

$V_{DSS}$	600V
$R_{DS(on)}(Max.)$	0.39Ω
$I_D$	±11A
$P_D$	53W

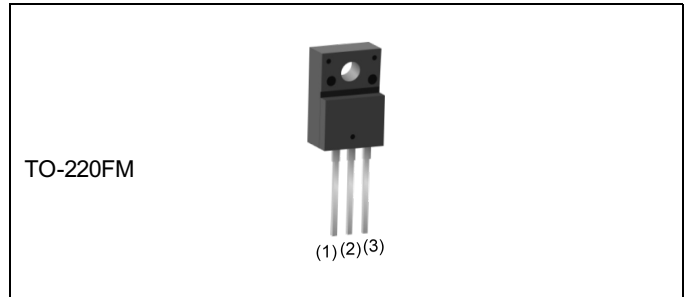
### ●Features

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

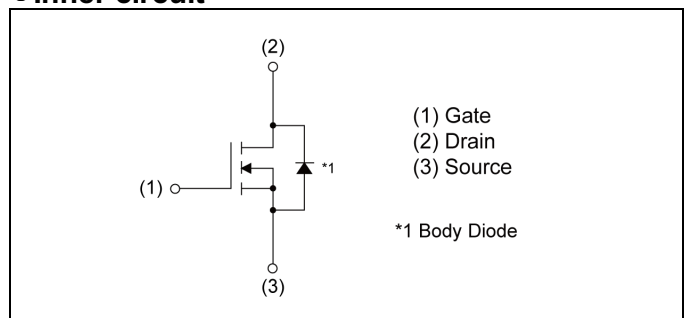
### ●Application

Switching

### ●Outline



### ●Inner circuit



### ●Packaging specifications

Type	Packing	Bulk
	Reel size (mm)	-
	Tape width (mm)	-
	Basic ordering unit (pcs)	500
	Taping code	-
	Marking	R6011KNX

### ●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 ( $T_c = 25^\circ C$ )		$I_D^{*1}$	±11	A
Pulsed drain current		$I_{DP}^{*2}$	±33	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		$E_{AS}^{*3}$	210	mJ
Power dissipation ( $T_c = 25^\circ C$ )		$P_D$	53	W
Junction temperature		$T_j$	150	°C
Operating junction and storage temperature range		$T_{stg}$	-55 to +150	°C

### ● Thermal resistance

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Thermal resistance, junction - case	$R_{thJC}^{*4}$	-	-	2.4	°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	$I_{DSS}$	$V_{DS} = 600V, V_{GS} = 0V$ $T_j = 25^\circ\text{C}$	-	-	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	$R_{DS(on)}^{*5}$	$V_{GS} = 10V, I_D = 3.8A$ $T_j = 25^\circ\text{C}$	-	0.34	0.39	$\Omega$
		$T_j = 125^\circ\text{C}$	-	0.72	-	
Gate resistance	$R_G$	$f = 1MHz, \text{open drain}$	-	1.5	-	$\Omega$

**●Electrical characteristics (T<sub>a</sub> = 25°C)**

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Forward Transfer Admittance	$ Y_{fs} ^{*5}$	V <sub>DS</sub> = 10V, I <sub>D</sub> = 5.5A	2.9	5.8	-	S
Input capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0V	-	740	-	pF
Output capacitance	C <sub>oss</sub>	V <sub>DS</sub> = 25V	-	630	-	
Reverse transfer capacitance	C <sub>rss</sub>	f = 1MHz	-	30	-	
Turn - on delay time	t <sub>d(on)</sub> <sup>*5</sup>	V <sub>DD</sub> ≈ 300V, V <sub>GS</sub> = 10V	-	20	-	ns
Rise time	t <sub>r</sub> <sup>*5</sup>	I <sub>D</sub> = 5.5A	-	25	-	
Turn - off delay time	t <sub>d(off)</sub> <sup>*5</sup>	R <sub>L</sub> ≈ 54.9Ω	-	40	-	
Fall time	t <sub>f</sub> <sup>*5</sup>	R <sub>G</sub> = 10Ω	-	20	-	

**●Gate charge characteristics (T<sub>a</sub> = 25°C)**

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q <sub>g</sub> <sup>*5</sup>	V <sub>DD</sub> ≈ 300V	-	22	-	nC
Gate - Source charge	Q <sub>gs</sub> <sup>*5</sup>	I <sub>D</sub> = 11A	-	6	-	
Gate - Drain charge	Q <sub>gd</sub> <sup>*5</sup>	V <sub>GS</sub> = 10V	-	10	-	
Gate plateau voltage	V <sub>(plateau)</sub>	V <sub>DD</sub> ≈ 300V, I <sub>D</sub> = 11A	-	6.7	-	V

\*1 Limited only by maximum channel temperature allowed.

