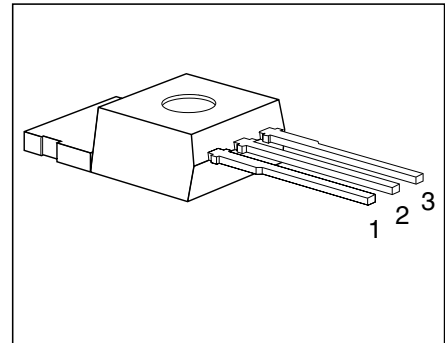


**Features**

- N channel
- Logic level
- Enhancement mode
- Temperature sensor with thyristor characteristic
- The drain pin is electrically shorted to the tab



Pin	1	2	3
	G	D	S

Type	$V_{DS}$	$I_D$	$R_{DS(on)}$	Package	Ordering Code
BTS 113A	60 V	11.5 A	0.17 $\Omega$	TO-220AB	C67078-S5015-A2

**Maximum Ratings**

Parameter	Symbol	Values	Unit
Drain-source voltage	$V_{DS}$	60	V
Drain-gate voltage, $R_{GS} = 20 \text{ k}\Omega$	$V_{DGR}$	60	
Gate-source voltage	$V_{GS}$	$\pm 10$	
Continuous drain current, $T_C = 25 \text{ }^\circ\text{C}$	$I_D$	11.5	A
ISO drain current $T_C = 85 \text{ }^\circ\text{C}$ , $V_{GS} = 10 \text{ V}$ , $V_{DS} = 0.5 \text{ V}$	$I_{D-ISO}$	2.2	
Pulsed drain current, $T_C = 25 \text{ }^\circ\text{C}$	$I_{D \text{ puls}}$	46	
Short circuit current, $T_j = -55 \dots +150 \text{ }^\circ\text{C}$	$I_{SC}$	27	
Short circuit dissipation, $T_j = -55 \dots +150 \text{ }^\circ\text{C}$	$P_{SCmax}$	400	W
Power dissipation	$P_{tot}$	40	
Operating and storage temperature range	$T_j, T_{stg}$	$-55 \dots +150$	$^\circ\text{C}$
DIN humidity category, DIN 40 040	–	E	
IEC climatic category, DIN IEC 68-1	–	55/150/56	
Thermal resistance			K/W
Chip-case	$R_{th \text{ JC}}$	$\leq 3.1$	
Chip-ambient	$R_{th \text{ JA}}$	$\leq 75$	

**Electrical Characteristics**

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

Parameter	Symbol	Values			Unit
		min.	typ.	max.	

**Static Characteristics**

Drain-source breakdown voltage $V_{GS} = 0, I_D = 0.25\text{ mA}$	$V_{(BR)DSS}$	60	–	–	V
Gate threshold voltage $V_{GS} = V_{DS}, I_D = 1\text{ mA}$	$V_{GS(th)}$	1.6	2.0	2.5	
Zero gate voltage drain current $V_{GS} = 0\text{ V}, V_{DS} = 60\text{ V}$ $T_j = 25\text{ °C}$ $T_j = 125\text{ °C}$	$I_{DSS}$	– –	0.1 10	1.0 100	$\mu\text{A}$
Gate-source leakage current $V_{GS} = \pm 20\text{ V}, V_{DS} = 0$ $T_j = 25\text{ °C}$ $T_j = 150\text{ °C}$	$I_{GSS}$	– –	10 2	100 4	nA $\mu\text{A}$
Drain-source on-state resistance $V_{GS} = 4.5\text{ V}, I_D = 5.8\text{ A}$	$R_{DS(on)}$	–	0.14	0.17	$\Omega$

