

# MOSFET

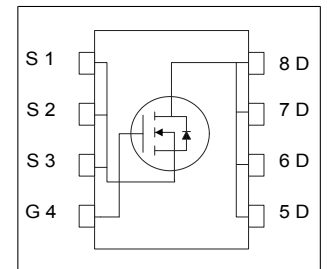
## OptiMOS™3 Power-Transistor, 200 V

### Features

- N-channel, normal level
- 175 °C rated
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21
- Ideal for high-frequency switching and synchronous rectification

### Product Validation:

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



**Table 1 Key Performance Parameters**

Parameter	Value	Unit
$V_{DS}$	200	V
$R_{DS(on),max}$	22	mΩ
$I_D$	52	A

Type / Ordering Code	Package	Marking	Related Links
BSC220N20NSFD	TSON-8-3	220N20F	-

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## 1 Maximum ratings

at  $T_A=25\text{ °C}$ , unless otherwise specified

**Table 2 Maximum ratings**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current	$I_D$	-	-	52 41	A	$T_C=25\text{ °C}$ $T_C=100\text{ °C}$
Pulsed drain current <sup>1)</sup>	$I_{D,pulse}$	-	-	208	A	$T_C=25\text{ °C}$
Avalanche energy, single pulse	$E_{AS}$	-	-	214	mJ	$I_D=38\text{ A}$ , $R_{GS}=25\ \Omega$
Reverse diode peak $dv/dt$	$dv/dt$	-	-	60	kV/ $\mu$ s	$I_D=52\text{ A}$ , $V_{DS}=100\text{ V}$ , $di/dt=1500\text{ A}/\mu\text{s}$ , $T_{j,max}=175\text{ °C}$
Gate source voltage	$V_{GS}$	-20	-	20	V	-
Power dissipation	$P_{tot}$	-	-	214	W	$T_C=25\text{ °C}$
Operating and storage temperature	$T_j$ , $T_{stg}$	-55	-	175	°C	IEC climatic category; DIN IEC 68-1: 55/175/56

## 2 Thermal characteristics

$T_j=25\text{ °C}$ , unless otherwise specified

**Table 3 Thermal characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	$R_{thJC}$	-	0.4	0.7	K/W	-
Thermal resistance, junction - ambient, minimal footprint	$R_{thJA}$	-	-	75	K/W	-
Thermal resistance, junction - ambient, 6 cm <sup>2</sup> cooling area <sup>2)</sup>	$R_{thJA}$	-	-	50	K/W	-

<sup>1)</sup> See Diagram 3

<sup>2)</sup> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70  $\mu$ m thick) copper area for drain connection. PCB is vertical in still air.

### 3 Electrical characteristics

at  $T_j=25\text{ °C}$ , unless otherwise specified

**Table 4 Static characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	200	-	-	V	$V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$
Gate threshold voltage	$V_{GS(th)}$	2	3	4	V	$V_{DS}=V_{GS}$ , $I_D=137\text{ }\mu\text{A}$
Zero gate voltage drain current	$I_{DSS}$	-	0.1 10	1 100	$\mu\text{A}$	$V_{DS}=160\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$ $V_{DS}=160\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ °C}$
Gate-source leakage current	$I_{GSS}$	-	1	100	nA	$V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	17.7	22	m $\Omega$	$V_{GS}=10\text{ V}$ , $I_D=52\text{ A}$
Gate resistance <sup>1)</sup>	$R_G$	-	3.7	5.5	$\Omega$	-
Transconductance	$g_{fs}$	44	88	-	S	$ V_{DS} >2 I_D R_{DS(on)max}$ , $I_D=52\text{ A}$

**Table 5 Dynamic characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance <sup>1)</sup>	$C_{iss}$	-	2770	3680	pF	$V_{GS}=0\text{ V}$ , $V_{DS}=100\text{ V}$ , $f=1\text{ MHz}$
Output capacitance <sup>1)</sup>	$C_{oss}$	-	210	279	pF	$V_{GS}=0\text{ V}$ , $V_{DS}=100\text{ V}$ , $f=1\text{ MHz}$
Reverse transfer capacitance <sup>1)</sup>	$C_{rss}$	-	5.7	10	pF	$V_{GS}=0\text{ V}$ , $V_{DS}=100\text{ V}$ , $f=1\text{ MHz}$
Turn-on delay time	$t_{d(on)}$	-	7	-	ns	$V_{DD}=100\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=17\text{ A}$ , $R_{G,ext}=1.6\text{ }\Omega$
Rise time	$t_r$	-	7	-	ns	$V_{DD}=100\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=17\text{ A}$ , $R_{G,ext}=1.6\text{ }\Omega$
Turn-off delay time	$t_{d(off)}$	-	28	-	ns	$V_{DD}=100\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=17\text{ A}$ , $R_{G,ext}=1.6\text{ }\Omega$
Fall time	$t_f$	-	10	-	ns	$V_{DD}=100\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=17\text{ A}$ , $R_{G,ext}=1.6\text{ }\Omega$

