# SCT4036KR

**N-channel SiC power MOSFET** Datasheet

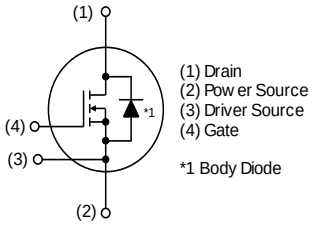
| | |
|---|---|
| $V_{DSS}$ | 1200V |
| $R_{DS(on)}$ (Typ.) | 36mΩ |
| $I_D$ *1 | 43A |
| $P_D$ | 176W |

## ●Outline

TO-247-4L




## ●Inner circuit




Please note Driver Source and Power Source are not exchangeable. Their exchange might lead to malfunction.

## ● Features

1) Low on-resistance
2) Fast switching speed
3) Fast reverse recovery
4) Easy to parallel
5) Simple to drive
6) Pb-free lead plating ; RoHS compliant

## ● Application

- Solar inverters
- DC/DC converters
- Switch mode power supplies
- Induction heating
- Motor drives

## ●Packaging specifications

| | | |
|---|---|---|
| Type | Packing | Tube |
| | Reel size (mm) | - |
| | Tape width (mm) | - |
| | Basic ordering unit (pcs) | 30 |
| | Taping code | C15 |
| | Marking | SCT4036KR |

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

| Parameter | | Symbol | Value | Unit |
|---|---|---|---|---|
| Drain - source voltage | | $V_{DSS}$ | 1200 | V |
| Continuous drain and source current | $V_{GS}$ = $V_{GS_on}$ | $I_D$, $I_S$ *1 | 43 | A |
| $T_c$ = 100°C | | | 30 | A |
| Pulsed drain current | $V_{GS}$ = $V_{GS_on}$ | $I_{D,pulse}$ *2 | 84 | A |
| Body diode pulsed forward current | $V_{GS}$ = 0 V | $I_{S,pulse}$ *3 | 43 | A |
| Body diode surge forward current | $V_{GS}$ = 0 V | $I_{S,pulse}$ *4 | 84 | A |
| Gate - source voltage (DC) | | $V_{GSS_DC}$ | -4 to +21 | V |
| Gate - source surge voltage ($t_{surge}$ < 300ns) | | $V_{GSS_surge}$ *5 | -4 to +23 | V |
| Recommended turn-on gate - source drive voltage | | $V_{GS_on}$ *6 | +15 to +18 | V |
| Recommended turn-off gate - source drive voltage | | $V_{GS_off}$ | 0 | V |
| Virtual junction temperature | | $T_{vj}$ | 175 | °C |
| Range of storage temperature | | $T_{stg}$ | -40 to +175 | °C |


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## ●Electrical characteristics ($T_{vj}$ = 25°C unless otherwise specified)

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Drain - Source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}$ = 0 V, $I_D$ = 9.2mA<br>$T_{vj}$ = 25°C | 1200 | - | - | V |
| Zero Gate voltage Drain current | $I_{DSS}$ | $V_{GS}$ = 0 V, $V_{DS}$ =1200V<br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 150°C | -<br>- | 1<br>10 | 80<br>- | μA |
| Gate - Source leakage current | $I_{GSS+}$ | $V_{GS}$ = +21V , $V_{DS}$ = 0V | - | - | 100 | nA |
| Gate - Source leakage current | $I_{GSS-}$ | $V_{GS}$ = -4V , $V_{DS}$ = 0V | - | - | -100 | nA |
| Gate threshold voltage | $V_{GS(th)}$ *7 | $V_{DS}$ = 10V, $I_D$ = 11.1mA | 2.8 | - | 4.8 | V |
| Static Drain - Source on - state resistance | $R_{DS(on)}$ *8 | $V_{GS}$ = 18V, $I_D$ = 21A<br>$T_{vj}$ = 25°C<br>$T_{vj}$ = 150°C | -<br>- | 36<br>72 | 47<br>- | mΩ |
| Gate input resistance | $R_G$ | f = 1MHz, open drain | - | 1 | - | Ω |

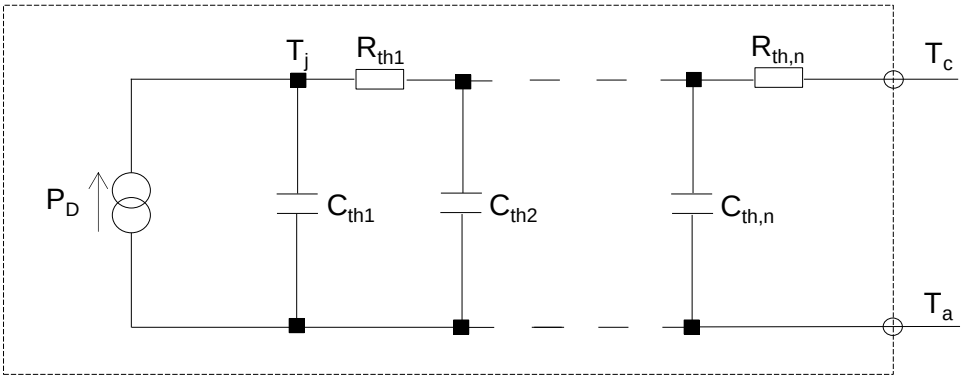
## ●Thermal resistance

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Thermal resistance, junction - case | $R_{thJC}$ *9 | - | 0.65 | 0.85 | K/W |

## ●Typical Transient Thermal Characteristics

| Symbol | Value | Unit |
|---|---|---|
| $R_{th1}$ | 1.1 ×10 $^{-1}$ | K/W |
| $R_{th2}$ | 2.5 ×10 $^{-1}$ | |
| $R_{th3}$ | 2.9 ×10 $^{-1}$ | |

| Symbol | Value | Unit |
|---|---|---|
| $C_{th1}$ | 5.8 ×10 $^{-4}$ | Ws/K |
| $C_{th2}$ | 2.3 ×10 $^{-3}$ | |
| $C_{th3}$ | 1.1 ×10 $^{-2}$ | |





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●**Electrical characteristics** ($T_{vj}$ = 25°C unless otherwise specified)

