

OptiMOS® Power-Transistor Buck converter series

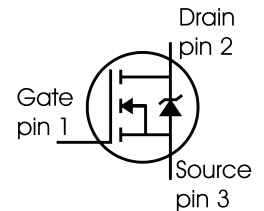
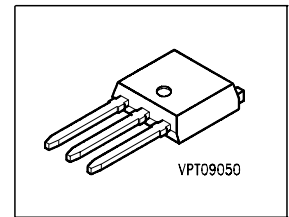
Feature

- N-Channel
- Logic Level
- Low on-resistance $R_{DS(on)}$
- Excellent Gate Charge x $R_{DS(on)}$ product (FOM)
- Superior thermal resistance
- 175°C operating temperature
- dv/dt rated
- Ideal for fast switching buck converter
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Product Summary

V_{DS}	30	V
$R_{DS(on)}$	14.4	mΩ
I_D	30	A

P-TO251



Type	Package	Ordering Code	Marking
IPU14N03L	P-TO251	Q67042-S4115	14N03L

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

Parameter	Symbol	Value	Unit
Continuous drain current	I_D		A
$T_C=25^\circ\text{C}$		30	
$T_C=100^\circ\text{C}$		30	
Pulsed drain current	$I_{D \text{ puls}}$	120	
$T_C=25^\circ\text{C}$			
Avalanche energy, single pulse	E_{AS}	20	mJ
$I_D=20\text{A}$, $V_{DD}=25\text{V}$, $R_{GS}=25\Omega$			
Reverse diode dv/dt	dv/dt	6	kV/μs
$I_S=30\text{A}$, $V_{DS}=-\text{V}$, di/dt=200A/μs, $T_{j\text{max}}=175^\circ\text{C}$			
Gate source voltage	V_{GS}	±20	V
Power dissipation	P_{tot}	60	W
$T_C=25^\circ\text{C}$			
Operating and storage temperature	T_j, T_{stg}	-55... +175	°C
IEC climatic category; DIN IEC 68-1		55/175/56	

Thermal Characteristics

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Characteristics					
Thermal resistance, junction - case	R_{thJC}	-	-	2.5	K/W
Thermal resistance, junction - ambient, leaded	R_{thJA}	-	-	100	
SMD version, device on PCB:	R_{thJA}				
@ min. footprint		-	-	75	
@ 6 cm ² cooling area ¹⁾		-	-	50	

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

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Static Characteristics					
Drain-source breakdown voltage $V_{GS}=0V, I_D=1mA$	$V_{(BR)DSS}$	30	-	-	V
Gate threshold voltage, $V_{GS} = V_{DS}$ $I_D = 30 \mu A$	$V_{GS(th)}$	1.2	1.6	2	
Zero gate voltage drain current $V_{DS}=30V, V_{GS}=0V, T_j=25^{\circ}C$ $V_{DS}=30V, V_{GS}=0V, T_j=125^{\circ}C$	I_{DSS}	- -	0.01 10	1 100	μA
Gate-source leakage current $V_{GS}=20V, V_{DS}=0V$	I_{GSS}	-	1	100	
Drain-source on-state resistance $V_{GS}=4.5V, I_D=20A$	$R_{DS(on)}$	-	16.7	20.9	m Ω
Drain-source on-state resistance $V_{GS}=10V, I_D=20A$	$R_{DS(on)}$	-	11.5	14.4	

¹⁾Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm² (one layer, 70 μm thick) copper area for drain connection. PCB is vertical without blown air.

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Dynamic Characteristics						
Transconductance	g_{fs}	$V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$, $I_D = 20A$	24	48	-	S
Input capacitance	C_{iss}	$V_{GS} = 0V$, $V_{DS} = 25V$, $f = 1MHz$	-	770	1025	pF
Output capacitance	C_{oss}		-	280	370	
Reverse transfer capacitance	C_{rss}		-	74	111	
Gate resistance	R_G		-	1.5	-	Ω
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 15V$, $V_{GS} = 10V$, $I_D = 15A$, $R_G = 8.5\Omega$	-	5.9	8.9	ns
Rise time	t_r		-	30.4	45.6	
Turn-off delay time	$t_{d(off)}$		-	26.6	39.9	
Fall time	t_f		-	14.4	21.6	

