

Final datasheet

CoolSiC™ 1200 V SiC MOSFET G2 : Q-DPAK top-side cooling

Features

- $V_{DS} = 1200\text{ V}$ at $T_{vj} = 25^\circ\text{C}$
- $I_{DC} = 31\text{ A}$ at $T_C = 100^\circ\text{C}$
- $R_{DS(on)} = 52.6\text{ m}\Omega$ at $V_{GS} = 18\text{ V}$, $T_{vj} = 25^\circ\text{C}$
- 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>

Potential applications

- Solid-state circuit breaker / Solid-state relay
- EV Charging
- Online UPS / Industrial UPS
- String inverter
- General purpose drives (GPD)
- CAV
- Servo drives

Product validation

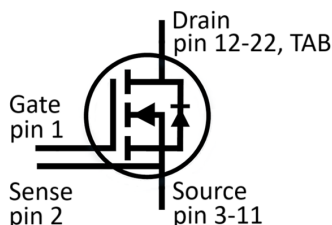
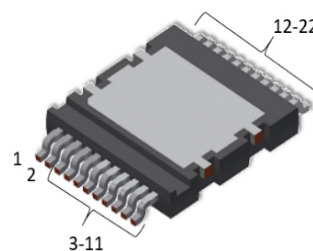
- Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

Description

Pin definition:

- Pin 1 – Gate
- Pin 2 – Kelvin sense contact
- Pin 3-11 – Source
- Pin 12-22, Tab – Drain

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



Type	Package	Marking
IMCQ120R053M2H	PG-HDSOP-22-U03	12M2H053



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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}	reflow soldering (MSL1 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}	$V_{GS} = 18\text{ V}$	$T_c = 25\text{ °C}$	43	A
			$T_c = 100\text{ °C}$	31	
Peak drain current, t_p limited by $T_{vj(max)}$ ¹⁾	I_{DM}	$V_{GS} = 18\text{ V}$		93	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}	$I_D = 13.2\text{ A}$, $V_{DD} = 50\text{ V}$, $L = 1.9\text{ mH}$		166	mJ
Avalanche energy, repetitive	E_{AR}	$I_D = 13.2\text{ A}$, $V_{DD} = 50\text{ V}$, $L = 9.5\text{ }\mu\text{H}$		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) **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	$V_{GS(on)}$		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	$R_{DS(on)}$	$I_D = 13.2 \text{ A}$	$T_{vj} = 25 \text{ °C}, V_{GS(on)} = 18 \text{ V}$	52.6		mΩ
			$T_{vj} = 150 \text{ °C}, V_{GS(on)} = 18 \text{ V}$	107	138	
			$T_{vj} = 175 \text{ °C}, V_{GS(on)} = 18 \text{ V}$	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	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}	$I_D = 13.2 \text{ A}, V_{DS} = 20 \text{ V}$		4.4		S
Internal gate resistance	$R_{G,int}$	$f = 1 \text{ MHz}, V_{AC} = 25 \text{ mV}$		8.5		Ω
Input capacitance	C_{iss}	$V_{DS} = 800 \text{ V}, V_{GS} = 0 \text{ V}, f = 100 \text{ kHz}, V_{AC} = 25 \text{ mV}$		1.27		nF
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}	$V_{DS} = 800 \text{ V}, V_{GS} = 0 \text{ V}, f = 100 \text{ kHz}, V_{AC} = 25 \text{ mV}$		3.6		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	$C_{o(er)}$	$V_{DS} = 0...800 \text{ V}, V_{GS} = 0 \text{ V}$		53.1		pF
Effective output capacitance, time related	$C_{o(tr)}$	$I_D = \text{constant}, V_{DS} = 0...800 \text{ V}, V_{GS} = 0 \text{ V}$		80.3		pF

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_G	$V_{DD} = 800 \text{ V}$, $I_D = 13.2 \text{ A}$, $V_{GS} = -2/18 \text{ V}$, turn-on pulse		32.8		nC
Plateau gate charge	$Q_{GS(pl)}$	$V_{DD} = 800 \text{ V}$, $I_D = 13.2 \text{ A}$, $V_{GS} = -2/18 \text{ V}$, turn-on pulse		8.5		nC
Gate-to-drain charge	Q_{GD}	$V_{DD} = 800 \text{ V}$, $I_D = 13.2 \text{ A}$, $V_{GS} = -2/18 \text{ V}$, turn-on pulse		6.7		nC
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 800 \text{ V}$, $I_D = 13.2 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 15 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	7		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	5.2		
Rise time	t_r	$V_{DD} = 800 \text{ V}$, $I_D = 13.2 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 15 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	4.1		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	3.7		
Turn-off delay time	$t_{d(off)}$	$V_{DD} = 800 \text{ V}$, $I_D = 13.2 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 15 \text{ nH}$, 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	$V_{DD} = 800 \text{ V}$, $I_D = 13.2 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 15 \text{ nH}$, 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}	$V_{DD} = 800 \text{ V}$, $I_D = 13.2 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 15 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	119		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$	242		
Turn-off energy	E_{off}	$V_{DD} = 800 \text{ V}$, $I_D = 13.2 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 15 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	37		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$	52		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total switching energy ¹⁾	E_{tot}	$V_{\text{DD}} = 800 \text{ V}$, $I_{\text{D}} = 13.2 \text{ A}$, $V_{\text{GS}} = 0/18 \text{ V}$, $R_{\text{GS(on)}} = 2.3 \Omega$, $R_{\text{GS(off)}} = 2.3 \Omega$, $L_{\sigma} = 15 \text{ nH}$, diode: body diode at $V_{\text{GS}} = 0 \text{ V}$	$T_{\text{vj}} = 25 \text{ }^{\circ}\text{C}$	165		μJ
			$T_{\text{vj}} = 175 \text{ }^{\circ}\text{C}$	321		
Virtual junction temperature	T_{vj}		-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}	$V_{\text{GS}} = 0 \text{ V}$	93	A

