


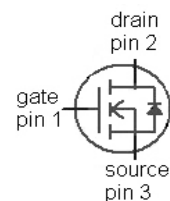
**OptiMOS<sup>®</sup> 3 Power-Transistor**
**Features**

- Fast switching MOSFET for SMPS
- Optimized technology for DC/DC converters
- Qualified according to JEDEC<sup>1)</sup> for target applications
- N-channel, normal level
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- 100% Avalanche tested
- Pb-free plating; RoHS compliant

**Product Summary**

$V_{DS}$	40	V
$R_{DS(on),max}$	6.5	m $\Omega$
$I_D$	50	A

<b>Type</b>	IPP065N04N G
	
<b>Package</b>	PG-TO220-3
<b>Marking</b>	065N04N



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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	$I_D$	$V_{GS}=10\text{ V}, T_C=25\text{ °C}$	50	A
		$V_{GS}=10\text{ V}, T_C=100\text{ °C}$	50	
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$	$T_C=25\text{ °C}$	350	
Avalanche current, single pulse <sup>3)</sup>	$I_{AS}$	$T_C=25\text{ °C}$	50	
Avalanche energy, single pulse	$E_{AS}$	$I_D=35\text{ A}, R_{GS}=25\ \Omega$	50	mJ
Gate source voltage	$V_{GS}$		$\pm 20$	V

<sup>1)</sup> J-STD20 and JESD22

<sup>2)</sup> See figure 3 for more detailed information

<sup>3)</sup> See figure 13 for more detailed information

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

Parameter	Symbol	Conditions	Value	Unit
Power dissipation	$P_{\text{tot}}$	$T_c=25\text{ °C}$	68	W
Operating and storage temperature	$T_j, T_{\text{stg}}$		-55 ... 175	°C
IEC climatic category; DIN IEC 68-1			55/175/56	

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Thermal characteristics**

Thermal resistance, junction - case	$R_{\text{thJC}}$		-	-	2.2	K/W
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**Electrical characteristics**, at  $T_j=25\text{ °C}$ , unless otherwise specified

**Static characteristics**

Drain-source breakdown voltage	$V_{(\text{BR})\text{DSS}}$	$V_{\text{GS}}=0\text{ V}, I_{\text{D}}=1\text{ mA}$	40	-	-	V
Gate threshold voltage	$V_{\text{GS(th)}}$	$V_{\text{DS}}=V_{\text{GS}}, I_{\text{D}}=200\text{ }\mu\text{A}$	2	-	4	
Zero gate voltage drain current	$I_{\text{DSS}}$	$V_{\text{DS}}=40\text{ V}, V_{\text{GS}}=0\text{ V}, T_j=25\text{ °C}$	-	0.1	1	$\mu\text{A}$
		$V_{\text{DS}}=40\text{ V}, V_{\text{GS}}=0\text{ V}, T_j=125\text{ °C}$	-	20	100	
Gate-source leakage current	$I_{\text{GSS}}$	$V_{\text{GS}}=20\text{ V}, V_{\text{DS}}=0\text{ V}$	-	10	100	nA
Drain-source on-state resistance <sup>5)</sup>	$R_{\text{DS(on)}}$	$V_{\text{GS}}=10\text{ V}, I_{\text{D}}=50\text{ A}$	-	5.4	6.5	m $\Omega$
Gate resistance	$R_{\text{G}}$		-	1.5	-	$\Omega$
Transconductance	$g_{\text{fs}}$	$ V_{\text{DS}} >2 I_{\text{D}} R_{\text{DS(on)max}}, I_{\text{D}}=30\text{ A}$	24	49	-	S

<sup>4)</sup> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70  $\mu\text{m}$  thick) copper area for drain connection. PCB is vertical in still air.

