# R5011ANJ

Nch 500V 11A Power MOSFET

Datasheet

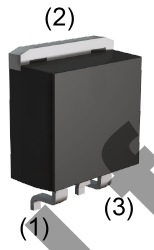
| | |
|---|---|
| $V_{DSS}$ | 500V |
| $R_{DS(on)}$(Max.) | 0.5Ω |
| $I_D$ | ±11A |
| $P_D$ | 75W |

## ●Outline

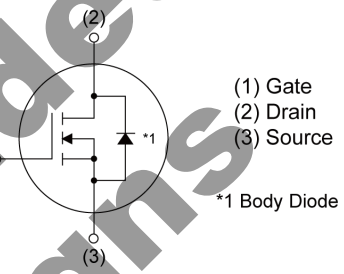
LPT(S)

SC-83

TO-263




## ●Inner circuit




## ●Features

1) Low on-resistance.
2) Fast switching speed.
3) Gate-source voltage ($V_{GSS}$) guaranteed to be ±30V.
4) Drive circuits can be simple.
5) Parallel use is easy.
6) Pb-free lead plating ; RoHS compliant

## ●Packaging specifications

| | | |
|---|---|---|
| Type | Packing | Embossed Tape |
| | Reel size (mm) | 330 |
| | Tape width (mm) | 24 |
| | Basic ordering unit (pcs) | 1000 |
| | Taping code | TL |
| | Marking | R5011ANJ |

## ●Application

Switching Power Supply

## ●Absolute maximum ratings ($T_a$ = 25°C)

| Parameter | | Symbol | Value | Unit |
|---|---|---|---|---|
| Drain - Source voltage | | $V_{DSS}$ | 500 | V |
| Continuous drain current | $T_C$ = 25°C | $I_D$ *1 | ±11 | A |
| | $T_C$ = 100°C | $I_D$ *1 | ±5.3 | 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 | 6.5 | mJ |
| Avalanche current | | $I_{AR}$ *3 | 5.5 | A |
| Power dissipation ($T_c$ = 25°C) | | $P_D$ | 75 | W |
| Junction temperature | | $T_j$ | 150 | ℃ |
| Range of storage temperature | | $T_{stg}$ | -55 to +150 | ℃ |
| Reverse diode dv/dt | | dv/dt | 15 | V/ns |

## ●Absolute maximum ratings

| Parameter | Symbol | Conditions | Values | Unit |
|---|---|---|---|---|
| Drain - Source voltage slope | dv/dt | $V_{DS}$ = 400V, $I_D$ = 11A<br>$T_j$ = 125℃ | 50 | V/ns |

## ●Thermal resistance

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Thermal resistance, junction - case | $R_{thJC}$ | - | - | 1.67 | ℃/W |
| Thermal resistance, junction - ambient | $R_{thJA}$ | - | - | 80 | ℃/W |
| Soldering temperature, wavesoldering for 10s | $T_{sold}$ | - | - | 265 | ℃ |

## ●Electrical characteristics ($T_a$ = 25°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<br>$T_j$ = 25°C<br>$T_j$ = 125°C | -<br>- | 0.1<br>- | 100<br>1000 | μA |
| Gate - Source leakage current | $I_{GSS}$ | $V_{GS}$ = ±30V, $V_{DS}$ = 0V | - | - | ±100 | nA |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}$ = 10V, $I_D$ = 1mA | 2.5 | - | 4.5 | V |
| Static drain - source on - state resistance | $R_{DS(on)}$ *6 | $V_{GS}$ = 10V, $I_D$ = 5.5A<br>$T_j$ = 25°C<br>$T_j$ = 125°C | -<br>- | 0.38<br>0.79 | 0.5<br>- | Ω |
| Gate input resistance | $R_G$ | f = 1MHz, open drain | - | 9.0 | - | Ω |

## ●Electrical characteristics ($T_a$ = 25°C)

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Transconductance | $g_{fs}$ *6 | $V_{DS}$ = 10V, $I_D$ = 5.5A | 3.5 | 8 | - | S |
| Input capacitance | $C_{iss}$ | $V_{GS}$ = 0V | - | 1000 | - | pF |
| Output capacitance | $C_{oss}$ | $V_{DS}$ = 25V | - | 400 | - | |
| Reverse transfer capacitance | $C_{rss}$ | f = 1MHz | - | 35 | - | |
| Effective output capacitance, energy related | $C_{o(er)}$ | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 400V | - | 44.1 | - | pF |
| Effective output capacitance, time related | $C_{o(tr)}$ | | - | 114 | - | |
| Turn - on delay time | $t_{d(on)}$ *6 | $V_{DD}$ ≃ 250V, $V_{GS}$ = 10V | - | 26 | - | ns |
| Rise time | $t_r$ *6 | $I_D$ = 5.5A | - | 28 | - | |
| Turn - off delay time | $t_{d(off)}$ *6 | $R_L$ ≃ 45.5Ω | - | 75 | 150 | |
| Fall time | $t_f$ *6 | $R_G$ = 10Ω | - | 30 | 60 | |

## ●Gate charge characteristics ($T_a$ = 25°C)

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Total gate charge | $Q_g$ *6 | $V_{DD}$ ≃ 250V | - | 30 | - | nC |
| Gate - Source charge | $Q_{gs}$ *6 | $I_D$ = 11A | - | 7 | - | |
| Gate - Drain charge | $Q_{gd}$ *6 | $V_{GS}$ = 10V | - | 12 | - | |
| Gate plateau voltage | $V_{(plateau)}$ | $V_{DD}$ ≃ 250V, $I_D$ = 11A | - | 6.7 | - | V |



*1 Limited only by maximum temperature allowed.

*2 Pw ≤ 10μs, Duty cycle ≤ 1%

*3 L ≃ 500μH, $V_{DD}$=50V, $R_G$=25Ω, starting $T_j$ = 25°C

*4 L ≃ 500μH, $V_{DD}$=50V, $R_G$=25Ω, starting $T_j$ = 25°C, f = 10kHz

*5 Reference measurement circuits Fig.5-1.