Gate Charge Characteristics

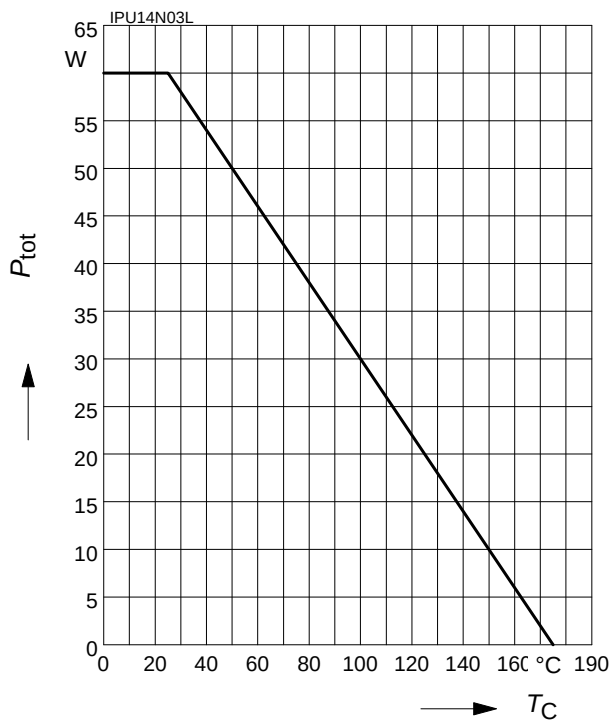
Gate to source charge	Q_{gs}	$V_{DD} = 15\text{V}$, $I_D = 15\text{A}$	-	2.5	3.1	nC
Gate to drain charge	Q_{gd}		-	6.2	9.3	
Gate charge total	Q_g	$V_{DD} = 15\text{V}$, $I_D = 15\text{A}$, $V_{GS} = 0$ to 5V	-	10.6	13.3	
Output charge	Q_{oss}	$V_{DS} = 15\text{V}$, $I_D = 15\text{A}$, $V_{GS} = 0\text{V}$	-	10.24	12.8	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} = 15\text{V}$, $I_D = 15\text{A}$	-	3.4	-	V

Reverse Diode

Inverse diode continuous forward current	I_S	$T_C = 25^\circ\text{C}$	-	-	30	A
Inverse diode direct current, pulsed	I_{SM}		-	-	120	
Inverse diode forward voltage	V_{SD}	$V_{GS} = 0\text{V}$, $I_F = 30\text{A}$	-	0.9	1.2	V
Reverse recovery time	t_{rr}	$V_R = -V$, $I_F = I_S$, $di_F/dt = 100\text{A}/\mu\text{s}$	-	23	29	ns
Reverse recovery charge	Q_{rr}		-	15	19	nC