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Transconductance | $g_{fs}$ *8 | $V_{DS}$ = 10V, $I_D$ = 21A | - | 11 | - | S |
| Input capacitance | $C_{iss}$ | $V_{GS}$ = 0V | - | 2335 | - | pF |
| Output capacitance | $C_{oss}$ | $V_{DS}$ = 800V | - | 70 | - | |
| Reverse transfer capacitance | $C_{rss}$ | f = 1MHz | - | 5 | - | |
| Effective output capacitance, energy related | $C_{o(er)}$ | $V_{GS}$ = 0V<br>$V_{DS}$ = 0V to 800V | - | 84 | - | pF |
| Total Gate charge | $Q_g$ *8 | $V_{DS}$ = 800V | - | 91 | - | nC |
| Gate - Source charge | $Q_{gs}$ *8 | $I_D$ = 21A<br>$V_{GS}$ = 18V | - | 20 | - | |
| Gate - Drain charge | $Q_{gd}$ *8 | See Fig. 1-1, 1-2. | - | 24 | - | |
| Turn - on delay time | $t_{d(on)}$ *8 | $V_{DS}$ = 800V | - | 8.1 | - | ns |
| Rise time | $t_r$ *8 | $I_D$ = 21A<br>$V_{GS}$ = +18V / 0V | - | 15 | - | |
| Turn - off delay time | $t_{d(off)}$ *8 | $R_G$ = 3.3Ω, L = 250μH<br>$E_{on}$ includes diode reverse recovery | - | 29 | - | |
| Fall time | $t_f$ *8 | $L_\sigma$ = 50nH, $C_\sigma$ = 10pF | - | 9.6 | - | |
| Turn - on switching loss | $E_{on}$ *8 | See Fig. 2-1, 2-2, 2-3. | - | 239 | - | μJ |
| Turn - off switching loss | $E_{off}$ *8 | | - | 26 | - | |


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●**Body diode electrical characteristics** (Source-Drain) ($T_{vj}$ = 25°C unless otherwise specified)

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Forward voltage | $V_{SD}$ *8 | $V_{GS}$ = 0V, $I_D$ = 21A | - | 3.3 | - | V |
| Reverse recovery time | $t_{rr}$ *8 | $I_F$ = 21A<br>$V_R$ = 800V<br>di/dt = 3700A/µs<br>$L_\sigma$ = 50nH, $C_\sigma$ = 10pF<br>See Fig. 3-1, 3-2. | - | 9.2 | - | ns |
| Reverse recovery charge | $Q_{rr}$ *8 | | - | 140 | - | nC |
| Peak reverse recovery current | $I_{rrm}$ *8 | | - | 31 | - | A |

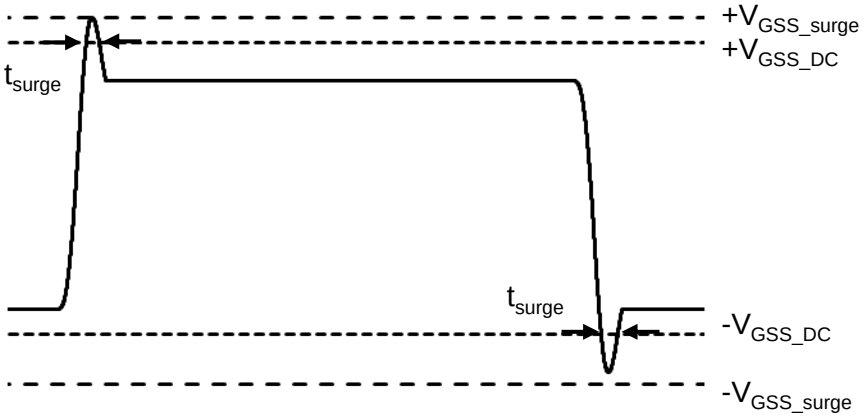
*1 Limited by maximum $T_{vj}$ and for Max. $R_{thJC}$.

*2 PW ≤ 10µs, Duty cycle ≤ 1%

*3 Only for body-diode, Repititive pulse, PW ≤ 500ns, Duty cycle ≤ 5%

*4 When used as a protective function, PW ≤ 10µs

*5 Example of acceptable $V_{GS}$ waveform




Please note especially when using driver source that $V_{GSS_surge}$ must be in the range of absolute maximum rating.

*6 Please be advised not to use SiC-MOSFETs with $V_{GS}$ below 10V as doing so may cause thermal runaway.

*7 Tested after applying $V_{GS}$ = 21V for 100ms.

*8 Pulsed

*9 Measured conformable to JESD51-14.

See the application note "rthjc_measurement_and_usage_an-e.pdf". Link

URL: https://fscdn.rohm.com/en/products/databook/applinote/discrete/common/rthjc_measurement_and_usage_an-e.pdf


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## ●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

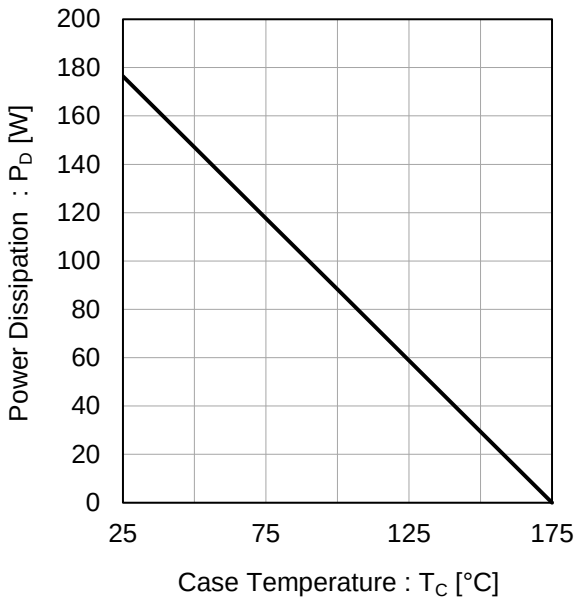



Fig.2 Maximum Safe Operating Area

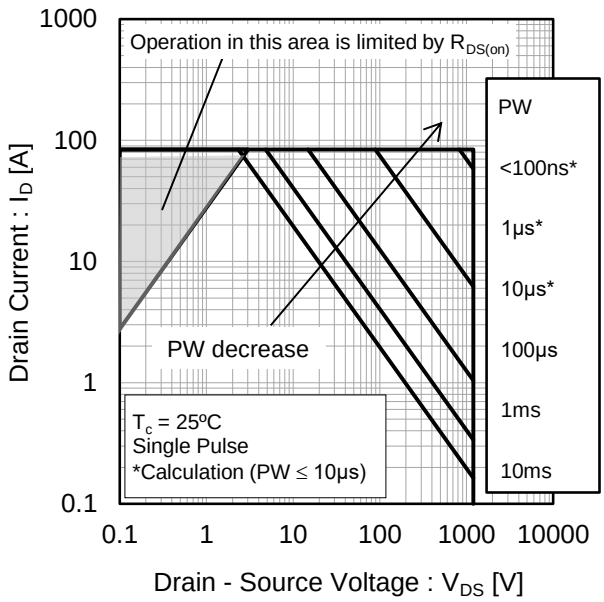
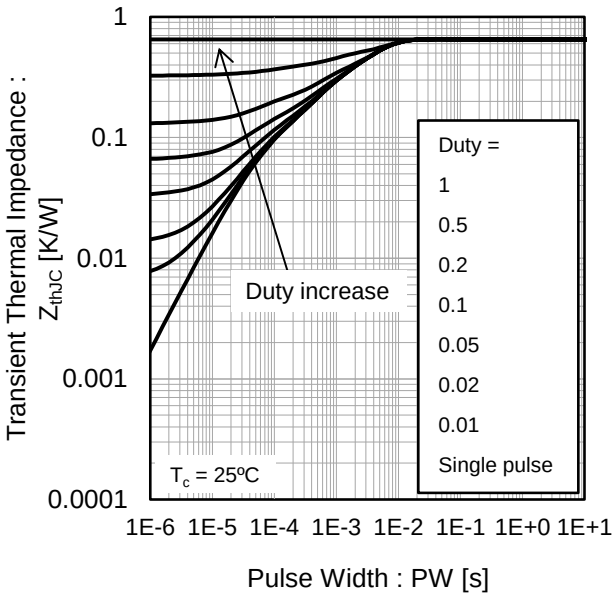



