

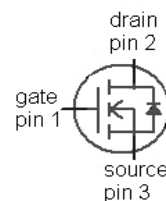
OptiMOS[®] 3 Power-Transistor
Features

- Fast switching MOSFET for SMPS
- Optimized technology for DC/DC converters
- Qualified according to JEDEC¹⁾ 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
$R_{DS(on),max}$	4.8	m Ω
I_D	70	A

Type	IPP048N04N G
	
Package	PG-TO220-3
Marking	048N04N



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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	$V_{GS}=10\text{ V}, T_C=25\text{ °C}$	70	A
		$V_{GS}=10\text{ V}, T_C=100\text{ °C}$	69	
Pulsed drain current ²⁾	$I_{D,pulse}$	$T_C=25\text{ °C}$	400	
Avalanche current, single pulse ³⁾	I_{AS}	$T_C=25\text{ °C}$	70	
Avalanche energy, single pulse	E_{AS}	$I_D=70\text{ A}, R_{GS}=25\text{ }\Omega$	35	mJ
Gate source voltage	V_{GS}		± 20	V

¹⁾ J-STD20 and JESD22

²⁾ See figure 3 for more detailed information

³⁾ See figure 13 for more detailed information

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

Parameter	Symbol	Conditions	Value	Unit
Power dissipation	P_{tot}	$T_c=25\text{ }^{\circ}\text{C}$	79	W
Operating and storage temperature	T_j, T_{stg}		-55 ... 175	$^{\circ}\text{C}$
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_{thJC}		-	-	1.9	K/W
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Electrical characteristics, at $T_j=25\text{ }^{\circ}\text{C}$, 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_{DSS}	$V_{\text{DS}}=40\text{ V}, V_{\text{GS}}=0\text{ V}, T_j=25\text{ }^{\circ}\text{C}$	-	0.1	1	μA
		$V_{\text{DS}}=40\text{ V}, V_{\text{GS}}=0\text{ V}, T_j=125\text{ }^{\circ}\text{C}$	-	20	100	
Gate-source leakage current	I_{GSS}	$V_{\text{GS}}=20\text{ V}, V_{\text{DS}}=0\text{ V}$	-	10	100	nA
Drain-source on-state resistance ⁵⁾	$R_{\text{DS(on)}}$	$V_{\text{GS}}=10\text{ V}, I_{\text{D}}=70\text{ A}$	-	4.0	4.8	$\text{m}\Omega$
Gate resistance	R_{G}		-	1.5	-	Ω
Transconductance	g_{fs}	$ V_{\text{DS}} >2 I_{\text{D}} R_{\text{DS(on)max}}, I_{\text{D}}=30\text{ A}$	28	56	-	S

⁴⁾ Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm² (one layer, 70 μm thick) copper area for drain connection. PCB is vertical in still air.

⁵⁾ measured from drain tab to source pin

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics

Input capacitance	C_{iss}	$V_{GS}=0\text{ V}, V_{DS}=20\text{ V},$ $f=1\text{ MHz}$	-	2500	3300	pF
Output capacitance	C_{oss}		-	740	980	
Reverse transfer capacitance	C_{rss}		-	27	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=20\text{ V}, V_{GS}=10\text{ V},$ $I_D=30\text{ A}, R_G=1.6\ \Omega$	-	13	-	ns
Rise time	t_r		-	3.2	-	
Turn-off delay time	$t_{d(off)}$		-	19	-	
Fall time	t_f		-	4.0	-	

Gate Charge Characteristics⁶⁾

Gate to source charge	Q_{gs}	$V_{DD}=20\text{ V}, I_D=30\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	13	-	nC
Gate charge at threshold	$Q_{g(th)}$		-	7.6	-	
Gate to drain charge	Q_{gd}		-	4.1	-	
Switching charge	Q_{sw}		-	10.5	-	
Gate charge total	Q_g		-	31	41	
Gate plateau voltage	$V_{plateau}$		-	5.6	-	
Gate charge total, sync. FET	$Q_{g(sync)}$	$V_{DS}=0.1\text{ V},$ $V_{GS}=0\text{ to }10\text{ V}$	-	29	39	nC
Output charge	Q_{oss}	$V_{DD}=20\text{ V}, V_{GS}=0\text{ V}$	-	27	-	

