



**THE DATASHEET OF  
BTS7904BATMA1**



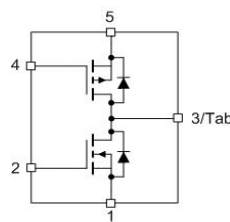
**OptiMOS<sup>®</sup> -T PN Half Bridge**

**Features**

- Dual p- and n-channel MOSFET
- Automotive AEC Q101 qualified
- Green package (RoHS compliant)
- Ultra low  $R_{DS(on)}$
- 150 °C operating temperature

**Product Summary**

	<b>P</b>	<b>N</b>	
$V_{DS}$	-30	55	V
$R_{DS(on),max}^{5)}$	12.7	11.7	mΩ
$I_D$	-40	40	A

**PG-TO263-5-1**


Type	Package	Marking
BTS7904B	PG-TO263-5-1	7904B

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

Parameter	Symbol	Conditions	Value		Unit
			<b>P</b>	<b>N</b>	
Continuous drain current <sup>1)</sup>	$I_D$	$T_C=25\text{ °C}$	-40	40	A
		$T_C=100\text{ °C}$	-40	40	
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$	$T_C=25\text{ °C}$	-160	160	
Avalanche energy, single pulse <sup>2)</sup>	$E_{AS}$	$I_D=\pm 20\text{ A}$	350	200	mJ
Avalanche current, single pulse	$I_{AS}$		-40	40	A
Gate source voltage	$V_{GS}$		-16 / +5	+16 / -16 <sup>3)</sup>	V
Power dissipation <sup>2)</sup>	$P_{tot}$	$T_C=25\text{ °C}$	96	69	W
Operating and storage temperature	$T_j, T_{stg}$		-55 ... 150		°C
IEC climatic category; DIN IEC 68-1			55/150/56		

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Thermal characteristics**

Thermal resistance, junction - case	P	$R_{thJC}$		-	-	1.3	K/W
	N			-	-	1.8	
SMD version, device on PCB		$R_{thJA}$	minimal footprint	-	-	62	
			6 cm <sup>2</sup> cooling area <sup>4)</sup>	-	-	45	

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

Drain-source breakdown voltage	P	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}, I_D=-1\text{ mA}$	-30	-	-	V
	N		$V_{GS}=0\text{ V}, I_D=1\text{ mA}$	55	-	-	
Gate threshold voltage	P	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=-70\text{ }\mu\text{A}$	-1	-1.5	-2.1	
	N		$V_{DS}=V_{GS}, I_D=40\text{ }\mu\text{A}$	1.2	1.7	2.2	
Zero gate voltage drain current	P	$I_{DSS}$	$V_{DS}=-18\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ }^\circ\text{C}$	-	-0.01	-1	$\mu\text{A}$
			$V_{DS}=-18\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ }^\circ\text{C}$	-	-1	-100	
	N		$V_{DS}=18\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ }^\circ\text{C}$	-	0.01	1	
			$V_{DS}=18\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ }^\circ\text{C}$	-	1	100	
Gate-source leakage current	P	$I_{GSS}$	$V_{GS}=-16\text{ V}, V_{DS}=0\text{ V}$	-	-10	-100	nA
	N		$V_{GS}=16\text{ V}, V_{DS}=0\text{ V}$	-	1	100	
Drain-source on-state resistance <sup>5)</sup>	P	$R_{DS(on)}$	$V_{GS}=-10\text{ V}, I_D=-20\text{ A}$	-	6.9	12.7	m $\Omega$
	N		$V_{GS}=10\text{ V}, I_D=20\text{ A}$	-	9.4	11.7	
	P		$V_{GS}=-4.5\text{ V}, I_D=-12.5\text{ A}$	-	17.2	20.7	
	N		$V_{GS}=4.5\text{ V}, I_D=20\text{ A}$	-	16.5	20.2	

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Dynamic characteristics**

Input capacitance	P	$C_{iss}$	$V_{GS}=0\text{ V}, V_{DS}=\pm 25\text{ V},$ $f=1\text{ MHz}$	-	3900	5200	pF	
	N			-	4600	6100		
Output capacitance	P	$C_{oss}$		-	1000	1300		
	N			-	570	760		
Reverse transfer capacitance	P	$C_{rss}$		-	850	1300		
	N			-	550	820		
Turn-on delay time	P	$t_{d(on)}$		$V_{DD}=15\text{ V}, V_{GS}=10\text{ V}$  N: $I_D=30\text{ A}, R_G=2\ \Omega$ P: $I_D=-30\text{ A}, R_G=2\ \Omega$	-	22	-	ns
	N				-	15	-	
Rise time	P	$t_r$			-	94	-	
	N				-	77	-	
Turn-off delay time	P	$t_{d(off)}$	-		104	-		
	N		-		31	-		
Fall time	P	$t_f$	-		150	-		
	N		-		8	-		

**Gate Charge Characteristics<sup>2)</sup>**

Gate to source charge	P	$Q_{gs}$	$V_{DD}=-24\text{ V}, I_D=-40\text{ A},$ $V_{GS}=0\text{ to }-10\text{ V}$	-	-12	-16	nC
Gate to drain charge		$Q_{gd}$		-	-30	-45	
Switching charge		$Q_g$		-	-80	-121	
Gate plateau voltage		$V_{plateau}$		-	-3.0	-	
Gate to source charge	N	$Q_{gs}$	$V_{DD}=44\text{ V}, I_D=40\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	20	27	
Gate to drain charge		$Q_{gd}$		-	32	48	
Gate charge		$Q_g$		-	82	123	
Gate plateau voltage		$V_{plateau}$			4.2		

