

$V_{DSS}$	600V
$R_{DS(on)}(Max.)$	0.196Ω
$I_D$	±20A
$P_D$	68W

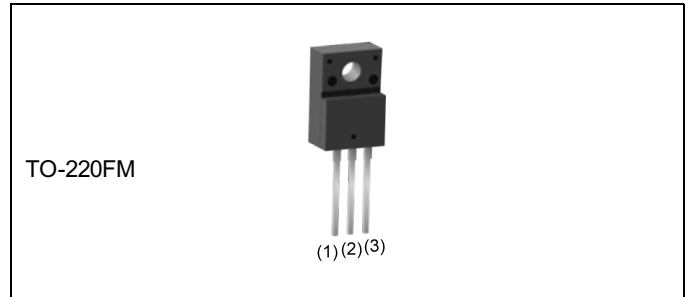
### ●Features

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

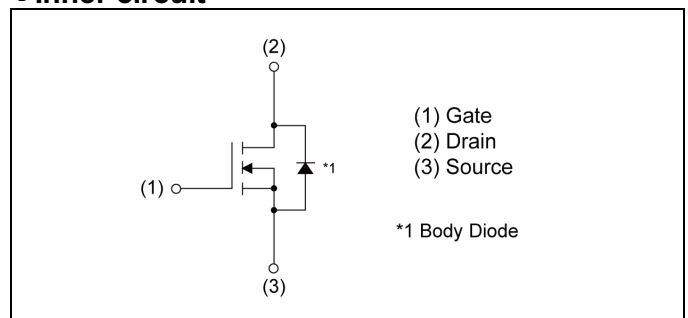
### ●Application

Switching

### ●Outline



### ●Inner circuit



### ●Packaging specifications

Type	Packing	Bulk
	Reel size (mm)	-
	Tape width (mm)	-
	Basic ordering unit (pcs)	500
	Taping code	-
	Marking	R6020KNX

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

Parameter		Symbol	Value	Unit
Drain - Source voltage		$V_{DSS}$	600	V
Continuous drain current ( $T_c = 25^\circ\text{C}$ )		$I_D^{*1}$	±20	A
Pulsed drain current		$I_{DP}^{*2}$	±60	A
Gate - Source voltage	Static	$V_{GSS}$	±20	V
	AC ( $f > 1\text{Hz}$ )		±30	V
Avalanche current, single pulse		$I_{AS}$	3.4	A
Avalanche energy, single pulse		$E_{AS}^{*3}$	418	mJ
Power dissipation ( $T_c = 25^\circ\text{C}$ )		$P_D$	68	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	$R_{thJC}^{*4}$	-	-	1.8	°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	$R_{DS(on)}^{*5}$	$V_{GS} = 10V, I_D = 9.5A$ $T_j = 25^\circ\text{C}$	-	0.170	0.196	$\Omega$
		$T_j = 125^\circ\text{C}$	-	0.36	-	
Gate resistance	$R_G$	$f = 1MHz, \text{open drain}$	-	2.3	-	$\Omega$

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

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Forward Transfer Admittance	$ Y_{fs} ^{*5}$	$V_{DS} = 10\text{V}, I_D = 10\text{A}$	5	10	-	S
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{V}$	-	1550	-	pF
Output capacitance	$C_{oss}$	$V_{DS} = 25\text{V}$	-	1350	-	
Reverse transfer capacitance	$C_{rss}$	$f = 1\text{MHz}$	-	55	-	
Turn - on delay time	$t_{d(on)}^{*5}$	$V_{DD} \approx 300\text{V}, V_{GS} = 10\text{V}$	-	30	-	ns
Rise time	$t_r^{*5}$	$I_D = 10\text{A}$	-	30	-	
Turn - off delay time	$t_{d(off)}^{*5}$	$R_L \approx 30\Omega$	-	55	-	
Fall time	$t_f^{*5}$	$R_G = 10\Omega$	-	10	-	

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

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	$Q_g^{*5}$	$V_{DD} \approx 300\text{V}$	-	40	-	nC
Gate - Source charge	$Q_{gs}^{*5}$	$I_D = 20\text{A}$	-	12	-	
Gate - Drain charge	$Q_{gd}^{*5}$	$V_{GS} = 10\text{V}$	-	15	-	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} \approx 300\text{V}, I_D = 20\text{A}$	-	6.4	-	V

\*1 Limited only by maximum channel temperature allowed.

