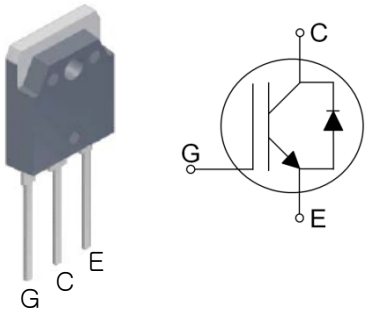
# TGAN15S135FD

## Reverse Conducting Field Stop Trench IGBT

## Features

- 1350V Reverse Conducting Field Stop Trench IGBT Technology
- Excellent EMI Behavior
- High Speed Switching
- Low Conduction Loss
- Positive Temperature Coefficient
- Easy Parallel Operation
- 175℃ Operating Temperature
- RoHS Compliant
- JEDEC Qualification




## Applications

- Induction Heating
- Inverterized microwave ovens
- Soft Switching Applications

| Device | Package | Marking | Remark |
|---|---|---|---|
| TGAN15S135FD | TO-3PN | TGAN15S135FD | RoHS |

## Absolute Maximum Ratings

| Parameter | | Symbol | Value | Unit |
|---|---|---|---|---|
| Collector-Emitter Voltage | | $V_{CES}$ | 1350 | V |
| Gate-Emitter Voltage | | $V_{GES}$ | ±25 | V |
| Continuous Collector Current | $T_C$ = 25 ℃ | $I_C$ | 30 | A |
| | $T_C$ = 100 ℃ | | 15 | A |
| Pulsed Collector Current (Note 1) | | $I_{CM}$ | 75 | A |
| Diode Continuous Forward Current | $T_C$ = 100 ℃ | $I_F$ | 15 | A |
| Power Dissipation | $T_C$ = 25 ℃ | $P_D$ | 181 | W |
| | $T_C$ = 100 ℃ | | 90 | W |
| Operating Junction Temperature | | $T_{vj}$ | -55 ~ 175 | ℃ |
| Storage Temperature Range | | $T_{STG}$ | -55 ~ 150 | ℃ |
| Maximum lead temperature for soldering purposes, 1/8” from case for 5 seconds | | $T_L$ | 300 | ℃ |

Notes :

(1) Repetitive rating : Pulse width limited by maximum junction temperature , During production, high current switching capability is 100% verified with the inductive load single-pulse switching test. (Ic=75A)

## Thermal Characteristics

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Maximum Thermal resistance, Junction-to-Case | $R_{\theta JC}$ (IGBT) | 0.83 | ℃/W |
| Maximum Thermal resistance, Junction-to-Case | $R_{\theta JC}$ (DIODE) | 0.83 | ℃/W |
| Maximum Thermal resistance, Junction-to-Ambient | $R_{\theta JA}$ | 40 | ℃/W |

## Electrical Characteristics $T_{vj}$ =25℃, unless otherwise noted

| Parameter | Symbol | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **OFF** | | | | | | |
| Collector – Emitter Breakdown Voltage | $BV_{CES}$ | $V_{GE}$ = 0V, $I_C$ = 1mA | 1350 | -- | -- | V |
| Zero Gate Voltage Collector Current | $I_{CES}$ | $V_{CE}$ = 1350V, $V_{GE}$ = 0V | -- | -- | 1 | mA |
| Gate – Emitter Leakage Current | $I_{GES}$ | $V_{CE}$ = 0V, $V_{GE}$ = ± 25V | -- | -- | ± 500 | nA |
| Integrated Gate Resistor | $R_{G(int)}$ | f = 1MHz, open Collector | -- | 15 | -- | Ω |
| **ON** | | | | | | |
| Gate – Emitter Threshold Voltage | $V_{GE(TH)}$ | $V_{GE}$ = $V_{CE}$, $I_C$ = 15mA | 4.0 | 6.0 | 8.0 | V |
| Collector – Emitter Saturation Voltage | $V_{CE(SAT)}$ | $V_{GE}$ = 15V, $I_C$ = 15A, $T_{vj}$ = 25 ℃ | -- | 1.95 | 2.35 | V |
| | | $V_{GE}$ = 15V, $I_C$ = 15A, $T_{vj}$ = 125 ℃ | -- | 2.25 | -- | V |
| | | $V_{GE}$ = 15V, $I_C$ = 15A, $T_{vj}$ = 175 ℃ | -- | 2.40 | -- | V |
| Diode Forward Voltage | $V_{FM}$ | $I_F$ = 15A, $T_{vj}$ = 25 ℃ | -- | 2.30 | -- | V |
| | | $I_F$ = 15A, $T_{vj}$ = 125 ℃ | -- | 2.55 | -- | V |
| | | $I_F$ = 15A, $T_{vj}$ = 175 ℃ | -- | 2.75 | -- | V |
| **DYNAMIC** | | | | | | |
| Input Capacitance | $C_{IES}$ | $V_{CE}$ = 30V, $V_{GE}$ = 0V f = 1MHz | -- | 1390 | -- | pF |
| Output Capacitance | $C_{OES}$ | | -- | 30 | -- | pF |
| Reverse Transfer Capacitance | $C_{RES}$ | | -- | 20 | -- | pF |
| Total Gate Charge | $Q_g$ | $V_{CC}$ = 600V, $I_C$ = 15A $V_{GE}$ = 15V | -- | 64 | 96 | nC |
| Gate-Emitter Charge | $Q_{ge}$ | | -- | 9 | 14 | nC |
| Gate-Collector Charge | $Q_{gc}$ | | -- | 28 | 41 | nC |