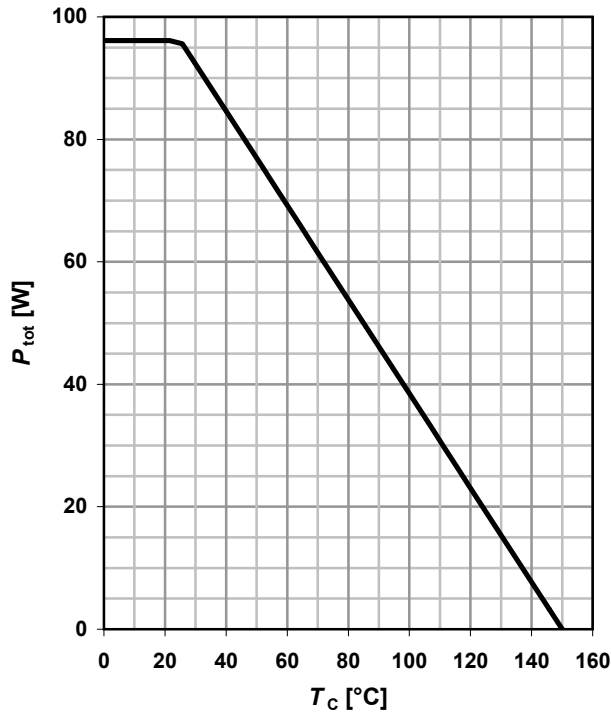
Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Reverse Diode**

Diode continuous forward current <sup>2)</sup>	P	$I_S$	$T_C=25\text{ °C}$	-	-	-40	A
	N					40	
Diode pulse current	P	$I_{S,pulse}$		-	-	-160	
	N					160	
Diode forward voltage	P	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=-40\text{ A}, T_j=25\text{ °C}$	-	-1.00	-1.2	V
	N		$V_{GS}=0\text{ V}, I_F=40\text{ A}, T_j=25\text{ °C}$	-	0.90	1.2	
Reverse recovery time <sup>2)</sup>	P	$t_{rr}$	$V_R=15\text{ V}, I_F=I_S, di_F/dt=400\text{ A}/\mu\text{s}$	-	41	-	ns
	N			-	47	-	
Reverse recovery charge <sup>2)</sup>	P	$Q_{rr}$		-	-40	-	nC
	N			-	50	-	

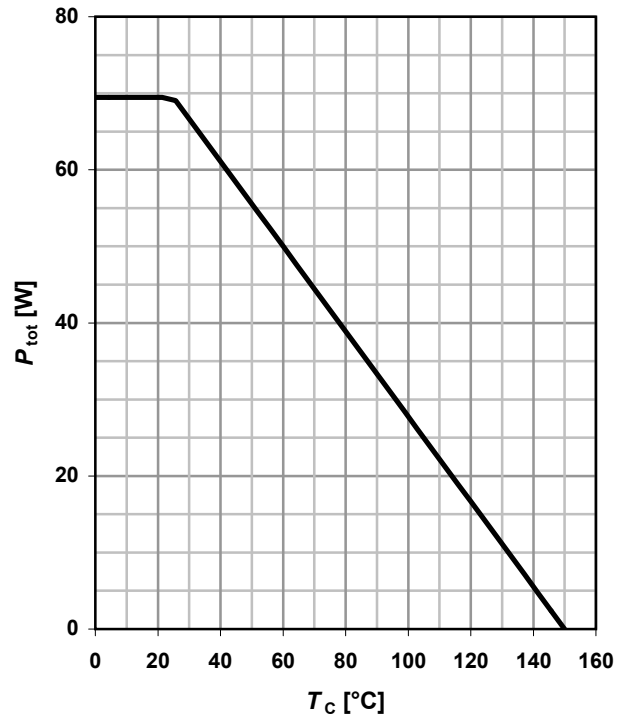
**1 Power dissipation (P)**

$P_{tot}=f(T_C), V_{GS} \geq 6\text{ V}$



**2 Power dissipation (N)**

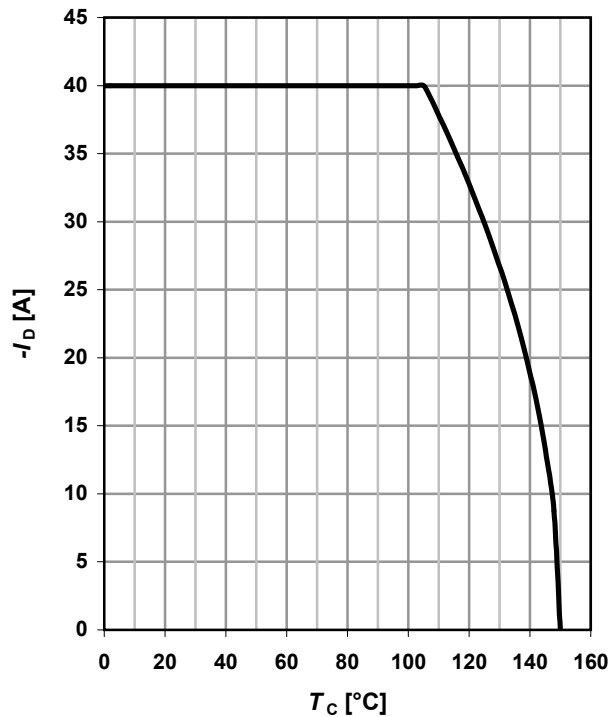
$P_{tot}=f(T_C), V_{GS} \geq 6\text{ V}$