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

\*3  $L \doteq 70\text{mH}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\Omega$ , STARTING  $T_j = 25^\circ\text{C}$

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

\*5 Pulsed

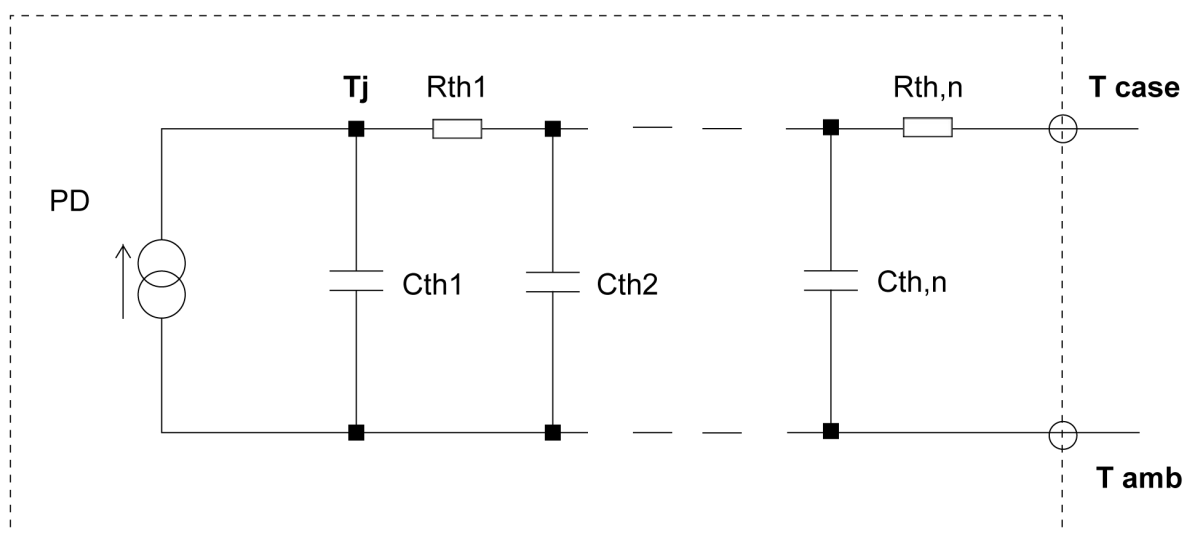
●Body diode electrical characteristics (Source-Drain) ( $T_a = 25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Continuous forward current	$I_S^{*1}$	$T_C = 25^\circ\text{C}$	-	-	20	A
Pulse forward current	$I_{SP}^{*2}$		-	-	60	A
Forward voltage	$V_{SD}^{*5}$	$V_{GS} = 0\text{V}, I_S = 20\text{A}$	-	-	1.5	V
Reverse recovery time	$t_{rr}^{*5}$	$I_S = 20\text{A}$ $di/dt = 100\text{A}/\mu\text{s}$	-	500	-	ns
Reverse recovery charge	$Q_{rr}^{*5}$		-	7.5	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rm}^{*5}$		-	30	-	A

