

## OptiMOS<sup>®</sup> 2 Power-Transistor

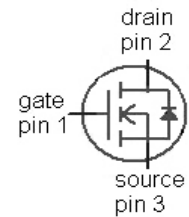
### Features

- Ideal for high-frequency dc/dc converters
- Qualified according to JEDEC<sup>1)</sup> 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	m $\Omega$
$I_D$	30	A



Type	IPD13N03LA G	IPF13N03LA G	IPS13N03LA G	IPU13N03LA G
				
Package	PG-TO252-3-11	PG-TO252-3-23	PG-TO251-3-11	PG-TO251-3-21
Ordering Code	Q67042-S4269	Q67042-S4287	Q67042-S4248	Q67042-S4270
Marking	13N03LA	13N03LA	13N03LA	13N03LA

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	$I_D$	$T_C=25\text{ °C}^2)$	30	A
		$T_C=100\text{ °C}$	30	
Pulsed drain current	$I_{D,pulse}$	$T_C=25\text{ °C}^3)$	210	
Avalanche energy, single pulse	$E_{AS}$	$I_D=24\text{ A}$ , $R_{GS}=25\ \Omega$	60	mJ
Reverse diode $dv/dt$	$dv/dt$	$I_D=30\text{ A}$ , $V_{DS}=20\text{ V}$ , $di/dt=200\text{ A}/\mu\text{s}$ , $T_{j,max}=175\text{ °C}$	6	kV/ $\mu\text{s}$
Gate source voltage <sup>4)</sup>	$V_{GS}$		$\pm 20$	V
Power dissipation	$P_{tot}$	$T_C=25\text{ °C}$	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

Thermal resistance, junction - case	$R_{thJC}$		-	-	3.2	K/W
SMD version, device on PCB	$R_{thJA}$	minimal footprint	-	-	75	
		6 cm <sup>2</sup> cooling area <sup>5)</sup>	-	-	50	

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

#### Static characteristics

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}, I_D=1\text{ mA}$	25	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=20\text{ }\mu\text{A}$	1.2	1.6	2	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=25\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ }^\circ\text{C}$	-	0.1	1	$\mu\text{A}$
		$V_{DS}=25\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ }^\circ\text{C}$	-	10	100	
Gate-source leakage current	$I_{GSS}$	$V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$	-	10	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=4.5\text{ V}, I_D=20\text{ A}$	-	17.5	21.9	m $\Omega$
		$V_{GS}=10\text{ V}, I_D=30\text{ A}$	-	10.7	12.8	
Gate resistance	$R_G$		-	0.9	-	$\Omega$
Transconductance	$g_{fs}$	$ V_{DS} >2 I_D R_{DS(on)max}, I_D=30\text{ A}$	18	36	-	S

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

<sup>2)</sup> Current is limited by bondwire; with an  $R_{thJC}=3.2\text{ K/W}$  the chip is able to carry 47 A.

<sup>3)</sup> See figure 3

<sup>4)</sup>  $T_{j,max}=150\text{ }^\circ\text{C}$  and duty cycle  $D<0.25$  for  $V_{GS}<-5\text{ V}$

<sup>5)</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.

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

### Dynamic characteristics

Input capacitance	$C_{iss}$	$V_{GS}=0\text{ V}, V_{DS}=15\text{ V},$ $f=1\text{ MHz}$	-	784	1043	pF
Output capacitance	$C_{oss}$		-	303	402	
Reverse transfer capacitance	$C_{rss}$		-	41	62	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=15\text{ V}, V_{GS}=10\text{ V},$ $I_D=15\text{ A}, R_G=2.7\ \Omega$	-	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<sup>6)</sup>

Gate to source charge	$Q_{gs}$	$V_{DD}=15\text{ V}, I_D=15\text{ A},$ $V_{GS}=0\text{ to }5\text{ V}$	-	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	$Q_{g(sync)}$	$V_{DS}=0.1\text{ V},$ $V_{GS}=0\text{ to }5\text{ V}$	-	5.5	7.3	nC
Output charge	$Q_{oss}$	$V_{DD}=15\text{ V}, V_{GS}=0\text{ V}$	-	6.6	8.7	

