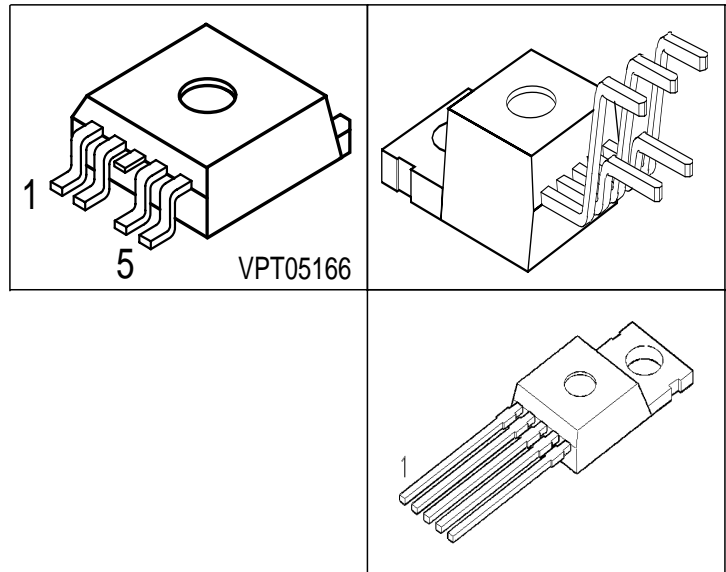
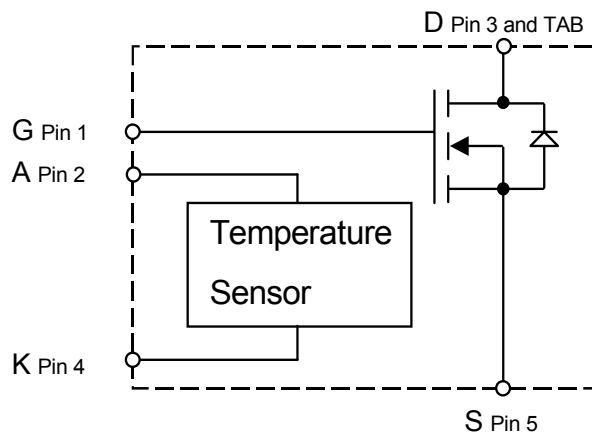


**Speed TEMPFET®**

- N-Channel
- Enhancement mode
- Logic Level Input
- Analog driving possible
- Fast switching up to 1 MHz
- Potential-free temperature sensor with thyristor characteristics
- Overtemperature protection
- Avalanche rated



Type	$V_{DS}$	$R_{DS(on)}$	Package	Ordering Code
BTS 247 Z	55 V	18 m $\Omega$	P-TO220-5-3	Q67060-S6001-A2
			P-TO220-5-62	Q67060-S6002-A2
			TO-220-5-43	Q67060-S6006



Pin	Symbol	Function
1	G	Gate
2	A	Anode Temperature Sensor
3	D	Drain
4	K	Cathode Temperature Sensor
5	S	Source

**Maximum Ratings**

Parameter	Symbol	Value	Unit
Drain source voltage	$V_{DS}$	55	V
Drain-gate voltage, $R_{GS} = 20 \text{ k}\Omega$	$V_{DGR}$	55	
Gate source voltage	$V_{GS}$	$\pm 20$	
Nominal load current (ISO 10483) $V_{GS} = 4.5 \text{ V}$ , $V_{DS} \leq 0.5 \text{ V}$ , $T_C = 85 \text{ }^\circ\text{C}$ $V_{GS} = 10 \text{ V}$ , $V_{DS} \leq 0.5 \text{ V}$ , $T_C = 85 \text{ }^\circ\text{C}$	$I_{D(ISO)}$	12 19	A
Continuous drain current <sup>1)</sup> $T_C = 100 \text{ }^\circ\text{C}$ , $V_{GS} = 4.5 \text{ V}$	$I_D$	33	
Pulsed drain current	$I_{D \text{ puls}}$	180	
Avalanche energy, single pulse $I_D = 12 \text{ A}$ , $R_{GS} = 25 \text{ }\Omega$	$E_{AS}$	1.3	J
Power dissipation $T_C = 25 \text{ }^\circ\text{C}$	$P_{\text{tot}}$	120	W
Operating temperature <sup>2)</sup>	$T_j$	-40 ... +175	$^\circ\text{C}$
Peak temperature ( single event )	$T_{j\text{peak}}$	200	
Storage temperature	$T_{\text{stg}}$	-55 ... +150	
DIN humidity category, DIN 40 040		E	
IEC climatic category; DIN IEC 68-1		40/150/56	

<sup>1</sup>current limited by bond wire

<sup>2</sup>Note: Thermal trip temperature of temperature sensor is below 175°C

**Thermal Characteristics**

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
<b>Characteristics</b>					
junction - case:	$R_{thJC}$	-	-	1.25	K/W
Thermal resistance @ min. footprint	$R_{th(JA)}$	-	-	62	
Thermal resistance @ 6 cm <sup>2</sup> cooling area <sup>1)</sup>	$R_{th(JA)}$	-	33	40	

