

|                     |        |
|---------------------|--------|
| $V_{DSS}$           | 600V   |
| $R_{DS(on)}$ (Max.) | 0.102Ω |
| $I_D$               | 35A    |
| $P_D$               | 120W   |

### ●Features

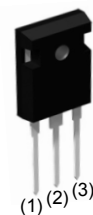
- 1) Low on-resistance.
- 2) Fast switching speed.
- 3) Gate-source voltage ( $V_{GSS}$ ) guaranteed to be  $\pm 20V$ .
- 4) Drive circuits can be simple.
- 5) Parallel use is easy.
- 6) Pb-free lead plating ; RoHS compliant

### ●Application

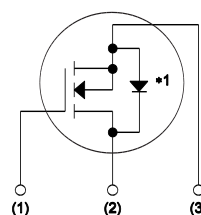
Switching Power Supply

### ●Outline

TO-247



### ●Inner circuit



- (1) Gate  
(2) Drain  
(3) Source

\*1 BODY DIODE

### ●Packaging specifications

|      |                           |           |
|------|---------------------------|-----------|
| Type | Packaging                 | Tube      |
|      | Reel size (mm)            | -         |
|      | Tape width (mm)           | -         |
|      | Basic ordering unit (pcs) | 450       |
|      | Taping code               | C9        |
|      | Marking                   | R6035ENZ1 |

### ●Absolute maximum ratings ( $T_a = 25^\circ C$ )

| Parameter                                |                     | Symbol             | Value       | Unit       |
|------------------------------------------|---------------------|--------------------|-------------|------------|
| Drain - Source voltage                   |                     | $V_{DSS}$          | 600         | V          |
| Continuous drain current                 | $T_c = 25^\circ C$  | $I_D^{*1}$         | $\pm 35$    | A          |
|                                          | $T_c = 100^\circ C$ | $I_D^{*1}$         | $\pm 19$    | A          |
| Pulsed drain current                     |                     | $I_{D,pulse}^{*2}$ | $\pm 105$   | A          |
| Gate - Source voltage                    |                     | $V_{GSS}$          | $\pm 20$    | V          |
| Avalanche energy, single pulse           |                     | $E_{AS}^{*3}$      | 796         | mJ         |
| Avalanche energy, repetitive             |                     | $E_{AR}^{*3}$      | 1.2         | mJ         |
| Avalanche current, repetitive            |                     | $I_{AR}$           | 6.6         | A          |
| Power dissipation ( $T_c = 25^\circ C$ ) |                     | $P_D$              | 120         | W          |
| Junction temperature                     |                     | $T_j$              | 150         | $^\circ C$ |
| Range of storage temperature             |                     | $T_{stg}$          | -55 to +150 | $^\circ C$ |
| Reverse diode dv/dt                      |                     | dv/dt $^{*4}$      | 15          | V/ns       |

### ●Absolute maximum ratings

| Parameter                    | Symbol | Conditions                             | Values | Unit |
|------------------------------|--------|----------------------------------------|--------|------|
| Drain - Source voltage slope | dv/dt  | $V_{DS} = 480V$<br>$T_j = 125^\circ C$ | 50     | V/ns |

### ●Thermal resistance

| Parameter                                    | Symbol     | Values |      |      | Unit         |
|----------------------------------------------|------------|--------|------|------|--------------|
|                                              |            | Min.   | Typ. | Max. |              |
| Thermal resistance, junction - case          | $R_{thJC}$ | -      | -    | 1.04 | $^\circ C/W$ |
| Thermal resistance, junction - ambient       | $R_{thJA}$ | -      | -    | 30   | $^\circ C/W$ |
| Soldering temperature, wavesoldering for 10s | $T_{sold}$ | -      | -    | 265  | $^\circ C$   |

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

| 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             | $I_{DSS}$         | $V_{DS} = 600V, V_{GS} = 0V$<br>$T_j = 25^\circ C$ | -      | 0.1   | 100       | $\mu A$  |
|                                             |                   | $T_j = 125^\circ C$                                | -      | -     | 1000      |          |
| Gate - Source leakage current               | $I_{GSS}$         | $V_{GS} = \pm 20V, V_{DS} = 0V$                    | -      | -     | $\pm 100$ | nA       |
| Gate threshold voltage                      | $V_{GS(th)}$      | $V_{DS} = 10V, I_D = 1mA$                          | 2      | -     | 4         | V        |
| Static drain - source on - state resistance | $R_{DS(on)}^{*5}$ | $V_{GS} = 10V, I_D = 18.1A$<br>$T_j = 25^\circ C$  | -      | 0.092 | 0.102     | $\Omega$ |
|                                             |                   | $T_j = 125^\circ C$                                | -      | 0.200 | -         |          |
| Gate input resistance                       | $R_G$             | $f = 1MHz, \text{open drain}$                      | -      | 1.5   | -         | $\Omega$ |

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

| Parameter                                    | Symbol            | Conditions                                                   | Values |      |      | Unit |
|----------------------------------------------|-------------------|--------------------------------------------------------------|--------|------|------|------|
|                                              |                   |                                                              | Min.   | Typ. | Max. |      |
| Transconductance                             | $g_{fs}^{*5}$     | $V_{DS} = 10\text{V}$ , $I_D = 17.5\text{A}$                 | 11     | 22   | -    | S    |
| Input capacitance                            | $C_{iss}$         | $V_{GS} = 0\text{V}$                                         | -      | 2720 | -    | pF   |
| Output capacitance                           | $C_{oss}$         | $V_{DS} = 25\text{V}$                                        | -      | 2000 | -    |      |
| Reverse transfer capacitance                 | $C_{rss}$         | $f = 1\text{MHz}$                                            | -      | 240  | -    |      |
| Effective output capacitance, energy related | $C_{o(er)}$       | $V_{GS} = 0\text{V}$<br>$V_{DS} = 0\text{V to } 480\text{V}$ | -      | 100  | -    | pF   |
| Effective output capacitance, time related   | $C_{o(tr)}$       |                                                              | -      | 500  | -    |      |
| Turn - on delay time                         | $t_{d(on)}^{*5}$  | $V_{DD} \approx 300\text{V}$ , $V_{GS} = 10\text{V}$         | -      | 40   | -    | ns   |
| Rise time                                    | $t_r^{*5}$        | $I_D = 17.5\text{A}$                                         | -      | 80   | -    |      |
| Turn - off delay time                        | $t_{d(off)}^{*5}$ | $R_L = 17.4\Omega$                                           | -      | 210  | -    |      |
| Fall time                                    | $t_f^{*5}$        | $R_G = 10\Omega$                                             | -      | 80   | -    |      |

