

OptiMOS[®] -T PN Half Bridge



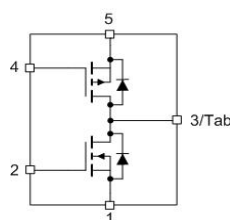
Features

- 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

	P	N	
V_{DS}	-30	55	V
$R_{DS(on),max}$	13	12	mΩ
I_D	-40	40	A

PG-TO220-5-13



Type	Package	Marking
BTS7904S	PG-TO220-5-13	7904S

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

Parameter	Symbol	Conditions	Value		Unit
			P	N	
Continuous drain current ¹⁾	I_D	$T_C=25\text{ °C}$	-40	40	A
		$T_C=100\text{ °C}$	-40	40	
Pulsed drain current ²⁾	$I_{D,pulse}$	$T_C=25\text{ °C}$	-160	160	
Avalanche energy, single pulse ²⁾	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 ³⁾	V
Power dissipation ²⁾	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 ⁵⁾		R_{thJA}	minimal footprint	-	-	62	
			6 cm ² cooling area ⁴⁾	-	-	45	

Electrical characteristics, at $T_j=25\text{ °C}$, 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}	$V_{DS}=-18\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$	-	-0.01	-1	μA
			$V_{DS}=-18\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ °C}$	-	-1	-100	
	N		$V_{DS}=18\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$	-	0.01	1	
			$V_{DS}=18\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ °C}$	-	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	P	$R_{DS(on)}$	$V_{GS}=-10\text{ V}, I_D=-20\text{ A}$	-	7.2	13	m Ω
	N		$V_{GS}=10\text{ V}, I_D=20\text{ A}$	-	9.7	12	
	P		$V_{GS}=-4.5\text{ V}, I_D=-12.5\text{ A}$	-	17.5	21	
	N		$V_{GS}=4.5\text{ V}, I_D=20\text{ A}$	-	16.8	20.5	

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	$t_{d(on)}$		-	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 Characteristics²⁾

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		

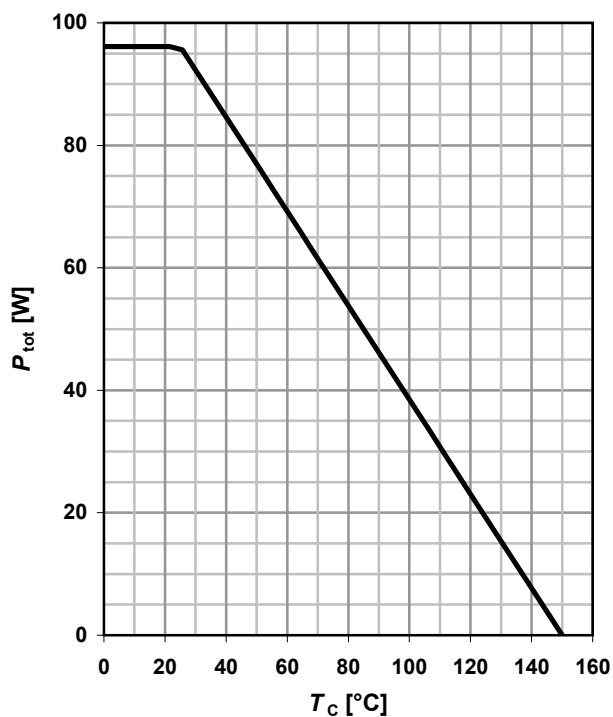
Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Reverse Diode

Diode continuous forward current ²⁾	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 ²⁾	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 ²⁾	P	Q_{rr}		-	-40	-	nC
	N			-	50	-	

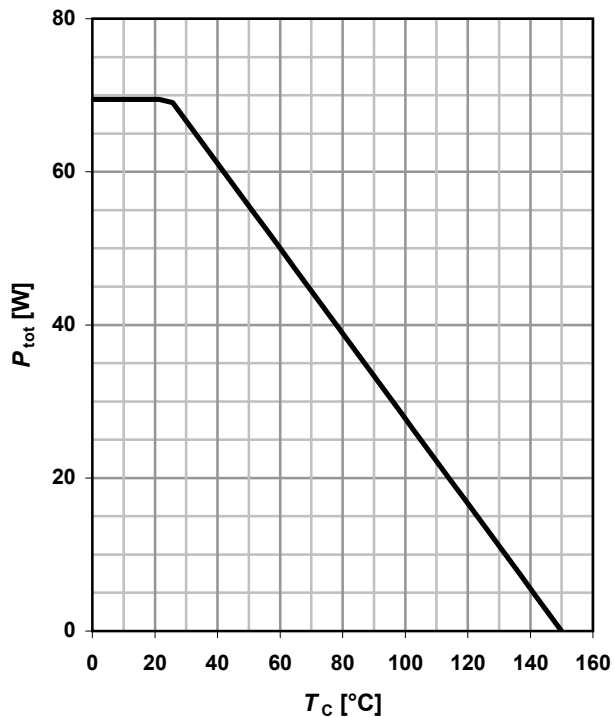
1 Power dissipation (P)

