MOSFETs Silicon Carbide N-Channel MOS

# TW107Z65C

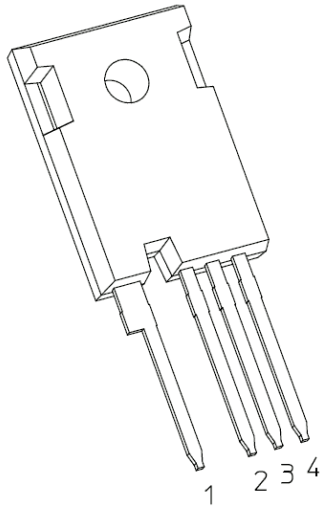
## 1. Applications

- Switching Voltage Regulators

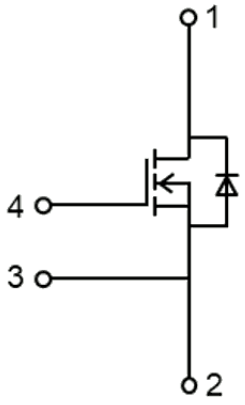
## 2. Features

(1) Chip design of 3rd generation (Built-in SiC schottky barrier diode)
(2) Low diode forward voltage: $V_{DSF}$ = -1.35 V (typ.)
(3) High voltage: $V_{DSS}$ = 650 V
(4) Low drain-source on-resistance: $R_{DS(ON)}$ = 107 mΩ (typ.)
(5) Less susceptible to malfunction due to high threshold voltage: $V_{th}$ = 3.0 to 5.0 V ($V_{DS}$ = 10 V, $I_D$ = 1.2 mA)
(6) Recommended gate - source drive voltage: $V_{GS_on}$ = 18 V, $V_{GS_off}$ = 0 V
(7) Enhancement mode.

## 3. Packaging and Internal Circuit




TO-247-4L(X)




1. Drain (heatsink)
2. Source 1
3. Source 2
4. Gate

Notice: Only use source 2 pin for gate input signal return. Please make sure that the main current flows into the source 1 pin.

Start of commercial production
2023-06

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## 4. Absolute Maximum Ratings (Note)
## (Unless otherwise specified, $T_a$ = 25 °C)

| Characteristics | | | Symbol | Rating | Unit |
|---|---|---|---|---|---|
| Drain-source voltage | | | $V_{DSS}$ | 650 | V |
| Gate-source voltage | | | $V_{GSS}$ | +25/-10 | |
| Drain current (DC) | ( $T_c$ = 25 °C ) | (Note 1) | $I_D$ | 20 | A |
| Drain current (DC) | ( $T_c$ = 100°C ) | (Note 1) | $I_D$ | 16 | |
| Drain current (pulsed) | ( $T_c$ = 25 °C ) | (Note 1) | $I_{DP}$ | 45 | |
| Drain current (pulsed) | ( $T_c$ = 100°C ) | (Note 1) | $I_{DP}$ | 35 | |
| Power dissipation | ( $T_c$ = 25°C ) | | $P_D$ | 76 | W |
| Channel temperature | | | $T_{ch}$ | 175 | °C |
| Storage temperature | | | $T_{stg}$ | -55 to 175 | |
| Mounting torque | | | TOR | 0.8 | N · m |

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

## 5. Thermal Characteristics

| Characteristics | Symbol | Max | Unit |
|---|---|---|---|
| Channel-to-case thermal resistance | $R_{th(ch-c)}$ | 1.950 | °C/W |
| Channel-to-ambient thermal resistance | $R_{th(ch-a)}$ | 50 | |

Note1: Ensure that the channel temperature does not exceed 175 °C.

Caution:This transistor is sensitive to electrostatic discharge and should be handled with care.
It should be used for switching applications.

