

$V_{DSS}$	600V
$R_{DS(on)}(Max.)$	0.98 $\Omega$
$I_D$	$\pm 4.0A$
$P_D$	40W

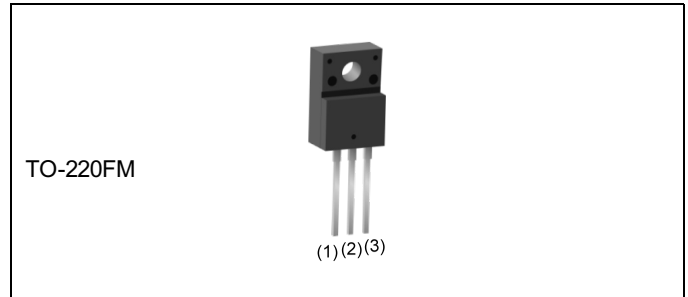
### ●Features

- 1) Low on-resistance.
- 2) Ultra fast switching speed.
- 3) Parallel use is easy.
- 4) Pb-free lead plating ; RoHS compliant

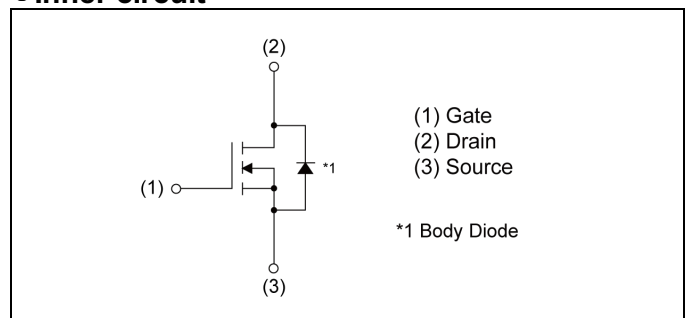
### ●Application

Switching

### ●Outline



### ●Inner circuit



### ●Packaging specifications

Type	Packing	Bulk
	Reel size (mm)	-
	Tape width (mm)	-
	Basic ordering unit (pcs)	500
	Taping code	-
	Marking	R6004KNX

### ●Absolute maximum ratings ( $T_a = 25^\circ C$ , unless otherwise specified)

Parameter		Symbol	Value	Unit
Drain - Source voltage		$V_{DSS}$	600	V
Continuous drain current ( $T_c = 25^\circ C$ )		$I_D^{*1}$	$\pm 4.0$	A
Pulsed drain current		$I_{DP}^{*2}$	$\pm 12$	A
Gate - Source voltage	static	$V_{GSS}$	$\pm 20$	V
	AC( $f > 1Hz$ )		$\pm 30$	V
Avalanche current, single pulse		$I_{AS}$	0.8	A
Avalanche energy, single pulse		$E_{AS}^{*3}$	46	mJ
Power dissipation ( $T_c = 25^\circ C$ )		$P_D$	40	W
Junction temperature		$T_j$	150	$^\circ C$
Operating junction and storage temperature range		$T_{stg}$	-55 to +150	$^\circ C$

### ● Thermal resistance

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - case	$R_{thJC}^{*4}$	-	-	3.13	°C/W
Thermal resistance, junction - ambient	$R_{thJA}$	-	-	70	°C/W
Soldering temperature, wavesoldering for 10s	$T_{sold}$	-	-	265	°C

### ● Electrical characteristics ( $T_a = 25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Drain - Source breakdown voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 1mA$	600	-	-	V
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = 600V, V_{GS} = 0V$	-	-	100	$\mu\text{A}$
		$T_j = 125^\circ\text{C}$	-	-	1000	
Gate - Source leakage current	$I_{GSS}$	$V_{GS} = \pm 20V, V_{DS} = 0V$	-	-	$\pm 100$	nA
Gate threshold voltage	$V_{GS(th)}$	$V_{DS} = 10V, I_D = 1mA$	3	-	5	V
Static drain - source on - state resistance	$R_{DS(on)}^{*5}$	$V_{GS} = 10V, I_D = 1.5A$	-	0.90	0.98	$\Omega$
		$T_j = 125^\circ\text{C}$	-	1.36	-	
Gate resistance	$R_G$	$f = 1MHz, \text{open drain}$	-	3.3	-	$\Omega$

**●Electrical characteristics** ( $T_a = 25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Forward Transfer Admittance	$ Y_{fs} ^{*5}$	$V_{DS} = 10\text{V}, I_D = 2\text{A}$	1.5	3.0	-	S
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{V}$	-	280	-	pF
Output capacitance	$C_{oss}$	$V_{DS} = 25\text{V}$	-	280	-	
Reverse transfer capacitance	$C_{rss}$	$f = 1\text{MHz}$	-	16	-	
Turn - on delay time	$t_{d(on)}^{*5}$	$V_{DD} \approx 300\text{V}, V_{GS} = 10\text{V}$	-	15	-	ns
Rise time	$t_r^{*5}$	$I_D = 2\text{A}$	-	10	-	
Turn - off delay time	$t_{d(off)}^{*5}$	$R_L \approx 150\Omega$	-	30	-	
Fall time	$t_f^{*5}$	$R_G = 10\Omega$	-	25	-	

**●Gate charge characteristics** ( $T_a = 25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	$Q_g^{*5}$	$V_{DD} \approx 300\text{V}$	-	10.2	-	nC
Gate - Source charge	$Q_{gs}^{*5}$	$I_D = 4\text{A}$	-	2.5	-	
Gate - Drain charge	$Q_{gd}^{*5}$	$V_{GS} = 10\text{V}$	-	4.8	-	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} \approx 300\text{V}, I_D = 4\text{A}$	-	5.8	-	V

\*1 Limited only by maximum channel temperature allowed.