**Dynamic Characteristics**

Forward transconductance $V_{DS} \geq 2 \times I_D \times R_{DS(on)max}, I_D = 5.8\text{ A}$	$g_{fs}$	4.5	7.5	–	S
Input capacitance $V_{GS} = 0, V_{DS} = 25\text{ V}, f = 1\text{ MHz}$	$C_{iss}$	–	420	560	pF
Output capacitance $V_{GS} = 0, V_{DS} = 25\text{ V}, f = 1\text{ MHz}$	$C_{oss}$	–	160	250	
Reverse transfer capacitance $V_{GS} = 0, V_{DS} = 25\text{ V}, f = 1\text{ MHz}$	$C_{rss}$	–	60	110	
Turn-on time $t_{on}$ , ( $t_{on} = t_{d(on)} + t_r$ ) $V_{CC} = 30\text{ V}, V_{GS} = 5.0\text{ V}, I_D = 3.0\text{ A},$ $R_{GS} = 50\text{ }\Omega$	$t_{d(on)}$	–	15	25	ns
	$t_r$	–	55	80	
Turn-off time $t_{off}$ , ( $t_{off} = t_{d(off)} + t_f$ ) $V_{CC} = 30\text{ V}, V_{GS} = 5.0\text{ V}, I_D = 3.0\text{ A},$ $R_{GS} = 50\text{ }\Omega$	$t_{d(off)}$	–	45	60	
	$t_f$	–	40	55	

**Electrical Characteristics (cont'd)**

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

Parameter	Symbol	Values			Unit
		min.	typ.	max.	

**Reverse Diode**

Continuous source current	$I_S$	–	–	11.5	A
Pulsed source current	$I_{SM}$	–	–	46	
Diode forward on-voltage $I_F = 11.5\text{ A}$ , $V_{GS} = 0\text{ V}$	$V_{SD}$	–	1.3	1.6	V
Reverse recovery time $I_F = I_S$ , $di_F/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$	$t_{rr}$	–	60	–	ns
Reverse recovery charge $I_F = I_S$ , $di_F/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$	$Q_{rr}$	–	0.10	–	$\mu\text{C}$

**Temperature Sensor**

Forward voltage $I_{TS(on)} = 5\text{ mA}$ , $T_j = -55 \dots +150\text{ °C}$ Sensor override, $t_p \leq 100\text{ }\mu\text{s}$ $T_j = -55 \dots +160\text{ °C}$	$V_{TS(on)}$	–	1.4	1.5	V
		–	–	10	
Forward current $T_j = -55 \dots +150\text{ °C}$ Sensor override, $t_p \leq 100\text{ }\mu\text{s}$ $T_j = -55 \dots +160\text{ °C}$	$I_{TS(on)}$	–	–	5	mA
		–	–	600	
Holding current, $V_{TS(off)} = 5.0\text{ V}$ , $T_j = 25\text{ °C}$ $T_j = 150\text{ °C}$	$I_H$	0.05 0.05	0.3 0.2	0.5 0.3	
Switching temperature $V_{TS} = 5.0\text{ V}$	$T_{TS(on)}$	150	–	–	$\text{°C}$
Turn-off time $V_{TS} = 5.0\text{ V}$ , $I_{TS(on)} = 2\text{ mA}$	$t_{off}$	0.5	–	2.5	$\mu\text{s}$

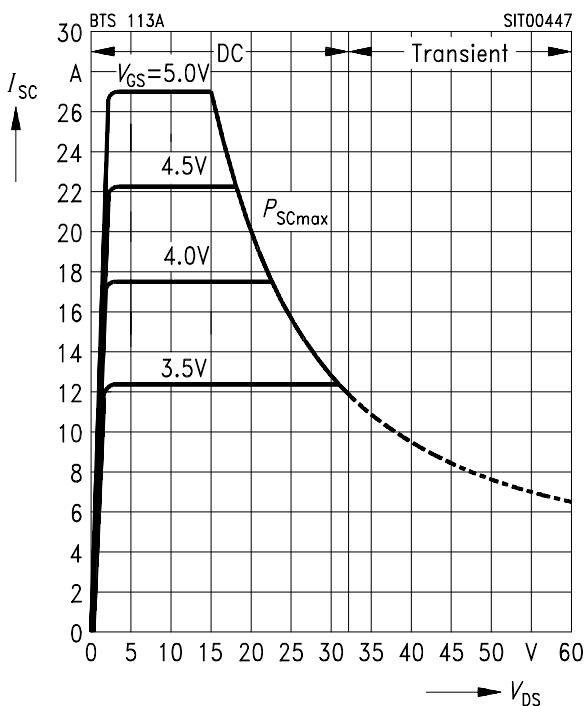
**Examples for short-circuit protection**