1 Power dissipation

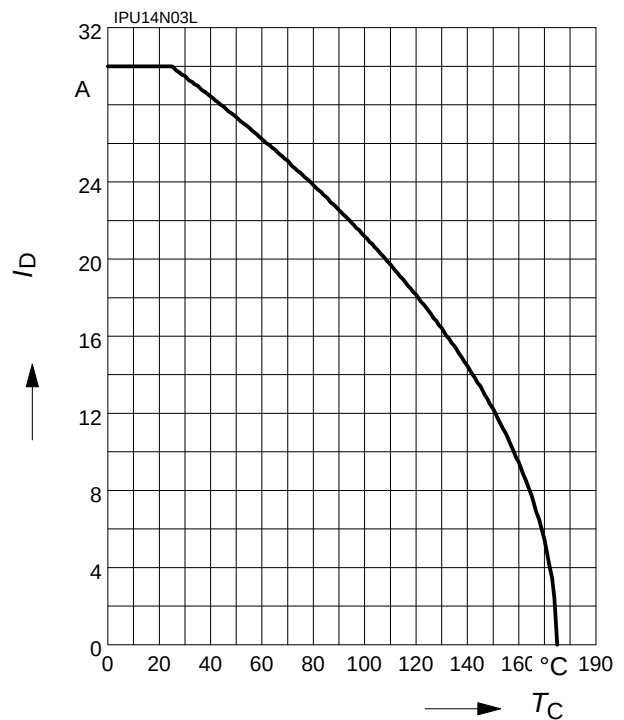
$$P_{\text{tot}} = f(T_C)$$



2 Drain current

$$I_D = f(T_C)$$

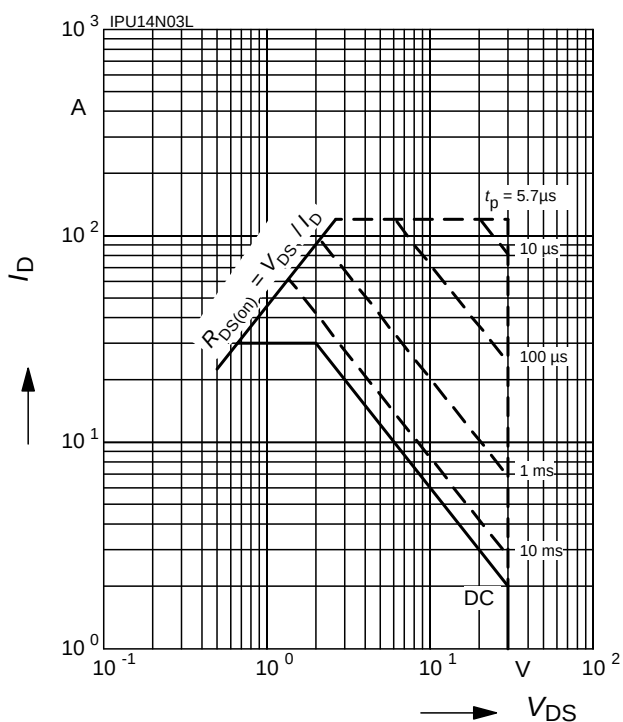
parameter: $V_{GS} \geq 10 \text{ V}$



3 Safe operating area

$$I_D = f(V_{DS})$$

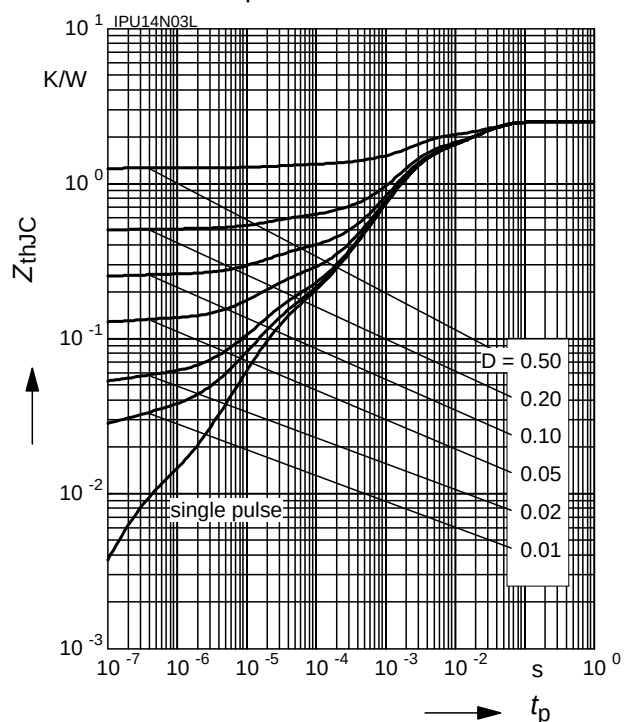
parameter: $D = 0$, $T_C = 25 \text{ °C}$