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



2 Power dissipation (N)

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



3 Drain current (P)

$$I_D = f(T_C)$$

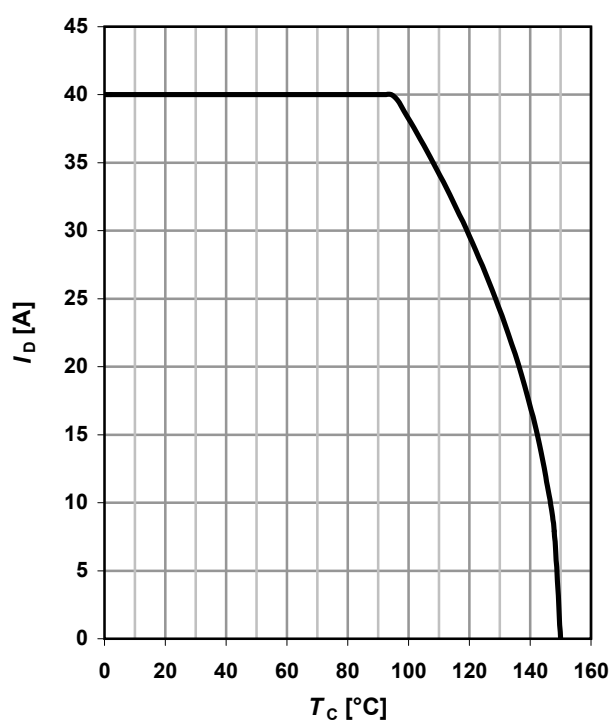
parameter: $V_{\text{GS}} \geq 6 \text{ V}$



4 Drain current (N)

$$I_D = f(T_C)$$

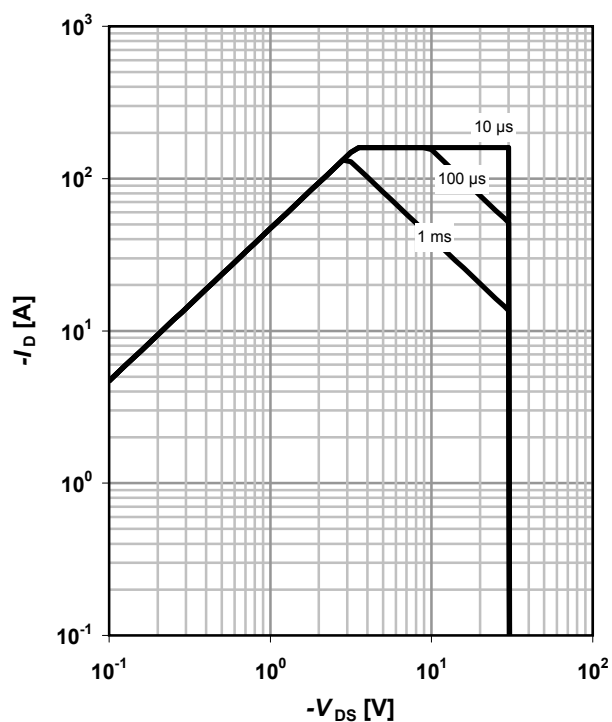
parameter: $V_{\text{GS}} \geq 6 \text{ V}$



