

$V_{DSS}$	600V
$R_{DS(on)}(Max.)$	0.98 $\Omega$
$I_D$	$\pm 4.0A$
$P_D$	58W

### ●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

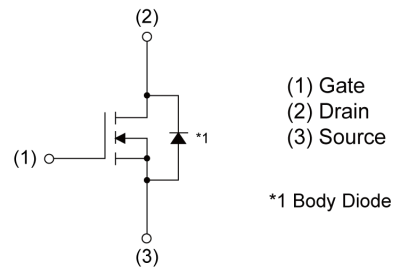
TO-263

SC-83

LPT(S)



### ●Inner circuit



### ●Packaging specifications

Type	Packing	Embossed Tape
	Reel size (mm)	330
Tape width (mm)	24	
Basic ordering unit (pcs)	1000	
Taping code	TL	
Marking	R6004KNJ	

### ●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	$V_{GSS}$	Static	$\pm 20$
		AC ( $f > 1Hz$ )	$\pm 30$
Avalanche current, single pulse	$I_{AS}$	0.8	A
Avalanche energy, single pulse	$E_{AS}^{*3}$	46	mJ
Power dissipation ( $T_c = 25^\circ C$ )	$P_D$	58	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	$R_{thJC}^{*4}$	-	-	2.2	°C/W
Thermal resistance, junction - ambient	$R_{thJA}^{*5}$	-	-	80	°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	$R_{DS(on)}^{*6}$	$V_{GS} = 10V, I_D = 1.5A$	-	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<sub>a</sub> = 25°C)**

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Forward Transfer Admittance	$ Y_{fs} ^{*6}$	V <sub>DS</sub> = 10V, I <sub>D</sub> = 2A	1.5	3.0	-	S
Input capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0V	-	280	-	pF
Output capacitance	C <sub>oss</sub>	V <sub>DS</sub> = 25V	-	280	-	
Reverse transfer capacitance	C <sub>rss</sub>	f = 1MHz	-	16	-	
Turn - on delay time	t <sub>d(on)</sub> <sup>*6</sup>	V <sub>DD</sub> ≈ 300V, V <sub>GS</sub> = 10V	-	15	-	ns
Rise time	t <sub>r</sub> <sup>*6</sup>	I <sub>D</sub> = 2A	-	10	-	
Turn - off delay time	t <sub>d(off)</sub> <sup>*6</sup>	R <sub>L</sub> ≈ 150Ω	-	30	-	
Fall time	t <sub>f</sub> <sup>*6</sup>	R <sub>G</sub> = 10Ω	-	25	-	

**●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>*6</sup>	V <sub>DD</sub> ≈ 300V	-	10.2	-	nC
Gate - Source charge	Q <sub>gs</sub> <sup>*6</sup>	I <sub>D</sub> = 4A	-	2.5	-	
Gate - Drain charge	Q <sub>gd</sub> <sup>*6</sup>	V <sub>GS</sub> = 10V	-	4.8	-	
Gate plateau voltage	V <sub>(plateau)</sub>	V <sub>DD</sub> ≈ 300V, I <sub>D</sub> = 4A	-	5.8	-	V

\*1 Limited only by maximum channel temperature allowed.

\*2 Pw ≤ 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 Mounted on a epoxy PCB FR4 (25mm x 27mm x 0.8mm)

\*6 Pulsed

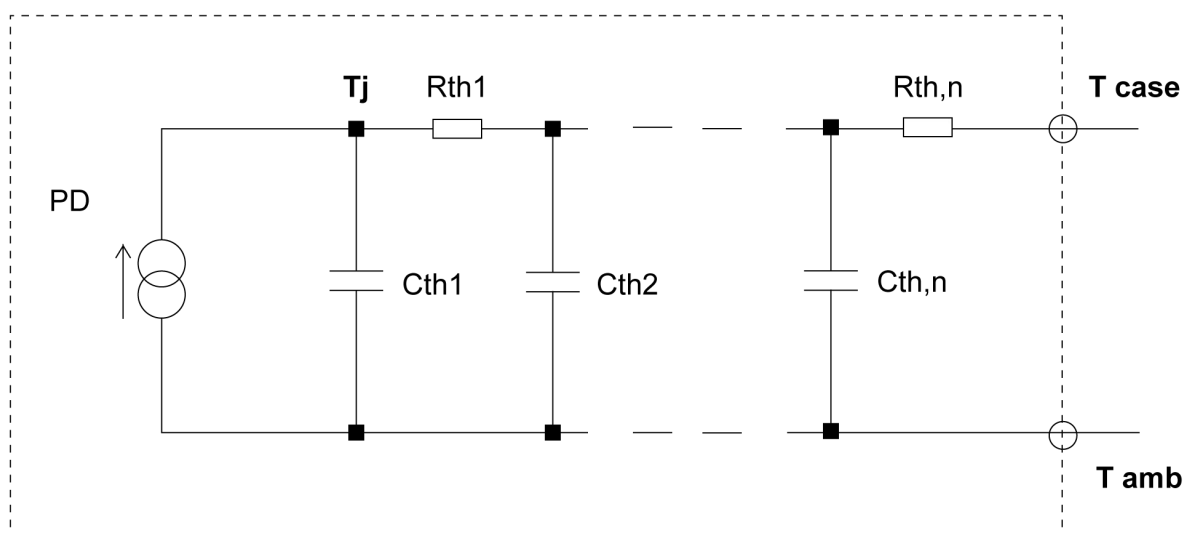
●Body diode electrical characteristics (Source-Drain) ( $T_a = 25^\circ\text{C}$ )

