R5011FNJ

Nch 500V 11A Power MOSFET

Datasheet

V_{DSS}	500V
$R_{DS(on)}$(Max.)	0.52Ω
I_D	±11A
P_D	50W

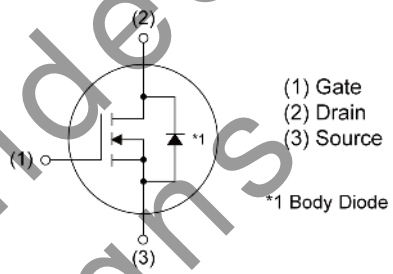
●Outline

LPT(S)

SC-83

TO-263

●Inner circuit



●Features

1) Fast reverse recovery time (trr).
2) Low on-resistance.
3) Fast switching speed.
4) Gate-source voltage (V_{GSS}) guaranteed to be ±30V.
5) Drive circuits can be simple.
6) Pb-free lead plating ; RoHS compliant

●Application

Switching Power Supply

●Packaging specifications

Type	Packing	Embossed Tape
	Reel size (mm)	330
	Tape width (mm)	24
	Basic ordering unit (pcs)	1000
	Taping code	TL
	Marking	R5011FNJ

●Absolute maximum ratings (T_a = 25°C)

Parameter		Symbol	Value	Unit
Drain - Source voltage		V_{DSS}	500	V
Continuous drain current	T_C = 25°C	I_D *1	±11	A
	T_C = 100°C	I_D *1	±5.2	A
Pulsed drain current		$I_{D,pulse}$ *2	±44	A
Gate - Source voltage		V_{GSS}	±30	V
Avalanche energy, single pulse		E_{AS} *3	8.1	mJ
Avalanche energy, repetitive		E_{AR} *4	3.5	mJ
Avalanche current		I_{AR} *3	5.5	A
Power dissipation (T_c = 25°C)		P_D	50	W
Junction temperature		T_j	150	℃
Range of storage temperature		T_{stg}	-55 to +150	℃
Reverse diode dv/dt		dv/dt	15	V/ns

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●Absolute maximum ratings

Parameter	Symbol	Conditions	Values	Unit
Drain - Source voltage slope	dv/dt	V_{DS} = 400V, I_D = 11A T_j = 125℃	50	V/ns

●Thermal resistance

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - case	R_{thJC}	-	-	2.5	℃/W
Thermal resistance, junction - ambient	R_{thJA}	-	-	80	℃/W
Soldering temperature, wavesoldering for 10s	T_{sold}	-	-	265	℃

●Electrical characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Drain - Source breakdown voltage	$V_{(BR)DSS}$	V_{GS} = 0V, I_D = 1mA	500	-	-	V
Drain - Source avalanche breakdown voltage	$V_{(BR)DS}$	V_{GS} = 0V, I_D = 5.5A	-	580	-	V
Zero gate voltage drain current	I_{DSS}	V_{DS} = 500V, V_{GS} = 0V T_j = 25°C T_j = 125°C	- -	1 -	100 1000	μA
Gate - Source leakage current	I_{GSS}	V_{GS} = ±30V, V_{DS} = 0V	-	-	±100	nA
Gate threshold voltage	$V_{GS(th)}$	V_{DS} = 10V, I_D = 1mA	2	-	4	V
Static drain - source on - state resistance	$R_{DS(on)}$ *6	V_{GS} = 10V, I_D = 5.5A T_j = 25°C T_j = 125°C	- -	0.4 0.85	0.52 -	Ω
Gate input resistance	R_G	f = 1MHz, open drain	-	8.8	-	Ω

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●Electrical characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Transconductance	g_{fs} *6	V_{DS} = 10V, I_D = 5.5A	4.5	8.0	-	S
Input capacitance	C_{iss}	V_{GS} = 0V	-	950	-	pF
Output capacitance	C_{oss}	V_{DS} = 25V	-	580	-	
Reverse transfer capacitance	C_{rss}	f = 1MHz	-	30	-	
Effective output capacitance, energy related	$C_{o(er)}$	V_{GS} = 0V, V_{DS} = 0V to 400V	-	40.7	-	pF
Effective output capacitance, time related	$C_{o(tr)}$		-	126	-	
Turn - on delay time	$t_{d(on)}$ *6	V_{DD} ≃ 250V, V_{GS} = 10V	-	26	-	ns
Rise time	t_r *6	I_D = 5.5A	-	28	-	
Turn - off delay time	$t_{d(off)}$ *6	R_L ≃ 45.3Ω	-	75	150	
Fall time	t_f *6	R_G = 10Ω	-	30	60	

●Gate charge characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_g *6	V_{DD} ≃ 250V	-	30	-	nC
Gate - Source charge	Q_{gs} *6	I_D = 11A	-	7	-	
Gate - Drain charge	Q_{gd} *6	V_{GS} = 10V	-	12	-	
Gate plateau voltage	$V_{(plateau)}$	V_{DD} ≃ 250V, I_D = 11A	-	5.9	-	V

*1 Limited only by maximum temperature allowed.

*2 Pw ≤ 10μs, Duty cycle ≤ 1%

*3 L ≃ 500μH, V_{DD} = 50V, R_G = 25Ω, starting T_j = 25°C

*4 L ≃ 500μH, V_{DD} = 50V, R_G = 25Ω, starting T_j = 25°C, f = 10kHz

*5 Reference measurement circuits Fig.5-1.

