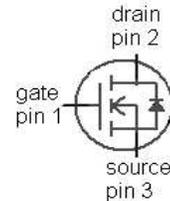## OptiMOS®2 Power-Transistor

Features

• Ideal for high-frequency dc/dc converters

• Qualified according to JEDEC[1] for target applications

• N-channel, logic level

• Excellent gate charge x $R_{DS(on)}$ product (FOM)

• Superior thermal resistance

• 175 °C operating temperature

• Pb-free lead plating; RoHS compliant

Product Summary

V_{DS}	25	V
$R_{DS(on),max}$	12.8	mΩ
I_D	30	A

Type	IPD13N03LA	IPF13N03LA	IPS13N03LA	IPU13N03LA
Package	P-TO252-3-11	P-TO252-3-23	P-TO251-3-11	P-TO251-3-1
Marking	13N03LA	13N03LA	13N03LA	13N03LA

Maximum ratings, at T_j=25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	T_C=25 °C[2]	30	A
		T_C=100 °C	30	
Pulsed drain current	$I_{D,pulse}$	T_C=25 °C[3]	210	
Avalanche energy, single pulse	E_{AS}	I_D=24 A, R_{GS}=25 Ω	60	mJ
Reverse diode dv/dt	dv/dt	I_D=30 A, V_{DS}=20 V, di/dt=200 A/µs, $T_{j,max}$=175 °C	6	kV/µs
Gate source voltage[4]	V_{GS}		±20	V
Power dissipation	P_{tot}	T_C=25 °C	46	W
Operating and storage temperature	T_j, T_{stg}		-55 ... 175	°C
IEC climatic category; DIN IEC 68-1			55/175/56	

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Thermal characteristics

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Thermal resistance, junction - case	R_{thJC}		-	-	3.2	K/W
SMD version, device on PCB	R_{thJA}	minimal footprint	-	-	75	
		6 cm^2 cooling area[5]	-	-	50	

Electrical characteristics, at T_j=25 °C, unless otherwise specified

Static characteristics

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Drain-source breakdown voltage	$V_{(BR)DSS}$	V_{GS}=0 V, I_D=1 mA	25	-	-	V
Gate threshold voltage	$V_{GS(th)}$	V_{DS}=V_{GS}, I_D=20 µA	1.2	1.6	2	
Zero gate voltage drain current	I_{DSS}	V_{DS}=25 V, V_{GS}=0 V, T_j=25 °C	-	0.1	1	µA
		V_{DS}=25 V, V_{GS}=0 V, T_j=125 °C	-	10	100	
Gate-source leakage current	I_{GSS}	V_{GS}=20 V, V_{DS}=0 V	-	10	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS}=4.5 V, I_D=20 A	-	17.5	21.9	mΩ
		V_{GS}=10 V, I_D=30 A	-	10.7	12.8	
Gate resistance	R_G		-	0.9	-	Ω
Transconductance	g_{fs}	$|V_{DS}|$>2$|I_D|R_{DS(on)max}$, I_D=30 A	18	36	-	S

[1] J-STD20 and JESD22

[2] Current is limited by bondwire; with an R_{thJC}=3.2 K/W the chip is able to carry 47 A.

[3] See figure 3

[4] $T_{j,max}$=150 °C and duty cycle D<0.25 for V_{GS}<-5 V

[5] 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.

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Input capacitance	C_{iss}	V_{GS}=0 V, V_{DS}=15 V, f=1 MHz	-	784	1043	pF
Output capacitance	C_{oss}		-	303	402	
Reverse transfer capacitance	C_{rss}		-	41	62	
Turn-on delay time	$t_{d(on)}$	V_{DD}=15 V, V_{GS}=10 V, I_D=15 A, R_G=2.7 Ω	-	5.4	8.0	ns
Rise time	t_r		-	4.6	6.9	
Turn-off delay time	$t_{d(off)}$		-	15	23	
Fall time	t_f		-	2.6	3.9	

Gate Charge Characteristics[6]

