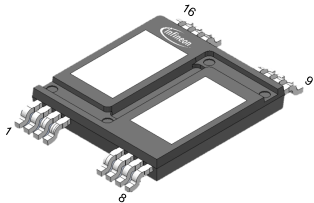


Final datasheet
CoolSiC™ 1200 V SiC MOSFET G2 : Silicon Carbide MOSFET with top side cooling and .XT technology

Features

- $V_{DS} = 1200\text{ V}$ at $T_{vj} = 25^{\circ}\text{C}$
- $I_{DC} = 40\text{ A}$ at $T_C = 100^{\circ}\text{C}$
- $R_{DS(on)} = 40\text{ m}\Omega$ at $V_{GS} = 18\text{ V}$, $T_{vj} = 25^{\circ}\text{C}$
- Internal layout optimized for fast switching
- Very low switching losses
- Overload operation up to $T_{vj} = 200^{\circ}\text{C}$
- Short circuit withstand time $2\text{ }\mu\text{s}$
- Benchmark gate threshold voltage, $V_{GS(th)} = 4.2\text{ V}$
- Robust against parasitic turn on, 0 V turn-off gate voltage can be applied
- Robust body diode for hard commutation
- .XT interconnection technology for best-in-class thermal performance
- Suitable Infineon gate drivers can be found under <https://www.infineon.com/gdfinder>



- Halogen-free
- Green
- Lead-free
- RoHS

Potential applications

- General purpose drives (GPD)
- EV Charging
- Online UPS / Industrial UPS
- String inverter
- Servo drives

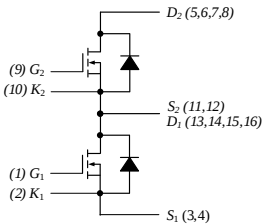
Product validation

- Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

Description

- 13-16 (5-8) – case 1(2) and drain D1(D2)
- 3,4 (11,12) – source S1(S2)
- 2(10) – kelvin sense K1(K2)
- 1(9)– gate G1(G2)

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



Type	Package	Marking
IMSQ120R040M2HH	PG-HDSOP-16-U03	12M2H040



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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}	reflow soldering (MSL2 according to JEDEC J-STD-020)			260	°C
Thermal resistance, junction-ambient	$R_{th(j-a)}$				62	K/W
MOSFET/body diode thermal resistance, junction-case	$R_{th(j-c)}$			0.4	0.52	K/W

2 MOSFET

Table 2 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}	$T_{vj} \geq 25\text{ °C}$		1200	V
Continuous DC drain current for $R_{th(j-c,max)}$, limited by $T_{vj(max)}$	I_{DDC}	$V_{GS}=18\text{ V}$	$T_c = 25\text{ °C}$	57	A
			$T_c = 100\text{ °C}$	40	
Peak drain current, t_p limited by $T_{vj(max)}$ ¹⁾	I_{DM}	$V_{GS}=18\text{ V}$		120	A
Gate-source voltage, max. transient voltage ²⁾	V_{GS}	$t_p \leq 0.5\text{ }\mu\text{s}$, $D < 0.01$		-10...25	V
Gate-source voltage, max. static voltage	V_{GS}			-7...23	V
Avalanche energy, single pulse	E_{AS}	$I_D = 18\text{ A}$, $V_{DD} = 50\text{ V}$, $L = 1.4\text{ mH}$, $T_{vj(start)} = 25\text{ °C}$		220	mJ
Avalanche energy, repetitive	E_{AR}	$I_D = 18\text{ A}$, $V_{DD} = 50\text{ V}$, $L = 7.2\text{ }\mu\text{H}$, $T_{vj(start)} = 25\text{ °C}$		1.1	mJ
Short-circuit withstand time	t_{SC}	$V_{DD} \leq 800\text{ V}$, $V_{DS,peak} < 1200\text{ V}$, $V_{GS(on)} = 15\text{ V}$, $T_{vj(start)} = 25\text{ °C}$		2	μs
Power dissipation, limited by $T_{vj(max)}$	P_{tot}		$T_c = 25\text{ °C}$	290	W
			$T_c = 100\text{ °C}$	140	

1) verified by design.

2) The maximum gate-source voltage in the application design should be in accordance to IPC-9592B.

Table 3 Recommended values

Parameter	Symbol	Note or test condition	Values	Unit
Recommended turn-on gate voltage	$V_{GS(on)}$		15...18	V
Recommended turn-off gate voltage	$V_{GS(off)}$		-5...0	V

Table 4 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Drain-source on-state resistance	$R_{DS(on)}$	$I_D = 18\text{ A}$		$T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 18\text{ V}$	40	mΩ
				$T_{vj} = 150\text{ °C}$, $V_{GS(on)} = 18\text{ V}$	81	
				$T_{vj} = 175\text{ °C}$, $V_{GS(on)} = 18\text{ V}$	94	
				$T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 15\text{ V}$	49.4	
Gate-source threshold voltage	$V_{GS(th)}$	$I_D = 5.5\text{ mA}$, $V_{DS} = V_{GS}$ (tested after 1 ms pulse at $V_{GS} = 20\text{ V}$)		$T_{vj} = 25\text{ °C}$	3.5	V
				$T_{vj} = 175\text{ °C}$	4.2	
Zero gate-voltage drain current	I_{DSS}	$V_{DS} = 1200\text{ V}$, $V_{GS} = 0\text{ V}$		$T_{vj} = 25\text{ °C}$		μA
				$T_{vj} = 175\text{ °C}$	150	
Gate leakage current	I_{GSS}	$V_{DS} = 0\text{ V}$		$V_{GS} = 23\text{ V}$		nA
				$V_{GS} = -10\text{ V}$	120	
Forward transconductance	g_{fs}	$I_D = 18\text{ A}$, $V_{DS} = 20\text{ V}$			12	S
Internal gate resistance	$R_{G,int}$	$f = 1\text{ MHz}$, $V_{AC} = 25\text{ mV}$			6.5	Ω
Input capacitance	C_{iss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$			1310	pF
Output capacitance	C_{oss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$			55	pF
Reverse transfer capacitance	C_{rss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$			5	pF
C_{oss} stored energy	E_{oss}	$V_{DS} = 0...800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$, Calculated based on C_{oss}			23	μJ
Output charge	Q_{oss}	$V_{DS} = 0...800\text{ V}$, $V_{GS} = 0\text{ V}$, Calculated based on C_{oss}			85.2	nC
Effective output capacitance, energy related	$C_{o(er)}$	$V_{DS} = 0...800\text{ V}$, $V_{GS} = 0\text{ V}$			72	pF
Effective output capacitance, time related	$C_{o(tr)}$	$I_D = \text{constant}$, $V_{DS} = 0...800\text{ V}$, $V_{GS} = 0\text{ V}$			106	pF

