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# SiC Power Module

**BSM180C12P3C202**

Datasheet

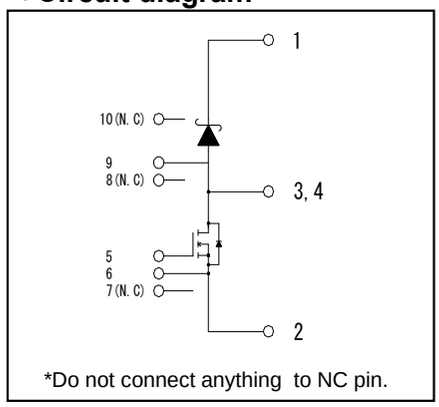
## ●Application

・Motor drive

・Converter

・Photovoltaics, wind power generation.

## ●Circuit diagram




*Do not connect anything to NC pin.

## ●Features

1) Low surge, low switching loss.

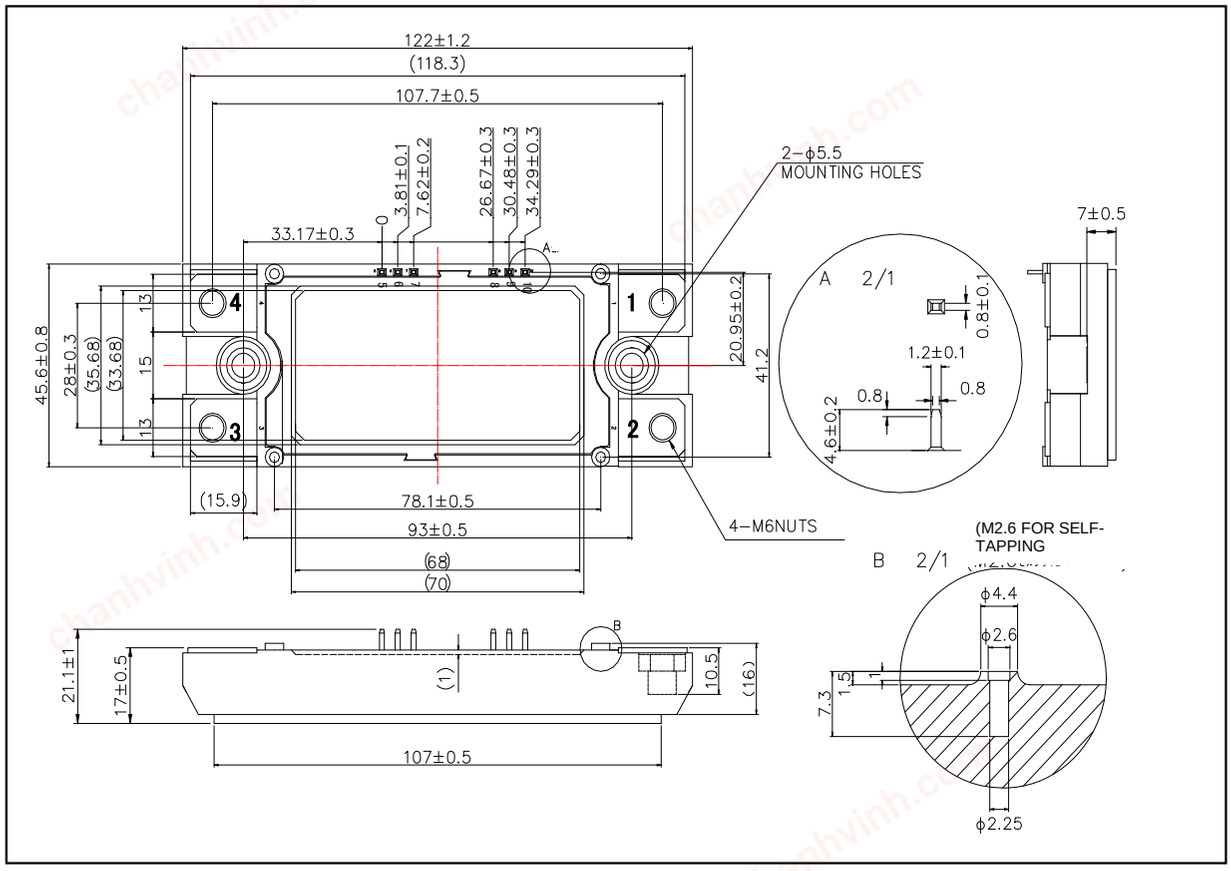
2) High-speed switching possible.

3) Reduced temperature dependence.

## ●Construction

This product is a chopper module consisting of SiC-UMOSFET and SiC-SBD from ROHM.

