

## SIPMOS® Small-Signal-Transistor

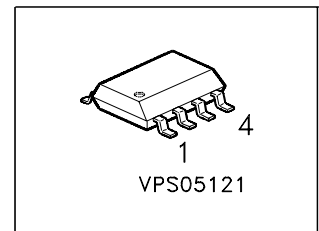
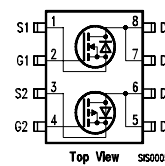
### Features

- Dual N- and P -Channel
- Enhancement mode
- Logic Level
- Avalanche rated
- dv/dt rated

### Product Summary

		N	P	
Drain source voltage	$V_{DS}$	60	-60	V
Drain-Source on-state resistance	$R_{DS(on)}$	0.11	0.3	$\Omega$
Continuous drain current	$I_D$	3.1	-2	A

Type	Package	Ordering Code
BSO 615 C	SO 8	Q67041-S4024



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

Parameter	Symbol	Value		Unit
		N	P	
Continuous drain current $T_A = 25\text{ °C}$ $T_A = 70\text{ °C}$	$I_D$	3.1 2.5	-2 -1.6	A
Pulsed drain current $T_A = 25\text{ °C}$	$I_{D\text{ puls}}$	12.4	-8	
Avalanche energy, single pulse $I_D = 3.1\text{ A}$ , $V_{DD} = 25\text{ V}$ , $R_{GS} = 25\ \Omega$ $I_D = -2\text{ A}$ , $V_{DD} = -25\text{ V}$ , $R_{GS} = 25\ \Omega$	$E_{AS}$	47 -	- 70	mJ
Avalanche energy, periodic limited by $T_{j\text{max}}$	$E_{AR}$	0.2	0.2	
Reverse diode dv/dt, $T_{j\text{max}} = 150\text{ °C}$ $I_S = 3.1\text{ A}$ , $V_{DS} = 48\text{ V}$ , $di/dt = 200\text{ A}/\mu\text{s}$ $I_S = -2\text{ A}$ , $V_{DS} = -48\text{ V}$ , $di/dt = -200\text{ A}/\mu\text{s}$	dv/dt	6 -	- 6	kV/ $\mu\text{s}$
Gate source voltage	$V_{GS}$	$\pm 20$	$\pm 20$	V
Power dissipation $T_A = 25\text{ °C}$	$P_{\text{tot}}$	2	2	W
Operating and storage temperature	$T_j, T_{\text{stg}}$	-55...+150		$^{\circ}\text{C}$
IEC climatic category; DIN IEC 68-1		55/150/56		

**Thermal Characteristics**

Parameter	Symbol	Values			Unit
		min.	typ.	max.	

**Dynamic Characteristics**

Thermal resistance, junction - soldering point ( Pin 4)	N	$R_{thJS}$	-	-	40	K/W
	P		-	-	40	
SMD version, device on PCB: @ min. footprint; $t \leq 10$ sec. @ 6 cm <sup>2</sup> cooling area 1); $t \leq 10$ sec. @ min. footprint; $t \leq 10$ sec. @ 6 cm <sup>2</sup> cooling area 1); $t \leq 10$ sec.	N	$R_{thJA}$	-	-	100	
	N		-	-	62.5	
	P		-	-	110	
	P		-	-	62.5	

**Static Characteristics**, at  $T_j = 25$  °C, unless otherwise specified

Drain- source breakdown voltage $V_{GS} = 0$ V, $I_D = 250$ $\mu$ A $V_{GS} = 0$ V, $I_D = -250$ $\mu$ A	N	$V_{(BR)DSS}$	60	-	-	V
	P		-60	-	-	
Gate threshold voltage, $V_{GS} = V_{DS}$ $I_D = 20$ $\mu$ A $I_D = -450$ $\mu$ A	N	$V_{GS(th)}$	1.2	1.6	2.0	
	P		-1	-1.5	-2.0	
Zero gate voltage drain current $V_{DS} = 60$ V, $V_{GS} = 0$ V, $T_j = 25$ °C $V_{DS} = 60$ V, $V_{GS} = 0$ V, $T_j = 125$ °C $V_{DS} = -60$ V, $V_{GS} = 0$ V, $T_j = 25$ °C $V_{DS} = -60$ V, $V_{GS} = 0$ V, $T_j = 125$ °C	N	$I_{DSS}$	-	0.1	1	$\mu$ A
	N		-	10	100	
	P		-	-0.1	-1	
	P		-	-10	-100	
Gate-source leakage current $V_{GS} = 20$ V, $V_{DS} = 0$ V $V_{GS} = -20$ V, $V_{DS} = 0$ V	N	$I_{GSS}$	-	10	100	nA
	P		-	-10	-100	
Drain-Source on-state resistance $V_{GS} = 4.5$ V, $I_D = 2.7$ A $V_{GS} = -4.5$ V, $I_D = -1.7$ A	N	$R_{DS(on)}$	-	0.1	0.15	$\Omega$
	P		-	0.27	0.45	
Drain-Source on-state resistance $V_{GS} = 10$ V, $I_D = 3.1$ A $V_{GS} = -10$ V, $I_D = -2$ A	N	$R_{DS(on)}$	-	0.07	0.11	
	P		-	0.19	0.3	

<sup>1</sup>Device on 40mm\*40mm\*1.5mm epoxy PCB FR4 with 6cm<sup>2</sup> (one layer, 70  $\mu$ m thick) copper area for drain connection. PCB is vertical without blown air.

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

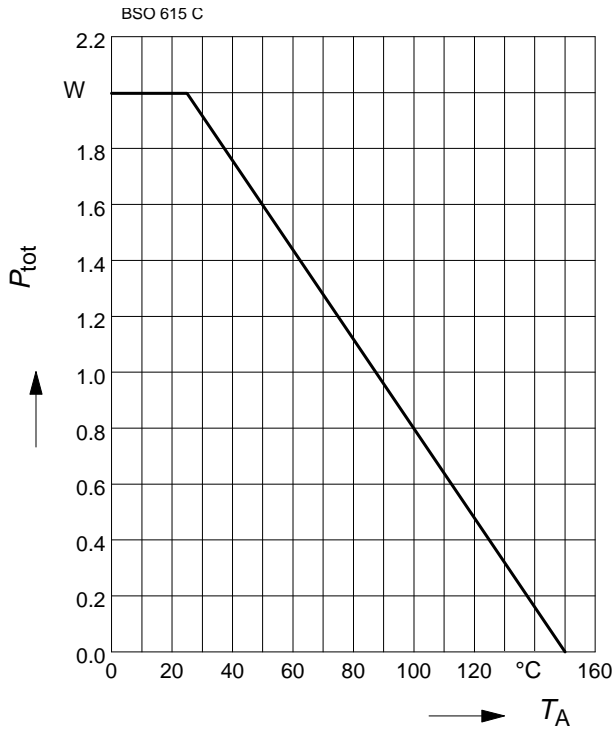
Parameter	Symbol	Values			Unit	
		min.	typ.	max.		
<b>Characteristics</b>						
Transconductance		$g_{fs}$				S
$V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$ , $I_D = 2.7\text{ A}$	N		2.25	5.5	-	
$V_{V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}}$ , $I_D = -1.7\text{ A}$	P		1.2	2.4	-	
Input capacitance		$C_{iss}$				pF
$V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$	N		-	300	380	
$V_{GS} = 0\text{ V}$ , $V_{DS} = -25\text{ V}$ , $f = 1\text{ MHz}$	P		-	365	460	
Output capacitance		$C_{oss}$				
$V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$	N		-	90	120	
$V_{GS} = 0\text{ V}$ , $V_{DS} = -25\text{ V}$ , $f = 1\text{ MHz}$	P		-	105	135	
Reverse transfer capacitance		$C_{rss}$				
$V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$	N		-	50	65	
$V_{GS} = 0\text{ V}$ , $V_{DS} = -25\text{ V}$ , $f = 1\text{ MHz}$	P		-	40	50	
Turn-on delay time		$t_{d(on)}$				ns
$V_{DD} = 30\text{ V}$ , $V_{GS} = 4.5\text{ V}$ , $I_D = 2.7\text{ A}$ , $R_G = 16\ \Omega$	N		-	16	24	
$V_{DD} = -30\text{ V}$ , $V_{GS} = -4.5\text{ V}$ , $I_D = -1.7\text{ A}$ , $R_G = 13\ \Omega$	P		-	24	36	
Rise time		$t_r$				
$V_{DD} = 30\text{ V}$ , $V_{GS} = 4.5\text{ V}$ , $I_D = 2.7\text{ A}$ , $R_G = 16\ \Omega$	N		-	75	115	
$V_{DD} = -30\text{ V}$ , $V_{GS} = -4.5\text{ V}$ , $I_D = -1.7\text{ A}$ , $R_G = 13\ \Omega$	P		-	105	160	
Turn-off delay time		$t_{d(off)}$				
$V_{DD} = 30\text{ V}$ , $V_{GS} = 4.5\text{ V}$ , $I_D = 2.7\text{ A}$ , $R_G = 16\ \Omega$	N		-	25	40	
$V_{DD} = -30\text{ V}$ , $V_{GS} = -4.5\text{ V}$ , $I_D = -1.7\text{ A}$ , $R_G = 13\ \Omega$	P		-	125	190	
Fall time		$t_f$				
$V_{DD} = 30\text{ V}$ , $V_{GS} = 4.5\text{ V}$ , $I_D = 2.7\text{ A}$ , $R_G = 16\ \Omega$	N		-	18	27	
$V_{DD} = -30\text{ V}$ , $V_{GS} = -4.5\text{ V}$ , $I_D = -1.7\text{ A}$ , $R_G = 13\ \Omega$	P		-	90	135	

