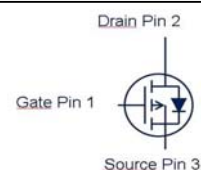
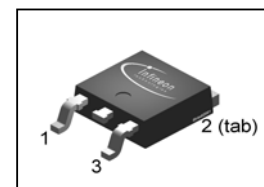


**SIPMOS® Power-Transistor**
**Features**

- P-Channel
- Enhancement mode
- Normal level
- Avalanche rated
- Pb-free lead plating; RoHS compliant
- ° Qualified according to AEC Q101

**Product Summary**

$V_{DS}$	-100	V
$R_{DS(on),max}$	1	$\Omega$
$I_D$	-4	A


**PG-TO252-3**


Type	Package	Marking	Lead free	Packing	Tape and reel information
SPD04P10P G	PG-TO252-3	04P10P	Yes	Non dry	1000 pcs / reel

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	$I_D$	$T_C=25\text{ °C}$	-4	A
		$T_C=100\text{ °C}$	-2.8	
Pulsed drain current	$I_{D,pulse}$	$V_{GS}=-10\text{ V}, I_D=-2.8\text{ A}$	-16	
Avalanche energy, single pulse	$E_{AS}$	$I_D=-4\text{ A}, R_{GS}=25\ \Omega$	57	mJ
Gate source voltage	$V_{GS}$		$\pm 20$	V
Power dissipation	$P_{tot}$	$T_C=25\text{ °C}$	38	W
Operating and storage temperature	$T_j, T_{stg}$		-55 ... 175	$^{\circ}\text{C}$
ESD class		JESD22-A114-HBM	1A (250 V to 500 V)	
Soldering temperature			260 $^{\circ}\text{C}$	
IEC climatic category; DIN IEC 68-1			55/175/56	

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Thermal characteristics**

Thermal resistance, junction - soldering point	$R_{thJC}$		-	-	3.9	K/W
Thermal resistance, junction - ambient	$R_{thJA}$	minimal footprint, steady state	-	-	75	
		6 cm <sup>2</sup> cooling area <sup>1)</sup> , steady state	-	-	50	

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

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}, I_D=-250\text{ }\mu\text{A}$	-100	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=-380\text{ }\mu\text{A}$	-2.1	-3.0	-4	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=-100\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ }^\circ\text{C}$	-	-0.1	-1	$\mu\text{A}$
		$V_{DS}=-100\text{ V}, V_{GS}=0\text{ V}, T_j=150\text{ }^\circ\text{C}$	-	-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	$R_{DS(on)}$	$V_{GS}=-10\text{ V}, I_D=-2.8\text{ A}$	-	644	1000	m $\Omega$
Transconductance	$g_{fs}$	$ V_{DS} >2 I_D R_{DS(on)max}, I_D=-2.8\text{ A}$	1.2	2.4	-	S

<sup>1)</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	$C_{iss}$	$V_{GS}=0\text{ V}, V_{DS}=-25\text{ V},$ $f=1\text{ MHz}$	-	240	319	pF
Output capacitance	$C_{oss}$		-	62	82	
Reverse transfer capacitance	$C_{rss}$		-	28	42	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=-50\text{ V}, V_{GS}=-$ $10\text{ V}, I_D=-4\text{ A}, R_G=6\ \Omega$	-	5.7	8.6	ns
Rise time	$t_r$		-	8.6	13	
Turn-off delay time	$t_{d(off)}$		-	14	21	
Fall time	$t_f$		-	4.5	6.8	

**Gate Charge Characteristics<sup>2)</sup>**

Gate to source charge	$Q_{gs}$	$V_{DD}=-80\text{ V}, I_D=-4\text{ A},$ $V_{GS}=0\text{ to }-10\text{ V}$	-	1.4	1.8	nC
Gate to drain charge	$Q_{gd}$		-	5	7	
Gate charge total	$Q_g$		-	9	12	
Gate plateau voltage	$V_{plateau}$		-	6	-	

