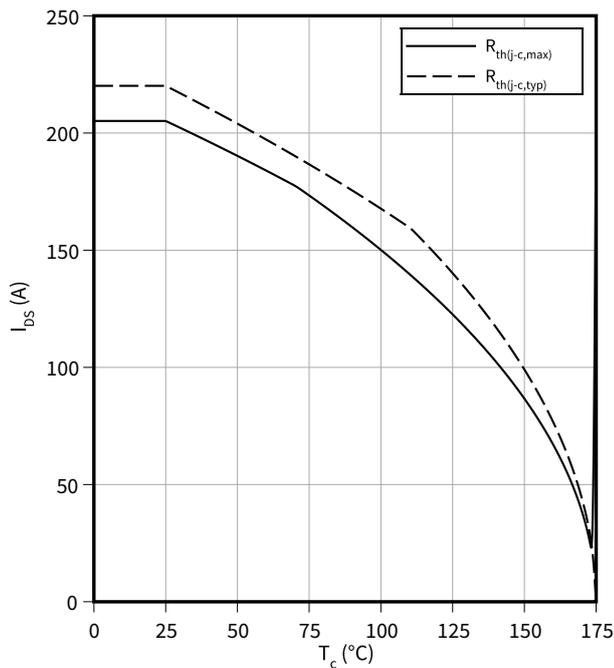
Power dissipation as a function of case temperature