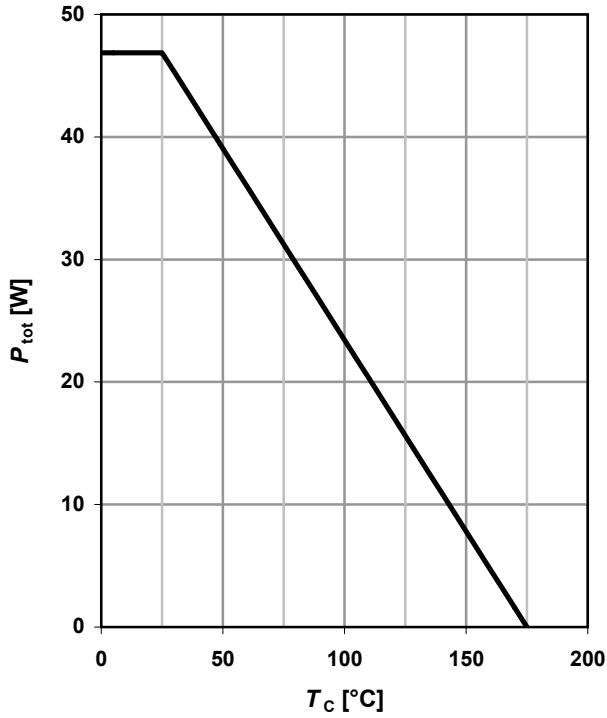
### Reverse Diode

Diode continuous forward current	$I_S$	$T_C=25\text{ }^\circ\text{C}$	-	-	30	A
Diode pulse current	$I_{S,pulse}$		-	-	210	
Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=30\text{ A},$ $T_J=25\text{ }^\circ\text{C}$	-	0.95	1.2	V
Reverse recovery charge	$Q_{rr}$	$V_R=15\text{ V}, I_F=I_S,$ $di_F/dt=400\text{ A}/\mu\text{s}$	-	-	10	nC

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

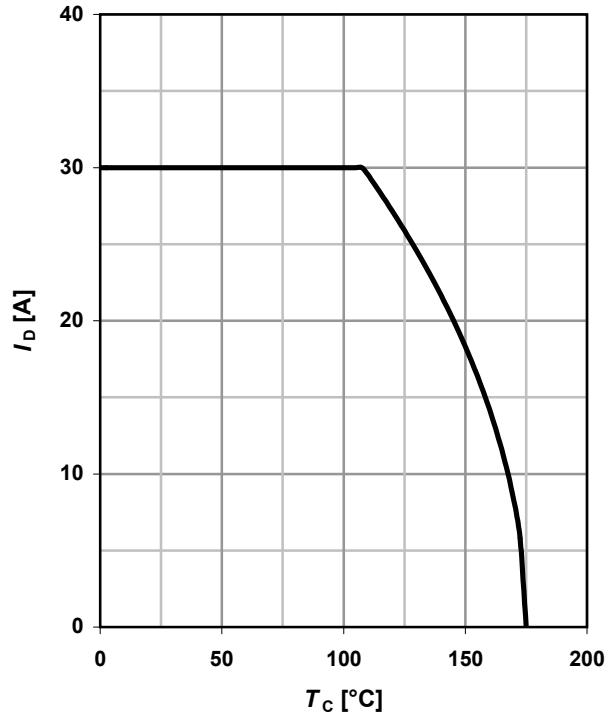
### 1 Power dissipation

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



### 2 Drain current

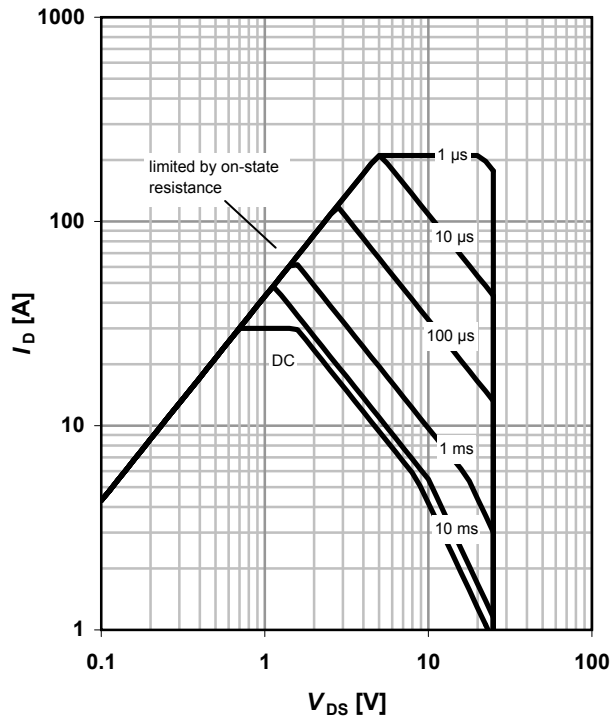
$$I_D = f(T_C); V_{GS} \geq 10 \text{ V}$$