5 Safe operating area (P)

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

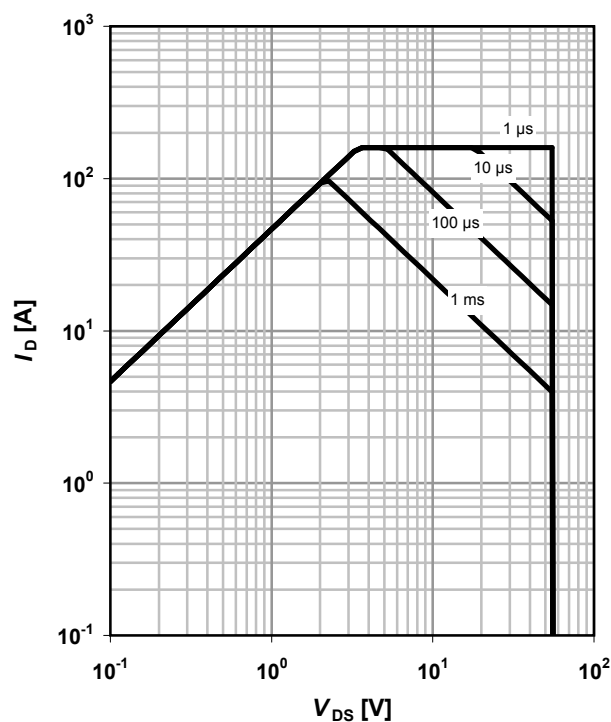
parameter: t_p



6 Safe operating area (N)

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

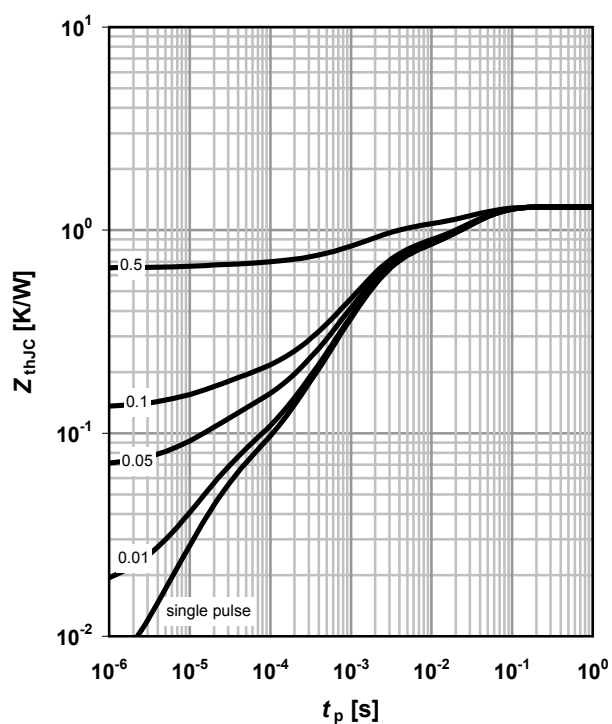
parameter: t_p



7 Max. transient thermal impedance (P)

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

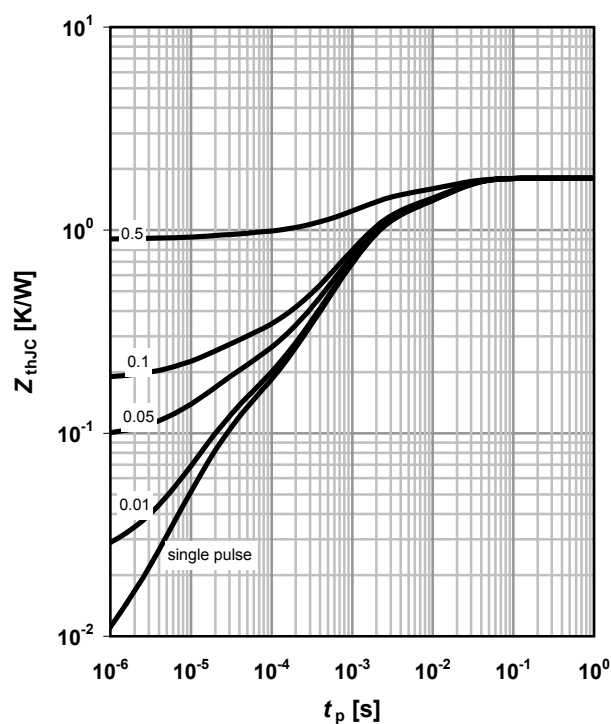
parameter: $D = t_p/T$



8 Max. transient thermal impedance (N)

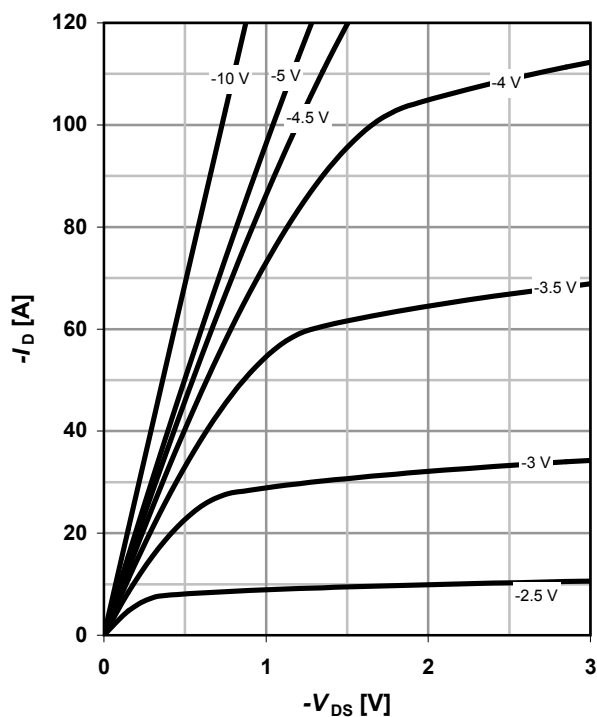
$$Z_{thJC} = f(t_p)$$

parameter: $D = t_p/T$



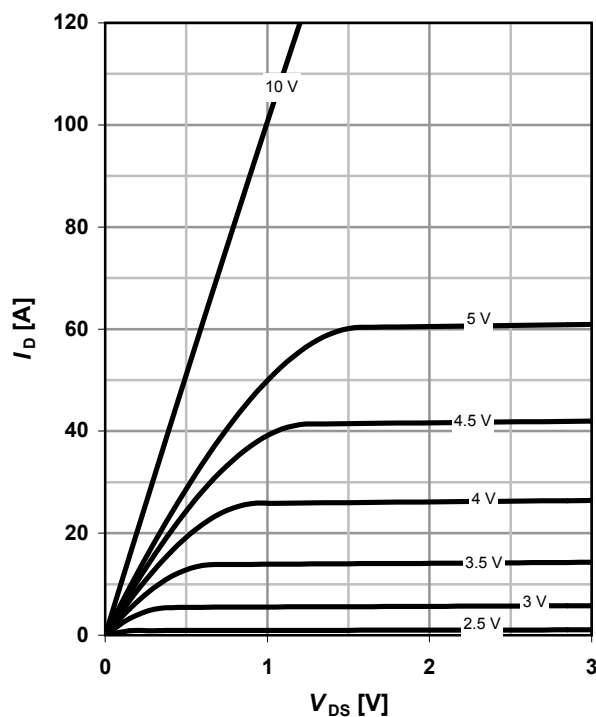
9 Typ. output characteristics (P)