$$P_{tot} = f(T_c)$$



Maximum DC drain to source current as a function of case temperature

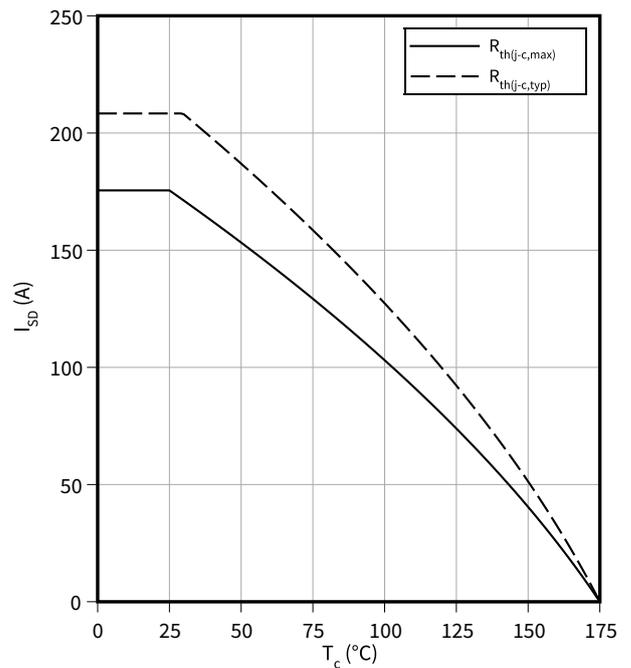
$$I_{DS} = f(T_c)$$



Maximum source to drain current as a function of case temperature

$$I_{SD} = f(T_c)$$

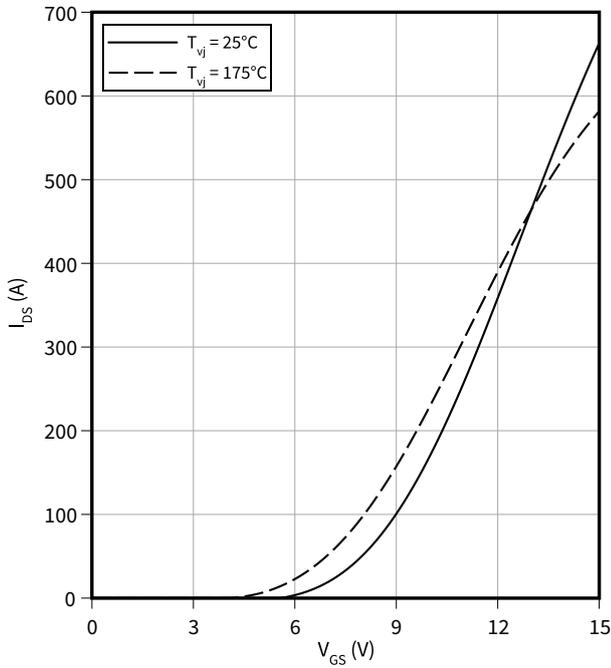
$$V_{GS} = 0\text{ V}$$



4 Characteristics diagrams

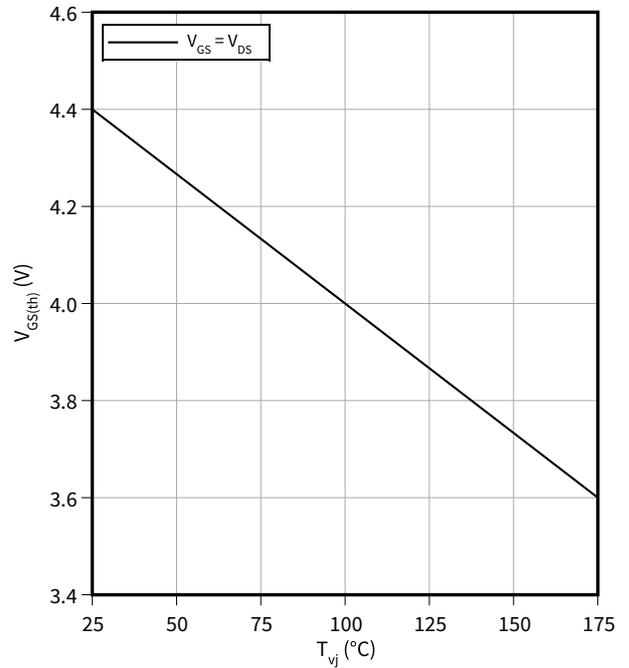
Typical transfer characteristic

$I_{DS} = f(V_{GS})$
 $V_{DS} = 20 \text{ V}$, $t_p = 20 \mu\text{s}$



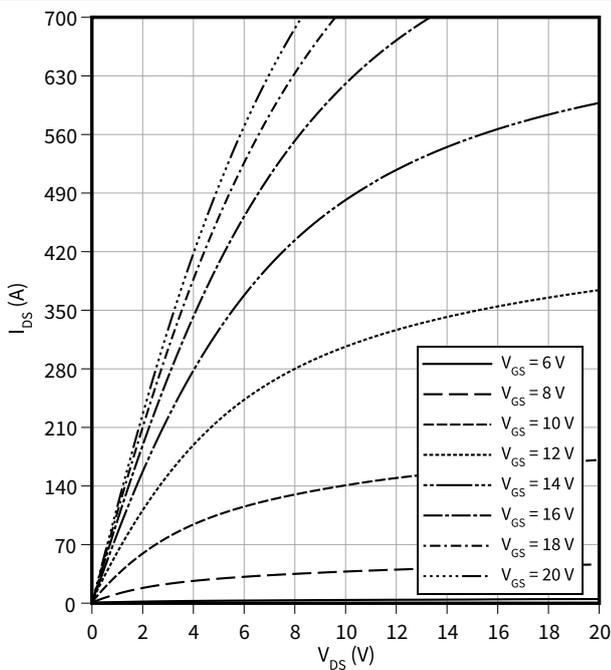
Typical gate-source threshold voltage as a function of junction temperature

$V_{GS(th)} = f(T_{vj})$
 $I_D = 30 \text{ mA}$



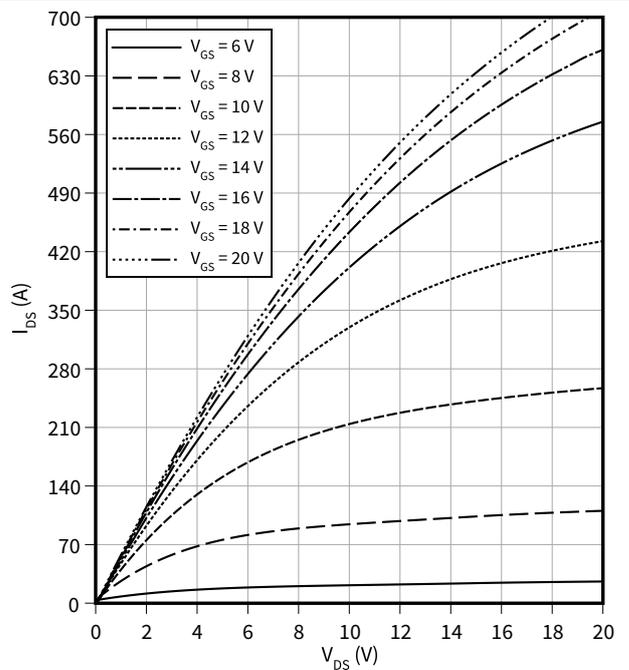
Typical output characteristic, V_{GS} as parameter