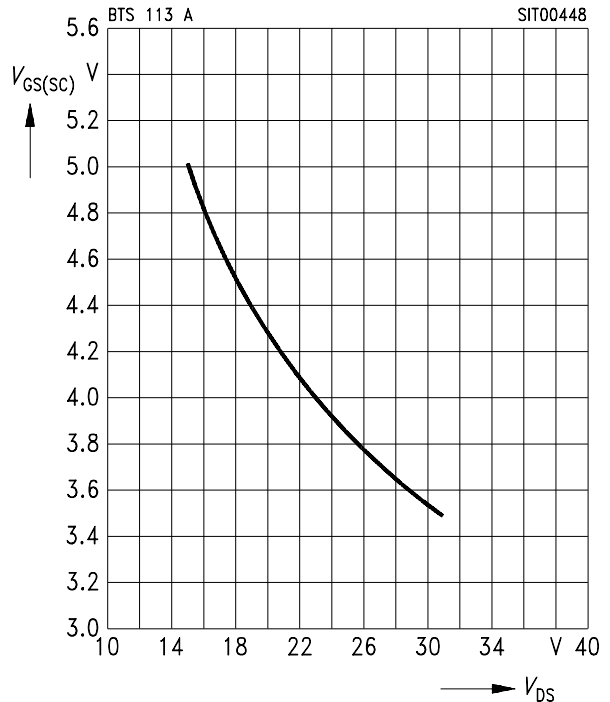
 at  $T_j = -55 \dots +150 \text{ °C}$ , unless otherwise specified.

Parameter	Symbol	Examples			Unit
		1	2	–	
Drain-source voltage	$V_{DS}$	15	30	–	V
Gate-source voltage	$V_{GS}$	5.0	3.5	–	
Short-circuit current	$I_{SC}$	27	12.6	–	A
Short-circuit dissipation	$P_{SC}$	400	380	–	W
Response time $T_j = 25 \text{ °C}$ , before short circuit	$t_{SC(off)}$	20	20	–	ms

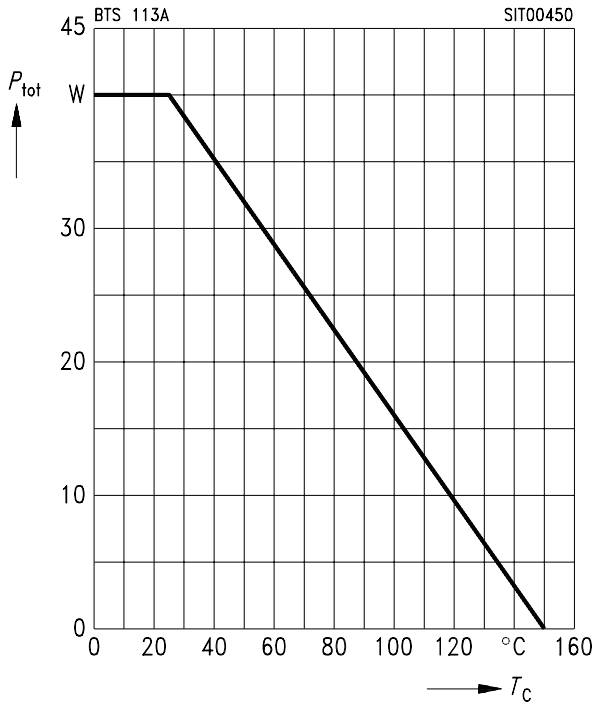
**Short-circuit protection  $I_{SC} = f(V_{DS})$** 