**3 Drain current (P)**

$I_D=f(T_C)$

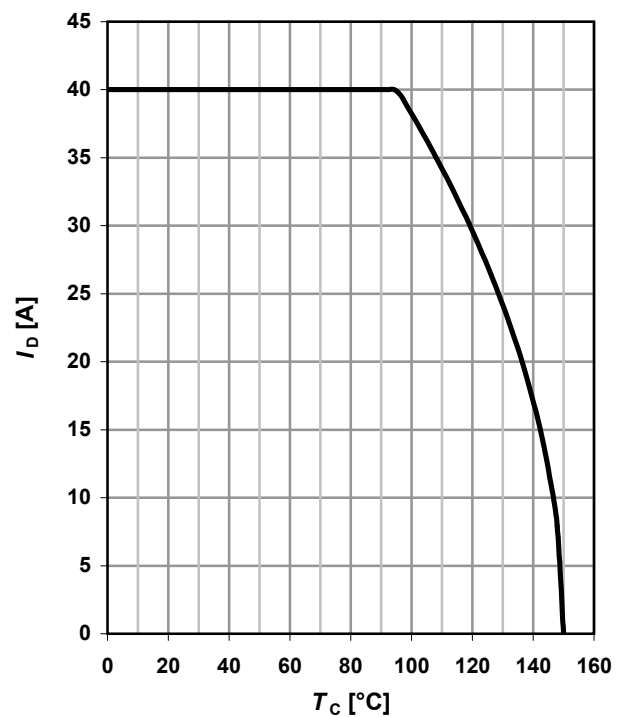
parameter:  $V_{GS} \geq 6\text{ V}$



**4 Drain current (N)**

$I_D=f(T_C)$

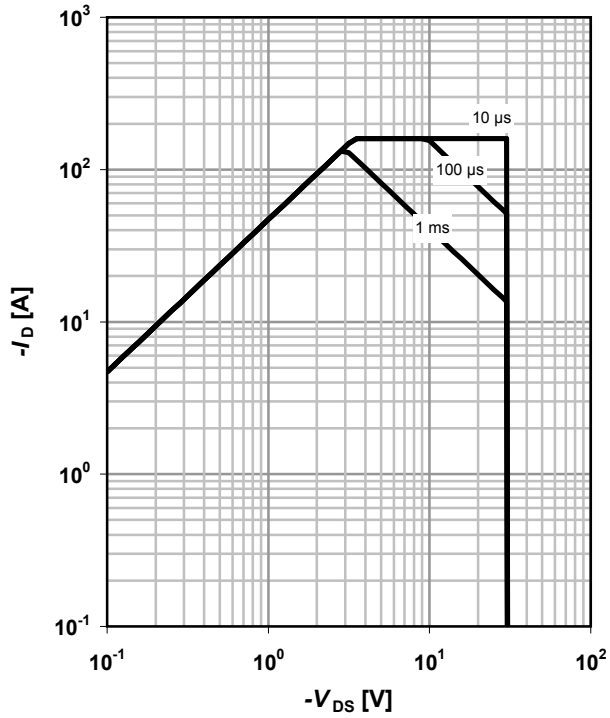
parameter:  $V_{GS} \geq 6\text{ V}$



**5 Safe operating area (P)**

$I_D=f(V_{DS}); T_C=25\text{ }^\circ\text{C}; D=0$

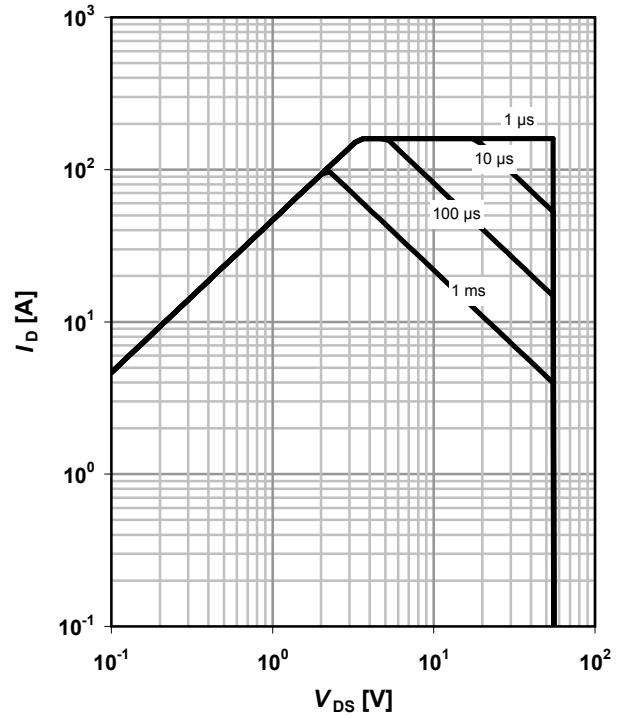
parameter:  $t_p$



**6 Safe operating area (N)**

$I_D=f(V_{DS}); T_C=25\text{ }^\circ\text{C}; D=0$

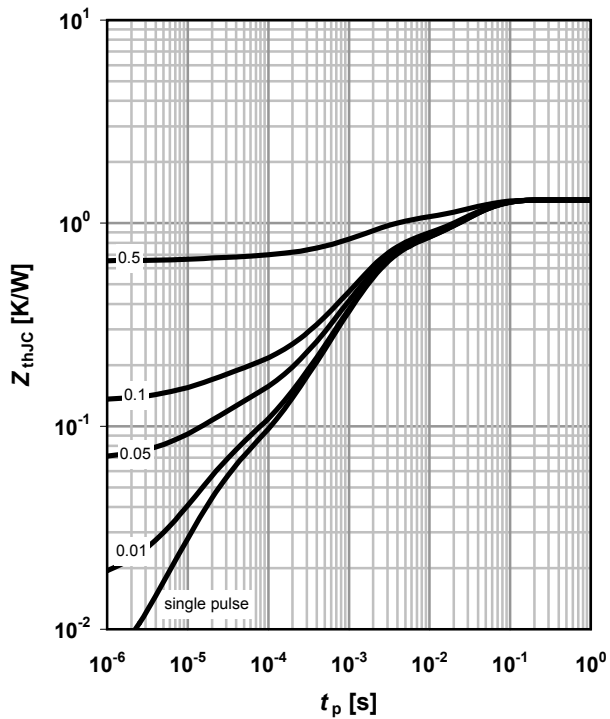
parameter:  $t_p$



**7 Max. transient thermal impedance (P)**

$Z_{thJC}=f(t_p)$

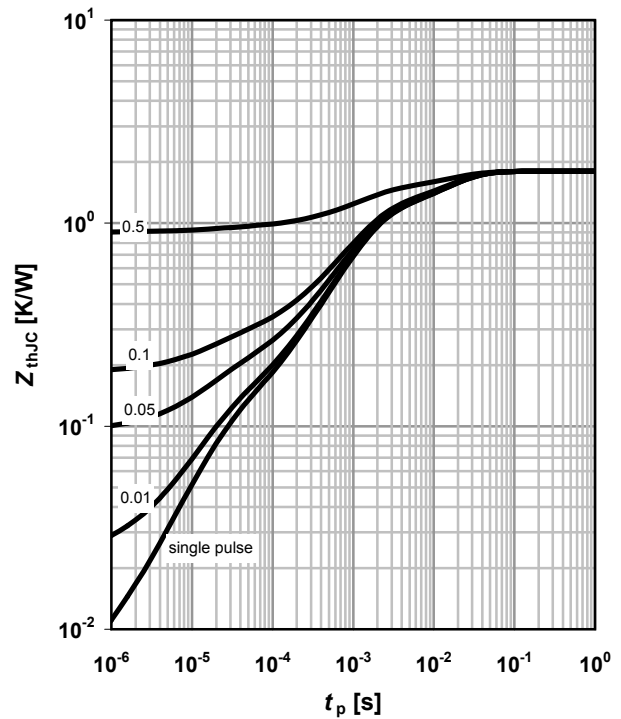
