# AOK20B65M1-VB Datasheet

## 600V Trench and Fieldstop IGBT

| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{CE}$ (V) | 600 | |
| $I_C$ (A) | 4 0 (TC=25°C) | 20 (TC=100°C) |
| $V_{CE}$ (sat) (V) | 1.6 | |
| $I_{CM}$ (A) | 60 | |

### 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)

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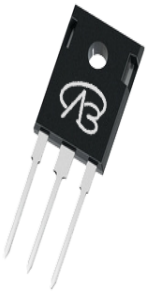
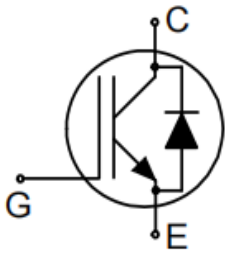


Top View




### 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 | |
| Continuous Collector Current ($T_J$ = 150 °C) | $V_{GE}$ at 15 V | $T_C$ = 25 °C | $I_C$ | 40 | A |
| | | $T_C$ = 100 °C | | 20 | |
| Pulsed Collector Current [a] | | | $I_{CM}$ | 60 | |
| Diode Forward Current [b] | | | $I_F$ | 20 | A |
| Maximum Power Dissipation | | $T_C$ = 25 °C | $P_D$ | 266 | W |
| | | $T_C$ = 100 °C | | 158 | 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 | |
| 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 | $R_{thJA}$ | - | 40 | °C/W |
| Maximum Junction-to-Case | $R_{thJC}$ | - | 0.5 | |

| 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 | $V_{CE(sat)}$ | $V_{GE}$ = 15 V | $I_C$ = 20 A | - | 1.8 | 2.1 | V |
| Forward Transconductance | $g_{fs}$ | $V_{CE}$ = 20 V, $I_C$ = 20 A | | - | 17 | - | S |
| **Dynamic** | | | | | | | |
| Input Capacitance | $C_{ies}$ | $V_{GE}$ = 0 V, $V_{CE}$ = 25 V, f = 500 KHz | | - | 2200 | - | pF |
| Output Capacitance | $C_{oes}$ | | | - | 162 | - | |
| Reverse Transfer Capacitance | $C_{res}$ | | | - | 121 | - | |
| Turn-on Energy | $E_{on}$ | $V_{CE}$ = 400 V , $V_{GE}$ = 0 /15V, $I_C$ = 20 A, $R_g$ = 10Ω | | - | 17 | - | nJ |
| Turn-off Energy | $E_{off}$ | | | - | 0.5 | - | |
| Total Gate Charge | $Q_g$ | $V_{GE}$ = 20 V | $I_C$ = 20 A, $V_{CE}$ = 400 V | - | 2 1 8 | - | nC |
| Gate-Emitter Charge | $Q_{ge}$ | | | - | 62 | - | |
| Gate to Collector Charge | $Q_{gc}$ | | | - | 121 | - | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{CE}$ = 400 V , $V_{GE}$ = 0 /15V, $I_C$ = 20 A, $R_g$ = 10Ω | | - | 46 | - | ns |
| Rise Time | $t_r$ | | | - | 42 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | - | 165 | - | |
| Fall Time | $t_f$ | | | - | 31 | - | |
| 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 | | - | - | 20 | A |
| Pulsed Diode Forward Current | $I_{FM}$ | | | - | - | 60 | |
| Diode Forward Voltage | $V_F$ | $I_F$ = 20 A | | - | 1.51 | 2.0 | V |
| Reverse Recovery Time | $t_{rr}$ | $T_J$ = 25 °C, $I_F$ = 20 A, $dI_F/dt$ = 200 A/μs, $V_R$ = 400 V | | - | 45 | - | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | | - | 0.23 | - | μC |
| Reverse Recovery Current | $I_{RRM}$ | | | - | 11.6 | - | A |