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Gate to source charge	Q_{gs}	V_{DD}=15 V, I_D=15 A, V_{GS}=0 to 5 V	-	2.7	3.6	nC
Gate charge at threshold	$Q_{g(th)}$		-	1.3	1.7	
Gate to drain charge	Q_{gd}		-	1.8	2.7	
Switching charge	Q_{sw}		-	3.3	4.7	
Gate charge total	Q_g		-	6.3	8.3	
Gate plateau voltage	$V_{plateau}$		-	3.4	-	V
Gate charge total, sync. FET	$Q_{g(sync)}$	V_{DS}=0.1 V, V_{GS}=0 to 5 V	-	5.5	7.3	nC
Output charge	Q_{oss}	V_{DD}=15 V, V_{GS}=0 V	-	6.6	8.7	

Reverse Diode

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Diode continous forward current	I_S	T_C=25 °C	-	-	30	A
Diode pulse current	$I_{S,pulse}$		-	-	210	
Diode forward voltage	V_{SD}	V_{GS}=0 V, I_F=30 A, T_j=25 °C	-	0.95	1.2	V
Reverse recovery charge	Q_{rr}	V_R=15 V, I_F=I_S, di_F/dt=400 A/µs	-	-	10	nC

[6] See figure 16 for gate charge parameter definition

1 Power dissipation

P_{tot}=f(T_C)
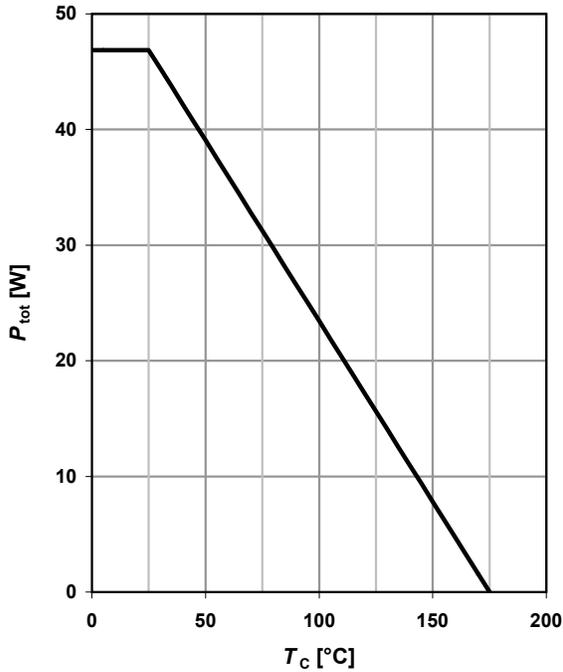
2 Drain current

I_D=f(T_C); V_{GS}≥10 V
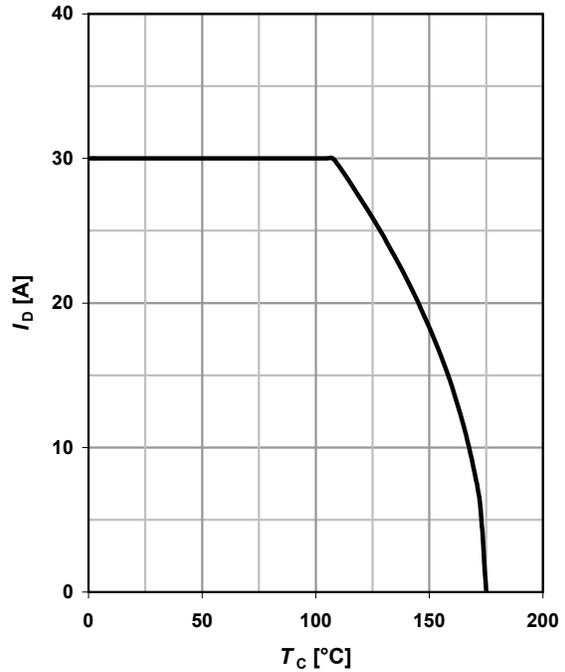
3 Safe operating area
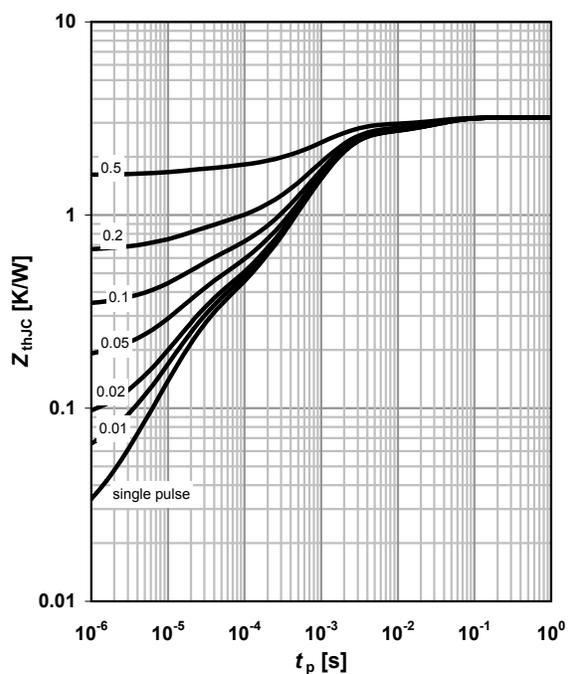
I_D=f(V_{DS}); T_C=25 °C; D=0