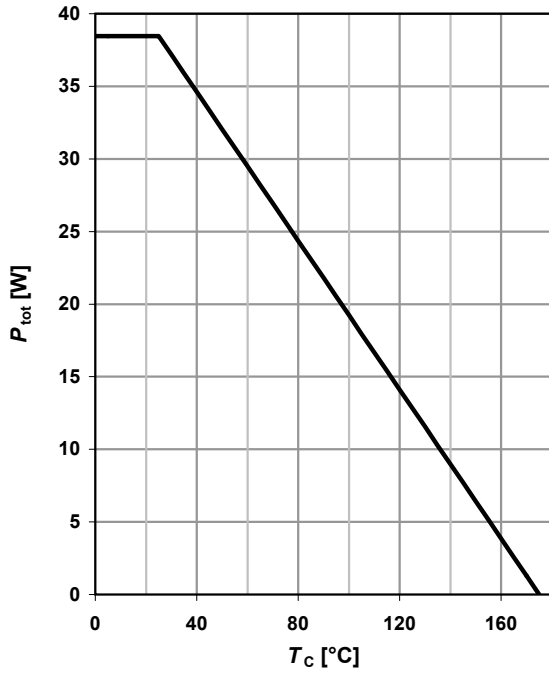
**Reverse Diode**

Diode continuous forward current	$I_S$	$T_C=25\text{ }^\circ\text{C}$	-	-	-4.0	A
Diode pulse current	$I_{S,pulse}$		-	-	16.0	
Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=-4\text{ A},$ $T_j=25\text{ }^\circ\text{C}$	-	-0.8	-1.2	V
Reverse recovery time	$t_{rr}$	$V_R=50\text{ V}, I_F= I_S ,$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	74	93	ns
Reverse recovery charge	$Q_{rr}$		-	218	273	nC

<sup>2)</sup> See figure 16 for gate charge parameter definition

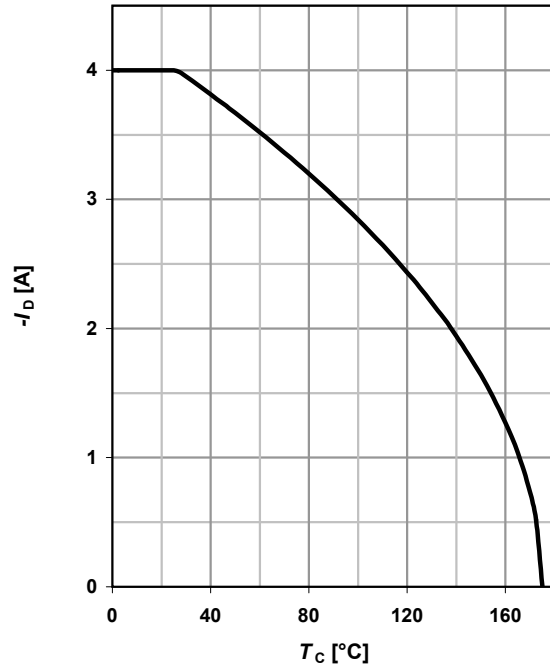
**1 Power dissipation**

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



**2 Drain current**

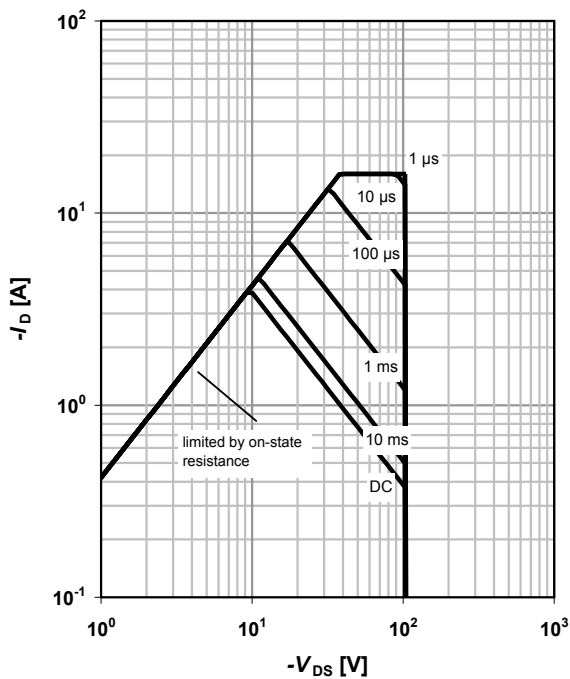
$$I_D = f(T_c); |V_{GS}| \geq 10 \text{ V}$$



