

|                    |        |
|--------------------|--------|
| $V_{DSS}$          | 600V   |
| $R_{DS(on)}(Max.)$ | 0.196Ω |
| $I_D$              | ±20A   |
| $P_D$              | 231W   |

### ●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

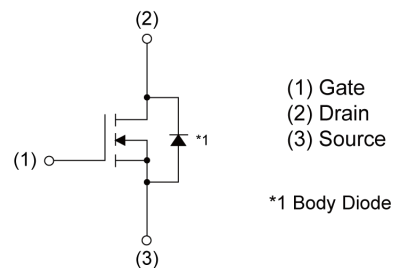
TO-263

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                   | R6020KNJ       |               |

### ●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                 | ±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 ( $T_c = 25^\circ\text{C}$ )        | $P_D$                  | 231         | 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          | $R_{thJC}^{*4}$ | -      | -    | 0.54 | °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 | $R_{DS(on)}^{*6}$ | $V_{GS} = 10V, I_D = 9.5A$      | -      | 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<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> = 10A   | 5      | 10   | -    | S    |
| Input capacitance            | C <sub>iss</sub>                  | V <sub>GS</sub> = 0V                          | -      | 1550 | -    | pF   |
| Output capacitance           | C <sub>oss</sub>                  | V <sub>DS</sub> = 25V                         | -      | 1350 | -    |      |
| Reverse transfer capacitance | C <sub>rss</sub>                  | f = 1MHz                                      | -      | 55   | -    |      |
| Turn - on delay time         | t <sub>d(on)</sub> <sup>*6</sup>  | V <sub>DD</sub> ≈ 300V, V <sub>GS</sub> = 10V | -      | 30   | -    | ns   |
| Rise time                    | t <sub>r</sub> <sup>*6</sup>      | I <sub>D</sub> = 10A                          | -      | 30   | -    |      |
| Turn - off delay time        | t <sub>d(off)</sub> <sup>*6</sup> | R <sub>L</sub> ≈ 30Ω                          | -      | 55   | -    |      |
| Fall time                    | t <sub>f</sub> <sup>*6</sup>      | R <sub>G</sub> = 10Ω                          | -      | 10   | -    |      |

**●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                       | -      | 40   | -    | nC   |
| Gate - Source charge | Q <sub>gs</sub> <sup>*6</sup> | I <sub>D</sub> = 20A                         | -      | 12   | -    |      |
| Gate - Drain charge  | Q <sub>gd</sub> <sup>*6</sup> | V <sub>GS</sub> = 10V                        | -      | 15   | -    |      |
| Gate plateau voltage | V <sub>(plateau)</sub>        | V <sub>DD</sub> ≈ 300V, I <sub>D</sub> = 20A | -      | 6.4  | -    | V    |

\*1 Limited only by maximum channel temperature allowed.

\*2 Pw ≤ 10μs, Duty cycle ≤ 1%

\*3 L ≐ 70mH, 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

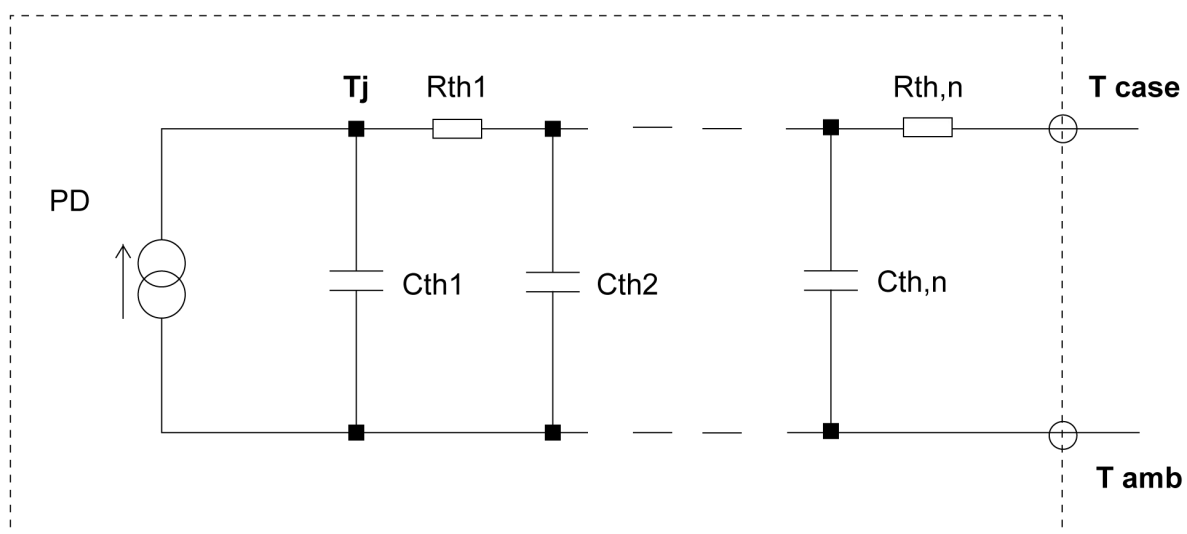
●Body diode electrical characteristics (Source-Drain) ( $T_a = 25^\circ\text{C}$ )