**Electrical Characteristics**, at  $T_j = 25\text{ }^\circ\text{C}$ , unless otherwise specified

Parameter	Symbol	Values			Unit	
		min.	typ.	max.		
<b>Characteristics</b>						
Gate to source charge $V_{DD} = 48\text{ V}$ , $I_D = 3.1\text{ A}$ $V_{DD} = -48\text{ V}$ , $I_D = -2\text{ A}$	N P	$Q_{gs}$	- -	0.5 1.7	0.75 2.6	nC
Gate to drain charge $V_{DD} = 48\text{ V}$ , $I_D = 3.1\text{ A}$ $V_{DD} = -48\text{ V}$ , $I_D = -2\text{ A}$	N P	$Q_{gd}$	- -	6.3 4.3	9.5 6.5	
Gate charge total $V_{DD} = 48\text{ V}$ , $I_D = 3.1\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$ $V_{DD} = -48\text{ V}$ , $I_D = -2\text{ A}$ , $V_{GS} = 0\text{ to }-10\text{ V}$	N P	$Q_g$	- -	15 13.5	22.5 20	
Gate plateau voltage $V_{DD} = 48\text{ V}$ , $I_D = 3.1\text{ A}$ $V_{DD} = -48\text{ V}$ , $I_D = -2\text{ A}$	N P	$V_{(\text{plateau})}$	- -	3.1 -2.8	- -	V
<b>Reverse Diode</b>						
Inverse diode continuous forward current $T_A = 25\text{ }^\circ\text{C}$	N P	$I_S$	- -	- -	3.1 -2	A
Inverse diode direct current, pulsed $T_A = 25\text{ }^\circ\text{C}$	N P	$I_{SM}$	- -	- -	12.4 -8	
Inverse diode forward voltage $V_{GS} = 0\text{ V}$ , $I_F = I_S$ $V_{GS} = 0\text{ V}$ , $I_F = I_S$	N P	$V_{SD}$	- -	0.8 -0.8	1.1 -1.1	V
Reverse recovery time $V_R = 30\text{ V}$ , $I_F = I_S$ , $di_F/dt = 100\text{ A}/\mu\text{s}$ $V_R = -30\text{ V}$ , $I_F = I_S$ , $di_F/dt = -100\text{ A}/\mu\text{s}$	N P	$t_{rr}$	- -	50 85	75 130	ns
Reverse recovery charge $V_R = 30\text{ V}$ , $I_F = I_S$ , $di_F/dt = 100\text{ A}/\mu\text{s}$ $V_R = -30\text{ V}$ , $I_F = I_S$ , $di_F/dt = -100\text{ A}/\mu\text{s}$	N P	$Q_{rr}$	- -	70 120	105 180	$\mu\text{C}$