\*2 P<sub>w</sub> ≤ 10μs, Duty cycle ≤ 1%

\*3 L ≐ 100mH, V<sub>DD</sub>=50V, R<sub>G</sub>=25Ω, STARTING T<sub>j</sub>=25°C

\*4 T<sub>C</sub>=25°C

\*5 Pulsed

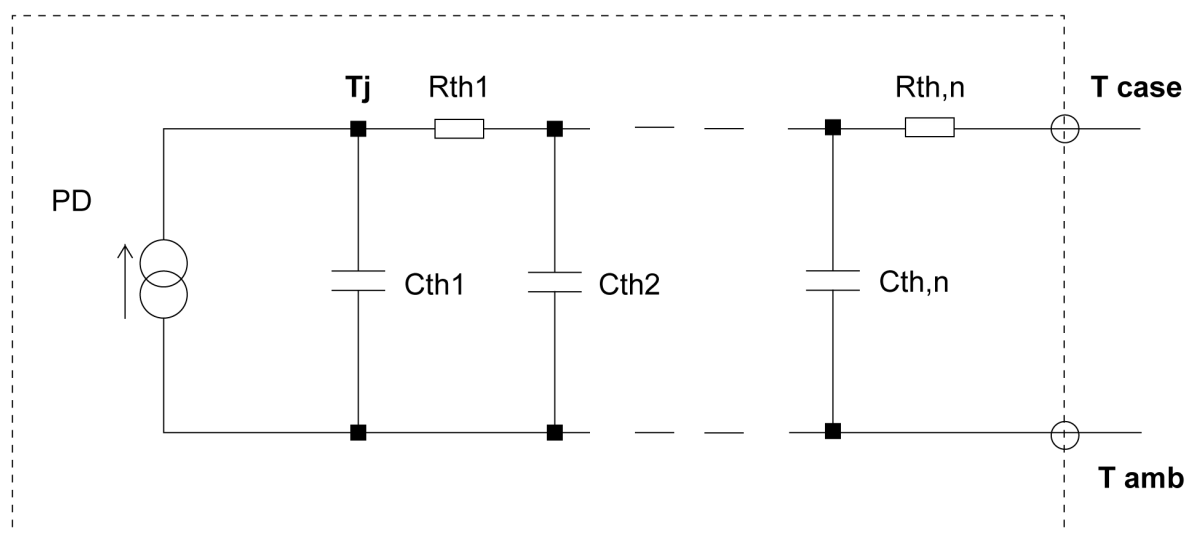
**● Body diode electrical characteristics (Source-Drain) ( $T_a = 25^\circ\text{C}$ )**

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Continuous forward current	$I_S^{*1}$	$T_C = 25^\circ\text{C}$	-	-	11	A
Pulse forward current	$I_{SP}^{*2}$		-	-	33	A
Forward voltage	$V_{SD}^{*5}$	$V_{GS} = 0\text{V}, I_S = 11\text{A}$	-	-	1.5	V
Reverse recovery time	$t_{rr}^{*5}$	$I_S = 11\text{A}$ $di/dt = 100\text{A}/\mu\text{s}$	-	355	-	ns
Reverse recovery charge	$Q_{rr}^{*5}$		-	3.8	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rm}^{*5}$		-	22	-	A

