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MOSFET

OptiMOS™ Power Transistor, -60 V

D-PAK



Features

- P-Channel
- Very low on-resistance $R_{DS(on)}$
- 100% avalanche tested
- Normal Level
- Enhancement mode
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

Product validation

Fully qualified according to JEDEC for Industrial Applications

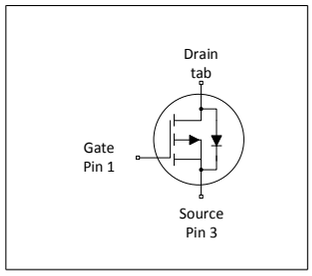


Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	-60	V
$R_{DS(on),max}$	400	mΩ
I_D	-4.3	A

Type / Ordering Code	Package	Marking	Related Links
IPD40DP06NM	PG-TO 252-3	40DP06NM	-

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1 Maximum ratings

at T_C=25 °C, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current	I_D	- -	- -	-4.3 -3.3	A	V_{GS}=-10 V, T_C=25 °C V_{GS}=-10 V, T_C=100 °C
Pulsed drain current[1]	$I_{D,pulse}$	-	-	-17.2	A	T_C=25 °C
Avalanche energy, single pulse[2]	E_{AS}	-	-	43	mJ	I_D=-4.3 A, R_{GS}=25 Ω
Gate source voltage	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	-	-	19	W	T_C=25 °C
Operating and storage temperature	T_j, T_{stg}	-55	-	175	°C	IEC climatic category; DIN IEC 68-1: 55/175/56

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case, bottom	R_{thJC}	-	-	7.9	°C/W	-
Device on PCB, 6 cm² cooling area[3]	R_{thJA}	-	-	75	°C/W	-

3 Electrical characteristics

at T_j=25 °C, unless otherwise specified

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	-60	-	-	V	V_{GS}=0 V, I_D=-250 µA
Gate threshold voltage	$V_{GS(th)}$	-2.1	-3	-4	V	V_{DS}=V_{GS}, I_D=-166 µA
Zero gate voltage drain current	I_{DSS}	- -	-0.1 -10	-1 -100	µA	V_{DS}=-60 V, V_{GS}=0 V, T_j=25 °C V_{DS}=-60 V, V_{GS}=0 V, T_j=125 °C
Gate-source leakage current	I_{GSS}	-	-10	-100	nA	V_{GS}=-20 V, V_{DS}=0 V
Drain-source on-state resistance	$R_{DS(on)}$	-	328	400	mΩ	V_{GS}=-10 V, I_D=-4.3 A
Gate resistance	R_G	-	4	-	Ω	-
Transconductance	g_{fs}	-	3.8	-	S	$\|V_{DS}\|\geq 2\|I_D\|R_{DS(on)max}$, I_D=-4.3 A

[1] See Diagram 3 for more detailed information
[2] See Diagram 13 for more detailed information
[3] 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.

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Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	260	-	pF	V_{GS}=0 V, V_{DS}=-30 V, f=1 MHz
Output capacitance	C_{oss}	-	40	-	pF	V_{GS}=0 V, V_{DS}=-30 V, f=1 MHz
Reverse transfer capacitance	C_{rss}	-	12	-	pF	V_{GS}=0 V, V_{DS}=-30 V, f=1 MHz
Turn-on delay time	$t_{d(on)}$	-	4	-	ns	V_{DD}=-30 V, V_{GS}=-10 V, I_D=-2.15 A, $R_{G,ext}$=1.6 Ω
Rise time	t_r	-	6	-	ns	V_{DD}=-30 V, V_{GS}=-10 V, I_D=-2.15 A, $R_{G,ext}$=1.6 Ω
Turn-off delay time	$t_{d(off)}$	-	10	-	ns	V_{DD}=-30 V, V_{GS}=-10 V, I_D=-2.15 A, $R_{G,ext}$=1.6 Ω
Fall time	t_f	-	4	-	ns	V_{DD}=-30 V, V_{GS}=-10 V, I_D=-2.15 A, $R_{G,ext}$=1.6 Ω

Table 6 Gate charge characteristics[1)]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	1.5	-	nC	V_{DD}=-30 V, I_D=-4.3 A, V_{GS}=0 to -10 V
Gate charge at threshold	$Q_{g(th)}$	-	0.8	-	nC	V_{DD}=-30 V, I_D=-4.3 A, V_{GS}=0 to -10 V
Gate to drain charge	Q_{gd}	-	2.7	-	nC	V_{DD}=-30 V, I_D=-4.3 A, V_{GS}=0 to -10 V
Switching charge	Q_{sw}	-	3.4	-	nC	V_{DD}=-30 V, I_D=-4.3 A, V_{GS}=0 to -10 V
Gate charge total	Q_g	-	6.7	-	nC	V_{DD}=-30 V, I_D=-4.3 A, V_{GS}=0 to -10 V
Gate plateau voltage	$V_{plateau}$	-	5.7	-	V	V_{DD}=-30 V, I_D=-4.3 A, V_{GS}=0 to -10 V
Output charge	Q_{oss}	-	-2.9	-	nC	V_{DD}=-30 V, V_{GS}=0 V