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	$I_{SP}^{*2}$		-	-	12.0	A
Forward voltage	$V_{SD}^{*6}$	$V_{GS} = 0\text{V}, I_S = 4\text{A}$	-	-	1.5	V
Reverse recovery time	$t_{rr}^{*6}$	$I_S = 4\text{A}$ $di/dt = 100\text{A}/\mu\text{s}$	-	230	-	ns
Reverse recovery charge	$Q_{rr}^{*6}$		-	1.5	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rm}^{*6}$		-	12	-	A

●Typical transient thermal characteristics

Symbol	Value	Unit
$R_{th1}$	0.246	K/W
$R_{th2}$	1.01	
$R_{th3}$	0.663	

Symbol	Value	Unit
$C_{th1}$	0.000809	Ws/K
$C_{th2}$	0.002	
$C_{th3}$	0.145	



● Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

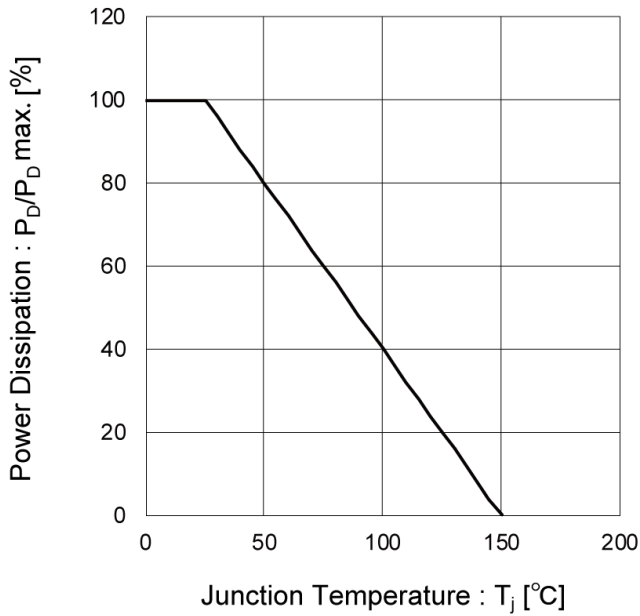


Fig.2 Maximum Safe Operating Area

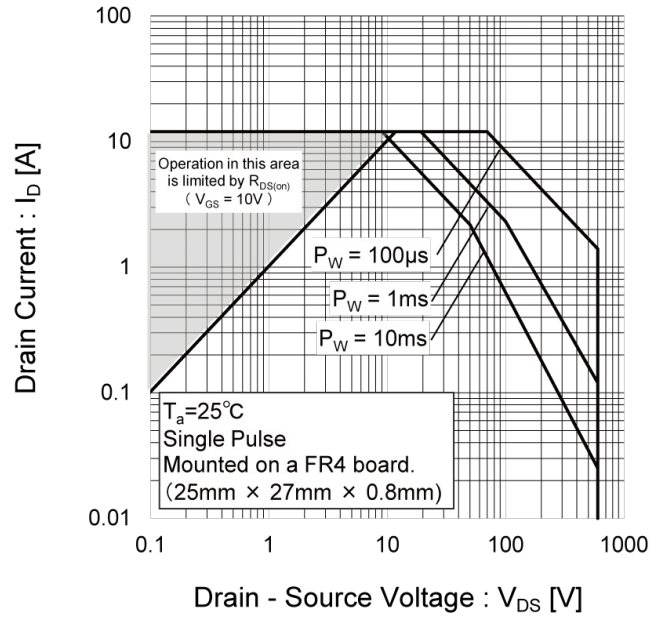
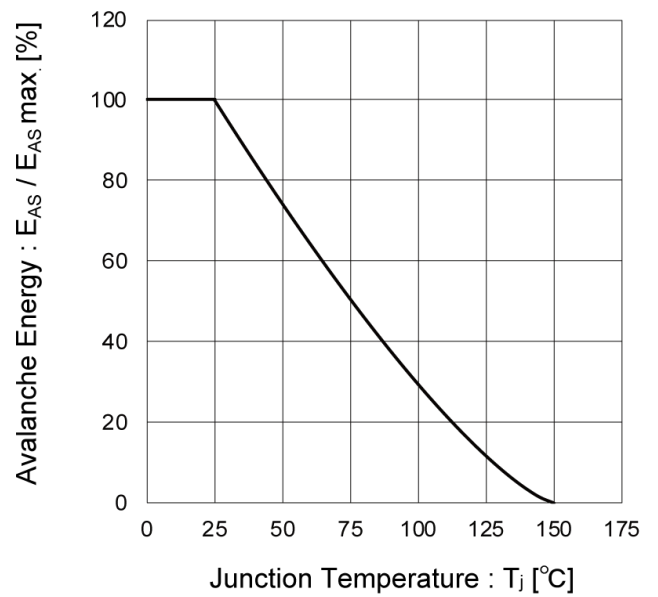