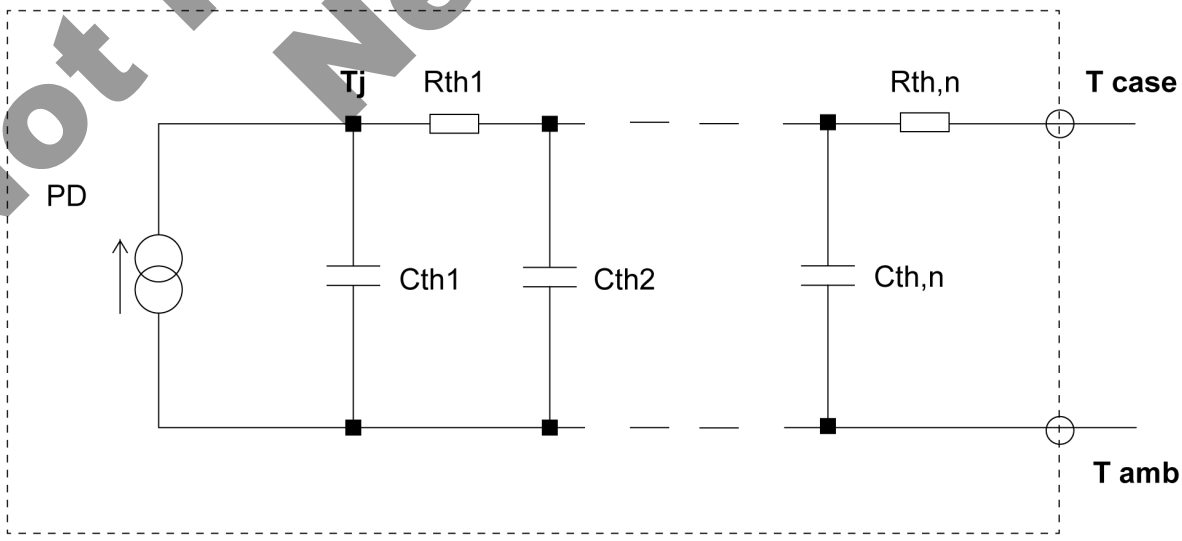
*6 Pulsed

## ●Body diode electrical characteristics (Source-Drain) ($T_a$ = 25°C)

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Inverse diode continuous, forward current | $I_S$ *1 | $T_C$ = 25℃ | - | - | 11 | A |
| Inverse diode direct current, pulsed | $I_{SM}$ *2 | | - | - | 44 | A |
| Forward voltage | $V_{SD}$ *6 | $V_{GS}$ = 0V, $I_S$ = 11A | - | - | 1.5 | V |
| Reverse recovery time | $t_{rr}$ *6 | $I_S$ = 11A<br>di/dt = 100A/μs | - | 343 | - | ns |
| Reverse recovery charge | $Q_{rr}$ *6 | | - | 3.1 | - | μC |
| Peak reverse recovery current | $I_{rrm}$ *6 | | - | 18.1 | - | A |
| Peak rate of fall of reverse recovery current | $di_{rr}/dt$ | $T_j$ = 25℃ | - | 500 | - | A/μs |

## ●Typical transient thermal characteristics

| Symbol | Value | Unit | Symbol | Value | Unit |
|---|---|---|---|---|---|
| $R_{th1}$ | 0.0868 | K/W | $C_{th1}$ | 0.00172 | Ws/K |
| $R_{th2}$ | 0.340 | | $C_{th2}$ | 0.00589 | |
| $R_{th3}$ | 0.613 | | $C_{th3}$ | 0.18 | |



## ●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

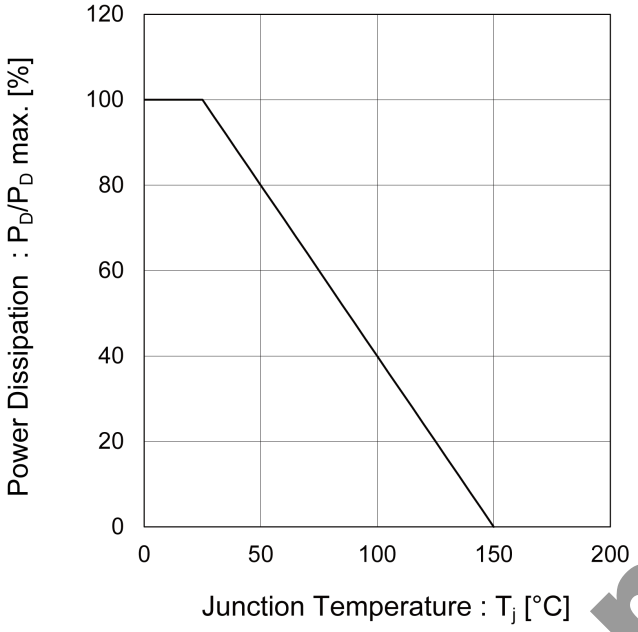



Fig.2 Maximum Safe Operating Area

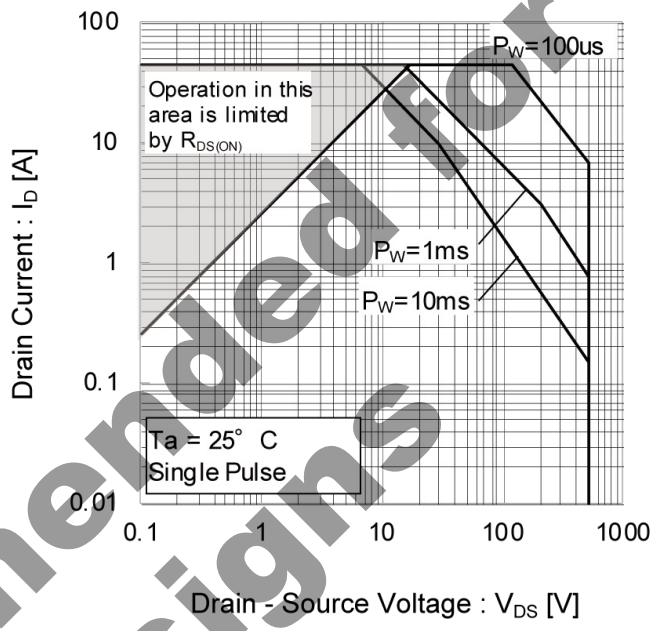
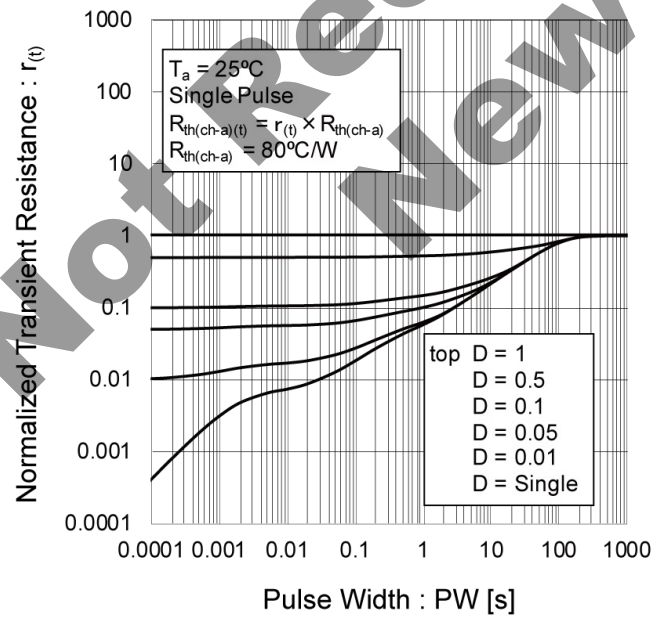



Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width



## ●Electrical characteristic curves

Fig.4 Avalanche Current vs. Inductive Load

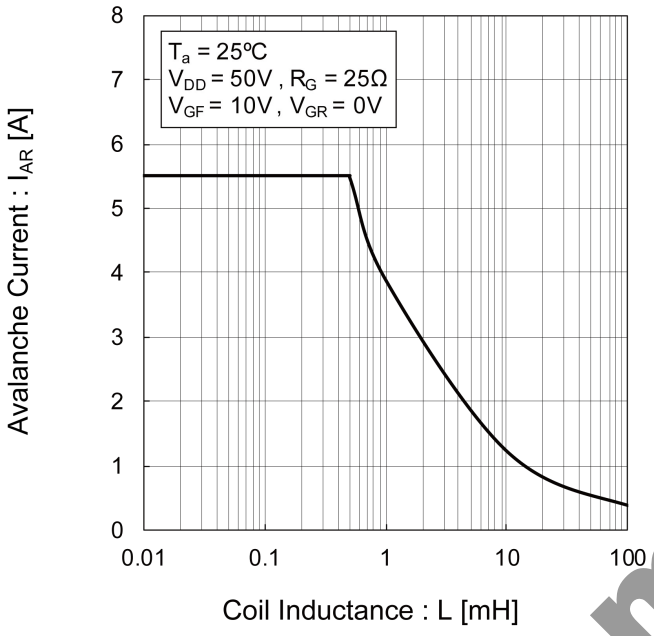



Fig.5 Avalanche Power Losses

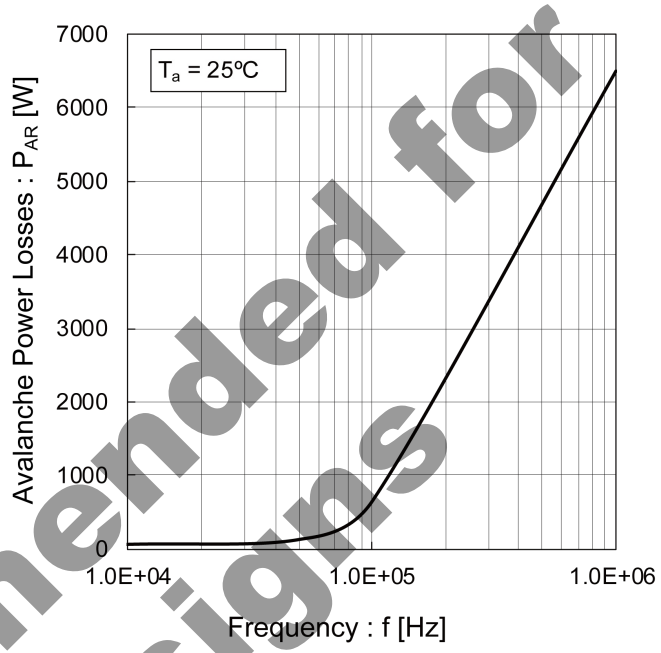
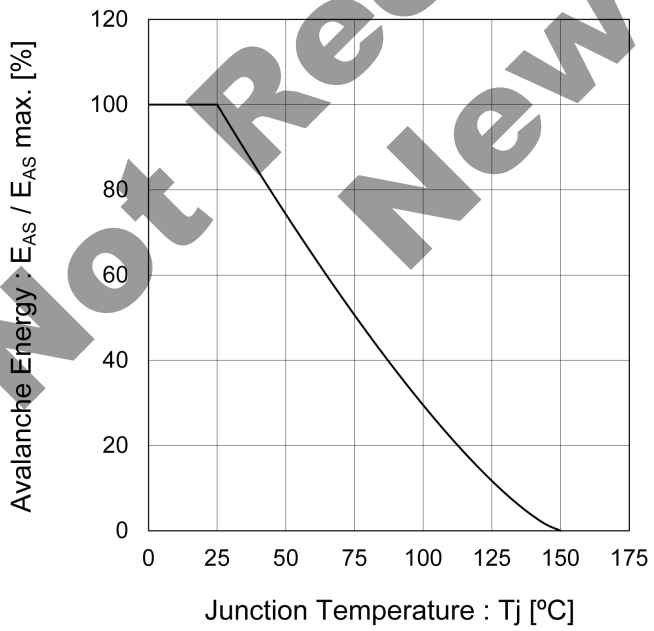



Fig.6 Avalanche Energy Derating Curve vs. Junction Temperature



## ●Electrical characteristic curves

Fig.7 Typical Output Characteristics(I)

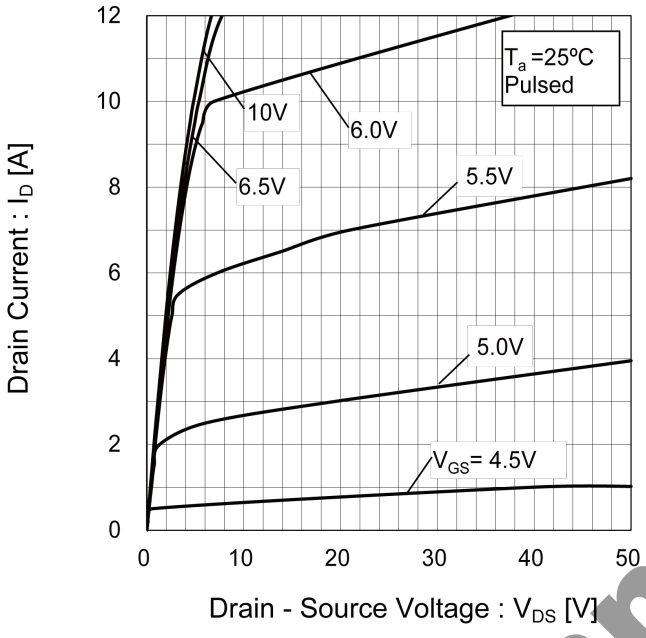



Fig.8 Typical Output Characteristics(II)

