Discrete IGBTs Silicon N-Channel IGBT

# GT20N135SRA

## 1. Applications

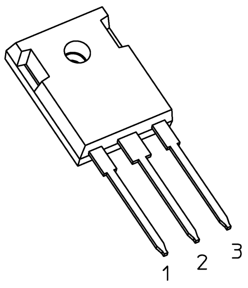
- Dedicated to Voltage-Resonant Inverter Switching Applications
- Dedicated to Soft Switching Applications
- Dedicated to Induction Cooktops and Home Appliance Applications

Note: The product(s) described herein should not be used for any other application.

## 2. Features

(1) 6.5th generation
(2) The RC-IGBT consists of a freewheeling diode (FWD) monolithically integrated in an IGBT chip.
(3) Enhancement mode
(4) High-speed switching:
IGBT $t_f$ = 0.25 μs (typ.) ($I_C$ = 40 A)
(5) Low saturation voltage: $V_{CE(sat)}$ = 1.60 V (typ.) ($I_C$ = 20 A, $T_a$ = 25 °C)
(6) High junction temperature: $T_j$ = 175 °C (max)

## 3. Packaging and Internal Circuit

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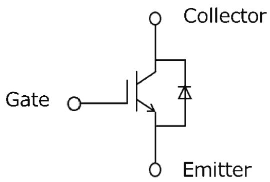



1: Gate
2: Collector
3: Emitter

Start of commercial production
2019-10

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

| Characteristics | | | Symbol | Rating | Unit |
|---|---|---|---|---|---|
| Collector-emitter voltage | | (Note 2) | $V_{CES}$ | 1350 | V |
| Gate-emitter voltage | | | $V_{GES}$ | ±25 | V |
| Collector current (DC) | ($T_c$ = 25 °C) | | $I_C$ | 40 | A |
| Collector current (DC) | ($T_c$ = 100 °C) | | | 20 | |
| Collector current (1 ms) | | | $I_{CP}$ | 80 | A |
| Non-repetitive peak collector current | | (Note 1) | $I_{CSM}$ | 220 | A |
| Diode forward current (DC) | ($T_c$ = 25 °C) | | $I_F$ | 40 | A |
| Diode forward current (DC) | ($T_c$ = 100 °C) | | | 20 | |
| Diode forward current (100 μs) | | | $I_{FP}$ | 80 | A |
| Collector power dissipation | ($T_c$ = 25 °C) | | $P_C$ | 312 | W |
| Junction temperature | | (Note 2) | $T_j$ | 175 | °C |
| Storage temperature | | | $T_{stg}$ | -55 to 175 | °C |
| 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).

In general, loss of IGBT increases more when it has positive temperature coefficient and gets higher temperature.
In case that the temperature rise due to loss of IGBT exceeds the heat release capacity of a device, it leads to thermorunaway and results in destruction.
Therefore, please design heat release of a device with due consideration to the temperature rise of IGBT.

Note 1: The maximum value of the capacitor charging current limited on $T_j$ < 175 °C and t < 3 μs

Note 2: To perform derating ensures the device reliability.
In operation, the collector emitter voltage($V_{CES}$) should be below 1150 V, as well as junction temperature($T_j$) should be below 140 °C.

## 5. Thermal Characteristics

| Characteristics | Symbol | Max | Unit |
|---|---|---|---|
| Junction-to-case thermal resistance | $R_{th(j-c)}$ | 0.48 | °C/W |