**Electrical Characteristics**

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
at $T_j = 25^\circ\text{C}$ , unless otherwise specified					

**Static Characteristics**

Drain-source breakdown voltage $V_{GS} = 0\text{ V}$ , $I_D = 0.25\text{ mA}$	$V_{(BR)DSS}$	55	-	-	V
Gate threshold voltage, $V_{GS} = V_{DS}$ $I_D = 90\ \mu\text{A}$ $I_D = 250\ \mu\text{A}$	$V_{GS(th)}$	1.2 -	1.6 1.65	2 -	
Zero gate voltage drain current $V_{DS} = 50\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_j = -40^\circ\text{C}$ $V_{DS} = 50\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_j = 25^\circ\text{C}$ $V_{DS} = 50\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_j = 150^\circ\text{C}$	$I_{DSS}$	- - -	- 0.1 -	0.1 1 100	$\mu\text{A}$
Gate-source leakage current $V_{GS} = 20\text{ V}$ , $V_{DS} = 0\text{ V}$ , $T_j = 25^\circ\text{C}$ $V_{GS} = 20\text{ V}$ , $V_{DS} = 0\text{ V}$ , $T_j = 150^\circ\text{C}$	$I_{GSS}$	- -	10 20	100 100	nA
Drain-Source on-state resistance $V_{GS} = 4.5\text{ V}$ , $I_D = 12\text{ A}$ $V_{GS} = 10\text{ V}$ , $I_D = 12\text{ A}$	$R_{DS(on)}$	- -	22 15	28 18	m $\Omega$

<sup>1</sup> Device on 50mm\*50mm\*1.5mm epoxy PCB FR4 with 6cm<sup>2</sup> (one layer, 70 $\mu\text{m}$  thick) copper area for drain connection. PCB mounted vertical without blown air.

**Electrical Characteristics**

Parameter at $T_j = 25^\circ\text{C}$ , unless otherwise specified	Symbol	Values			Unit
		min.	typ.	max.	

**Dynamic Characteristics**

Forward transconductance $V_{DS} > 2 \cdot I_D \cdot R_{DS(on)max}$ , $I_D = 33\text{ A}$	$g_{fs}$	10	-	-	S
Input capacitance $V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$	$C_{iss}$	-	1380	1730	pF
Output capacitance $V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$	$C_{oss}$	-	410	515	
Reverse transfer capacitance $V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$	$C_{rss}$	-	230	290	
Turn-on delay time $V_{DD} = 30\text{ V}$ , $V_{GS} = 4.5\text{ V}$ , $I_D = 45\text{ A}$ , $R_G = 3.6\ \Omega$	$t_{d(on)}$	-	15	25	ns
Rise time $V_{DD} = 30\text{ V}$ , $V_{GS} = 4.5\text{ V}$ , $I_D = 45\text{ A}$ , $R_G = 3.6\ \Omega$	$t_r$	-	30	45	
Turn-off delay time $V_{DD} = 30\text{ V}$ , $V_{GS} = 4.5\text{ V}$ , $I_D = 45\text{ A}$ , $R_G = 3.6\ \Omega$	$t_{d(off)}$	-	30	45	
Fall time $V_{DD} = 30\text{ V}$ , $V_{GS} = 4.5\text{ V}$ , $I_D = 45\text{ A}$ , $R_G = 3.6\ \Omega$	$t_f$	-	20	30	

**Gate Charge Characteristics**

Gate charge at threshold $V_{DD} = 40\text{ V}$ , $I_D = 0.1\text{ A}$ , $V_{GS} = 0\text{ to }1\text{ V}$	$Q_{g(th)}$	-	2	3	nC
Gate charge at 5.0 V $V_{DD} = 40\text{ V}$ , $I_D = 45\text{ A}$ , $V_{GS} = 0\text{ to }5\text{ V}$	$Q_{g(5)}$	-	35	55	
Gate charge total $V_{DD} = 40\text{ V}$ , $I_D = 45\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$	$Q_{g(total)}$	-	60	90	
Gate plateau voltage $V_{DD} = 40\text{ V}$ , $I_D = 45\text{ A}$	$V_{(plateau)}$	-	4.5	-	V

**Electrical Characteristics**

Parameter at $T_j = 25^\circ\text{C}$ , unless otherwise specified	Symbol	Values			Unit
		min.	typ.	max.	
<b>Reverse Diode</b>					
Inverse diode continuous forward current $T_C = 25^\circ\text{C}$	$I_S$	33	-	-	A
Inverse diode direct current, pulsed $T_C = 25^\circ\text{C}$	$I_{FM}$	180	-	-	
Inverse diode forward voltage $V_{GS} = 0\text{ V}$ , $I_F = 90\text{ A}$	$V_{SD}$	-	1.1	1.7	V
Reverse recovery time $V_R = 30\text{ V}$ , $I_F = I_S$ , $di_F/dt = 100\text{ A}/\mu\text{s}$	$t_{rr}$	-	75	115	ns
Reverse recovery charge $V_R = 30\text{ V}$ , $I_F = I_S$ , $di_F/dt = 100\text{ A}/\mu\text{s}$	$Q_{rr}$	-	0.15	0.25	$\mu\text{C}$

**Sensor Characteristics**

For temperature sensing, i.e. temperature protection, please consider application note "Temperature sense concept - Speed TEMPFET".