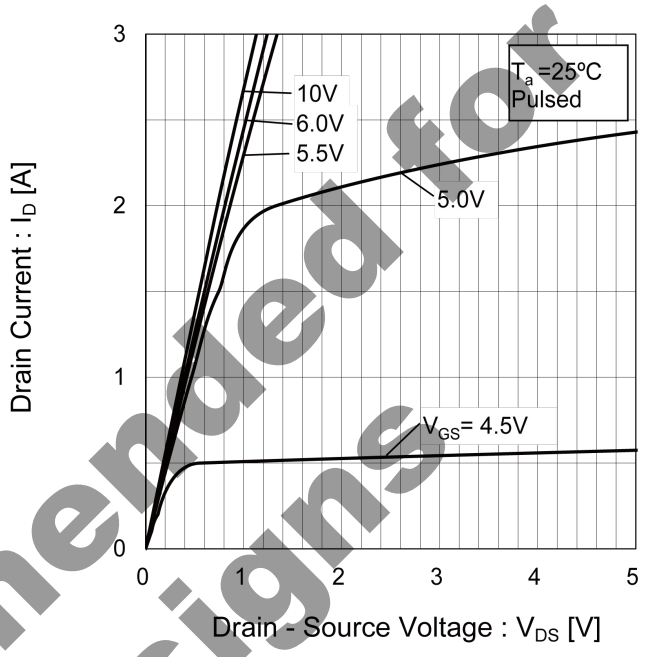



Fig.9 Tj = 150°C Typical Output Characteristics (I)

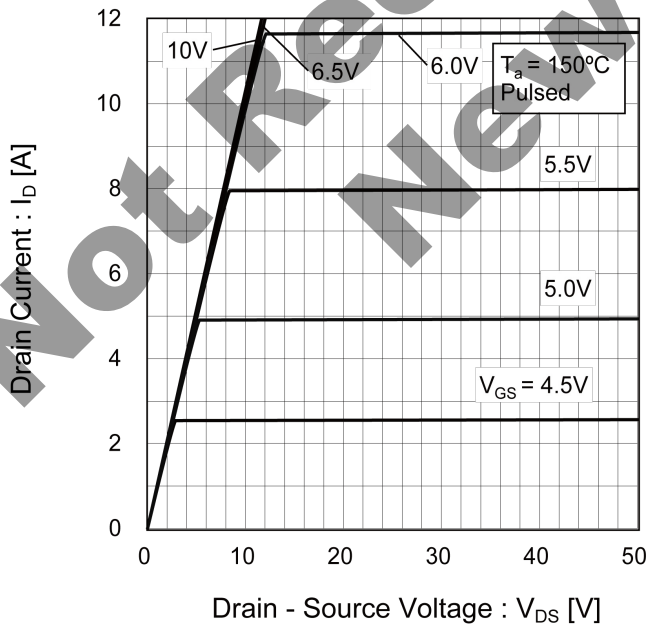
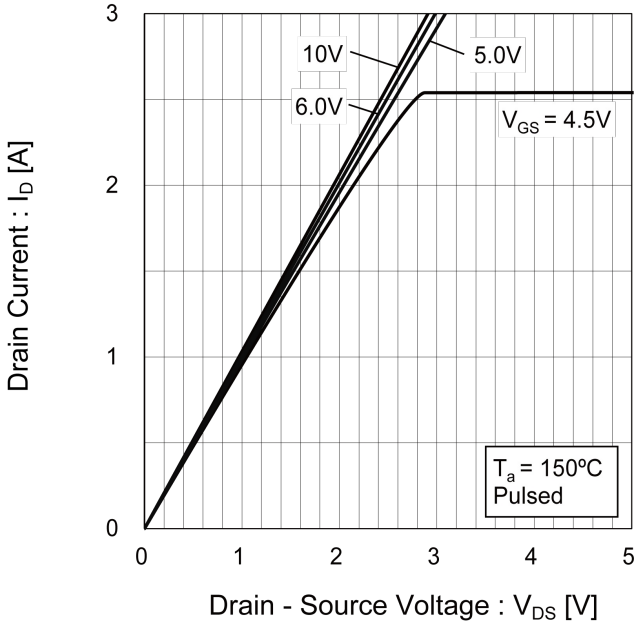



Fig.10 Tj = 150°C Typical Output Characteristics (II)