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_G	$V_{DD} = 800 \text{ V}$, $I_D = 18 \text{ A}$, $V_{GS} = 0 \text{ V}$, turn-on pulse		36		nC
Plateau gate charge	$Q_{GS(pl)}$	$V_{DD} = 800 \text{ V}$, $I_D = 18 \text{ A}$, $V_{GS} = 0 \text{ V}$, turn-on pulse		8.2		nC
Gate-to-drain charge	Q_{GD}	$V_{DD} = 800 \text{ V}$, $I_D = 18 \text{ A}$, $V_{GS} = 0 \text{ V}$, turn-on pulse		8.8		nC
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 800 \text{ V}$, $I_D = 18 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 9 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	8		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	5.9		
Rise time	t_r	$V_{DD} = 800 \text{ V}$, $I_D = 18 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 9 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	5		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	4.4		
Turn-off delay time	$t_{d(off)}$	$V_{DD} = 800 \text{ V}$, $I_D = 18 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 9 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	15.7		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	18.3		
Fall time	t_f	$V_{DD} = 800 \text{ V}$, $I_D = 18 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 9 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	6.6		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	7.8		
Turn-on energy	E_{on}	$V_{DD} = 800 \text{ V}$, $I_D = 18 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 9 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	140		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$	270		
Turn-off energy	E_{off}	$V_{DD} = 800 \text{ V}$, $I_D = 18 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 9 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	45		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$	61		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total switching energy ¹⁾	E_{tot}	$V_{\text{DD}} = 800 \text{ V}$, $I_{\text{D}} = 18 \text{ A}$, $V_{\text{GS}} = 0/18 \text{ V}$, $R_{\text{GS(on)}} = 2.3 \Omega$, $R_{\text{GS(off)}} = 2.3 \Omega$, $L_{\sigma} = 9 \text{ nH}$, diode: body diode at $V_{\text{GS}} = 0 \text{ V}$	$T_{\text{vj}} = 25 \text{ }^{\circ}\text{C}$	231		μJ
			$T_{\text{vj}} = 175 \text{ }^{\circ}\text{C}$	462		
Virtual junction temperature	$T_{\text{vj(min ... max)}}$		-55		175	$^{\circ}\text{C}$
Virtual junction temperature	$T_{\text{vj(over)}}$	overload, cumulative max. 100 h ²⁾			200	$^{\circ}\text{C}$

1) including E_{fr}

2) up to 5000 cycles. Maximum ΔT limited to 100 K.

Note: The chip technology was characterized up to 200 kV/ μs . The measured dV/dt was limited by measurement test setup and package.

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

3 Body diode (MOSFET)

Table 5 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Drain-source voltage	V_{DSS}	$T_{\text{vj}} \geq 25 \text{ }^{\circ}\text{C}$	1200	V
Peak reverse drain current, t_{p} limited by $T_{\text{vj(max)}}$	I_{SM}	$V_{\text{GS}} = 0 \text{ V}$	120	A

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Drain-source reverse voltage	V_{SD}	$I_{\text{SD}} = 18 \text{ A}$, $V_{\text{GS}} = 0 \text{ V}$	$T_{\text{vj}} = 25 \text{ }^{\circ}\text{C}$	4.2	5.5	V
			$T_{\text{vj}} = 100 \text{ }^{\circ}\text{C}$	4.11		
			$T_{\text{vj}} = 175 \text{ }^{\circ}\text{C}$	4.05		
MOSFET forward recovery charge	Q_{fr}	$V_{\text{DD}} = 800 \text{ V}$, $I_{\text{SD}} = 18 \text{ A}$, $V_{\text{GS}} = 0 \text{ V}$, $R_{\text{GS(on)}} = 2.3 \Omega$, Q_{fr} includes also Q_{C}	$T_{\text{vj}} = 25 \text{ }^{\circ}\text{C}$	120		nC
			$T_{\text{vj}} = 175 \text{ }^{\circ}\text{C}$	480		
MOSFET peak forward recovery current	I_{frm}	$V_{\text{DD}} = 800 \text{ V}$, $I_{\text{SD}} = 18 \text{ A}$, $V_{\text{GS}} = 0 \text{ V}$, $R_{\text{GS(on)}} = 2.3 \Omega$, Q_{fr} includes also Q_{C}	$T_{\text{vj}} = 25 \text{ }^{\circ}\text{C}$	18.9		A
			$T_{\text{vj}} = 175 \text{ }^{\circ}\text{C}$	33.4		

(table continues...)

3 Body diode (MOSFET)

Table 6 (continued) **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
MOSFET forward recovery energy	E_{fr}	$V_{DD} = 800 \text{ V}$, $I_{SD} = 18 \text{ A}$, $V_{GS} = 0 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, Q_{fr} includes also Q_C	$T_{vj} = 25 \text{ °C}$		46		μJ
			$T_{vj} = 175 \text{ °C}$		131		
Virtual junction temperature	$T_{vj(\text{min ... max})}$			-55		175	$^{\circ}\text{C}$
Virtual junction temperature	$T_{vj(\text{over})}$	overload, cumulative max. 100 h ¹⁾				200	$^{\circ}\text{C}$

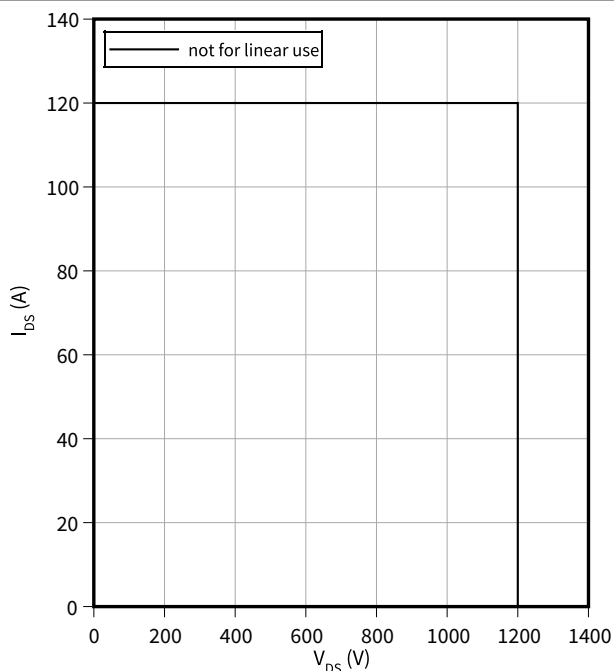
1) up to 5000 cycles. Maximum ΔT limited to 100 K.