**Table 6 Gate charge characteristics<sup>2)</sup>**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	$Q_{gs}$	-	13.1	-	nC	$V_{DD}=100\text{ V}$ , $I_D=52\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$
Gate to drain charge <sup>1)</sup>	$Q_{gd}$	-	4.4	7	nC	$V_{DD}=100\text{ V}$ , $I_D=52\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$
Switching charge	$Q_{sw}$	-	9.2	-	nC	$V_{DD}=100\text{ V}$ , $I_D=52\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$
Gate charge total <sup>1)</sup>	$Q_g$	-	34	43	nC	$V_{DD}=100\text{ V}$ , $I_D=52\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$
Gate plateau voltage	$V_{plateau}$	-	4.7	-	V	$V_{DD}=100\text{ V}$ , $I_D=52\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$
Output charge <sup>1)</sup>	$Q_{oss}$	-	84	111	nC	$V_{DD}=100\text{ V}$ , $V_{GS}=0\text{ V}$

<sup>1)</sup> Defined by design. Not subject to production test.

<sup>2)</sup> See "Gate charge waveforms" for parameter definition

**Table 7 Reverse diode**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current	$I_S$	-	-	52	A	$T_C=25\text{ °C}$
Diode pulse current <sup>1)</sup>	$I_{S,pulse}$	-	-	208	A	$T_C=25\text{ °C}$
Diode hard commutation current <sup>2)</sup>	$I_{S,hard}$	-	-	52	A	$T_C=25\text{ °C}$ , $di_F/dt=1500\text{ A}/\mu\text{s}$
Diode forward voltage	$V_{SD}$	-	1.0	1.2	V	$V_{GS}=0\text{ V}$ , $I_F=52\text{ A}$ , $T_J=25\text{ °C}$
Reverse recovery time <sup>3)</sup>	$t_{rr}$	-	89	-	ns	$V_R=100\text{ V}$ , $I_F=12.5\text{ A}$ , $di_F/dt=100\text{ A}/\mu\text{s}$
Reverse recovery charge <sup>3)</sup>	$Q_{rr}$	-	195	-	nC	$V_R=100\text{ V}$ , $I_F=12.5\text{ A}$ , $di_F/dt=100\text{ A}/\mu\text{s}$

<sup>1)</sup> Diode pulse current is defined by thermal and/or package limits

<sup>2)</sup> Maximum allowed hard-commutated current through diode at  $di/dt=1500\text{ A}/\mu\text{s}$

<sup>3)</sup> Defined by design. Not subject to production test.