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

| Parameter            | Symbol          | Conditions                                        | Values |      |      | Unit |
|----------------------|-----------------|---------------------------------------------------|--------|------|------|------|
|                      |                 |                                                   | Min.   | Typ. | Max. |      |
| Total gate charge    | $Q_g^{*5}$      | $V_{DD} \approx 300\text{V}$                      | -      | 110  | -    | nC   |
| Gate - Source charge | $Q_{gs}^{*5}$   | $I_D = 35\text{A}$                                | -      | 15   | -    |      |
| Gate - Drain charge  | $Q_{gd}^{*5}$   | $V_{GS} = 10\text{V}$                             | -      | 60   | -    |      |
| Gate plateau voltage | $V_{(plateau)}$ | $V_{DD} \approx 300\text{V}$ , $I_D = 35\text{A}$ | -      | 6.0  | -    | V    |

\*1 Limited only by maximum temperature allowed.

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

\*3  $I_D = 6.6\text{A}$ ,  $V_{DD} = 50\text{V}$

\*4 Reference measurement circuits Fig.5-1.

\*5 Pulsed

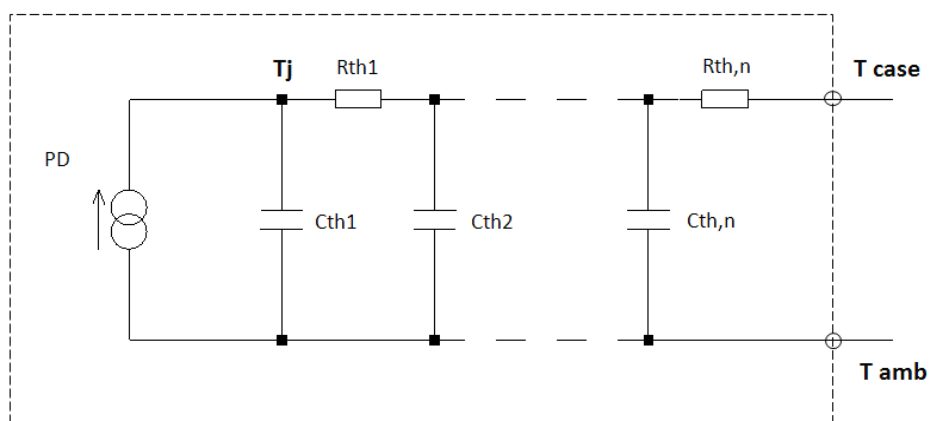
**●Body diode electrical characteristics (Source-Drain) ( $T_a = 25^\circ\text{C}$ )**

| Parameter                                 | Symbol         | Conditions                                              | Values |      |      | Unit          |
|-------------------------------------------|----------------|---------------------------------------------------------|--------|------|------|---------------|
|                                           |                |                                                         | Min.   | Typ. | Max. |               |
| Inverse diode continuous, forward current | $I_S^{*1}$     | $T_c = 25^\circ\text{C}$                                | -      | -    | 35   | A             |
| Inverse diode direct current, pulsed      | $I_{SM}^{*2}$  |                                                         | -      | -    | 105  | A             |
| Forward voltage                           | $V_{SD}^{*5}$  | $V_{GS} = 0\text{V}, I_S = 35\text{A}$                  | -      | -    | 1.5  | V             |
| Reverse recovery time                     | $t_{rr}^{*5}$  | $I_S = 35\text{A}$<br>$di/dt = 100\text{A}/\mu\text{s}$ | -      | 780  | -    | ns            |
| Reverse recovery charge                   | $Q_{rr}^{*5}$  |                                                         | -      | 16.5 | -    | $\mu\text{C}$ |
| Peak reverse recovery current             | $I_{rrm}^{*5}$ |                                                         | -      | 45   | -    | A             |

**●Typical Transient Thermal Characteristics**

| Symbol    | Value | Unit |
|-----------|-------|------|
| $R_{th1}$ | 0.151 | K/W  |
| $R_{th2}$ | 0.428 |      |
| $R_{th3}$ | 0.250 |      |

| Symbol    | Value | Unit |
|-----------|-------|------|
| $C_{th1}$ | 0.018 | Ws/K |
| $C_{th2}$ | 0.400 |      |
| $C_{th3}$ | 15.4  |      |