**● Typical transient thermal characteristics**

Symbol	Value	Unit
$R_{th1}$	0.261	K/W
$R_{th2}$	0.973	
$R_{th3}$	2.18	

Symbol	Value	Unit
$C_{th1}$	0.00167	Ws/K
$C_{th2}$	0.0192	
$C_{th3}$	0.460	



● Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

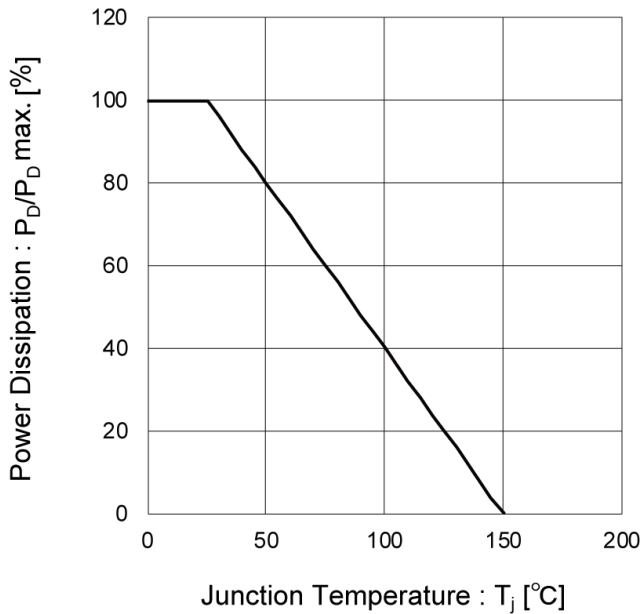


Fig.2 Maximum Safe Operating Area

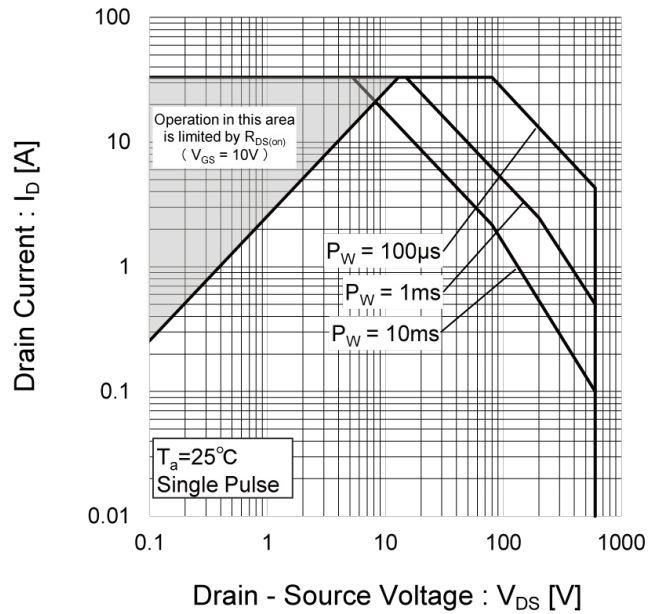
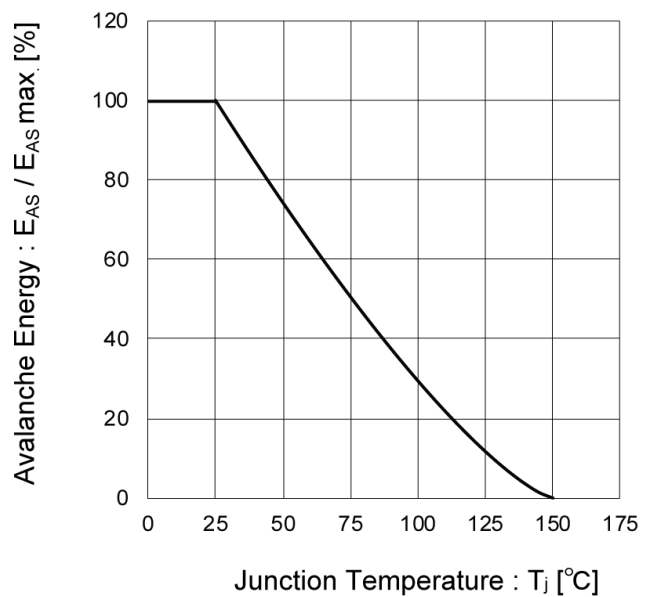


Fig.3 Avalanche Energy Derating Curve vs. Junction Temperature



● Electrical characteristic curves

Fig.4 Typical Output Characteristics(I)

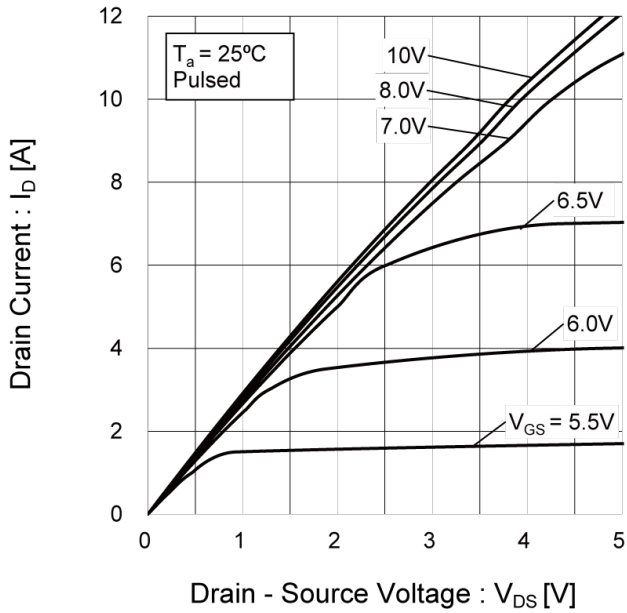
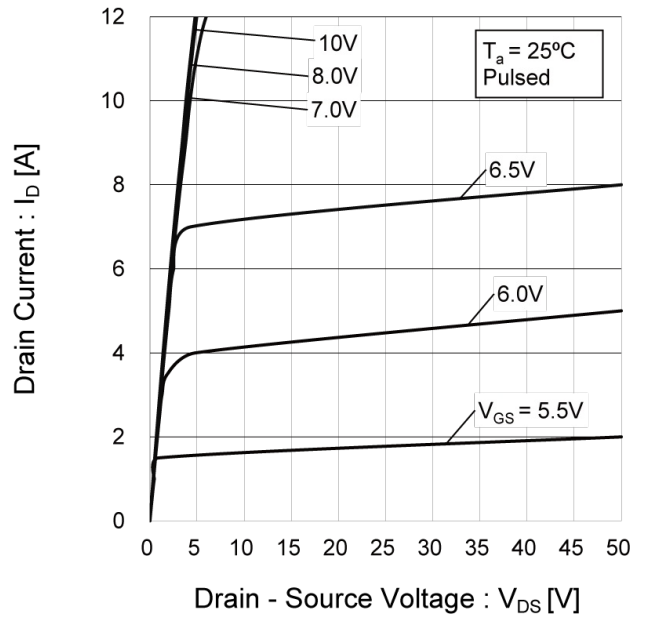


Fig.5 Typical Output Characteristics(II)