| Parameter | Symbol | Test condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **SWITCHING** (Note 2) | | | | | | |
| Turn-Off Delay Time | $t_{d(off)}$ | $V_{CC}$ = 600V, $I_C$ = 7.5A<br>$R_G$ = 5Ω, $V_{GE}$ = 15V<br>Inductive Load, $T_{vj}$ = 25 ℃ | -- | 88 | -- | ns |
| Fall Time | $t_f$ | | -- | 99 | 148 | ns |
| Turn-Off Switching Loss | $E_{OFF}$ | | -- | 0.10 | 0.15 | mJ |
| Turn-Off Delay Time | $t_{d(off)}$ | $V_{CC}$ = 600V, $I_C$ = 15A<br>$R_G$ = 5Ω, $V_{GE}$ = 15V<br>Inductive Load, $T_{vj}$ = 25 ℃ | -- | 88 | -- | ns |
| Fall Time | $t_f$ | | -- | 104 | 156 | ns |
| Turn-Off Switching Loss | $E_{OFF}$ | | -- | 0.28 | 0.42 | mJ |
| Turn-Off Delay Time | $t_{d(off)}$ | $V_{CC}$ = 600V, $I_C$ = 7.5A<br>$R_G$ = 5Ω, $V_{GE}$ = 15V<br>Inductive Load, $T_{vj}$ = 175 ℃ | -- | 105 | -- | ns |
| Fall Time | $t_f$ | | -- | 167 | -- | ns |
| Turn-Off Switching Loss | $E_{OFF}$ | | -- | 0.18 | 0.27 | mJ |
| Turn-Off Delay Time | $t_{d(off)}$ | $V_{CC}$ = 600V, $I_C$ = 15A<br>$R_G$ = 5Ω, $V_{GE}$ = 15V<br>Inductive Load, $T_{vj}$ = 175 ℃ | -- | 98 | -- | ns |
| Fall Time | $t_f$ | | -- | 166 | -- | ns |
| Turn-Off Switching Loss | $E_{OFF}$ | | -- | 0.48 | 0.72 | mJ |