## ●Dimensions & Pin layout (Unit : mm)





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

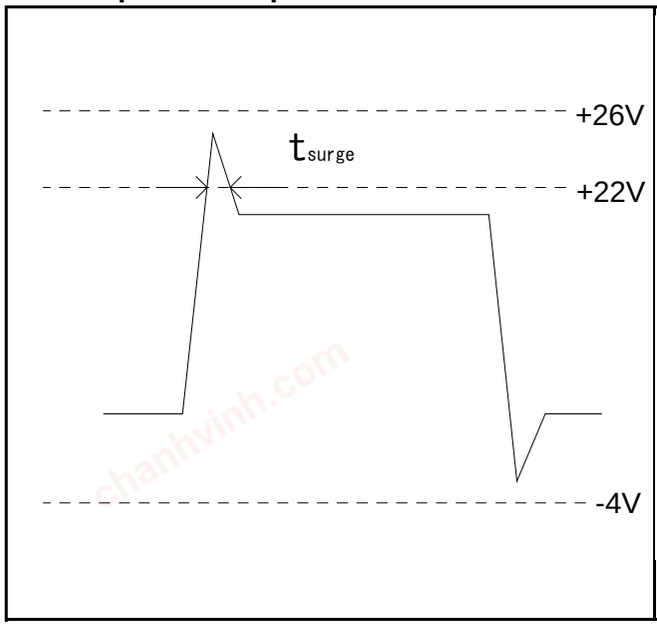
| Parameter | Symbol | Conditions | Limit | Unit |
|---|---|---|---|---|
| Drain-source voltage | $V_{DSS}$ | G-S short | 1200 | V |
| Repetitive reverse voltage | $V_{DSS}$ | Clamp diode | 1200 | |
| Gate-source voltage(+) | $V_{GSS}$ | D-S short | 22 | |
| Gate-source voltage(–) | | | –4 | |
| G - S Voltage ($t_{surge}$<300nsec) | $V_{GSSsurge}$ | | -4 to 26 | |
| Drain current *1 | $I_D$ | DC ($T_c$=60°C) | 180 | A |
| | $I_{DRM}$ | Pulse ($T_c$=60°C) 1ms *2 | 360 | |
| Source current *1 | $I_S$ | DC ($T_c$=60°C ) $V_{GS}$=18V | 180 | |
| | $I_{SRM}$ | Pulse (Tc=60°C) 1ms $V_{GS}$=18V *2 | 360 | |
| | $I_{SRM}$ | Pulse (Tc=60°C) 10μs $V_{GS}$=0V *2 | 360 | |
| Forward curent (clamp diode) *1 | $I_F$ | DC ($T_c$=60°C ) $V_{GS}$=18V | 180 | |
| | $I_{FRM}$ | Pulse (Tc=60°C) 1ms $V_{GS}$=18V *2 | 360 | |
| Total power disspation *3 | Ptot | $T_c$=25°C | 880 | W |
| Max Junction Temperature | $T_{jmax}$ | | 175 | °C |
| Junction temperature | $T_{jop}$ | | –40 to150 | |
| Storage temperature | $T_{stg}$ | | –40 to125 | |
| Isolation voltage | Visol | Terminals to baseplate, f=60Hz AC 1min. | 2500 | Vrms |
| Mounting torque | – | Main Terminals : M6 screw | 4.5 | N · m |
| | | Mounting to heat shink : M5 screw | 3.5 | |

(*1) Case temperature ($T_c$)is defined on the surface of base plate just under the chips.

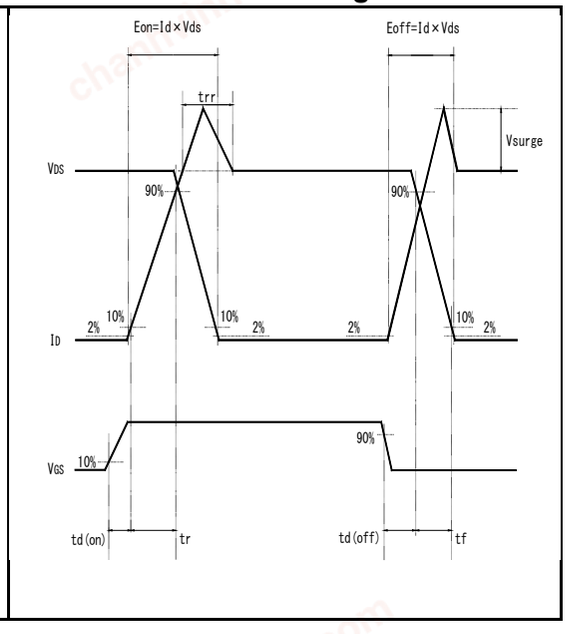
(*2) Repetition rate should be kept within the range where temperature rise if die should not exceed $T_{j\,max.}$

(*3) $T_j$ is less than 175°C

### ●Example of acceptable VGS waveform




### ●Waveform for switching test





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

| Parameter | Symbol | Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Static drain-source on-state voltage | $V_{DS(on)}$ | $I_C$=180A, $V_{GS}$=18V | $T_j$=25°C | - | 1.8 | 2.6 | V |
| | | | $T_j$=125°C | - | 2.7 | - | |
| | | | $T_j$=150°C | - | 3.1 | 4.0 | |
| Drain cutoff current | $I_{DSS}$ | $V_{DS}$=1200V, $V_{GS}$=0V | | - | - | 10 | μA |
| Forwad Voltag | $V_F$ | $I_F$=180A | $T_j$=25°C | - | 1.6 | 2.2 | V |
| | | | $T_j$=125°C | | 2.0 | - | |
| | | | $T_j$=150°C | - | 2.2 | 3.3 | |
| Reverse curent | $I_{RRM}$ | Clamp diode | | - | - | 3.2 | mA |
| Gate-source threshold voltage | $V_{GS(th)}$ | $V_{DS}$=10V, $I_D$=50mA | | 2.7 | - | 5.6 | V |
| Gate-source leakage current | $I_{GSS}$ | $V_{GS}$=22V, $V_{DS}$=0V | | - | - | 0.5 | μA |
| | | $V_{GS}$= −4V, $V_{DS}$=0V | | −0.5 | - | - | |
| Switching characteristics | $t_{d(on)}$ | $V_{GS(on)}$=18V, $V_{GS(off)}$=0V | | - | 30 | - | ns |
| | $t_r$ | $V_{DS}$=600V | | - | 45 | - | |
| | $t_{rr}$ | $I_D$=180A | | - | 20 | - | |
| | $t_{d(off)}$ | $R_G$=3.9Ω | | - | 165 | - | |
| | $t_f$ | inductive load | | - | 45 | - | |
| Input capacitance | Ciss | $V_{DS}$=10V, $V_{GS}$=0V,100kHz | | - | 9 | - | nF |
| Gate Registance | $R_{Gint}$ | $T_j$=25°C | | - | 1.4 | - | Ω |
| Stray Inductance | Ls | | | | 25 | - | nH |
| Creepage Distance | - | Terminal to heat sink | | | 12.5 | - | mm |
| | | Terminal to terminal | | | 20 | - | mm |
| Clearance Distance | - | Terminal to heat sink | | | 10.5 | - | mm |
| | | Terminal to terminal | | | 14.0 | - | mm |
| Junction-to-case thermal resistance | $R_{th}$(j-c) | UMOS (1/2 module) *4 | | - | - | 0.17 | °C/W |
| | | SBD (1/2 module) *4 | | - | - | 0.14 | |
| Case-to-heat sink Thermal resistance | $R_{th}$(c-f) | Case to heat sink, per 1 module, Thermal grease applied *5 | | - | 0.035 | - | |

(*4) Measurement of Tc is to be done at the point just under the chip.