Table 7 Reverse diode

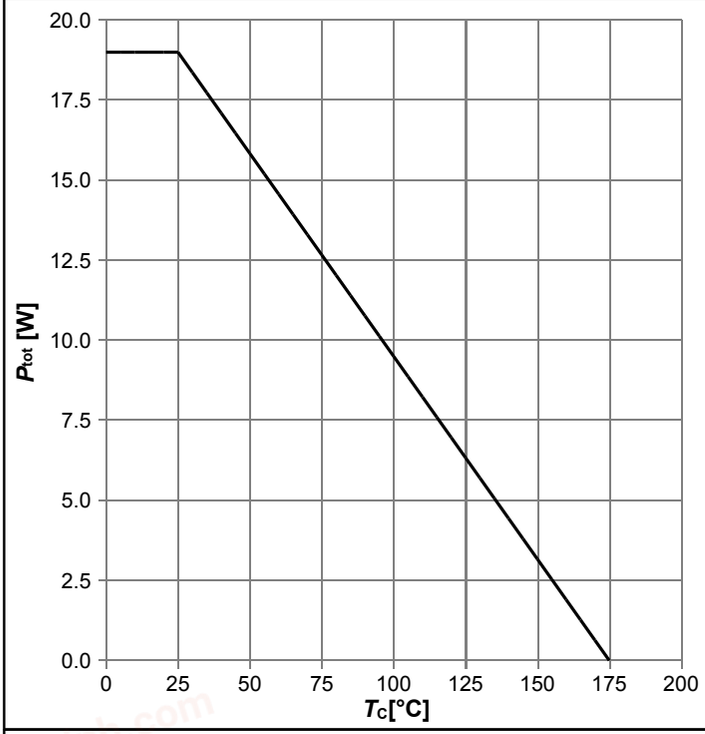
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current	I_S	-	-	-4.3	A	T_C=25 °C
Diode pulse current	$I_{S,pulse}$	-	-	-17.2	A	T_C=25 °C
Diode forward voltage	V_{SD}	-	-0.9	-1.2	V	V_{GS}=0 V, I_F=-4.3 A, T_j=25 °C
Reverse recovery time	t_{rr}	-	36	-	ns	V_R=-30 V, I_F=-4.3 A, di_F/dt=-100 A/µs
Reverse recovery charge	Q_{rr}	-	-60	-	nC	V_R=-30 V, I_F=-4.3 A, di_F/dt=-100 A/µs

[1)] See diagram ,Gate charge waveforms, for gate charge parameter definition

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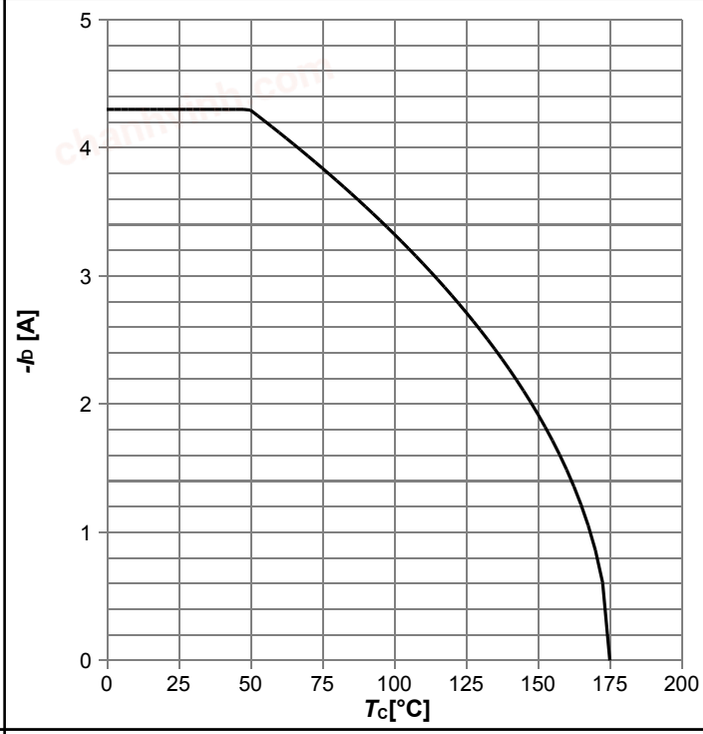
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