*6 Pulsed

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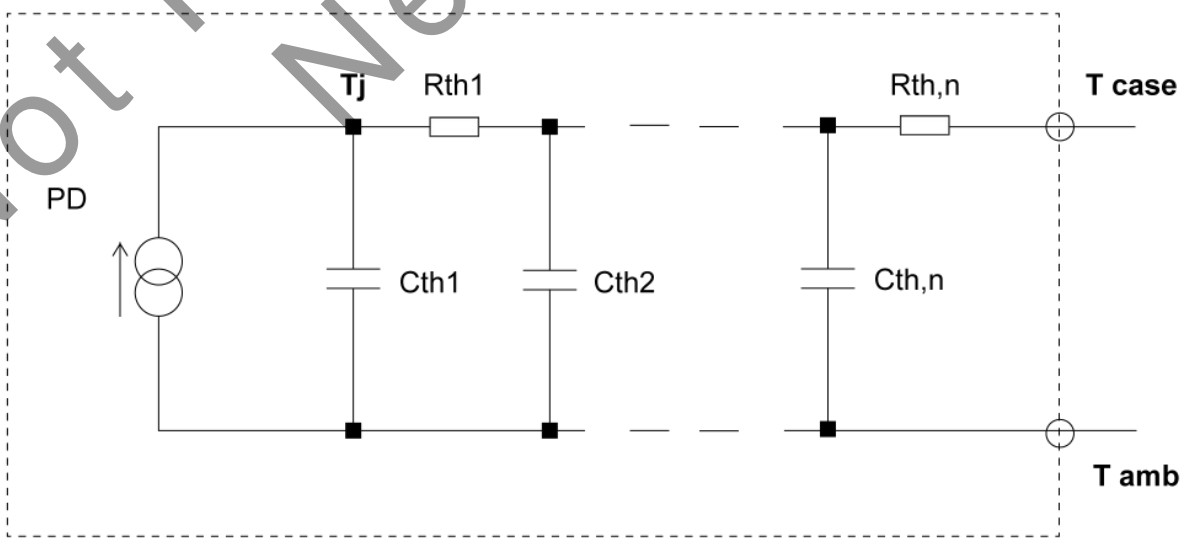
●Body diode electrical characteristics (Source-Drain) (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Inverse diode continuous, forward current	I_S *1	T_C = 25℃	-	-	11	A
Inverse diode direct current, pulsed	I_{SM} *2		-	-	44	A
Forward voltage	V_{SD} *6	V_{GS} = 0V, I_S = 11A	-	-	1.5	V
Reverse recovery time	t_{rr} *6	I_S = 11A di/dt = 100A/μs	-	85	-	ns
Reverse recovery charge	Q_{rr} *6		-	0.26	-	μC
Peak reverse recovery current	I_{rrm} *6		-	6.3	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt	T_j = 25℃	-	710	-	A/μs

●Typical transient thermal characteristics

Symbol	Value	Unit	Symbol	Value	Unit
R_{th1}	0.0868	K/W	C_{th1}	0.00172	Ws/K
R_{th2}	0.34		C_{th2}	0.00589	
R_{th3}	0.613		C_{th3}	0.18	



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●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

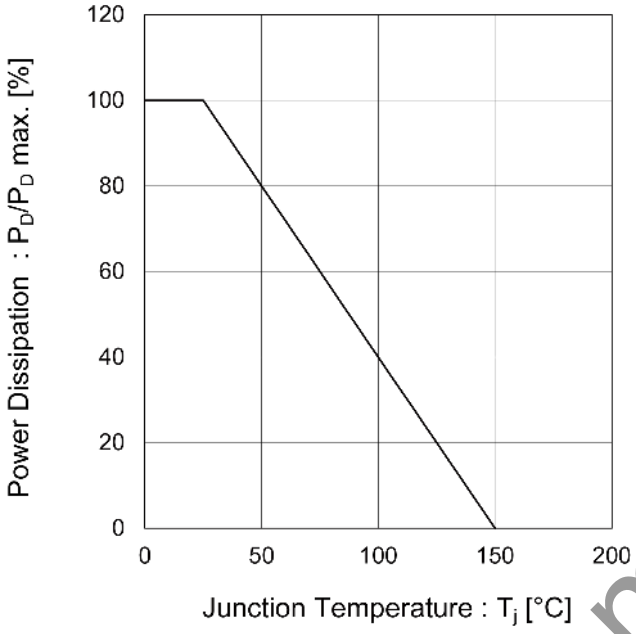


Fig.2 Maximum Safe Operating Area

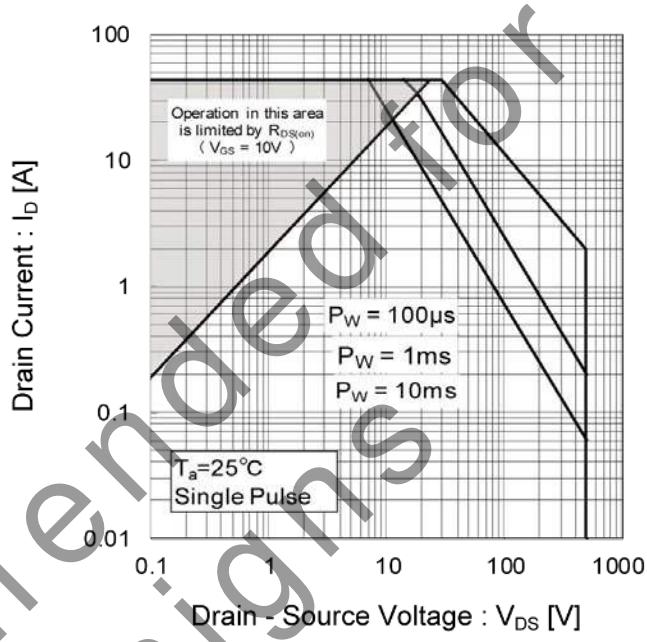
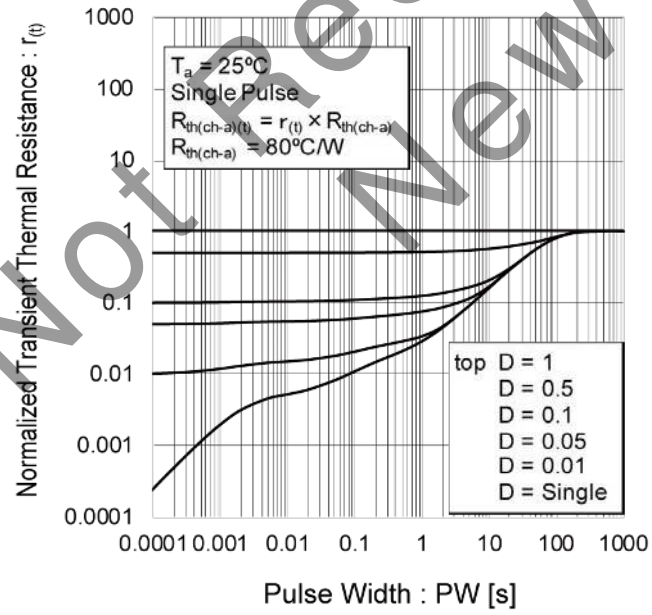


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width



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●Electrical characteristic curves