<sup>5)</sup> measured from drain tab to source pin

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Dynamic characteristics**

Input capacitance	$C_{iss}$	$V_{GS}=0\text{ V}, V_{DS}=20\text{ V},$ $f=1\text{ MHz}$	-	2100	2800	pF
Output capacitance	$C_{oss}$		-	620	820	
Reverse transfer capacitance	$C_{rss}$		-	22	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=20\text{ V}, V_{GS}=10\text{ V},$ $I_D=30\text{ A}, R_G=1.6\ \Omega$	-	12	-	ns
Rise time	$t_r$		-	2.8	-	
Turn-off delay time	$t_{d(off)}$		-	17	-	
Fall time	$t_f$		-	3.6	-	

**Gate Charge Characteristics<sup>6)</sup>**

Gate to source charge	$Q_{gs}$	$V_{DD}=20\text{ V}, I_D=30\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	11	-	nC
Gate charge at threshold	$Q_{g(th)}$		-	6.2	-	
Gate to drain charge	$Q_{gd}$		-	3.3	-	
Switching charge	$Q_{sw}$		-	8.2	-	
Gate charge total	$Q_g$		-	26	34	
Gate plateau voltage	$V_{plateau}$		-	5.4	-	
Gate charge total, sync. FET	$Q_{g(sync)}$	$V_{DS}=0.1\text{ V},$ $V_{GS}=0\text{ to }10\text{ V}$	-	24	32	nC
Output charge	$Q_{oss}$	$V_{DD}=20\text{ V}, V_{GS}=0\text{ V}$	-	23	-	

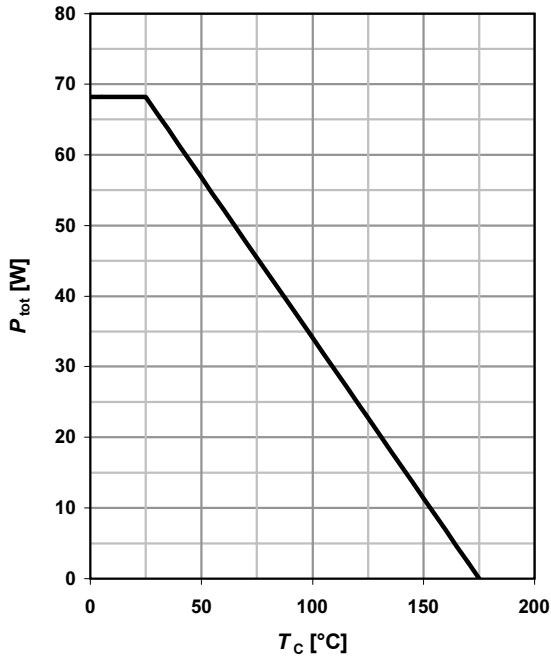
**Reverse Diode**

Diode continuous forward current	$I_S$	$T_C=25\text{ }^\circ\text{C}$	-	-	50	A
Diode pulse current	$I_{S,pulse}$		-	-	350	
Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=30\text{ A},$ $T_j=25\text{ }^\circ\text{C}$	-	0.91	-	V
Reverse recovery charge	$Q_{rr}$	$V_R=15\text{ V}, I_F=I_S,$ $di_F/dt=400\text{ A}/\mu\text{s}$	-	-	20	nC