Notes :
(2) Not subject to production test – verified by design/characterization

# Device Characteristics

Fig. 1 IGBT Output Characteristics

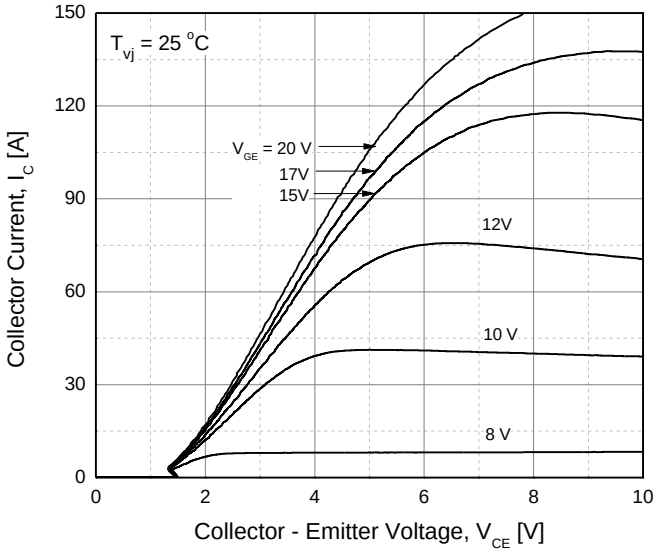



Fig. 2 IGBT Output Characteristics

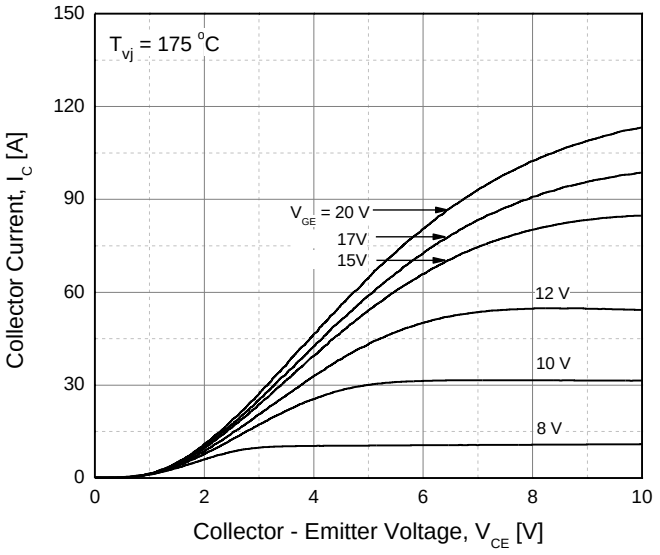



Fig. 3 IGBT Saturation Voltage vs. Junction Temperature

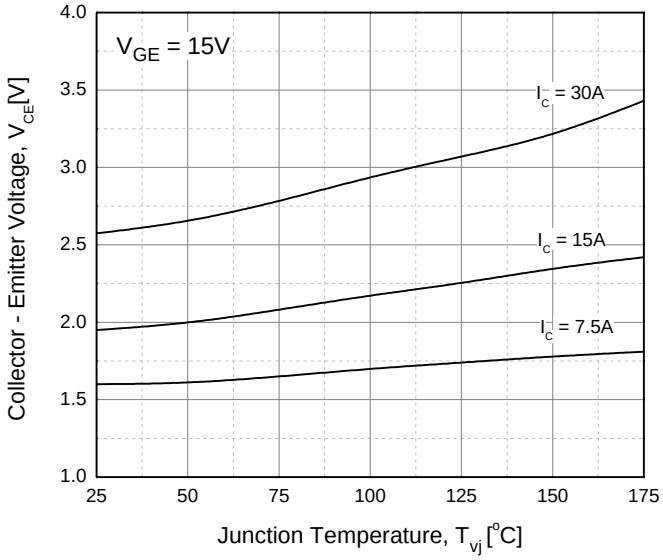
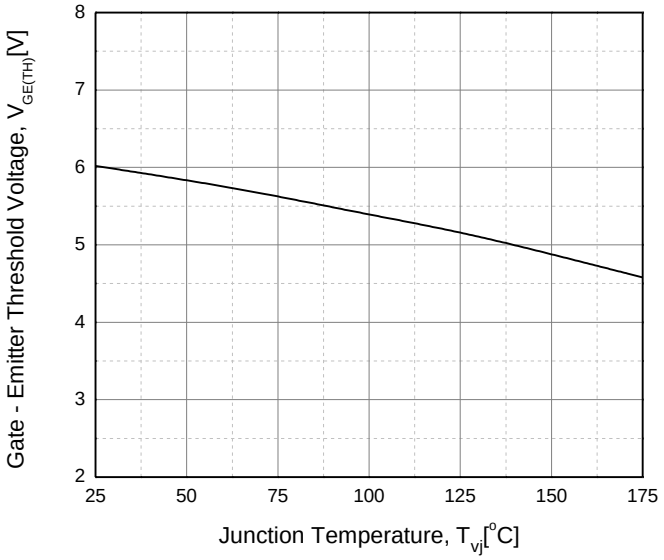