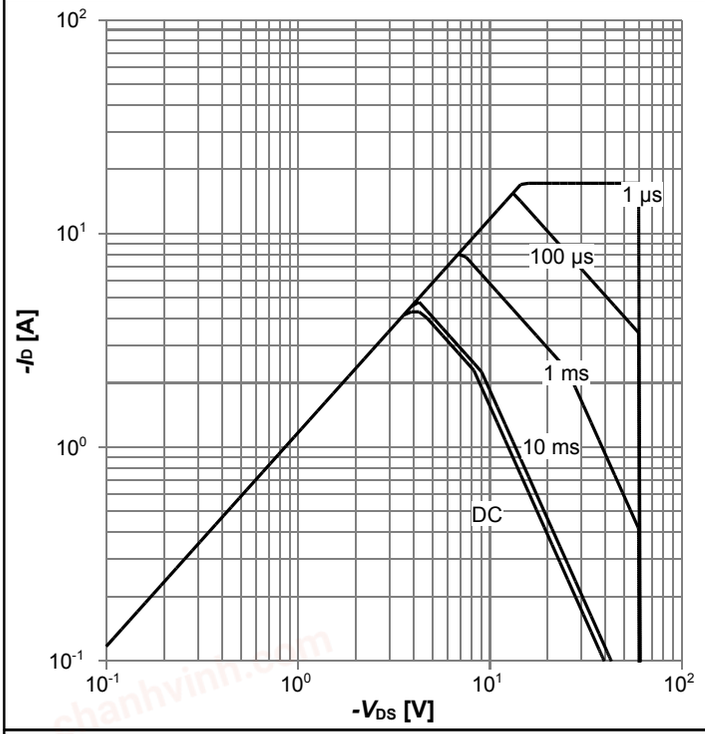
$P_{tot}=f(T_C)$

Diagram 2: Drain current



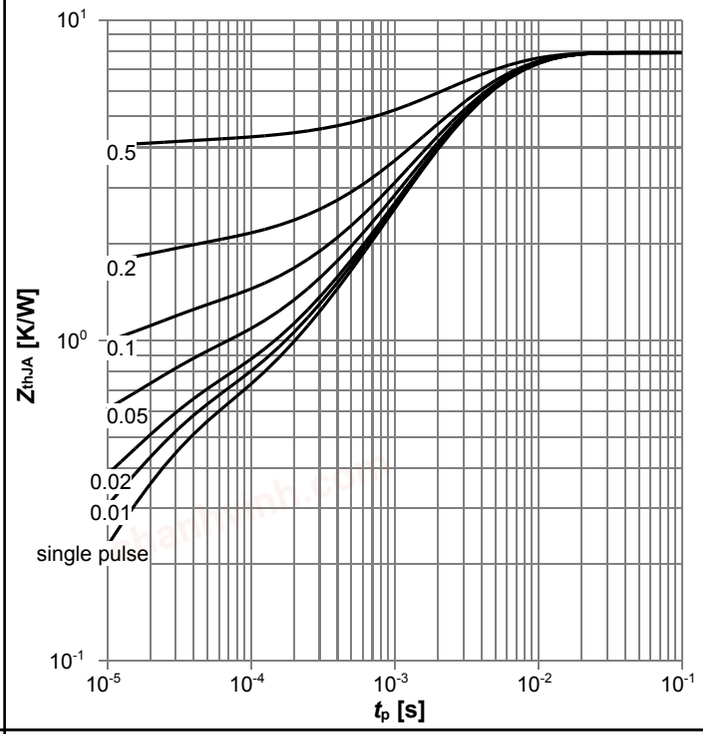
$I_D=f(T_C)$; $|V_{GS}|\geq 10$ V

Diagram 3: Safe operating area



$I_D=f(V_{DS})$; T_C=25 °C; D=0; parameter: t_p

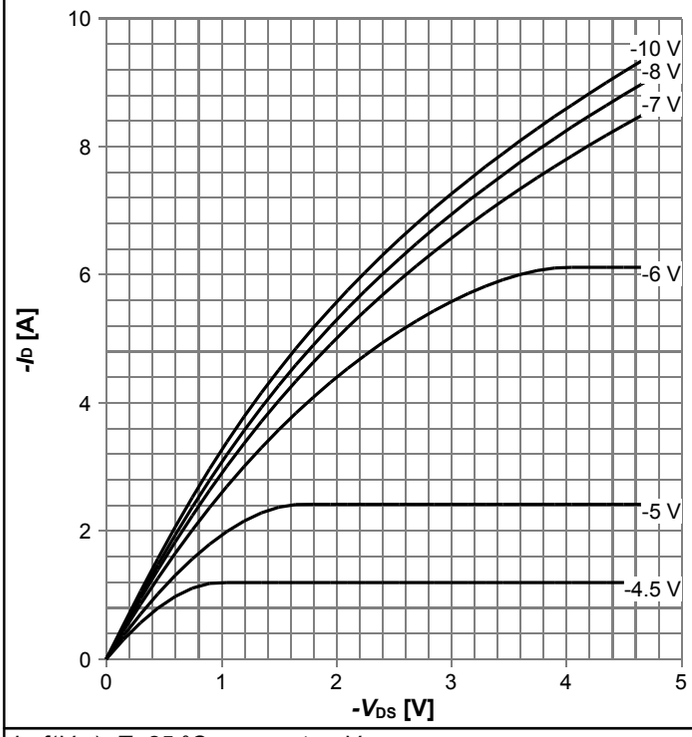
Diagram 4: Max. transient thermal impedance