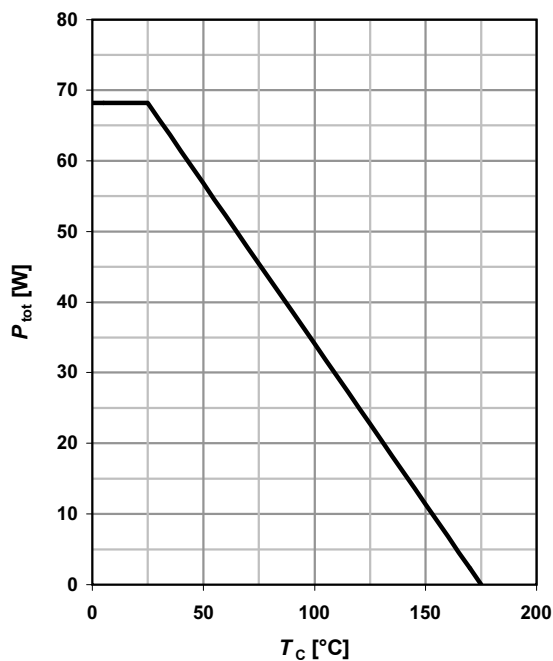
Reverse Diode

Diode continuous forward current	I_S	$T_C=25\text{ °C}$	-	-	50	A
Diode pulse current	$I_{S,pulse}$		-	-	350	
Diode forward voltage	V_{SD}	$V_{GS}=0\text{ V}, I_F=30\text{ A},$ $T_j=25\text{ °C}$	-	0.89	-	V
Reverse recovery charge	Q_{rr}	$V_R=15\text{ V}, I_F=I_S,$ $di_F/dt=400\text{ A}/\mu\text{s}$	-	40	-	nC

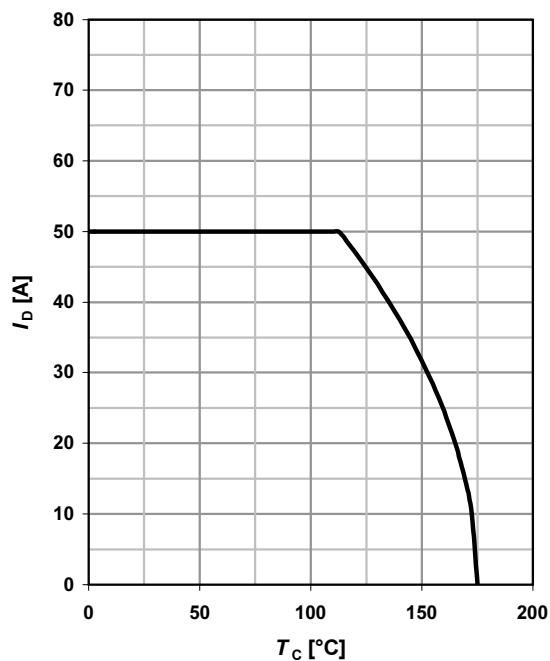
⁶⁾ See figure 16 for gate charge parameter definition