\*2  $P_w \leq 10\mu\text{s}$ , Duty cycle  $\leq 1\%$

\*3  $L \doteq 100\text{mH}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\Omega$ , STARTING  $T_j = 25^\circ\text{C}$

\*4  $T_C = 25^\circ\text{C}$

\*5 Pulsed

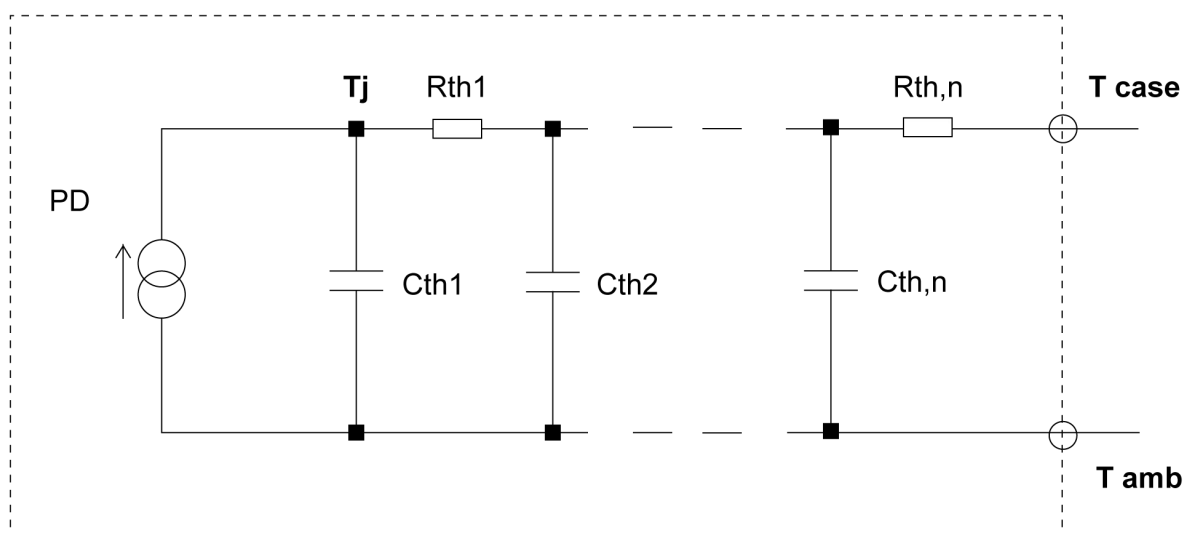
●Body diode electrical characteristics (Source-Drain) ( $T_a = 25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Continuous forward current	$I_S^{*1}$	$T_C = 25^\circ\text{C}$	-	-	4.0	A
Pulse forward current	$I_{SP}^{*2}$		-	-	12	A
Forward voltage	$V_{SD}^{*5}$	$V_{GS} = 0\text{V}, I_S = 4\text{A}$	-	-	1.5	V
Reverse recovery time	$t_{rr}^{*5}$	$I_S = 4\text{A}$ $di/dt = 100\text{A}/\mu\text{s}$	-	230	-	ns
Reverse recovery charge	$Q_{rr}^{*5}$		-	1.5	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rm}^{*5}$		-	12	-	A