## ●Electrical characteristic curves

Fig.11 Breakdown Voltage vs. Junction Temperature

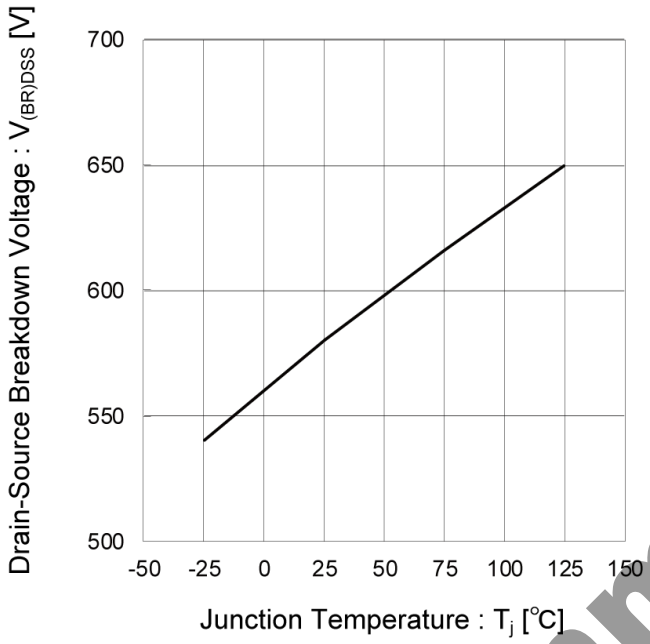



Fig.12 Typical Transfer Characteristics

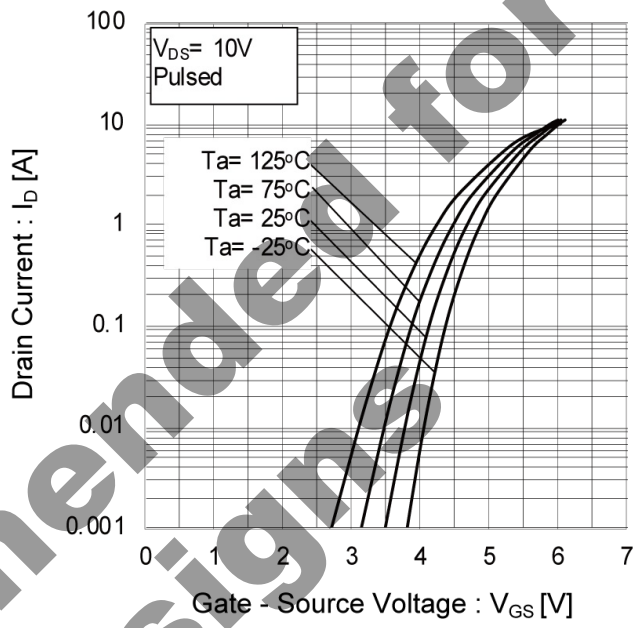



Fig.13 Gate Threshold Voltage vs. Junction Temperature

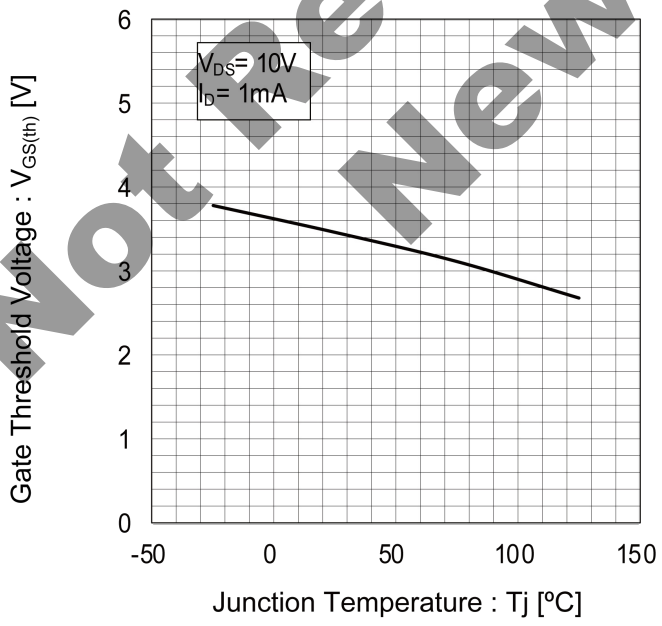
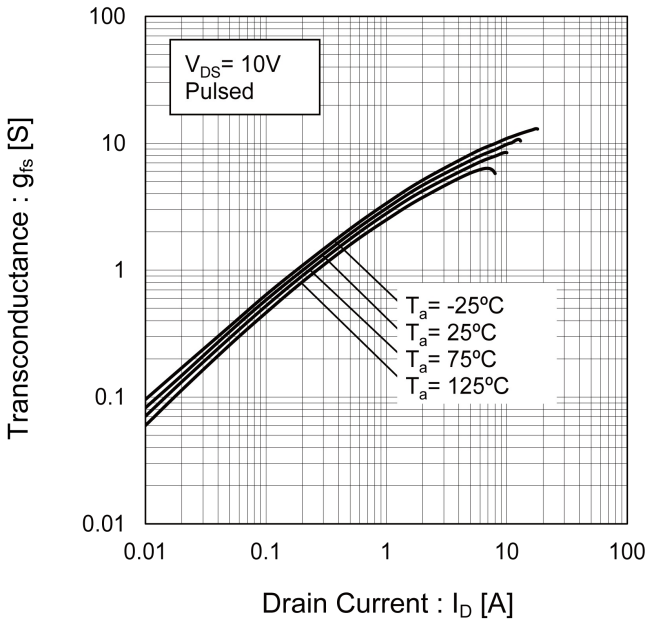