| Parameter                     | Symbol        | Conditions  | Values |      |      | Unit          |
|-------------------------------|---------------|---|--------|------|------|---------------|
|                               |               |   | Min.   | Typ. | Max. |               |
| Continuous forward current    | $I_S^{*1}$    | $T_C = 25^\circ\text{C}$                                | -      | -    | 20   | A             |
| Pulse forward current         | $I_{SP}^{*2}$ |   | -      | -    | 60   | A             |
| Forward voltage               | $V_{SD}^{*6}$ | $V_{GS} = 0\text{V}, I_S = 20\text{A}$                  | -      | -    | 1.5  | V             |
| Reverse recovery time         | $t_{rr}^{*6}$ | $I_S = 20\text{A}$<br>$di/dt = 100\text{A}/\mu\text{s}$ | -      | 500  | -    | ns            |
| Reverse recovery charge       | $Q_{rr}^{*6}$ |   | -      | 7.5  | -    | $\mu\text{C}$ |
| Peak reverse recovery current | $I_{rm}^{*6}$ |   | -      | 38   | -    | A             |

●Typical transient thermal characteristics

| Symbol    | Value | Unit |
|-----------|-------|------|
| $R_{th1}$ | 0.068 | K/W  |
| $R_{th2}$ | 0.261 |      |
| $R_{th3}$ | 0.607 |      |

| Symbol    | Value   | Unit |
|-----------|---------|------|
| $C_{th1}$ | 0.00213 | Ws/K |
| $C_{th2}$ | 0.00766 |      |
| $C_{th3}$ | 0.195   |      |



● Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

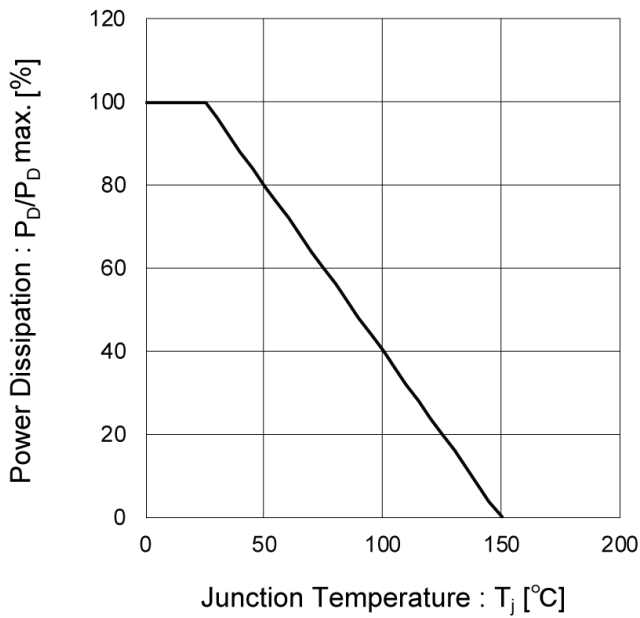


Fig.2 Maximum Safe Operating Area

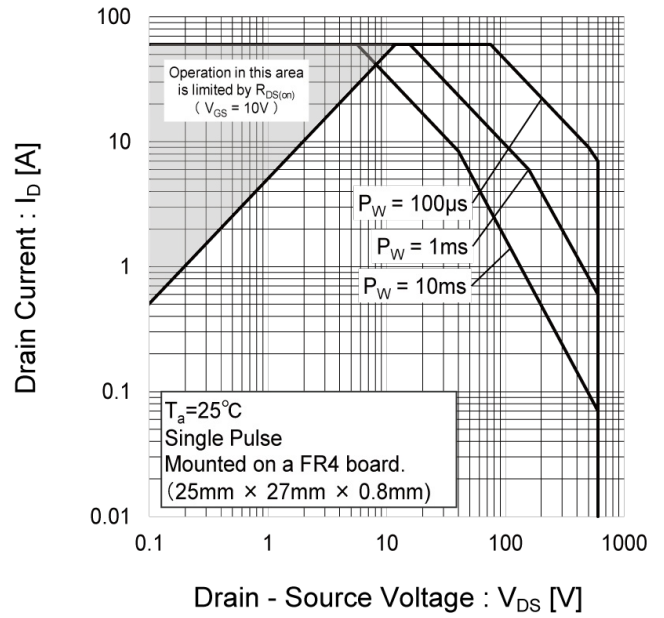
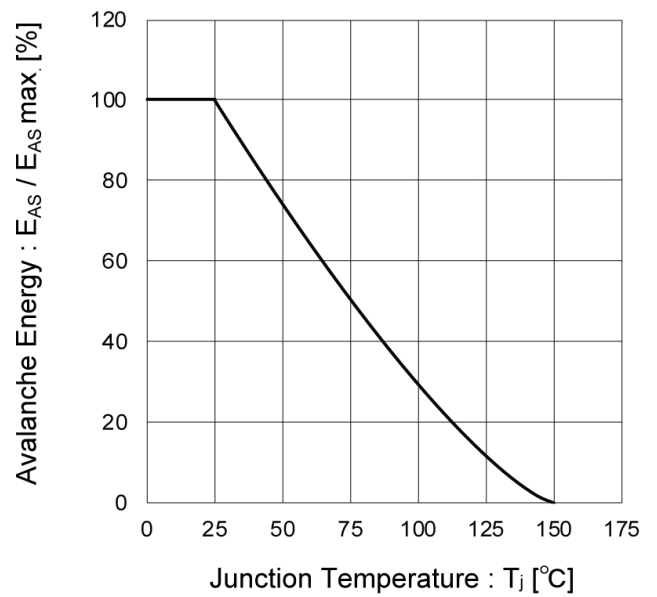