●Typical transient thermal characteristics

Symbol	Value	Unit
$R_{th1}$	0.557	K/W
$R_{th2}$	1.61	
$R_{th3}$	2.24	

Symbol	Value	Unit
$C_{th1}$	0.00102	Ws/K
$C_{th2}$	0.00898	
$C_{th3}$	0.440	



● Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

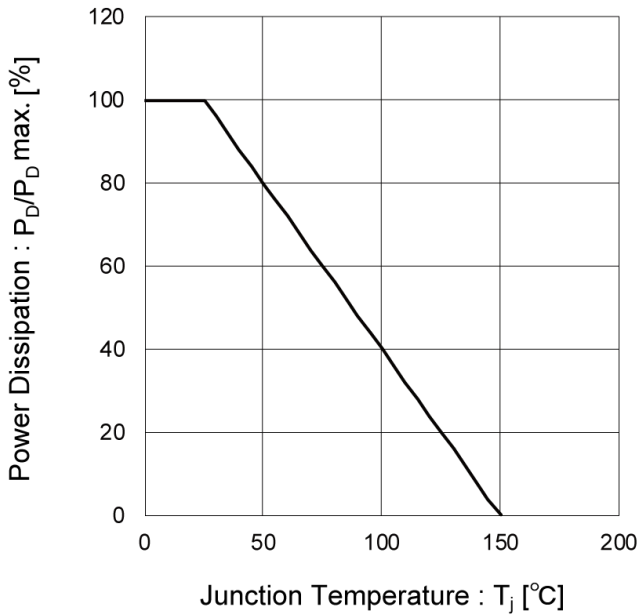


Fig.2 Maximum Safe Operating Area

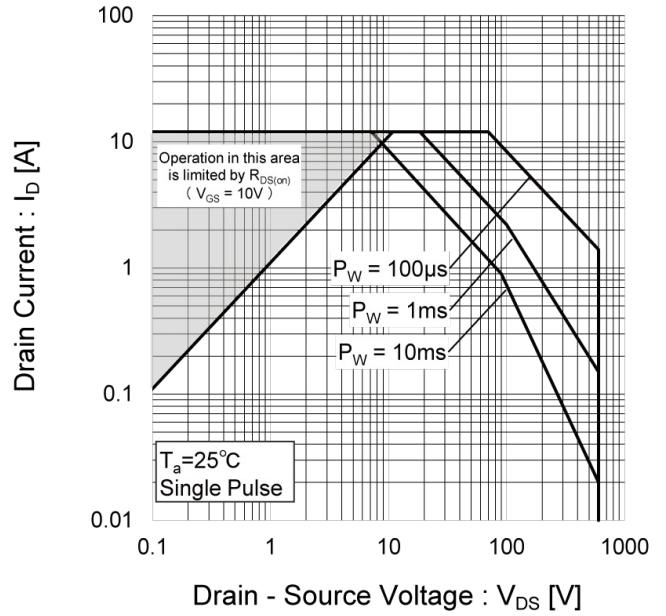
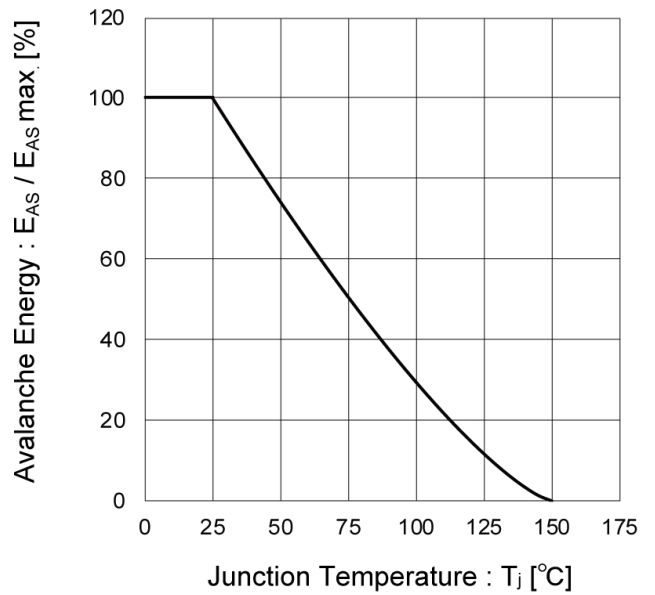


Fig.3 Avalanche Energy Derating Curve vs Junction temperature



● Electrical characteristic curves

Fig.4 Typical Output Characteristics(I)

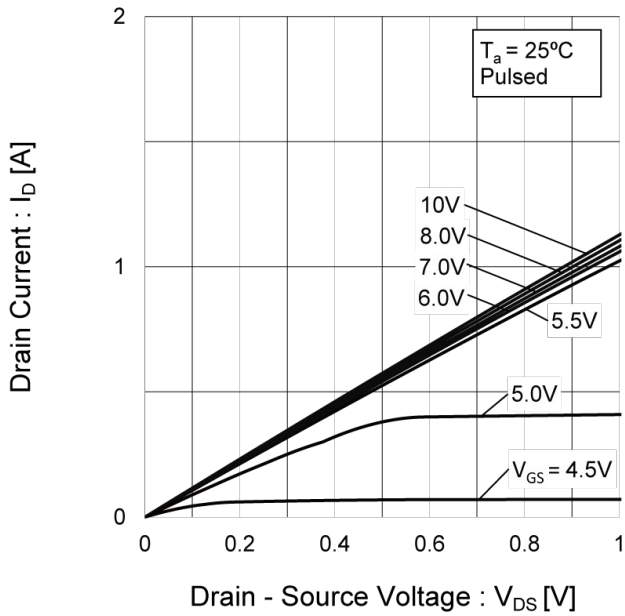
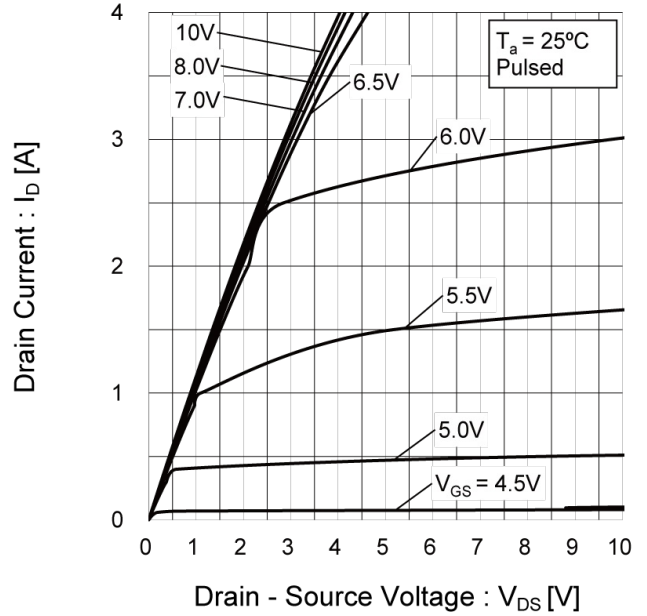