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Drain-source reverse voltage	V_{SD}	$I_{\text{SD}} = 13.2 \text{ A}$, $V_{\text{GS}} = 0 \text{ V}$	$T_{\text{vj}} = 25 \text{ }^{\circ}\text{C}$	4.2	5.5	V
			$T_{\text{vj}} = 100 \text{ }^{\circ}\text{C}$	4.1		
			$T_{\text{vj}} = 175 \text{ }^{\circ}\text{C}$	4		
MOSFET forward recovery charge	Q_{fr}	$V_{\text{DD}} = 800 \text{ V}$, $I_{\text{SD}} = 13.2 \text{ A}$, $V_{\text{GS}} = 0 \text{ V}$, $-di_{\text{SD}}/dt = 1000 \text{ A}/\mu\text{s}$, Q_{fr} includes also Q_{C}	$T_{\text{vj}} = 25 \text{ }^{\circ}\text{C}$	0.12		μC
			$T_{\text{vj}} = 175 \text{ }^{\circ}\text{C}$	0.47		
MOSFET peak forward recovery current	I_{frm}	$V_{\text{DD}} = 800 \text{ V}$, $I_{\text{SD}} = 13.2 \text{ A}$, $V_{\text{GS}} = 0 \text{ V}$, $-di_{\text{SD}}/dt = 1000 \text{ A}/\mu\text{s}$, Q_{fr} includes also Q_{C}	$T_{\text{vj}} = 25 \text{ }^{\circ}\text{C}$	8		A
			$T_{\text{vj}} = 175 \text{ }^{\circ}\text{C}$	12		

(table continues...)

Table 6 (continued) Characteristic values

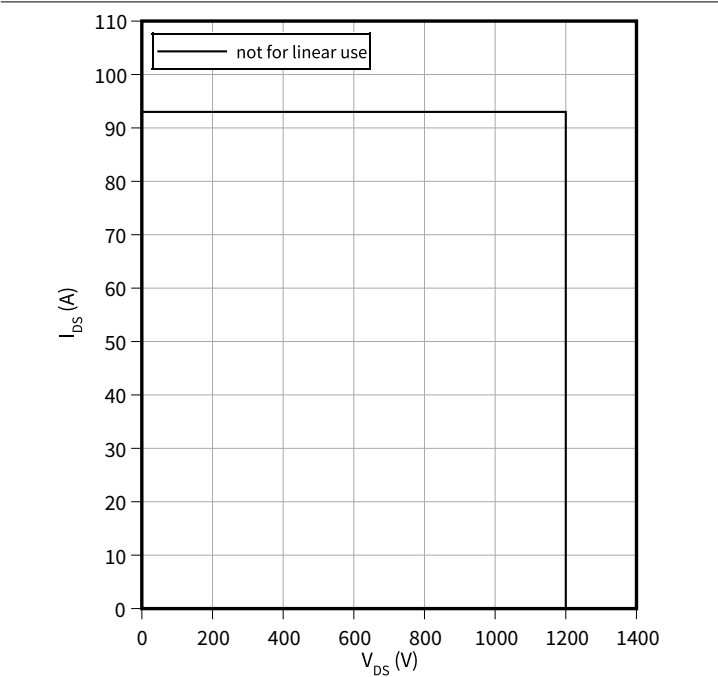
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
MOSFET forward recovery energy	E_{fr}	$V_{DD} = 800 \text{ V}$, $I_{SD} = 13.2 \text{ A}$, $V_{GS} = 0 \text{ V}$, $-di_{SD}/dt = 1000 \text{ A}/\mu\text{s}$, Q_{fr} includes also Q_C	$T_{vj} = 25 \text{ }^\circ\text{C}$		9		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$		27		
Virtual junction temperature	T_{vj}			-55		175	$^\circ\text{C}$
Virtual junction temperature	$T_{vj(over)}$	overload, cumulative max. 100 h ¹⁾				200	$^\circ\text{C}$

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

4 Characteristics diagrams

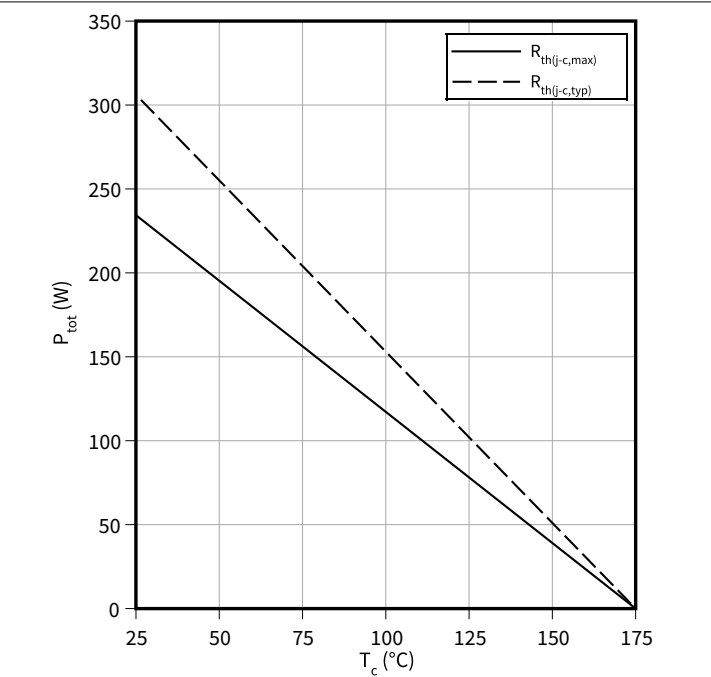
Reverse bias safe operating area (RBSOA)

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



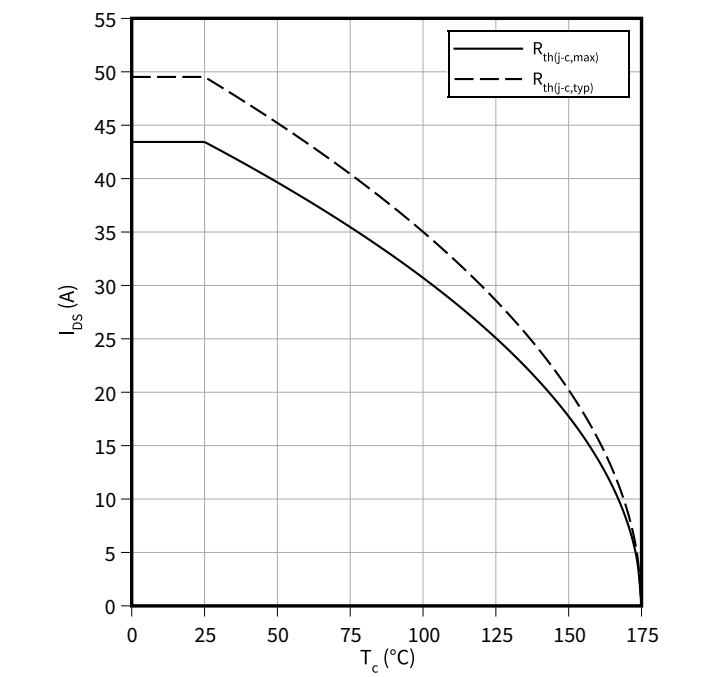
Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$