# 6. Electrical Characteristics

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

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Gate leakage current | $I_{GES}$ | $V_{GE}$ = ±25 V, $V_{CE}$ = 0 V | — | — | ±100 | nA |
| Collector cut-off current | $I_{CES}$ | $V_{CE}$ = 1350 V, $V_{GE}$ = 0 V | — | — | 100 | μA |
| Collector-emitter breakdown voltage | $V_{(BR)CES}$ | $I_C$ = 0.5 mA, $V_{GE}$ = 0 V | 1350 | — | — | V |
| Gate-emitter cut-off voltage | $V_{GE(OFF)}$ | $I_C$ = 40 mA, $V_{CE}$ = 5 V | 5.3 | — | 7.3 | V |
| Collector-emitter saturation voltage | $V_{CE(sat)(1)}$ | $I_C$ = 20 A, $V_{GE}$ = 15 V (pulse test) | — | 1.60 | 1.80 | V |
| | $V_{CE(sat)(2)}$ | $I_C$ = 20 A, $V_{GE}$ = 15 V, $T_c$ = 125 °C (pulse test) | — | 1.83 | — | |
| | $V_{CE(sat)(3)}$ | $I_C$ = 40 A, $V_{GE}$ = 15 V (pulse test) | — | 2.00 | 2.40 | |
| | $V_{CE(sat)(4)}$ | $I_C$ = 40 A, $V_{GE}$ = 15 V, $T_c$ = 125 °C (pulse test) | — | 2.40 | — | |
| Diode forward voltage | $V_{F(1)}$ | $I_F$ = 20 A, $V_{GE}$ = 0 V (pulse test) | — | 1.75 | 2.50 | V |
| | $V_{F(2)}$ | $I_F$ = 20 A, $V_{GE}$ = 0 V, $T_c$ = 125 °C (pulse test) | — | 1.80 | — | |

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

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, f = 100 kHz | — | 2700 | — | pF |
| Reverse transfer capacitance | $C_{res}$ | | — | 35 | — | |
| Output capacitance | $C_{oes}$ | | — | 42 | — | |
| Total gate charge | $Q_g$ | $V_{CE}$ = 600 V, $I_C$ = 40 A, $V_{GE}$ = 15 V | — | 185 | — | nC |
| Switching time (rise time) | $t_r$ | Resistive load $V_{CE}$ = 600 V, $I_C$ = 40 A, $V_{GE}$ = +15 V, $R_G$ = 10 Ω See Fig. 6.2.1, 6.2.2 | — | 0.09 | — | μs |
| Switching time (turn-on time) | $t_{on}$ | | — | 0.14 | — | |
| Switching time (fall time) | $t_f$ | | — | 0.25 | 0.40 | |
| Switching time (turn-off time) | $t_{off}$ | | — | 0.46 | — | |
| Switching loss (turn-off switching loss) | $E_{off(1)}$ | Inductive load $V_{CE}$ = 300 V, $I_C$ = 40 A, $V_{GE}$ = +15 V, $R_G$ = 39 Ω L = 30 μH, C = 0.33 μF See Fig. 6.2.3, 6.2.4 | — | 0.28 | — | mJ |
| | $E_{off(2)}$ | Inductive load $V_{CE}$ = 300 V, $I_C$ = 40 A, $V_{GE}$ = +15 V, $R_G$ = 39 Ω, L = 30 μH, C = 0.33 μF $T_c$ = 125 °C See Fig. 6.2.3, 6.2.4 | — | 0.70 | — | |

