

| | |
|--------------------|---------------|
| V_{DSS} | 500V |
| $R_{DS(on)}(Max.)$ | 0.52 Ω |
| I_D | $\pm 11A$ |
| P_D | 50W |

●Features

- 1) Fast reverse recovery time (trr).
- 2) Low on-resistance.
- 3) Fast switching speed.
- 4) Gate-source voltage (V_{GSS}) guaranteed to be $\pm 30V$.
- 5) Drive circuits can be simple.
- 6) Pb-free lead plating ; RoHS compliant

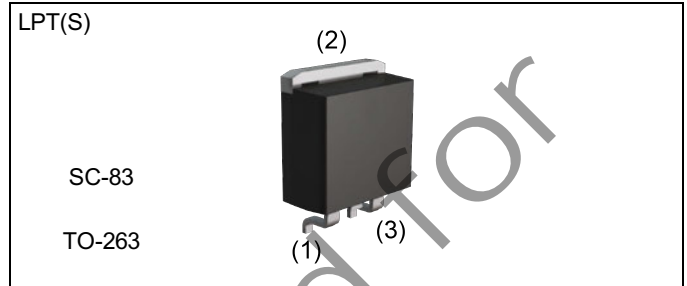
●Application

Switching Power Supply

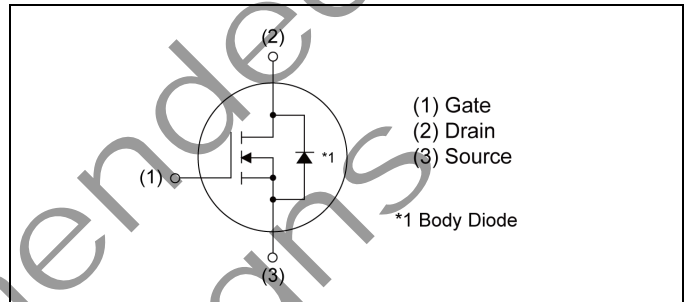
●Absolute maximum ratings ($T_a = 25^\circ C$)

| Parameter | Symbol | Value | Unit | |
|--|---------------------|-------------|------------|---|
| Drain - Source voltage | V_{DSS} | 500 | V | |
| Continuous drain current | $T_C = 25^\circ C$ | I_D^{*1} | ± 11 | A |
| | $T_C = 100^\circ C$ | I_D^{*1} | ± 5.2 | A |
| Pulsed drain current | $I_{D,pulse}^{*2}$ | ± 44 | A | |
| Gate - Source voltage | V_{GSS} | ± 30 | V | |
| Avalanche energy, single pulse | E_{AS}^{*3} | 8.1 | mJ | |
| Avalanche energy, repetitive | E_{AR}^{*4} | 3.5 | mJ | |
| Avalanche current | I_{AR}^{*3} | 5.5 | A | |
| Power dissipation ($T_C = 25^\circ C$) | P_D | 50 | 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 | 15 | V/ns | |

●Outline



●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 | R5011FNJ |

● Absolute maximum ratings

| Parameter | Symbol | Conditions | Values | Unit |
|------------------------------|--------|---|--------|------|
| Drain - Source voltage slope | dv/dt | $V_{DS} = 400V, I_D = 11A$ $T_j = 125^\circ C$ | 50 | V/ns |

● Thermal resistance

| Parameter | Symbol | Values | | | Unit |
|--|------------|--------|------|------|--------------|
| | | Min. | Typ. | Max. | |
| Thermal resistance, junction - case | R_{thJC} | - | - | 2.5 | $^\circ C/W$ |
| Thermal resistance, junction - ambient | R_{thJA} | - | - | 80 | $^\circ C/W$ |
| 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 | $V_{(BR)DSS}$ | $V_{GS} = 0V, I_D = 1mA$ | 500 | - | - | V |
| Drain - Source avalanche breakdown voltage | $V_{(BR)DS}$ | $V_{GS} = 0V, I_D = 5.5A$ | - | 580 | - | V |
| Zero gate voltage drain current | I_{DSS} | $V_{DS} = 500V, V_{GS} = 0V$ $T_j = 25^\circ C$ | - | 1 | 100 | μA |
| | | $T_j = 125^\circ C$ | - | - | 1000 | |
| Gate - Source leakage current | I_{GSS} | $V_{GS} = \pm 30V, V_{DS} = 0V$ | - | - | ± 100 | nA |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS} = 10V, I_D = 1mA$ | 2 | - | 4 | V |
| Static drain - source on - state resistance | $R_{DS(on)}^{*6}$ | $V_{GS} = 10V, I_D = 5.5A$ $T_j = 25^\circ C$ | - | 0.4 | 0.52 | Ω |
| | | $T_j = 125^\circ C$ | - | 0.85 | - | |
| Gate input resistance | R_G | f = 1MHz, open drain | - | 8.8 | - | Ω |

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

| Parameter | Symbol | Conditions | Values | | | Unit |
|--|-------------------|--|--------|------|------|------|
| | | | Min. | Typ. | Max. | |
| Transconductance | g_{fs}^{*6} | $V_{DS} = 10\text{V}, I_D = 5.5\text{A}$ | 4.5 | 8.0 | - | S |
| Input capacitance | C_{iss} | $V_{GS} = 0\text{V}$ | - | 950 | - | pF |
| Output capacitance | C_{oss} | $V_{DS} = 25\text{V}$ | - | 580 | - | |
| Reverse transfer capacitance | C_{rss} | $f = 1\text{MHz}$ | - | 30 | - | |
| Effective output capacitance, energy related | $C_{o(er)}$ | $V_{GS} = 0\text{V},$ $V_{DS} = 0\text{V to } 400\text{V}$ | - | 40.7 | - | pF |
| Effective output capacitance, time related | $C_{o(tr)}$ | | - | 126 | - | |
| Turn - on delay time | $t_{d(on)}^{*6}$ | $V_{DD} \approx 250\text{V}, V_{GS} = 10\text{V}$ $I_D = 5.5\text{A}$ $R_L \approx 45.3\Omega$ $R_G = 10\Omega$ | - | 26 | - | ns |
| Rise time | t_r^{*6} | | - | 28 | - | |
| Turn - off delay time | $t_{d(off)}^{*6}$ | | - | 75 | 150 | |
| Fall time | t_f^{*6} | | - | 30 | 60 | |

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

| Parameter | Symbol | Conditions | Values | | | Unit |
|----------------------|-----------------|--|--------|------|------|------|
| | | | Min. | Typ. | Max. | |
| Total gate charge | Q_g^{*6} | $V_{DD} \approx 250\text{V}$ | - | 30 | - | nC |
| Gate - Source charge | Q_{gs}^{*6} | $I_D = 11\text{A}$ | - | 7 | - | |
| Gate - Drain charge | Q_{gd}^{*6} | $V_{GS} = 10\text{V}$ | - | 12 | - | |
| Gate plateau voltage | $V_{(plateau)}$ | $V_{DD} \approx 250\text{V}, I_D = 11\text{A}$ | - | 5.9 | - | V |

*1 Limited only by maximum temperature allowed.