Fig.4 Avalanche Current vs. Inductive Load

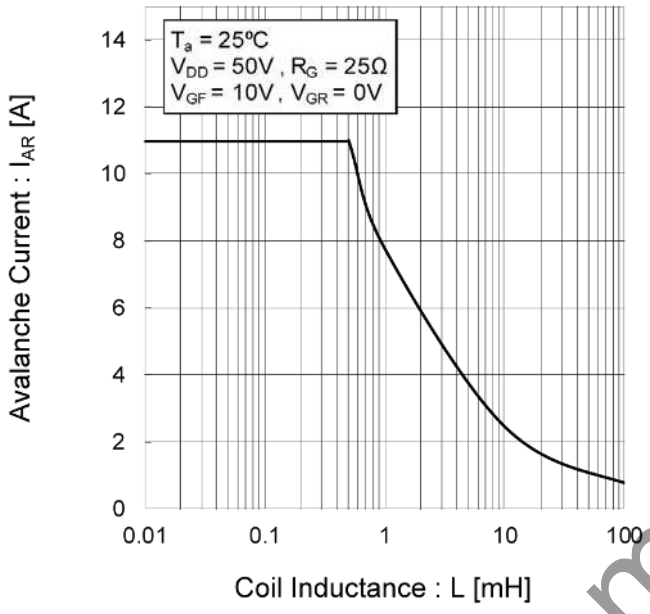


Fig.5 Avalanche Power Losses

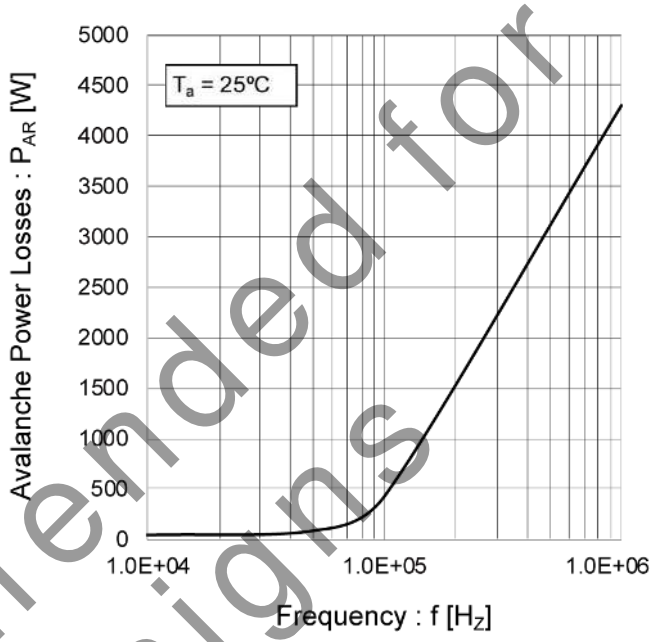
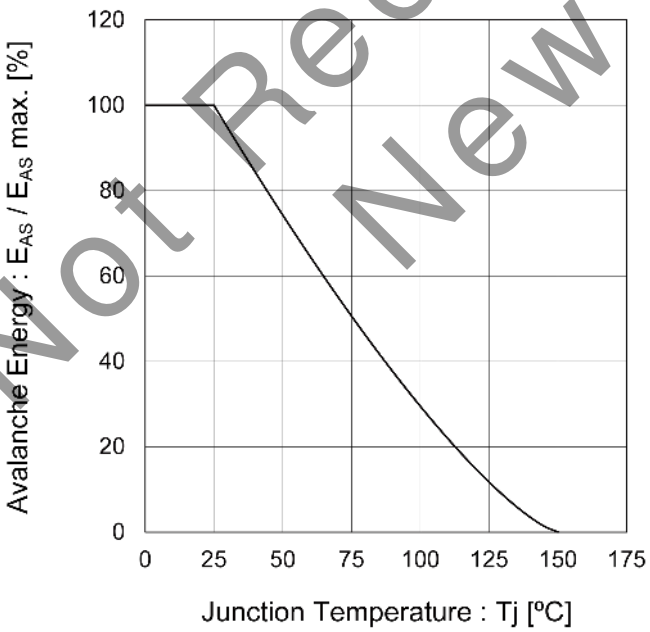


Fig.6 Avalanche Energy Derating Curve vs. Junction Temperature



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●Electrical characteristic curves

Fig.7 Typical Output Characteristics(I)

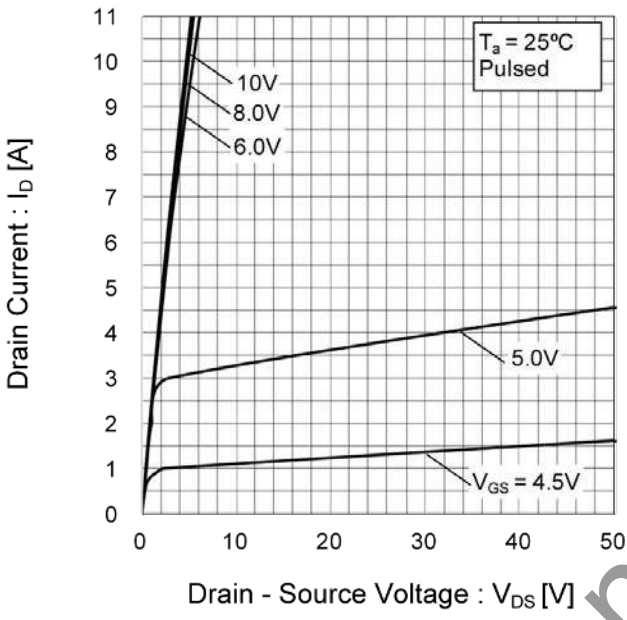


Fig.8 Typical Output Characteristics(II)

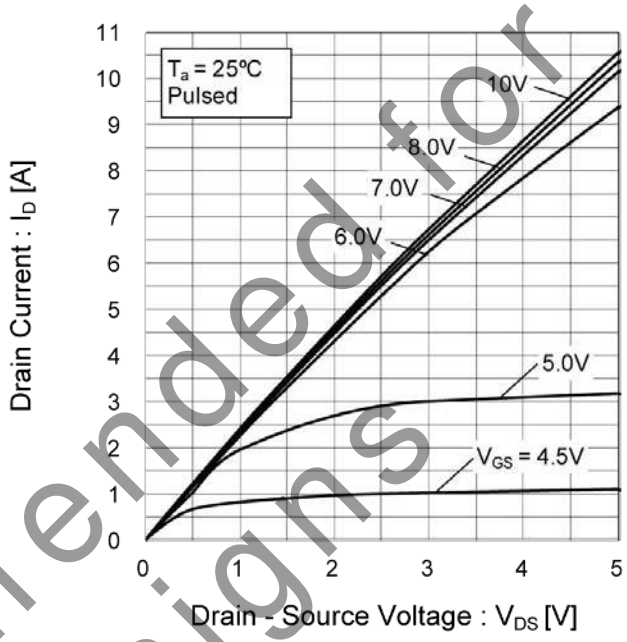


Fig.9 Tj = 150°C Typical Output Characteristics (I)