For short circuit protection please consider application note "Short circuit behaviour of the Speed TEMPFET family".

All application notes are available at <http://www.infineon.com/tempfet/>

Forward voltage $I_{AK(on)} = 5\text{ mA}$ , $T_j = -40\dots+150^\circ\text{C}$ $I_{AK(on)} = 1.5\text{ mA}$ , $T_j = 150^\circ\text{C}$	$V_{AK(on)}$	-	1.3	1.4	V
Sensor override $t_P = 100\ \mu\text{s}$ , $T_j = -40\dots+150^\circ\text{C}$		-	-	10	
Forward current $T_j = -40\dots+150^\circ\text{C}$	$I_{AK(on)}$	-	-	5	
Sensor override $t_P = 100\ \mu\text{s}$ , $T_j = -40\dots+150^\circ\text{C}$		-	-	600	

**Electrical Characteristics**

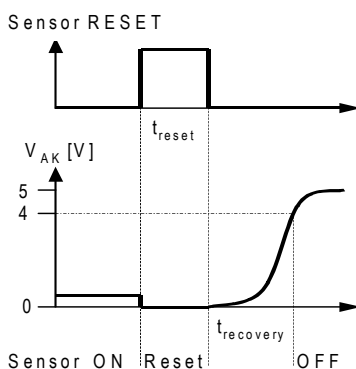
Parameter	Symbol	Values			Unit
		min.	typ.	max.	
at $T_j = 25^\circ\text{C}$ , unless otherwise specified					

**Sensor Characteristics**

Temperature sensor leakage current $T_j = 150^\circ\text{C}$	$I_{AK(\text{off})}$	-	-	4	$\mu\text{A}$
Min. reset pulse duration <sup>1)</sup> $T_j = -40\dots+150^\circ\text{C}$ , $I_{AK(\text{on})} = 0.3\text{ mA}$ , $V_{AK(\text{Reset})} < 0.5\text{V}$	$t_{\text{reset}}$	100	-	-	$\mu\text{s}$
$V_{AK}$ Recovery time <sup>1)2)</sup> $T_j = -40\dots+150^\circ\text{C}$ , $I_{AK(\text{on})} = 0.3\text{ mA}$	$t_{\text{recovery}}$	-	-	150	

**Characteristics**

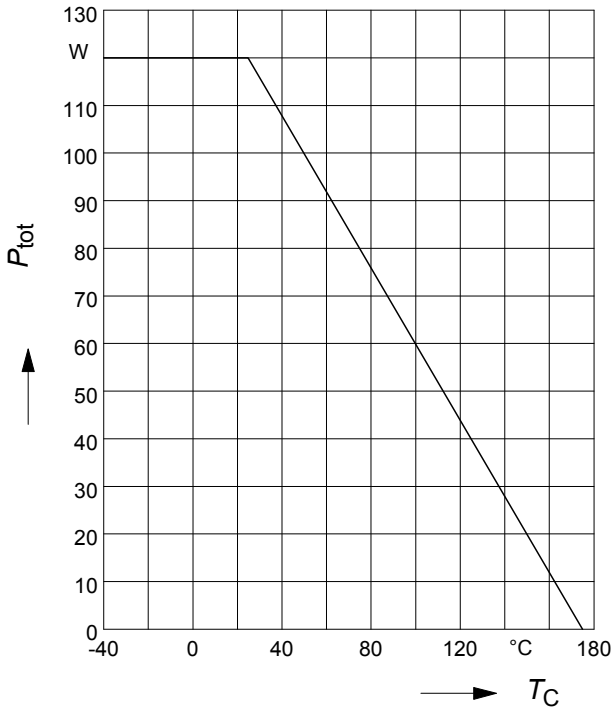
Holding current, $V_{AK(\text{off})} = 5\text{V}$ $T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$	$I_{AK(\text{hold})}$	0.05 0.05	- -	0.5 0.3	$\text{mA}$
Thermal trip temperature $V_{TS} = 5\text{V}$	$T_{TS(\text{on})}$	150	160	170	$^\circ\text{C}$
Turn-off time (Pin G+A and K+S connected) $V_{TS} = 5\text{V}$ , $I_{TS(\text{on})} = 2\text{ mA}$	$t_{\text{off}}$	0.5	-	2.5	$\mu\text{s}$
Reset voltage $T_j = -40\dots+150^\circ\text{C}$	$V_{AK(\text{reset})}$	0.5	-	-	$\text{V}$