Fig.14 Transconductance vs. Drain Current



## ●Electrical characteristic curves

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

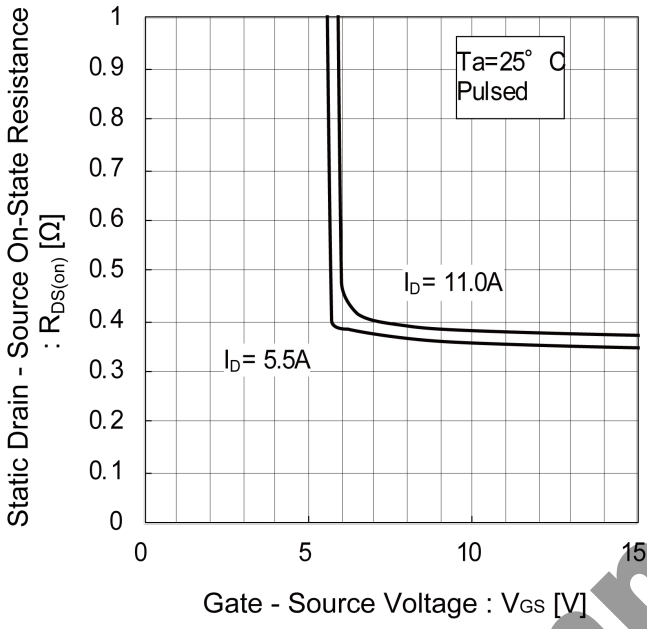



Fig.16 Static Drain - Source On - State Resistance vs. Junction Temperature

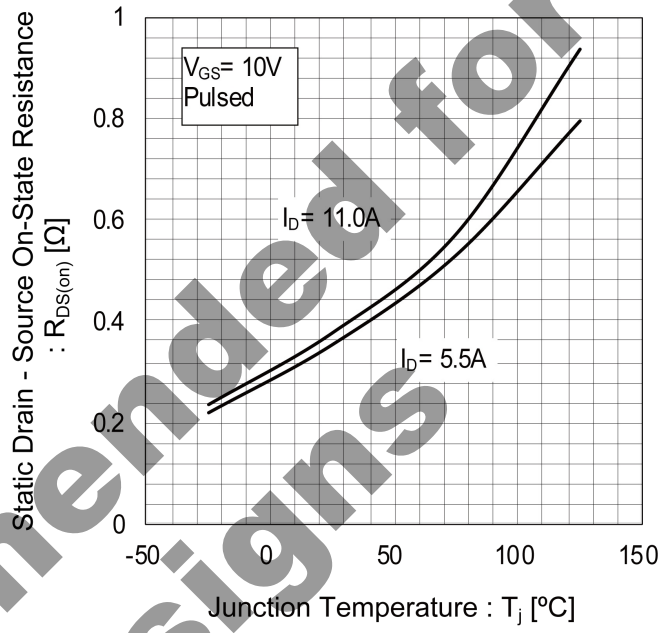
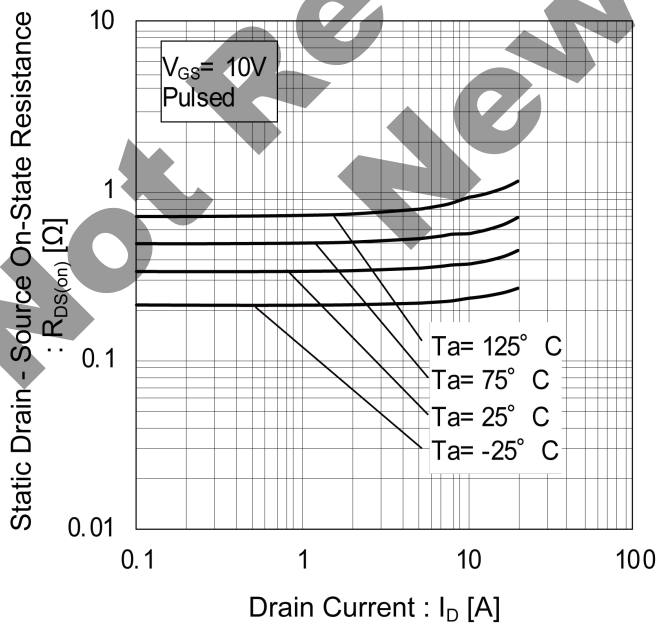



Fig.17 Static Drain - Source On - State Resistance vs. Drain Current



## ●Electrical characteristic curves

Fig.18 Typical Capacitance vs. Drain - Source Voltage

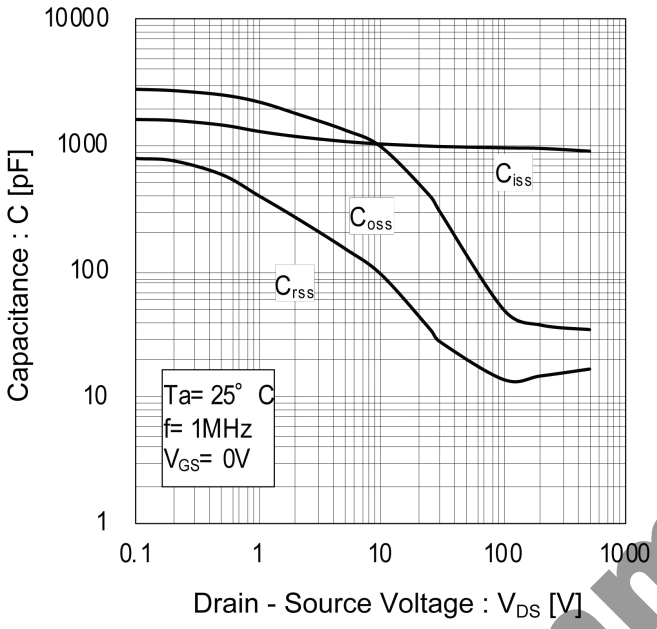



Fig.19 Coss Stored Energy

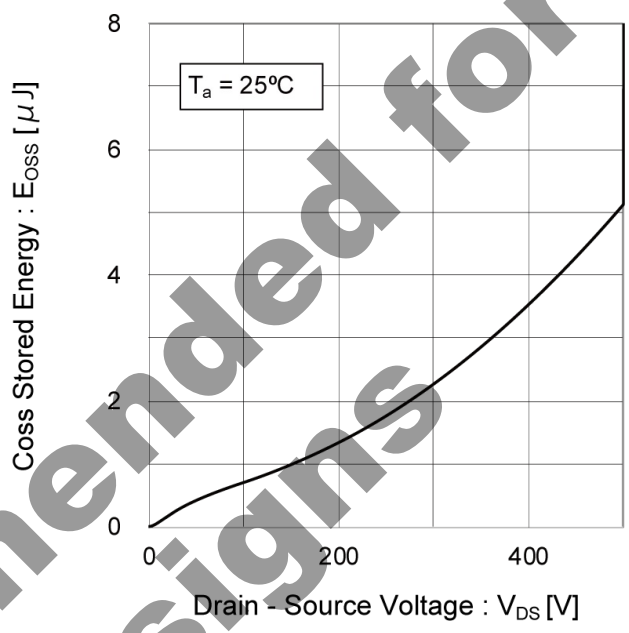



Fig.20 Switching Characteristics

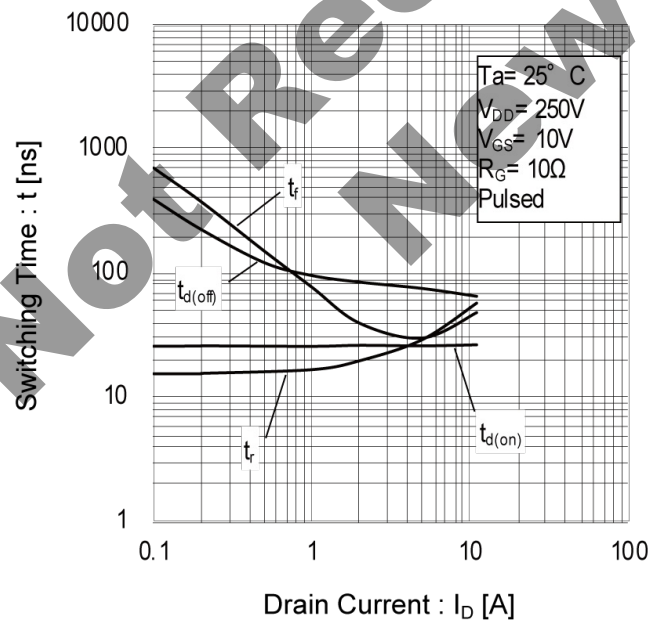
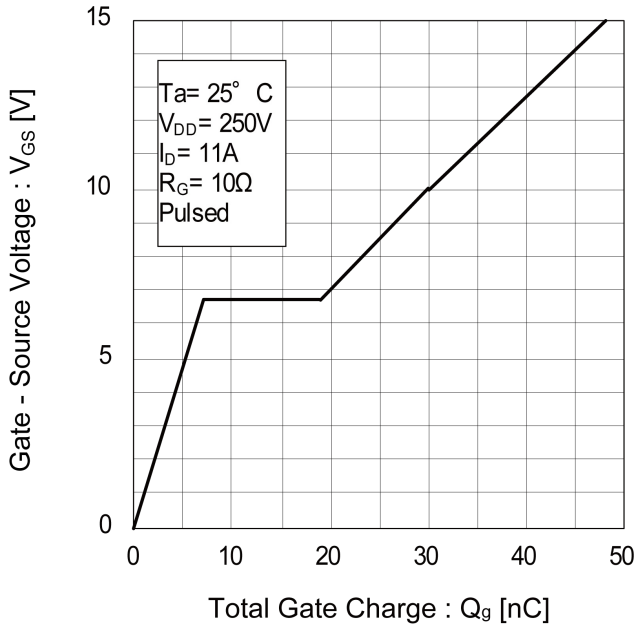