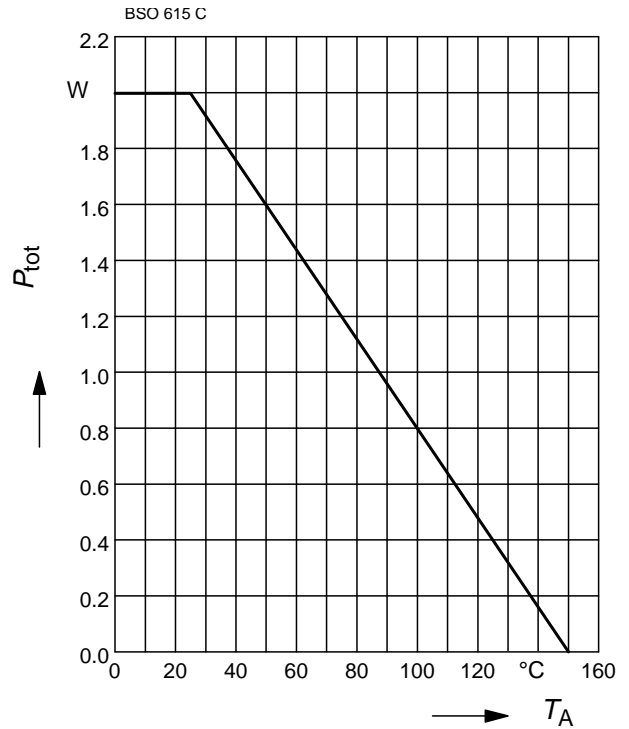
**Power Dissipation (N-Ch.)**

$$P_{\text{tot}} = f(T_A)$$



**Power Dissipation (P-Ch.)**

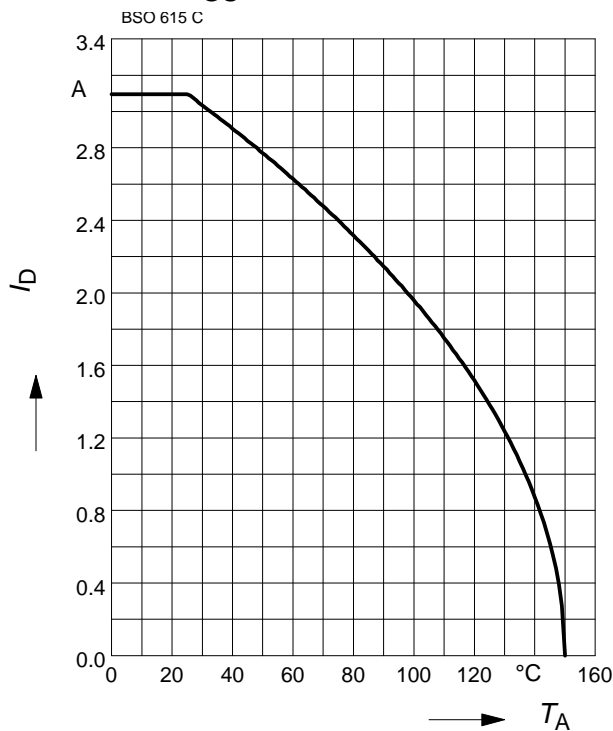
$$P_{\text{tot}} = f(T_A)$$



**Drain current (N-Ch.)**

$$I_D = f(T_A)$$

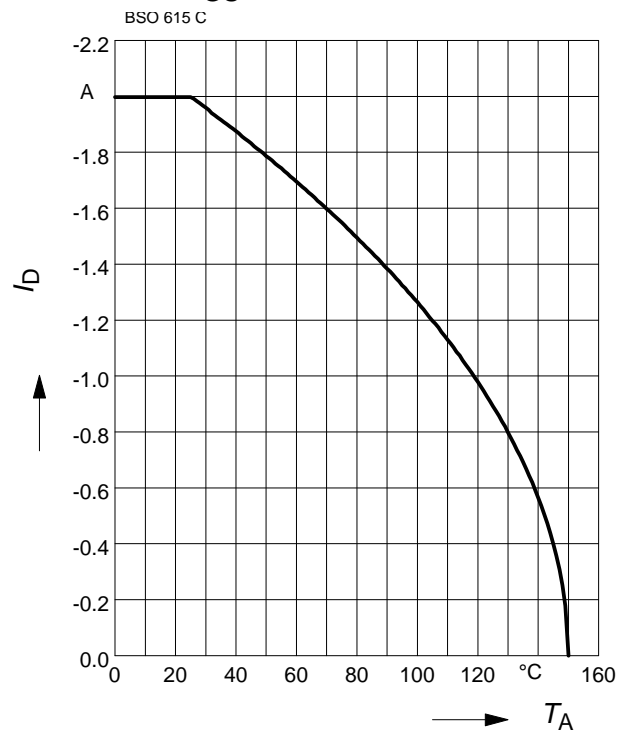
parameter:  $V_{GS} \geq 10 \text{ V}$



**Drain current (P-Ch.)**

$$I_D = f(T_A)$$

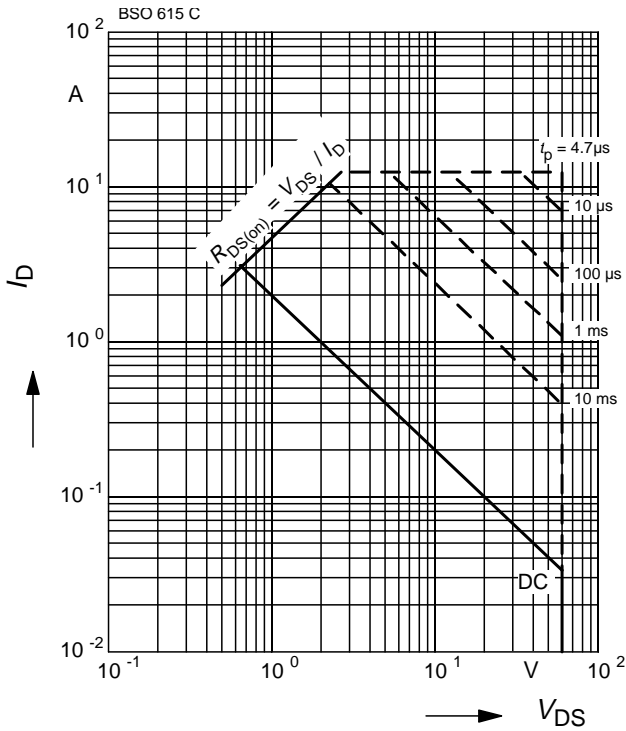
parameter:  $V_{GS} \geq -10 \text{ V}$



**Safe operating area (N-Ch.)**

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

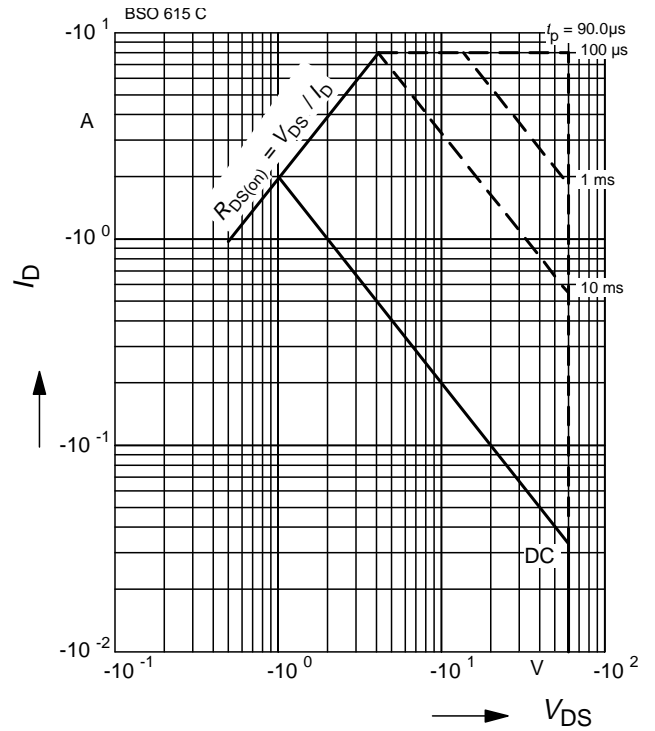
parameter :  $D = 0, T_A = 25\text{ }^\circ\text{C}$



**Safe operating area (P-Ch.)**

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

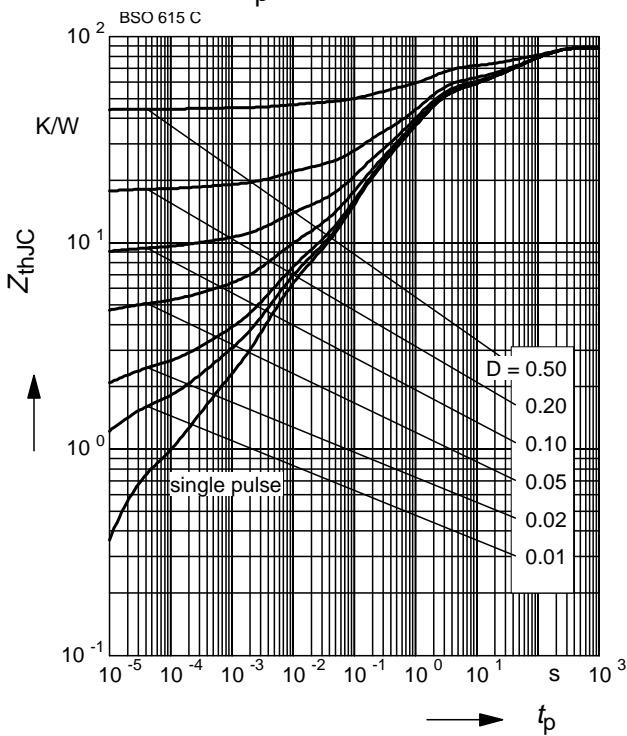
parameter :  $D = 0, T_A = 25\text{ }^\circ\text{C}$