Fig.3 Avalanche Energy Derating Curve vs. Junction Temperature



● Electrical characteristic curves

Fig.4 Typical Output Characteristics(I)

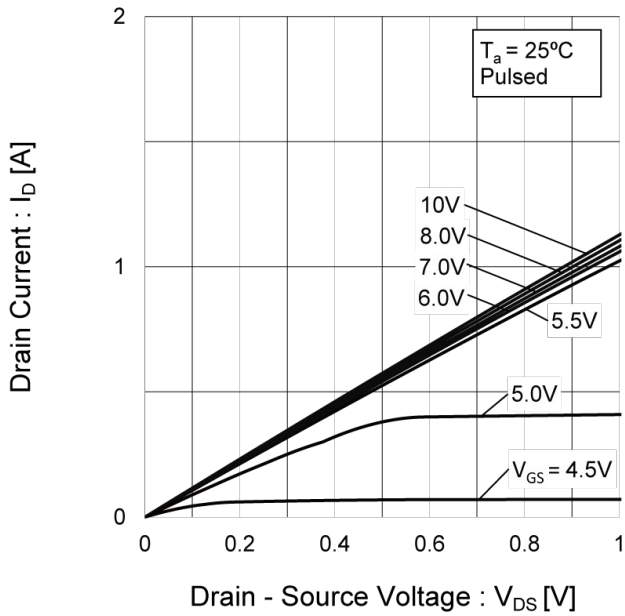
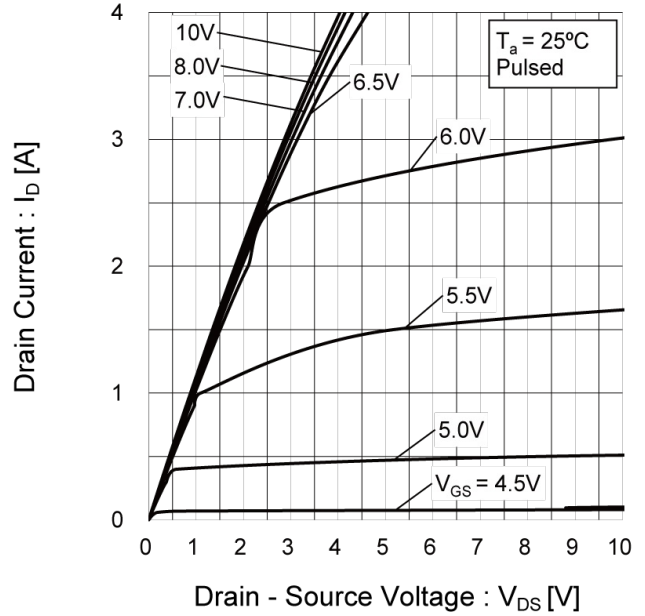


Fig.5 Typical Output Characteristics(II)