### 4 Electrical characteristics diagrams

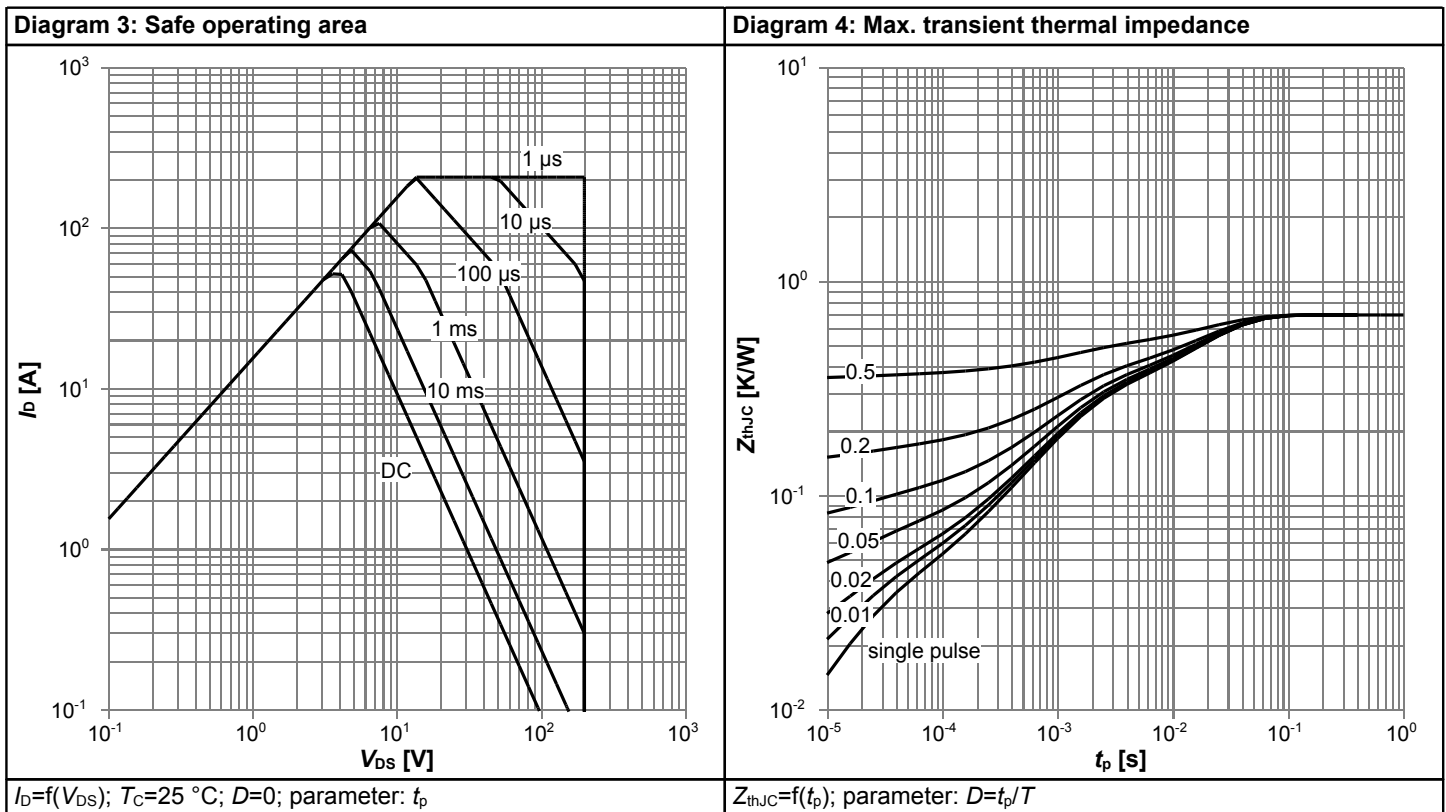
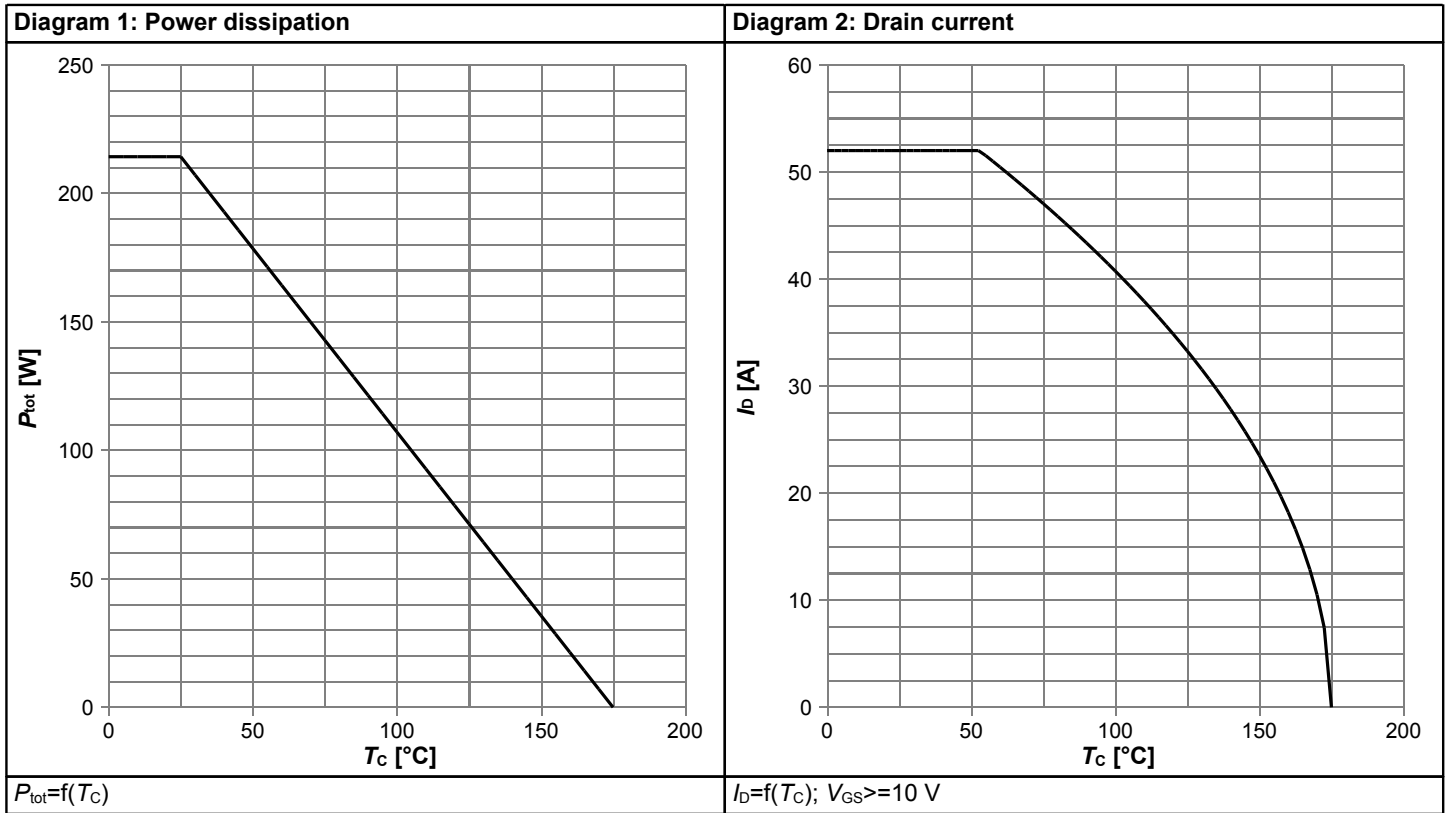
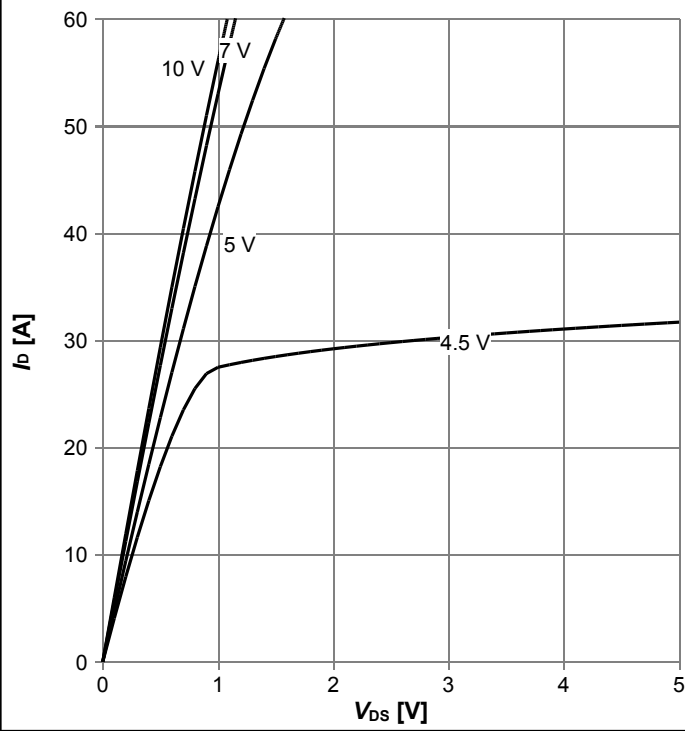
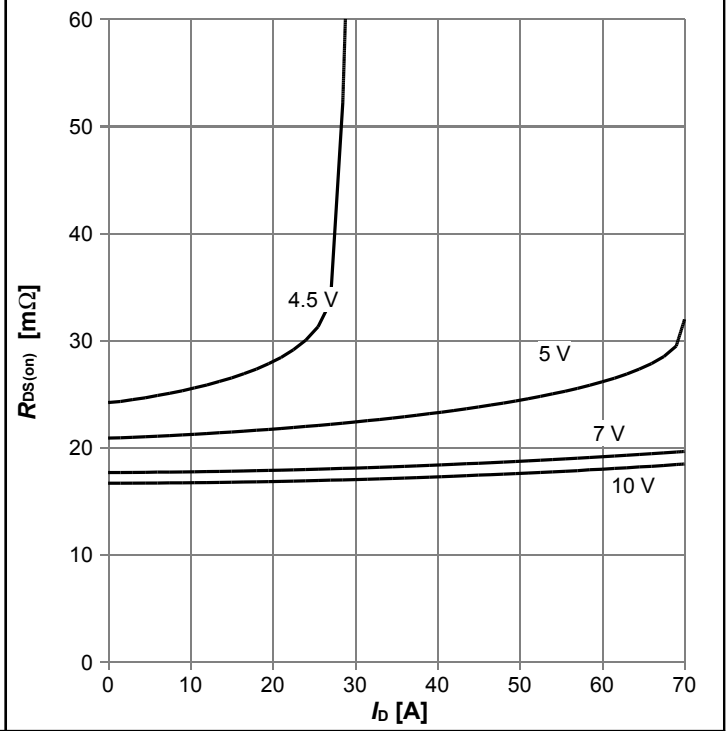


