

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

Features

- $V_{DS} = 1200\text{ V}$ at $T_{vj} = 25^{\circ}\text{C}$
- $I_{DDC} = 39\text{ A}$ at $T_C = 100^{\circ}\text{C}$
- $R_{DS(on)} = 39.6\text{ m}\Omega$ 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

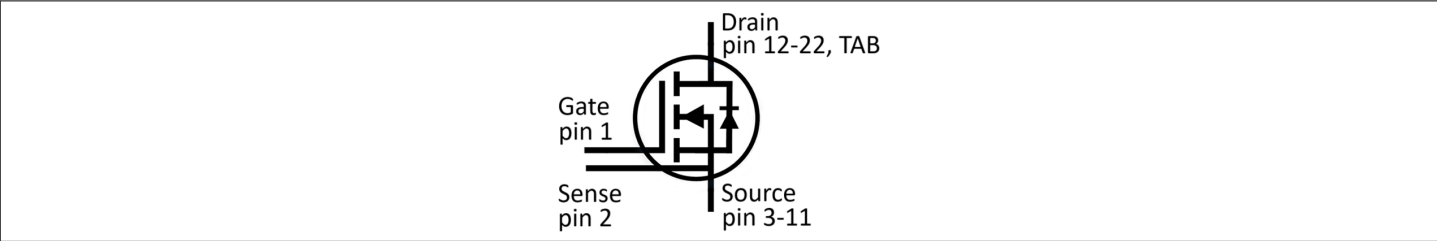
- Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

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
IMCQ120R040M2H	PG-HDSOP-22-U03	12M2H040



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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	$R_{th(j-c)}$			0.4	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}	$V_{GS} = 18\text{ V}$	$T_c = 25\text{ °C}$	56	A
			$T_c = 100\text{ °C}$	39	
Peak drain current, t_p limited by $T_{vj(max)}$ ¹⁾	I_{DM}	$V_{GS} = 18\text{ V}$		117	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}			-5...23	V
Avalanche energy, single pulse	E_{AS}	$I_D = 17.5\text{ A}$, $V_{DD} = 50\text{ V}$, $L = 1.4\text{ mH}$		220	mJ
Avalanche energy, repetitive	E_{AR}	$I_D = 17.5\text{ A}$, $V_{DD} = 50\text{ V}$, $L = 7.2\text{ }\mu\text{H}$		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}		$T_c = 25\text{ °C}$	288	W
			$T_c = 100\text{ °C}$	144	

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	$R_{DS(on)}$	$I_D = 17.5 \text{ A}$	$T_{vj} = 25 \text{ °C}, V_{GS(on)} = 18 \text{ V}$	39.6		mΩ
			$T_{vj} = 150 \text{ °C}, V_{GS(on)} = 18 \text{ V}$	80.7	104	
			$T_{vj} = 175 \text{ °C}, V_{GS(on)} = 18 \text{ V}$	93.7		
			$T_{vj} = 25 \text{ °C}, V_{GS(on)} = 15 \text{ V}$	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	4.2	V
			$T_{vj} = 175 \text{ °C}$		3.2	
Zero gate-voltage drain current	I_{DSS}	$V_{DS} = 1200 \text{ V}, V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$		150	μA
			$T_{vj} = 175 \text{ °C}$	2.6		
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}	$I_D = 17.5 \text{ A}, V_{DS} = 20 \text{ V}$		5.9		S
Internal gate resistance	$R_{G,int}$	$f = 1 \text{ MHz}, V_{AC} = 25 \text{ mV}$		6.5		Ω
Input capacitance	C_{iss}	$V_{DS} = 800 \text{ V}, V_{GS} = 0 \text{ V}, f = 100 \text{ kHz}, V_{AC} = 25 \text{ mV}$		1.66		nF
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}	$V_{DS} = 800 \text{ V}, V_{GS} = 0 \text{ V}, f = 100 \text{ kHz}, V_{AC} = 25 \text{ mV}$		4.7		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	$C_{o(er)}$	$V_{DS} = 0...800 \text{ V}, V_{GS} = 0 \text{ V}$		71.9		pF
Effective output capacitance, time related	$C_{o(tr)}$	$I_D = \text{constant}, V_{DS} = 0...800 \text{ V}, V_{GS} = 0 \text{ V}$		107		pF

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_G	$V_{DD} = 800 \text{ V}$, $I_D = 17.5 \text{ A}$, $V_{GS} = -2/18 \text{ V}$, turn-on pulse		42.4		nC
Plateau gate charge	$Q_{GS(pl)}$	$V_{DD} = 800 \text{ V}$, $I_D = 17.5 \text{ A}$, $V_{GS} = -2/18 \text{ V}$, turn-on pulse		10.8		nC
Gate-to-drain charge	Q_{GD}	$V_{DD} = 800 \text{ V}$, $I_D = 17.5 \text{ A}$, $V_{GS} = -2/18 \text{ V}$, turn-on pulse		8.9		nC
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 800 \text{ V}$, $I_D = 17.5 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 15 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	7		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	5.6		
Rise time	t_r	$V_{DD} = 800 \text{ V}$, $I_D = 17.5 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 15 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	4.4		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	3.9		
Turn-off delay time	$t_{d(off)}$	$V_{DD} = 800 \text{ V}$, $I_D = 17.5 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 15 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	15.7		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	18.4		
Fall time	t_f	$V_{DD} = 800 \text{ V}$, $I_D = 17.5 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 15 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	6.6		ns
			$T_{vj} = 175 \text{ }^\circ\text{C}$	7.8		
Turn-on energy	E_{on}	$V_{DD} = 800 \text{ V}$, $I_D = 17.5 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 15 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	160		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$	321		
Turn-off energy	E_{off}	$V_{DD} = 800 \text{ V}$, $I_D = 17.5 \text{ A}$, $V_{GS} = 0/18 \text{ V}$, $R_{GS(on)} = 2.3 \Omega$, $R_{GS(off)} = 2.3 \Omega$, $L_\sigma = 15 \text{ nH}$, diode: body diode at $V_{GS} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	41		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$	63		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Total switching energy ¹⁾	E_{tot}	$V_{\text{DD}} = 800 \text{ V}$, $I_{\text{D}} = 17.5 \text{ A}$, $V_{\text{GS}} = 0/18 \text{ V}$, $R_{\text{GS(on)}} = 2.3 \Omega$, $R_{\text{GS(off)}} = 2.3 \Omega$, $L_{\sigma} = 15 \text{ nH}$, diode: body diode at $V_{\text{GS}} = 0 \text{ V}$	$T_{\text{vj}} = 25 \text{ }^{\circ}\text{C}$	216		μJ
			$T_{\text{vj}} = 175 \text{ }^{\circ}\text{C}$	424		
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}	$V_{\text{GS}} = 0 \text{ V}$	117	A