parameter:  $D=t_p/T$



**8 Max. transient thermal impedance (N)**

$Z_{thJC}=f(t_p)$

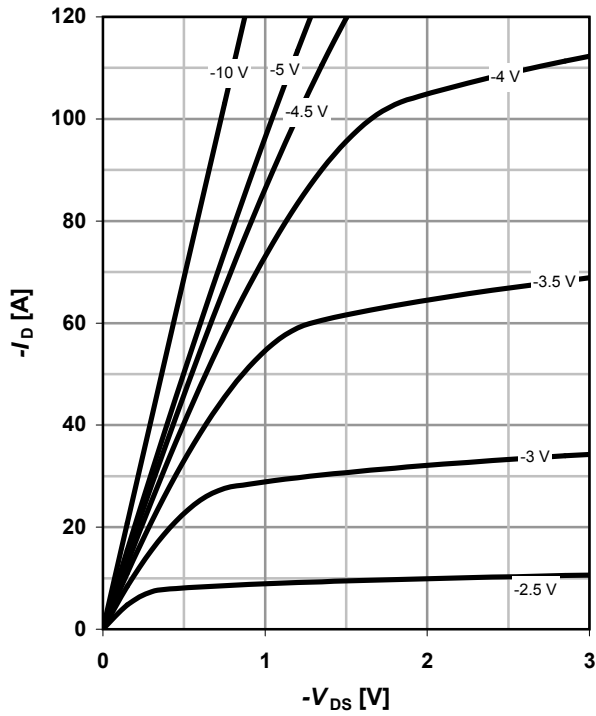
parameter:  $D=t_p/T$



**9 Typ. output characteristics (P)**

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

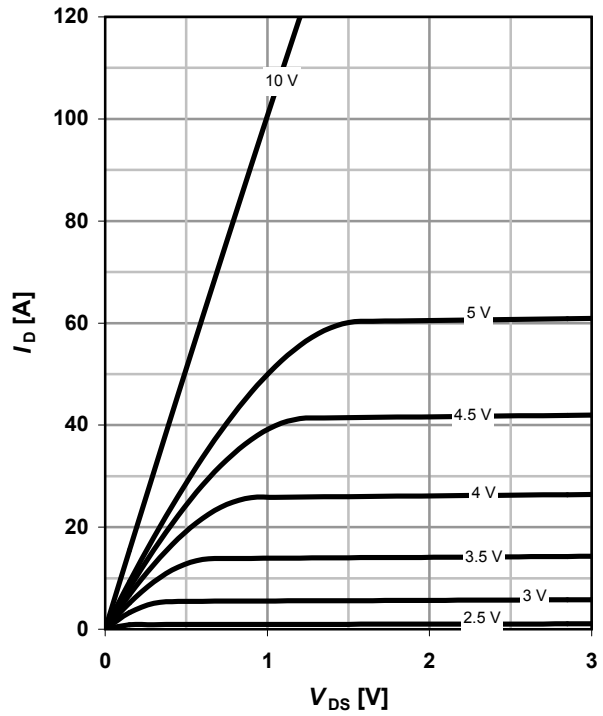
parameter:  $V_{GS}$



**10 Typ. output characteristics (N)**

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

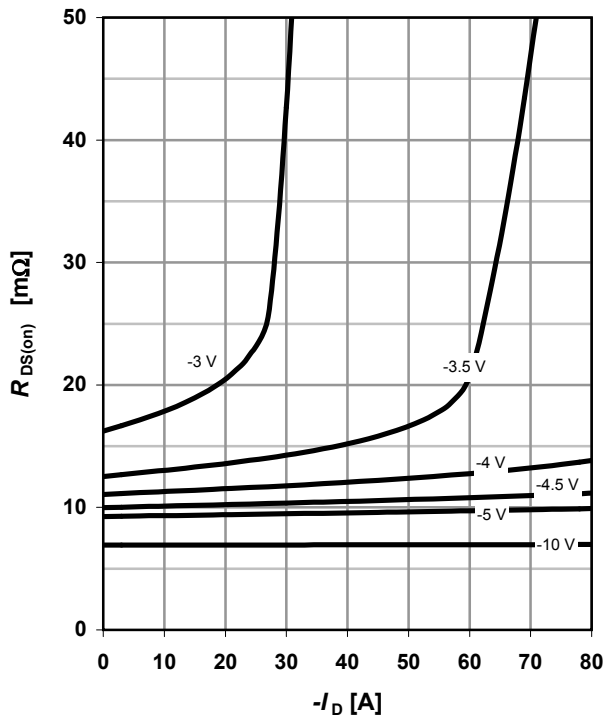
parameter:  $V_{GS}$



**11 Typ. drain-source on resistance (P)<sup>5)</sup>**

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