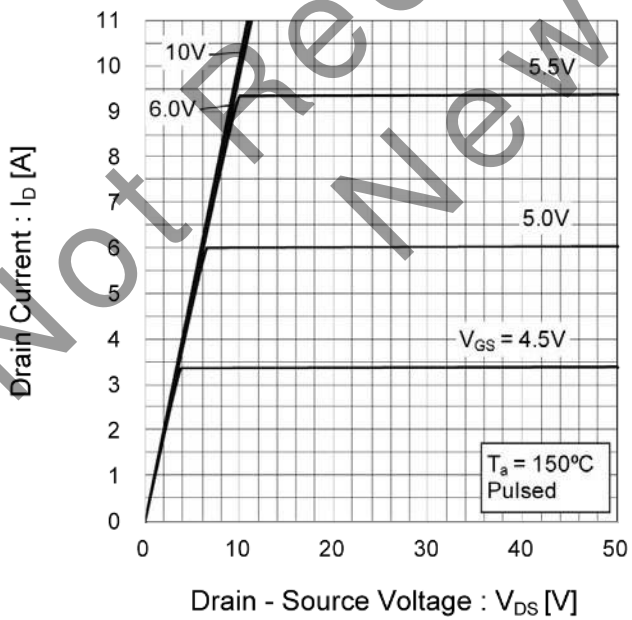
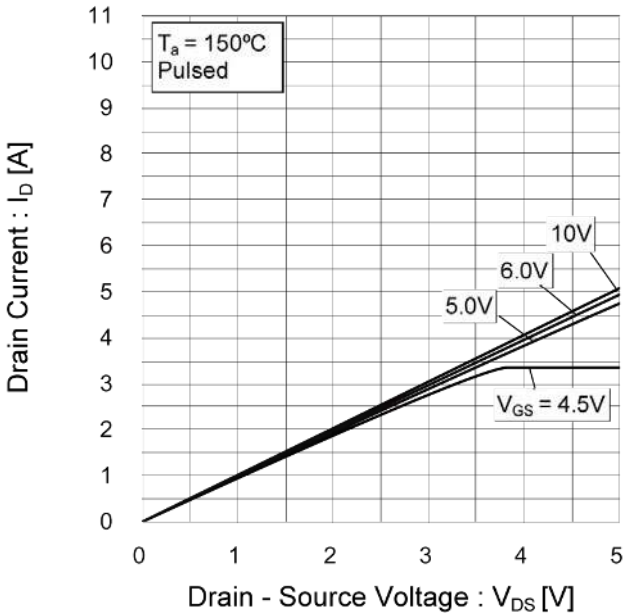


Fig.10 Tj = 150°C Typical Output Characteristics (II)



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●Electrical characteristic curves

Fig.11 Breakdown Voltage vs. Junction Temperature

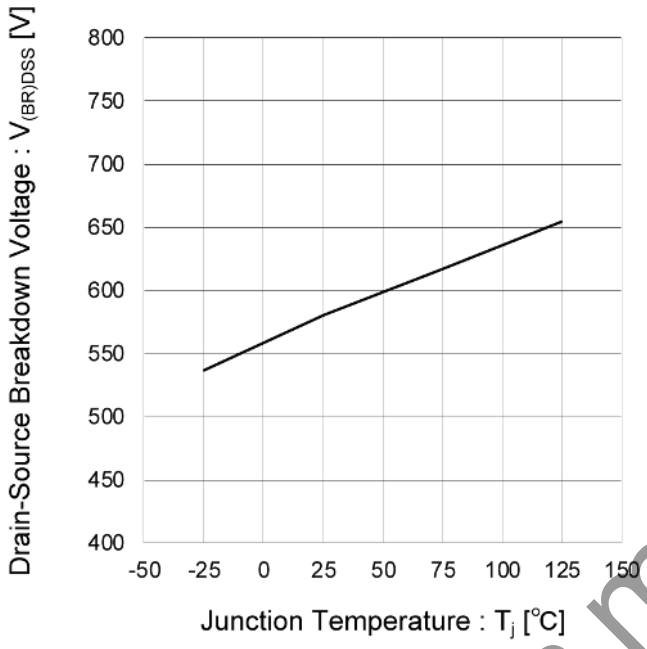


Fig.12 Typical Transfer Characteristics

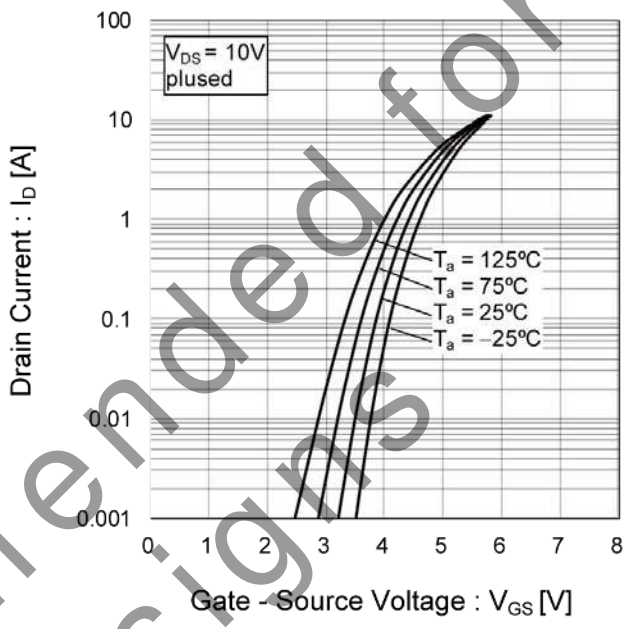


Fig.13 Gate Threshold Voltage vs. Junction Temperature

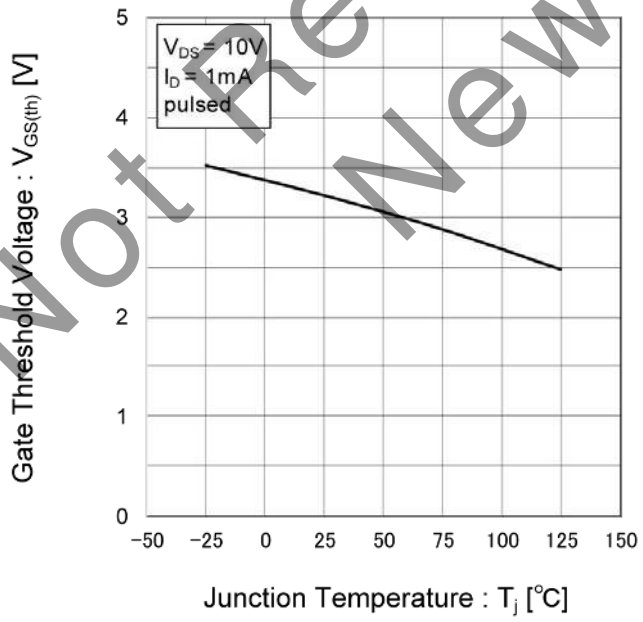
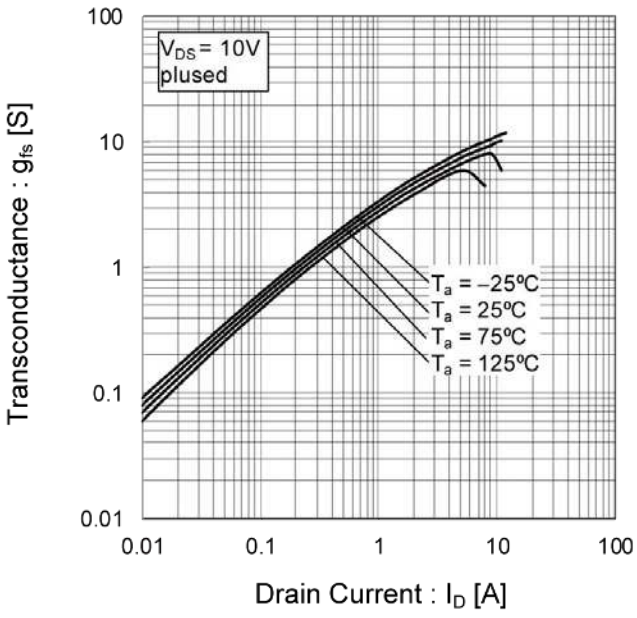


