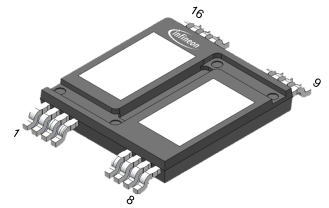


Final datasheet

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

Features

- $V_{DSS} = 1200\text{ V}$ at $T_{vj} = 25^\circ\text{C}$
- $I_{DC} = 32\text{ A}$ at $T_C = 100^\circ\text{C}$
- $R_{DS(on)} = 53\text{ m}\Omega$ 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

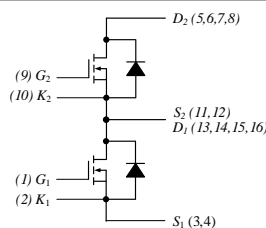
Product validation

- 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
IMSQ120R053M2HH	PG-HDSOP-16-U03	12M2H053

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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	$R_{th(j-c)}$			0.49	0.64	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}	$V_{GS}=18 \text{ V}$	$T_c = 25 \text{ °C}$	45	A
			$T_c = 100 \text{ °C}$	32	
Peak drain current, t_p limited by $T_{vj(max)}$ ¹⁾	I_{DM}	$V_{GS}=18 \text{ V}$	96	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}	$I_D = 13 \text{ A}$, $V_{DD} = 50 \text{ V}$, $L = 1.9 \text{ mH}$, $T_{vj(start)} = 25 \text{ °C}$	166	mJ	
Avalanche energy, repetitive	E_{AR}	$I_D = 13 \text{ A}$, $V_{DD} = 50 \text{ V}$, $L = 9.5 \text{ }\mu\text{H}$, $T_{vj(start)} = 25 \text{ °C}$	0.83	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}		$T_c = 25 \text{ °C}$	234	W
			$T_c = 100 \text{ °C}$	117	

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	$R_{DS(on)}$	$I_D = 13\text{ A}$	$T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 18\text{ V}$		53		mΩ
			$T_{vj} = 150\text{ °C}$, $V_{GS(on)} = 18\text{ V}$		107	142	
			$T_{vj} = 175\text{ °C}$, $V_{GS(on)} = 18\text{ V}$		124		
			$T_{vj} = 25\text{ °C}$, $V_{GS(on)} = 15\text{ V}$		65.6		
Gate-source threshold voltage	$V_{GS(th)}$	$I_D = 4.1\text{ mA}$, $V_{DS} = V_{GS}$ (tested after 1 ms pulse at $V_{GS} = 20\text{ V}$)	$T_{vj} = 25\text{ °C}$	3.5	4.2	5.1	V
			$T_{vj} = 175\text{ °C}$		3.2		
Zero gate-voltage drain current	I_{DSS}	$V_{DS} = 1200\text{ V}$, $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			110	μA
			$T_{vj} = 175\text{ °C}$		1.9		
Gate leakage current	I_{GSS}	$V_{DS} = 0\text{ V}$	$V_{GS} = 23\text{ V}$			120	nA
			$V_{GS} = -10\text{ V}$			-120	
Forward transconductance	g_{fs}	$I_D = 13\text{ A}$, $V_{DS} = 20\text{ V}$		9			S
Internal gate resistance	$R_{G,int}$	$f = 1\text{ MHz}$, $V_{AC} = 25\text{ mV}$		8.5			Ω
Input capacitance	C_{iss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$		1010			pF
Output capacitance	C_{oss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$		41			pF
Reverse transfer capacitance	C_{rss}	$V_{DS} = 800\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$, $V_{AC} = 25\text{ mV}$		4			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}		17			μJ
Output charge	Q_{oss}	$V_{DS} = 0...800\text{ V}$, $V_{GS} = 0\text{ V}$, Calculated based on C_{oss}		64.2			nC
Effective output capacitance, energy related	$C_{o(er)}$	$V_{DS} = 0...800\text{ V}$, $V_{GS} = 0\text{ V}$		53			pF
Effective output capacitance, time related	$C_{o(tr)}$	$I_D = \text{constant}$, $V_{DS} = 0...800\text{ V}$, $V_{GS} = 0\text{ V}$		80			pF

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_G	$V_{DD} = 800\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 0\text{ V}$, turn-on pulse		28		nC
Plateau gate charge	$Q_{GS(pl)}$	$V_{DD} = 800\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 0\text{ V}$, turn-on pulse		6.5		nC
Gate-to-drain charge	Q_{GD}	$V_{DD} = 800\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 0\text{ V}$, turn-on pulse		6.9		nC
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 800\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2.3\ \Omega$, $R_{GS(off)} = 2.3\ \Omega$, $L_\sigma = 9\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	7		ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		5.6	
Rise time	t_r	$V_{DD} = 800\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2.3\ \Omega$, $R_{GS(off)} = 2.3\ \Omega$, $L_\sigma = 9\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	4.6		ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		4.1	
Turn-off delay time	$t_{d(off)}$	$V_{DD} = 800\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2.3\ \Omega$, $R_{GS(off)} = 2.3\ \Omega$, $L_\sigma = 9\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	14.8		ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		17.3	
Fall time	t_f	$V_{DD} = 800\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2.3\ \Omega$, $R_{GS(off)} = 2.3\ \Omega$, $L_\sigma = 9\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	6.2		ns
			$T_{vj} = 175\text{ }^\circ\text{C}$		7.3	
Turn-on energy	E_{on}	$V_{DD} = 800\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2.3\ \Omega$, $R_{GS(off)} = 2.3\ \Omega$, $L_\sigma = 9\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	101		μJ
			$T_{vj} = 175\text{ }^\circ\text{C}$		192	
Turn-off energy	E_{off}	$V_{DD} = 800\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2.3\ \Omega$, $R_{GS(off)} = 2.3\ \Omega$, $L_\sigma = 9\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	36		μJ
			$T_{vj} = 175\text{ }^\circ\text{C}$		48	

(table continues...)