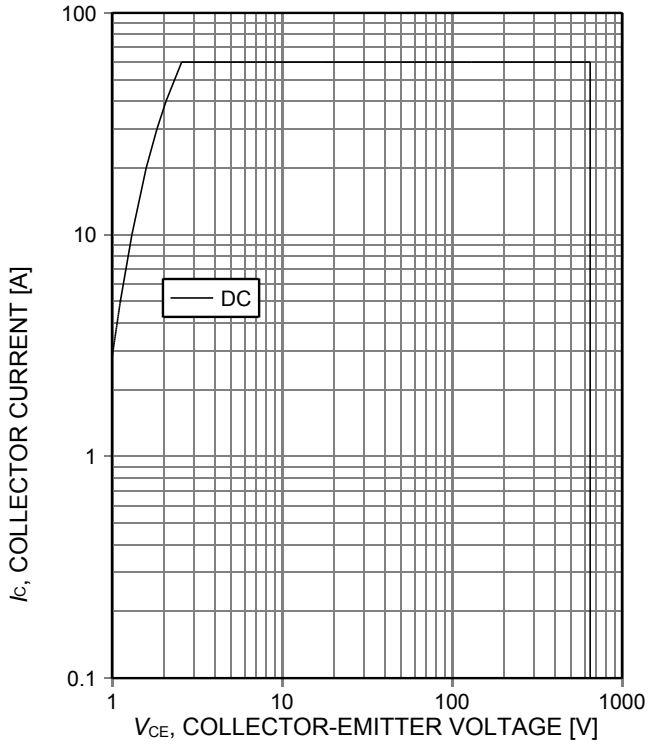



Figure 1. **Forward bias safe operating area** ($D$=0, $T_C$=25°C, $T_{vj}$≤175°C; $V_{GE}$=15V. Recommended use at $V_{GE}$≥7.5V)

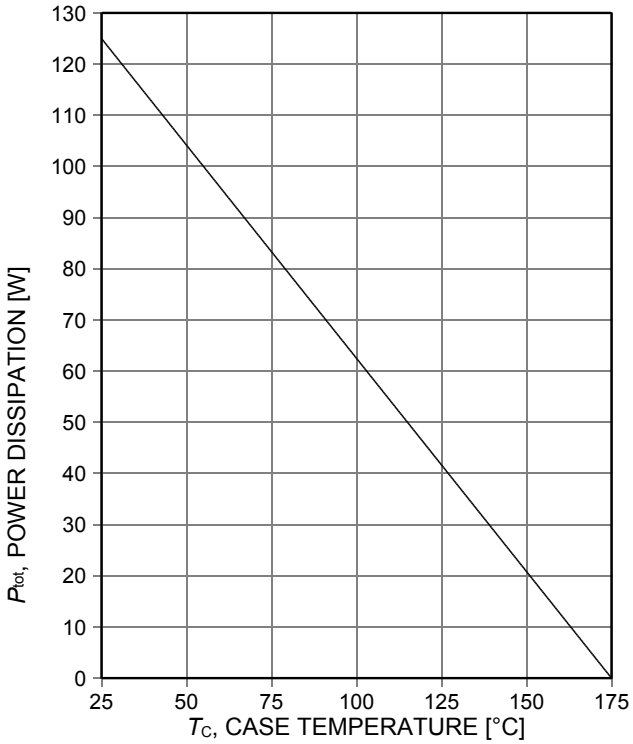



Figure 2. **Power dissipation as a function of case temperature** ($T_{vj}$≤175°C)