4 Characteristics diagrams

Reverse bias safe operating area (RBSOA)

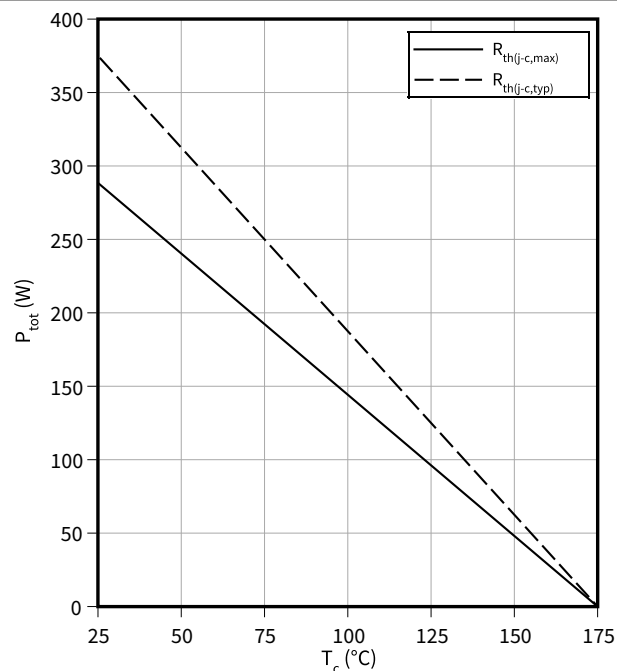
$$I_{DS} = f(V_{DS})$$

$$V_{GS} = 0/18 \text{ V}, T_c = 25 \text{ °C}, T_{vj} \leq 200 \text{ °C}$$



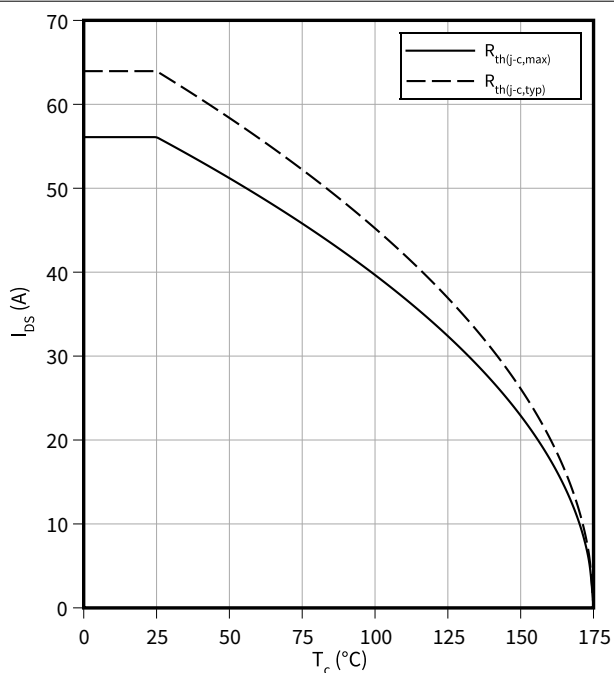
Power dissipation as a function of case temperature

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



Maximum DC drain to source current as a function of case temperature limited by bond wire

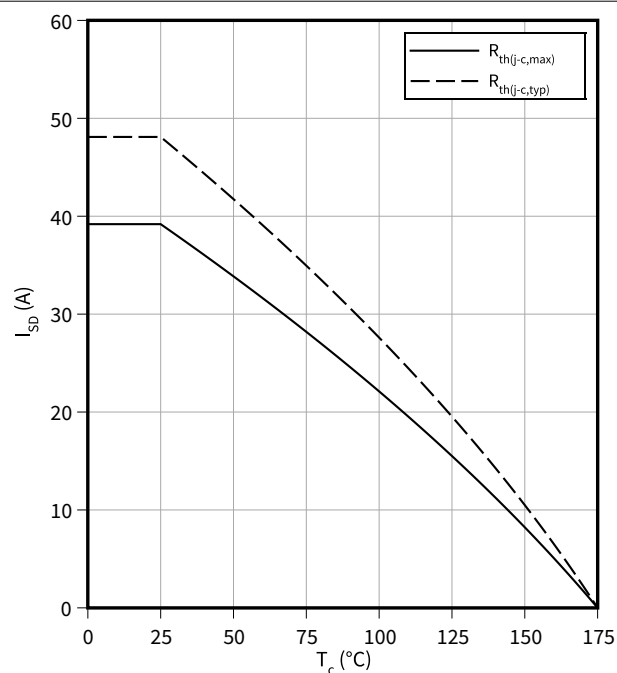
$$I_{DS} = f(T_c)$$



Maximum source to drain current as a function of case temperature limited by bond wire