●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

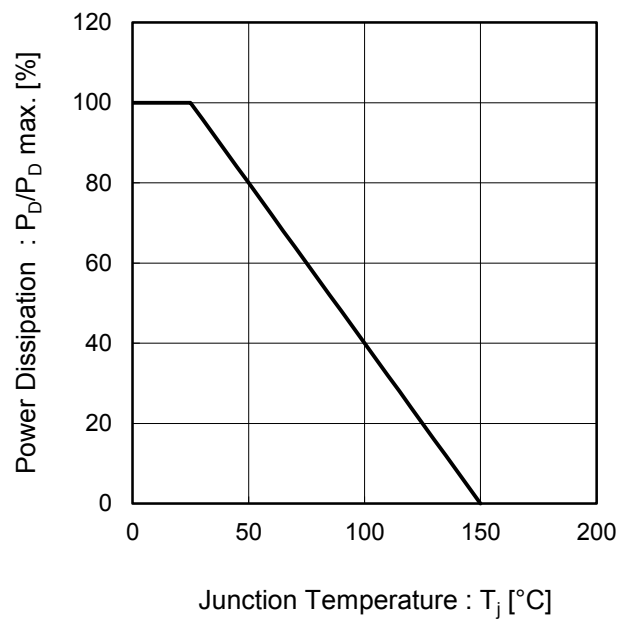


Fig.2 Normalized Transient Thermal Resistance vs. Pulse Width

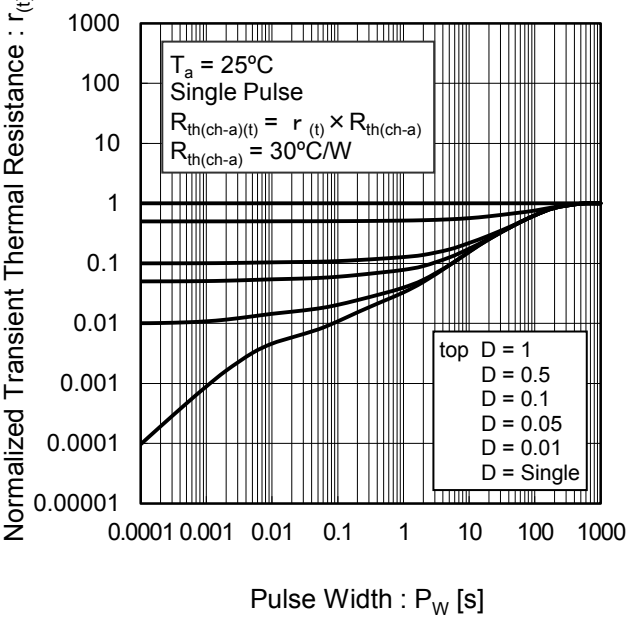
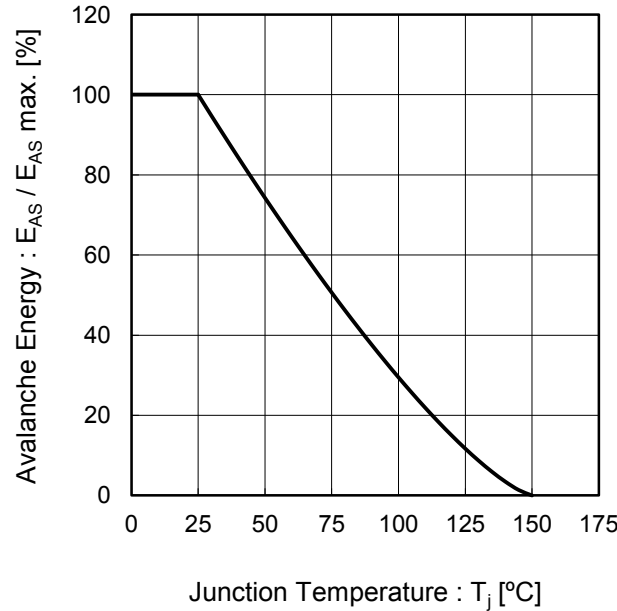


Fig.3 Avalanche Energy Derating Curve vs Junction Temperature



●Electrical characteristic curves

Fig.4 Typical Output Characteristics(I)

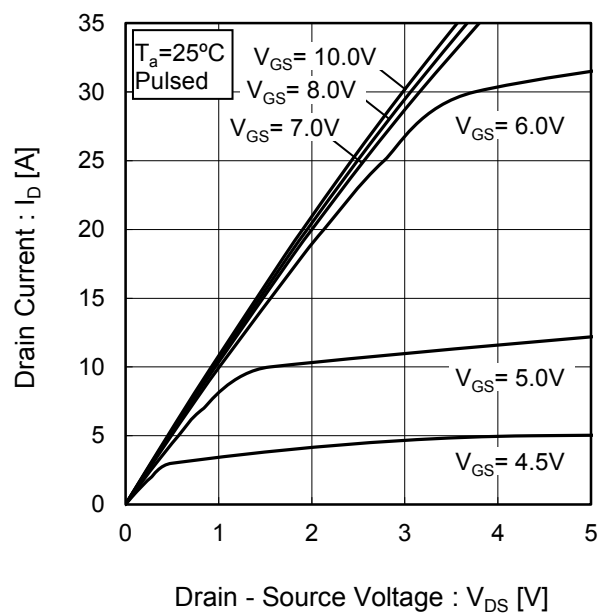


Fig.5 Typical Output Characteristics(II)

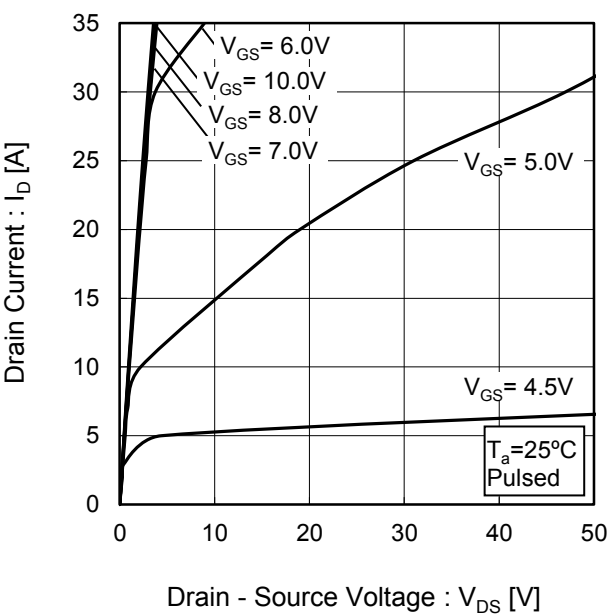


Fig.6  $T_j = 150^\circ\text{C}$  Typical Output Characteristics(I)