Fig.5 Typical Output Characteristics(II)



● Electrical characteristic curves

Fig. 6 Breakdown Voltage vs. Junction Temperature

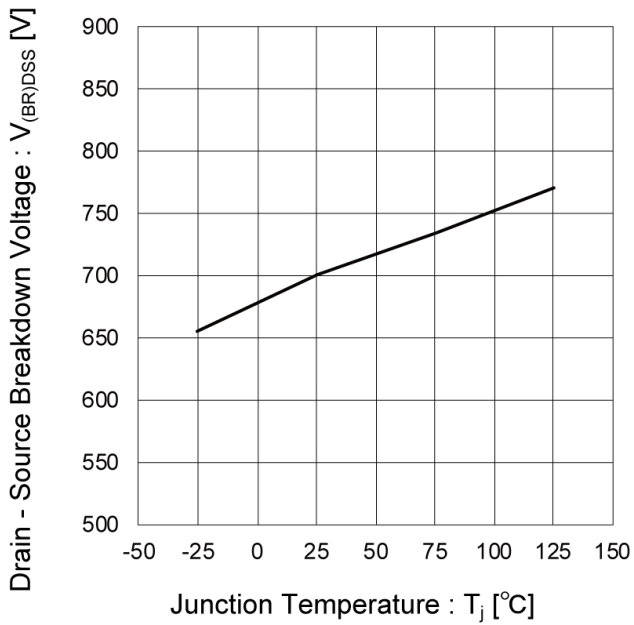


Fig.7 Typical Transfer Characteristics

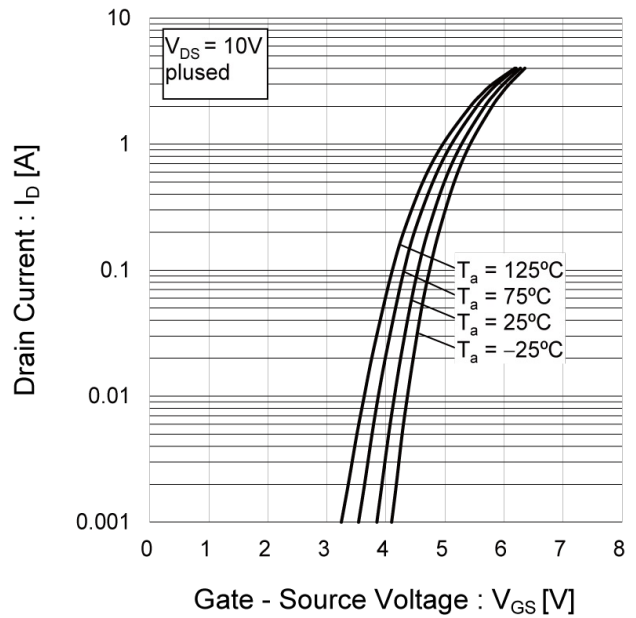


Fig.8 Gate Threshold Voltage vs. Junction Temperature

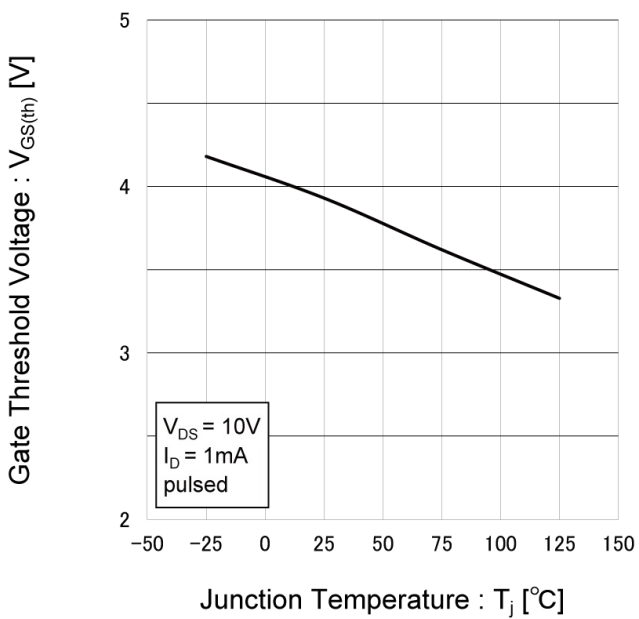
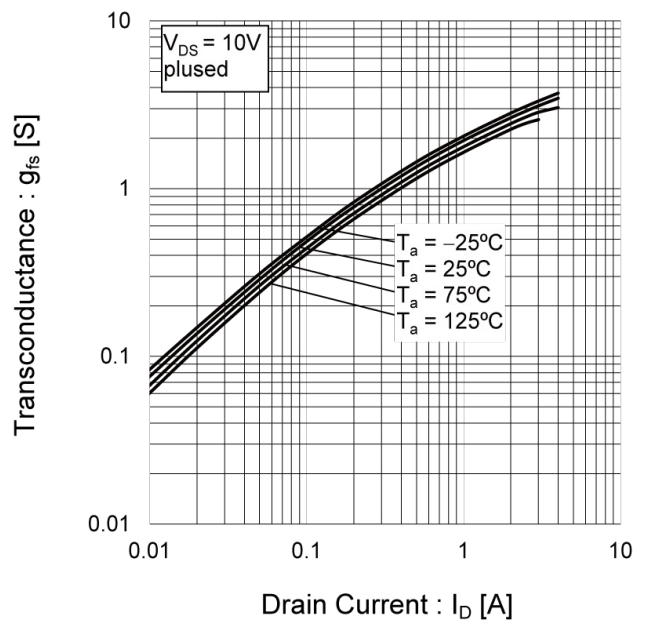


