# 600V Trench and Fieldstop IGBT

| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{CE}$ (V) | 600 | |
| $I_C$ (A) | 14 (TC=25°C) | 7 (TC=100°C) |
| $V_{CE}$ (sat) (V) | 1.6 | |
| $I_{CM}$ (A) | 21 | |

## FEATURES

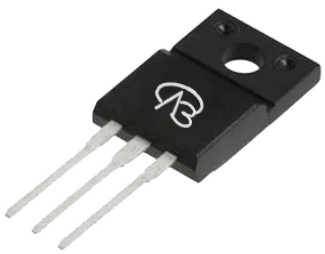
- Very Low VCEsat
- Low turn-off losses
- High speed switching
- Maximum junction temperature 175°C
- Ultra low gate charge ($Q_g$)
- Avalanche energy rated (UIS)

RoHS COMPLIANT
HALOGEN FREE

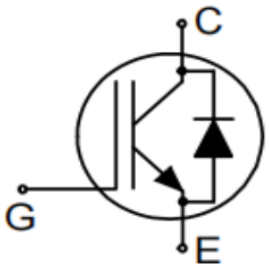
## APPLICATIONS

- Telecommunications
  - Server and telecom power supplies
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Consumer and computing
  - ATX power supplies
- Industrial
  - Welding
  - Battery chargers
- Renewable energy
  - Solar (PV inverters)
- Switch mode power supplies (SMPS)

TO-220F



Top View




## Package pin definition

- Pin1 G - Gate
- Pin2 C & backside - Collector
- Pin3 E - Emitter

**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25 °C, unless otherwise noted)

| PARAMETER | | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|---|
| Collector-Emitter Voltage | | | $V_{CE}$ | 600 | V |
| Gate-Emitter Voltage | | | $V_{GE}$ | ±30 | V |
| Continuous Collector Current ($T_J$ = 150 °C) | $V_{GE}$ at 15 V | $T_C$ = 25 °C | $I_C$ | 14 | A |
| | | $T_C$ = 100 °C | | 7 | A |
| Pulsed Collector Current [a] | | | $I_{CM}$ | 21 | A |
| Diode Forward Current [b] | | | $I_F$ | 7 | A |
| Maximum Power Dissipation | | $T_C$ = 25 °C | $P_D$ | 32 | W |
| | | $T_C$ = 100 °C | | 11.0 | W |
| Operating Junction and Storage Temperature Range | | | $T_J$, $T_{stg}$ | -55 to +175 | °C |
| Short Circuit Withstand Time TC=150°C | VGE= 15V, VCE≤ 400V | | $t_{SC}$ | 3 | μs |
| Short Circuit Withstand Time TC=100°C | VGE= 15V, VCE≤330V | | | 5 | μs |
| Soldering Recommendations (Peak Temperature) [c] | for 10 s | | | 260 | °C |

**Notes**

a. Repetitive rating; pulse width limited by maximum junction temperature.

b. Current limited by maximum junction temperature.

c. 1.6 mm from case.

| THERMAL RESISTANCE RATINGS | | | | |
|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TYP.** | **MAX.** | **UNIT** |
| Maximum Junction-to-Ambient | $R_{thJA}$ | - | 78 | °C/W |
| Maximum Junction-to-Case | $R_{thJC}$ | - | 3.6 | |

| **SPECIFICATIONS** ($T_J$ = 25 °C, unless otherwise noted) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | | |
| Collector-Emitter Breakdown Voltage | $BV_{CE}$ | $V_{GE}$ = 0 V, $I_C$ = 250 μA | | 600 | - | - | V |
| | | $V_{GE}$ = 0 V, $I_C$ = 1 mA | | 600 | - | - | |
| Gate-Source Threshold Voltage (N) | $V_{GE(th)}$ | $V_{CE}$ = $V_{GE}$, $I_D$ = 250 μA | | 4 | 5 | 6 | V |
| Zero Gate Voltage Collector Current | $I_{CES}$ | $V_{CE}$ = 600 V, $V_{GE}$ = 0 V, $T_J$ = 25 °C | | - | 1 | 20 | μA |
| | | $V_{CE}$ = 600 V, $V_{GE}$ = 0 V, $T_J$ = 150 °C | | - | 1000 | - | μA |
| Gate-Emitter Leakage Current | $I_{GES}$ | $V_{CE}$ = 0 V, $V_{GS}$ = ± 2 0 V | | - | - | 100 | nA |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_{GE}$ = 7 V | $I_C$ = 7 A | - | 1.7 | 2.1 | V |
| Forward Transconductance | $g_{fs}$ | $V_{CE}$ = 20 V, $I_C$ = 7 A | | - | 15 | - | S |
| **Dynamic** | | | | | | | |
| Input Capacitance | $C_{ies}$ | $V_{GE}$ = 0 V, $V_{CE}$ = 25 V, f = 500 KHz | | - | 930 | - | pF |
| Output Capacitance | $C_{oes}$ | | | - | 30 | - | |
| Reverse Transfer Capacitance | $C_{res}$ | | | - | 28 | - | |
| Turn-on Energy | $E_{on}$ | $V_{CE}$ = 400 V , $V_{GE}$ = 0 /15V, $I_C$ = 7 A, $R_g$ = 10Ω | | - | 0.32 | - | nJ |
| Turn-off Energy | $E_{off}$ | | | - | 0.18 | - | |
| Total Gate Charge | $Q_g$ | $V_{GE}$ = 7 V | $I_C$ = 7 A, $V_{CE}$ = 400 V | - | 58 | - | nC |
| Gate-Emitter Charge | $Q_{ge}$ | | | - | 11 | - | |
| Gate to Collector Charge | $Q_{gc}$ | | | - | 19 | - | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{CE}$ = 400 V , $V_{GE}$ = 0 /15V, $I_C$ = 7 A, $R_g$ = 10Ω | | - | 15 | - | ns |
| Rise Time | $t_r$ | | | - | 29 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | - | 108 | - | |
| Fall Time | $t_f$ | | | - | 39 | - | |
| Internal emitter inductance measured 5 mm | $L_E$ | | | - | 13 | - | nH |
| **Diode Characteristics** | | | | | | | |
| Diode Forward Current | $I_F$ | IGBT symbol showing the integral reverse junction diode | | - | - | 7 | A |
| Pulsed Diode Forward Current | $I_{FM}$ | | | - | - | 21 | |
| Diode Forward Voltage | $V_F$ | $I_F$ = 7 A | | - | 1.68 | 2.0 | V |
| Reverse Recovery Time | $t_{rr}$ | $T_J$ = 25 °C, $I_F$ = 7 A, $dI_F/dt$ = 200 A/μs, $V_R$ = 400 V | | - | 60 | - | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | | - | 0.36 | - | μC |
| Reverse Recovery Current | $I_{RRM}$ | | | - | 8 | - | A |