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# 6. Electrical Characteristics

## 6.1. Static Characteristics (Unless otherwise specified, $T_a$ = 25 °C)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Gate leakage current | $I_{GSS}$ | $V_{GS}$ = +25/-10 V, $V_{DS}$ = 0 V | — | — | ±0.1 | μA |
| Drain cut-off current | $I_{DSS}$ | $V_{DS}$ = 650 V, $V_{GS}$ = 0 V | — | 2 | 25 | |
| | | $T_a$ = 150 °C, $V_{DS}$ = 650 V, $V_{GS}$ = 0 V | — | 10 | — | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $I_D$ = 4 mA, $V_{GS}$ = 0 V | 650 | — | — | V |
| Gate threshold voltage (Note2) | $V_{th}$ | $V_{DS}$ = 10 V, $I_D$ = 1.2 mA | 3.0 | — | 5.0 | |
| Drain-source on-resistance | $R_{DS(ON)}$ | $V_{GS}$ = 18 V, $I_D$ = 10 A | — | 107 | 152 | mΩ |
| | | $T_a$ = 150 °C, $V_{GS}$ = 18 V, $I_D$ = 10 A | — | 127 | — | |

Note2: Please be sure to apply $I_{GSS}$ ($V_{GS}$ = 25 V) before the $V_{th}$ test.

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## 6.2. Dynamic Characteristics (Unless otherwise specified, $T_a$ = 25 °C)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Input capacitance | $C_{iss}$ | $V_{DS}$ = 400 V, $V_{GS}$ = 0 V, f = 100 kHz | — | 600 | — | pF |
| Reverse transfer capacitance | $C_{rss}$ | | — | 3.7 | — | |
| Output capacitance | $C_{oss}$ | | — | 80 | — | |
| Effective output capacitance (energy related) | $C_{o(er)}$ | | — | 90 | — | |
| Effective output capacitance (time related) | $C_{o(tr)}$ | | — | 128 | — | |
| Output charge | $Q_{oss}$ | | — | 51 | — | nC |
| $C_{oss}$ stored energy | $E_{oss}$ | | — | 7.2 | — | μJ |
| Gate resistance | $r_g$ | $V_{DS}$ = OPEN, f = 1 MHz | — | 11 | — | Ω |
| Turn-on delay time | $t_{d(on)}$ | See Fig. 6.2.1 | — | 21 | — | ns |
| Switching time (rise time) | $t_r$ | | — | 14 | — | |
| Turn-off delay time | $t_{d(off)}$ | | — | 31 | — | |
| Switching time (fall time) | $t_f$ | | — | 15 | — | |
| Turn-on switching loss | $E_{on}$ | | — | 71 | — | μJ |
| Turn-off switching loss | $E_{off}$ | | — | 25 | — | |

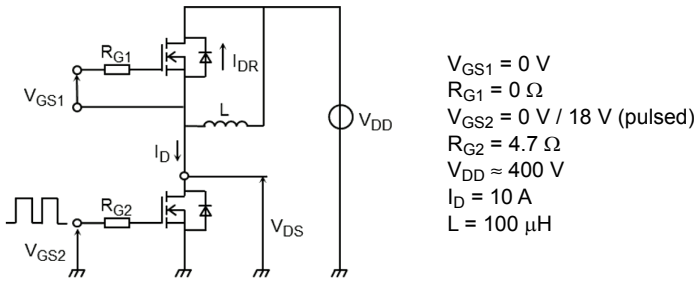



**Fig. 6.2.1 Switching Time Test Circuit**

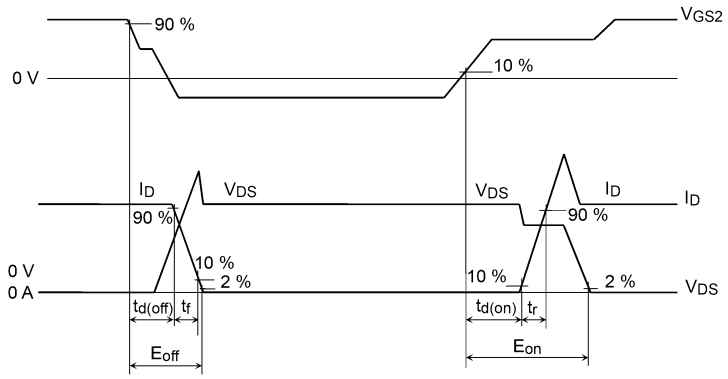



**Fig. 6.2.2 Timing Diagrams**

## 6.3. Gate Charge Characteristics (Unless otherwise specified, $T_a$ = 25 °C)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Total gate charge (gate-source plus gate-drain) | $Q_g$ | $V_{DD} \approx 400$ V, $V_{GS}$ = 18 V, $I_D$ = 10 A | — | 21 | — | nC |
| Gate-source charge 1 | $Q_{gs1}$ | | — | 12 | — | |
| Gate-drain charge | $Q_{gd}$ | | — | 2.3 | — | |