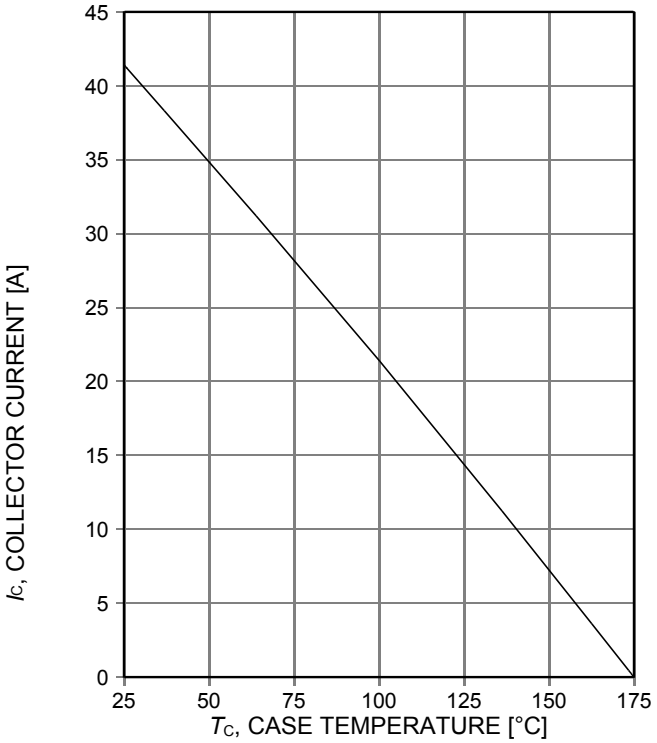



Figure 3. **Collector current as a function of case temperature**

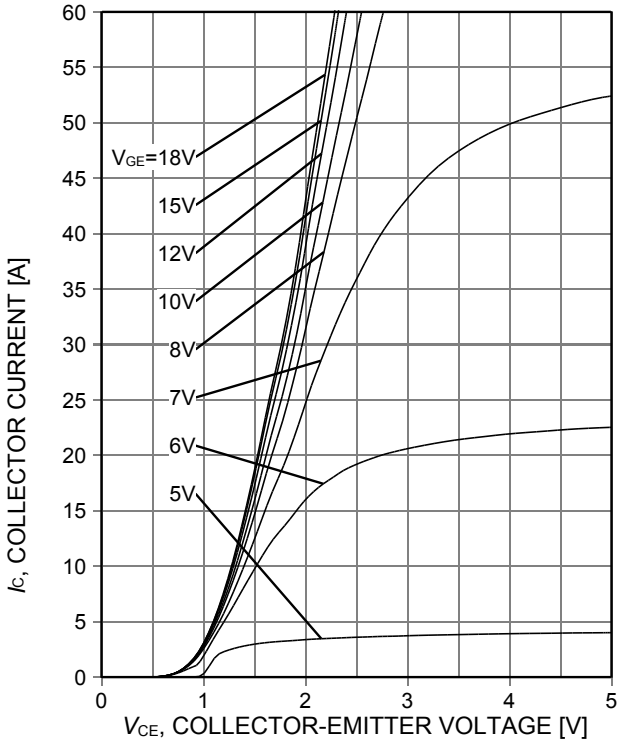



Figure 4. **Typical output characteristic**

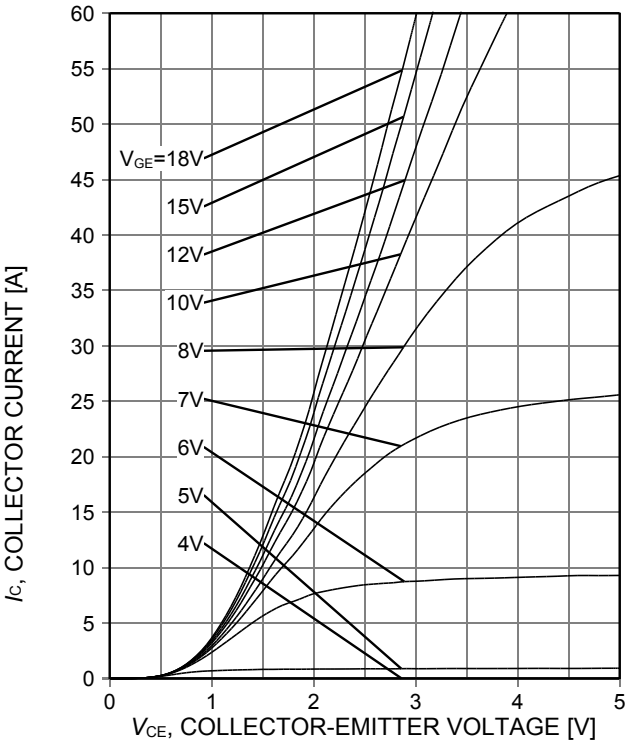



Figure 5. **Typical output characteristic** ($T_{vj}$=150°C)