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

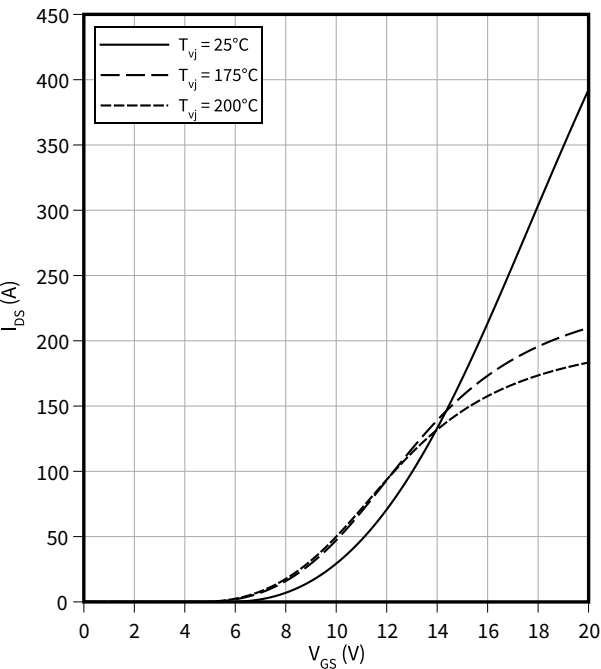
$$V_{GS} = 0 \text{ V}$$



4 Characteristics diagrams

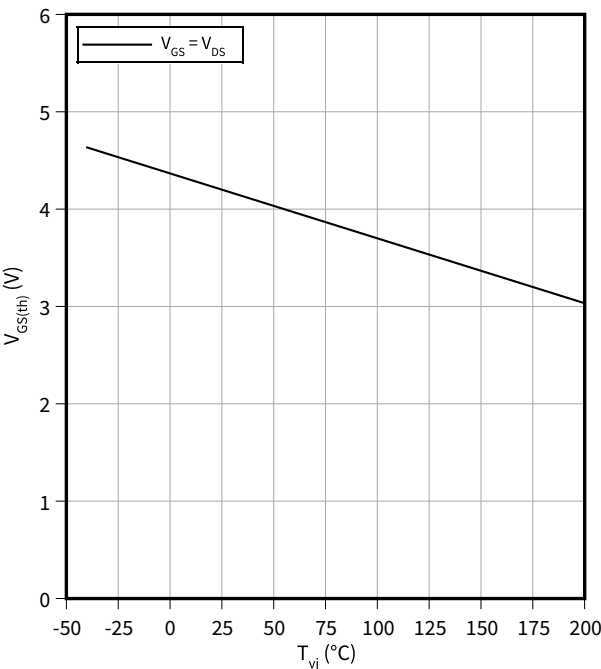
Typical transfer characteristic

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



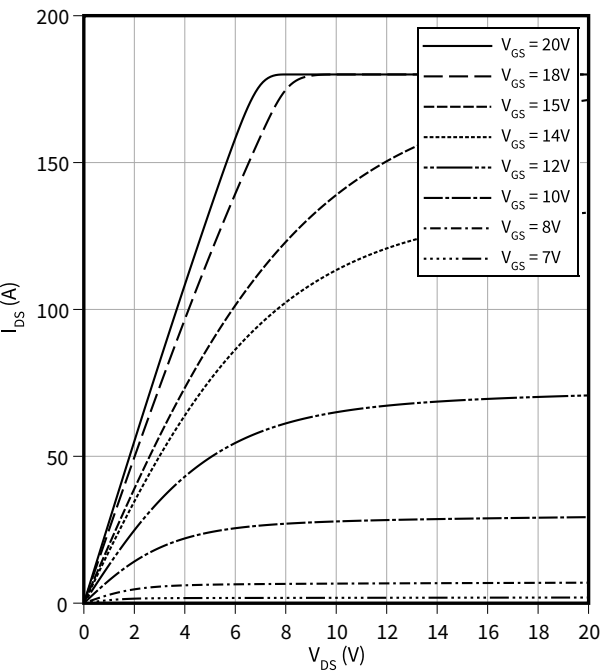
Typical gate-source threshold voltage as a function of junction temperature

$V_{GS(th)} = f(T_{vj})$
 $I_D = 5.5\text{ mA}$



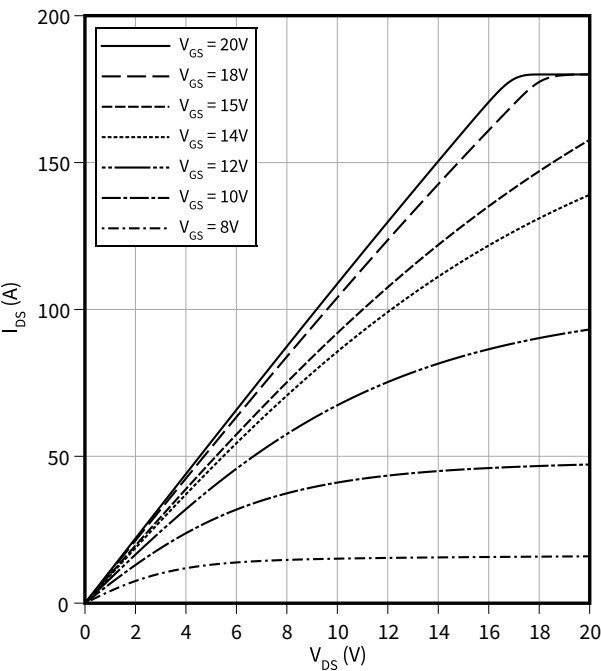
Typical output characteristic, V_{GS} as parameter