<sup>6)</sup> See figure 16 for gate charge parameter definition

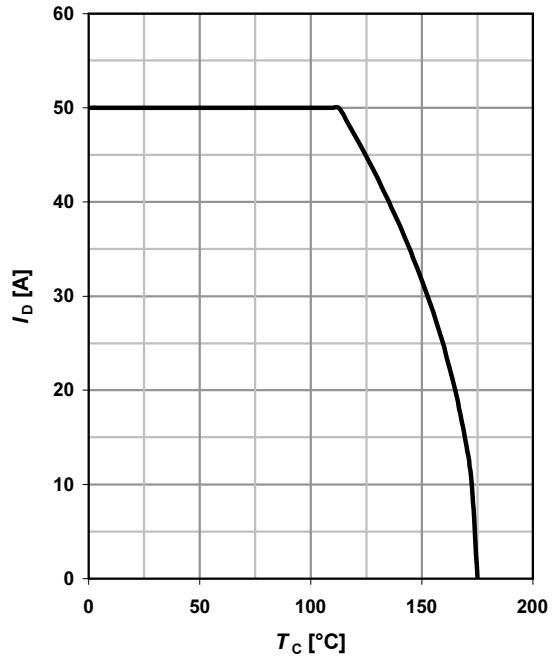
**1 Power dissipation**

$P_{tot}=f(T_C)$



**2 Drain current**

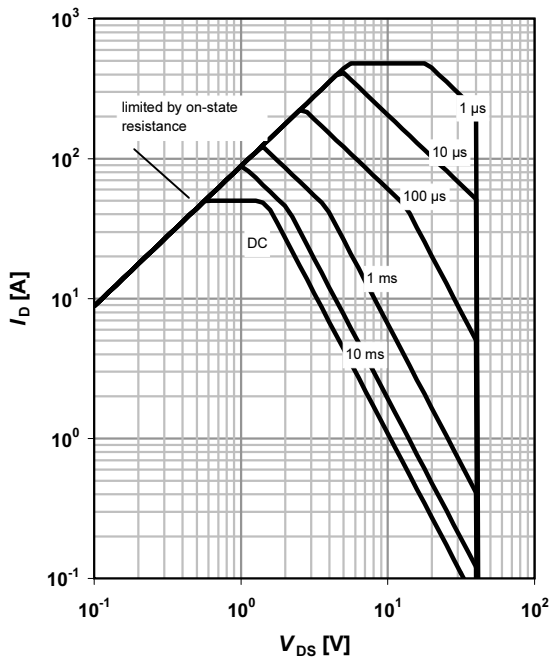
$I_D=f(T_C); V_{GS} \geq 10\text{ V}$



**3 Safe operating area**

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