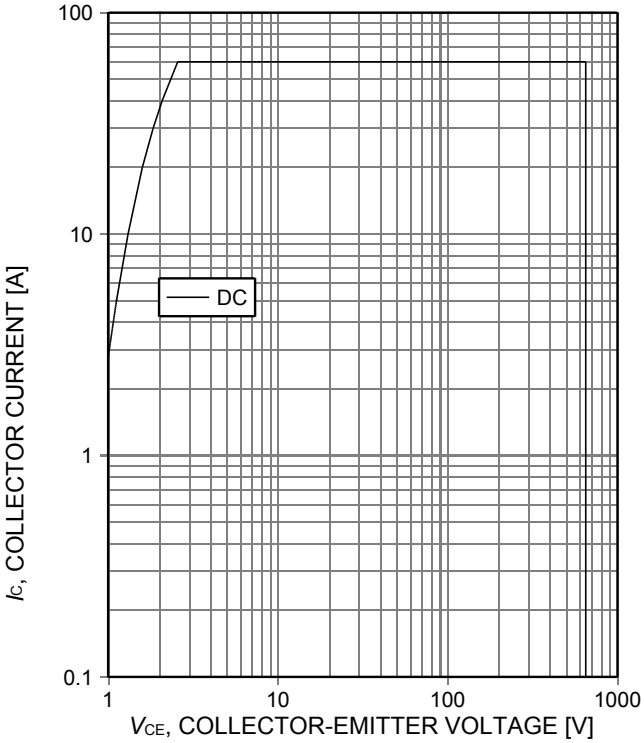



Figure 1. **Forward bias safe operating area**
($D$=0, $T_C$=25°C, $T_{vj}$≤175°C; $V_{GE}$=15V.
Recommended use at $V_{GE}$≥7.5V)

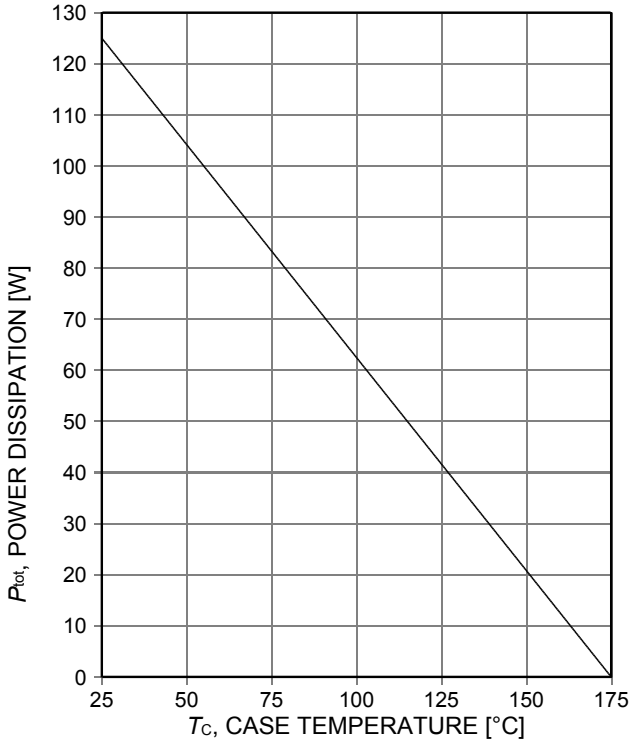



Figure 2. **Power dissipation as a function of case temperature**
($T_{vj}$≤175°C)