●Typical transient thermal characteristics

Symbol	Value	Unit
$R_{th1}$	0.118	K/W
$R_{th2}$	0.722	
$R_{th3}$	2.15	

Symbol	Value	Unit
$C_{th1}$	0.00216	Ws/K
$C_{th2}$	0.0346	
$C_{th3}$	0.491	



● Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

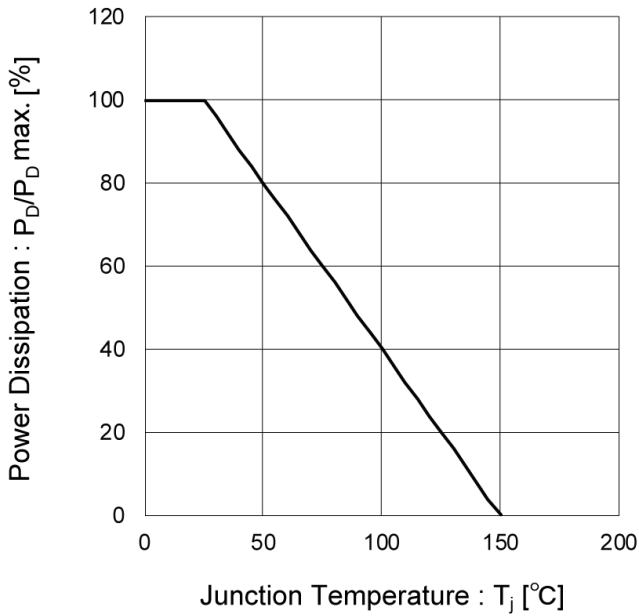


Fig.2 Maximum Safe Operating Area

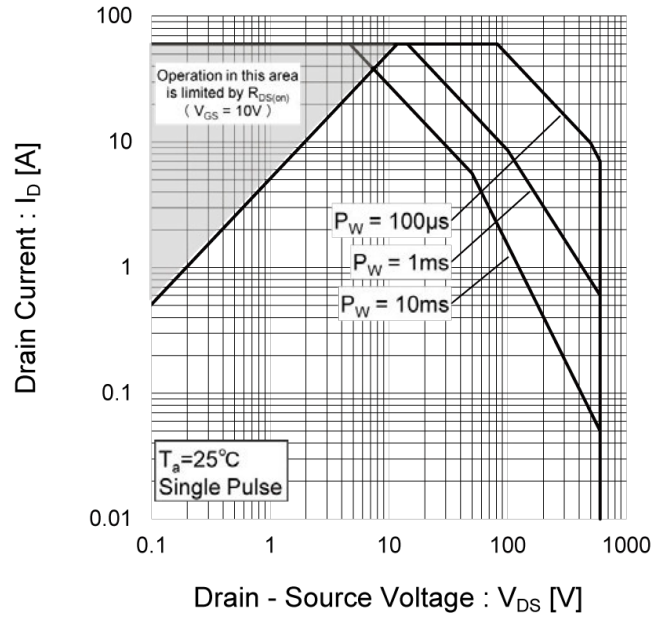
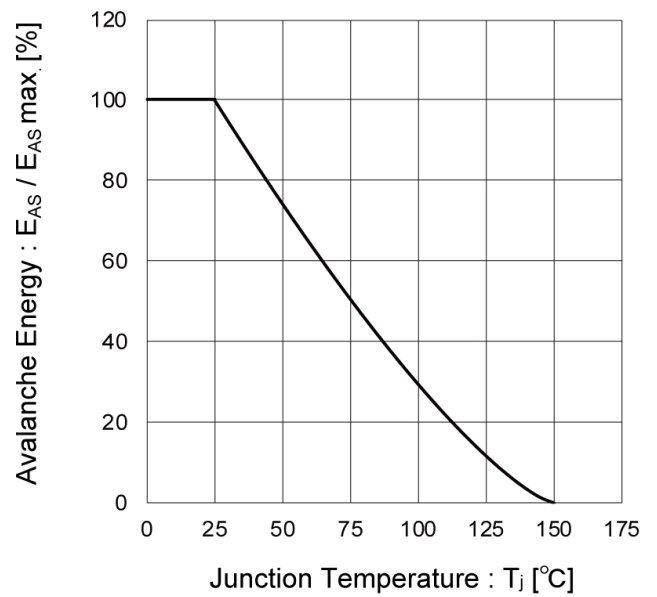


Fig.3 Avalanche Energy Derating Curve vs. Junction Temperature



● Electrical characteristic curves

Fig.4 Typical Output Characteristics(I)

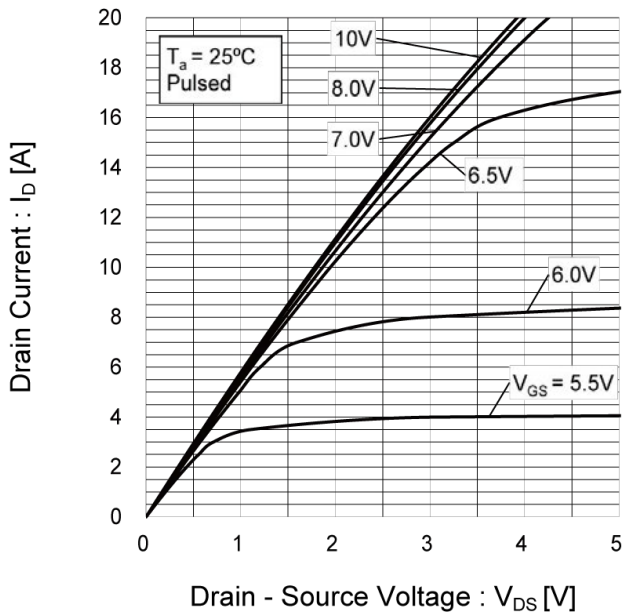
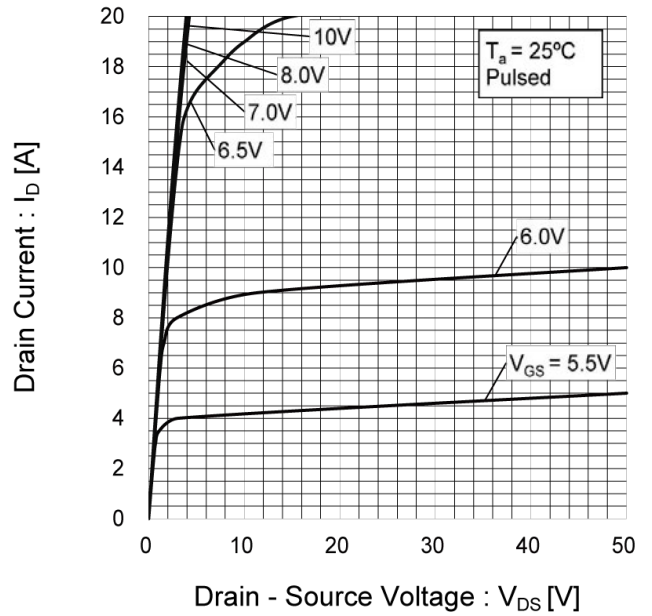


Fig.5 Typical Output Characteristics(II)