**Sensor recovery behaviour:**

<sup>1</sup>See diagram Sensor recovery behaviour

<sup>2</sup>Time after reset pulse until  $V_{AK}$  reaches 4V again

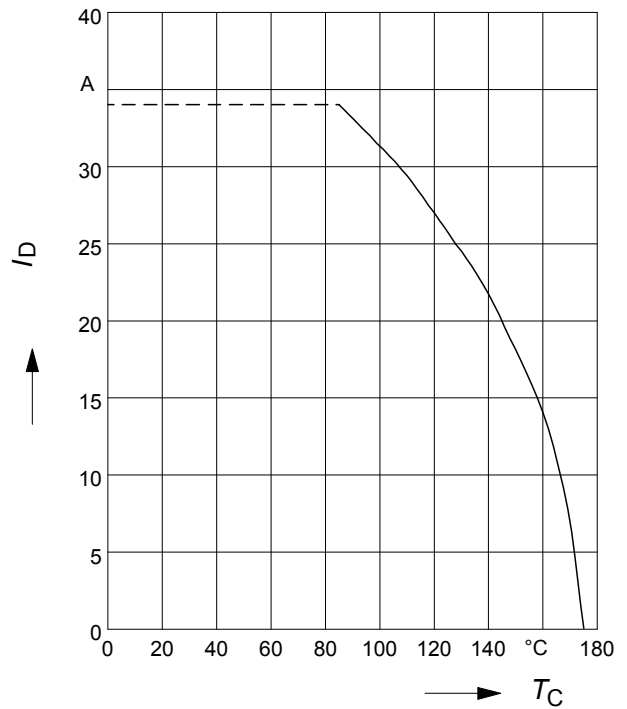
**1 Maximum allowable power dissipation**