**Transient thermal impedance (N-Ch.)**

$$Z_{thJC} = f(t_p)$$

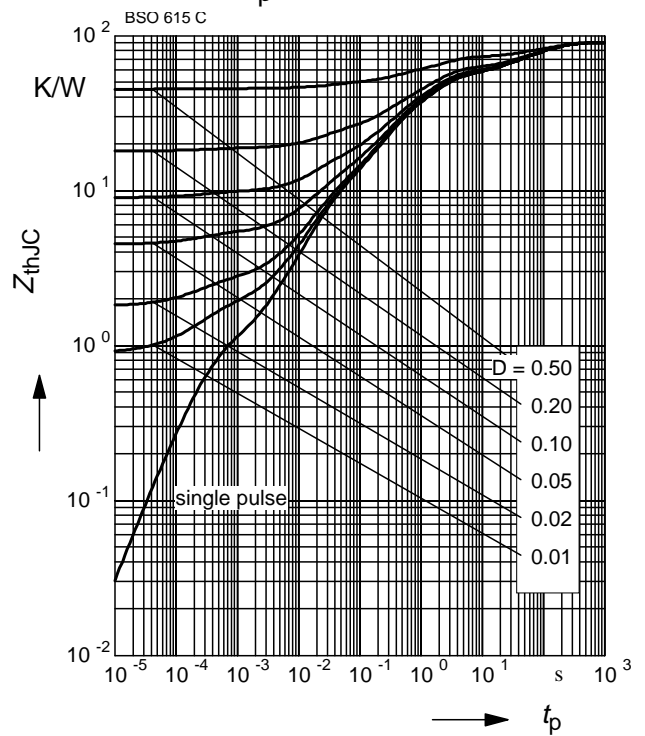
parameter :  $D = t_p/T$



**Transient thermal impedance (P-Ch.)**

$$Z_{thJC} = f(t_p)$$

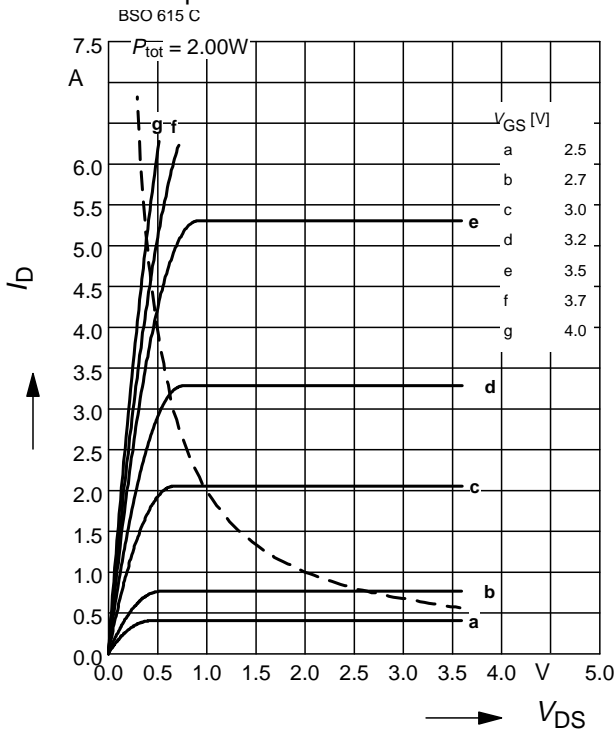
parameter :  $D = t_p/T$



**Typ. output characteristics (N-Ch.)**

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

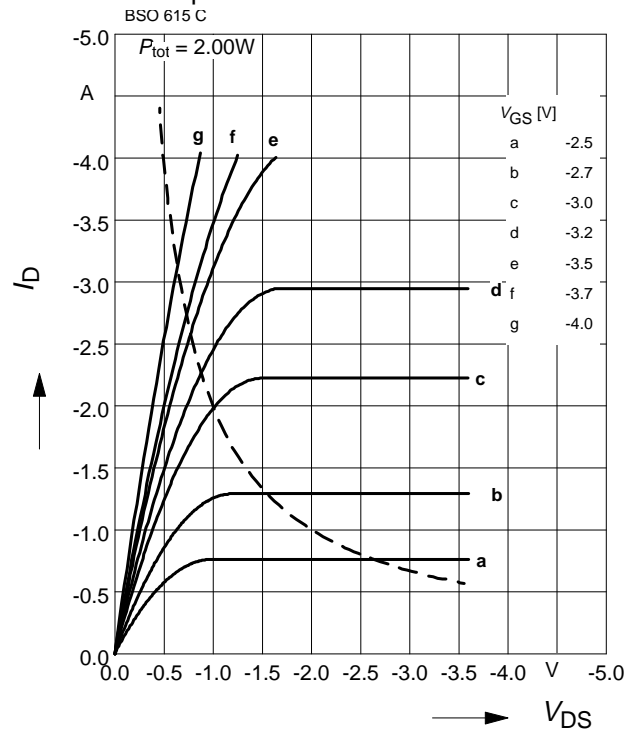
parameter:  $t_p = 80 \mu s$



**Typ. output characteristics (P-Ch.)**

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

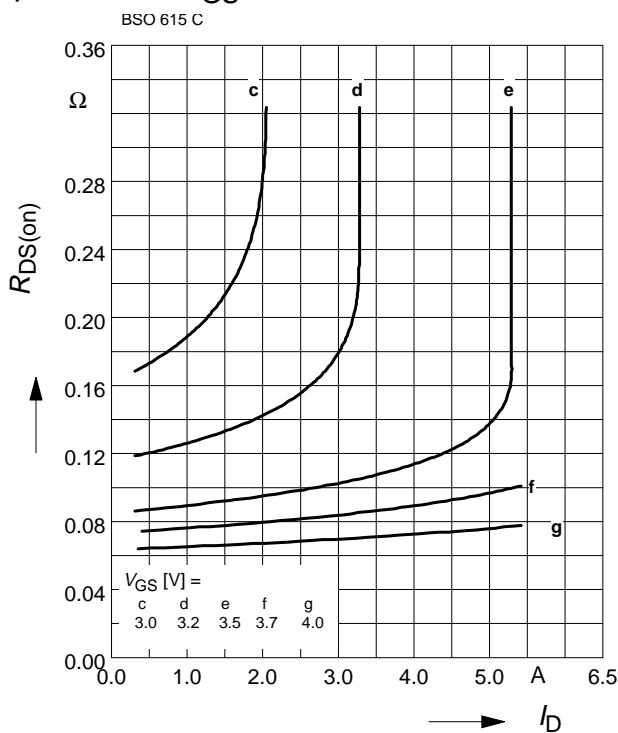
parameter:  $t_p = 80 \mu s$