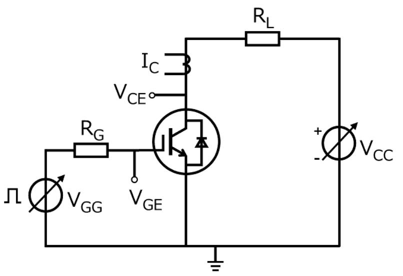



Fig. 6.2.1 Test Circuit of Switching Time

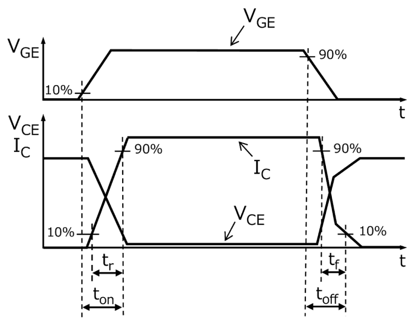



Fig. 6.2.2 Timing Chart of Switching Time

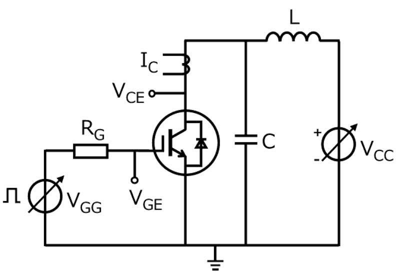



Fig. 6.2.3 Test Circuit of Switching Loss

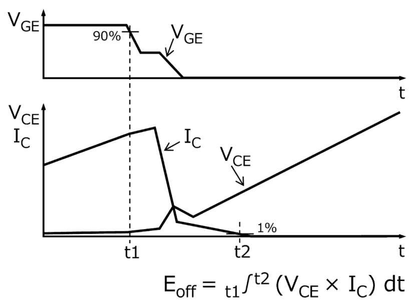



Fig. 6.2.4 Timing Chart of Switching Loss

## 7. Marking (Note)

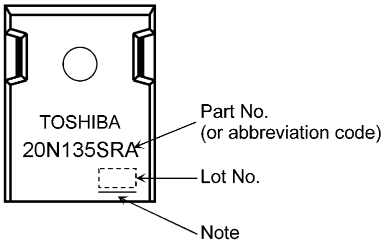



**Fig. 7.1 Marking**

Note: A line under a Lot No. identifies the indication of product Labels.
[[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.

Note: This transistor is sensitive to electrostatic discharge and should be handled with care.

