ROHM SEMICONDUCTOR

RSJ400N10FRA

Nch 100V 40A Power MOSFET

Datasheet

V_{DSS}	100V
$R_{DS(on)}$(Max.)	27mΩ
I_D	±40A
P_D	50W

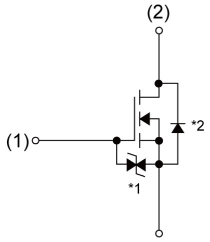
●Outline

TO-263

SC-83

LPT(S)

●Inner circuit



(1) Gate
(2) Drain
(3) Source

*1 ESD Protection Diode
*2 Body Diode

●Features

1) Low on-resistance
2) Fast switching speed
3) High power small mold package
4) Pb-free plating ; RoHS compliant
5) AEC-Q101 Qualified

●Packaging specifications

Type	Packing	Embossed Tape
	Reel size (mm)	330
	Tape width (mm)	24
	Quantity (pcs)	1000
	Taping code	TL
	Marking	RSJ400N10

●Application

Switching

●Absolute maximum ratings (T_a = 25°C ,unless otherwise specified)

Parameter	Symbol	Value	Unit
Drain - Source voltage	V_{DSS}	100	V
Continuous drain current	I_D *1	±40	A
Pulsed drain current	I_{DP} *2	±80	A
Gate - Source voltage	V_{GSS}	±20	V
Avalanche current, single pulse	I_{AS} *3	10	A
Avalanche energy, single pulse	E_{AS} *3	73	mJ
Power dissipation	P_D *1	50	W
Junction temperature	T_j	150	℃
Operating junction and storage temperature range	T_{stg}	-55 to +150	℃

●Thermal resistance

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - case	R_{thJC} *1	-	-	2.5	°C/W

●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	100	-	-	V
Breakdown voltage temperature coefficient	$\frac{\Delta V_{(BR)DSS}}{\Delta T_j}$	I_D = 1mA referenced to 25°C	-	116.9	-	mV/°C
Zero gate voltage drain current	I_{DSS}	V_{DS} = 100V, V_{GS} = 0V	-	-	1	μA
Gate - Source leakage current	I_{GSS}	V_{GS} = ±20V, V_{DS} = 0V	-	-	±10	μA
Gate threshold voltage	$V_{GS(th)}$	V_{DS} = 10V, I_D = 1mA	1.0	-	2.5	V
Gate threshold voltage temperature coefficient	$\frac{\Delta V_{GS(th)}}{\Delta T_j}$	I_D = 1mA referenced to 25°C	-	-3.6	-	mV/°C
Static drain - source on - state resistance	$R_{DS(on)}$ *4	V_{GS} = 10V, I_D = 20A	-	19	27	mΩ
		V_{GS} = 4V, I_D = 20A	-	21	30	
Gate resistance	R_G	f = 1MHz, open drain	-	2.9	-	Ω
Forward Transfer Admittance	$\|Y_{fs}\|$ *4	V_{DS} = 10V, I_D = 20A	23	-	-	S

*1 T_c =25°C, Limited only by maximum temperature allowed.

*2 Pw ≤ 10μs, Duty cycle ≤ 1%

*3 L ≃ 1mH, V_{DD} = 50V, R_G = 25Ω, Starting T_j = 25°C Fig.3-1,3-2

*4 Pulsed

●Electrical characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Input capacitance	C_{iss}	V_{GS} = 0V	-	3600	-	pF
Output capacitance	C_{oss}	V_{DS} = 25V	-	270	-	
Reverse transfer capacitance	C_{rss}	f = 1MHz	-	180	-	
Turn - on delay time	$t_{d(on)}$ *4	V_{DD} ≃ 50V, V_{GS} = 10V	-	25	-	ns
Rise time	t_r *4	I_D = 20A	-	80	-	
Turn - off delay time	$t_{d(off)}$ *4	R_L ≃ 2.5Ω	-	205	-	
Fall time	t_f *4	R_G = 10Ω	-	250	-	

●Gate charge characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_g *4	V_{DD} ≃ 50V, I_D = 40A, V_{GS} = 10V	-	90	-	nC
Gate - Source charge	Q_{gs} *4		-	12	-	
Gate - Drain charge	Q_{gd} *4		-	18	-	

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

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Continuous forward current	I_S	T_a = 25°C	-	-	40	A
Pulse forward current	I_{SP} *2		-	-	80	A
Forward voltage	V_{SD} *4	V_{GS} = 0V, I_S = 40A	-	-	1.5	V