**Typ. drain-source-on-resistance (N-Ch.)**

$$R_{DS(on)} = f(I_D)$$

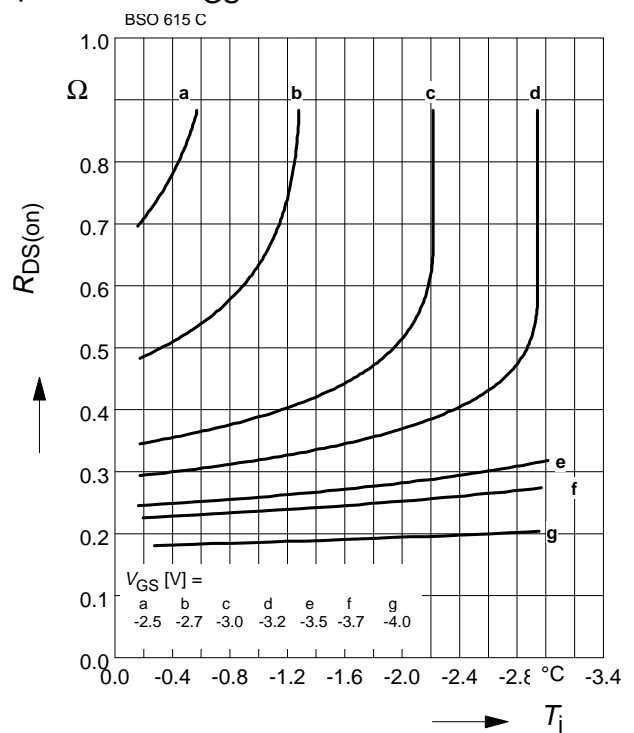
parameter:  $V_{GS}$



**Typ. drain-source-on-resistance (P-Ch.)**

$$R_{DS(on)} = f(I_D)$$

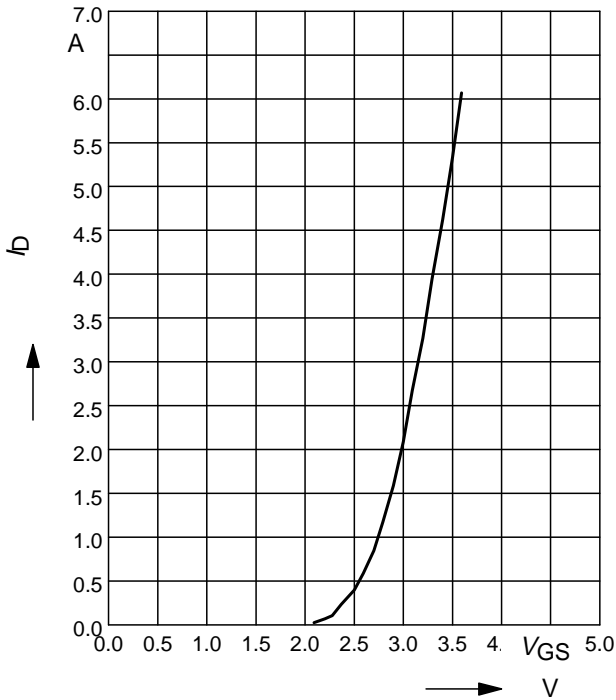
parameter:  $V_{GS}$



**Typ. transfer characteristics (N-Ch.)**

parameter:  $t_p = 80 \mu s$

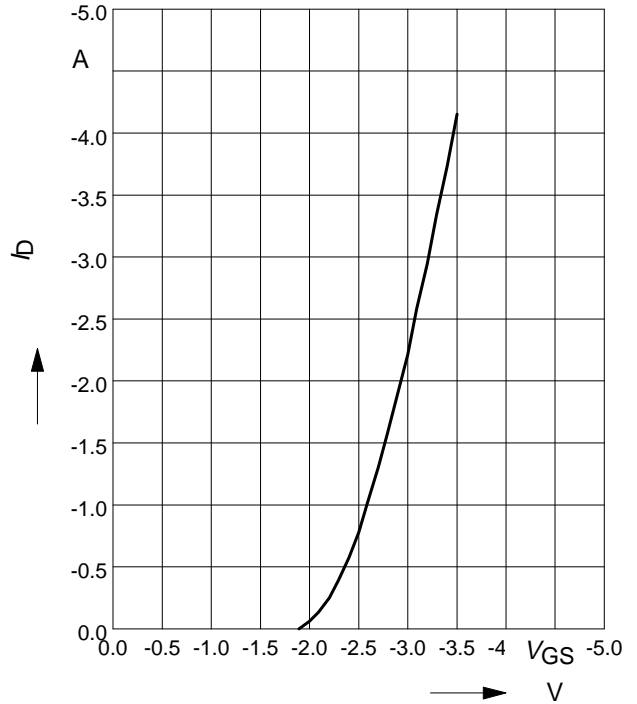
$I_D = f(V_{GS}), V_{DS} \geq 2 \times I_D \times R_{DS(on)max}$



**Typ. transfer characteristics (P-Ch.)**

parameter:  $t_p = 80 \mu s$

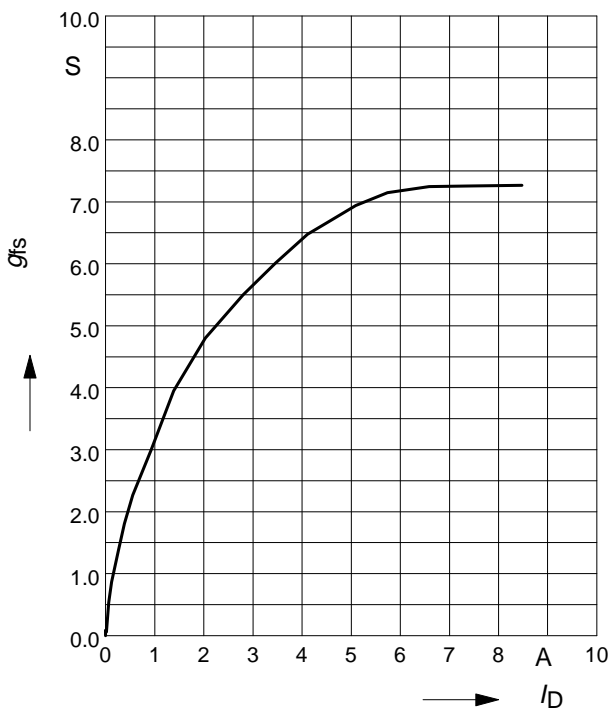
$I_D = f(V_{GS}), V_{DS} \geq 2 \times I_D \times R_{DS(on)max}$