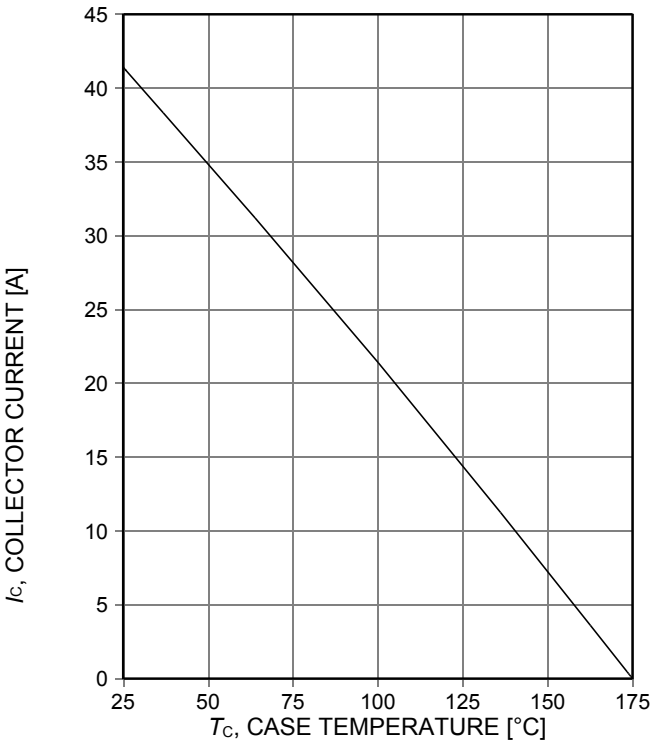



Figure 3. **Collector current as a function of case temperature**

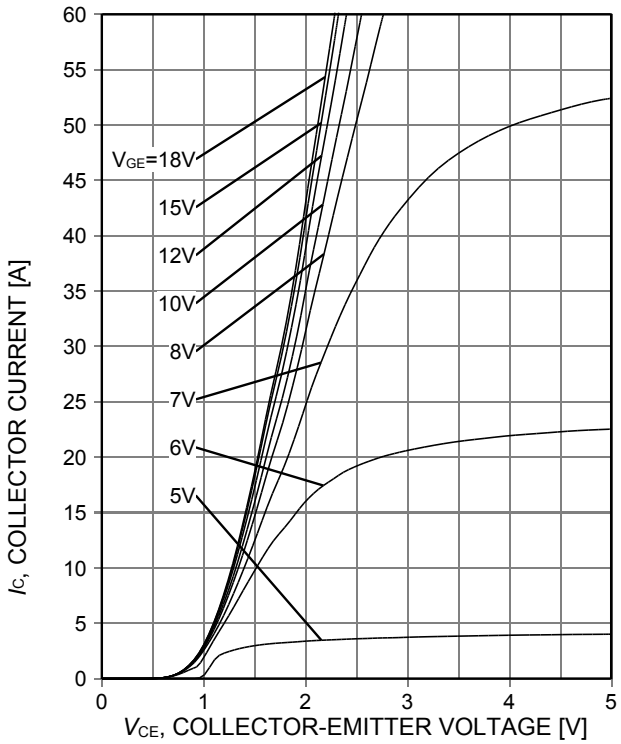



Figure 4. **Typical output characteristic**

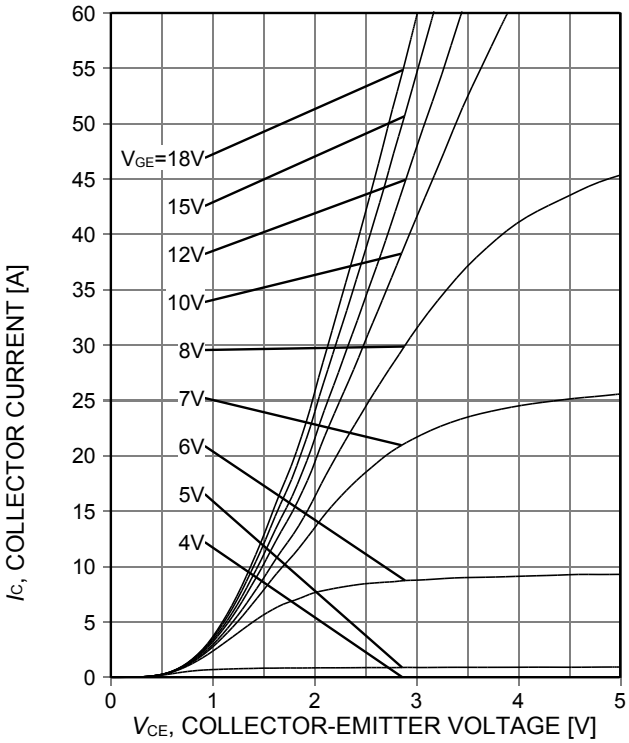



Figure 5. **Typical output characteristic** ($T_{vj}$=150°C)

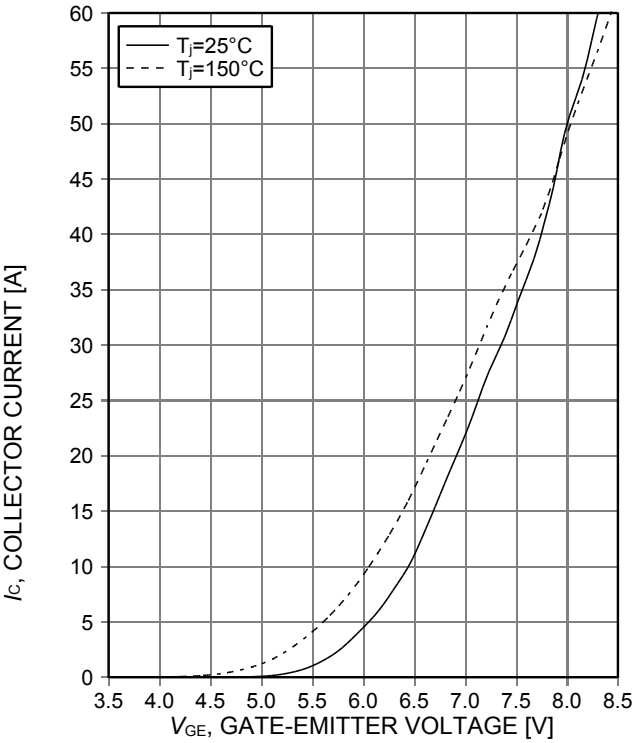



Figure 6. **Typical transfer characteristic** ($V_{CE}$=20V)