● Electrical characteristic curves

Fig.6 Breakdown Voltage vs. Junction Temperature

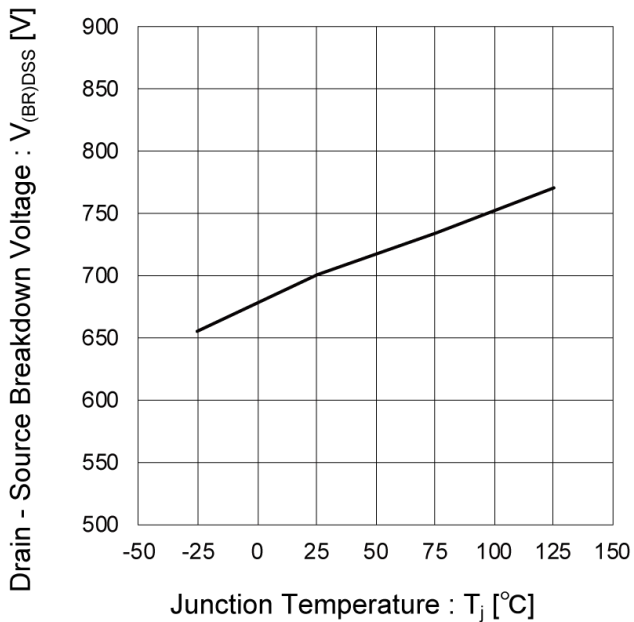


Fig.7 Typical Transfer Characteristics

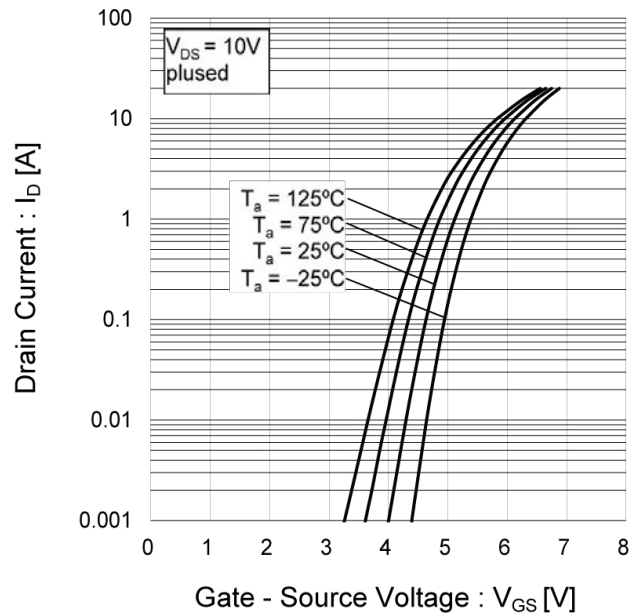


Fig.8 Gate Threshold Voltage vs. Junction Temperature

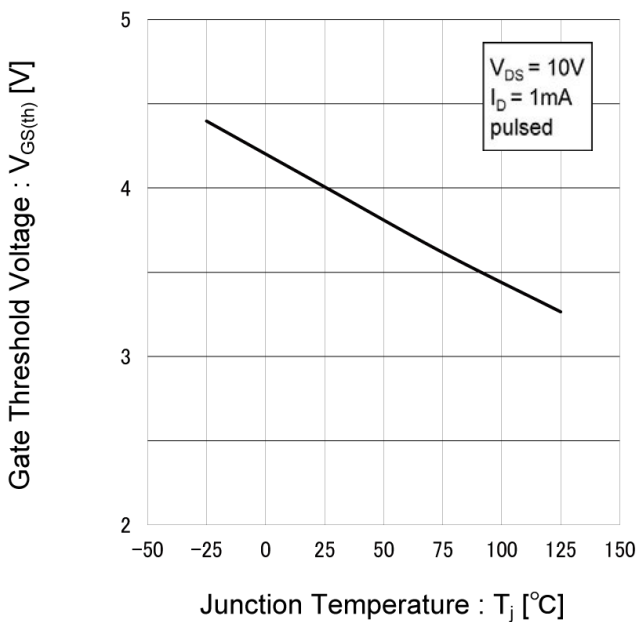
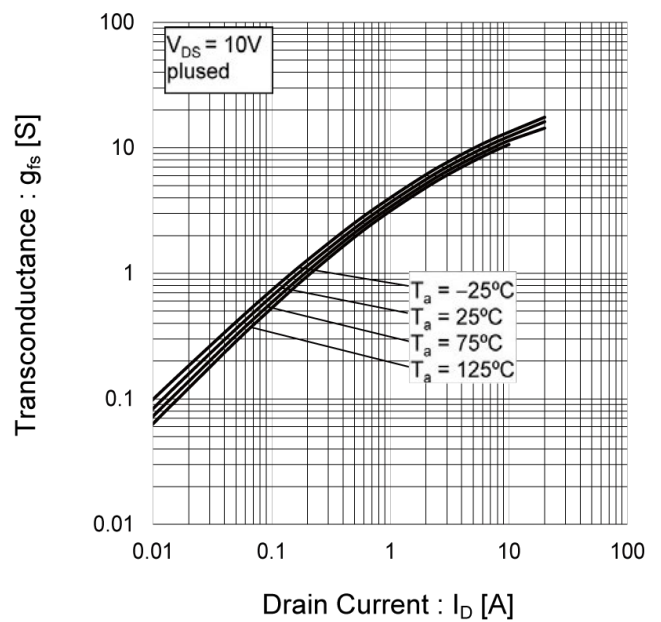