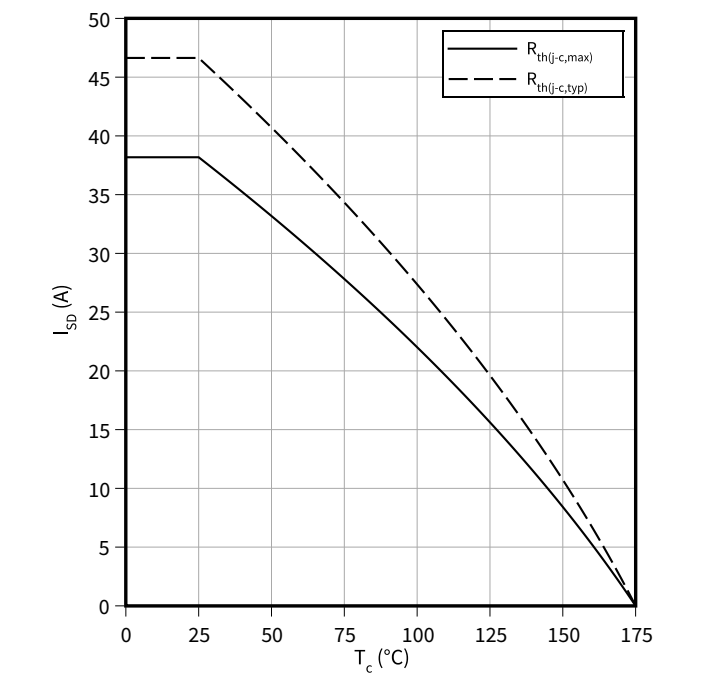
Maximum DC drain to source current as a function of case temperature limited by bond wire

$I_{DS} = f(T_c)$



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

$I_{SD} = f(T_c)$
 $V_{GS} = 0\text{ V}$

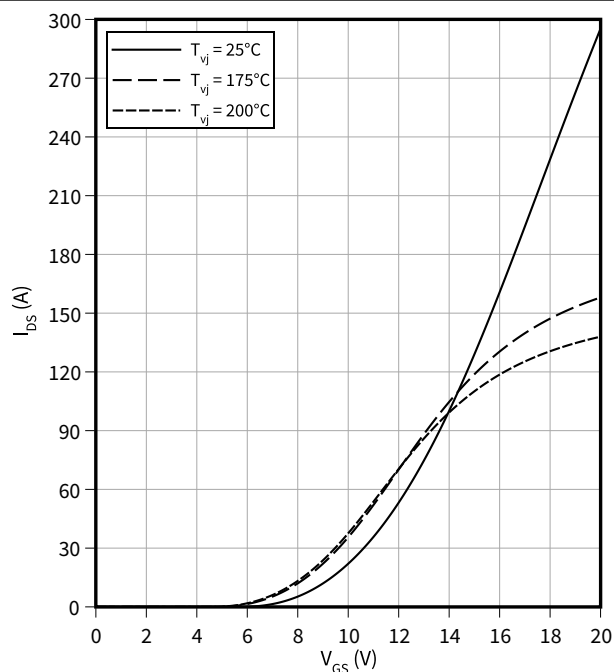


4 Characteristics diagrams

Typical transfer characteristic

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

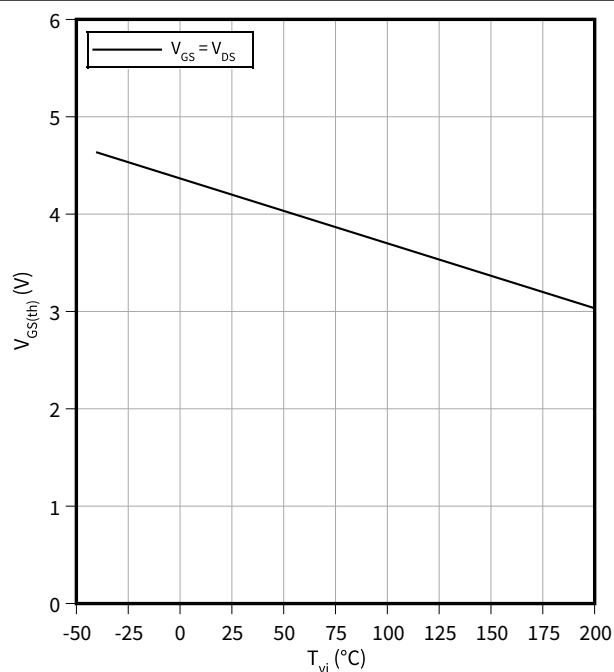
$$V_{DS} = 20 \text{ V}, t_p = 20 \mu\text{s}$$