Fig.9 Forward Transfer Admittance vs. Drain Current



● Electrical characteristic curves

Fig.10 Static Drain - Source On - State Resistance vs. Gate Source Voltage

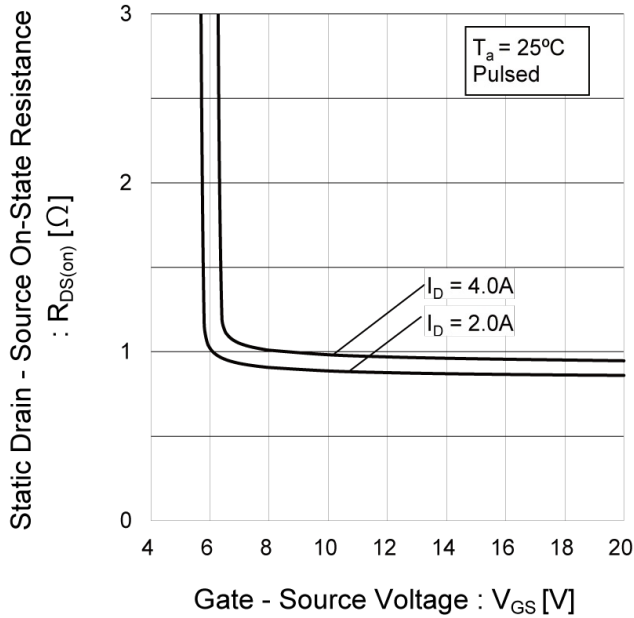


Fig.11 Static Drain - Source On - State Resistance vs. Junction Temperature

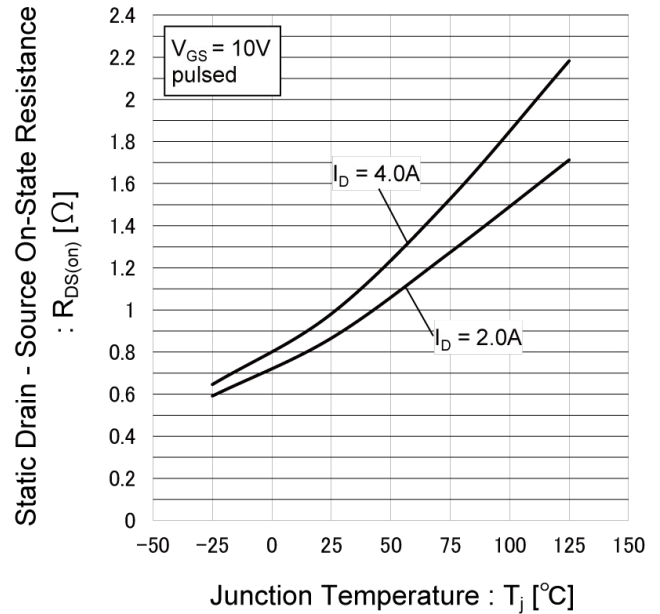
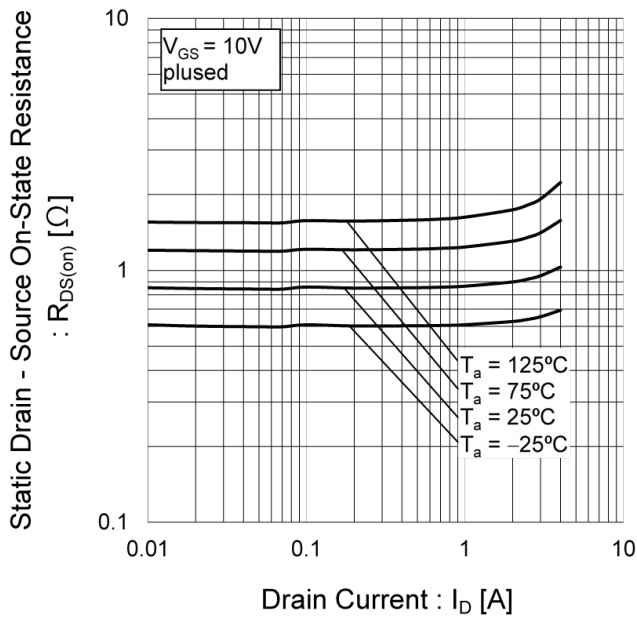