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

parameter: V_{GS}


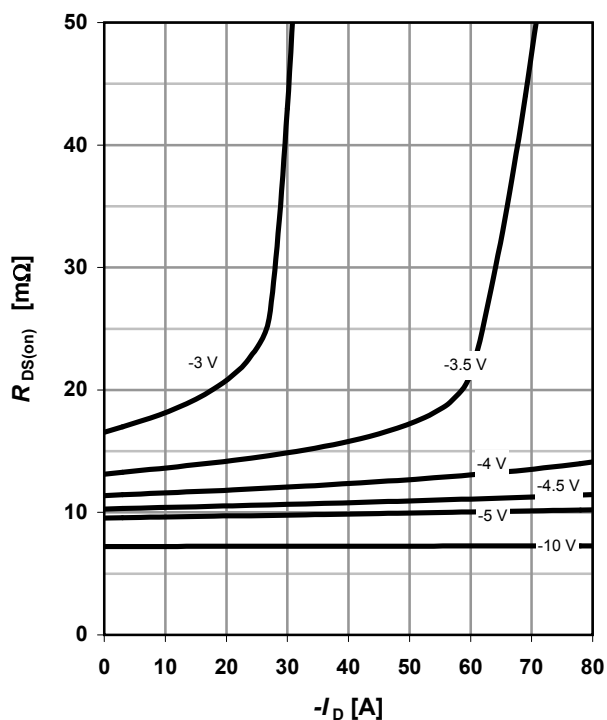
10 Typ. output characteristics (N)

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

parameter: V_{GS}


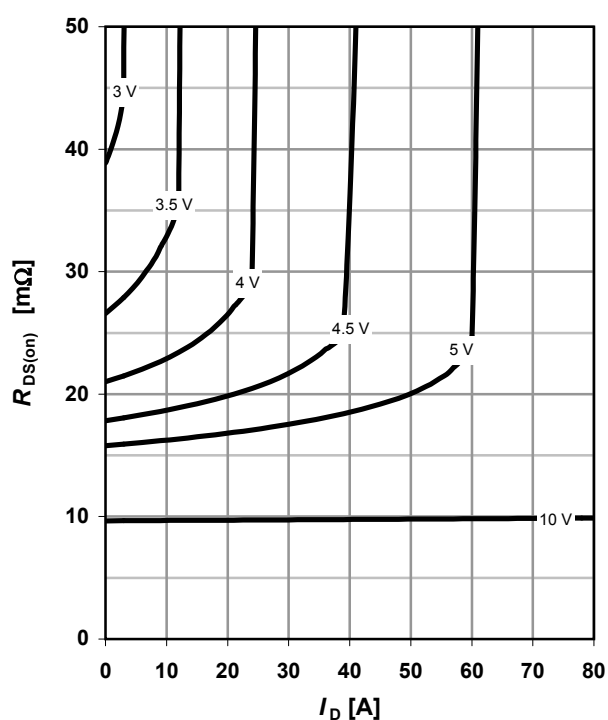
11 Typ. drain-source on resistance (P)

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

parameter: V_{GS}


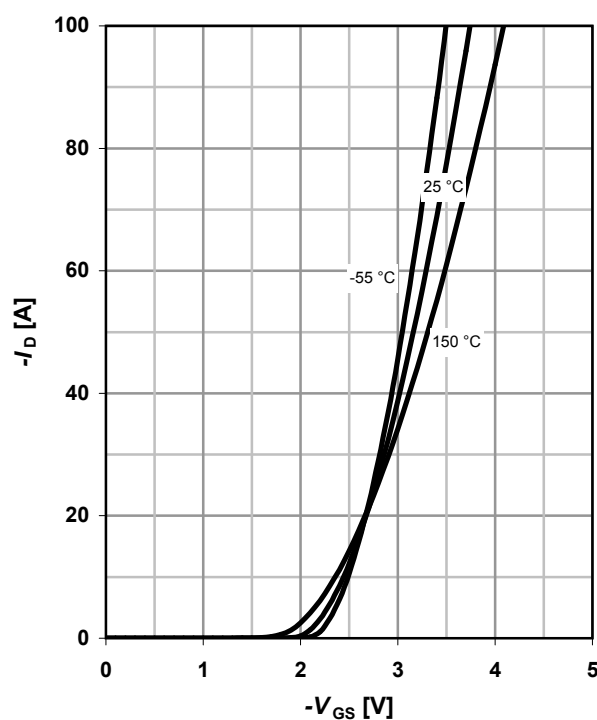
12 Typ. drain-source on resistance (N)

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

parameter: V_{GS}


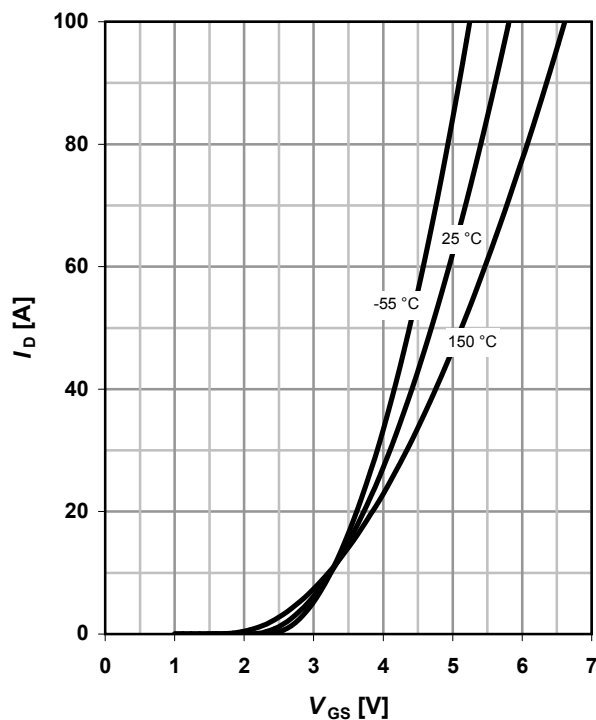
13 Typ. transfer characteristics (P)