**3 Safe operating area**

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

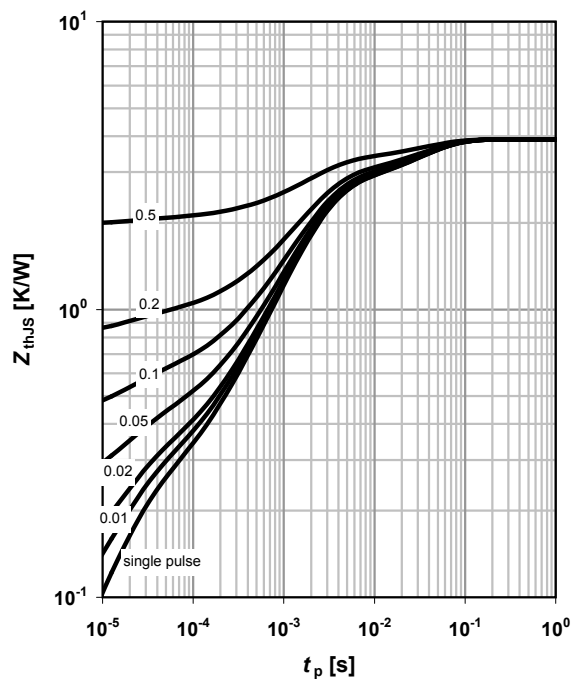
parameter:  $t_p$



**4 Max. transient thermal impedance**

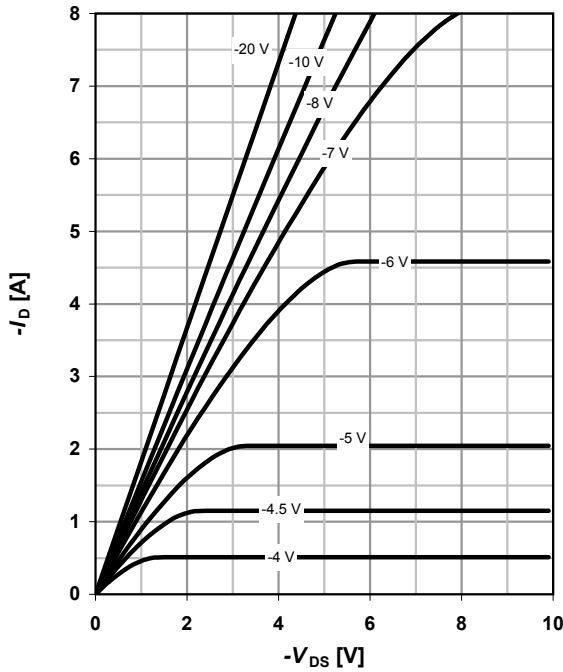
$$Z_{thJC} = f(t_p)$$

parameter:  $D = t_p / T$

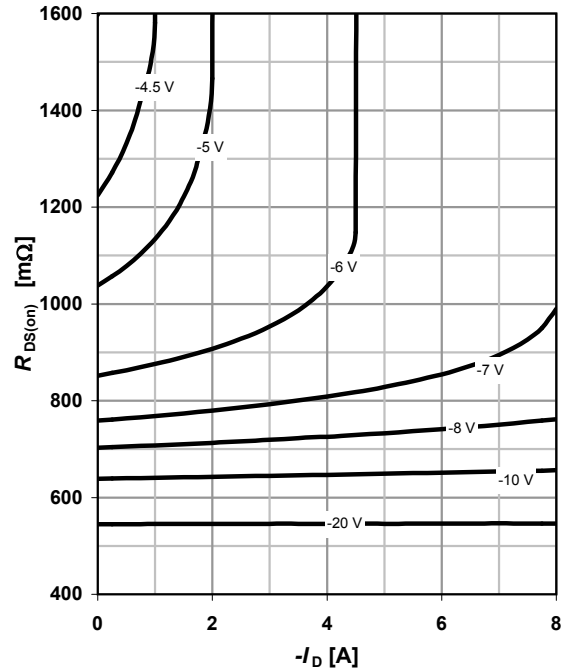