parameter: t_p
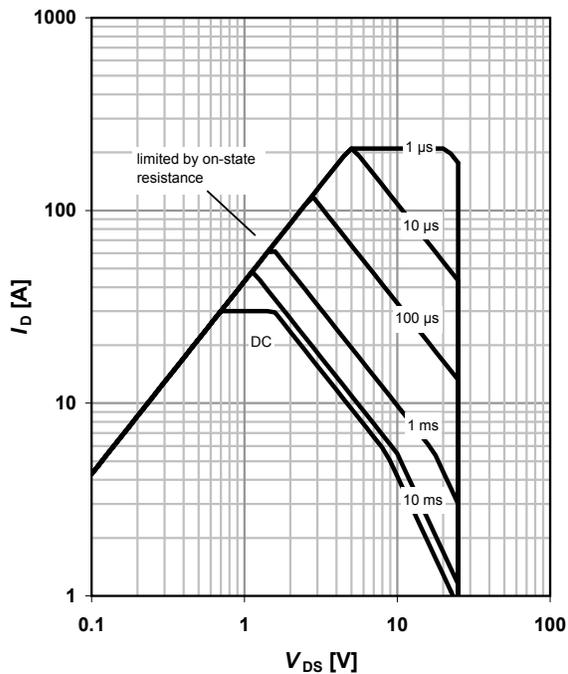
4 Max. transient thermal impedance

Z_{thJC}=f(t_p)

parameter: D=t_p/T

5 Typ. output characteristics

I_D=f(V_{DS}); T_j=25 °C

parameter: V_{GS}
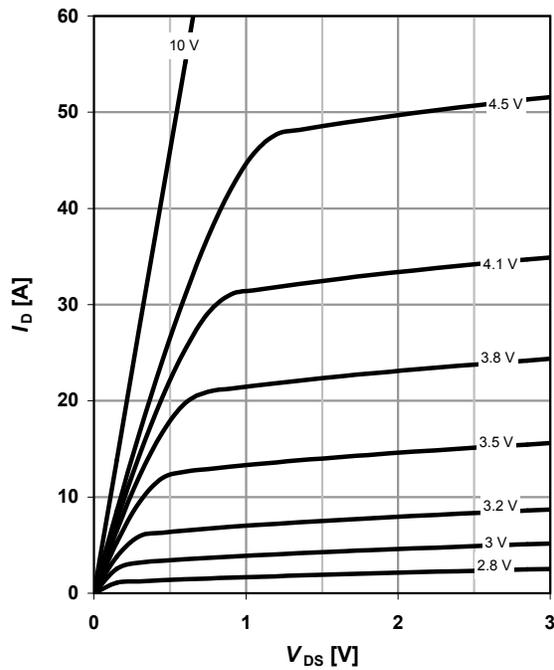
6 Typ. drain-source on resistance