●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

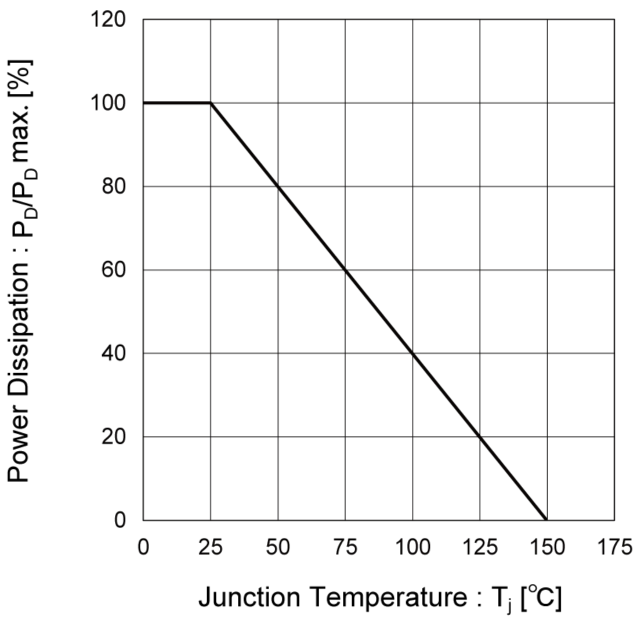


Fig.2 Maximum Safe Operating Area

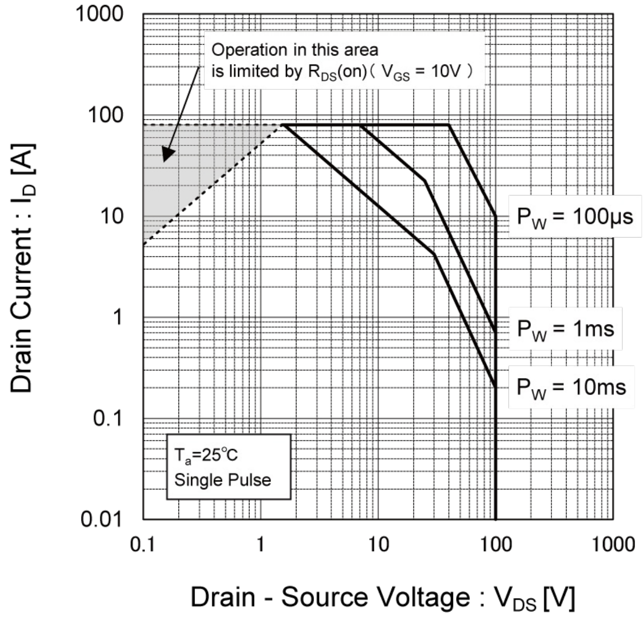


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

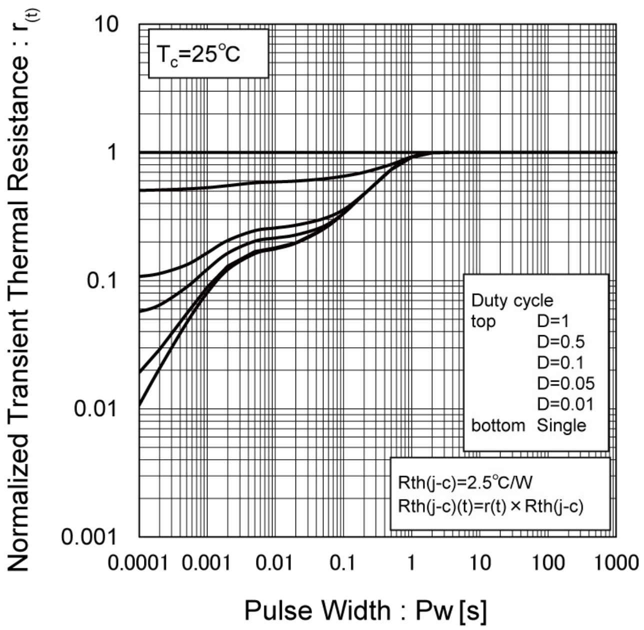
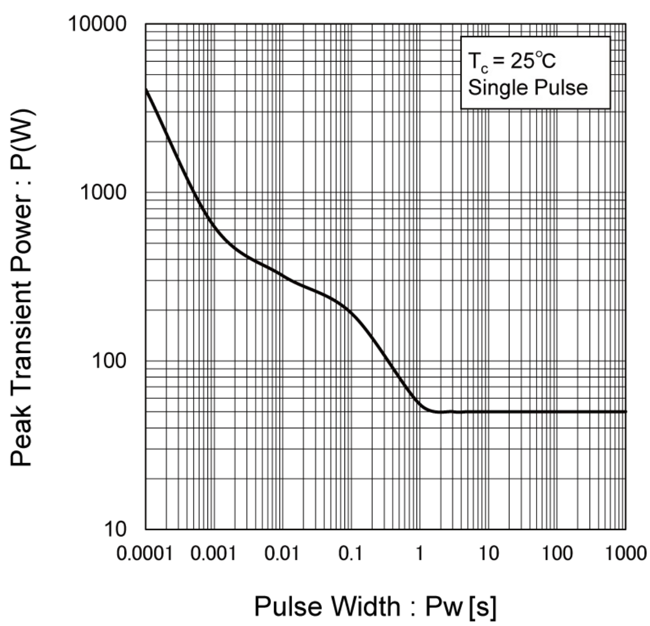


Fig.4 Single Pulse Maximum Power Dissipation



●Electrical characteristic curves

Fig.5 Typical Output Characteristics(I)