Fig.14 Transconductance vs. Drain Current



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●Electrical characteristic curves

Fig.15 Static Drain - Source On - State Resistance vs. Gate Source Voltage

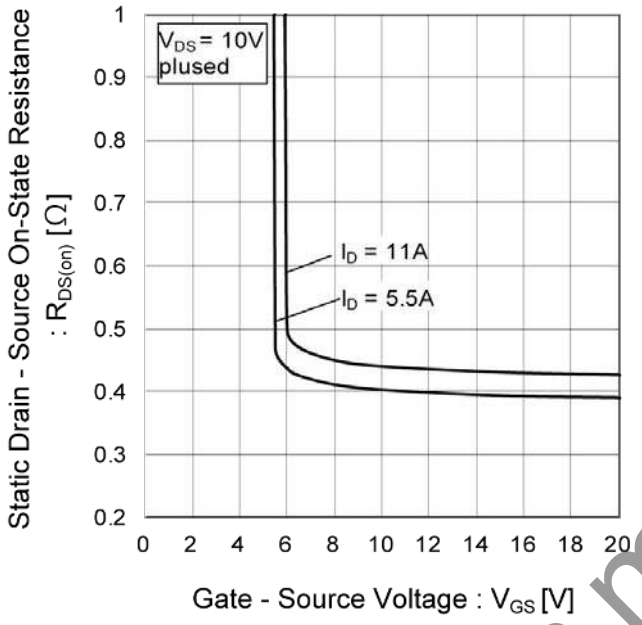


Fig.16 Static Drain - Source On - State Resistance vs. Junction Temperature

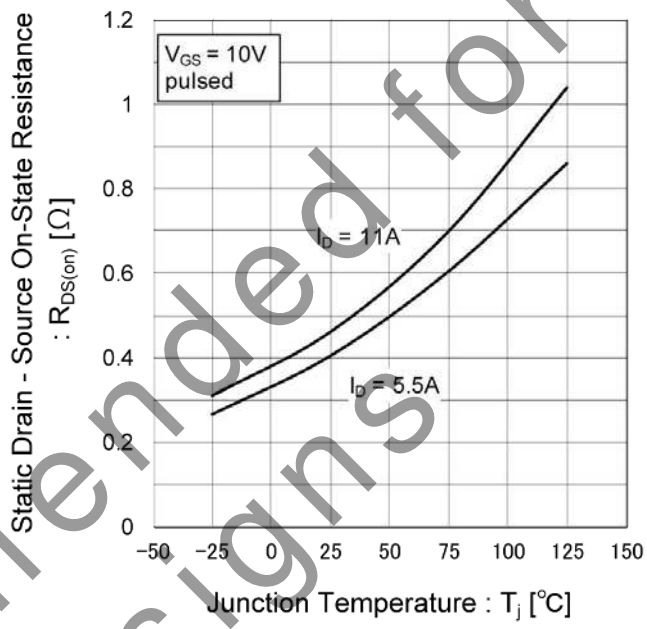
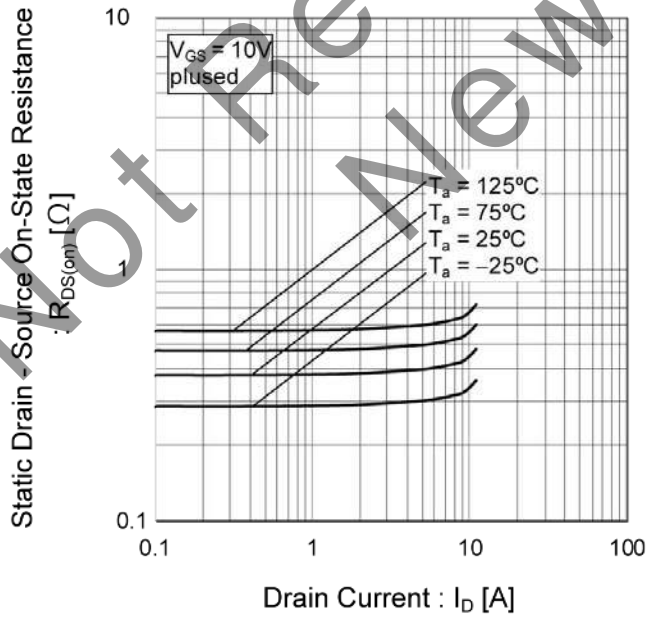


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current



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●Electrical characteristic curves