$Z_{thJC}=f(t_p)$; parameter: $D=t_p/T$

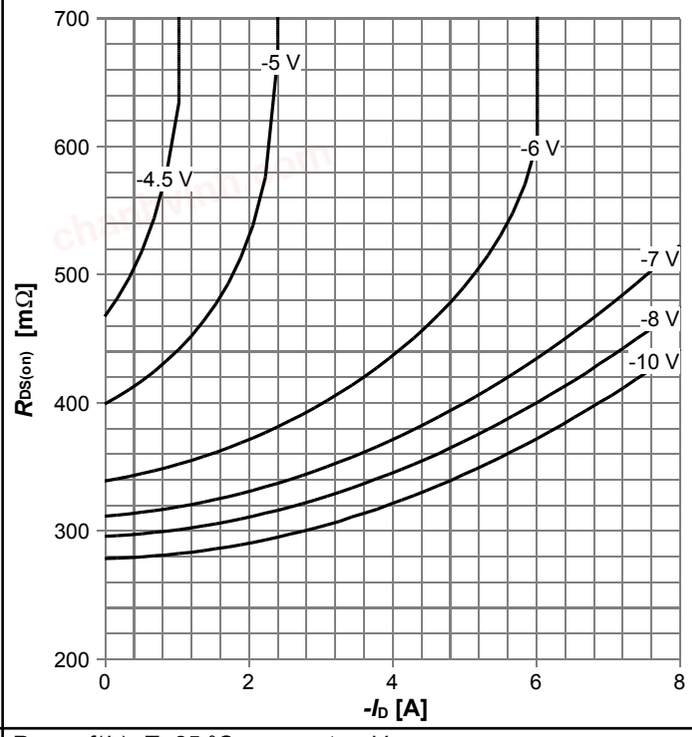
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Diagram 5: Typ. output characteristics



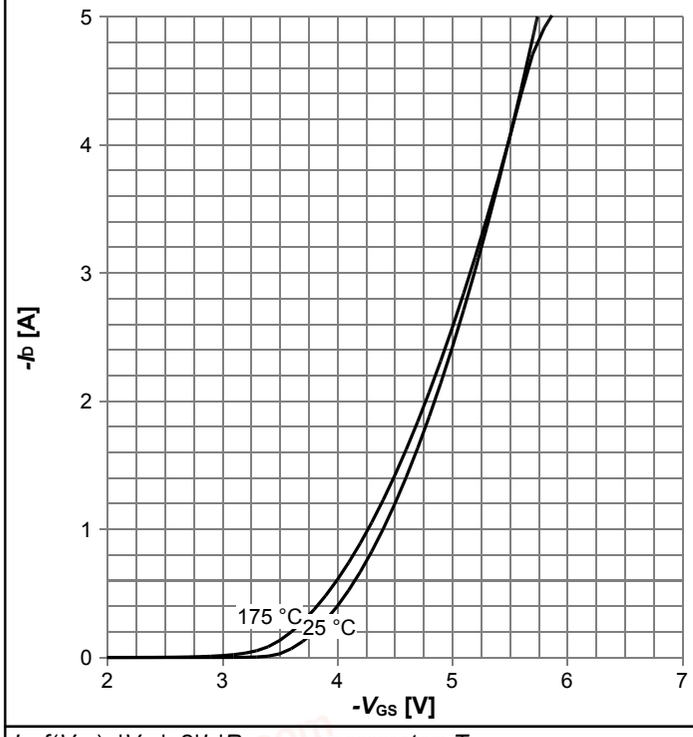
I_D=f(V_{DS}), T_j=25 °C; parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