Fig.12 Static Drain - Source On - State Resistance vs. Drain Current(I)





●Electrical characteristic curves

Fig.13 Typical Capacitance vs. Drain - Source Voltage

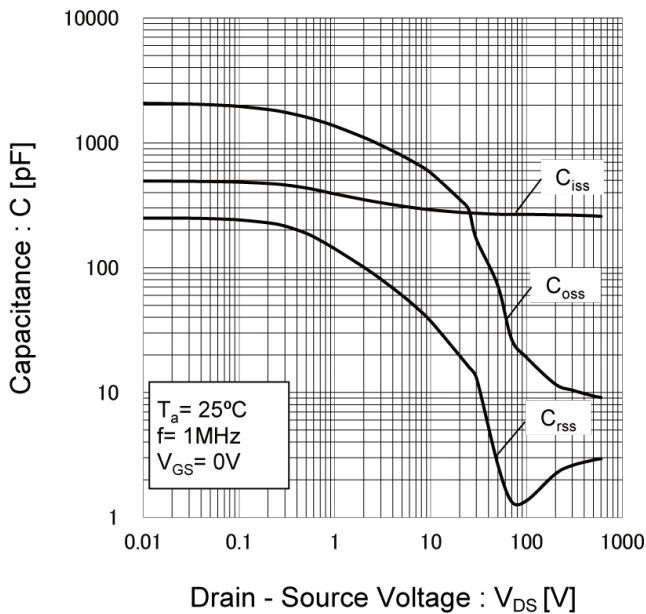


Fig.14 Switching Characteristics

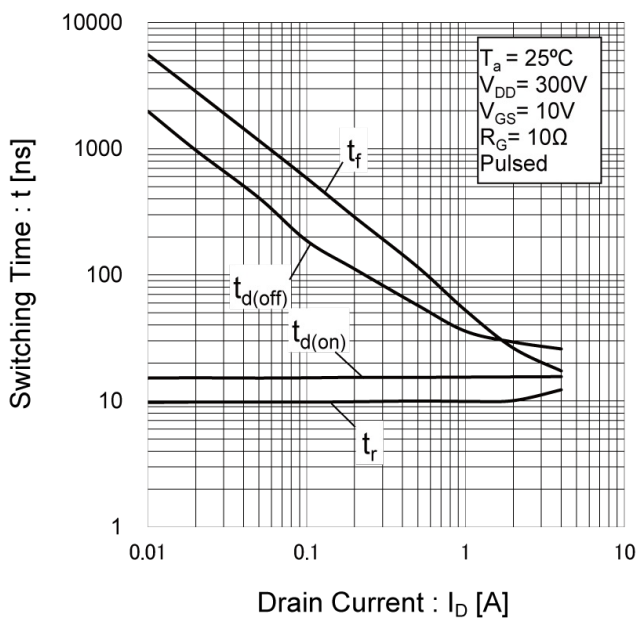
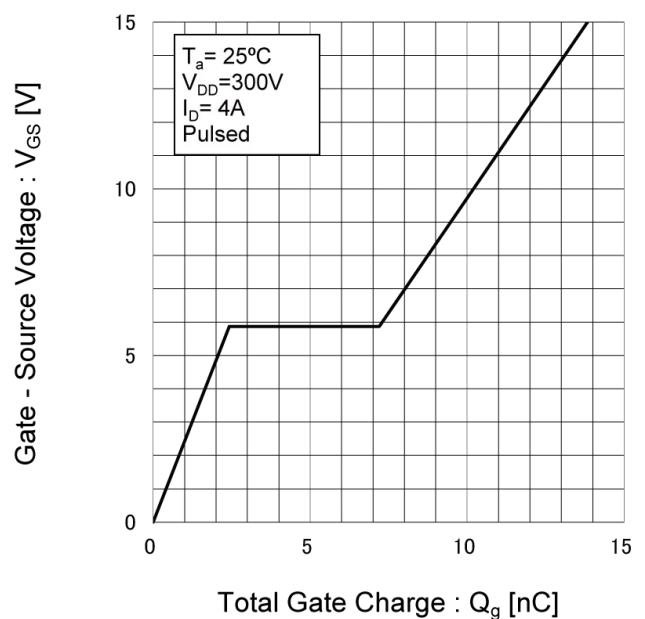