**Typ. forward transconductance (N-Ch.)**

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

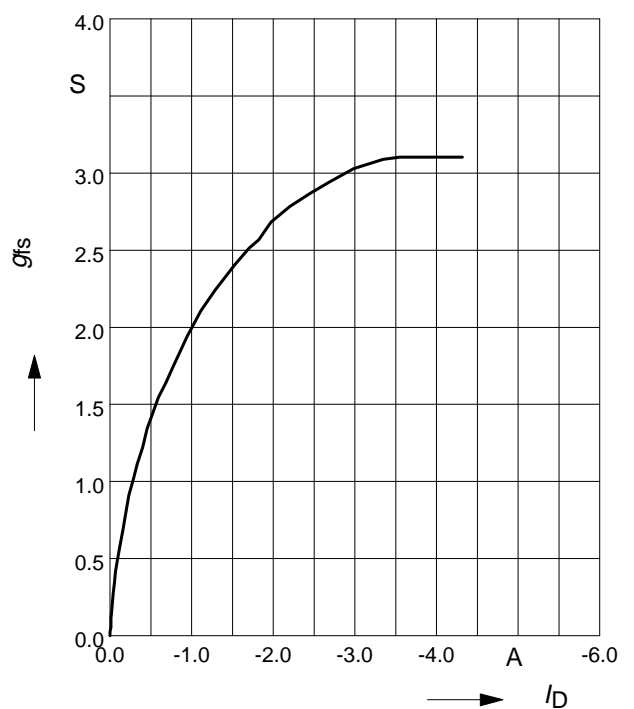
parameter:  $g_{fs}$



**Typ. forward transconductance (P-Ch.)**

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

parameter:  $g_{fs}$



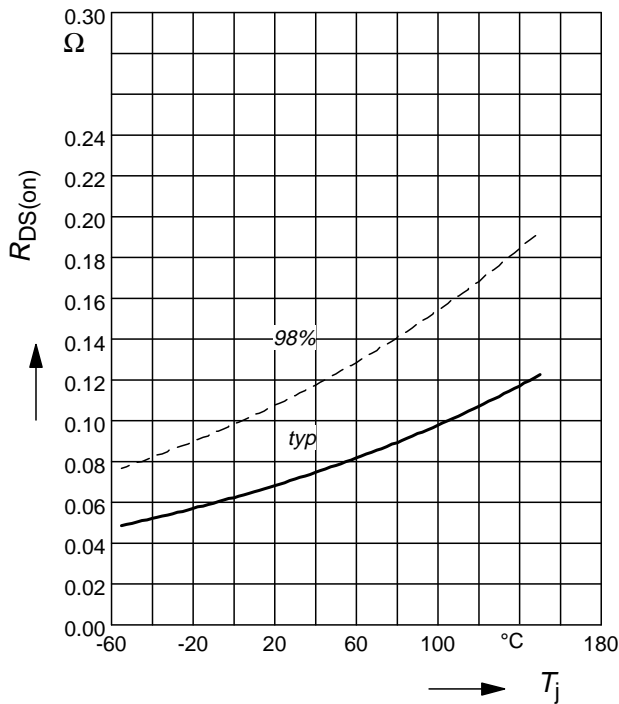


**Drain-source on-resistance (N-Ch.)**

$$R_{DS(on)} = f(T_j)$$

parameter :  $I_D = 3.1 \text{ A}$  ,  $V_{GS} = 10 \text{ V}$

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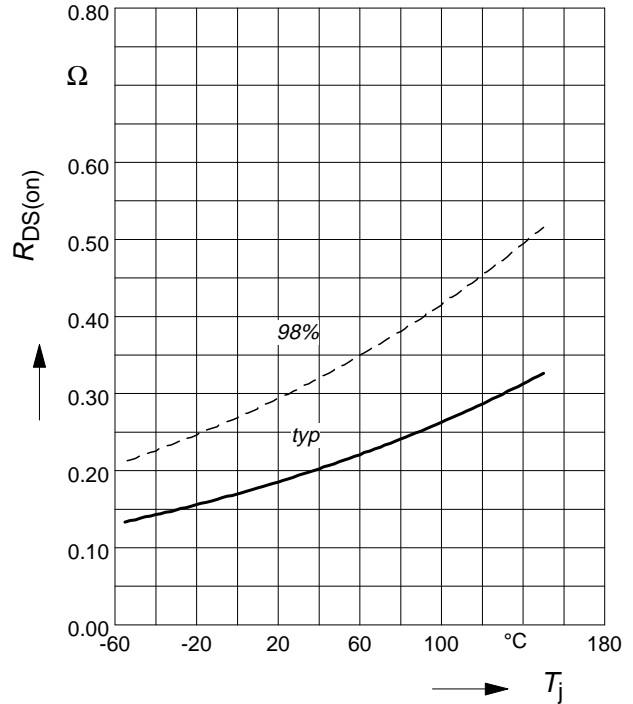


**Drain-source on-resistance (P-Ch.)**

$$R_{DS(on)} = f(T_j)$$

parameter :  $I_D = -2 \text{ A}$  ,  $V_{GS} = -10 \text{ V}$

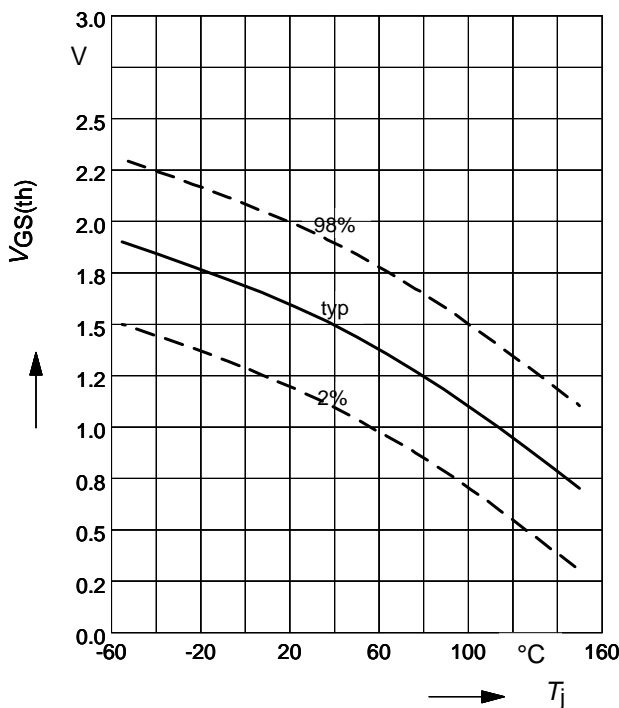
BSO 615 C



**Gate threshold voltage (N-Ch.)**

$$V_{GS(th)} = f(T_j)$$

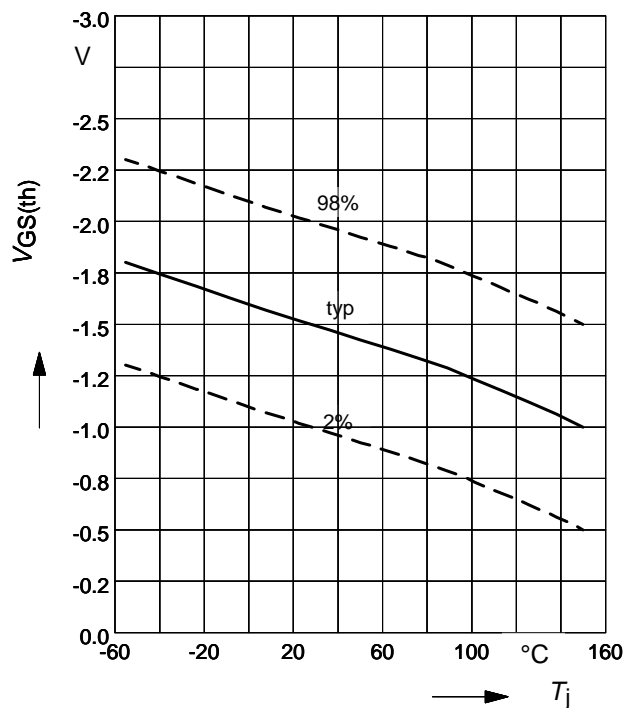
parameter:  $V_{GS} = V_{DS}$ ,  $I_D = 20 \mu\text{A}$



**Gate threshold voltage (P-Ch.)**

$$V_{GS(th)} = f(T_j)$$

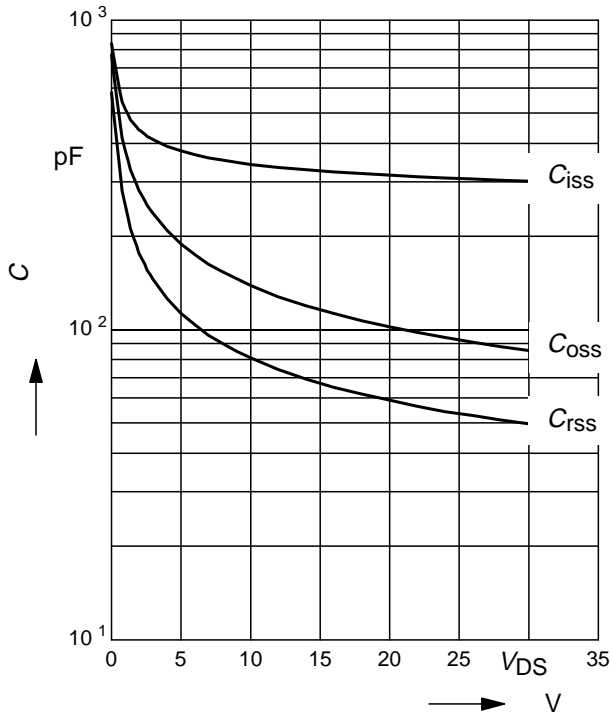
parameter:  $V_{GS} = V_{DS}$ ,  $I_D = -450 \mu\text{A}$