$I_{DS} = f(V_{DS})$
 $T_{vj} = 25^\circ\text{C}$, $t_p = 20 \mu\text{s}$



Typical output characteristic, V_{GS} as parameter

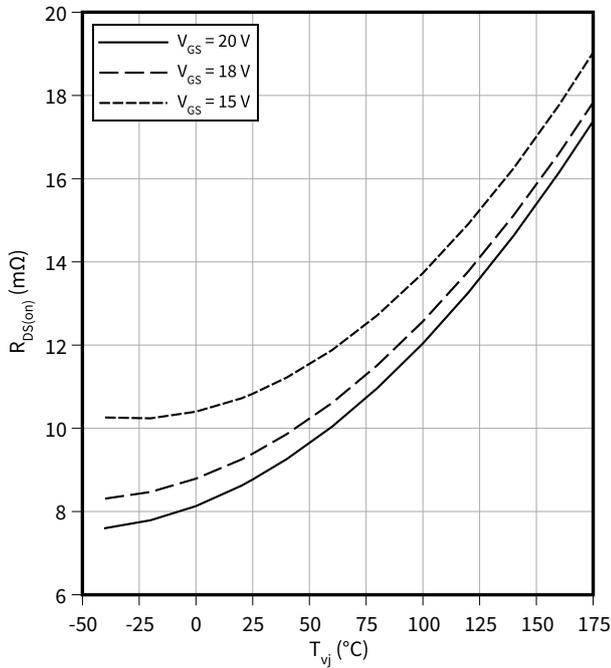
$I_{DS} = f(V_{DS})$
 $T_{vj} = 175^\circ\text{C}$, $t_p = 20 \mu\text{s}$



4 Characteristics diagrams

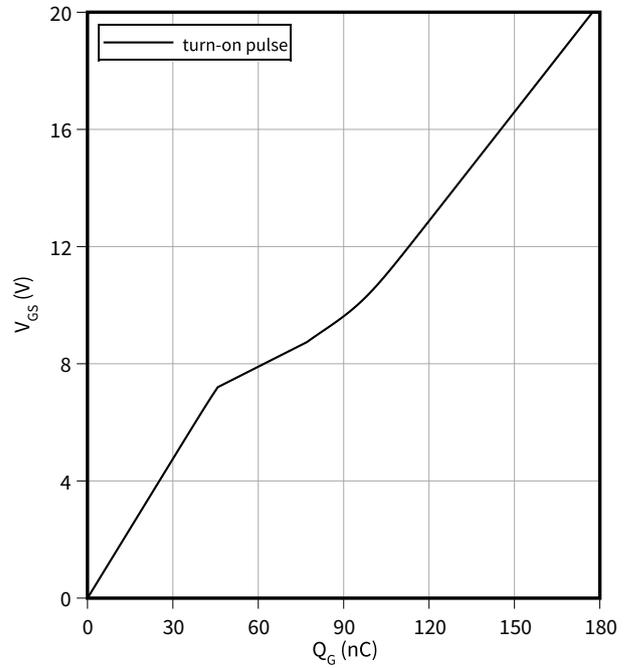
Typical on-state resistance as a function of junction temperature

$R_{DS(on)} = f(T_{vj})$
 $I_D = 93 \text{ A}$



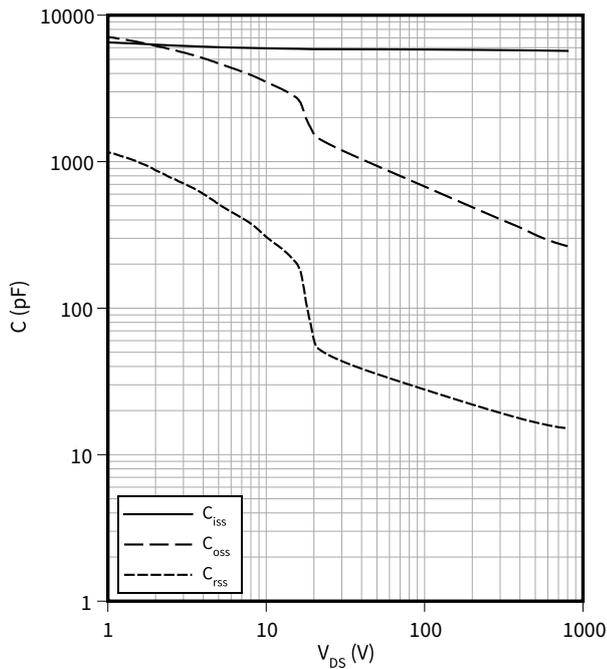
Typical gate charge

$V_{GS} = f(Q_G)$
 $I_D = 93 \text{ A}, V_{DS} = 800 \text{ V}$



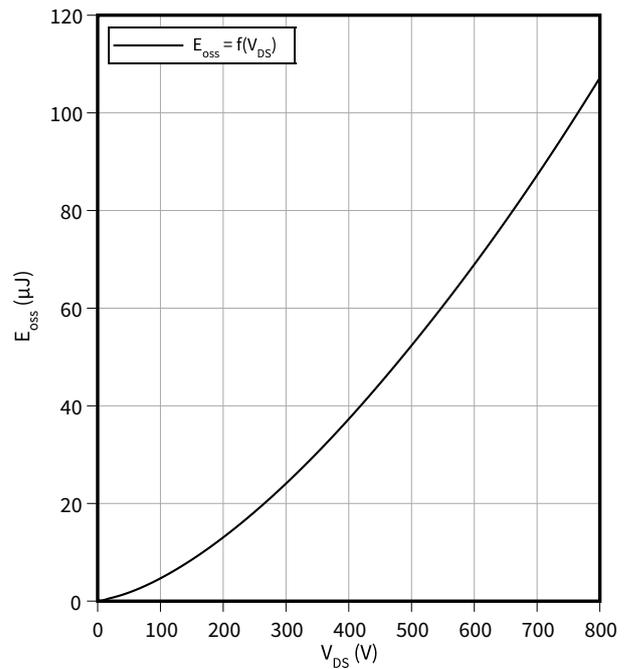
Typical capacitance as a function of drain-source voltage

