R8009KNX

Nch 800V 9A Power MOSFET

Datasheet

V_{DSS}	800V
$R_{DS(on)}$(Max.)	0.6Ω
I_D	±9A
P_D	59W

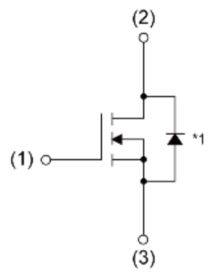
●Package

TO-220FM

●Features

1) Low on-resistance
2) Fast switching
3) Parallel use is easy
4) Pb-free plating ; RoHS compliant

●Inner circuit



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

*1 Body Diode

●Application

Switching

●Marking specification

Marking	R8009KNX

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

Parameter		Symbol	Value	Unit
Drain - Source voltage		V_{DSS}	800	V
Continuous drain current		I_D *1	±9	A
Pulsed drain current		I_{DP} *2	±27	A
Gate - Source voltage	static	V_{GSS}	±20	V
	AC(f＞1Hz)		±30	V
Avalanche current, single pulse		I_{AS}	1.8	A
Avalanche energy, single pulse		E_{AS} *3	171	mJ
Power dissipation (T_c = 25°C)		P_D	59	W
Junction temperature		T_j	150	℃
Operating junction and storage temperature range		T_{stg}	-55 to +150	℃

●Thermal characteristics

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - case	$R_{th(j-c)}$ *4	-	-	2.1	°C/W
Thermal resistance, junction - ambient	$R_{th(j-a)}$	-	-	75	°C/W
Soldering temperature, wavesoldering for 10s	T_{sold}	-	-	265	°C

●Static 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	800	-	-	V
Zero gate voltage drain current	I_{DSS}	V_{DS} = 800V, V_{GS} = 0V	-	-	100	μA
Gate - Source leakage current	I_{GSS}	V_{GS} = ±20V, V_{DS} = 0V	-	-	±100	nA
Gate threshold voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 5mA	2.5	3.5	4.5	V
Static drain - source on - state resistance	$R_{DS(on)}$ *5	V_{GS} = 10V, I_D = 4.5A	-	0.5	0.6	Ω

●Dynamic characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Gate resistance	R_G	f = 1MHz, open drain	-	2.8	-	Ω
Input capacitance	C_{iss}	V_{GS} = 0V, VDS = 100V	-	900	-	pF
Output capacitance	C_{oss}	f = 1MHz	-	60	-	
Effective output capacitance energy related	$C_{o(er)}$ *6	V_{GS} = 0V	-	12	-	
Effective output capacitance time related	$C_{o(tr)}$ *7	V_{DS} = 0V to 400V	-	58	-	
Turn - on delay time	$t_{d(on)}$ *5	V_{DD} ≃ 400V, V_{GS} = 10V	-	18	-	ns
Rise time	t_r *5	I_D = 4.5A	-	40	-	
Turn - off delay time	$t_{d(off)}$ *5	R_L ≃ 88.9Ω	-	30	-	
Fall time	t_f *5	R_G = 10Ω	-	30	-	

●Gate charge characteristics (T_a = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_g *5	V_{DD} ≃ 400V	-	27	-	nC
Gate - Source charge	Q_{gs} *5	I_D = 9A	-	5	-	
Gate - Drain charge	Q_{gd} *5	V_{GS} = 10V	-	12	-	
Gate plateau voltage	$V_{(plateau)}$	V_{DD} ≃ 400V, I_D = 9A	-	5.7	-	V

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

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Source current	I_S *1	T_C = 25°C	-	-	9	A
Pulsed source current	I_{SP} *2		-	-	27	A
Source-Drain voltage	V_{SD} *5	V_{GS} = 0V, I_S = 9A	-	-	1.5	V
Reverse recovery time	t_{rr} *5	I_S = 9A di/dt = 100A/μs	-	500	-	ns
Reverse recovery charge	Q_{rr} *5		-	8.0	-	μC
Peak reverse recovery current	I_{rr} *5		-	30	-	A

*1 Limited only by maximum channel temperature allowed.

*2 Pw ≤ 10μs, Duty cycle ≤ 1%

*3 L≒100mH, V_{DD}=50V, R_G=25Ω, starting T_j=25℃

*4 T_C=25℃

*5 Pulsed

*6 $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as Coss while V_{DS} is rising from 0 to 50% V_{DSS}.

*7 $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as Coss while V_{DS} is rising from 0 to 50% V_{DSS}.