## 6.4. Source-Drain Characteristics (Unless otherwise specified, $T_a$ = 25 °C)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Reverse drain current (DC) (Note3) | $I_{DR}$ | $T_c$ = 25 °C, $V_{GS}$ = -5 V | — | — | 18 | A |
| | | $T_c$ = 100 °C, $V_{GS}$ = -5 V | — | — | 12 | |
| | | $T_c$ = 25 °C, $V_{GS}$ = 18 V | — | — | 20 | |
| | | $T_c$ = 100 °C, $V_{GS}$ = 18 V | — | — | 16 | |
| Reverse drain current (pulsed) (Note3) | $I_{DRP}$ | $T_c$ = 25 °C, $V_{GS}$ = -5 V | — | — | 45 | |
| | | $T_c$ = 100 °C, $V_{GS}$ = -5 V | — | — | 24 | |
| | | $T_c$ = 25 °C, $V_{GS}$ = 18 V | — | — | 45 | |
| | | $T_c$ = 100 °C, $V_{GS}$ = 18 V | — | — | 35 | |
| Diode forward voltage | $V_{DSF}$ | $I_{DR}$ = 5 A, $V_{GS}$ = -5 V | — | -1.35 | -1.80 | V |
| | | $T_a$ = 150 °C, $I_{DR}$ = 5 A, $V_{GS}$ = -5 V | — | -1.60 | — | |
| Reverse recovery time | $t_{rr}$ | $I_{DR}$ = 7 A, $V_{GS}$ = 0 V, $V_{DD}$ = 400 V, $-dI_{DR}/dt$ = 1000 A/μs | — | 38 | — | ns |
| Reverse recovery charge | $Q_{rr}$ | | — | 137 | — | nC |
| Peak reverse recovery current | $I_{rr}$ | | — | 7.2 | — | A |

Note3: Ensure that the channel temperature does not exceed 175 °C.

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## 7. Marking (Note)

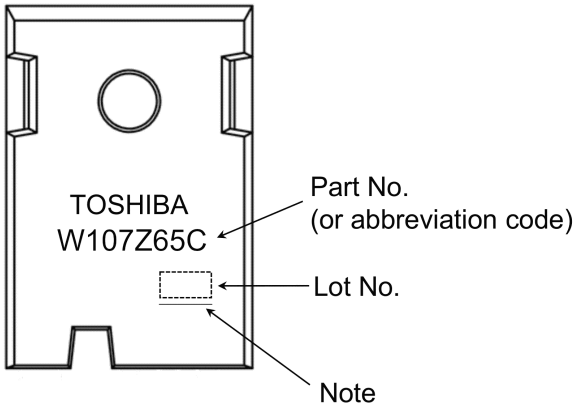



**Fig. 7.1 Marking**

Note: A line under a Lot No. identifies the indication of product Labels.
Not underlined: [[Pb]]/INCLUDES > MCV
Underlined: [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]
Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.
The RoHS is the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

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## 8. Characteristics Curves (Note)