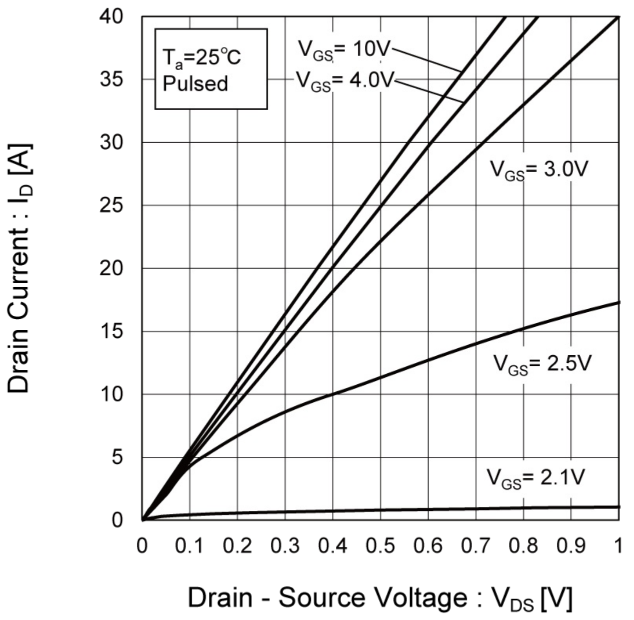


Fig.6 Typical Output Characteristics(II)

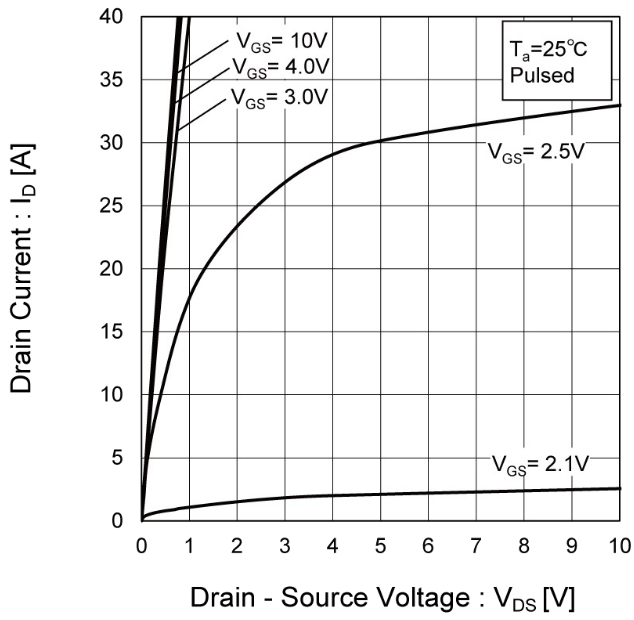
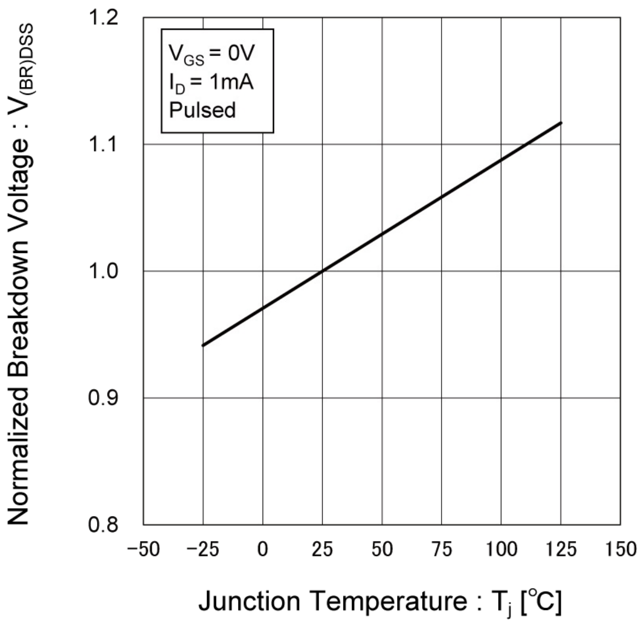