3 Body diode (MOSFET)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total switching energy ¹⁾	E_{tot}	$V_{DD} = 800\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 0/18\text{ V}$, $R_{GS(on)} = 2.3\ \Omega$, $R_{GS(off)} = 2.3\ \Omega$, $L_\sigma = 9\text{ nH}$, diode: body diode at $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		176	μJ
			$T_{vj} = 175\text{ }^\circ\text{C}$		352	
Virtual junction temperature	$T_{vj(min \dots max)}$		-55		175	$^\circ\text{C}$
Virtual junction temperature	$T_{vj(over)}$	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 $T_{vj} = 25\text{ }^\circ\text{C}$, 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}	$T_{vj} \geq 25\text{ }^\circ\text{C}$	1200	V
Peak reverse drain current, t_p limited by $T_{vj(max)}$	I_{SM}	$V_{GS} = 0\text{ V}$	96	A

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Drain-source reverse voltage	V_{SD}	$I_{SD} = 13\text{ A}$, $V_{GS} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		4.2	V
			$T_{vj} = 100\text{ }^\circ\text{C}$		4.11	
			$T_{vj} = 175\text{ }^\circ\text{C}$		4.05	
MOSFET forward recovery charge	Q_{fr}	$V_{DD} = 800\text{ V}$, $I_{SD} = 13\text{ A}$, $V_{GS} = 0\text{ V}$, $R_{GS(on)} = 2.3\ \Omega$, Q_f includes also Q_C	$T_{vj} = 25\text{ }^\circ\text{C}$		110	nC
			$T_{vj} = 175\text{ }^\circ\text{C}$		400	
MOSFET peak forward recovery current	I_{frm}	$V_{DD} = 800\text{ V}$, $I_{SD} = 13\text{ A}$, $V_{GS} = 0\text{ V}$, $R_{GS(on)} = 2.3\ \Omega$, Q_f includes also Q_C	$T_{vj} = 25\text{ }^\circ\text{C}$		15.9	A
			$T_{vj} = 175\text{ }^\circ\text{C}$		28.5	

(table continues...)

Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
MOSFET forward recovery energy	E_{fr}	$V_{DD} = 800 \text{ V}, I_{SD} = 13 \text{ A}, V_{GS} = 0 \text{ V}, R_{GS(on)} = 2.3 \Omega, Q_f$ includes also Q_C	$T_{vj} = 25 \text{ }^\circ\text{C}$	39		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$	112		
Virtual junction temperature	$T_{vj(\text{min} \dots \text{max})}$		-55		175	$^\circ\text{C}$
Virtual junction temperature	$T_{vj(\text{over})}$	overload, cumulative max. 100 h ¹⁾			200	$^\circ\text{C}$

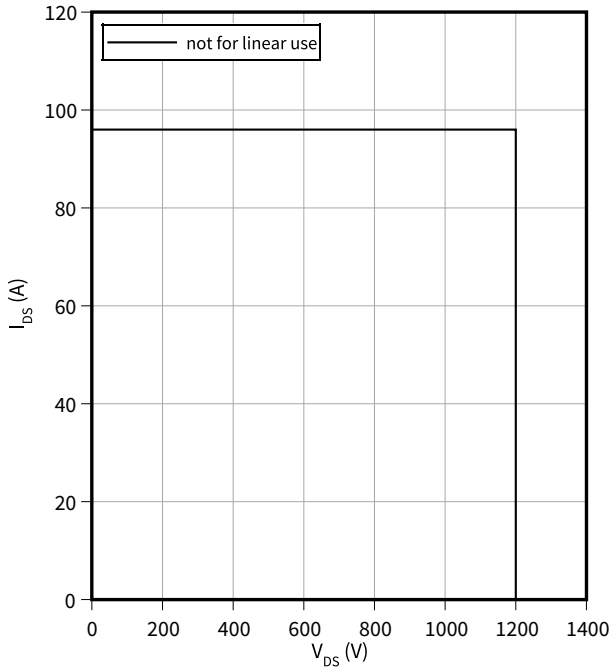
1) up to 5000 cycles. Maximum ΔT limited to 100 K.

4 Characteristics diagrams

Reverse bias safe operating area (RBSOA)

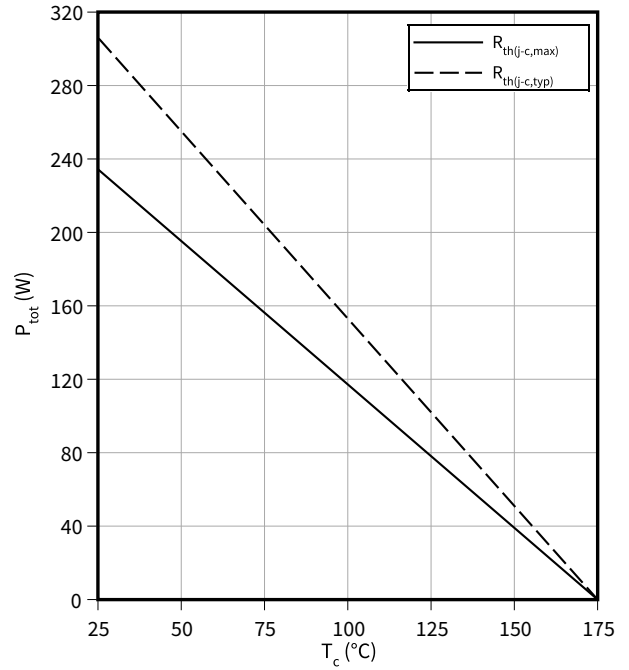
$$I_{DS} = f(V_{DS})$$

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



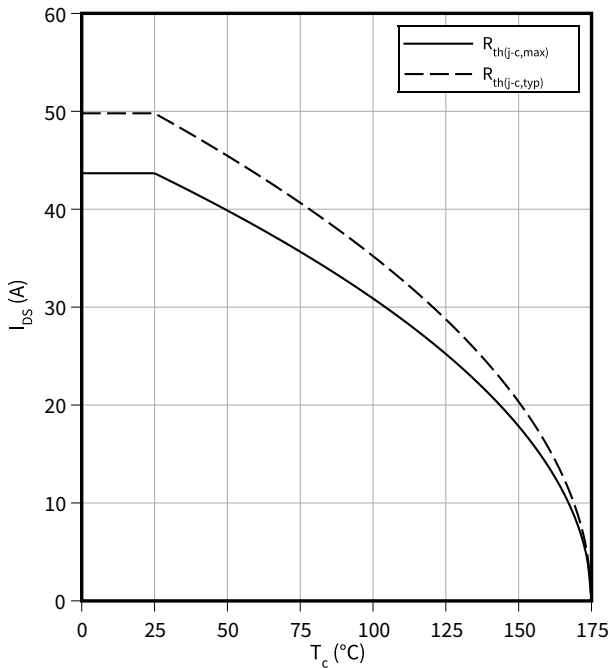
Power dissipation as a function of case temperature