### 3 Safe operating area

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

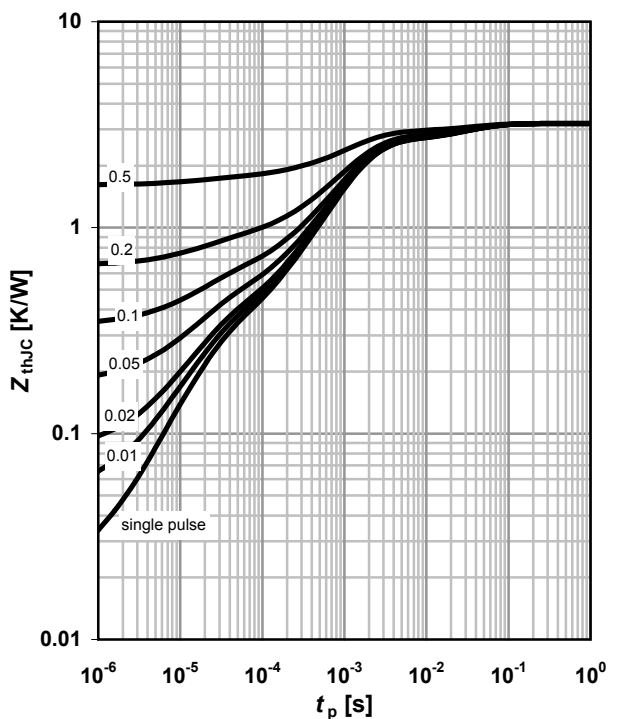
parameter:  $t_p$



### 4 Max. transient thermal impedance

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

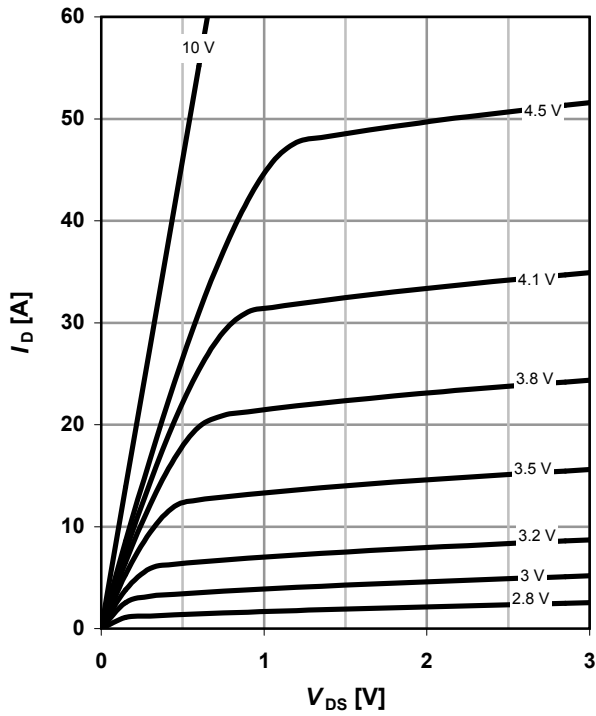
parameter:  $D = t_p / T$



**5 Typ. output characteristics**

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