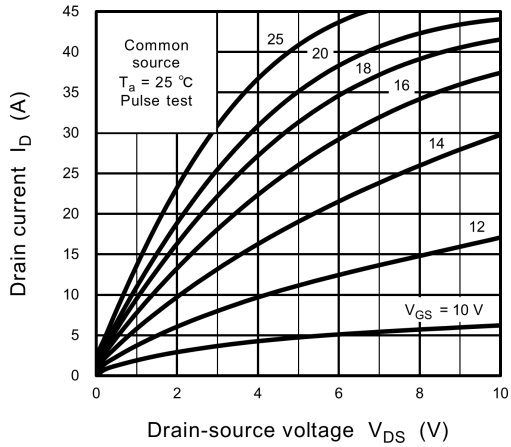



Fig. 8.1 $I_D$ - $V_{DS}$

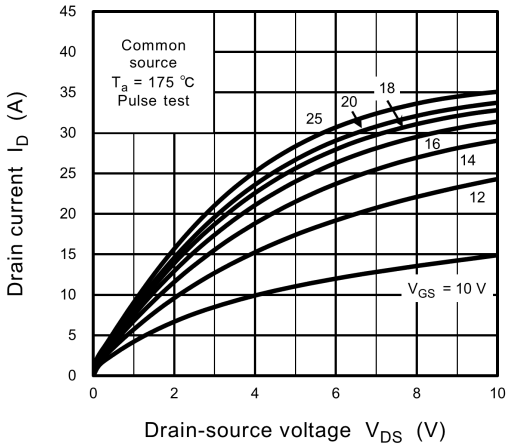



Fig. 8.2 $I_D$ - $V_{DS}$

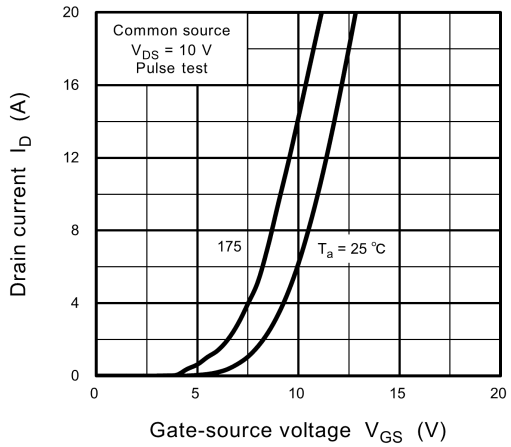



Fig. 8.3 $I_D$ - $V_{GS}$

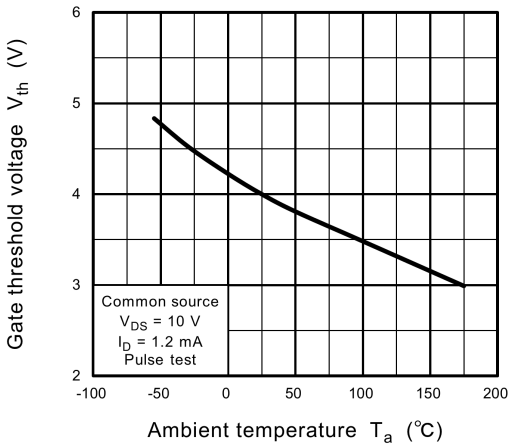



Fig. 8.4 $V_{th}$ - $T_a$

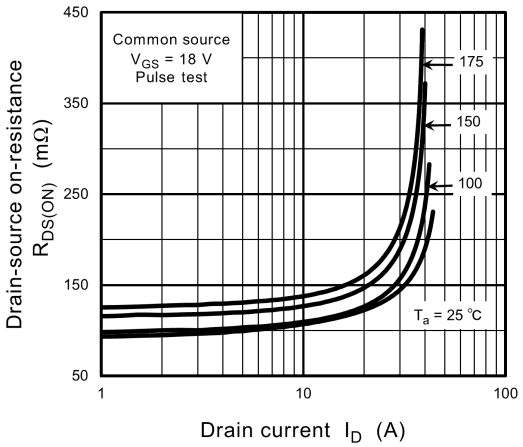



Fig. 8.5 $R_{DS(ON)}$ - $I_D$

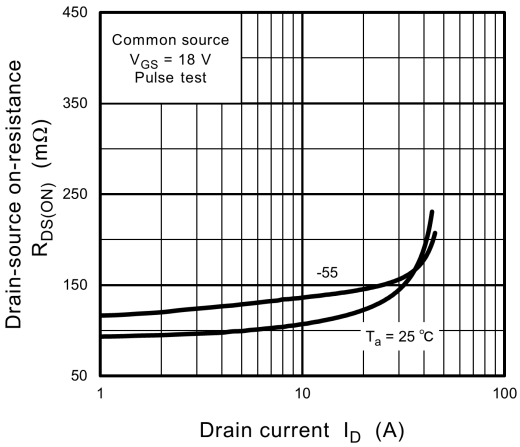



Fig. 8.6 $R_{DS(ON)}$ - $I_D$

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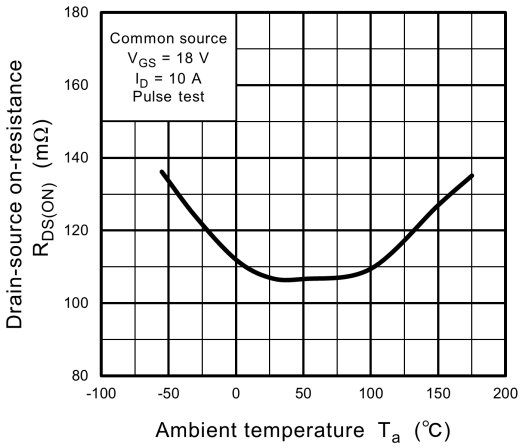