$P_{tot} = f(T_C)$



**2 Drain current**

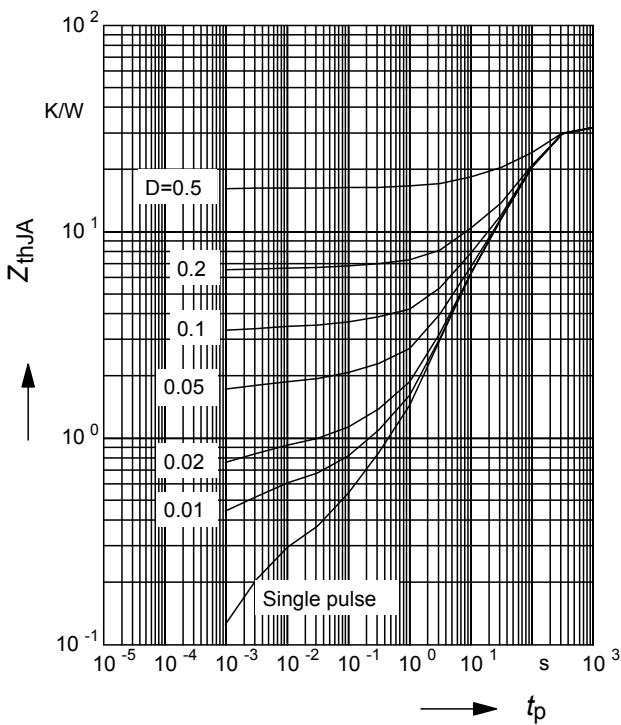
$I_D = f(T_C); V_{GS} \geq 4.5V$



**3 Typ. transient thermal impedance**

$Z_{thJA} = f(t_p) @ 6 \text{ cm}^2 \text{ cooling area}$

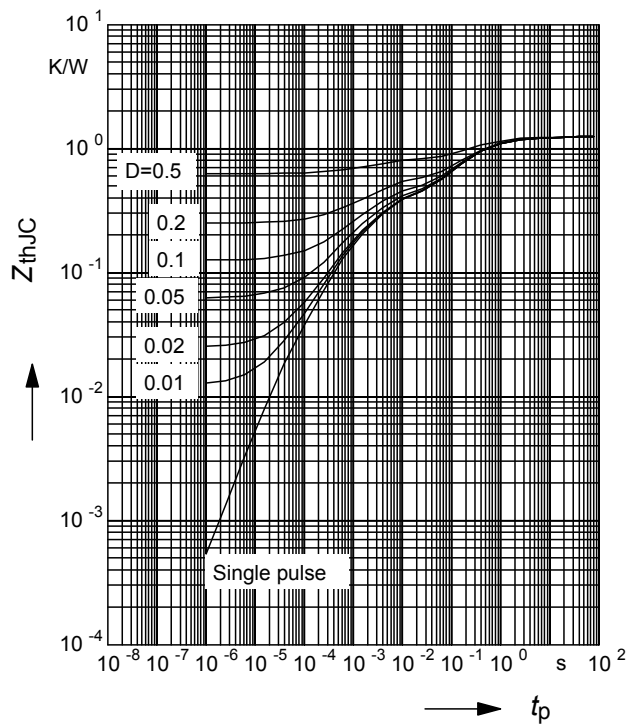
Parameter:  $D = t_p / T$



**4 Transient thermal impedance**

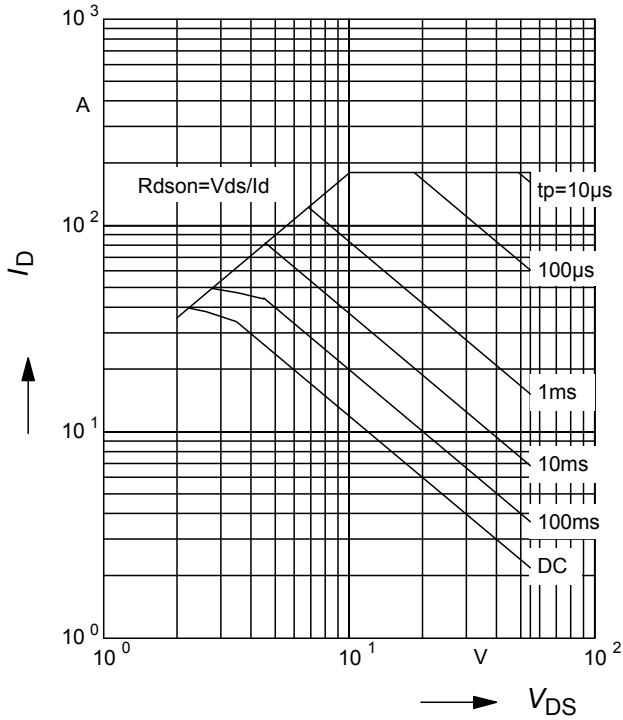
$Z_{thJC} = f(t_p)$

parameter :  $D = t_p / T$



**5 Safe operating area**

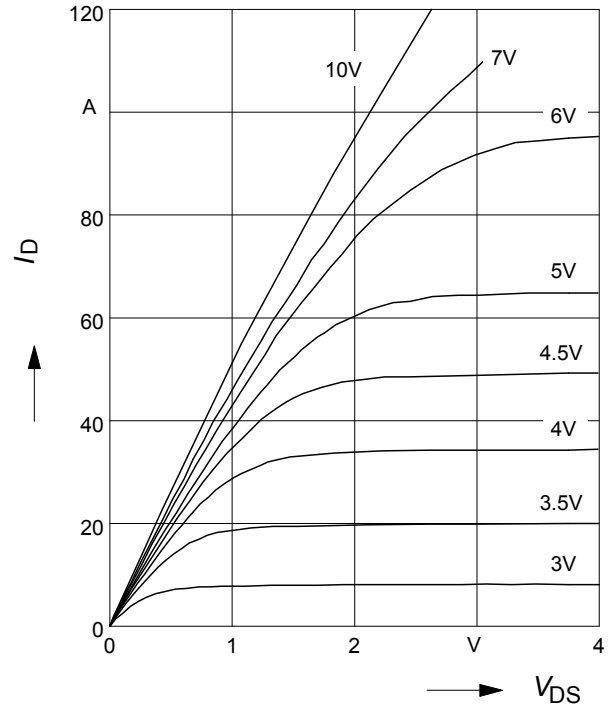
$I_D = f(V_{DS})$ ;  $D=0.01$ ;  $T_C=25^\circ\text{C}$ ;  $V_{GS}=4.5\text{V}$



**6 Typ. output characteristic**

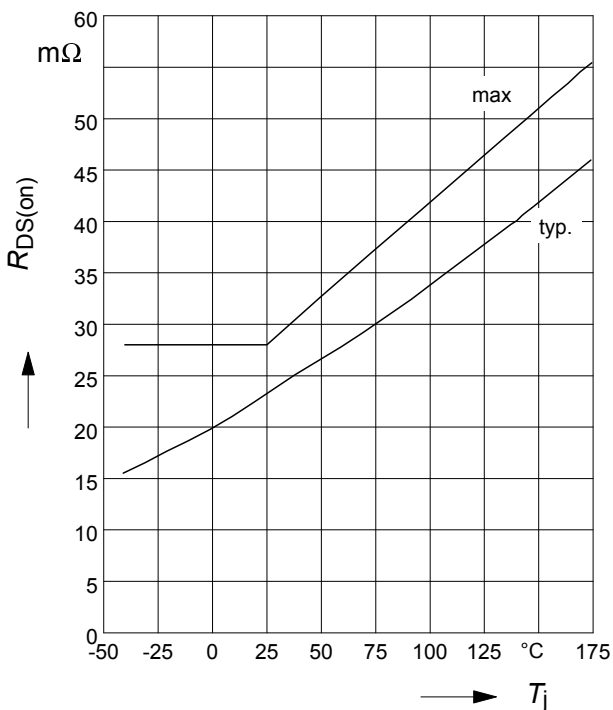
$I_D = f(V_{DS})$ ;  $T_j=25^\circ\text{C}$