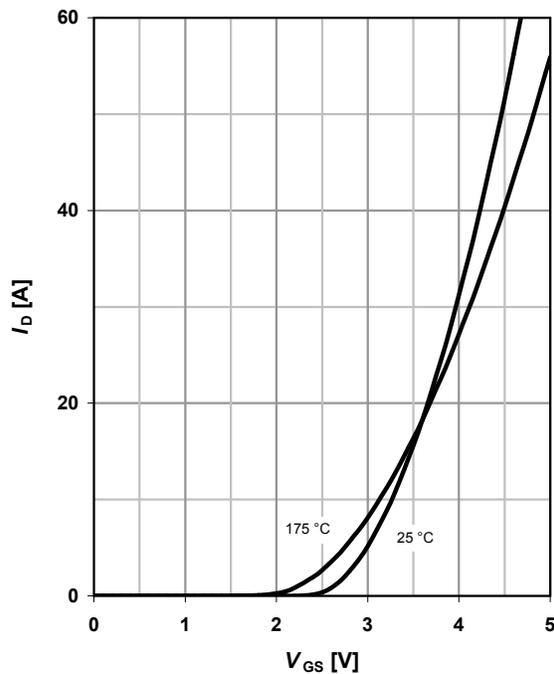$R_{DS(on)}$=f(I_D); T_j=25 °C

parameter: V_{GS}
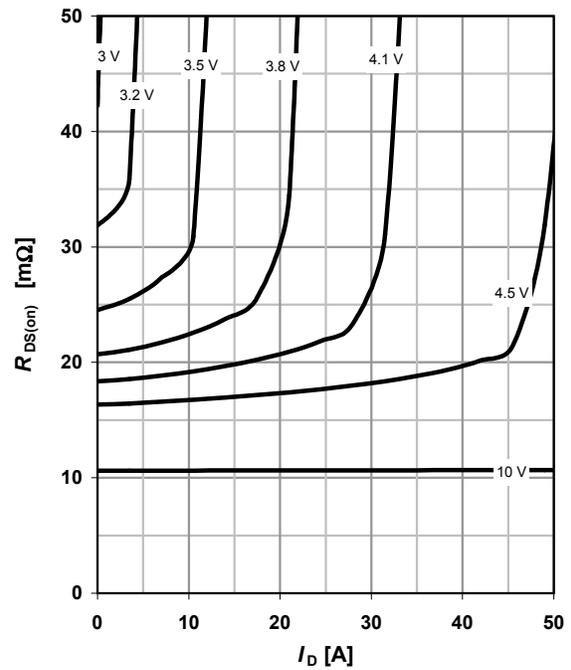
7 Typ. transfer characteristics

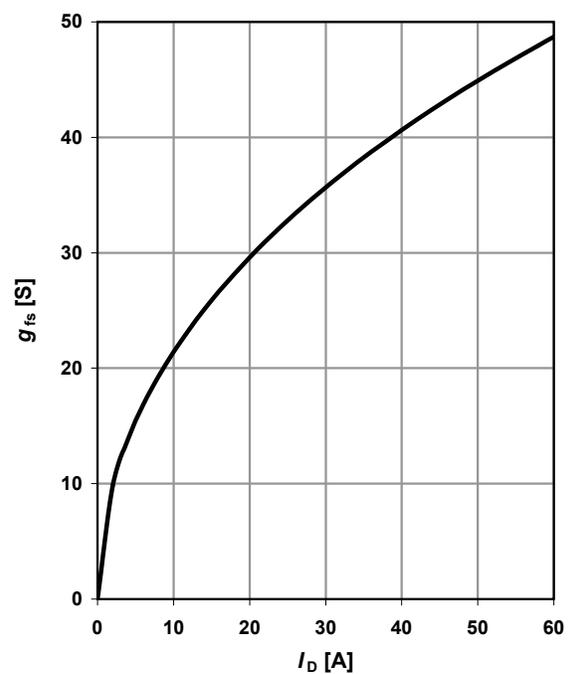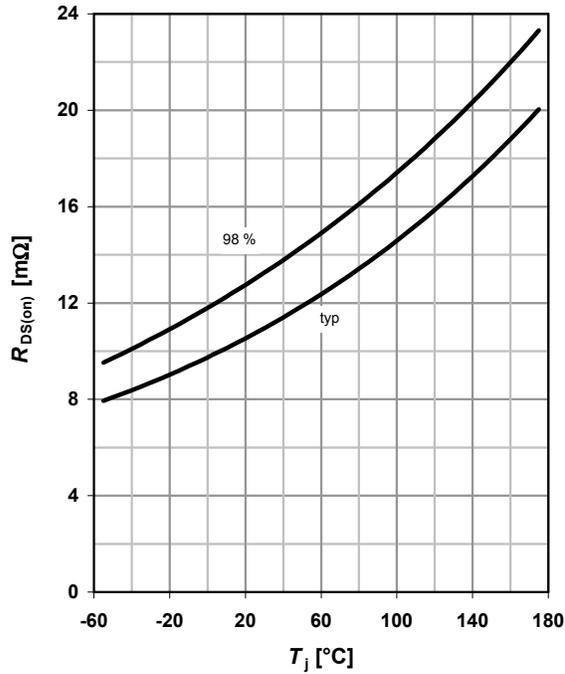I_D=f(V_{GS}); $|V_{DS}|>2|I_D|R_{DS(on)max}$