Fig.3 Avalanche Energy Derating Curve vs. Junction Temperature



● Electrical characteristic curves

Fig.4 Typical Output Characteristics(I)

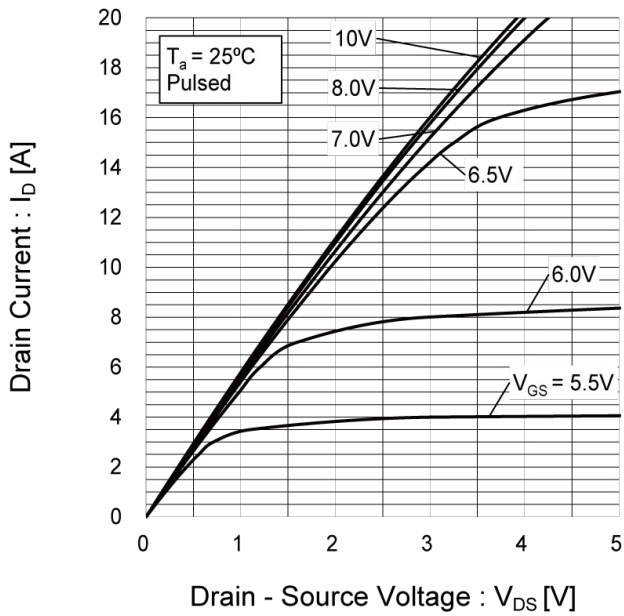
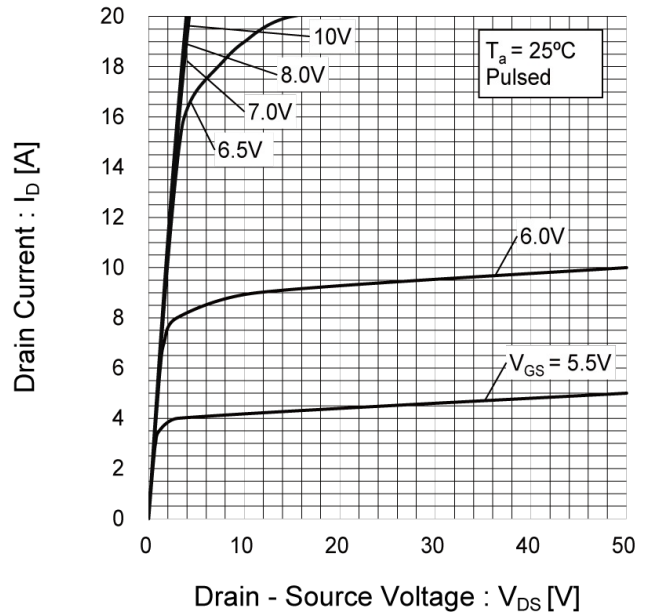


Fig.5 Typical Output Characteristics(II)