Fig.7 Breakdown Voltage vs. Junction Temperature



●Electrical characteristic curves

Fig.8 Typical Transfer Characteristics

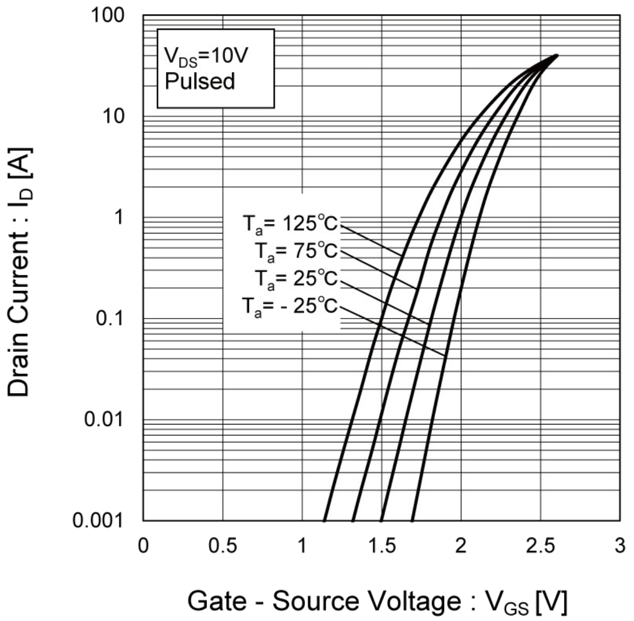


Fig.9 Gate Threshold Voltage vs. Junction Temperature

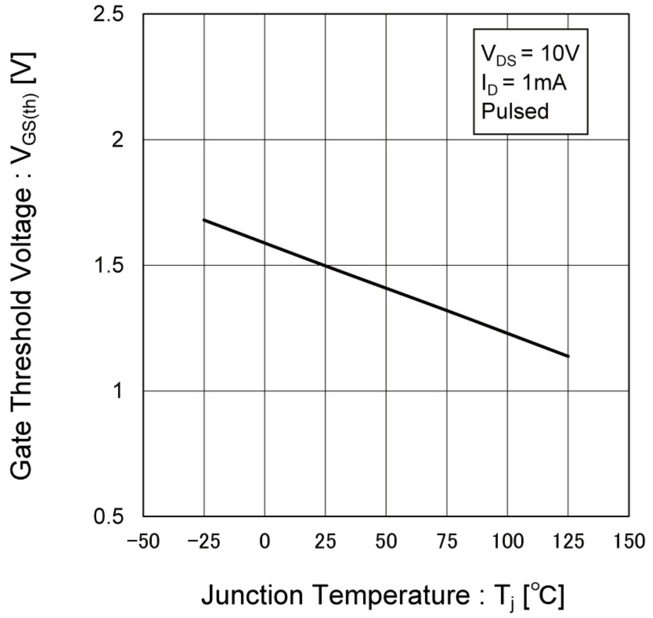
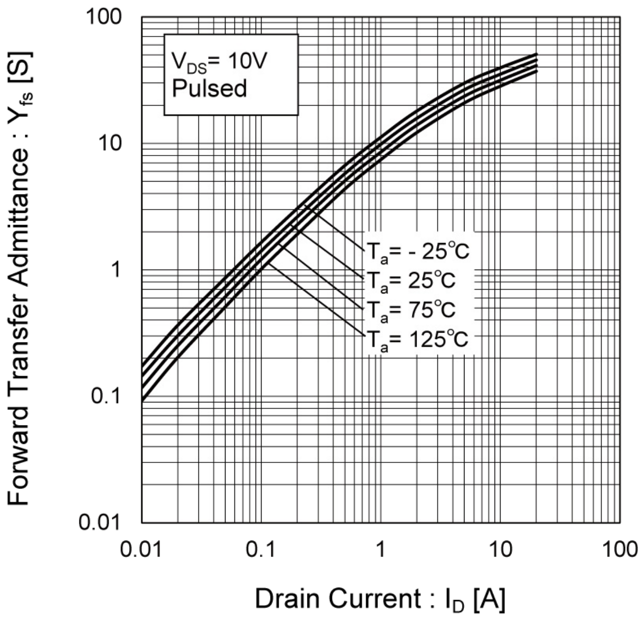