●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

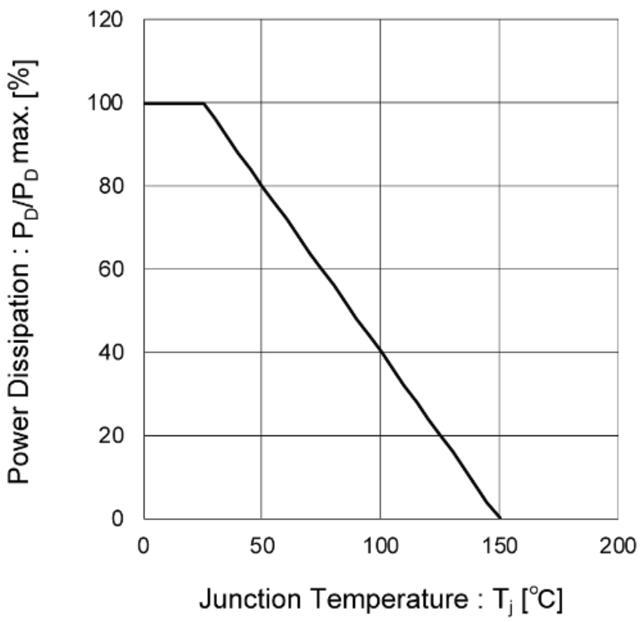


Fig.2 Drain Current Derating Curve

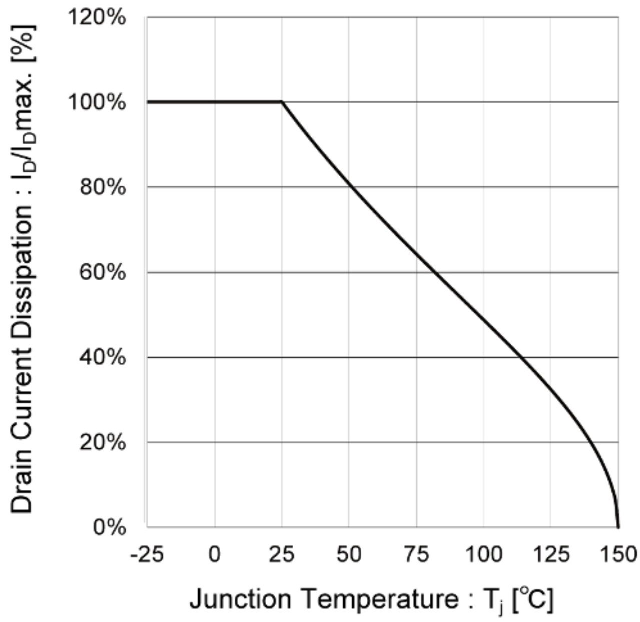


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

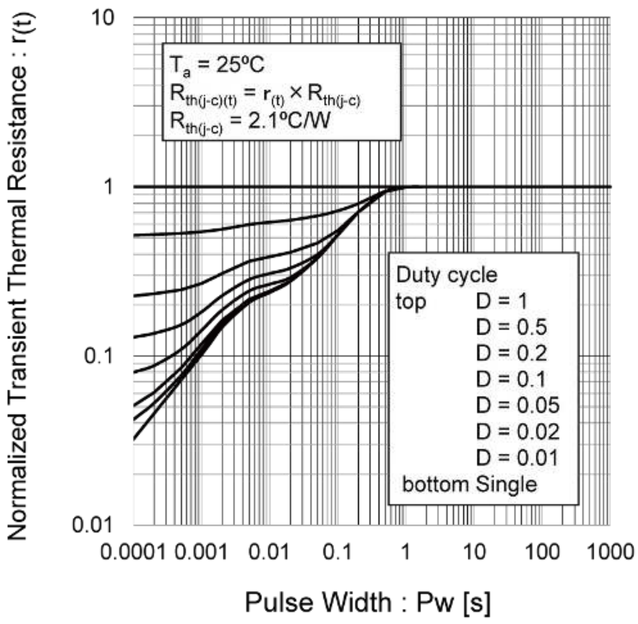
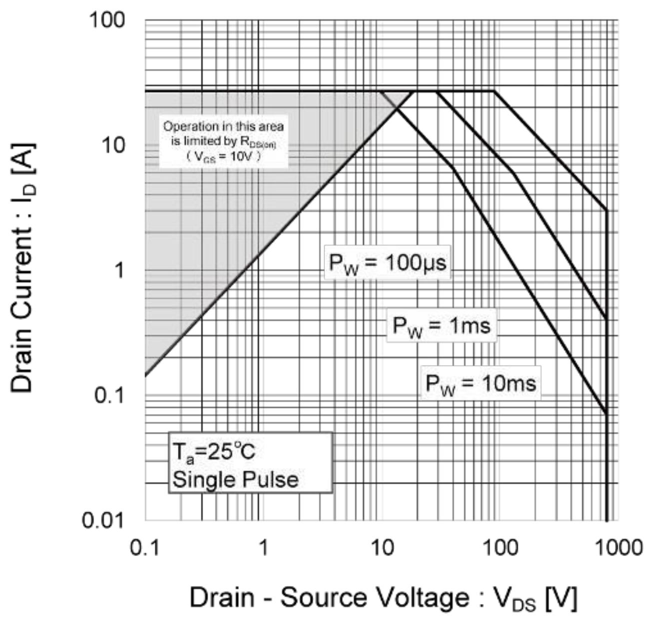