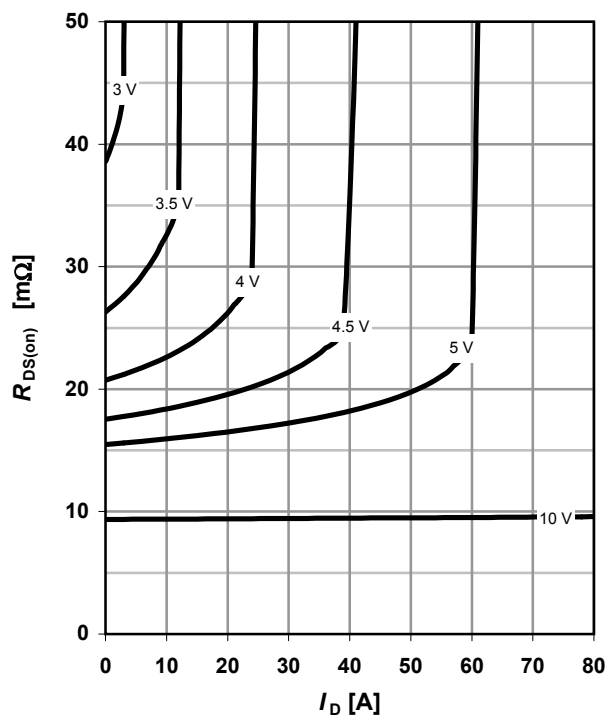
parameter:  $V_{GS}$



**12 Typ. drain-source on resistance (N)<sup>5)</sup>**

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

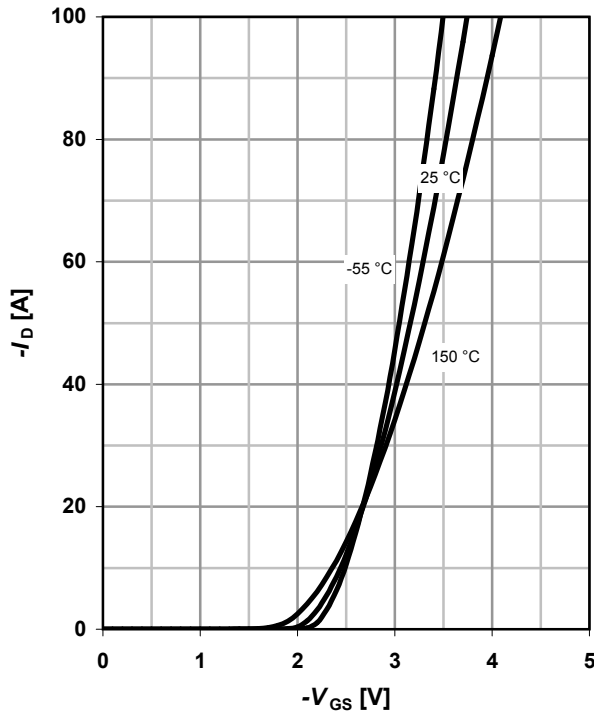
parameter:  $V_{GS}$



**13 Typ. transfer characteristics (P)**

$I_D=f(V_{GS}); V_{DS}=-6\text{ V}$

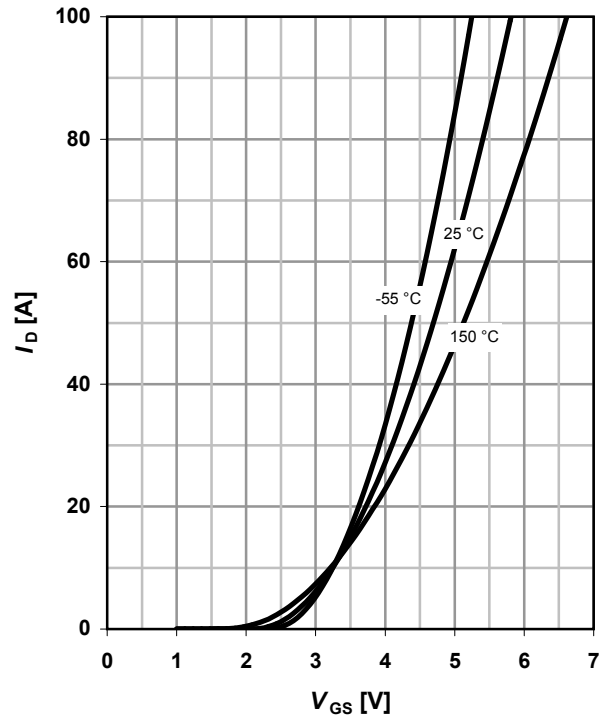
parameter:  $T_j$



**14 Typ. transfer characteristics (N)**

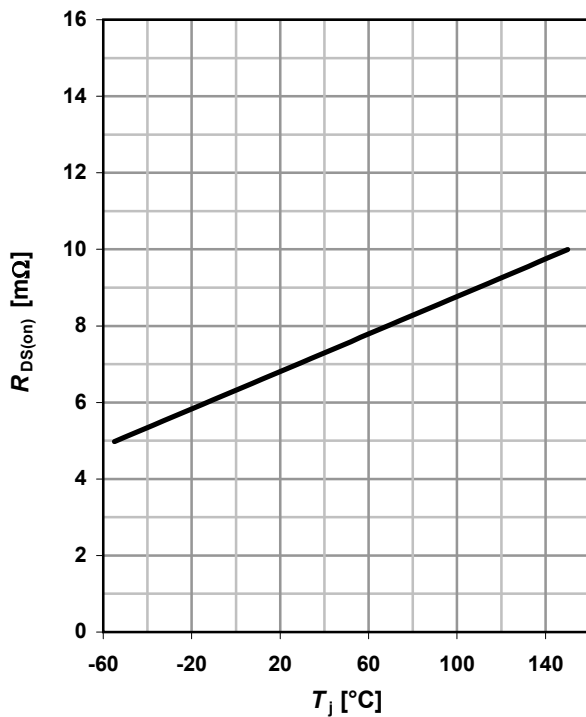
$I_D=f(V_{GS}); V_{DS}=6\text{ V}$

parameter:  $T_j$



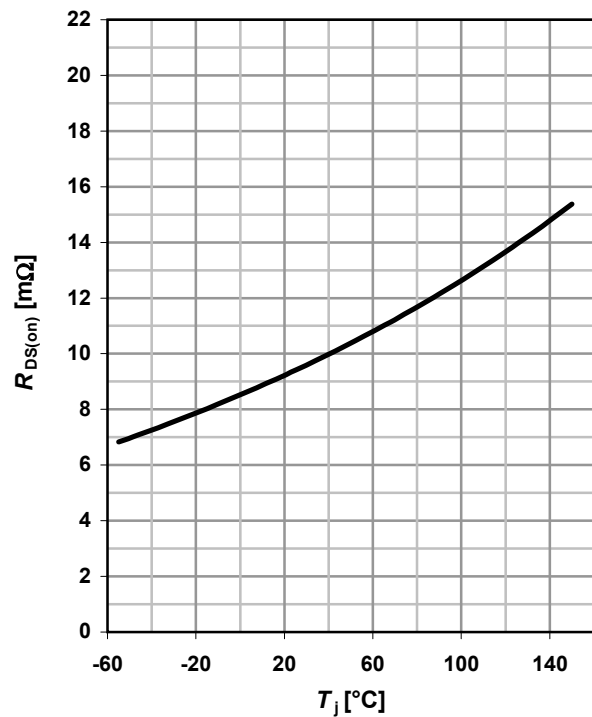
**15 Drain-source on-state resistance (P)<sup>5)</sup>**

