# R6015ANZ

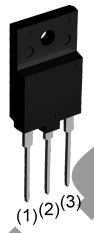
Nch 600V 15A Power MOSFET

Datasheet

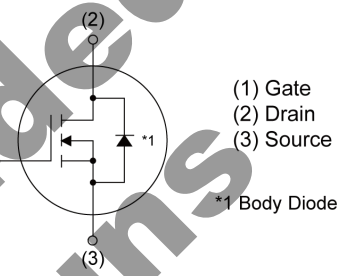
| | |
|---|---|
| $V_{DSS}$ | 600V |
| $R_{DS(on)}$(Max.) | 0.3Ω |
| $I_D$ | ±15A |
| $P_D$ | 110W |

## ●Outline

TO-3PF




## ●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

## ●Application

Switching Power Supply

## ●Packaging specifications

| | | |
|---|---|---|
| Type | Packing | Tube |
| | Reel size (mm) | - |
| | Tape width (mm) | - |
| | Basic ordering unit (pcs) | 360 |
| | Taping code | C8 |
| | Marking | R6015ANZ |

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

| Parameter | | Symbol | Value | Unit |
|---|---|---|---|---|
| Drain - Source voltage | | $V_{DSS}$ | 600 | V |
| Continuous drain current | $T_C$ = 25°C | $I_D$ *1 | ±15 | A |
| | $T_C$ = 100°C | $I_D$ *1 | ±7.1 | A |
| Pulsed drain current | | $I_{D,pulse}$ *2 | ±60 | A |
| Gate - Source voltage | | $V_{GSS}$ | ±30 | V |
| Avalanche energy, single pulse | | $E_{AS}$ *3 | 15 | mJ |
| Avalanche energy, repetitive | | $E_{AR}$ *4 | 9.1 | mJ |
| Avalanche current | | $I_{AR}$ *3 | 7.5 | A |
| Power dissipation ($T_c$ = 25°C) | | $P_D$ | 110 | 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 | $V_{DS}$ = 480V, $I_D$ = 15A<br>$T_j$ = 125℃ | 50 | V/ns |

## ●Thermal resistance

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Thermal resistance, junction - case | $R_{thJC}$ | - | - | 1.13 | ℃/W |
| Thermal resistance, junction - ambient | $R_{thJA}$ | - | - | 40 | ℃/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 | 600 | - | - | V |
| Drain - Source avalanche breakdown voltage | $V_{(BR)DS}$ | $V_{GS}$ = 0V, $I_D$ = 7.5A | - | 700 | - | V |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$ = 600V, $V_{GS}$ = 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 | 2.95 | - | 4.15 | V |
| Static drain - source on - state resistance | $R_{DS(on)}$ *6 | $V_{GS}$ = 10V, $I_D$ = 7.5A<br>$T_j$ = 25°C<br>$T_j$ = 125°C | -<br>- | 0.23<br>0.46 | 0.3<br>- | Ω |
| Gate input resistance | $R_G$ | f = 1MHz, open drain | - | 10.1 | - | Ω |

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

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Transconductance | $g_{fs}$ *6 | $V_{DS}$ = 10V, $I_D$ = 7.5A | 4.5 | 12 | - | S |
| Input capacitance | $C_{iss}$ | $V_{GS}$ = 0V | - | 1700 | - | pF |
| Output capacitance | $C_{oss}$ | $V_{DS}$ = 25V | - | 1120 | - | |
| Reverse transfer capacitance | $C_{rss}$ | f = 1MHz | - | 80 | - | |
| Effective output capacitance, energy related | $C_{o(er)}$ | $V_{GS}$ = 0V, $V_{DS}$ = 0V to 480V | - | 64.7 | - | pF |
| Effective output capacitance, time related | $C_{o(tr)}$ | | - | 204 | - | |
| Turn - on delay time | $t_{d(on)}$ *6 | $V_{DD}$ ≃ 300V, $V_{GS}$ = 10V | - | 50 | - | ns |
| Rise time | $t_r$ *6 | $I_D$ = 7.5A | - | 50 | - | |
| Turn - off delay time | $t_{d(off)}$ *6 | $R_L$ = 40Ω | - | 150 | 300 | |
| Fall time | $t_f$ *6 | $R_G$ = 10Ω | - | 60 | 120 | |

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

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Total gate charge | $Q_g$ *6 | $V_{DD}$ ≃ 300V | - | 50 | - | nC |
| Gate - Source charge | $Q_{gs}$ *6 | $I_D$ = 15A | - | 8 | - | |
| Gate - Drain charge | $Q_{gd}$ *6 | $V_{GS}$ = 10V | - | 20 | - | |
| Gate plateau voltage | $V_{(plateau)}$ | $V_{DD}$ ≃ 300V, $I_D$ = 15A | - | 5.6 | - | 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.

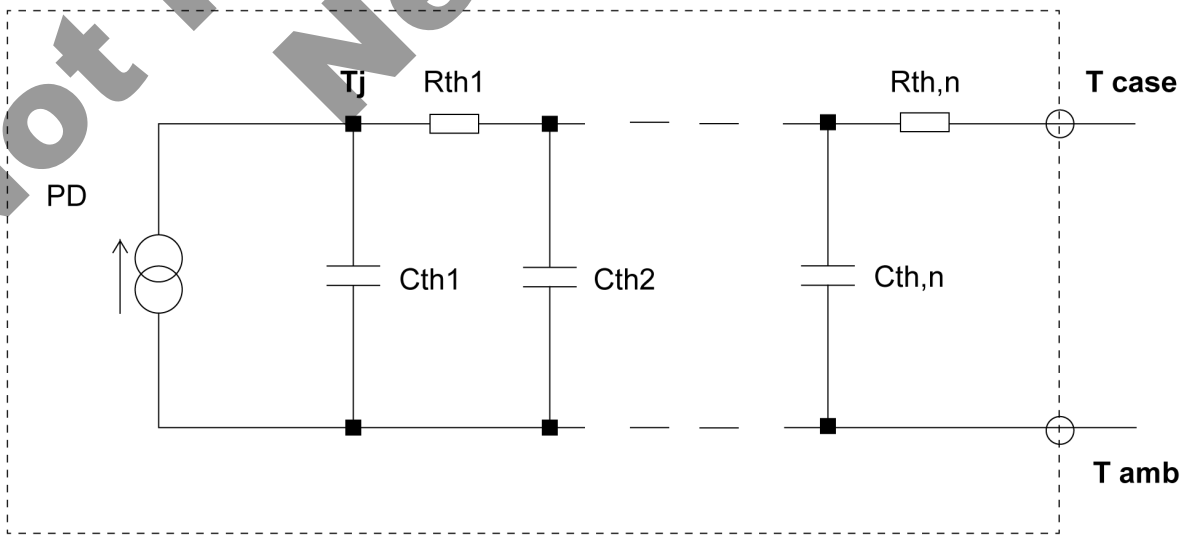
*6 Pulsed

## ●Body diode electirical 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℃ | - | - | 15 | A |
| Inverse diode direct current, pulsed | $I_{SM}$ *2 | | - | - | 60 | A |
| Forward voltage | $V_{SD}$ *6 | $V_{GS}$ = 0V, $I_S$ = 15A | - | - | 1.5 | V |
| Reverse recovery time | $t_{rr}$ *6 | $I_S$ = 15A<br>di/dt = 100A/μs | - | 409 | - | ns |
| Reverse recovery charge | $Q_{rr}$ *6 | | - | 6.3 | - | μC |
| Peak reverse recovery current | $I_{rrm}$ *6 | | - | 26 | - | A |
| Peak rate of fall of reverse recovery current | $di_{rr}/dt$ | $T_j$ = 25℃ | - | 700 | - | A/μs |