Fig.4 Maximum Safe Operating Area



●Electrical characteristic curves

Fig.5 Avalanche Energy Derating Curve

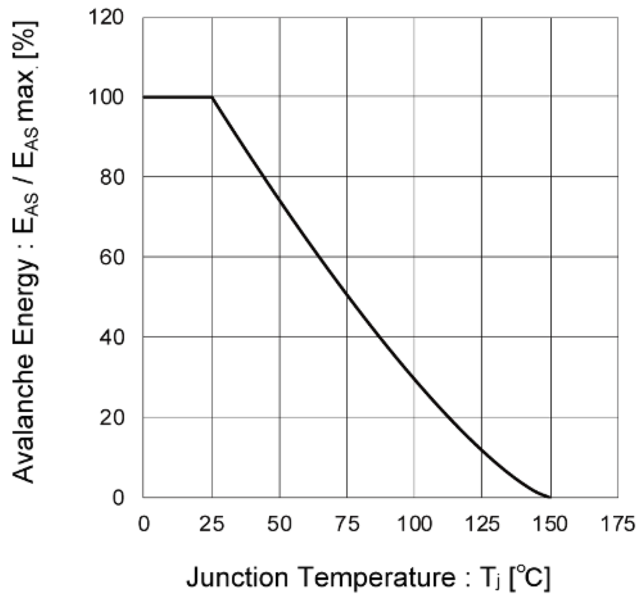


Fig.6 Normalized Breakdown Voltage vs. Junction Temperature

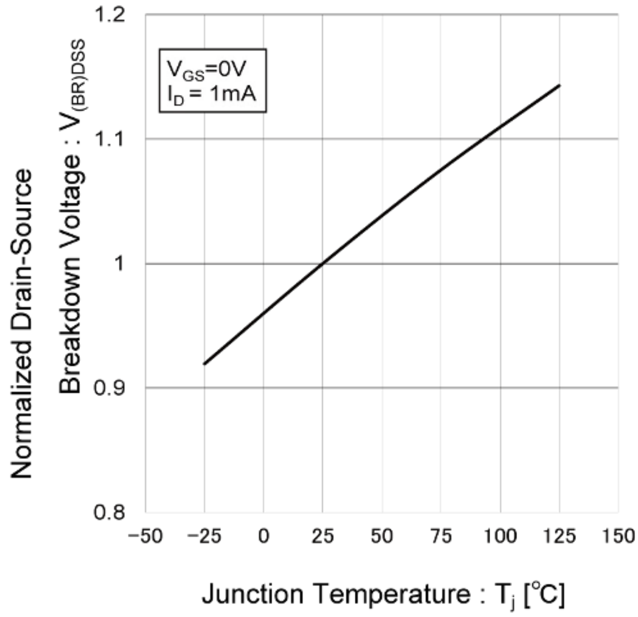


Fig.7 Output Characteristics(I)

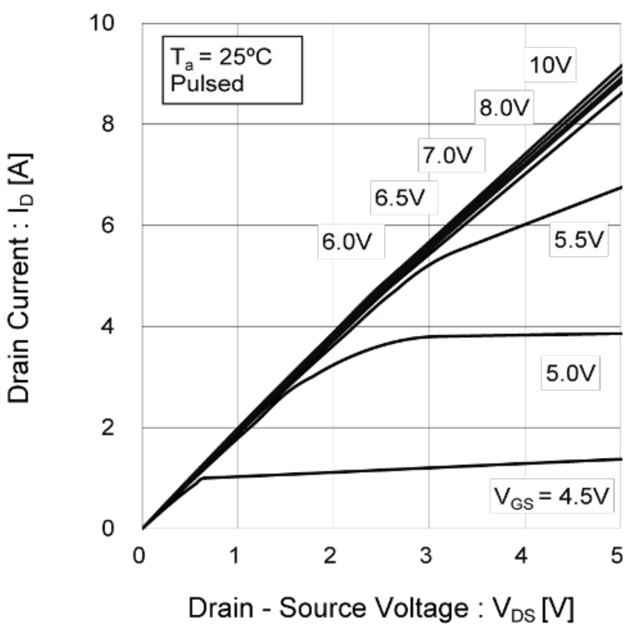
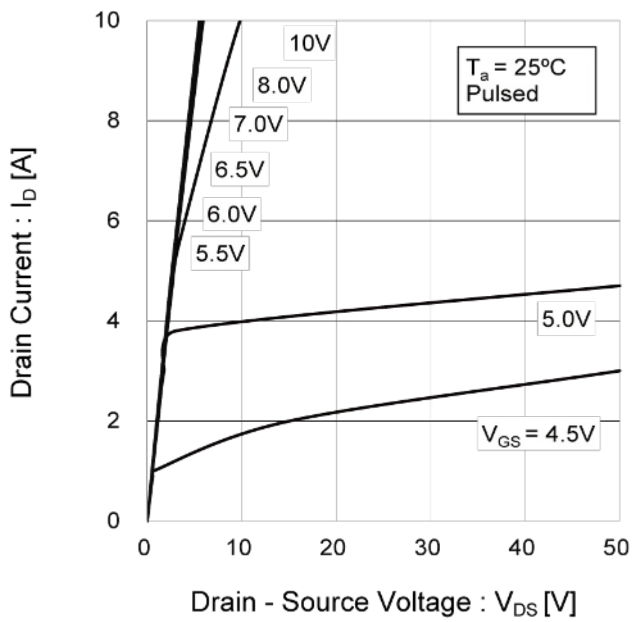