Fig.3 Typical Transient Thermal Impedance vs. Pulse Width





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## ●Electrical characteristic curves

Fig.4 $T_{vj}$ = 25ºC Typical Output Characteristics(I)

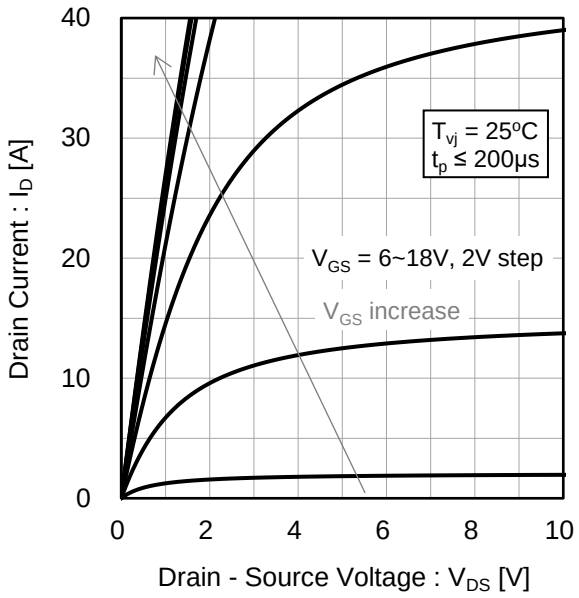



Fig.5 $T_{vj}$ = 25ºC Typical Output Characteristics(II)

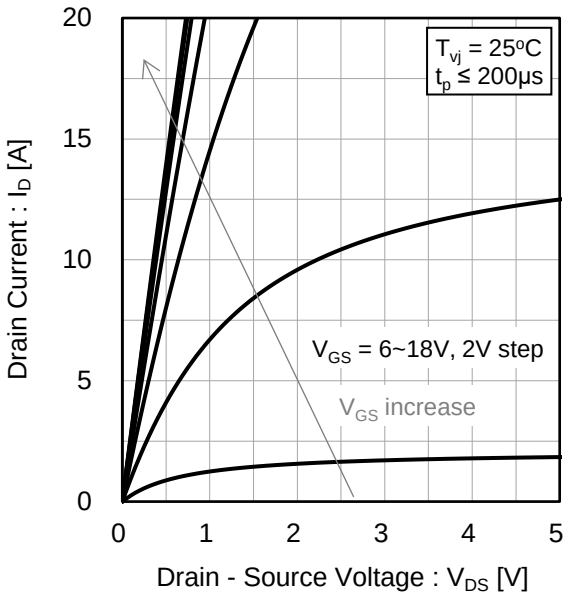
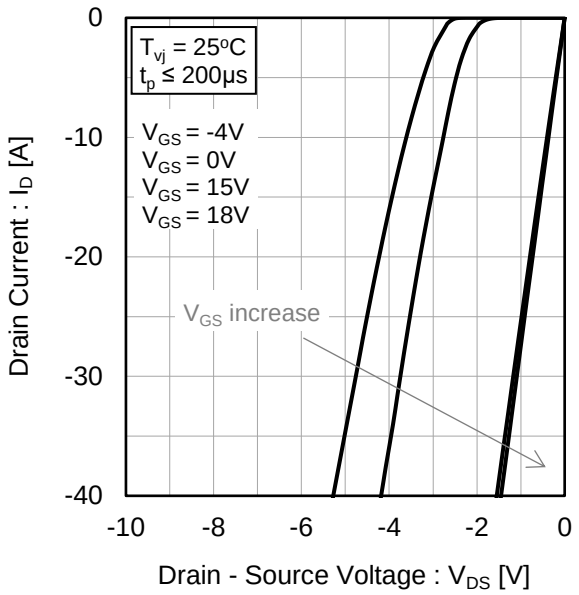



Fig.6 $T_{vj}$ = 25ºC 3rd Quadrant Characteristics





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## ●Electrical characteristic curves

Fig.7 $T_{vj}$ = 150ºC Typical Output Characteristics(I)

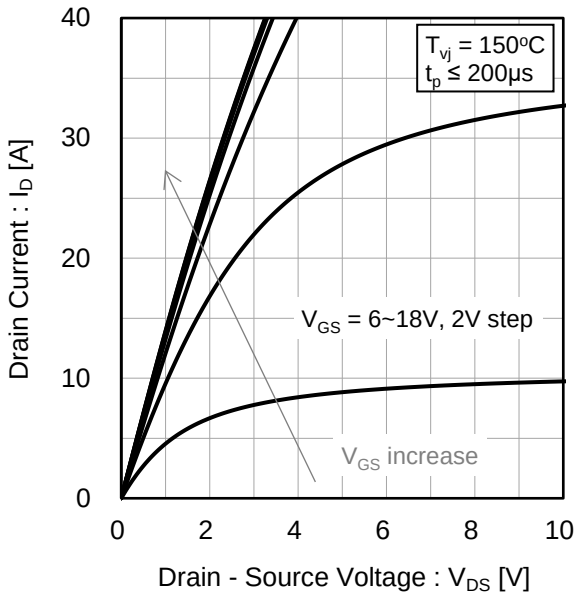



Fig.8 $T_{vj}$ = 150ºC Typical Output Characteristics(II)