**5 Typ. output characteristics**

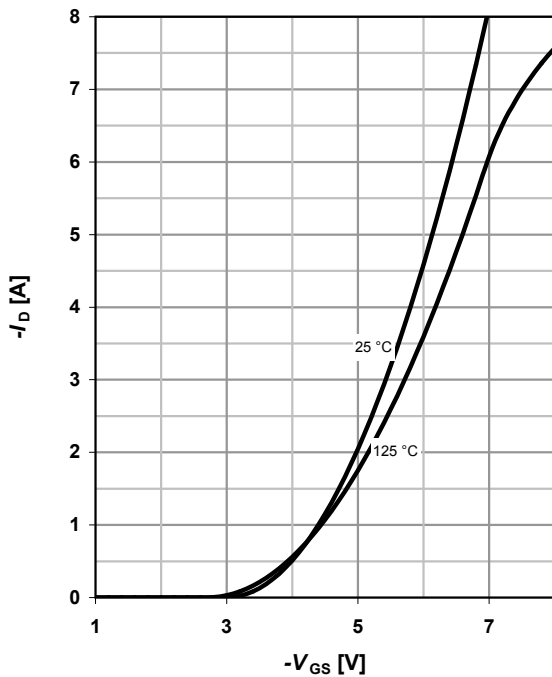
$$I_D = f(V_{DS}); T_j = 25\text{ }^\circ\text{C}$$

 parameter:  $V_{GS}$ 

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

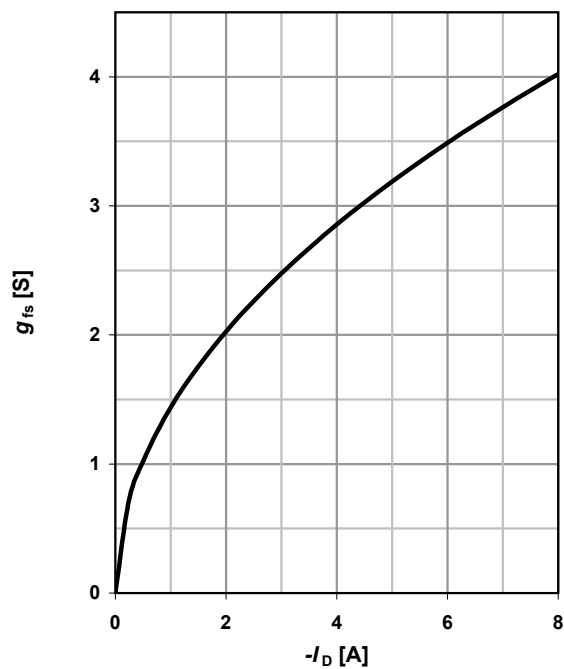
$$R_{DS(on)} = f(I_D); T_j = 25\text{ }^\circ\text{C}$$