Diagram 5: Typ. output characteristics



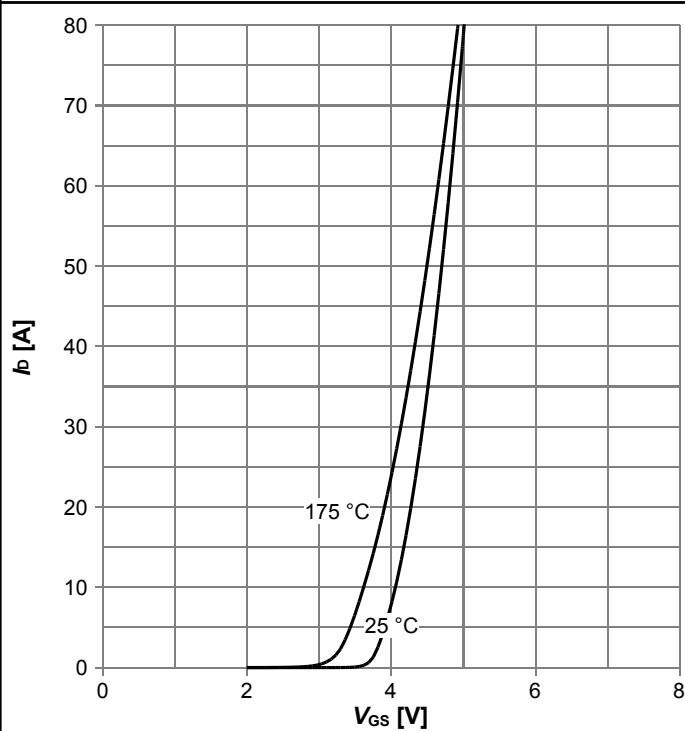
$I_D = f(V_{DS}); T_j = 25\text{ °C};$  parameter:  $V_{GS}$