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



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

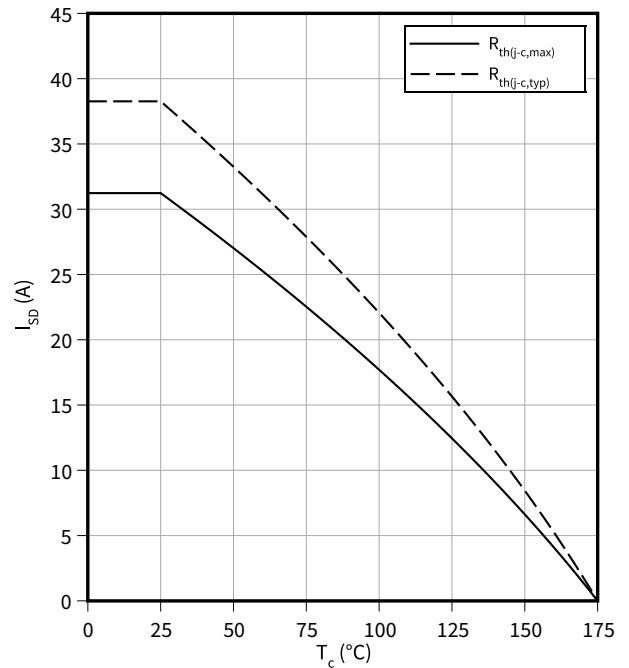
$$I_{DS} = f(T_c)$$



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

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

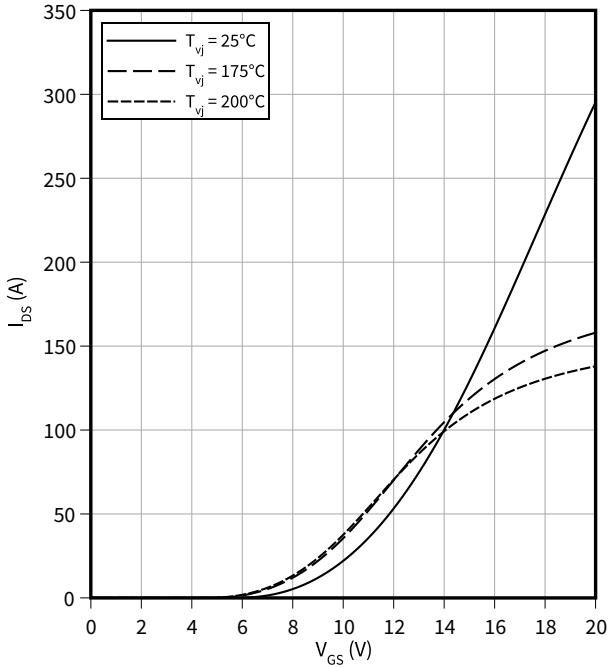
$$V_{GS} = 0 \text{ V}$$



4 Characteristics diagrams

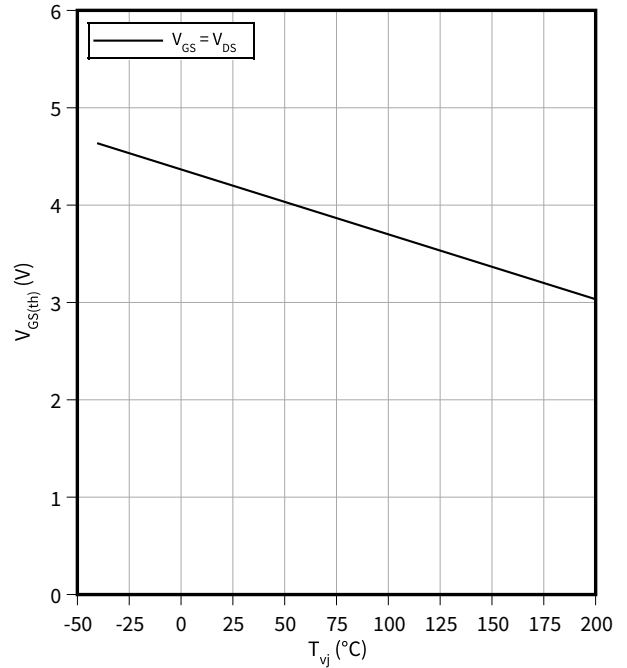
Typical transfer characteristic

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



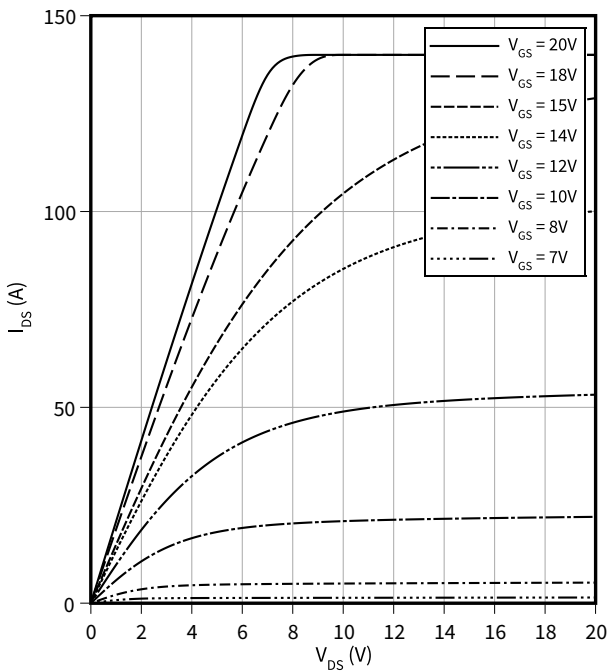
Typical gate-source threshold voltage as a function of junction temperature