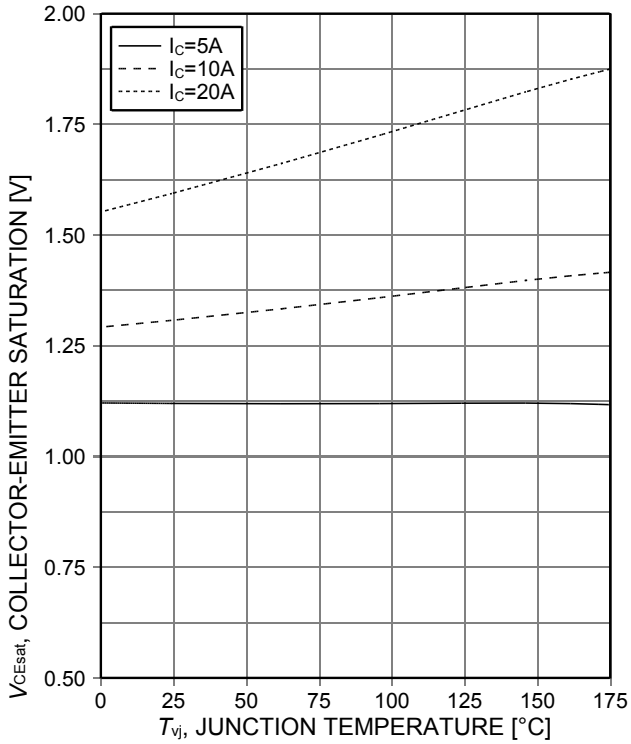



Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**

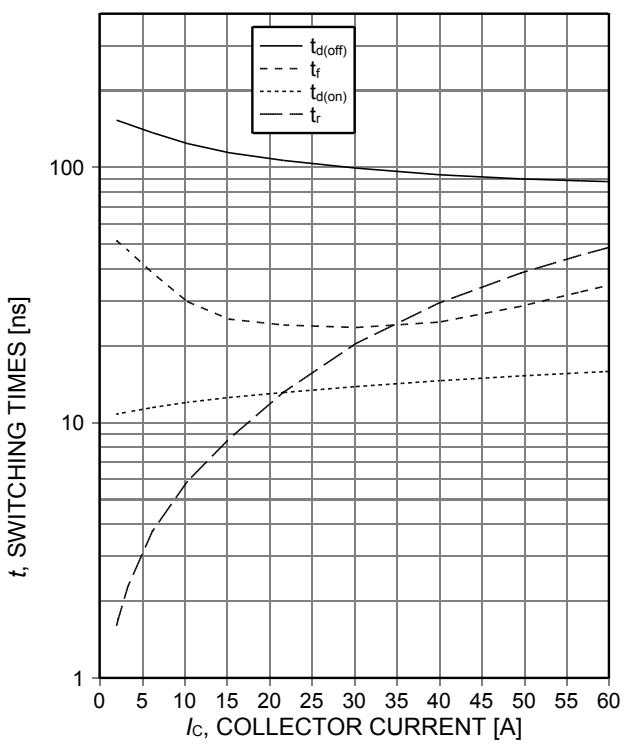



Figure 8. **Typical switching times as a function of collector current**

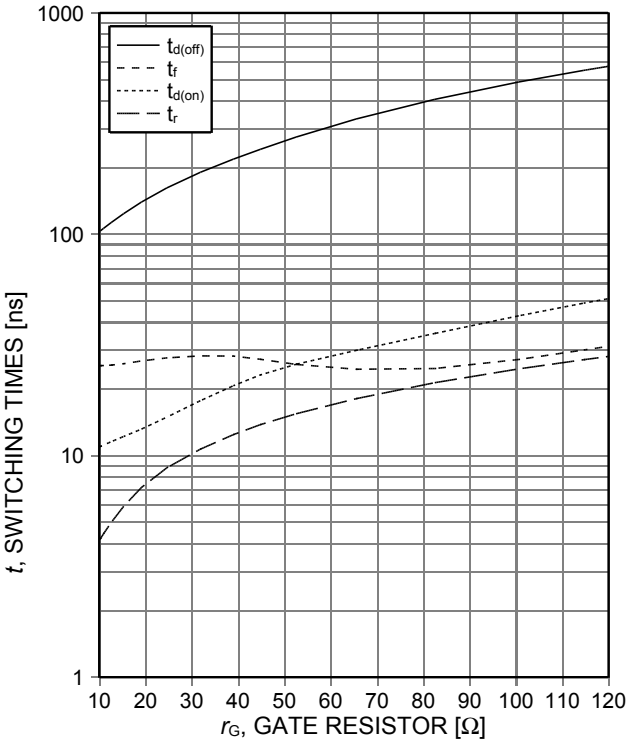



Figure 9. **Typical switching times as a function of gate resistor**