$R_{DS(on)}=f(T_j); I_D=-20\text{ A}; V_{GS}=-10\text{ V}$



**16 Drain-source on-state resistance (N)<sup>5)</sup>**

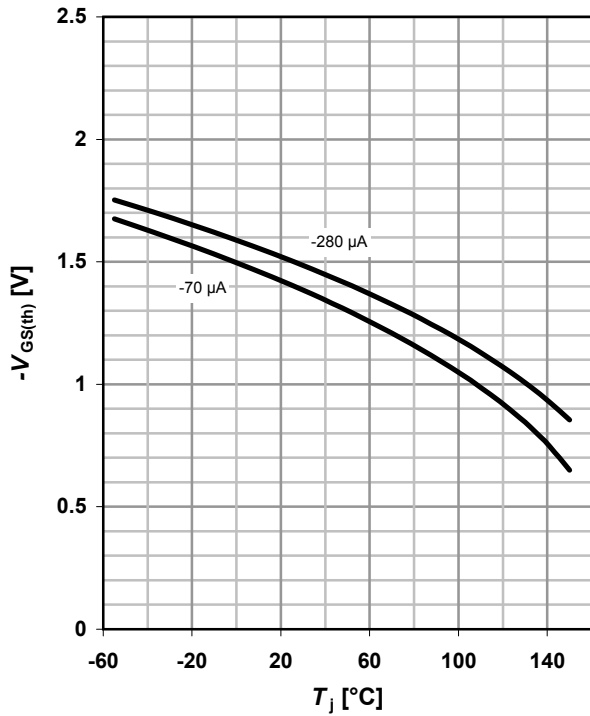
$R_{DS(on)}=f(T_j); I_D=20\text{ A}; V_{GS}=10\text{ V}$