## ●Typical transient thermal characteristics

| Symbol | Value | Unit | Symbol | Value | Unit |
|---|---|---|---|---|---|
| $R_{th1}$ | 0.106 | K/W | $C_{th1}$ | 0.00538 | Ws/K |
| $R_{th2}$ | 0.516 | | $C_{th2}$ | 0.0467 | |
| $R_{th3}$ | 1.15 | | $C_{th3}$ | 1.09 | |



## ●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

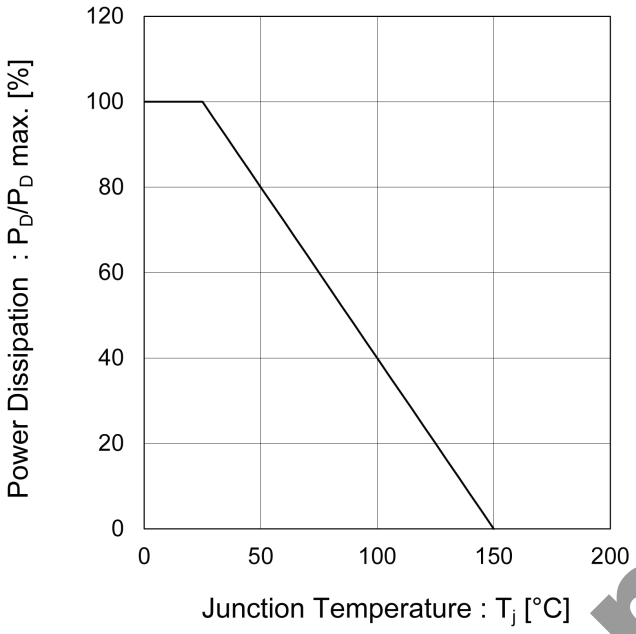



Fig.2 Maximum Safe Operating Area

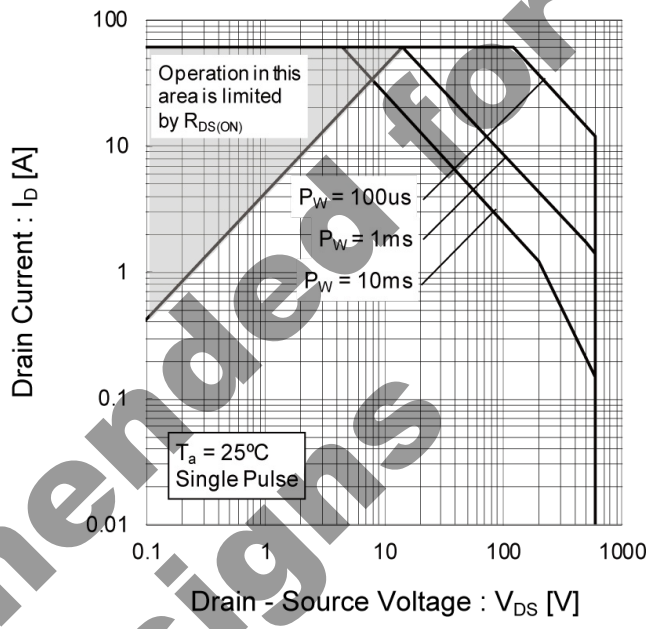
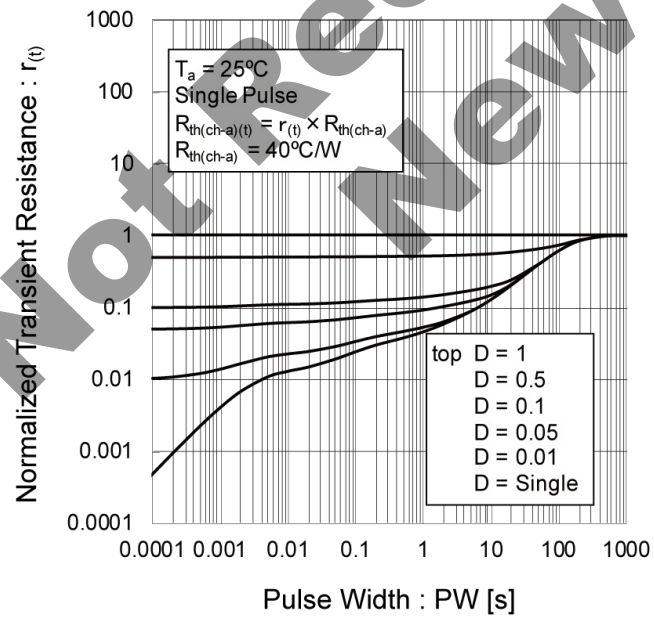



Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width



## ●Electrical characteristic curves

Fig.4 Avalanche Current vs. Inductive Load

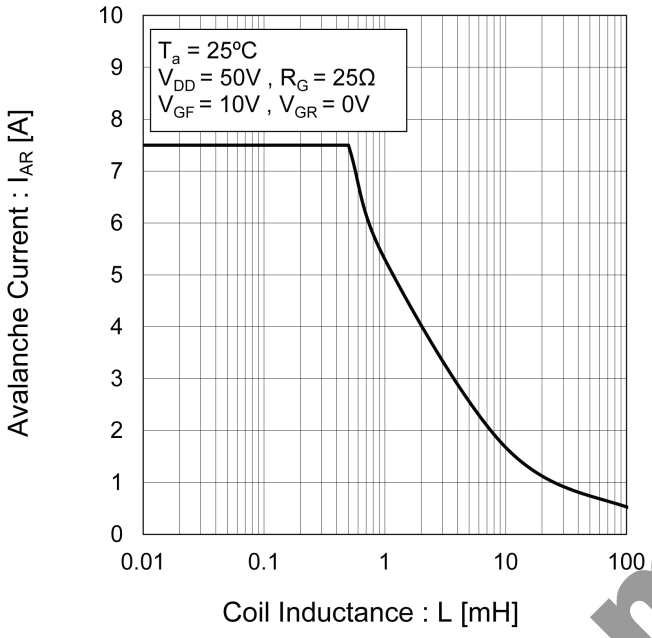



Fig.5 Avalanche Power Losses

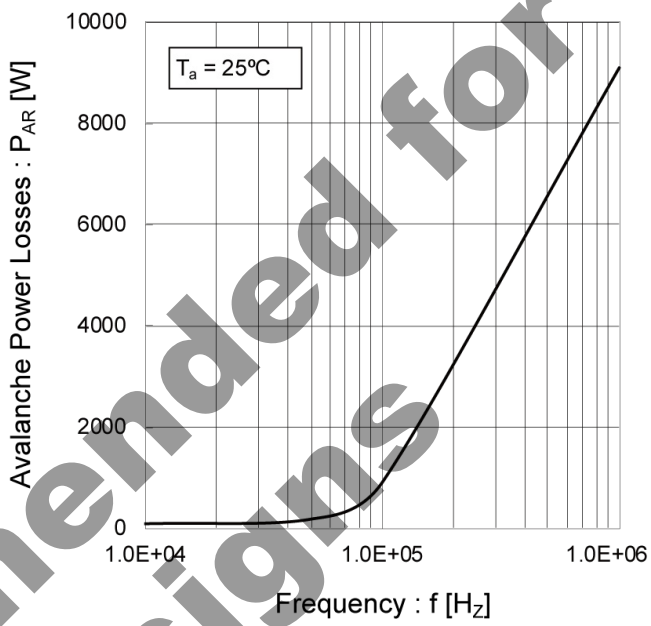
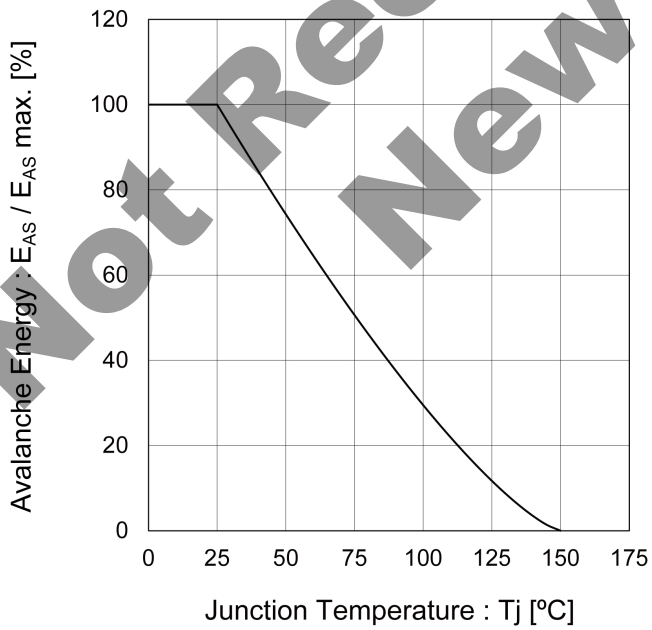



Fig.6 Avalanche Energy Derating Curve vs. Junction Temperature



## ●Electrical characteristic curves

Fig.7 Typical Output Characteristics(I)

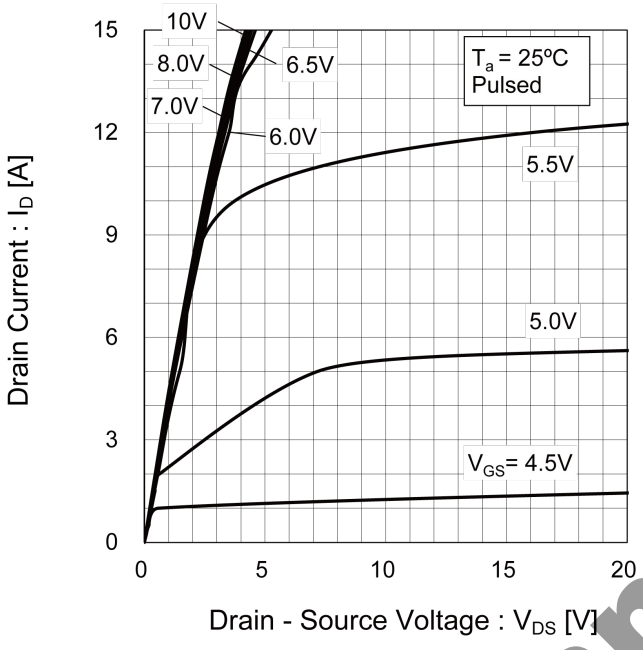



Fig.8 Typical Output Characteristics(II)

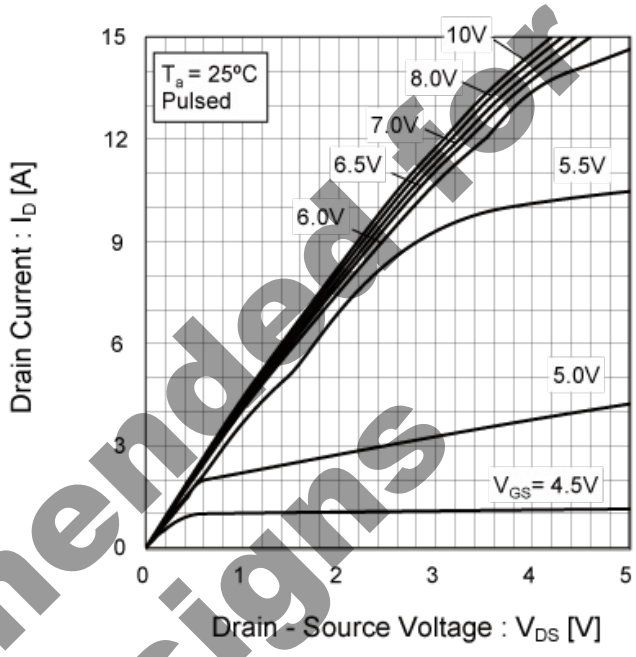



Fig.9 Tj = 150°C Typical Output Characteristics (I)