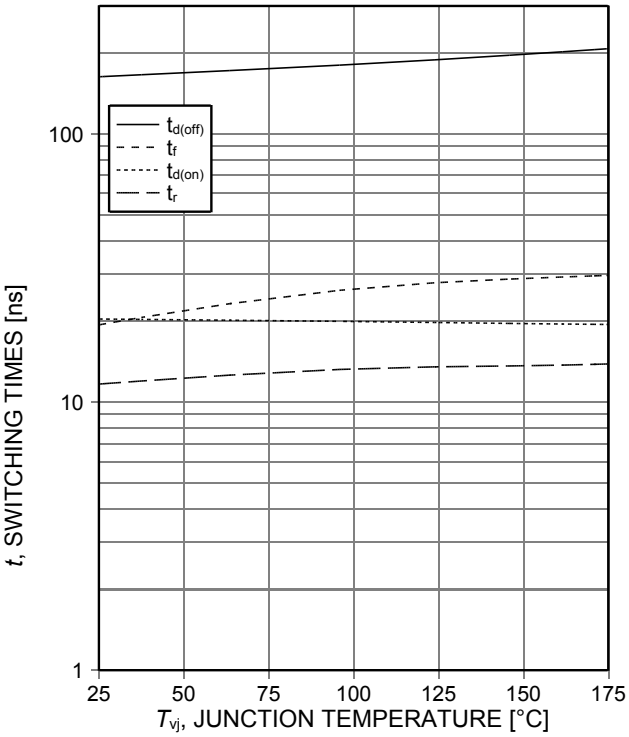



Figure 10. **Typical switching times as a function of junction temperature**

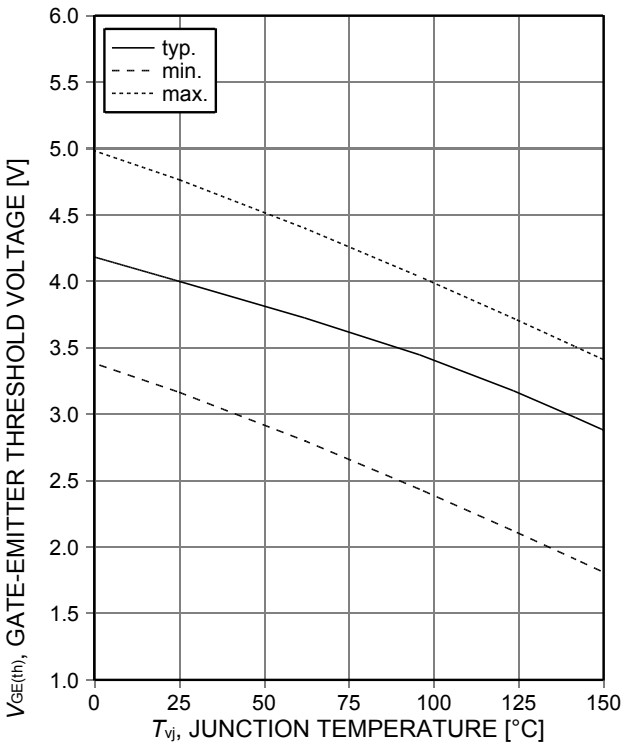



Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**

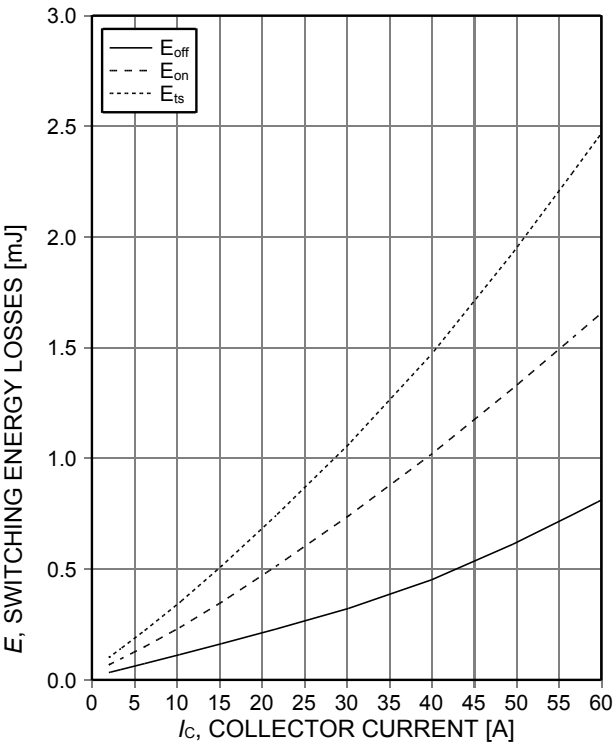



Figure 12. **Typical switching energy losses as a function of collector current**