● Electrical characteristic curves

Fig.6 Breakdown Voltage vs. Junction Temperature

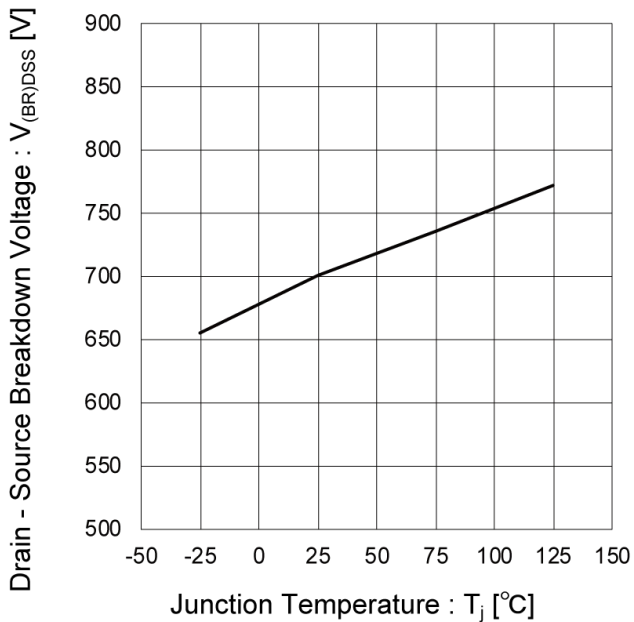


Fig.7 Typical Transfer Characteristics

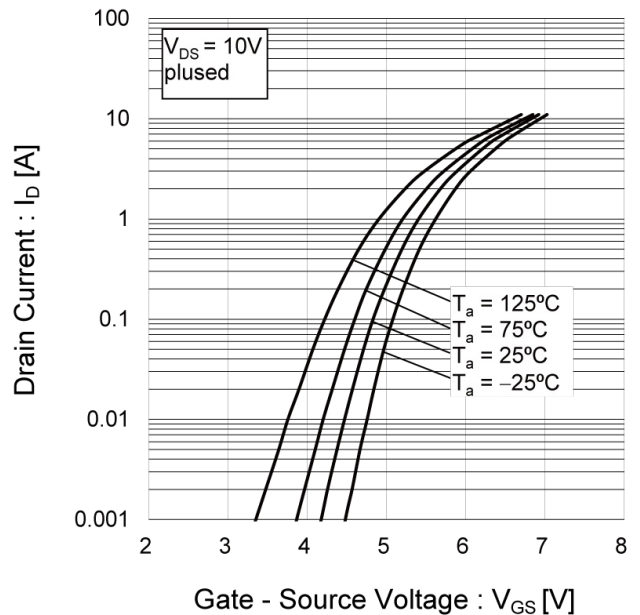


Fig.8 Gate Threshold Voltage vs. Junction Temperature

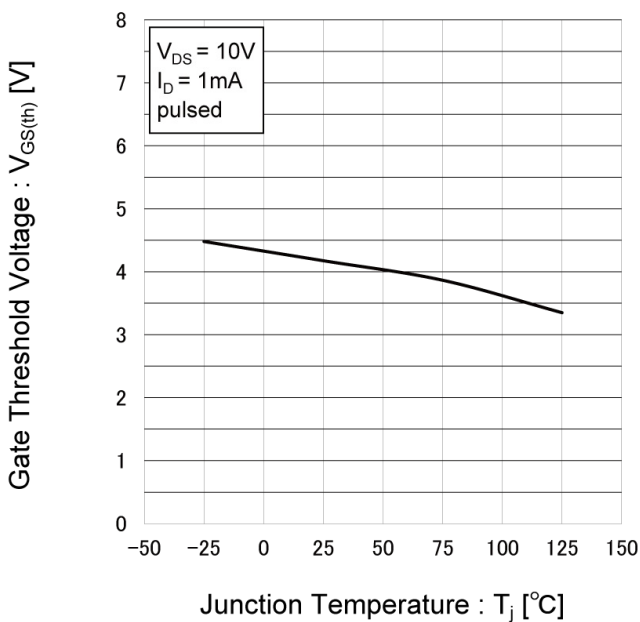
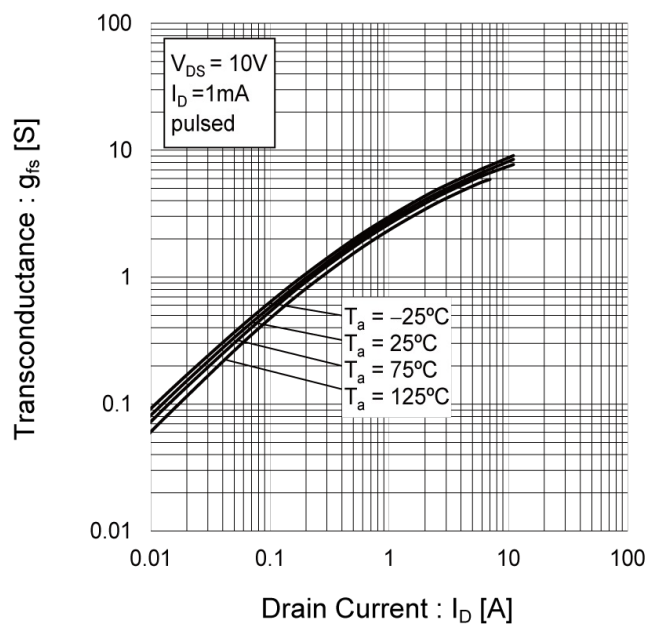