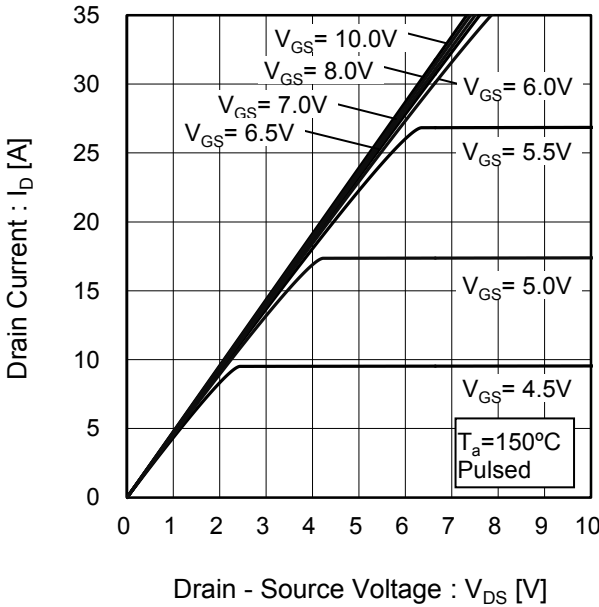
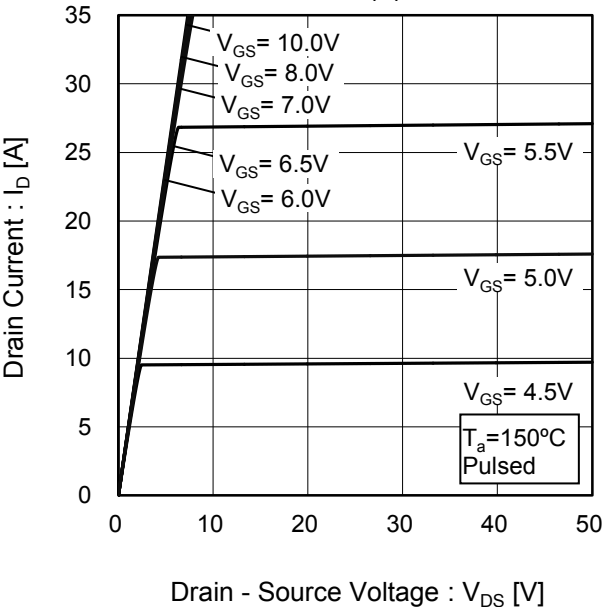


Fig.7  $T_j = 150^\circ\text{C}$  Typical Output Characteristics(II)



●Electrical characteristic curves

Fig.8 Breakdown Voltage  
vs. Junction Temperature

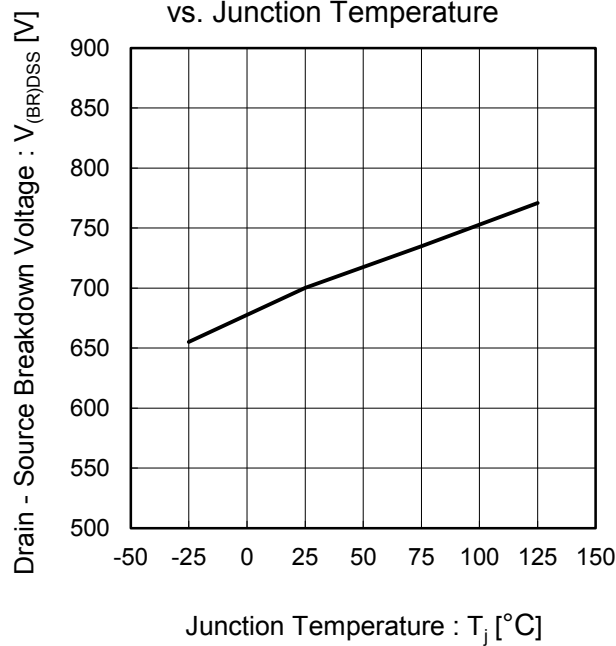


Fig.9 Typical Transfer Characteristics

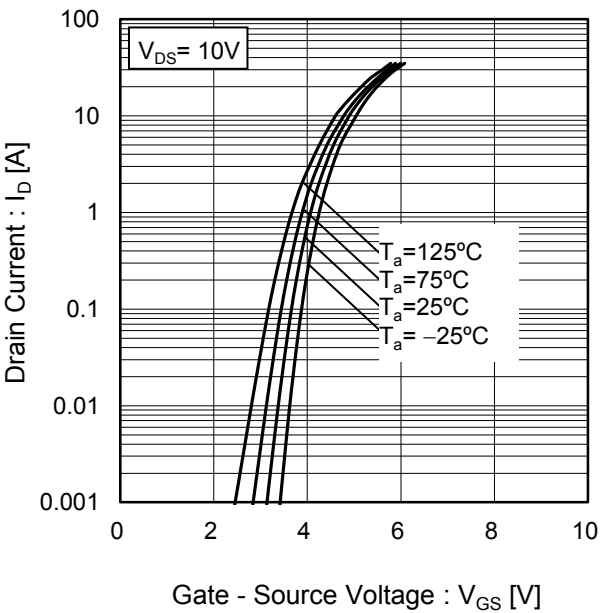


Fig.10 Gate Threshold Voltage  
vs. Junction Temperature

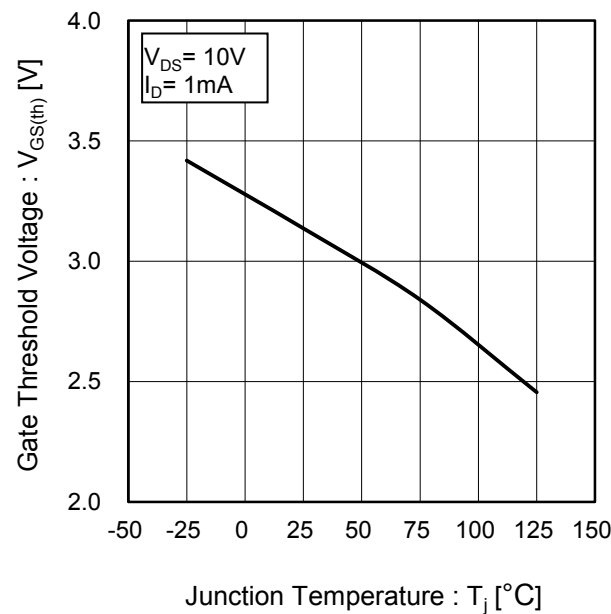
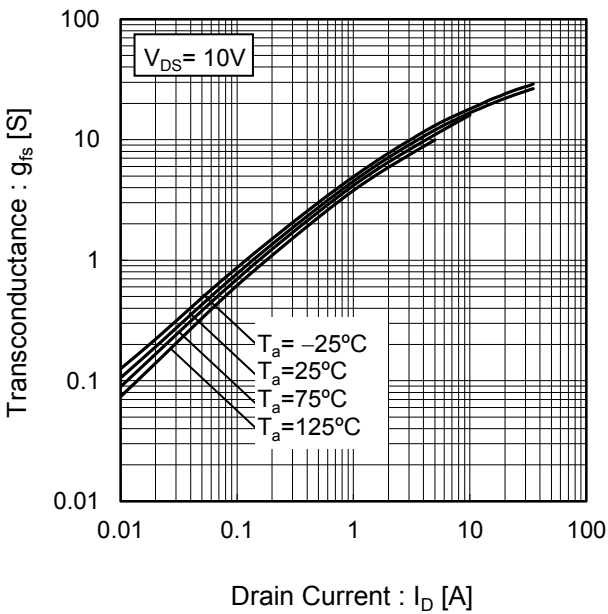