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

*3 $L \approx 500\mu\text{H}$, $V_{DD} = 50\text{V}$, $R_G = 25\Omega$, starting $T_j = 25^\circ\text{C}$

*4 $L \approx 500\mu\text{H}$, $V_{DD} = 50\text{V}$, $R_G = 25\Omega$, starting $T_j = 25^\circ\text{C}$, $f = 10\text{kHz}$

*5 Reference measurement circuits Fig.5-1.

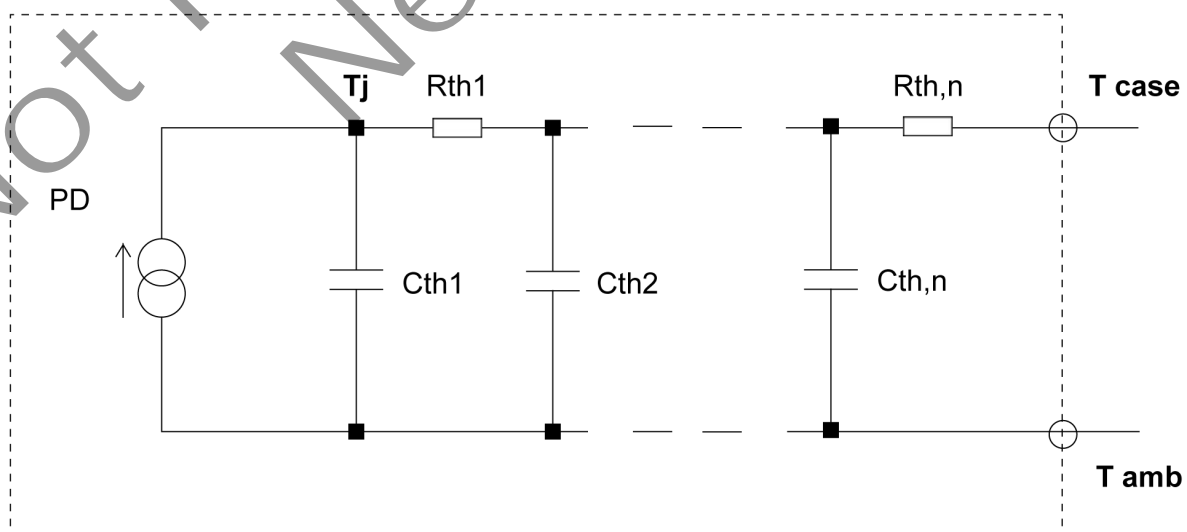
*6 Pulsed

●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} | $T_C = 25^\circ\text{C}$ | - | - | 11 | A |
| Inverse diode direct current, pulsed | I_{SM}^{*2} | | - | - | 44 | A |
| Forward voltage | V_{SD}^{*6} | $V_{GS} = 0\text{V}, I_S = 11\text{A}$ | - | - | 1.5 | V |
| Reverse recovery time | t_{rr}^{*6} | $I_S = 11\text{A}$ $di/dt = 100\text{A}/\mu\text{s}$ | - | 85 | - | ns |
| Reverse recovery charge | Q_{rr}^{*6} | | - | 0.26 | - | μC |
| Peak reverse recovery current | I_{rm}^{*6} | | - | 6.3 | - | A |
| Peak rate of fall of reverse recovery current | di_{rr}/dt | $T_j = 25^\circ\text{C}$ | - | 710 | - | $\text{A}/\mu\text{s}$ |

●Typical transient thermal characteristics

| Symbol | Value | Unit | Symbol | Value | Unit |
|-----------|--------|------|-----------|---------|------|
| R_{th1} | 0.0868 | K/W | C_{th1} | 0.00172 | Ws/K |
| R_{th2} | 0.34 | | C_{th2} | 0.00589 | |
| R_{th3} | 0.613 | | C_{th3} | 0.18 | |



● Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

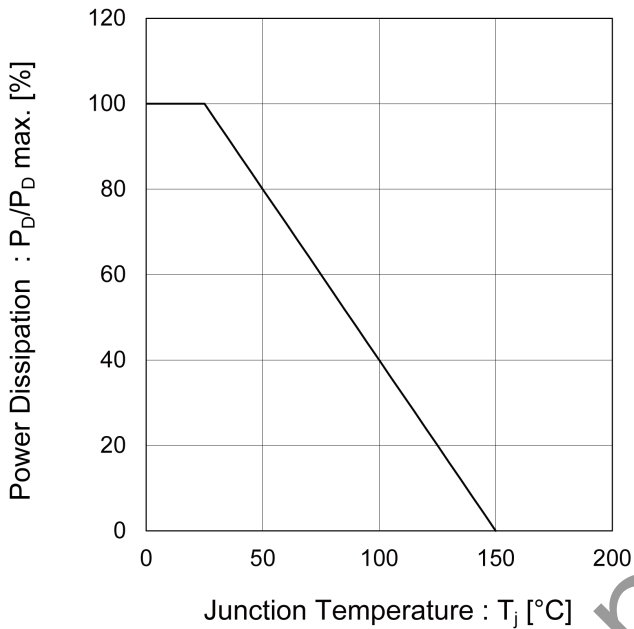


Fig.2 Maximum Safe Operating Area

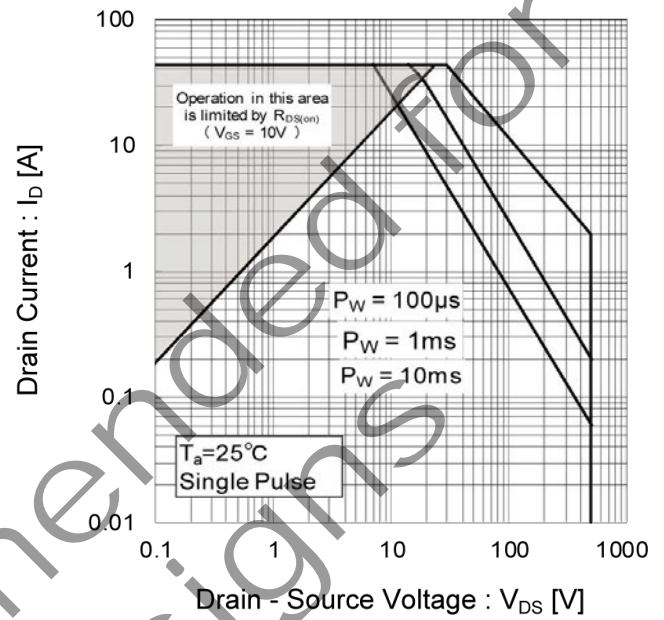
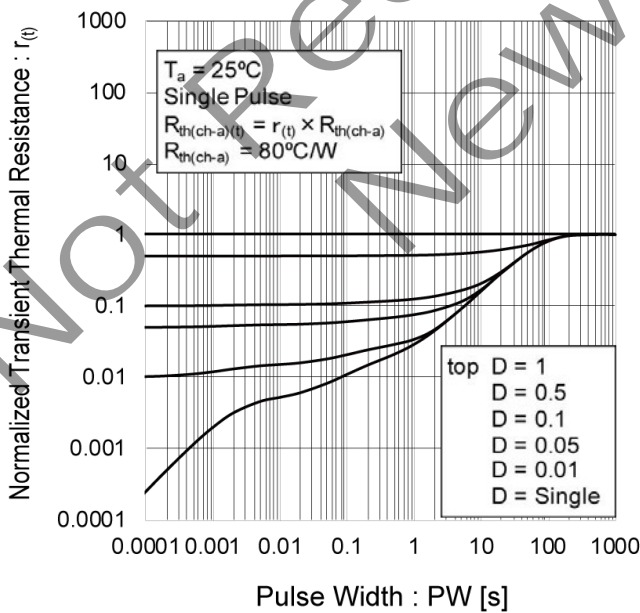


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width



● Electrical characteristic curves

Fig.4 Avalanche Current vs. Inductive Load

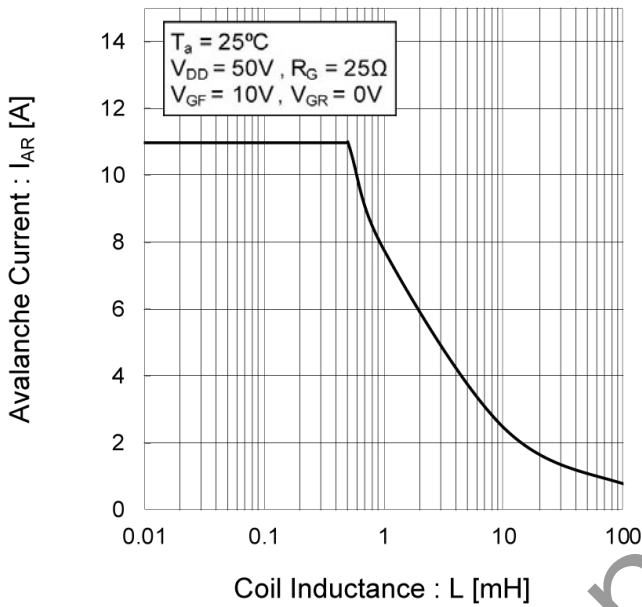


Fig.5 Avalanche Power Losses

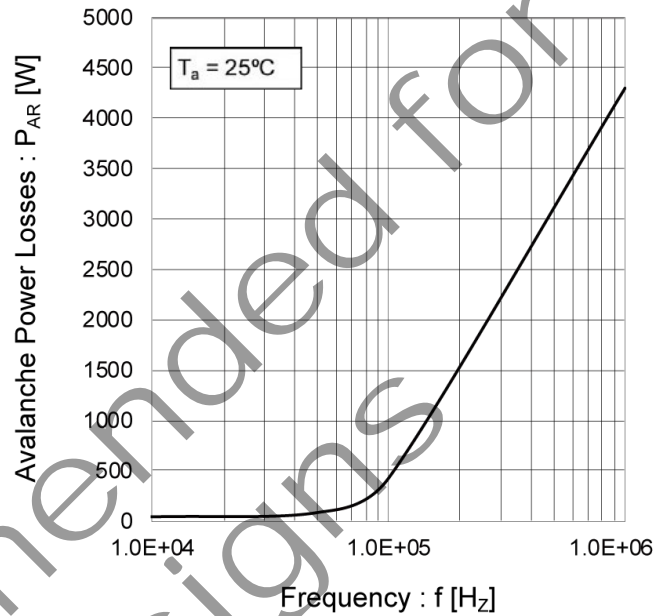
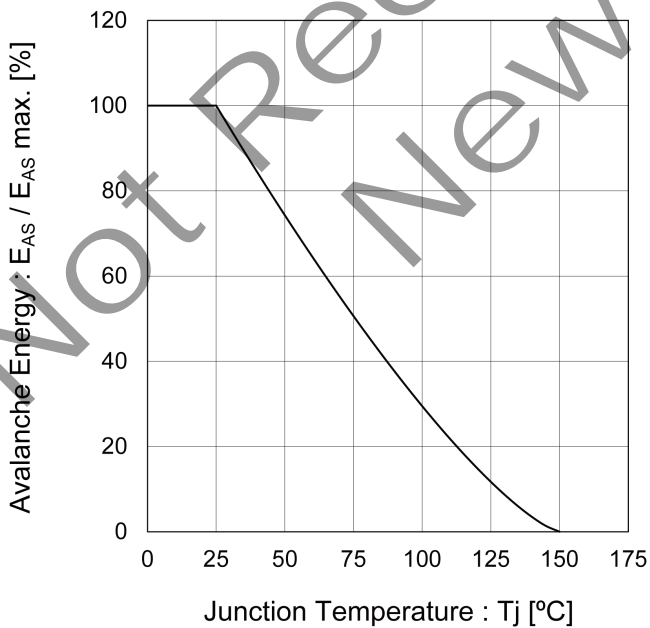


Fig.6 Avalanche Energy Derating Curve vs. Junction Temperature



● Electrical characteristic curves

Fig.7 Typical Output Characteristics(I)