 Parameter:  $V_{GS}$ 

 Diagram to determine  $I_{SC}$  for  $T_j = -55 \dots +150 \text{ °C}$ 

**Max. gate voltage  $V_{GS(SC)} = f(V_{DS})$** 

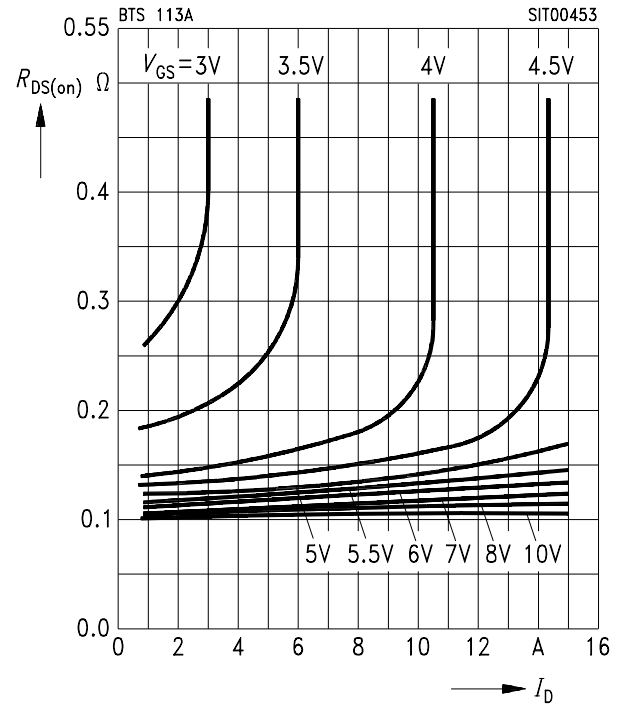
 Parameter:  $T_j = -55 \dots +150 \text{ °C}$ 


**Max. power dissipation  $P_{tot} = f(T_C)$**



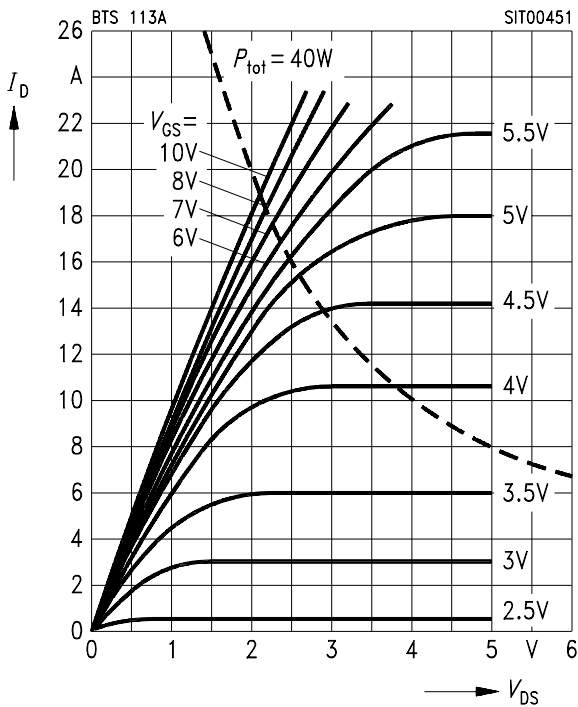
**Typ. drain-source on-state resistance  $R_{DS(on)} = f(I_D)$**

Parameter:  $V_{GS}$



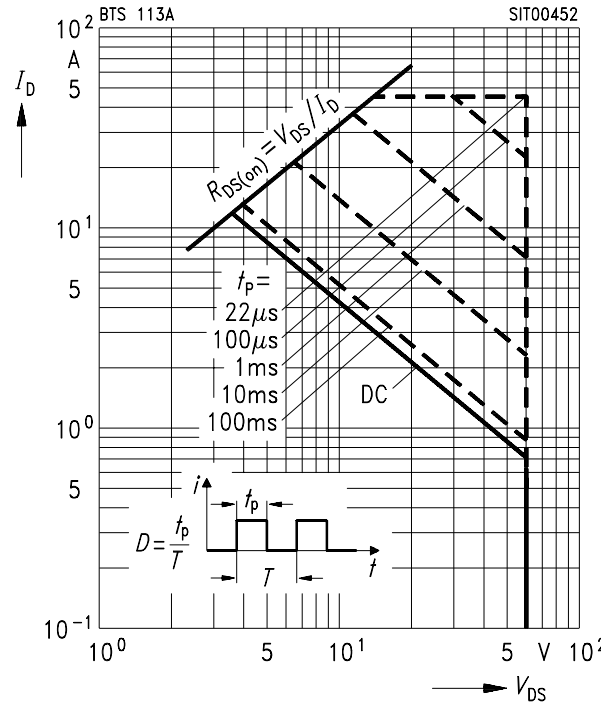
**Typical output characteristics  $I_D = f(V_{DS})$**