Parameter:  $V_{GS}$



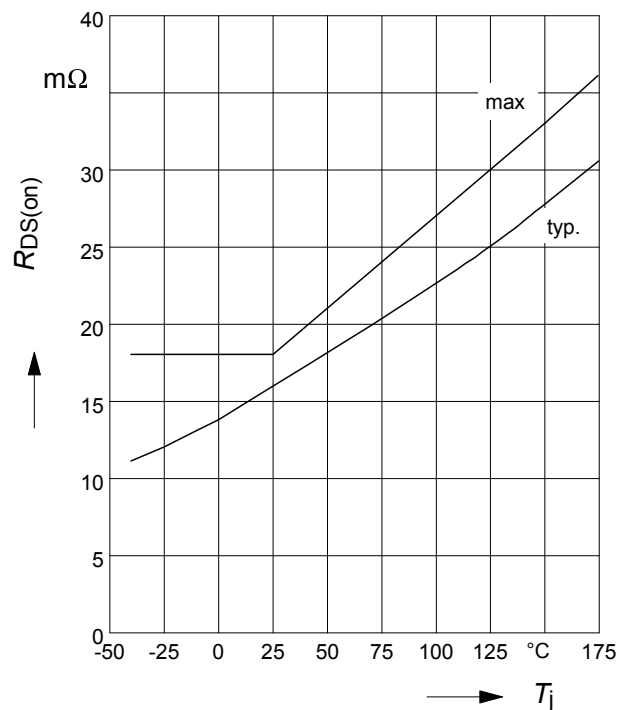
**7 On-state resistance**

$R_{ON} = f(T_j)$ ;  $I_D=12\text{A}$ ;  $V_{GS} = 4.5\text{V}$



**8 On-state resistance**

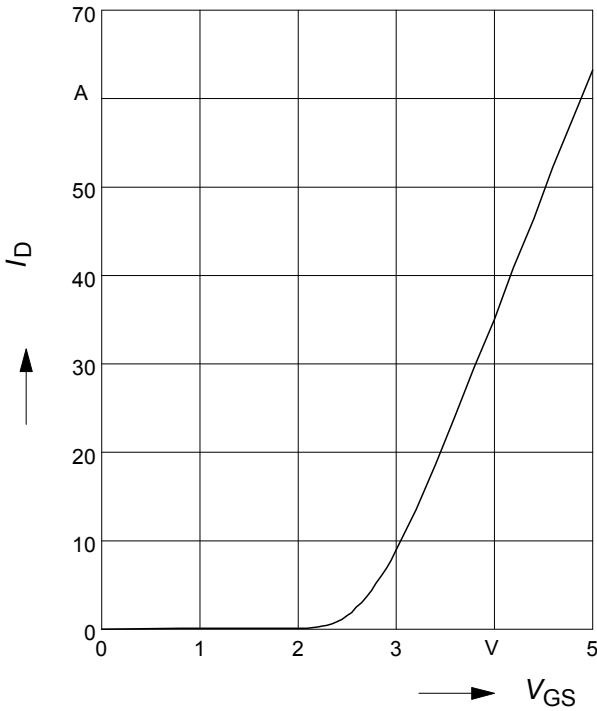
$R_{ON} = f(T_j)$ ;  $I_D=12\text{A}$ ;  $V_{GS} = 10\text{V}$





**9 Typ. transfer characteristics**

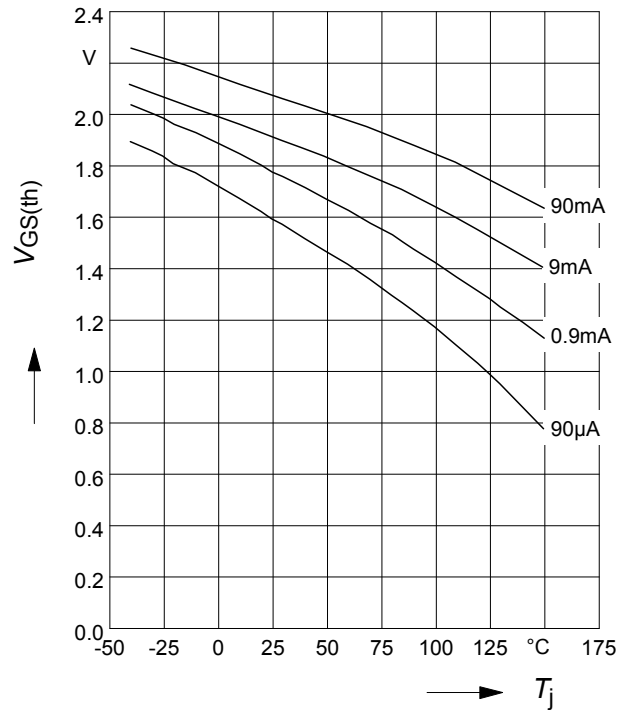
$I_D = f(V_{GS}); V_{DS} = 12V; T_j = 25^\circ C$