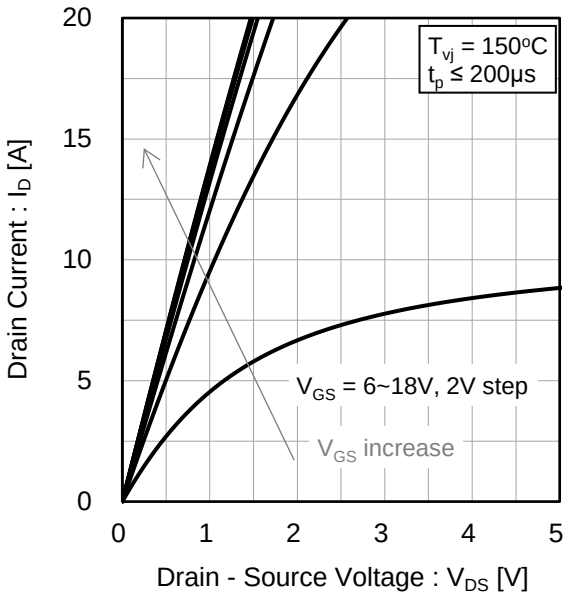



Fig.9 $T_{vj}$ = 150ºC 3rd Quadrant Characteristics

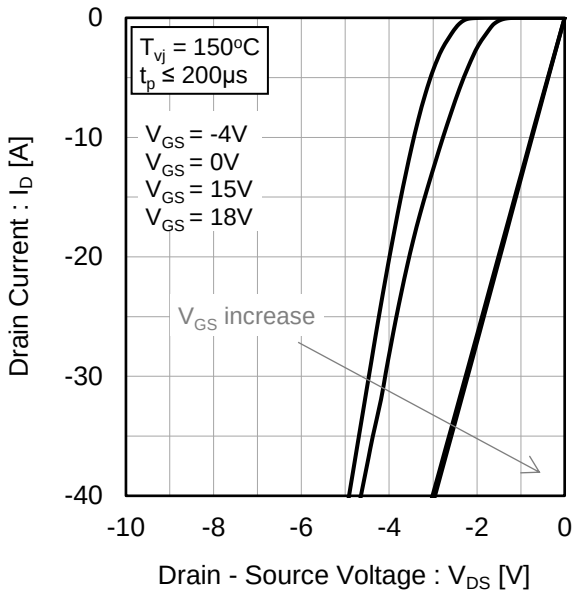
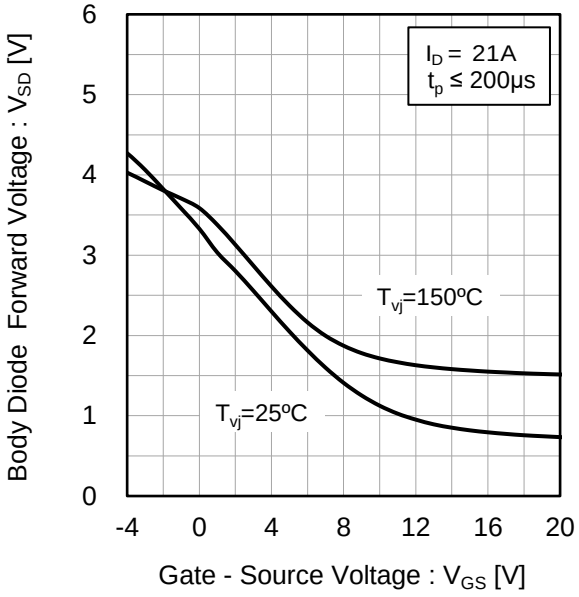



Fig.10 Body Diode Forward Voltage vs. Gate - Source Voltage





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## ●Electrical characteristic curves

Fig.11 Typical Transfer Characteristics (I)

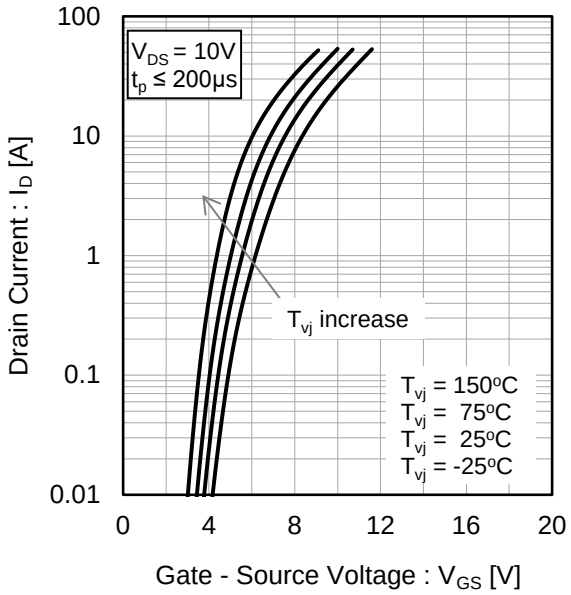



Fig.12 Typical Transfer Characteristics (II)

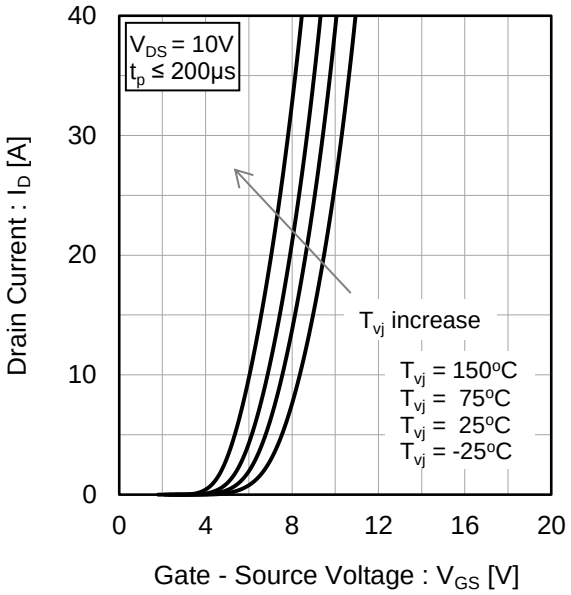



Fig.13 Gate Threshold Voltage vs. Virtual Junction Temperature

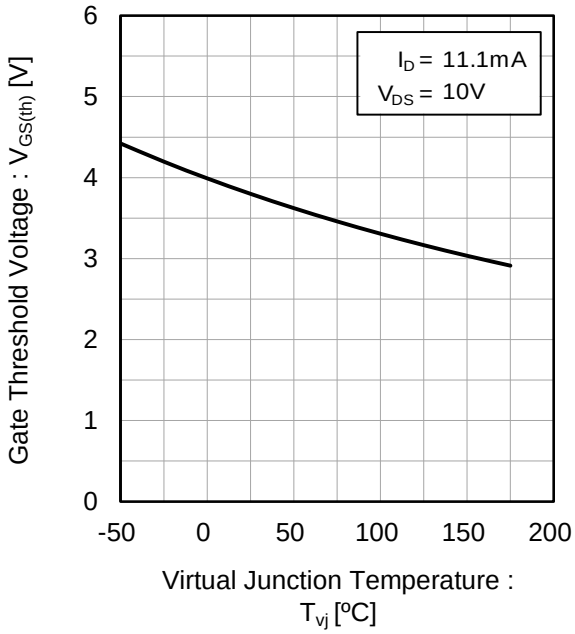
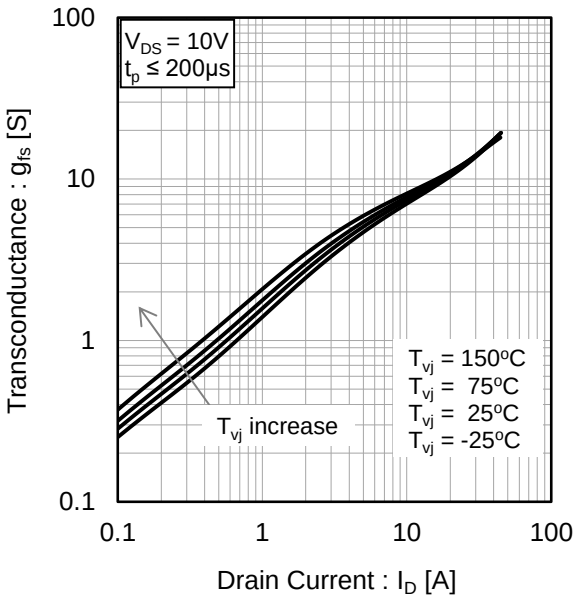