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

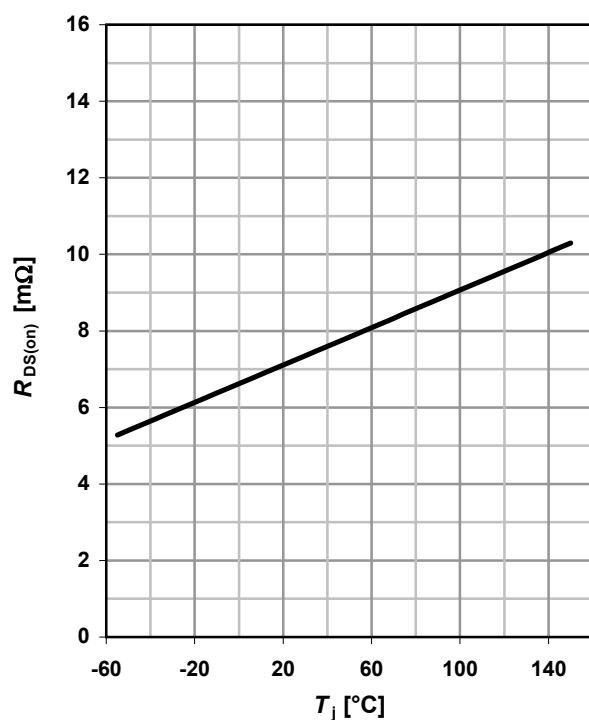
parameter: T_j


14 Typ. transfer characteristics (N)

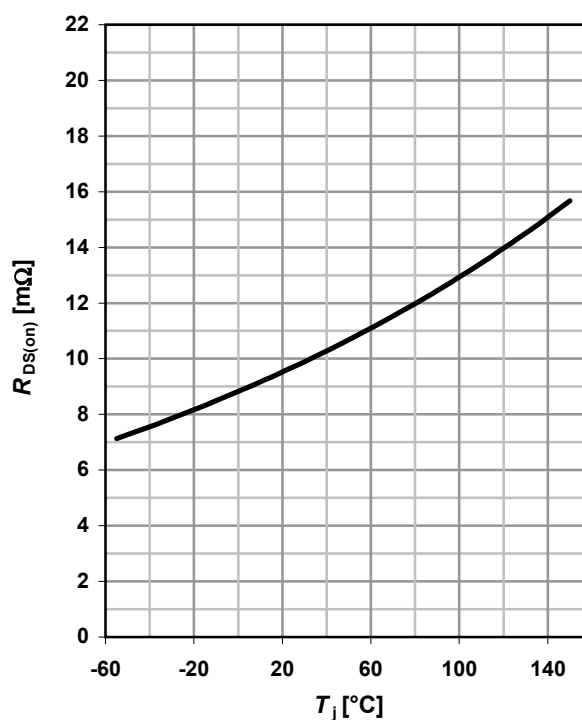
 $I_D = f(V_{GS}); V_{DS} = 6 \text{ V}$

parameter: T_j


15 Drain-source on-state resistance (P)

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


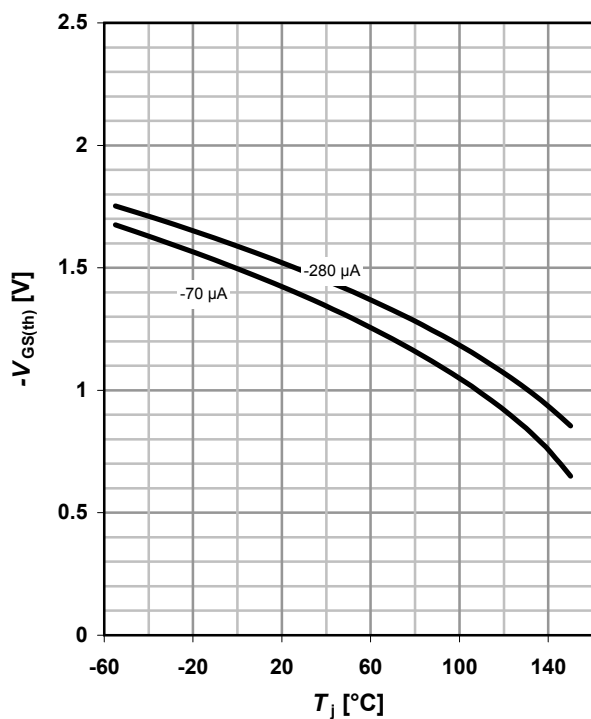
16 Drain-source on-state resistance (N)