Fig. 8.7 $R_{DS(ON)}$ - $T_a$

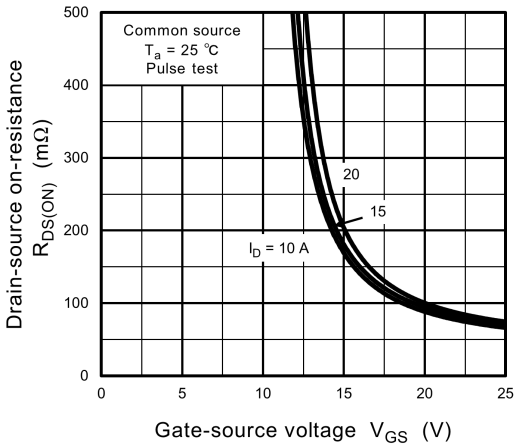



Fig. 8.8 $R_{DS(ON)}$ - $V_{GS}$

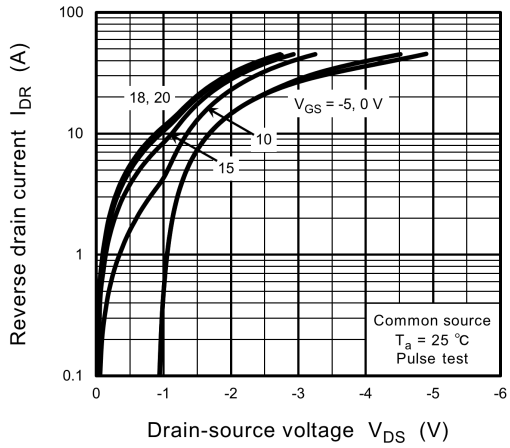



Fig. 8.9 $I_{DR}$ - $V_{DS}$

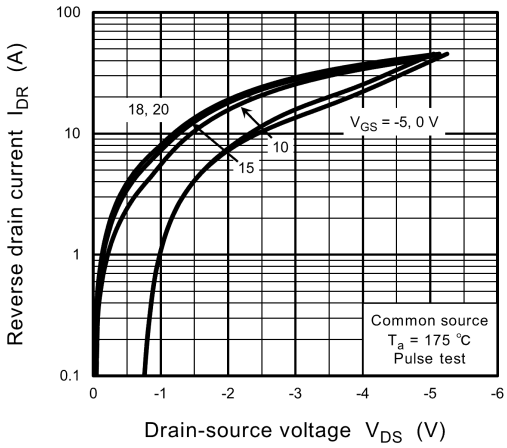



Fig. 8.10 $I_{DR}$ - $V_{DS}$

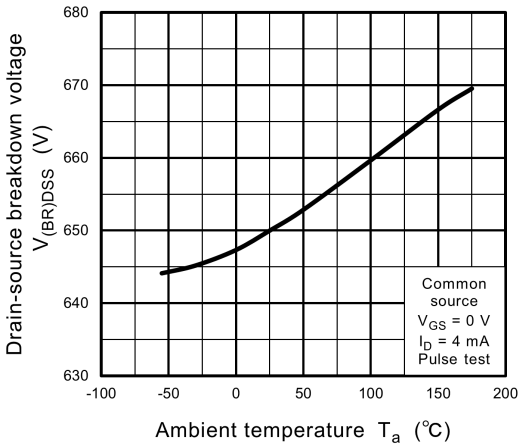



Fig. 8.11 $V_{(BR)DSS}$ - $T_a$

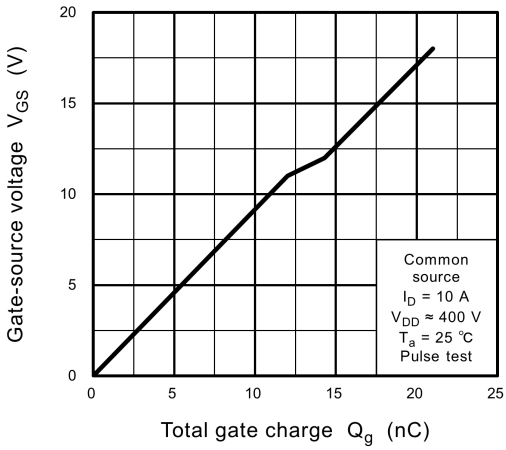



Fig. 8.12 Dynamic Input Characteristics

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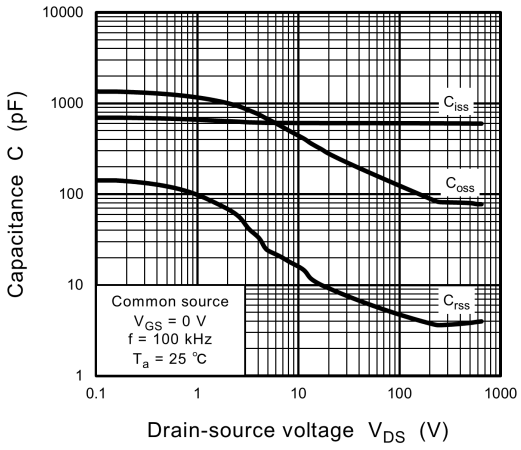