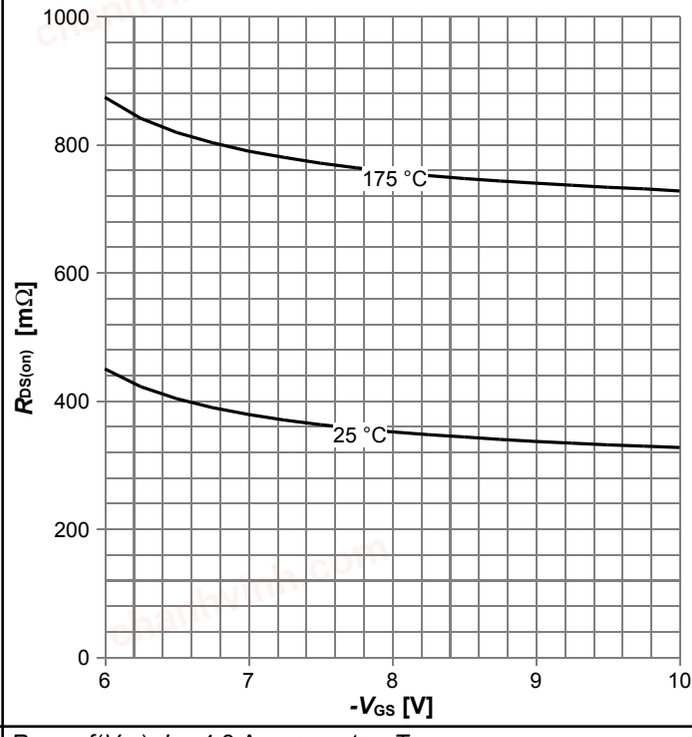
$R_{DS(on)}$=f(I_D), T_j=25 °C; parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



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

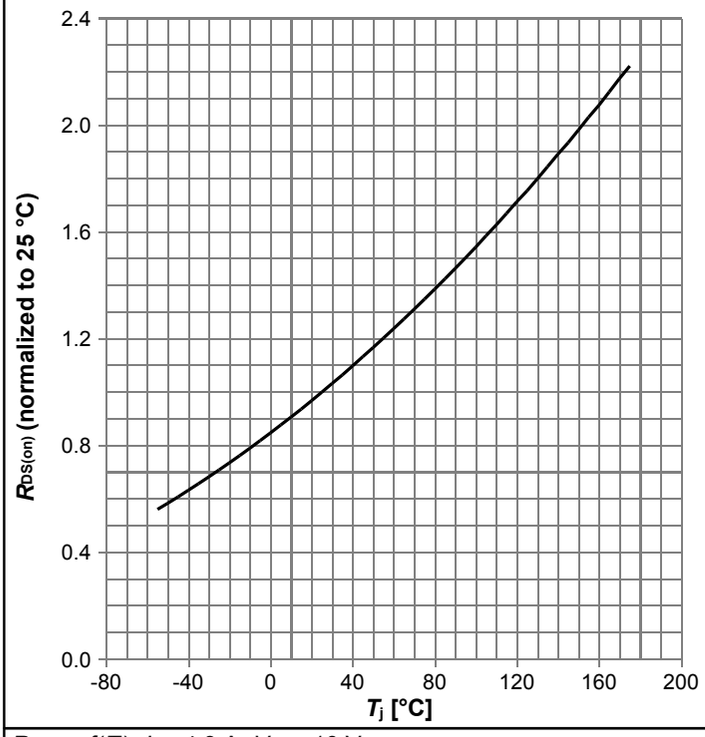
Diagram 8: Typ. drain-source on resistance



$R_{DS(on)}$=f(V_{GS}), I_D=-4.3 A; parameter: T_j

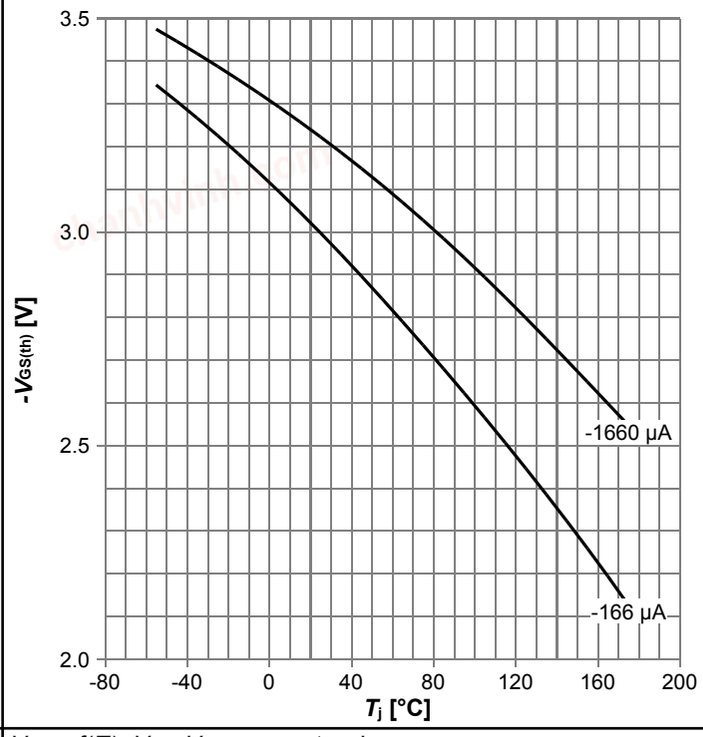
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Diagram 9: Normalized drain-source on resistance