Fig.9 Forward Transfer Admittance vs. Drain Current



● Electrical characteristic curves

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

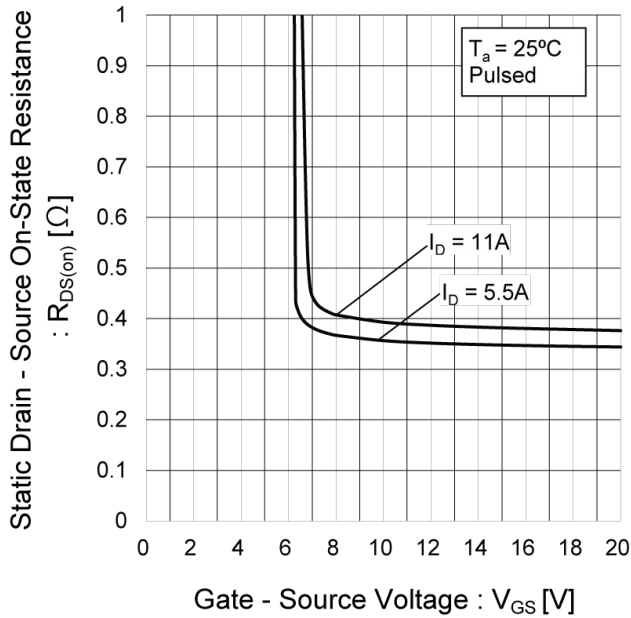


Fig.11 Static Drain - Source On - State Resistance vs. Junction Temperature

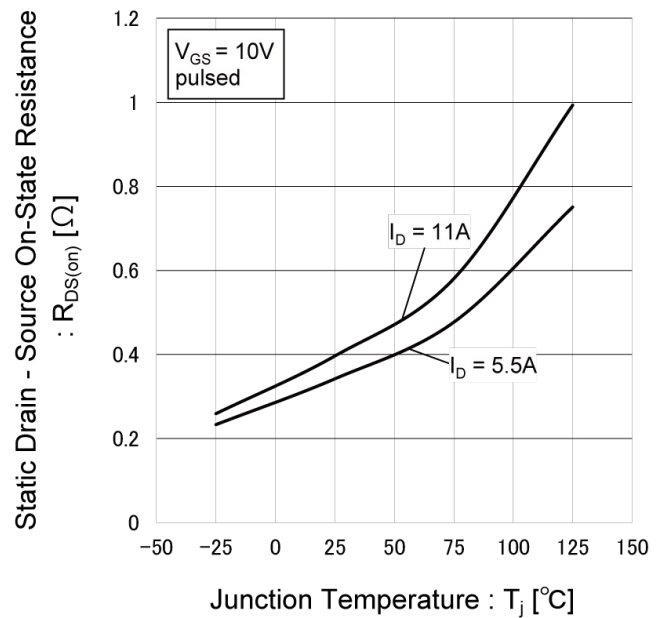
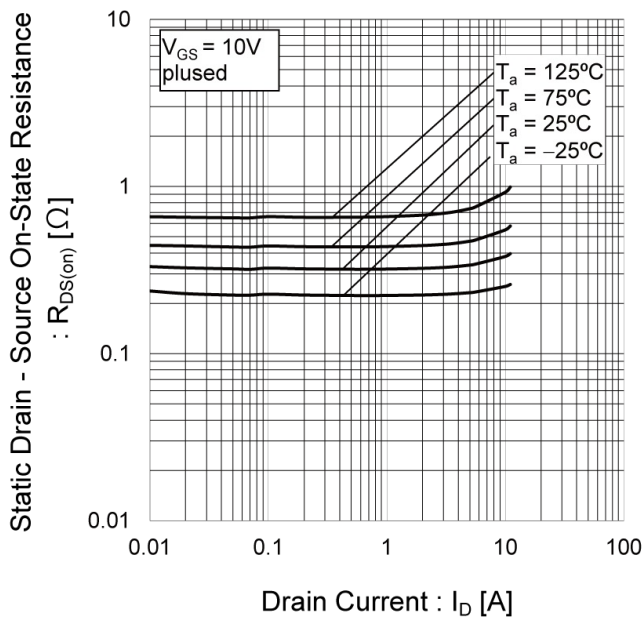


Fig.12 Static Drain - Source On - State Resistance vs. Drain Current(I)