**10 Typ. input threshold voltage**

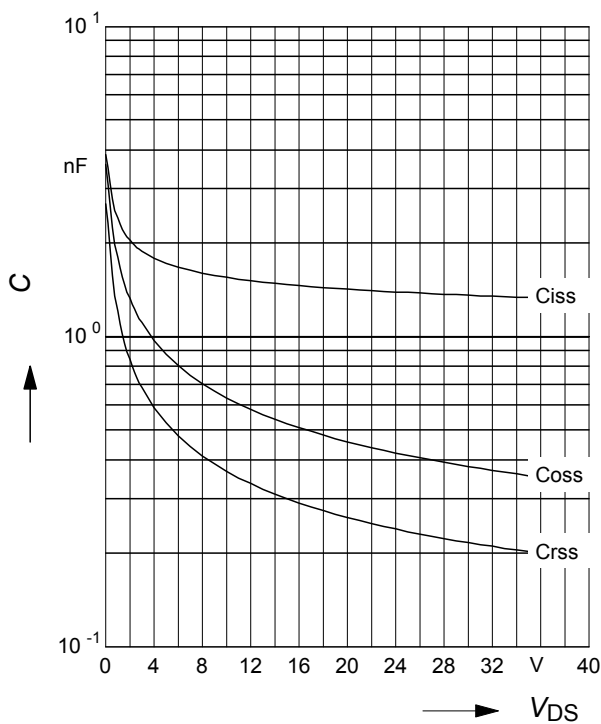
$V_{GS(th)} = f(T_j); V_{DS} = V_{GS}$

Parameter:  $I_D$



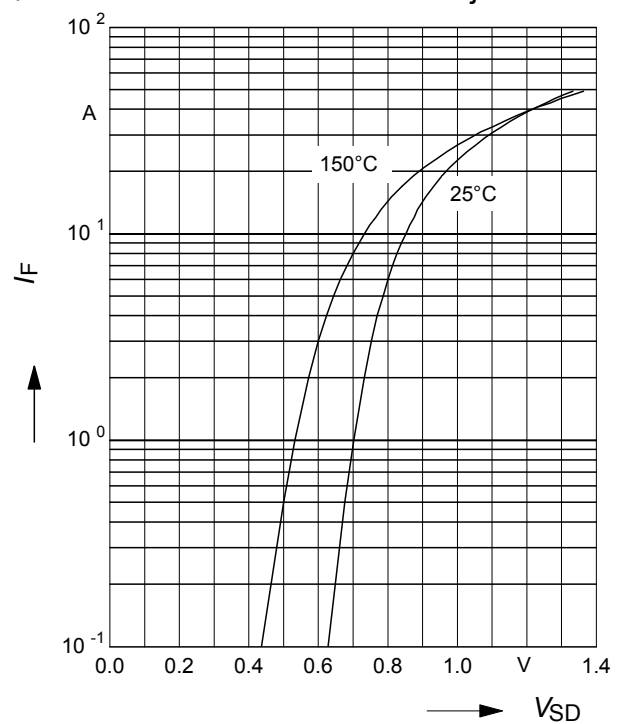
**11 Typ. capacitances**

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



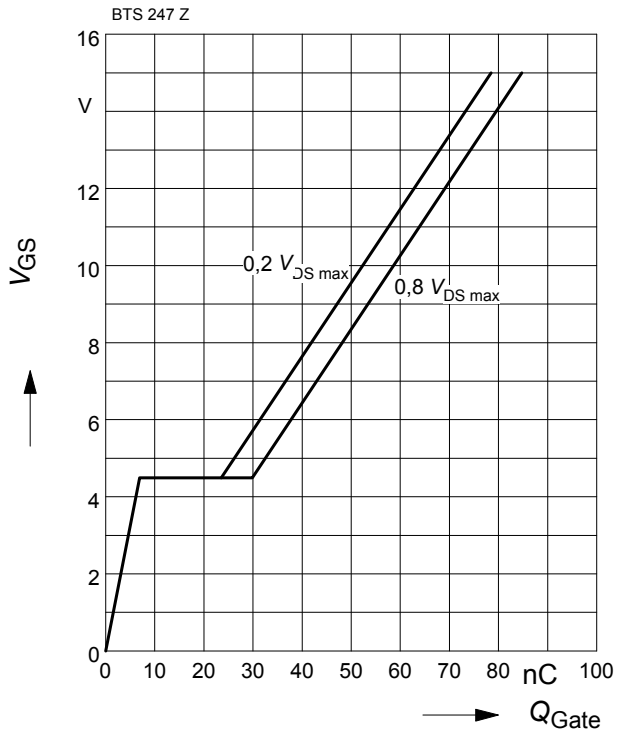
**12 Typ. forward characteristics of reverse diode  $I_F = f(V_{SD})$**