**17 Typ. gate threshold voltage (P)**

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

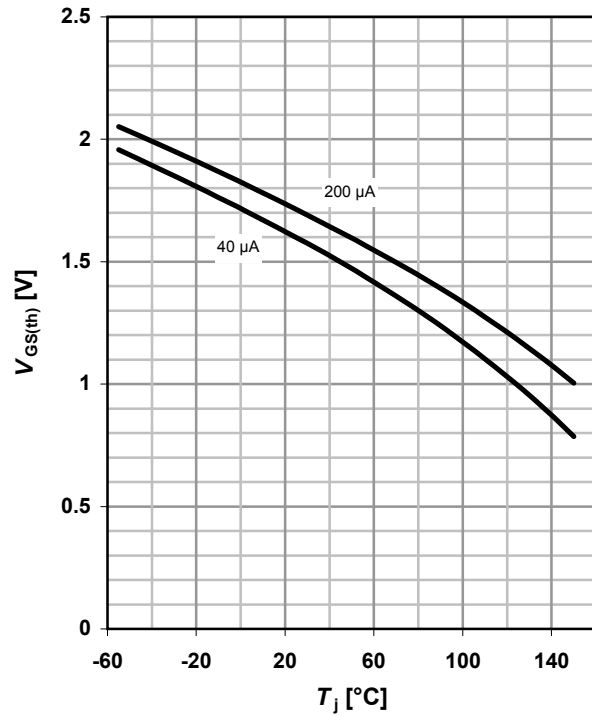
parameter:  $I_D$



**18 Typ. gate threshold voltage (N)**

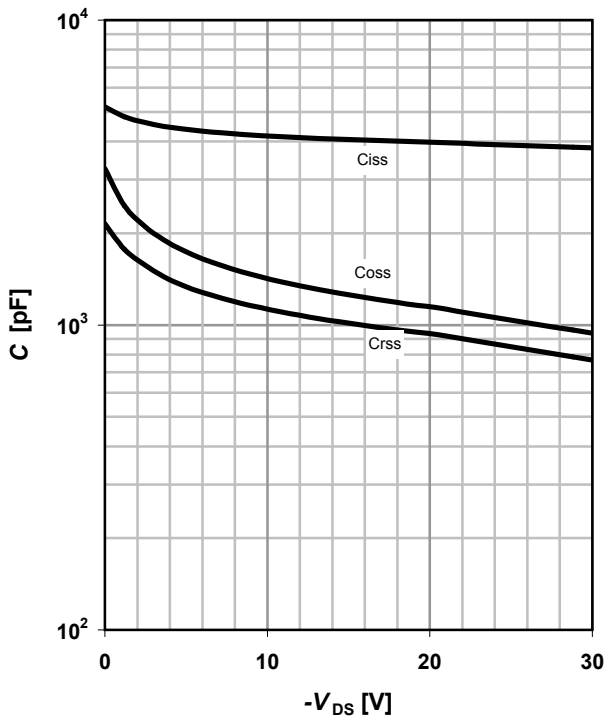
$V_{GS(th)}=f(T_j); V_{GS}=V_{DS}$

parameter:  $I_D$



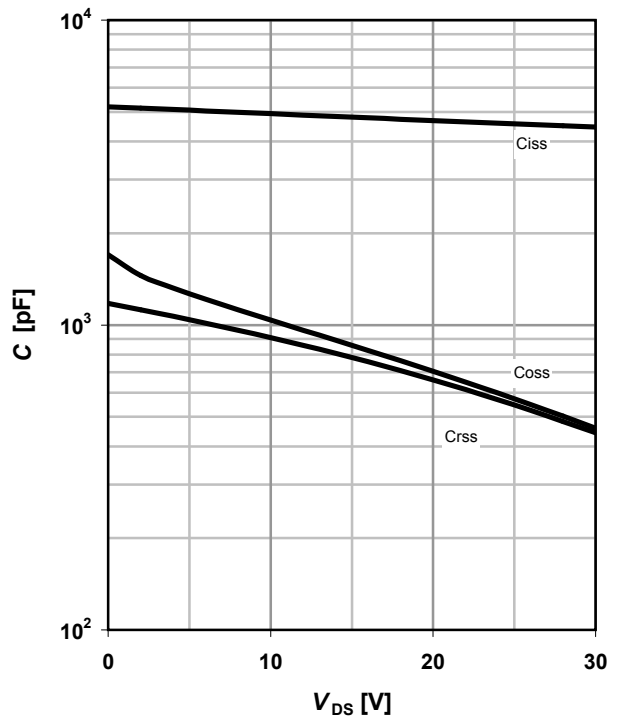
**19 Typ. capacitances (P)**

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



**20 Typ. capacitances (N)**

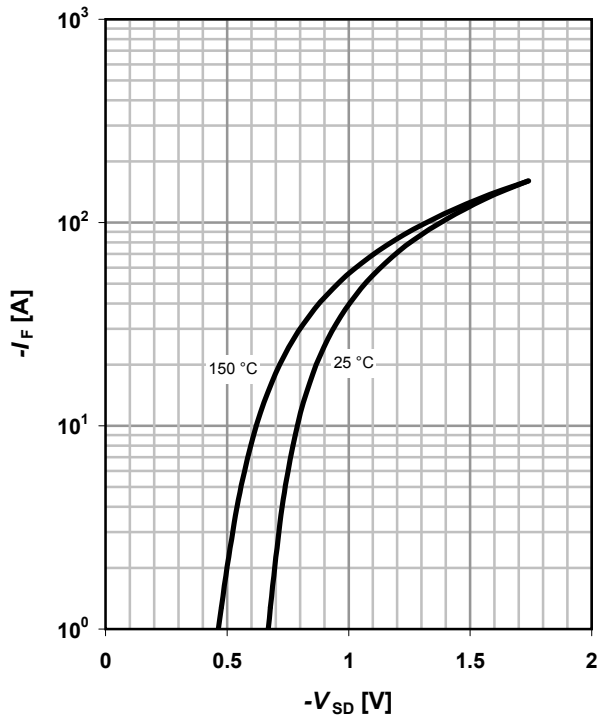
$C=f(V_{DS}); V_{GS}=0 V; f=1 MHz$



**21 Forward characteristics of reverse diode (P)**

$I_F=f(V_{SD})$

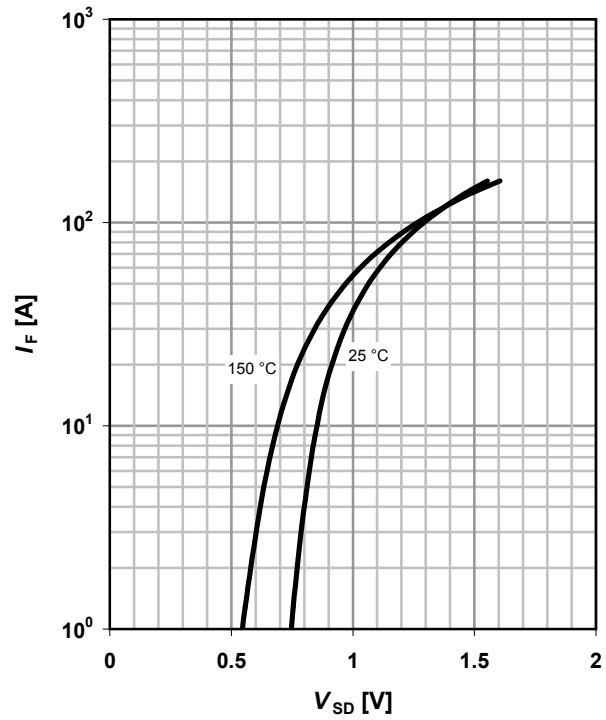
parameter:  $T_j$



**22 Forward characteristics of reverse diode (N)**

$I_F=f(V_{SD})$

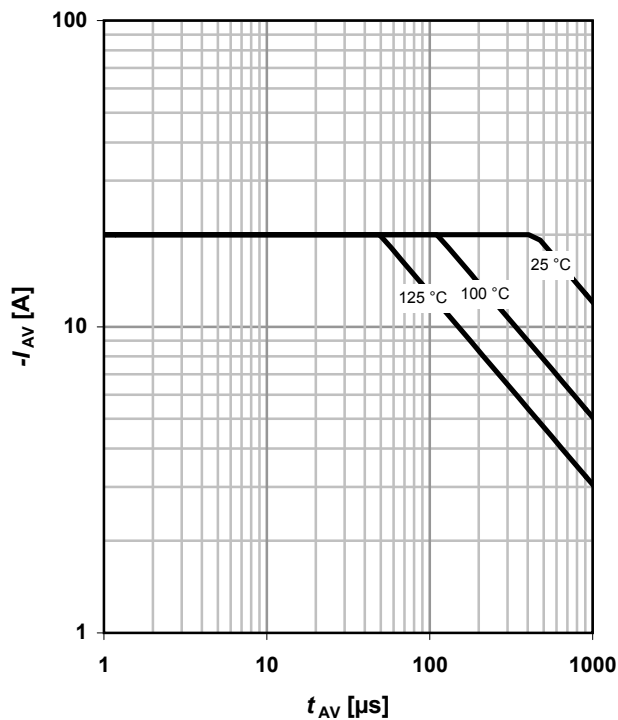
parameter:  $T_j$



**23 Avalanche characteristics (P)**

$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$