Parameter:  $t_p = 80 \mu s$



**Safe operating area  $I_D = f(V_{DS})$**

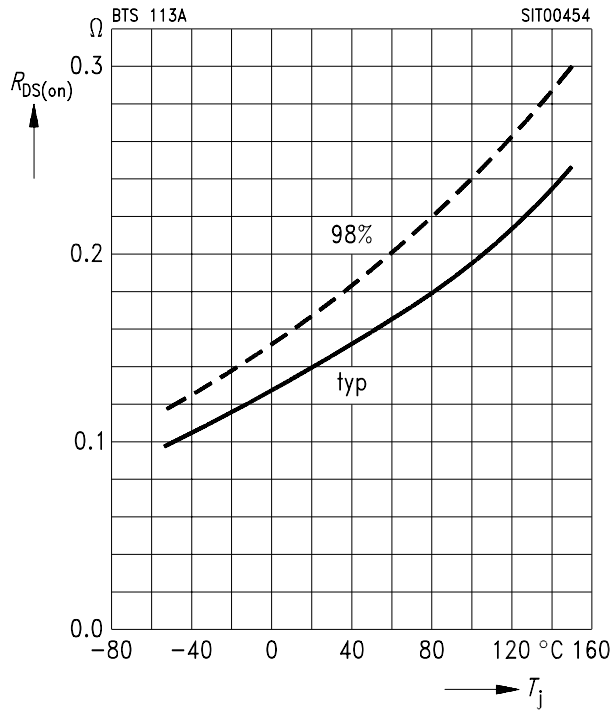
Parameter:  $D = 0.01, T_C = 25^\circ C$