Fig.14 Transconductance vs. Drain Current





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## ●Electrical characteristic curves

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

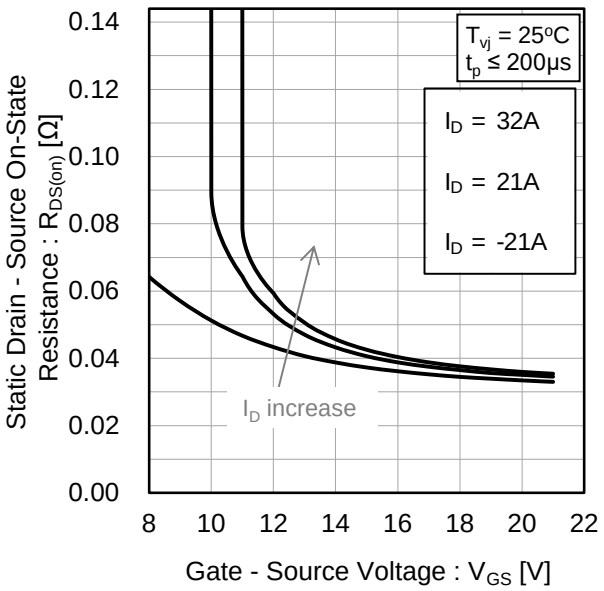



Fig.16 Static Drain - Source On - State Resistance vs. Virtual Junction Temperature

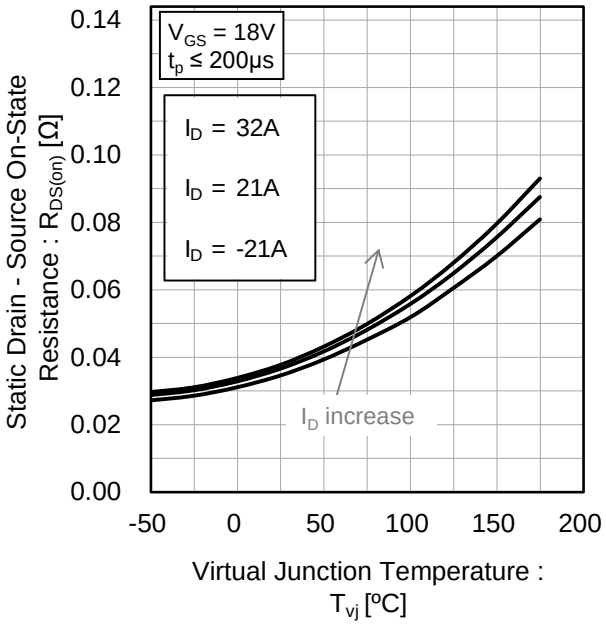



Fig.17 Static Drain - Source On - State Resistance vs. Drain Current

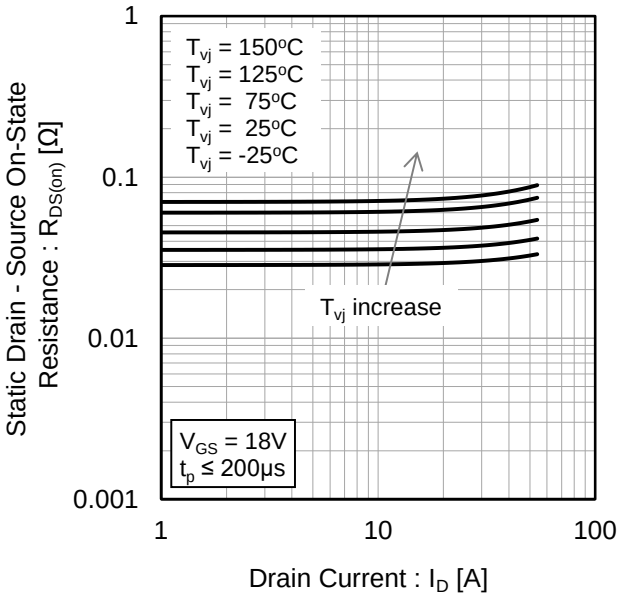
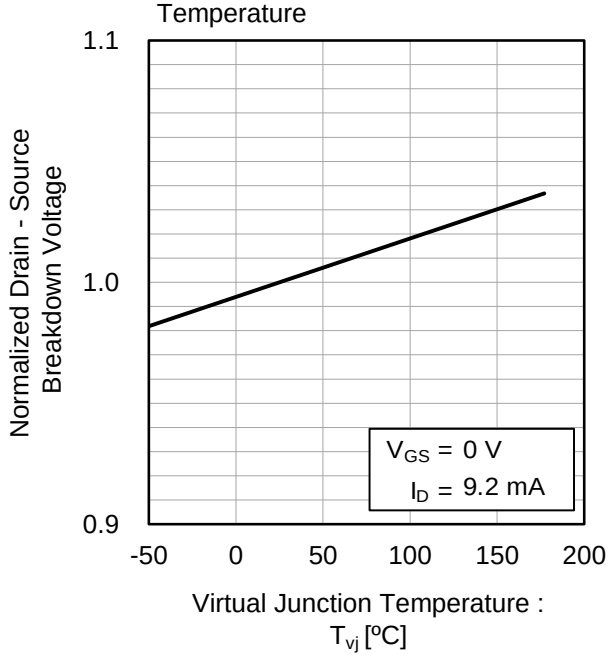



Fig.18 Normalized Drain - Source Breakdown Voltage vs. Virtual Junction Temperature





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## ●Electrical characteristic curves