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Drain-source reverse voltage	V_{SD}	$I_{\text{SD}} = 17.5 \text{ A}$, $V_{\text{GS}} = 0 \text{ V}$	$T_{\text{vj}} = 25 \text{ }^{\circ}\text{C}$	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}	$V_{\text{DD}} = 800 \text{ V}$, $I_{\text{SD}} = 17.5 \text{ A}$, $V_{\text{GS}} = 0 \text{ V}$, $-di_{\text{SD}}/dt = 1000 \text{ A}/\mu\text{s}$, Q_{fr} includes also Q_{C}	$T_{\text{vj}} = 25 \text{ }^{\circ}\text{C}$	0.14		μC
			$T_{\text{vj}} = 175 \text{ }^{\circ}\text{C}$	0.52		
MOSFET peak forward recovery current	I_{frm}	$V_{\text{DD}} = 800 \text{ V}$, $I_{\text{SD}} = 17.5 \text{ A}$, $V_{\text{GS}} = 0 \text{ V}$, $-di_{\text{SD}}/dt = 1000 \text{ A}/\mu\text{s}$, Q_{fr} includes also Q_{C}	$T_{\text{vj}} = 25 \text{ }^{\circ}\text{C}$	8.3		A
			$T_{\text{vj}} = 175 \text{ }^{\circ}\text{C}$	12.4		

(table continues...)

Table 6 (continued) Characteristic values

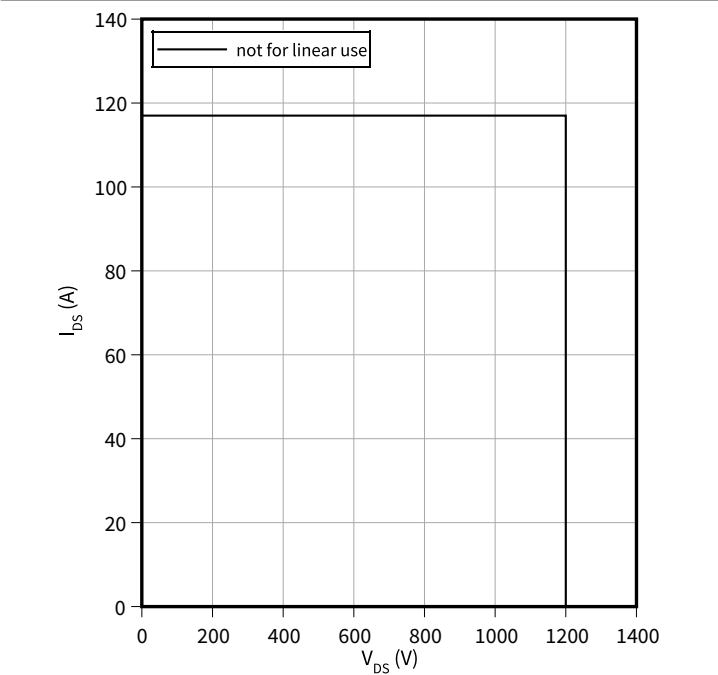
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
MOSFET forward recovery energy	E_{fr}	$V_{DD} = 800 \text{ V}$, $I_{SD} = 17.5 \text{ A}$, $V_{GS} = 0 \text{ V}$, $-di_{SD}/dt = 1000 \text{ A}/\mu\text{s}$, Q_{fr} includes also Q_C	$T_{vj} = 25 \text{ }^\circ\text{C}$		15		μJ
			$T_{vj} = 175 \text{ }^\circ\text{C}$		40		
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

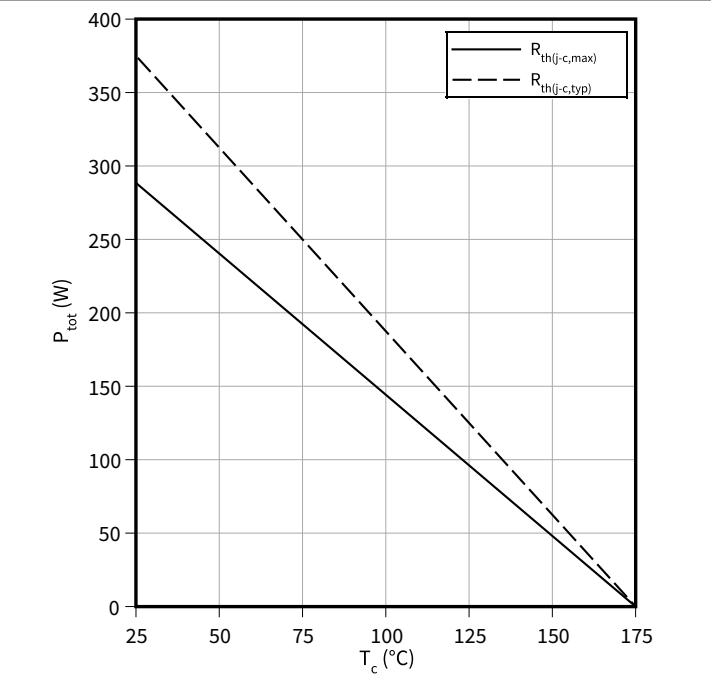
Reverse bias safe operating area (RBSOA)