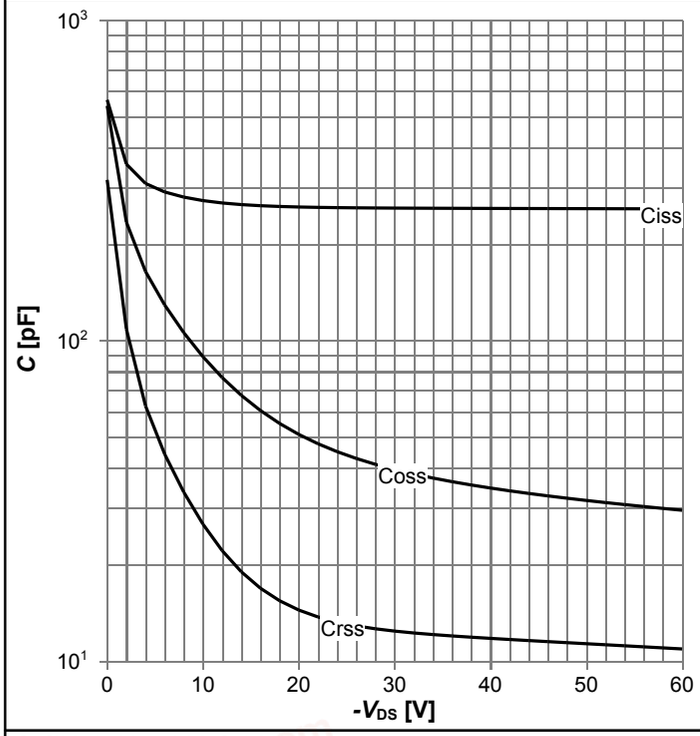
$R_{DS(on)}$=f(T_j), I_D=-4.3 A, V_{GS}=-10 V

Diagram 10: Typ. gate threshold voltage



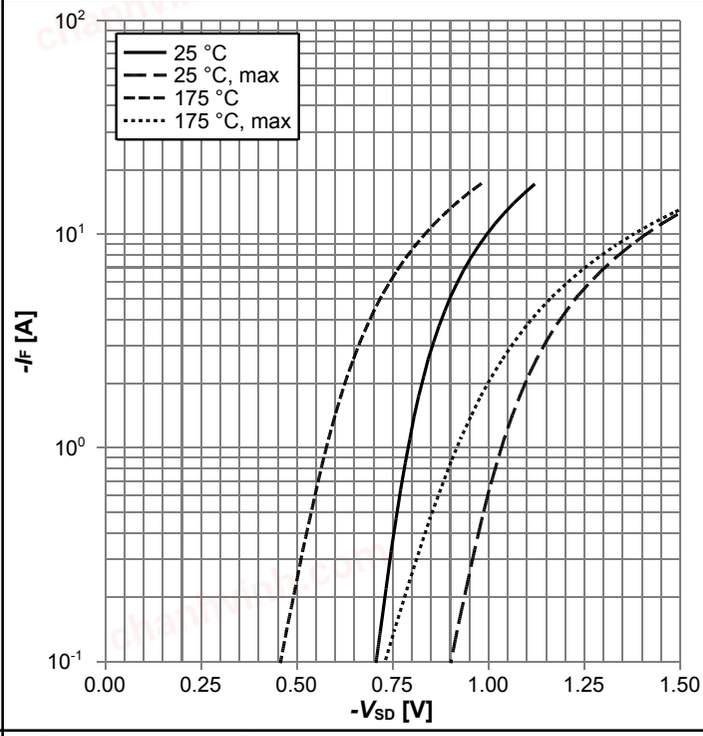
$V_{GS(th)}$=f(T_j), V_{GS}=V_{DS}; parameter: I_D

Diagram 11: Typ. capacitances



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

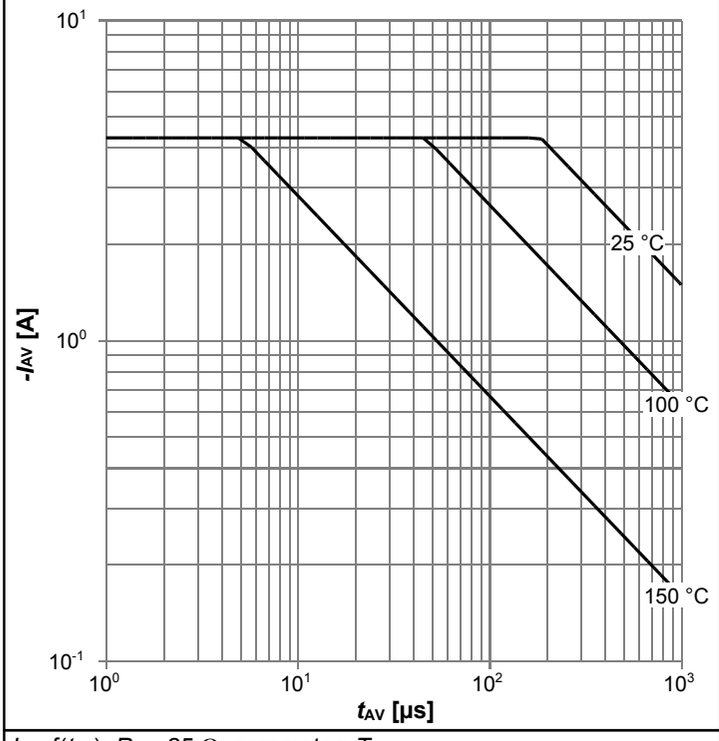
Diagram 12: Forward characteristics of reverse diode