 parameter:  $V_{GS}$ 

**7 Typ. transfer characteristics**

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

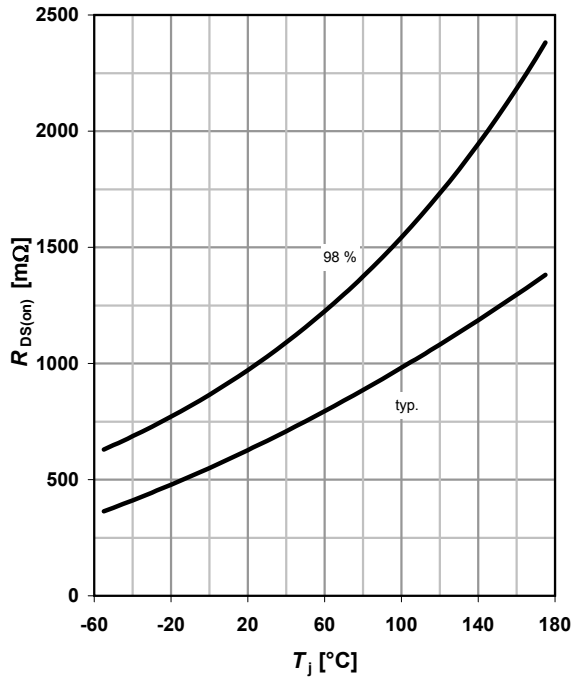
 parameter:  $T_j$ 

**8 Typ. forward transconductance**

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



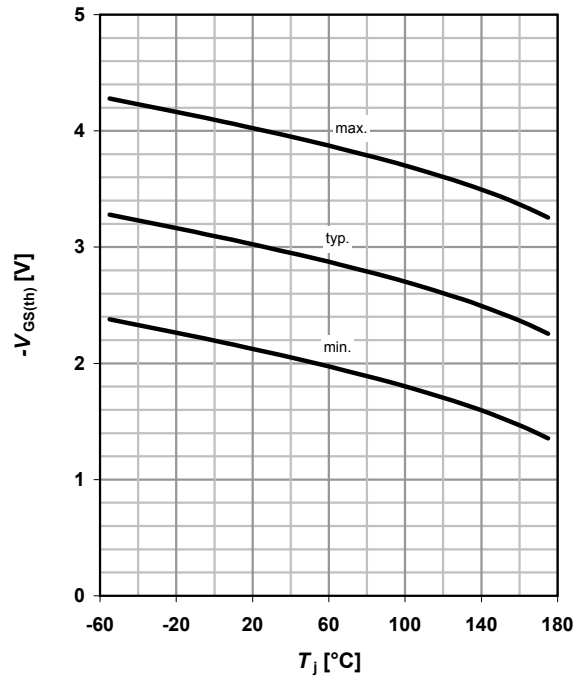
**9 Drain-source on-state resistance**

$R_{DS(on)} = f(T_j); I_D = -4 \text{ A}; V_{GS} = -10 \text{ V}$



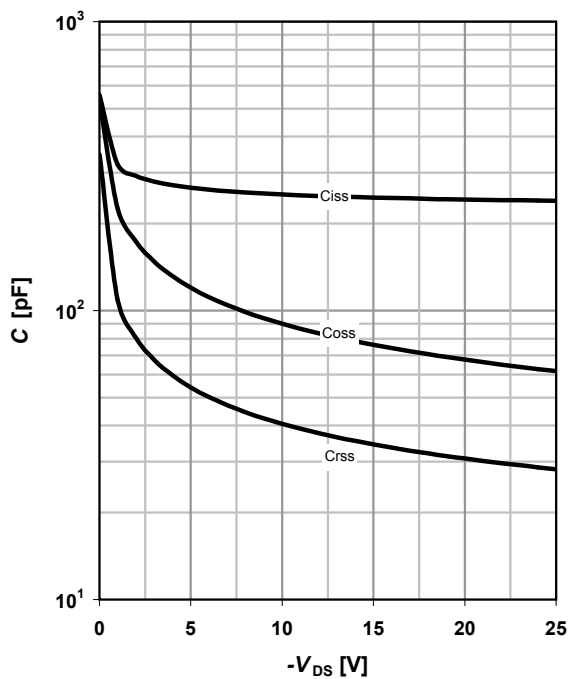
**10 Typ. gate threshold voltage**

$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}; I_D = -380 \mu\text{A}$



**11 Typ. capacitances**

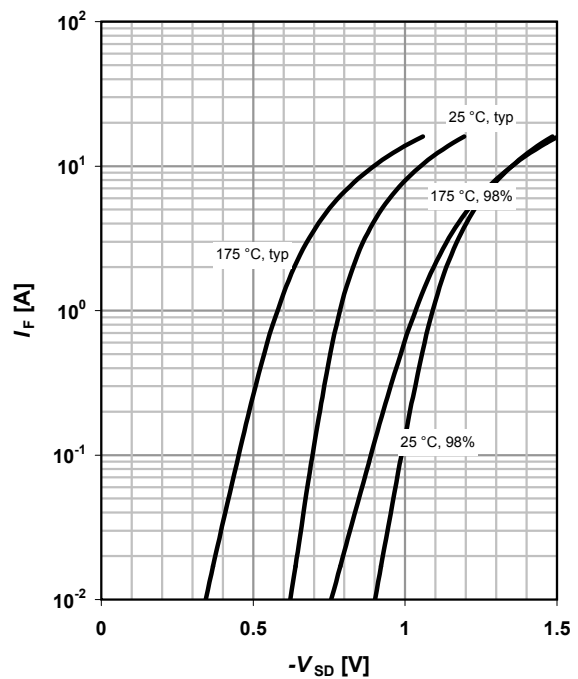
$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$