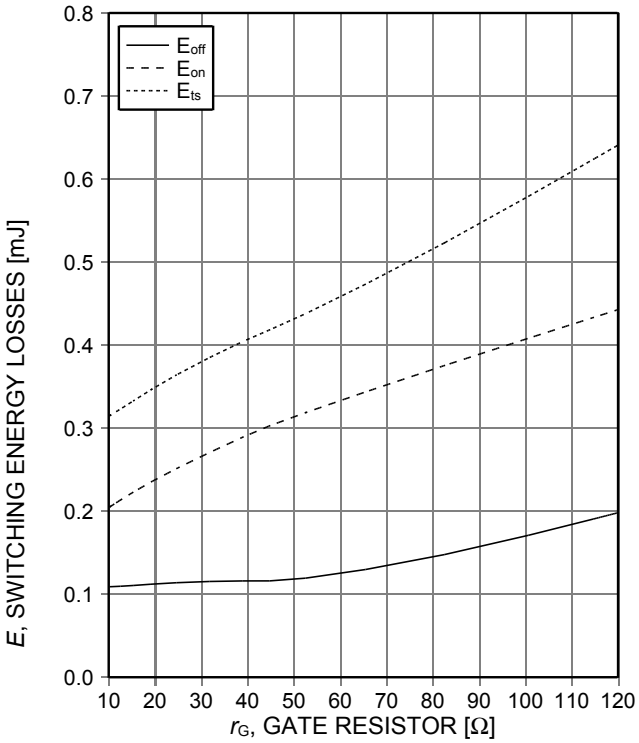



Figure 13. **Typical switching energy losses as a function of gate resistor**

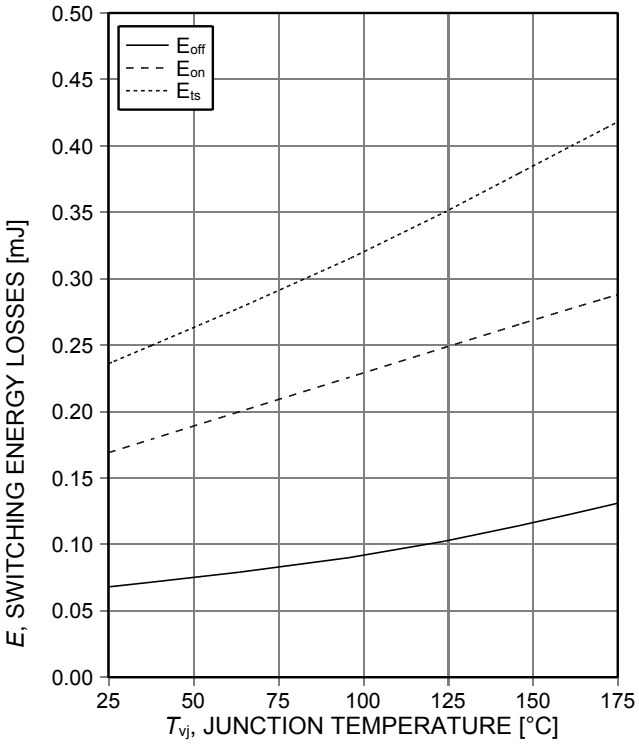



Figure 14. **Typical switching energy losses as a function of junction temperature**

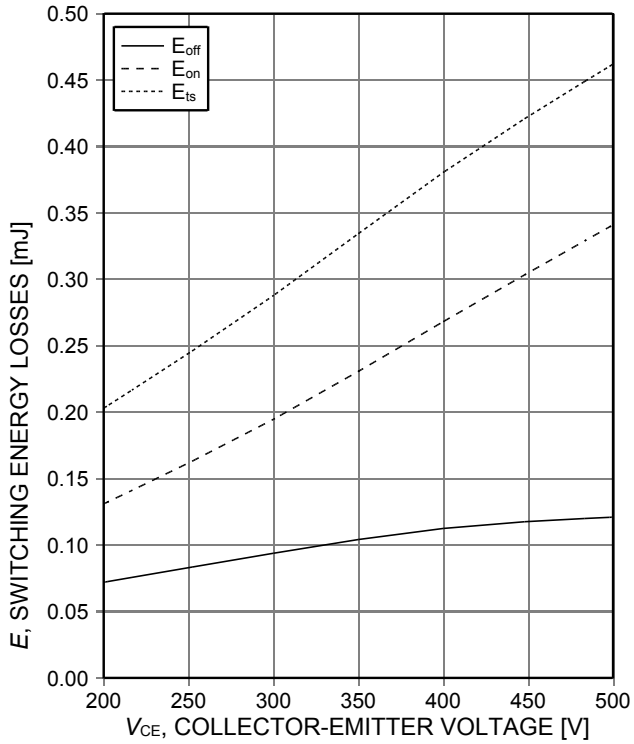



Figure 15. **Typical switching energy losses as a function of collector emitter voltage**