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

$$V_{GS(th)} = f(T_{vj})$$

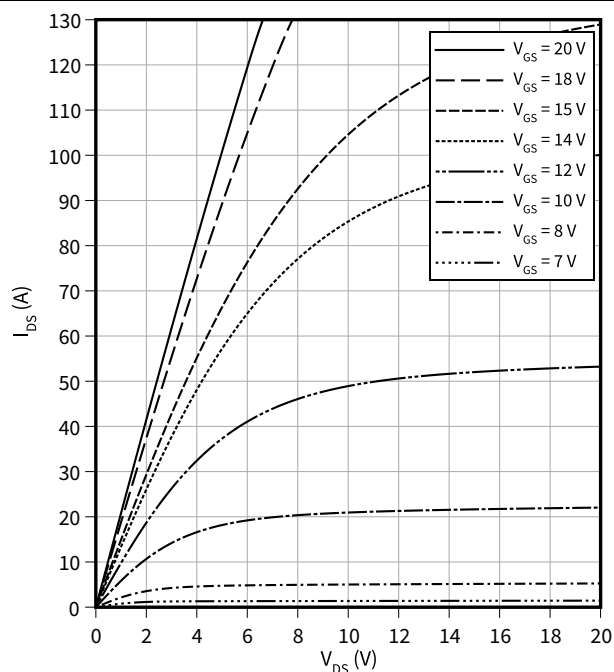
$$I_D = 4.1 \text{ mA}$$



Typical output characteristic, V_{GS} as a parameter

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

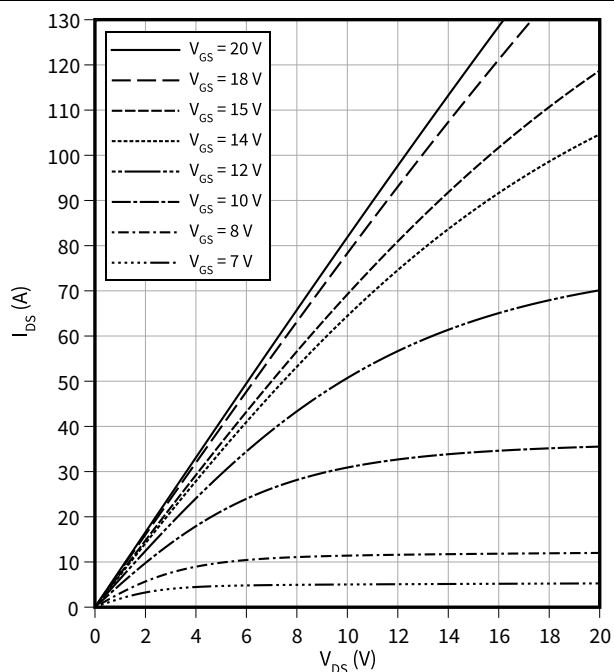
$$T_{vj} = 25^\circ\text{C}, t_p = 20 \mu\text{s}$$



Typical output characteristic, V_{GS} as a parameter

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

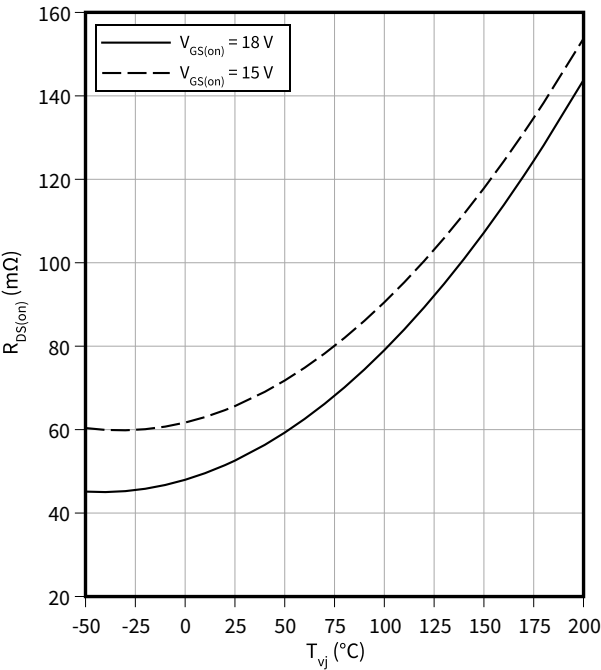
$$T_{vj} = 175^\circ\text{C}, t_p = 20 \mu\text{s}$$



4 Characteristics diagrams

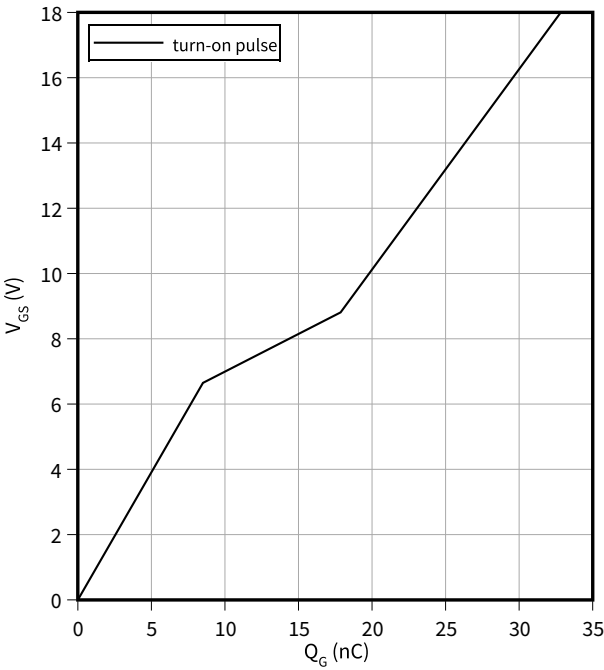
Typical on-state resistance as a function of junction temperature