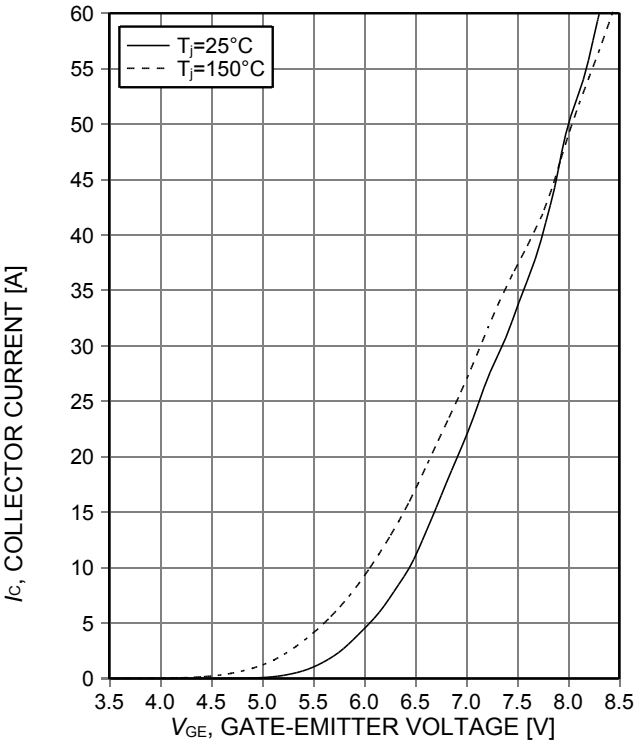



Figure 6. **Typical transfer characteristic** ($V_{CE}$=20V)