**Typ. capacitances (N-Ch.)**

$C = f(V_{DS})$

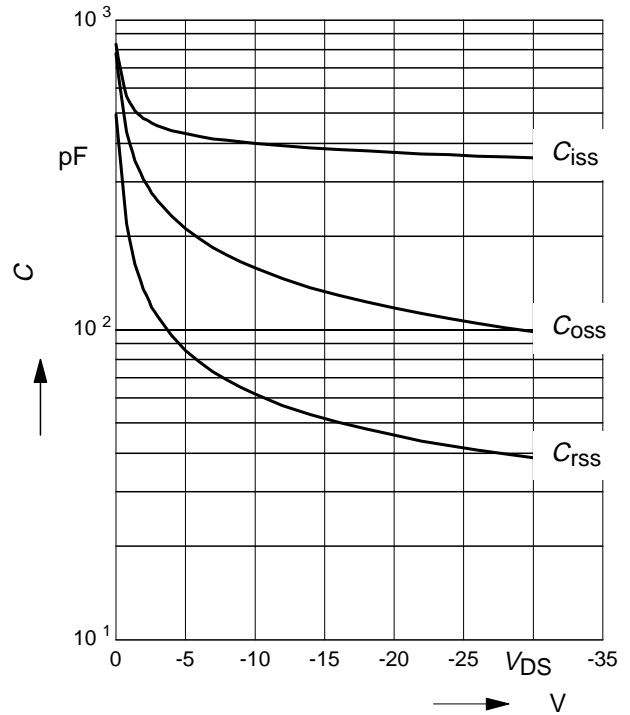
parameter:  $V_{GS}=0\text{ V}$ ,  $f=1\text{ MHz}$



**Typ. capacitances (P-Ch.)**

$C = f(V_{DS})$

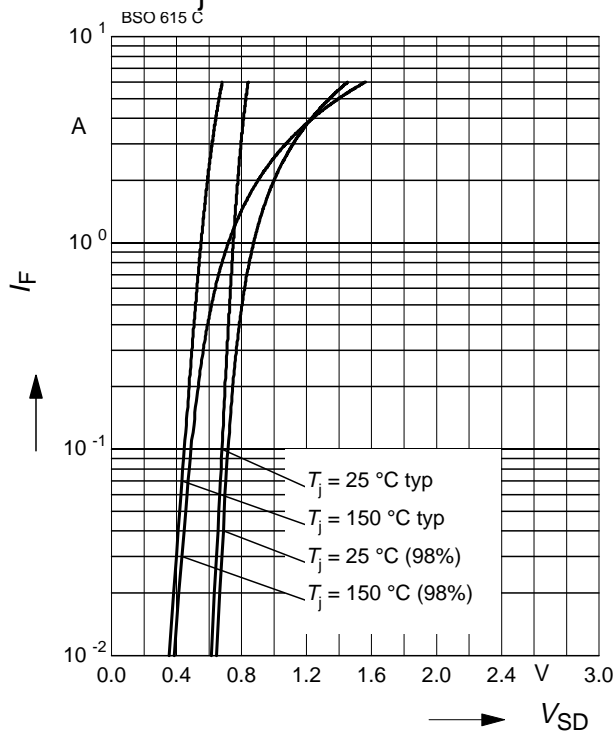
parameter:  $V_{GS}=0\text{ V}$ ,  $f=1\text{ MHz}$



**Forward characteristics of reverse diode**

$I_F = f(V_{SD})$ , (N-Ch.)

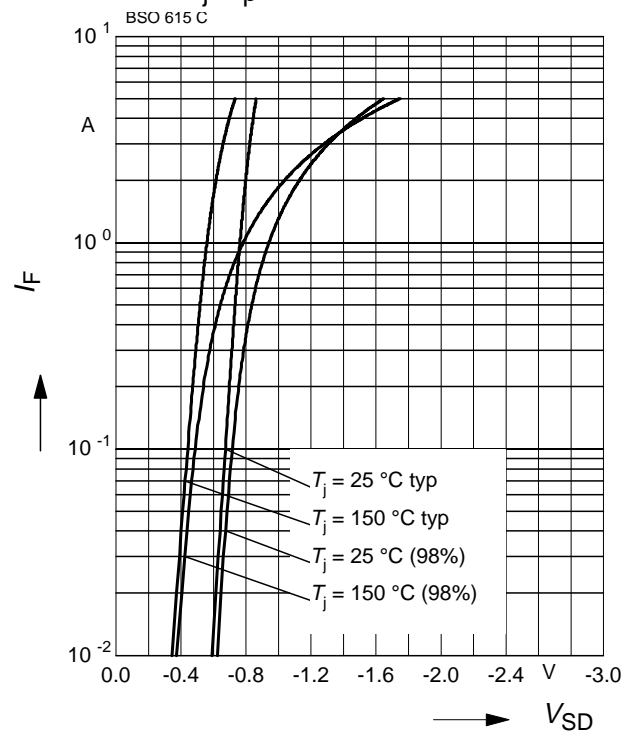
parameter:  $T_j$ ,  $t_p = 80\ \mu\text{s}$



**Forward characteristics of reverse diode**

$I_F = f(V_{SD})$ , (P-Ch.)

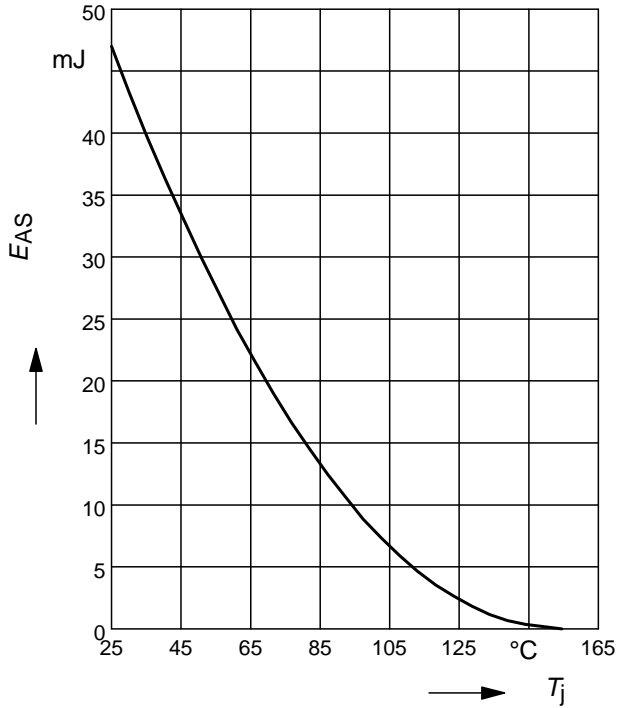
parameter:  $T_j$ ,  $t_p = 80\ \mu\text{s}$