$R_{DS(on)} = f(T_{vj})$
 $I_D = 13.2\text{ A}$



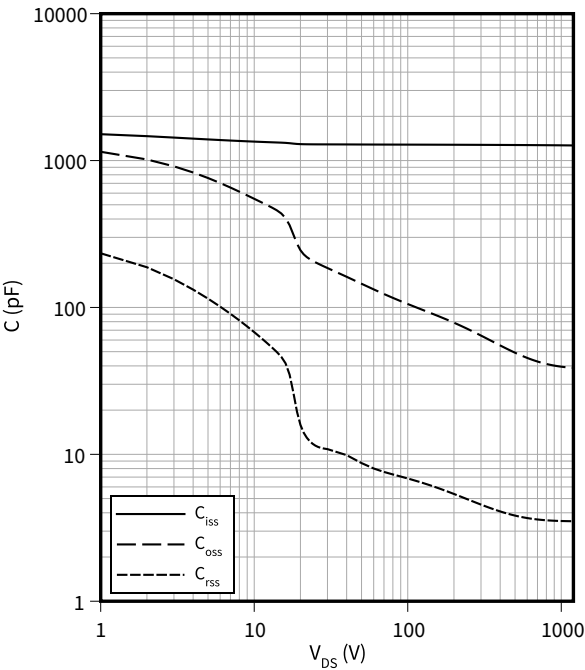
Typical gate charge

$V_{GS} = f(Q_G)$
 $I_D = 13.2\text{ A}, V_{DS} = 800\text{ V}$



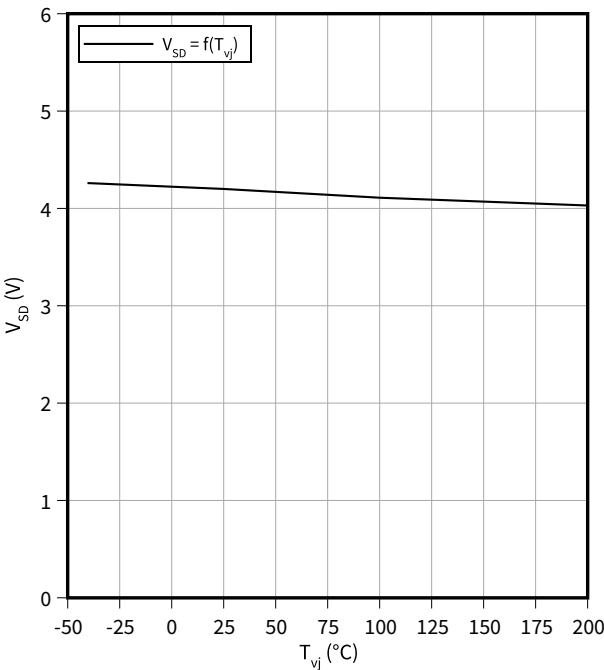
Typical capacitance as a function of drain-source voltage

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



Typical reverse drain voltage as a function of junction temperature

$V_{SD} = f(T_{vj})$
 $I_{SD} = 13.2\text{ A}, V_{GS} = 0\text{ V}$

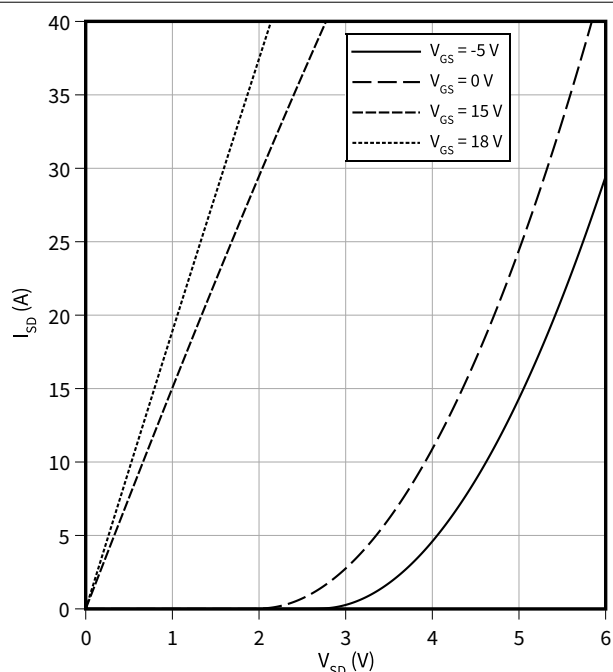


4 Characteristics diagrams

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

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

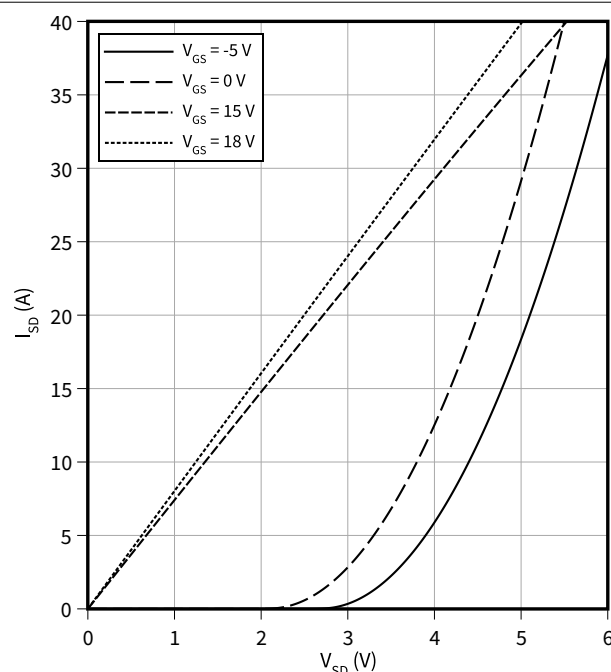
$T_{vj} = 25\text{ °C}$, $t_p = 20\text{ }\mu\text{s}$



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

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

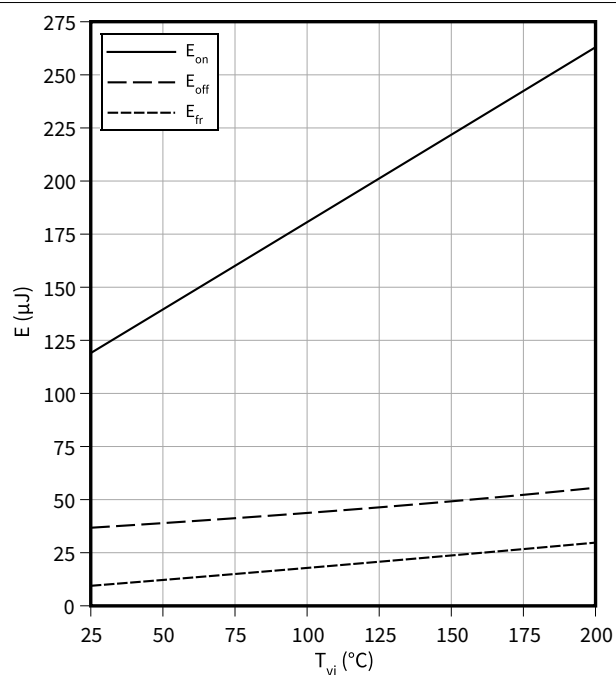
$T_{vj} = 175\text{ °C}$, $t_p = 20\text{ }\mu\text{s}$