Fig.9 Forward Transfer Admittance vs. Drain Current



● Electrical characteristic curves

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

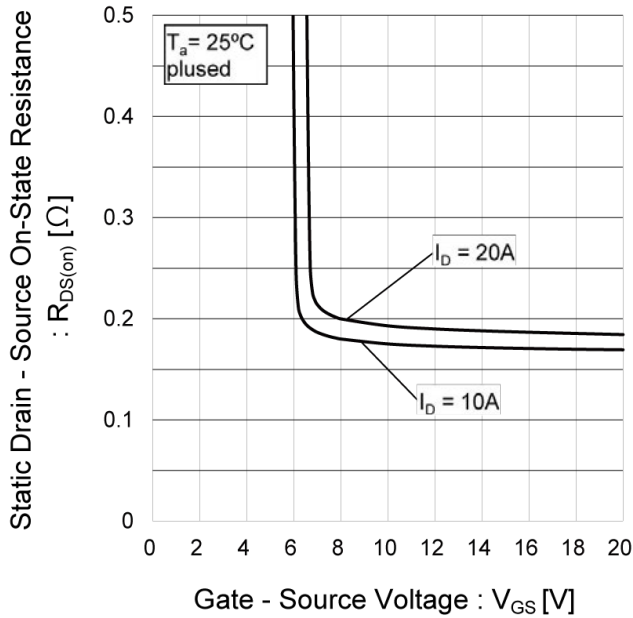


Fig.11 Static Drain - Source On - State Resistance vs. Junction Temperature

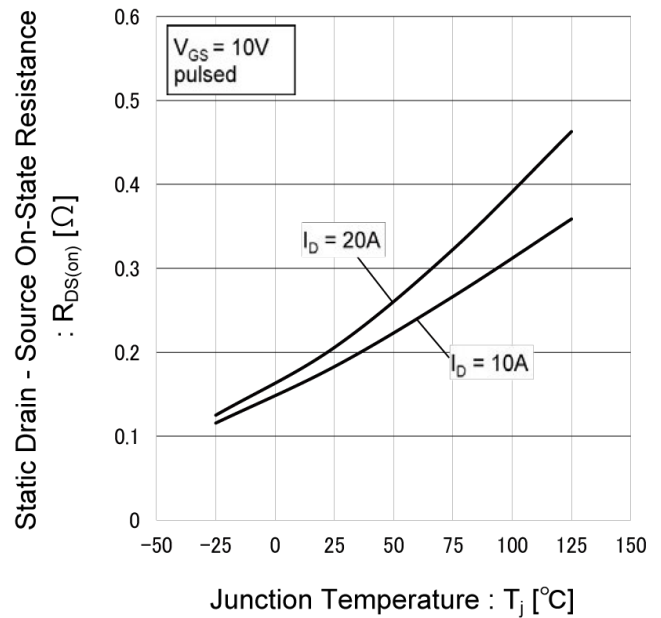
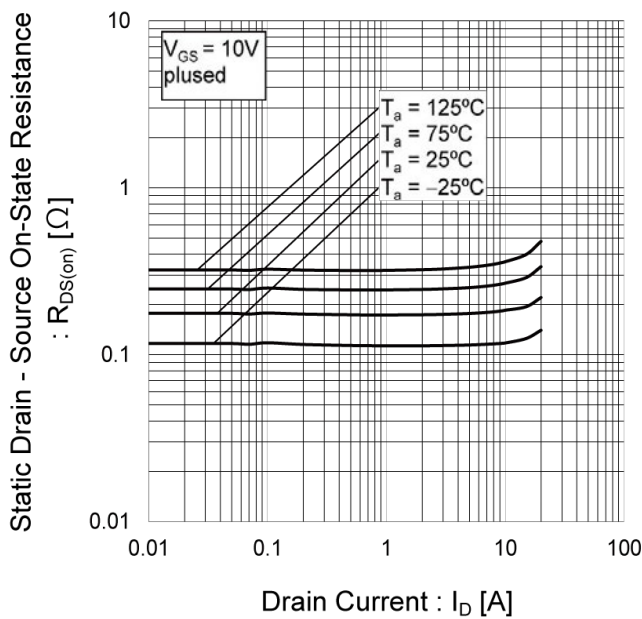