Diagram 6: Typ. drain-source on resistance



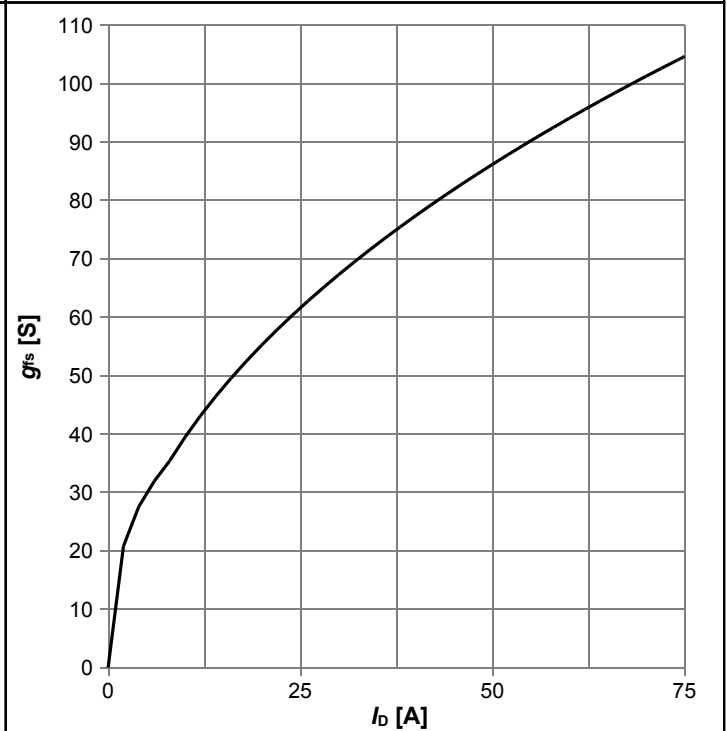
$R_{DS(on)} = f(I_D); T_j = 25\text{ °C};$  parameter:  $V_{GS}$

Diagram 7: Typ. transfer characteristics



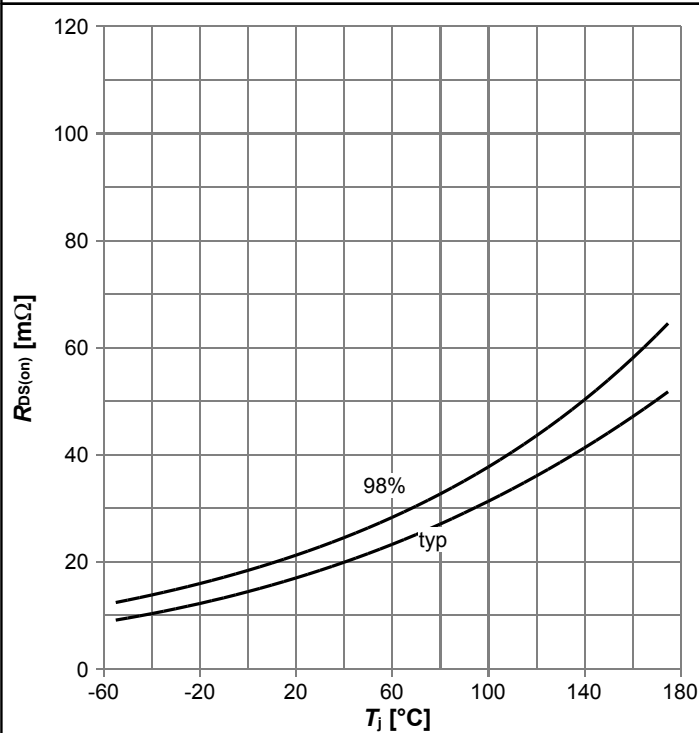
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max};$  parameter:  $T_j$