$V_{GS(th)} = f(T_{vj})$
 $I_D = 4.1\text{ mA}$



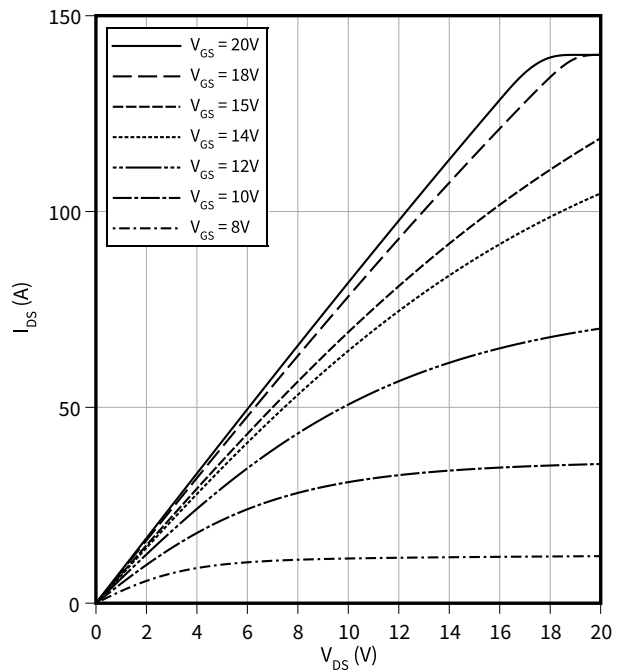
Typical output characteristic, V_{GS} as parameter

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



Typical output characteristic, V_{GS} as parameter

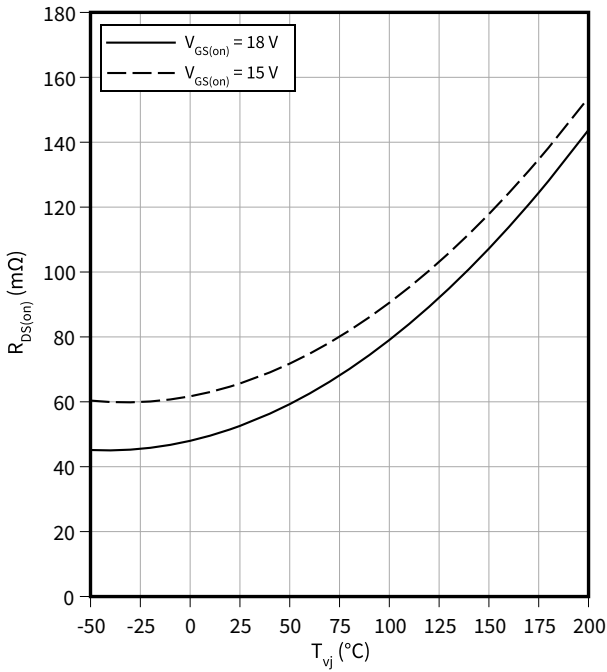
$I_{DS} = f(V_{DS})$
 $T_{vj} = 175\ ^\circ\text{C}$, $t_p = 20\ \mu\text{s}$



4 Characteristics diagrams

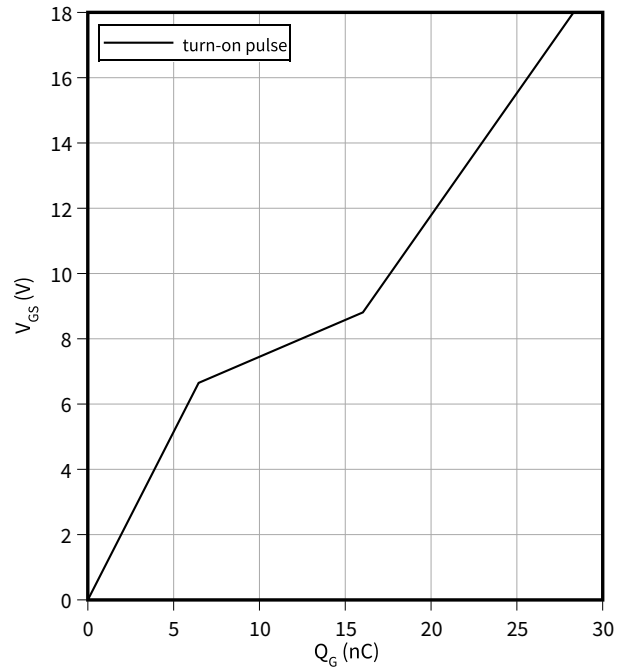
Typical on-state resistance as a function of junction temperature