(*5) Typical value is measured by using thermally conductive grease of λ=0.9W/(m・K).

(*6) SiC devices have lower short cuicuit withstand capability due to high current density.
Please be advised to pay careful attention to short cuicuit accident and try to adjust protection time to shutdown them as short as possible.

(*7) If the Product is used beyond absolute maximum ratings defined in the Specifications, as its internal structure may be dameged, please replace such Product with a new one.


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## ●Electrical characteristic curves (Typical)

Fig.1 Typical Output Characteristics [ $T_j$=25ºC ]

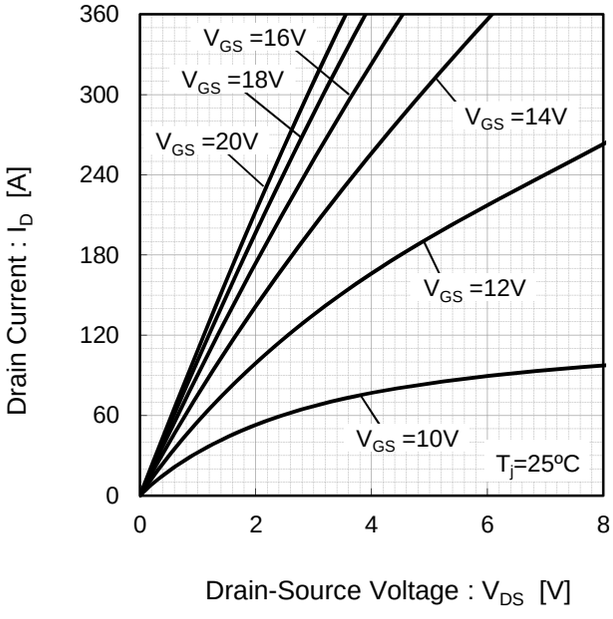



Fig.2 Drain-Source Voltage vs. Drain Current

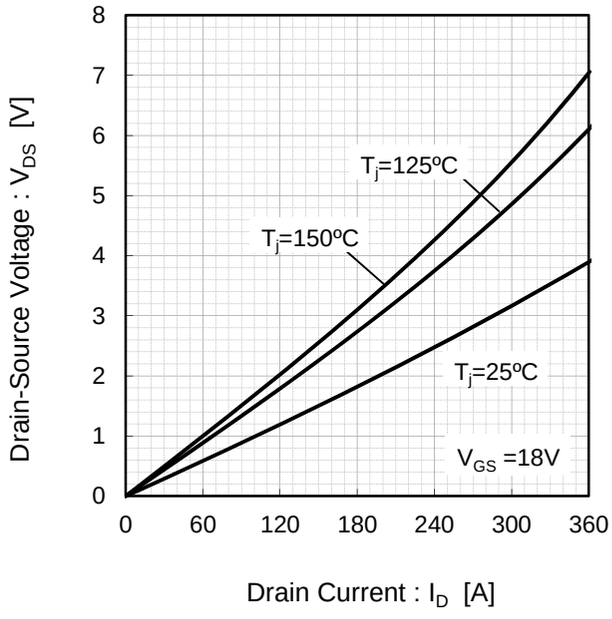



Fig.3 Drain-Source Voltage vs. Gate-Source Voltage [ $T_j$=25ºC ]

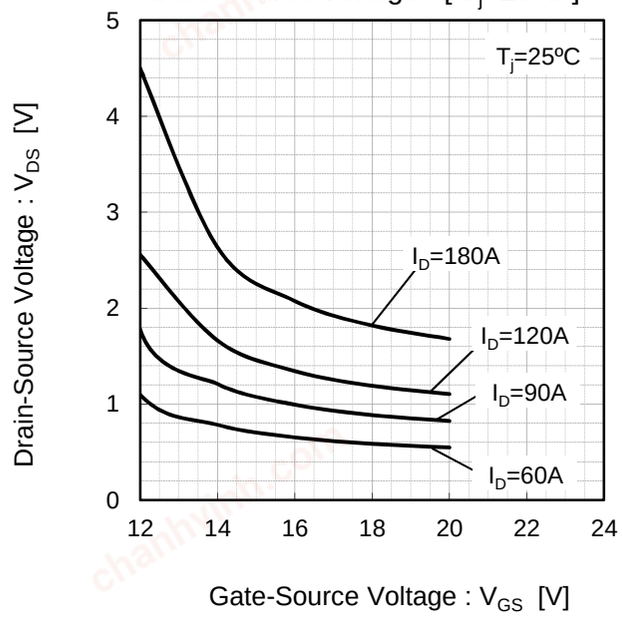
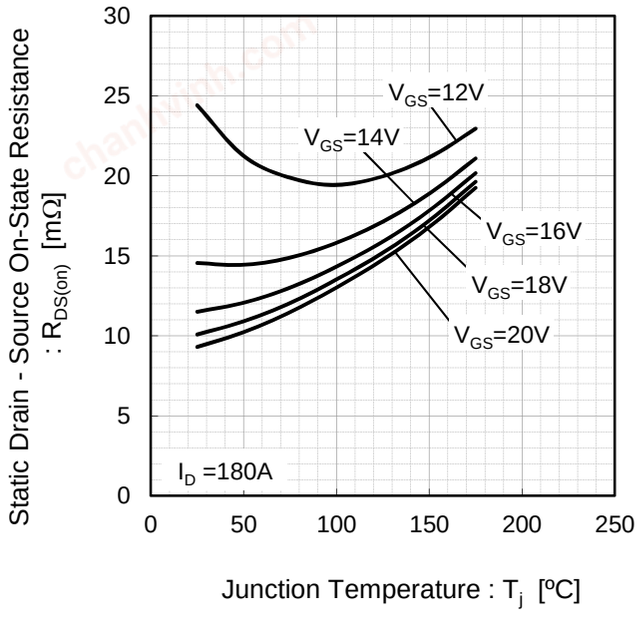