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



Typical output characteristic, V_{GS} as parameter

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

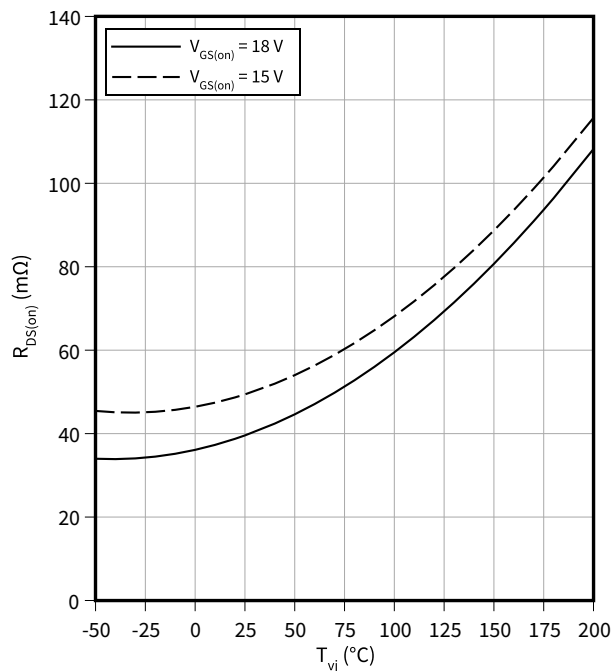


4 Characteristics diagrams

Typical on-state resistance as a function of junction temperature

$$R_{DS(on)} = f(T_{vj})$$

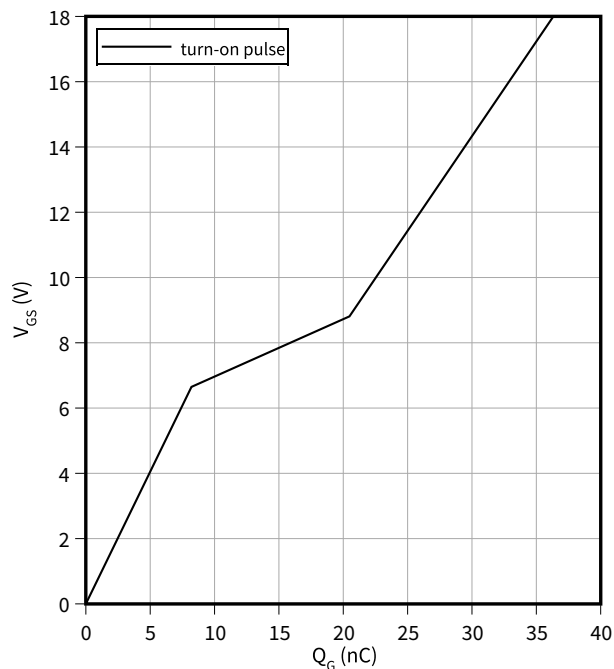
$$I_D = 18 \text{ A}$$



Typical gate charge

$$V_{GS} = f(Q_G)$$

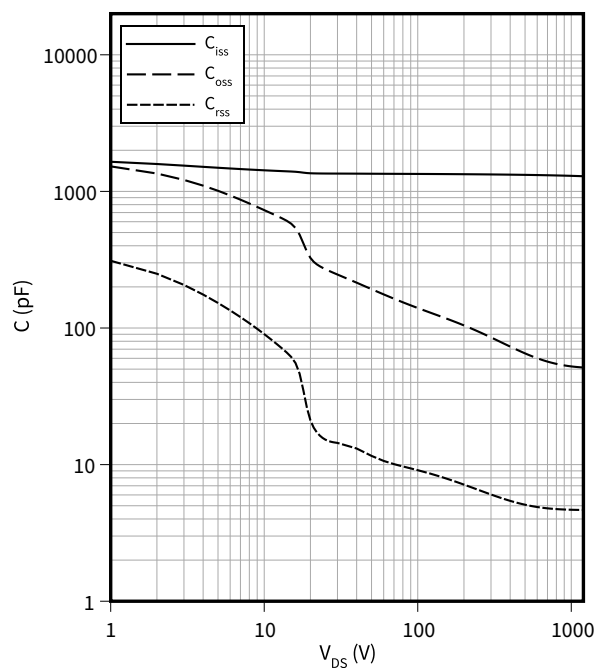
$$I_D = 18 \text{ A}, V_{DS} = 800 \text{ V}$$



Typical capacitance as a function of drain-source voltage

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

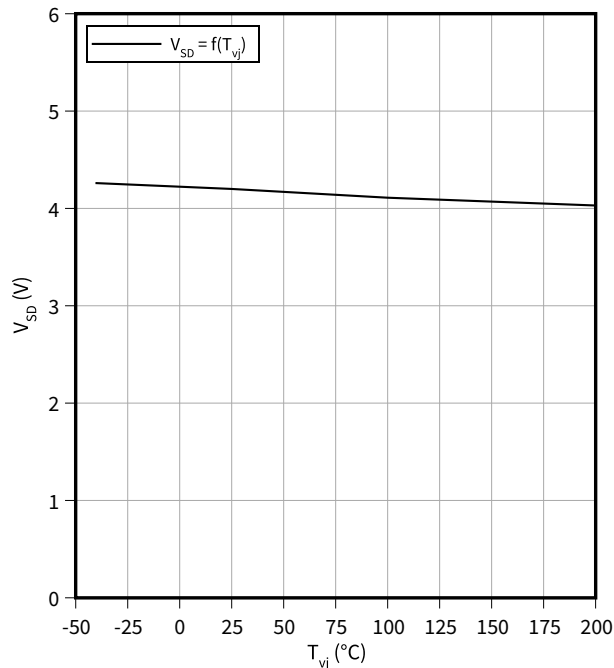
$$f = 100 \text{ kHz}, V_{GS} = 0 \text{ V}$$



Typical reverse drain voltage as function of junction temperature

$$V_{SD} = f(T_{vj})$$

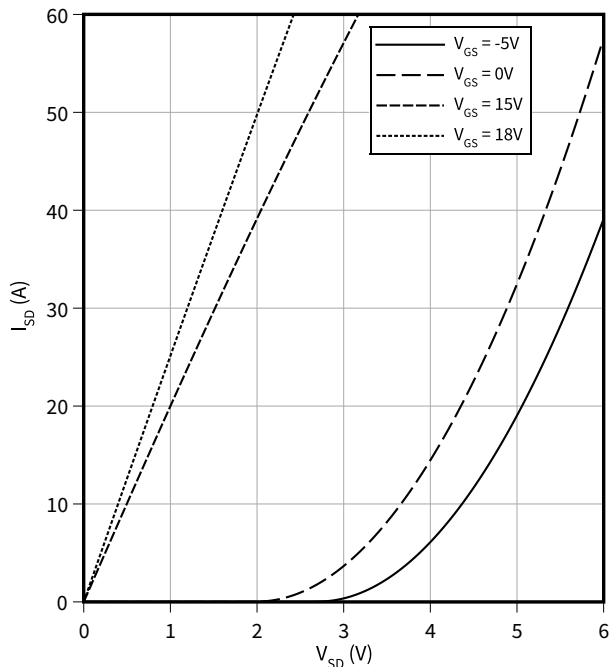
$$I_{SD} = 18 \text{ A}, V_{GS} = 0 \text{ V}$$



4 Characteristics diagrams

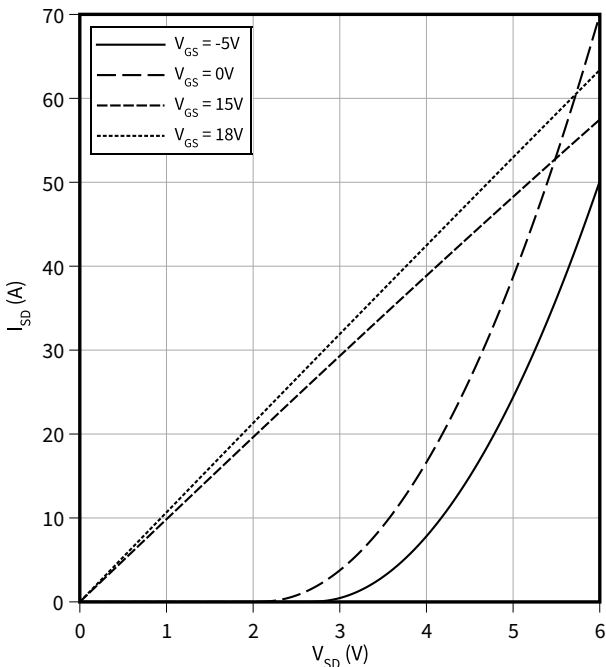
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

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



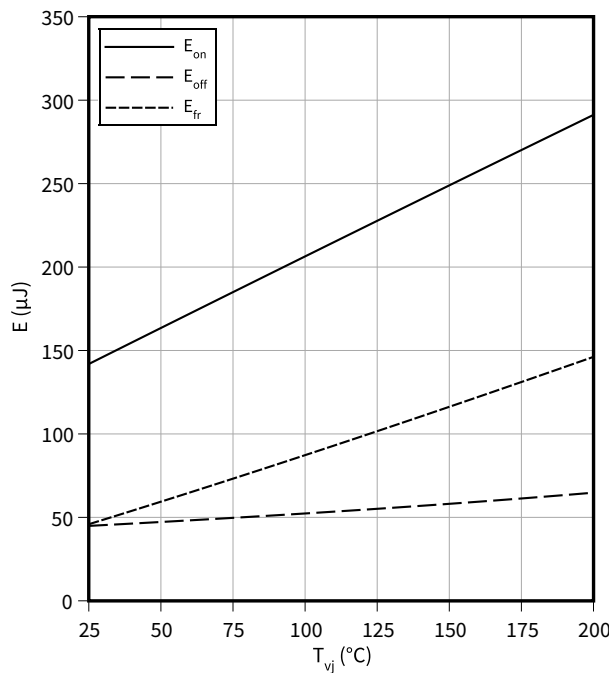
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