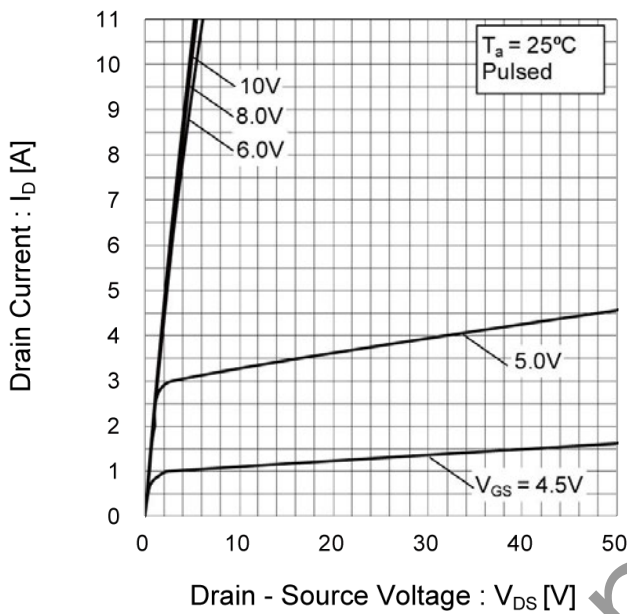


Fig.8 Typical Output Characteristics(II)

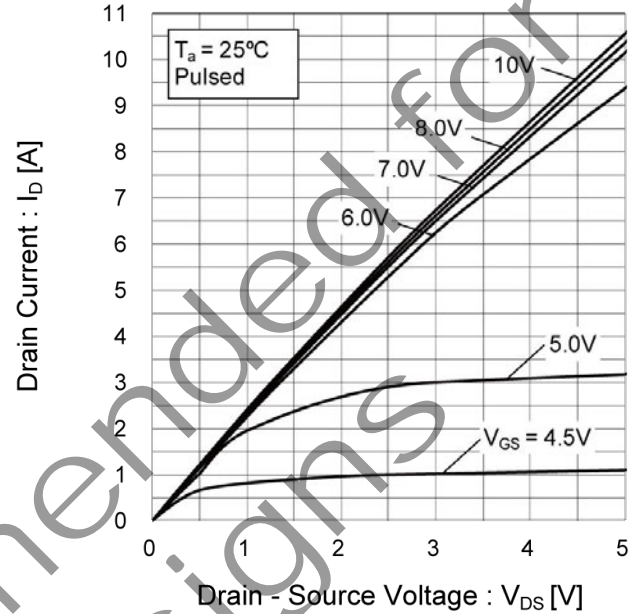


Fig.9 $T_j = 150^\circ\text{C}$ Typical Output Characteristics (I)

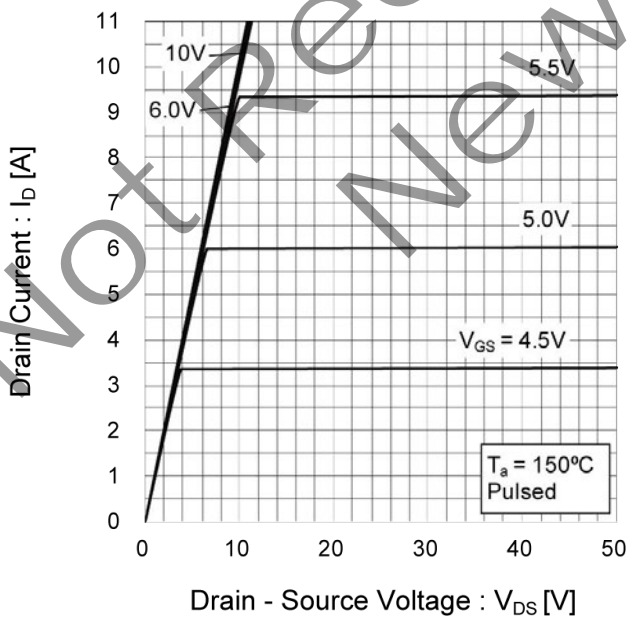
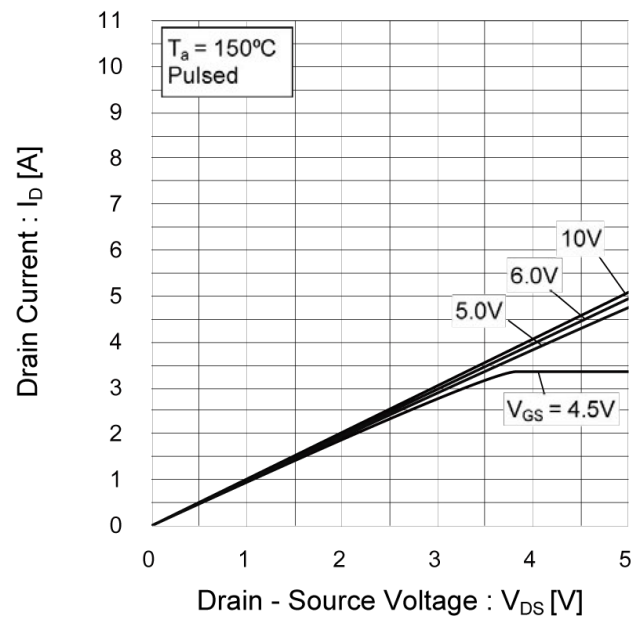


Fig.10 $T_j = 150^\circ\text{C}$ Typical Output Characteristics (II)