Fig.11 Transconductance vs. Drain Current



●Electrical characteristic curves

Fig.12 Static Drain - Source On - State Resistance vs. Gate Source Voltage

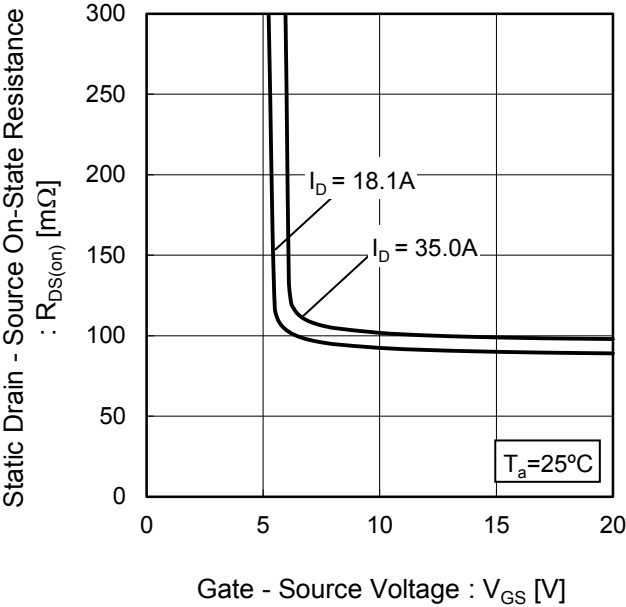


Fig.13 Static Drain - Source On - State Resistance vs. Junction Temperature

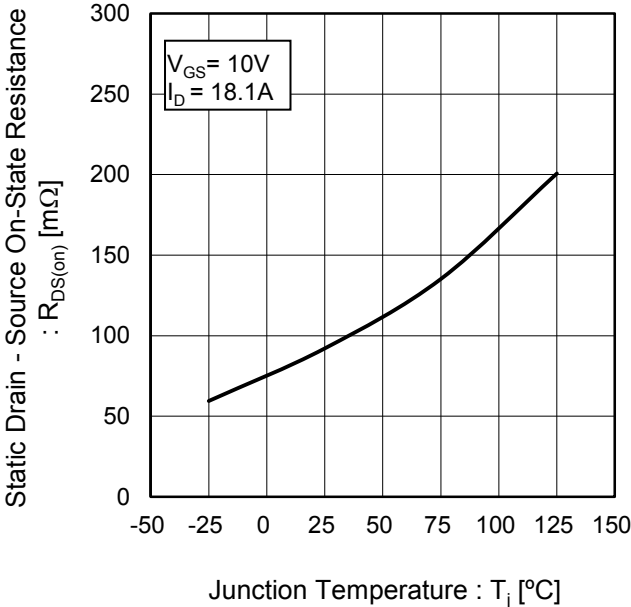


Fig.14 Static Drain - Source On - State Resistance vs. Drain Current

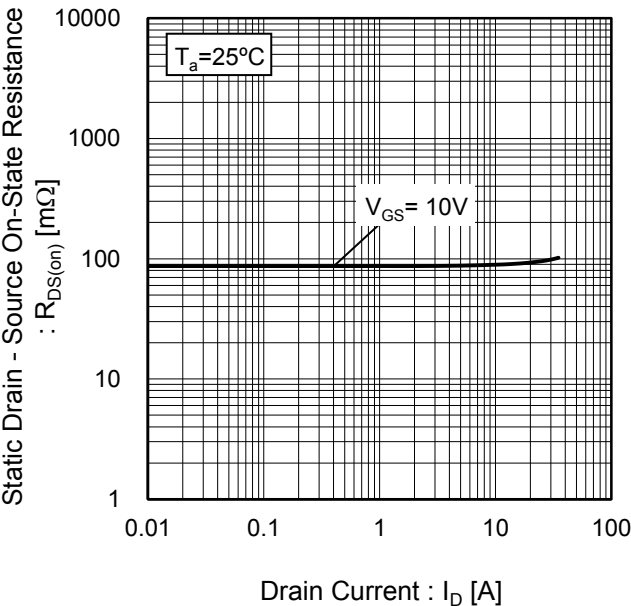
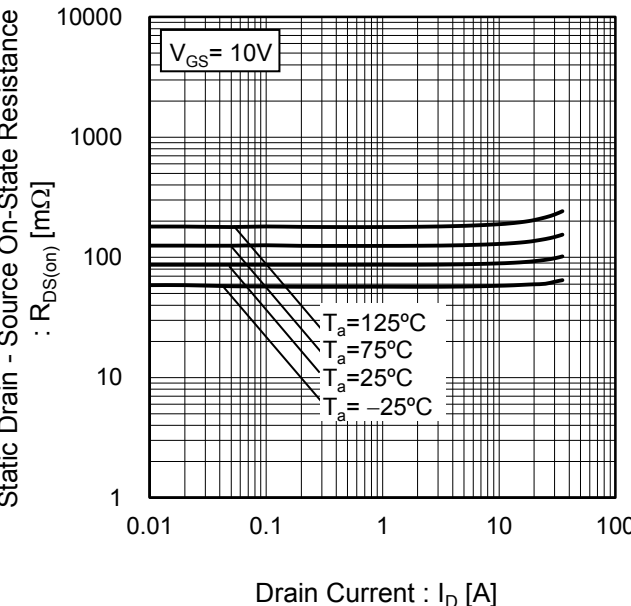