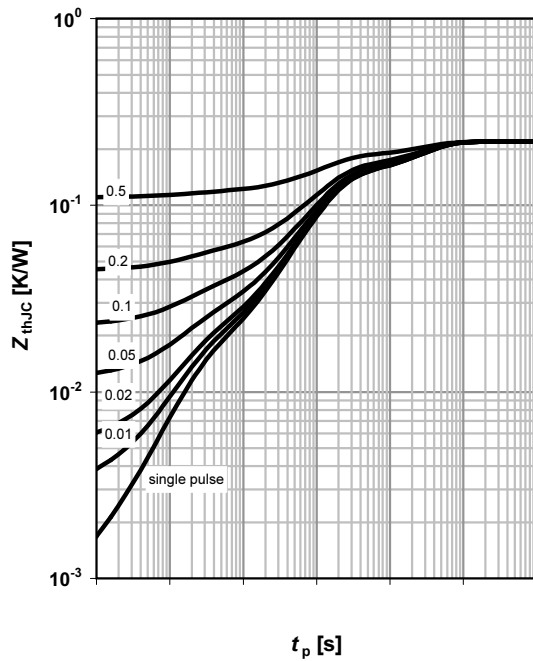
parameter:  $t_p$



**4 Max. transient thermal impedance**

$Z_{thJC}=f(t_p)$

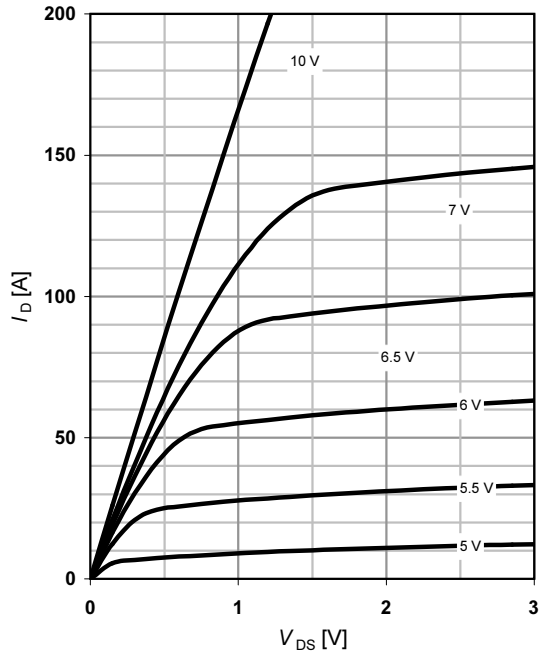
parameter:  $D=t_p/T$



**5 Typ. output characteristics**

$I_D = f(V_{DS}); T_j = 25\text{ °C}$

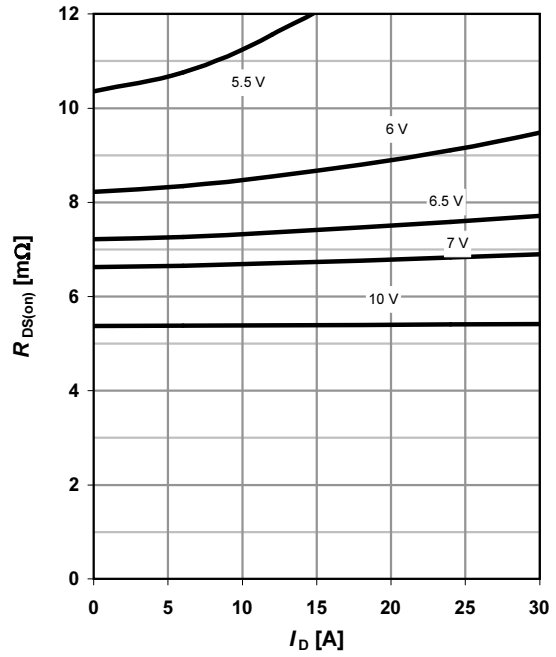