Fig.19 Typical Capacitance vs. Drain - Source Voltage

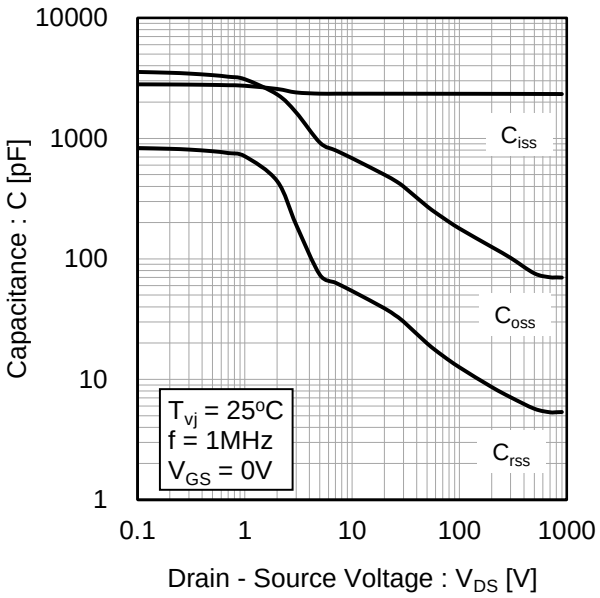



Fig.20 $C_{oss}$ Stored Energy

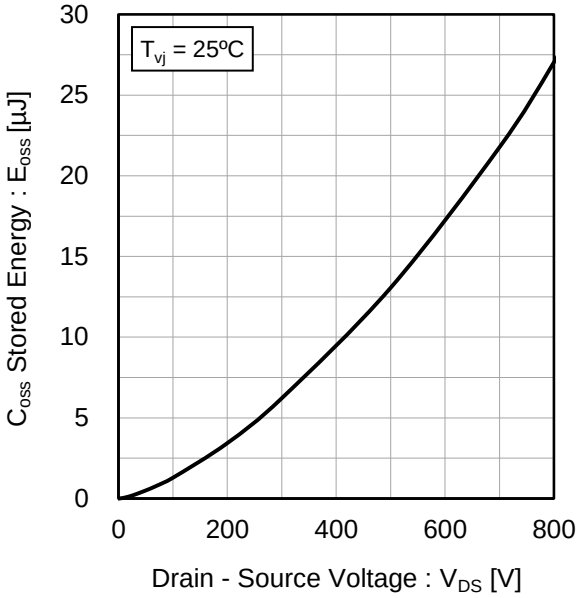
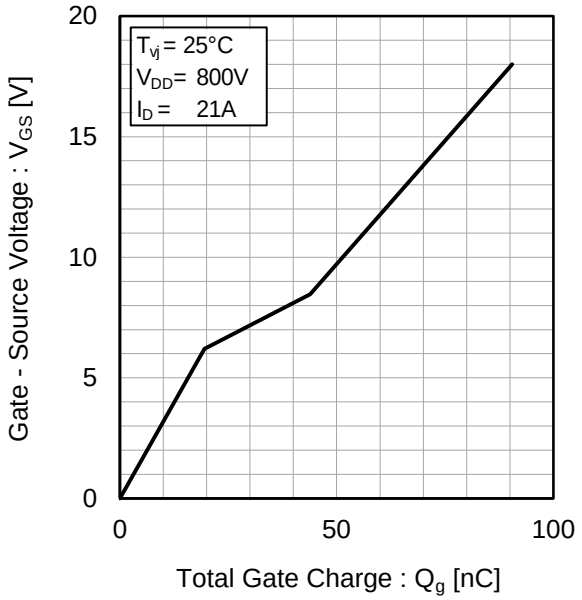



Fig.21 Dynamic Input Characteristics





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## ●Electrical characteristic curves