Fig. 4 IGBT Threshold Voltage vs. Junction Temperature



# Device Characteristics

Fig. 5 IGBT Transfer Characteristic

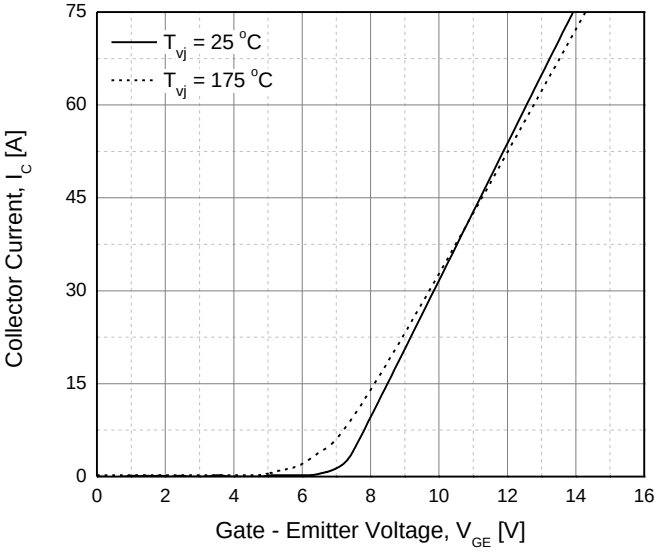



Fig. 6 IGBT Capacitance Characteristics

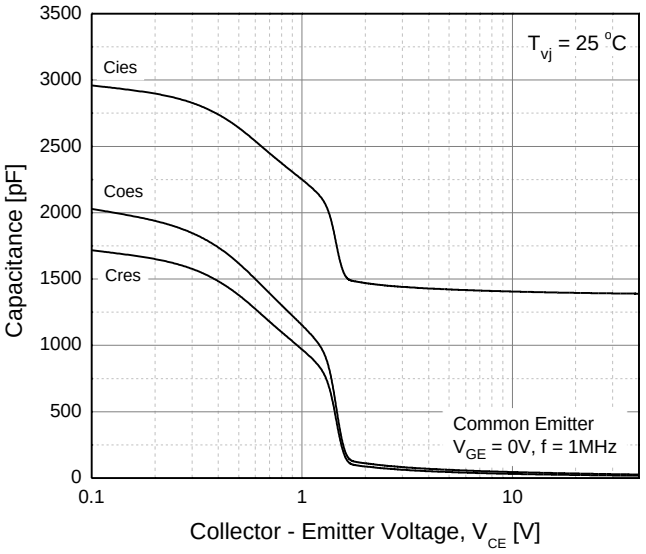



Fig. 7 Diode Conduction Characteristics

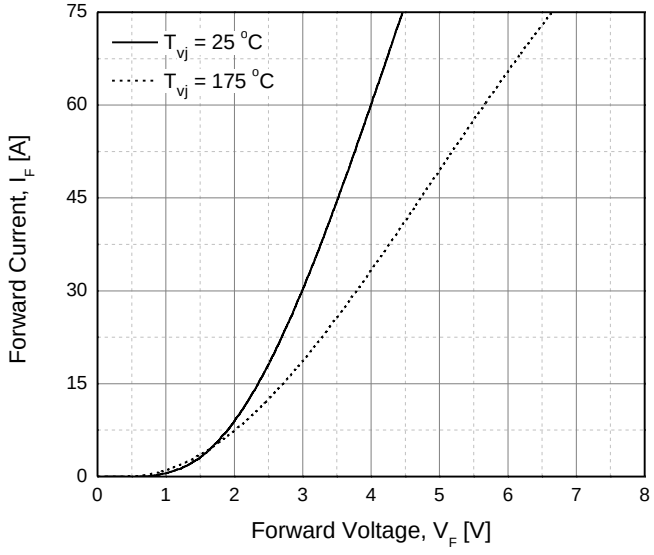
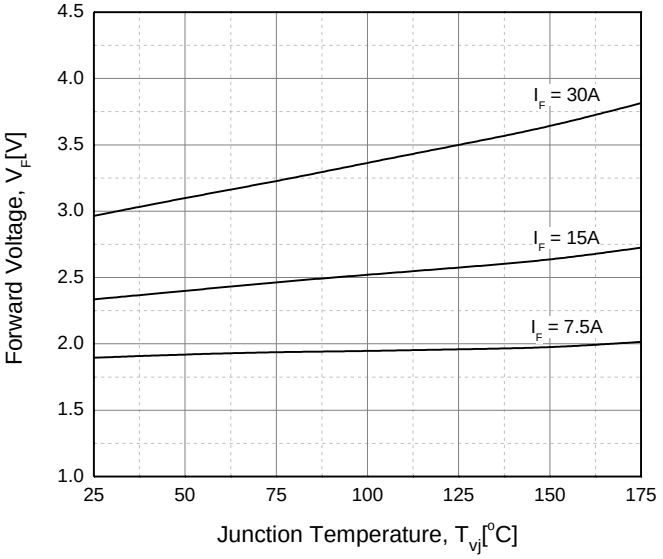