I_F=f(V_{SD}); parameter: T_j

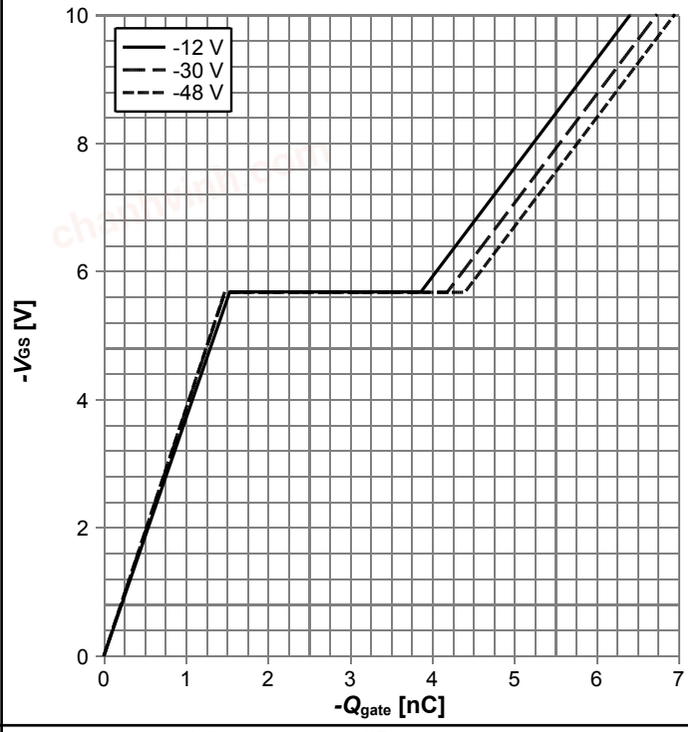
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Diagram 13: Avalanche characteristics



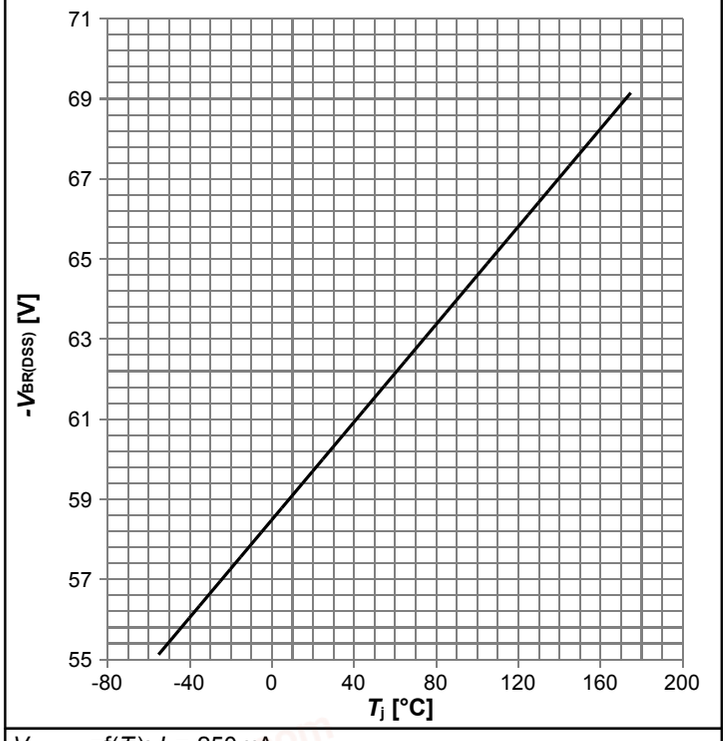
I_{AS}=f(t_{AV}); R_{GS}=25 Ω; parameter: $T_{j,start}$