**Drain-source on-state resistance**

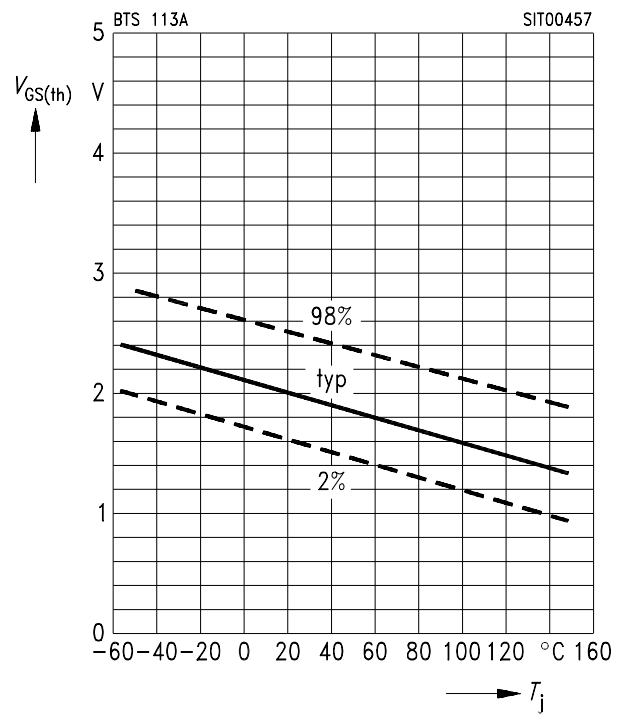
$R_{DS(on)} = f(T_j)$

Parameter:  $I_D = -5\text{ A}$ ,  $V_{GS} = 4.5\text{ V}$



**Gate threshold voltage  $V_{GS(th)} = f(T_j)$**

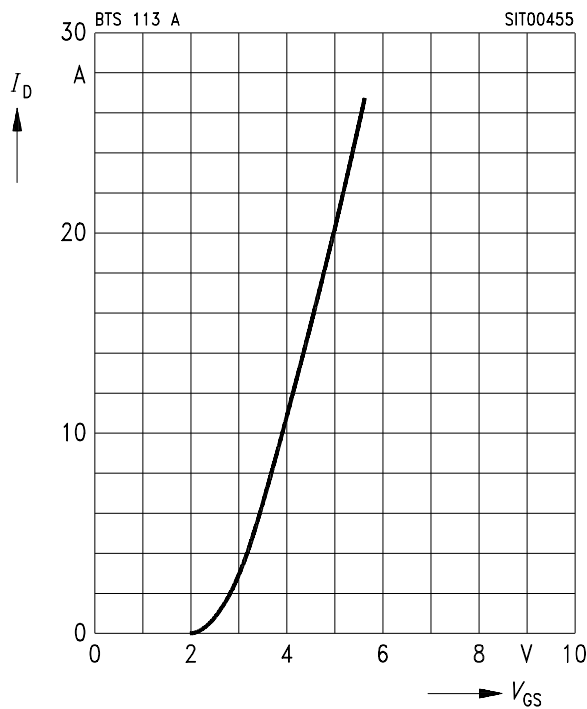
Parameter:  $V_{DS} = V_{GS}$ ,  $I_D = -1\text{ mA}$



**Typ. transfer characteristic**

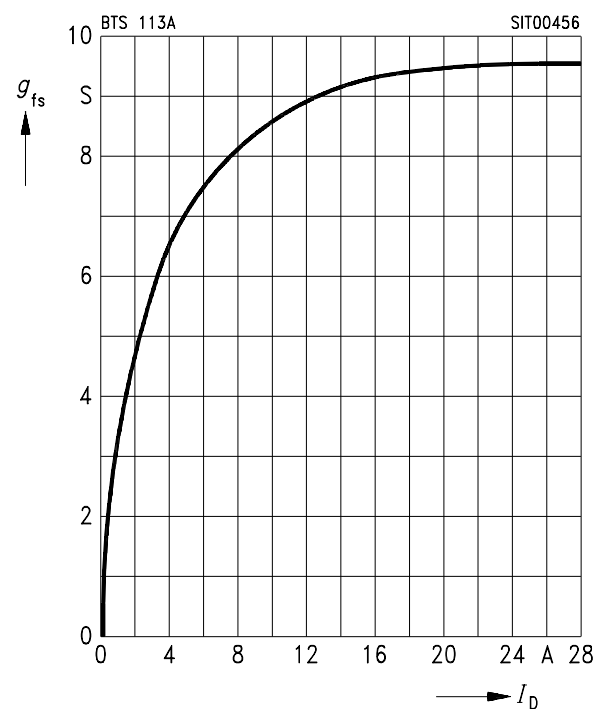
$I_D = f(V_{GS})$

Parameter:  $t_p = 80\text{ }\mu\text{s}$ ,  $V_{DS} = -25\text{ V}$



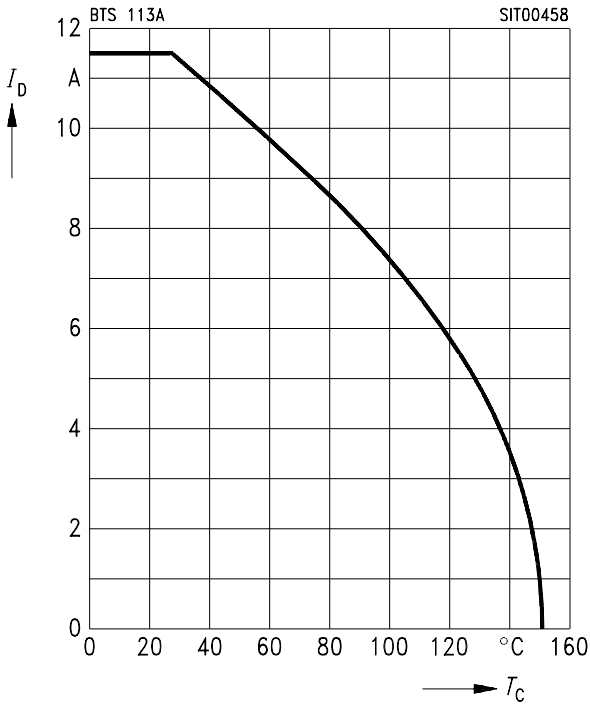
**Typ. transconductance  $g_{fs} = f(I_D)$**