Fig. 8 Diode Forward Voltage vs. Junction Temperature



# Device Characteristics

Fig. 9 Turn-off Time vs. Gate Resistor

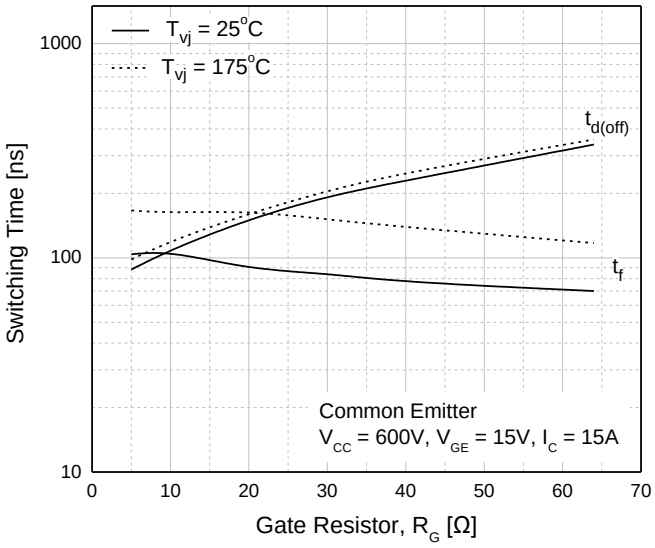



Fig. 10 Turn-off Time vs. Collector Current

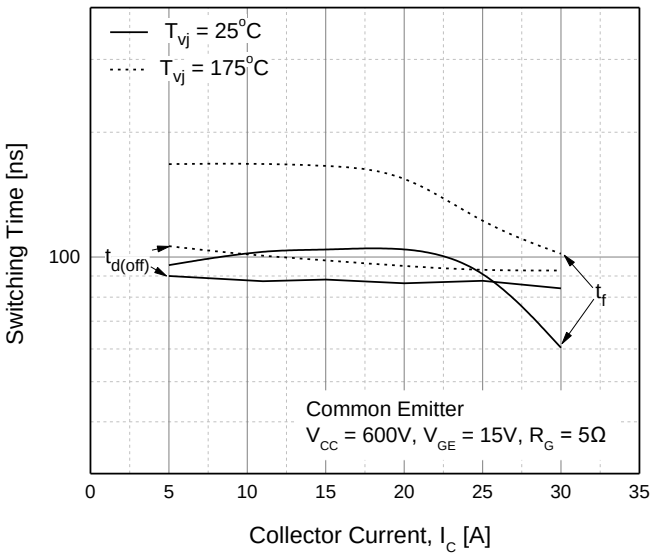



Fig. 11 Turn-off Loss vs. Gate Resistor

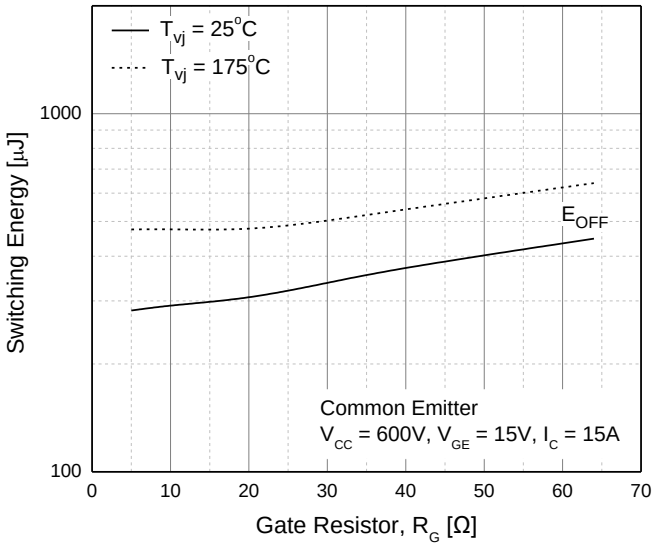
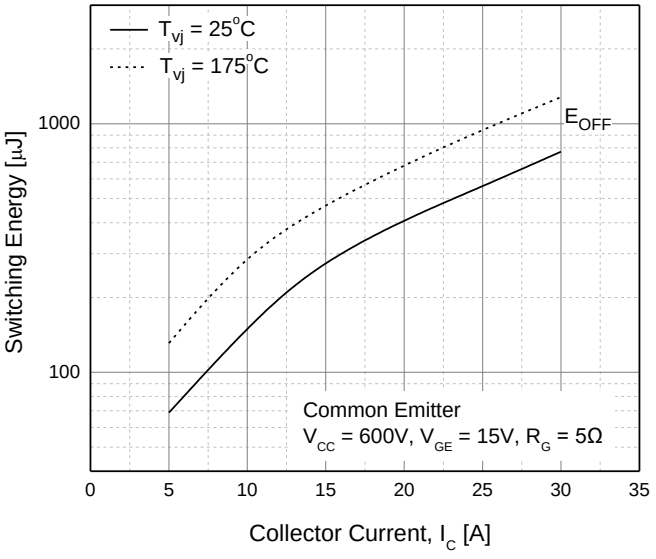