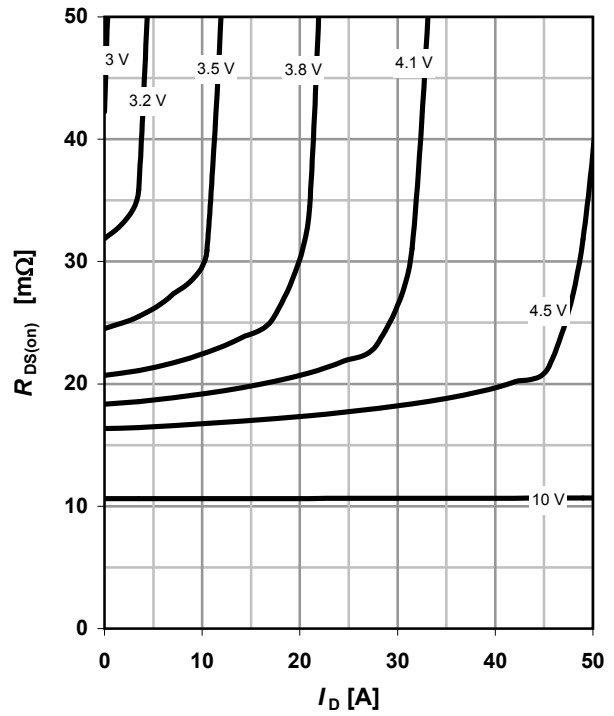
parameter:  $V_{GS}$



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

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

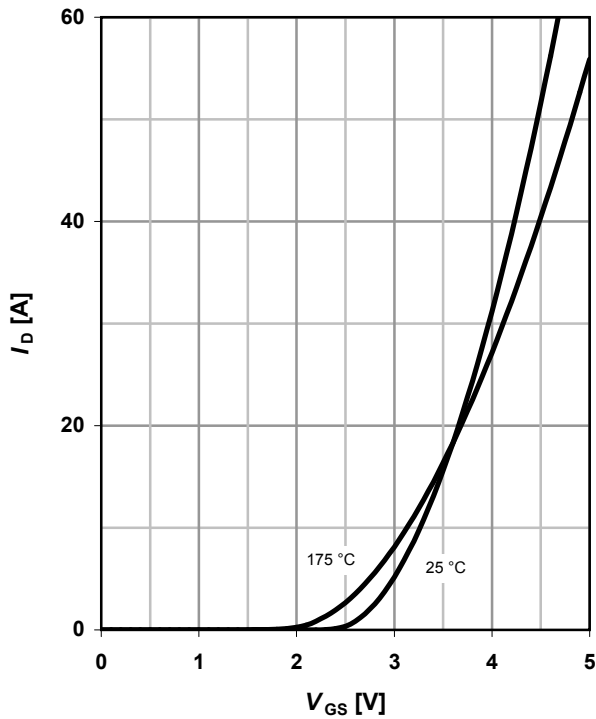
parameter:  $V_{GS}$



**7 Typ. transfer characteristics**

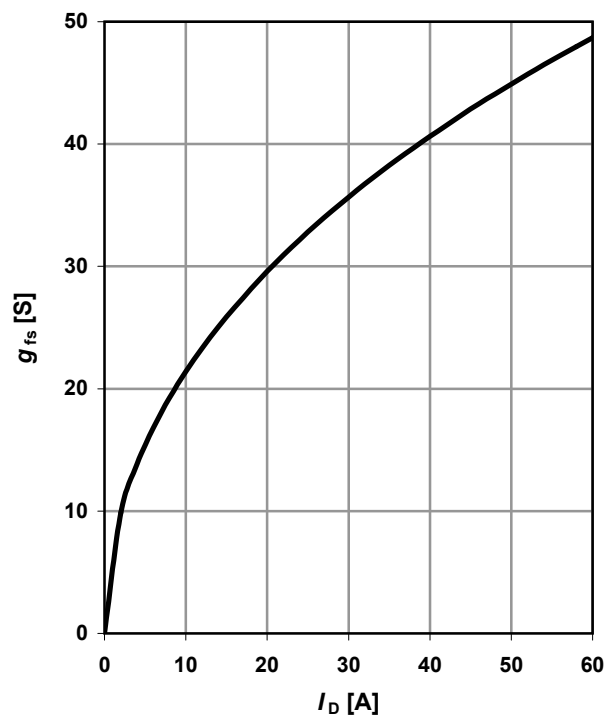
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter:  $T_j$