● Electrical characteristic curves

Fig.6 Breakdown Voltage vs. Junction Temperature

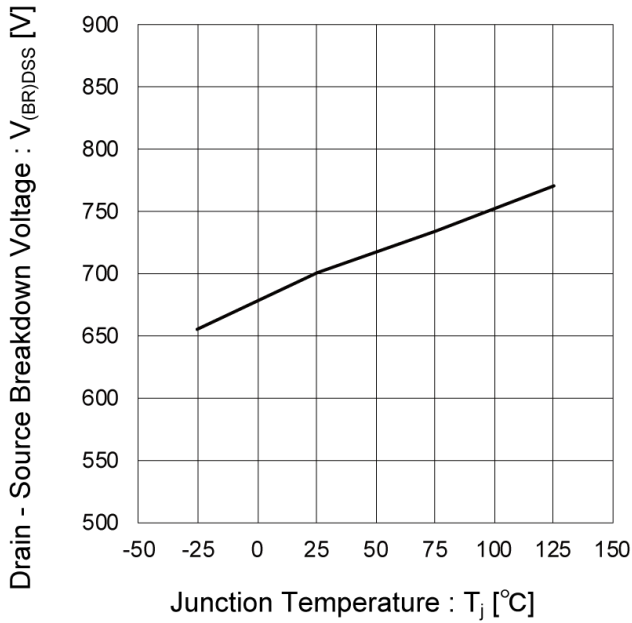


Fig.7 Typical Transfer Characteristics

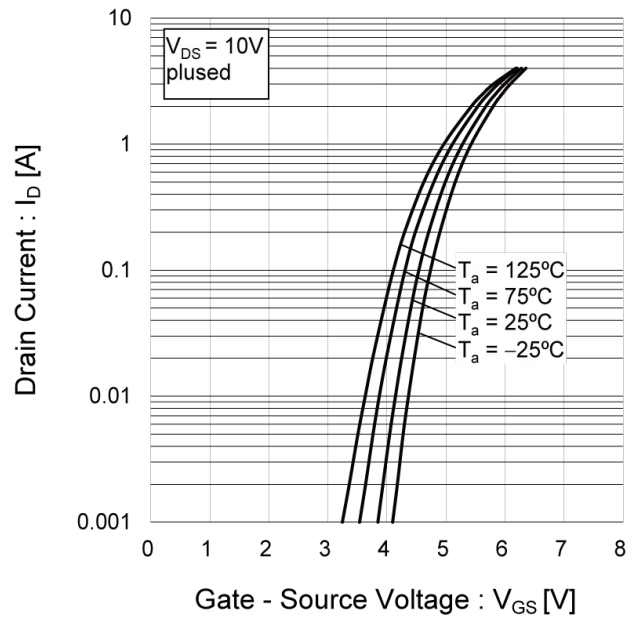


Fig.8 Gate Threshold Voltage vs. Junction Temperature

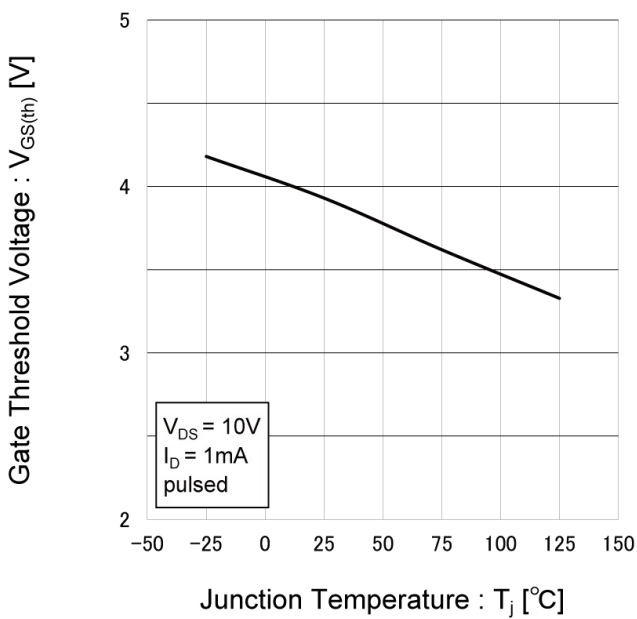
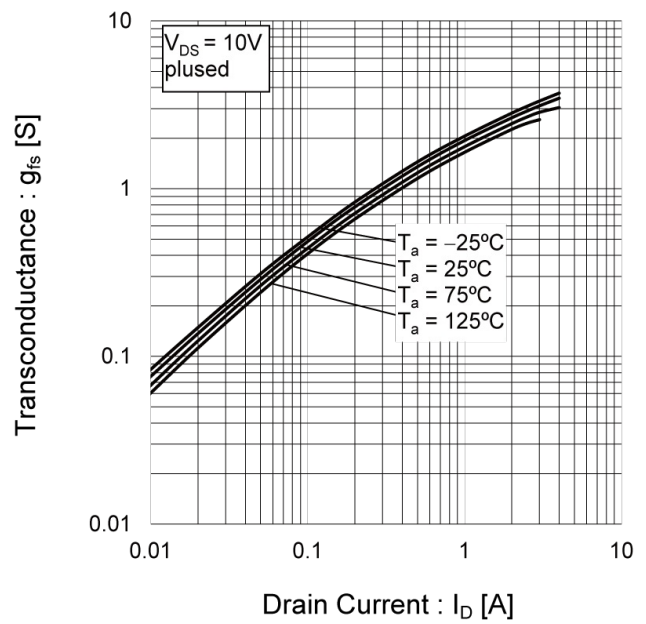