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



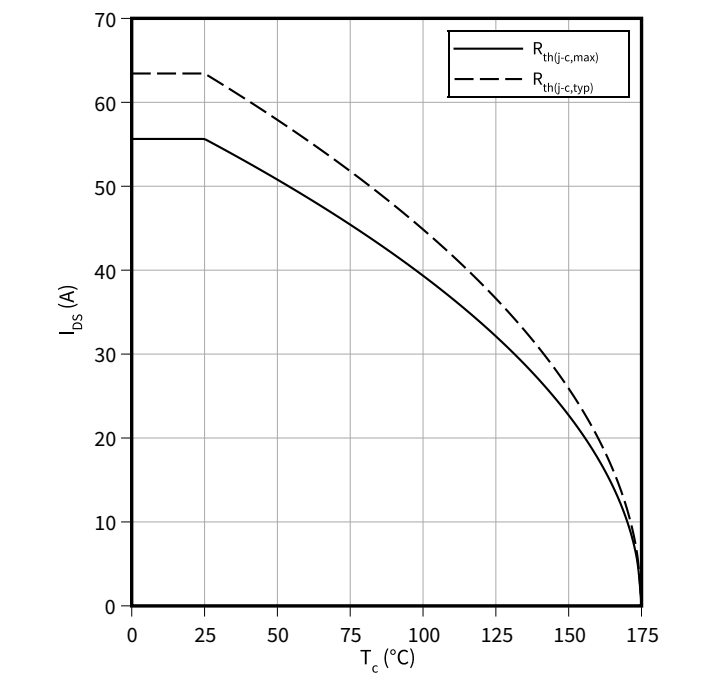
Power dissipation as a function of case temperature

$P_{tot} = f(T_c)$



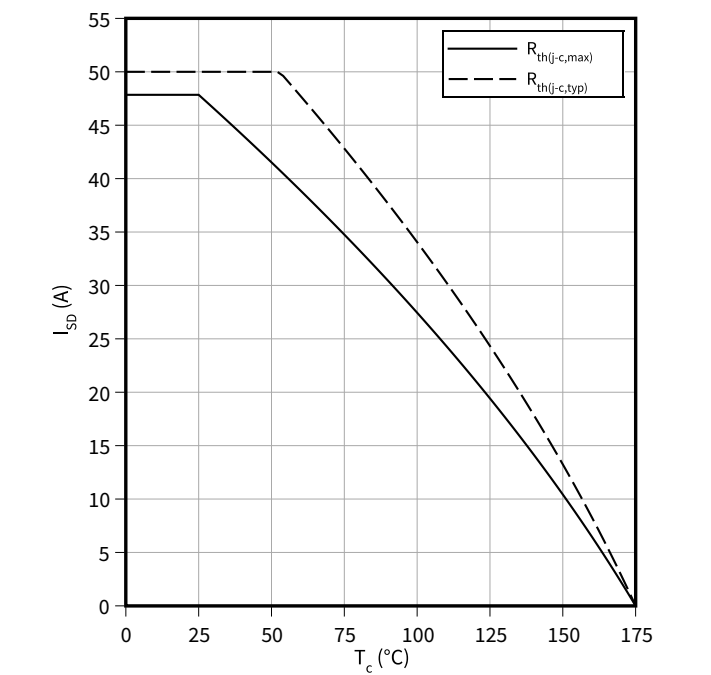
Maximum DC drain to source current as a function of case temperature limited by bond wire

$I_{DS} = f(T_c)$



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

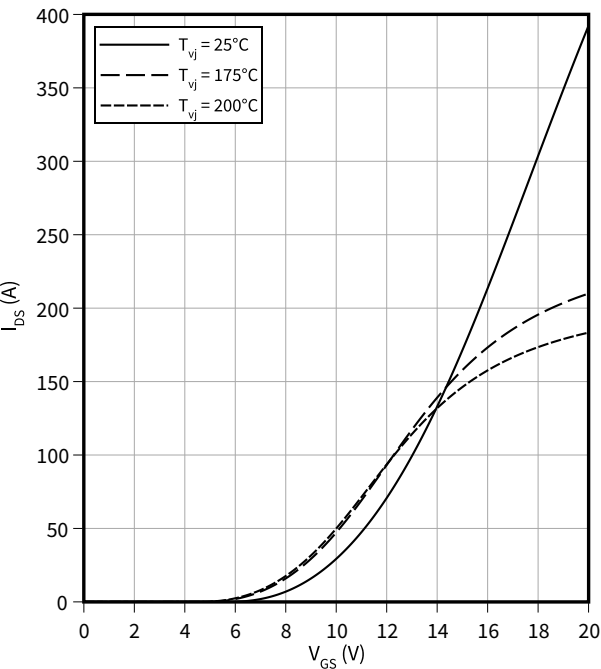
$I_{SD} = f(T_c)$
 $V_{GS} = 0\text{ V}$