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

$$E = f(T_{vj})$$

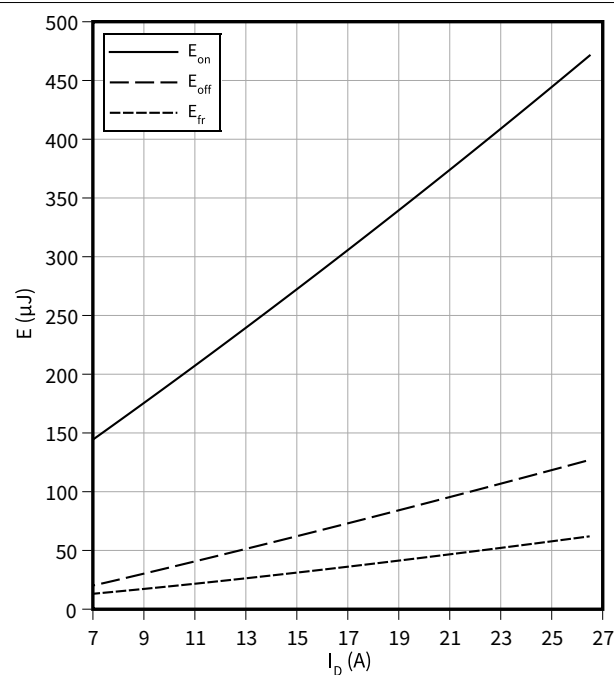
$V_{GS} = 0/18\text{ V}$, $I_D = 13.2\text{ A}$, $R_{G,ext} = 2.3\text{ }\Omega$, $V_{DD} = 800\text{ V}$



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

$$E = f(I_D)$$

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

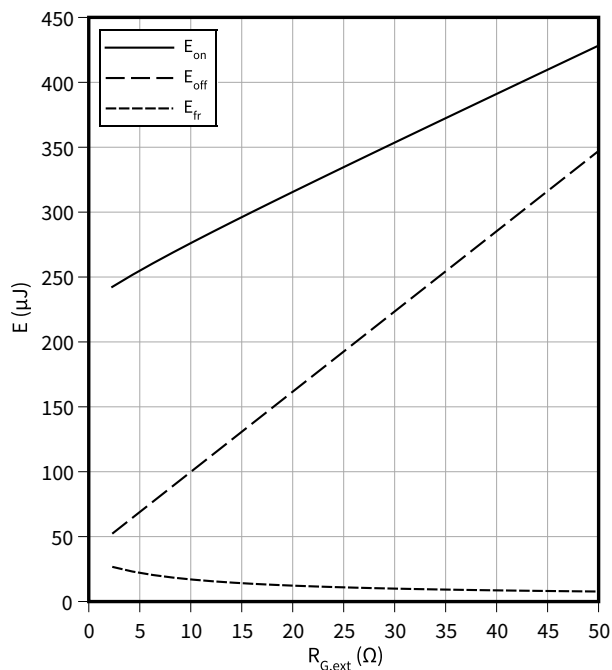


4 Characteristics diagrams

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

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

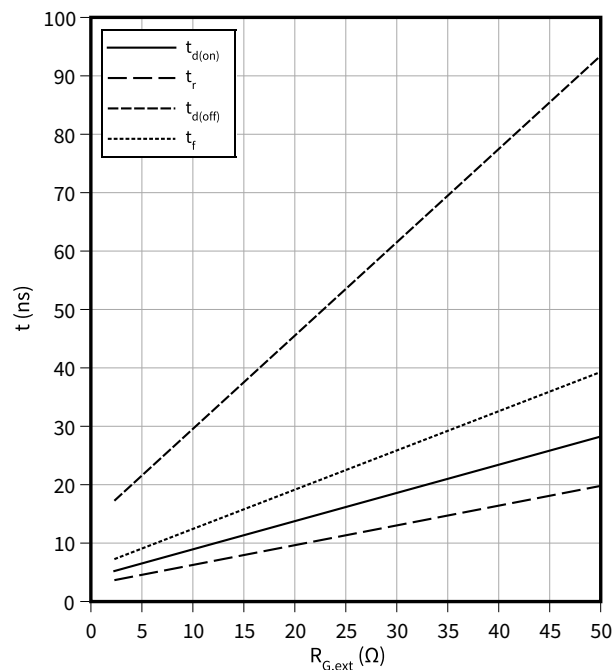
$V_{GS} = 0/18$ V, $I_D = 13.2$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V



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

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

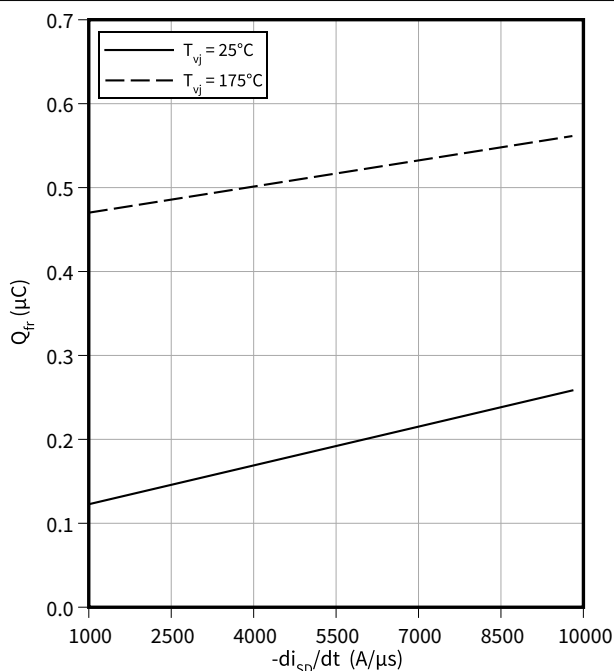
$V_{GS} = 0/18$ V, $I_D = 13.2$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V



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

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

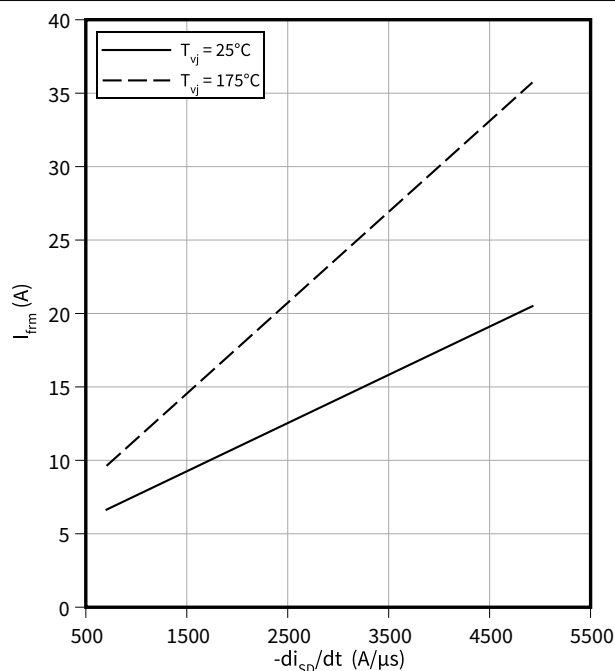
$V_{GS} = 0/18$ V, $I_{SD} = 13.2$ A, $V_{DD} = 800$ V