Fig.10 Forward Transfer Admittance vs. Drain Current



●Electrical characteristic curves

Fig.11 Drain Current Derating Curve

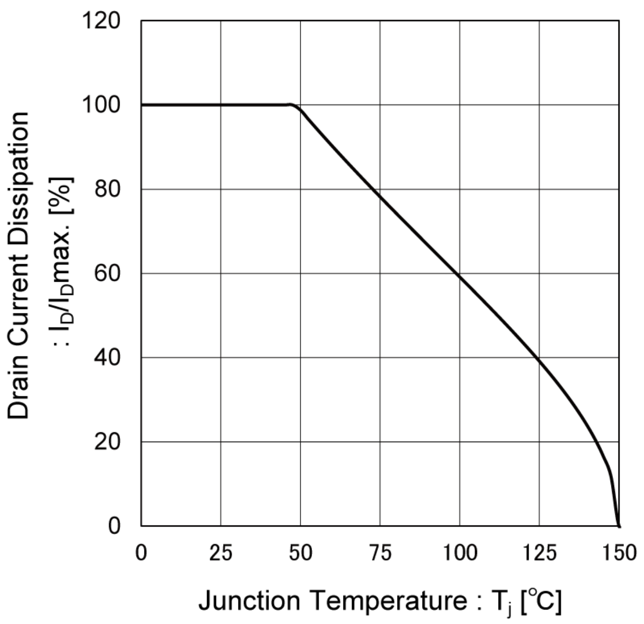


Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage

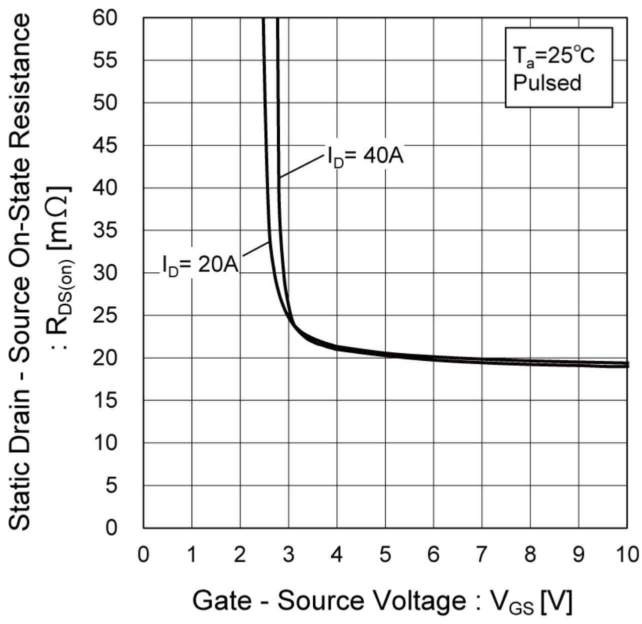
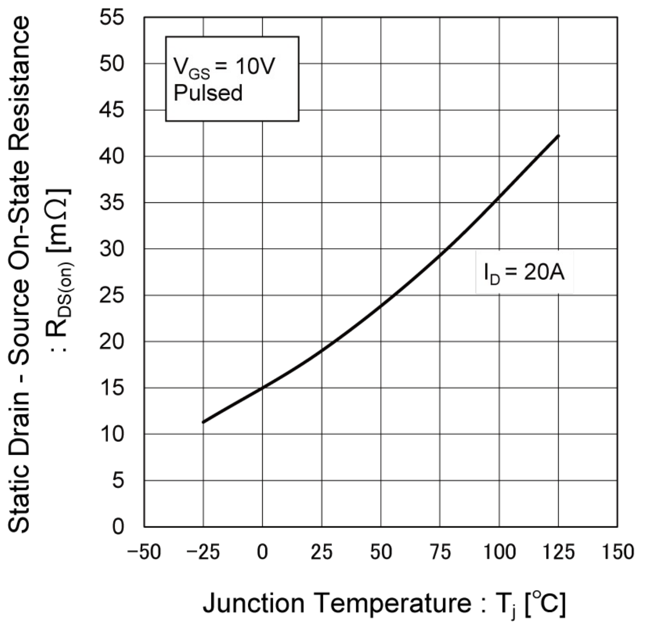


Fig.13 Static Drain - Source On - State Resistance vs. Junction Temperature



●Electrical characteristic curves

Fig.14 Static Drain - Source On - State Resistance vs. Drain Current (I)

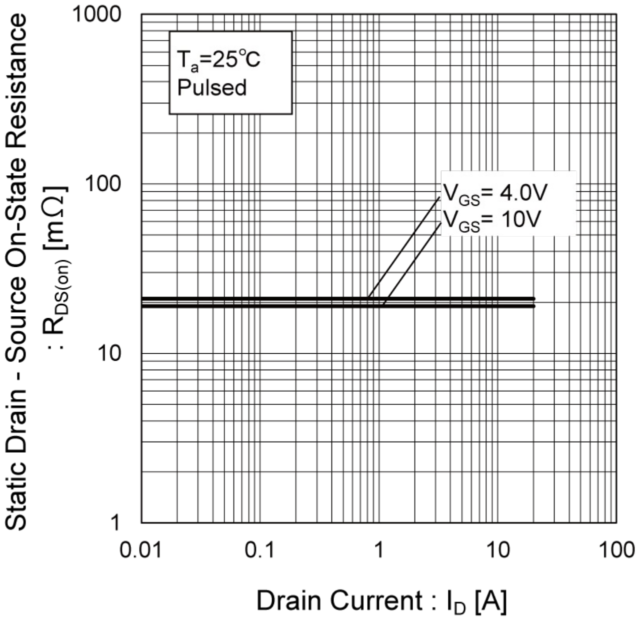


Fig.15 Static Drain - Source On - State Resistance vs. Drain Current (II)