$R_{DS(on)} = f(T_{vj})$
 $I_D = 13 \text{ A}$



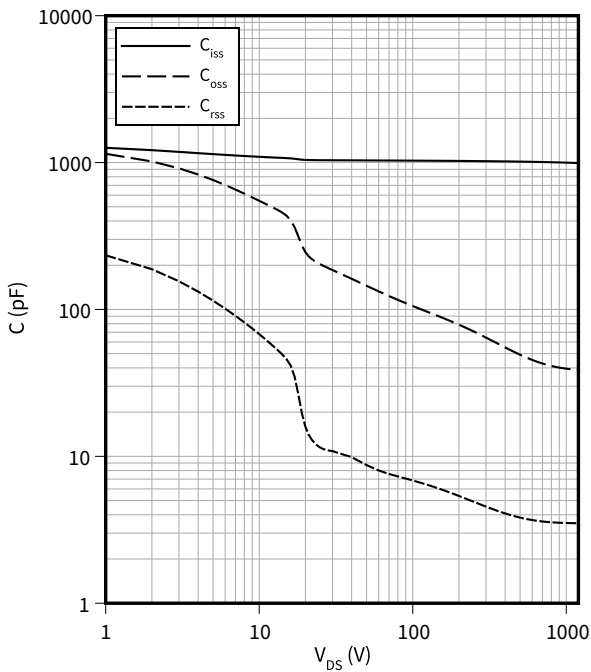
Typical gate charge

$V_{GS} = f(Q_G)$
 $I_D = 13 \text{ A}, V_{DS} = 800 \text{ V}$



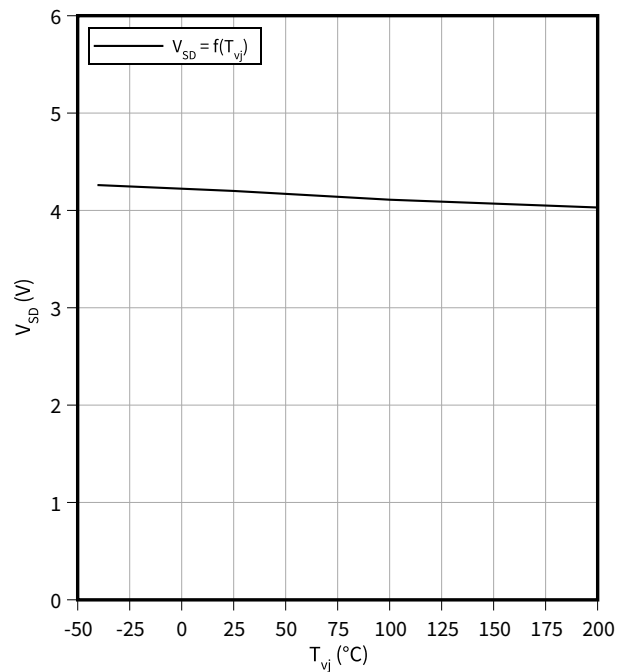
Typical capacitance as a function of drain-source voltage

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



Typical reverse drain voltage as function of junction temperature

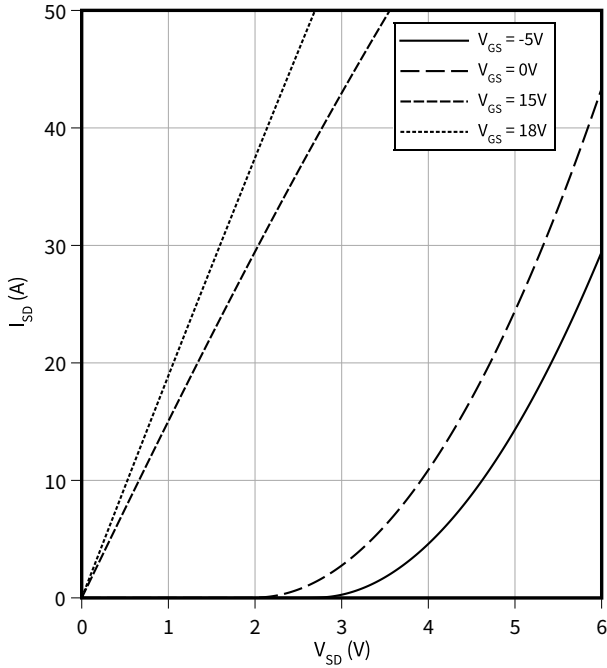
$V_{SD} = f(T_{vj})$
 $I_{SD} = 13 \text{ A}, V_{GS} = 0 \text{ V}$



4 Characteristics diagrams

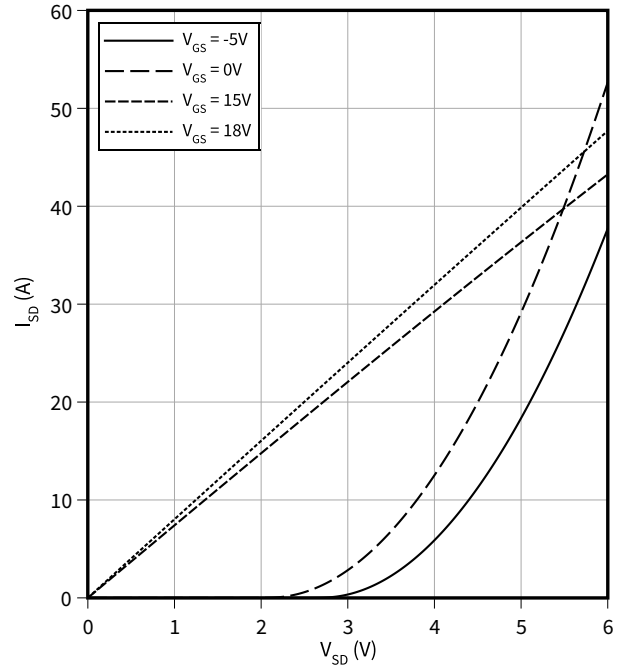
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

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



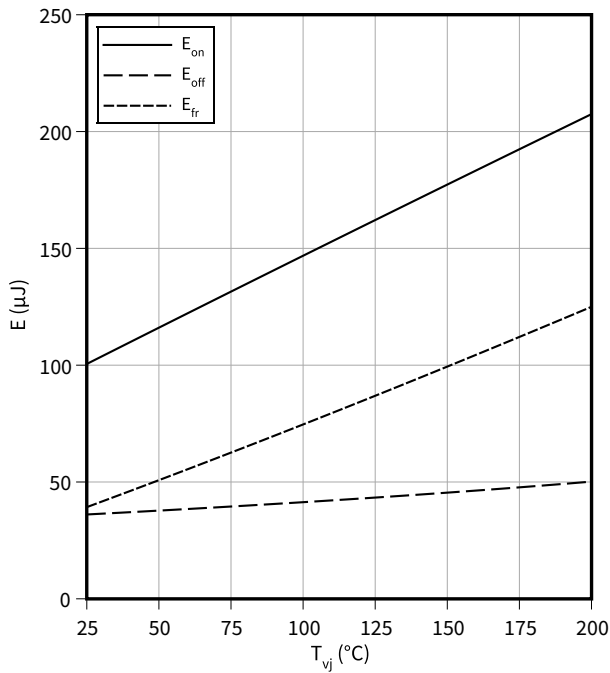
Typical reverse drain current as function of reverse drain voltage, V_{GS} as parameter