Fig.12 Static Drain - Source On - State Resistance vs. Drain Current





● Electrical characteristic curves

Fig.13 Typical Capacitance vs. Drain - Source Voltage

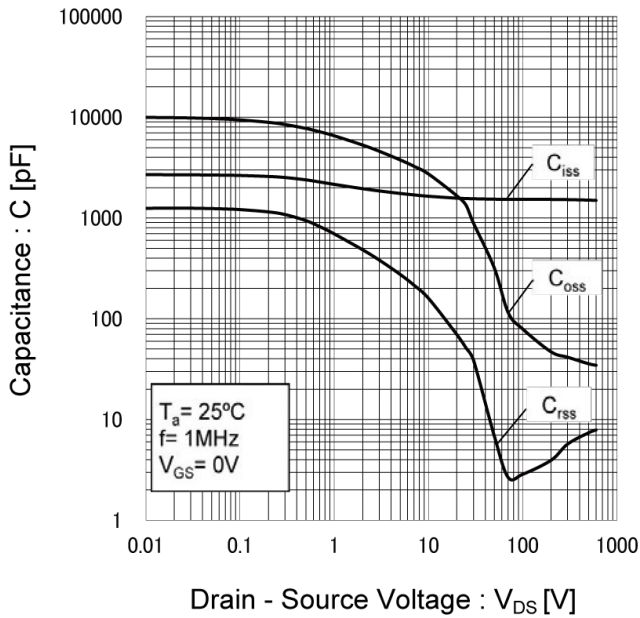


Fig.14 Switching Characteristics

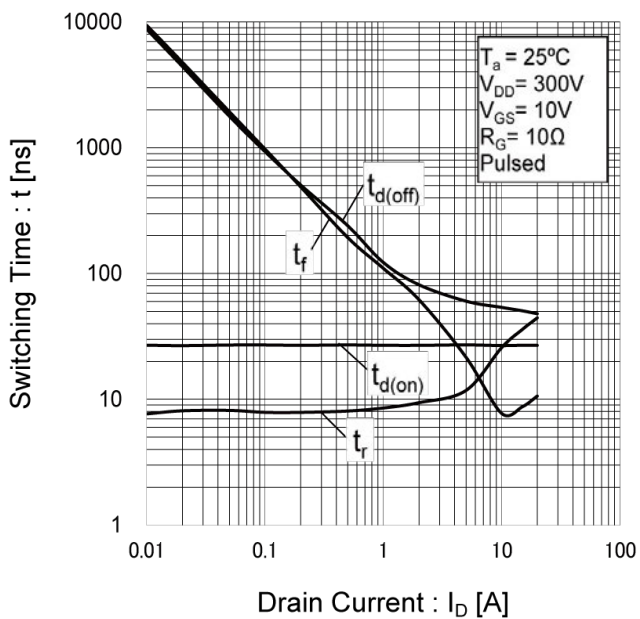
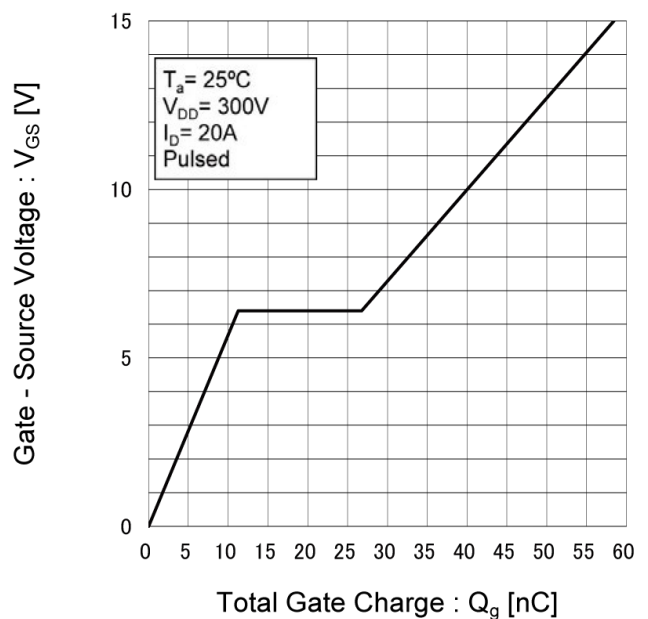


Fig.15 Dynamic Input Characteristics



● Electrical characteristic curves

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

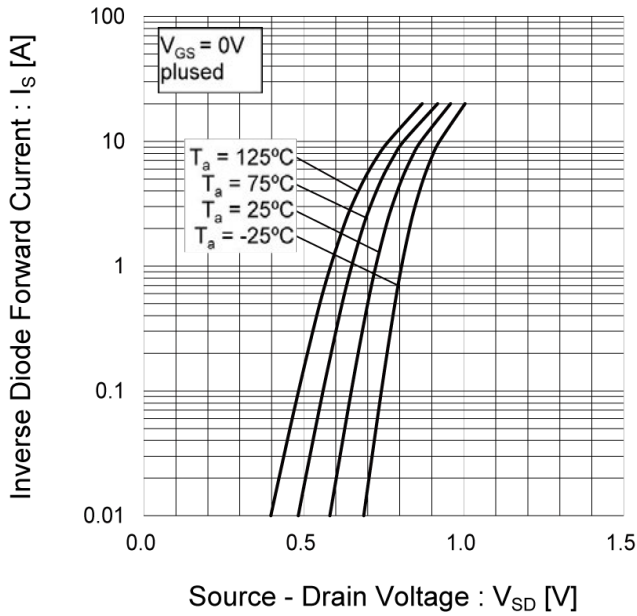
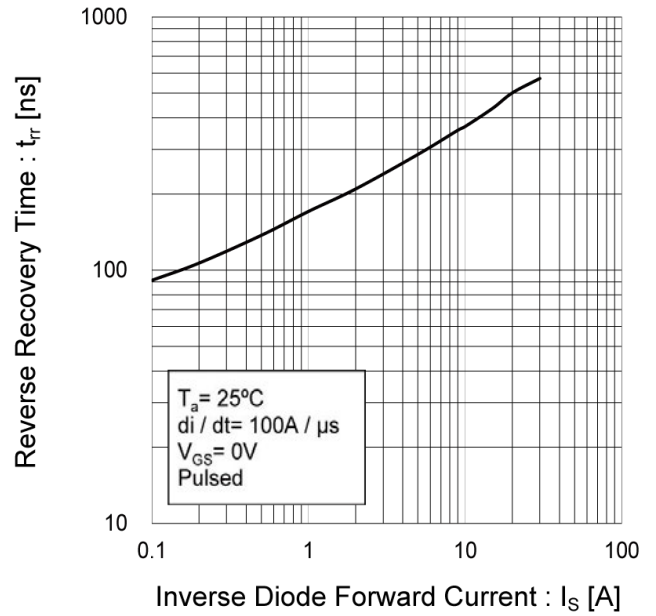