$C = f(V_{DS})$
 $f = 100 \text{ kHz}, V_{GS} = 0 \text{ V}$



Typical C_{oss} stored energy

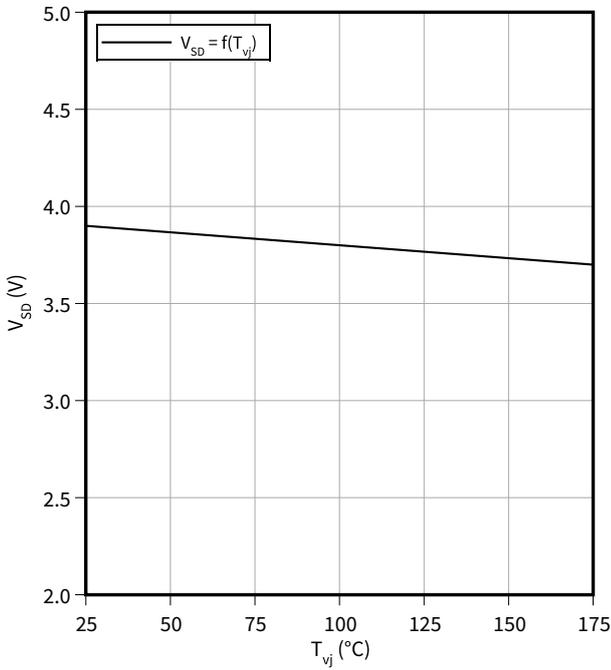
$E_{oss} = f(V_{DS})$
 $f = 100 \text{ kHz}, V_{GS} = 0 \text{ V}$



4 Characteristics diagrams

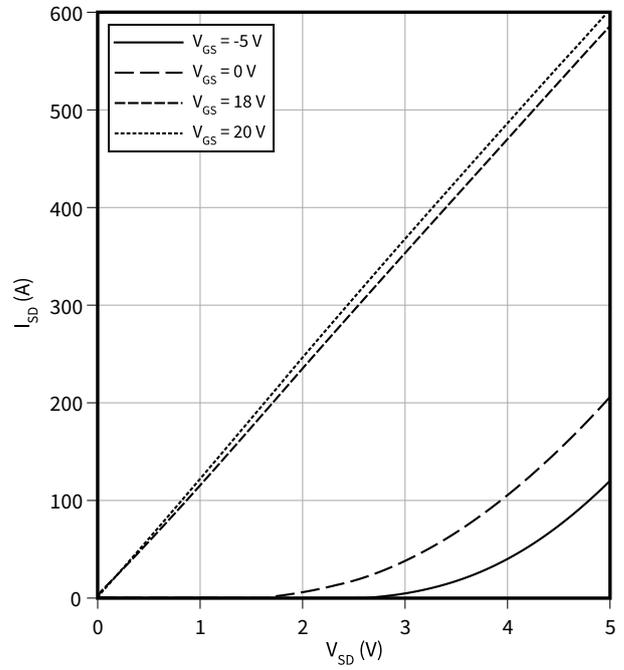
Typical reverse drain voltage as function of junction temperature

$V_{SD} = f(T_{vj})$
 $I_{SD} = 93 \text{ A}, V_{GS} = 0 \text{ V}$



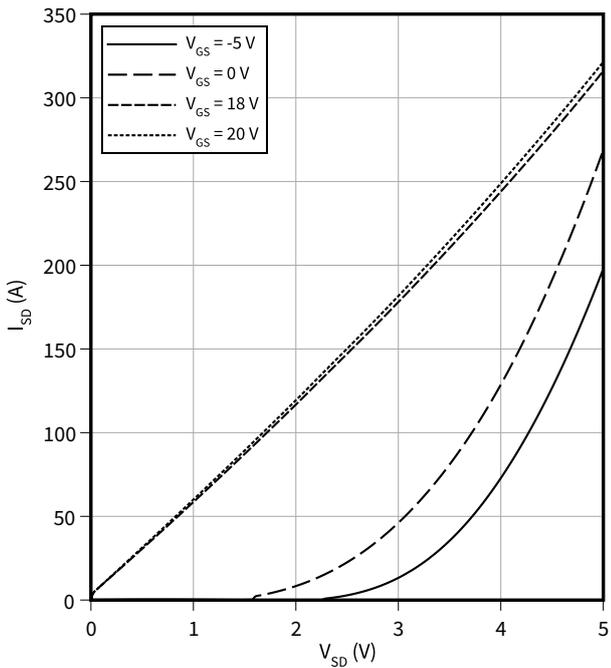
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