Fig.21 Dynamic Input Characteristics



## ●Electrical characteristic curves

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

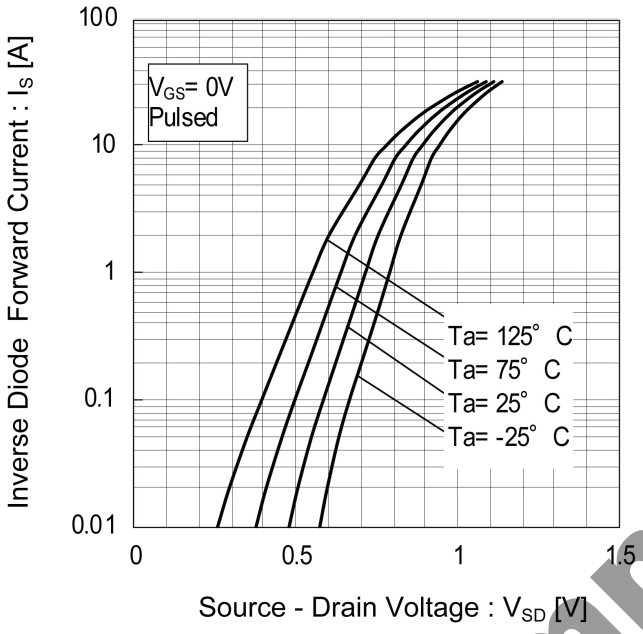
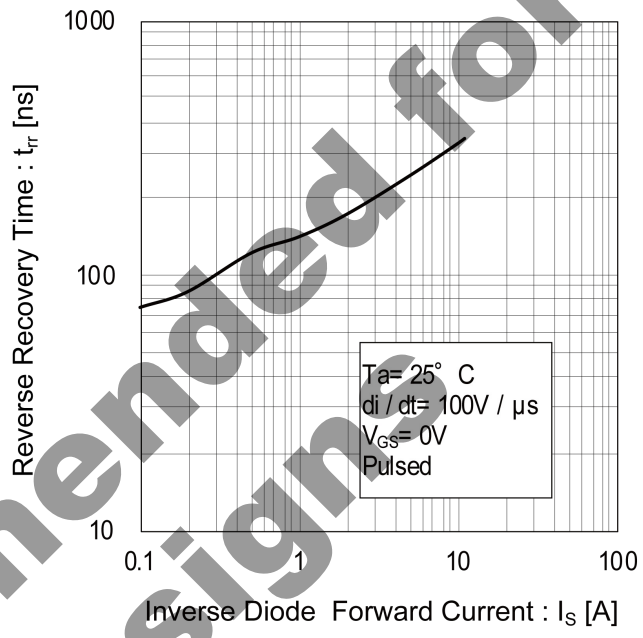