parameter:  $V_{GS}$



**6 Typ. drain-source on resistance**

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

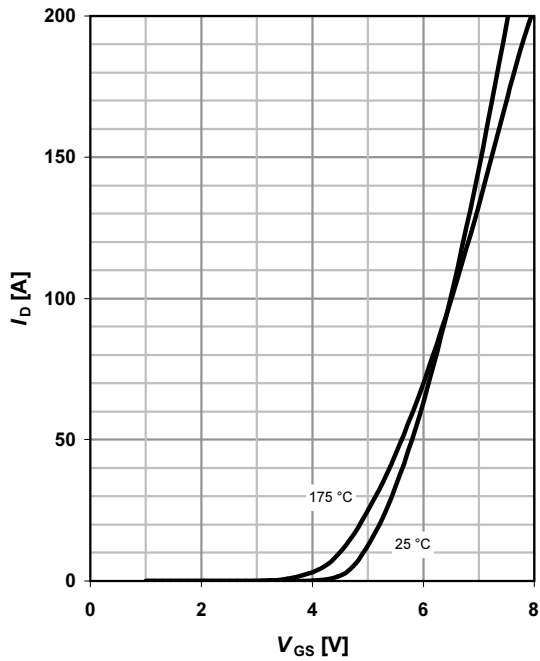
parameter:  $V_{GS}$



**7 Typ. transfer characteristics**

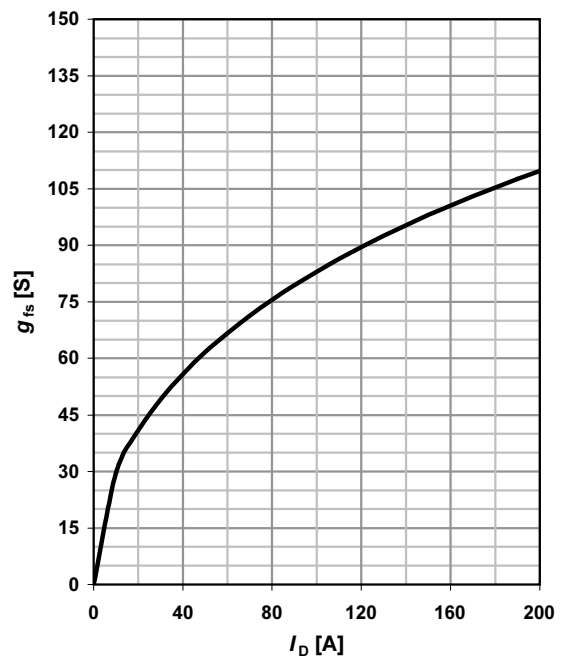
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter:  $T_j$