$I_{SD} = f(V_{SD})$
 $T_{vj} = 25 \text{ °C}, t_p = 20 \mu\text{s}$



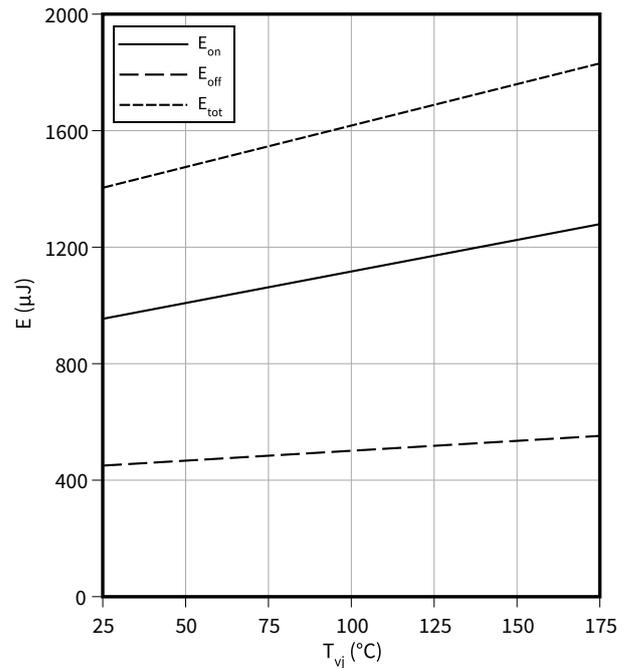
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

$I_{SD} = f(V_{SD})$
 $T_{vj} = 175 \text{ °C}, t_p = 20 \mu\text{s}$



Typical switching energy as a function of junction temperature, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0 \text{ V}$

$E = f(T_{vj})$
 $V_{GS} = 0/20 \text{ V}, I_D = 93 \text{ A}, R_{G,ext} = 2 \Omega, V_{DD} = 800 \text{ V}$

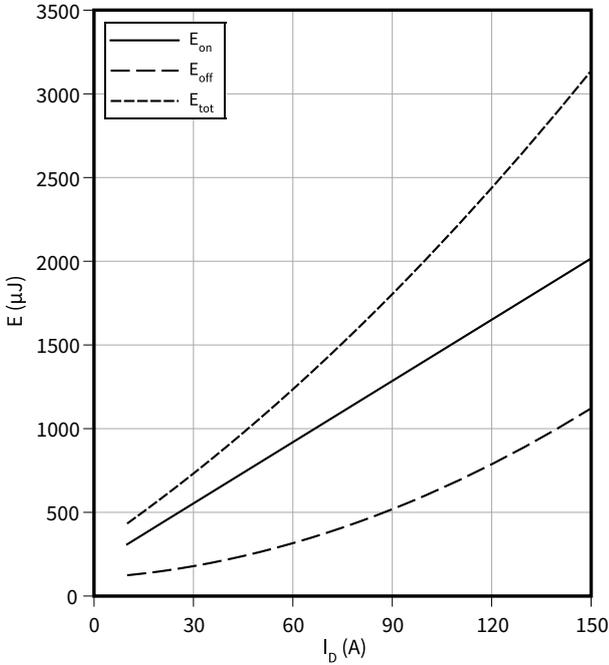


4 Characteristics diagrams

Typical switching energy as a function of drain current, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0\text{ V}$

$E = f(I_D)$

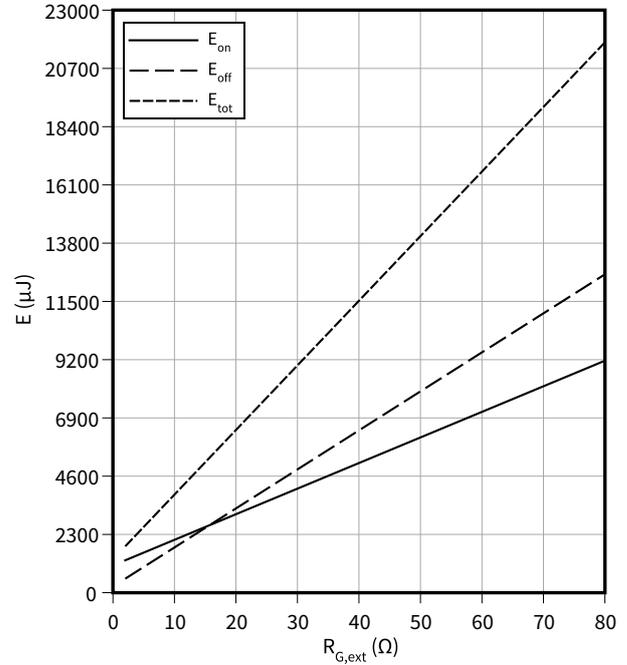
$V_{GS} = 0/20\text{ V}$, $T_{vj} = 175\text{ °C}$, $R_{G,ext} = 2\text{ }\Omega$, $V_{DD} = 800\text{ V}$