Fig. 12 Turn-off Loss vs. Collector Current



# Device Characteristics

Fig. 13 Gate Charge Characteristics

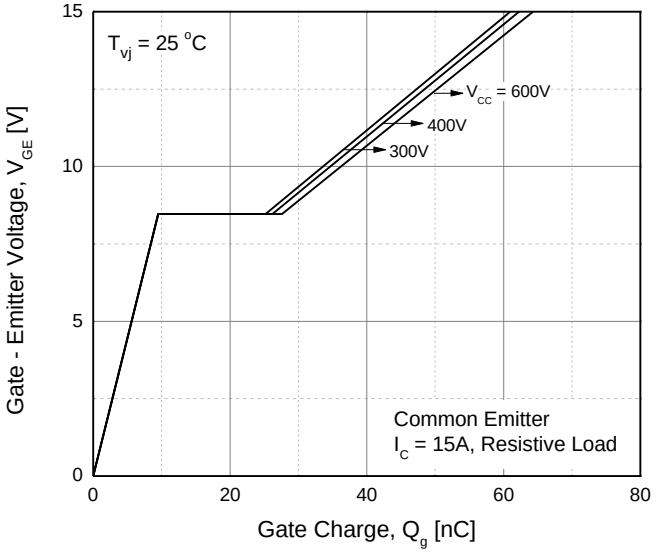



Fig. 14 Transient Thermal Impedance

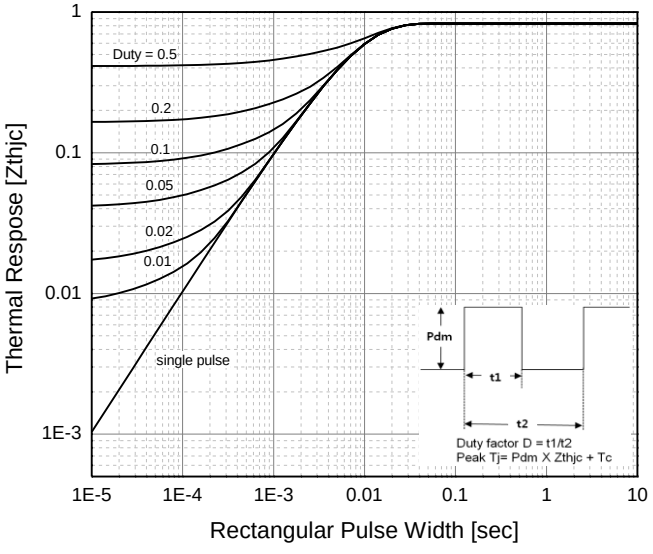



Fig. 15 Power Dissipation vs. Case Temperature

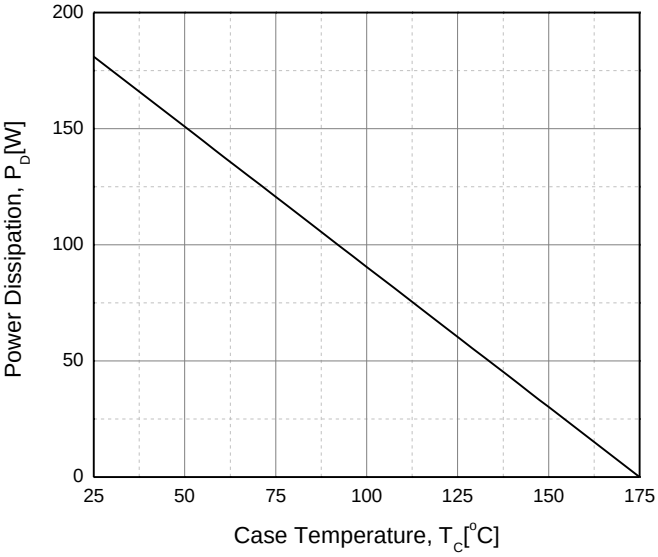
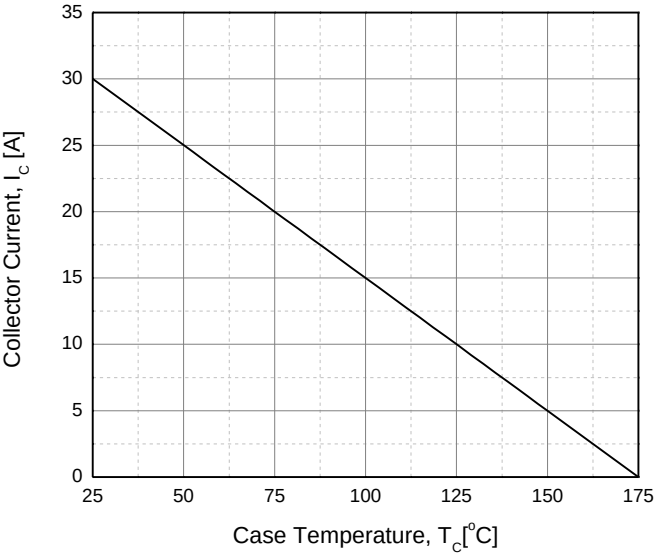