Fig.4 Static Drain - Source On-State Resistance vs. Junction Temperature





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## ●Electrical characteristic curves (Typical)

Fig.5 Forward characteristic of Diode

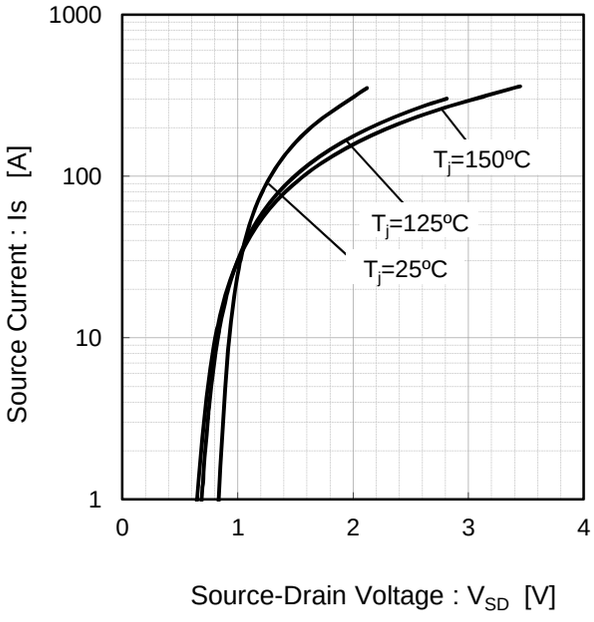



Fig.6 Forward characteristic of Diode

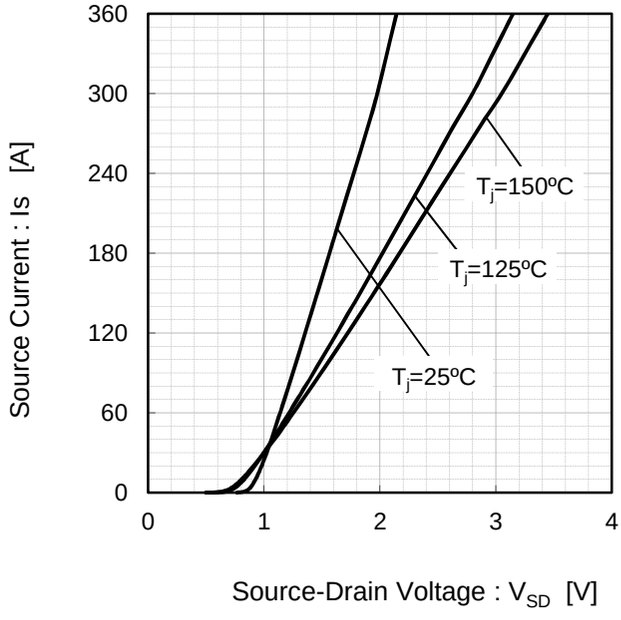



Fig.7 Drain Current vs. Gate-Source Voltage

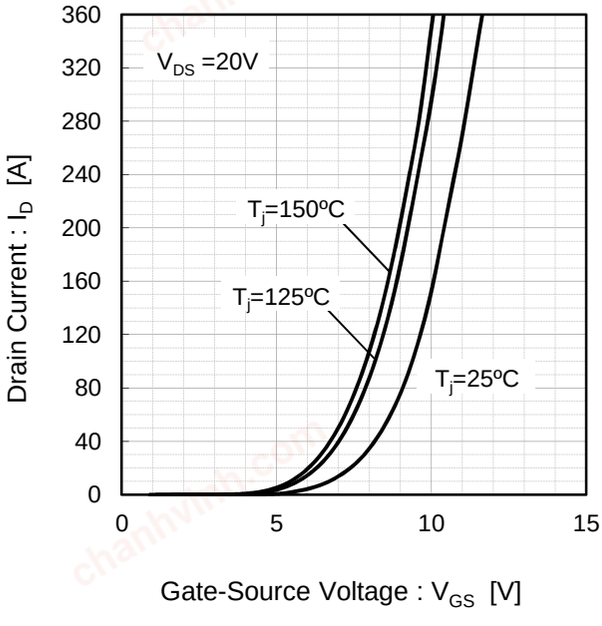
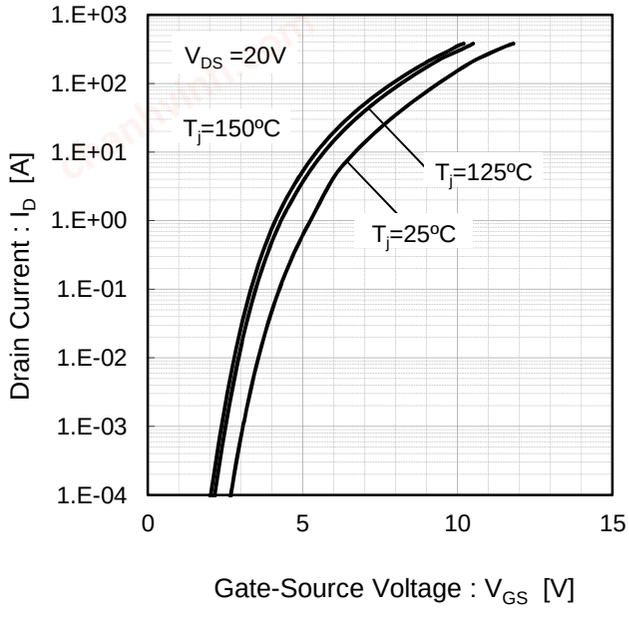



Fig.8 Drain Current vs. Gate-Source Voltage





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## ●Electrical characteristic curves (Typical)

Fig.9 Switching Characteristics [ $T_j$=25ºC ]