● Electrical characteristic curves

Fig.13 Typical Capacitance vs. Drain - Source Voltage

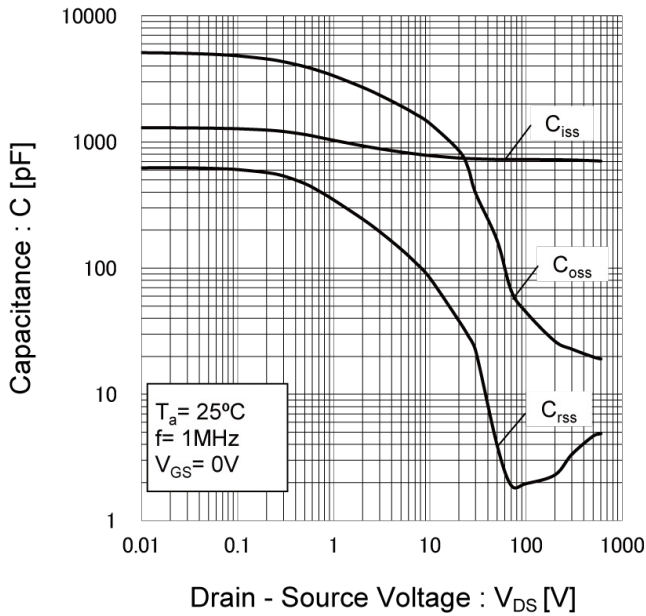


Fig.14 Switching Characteristics

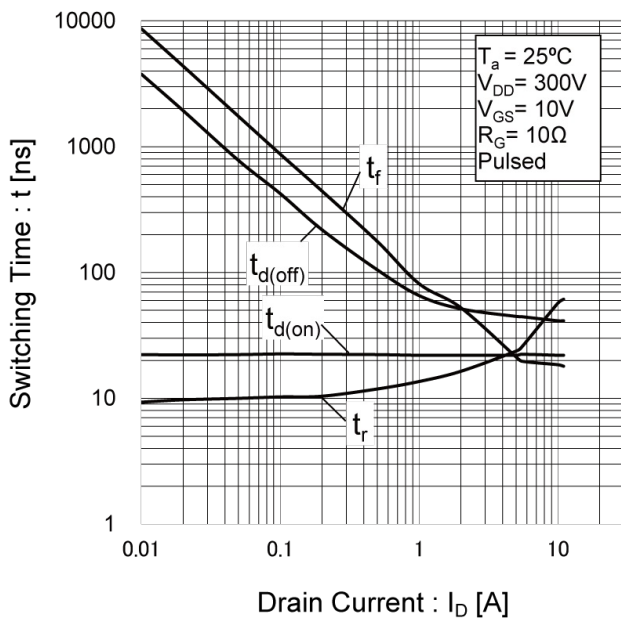
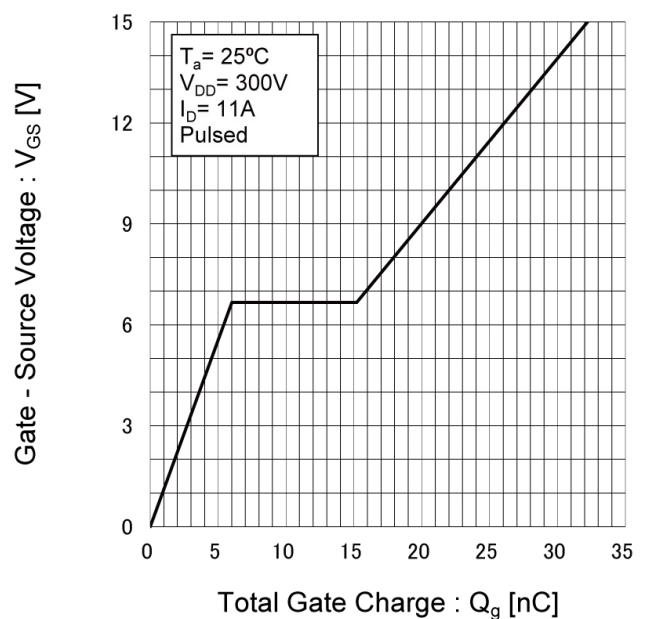


Fig.15 Dynamic Input Characteristics



● Electrical characteristic curves

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

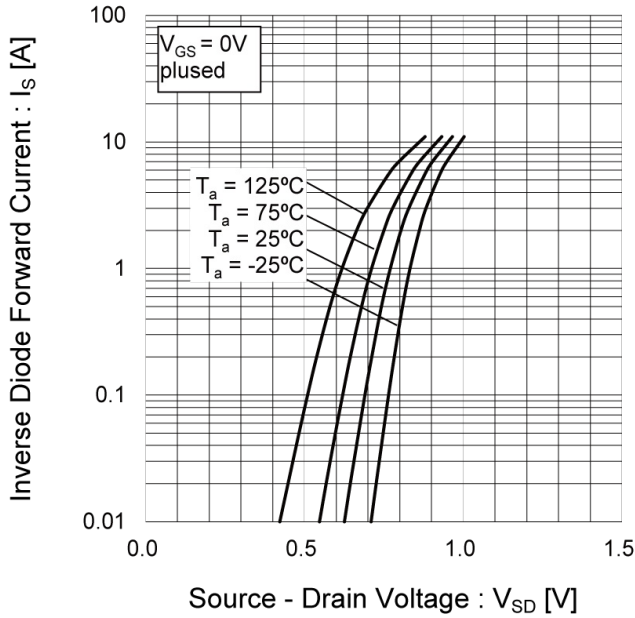
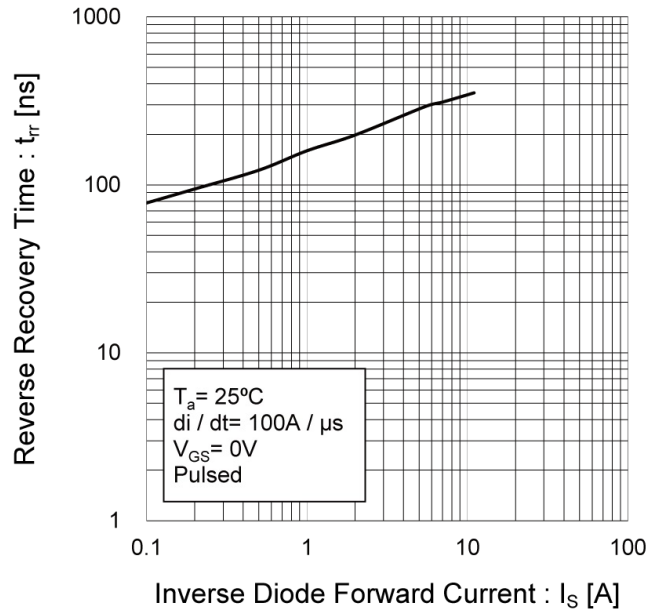