1 Power dissipation

$$P_{\text{tot}} = f(T_C)$$

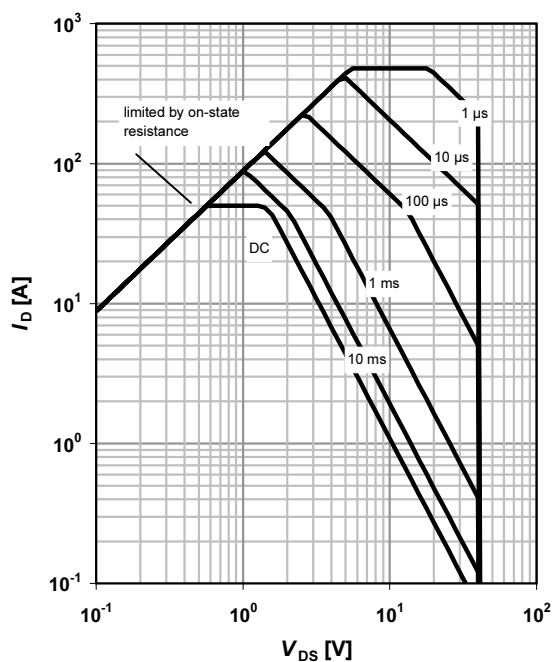

2 Drain current

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


3 Safe operating area

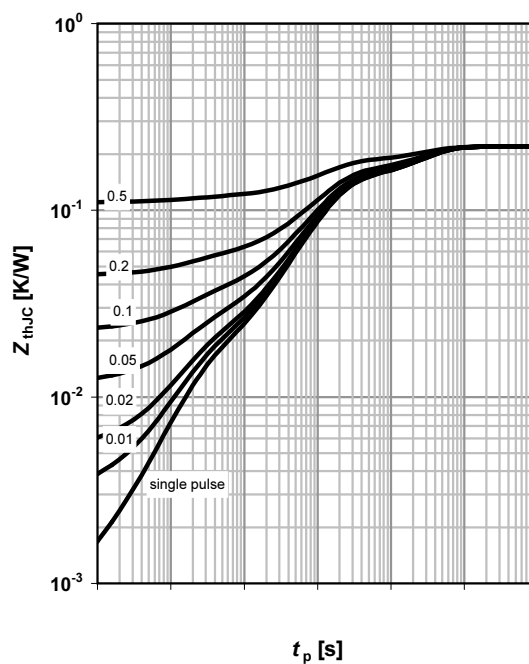
$$I_D = f(V_{DS}); T_C = 25 \text{ °C}; D = 0$$

parameter: t_p


4 Max. transient thermal impedance

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

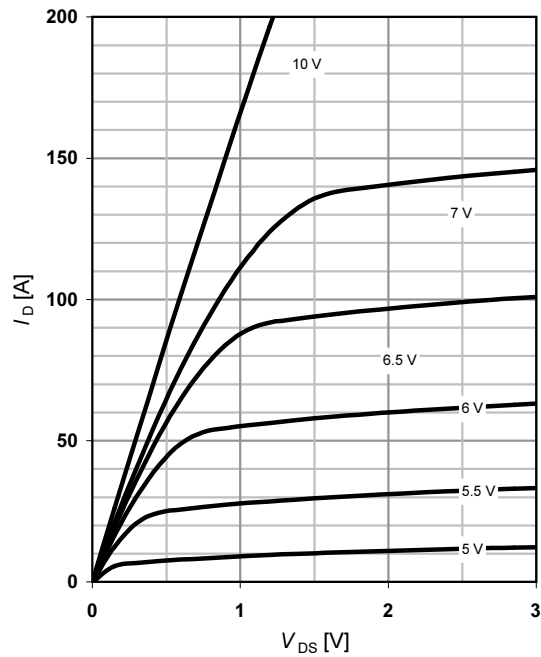
parameter: $D = t_p / T$



5 Typ. output characteristics

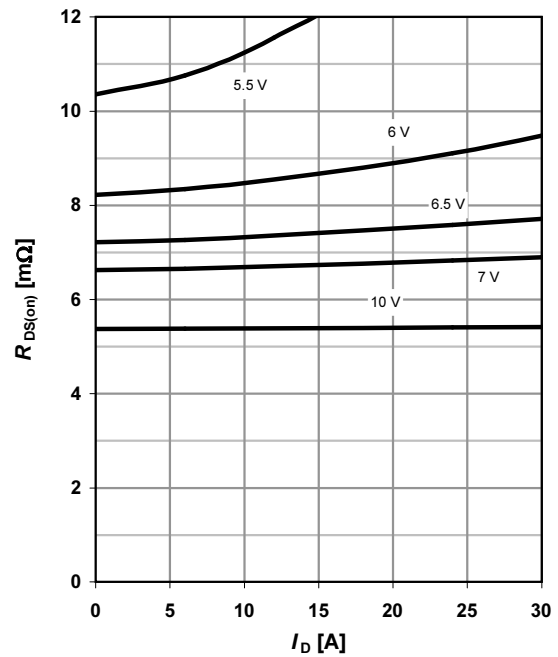
$$I_D = f(V_{DS}); T_J = 25^\circ\text{C}$$