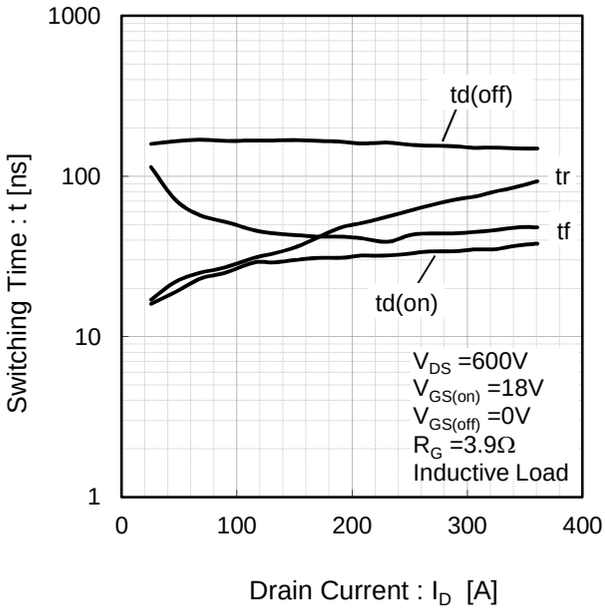



Fig.10 Switching Characteristics [ $T_j$=125ºC ]

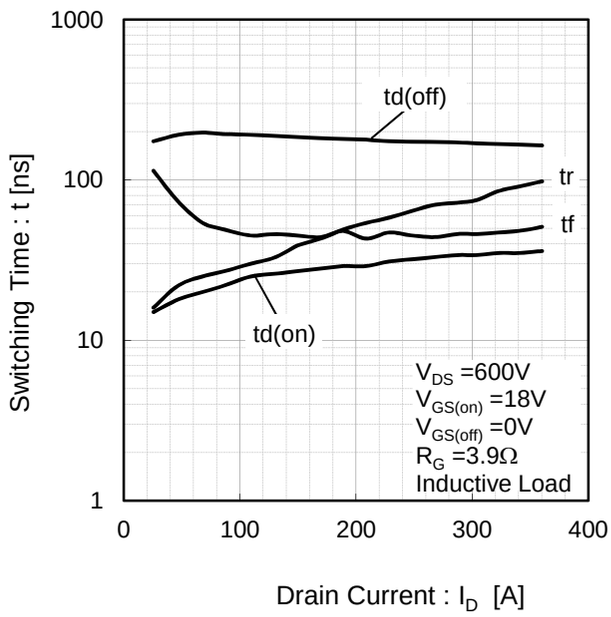



Fig.11 Switching Characteristics [ $T_j$=150ºC ]

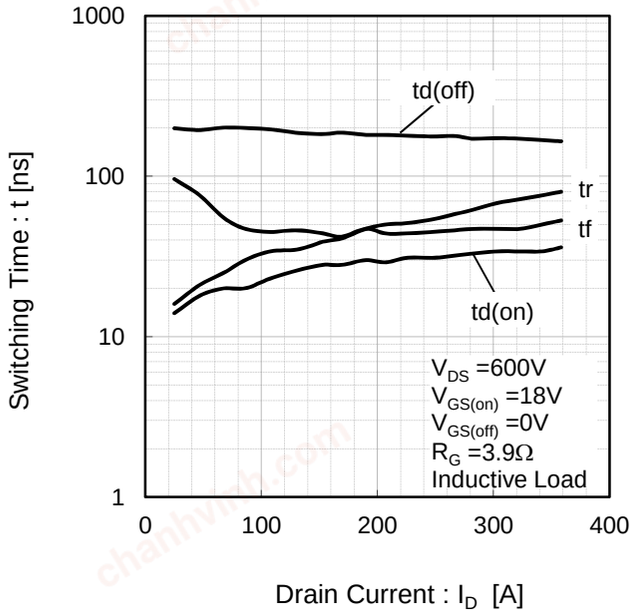
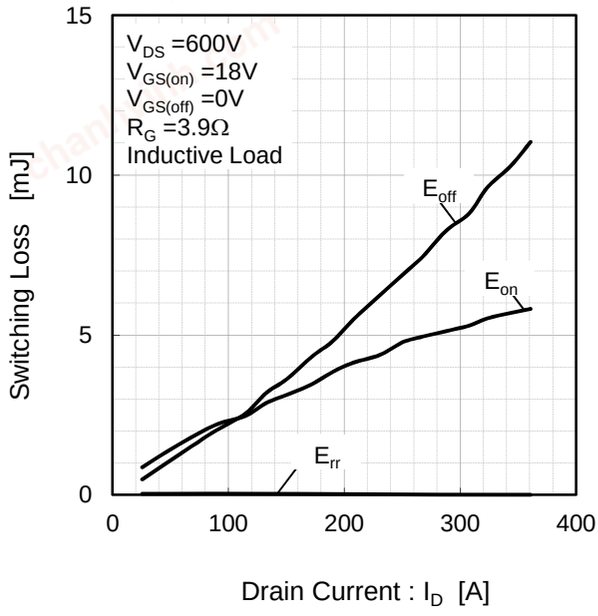



Fig.12 Switching Loss vs. Drain Current [ $T_j$=25ºC ]





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## ●Electrical characteristic curves (Typical)

Fig.13 Switching Loss vs. Drain Current [ $T_j$=125ºC ]

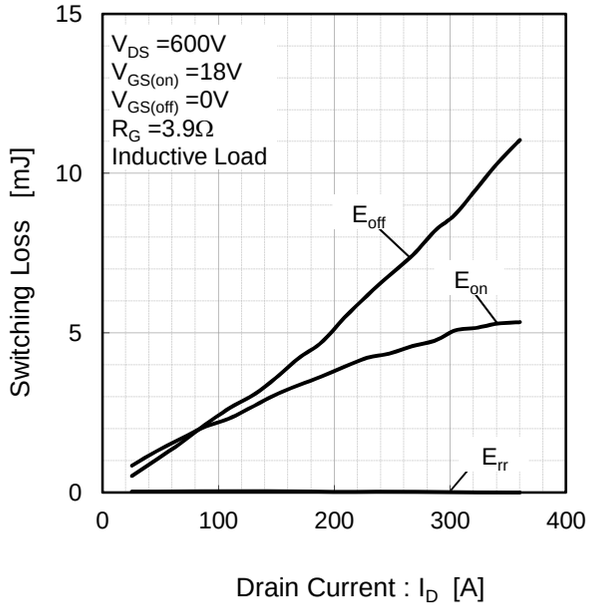



Fig.14 Switching Loss vs. Drain Current [ $T_j$=150ºC ]