4 Transient thermal impedance

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

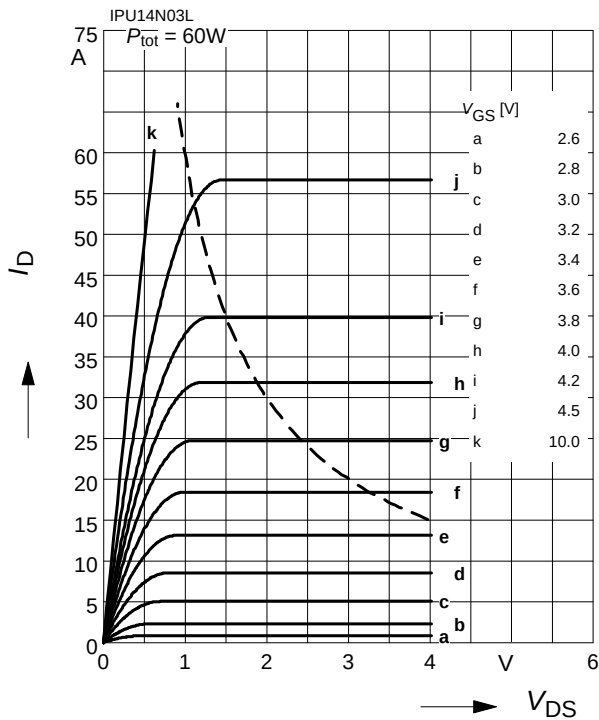
parameter: $D = t_p/T$



5 Typ. output characteristic

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

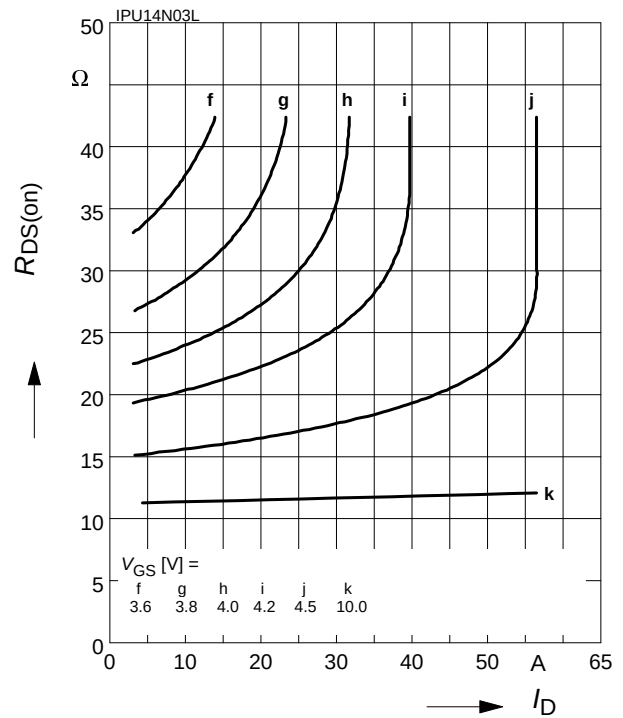
parameter: $t_p = 80 \mu\text{s}$



6 Typ. drain-source on resistance

$$R_{DS(\text{on})} = f(I_D)$$

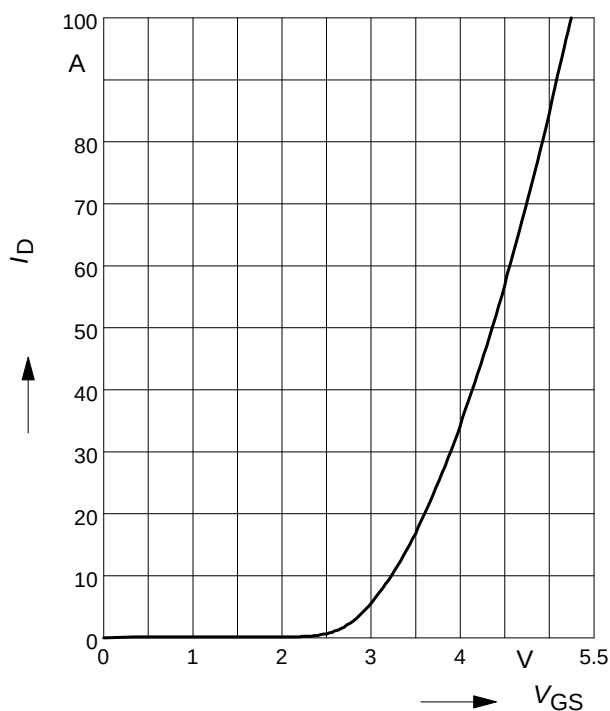
parameter: V_{GS}



7 Typ. transfer characteristics