4 Characteristics diagrams

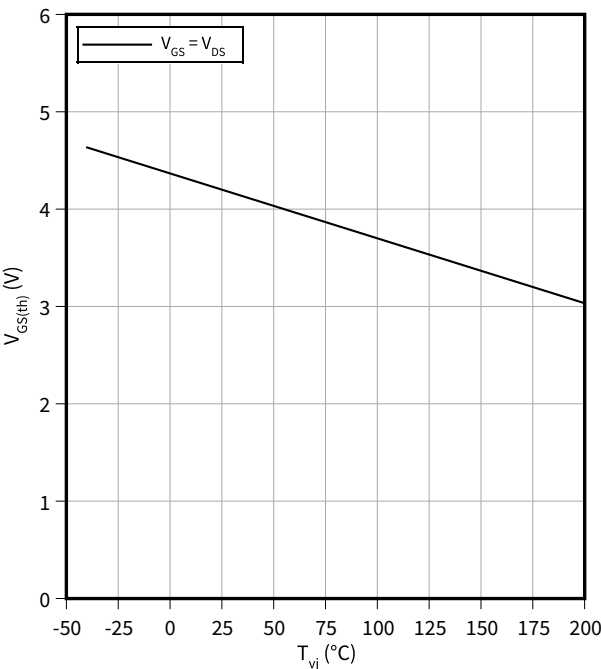
Typical transfer characteristic

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



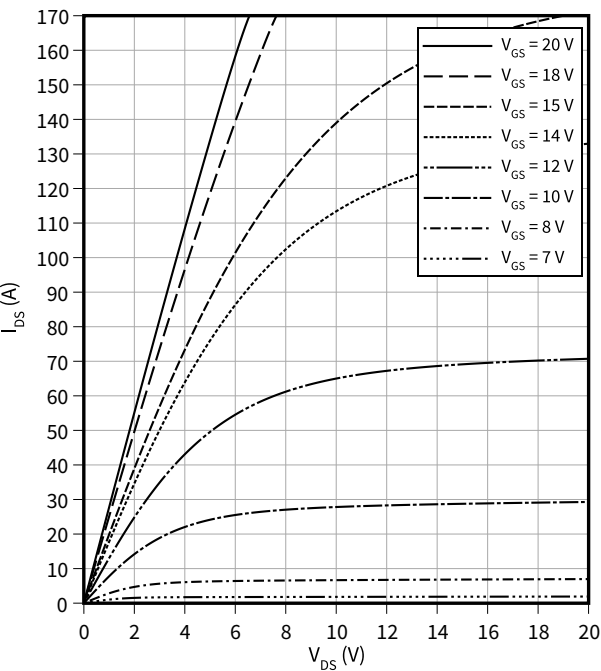
Typical gate-source threshold voltage as a function of junction temperature

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



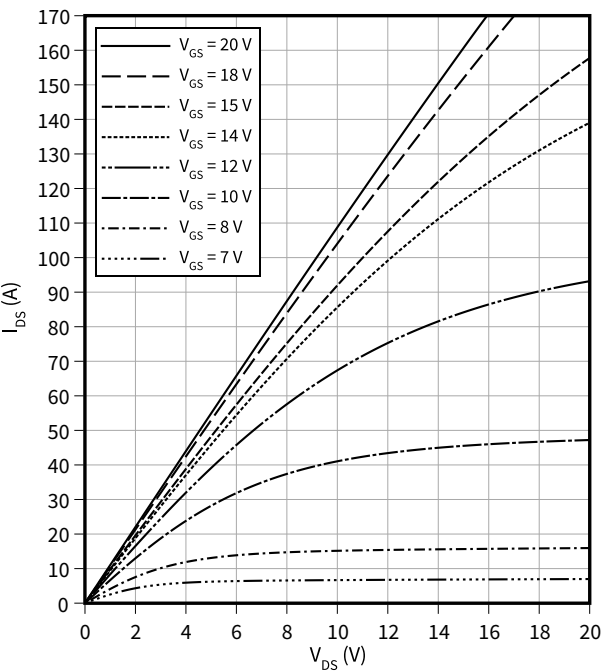
Typical output characteristic, V_{GS} as a parameter

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



Typical output characteristic, V_{GS} as a parameter

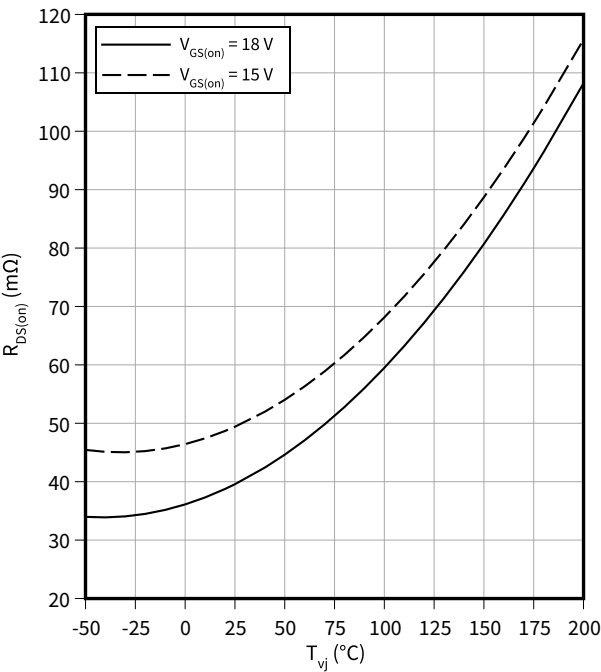
$I_{DS} = f(V_{DS})$
 $T_{vj} = 175\text{ }^\circ\text{C}$, $t_p = 20\text{ }\mu\text{s}$



4 Characteristics diagrams

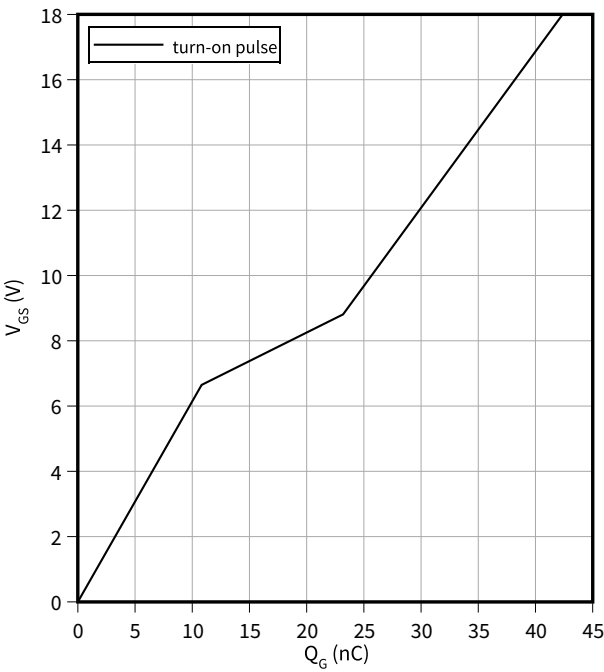
Typical on-state resistance as a function of junction temperature