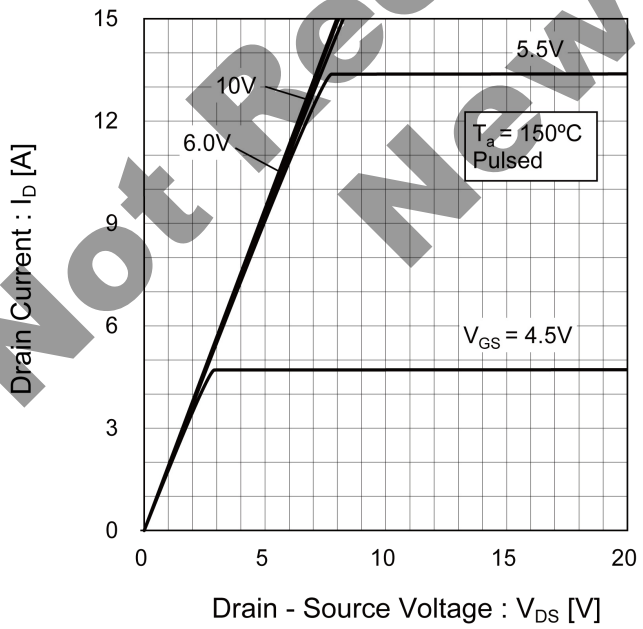
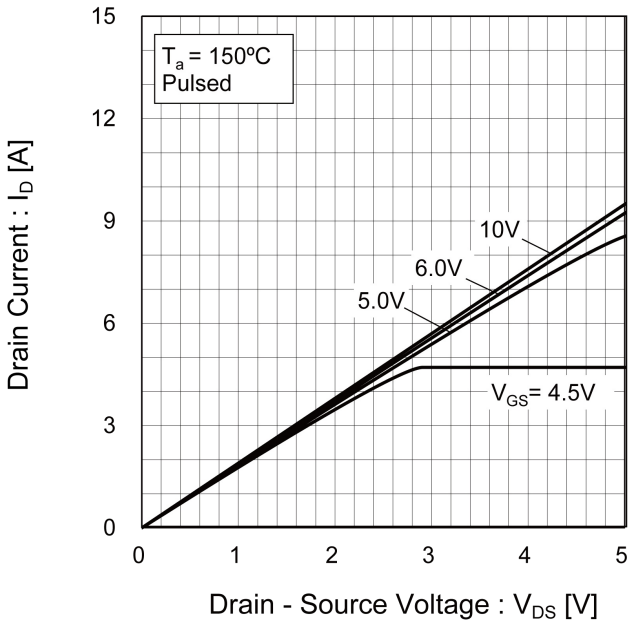



Fig.10 Tj = 150°C Typical Output Characteristics (II)



## ●Electrical characteristic curves

Fig.11 Breakdown Voltage vs. Junction Temperature

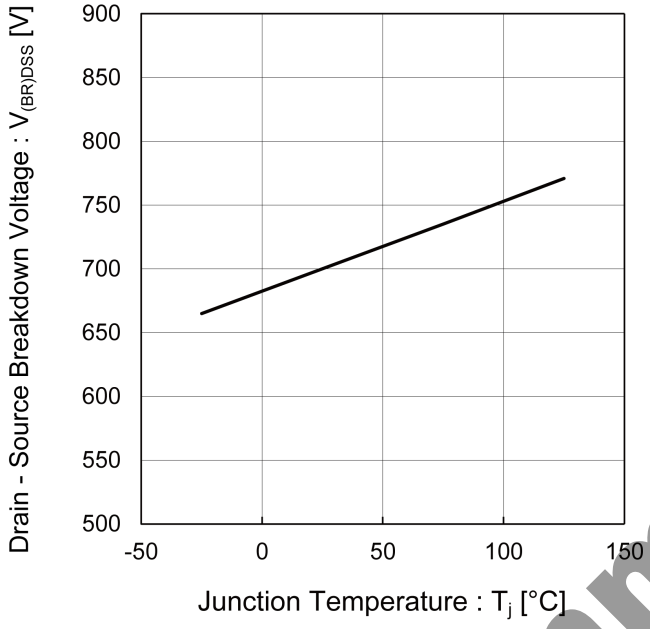



Fig.12 Typical Transfer Characteristics

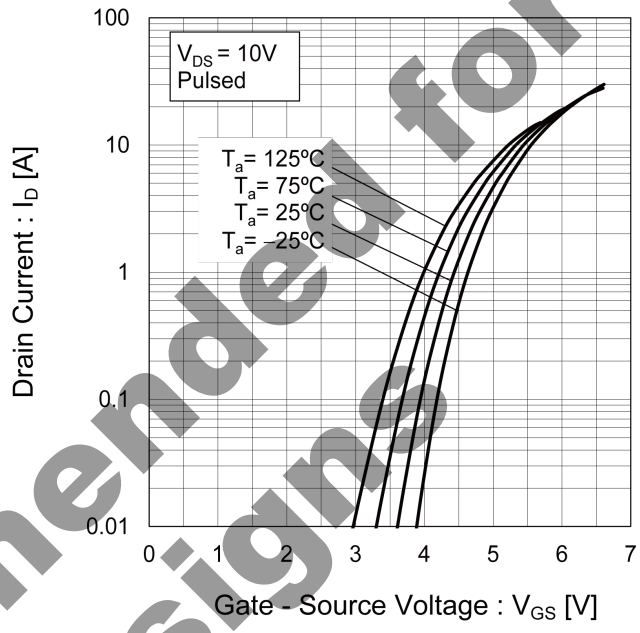



Fig.13 Gate Threshold Voltage vs. Junction Temperature

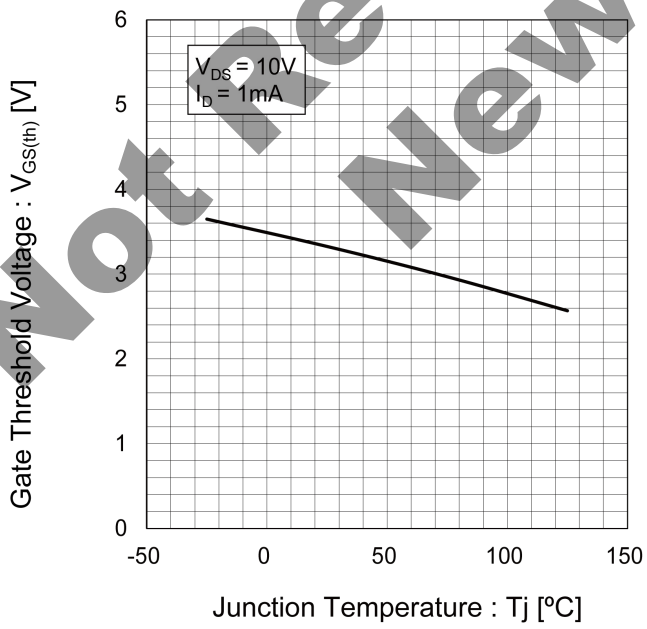
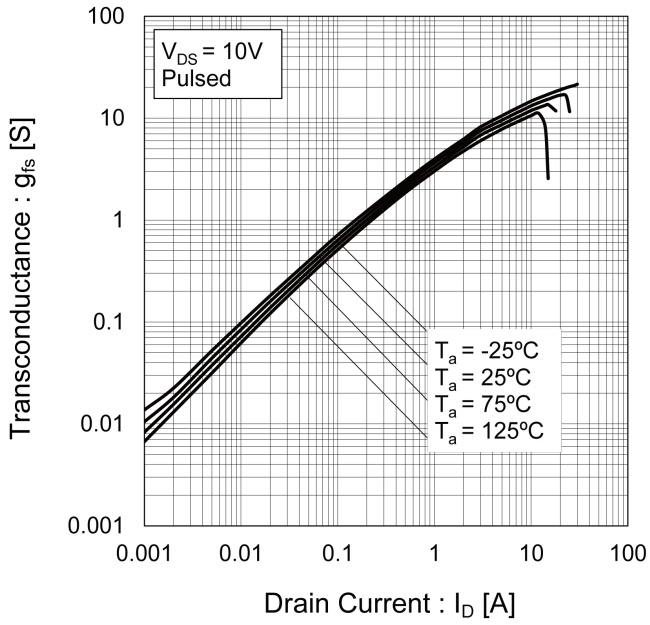