Fig.9 Forward Transfer Admittance vs. Drain Current



● Electrical characteristic curves

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

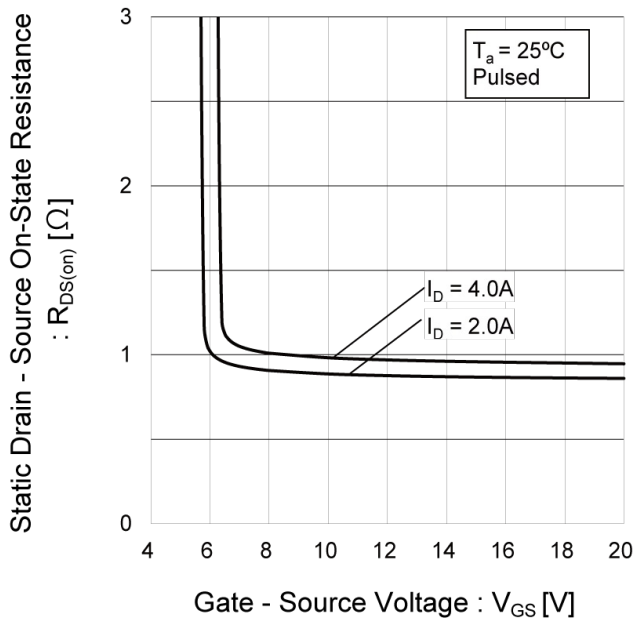


Fig.11 Static Drain - Source On - State Resistance vs. Junction Temperature

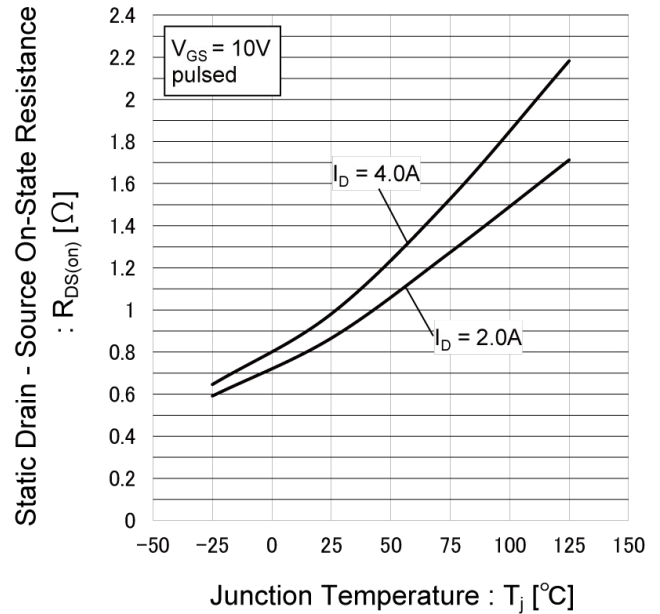
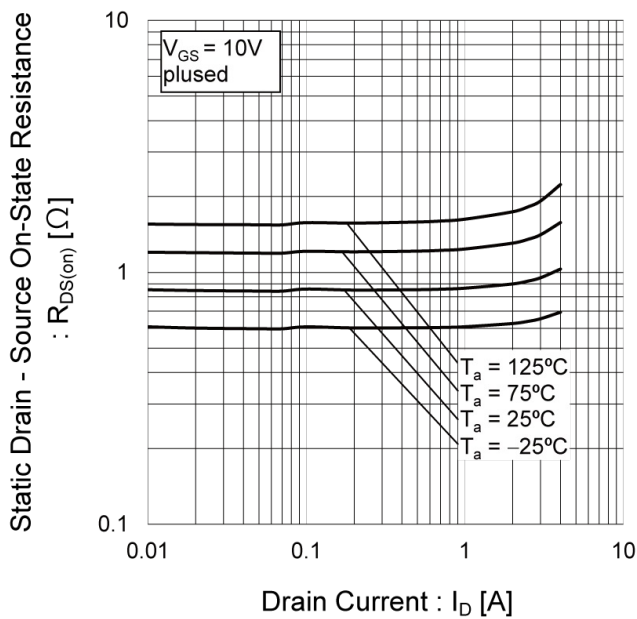


Fig.12 Static Drain - Source On - State Resistance vs. Drain Current(I)