$t_p = 80\mu s$  (spread); Parameter:  $T_j$



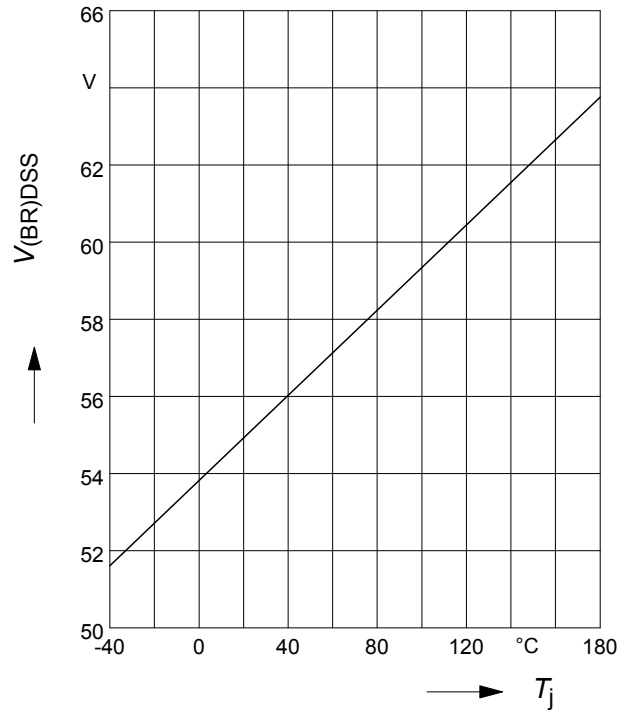
**13 Typ. gate charge**

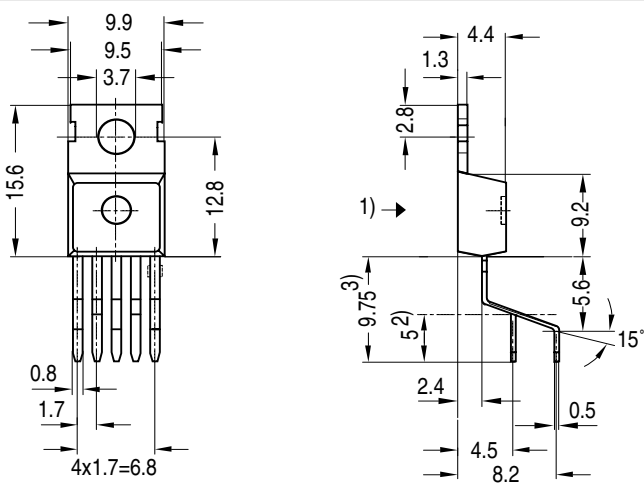
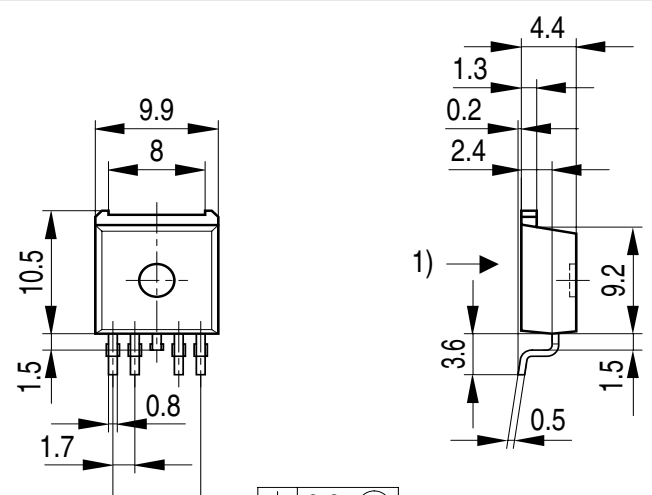
$V_{GS} = f(Q_{Gate}); I_D \text{ puls} = 45 \text{ A}$

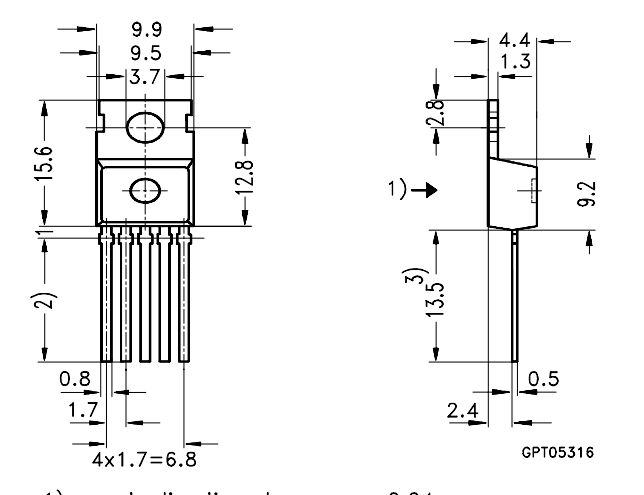


**14 Drain-source break down voltage**

$V_{(BR)DSS} = f(T_j)$



Package	Ordering Code	Package	Ordering Code
P-TO220-5-3	Q67060-S6001-A2	P-TO220-5-62	Q67060-S6002-A2
 <p>1) shear and punch direction no burrs this surface 2) min. length by tinning 3) max. 11 mm allowable by tinning</p>		 <p>1) shear and punch direction no burrs this surface</p>	

Package	Ordering Code
TO-220-5-43	Q67060-S6006
 <p>1) punch direction, burr max. 0.04 2) dip tinning 3) max. 14.5 by dip tinning press burr max. 0.05</p>	

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