Fig.17 Reverse Recovery Time vs. Inverse Diode Forward Current



● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

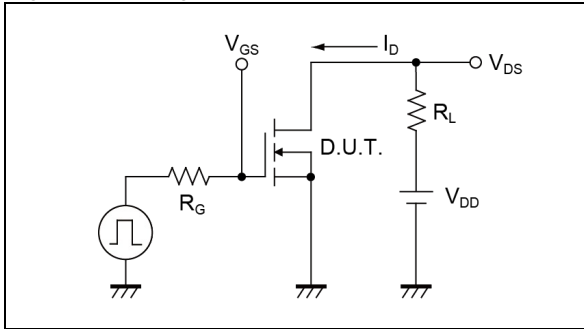


Fig.1-2 Switching Waveforms

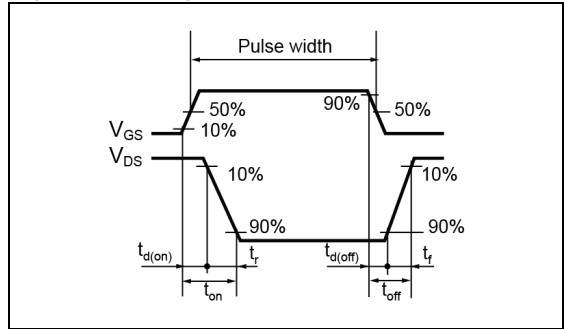


Fig.2-1 Gate Charge Measurement Circuit

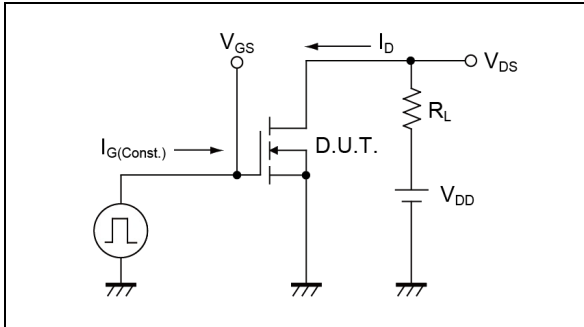


Fig.2-2 Gate Charge Waveform

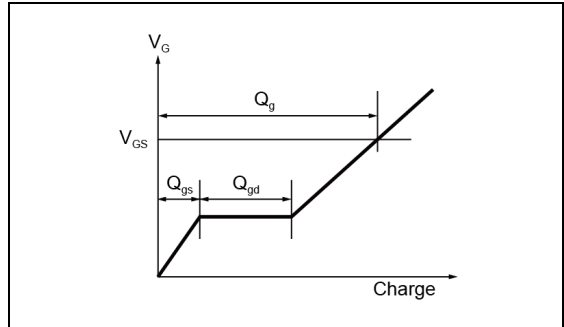


Fig.3-1 Avalanche Measurement Circuit

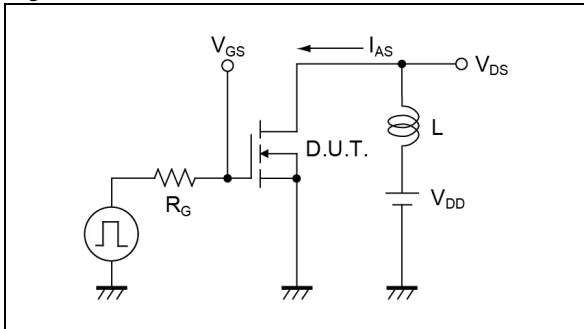


Fig.3-2 Avalanche Waveform