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



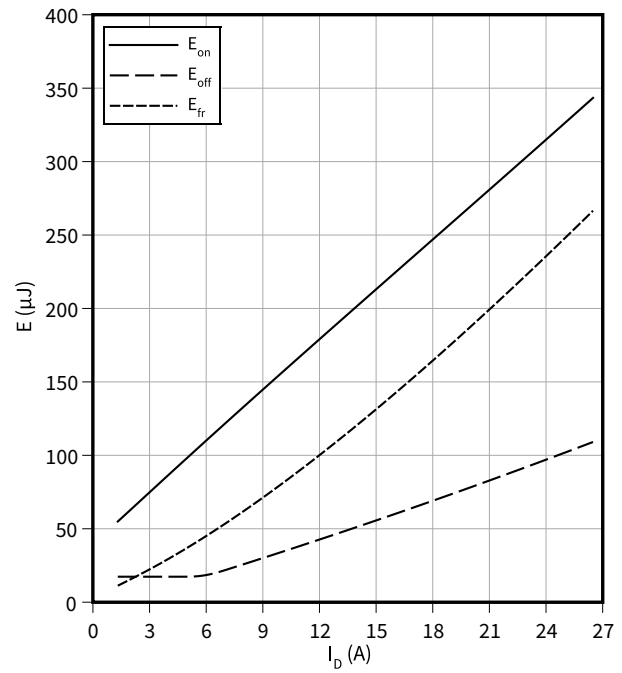
Typical switching energy as a function of junction temperature, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0\text{ V}$

$E = f(T_{vj})$
 $V_{GS} = 0/18\text{ V}$, $I_D = 13\text{ A}$, $R_{G,ext} = 2.3\text{ }\Omega$, $V_{DD} = 800\text{ V}$



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

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

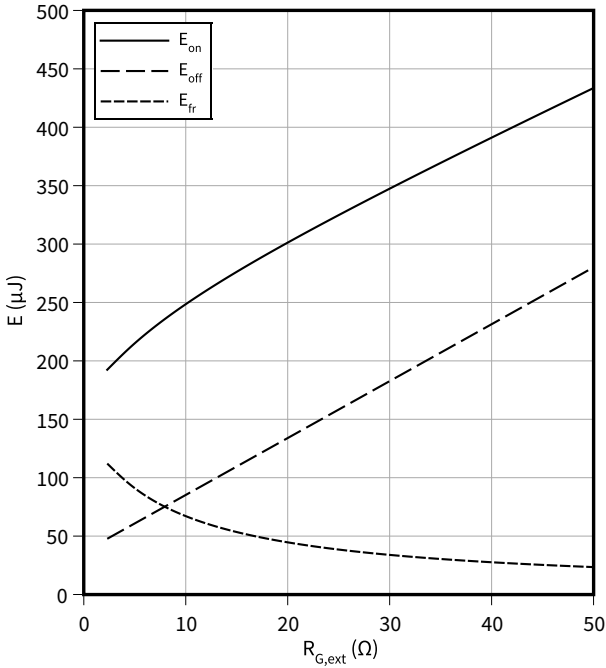


4 Characteristics diagrams

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

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

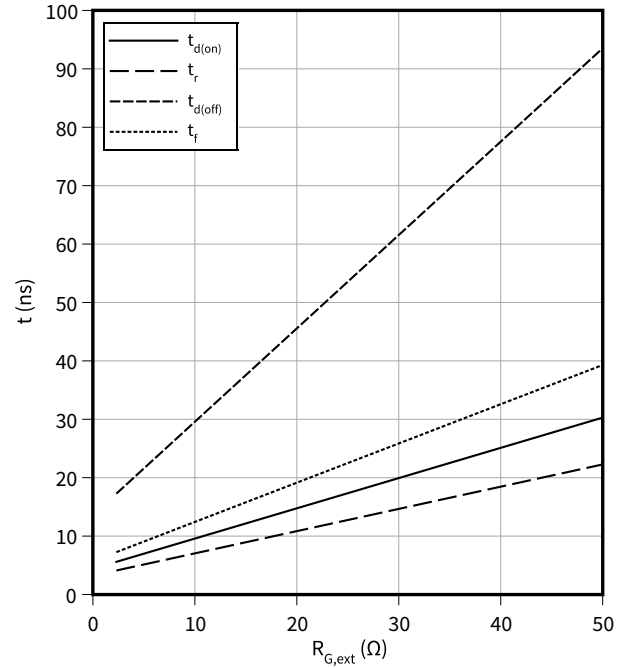
$V_{GS} = 0/18\text{ V}$, $I_D = 13\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{DD} = 800\text{ V}$



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

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

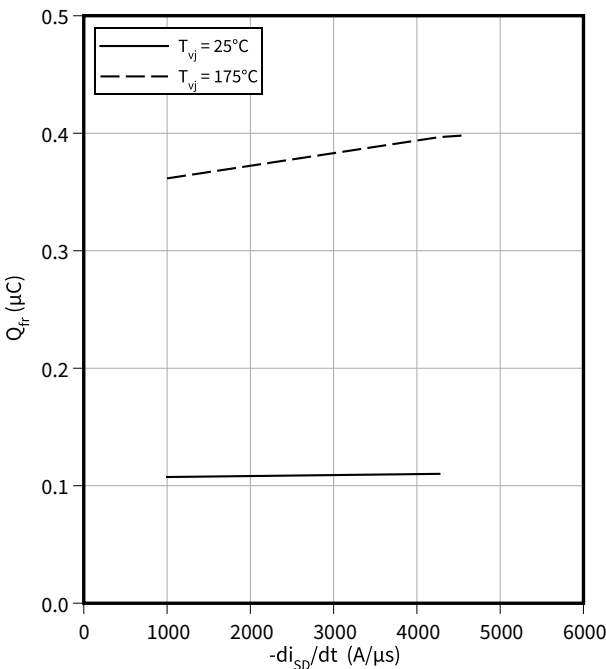
$V_{GS} = 0/18\text{ V}$, $I_D = 13\text{ A}$, $T_{vj} = 175\text{ °C}$, $V_{DD} = 800\text{ V}$