Fig.8 Output Characteristics(II)



●Electrical characteristic curves

Fig.9 Gate Threshold Voltage vs. Drain current

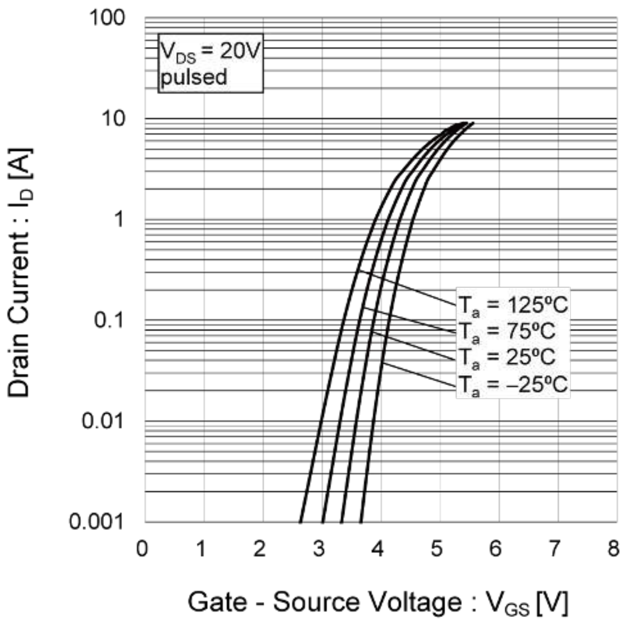


Fig.10 Normalized Gate Threshold Voltage vs. Junction Temperature

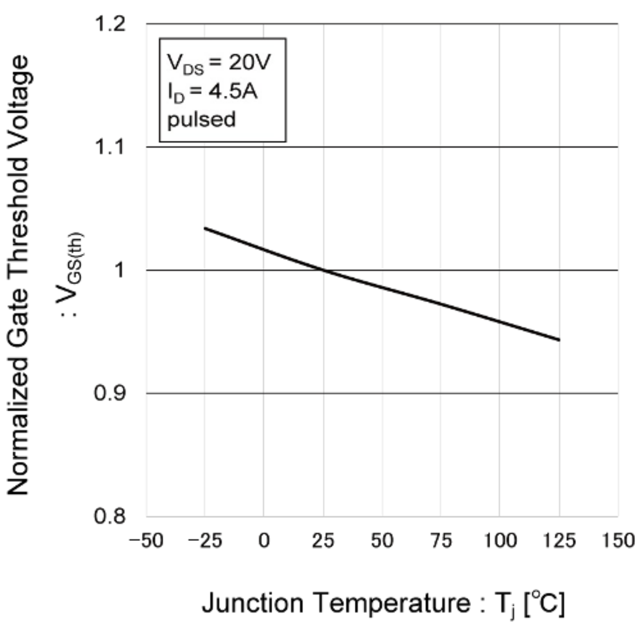


Fig.11 Static Drain - Source On - State Resistance vs. Drain Current

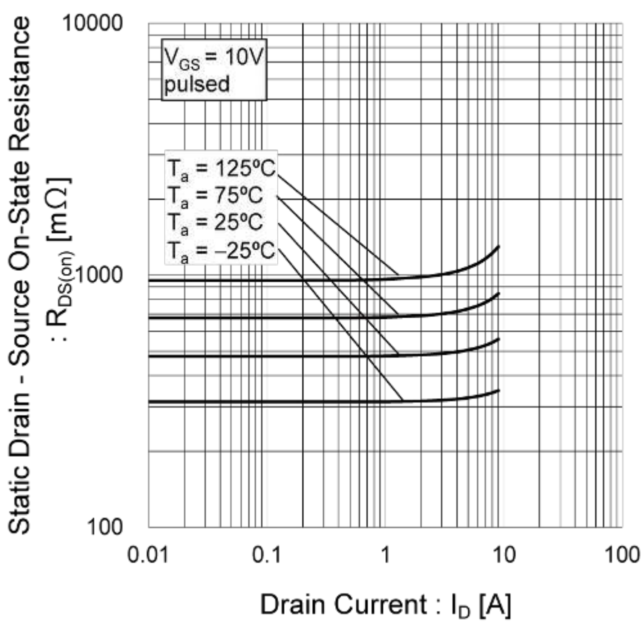
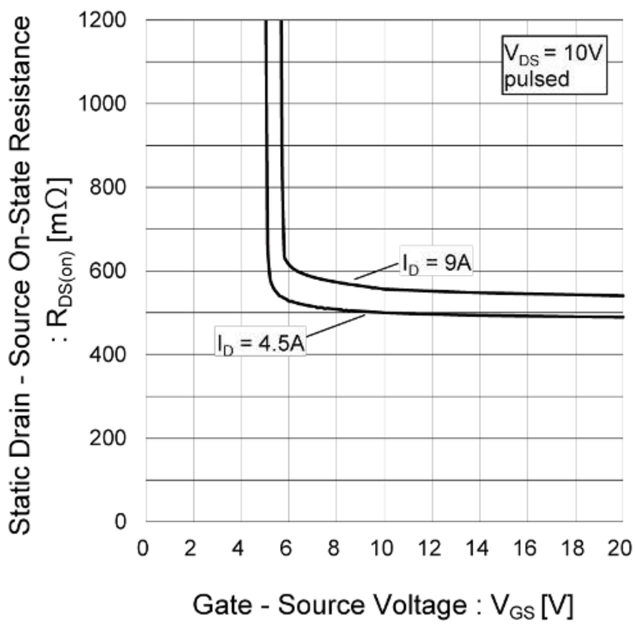