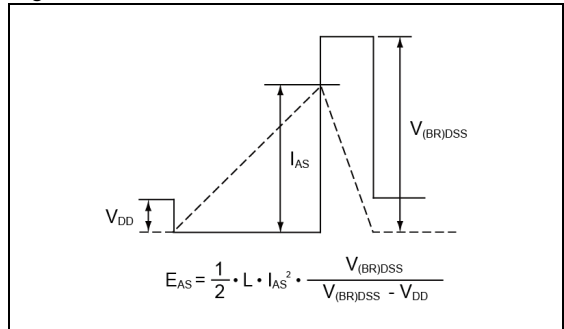


Fig.4-1 dv/dt Measurement Circuit

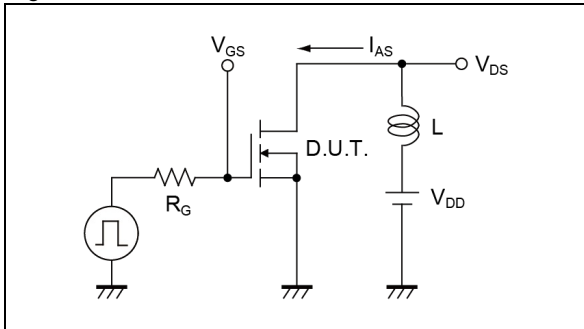


Fig.4-2 dv/dt Waveform

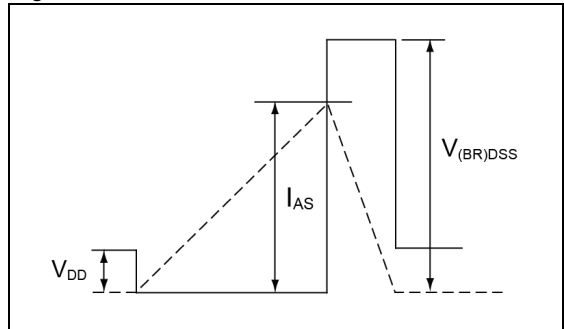


Fig.5-1 dv/dt Measurement Circuit

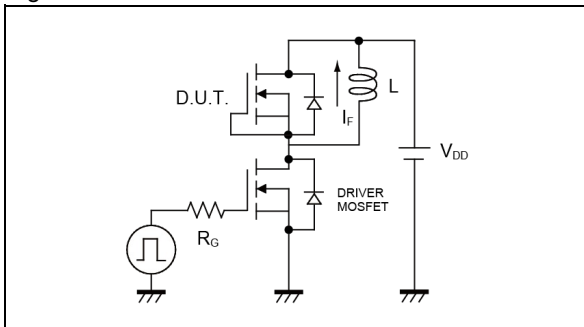
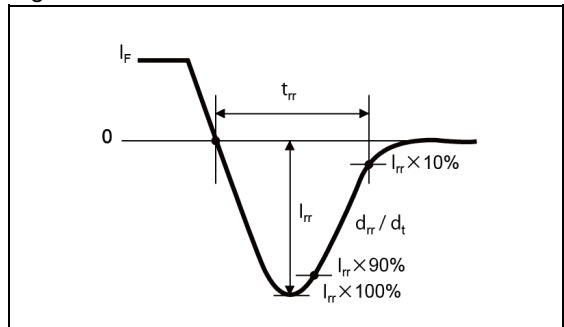
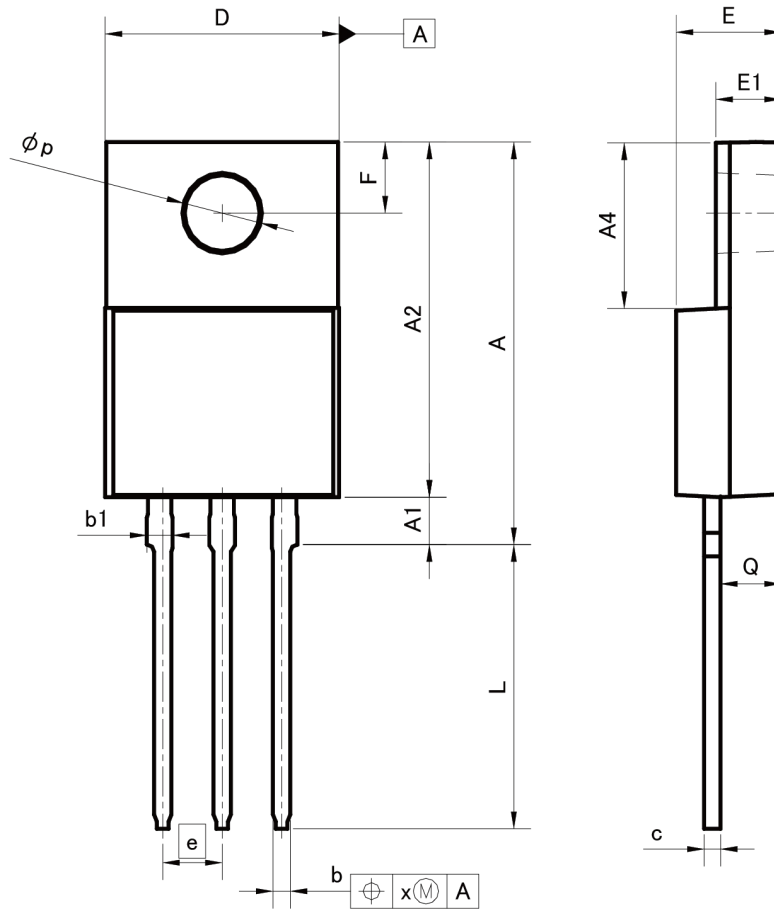


Fig.5-2 dv/dt Waveform



●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

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