●Electrical characteristic curves

Fig.13 Typical Capacitance vs. Drain - Source Voltage

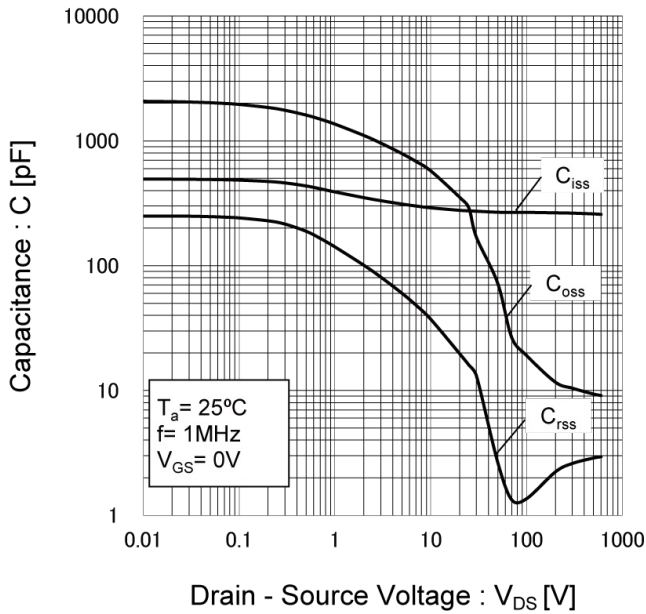


Fig.14 Switching Characteristics

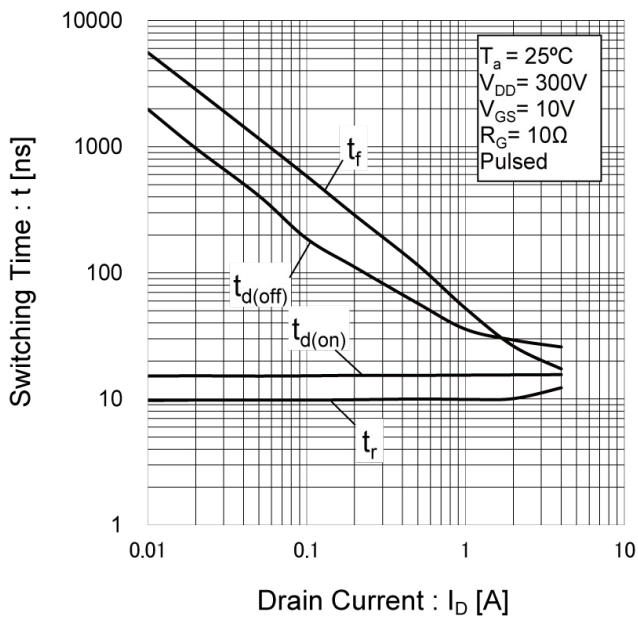
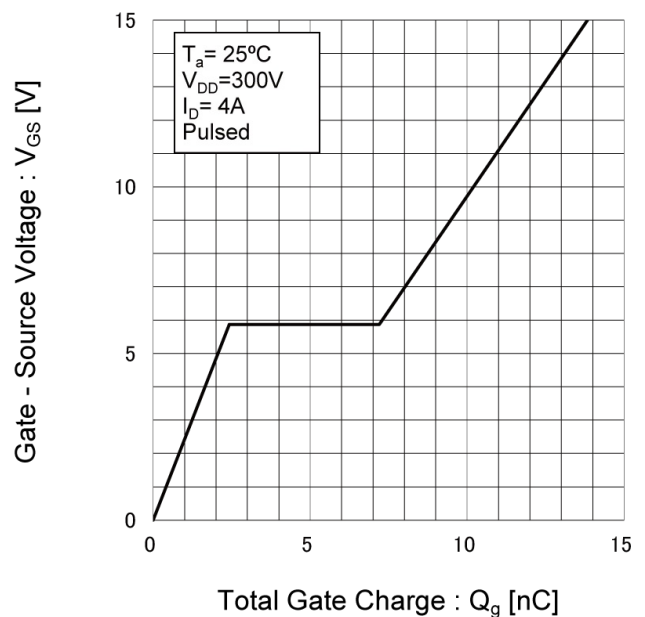


Fig.15 Dynamic Input Characteristics



● Electrical characteristic curves

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

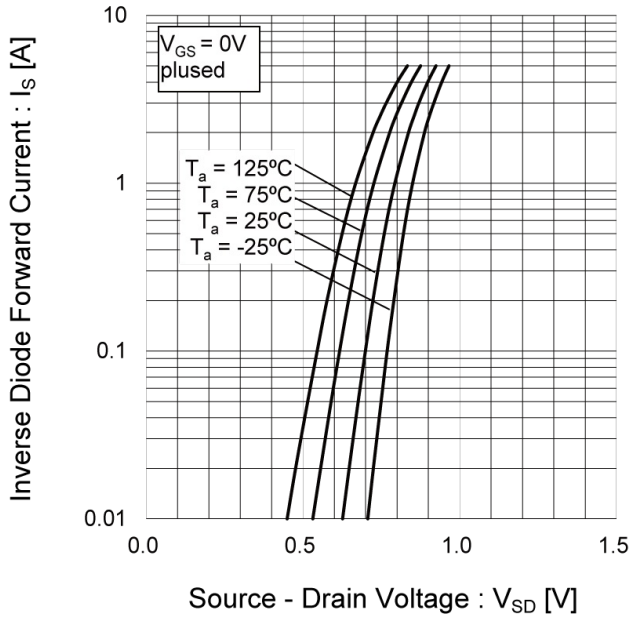
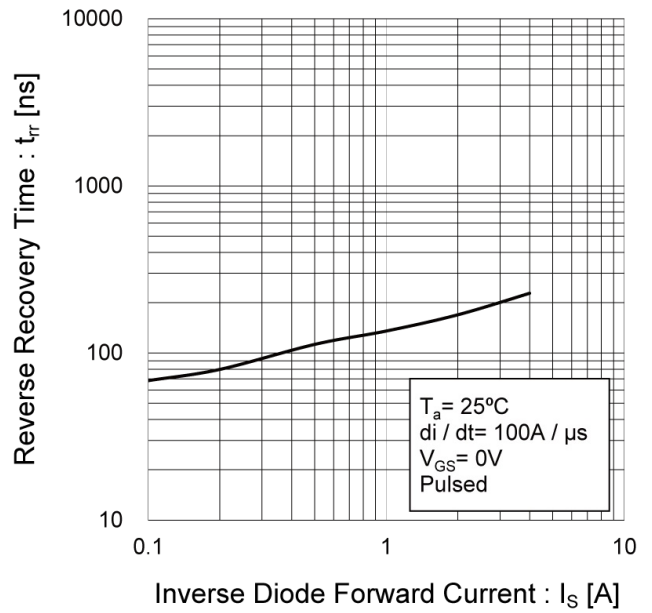