**Fig. 8.13 C - $V_{DS}$**

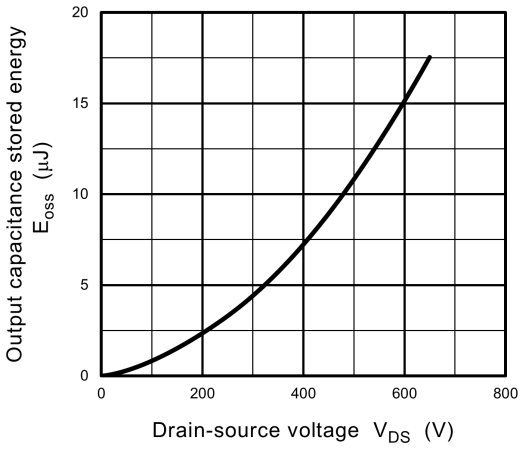



**Fig. 8.14 $E_{oss}$ - $V_{DS}$**

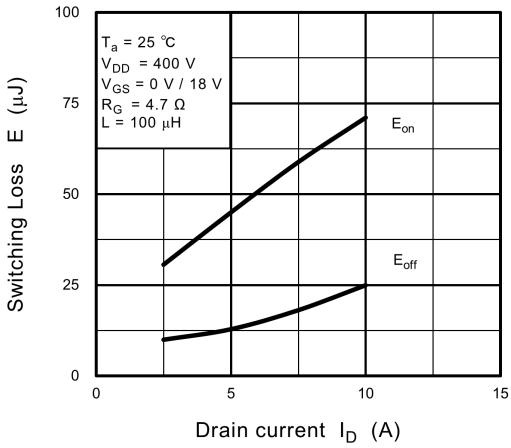



**Fig. 8.15 E - $I_D$**

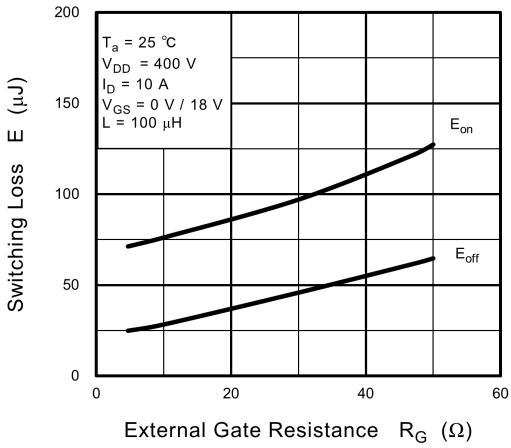



**Fig. 8.16 E - $R_G$**

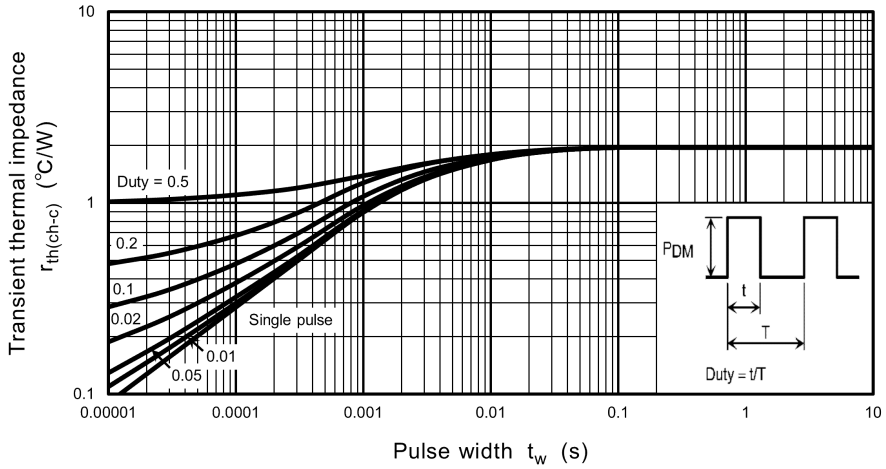