Fig. 16 Collector Current vs. Case Temperature



# Device Characteristics

Fig. 17 SOA

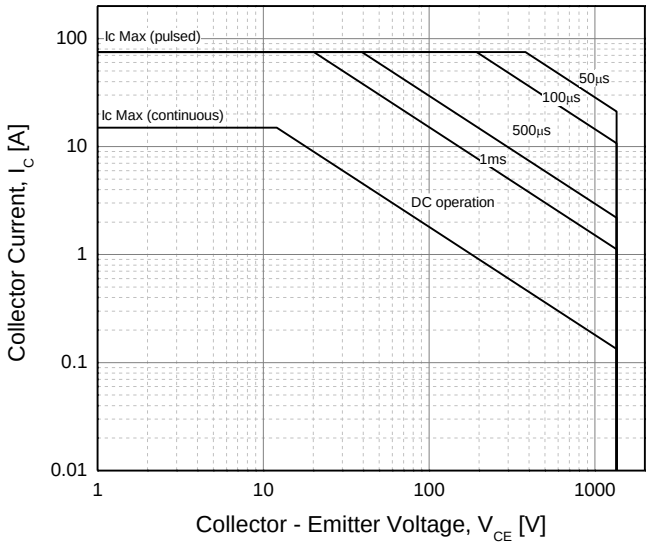



Fig. 18 RBSOA

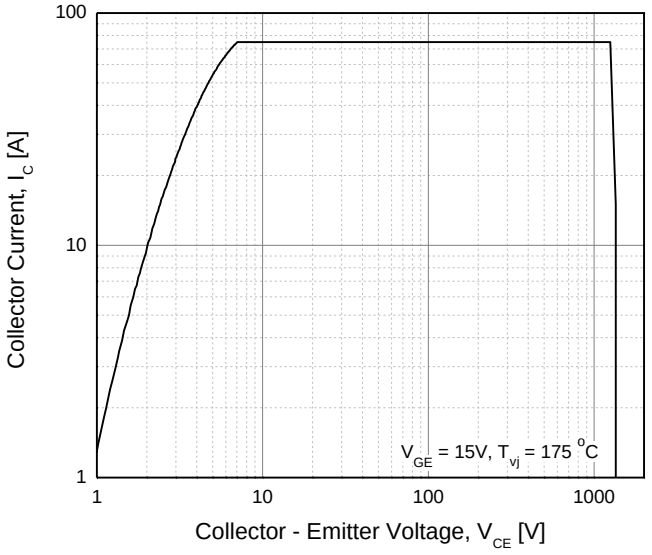



Fig. 19 Load Current vs. Frequency

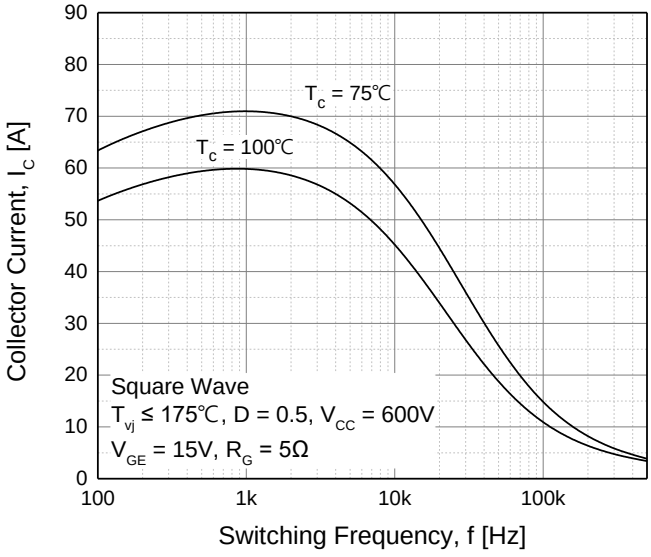
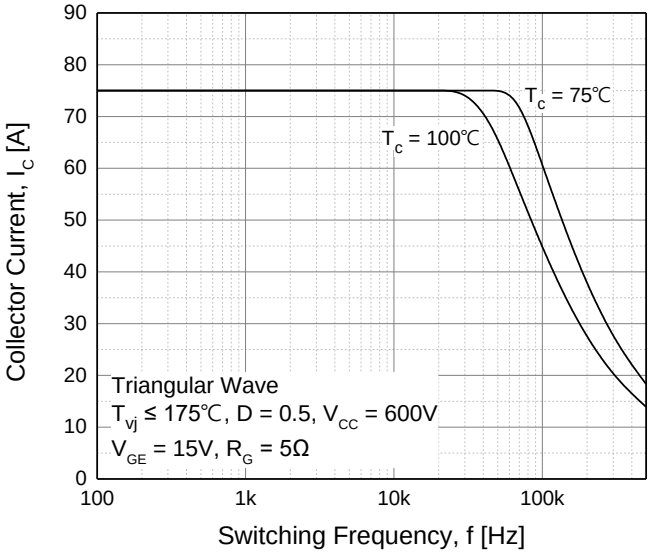
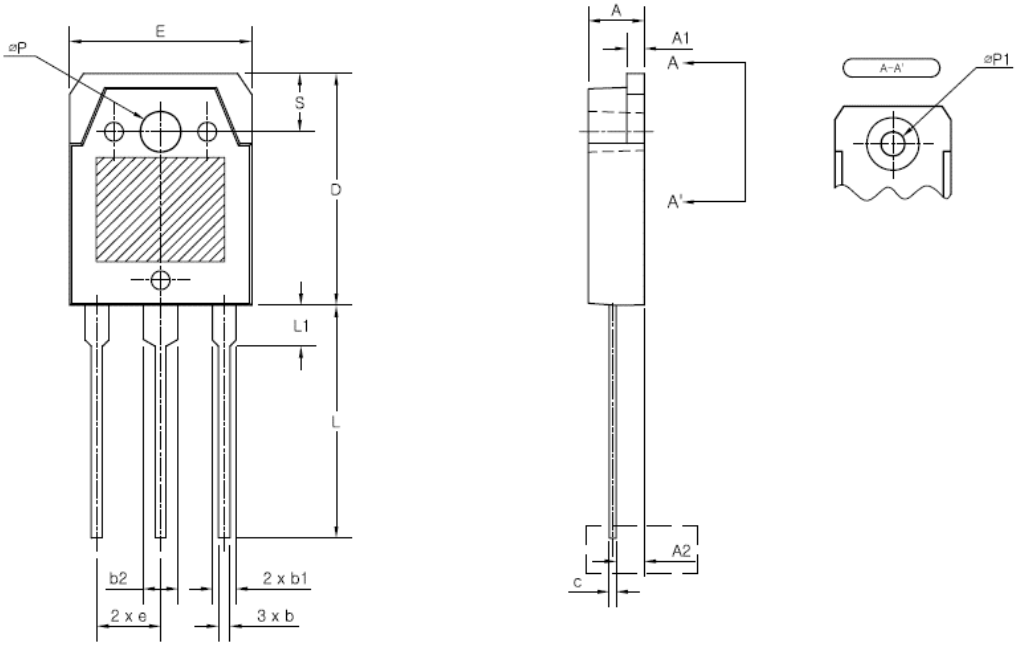



Fig. 20 Load Current vs. Frequency



# TO-3PN MECHANICAL DATA




| SYMBOL | mm | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 4.6 | 4.8 | 5 |
| A1 | 1.45 | 1.5 | 1.65 |
| A2 | 2.2 | 2.4 | 2.6 |
| b | 0.8 | 1 | 1.2 |
| b1 | 2.8 | 3 | 3.2 |
| b2 | 1.8 | 2 | 2.2 |
| c | 0.55 | 0.6 | 0.75 |
| D | 19.20 | 19.65 | 20.10 |
| E | 15.4 | 15.6 | 15.8 |
| e | 5.15 | 5.45 | 5.75 |
| L | 19.8 | 20 | 20.2 |
| L1 | 3.3 | 3.5 | 3.7 |
| ΦP | 3.5 | | |
| ΦP1 | 3.2 | | |
| S | 5 | | |

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