Fig.14 Transconductance vs. Drain Current



## ●Electrical characteristic curves

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

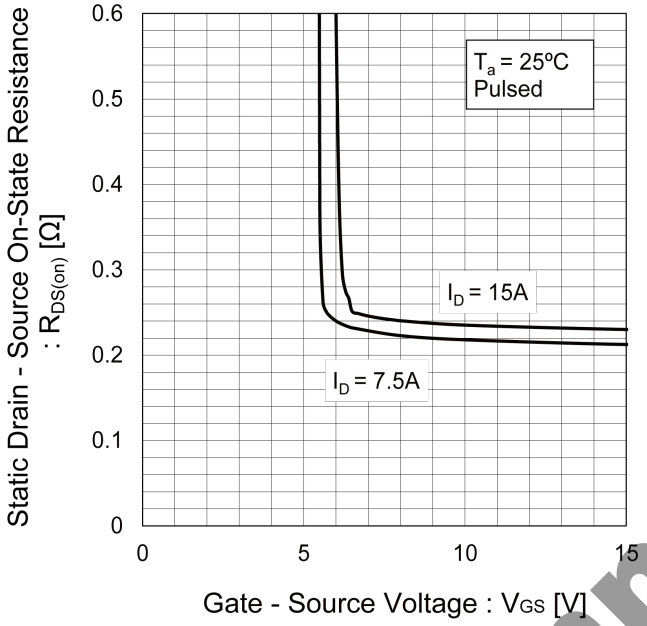



Fig.16 Static Drain - Source On - State Resistance vs. Junction Temperature

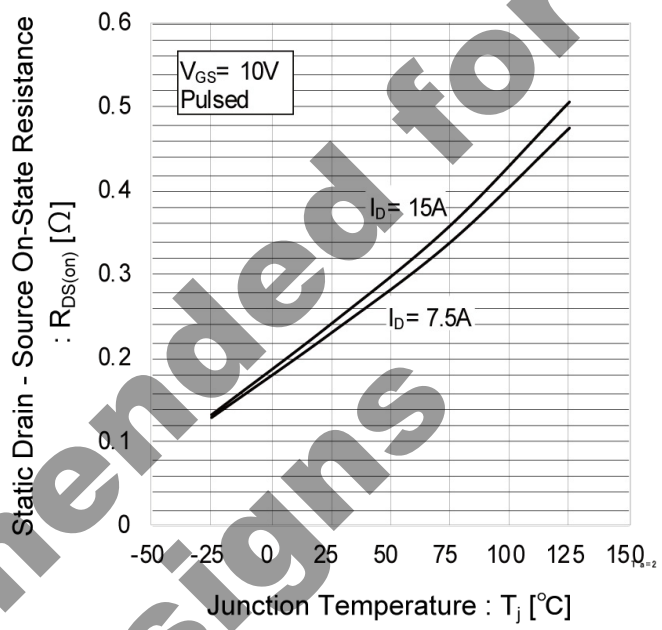
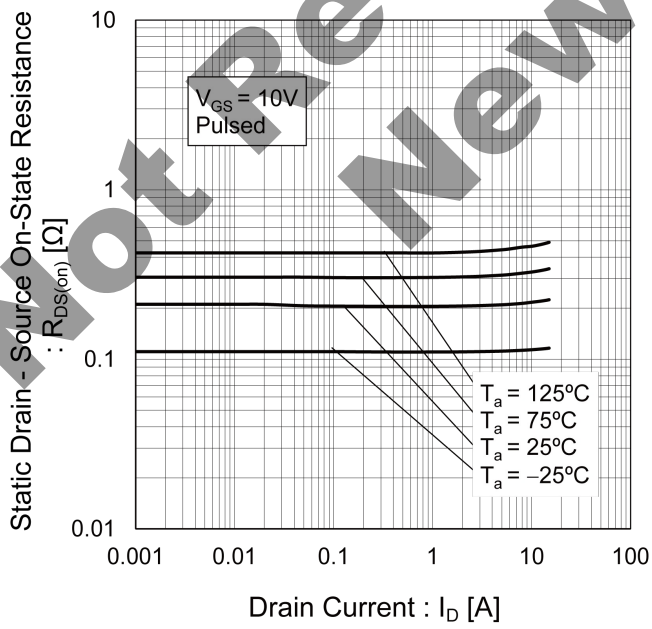