**12 Forward characteristics of reverse diode**

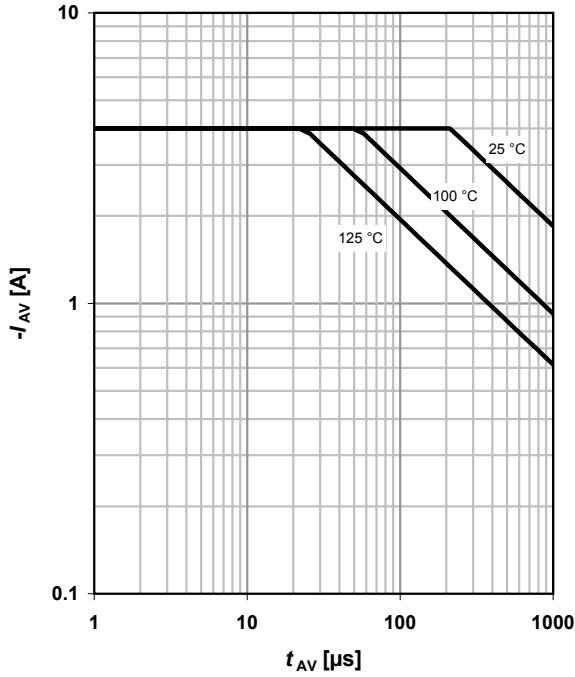
$I_F = f(V_{SD})$

parameter:  $T_j$

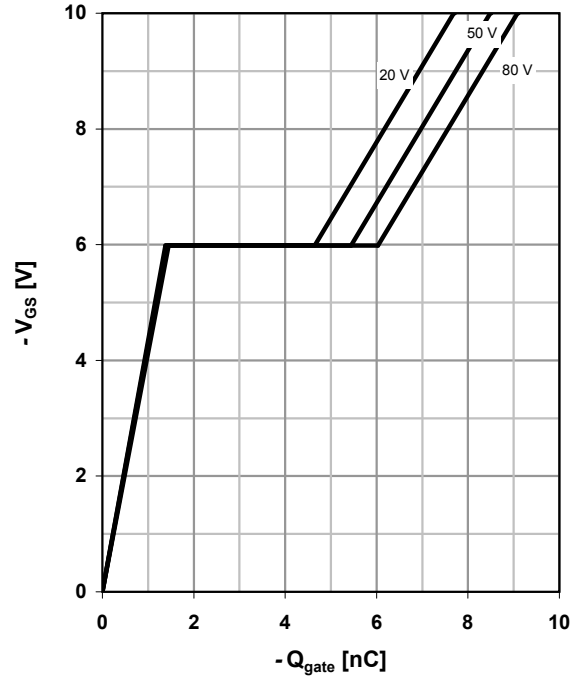


**13 Avalanche characteristics**

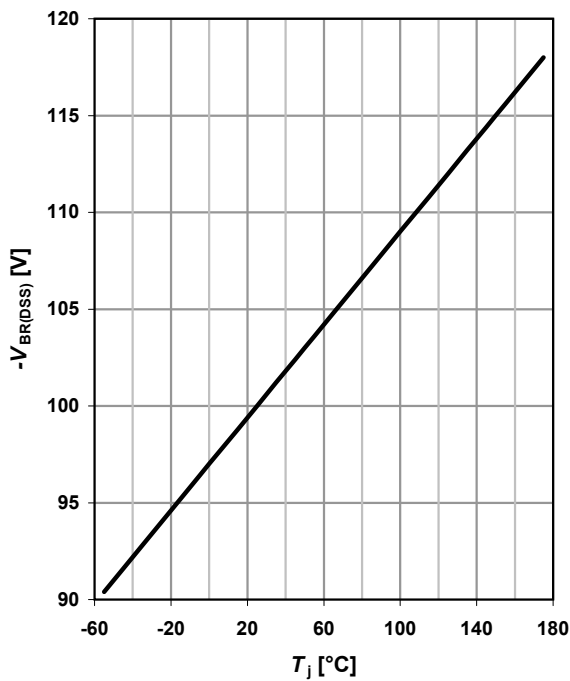
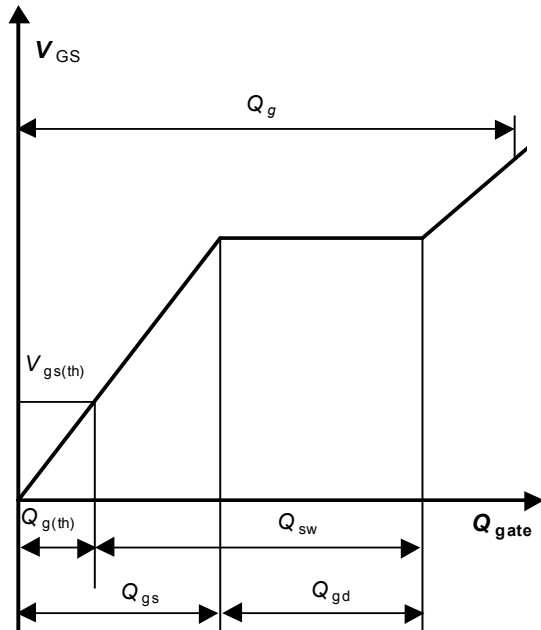
$$I_{AS}=f(t_{AV}); R_{GS}=25\ \Omega$$