Fig.17 Reverse Recovery Time vs. Inverse Diode Forward Current



● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

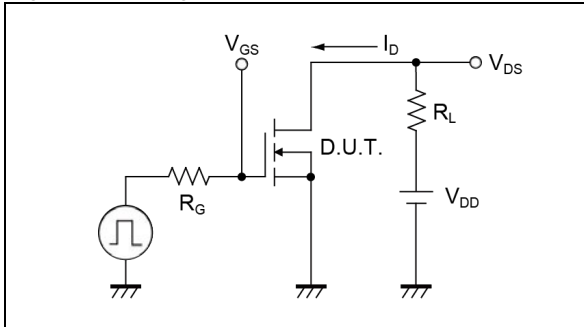


Fig.1-2 Switching Waveforms

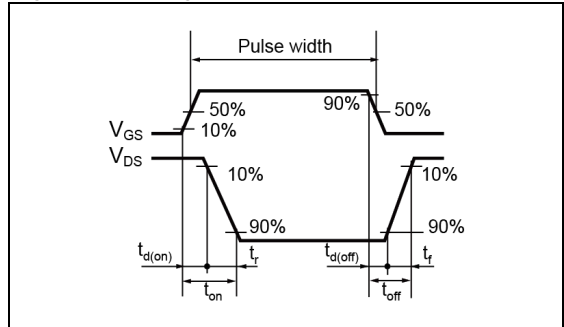


Fig.2-1 Gate Charge Measurement Circuit

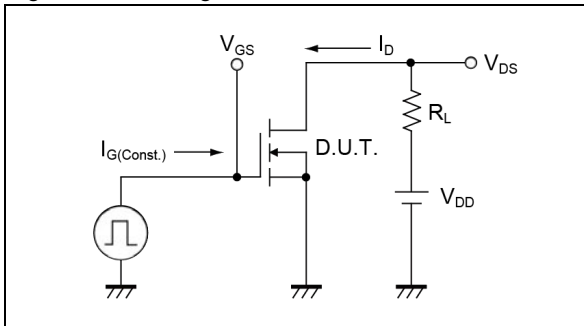


Fig.2-2 Gate Charge Waveform

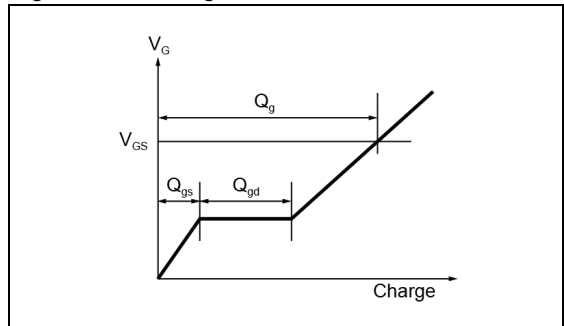


Fig.3-1 Avalanche Measurement Circuit

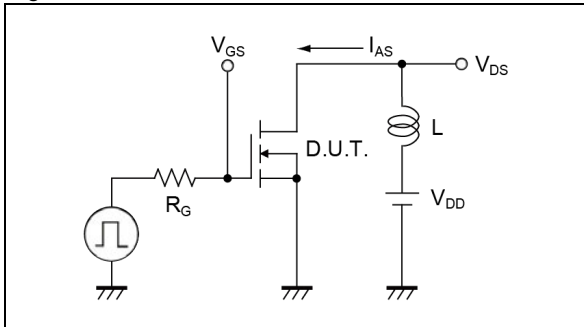


Fig.3-2 Avalanche Waveform