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

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

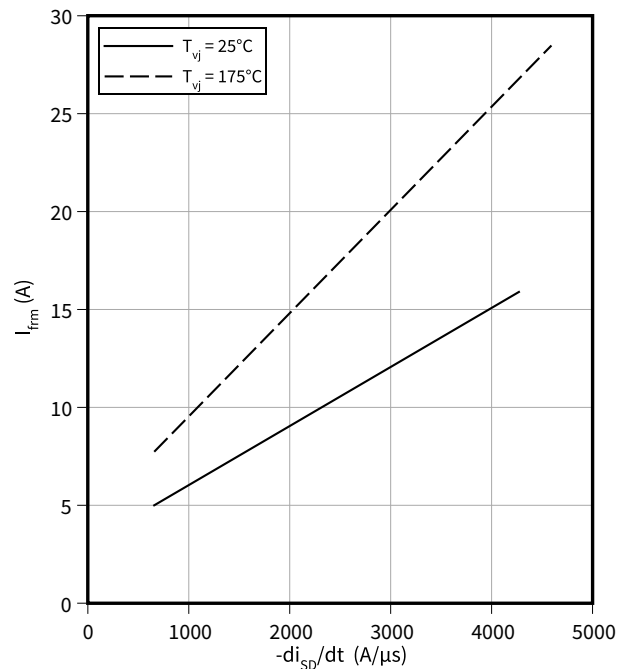
$V_{GS} = 0/18\text{ V}$, $I_{SD} = 13\text{ A}$, $V_{DD} = 800\text{ V}$



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

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

$V_{GS} = 0/18\text{ V}$, $I_{SD} = 13\text{ A}$, $V_{DD} = 800\text{ V}$



4 Characteristics diagrams

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

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

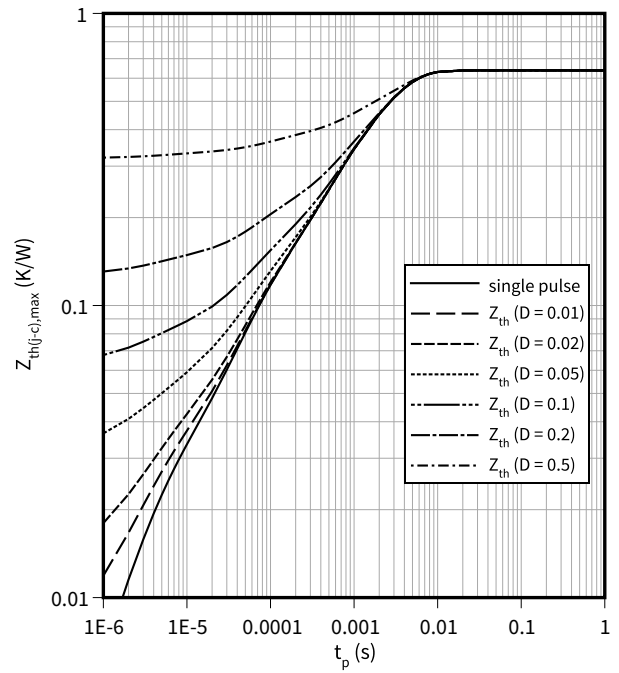
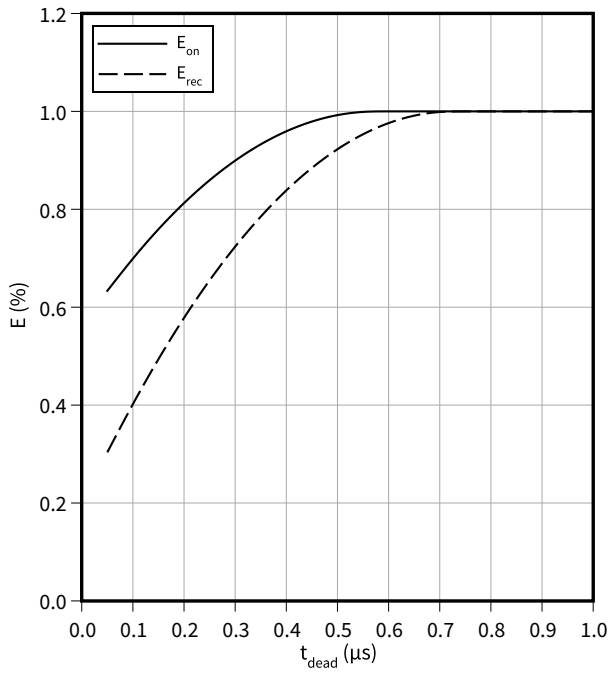
$V_{GS} = 0/18 V$, $I_D = 13 A$, $T_{vj} = 175 ^\circ C$, $R_{G,ext} = 2.3 \Omega$, $V_{DD} = 800 V$

$V_{DD} = 800 V$

Max. transient thermal impedance (MOSFET/diode)