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

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

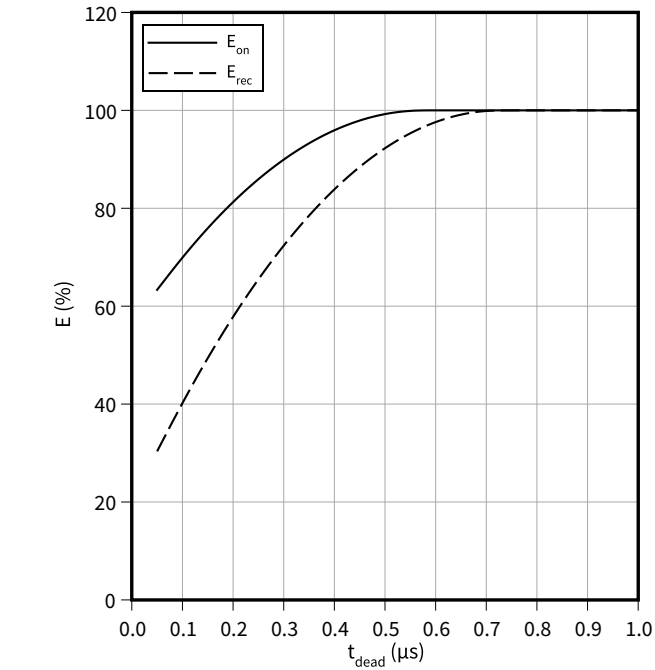
$V_{GS} = 0/18$ V, $I_{SD} = 13.2$ A, $V_{DD} = 800$ V



4 Characteristics diagrams

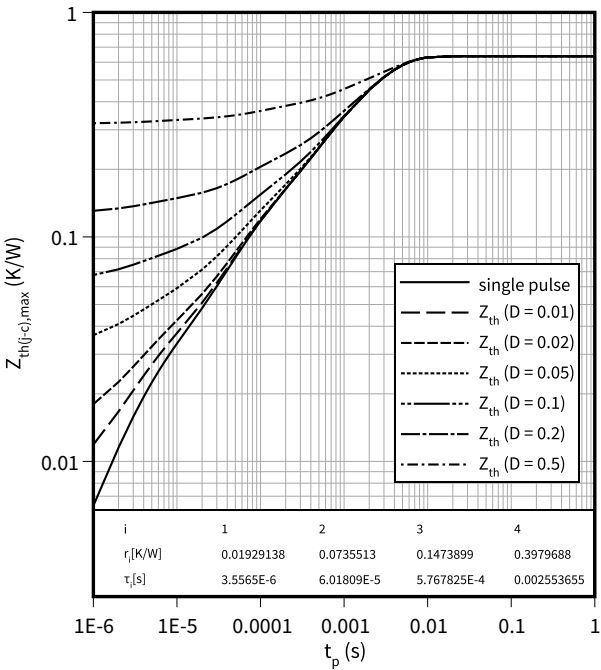
Typical switching energy as a function of dead time / blanking time, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = -5\text{ V}$

$E = f(t_{dead})$
 $V_{GS} = 0/18\text{ V}$, $I_D = 13.2\text{ A}$, $T_{vj} = 175\text{ °C}$, $R_{G,ext} = 2.3\text{ }\Omega$
 $V_{DD} = 800\text{ V}$



Max. transient thermal impedance (MOSFET/diode)