parameter: T_j

8 Typ. forward transconductance

g_{fs}=f(I_D); T_j=25 °C

9 Drain-source on-state resistance

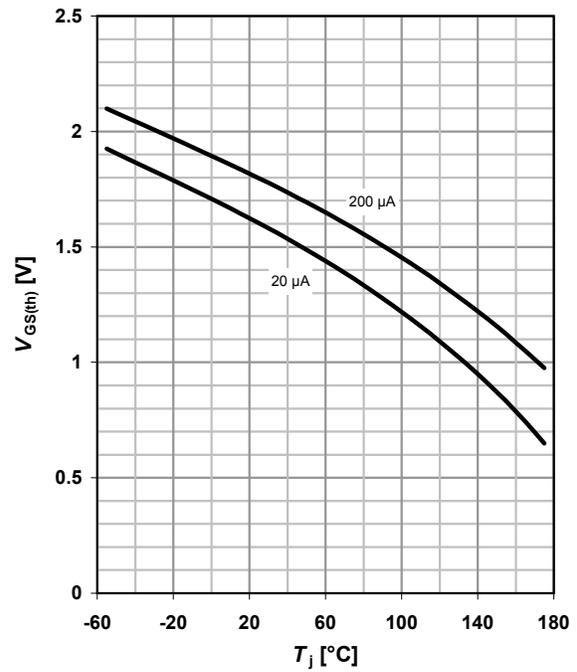$R_{DS(on)}$=f(T_j); I_D=30 A; V_{GS}=10 V

10 Typ. gate threshold voltage

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

parameter: I_D

11 Typ. Capacitances

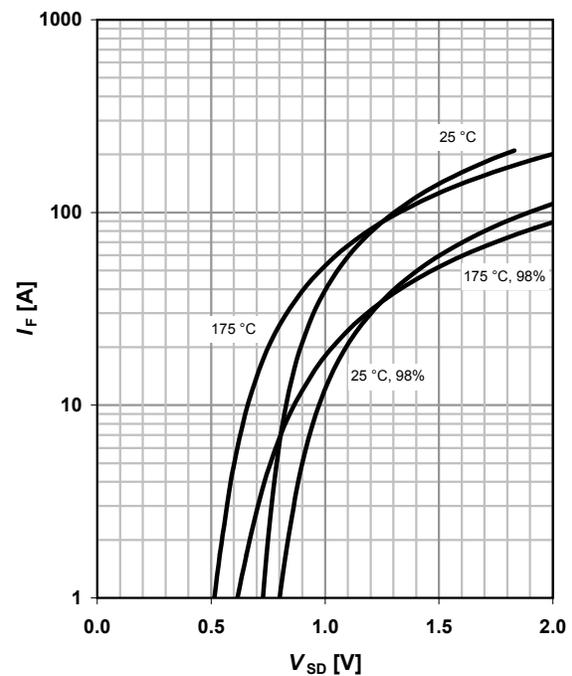C=f(V_{DS}); V_{GS}=0 V; f=1 MHz
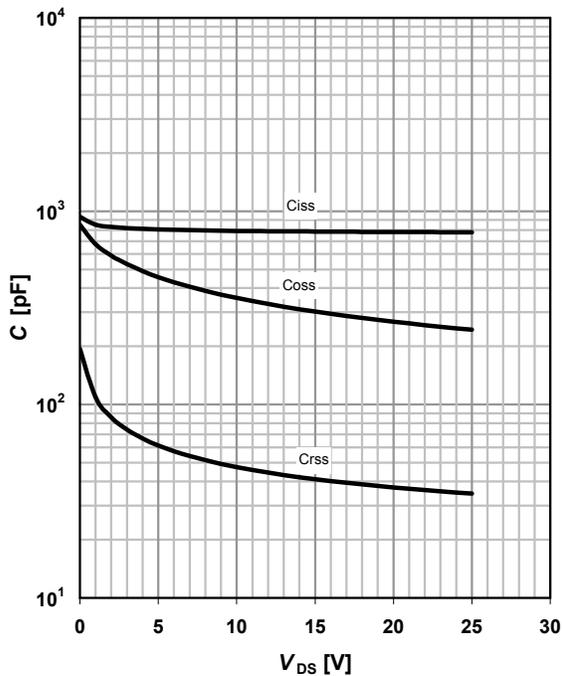
12 Forward characteristics of reverse diode
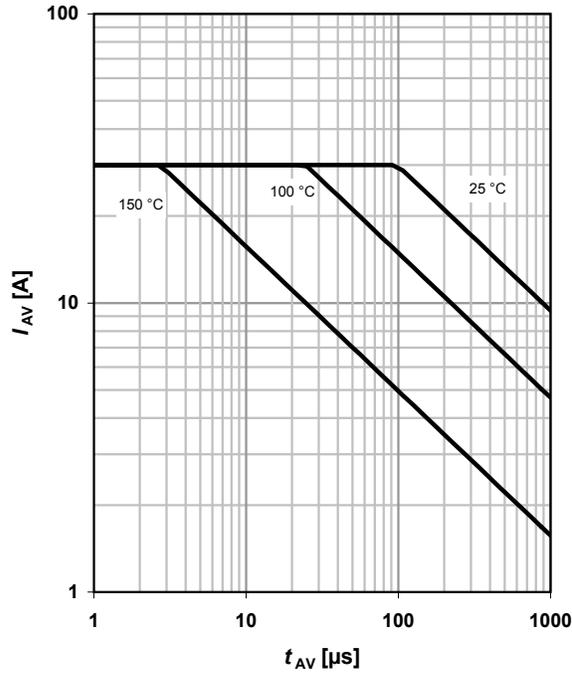
I_F=f(V_{SD})