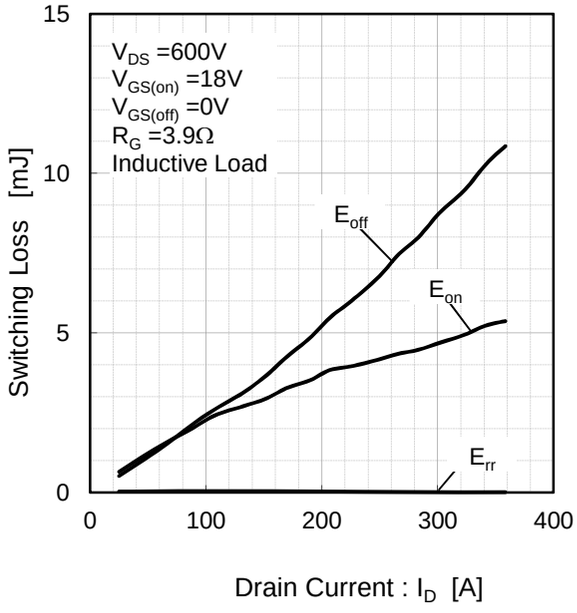



Fig.15 Recovery Characteristics vs. Drain Current [ $T_j$=25ºC ]

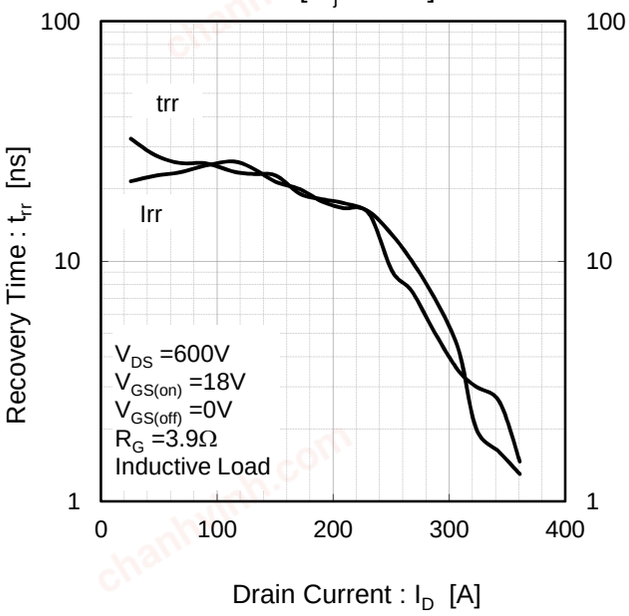
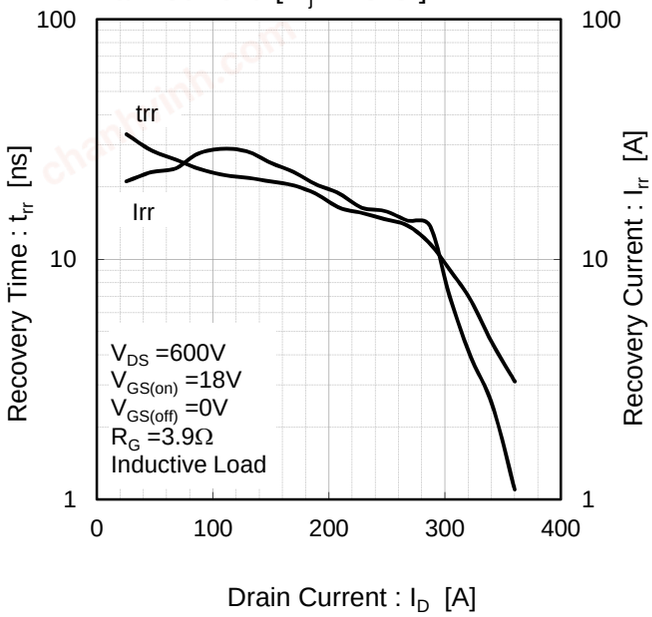



Fig.16 Recovery Characteristics vs. Drain Current [ $T_j$=125ºC ]





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## ●Electrical characteristic curves (Typical)

Fig.17 Recovery Characteristics vs. Drain Current [ $T_j$=150ºC ]

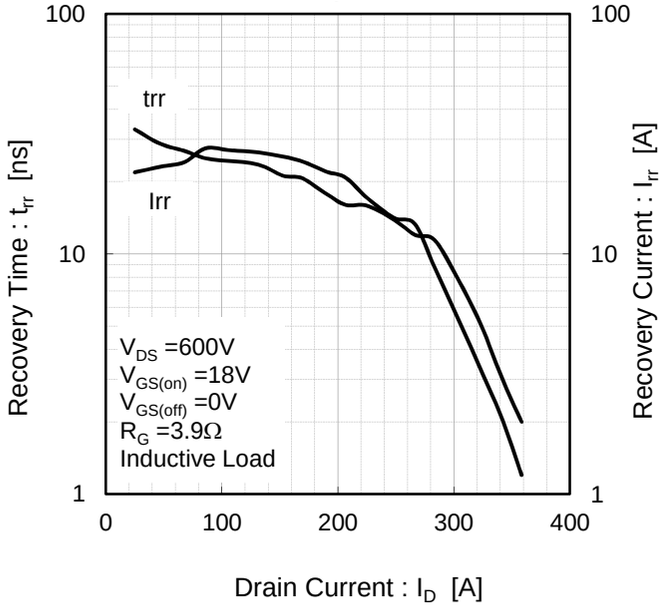



Fig.18 Switching Characteristics vs. Gate Resistance [ $T_j$=25ºC ]