Fig.23 Reverse Recovery Time vs. Inverse Diode Forward Current



## ●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

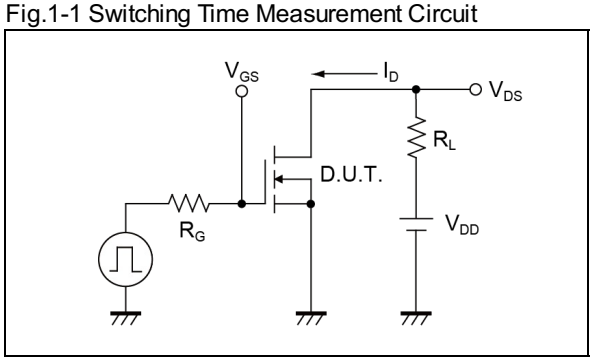



Fig.1-2 Switching Waveforms

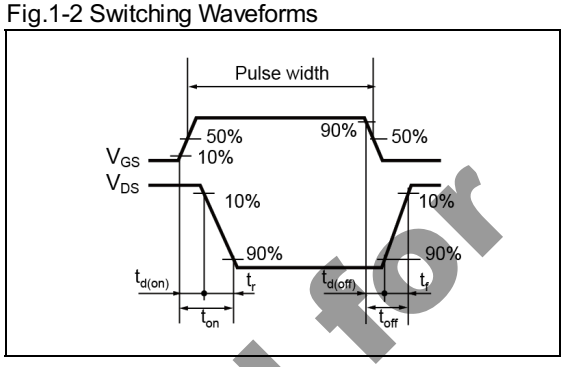



Fig.2-1 Gate Charge Measurement Circuit

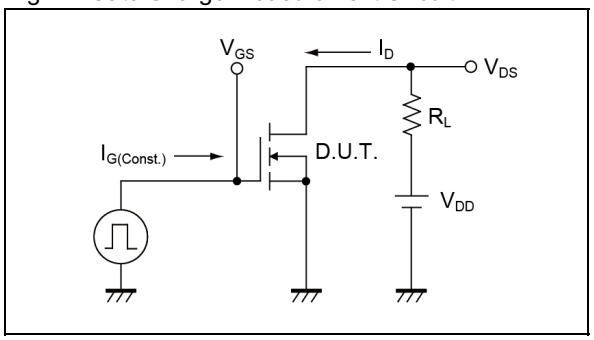



Fig.2-2 Gate Charge Waveform

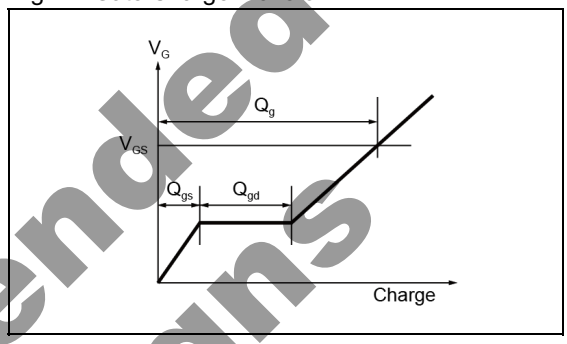



Fig.3-1 Avalanche Measurement Circuit

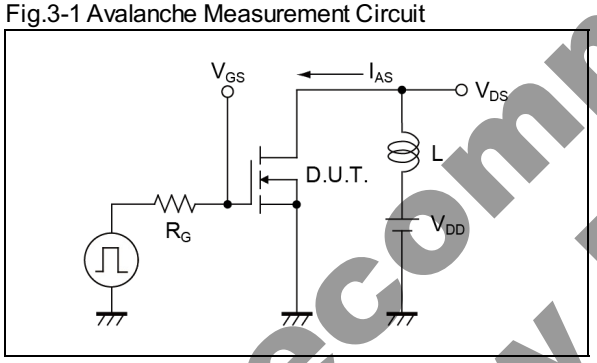



Fig.3-2 Avalanche Waveform

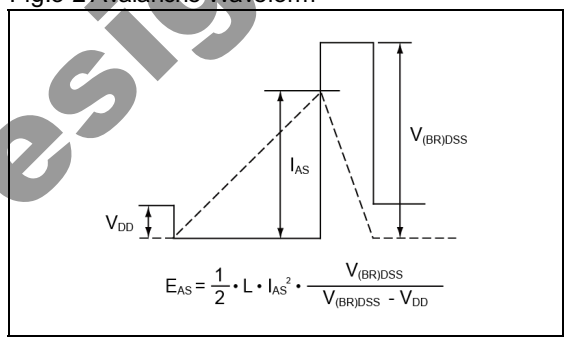



Fig.4-1 dv/dt Measurement Circuit

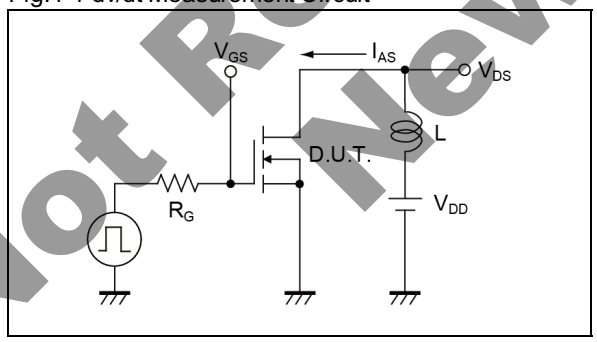



Fig.4-2 dv/dt Waveform

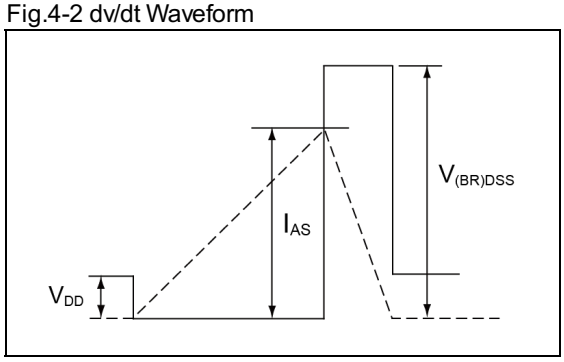



Fig.5-1 di/dt Measurement Circuit

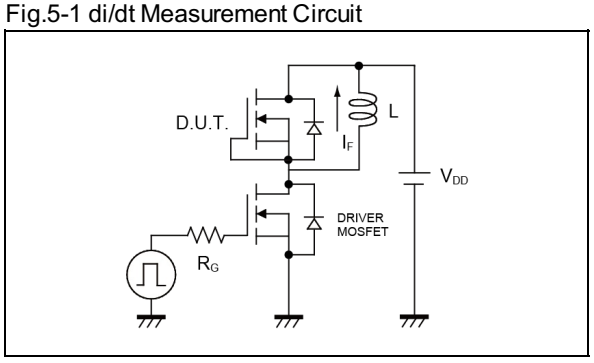
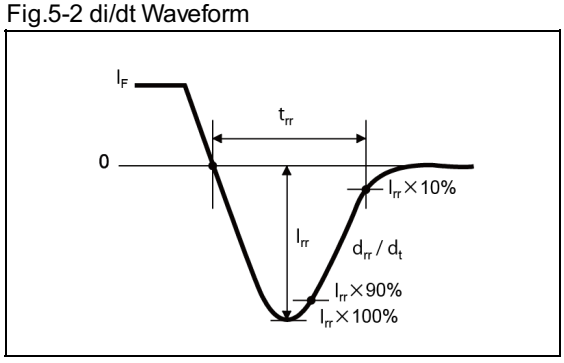
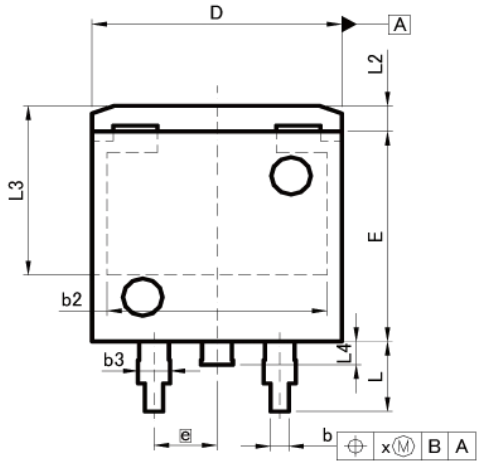


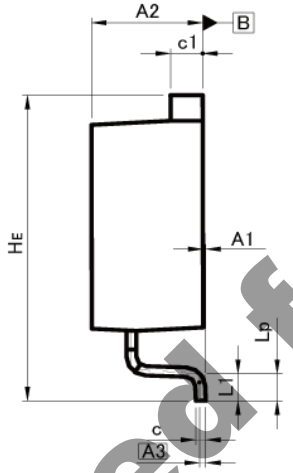

Fig.5-2 di/dt Waveform

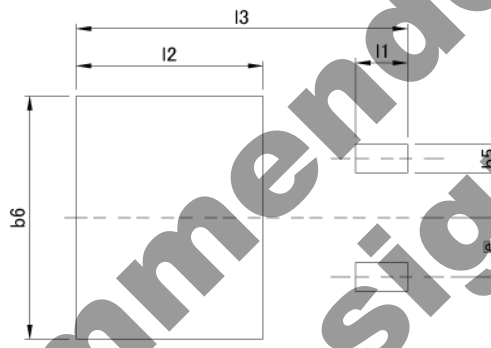


## ●Dimensions

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 |
| l1 | – | 2.10 | – | 0.083 |
| l2 | – | 7.55 | – | 0.297 |
| l3 | – | 13.40 | – | 0.528 |

Dimension in mm/inches

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