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


17 Typ. gate threshold voltage (P)

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

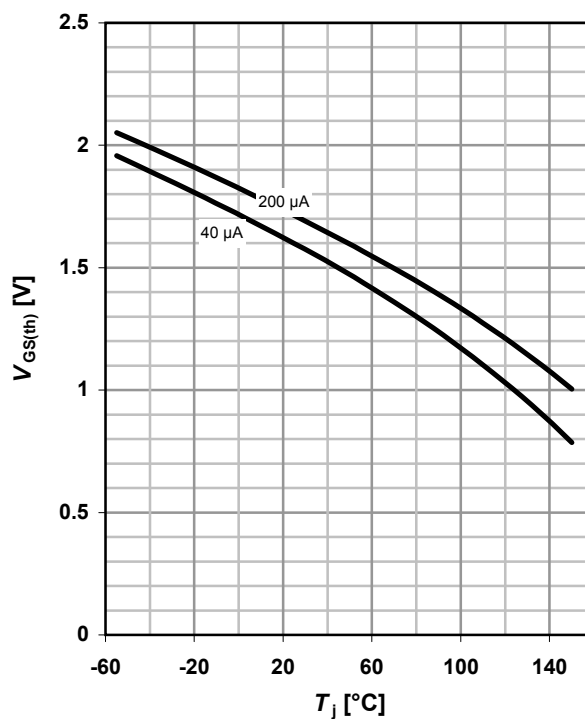
parameter: I_D



18 Typ. gate threshold voltage (N)

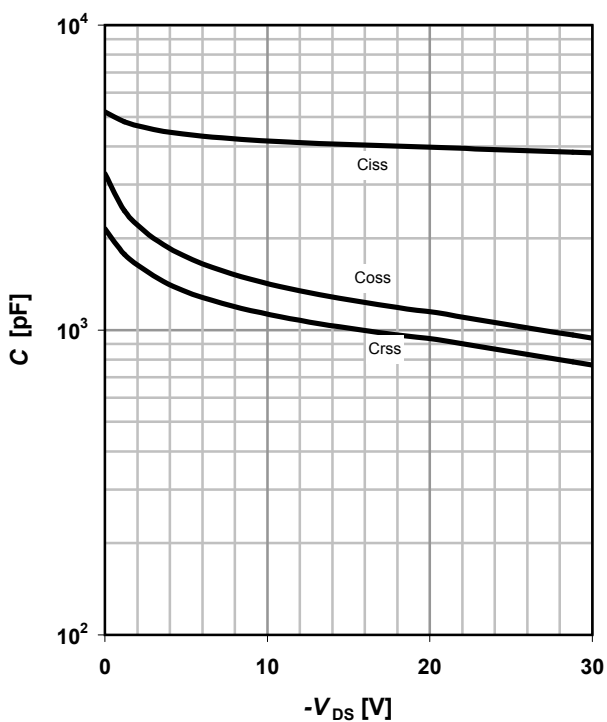
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter: I_D



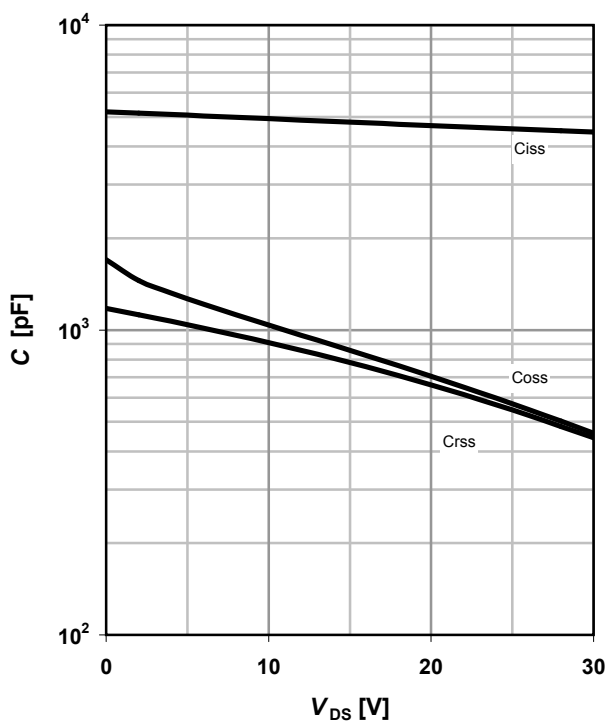
19 Typ. capacitances (P)

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



20 Typ. capacitances (N)

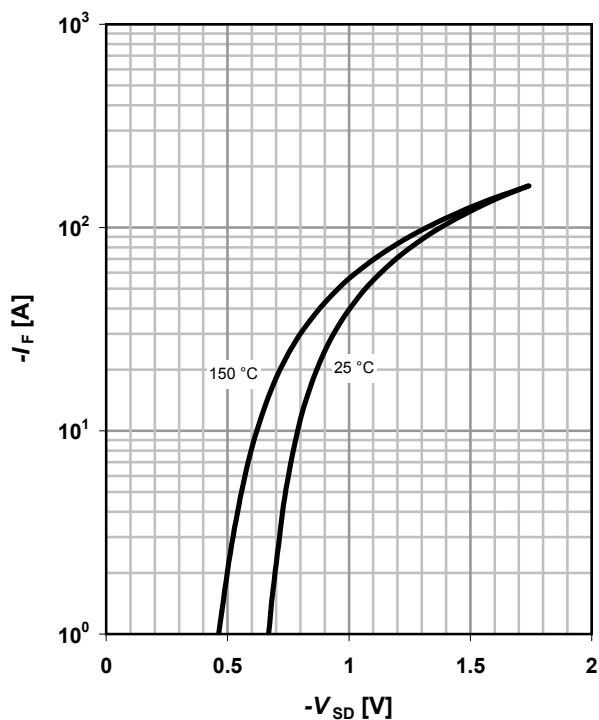
$$C = f(V_{DS}); V_{GS} = 0 V; f = 1 MHz$$