●Electrical characteristic curves

Fig.6 Breakdown Voltage vs. Junction Temperature

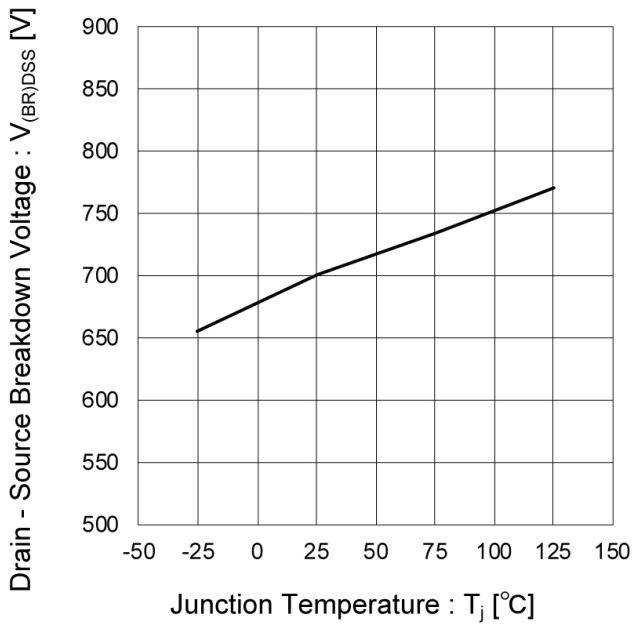


Fig.7 Typical Transfer Characteristics

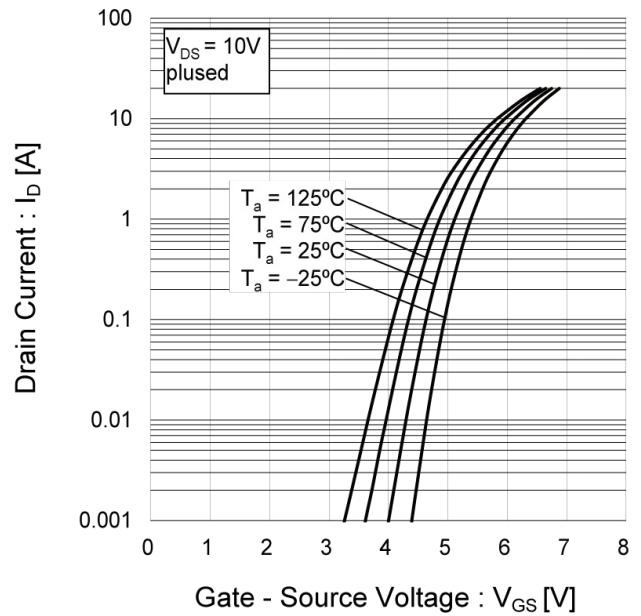


Fig.8 Gate Threshold Voltage vs. Junction Temperature

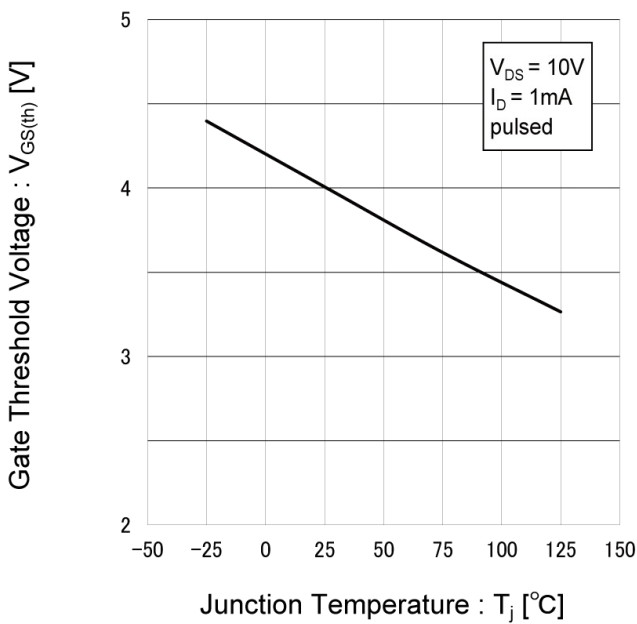
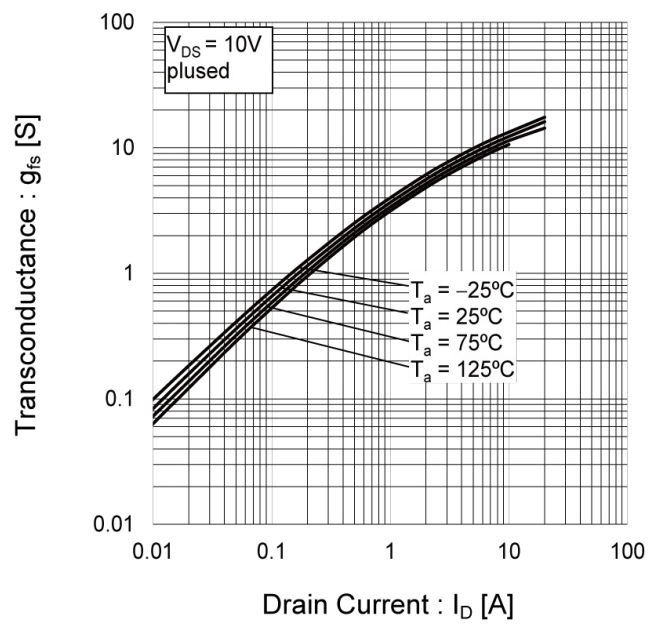