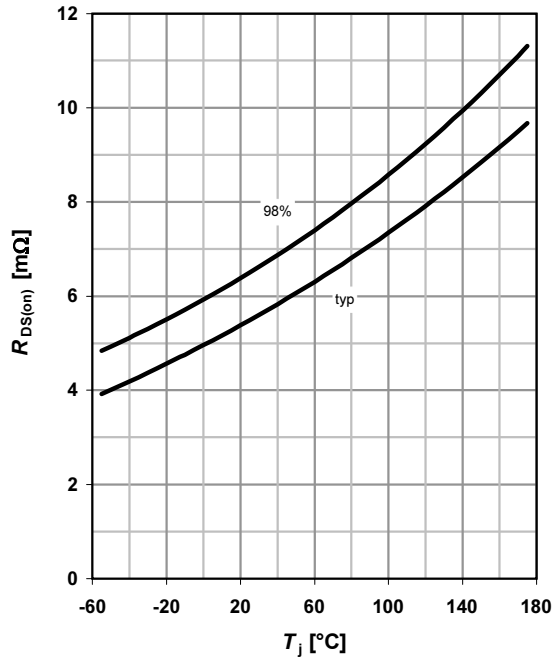
**8 Typ. forward transconductance**

$g_{fs} = f(I_D); T_j = 25\text{ °C}$



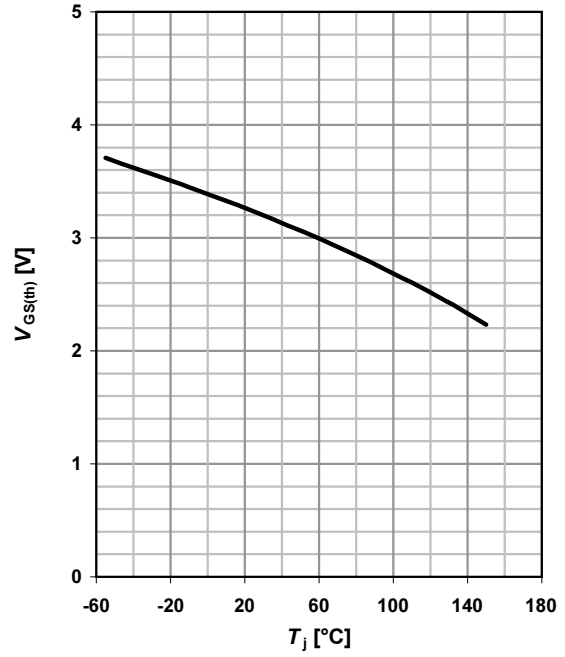
**9 Drain-source on-state resistance**

$R_{DS(on)} = f(T_j); I_D = 50 \text{ A}; V_{GS} = 10 \text{ V}$



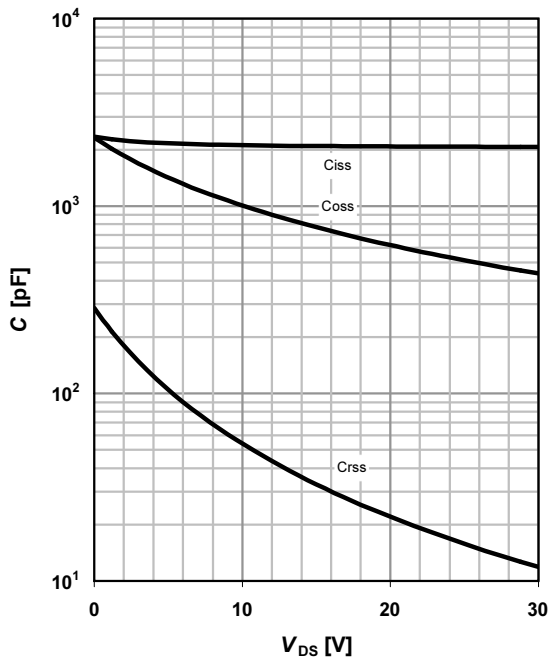
**10 Typ. gate threshold voltage**

$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}; I_D = 250 \mu\text{A}$



**11 Typ. capacitances**

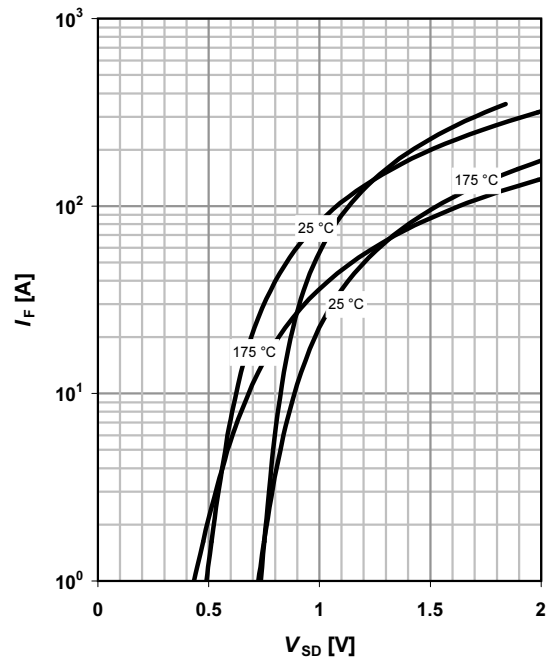
$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$