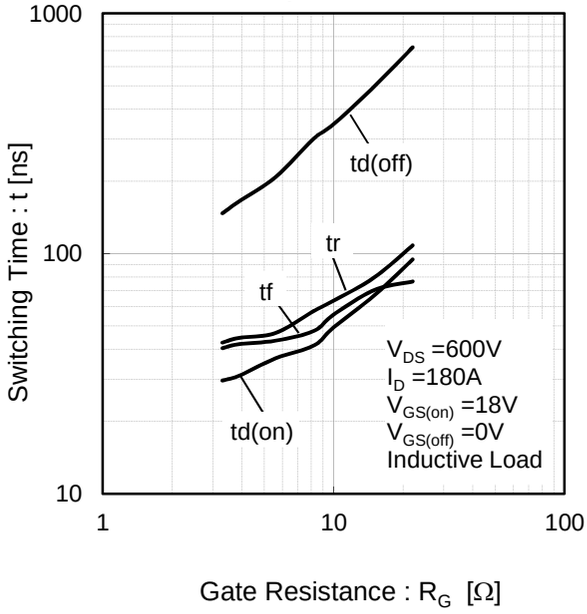



Fig.19 Switching Characteristics vs. Gate Resistance [ $T_j$=125ºC ]

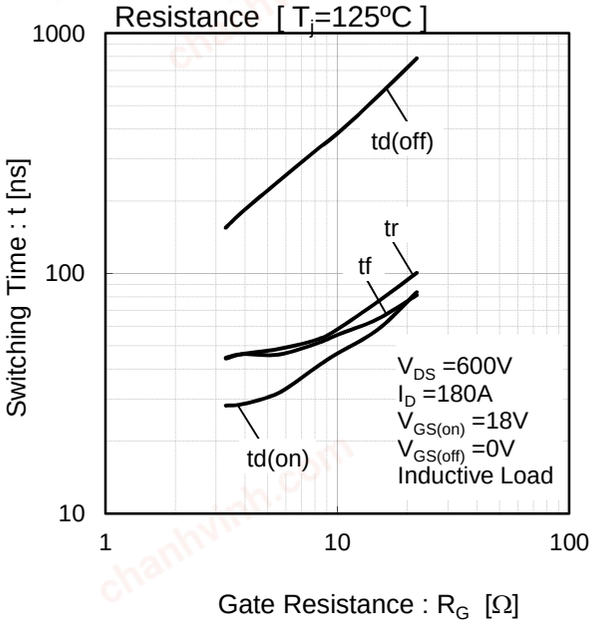
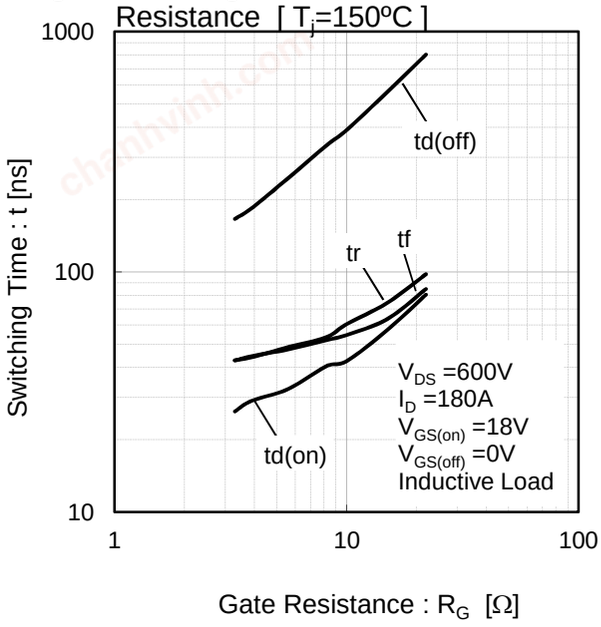



Fig.20 Switching Characteristics vs. Gate Resistance [ $T_j$=150ºC ]





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## ●Electrical characteristic curves (Typical)

Fig.21 Switching Loss vs. Gate Resistance
[ $T_j$=25ºC ]

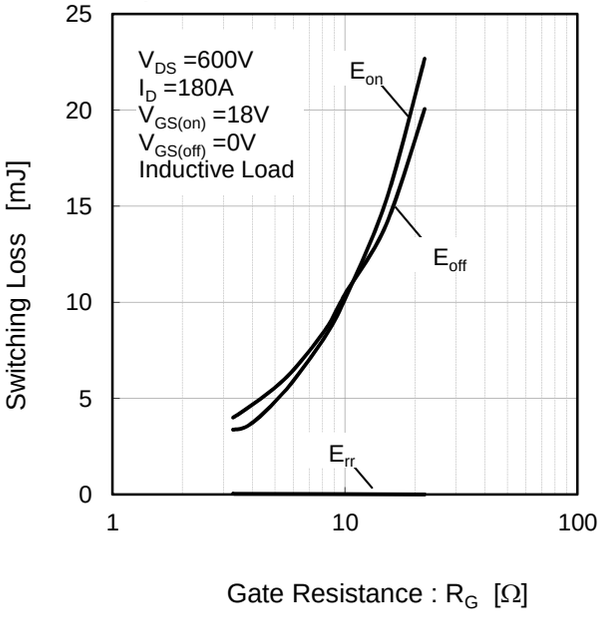



Fig.22 Switching Loss vs. Gate Resistance
[ $T_j$=125ºC ]