Fig.22 Typical Switching Time vs. External Gate Resistance

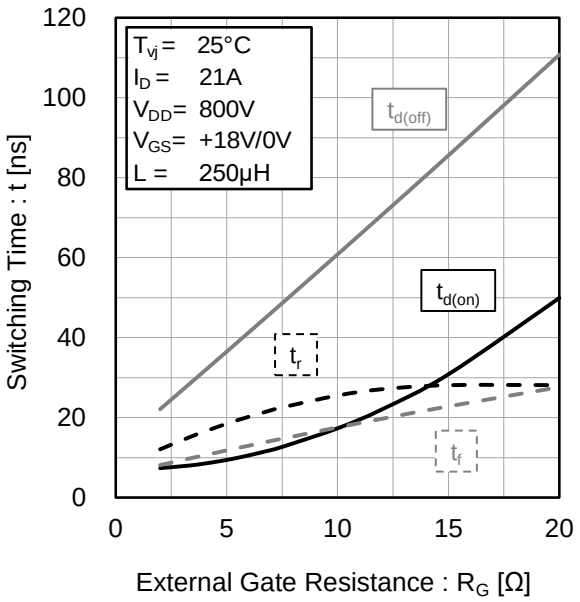



Fig.23 Typical Switching Loss vs. Drain - Source Voltage

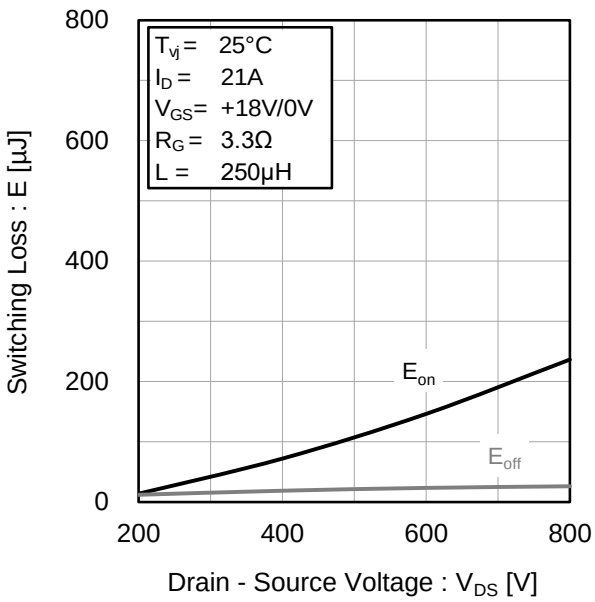



Fig.24 Typical Switching Loss vs. Drain Current

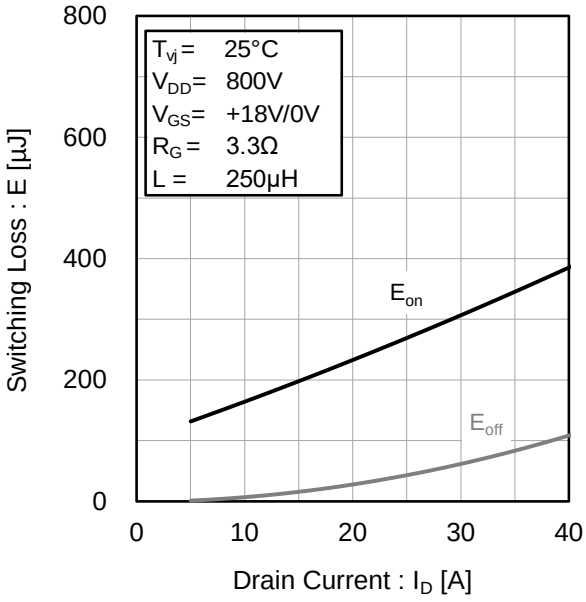
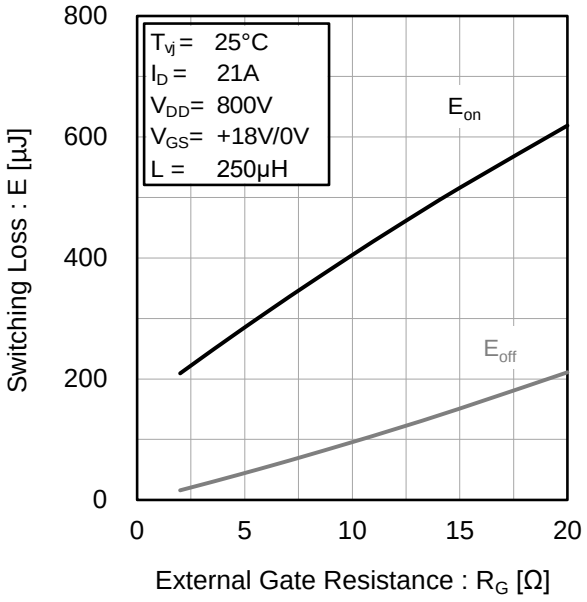



Fig.25 Typical Switching Loss vs. External Gate Resistance





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## ●Measurement circuits and waveforms

Fig.1-1 Gate Charge Measurement Circuit

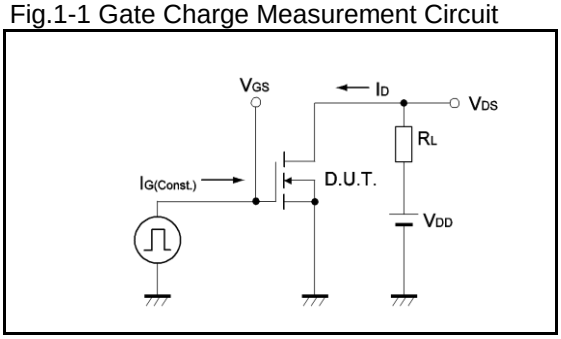



Fig.1-2 Gate Charge Waveform

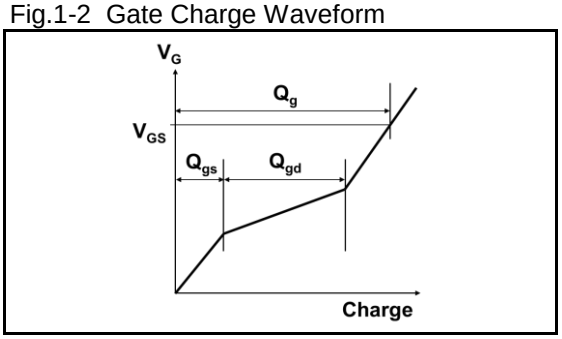



Fig.2-1 Switching Characteristics Measurement Circuit

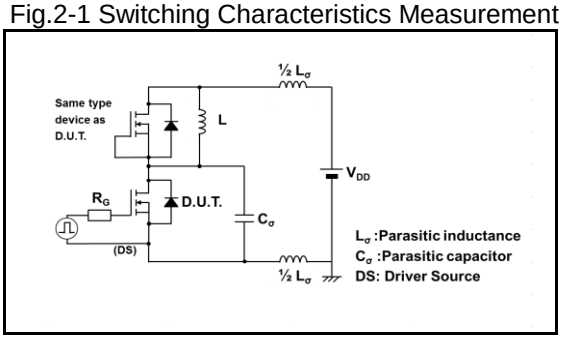



Fig.2-2 Waveforms for Switching Time

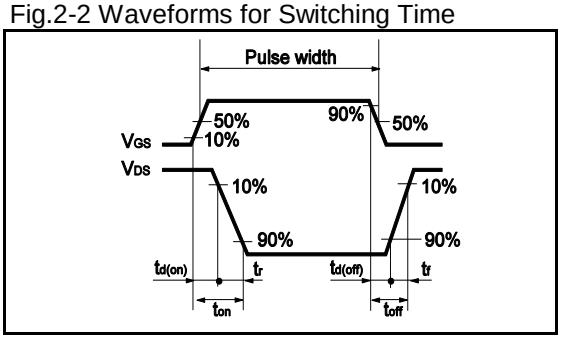



Fig.2-3 Waveforms for Switching Energy Loss

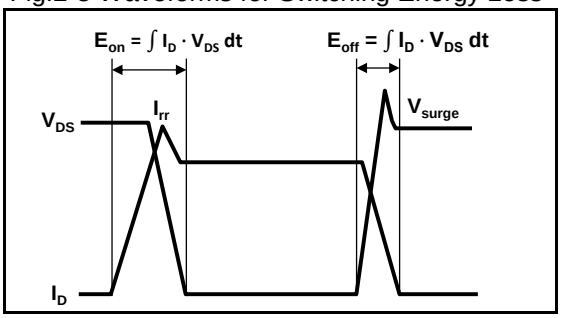



Fig.3-1 Reverse Recovery Time Measurement Circuit

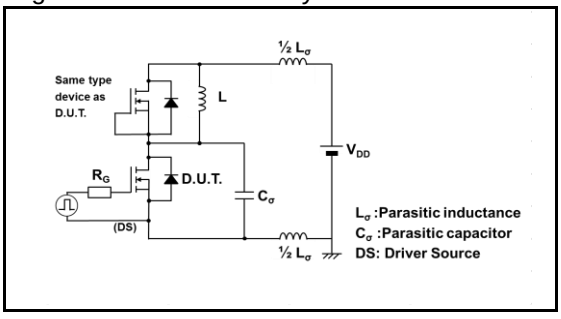
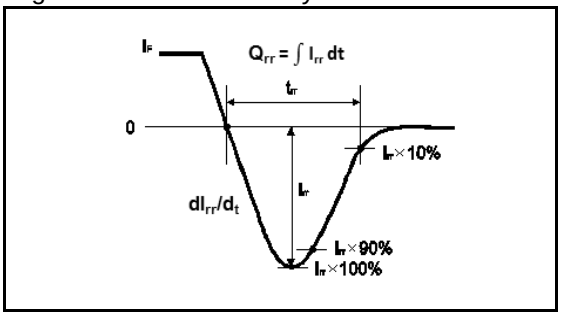