Fig.17 Static Drain - Source On - State Resistance vs. Drain Current



## ●Electrical characteristic curves

Fig.18 Typical Capacitance vs. Drain - Source Voltage

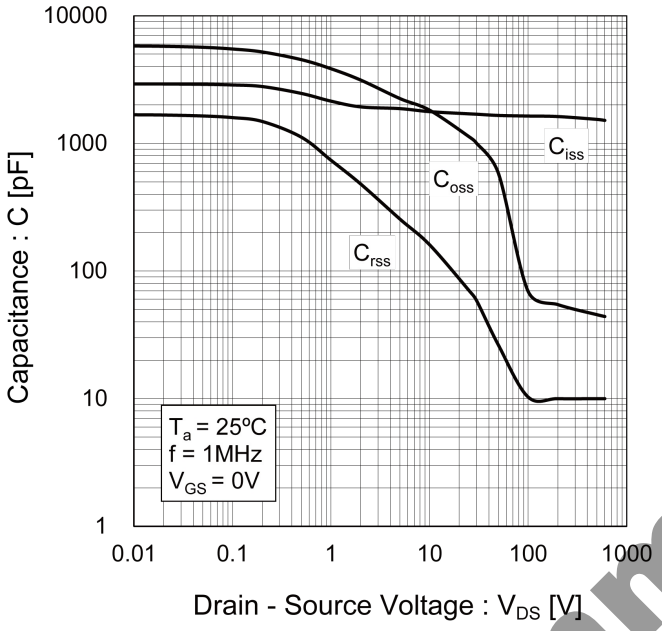



Fig.19 Coss Stored Energy

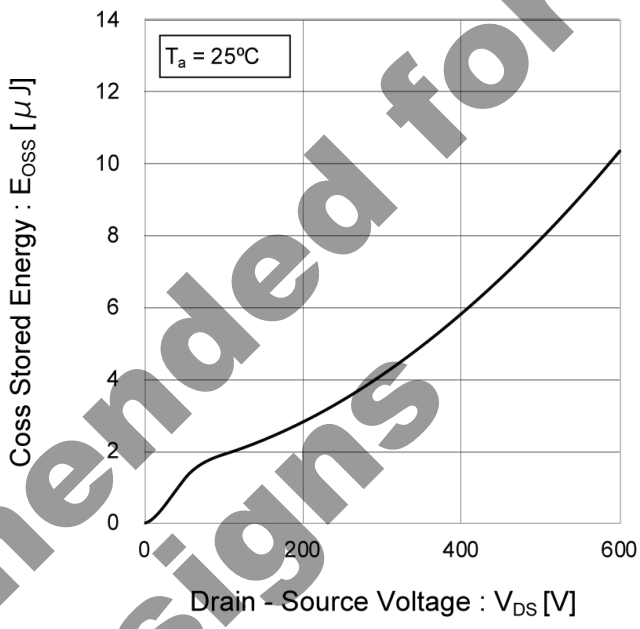



Fig.20 Switching Characteristics

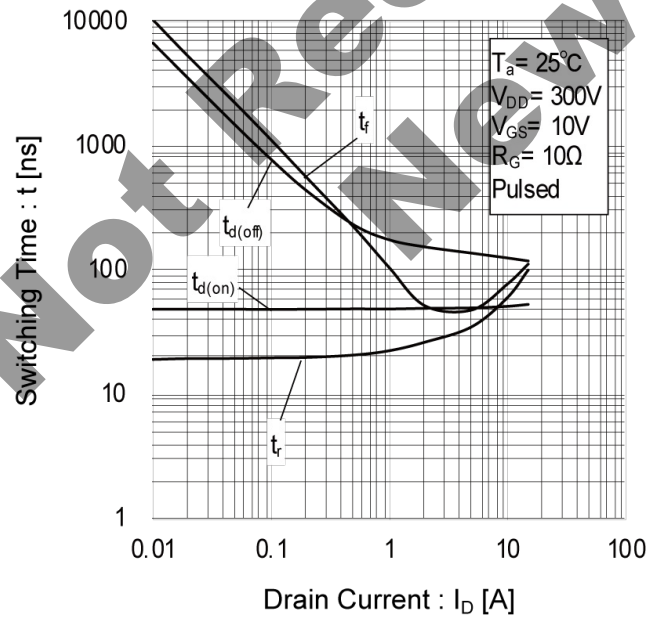
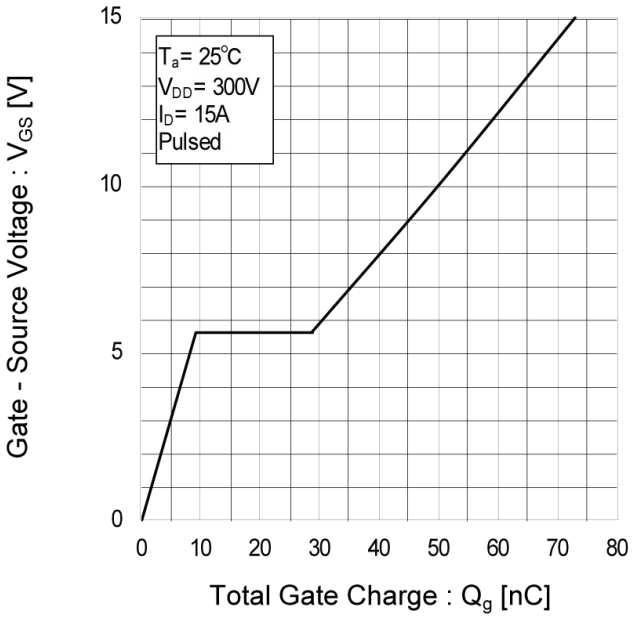



Fig.21 Dynamic Input Characteristics



## ●Electrical characteristic curves

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

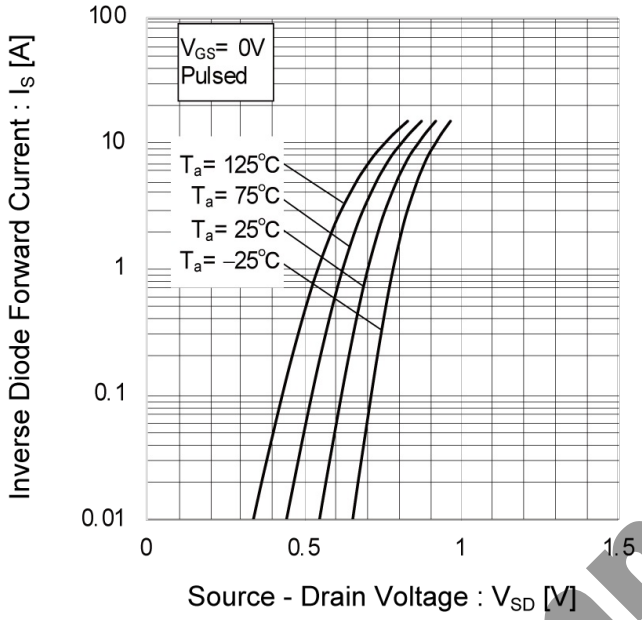
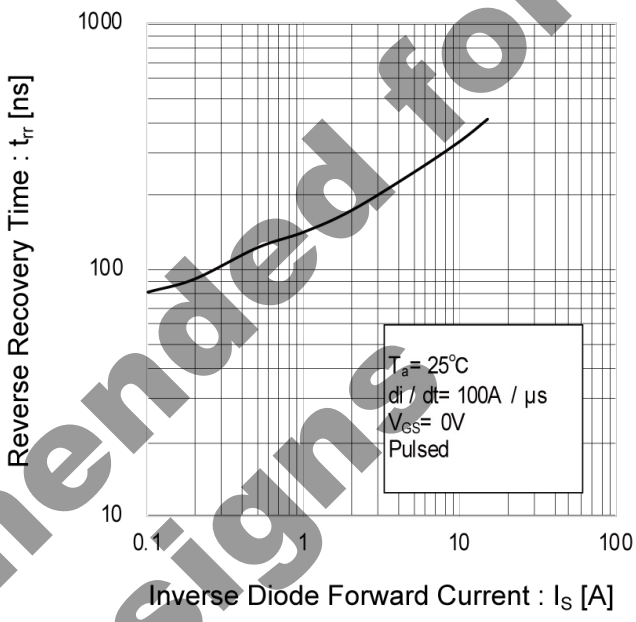