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



5 Package outlines

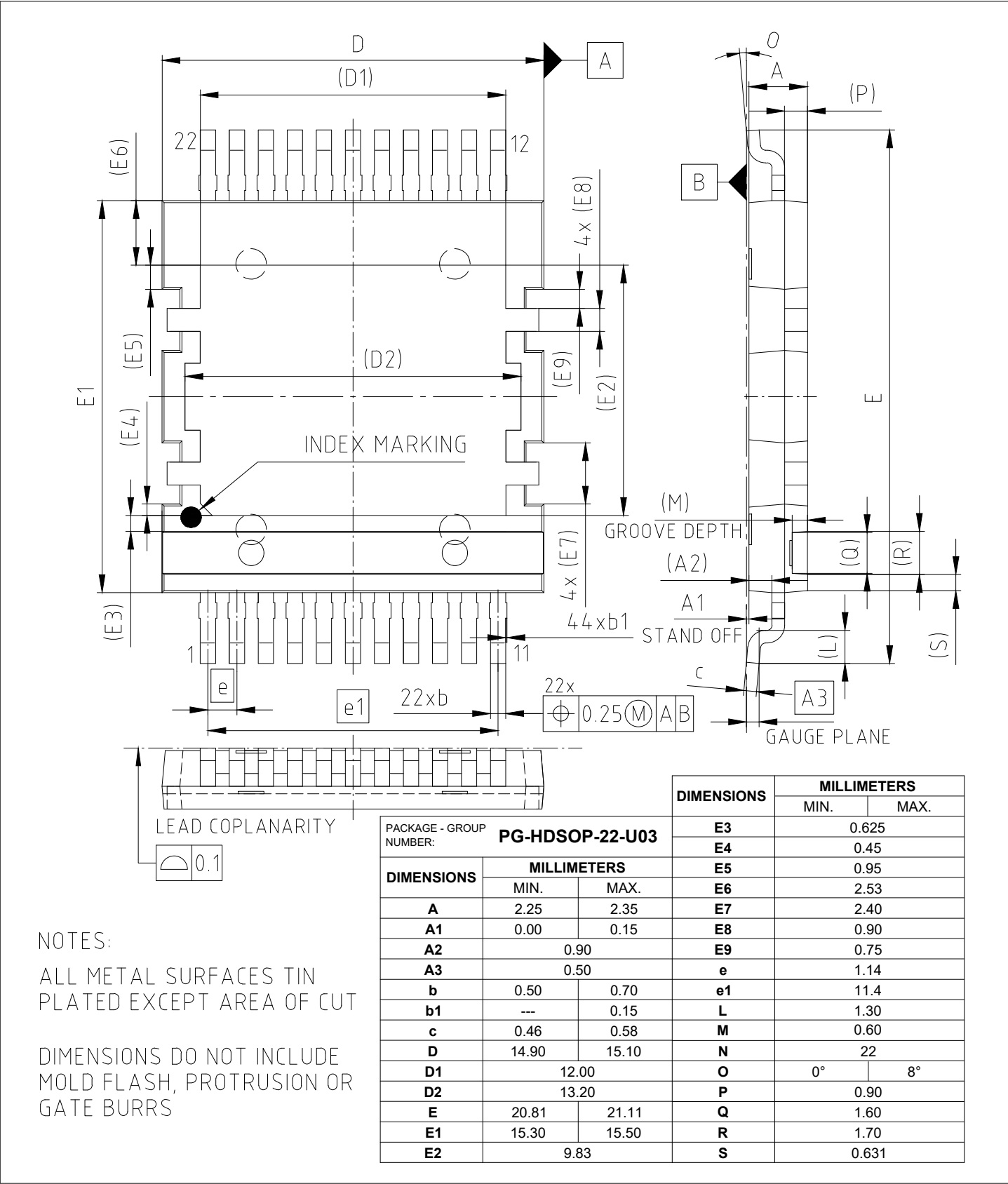


Figure 1

6 Testing conditions

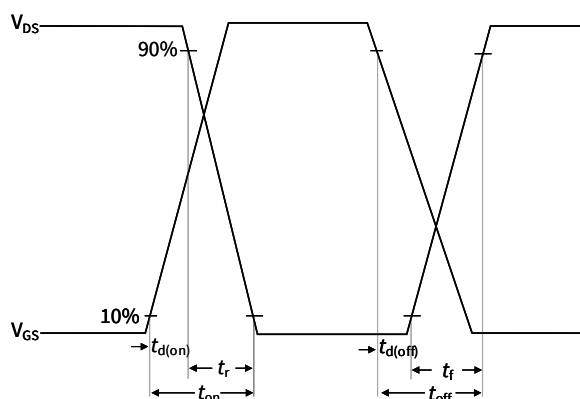


Figure A. Definition of switching times

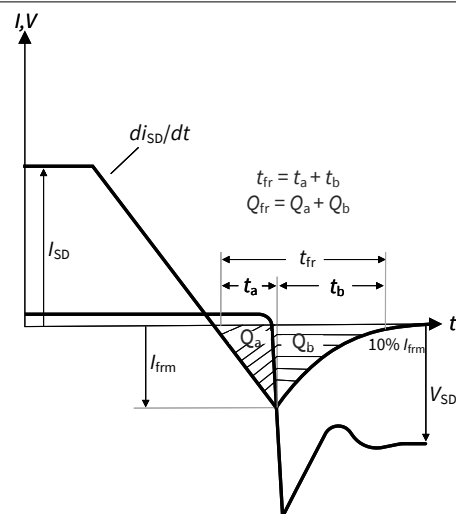


Figure B. Definition of body diode switching characteristics

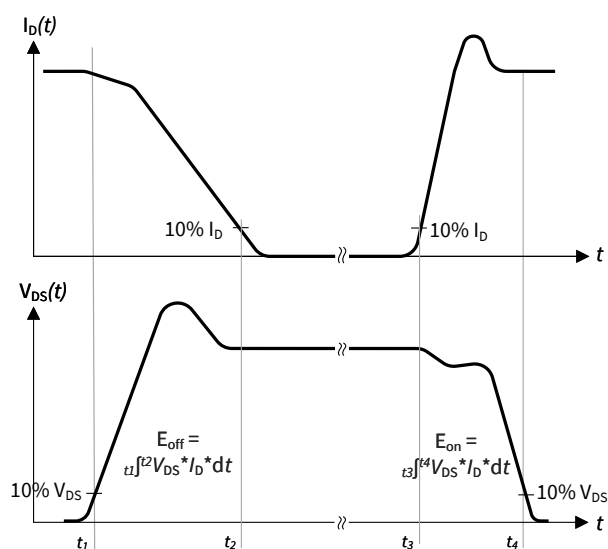


Figure C. Definition of switching losses

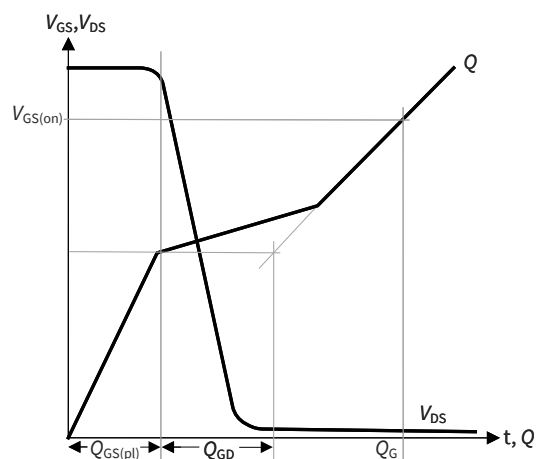


Figure D. Definition of QGD

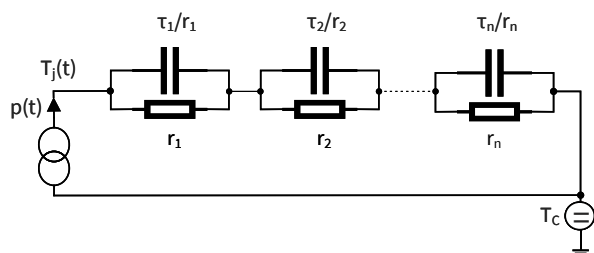


Figure E. Thermal equivalent circuit

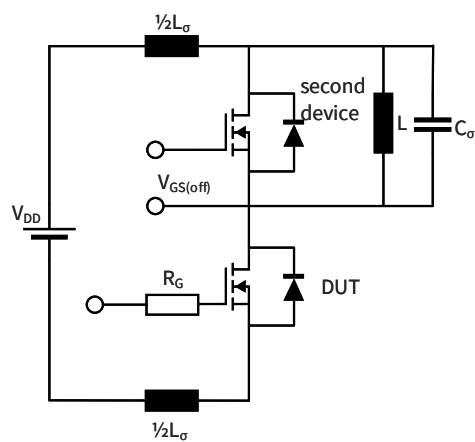


Figure F. Dynamic test circuit

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

Figure 2



Revision history

Revision history

Document revision	Date of release	Description of changes
0.10	2024-11-20	Preliminary datasheet
1.00	2024-12-12	Final datasheet

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