parameter: V_{GS}


6 Typ. drain-source on resistance

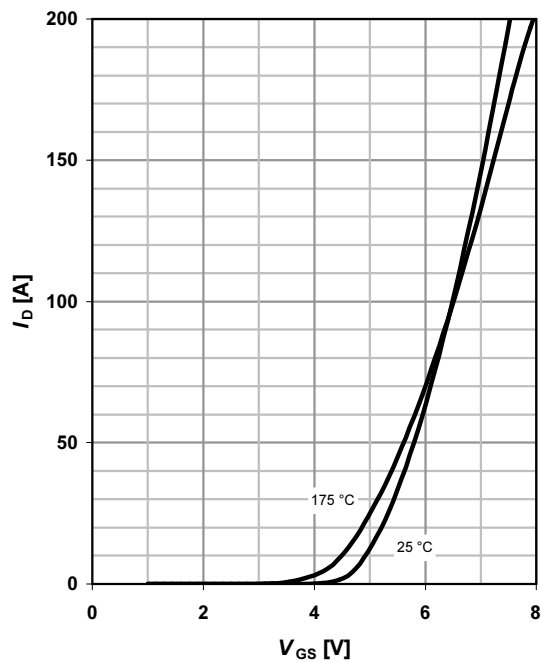
$$R_{DS(on)} = f(I_D); T_J = 25^\circ\text{C}$$