Fig.15 Static Drain - Source On - State Resistance vs. Drain Current



●Electrical characteristic curves

Fig.16 Typical Capacitance vs. Drain - Source Voltage

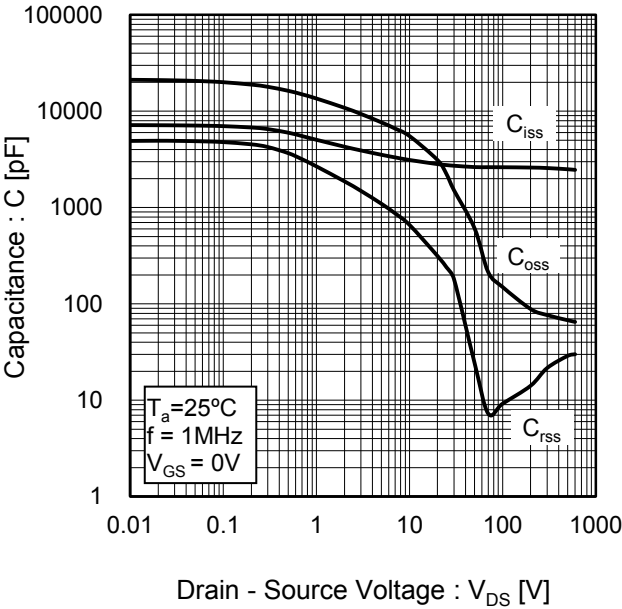


Fig.17 Coss Stored Energy

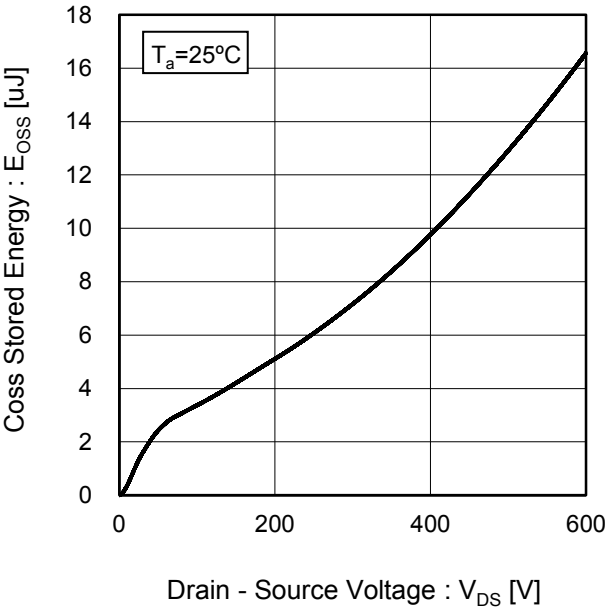


Fig.18 Switching Characteristics

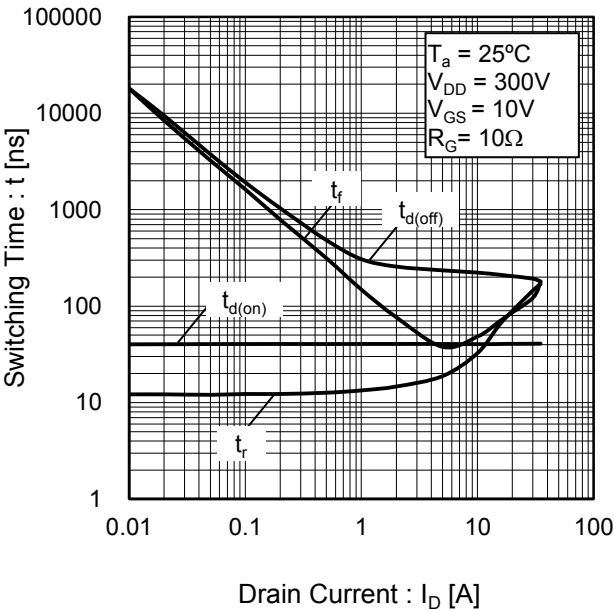
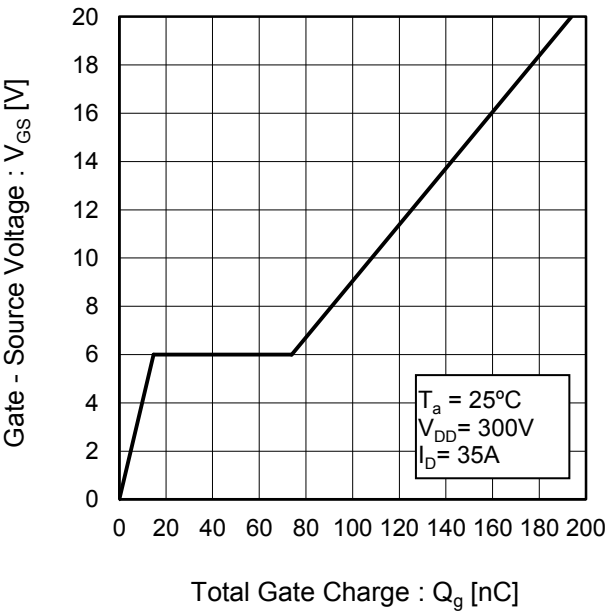