Fig.17 Reverse Recovery Time vs. Inverse Diode Forward Current



● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

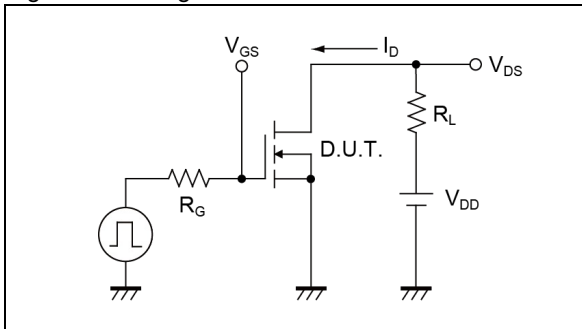


Fig.1-2 Switching Waveforms

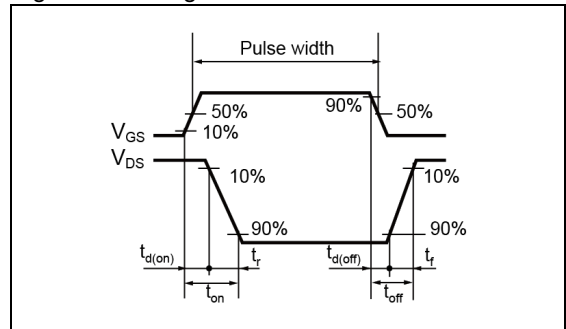


Fig.2-1 Gate Charge Measurement Circuit

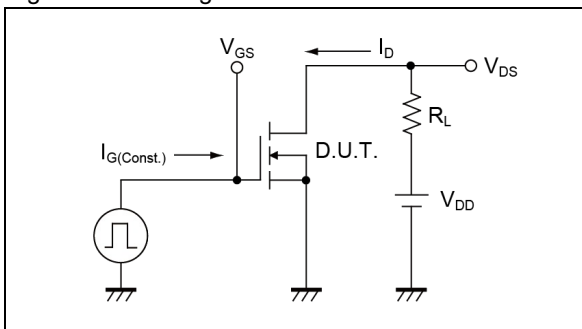


Fig.2-2 Gate Charge Waveform

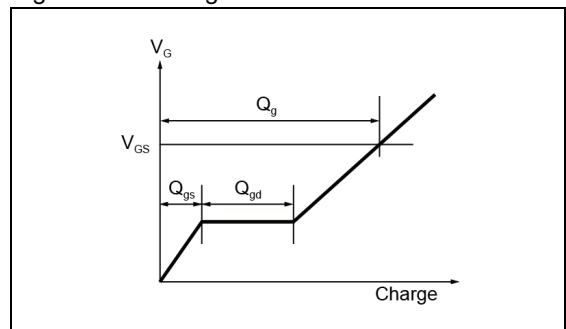


Fig.3-1 Avalanche Measurement Circuit

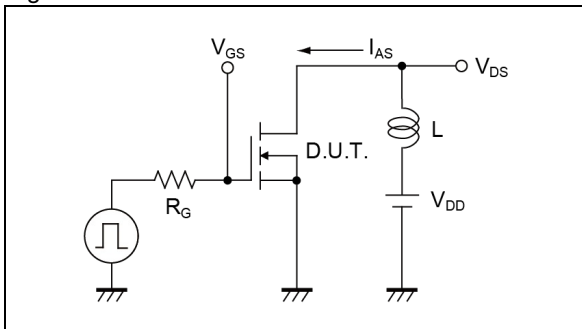


Fig.3-2 Avalanche Waveform

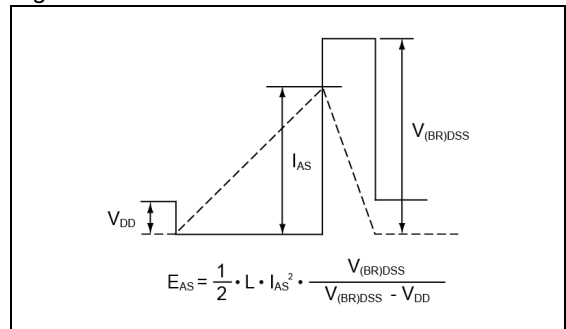


Fig.4-1 dv/dt Measurement Circuit

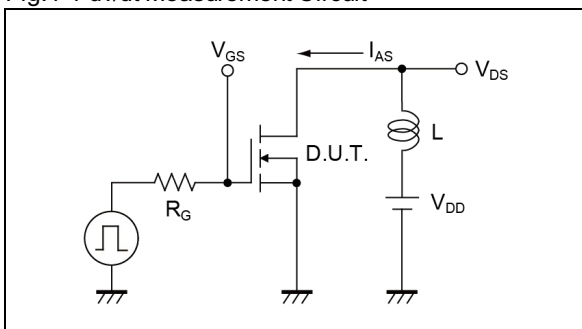


Fig.4-2 dv/dt Waveform