**12 Forward characteristics of reverse diode**

$I_F = f(V_{SD})$

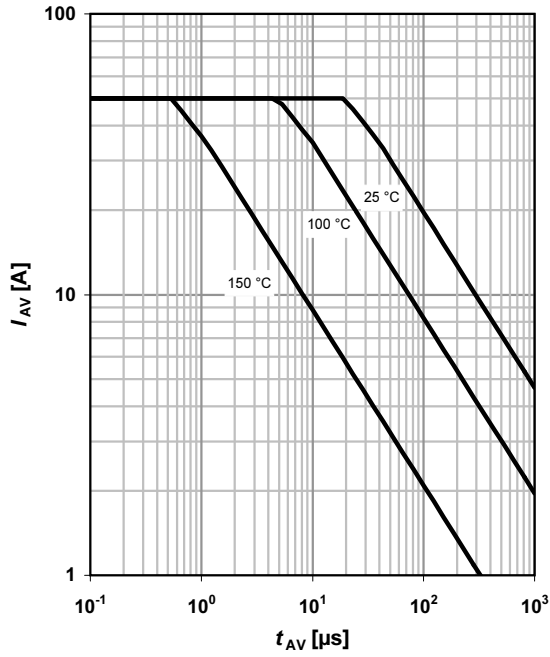
parameter:  $T_j$



**13 Avalanche characteristics**

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

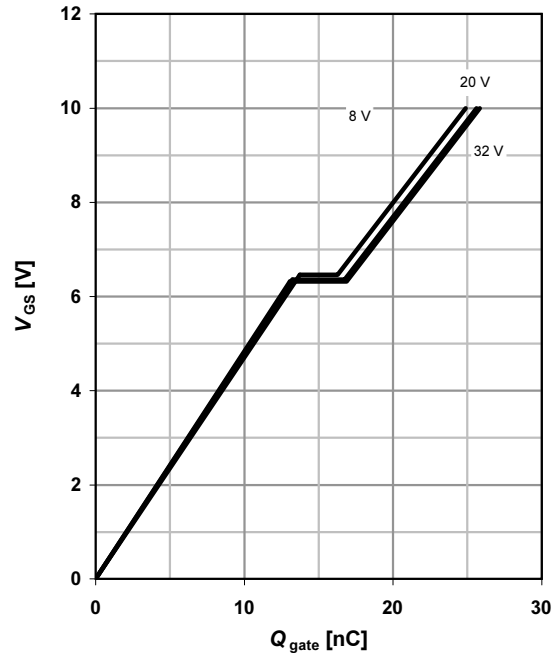
parameter:  $T_{j(start)}$



**14 Typ. gate charge**

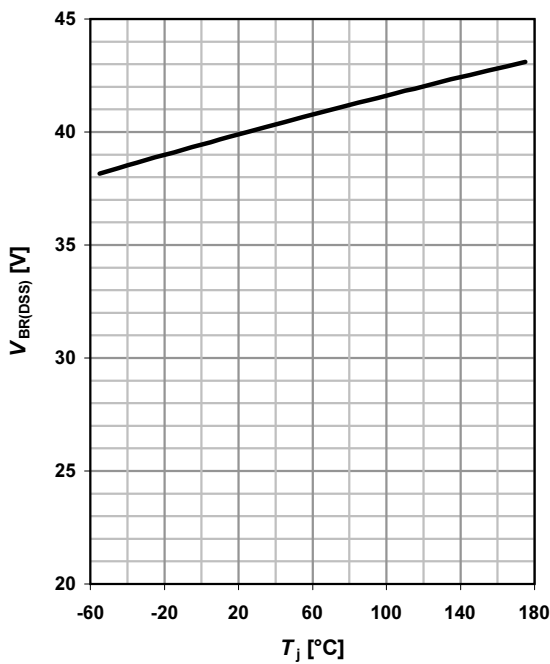
$V_{GS}=f(Q_{gate}); I_D=30 \text{ A pulsed}$