parameter: V_{GS}

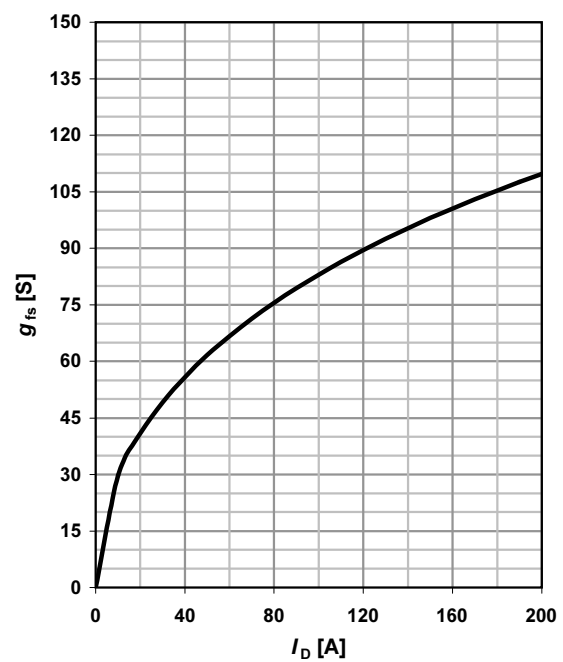

7 Typ. transfer characteristics

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

parameter: T_J

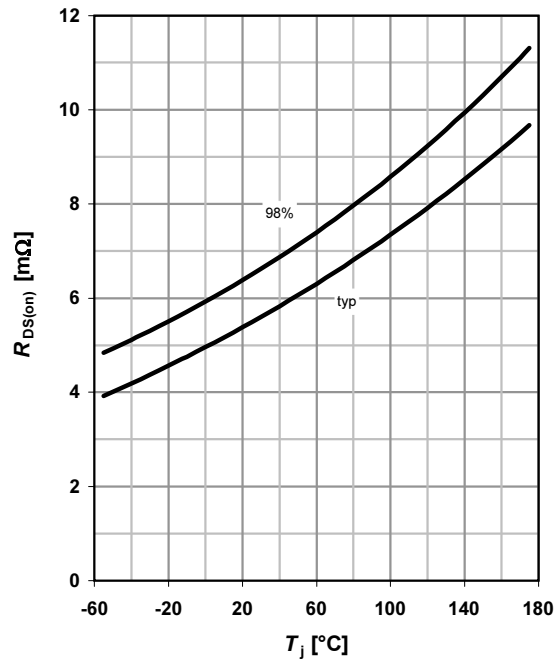

8 Typ. forward transconductance

$$g_{fs} = f(I_D); T_J = 25^\circ\text{C}$$

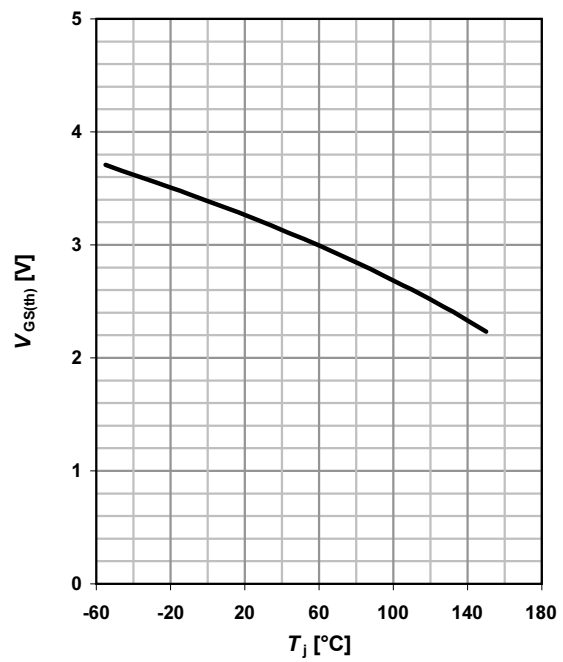


9 Drain-source on-state resistance

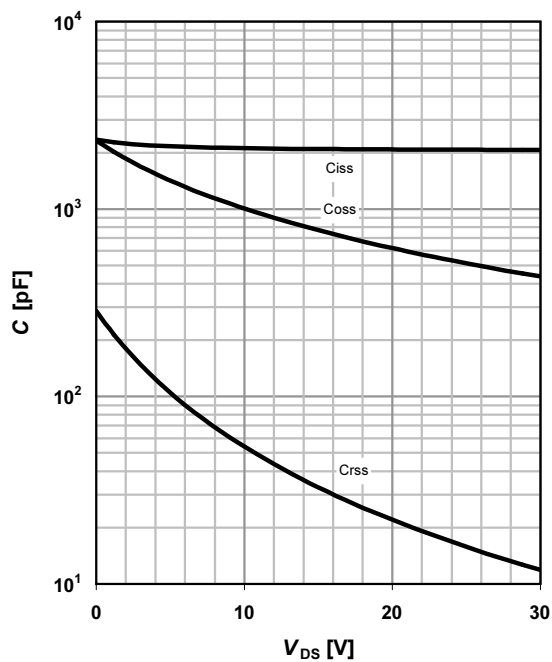
$$R_{DS(on)} = f(T_j); I_D = 70 \text{ A}; V_{GS} = 10 \text{ V}$$