Parameter:  $t_p = 80\text{ }\mu\text{s}$ ,  $V_{DS} = -25\text{ V}$



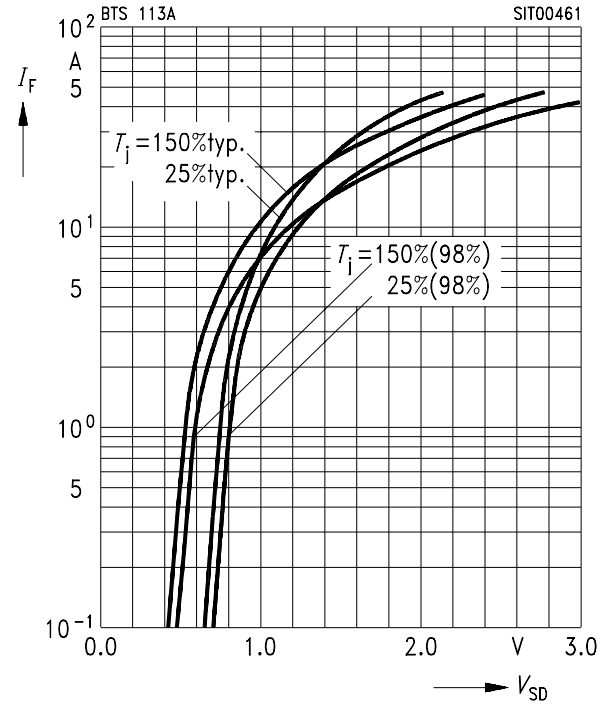
**Continuous drain current  $I_D = f(T_C)$**

Parameter:  $V_{GS} = 4.5 \text{ V}$



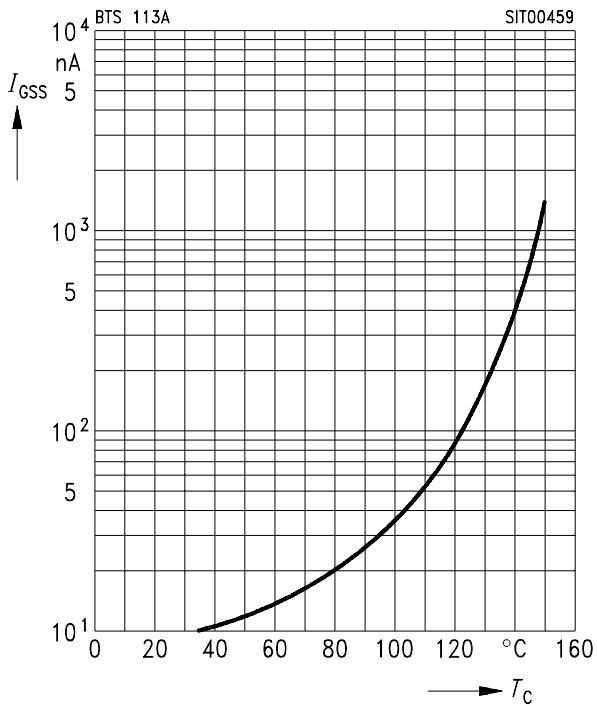
**Forward characteristics of reverse diode  $I_F = f(V_{SD})$**