Fig.9 Forward Transfer Admittance vs. Drain Current



● Electrical characteristic curves

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

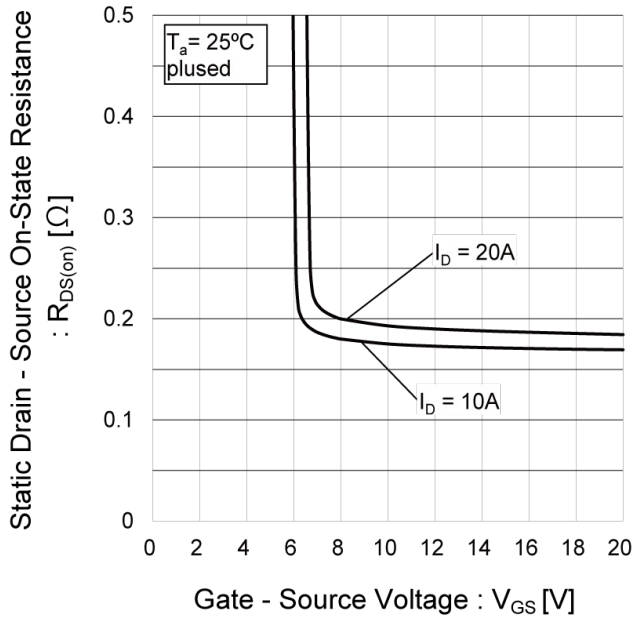


Fig.11 Static Drain - Source On - State Resistance vs. Junction Temperature

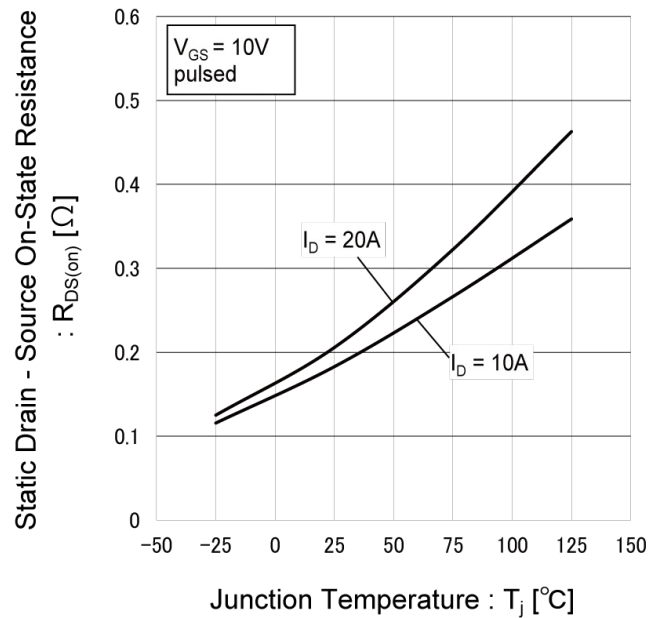
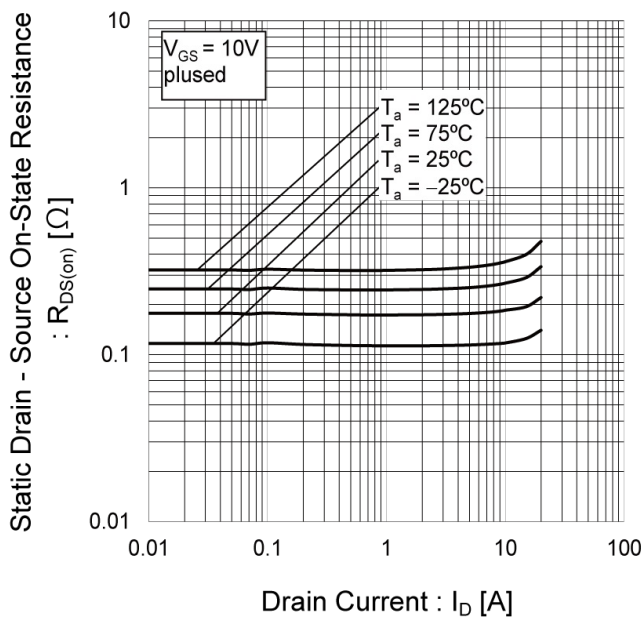


Fig.12 Static Drain - Source On - State Resistance vs. Drain Current(I)