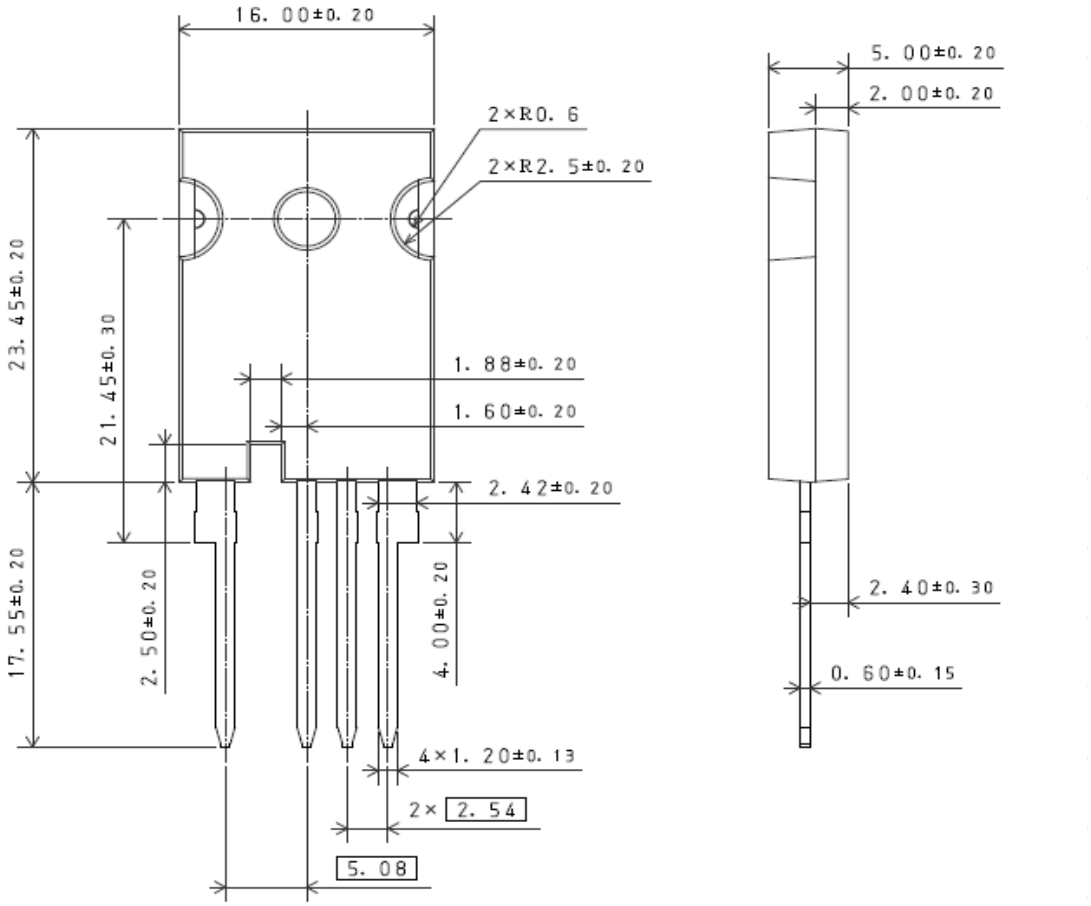

Fig.3-2 Reverse Recovery Waveform





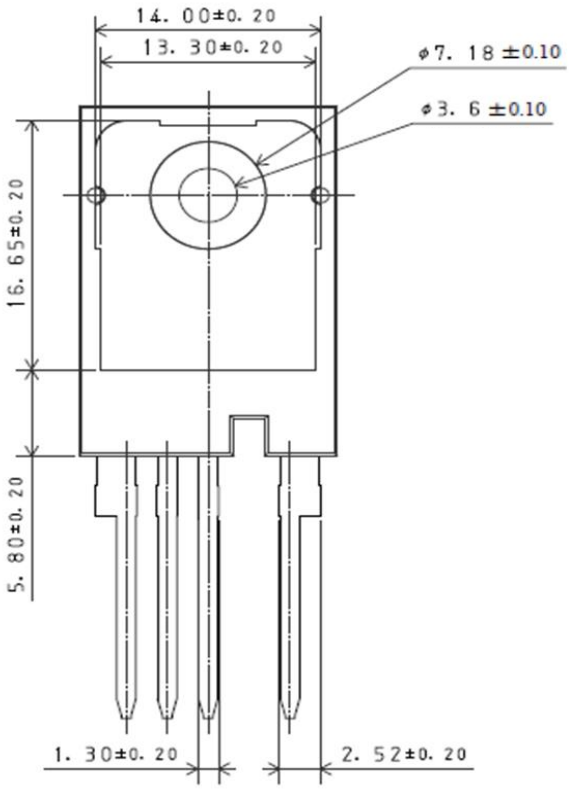
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## ●Package Dimensions




Unit: mm

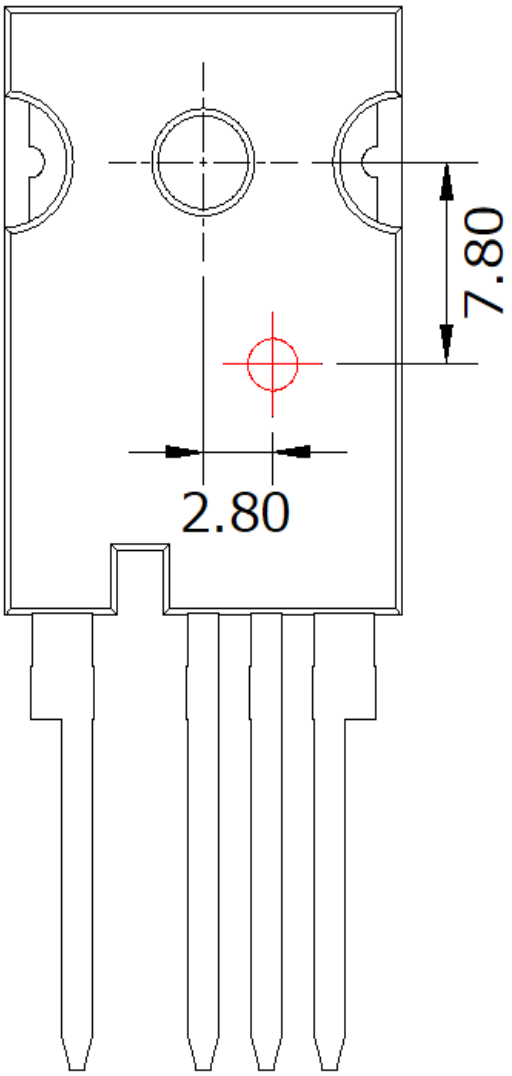

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Unit: mm


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## ●Die Bonding Layout




: Die position

・Front view of the packaging.

・Dimensions are design values.

・If the heat sink is to be installed, it should be in contact with the die bonding point.

Unit: mm


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