Typical switching energy as a function of gate resistance, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0\text{ V}$

$E = f(R_{G,ext})$

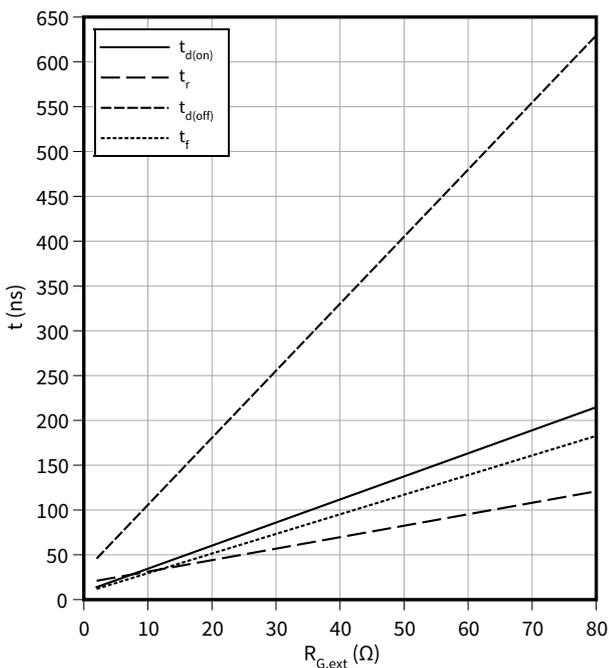
$V_{GS} = 0/20\text{ V}$, $I_D = 93\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{DD} = 800\text{ V}$



Typical switching times as a function of gate resistance, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0\text{ V}$

$t = f(R_{G,ext})$

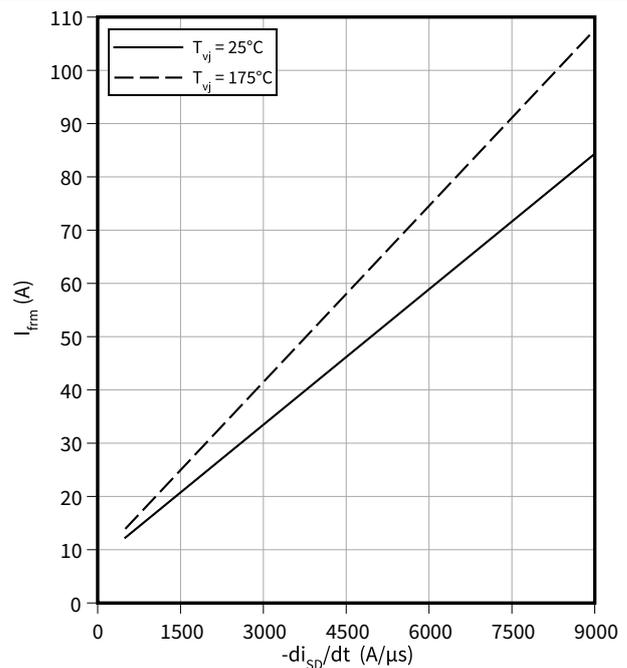
$V_{GS} = 0/20\text{ V}$, $I_D = 93\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{DD} = 800\text{ V}$



Typical MOSFET peak forward recovery current as a function of reverse drain current slope

$I_{frm} = f(-di_{SD}/dt)$

$V_{GS} = 0/20\text{ V}$, $I_{SD} = 93\text{ A}$, $V_{DD} = 800\text{ V}$

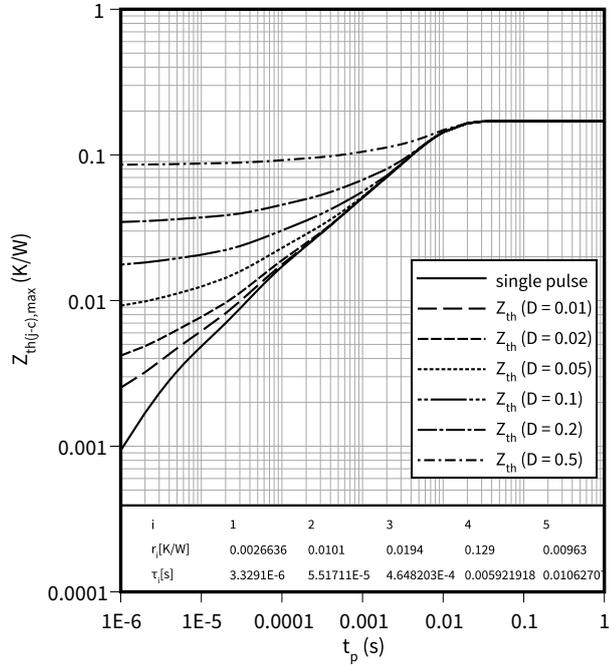


4 Characteristics diagrams

Max. transient thermal impedance (MOSFET/diode)