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



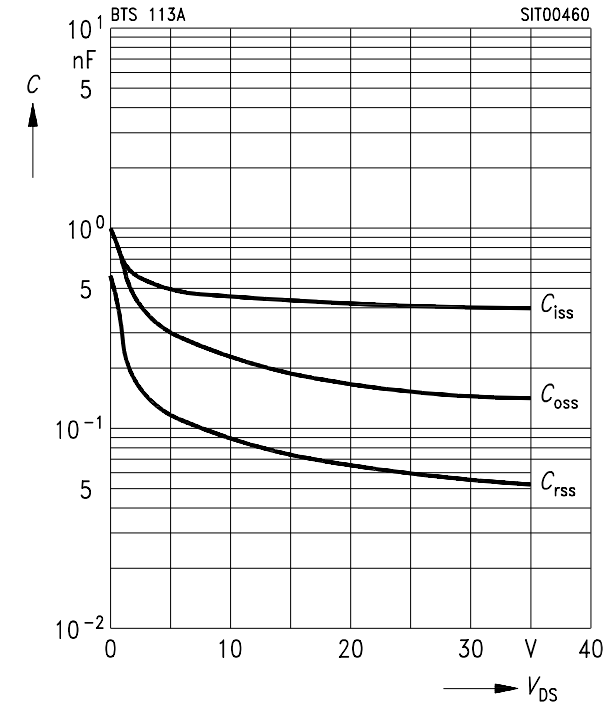
**Typ. gate-source leakage current  $I_{GSS} = f(T_C)$**

Parameter:  $V_{GS} = 10 \text{ V}, V_{DS} = 0$

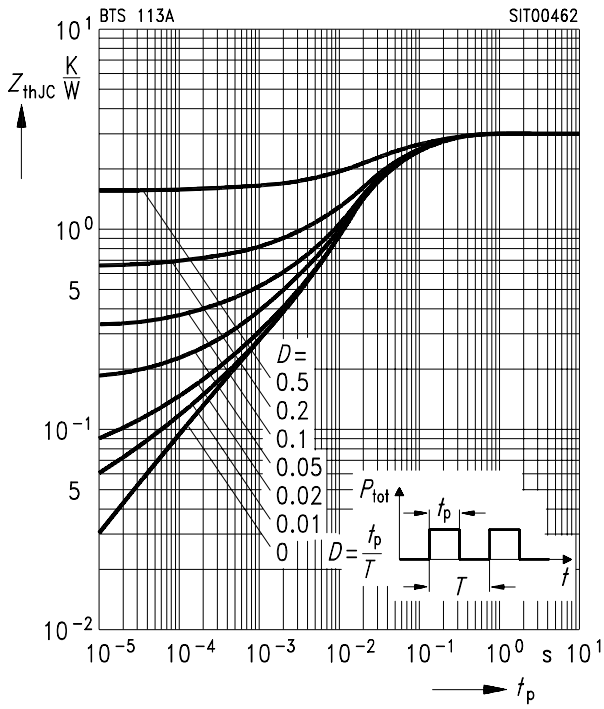


**Typ. capacitances  $C = f(V_{DS})$**

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



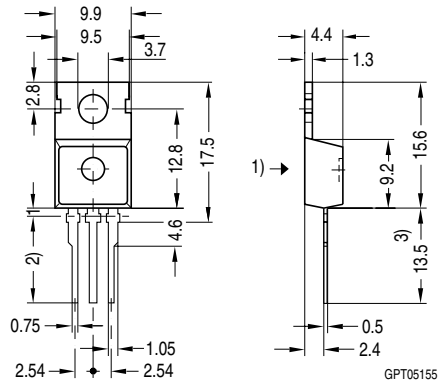
**Transient thermal impedance**  $Z_{thJC} = f(t_p)$   
 Parameter:  $D = t_p/T$





**TO 220 AB**  
Standard

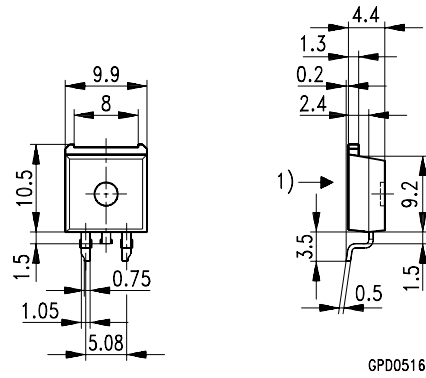
**Ordering Code**  
C67078-S5015-A3



- 1) punch direction, burr max. 0.04
- 2) dip tinning
- 3) max. 14.5 by dip tinning press burr max. 0.05

**TO 220 AB**

**SMD Version E 3045 A** **Ordering Code**  
(Tape & reel) C67078-S5015-A4



- 1) shear and punch direction no burrs this surface

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