Fig.18 Typical Capacitance vs. Drain - Source Voltage

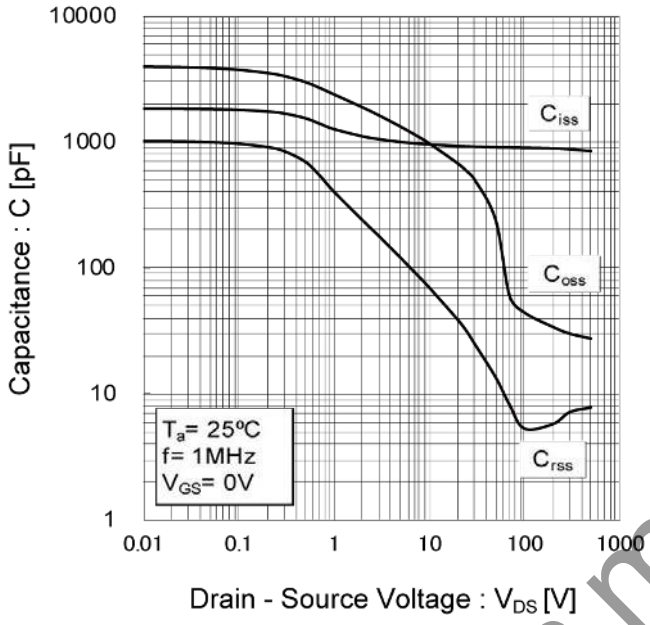


Fig.19 Coss Stored Energy

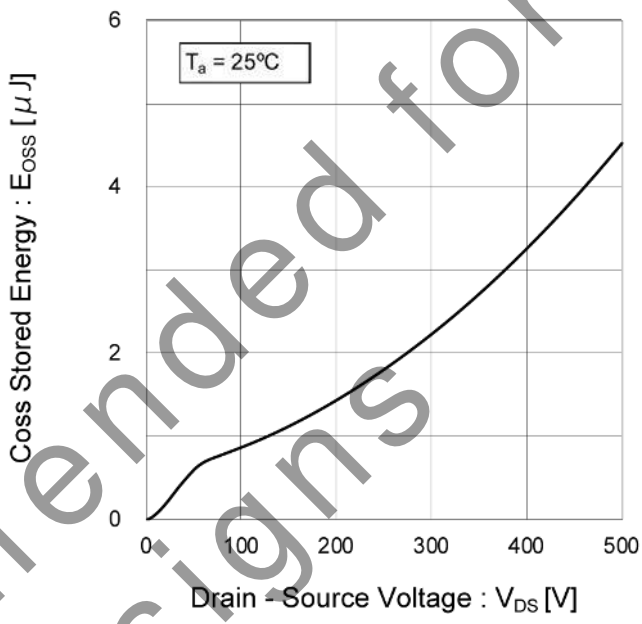


Fig.20 Switching Characteristics

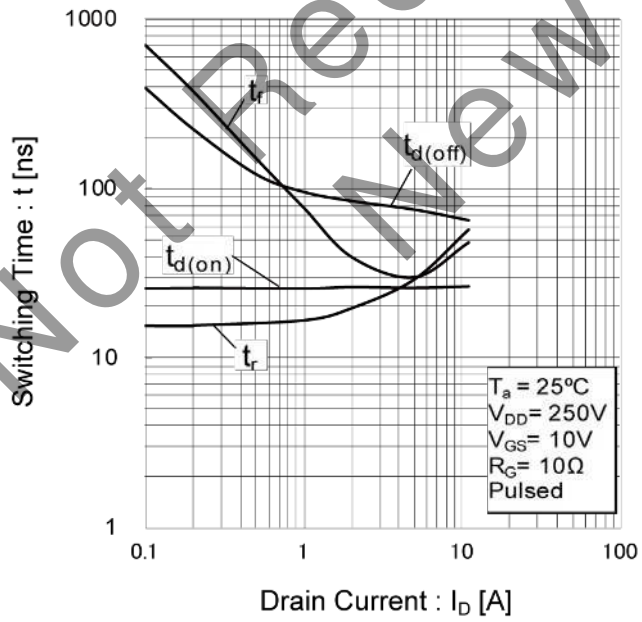
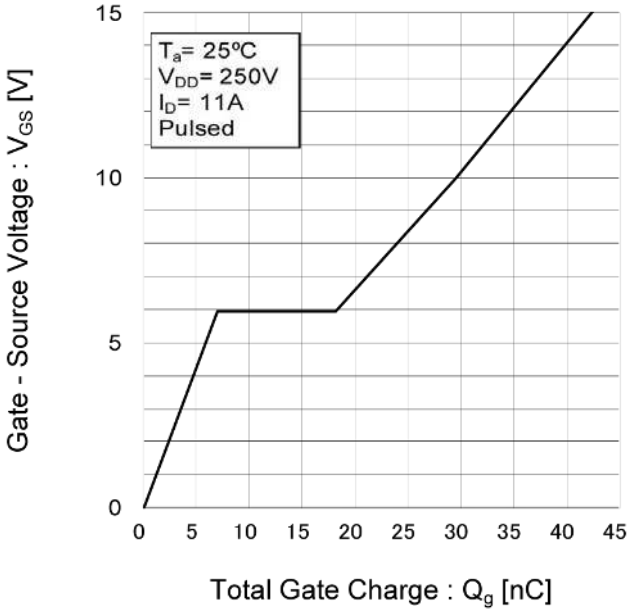


Fig.21 Dynamic Input Characteristics



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●Electrical characteristic curves

Fig.22 Inverse Diode Forward Current vs. Source - Drain Voltage

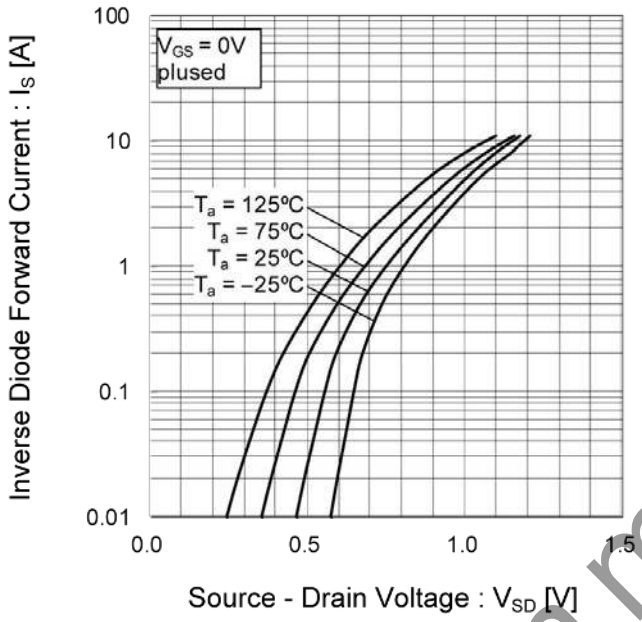
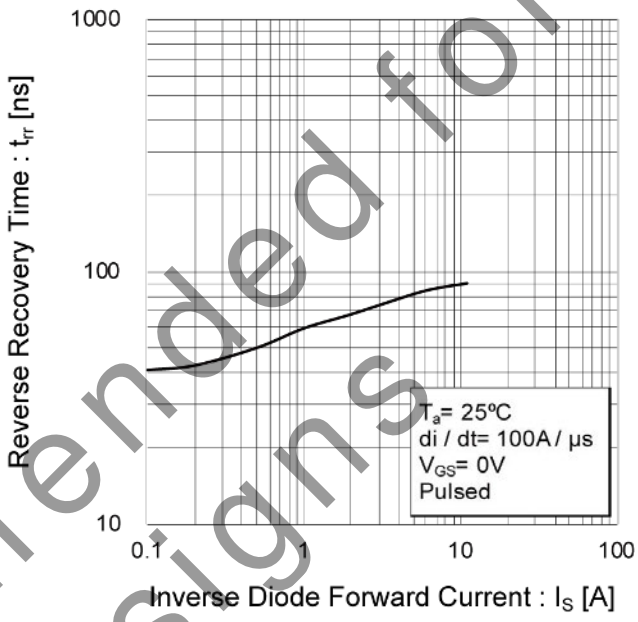