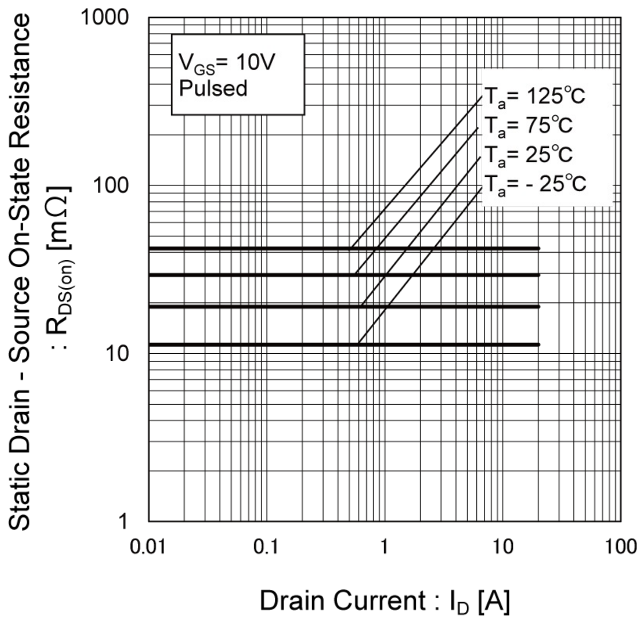
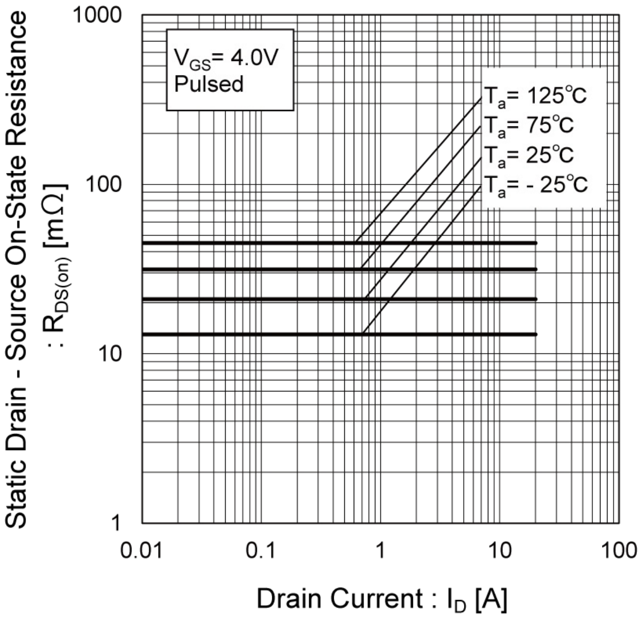


Fig.16 Static Drain - Source On - State Resistance vs. Drain Current (III)