$$I_D = f(V_{GS}); V_{DS} \geq 2 \times I_D \times R_{DS(\text{on})\text{max}}$$

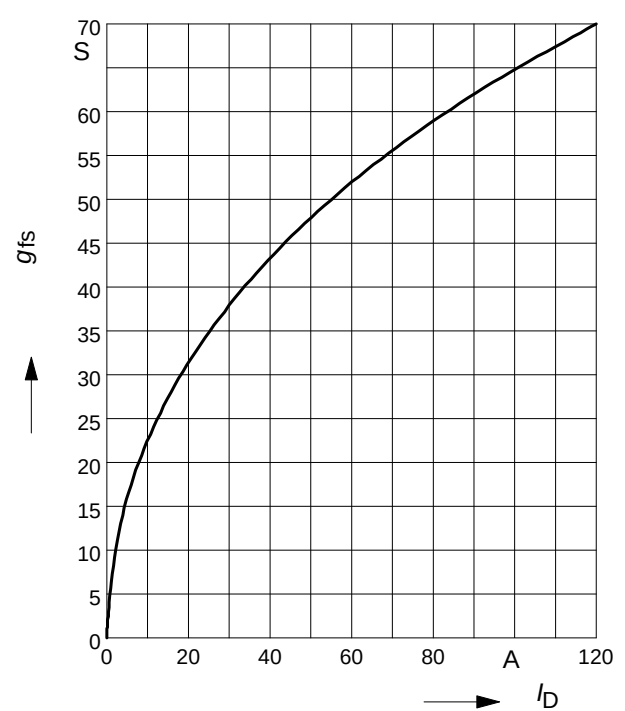
parameter: $t_p = 80 \mu\text{s}$



8 Typ. forward transconductance

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

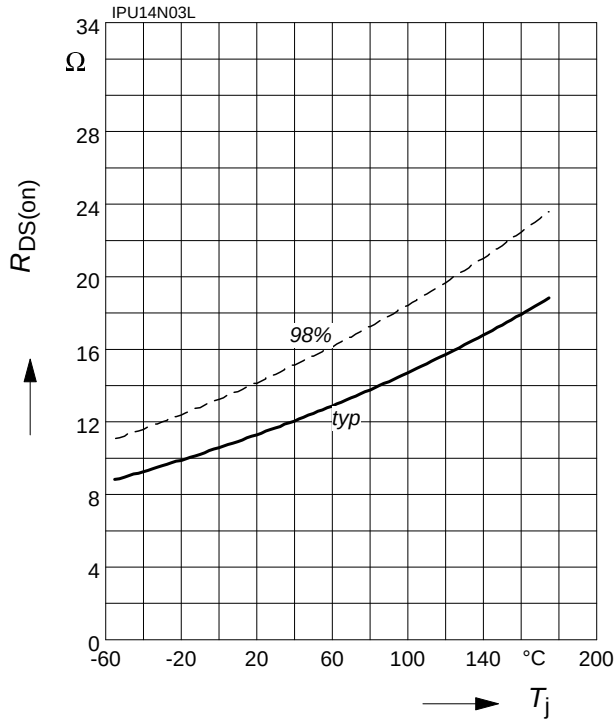
parameter: g_{fs}



9 Drain-source on-state resistance

$$R_{DS(on)} = f(T_j)$$

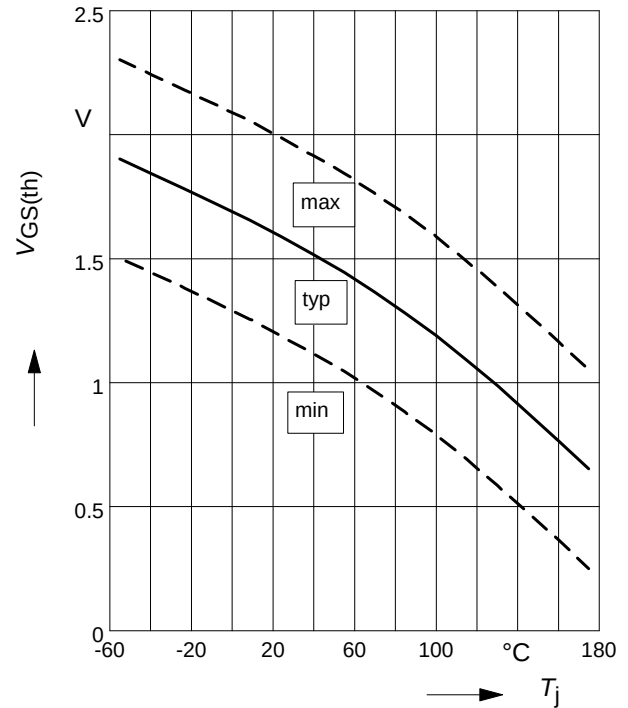
parameter: $I_D = 20\text{ A}$, $V_{GS} = 10\text{ V}$