**Fig. 8.17 $r_{th(ch-c)}$ - $t_w$**
**(Guaranteed Maximum)**

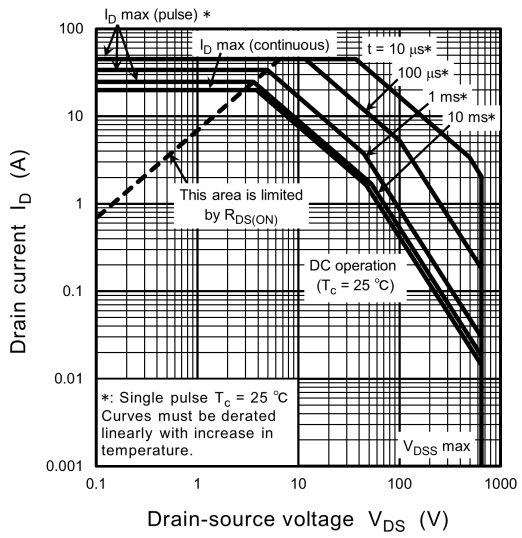



**Fig. 8.18 Safe Operating Area (Guaranteed Maximum)**

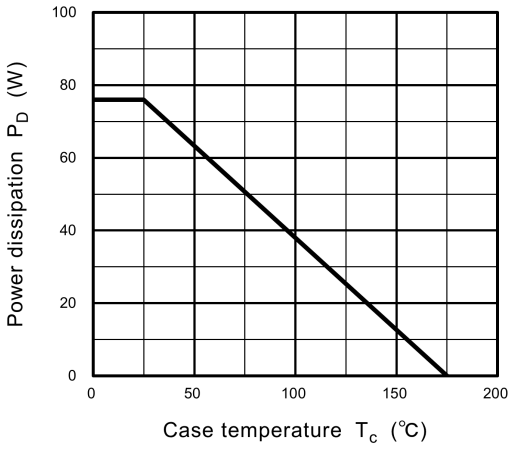
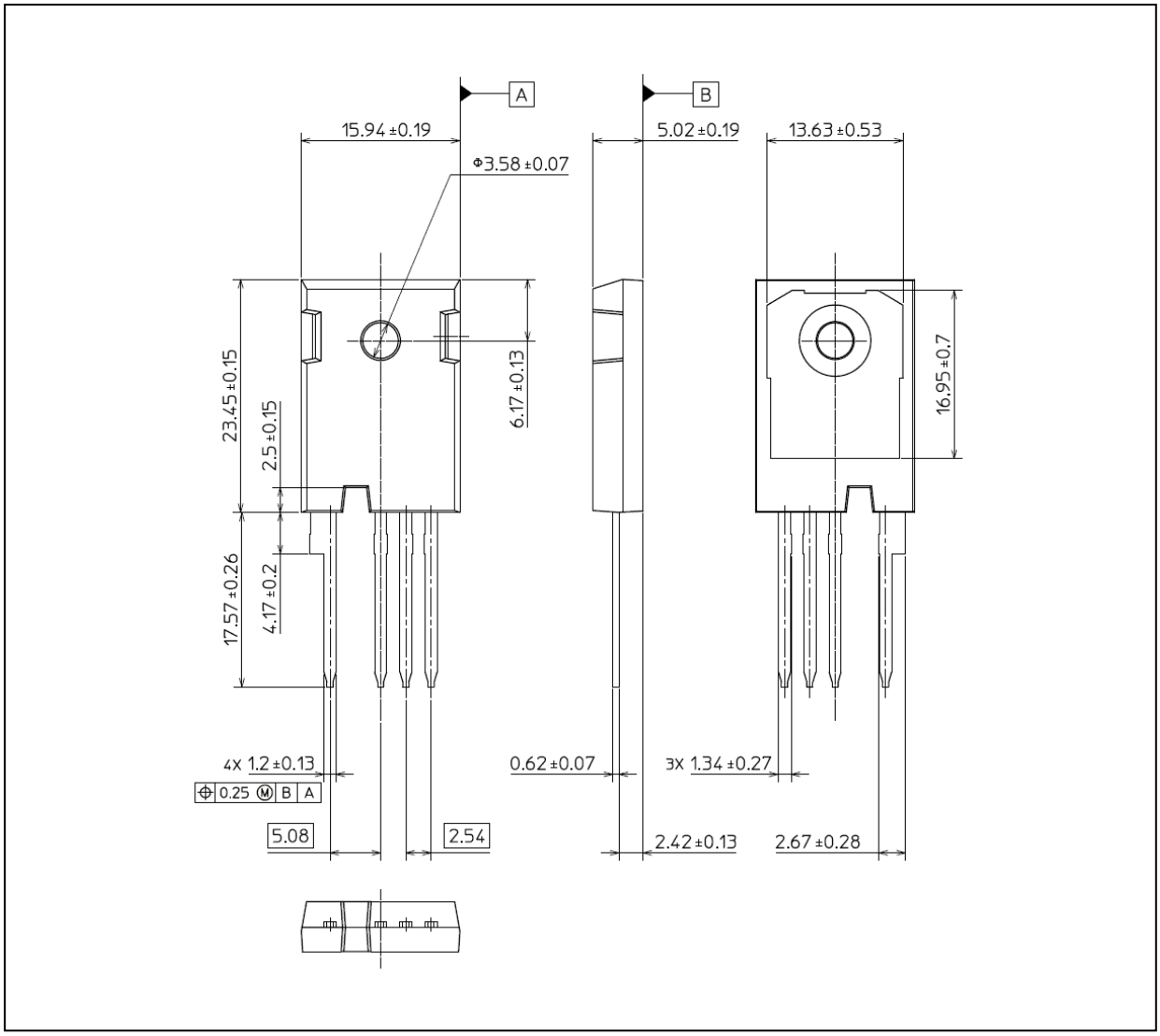



**Fig. 8.19 $P_D$ - $T_c$ (Guaranteed Maximum)**

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

## Package Dimensions

Unit: mm




Weight: 6.55 g (typ.)

| Package Name(s) |
|---|
| TOSHIBA: 2-16M3A |
| Nickname: TO-247-4L(X) |

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