● Electrical characteristic curves

Fig.13 Typical Capacitance vs. Drain - Source Voltage

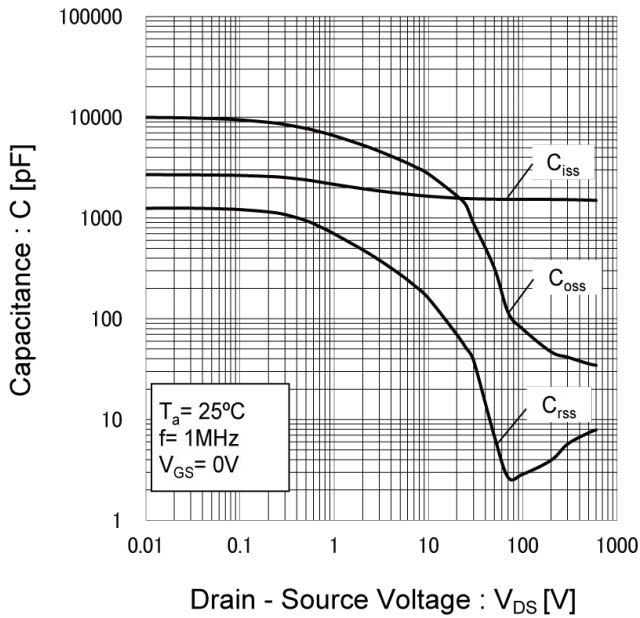


Fig.14 Switching Characteristics

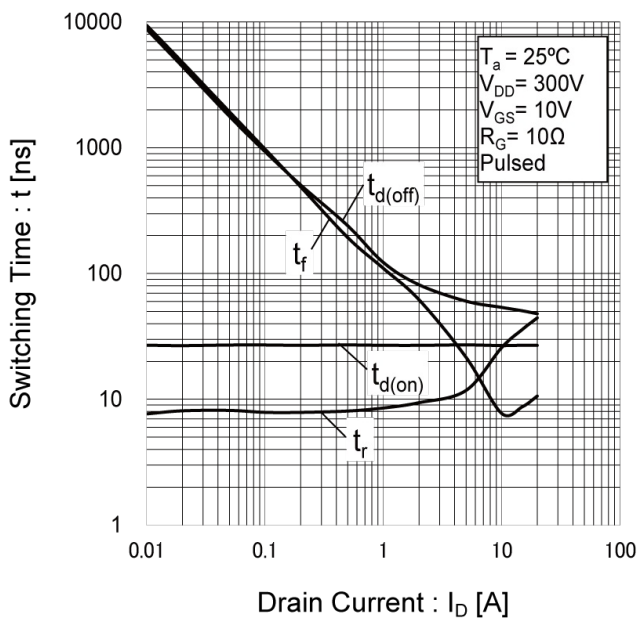
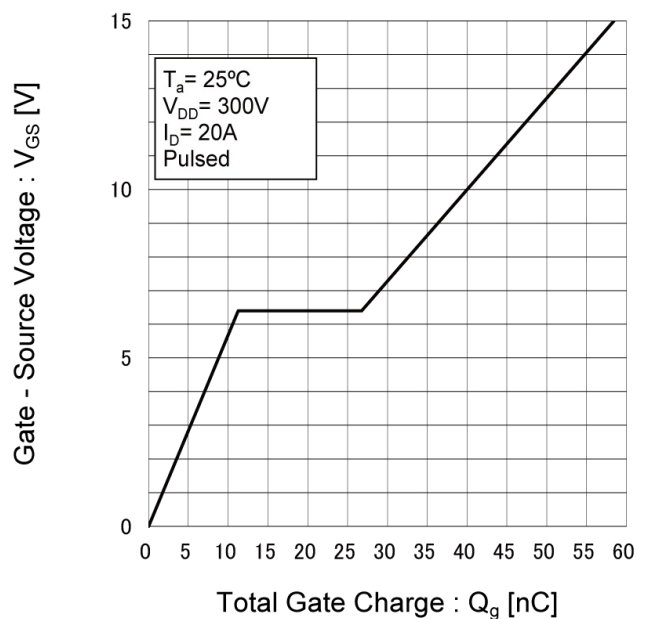


Fig.15 Dynamic Input Characteristics



● Electrical characteristic curves

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

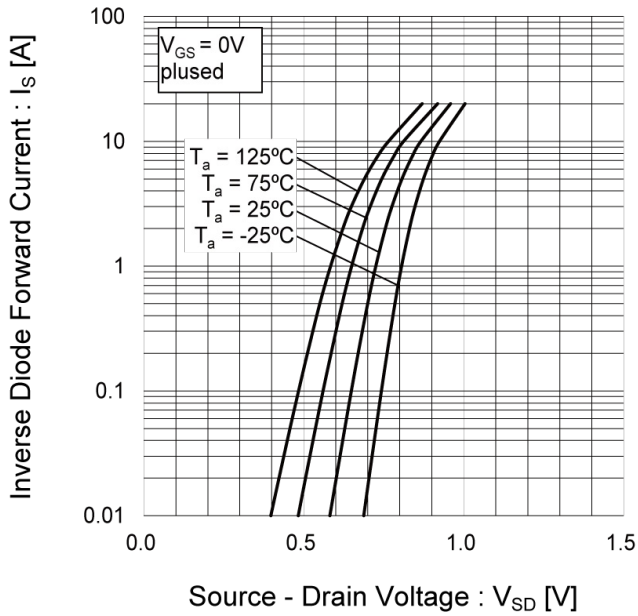
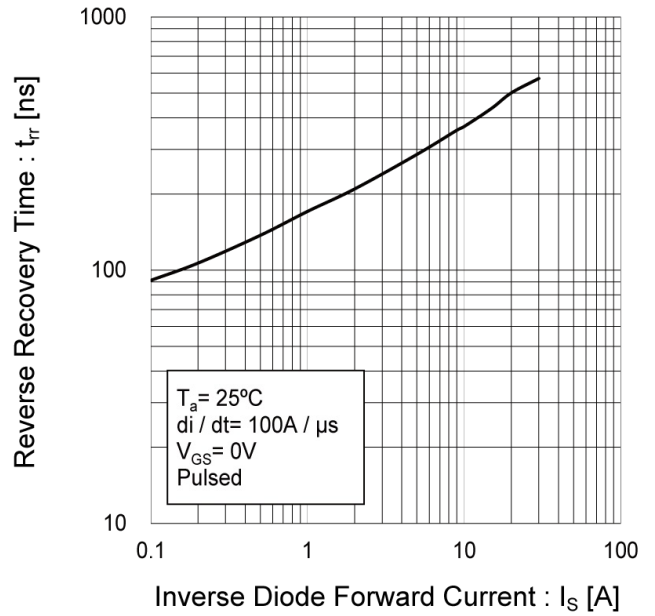