**Avalanche Energy  $E_{AS} = f(T_j)$  (N-Ch.)**

parameter:  $I_D = 3.1 \text{ A}$  ,  $V_{DD} = 25 \text{ V}$

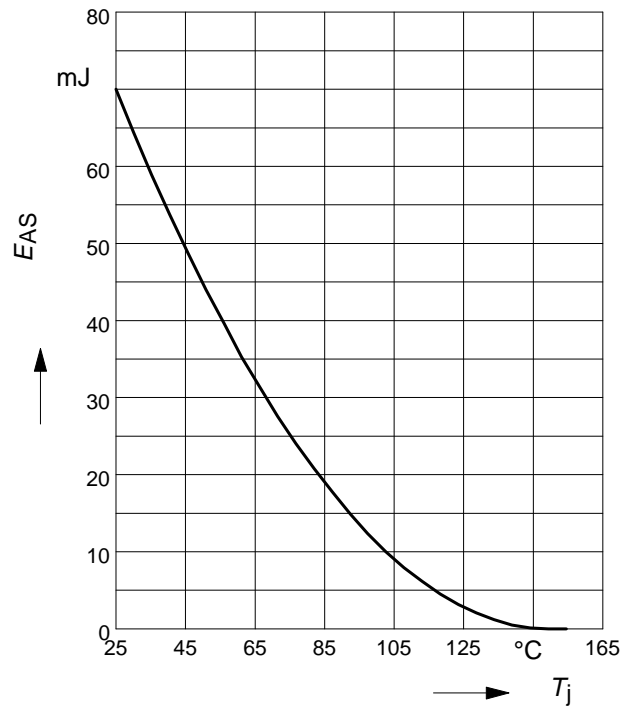
$R_{GS} = 25 \text{ } \Omega$



**Avalanche Energy  $E_{AS} = f(T_j)$**

parameter:  $I_D = -2 \text{ A}$  ,  $V_{DD} = -25 \text{ V}$

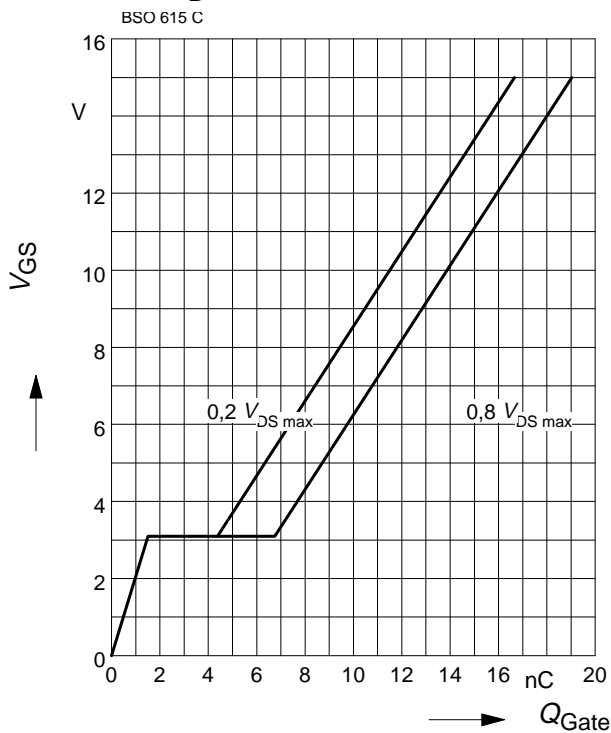
$R_{GS} = 25 \text{ } \Omega$



**Typ. gate charge (N-Ch.)**

$V_{GS} = f(Q_{Gate})$

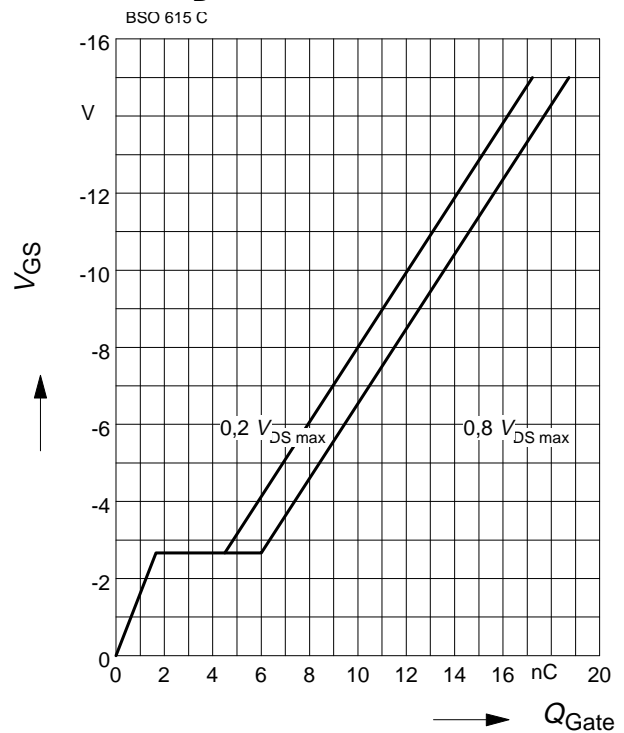
parameter:  $I_D = 3.1 \text{ A}$



**Typ. gate charge (P-Ch.)**

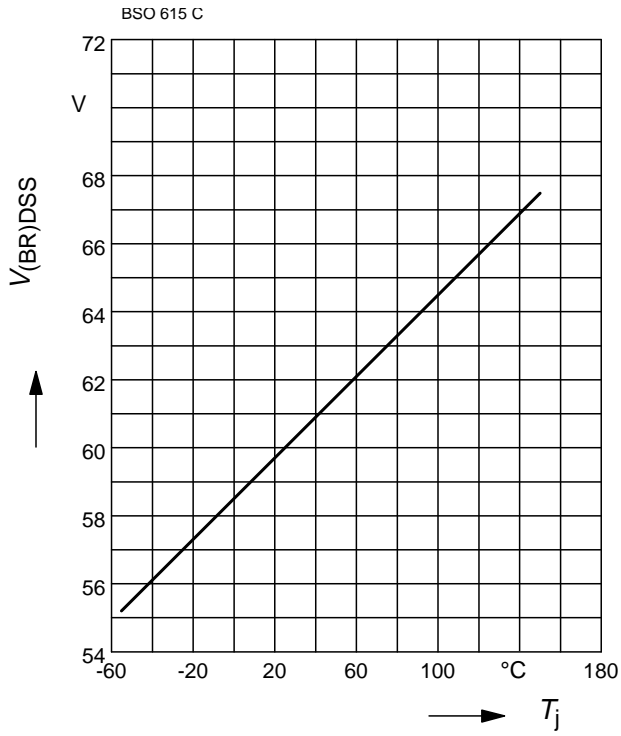
$V_{GS} = f(Q_{Gate})$

parameter:  $I_D = -2 \text{ A}$



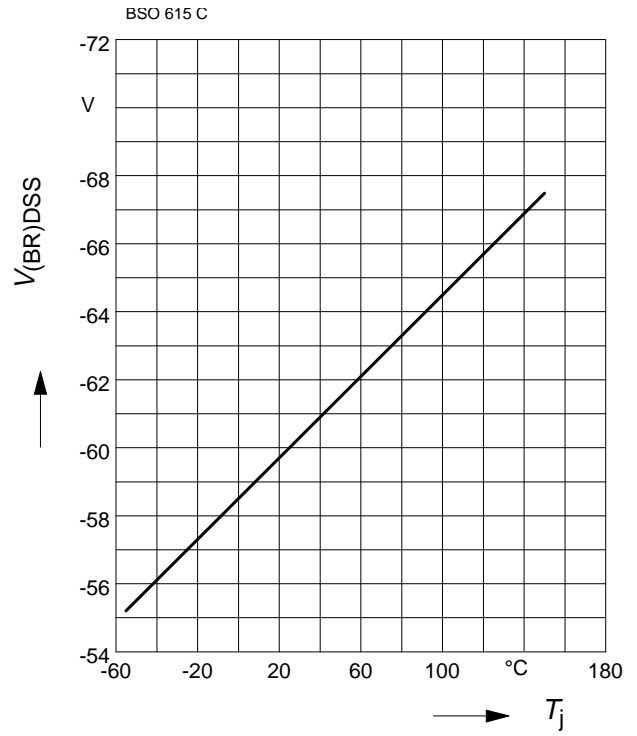
**Drain-source breakdown voltage**

$$V_{(BR)DSS} = f(T_j), \text{ (N-Ch.)}$$



**Drain-source breakdown voltage**

$$V_{(BR)DSS} = f(T_j), \text{ (P-Ch.)}$$



**Published by**  
**Infineon Technologies AG,**  
**Bereichs Kommunikation**  
**St.-Martin-Strasse 53,**  
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