## 8. Characteristics Curves (Note)

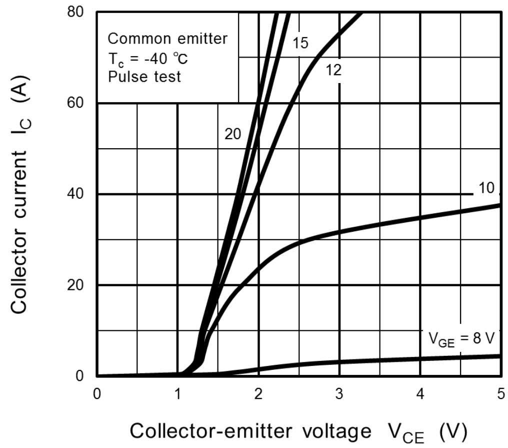



Fig. 8.1 $I_C$ - $V_{CE}$

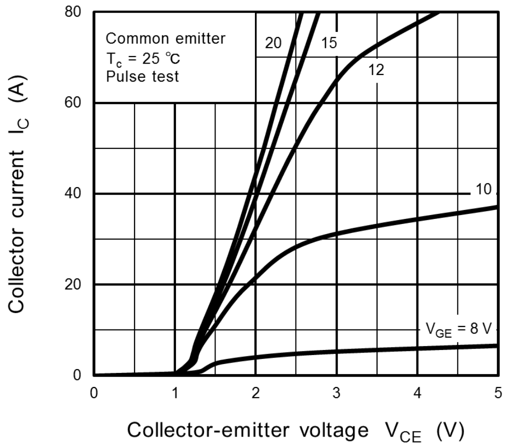



Fig. 8.2 $I_C$ - $V_{CE}$

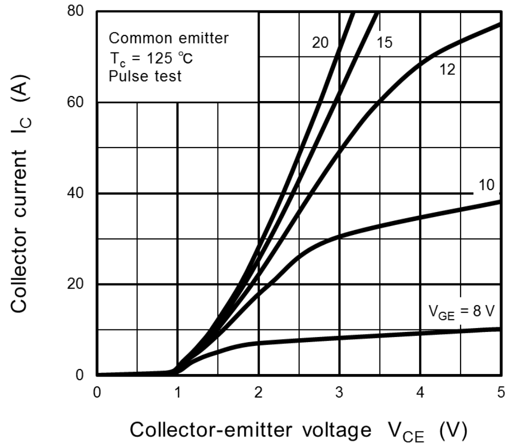



Fig. 8.3 $I_C$ - $V_{CE}$

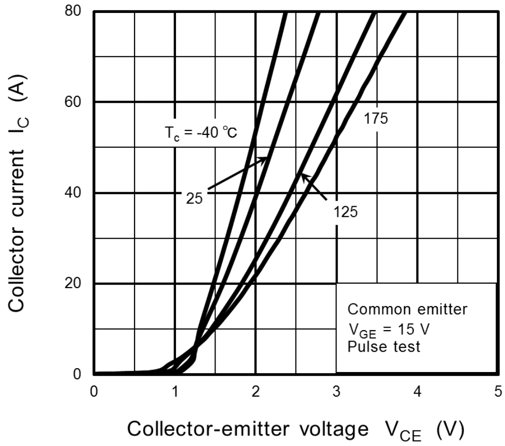



Fig. 8.4 $I_C$ - $V_{CE}$

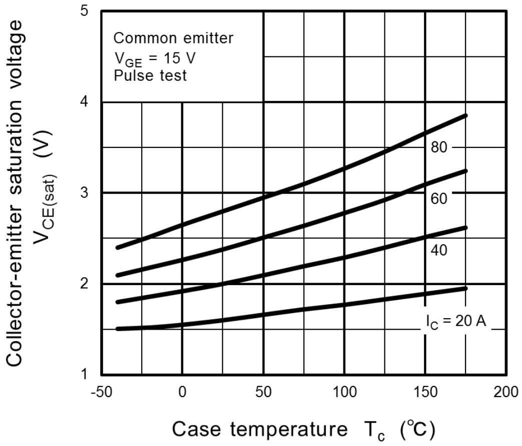



Fig. 8.5 $V_{CE(sat)}$ - $T_c$

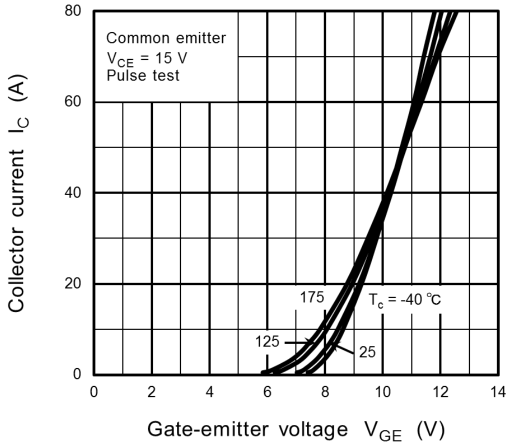



Fig. 8.6 $I_C$ - $V_{GE}$

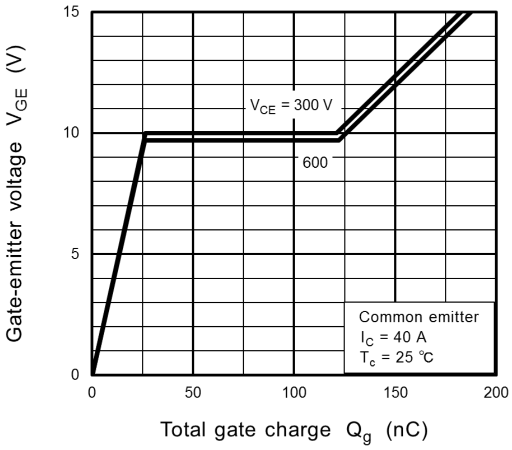



Fig. 8.7 $V_{GE}$ - $Q_g$

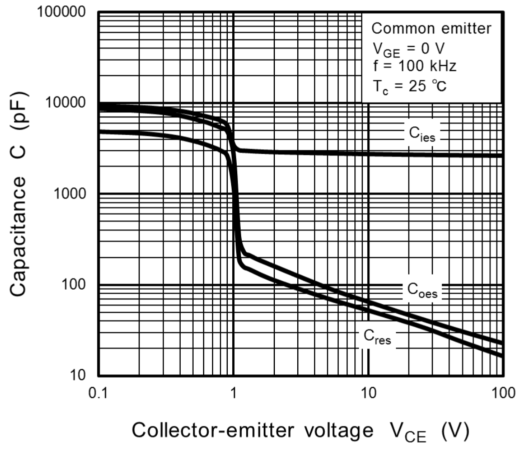



Fig. 8.8 C -$V_{CE}$

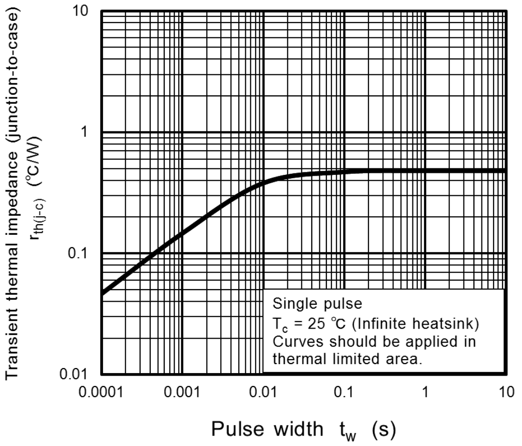



Fig. 8.9 $r_{th(j-c)}$ - $t_w$
(Guaranteed Maximum)