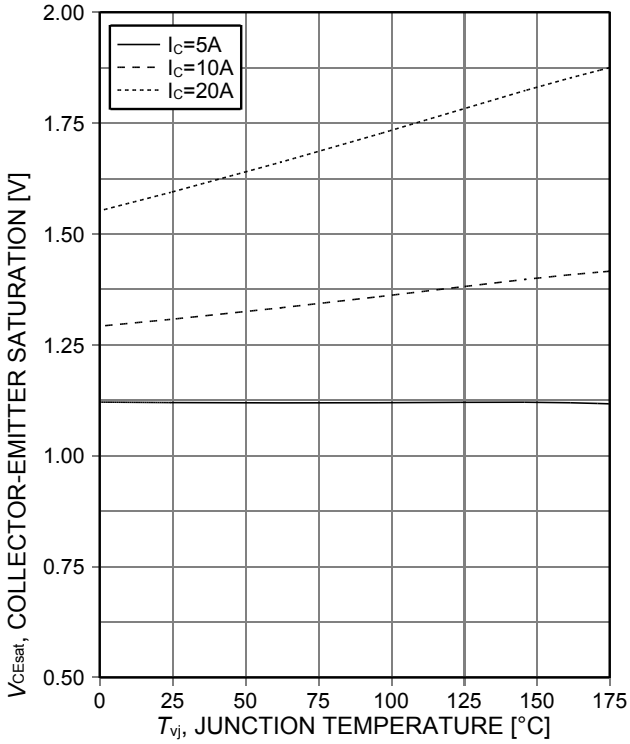



Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**

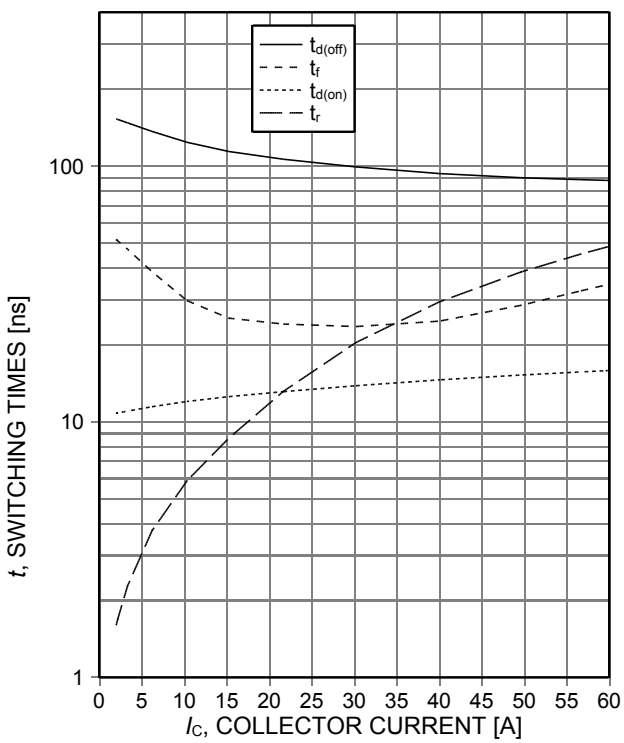



Figure 8. **Typical switching times as a function of collector current**

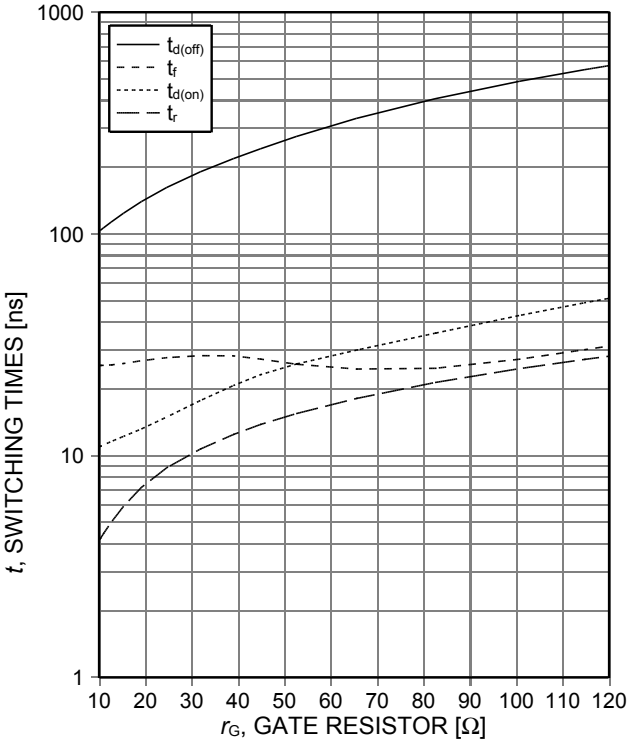



Figure 9. **Typical switching times as a function of gate resistor**