Fig.15 Dynamic Input Characteristics



● Electrical characteristic curves

Fig.16 Inverse Diode Forward Current vs. Source - Drain Voltage

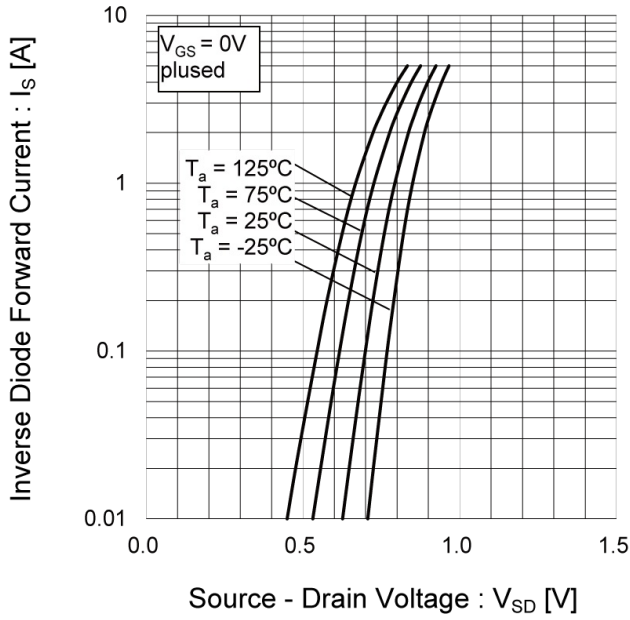
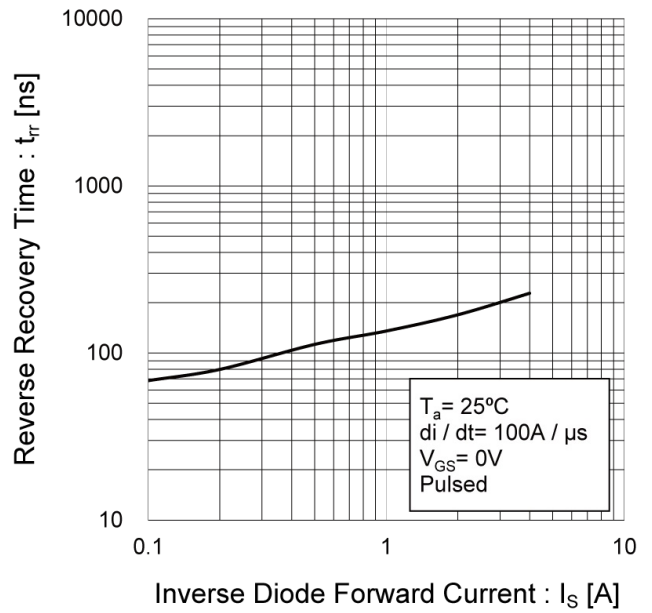