Fig.19 Dynamic Input Characteristics



●Electrical characteristic curves

Fig.20 Inverse Diode Forward Current vs. Source - Drain Voltage

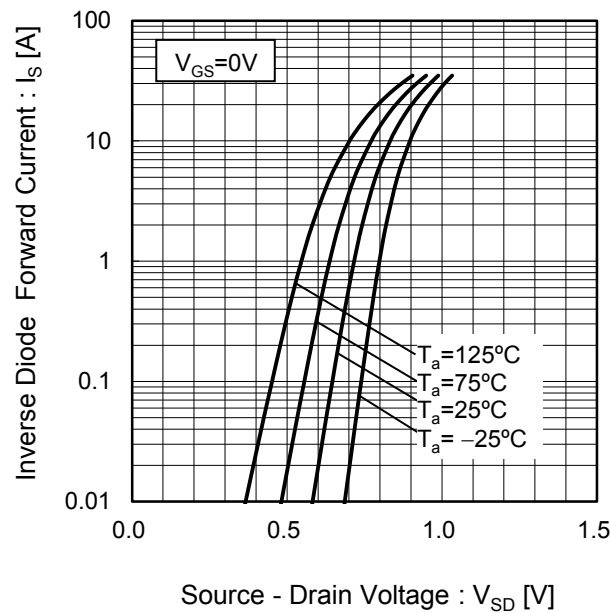
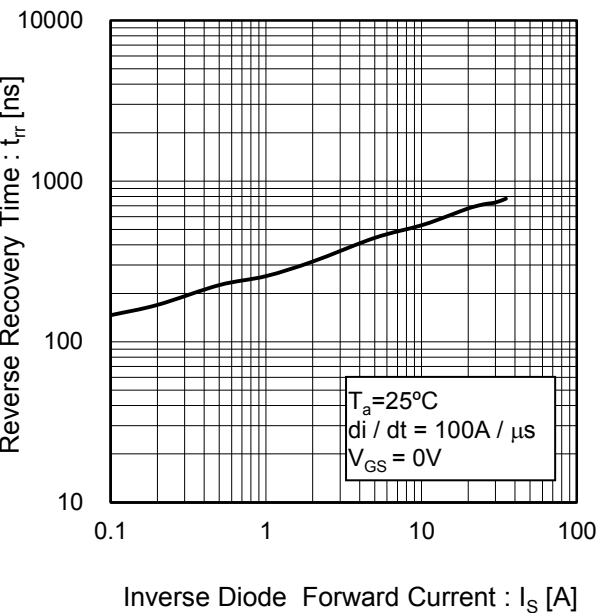