parameter: T_j

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13 Avalanche characteristics

I_{AS}=f(t_{AV}); R_{GS}=25 Ω
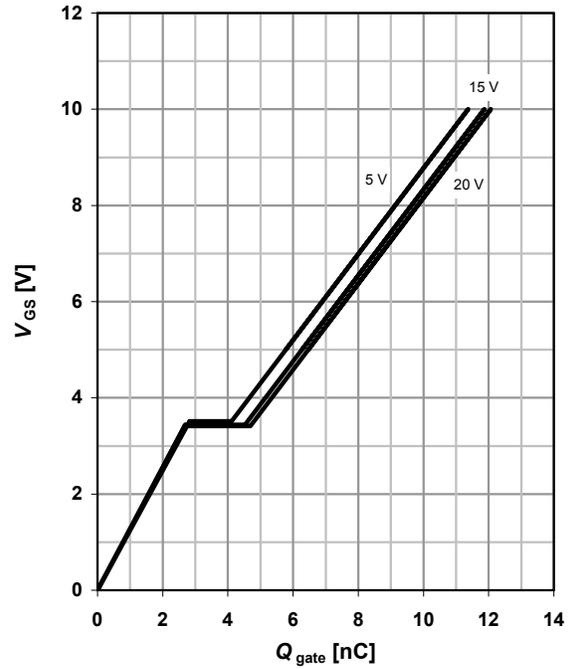
parameter: $T_{j(start)}$

14 Typ. gate charge

V_{GS}=f(Q_{gate}); I_D=25 A pulsed
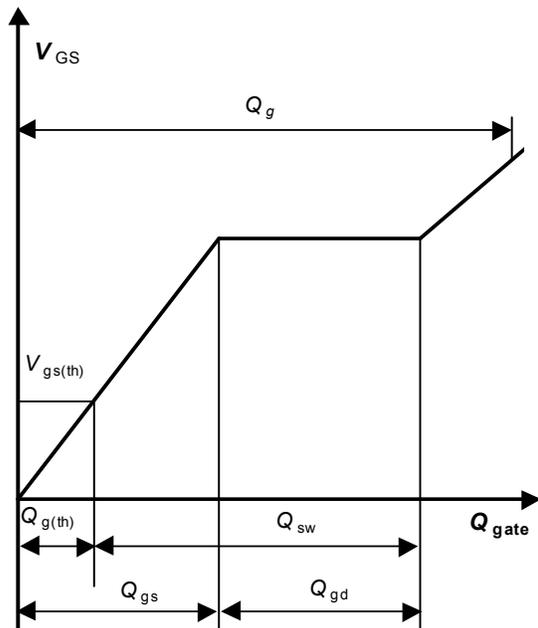
parameter: V_{DD}