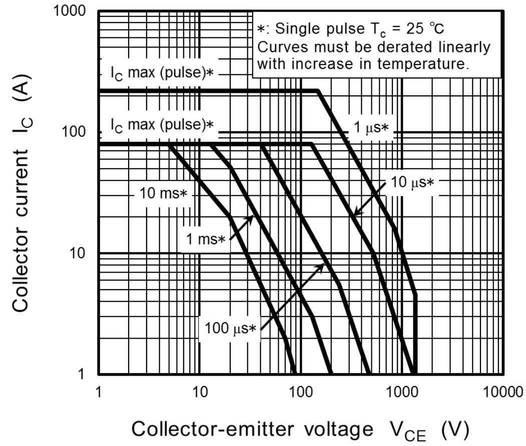



Fig. 8.10 Safe Operating Area
(Guaranteed Maximum)

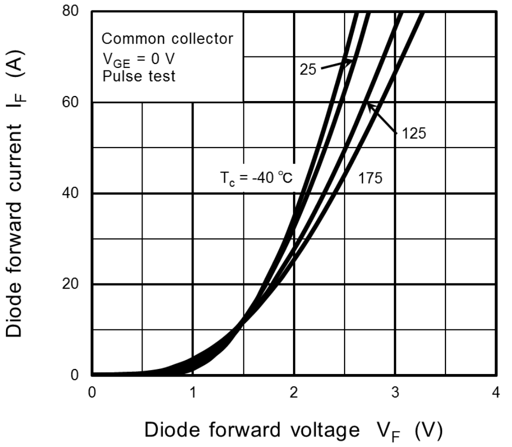



Fig. 8.11 $I_F$ - $V_F$

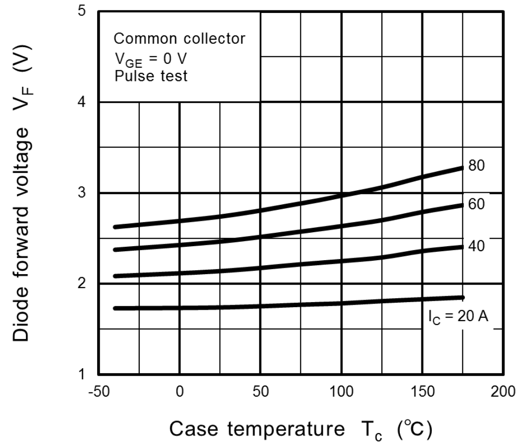



Fig. 8.12 $V_F$ - $T_c$

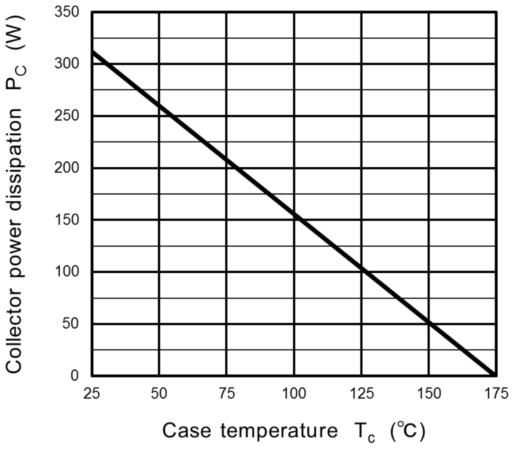



Fig. 8.13 $P_C$ - $T_C$

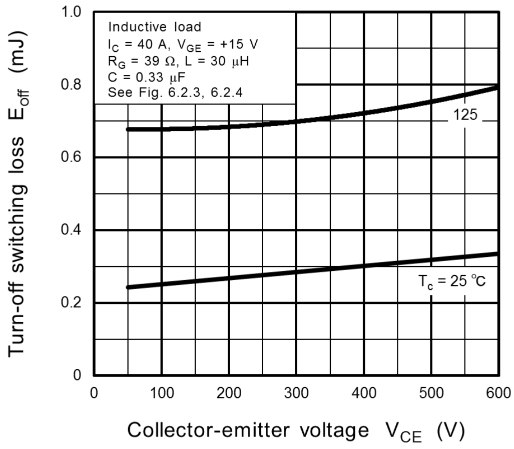



Fig. 8.14 $E_{off}$ - $V_{CE}$

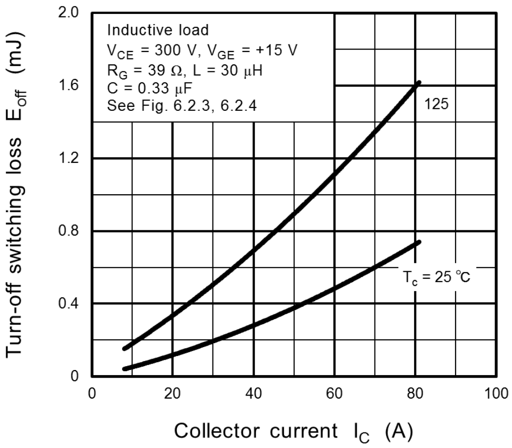