10 Typ. gate threshold voltage

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

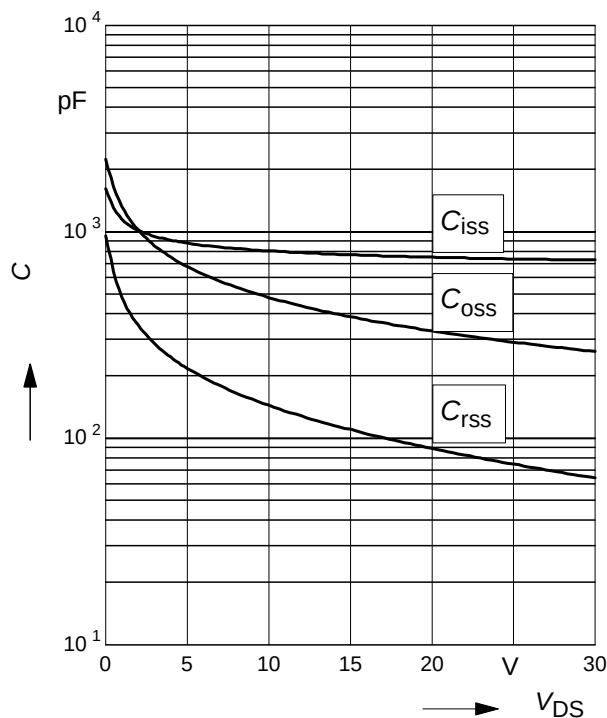
parameter: $V_{GS} = V_{DS}$



11 Typ. capacitances

$$C = f(V_{DS})$$

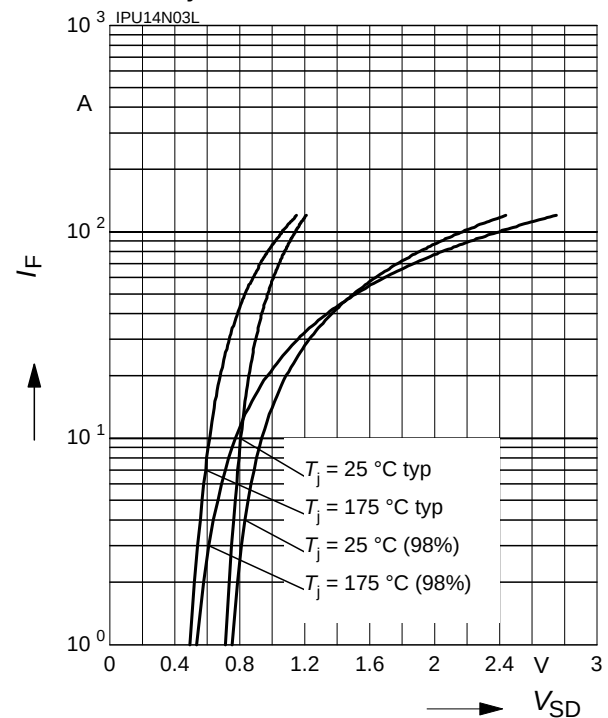
parameter: $V_{GS} = 0\text{ V}$, $f = 1\text{ MHz}$