● Electrical characteristic curves

Fig.11 Breakdown Voltage vs. Junction Temperature

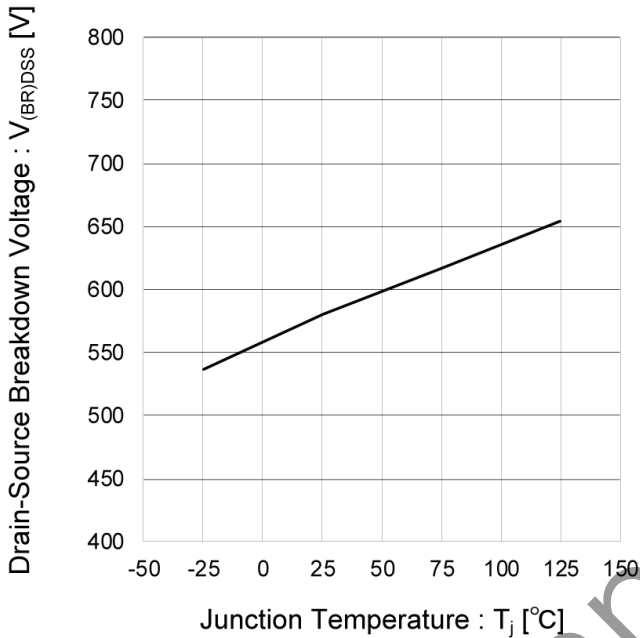


Fig.12 Typical Transfer Characteristics

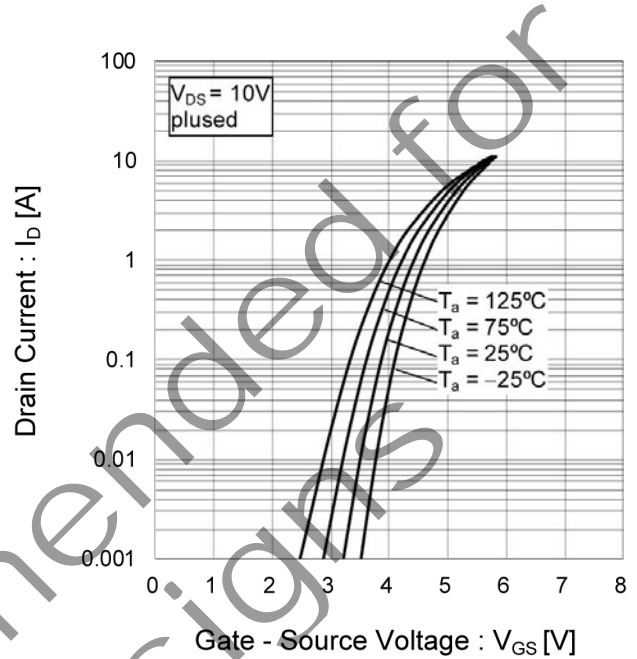


Fig.13 Gate Threshold Voltage vs. Junction Temperature

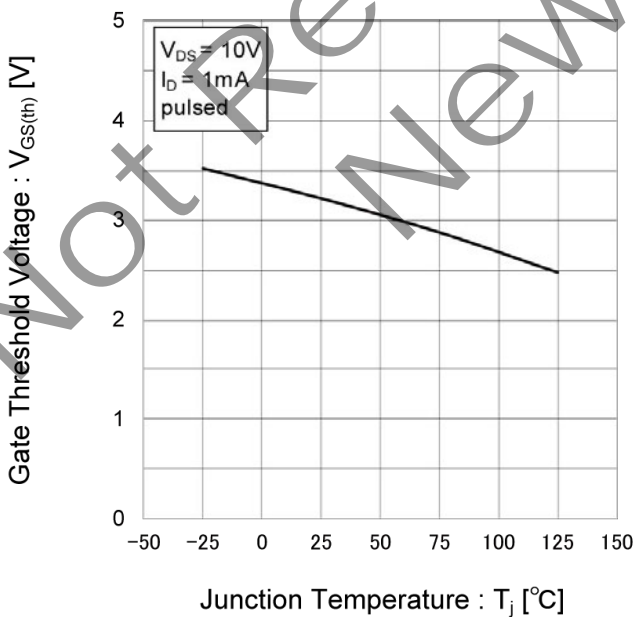
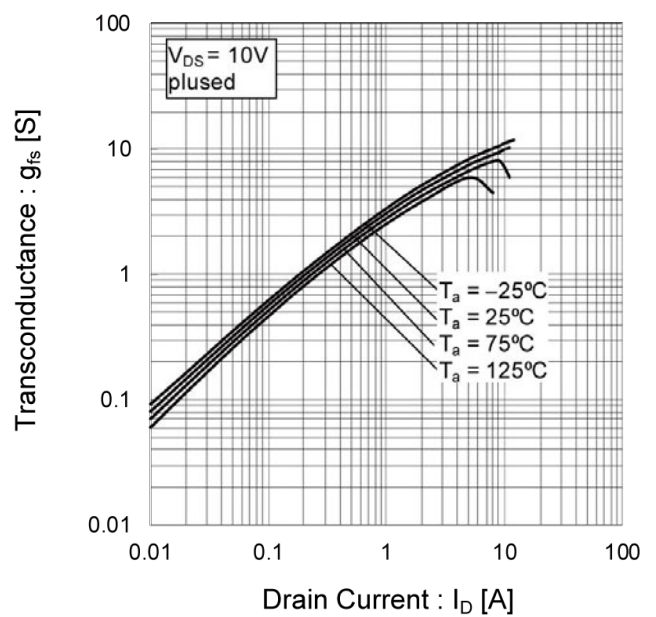