Fig. 8.15 $E_{off}$ - $I_C$

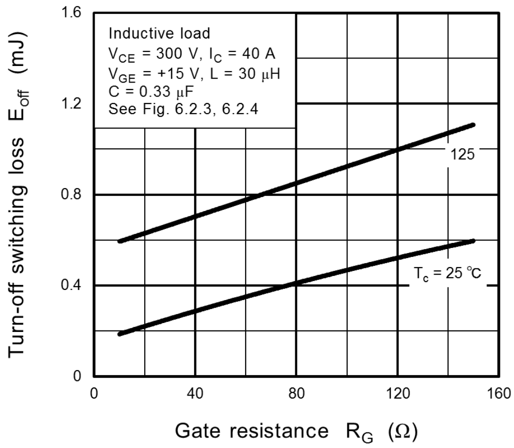



Fig. 8.16 $E_{off}$ - $R_G$

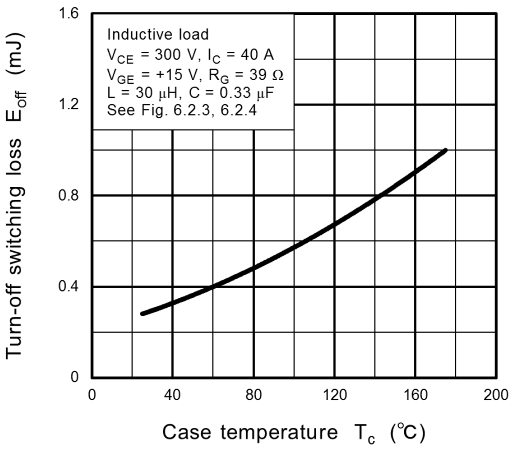
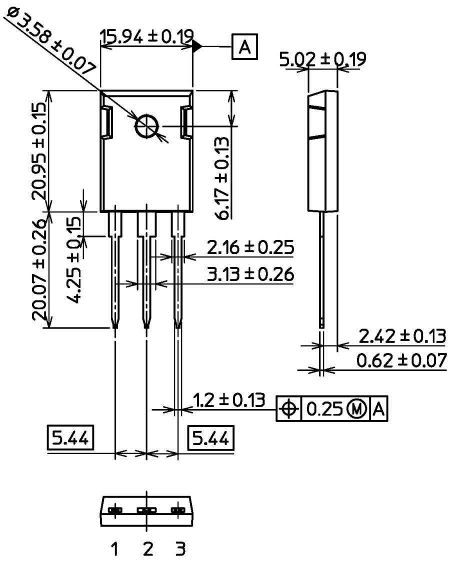



Fig. 8.17 $E_{off}$ - $T_C$

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

## Package Dimensions

Unit: mm




Weight: 6.15 g (typ.)

| Package Name(s) |
|---|
| TOSHIBA: 2-16L1A |
| Nickname: TO-247 |

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