Fig.12 Static Drain - Source On - State Resistance vs. Gate - Source Voltage



●Electrical characteristic curves

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

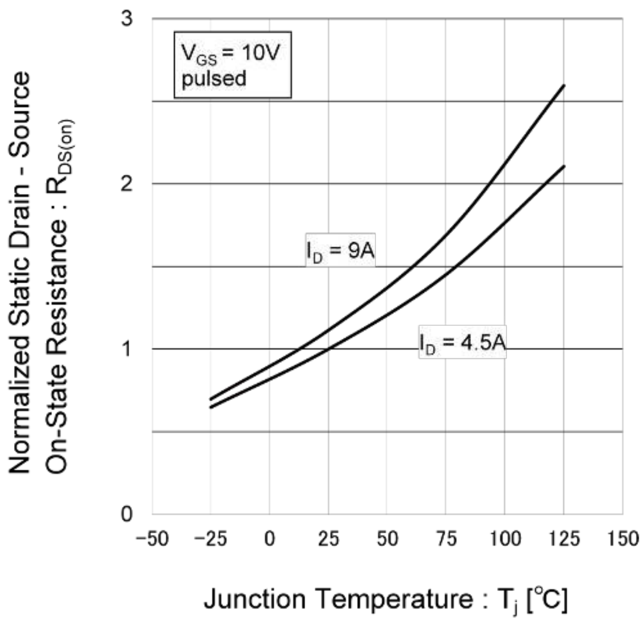


Fig.14 Capacitances

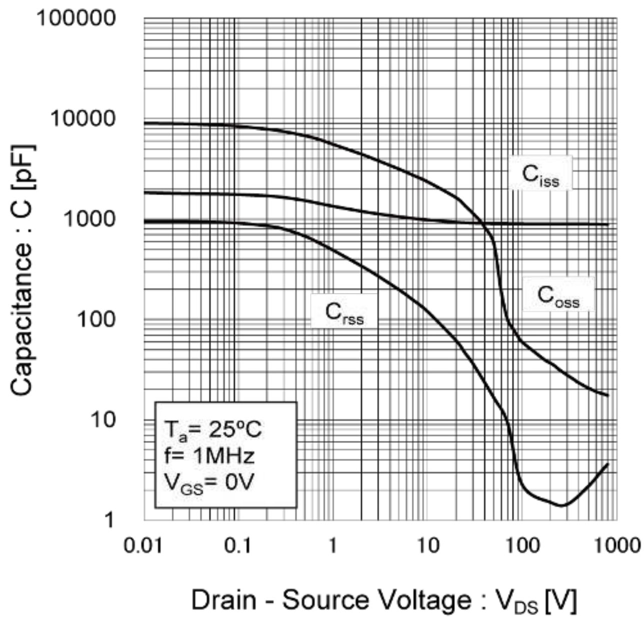