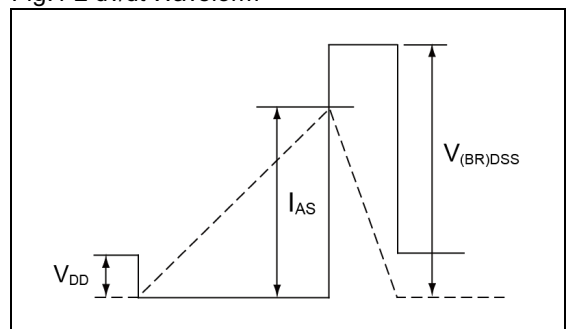


Fig.5-1 dv/dt Measurement Circuit

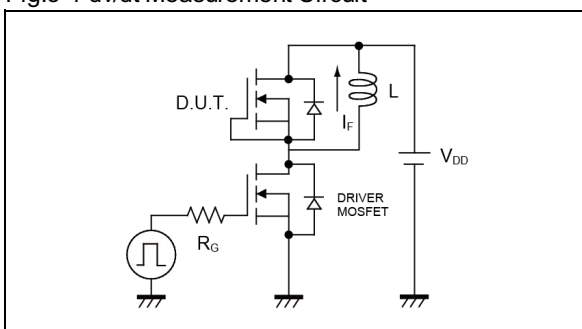
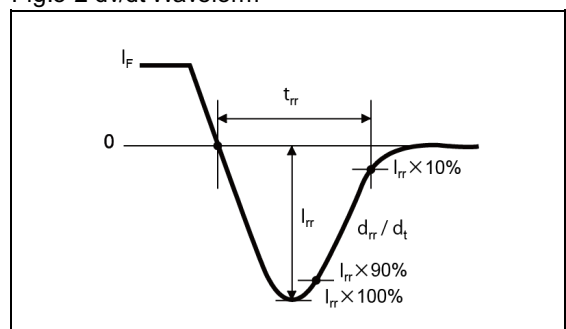
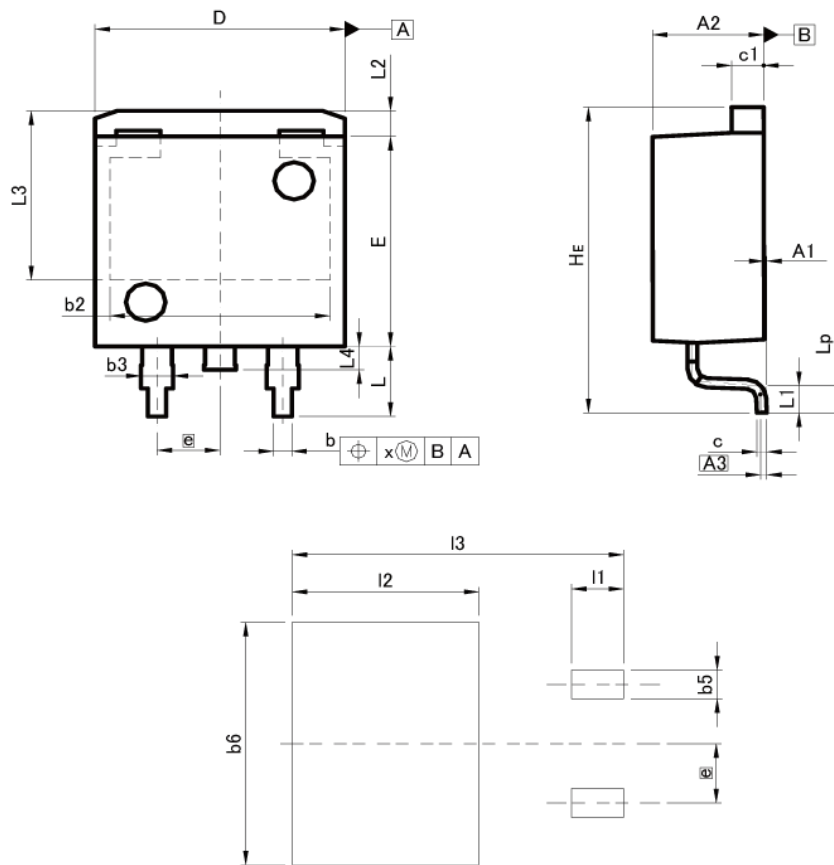


Fig.5-2 dv/dt Waveform



●Dimensions

LPTS  
< TO-263 >  
( D2PAK )



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	0.90	1.50	0.035	0.059
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

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R6004KNJ - Web Page

Part Number	R6004KNJ
Package	LPTS(D2PAK)
Unit Quantity	1000
Minimum Package Quantity	1000
Packing Type	Taping
Constitution Materials List	inquiry
RoHS	Yes