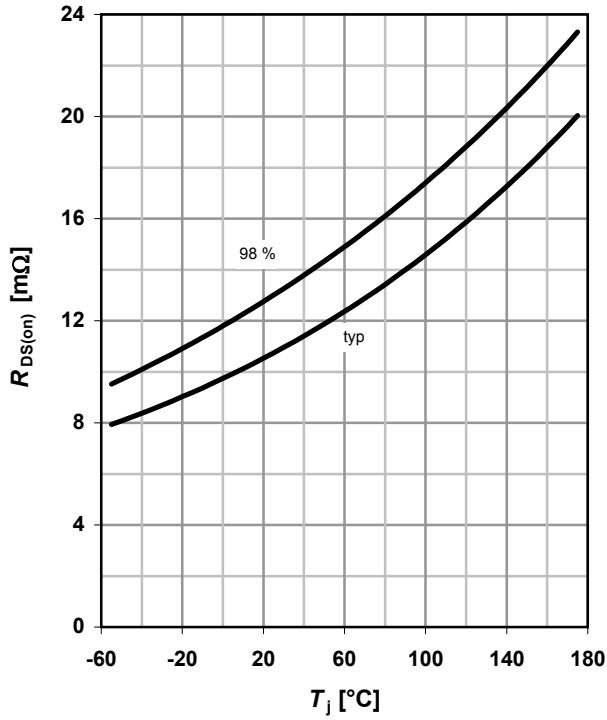
**8 Typ. forward transconductance**

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



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

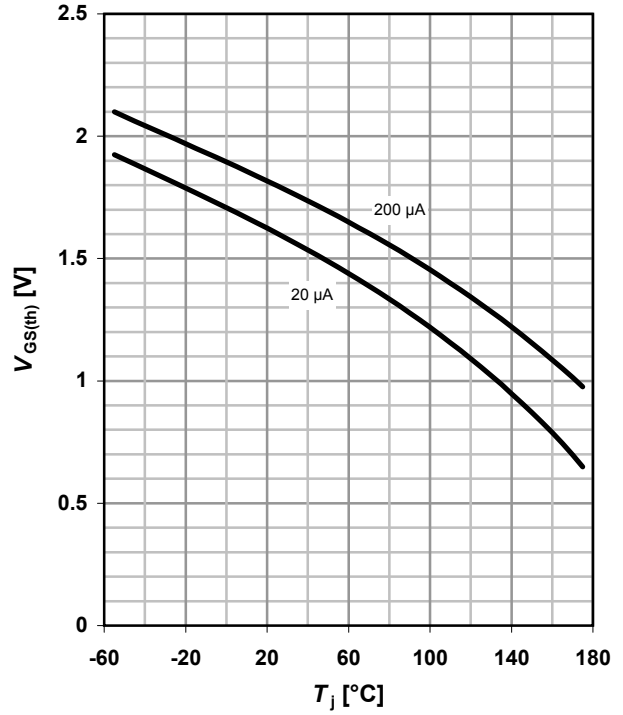
$R_{DS(on)}=f(T_j); I_D=30\text{ A}; V_{GS}=10\text{ V}$



**10 Typ. gate threshold voltage**

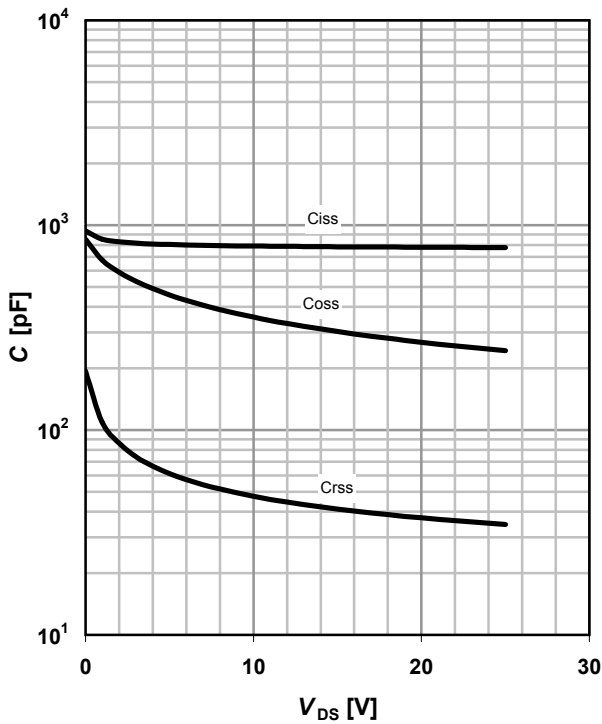
$V_{GS(th)}=f(T_j); V_{GS}=V_{DS}$

parameter:  $I_D$



**11 Typ. Capacitances**

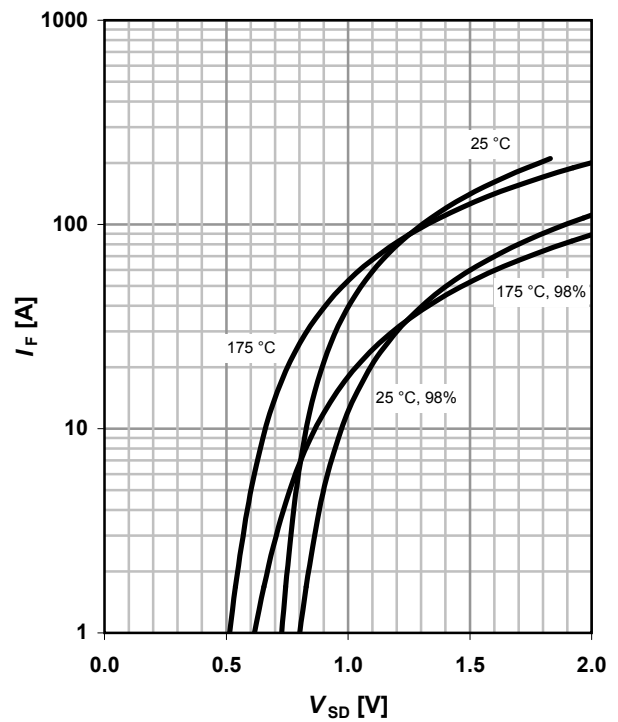
$C=f(V_{DS}); V_{GS}=0\text{ V}; f=1\text{ MHz}$