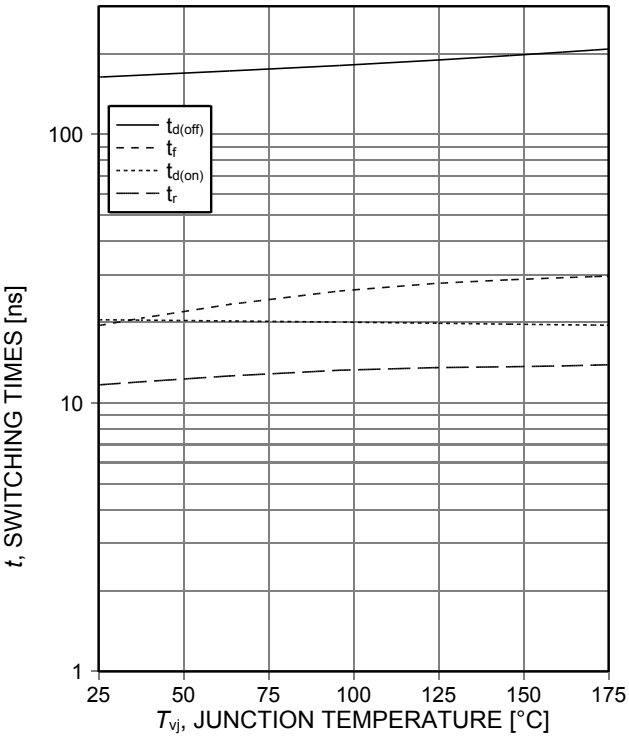



Figure 10. **Typical switching times as a function of junction temperature**

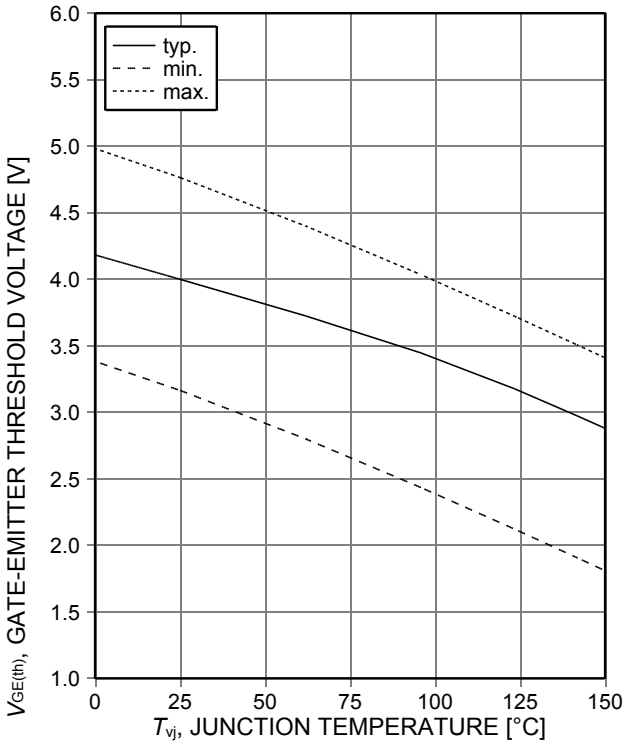



Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**

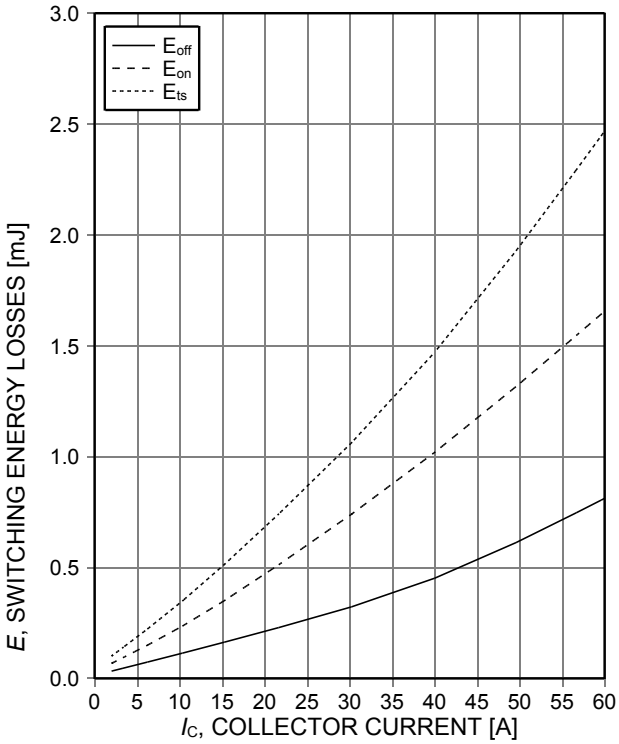



Figure 12. **Typical switching energy losses as a function of collector current**