Diagram 14: Typ. gate charge



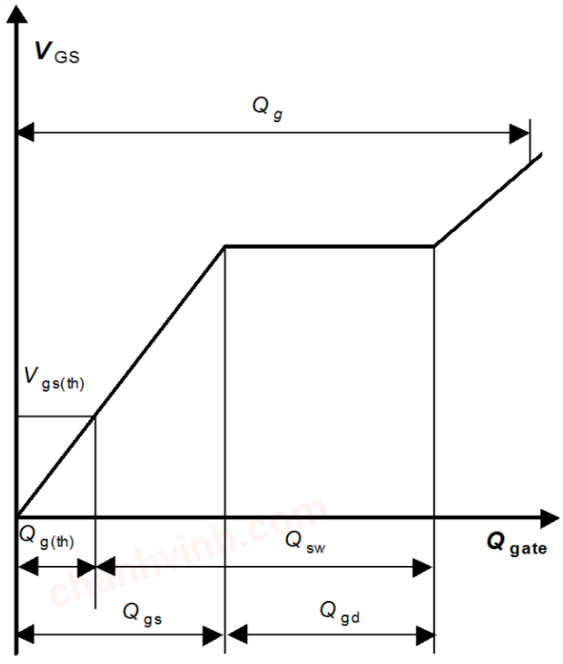
V_{GS}=f(Q_{gate}), I_D=-4.3 A pulsed, T_j=25 °C; parameter: V_{DD}

Diagram 15: Drain-source breakdown voltage



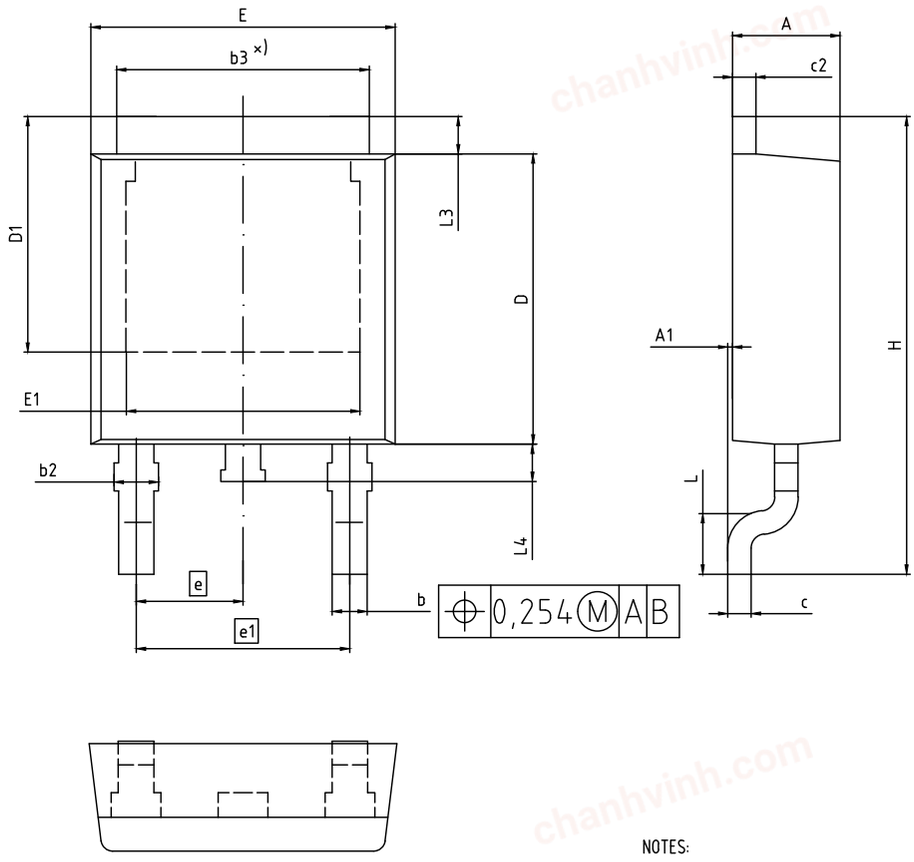
$V_{BR(DSS)}$=f(T_j); I_D=-250 µA

Diagram Gate charge waveforms



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5 Package Outlines



NOTES:

1. INDUSTRIAL QUALITY GRADE
2. ALL DIMENSIONS REFER TO JEDEC STANDARD TO-252 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.

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	4,95	5.50	0.195	0.217
c	0.46	0.61	0.018	0.024
c2	0.40	0.98	0.016	0.039
D	5.97	6.22	0.235	0.245
D1	5.02	5.84	0.198	0.230
E	6.35	6.73	0.250	0.265
E1	4.32	5.21	0.185	0.205
e	2.29 (BSC)		0.090 (BSC)	
e1	4.57 (BSC)		0.180 (BSC)	
N	3		3	
H	9.40	10.48	0.370	0.413
L	1.18	1.78	0.046	0.070
L3	0.89	1.27	0.035	0.050
L4	0.51	1.02	0.020	0.040

DOCUMENT NO.	Z8B00003328
SCALE	0 2.5 0 2.5 5mm
EUROPEAN PROJECTION	
ISSUE DATE	05-02-2016
REVISION	06

Figure 1 Outline PG-TO 252-3, dimensions in mm/inches

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Revision History

IPD40DP06NM

Revision: 2019-03-26, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2019-03-26	Release of final version

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