Diagram 8: Typ. forward transconductance



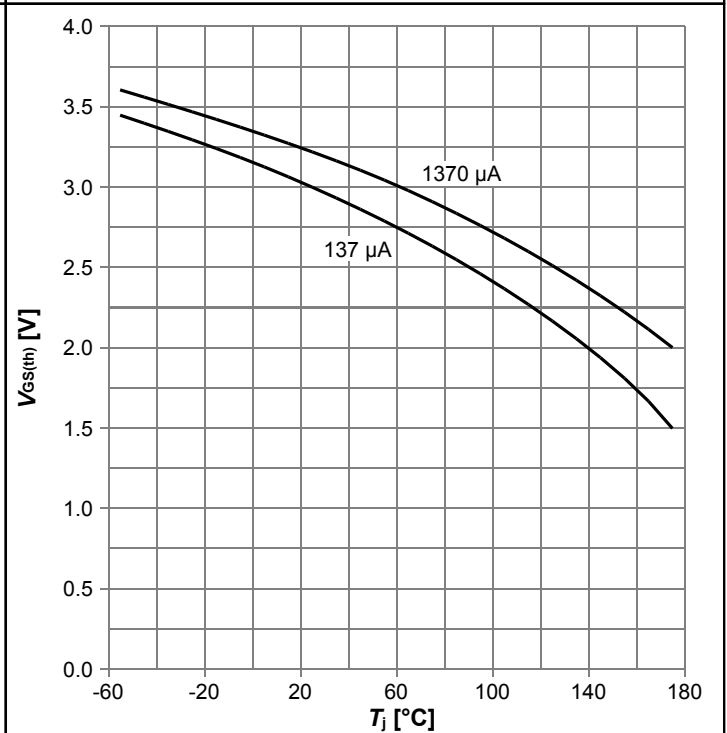
$g_{fs} = f(I_D); T_j = 25\text{ °C}$

Diagram 9: Drain-source on-state resistance



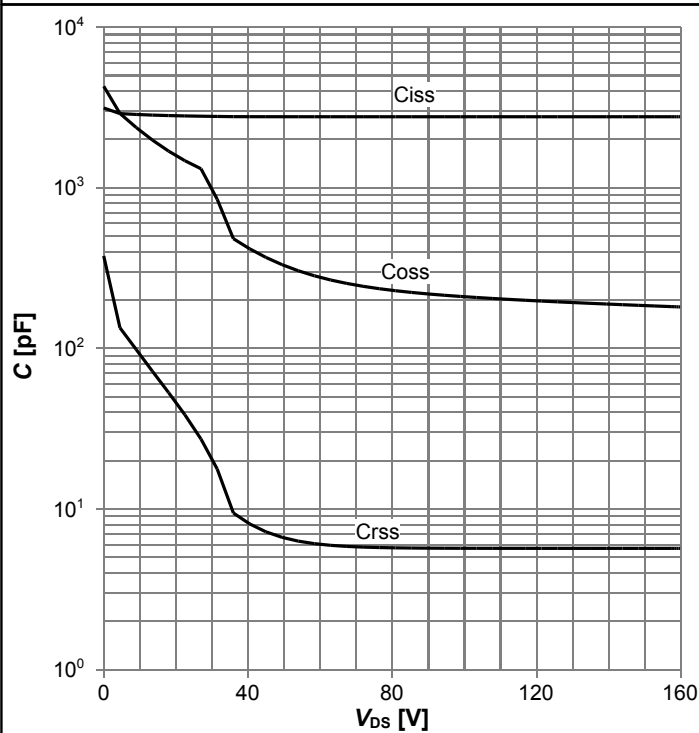
$R_{DS(on)}=f(T_j)$ ;  $I_D=55\text{ A}$ ;  $V_{GS}=10\text{ V}$

Diagram 10: Typ. gate threshold voltage



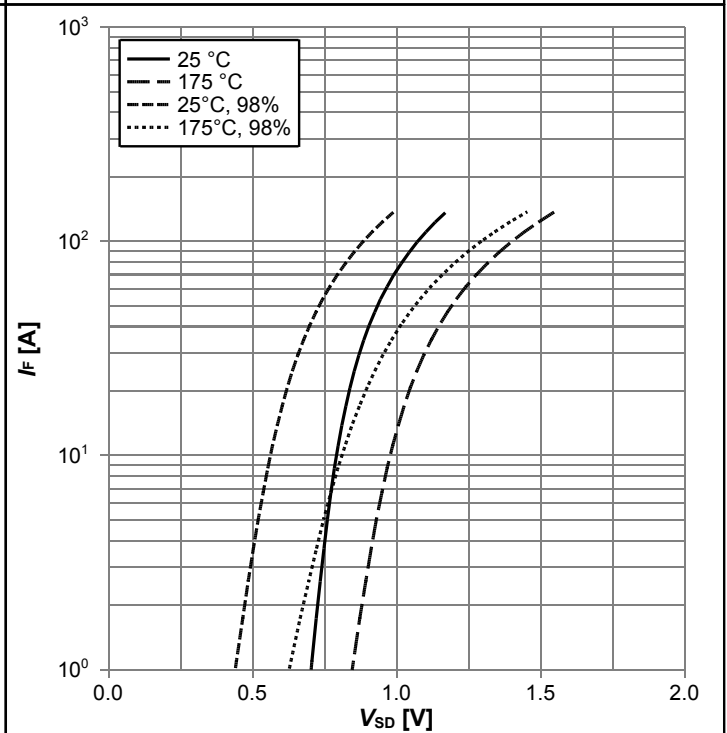
$V_{GS(th)}=f(T_j)$ ;  $V_{GS}=V_{DS}$ ; parameter:  $I_D$