Fig.17 Reverse Recovery Time vs. Inverse Diode Forward Current



● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

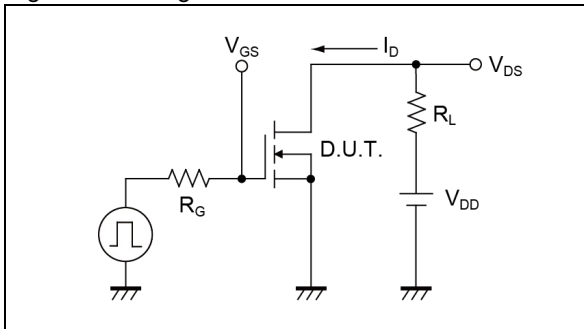


Fig.1-2 Switching Waveforms

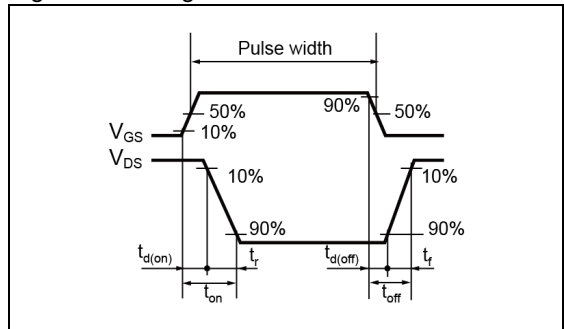


Fig.2-1 Gate Charge Measurement Circuit

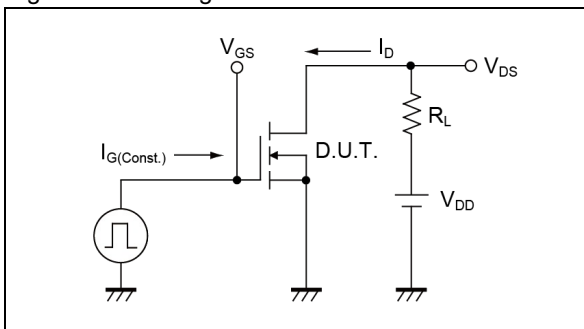


Fig.2-2 Gate Charge Waveform

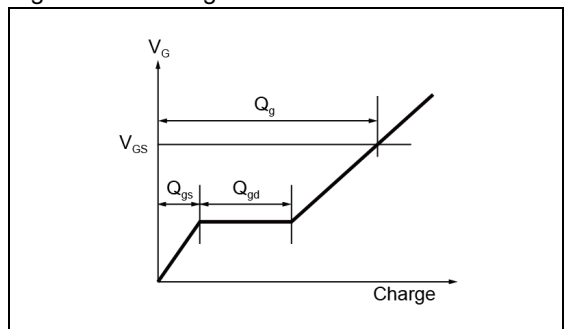


Fig.3-1 Avalanche Measurement Circuit

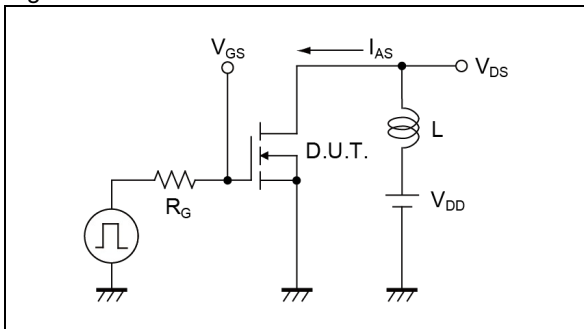


Fig.3-2 Avalanche Waveform

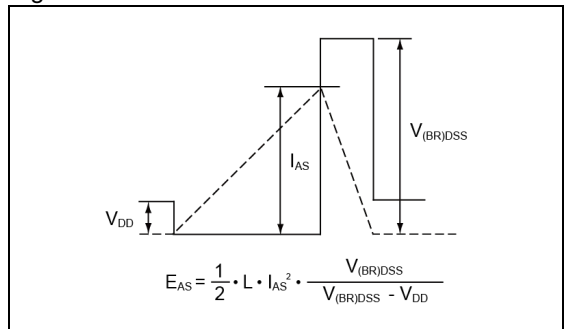


Fig.4-1 dv/dt Measurement Circuit

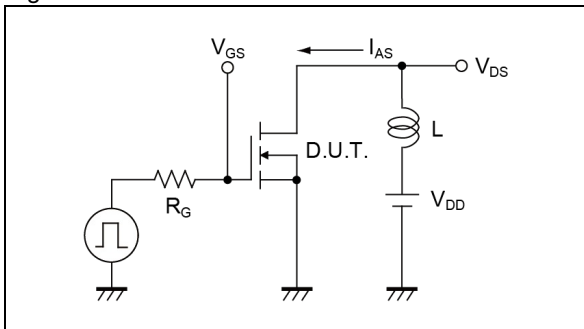


Fig.4-2 dv/dt Waveform

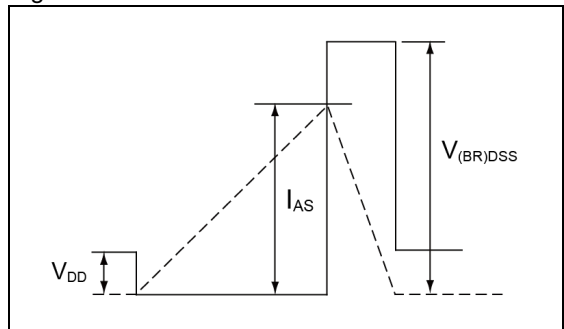


Fig.5-1 dv/dt Measurement Circuit

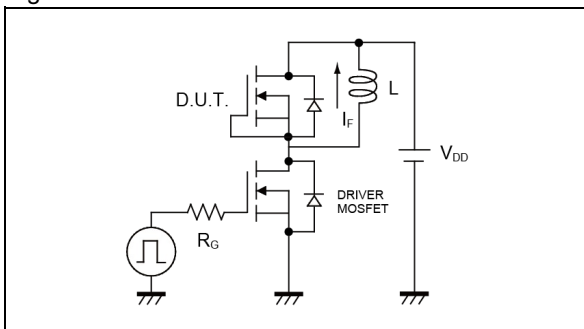
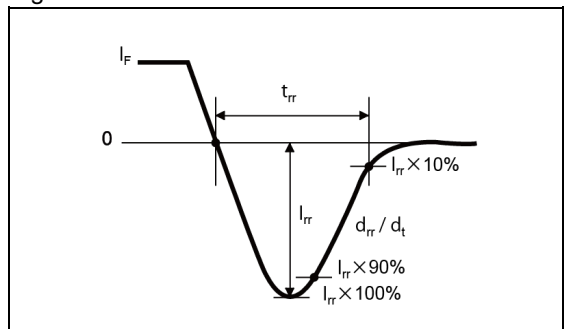
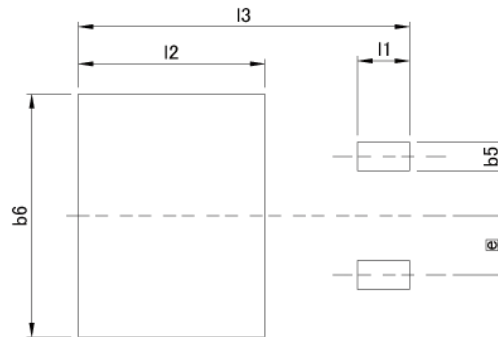