Fig.23 Reverse Recovery Time vs. Inverse Diode Forward Current



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●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

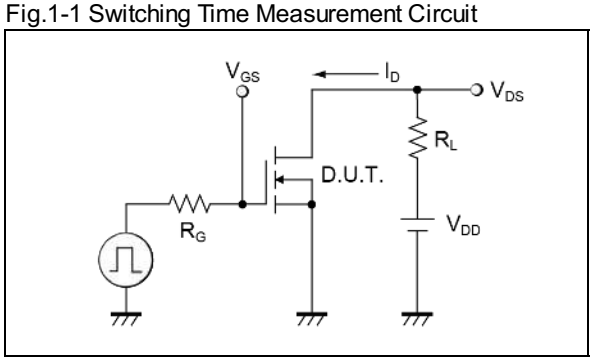


Fig.1-2 Switching Waveforms

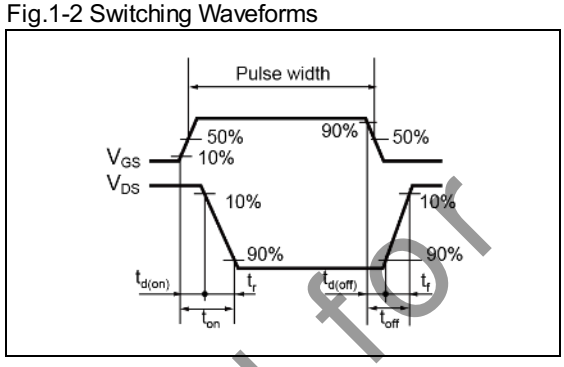


Fig.2-1 Gate Charge Measurement Circuit

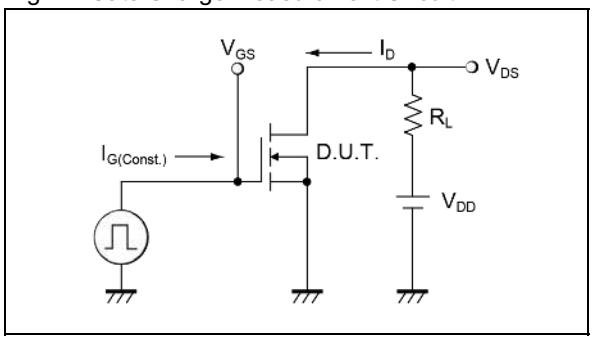


Fig.2-2 Gate Charge Waveform

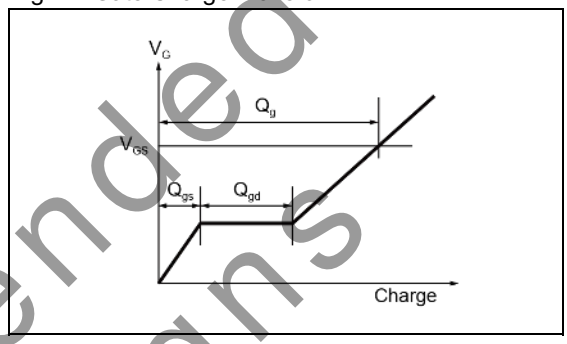


Fig.3-1 Avalanche Measurement Circuit

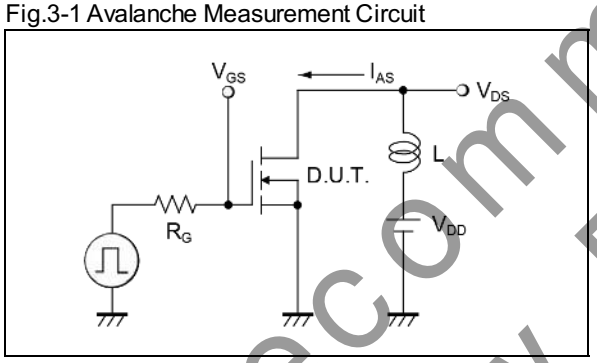


Fig.3-2 Avalanche Waveform

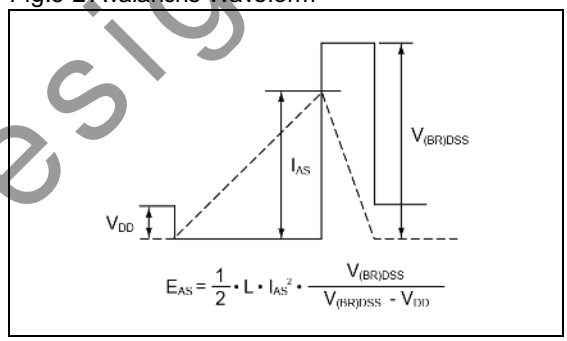


Fig.4-1 dv/dt Measurement Circuit

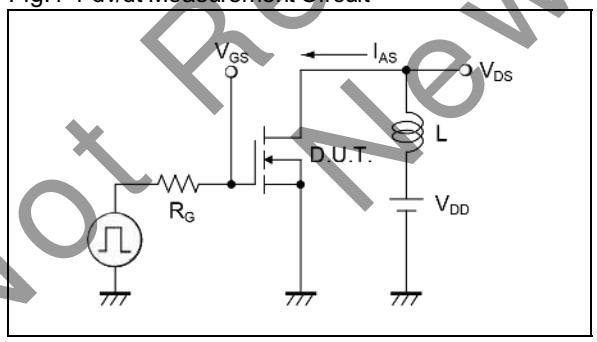


Fig.4-2 dv/dt Waveform

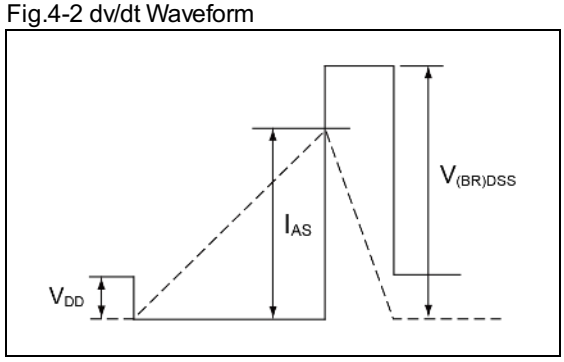


Fig.5-1 di/dt Measurement Circuit

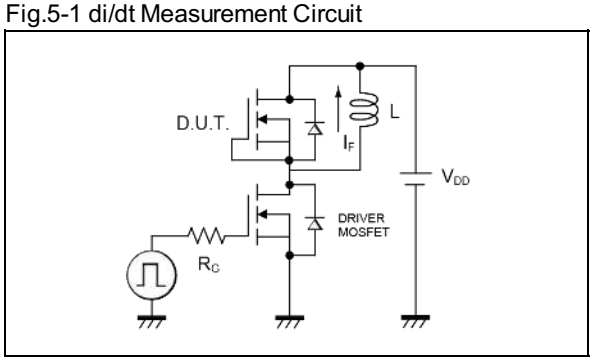
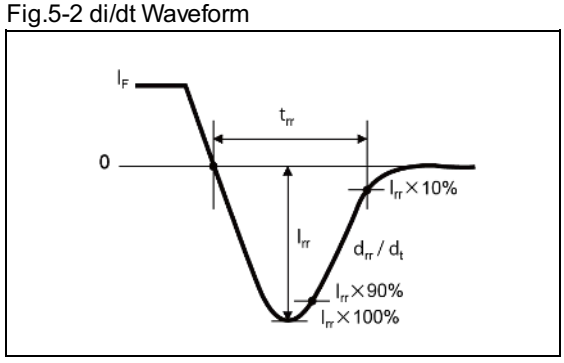


Fig.5-2 di/dt Waveform



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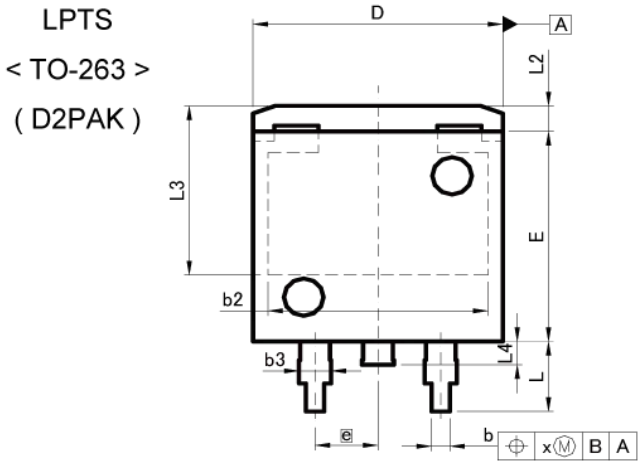
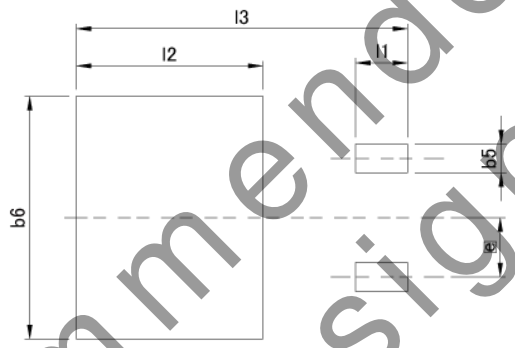
●Dimensions

LPTS
< TO-263 >
(D2PAK)





Pattern of terminal position areas
[Not a pattern of soldering pads]

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A1	0.00	0.30	0.000	0.012
A2	4.30	4.70	0.169	0.185
A3	0.25		0.010	
b	0.68	0.98	0.027	0.039
b2	8.90		0.350	
b3	1.14	1.44	0.045	0.057
c	0.30	0.60	0.012	0.024
c1	1.10	1.50	0.043	0.059
D	9.80	10.40	0.386	0.409
E	8.80	9.20	0.346	0.362
e	2.54		0.100	
HE	12.80	13.40	0.504	0.528
L	2.70	3.30	0.106	0.130
L1	0.90	1.50	0.035	0.059
L2	1.10		0.043	
L3	7.25		0.285	
L4	1.00		0.039	
Lp	0.90	1.50	0.035	0.059
x	–	0.25	–	0.010

DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
b5	–	1.23	–	0.049
b6	–	10.40	–	0.409
l1	–	2.10	–	0.083
l2	–	7.55	–	0.297
l3	–	13.40	–	0.528

Dimension in mm/inches

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Notes

1) The information contained herein is subject to change without notice.

2) Before you use our Products, please contact our sales representative and verify the latest specifications :

3) Although ROHM is continuously working to improve product reliability and quality, semiconductors can break down and malfunction due to various factors.
Therefore, in order to prevent personal injury or fire arising from failure, please take safety measures such as complying with the derating characteristics, implementing redundant and fire prevention designs, and utilizing backups and fail-safe procedures. ROHM shall have no responsibility for any damages arising out of the use of our Poducts beyond the rating specified by ROHM.

4) Examples of application circuits, circuit constants and any other information contained herein are provided only to illustrate the standard usage and operations of the Products. The peripheral conditions must be taken into account when designing circuits for mass production.