10 Typ. gate threshold voltage

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

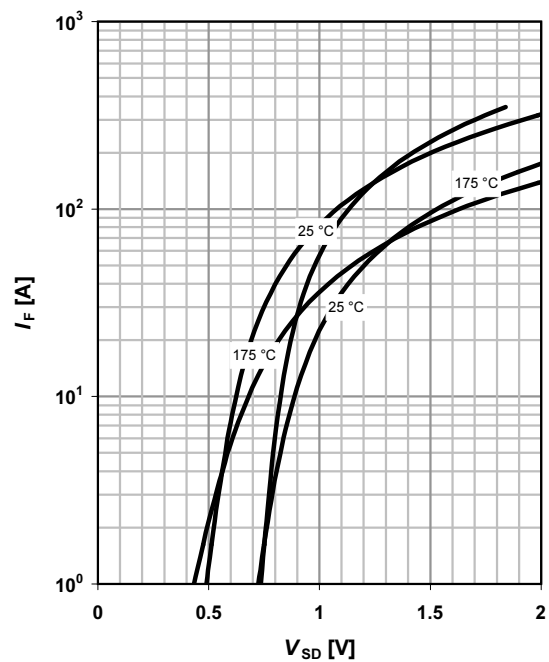

11 Typ. capacitances

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


12 Forward characteristics of reverse diode

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

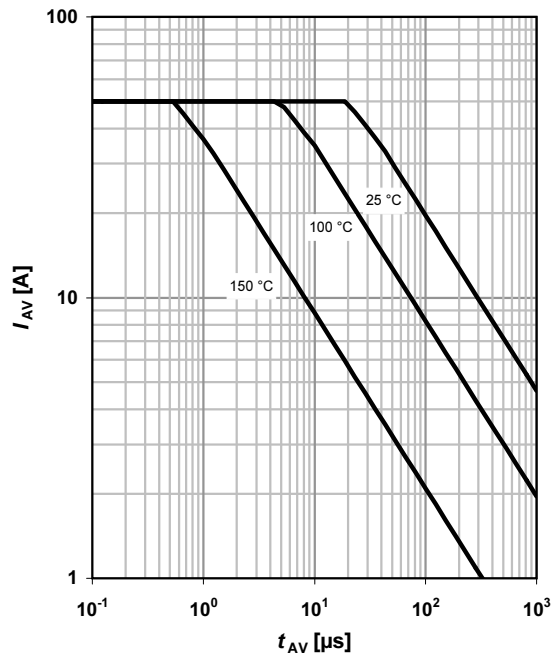
parameter: T_j



13 Avalanche characteristics

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

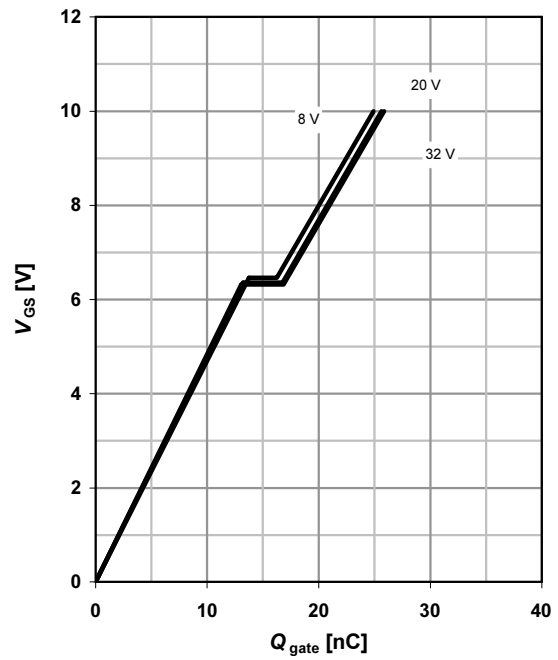
parameter: $T_{j(\text{start})}$



14 Typ. gate charge

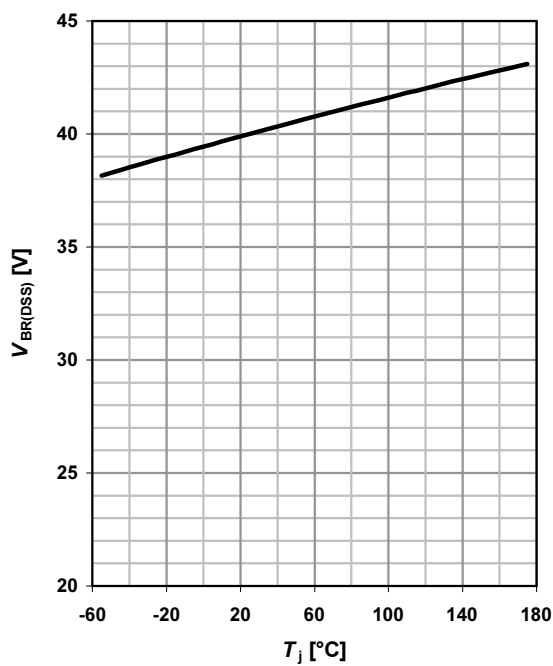
$$V_{GS}=f(Q_{\text{gate}}); I_D=30\ \text{A pulsed}$$