Fig.23 Reverse Recovery Time vs. Inverse Diode Forward Current



## ●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

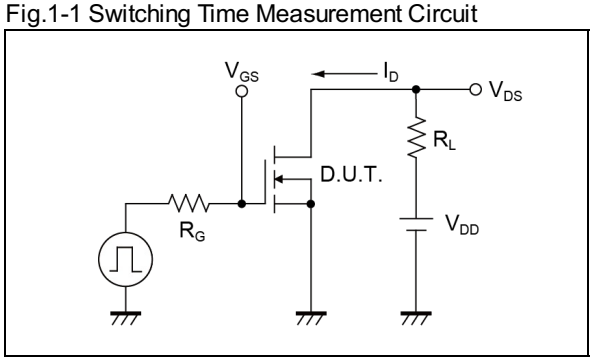



Fig.1-2 Switching Waveforms

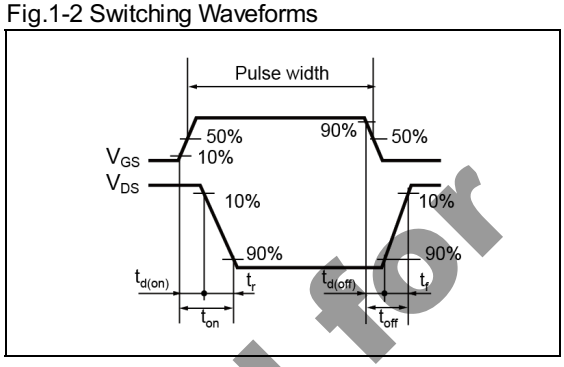



Fig.2-1 Gate Charge Measurement Circuit

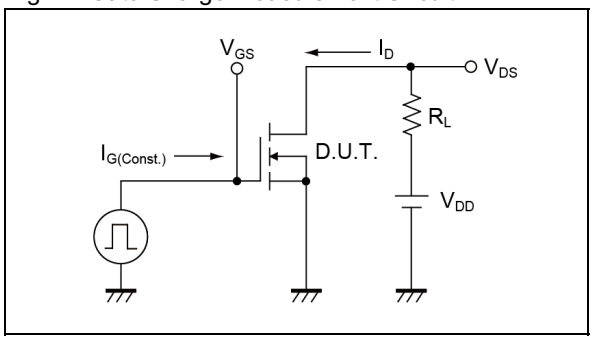



Fig.2-2 Gate Charge Waveform

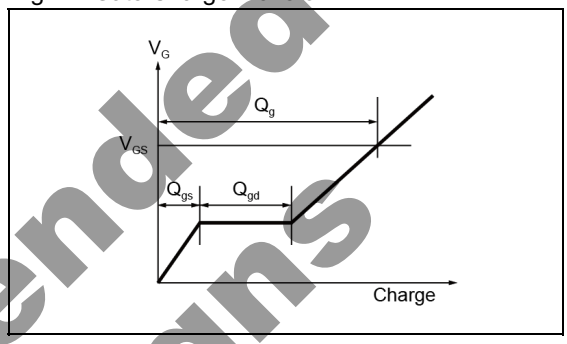



Fig.3-1 Avalanche Measurement Circuit

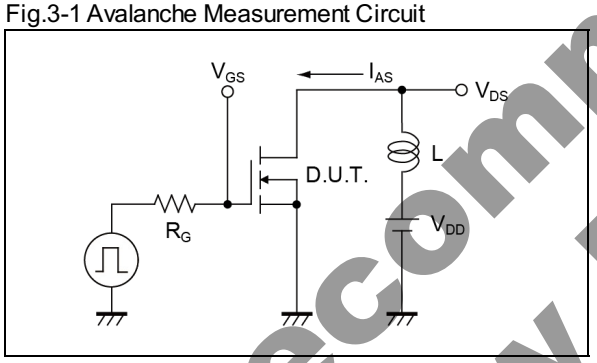



Fig.3-2 Avalanche Waveform

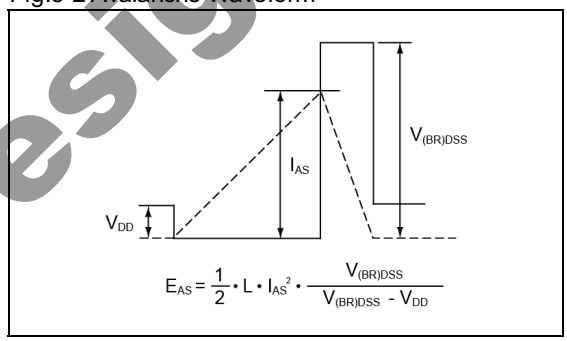



Fig.4-1 dv/dt Measurement Circuit

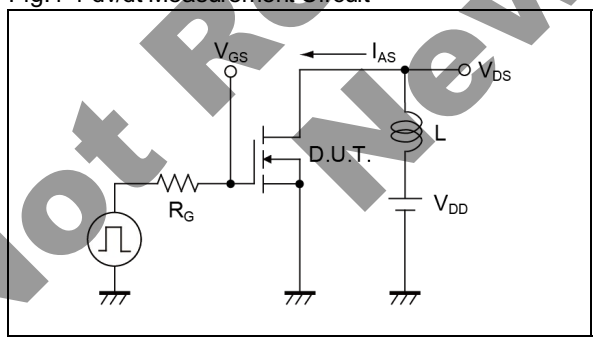



Fig.4-2 dv/dt Waveform

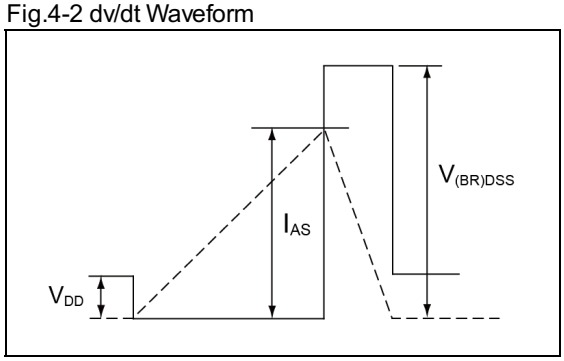



Fig.5-1 di/dt Measurement Circuit

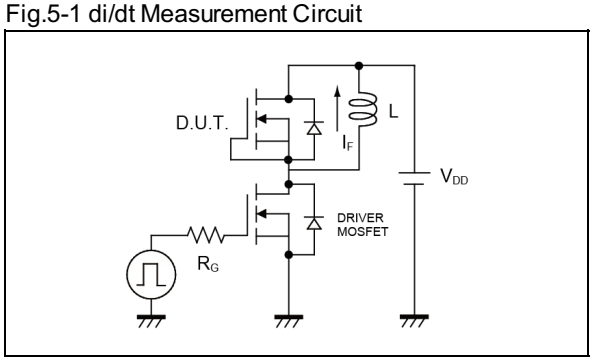
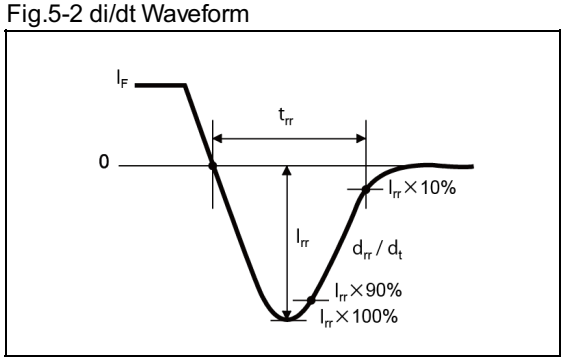
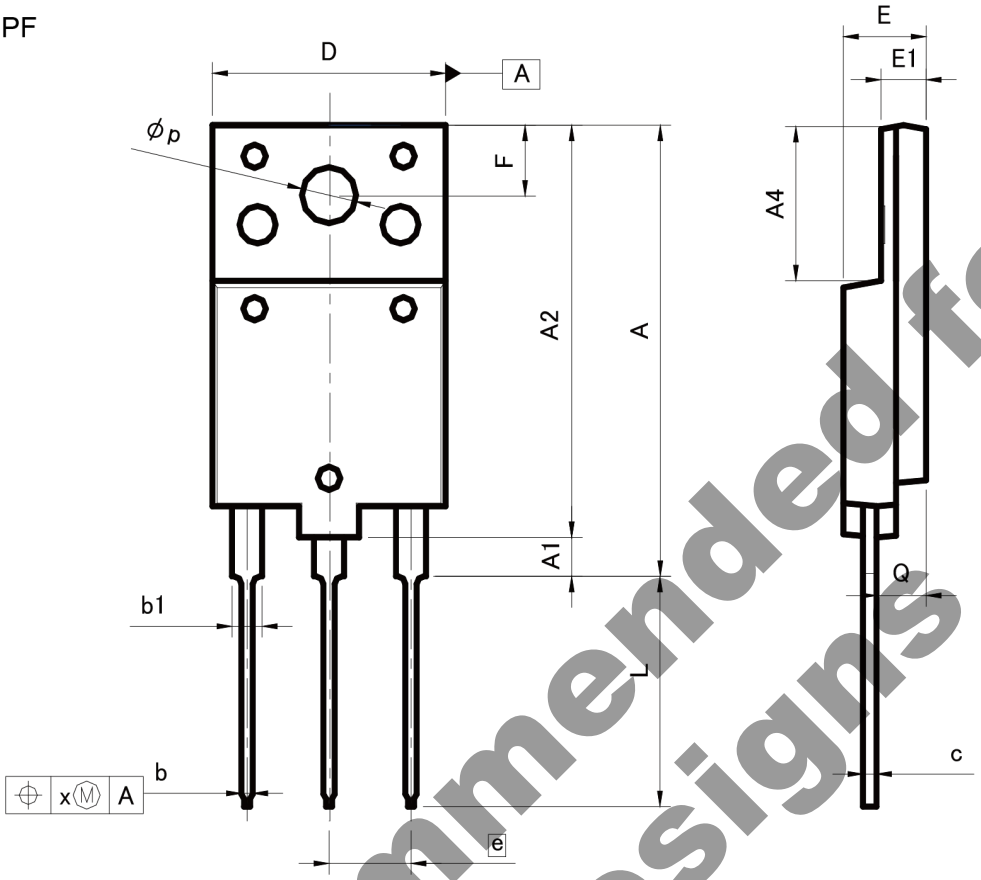



Fig.5-2 di/dt Waveform



## ●Dimensions

TO-3PF




| DIM | MILIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 26.30 | 26.70 | 1.035 | 1.051 |
| A1 | 2.30 | 2.70 | 0.091 | 0.106 |
| A2 | 26.30 | 26.70 | 1.035 | 1.051 |
| A4 | 9.80 | 10.20 | 0.386 | 0.402 |
| b | 0.65 | 0.95 | 0.026 | 0.037 |
| b1 | 1.80 | 2.20 | 0.071 | 0.087 |
| c | 0.80 | 1.10 | 0.031 | 0.043 |
| D | 15.30 | 15.70 | 0.602 | 0.618 |
| E | 5.30 | 5.70 | 0.209 | 0.224 |
| e | 5.45 | | 0.215 | – |
| E1 | 2.80 | 3.20 | 0.110 | 0.126 |
| F | 4.30 | 4.70 | 0.169 | 0.185 |
| L | 14.60 | 15.00 | 0.575 | 0.591 |
| p | 3.40 | 3.80 | 0.134 | 0.150 |
| Q | 3.10 | 3.50 | 0.122 | 0.138 |
| x | – | 0.50 | – | 0.020 |

Dimension in mm/inches

## Notes

1) The information contained herein is subject to change without notice.

2) Before you use our Products, please contact our sales representative and verify the latest specifications :

3) Although ROHM is continuously working to improve product reliability and quality, semiconductors can break down and malfunction due to various factors.
Therefore, in order to prevent personal injury or fire arising from failure, please take safety measures such as complying with the derating characteristics, implementing redundant and fire prevention designs, and utilizing backups and fail-safe procedures. ROHM shall have no responsibility for any damages arising out of the use of our Poducts beyond the rating specified by ROHM.

4) Examples of application circuits, circuit constants and any other information contained herein are provided only to illustrate the standard usage and operations of the Products. The peripheral conditions must be taken into account when designing circuits for mass production.