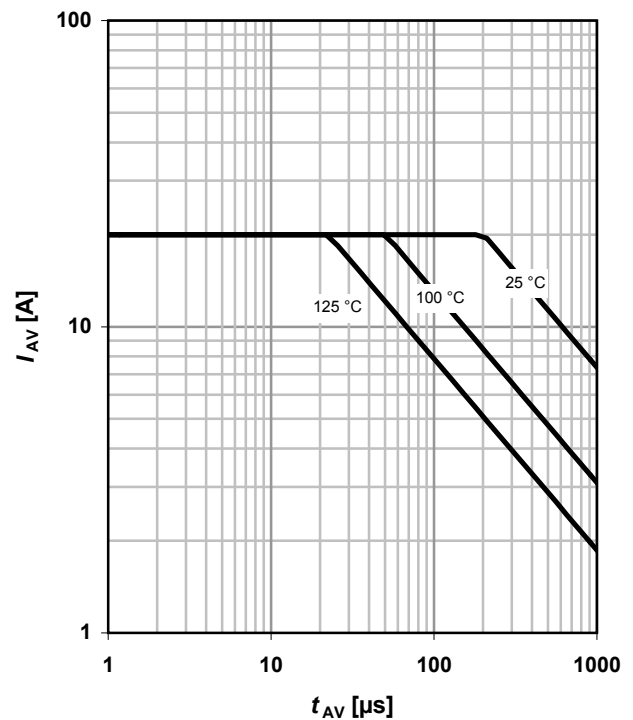
parameter:  $T_{j(start)}$



**24 Avalanche characteristics (N)**

$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$

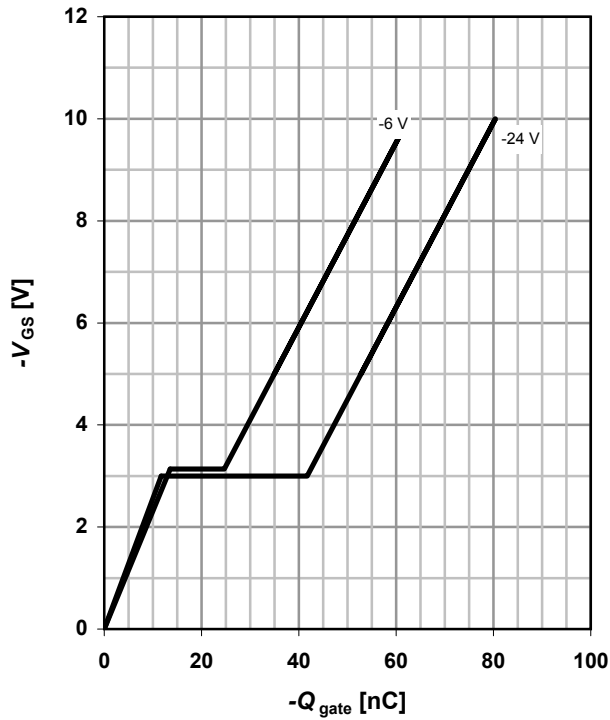
parameter:  $T_{j(start)}$



**25 Typ. gate charge (P)**

$V_{GS}=f(Q_{gate}); I_D=-40\text{ A pulsed}$

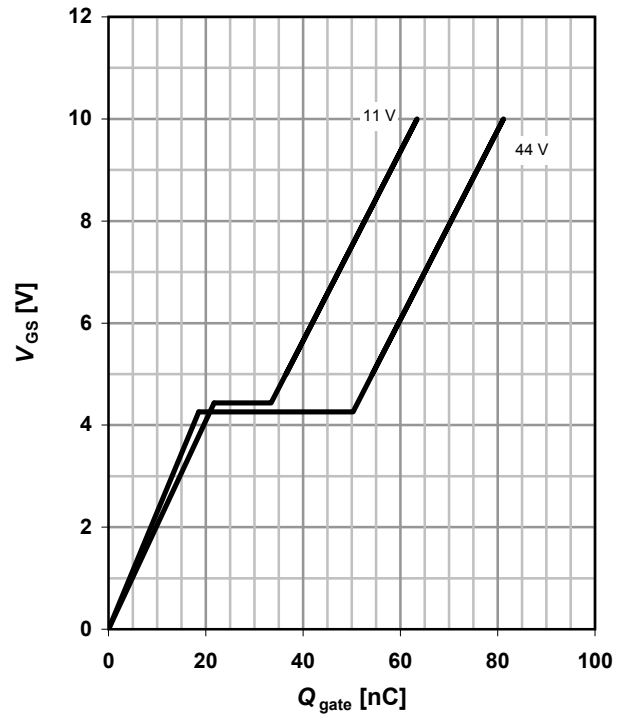
parameter:  $V_{DD}$



**26 Typ. gate charge (N)**

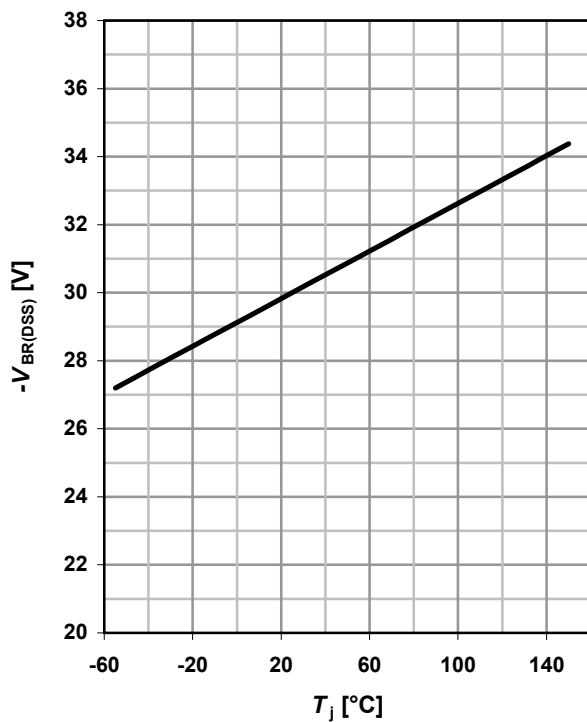
$V_{GS}=f(Q_{gate}); I_D=40\text{ A pulsed}$

parameter:  $V_{DD}$



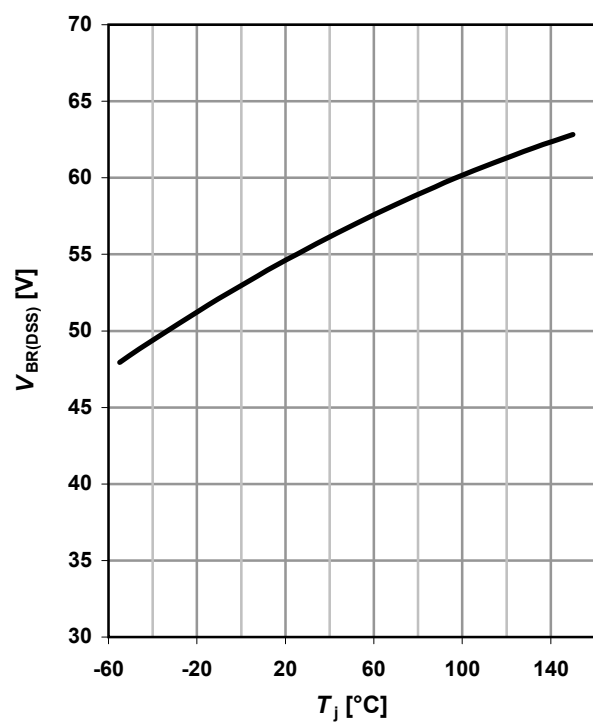
**27 Drain-source breakdown voltage (P)**

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



**28 Drain-source breakdown voltage (N)**

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



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