15 Drain-source breakdown voltage

$V_{BR(DSS)}$=f(T_j); I_D=1 mA
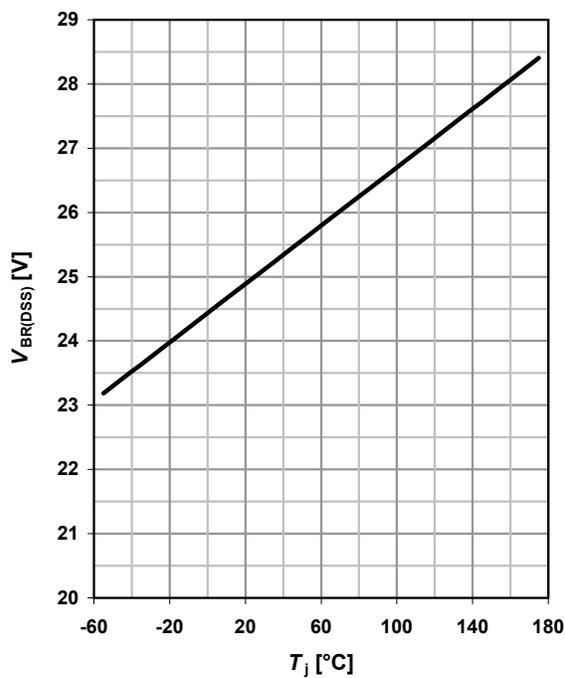
16 Gate charge waveforms

Package Outline **PG-TO252-3-11**

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.159	2.413	0.085	0.095
A1	0.000	0.150	0.000	0.006
b	0.635	0.889	0.025	0.035
b2	0.650	1.150	0.026	0.045
b3	5.004	5.500	0.197	0.217
c	0.457	0.580	0.018	0.023
c2	0.460	0.980	0.018	0.039
D	5.969	6.223	0.235	0.245
D1	5.020	5.842	0.198	0.230
E	6.400	6.731	0.252	0.265
E1	4.850	5.207	0.191	0.205
e	2.286		0.090	
e1	4.572		0.180	
N	3		3	
H	9.400	10.480	0.370	0.413
L3	0.900	1.143	0.035	0.045
L4	0.584	0.950	0.023	0.037
L6	0.510	0.686	0.020	0.027
F1	10.500	10.700	0.413	0.421
F2	6.300	6.500	0.248	0.256
F3	2.100	2.300	0.083	0.091
F4	5.700	5.900	0.224	0.232
F5	5.660	5.860	0.222	0.231
F6	1.100	1.300	0.043	0.051

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JEDEC TO252

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Package Outline   **PG-TO252-3-23**

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.159	2.413	0.085	0.095
A1	0.000	0.150	0.000	0.006
b	0.635	0.889	0.025	0.035
b2	0.650	1.150	0.026	0.045
b3	5.004	5.500	0.197	0.217
c	0.457	0.580	0.018	0.023
c2	0.460	0.980	0.018	0.039
D	5.969	6.223	0.235	0.245
D1	5.020	5.842	0.198	0.230
E	6.400	6.731	0.252	0.265
E1	4.850	5.207	0.191	0.205
e	2.286		0.090	
e1	4.572		0.180	
N	3		3	
H	9.400	10.480	0.370	0.413
L3	0.900	1.143	0.035	0.045
L4	0.584	0.950	0.023	0.037
L6	0.510	0.686	0.020	0.027
F1	10.500	10.700	0.413	0.421
F2	6.300	6.500	0.248	0.256
F3	2.100	2.300	0.083	0.091
F4	5.700	5.900	0.224	0.232
F5	5.660	5.860	0.222	0.231
F6	1.100	1.300	0.043	0.051