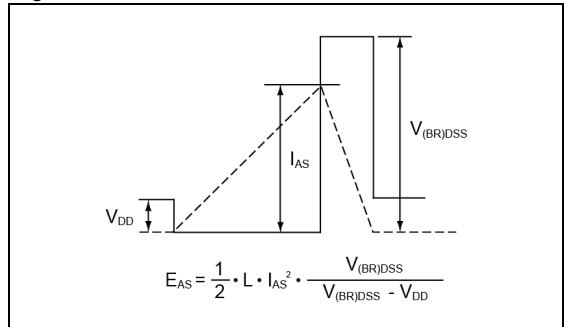


Fig.4-1 dv/dt Measurement Circuit

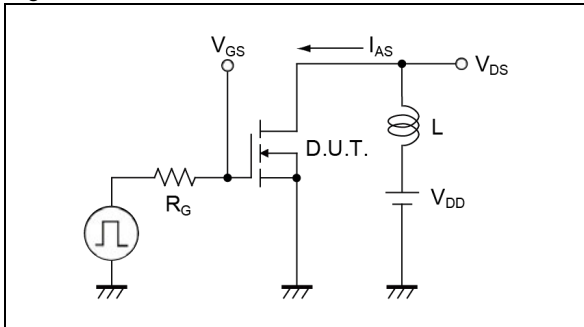


Fig.4-2 dv/dt Waveform

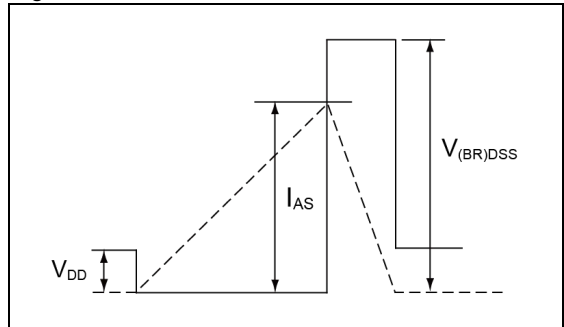


Fig.5-1 dv/dt Measurement Circuit

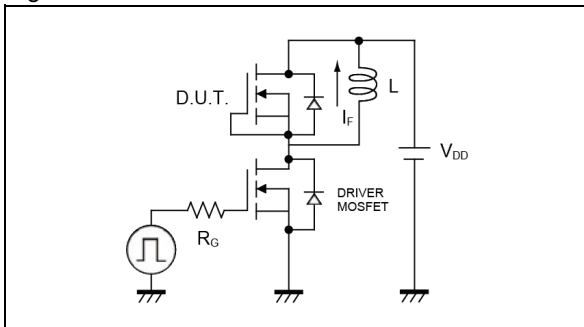
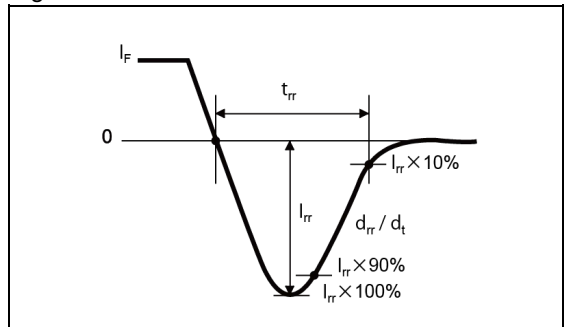
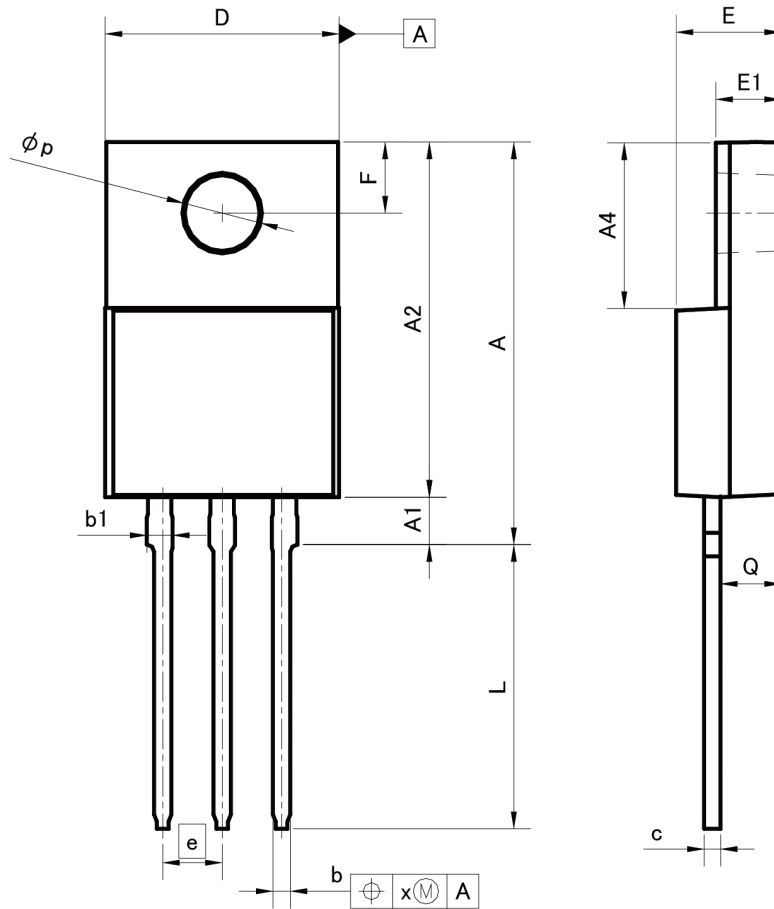


Fig.5-2 dv/dt Waveform



●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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