12 Forward character. of reverse diode

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

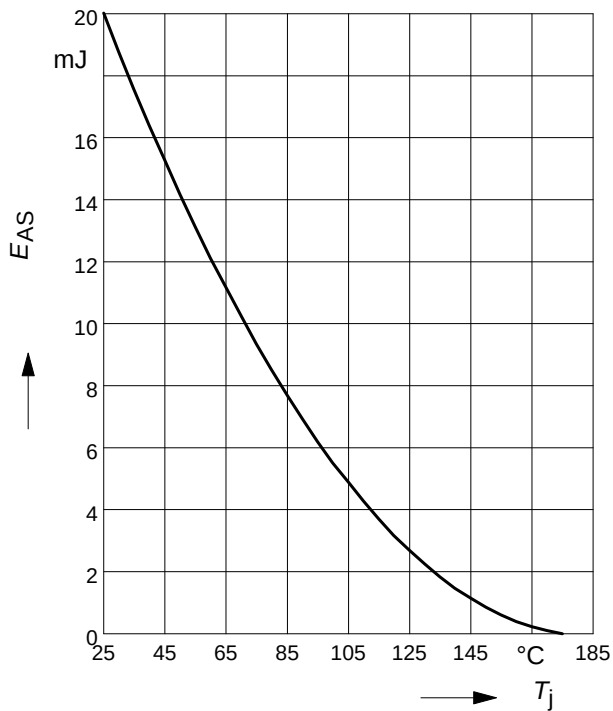
parameter: T_j , $t_p = 80\text{ }\mu\text{s}$



13 Typ. avalanche energy

$$E_{AS} = f(T_j)$$

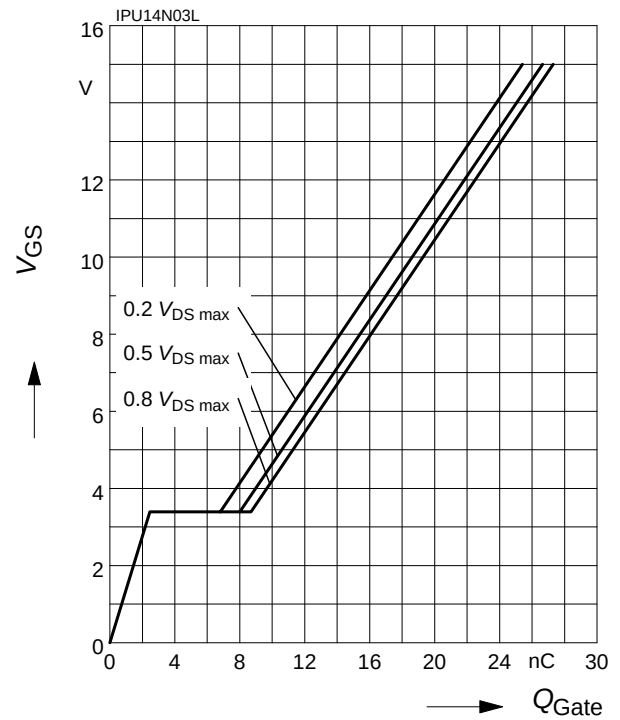
par.: $I_D = 20\text{ A}$, $V_{DD} = 25\text{ V}$, $R_{GS} = 25\ \Omega$



14 Typ. gate charge

$$V_{GS} = f(Q_{Gate})$$

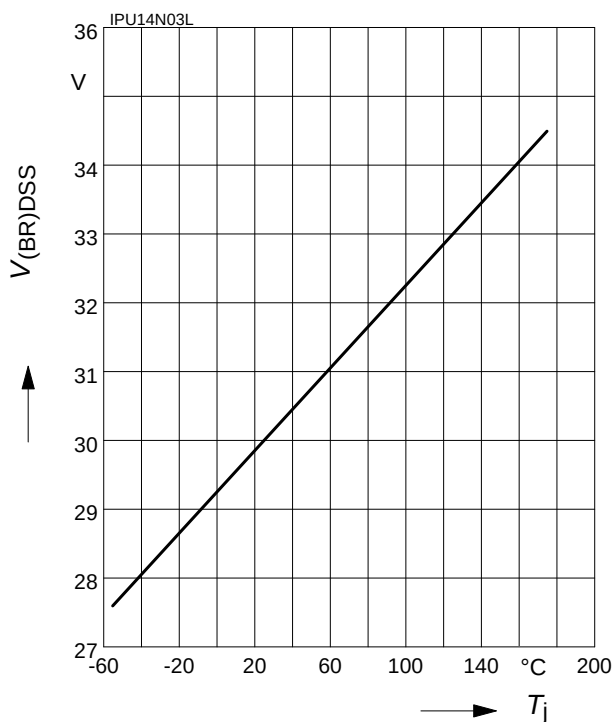
parameter: $I_D = 15\text{ A}$ pulsed



15 Drain-source breakdown voltage

$$V_{(BR)DSS} = f(T_j)$$

parameter: $I_D = 10\text{ mA}$



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