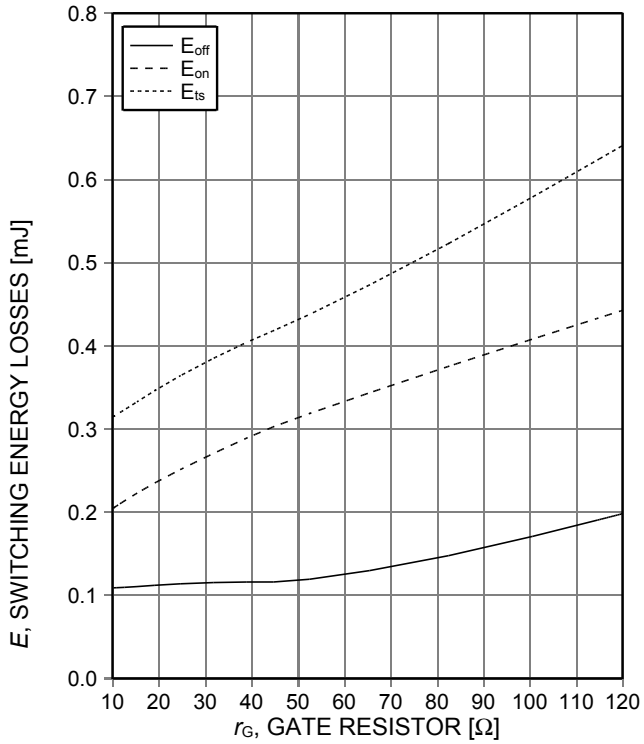



Figure 13. **Typical switching energy losses as a function of gate resistor**

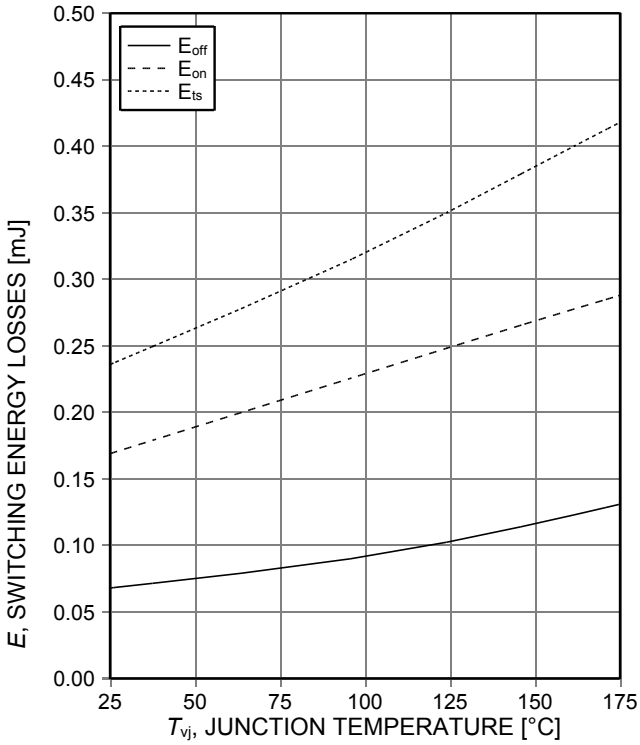



Figure 14. **Typical switching energy losses as a function of junction temperature**