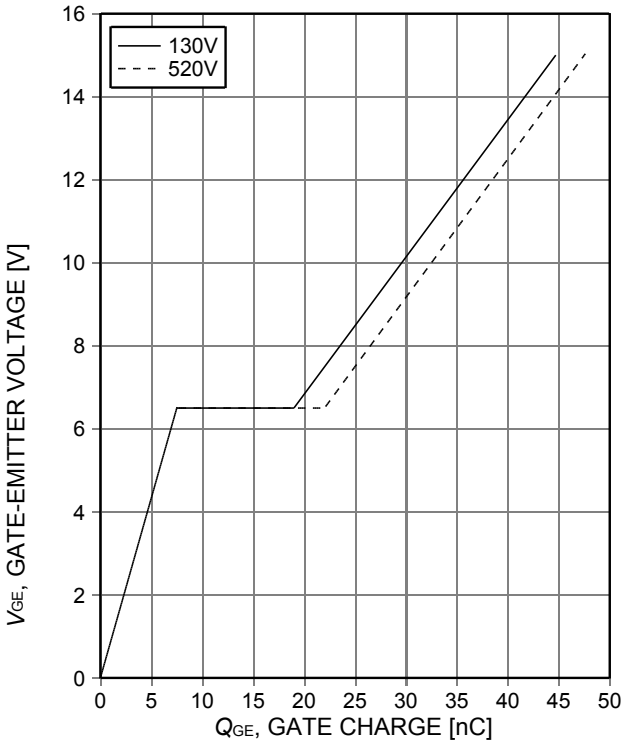



Figure 16. **Typical gate charge**

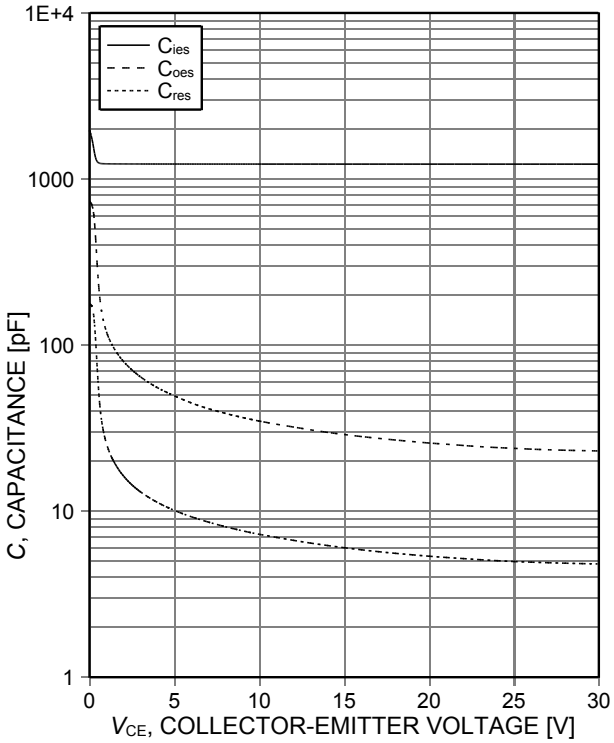



Figure 17. **Typical capacitance as a function of collector-emitter voltage**

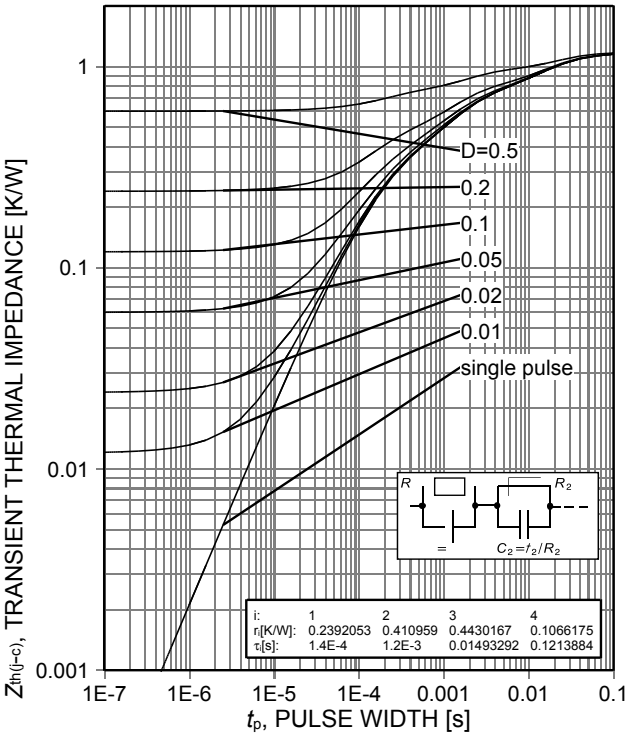



Figure 18. **IGBT transient thermal impedance**

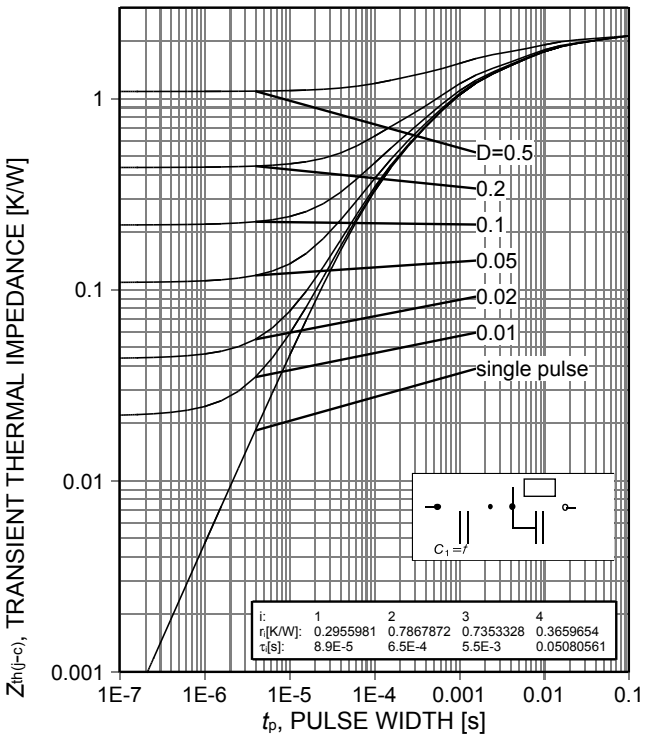



Figure 19. **Diode transient thermal impedance as a function of pulse width**

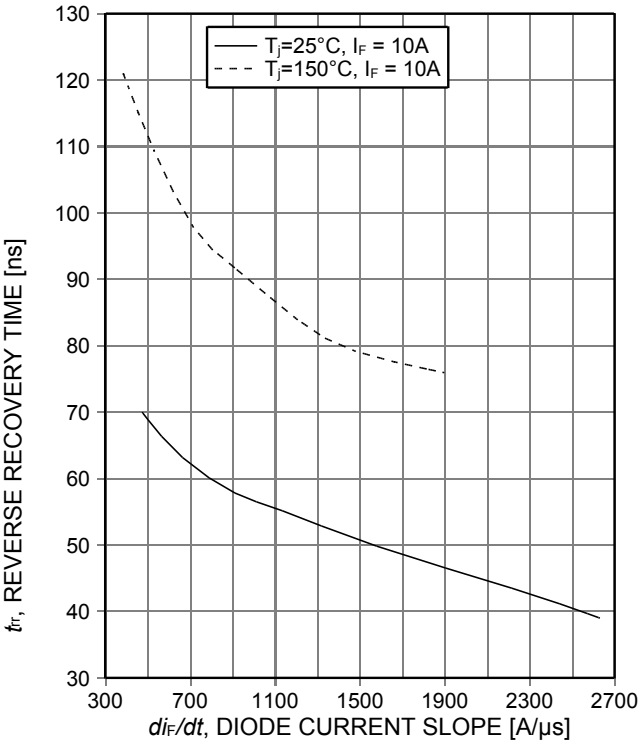
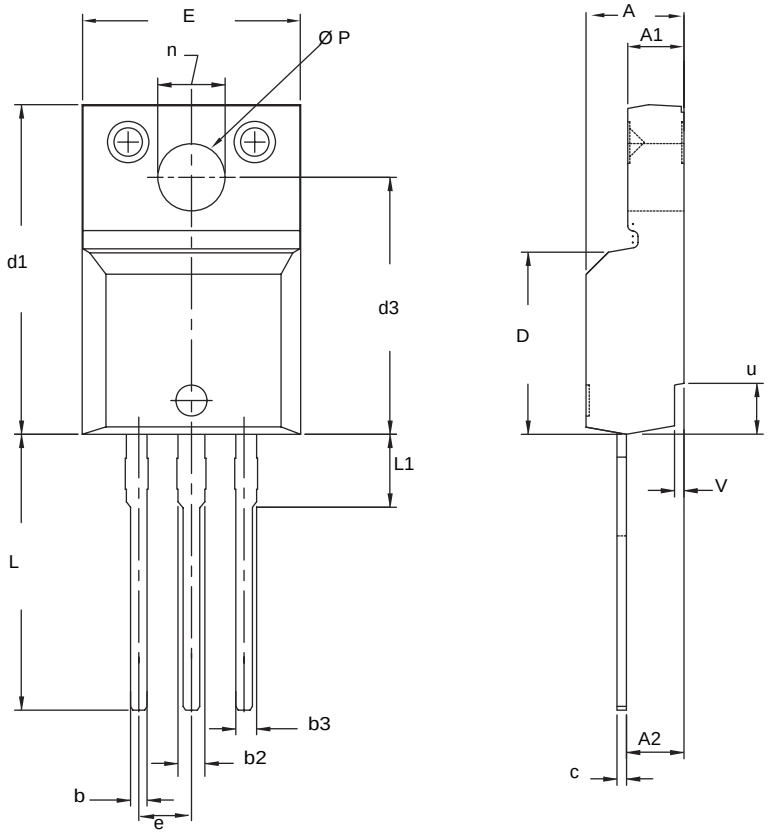



Figure 20. **Typical reverse recovery time as a function of diode current slope**

## TO-220 FULLPAK (HIGH VOLTAGE)




| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM. | MIN. | MAX. | MIN. | MAX. |
| A | 4.570 | 4.830 | 0.180 | 0.190 |
| A1 | 2.570 | 2.830 | 0.101 | 0.111 |
| A2 | 2.510 | 2.850 | 0.099 | 0.112 |
| b | 0.622 | 0.890 | 0.024 | 0.035 |