5) The technical information specified herein is intended only to show the typical functions of and examples of application circuits for the Products. ROHM does not grant you, explicitly or implicitly, any license to use or exercise intellectual property or other rights held by ROHM or any other parties. ROHM shall have no responsibility whatsoever for any dispute arising out of the use of such technical information.

6) The Products are intended for use in general electronic equipment (i.e. AV/OA devices, communication, consumer systems, gaming/entertainment sets) as well as the applications indicated in this document.

7) The Products specified in this document are not designed to be radiation tolerant.

8) For use of our Products in applications requiring a high degree of reliability (as exemplified below), please contact and consult with a ROHM representative : transportation equipment (i.e. cars, ships, trains), primary communication equipment, traffic lights, fire/crime prevention, safety equipment, medical systems, servers, solar cells, and power transmission systems.

9) Do not use our Products in applications requiring extremely high reliability, such as aerospace equipment, nuclear power control systems, and submarine repeaters.

10) ROHM shall have no responsibility for any damages or injury arising from non-compliance with the recommended usage conditions and specifications contained herein.

11) ROHM has used reasonable care to ensur the accuracy of the information contained in this document. However, ROHM does not warrants that such information is error-free, and ROHM shall have no responsibility for any damages arising from any inaccuracy or misprint of such information.

12) Please use the Products in accordance with any applicable environmental laws and regulations, such as the RoHS Directive. For more details, including RoHS compatibility, please contact a ROHM sales office. ROHM shall have no responsibility for any damages or losses resulting non-compliance with any applicable laws or regulations.

13) When providing our Products and technologies contained in this document to other countries, you must abide by the procedures and provisions stipulated in all applicable export laws and regulations, including without limitation the US Export Administration Regulations and the Foreign Exchange and Foreign Trade Act.

14) This document, in part or in whole, may not be reprinted or reproduced without prior consent of ROHM.

Not Recommended for New Designs

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