$$Z_{th(j-c),max} = f(t_p)$$

$$D = t_p/T$$



5 Package outlines

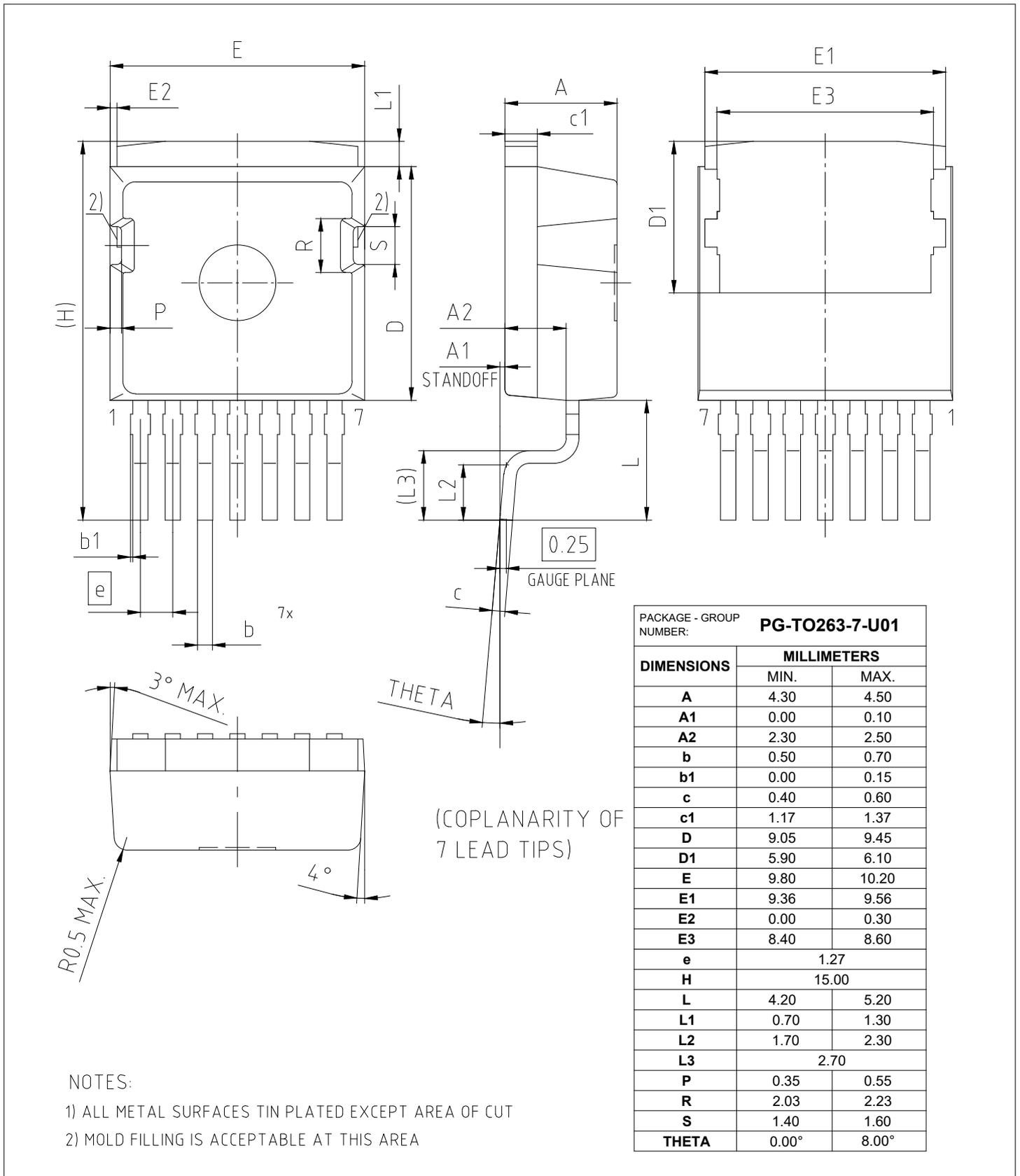


Figure 1

6 Testing conditions

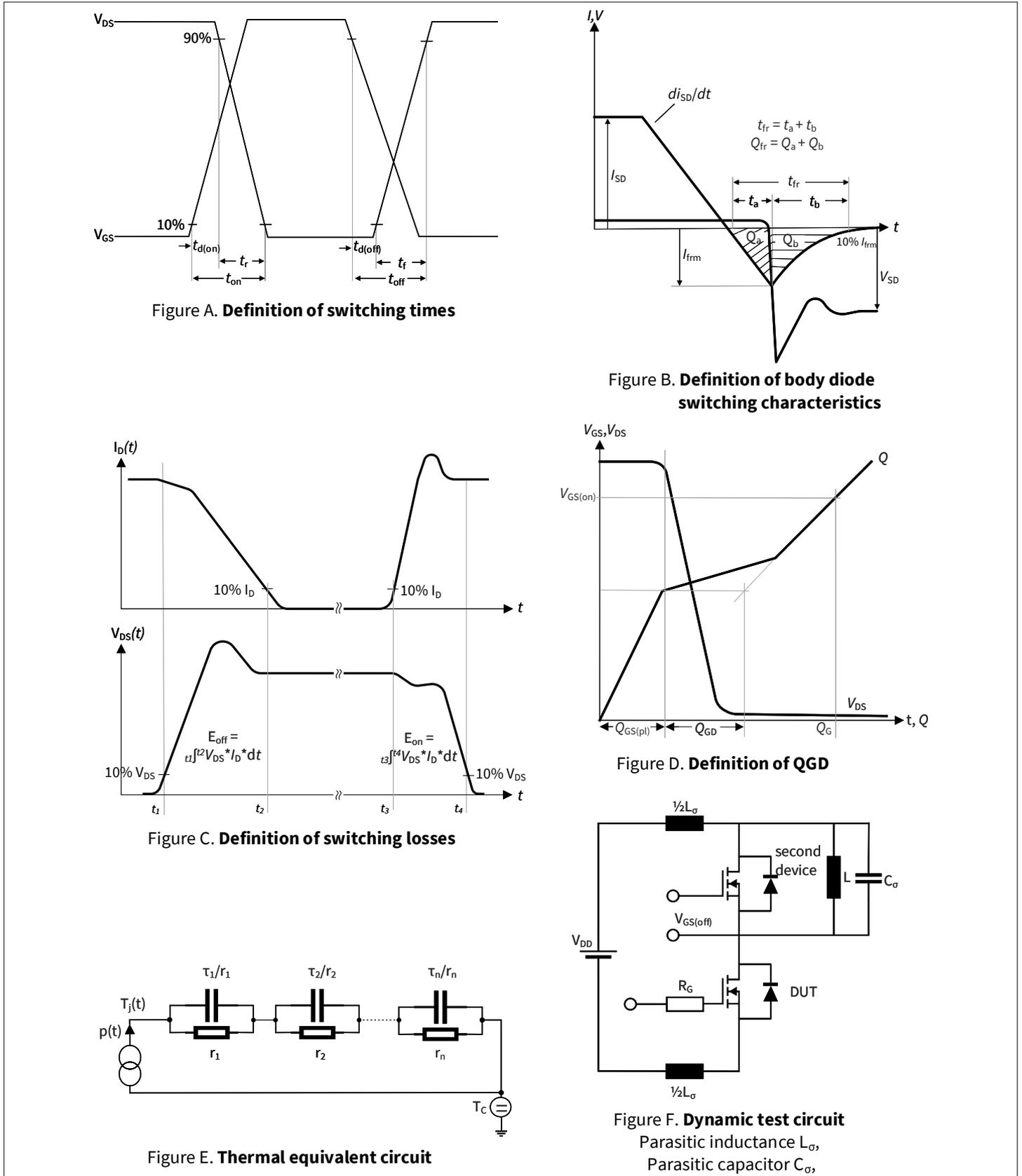


Figure 2

Revision history

| Document revision | Date of release | Description of changes |
|-------------------|-----------------|--|
| 0.10 | 2022-11-15 | Preliminary datasheet |
| 1.00 | 2023-04-25 | Final datasheet |
| 1.10 | 2024-04-02 | <p>Updated table values: R_{dson}, V_{gsth}, I_{dss}, g_{fs}, t_{don}, t_r, t_{doff}, t_f, E_{on}, E_{off}, E_{tot}, Q_{fr}, I_{frm}</p> <p>Updated graphs: $I_{DS} = f(V_{GS})$, $V_{GS(th)} = f(T_{vj})$, $I_{DS} = f(V_{DS})$, $R_{DS(on)} = f(T_{vj})$, $I_{SD} = f(V_{SD})$, $E = f(T_{vj})$, $E = f(RG, ext)$, $t = f(RG, ext)$, $I_{frm} = f(-diSD/dt)$</p> <p>Added new graphs: $E = f(I_D)$, $E_{oss} = f(V_{DS})$</p> <p>No change to the product, new values based on additional characterization</p> |
| 1.20 | 2024-11-12 | <p>Updated features: “Minimal creepage distance 5.85mm (material group II) to fit 800V applications without coating” changed to “Creepage distance of 5.8mm (material group II) to fit 800V applications”</p> <p>Updated package from PG-TO263-7-HV-ND5.8 to PG-TO263-7-U01</p> |

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