| b2 | 1.229 | 1.400 | 0.048 | 0.055 |
| b3 | 1.229 | 1.400 | 0.048 | 0.055 |
| c | 0.440 | 0.629 | 0.017 | 0.025 |
| D | 8.650 | 9.800 | 0.341 | 0.386 |
| d1 | 15.88 | 16.120 | 0.622 | 0.635 |
| d3 | 12.300 | 12.920 | 0.484 | 0.509 |
| E | 10.360 | 10.630 | 0.408 | 0.419 |
| e | 2.54 BSC | | 0.100 BSC | |
| L | 13.200 | 13.730 | 0.520 | 0.541 |
| L1 | 3.100 | 3.500 | 0.122 | 0.138 |
| n | 6.050 | 6.150 | 0.238 | 0.242 |
| Ø P | 3.050 | 3.450 | 0.120 | 0.136 |
| u | 2.400 | 2.500 | 0.094 | 0.098 |
| v | 0.400 | 0.500 | 0.016 | 0.020 |

**Notes**

1. To be used only for process drawing.
2. These dimensions apply to all TO-220, FULLPAK leadframe versions 3 leads.
3. All critical dimensions should C meet $C_{pk}$ > 1.33.
4. All dimensions include burrs and plating thickness.
5. No chipping or package damage.

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