21 Forward characteristics of reverse diode (P)

$$I_F = f(V_{SD})$$

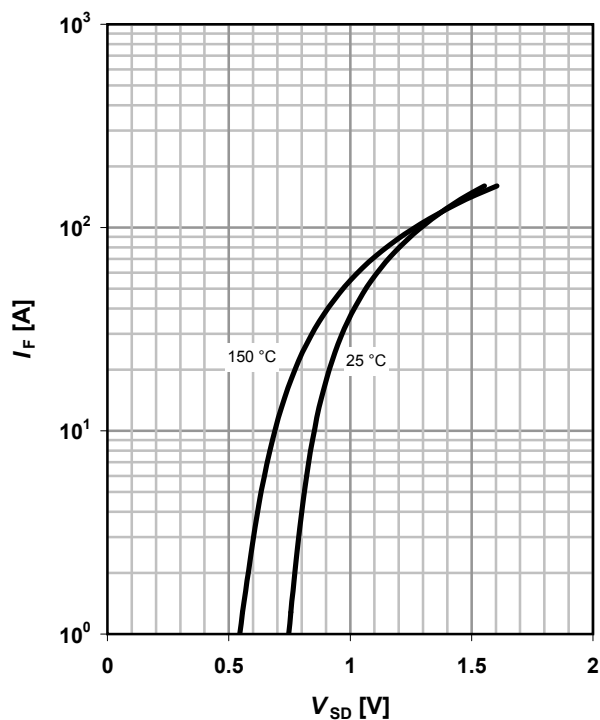
parameter: T_j



22 Forward characteristics of reverse diode (N)

$$I_F = f(V_{SD})$$

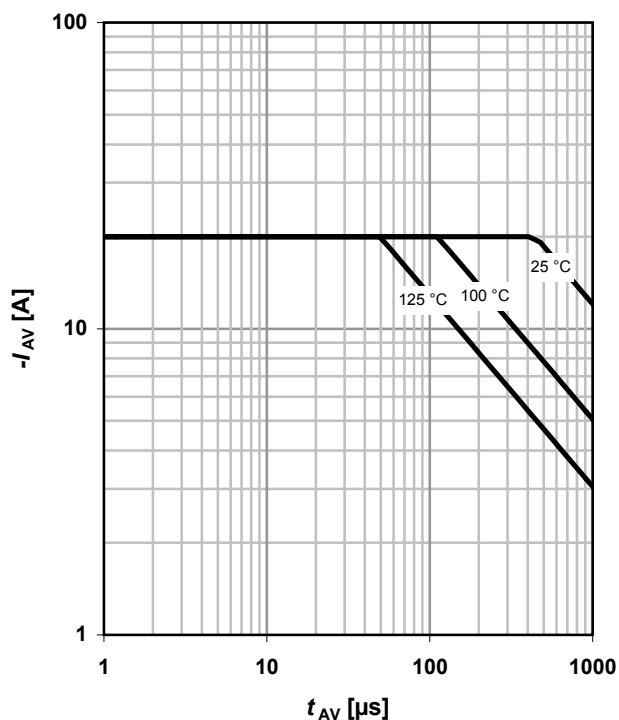
parameter: T_j



23 Avalanche characteristics (P)

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

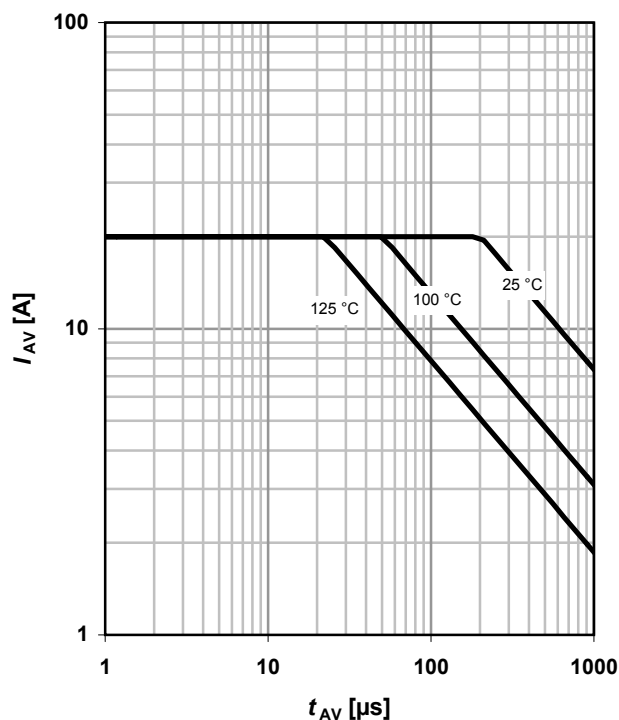
parameter: $T_{j(start)}$



24 Avalanche characteristics (N)

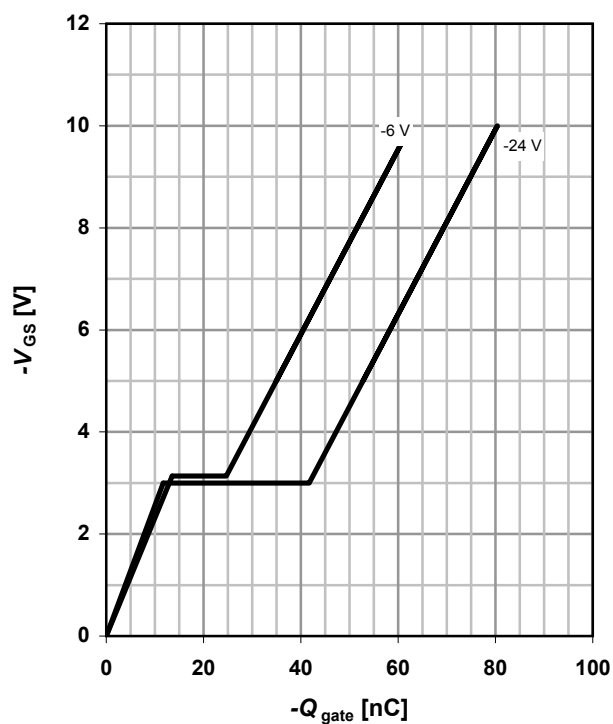
$$I_{AS} = f(t_{AV}); R_{GS} = 25 \Omega$$