$R_{DS(on)} = f(T_{vj})$
 $I_D = 17.5\text{ A}$



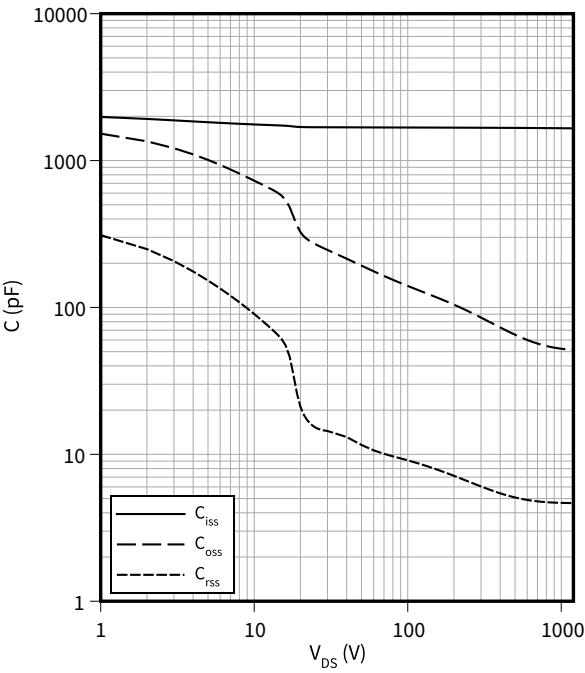
Typical gate charge

$V_{GS} = f(Q_G)$
 $I_D = 17.5\text{ A}, V_{DS} = 800\text{ V}$



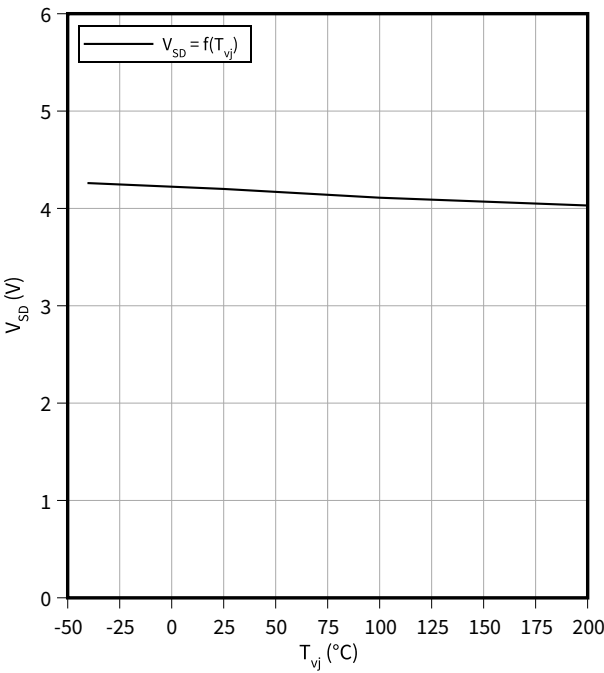
Typical capacitance as a function of drain-source voltage

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



Typical reverse drain voltage as a function of junction temperature

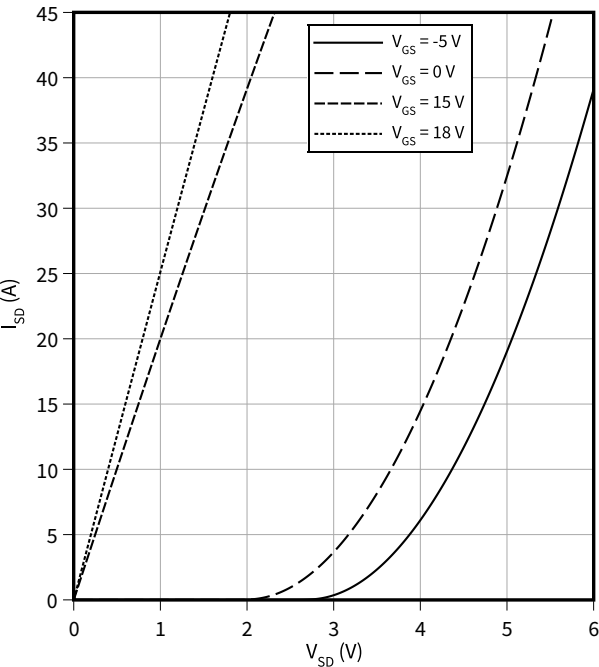
$V_{SD} = f(T_{vj})$
 $I_{SD} = 17.5\text{ A}, V_{GS} = 0\text{ V}$



4 Characteristics diagrams

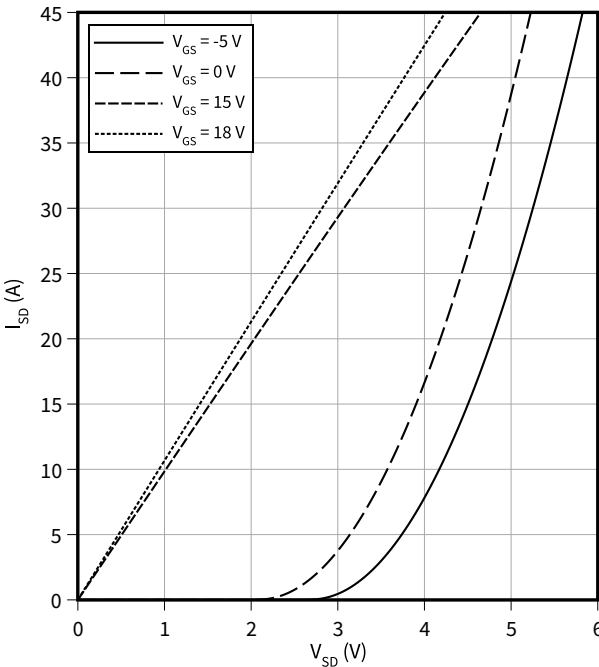
Typical reverse drain current as a function of reverse drain voltage, V_{GS} as a parameter

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



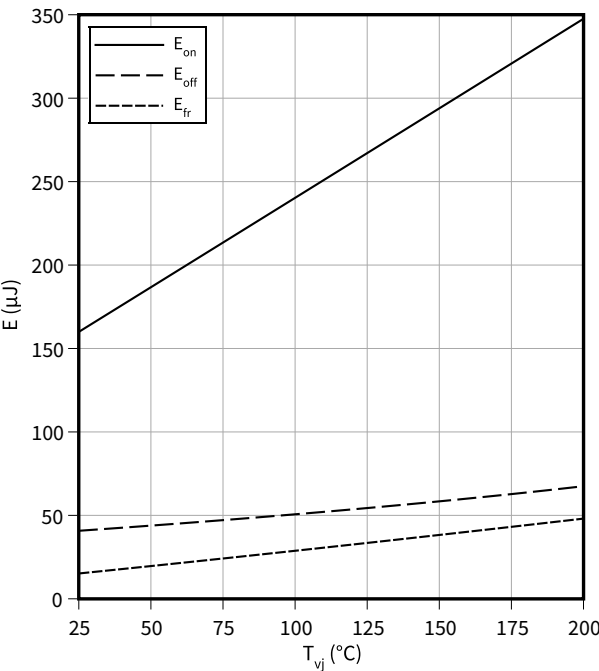
Typical reverse drain current as a function of reverse drain voltage, V_{GS} as a parameter