Fig.14 Transconductance vs. Drain Current



● Electrical characteristic curves

Fig.15 Static Drain - Source On - State Resistance vs. Gate Source Voltage

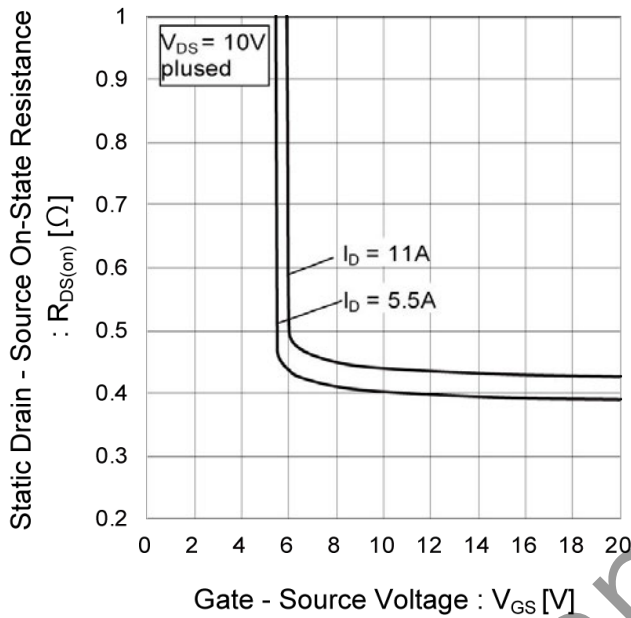


Fig.16 Static Drain - Source On - State Resistance vs. Junction Temperature

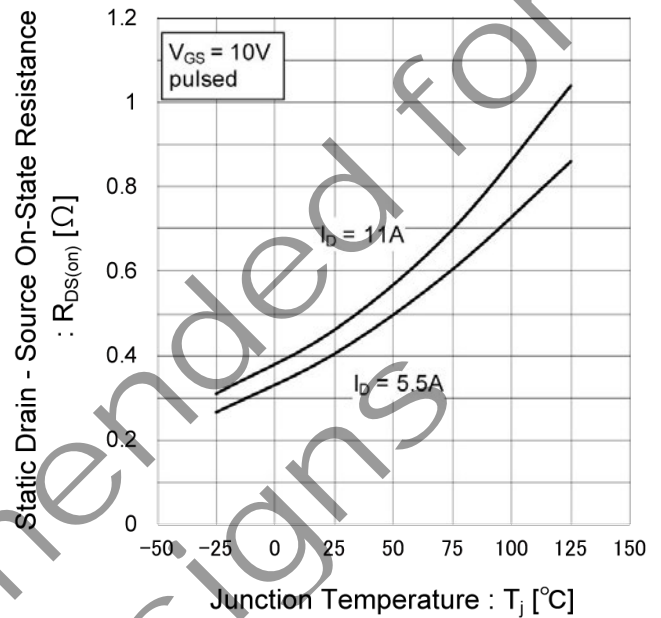
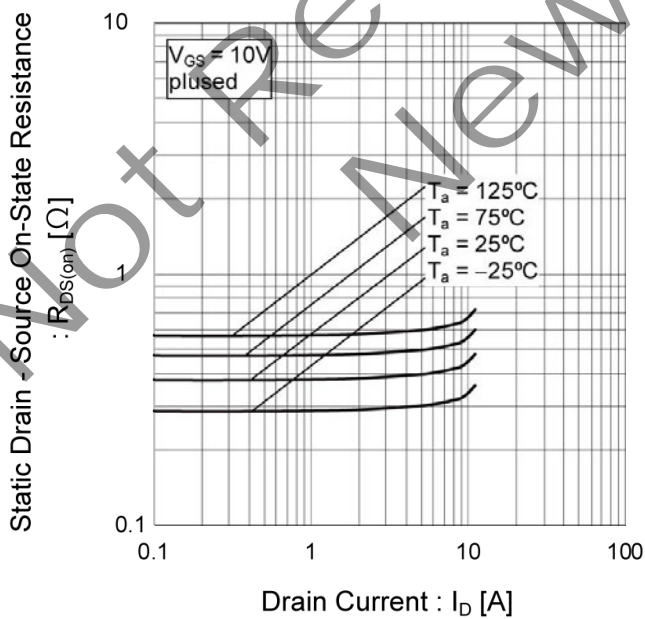


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current



● Electrical characteristic curves

Fig.18 Typical Capacitance vs. Drain - Source Voltage

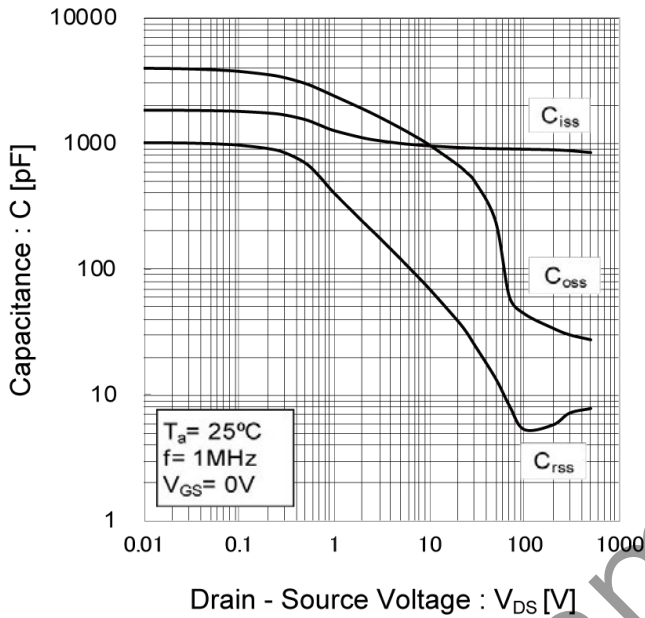


Fig.19 Coss Stored Energy

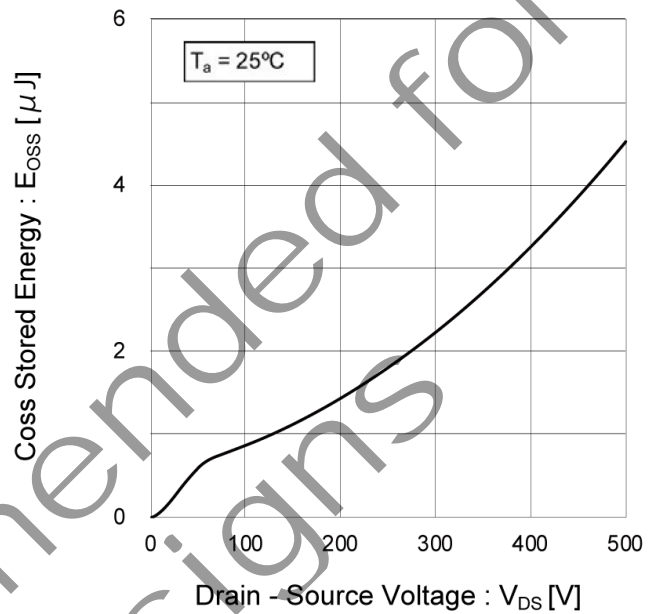


Fig.20 Switching Characteristics

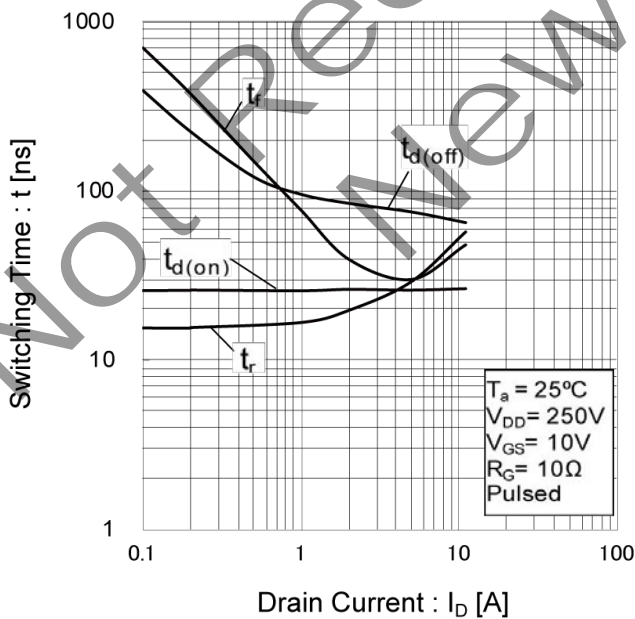
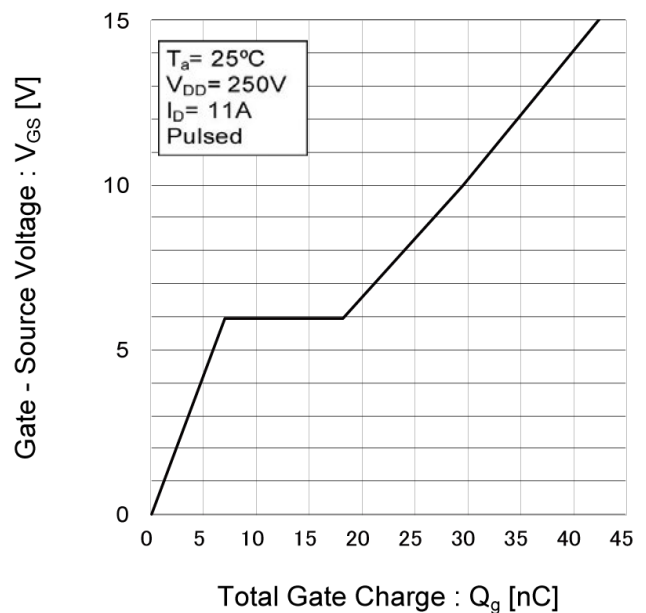