5) The technical information specified herein is intended only to show the typical functions of and examples of application circuits for the Products. ROHM does not grant you, explicitly or implicitly, any license to use or exercise intellectual property or other rights held by ROHM or any other parties. ROHM shall have no responsibility whatsoever for any dispute arising out of the use of such technical information.

6) The Products are intended for use in general electronic equipment (i.e. AV/OA devices, communication, consumer systems, gaming/entertainment sets) as well as the applications indicated in this document.

7) The Products specified in this document are not designed to be radiation tolerant.

8) For use of our Products in applications requiring a high degree of reliability (as exemplified below), please contact and consult with a ROHM representative : transportation equipment (i.e. cars, ships, trains), primary communication equipment, traffic lights, fire/crime prevention, safety equipment, medical systems, servers, solar cells, and power transmission systems.

9) Do not use our Products in applications requiring extremely high reliability, such as aerospace equipment, nuclear power control systems, and submarine repeaters.

10) ROHM shall have no responsibility for any damages or injury arising from non-compliance with the recommended usage conditions and specifications contained herein.

11) ROHM has used reasonable care to ensur the accuracy of the information contained in this document. However, ROHM does not warrants that such information is error-free, and ROHM shall have no responsibility for any damages arising from any inaccuracy or misprint of such information.

12) Please use the Products in accordance with any applicable environmental laws and regulations, such as the RoHS Directive. For more details, including RoHS compatibility, please contact a ROHM sales office. ROHM shall have no responsibility for any damages or losses resulting non-compliance with any applicable laws or regulations.

13) When providing our Products and technologies contained in this document to other countries, you must abide by the procedures and provisions stipulated in all applicable export laws and regulations, including without limitation the US Export Administration Regulations and the Foreign Exchange and Foreign Trade Act.

14) This document, in part or in whole, may not be reprinted or reproduced without prior consent of ROHM.



ROHM SEMICONDUCTOR

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