Diagram 11: Typ. capacitances



$C=f(V_{DS})$ ;  $V_{GS}=0\text{ V}$ ;  $f=1\text{ MHz}$

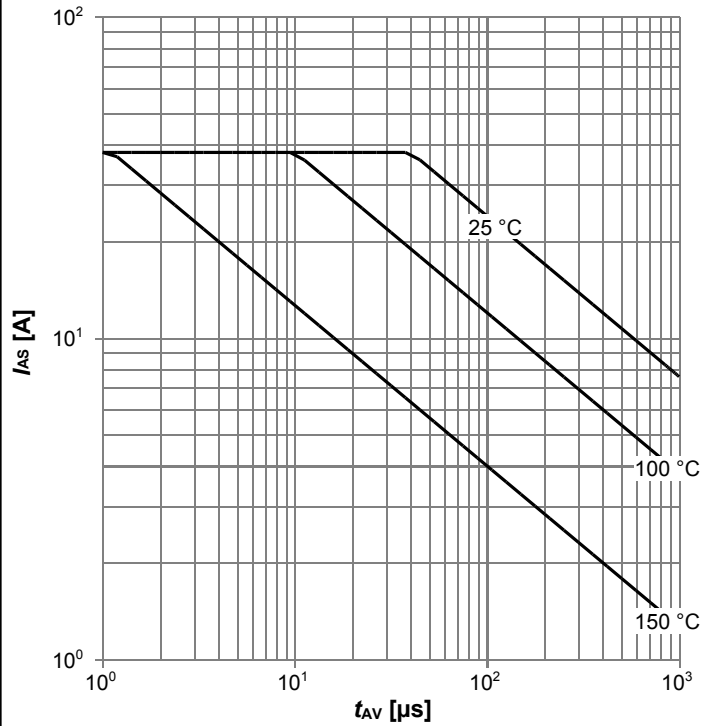
Diagram 12: Forward characteristics of reverse diode



$I_F=f(V_{SD})$ ; parameter:  $T_j$

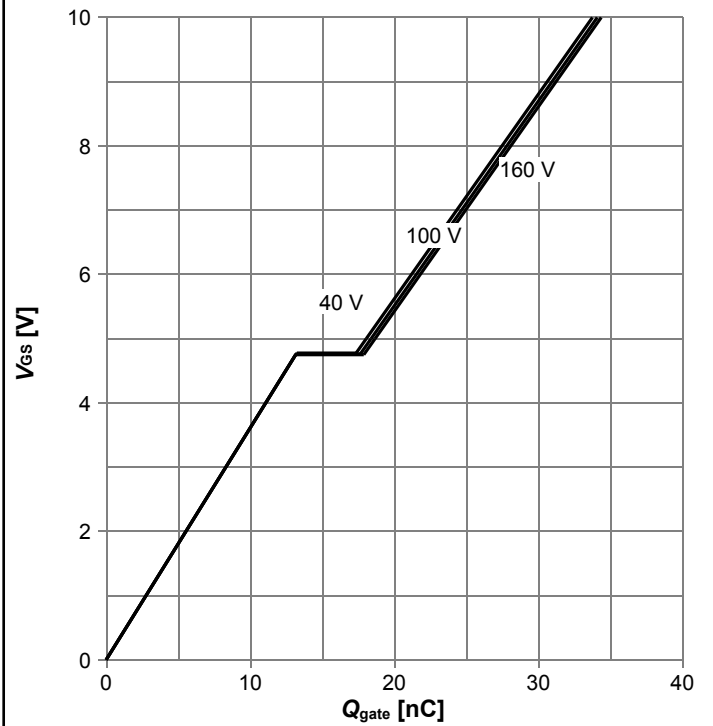


**Diagram 13: Avalanche characteristics**



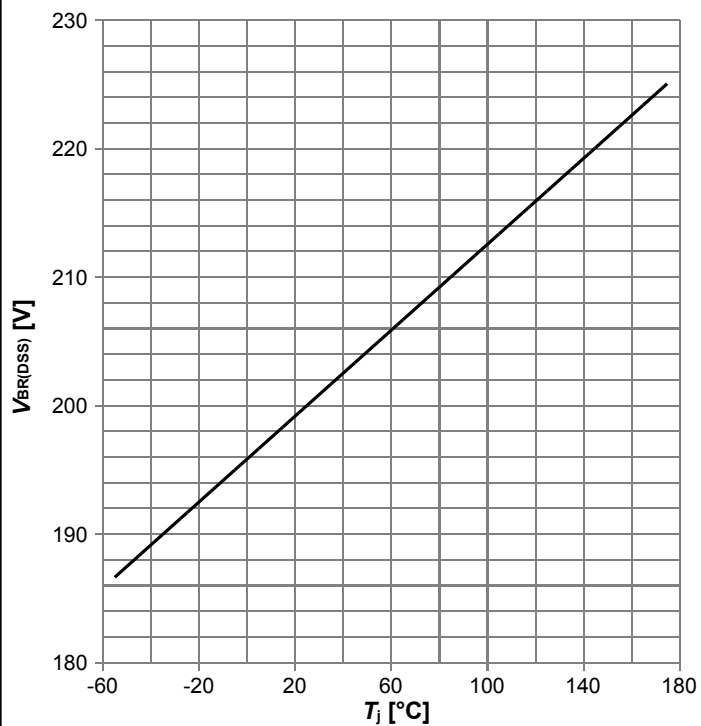
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$ ; parameter:  $T_{j(start)}$