**12 Forward characteristics of reverse diode**

$I_F=f(V_{SD})$

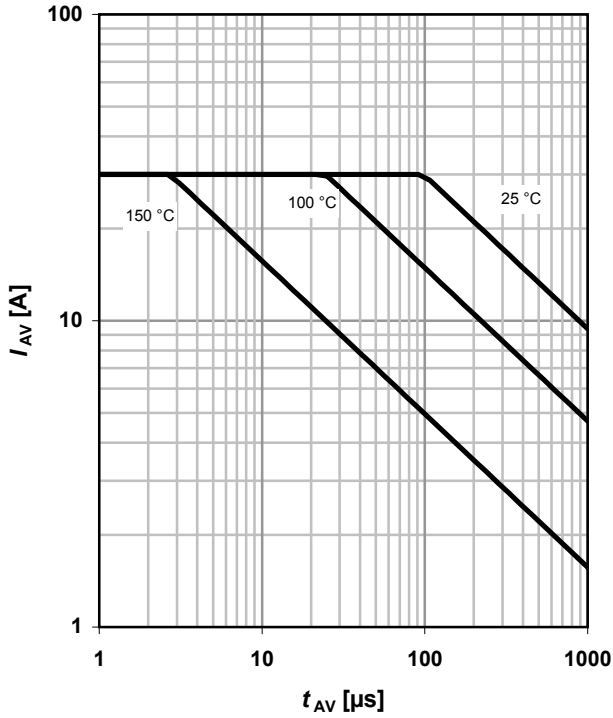
parameter:  $T_j$



### 13 Avalanche characteristics

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

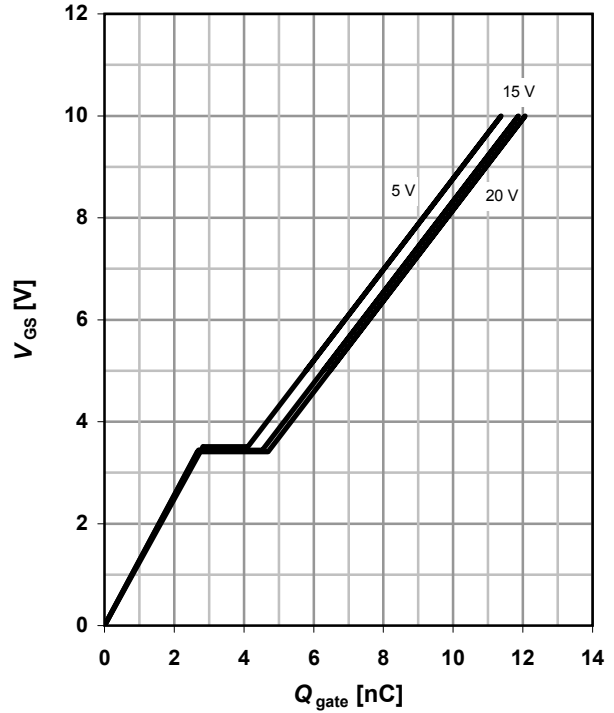
parameter:  $T_{j(start)}$



### 14 Typ. gate charge

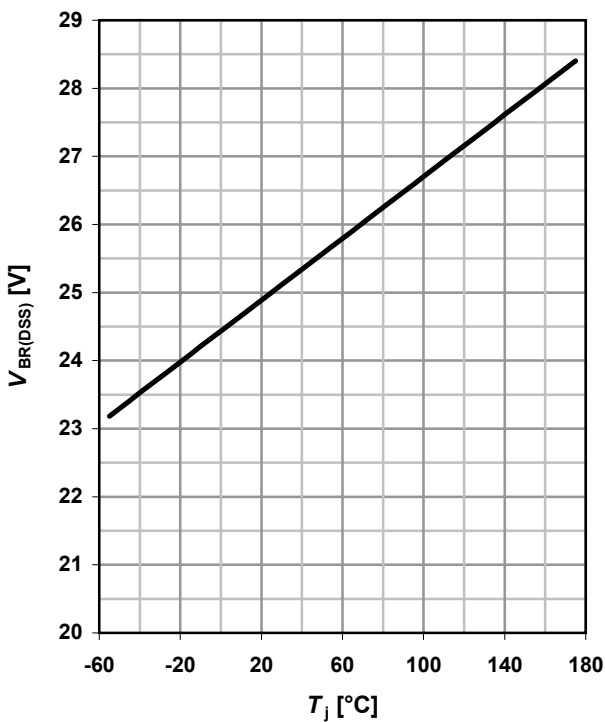