Fig.21 Dynamic Input Characteristics



● Electrical characteristic curves

Fig.22 Inverse Diode Forward Current vs. Source - Drain Voltage

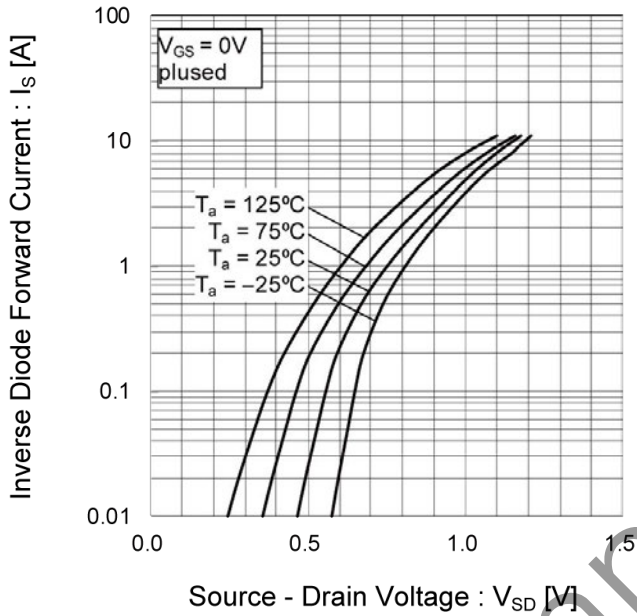
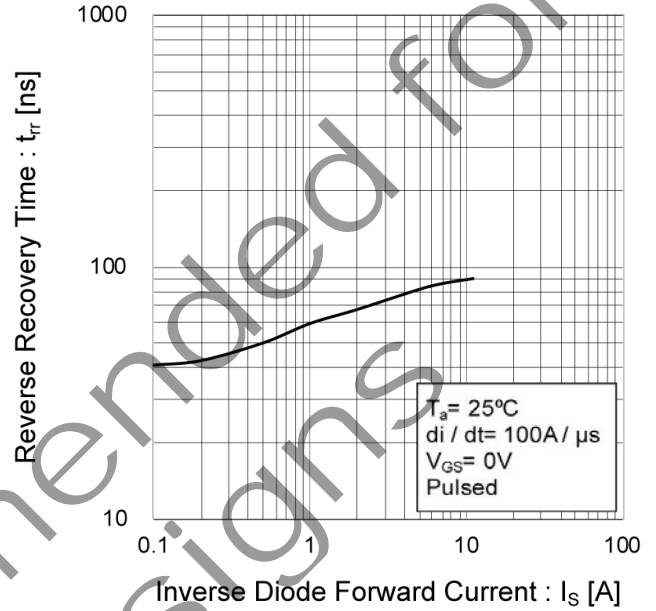