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Package Outline   **PG-TO251-3-11**
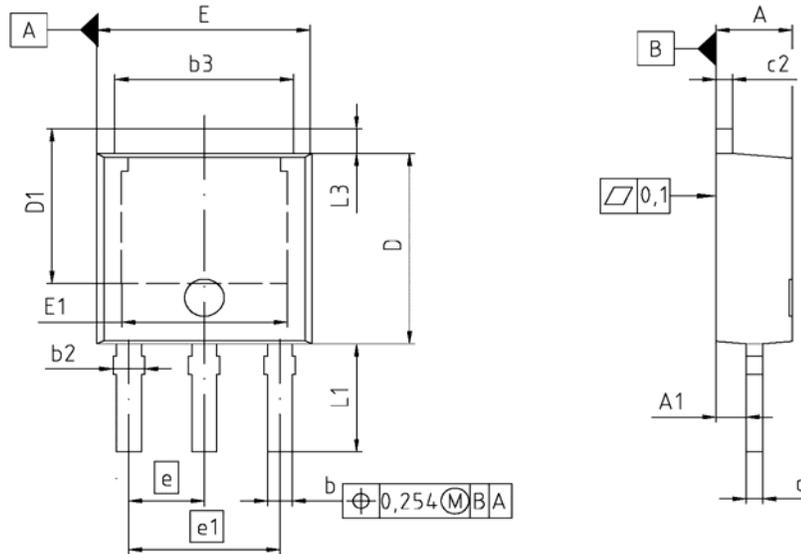
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.184	2.388	0.086	0.094
A1	0.000	0.150	0.000	0.006
b	0.635	0.889	0.025	0.035
b2	0.650	1.150	0.025	0.045
b3	5.004	5.500	0.197	0.217
c	0.460	0.580	0.018	0.023
c2	0.460	0.980	0.018	0.039
D	5.969	6.223	0.235	0.245
D1	5.020	5.320	0.198	0.209
E	6.400	6.731	0.252	0.265
E1	4.900	5.100	0.193	0.201
e	2.286		0.090	
e1	4.572		0.180	
N	3		3	
L1	3.400	3.600	0.134	0.142
L3	0.900	1.118	0.035	0.044

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ISSUE DATE
20-07-2005

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Package Outline   **PG-TO251-3-21**
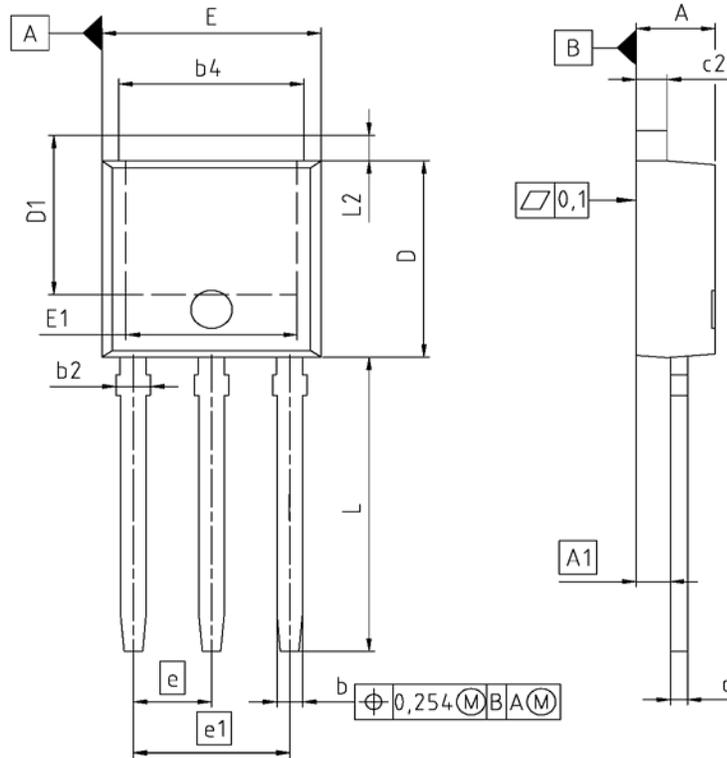
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.159	2.413	0.085	0.095
A1	0.900	1.118	0.035	0.044
b	0.650	0.850	0.026	0.033
b2	0.650	1.150	0.026	0.045
b4	5.004	5.500	0.197	0.217
c	0.457	0.580	0.018	0.023
c2	0.737	0.980	0.029	0.039
D	5.969	6.223	0.235	0.245
D1	5.100	6.121	0.201	0.241
E	6.400	6.731	0.252	0.265
E1	4.850	5.207	0.191	0.205
e	2.286		0.090	
e1	4.572		0.180	
N	3		3	
L	8.900	9.525	0.350	0.375
L1	0.900	1.143	0.035	0.045

REFERENCE
JEDEC TO251

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TO251_1

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