Fig.15 Switching times

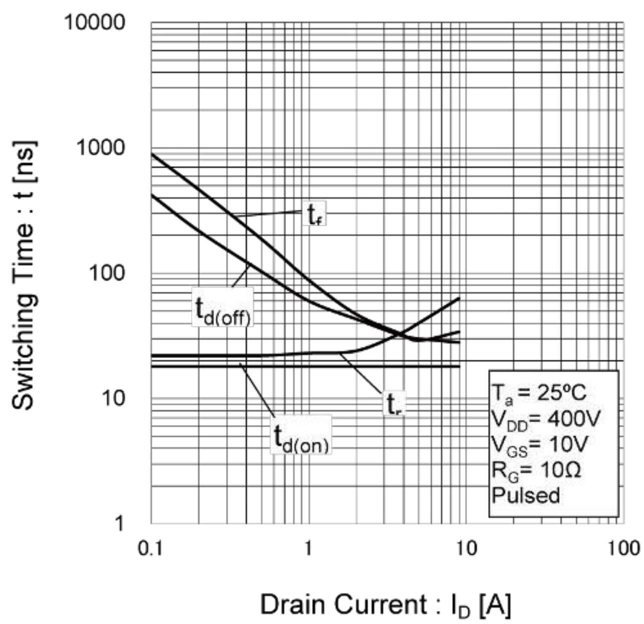
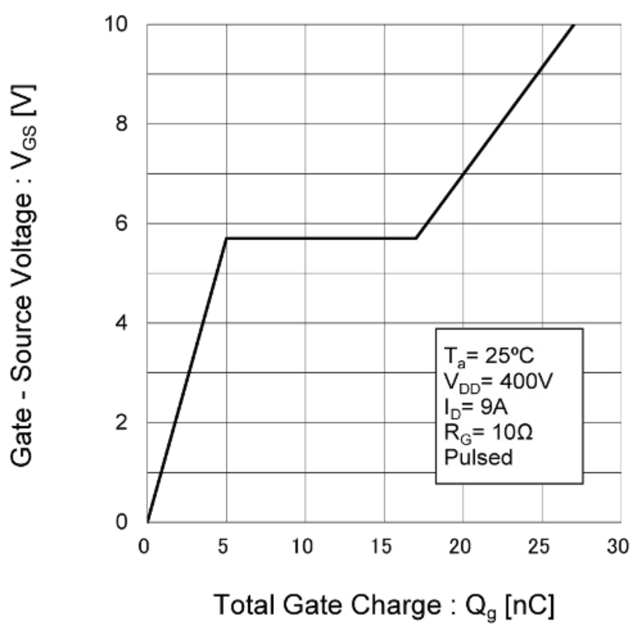


Fig.16 Gate Charge



●Electrical characteristic curves

Fig.17 Source Current vs. Source - Drain Voltage

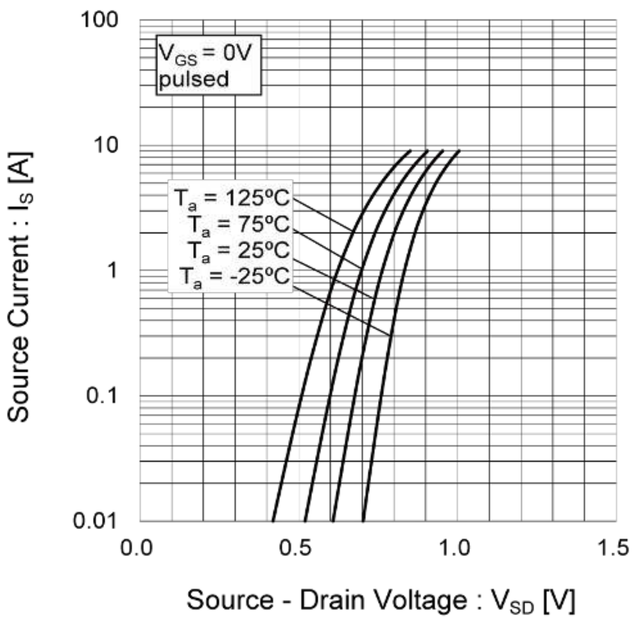
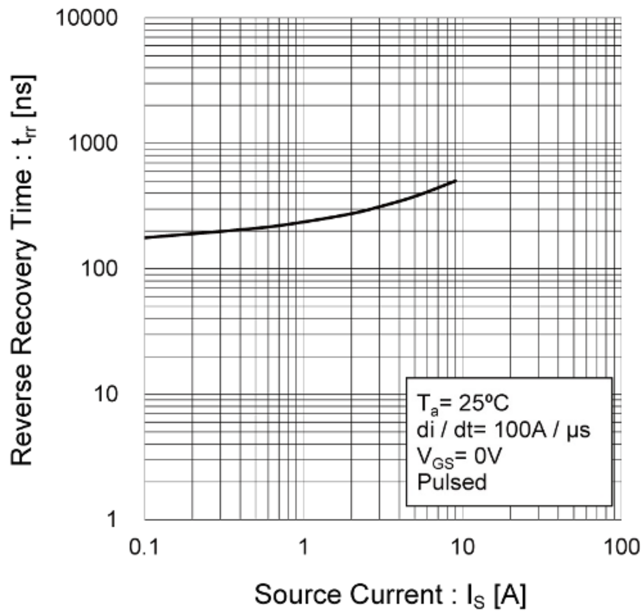