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



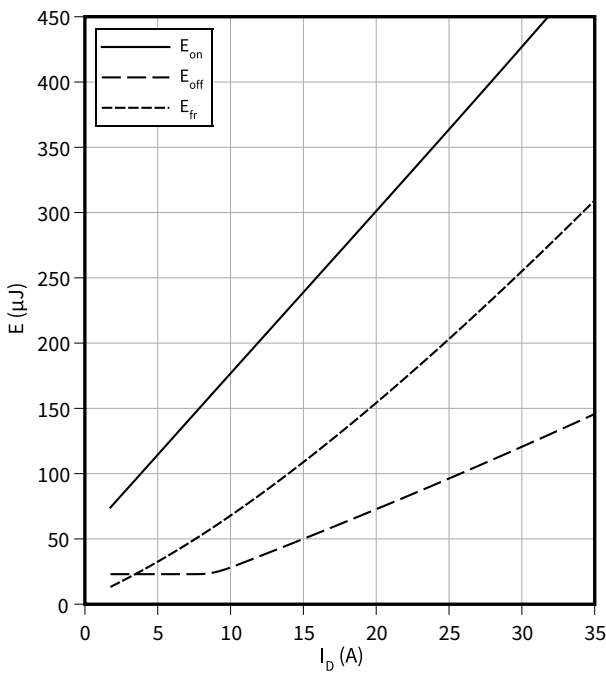
Typical switching energy as a function of junction temperature, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0\text{ V}$

$E = f(T_{vj})$
 $V_{GS} = 0/18\text{ V}$, $I_D = 18\text{ A}$, $R_{G,ext} = 2.3\text{ }\Omega$, $V_{DD} = 800\text{ V}$



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

$E = f(I_D)$
 $V_{GS} = 0/18\text{ V}$, $T_{vj} = 175\text{ }^{\circ}\text{C}$, $R_{G,ext} = 2.3\text{ }\Omega$, $V_{DD} = 800\text{ V}$

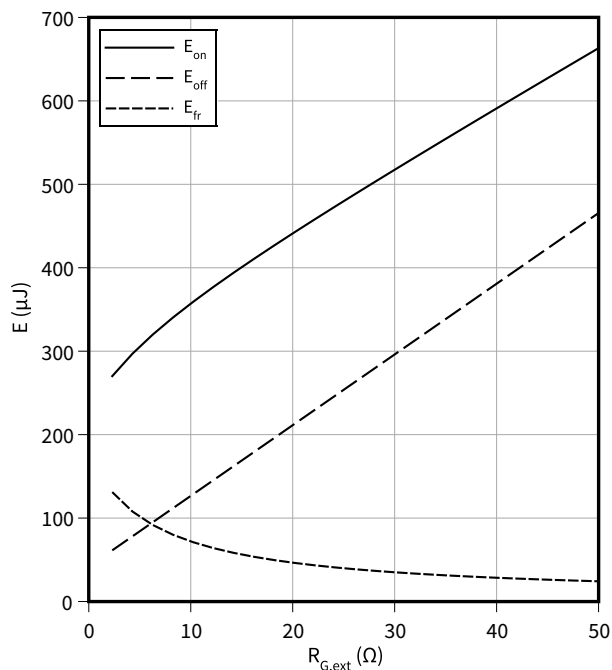


4 Characteristics diagrams

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

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

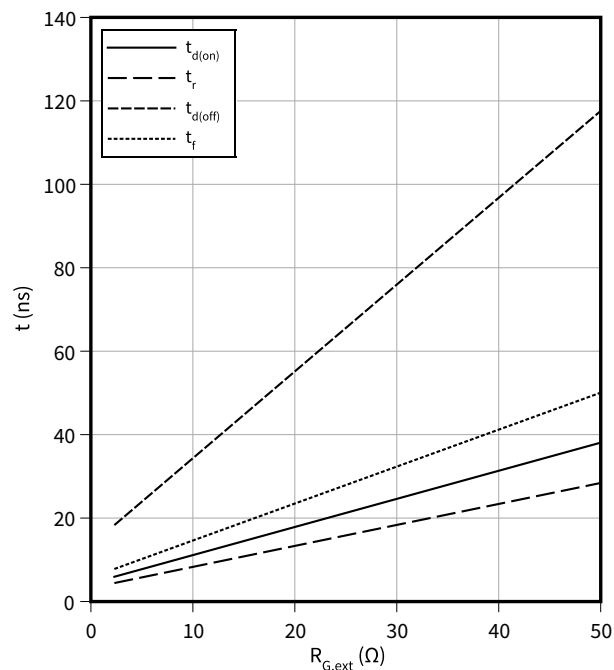
$V_{GS} = 0/18$ V, $I_D = 18$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V



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

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

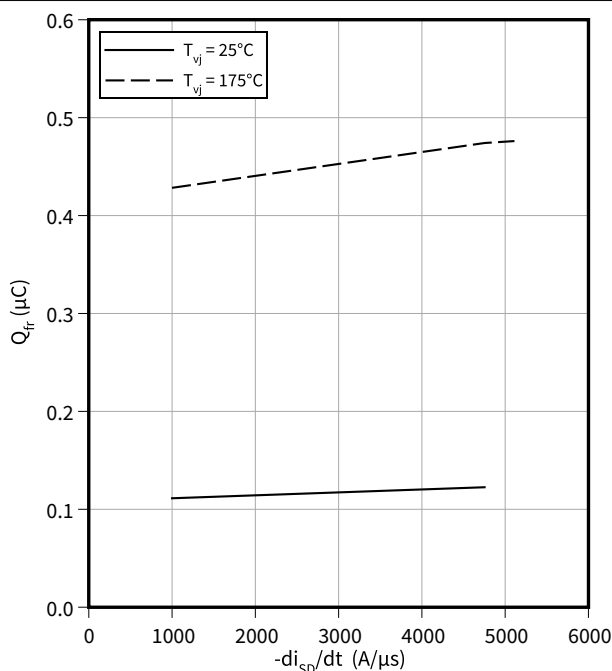
$V_{GS} = 0/18$ V, $I_D = 18$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V