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

$$D = t_p/T$$



5 Package outlines

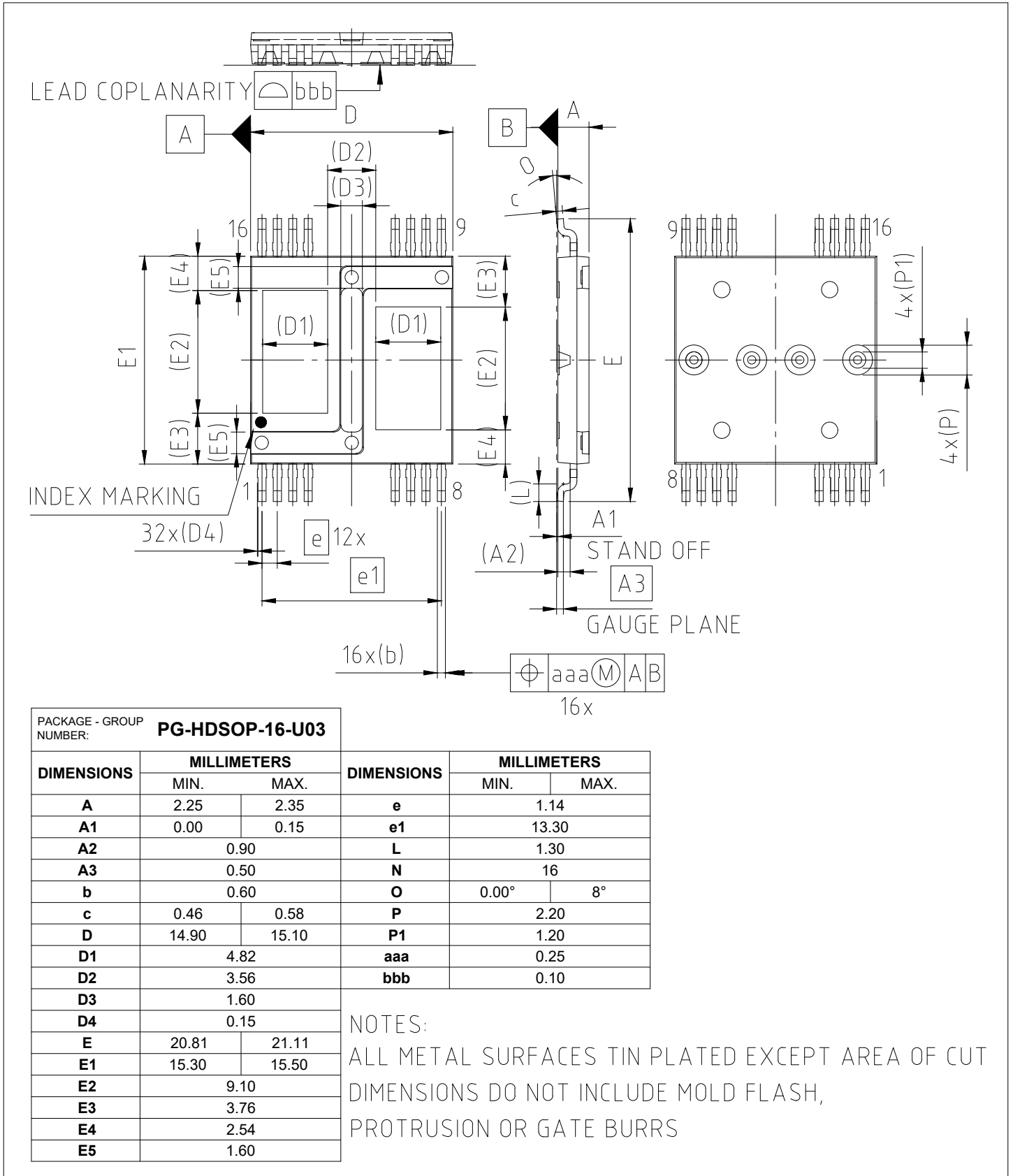


Figure 1

6 Testing conditions

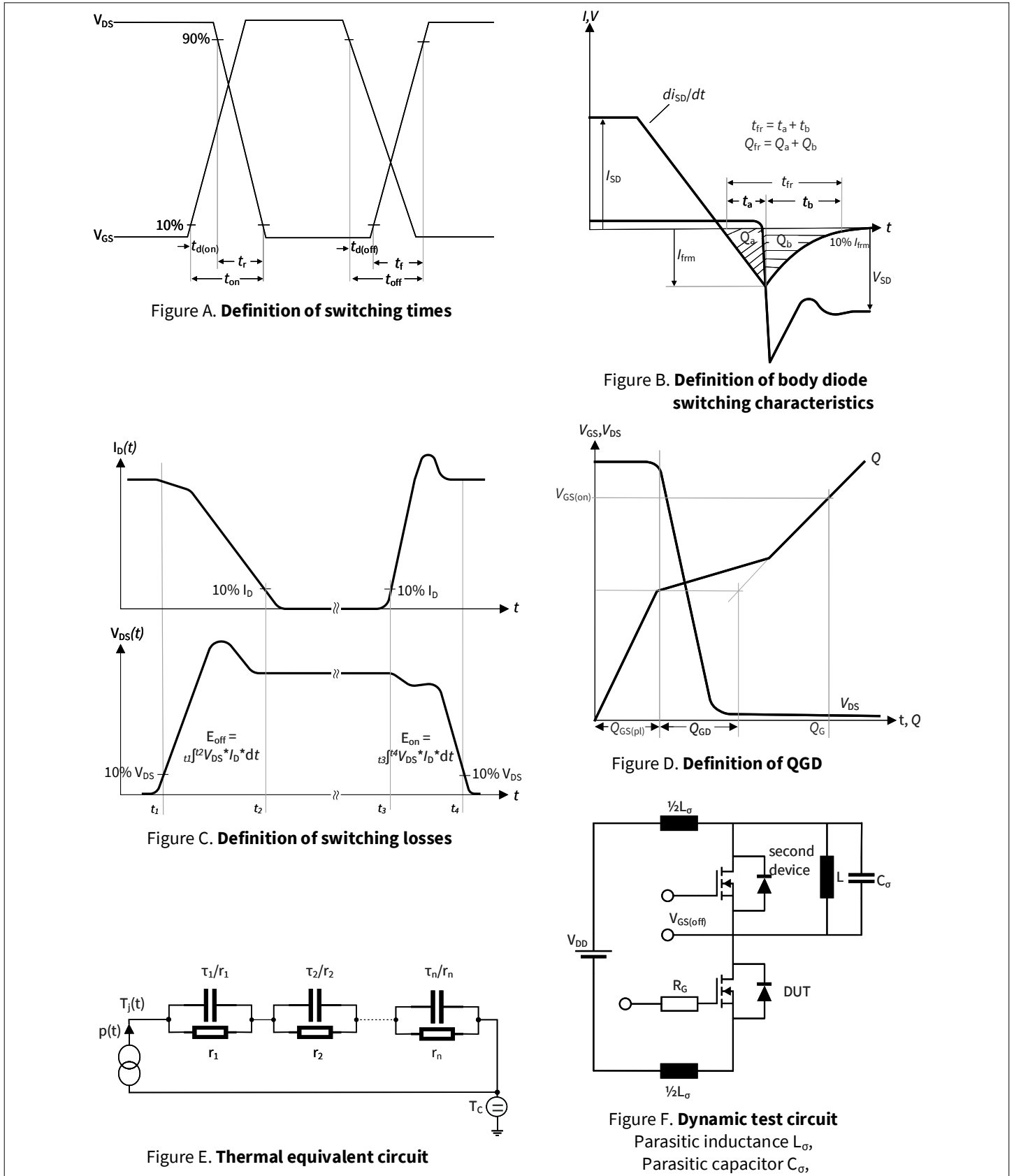


Figure 2

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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