parameter: $T_{j(start)}$



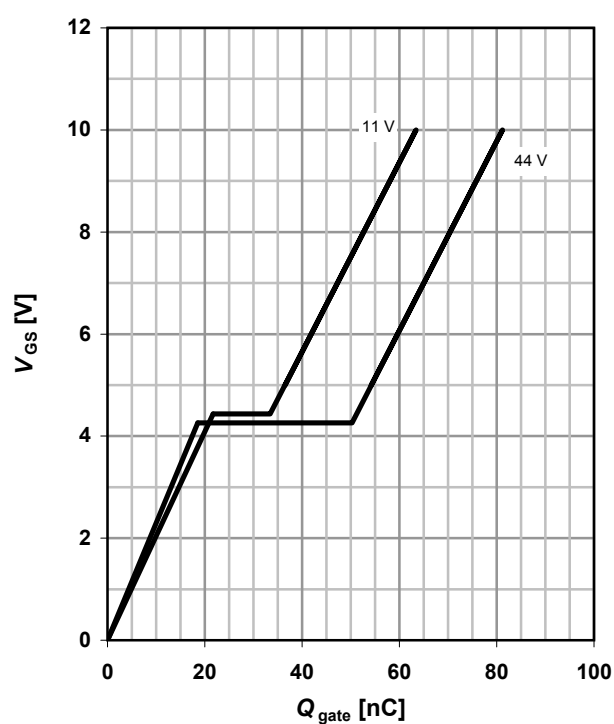
25 Typ. gate charge (P)

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

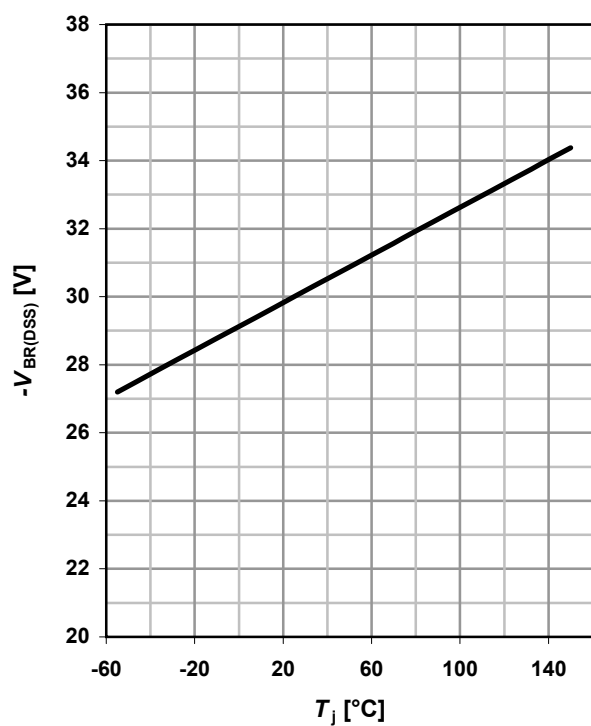
parameter: V_{DD}


26 Typ. gate charge (N)

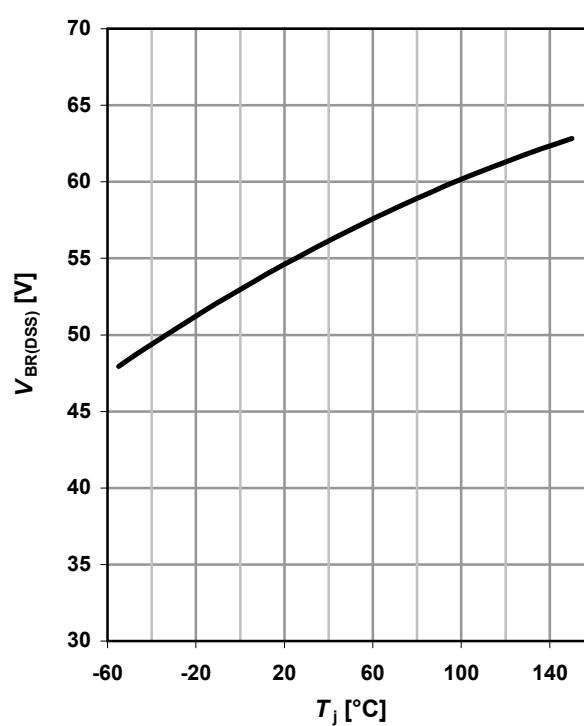
 $V_{GS}=f(Q_{gate}); I_D=40\text{ A pulsed}$

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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Revision History

Version	Date	Changes

¹⁾ Current is limited by bondwire.

With an $R_{thJC}(HS)=1.3K/W$ the HS chip is able to carry $I_D=80A$ at $25^{\circ}C$.

With an $R_{thJC}(LS)=1.8K/W$ the LS chip is able to carry $I_D=63A$ at $25^{\circ}C$.

For detailed information see Application Note ANPS071E at www.infineon.com/optimos

²⁾ Defined by design, not subject to production tests

³⁾ Qualified at -5V and +16V.

⁴⁾ Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm^2 (one layer, 70 μm thick) copper area for drain connection. PCB is vertical in still air.