Fig.17 Reverse Recovery Time vs. Inverse Diode Forward Current



● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit



Fig.1-2 Switching Waveforms

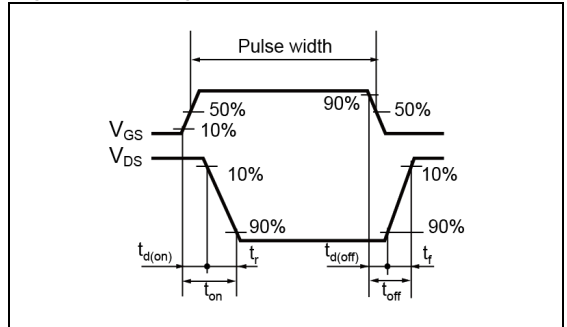


Fig.2-1 Gate Charge Measurement Circuit



Fig.2-2 Gate Charge Waveform

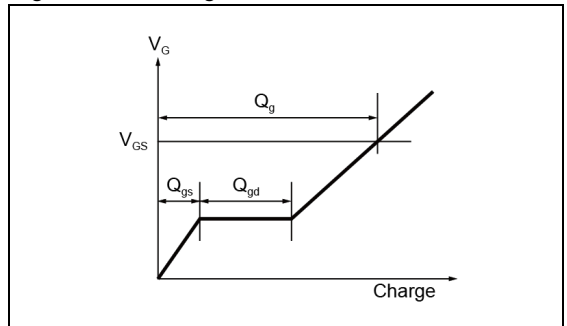


Fig.3-1 Avalanche Measurement Circuit



Fig.3-2 Avalanche Waveform

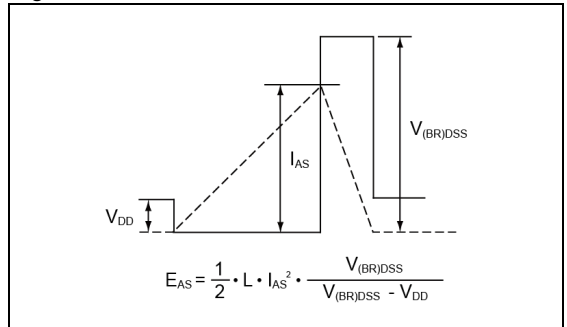


Fig.4-1 dv/dt Measurement Circuit

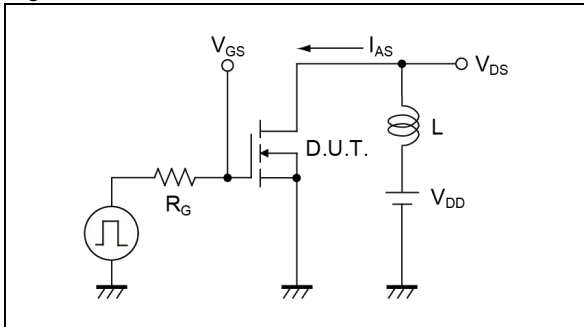


Fig.4-2 dv/dt Waveform

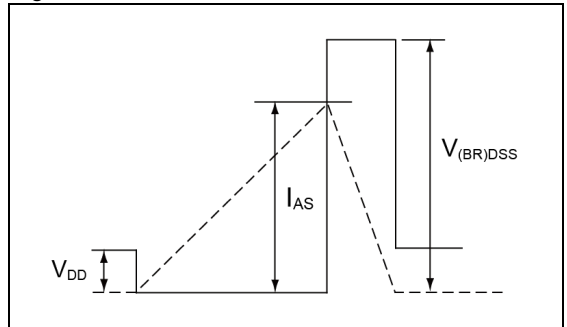


Fig.5-1 dv/dt Measurement Circuit

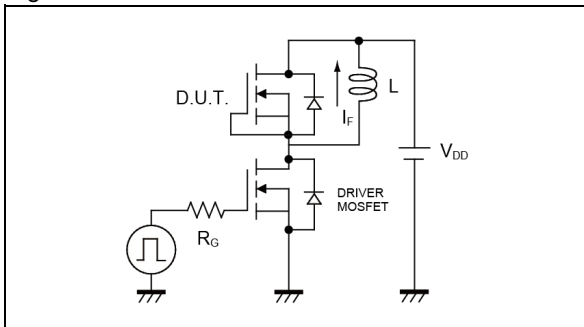
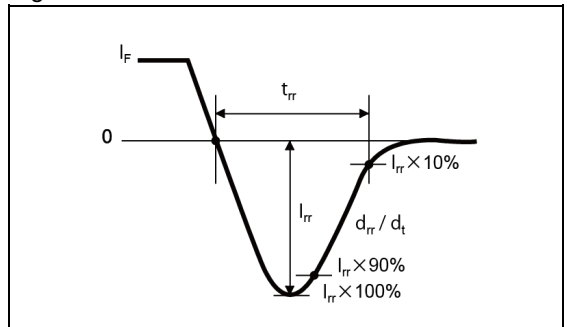
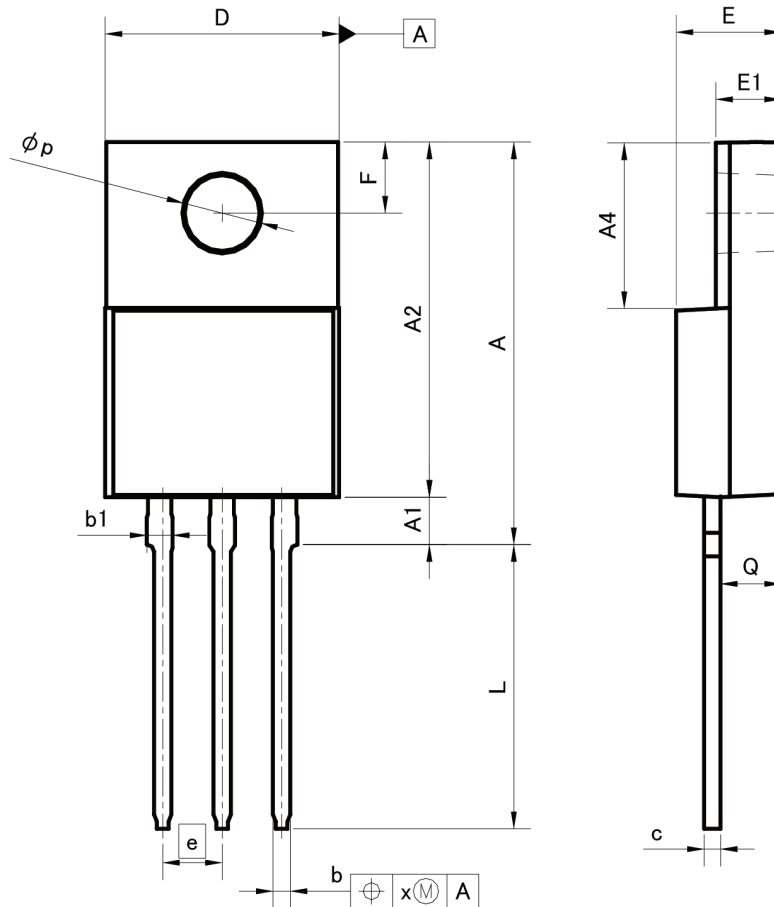


Fig.5-2 dv/dt Waveform



●Dimensions

TO-220FM



DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	16.60	17.60	0.654	0.693
A1	1.80	2.20	0.071	0.087
A2	14.80	15.40	0.583	0.606
A4	6.80	7.20	0.268	0.283
b	0.70	0.85	0.028	0.033
b1	1.10	1.50	0.043	0.059
c	0.70	0.85	0.028	0.033
D	9.90	10.30	0.390	0.406
E	4.40	4.80	0.173	0.189
e	2.54		0.100	
E1	2.70	3.00	0.106	0.118
F	2.80	3.20	0.110	0.126
L	11.50	12.50	0.453	0.492
p	3.00	3.40	0.118	0.134
Q	2.10	3.10	0.083	0.122
x	-	0.38	-	0.015

Dimension in mm/inches

## 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 Products 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 ensure the accuracy of the information contained in this document. However, ROHM does not warrant 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.



Thank you for your accessing to ROHM product informations.  
More detail product informations and catalogs are available, please contact us.

**ROHM Customer Support System**

<http://www.rohm.com/contact/>