Typical reverse recovery charge as a function of reverse drain current slope, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0$ V

$$Q_{fr} = f(-di_{SD}/dt)$$

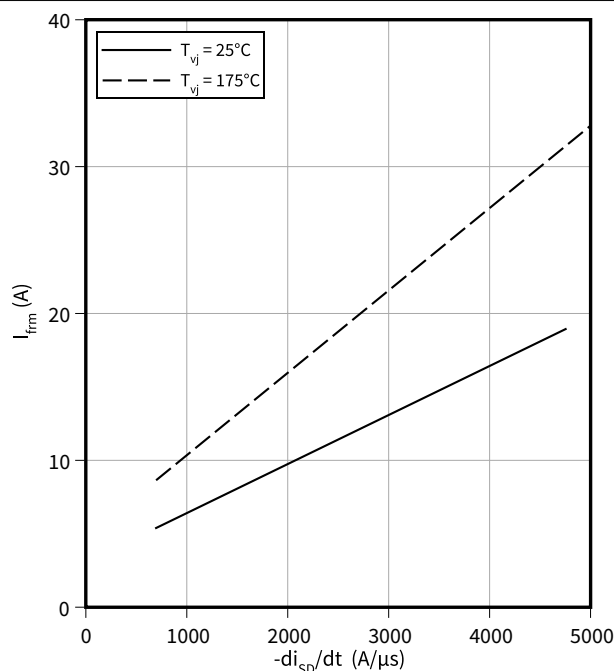
$V_{GS} = 0/18$ V, $I_{SD} = 18$ A, $V_{DD} = 800$ V



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

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

$V_{GS} = 0/18$ V, $I_{SD} = 18$ A, $V_{DD} = 800$ V



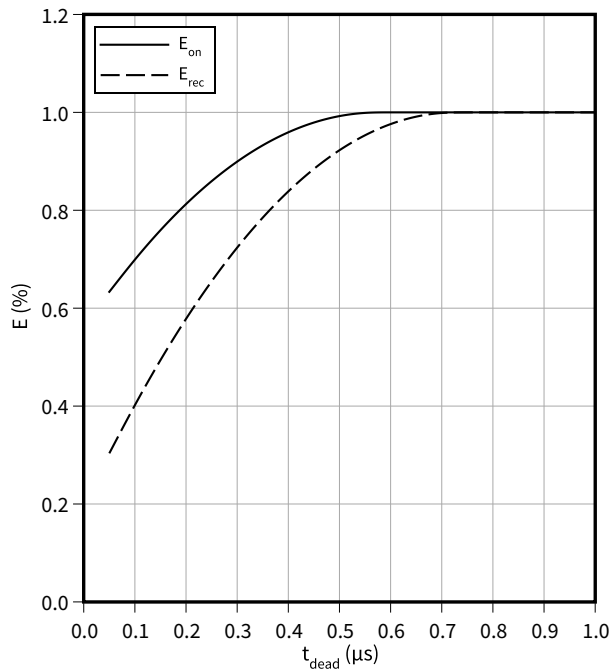
4 Characteristics diagrams

Typical switching energy as a function of dead time / blanking time, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = -5\text{ V}$

$$E = f(t_{dead})$$

$V_{GS} = 0/18\text{ V}$, $I_D = 18\text{ A}$, $T_{vj} = 175\text{ °C}$, $R_{G,ext} = 2.3\text{ }\Omega$

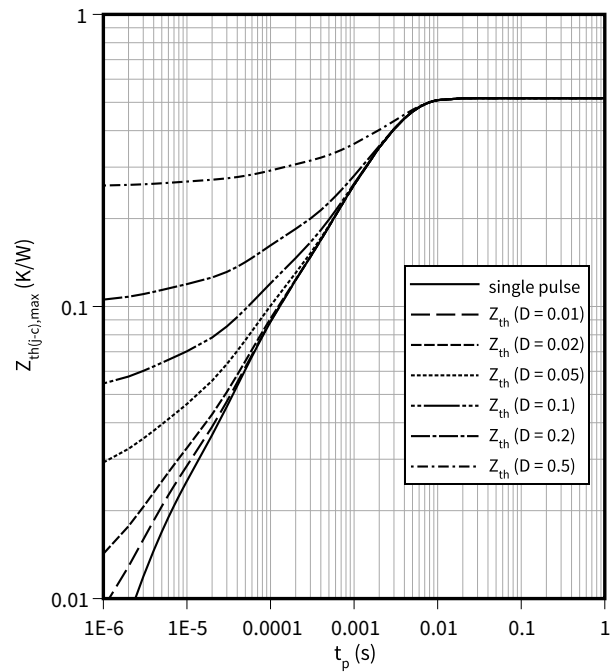
$V_{DD} = 800\text{ V}$



Max. transient thermal impedance (MOSFET/diode)