$V_{GS}=f(Q_{gate}); I_D=25\ A\ pulsed$

parameter:  $V_{DD}$

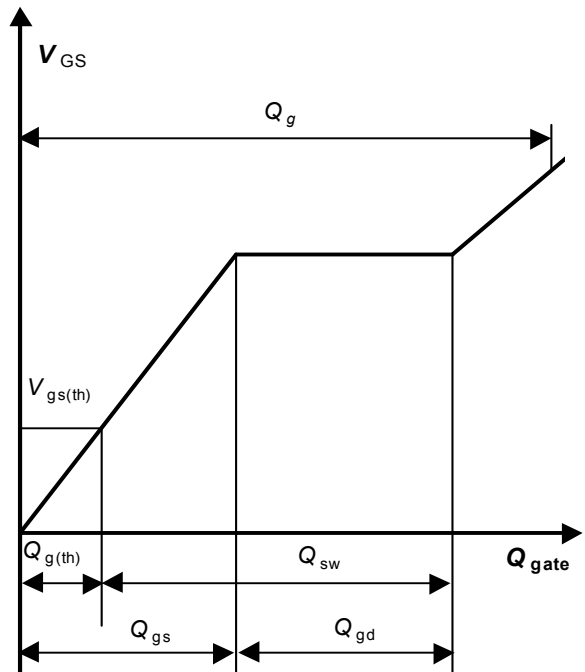


### 15 Drain-source breakdown voltage

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

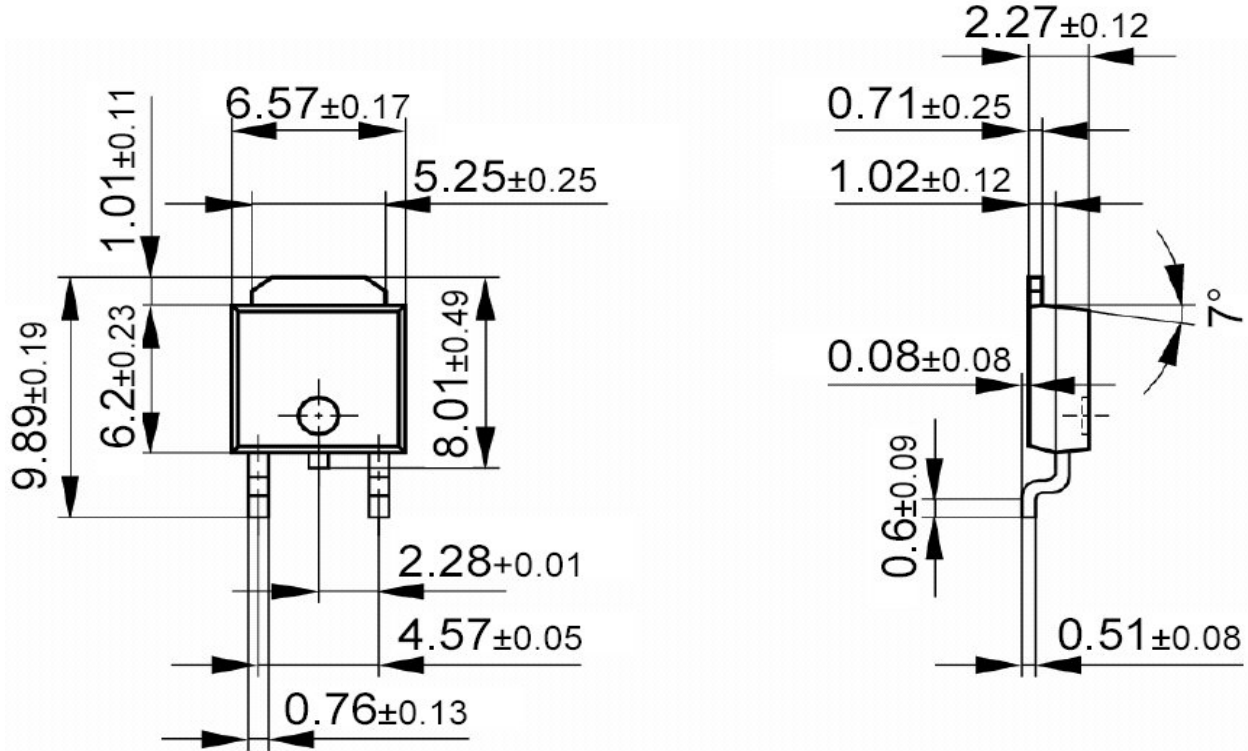


### 16 Gate charge waveforms

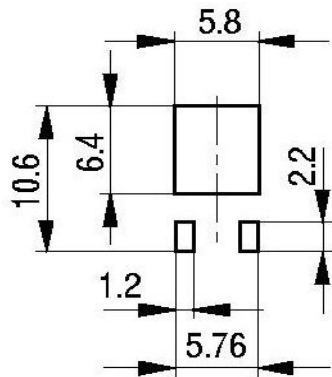