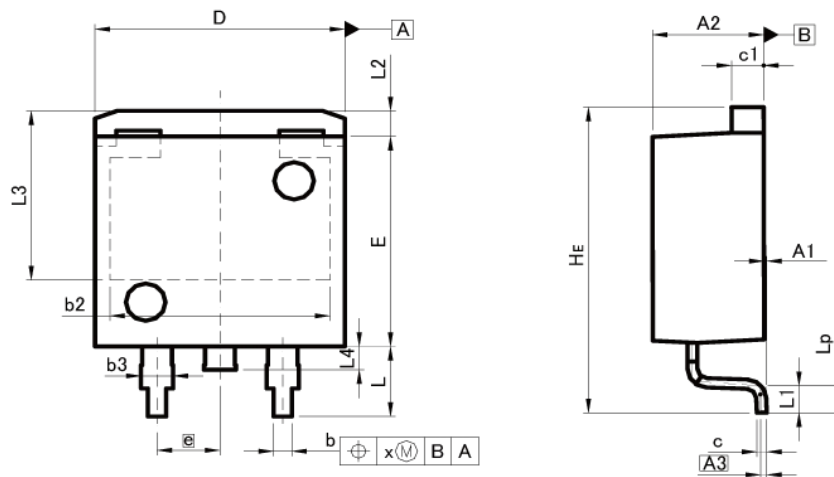


Fig.5-2 dv/dt Waveform



●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 |
| i1  | -          | 2.10  | -      | 0.083 |
| i2  | -          | 7.55  | -      | 0.297 |
| i3  | -          | 13.40 | -      | 0.528 |

Dimension in mm/inches

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### R6020KNJ - Web Page

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|                             |             |
|-----------------------------|-------------|
| Part Number                 | R6020KNJ    |
| Package                     | LPTS(D2PAK) |
| Unit Quantity               | 1000        |
| Minimum Package Quantity    | 1000        |
| Packing Type                | Taping      |
| Constitution Materials List | inquiry     |
| RoHS                        | Yes         |