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



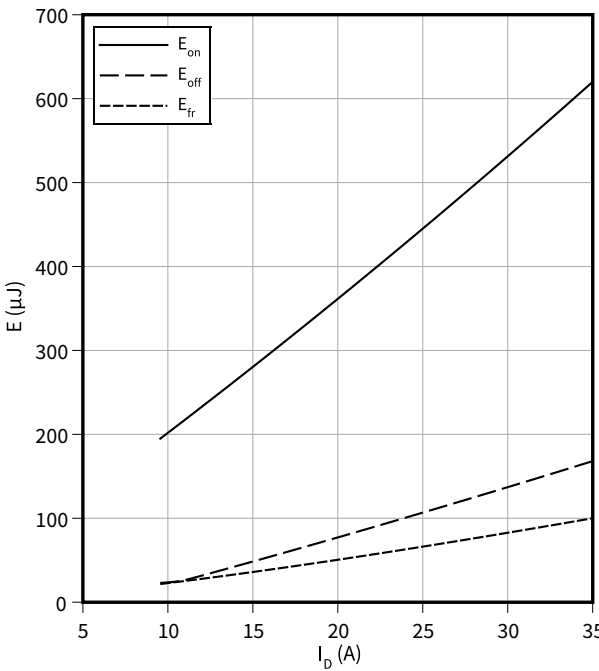
Typical switching energy as a function of junction temperature, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = 0\text{ V}$

$E = f(T_{vj})$
 $V_{GS} = 0/18\text{ V}$, $I_D = 17.5\text{ A}$, $R_{G,ext} = 2.3\text{ }\Omega$, $V_{DD} = 800\text{ V}$



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

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

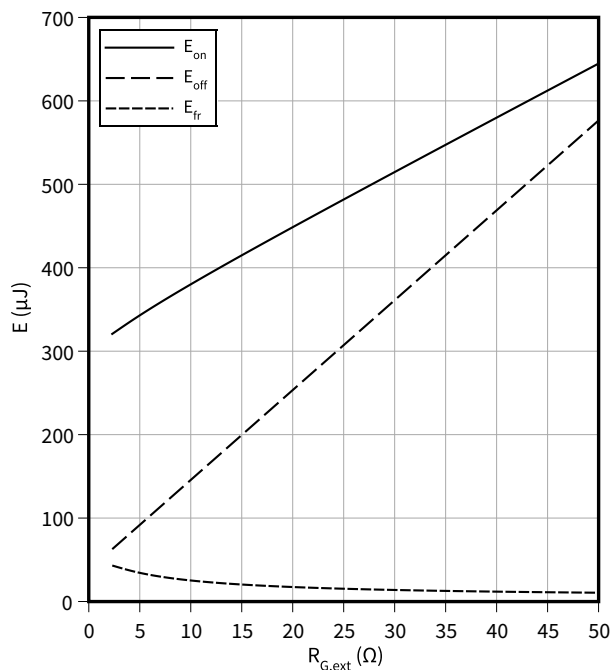


4 Characteristics diagrams

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

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

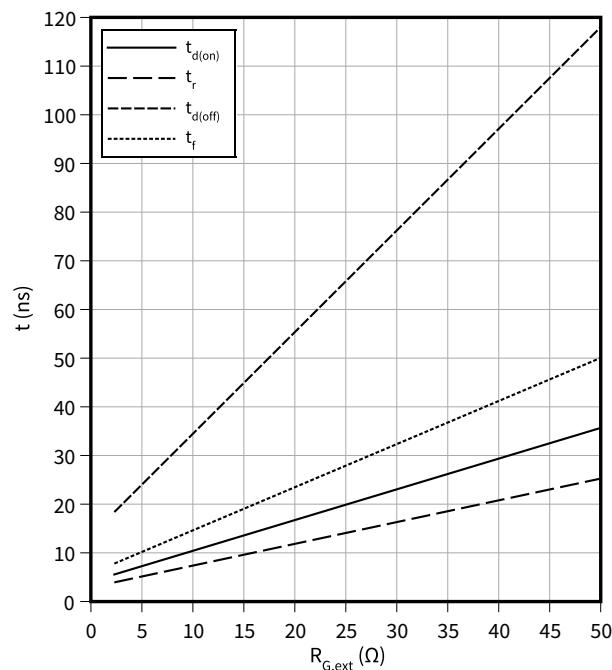
$V_{GS} = 0/18$ V, $I_D = 17.5$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V



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

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

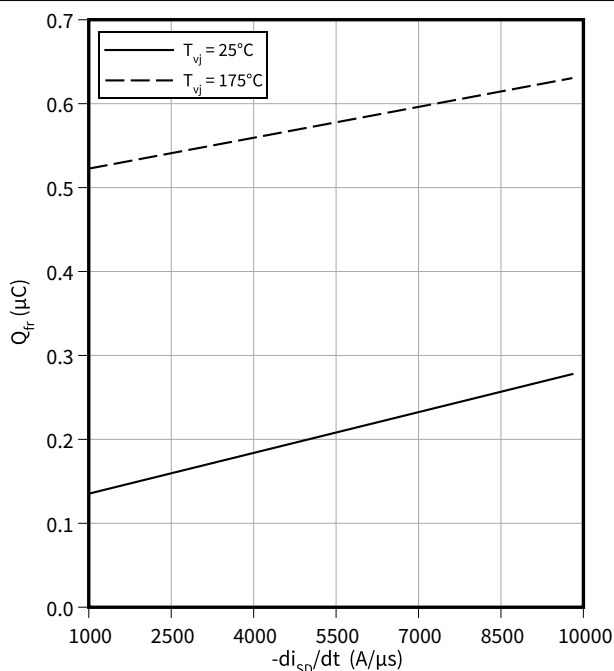
$V_{GS} = 0/18$ V, $I_D = 17.5$ A, $T_{vj} = 175$ °C, $V_{DD} = 800$ V