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

**14 Typ. gate charge**

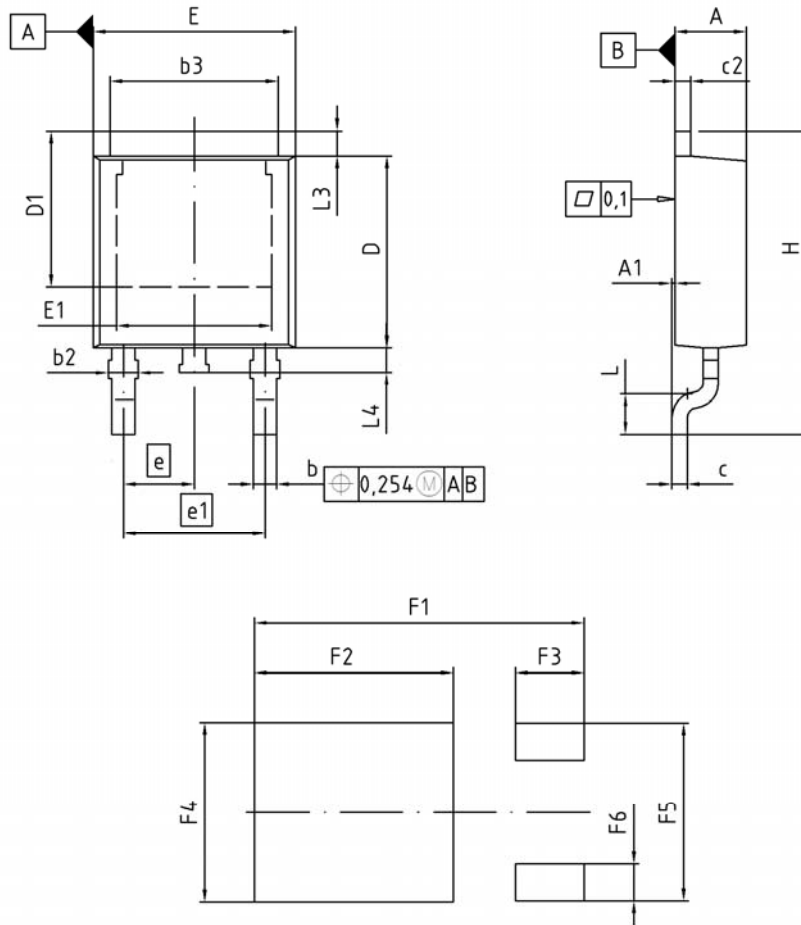
$$V_{GS}=f(Q_{\text{gate}}); I_D=-4\ \text{A pulsed}$$

 parameter:  $V_{DD}$ 

**15 Drain-source breakdown voltage**

$$V_{BR(DSS)}=f(T_j); I_D=-250\ \mu\text{A}$$


**16 Gate charge waveforms**


Package Outline: PG-TO-252-3



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.16	2.41	0.085	0.095
A1	0.00	0.15	0.000	0.006
b	0.64	0.89	0.025	0.035
b2	0.65	1.15	0.026	0.045
b3	5.00	5.50	0.197	0.217
c	0.46	0.60	0.018	0.024
c2	0.46	0.98	0.018	0.039
D	5.97	6.22	0.235	0.245
D1	5.02	5.84	0.198	0.230
E	6.40	6.73	0.252	0.265
E1	4.70	5.21	0.185	0.205
e	2.29		0.090	
e1	4.57		0.180	
N	3		3	
H	9.40	10.48	0.370	0.413
L	1.18	1.70	0.046	0.067
L3	0.90	1.25	0.035	0.049
L4	0.51	1.00	0.020	0.039
F1	10.50	10.70	0.413	0.421
F2	6.30	6.50	0.248	0.256
F3	2.10	2.30	0.083	0.091
F4	5.70	5.90	0.224	0.232
F5	5.66	5.86	0.223	0.231
F6	1.10	1.30	0.043	0.051

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