Fig.21 Reverse Recovery Time vs. Inverse Diode Forward Current



●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

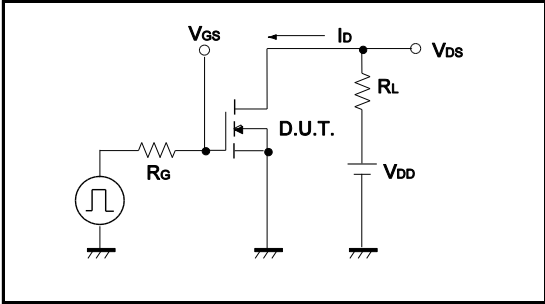


Fig.1-2 Switching Waveforms

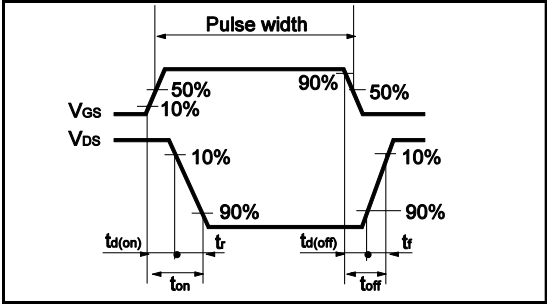


Fig.2-1 Gate Charge Measurement Circuit

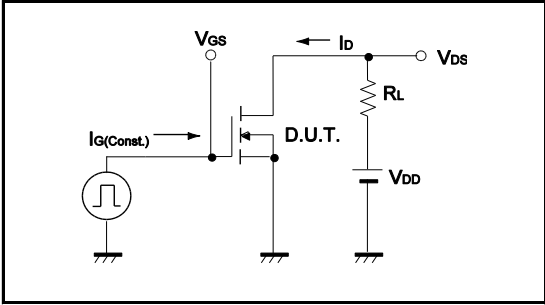


Fig.2-2 Gate Charge Waveform

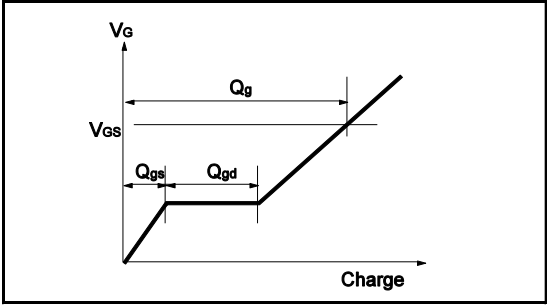


Fig.3-1 Avalanche Measurement Circuit

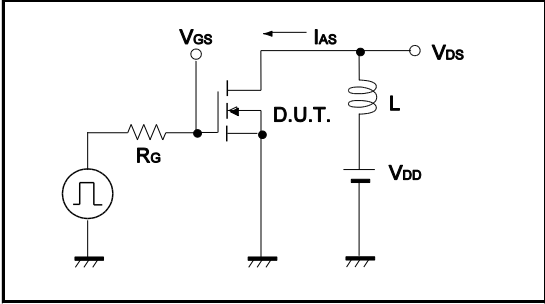


Fig.3-2 Avalanche Waveform

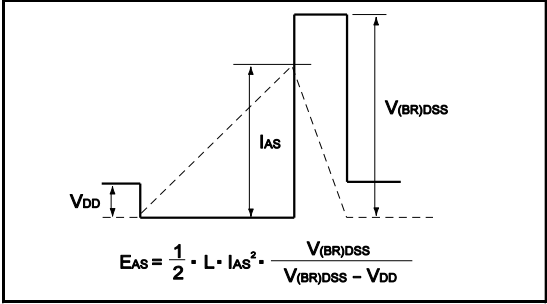


Fig.4-1 dv/dt Measurement Circuit

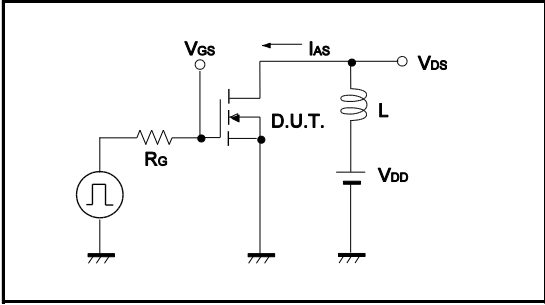


Fig.4-2 dv/dt Waveform

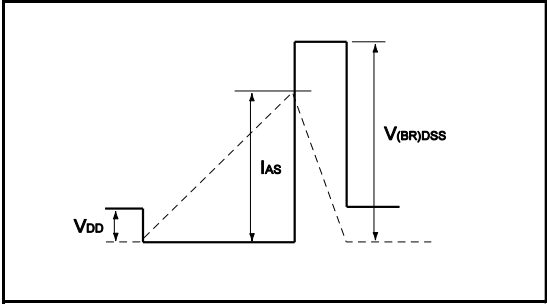


Fig.5-1 di/dt Measurement Circuit

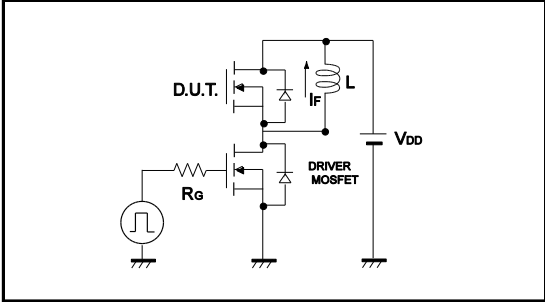
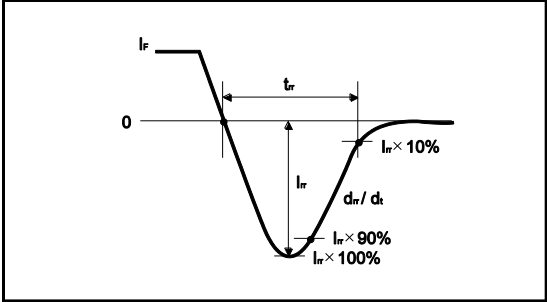
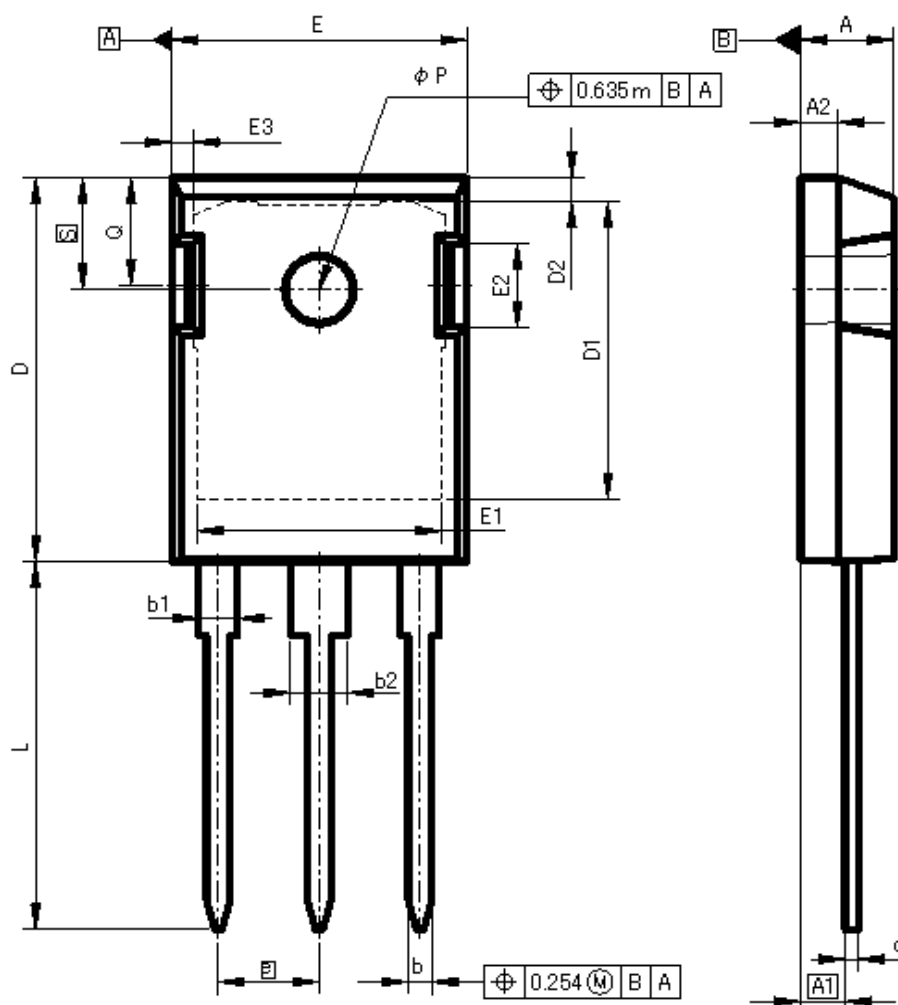


Fig.5-2 di/dt Waveform



## ●Dimensions (Unit : mm)

TO-247



| DIM | MILIMETERS |       | INCHES |       |
|-----|------------|-------|--------|-------|
|     | MIN        | MAX   | MIN    | MAX   |
| A   | 4.83       | 5.21  | 0.190  | 0.205 |
| A1  | 2.29       | 2.54  | 0.090  | 0.100 |
| A2  | 1.91       | 2.16  | 0.075  | 0.085 |
| b   | 1.14       | 1.40  | 0.045  | 0.055 |
| b1  | 1.91       | 2.20  | 0.075  | 0.087 |
| b2  | 2.92       | 3.20  | 0.115  | 0.126 |
| c   | 0.61       | 0.80  | 0.024  | 0.031 |
| D   | 20.80      | 21.34 | 0.819  | 0.840 |
| D1  | 17.43      | 17.83 | 0.686  | 0.702 |
| E   | 15.75      | 16.13 | 0.620  | 0.635 |
| e   | 5.45       |       | 0.215  |       |
| N   | 3.00       |       | 3.000  |       |
| L   | 19.81      | 20.57 | 0.780  | 0.810 |
| L1  | 3.81       | 4.32  | 0.150  | 0.170 |
| ΦP  | 3.55       | 3.65  | 0.140  | 0.144 |
| Q   | 5.59       | 6.20  | 0.220  | 0.244 |
| S   | 6.15       |       | 0.240  |       |

Dimension in mm / inches

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