Fig.18 Reverse Recovery Time vs. Source Current



●Measurement circuits

Fig.1-1 Switching time measurement circuit

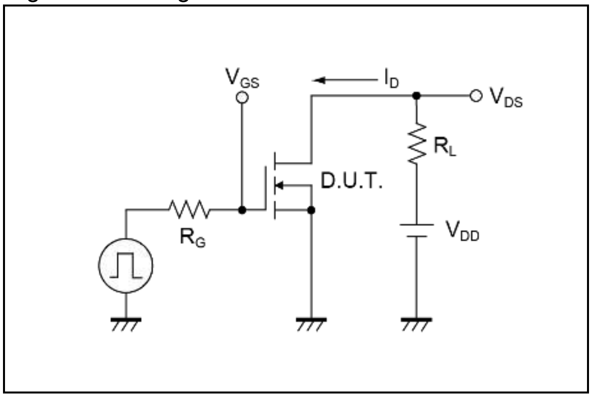


Fig.1-2 Switching waveforms

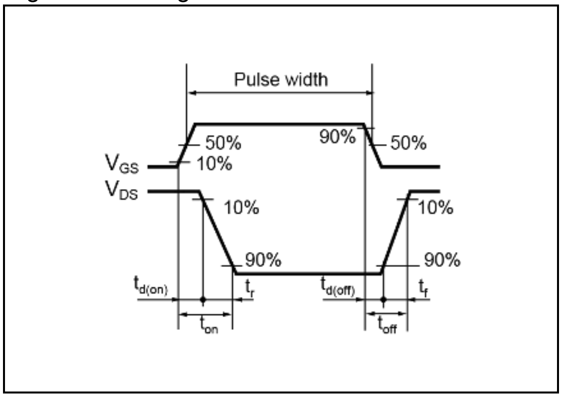


Fig.2-1 Gate charge measurement circuit

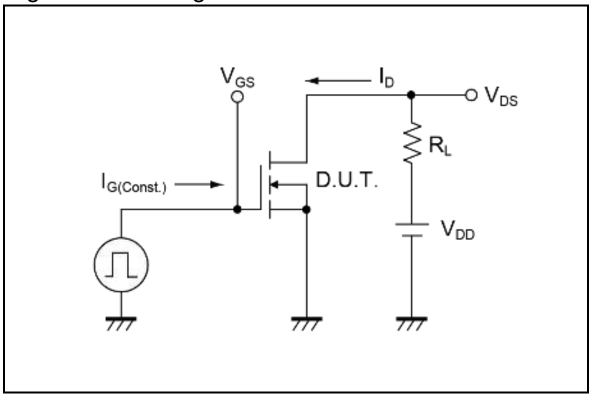


Fig.2-2 Gate charge waveform

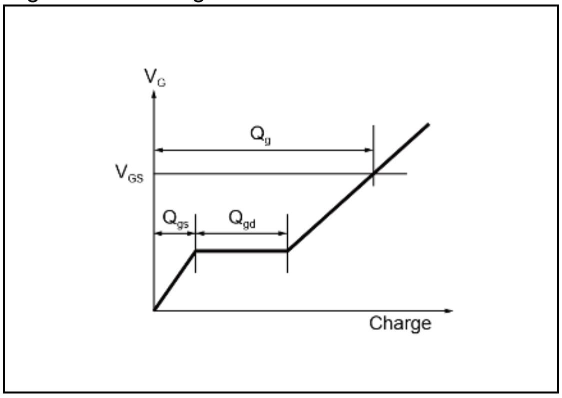


Fig.3-1 Avalanche measurement circuit

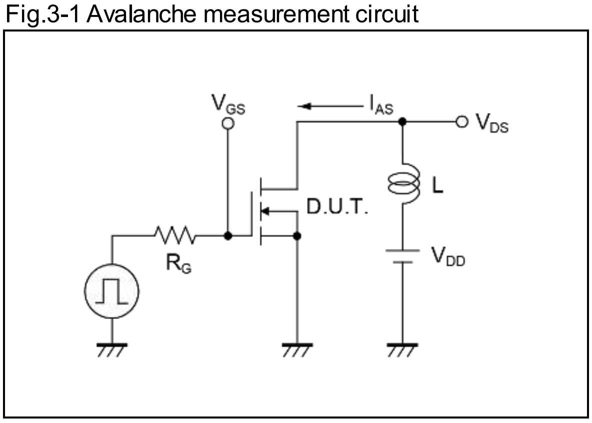
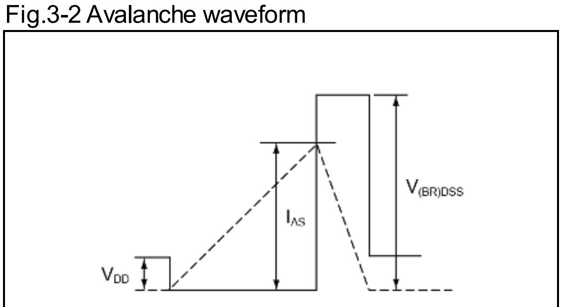