**Diagram 14: Typ. gate charge**



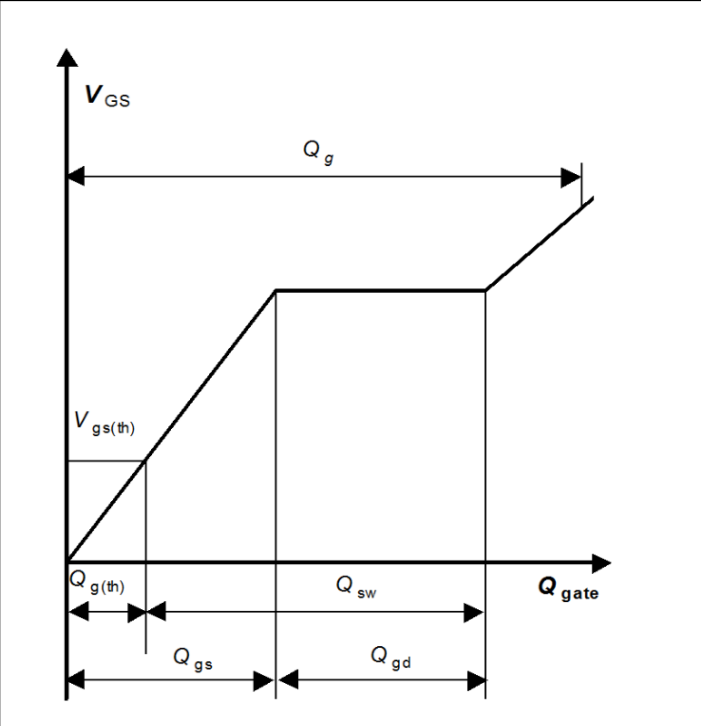
$V_{GS}=f(Q_{gate}); I_D=55 \text{ A pulsed}$ ; parameter:  $V_{DD}$

**Diagram 15: Drain-source breakdown voltage**

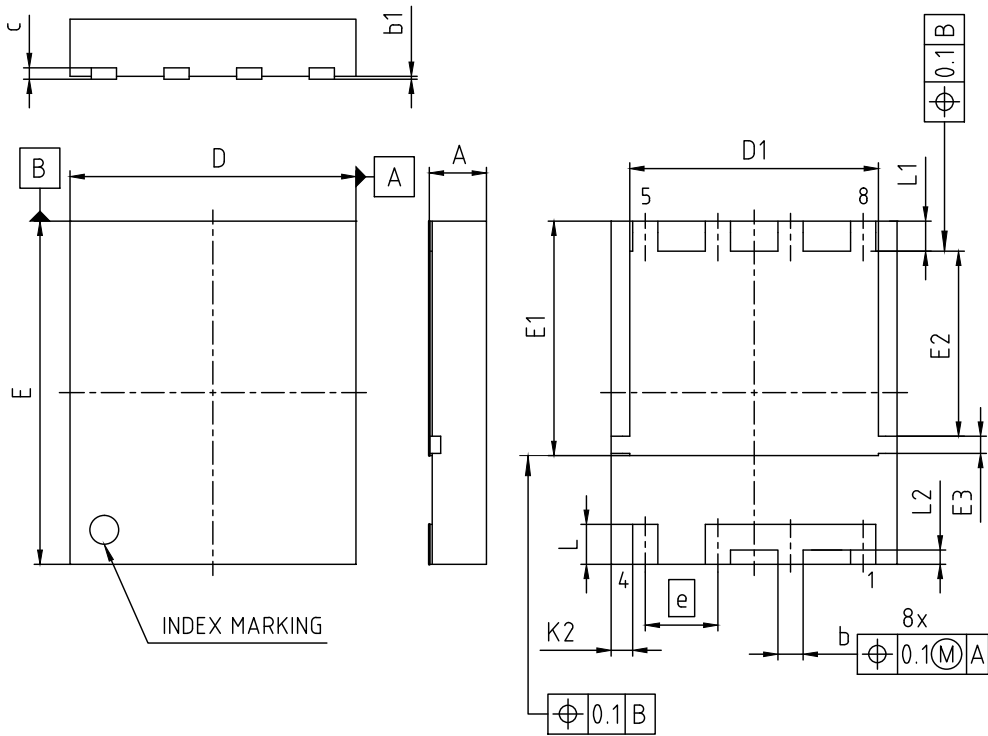


$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$

**Diagram Gate charge waveforms**



### 5 Package Outlines



DIMENSION	MILLIMETERS	
	MIN.	MAX.
A	-	1.10
b	0.34	0.54
b1	-	0.05
c	0.20	
D	4.90	5.10
D1	4.25	4.45
E	5.90	6.10
E1	4.00	4.20
E2	3.14	3.34
E3	0.20	0.40
e	1.27	
K2	(0.37)	
L	0.60	0.80
L1	0.43	0.63
L2	(0.25)	

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Figure 1 Outline TSON-8-3, dimensions in mm/inches

## Revision History

BSC220N20NSFD

**Revision: 2018-03-14, Rev. 2.0**

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2018-03-14	Release of final version

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