● **Electrical characteristic curves**

Fig.17 Typical Capacitances vs. Drain - Source Voltage

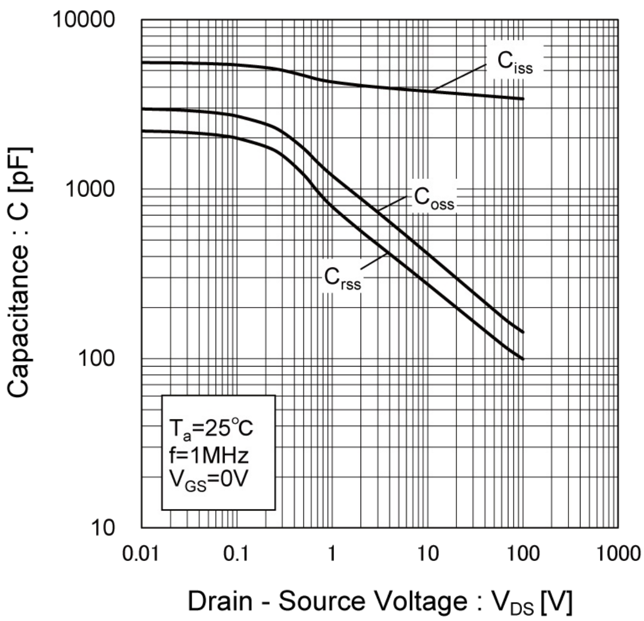


Fig.18 Switching Characteristics

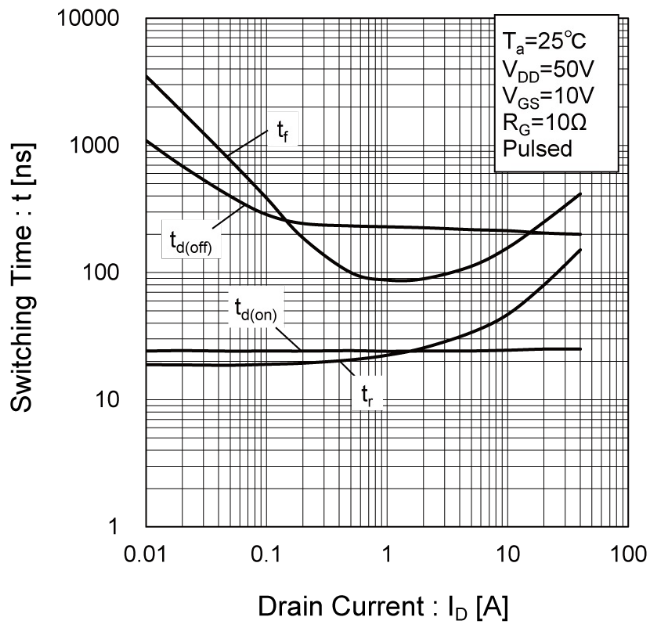


Fig.19 Typical Gate Charge

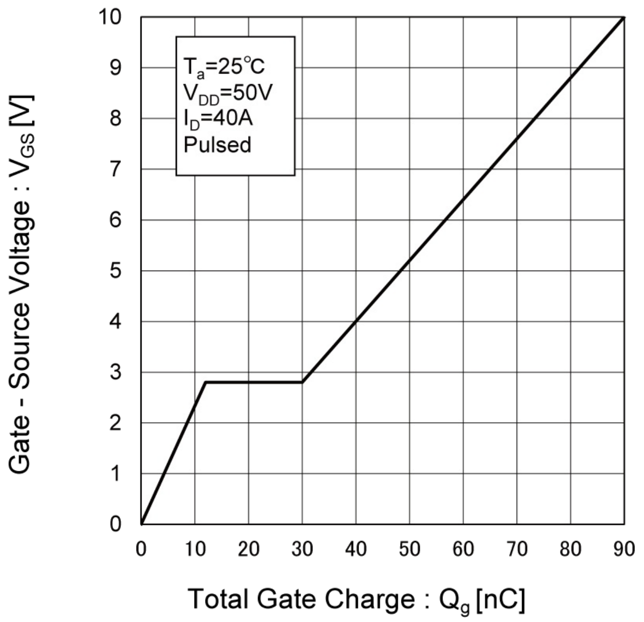
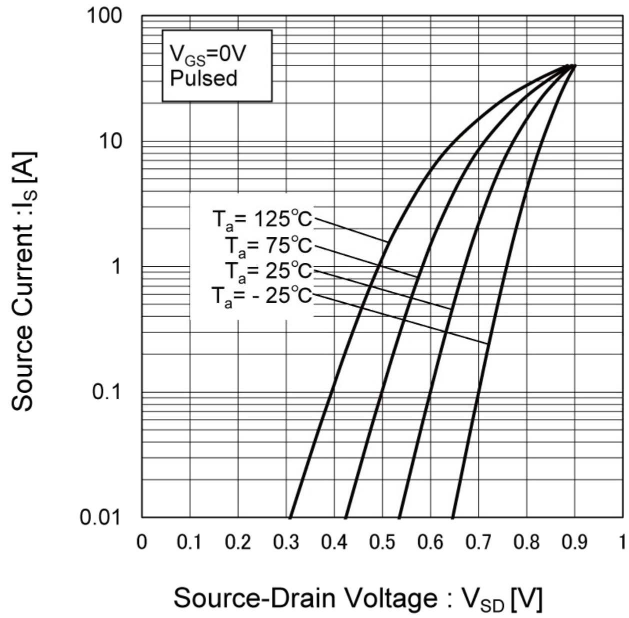