parameter: V_{DD}

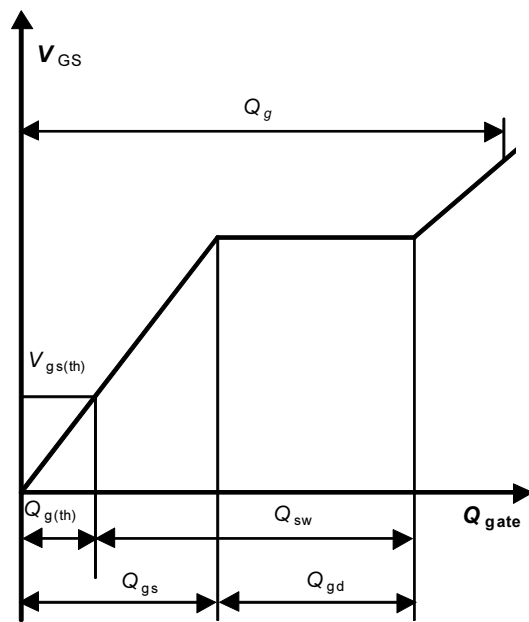


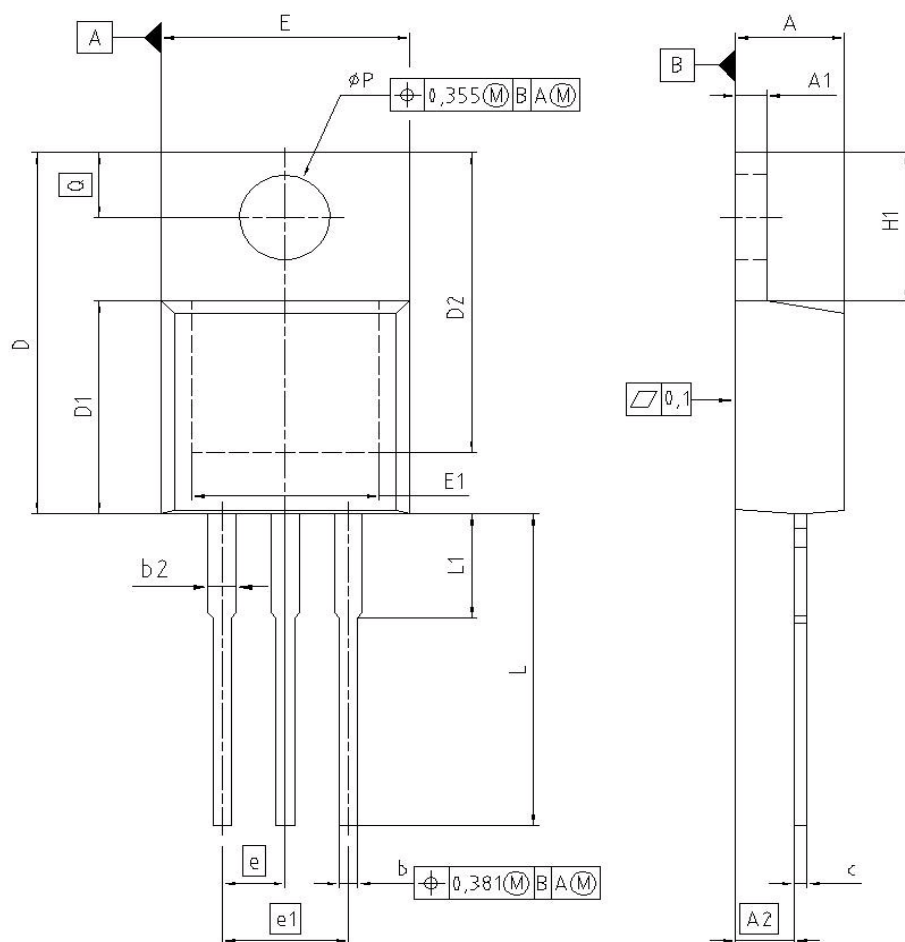
15 Drain-source breakdown voltage

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

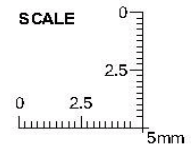
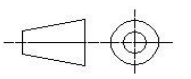


16 Gate charge waveforms



Package Outline: PG-TO220-3


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

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