Package Outline

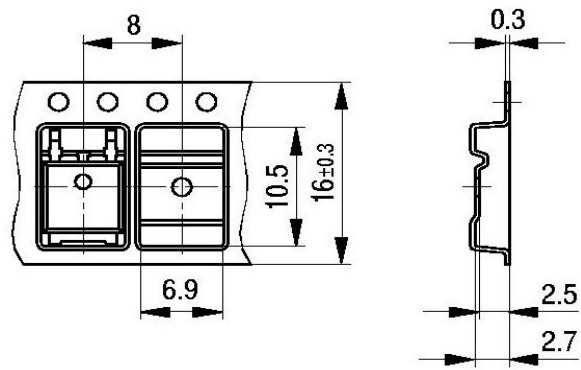
P-TO252-3-11: Outline



Footprint:



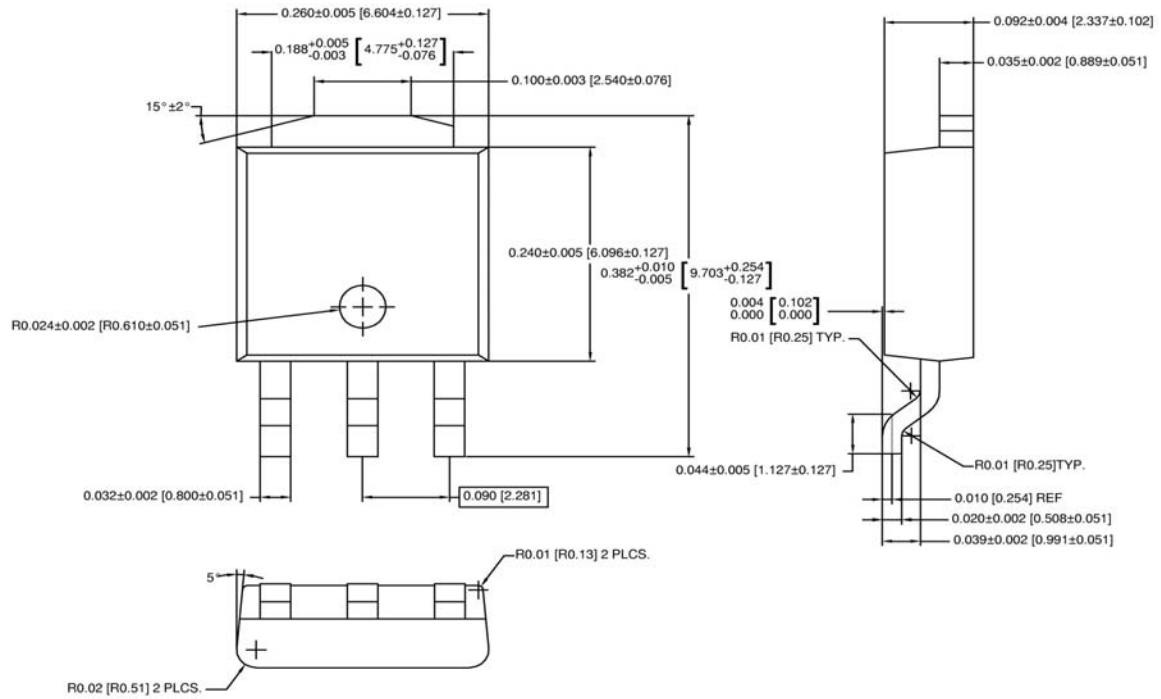
Packaging:



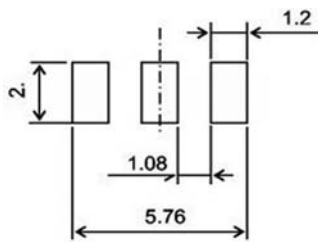
Dimensions in mm

Package Outline

P-TO252-3-23: Outline



Footprint:



Dimensions in inch [mm]



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