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

$$D = t_p/T$$



5 Package outlines

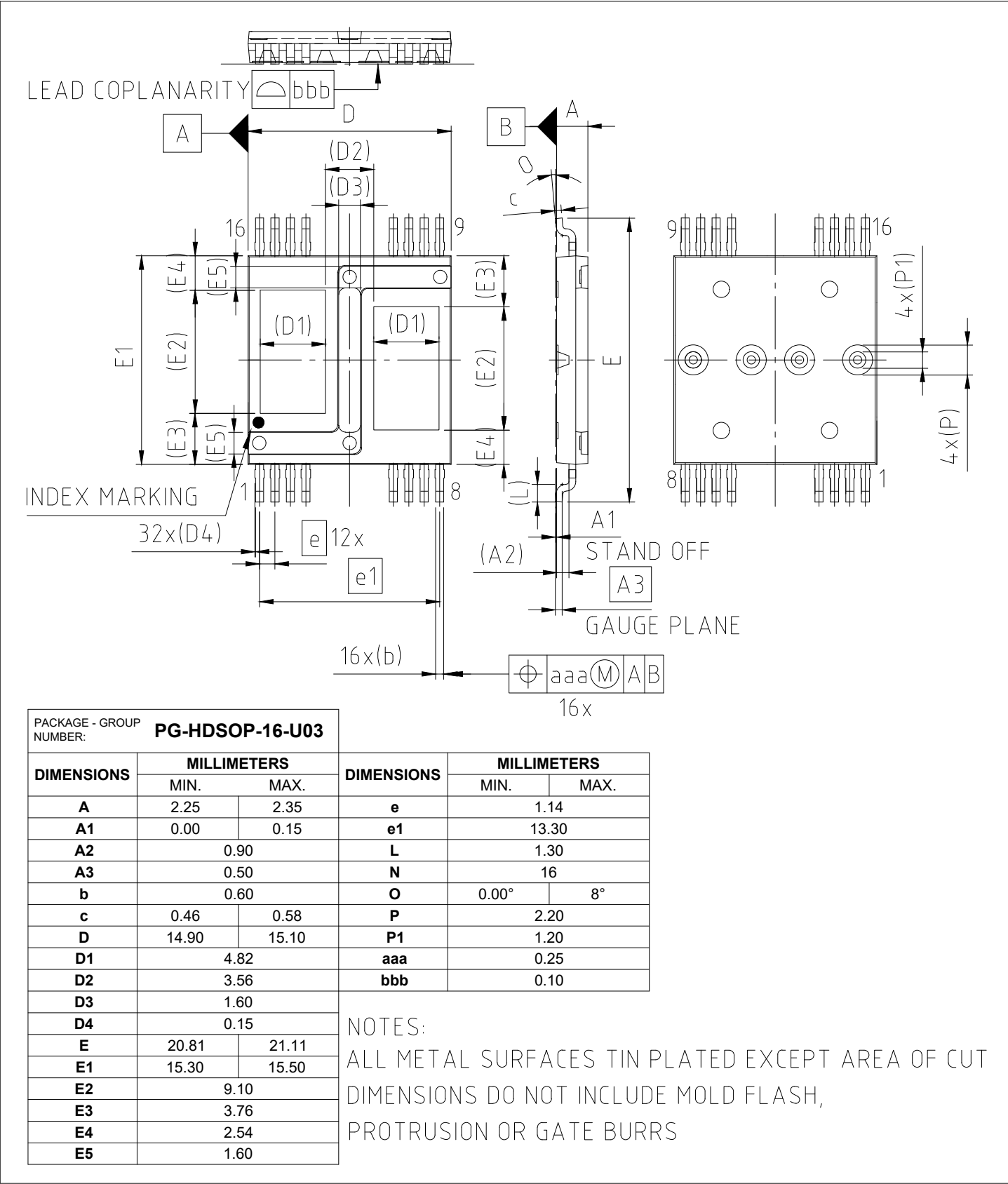


Figure 1

6 Testing conditions

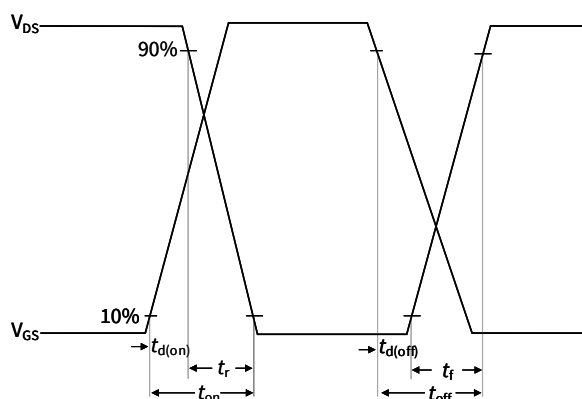


Figure A. Definition of switching times

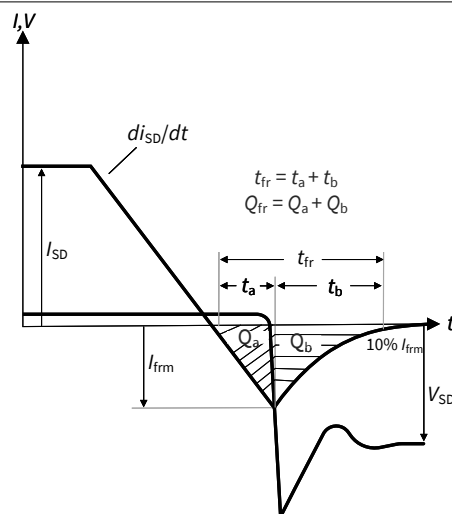


Figure B. Definition of body diode switching characteristics

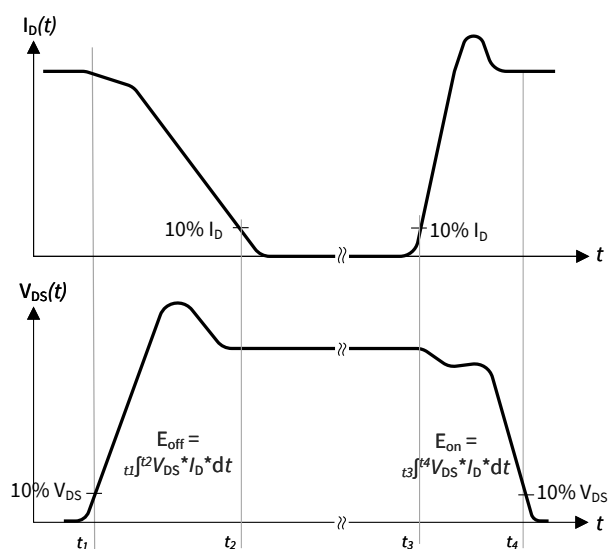


Figure C. Definition of switching losses

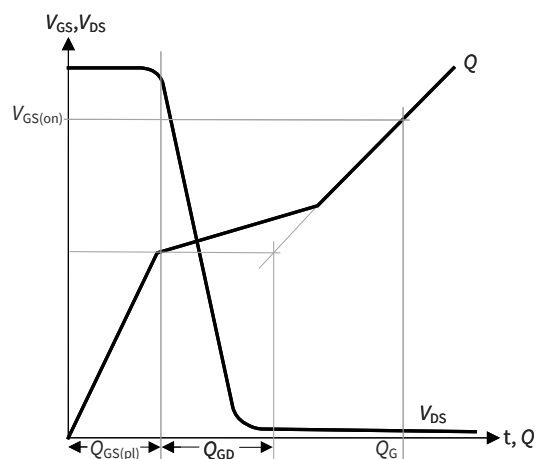


Figure D. Definition of QGD



Figure E. Thermal equivalent circuit

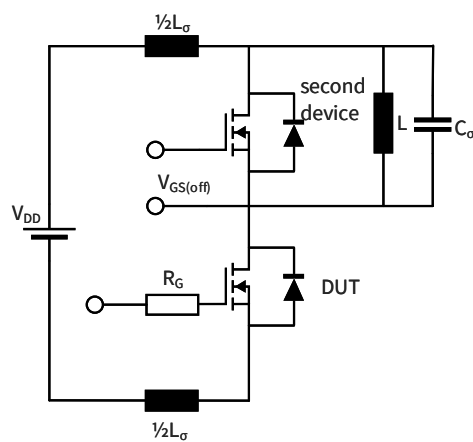


Figure F. Dynamic test circuit

Parasitic inductance L_{σ} ,
Parasitic capacitor C_{σ} ,

Figure 2



Revision history

Revision history

Document revision	Date of release	Description of changes
0.10	2022-10-28	Target datasheet
0.20	2023-11-24	Preliminary datasheet
1.00	2025-02-13	Final datasheet

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