Fig.23 Reverse Recovery Time vs. Inverse Diode Forward Current



Not Recommended for New Designs

● Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

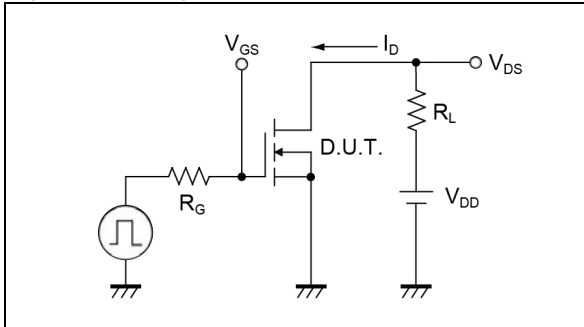


Fig.1-2 Switching Waveforms

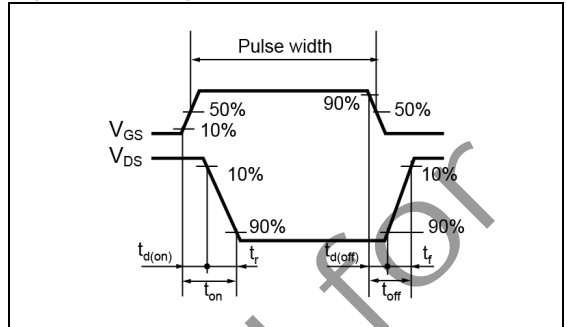


Fig.2-1 Gate Charge Measurement Circuit

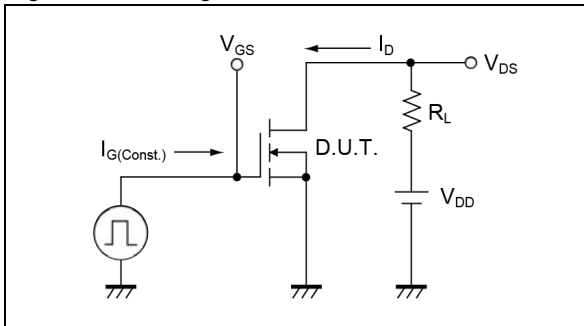


Fig.2-2 Gate Charge Waveform

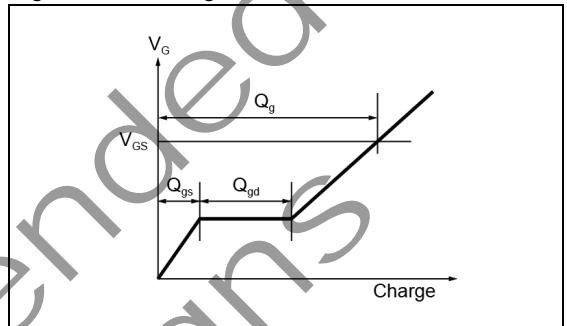


Fig.3-1 Avalanche Measurement Circuit

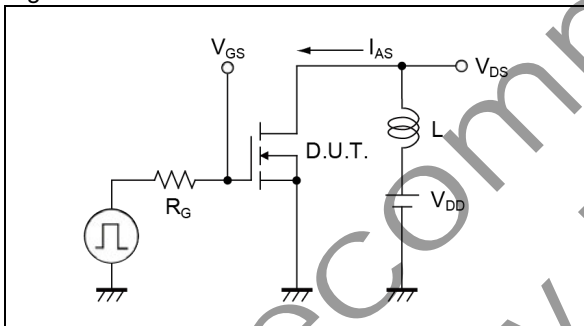


Fig.3-2 Avalanche Waveform

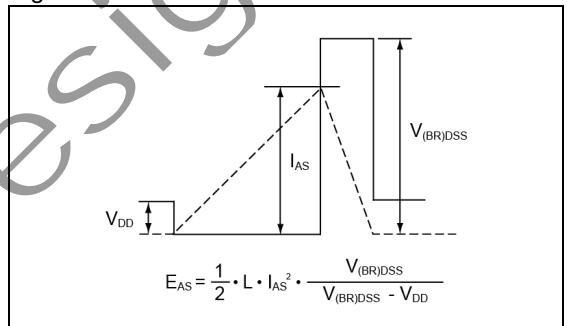


Fig.4-1 dv/dt Measurement Circuit

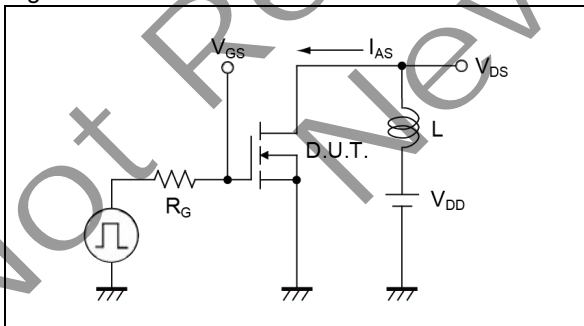


Fig.4-2 dv/dt Waveform

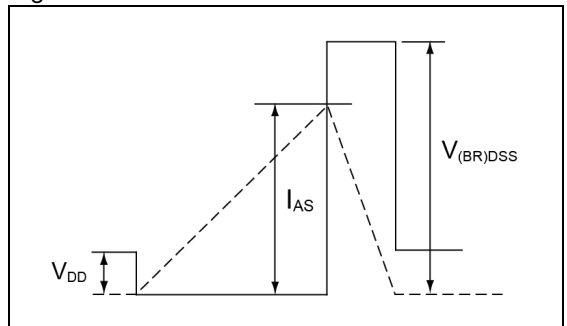


Fig.5-1 di/dt Measurement Circuit

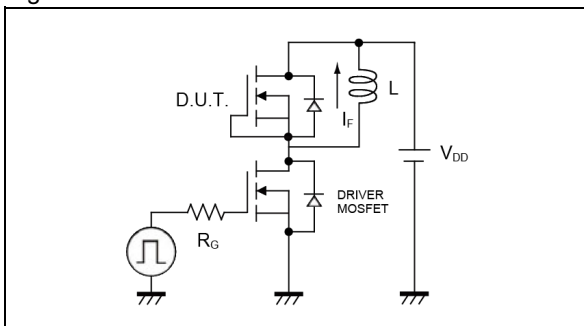
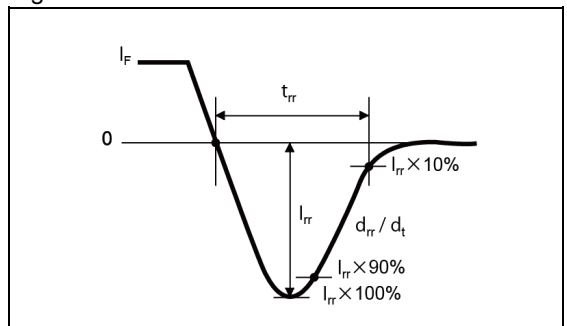
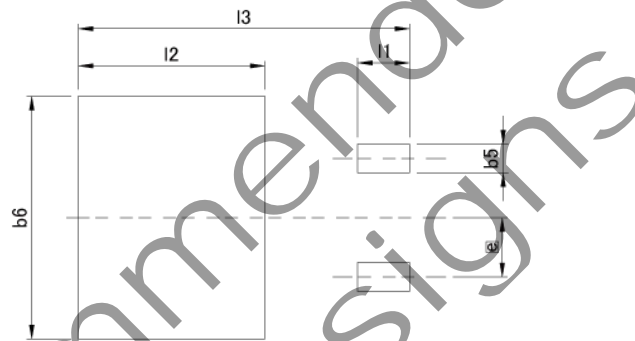
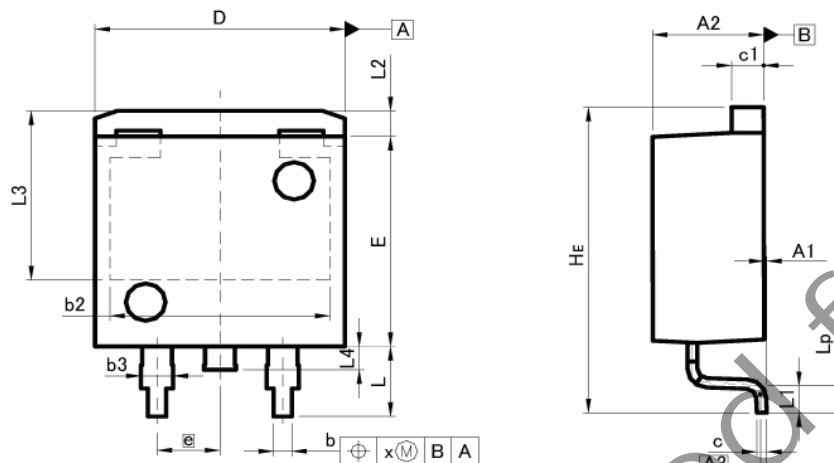


Fig.5-2 di/dt Waveform



●Dimensions

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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