parameter:  $V_{DD}$

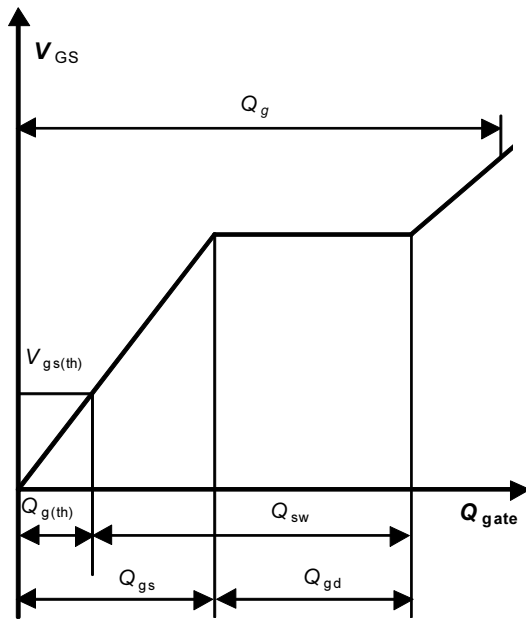


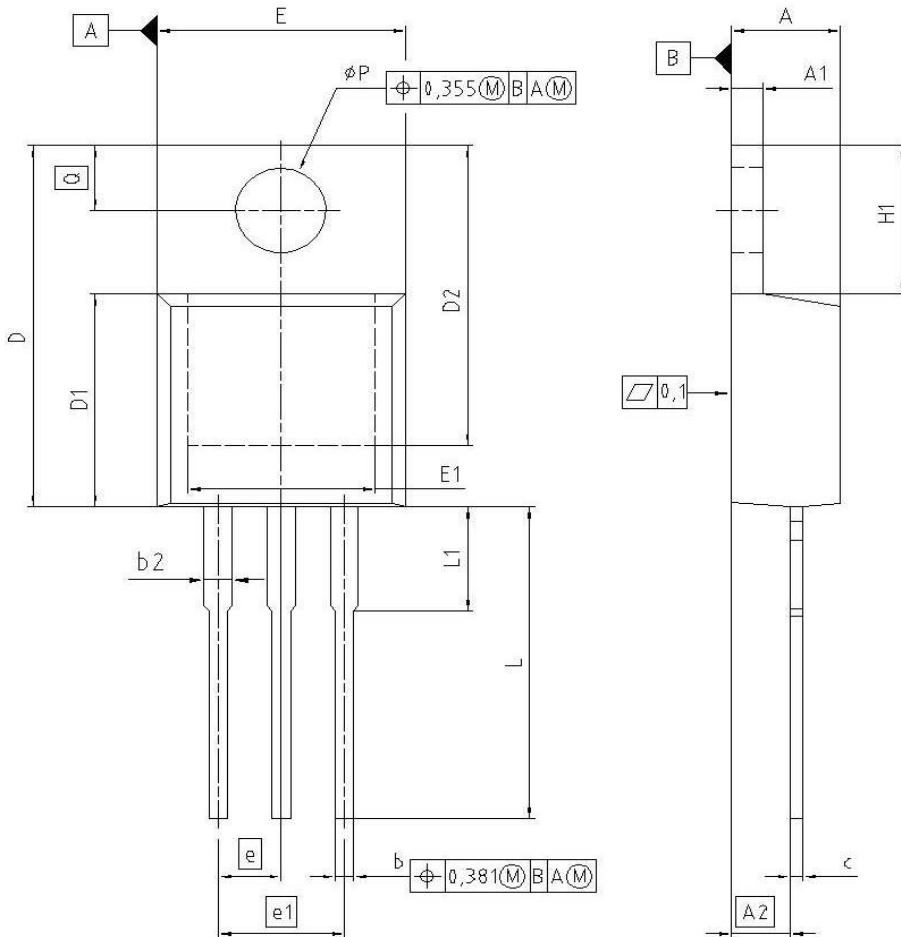
**15 Drain-source breakdown voltage**

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



**16 Gate charge waveforms**



**Package Outline: PG-TO220-3**


DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
<b>A</b>	4.300	4.572	0.169	0.180
<b>A1</b>	1.170	1.400	0.046	0.055
<b>A2</b>	2.215	2.718	0.087	0.107
<b>b</b>	0.650	0.864	0.026	0.034
<b>b2</b>	0.635	1.778	0.025	0.070
<b>c</b>	0.330	0.600	0.013	0.024
<b>D</b>	14.808	15.950	0.583	0.628
<b>D1</b>	8.509	9.450	0.335	0.372
<b>D2</b>	12.850	13.100	0.506	0.516
<b>E</b>	9.700	10.363	0.382	0.408
<b>E1</b>	6.500	8.600	0.256	0.339
<b>e</b>	2.540		0.100	
<b>e1</b>	5.080		0.200	
<b>N</b>	3		3	
<b>H1</b>	5.900	6.900	0.232	0.272
<b>L</b>	13.000	14.000	0.512	0.551
<b>L1</b>	-	4.800	-	0.189
<b>pP</b>	3.700	3.886	0.146	0.153
<b>Q</b>	2.600	3.000	0.102	0.118

**REFERENCE**  
JEDEC TO220

**SCALE**

**EUROPEAN PROJECTION**

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