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

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

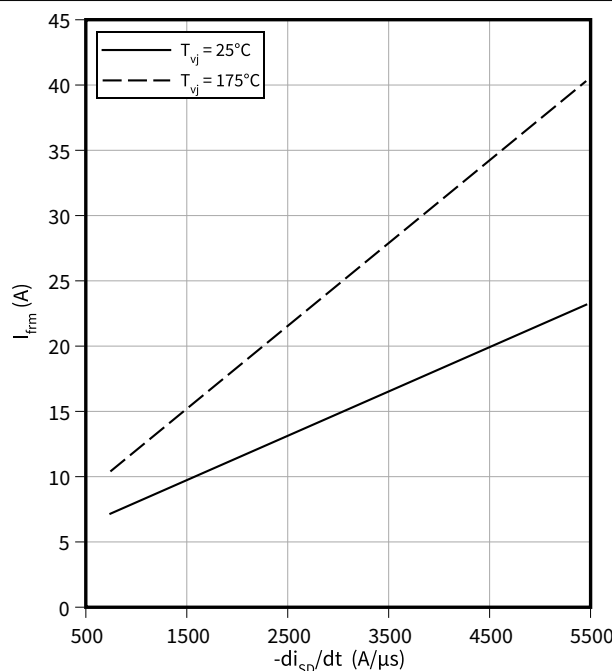
$V_{GS} = 0/18$ V, $I_{SD} = 17.5$ A, $V_{DD} = 800$ V



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

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

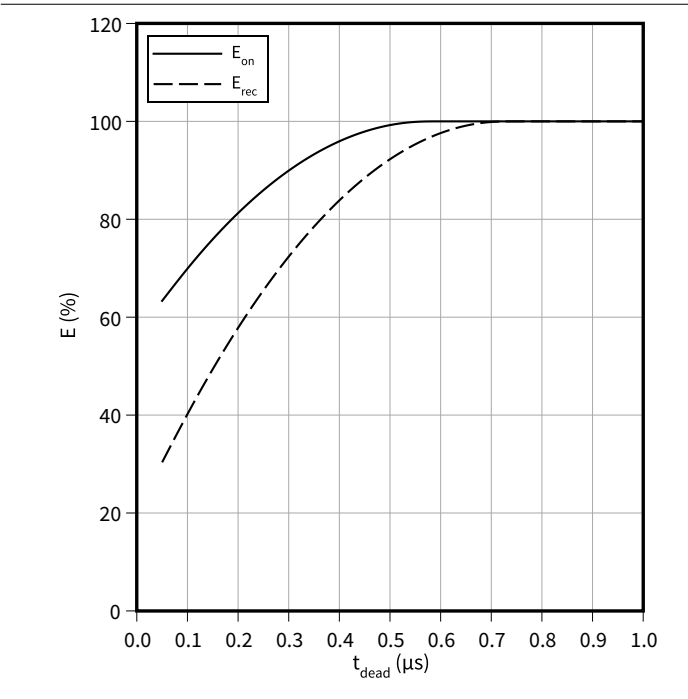
$V_{GS} = 0/18$ V, $I_{SD} = 17.5$ A, $V_{DD} = 800$ V



4 Characteristics diagrams

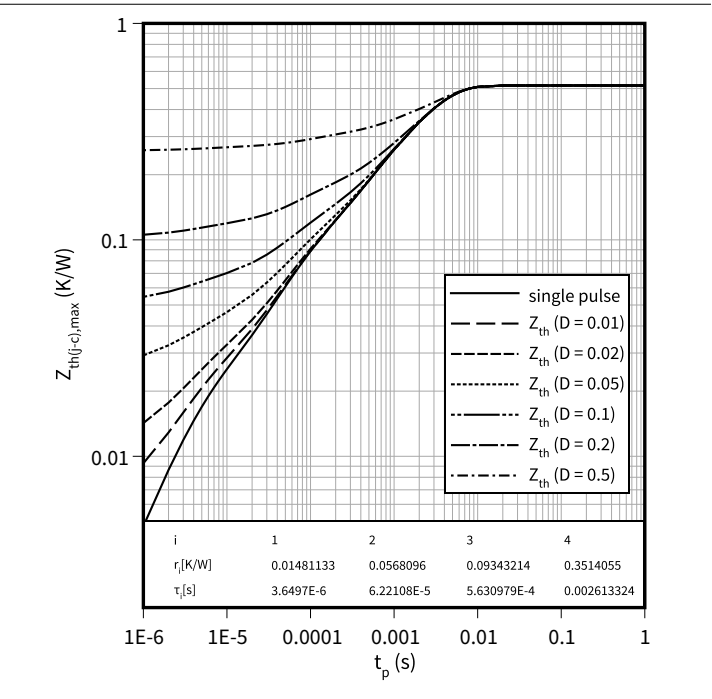
Typical switching energy as a function of dead time / blanking time, test circuit in Fig. F, 2nd device own body diode: $V_{GS} = -5\text{ V}$

$E = f(t_{dead})$
 $V_{GS} = 0/18\text{ V}$, $I_D = 17.5\text{ A}$, $T_{vj} = 175\text{ °C}$, $R_{G,ext} = 2.3\text{ }\Omega$
 $V_{DD} = 800\text{ V}$



Max. transient thermal impedance (MOSFET/diode)