Fig.20 Source Current vs. Source Drain Voltage



●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

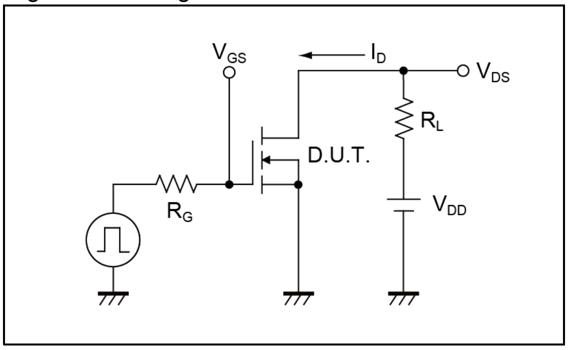


Fig.1-2 Switching Waveforms

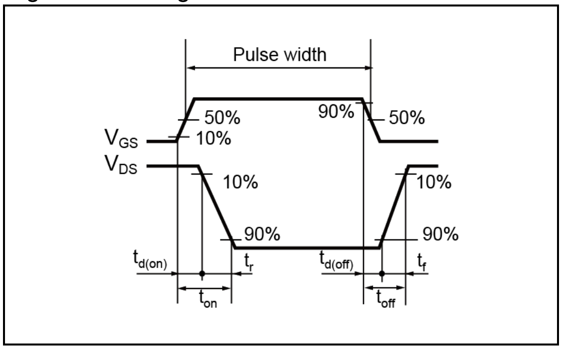


Fig.2-1 Gate Charge Measurement Circuit

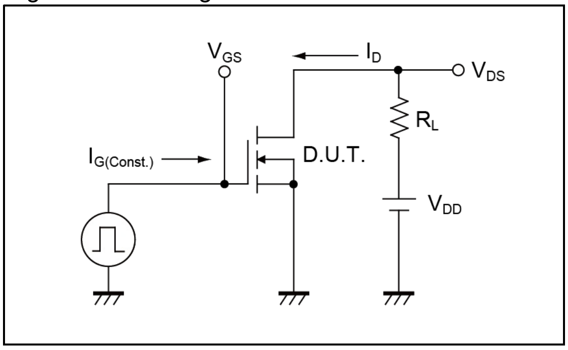


Fig.2-2 Gate Charge Waveform

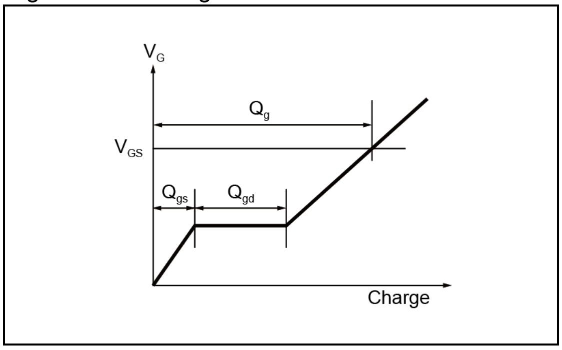


Fig.3-1 Avalanche Measurement Circuit

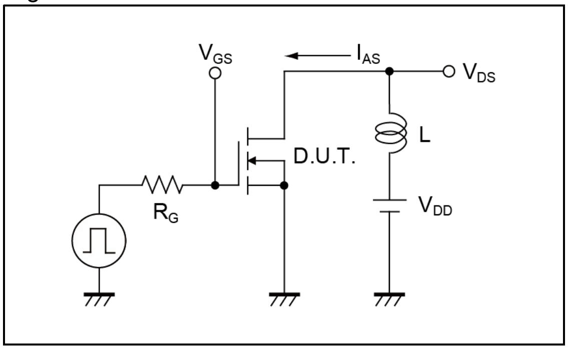
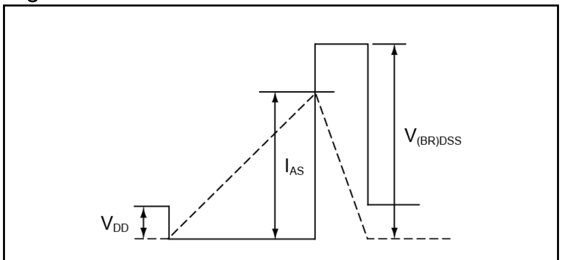


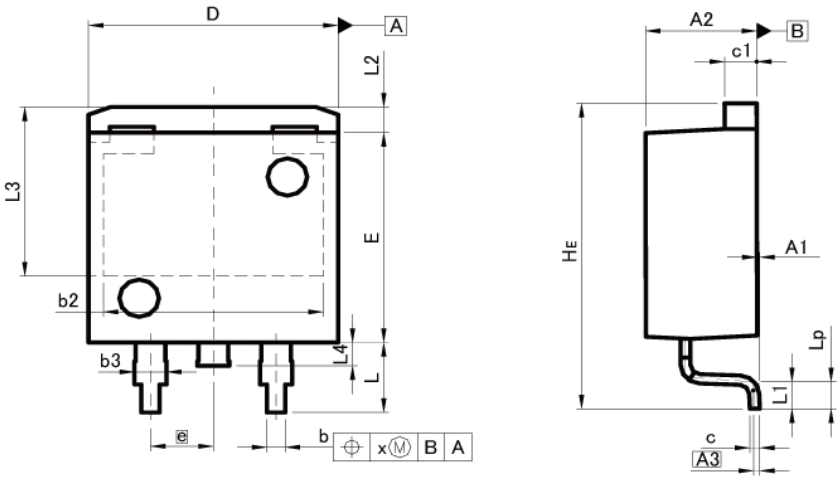
Fig.3-2 Avalanche Waveform

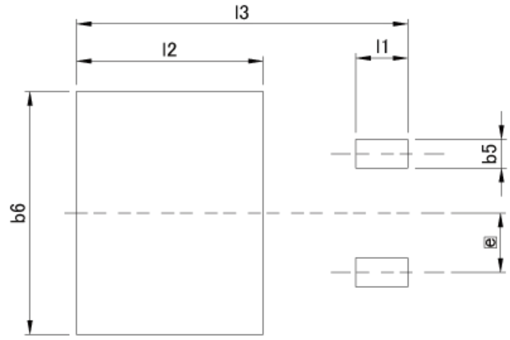


$$E_{AS} = \frac{1}{2} \cdot L \cdot I_{AS}^2 \cdot \frac{V_{(BR)DSS}}{V_{(BR)DSS} - V_{DD}}$$

●Dimensions

TO-263S
SC-83
(LPTS D2-PAK)





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	1.20		0.047	
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

Notice

Precaution on using ROHM Products

1. If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), aircraft/spacecraft, nuclear power controllers, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

<table>
<tr><th>JAPAN</th><th>USA</th><th>EU</th><th>CHINA</th></tr>
<tr><td>CLASSⅢ</td><td rowspan="2">CLASSⅢ</td><td>CLASSⅡb</td><td rowspan="2">CLASSⅢ</td></tr>
<tr><td>CLASSⅣ</td><td>CLASSⅢ</td></tr>
</table>

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are not designed under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (Exclude cases where no-clean type fluxes is used. However, recommend sufficiently about the residue.); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse, is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   [a] the Products are exposed to sea winds or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [b] the temperature or humidity exceeds those recommended by ROHM
   [c] the Products are exposed to direct sunshine or condensation
   [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

A two-dimensional barcode printed on ROHM Products label is for ROHM's internal use only.

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When disposing Products please dispose them properly using an authorized industry waste company.

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