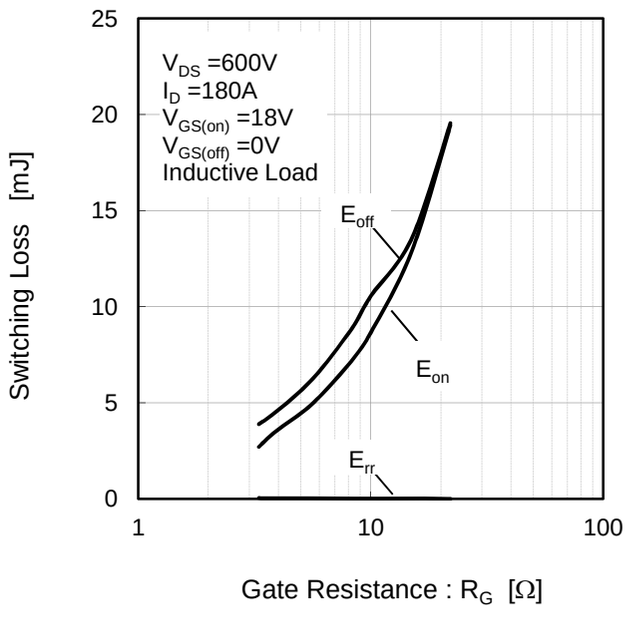



Fig.23 Switching Loss vs. Gate Resistance
[ $T_j$=150ºC ]

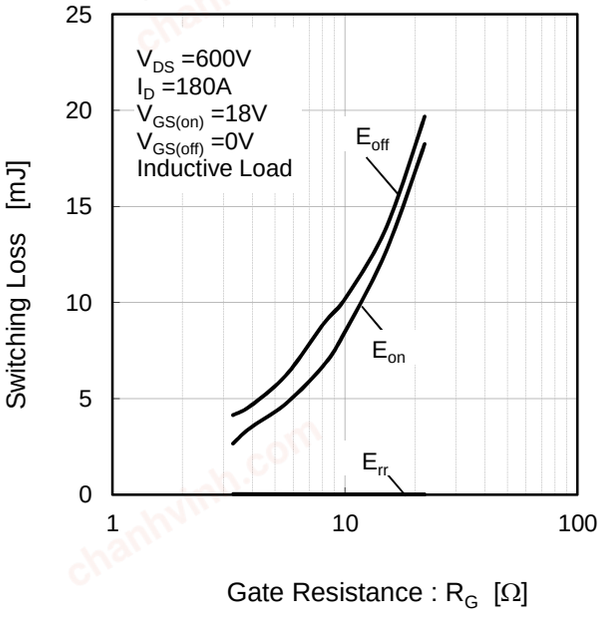
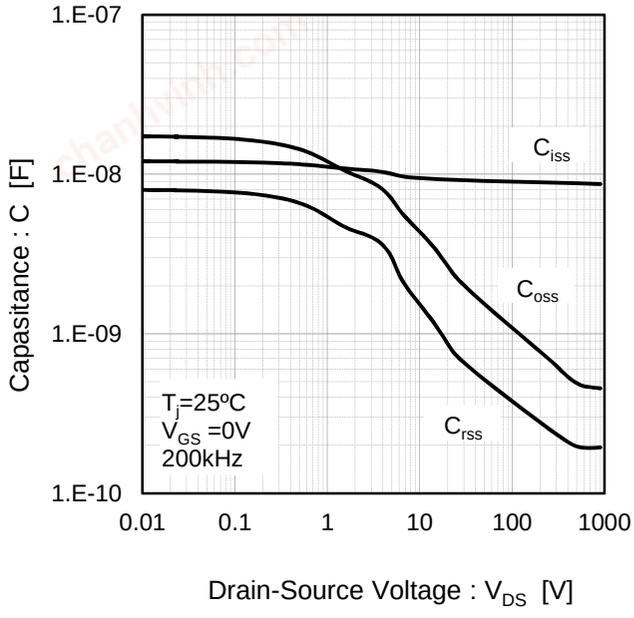



Fig.24 Typical Capacitance vs. Drain-Source Voltage





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## ●Electrical characteristic curves (Typical)

Fig.25 Gate Charge Characteristics

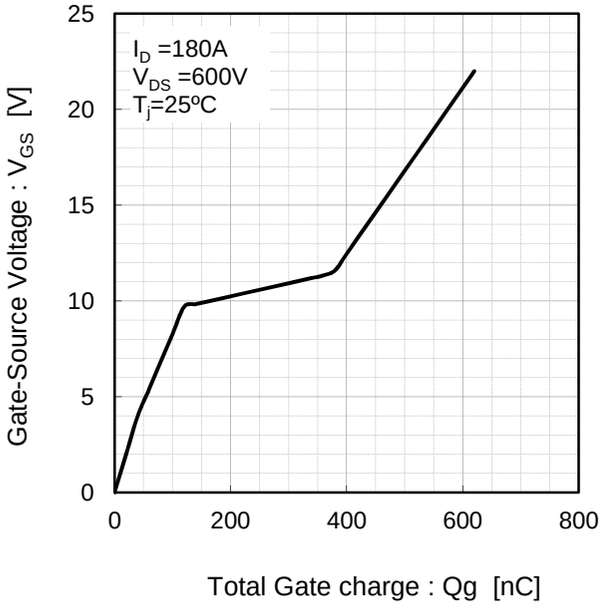
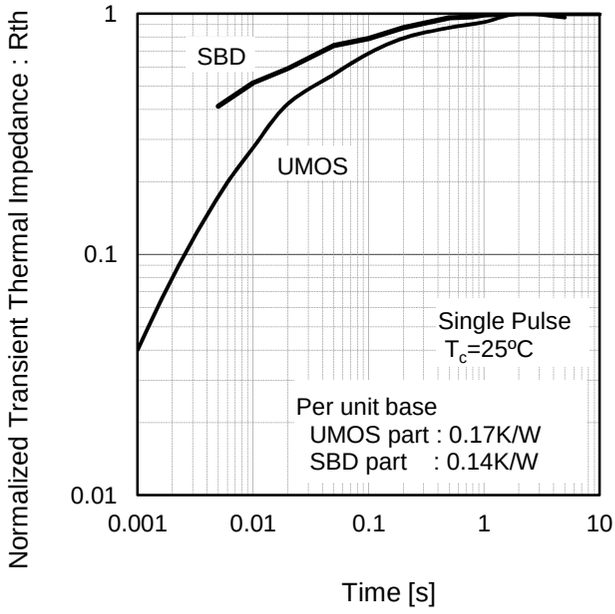



Fig.26 Normalized Transient Thermal Impedance





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