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



5 Package outlines

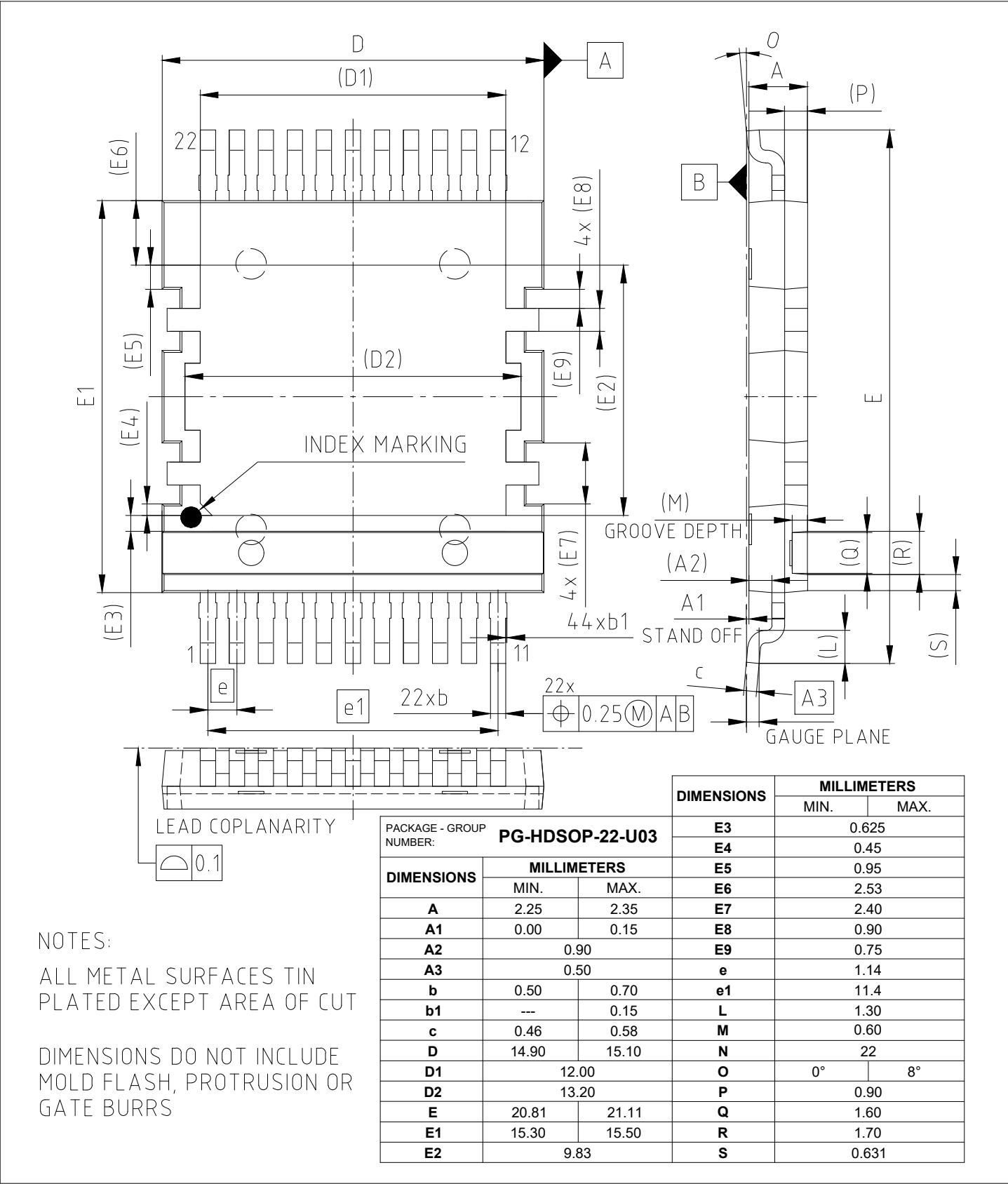


Figure 1

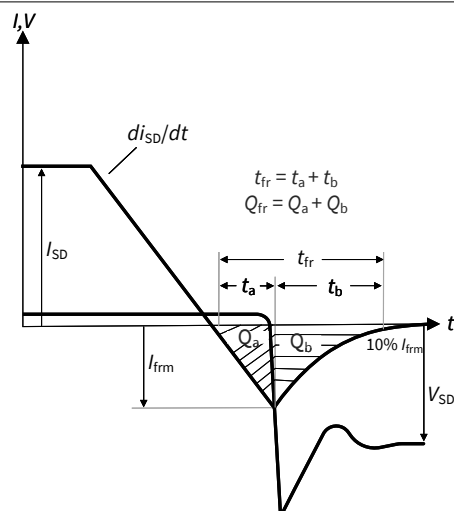


Figure B. **Definition of body diode switching characteristics**

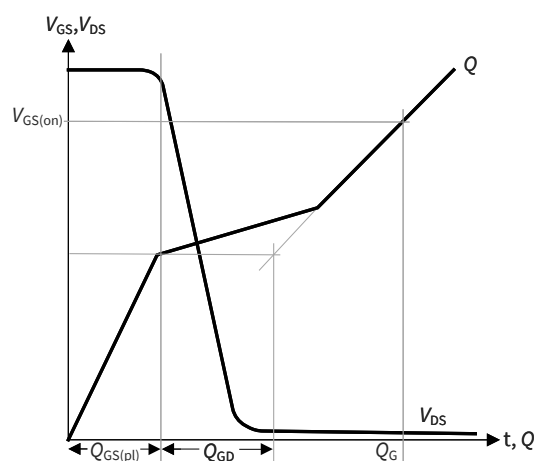
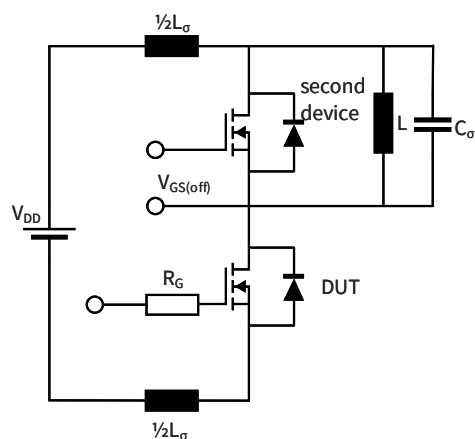
Figure D. **Definition of QGD**

Figure F. **Dynamic test circuit**

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



Revision history

Revision history

Document revision	Date of release	Description of changes
0.10	2023-11-13	Target datasheet
0.20	2024-11-20	Updated values Added diagrams
1.00	2024-12-12	Final datasheet

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