Fig.3-2 Avalanche waveform



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

Fig.4-1 trr measurement circuit

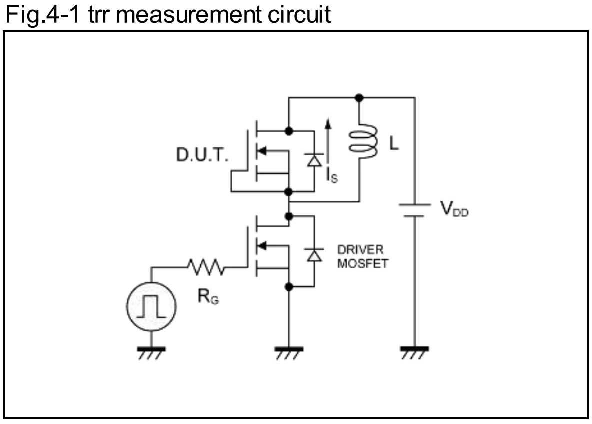
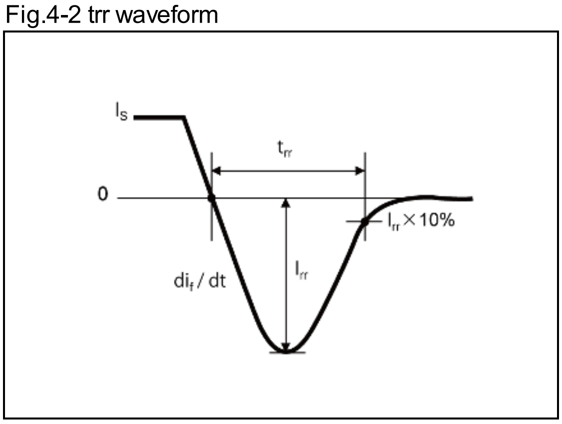


Fig.4-2 trr waveform

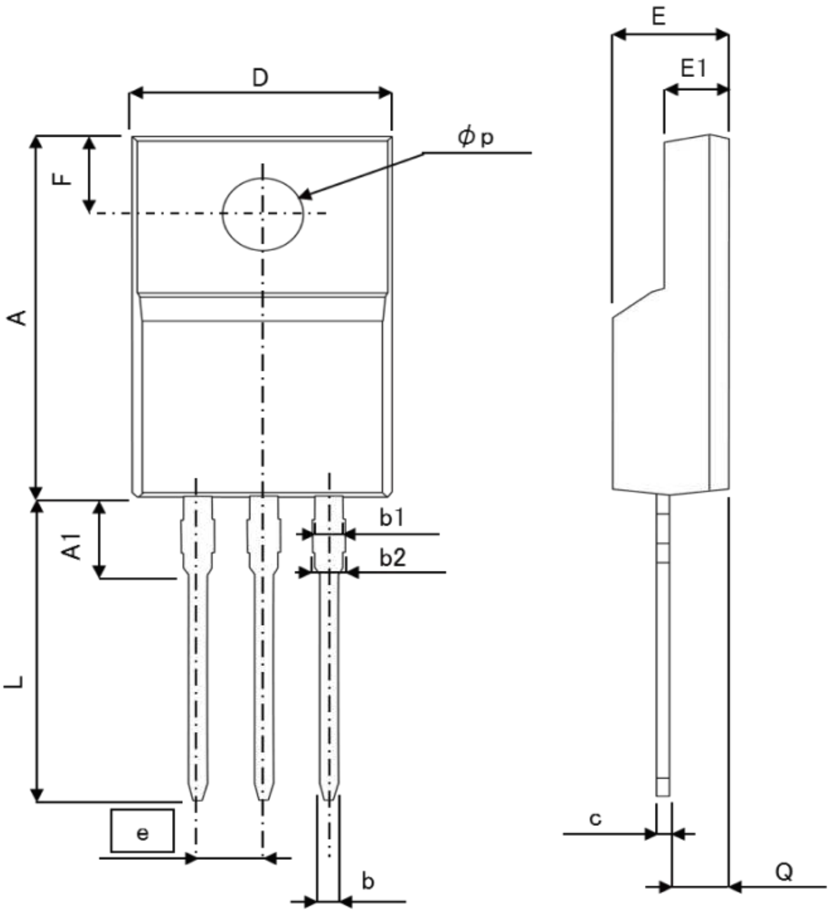


●Dimensions

TO-220FM

Packing code

C7 G



DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	15.67	16.27	0.617	0.641
A1	3.03	3.43	0.119	0.135
b	0.70	0.95	0.028	0.037
b1	1.00	1.40	0.039	0.055
b2	1.10	1.50	0.043	0.059
c	0.45	0.65	0.018	0.026
D	9.90	10.30	0.390	0.406
E	4.60	5.00	0.181	0.197
E1	2.44	2.74	0.096	0.108
e	2.54		0.100	
F	3.10	3.50	0.122	0.138
L	12.6	13.6	0.946	0.535
p	2.98	3.38	0.117	0.133
Q	2.25	3.25	0.089	0.128

Dimension in mm/inches

Notice

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(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

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   [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.

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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.

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