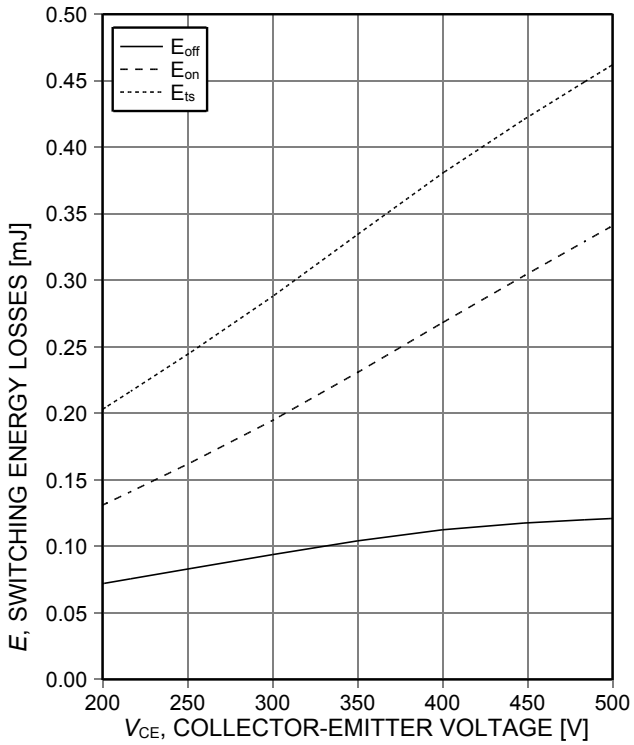



Figure 15. **Typical switching energy losses as a function of collector emitter voltage**

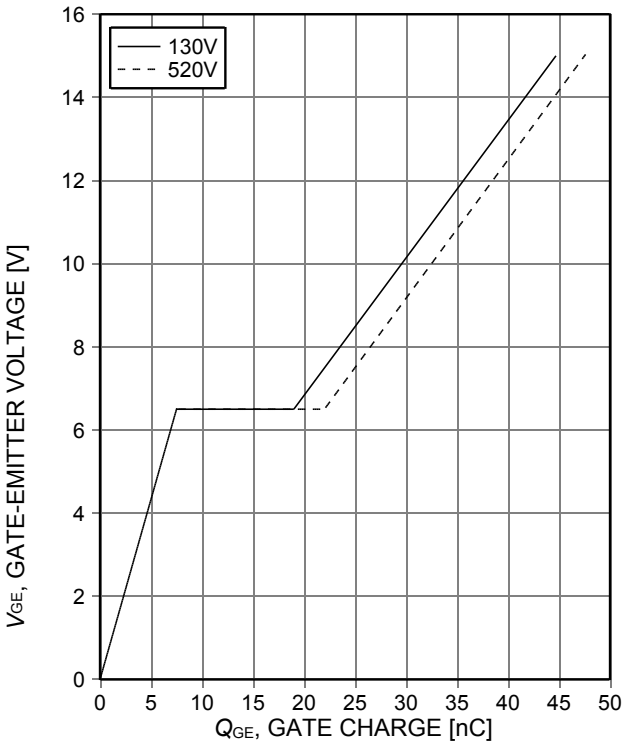



Figure 16. **Typical gate charge**

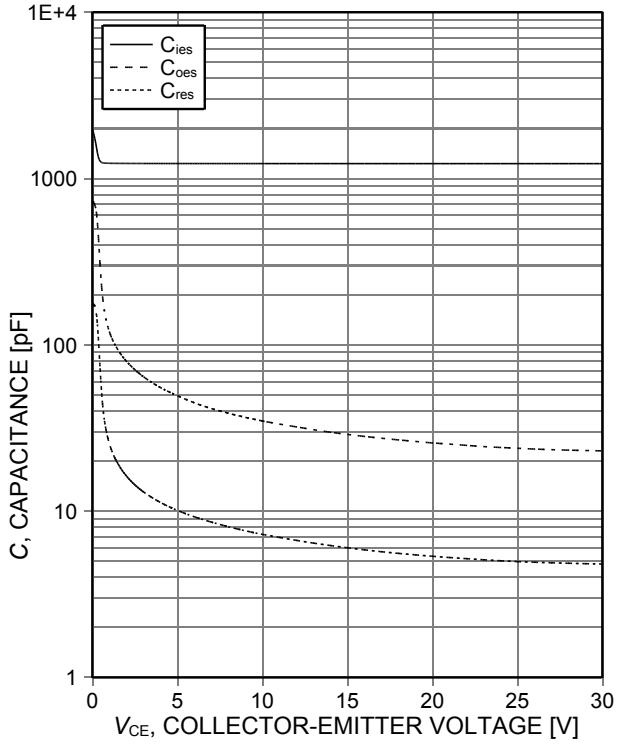



Figure 17. **Typical capacitance as a function of collector-emitter voltage**

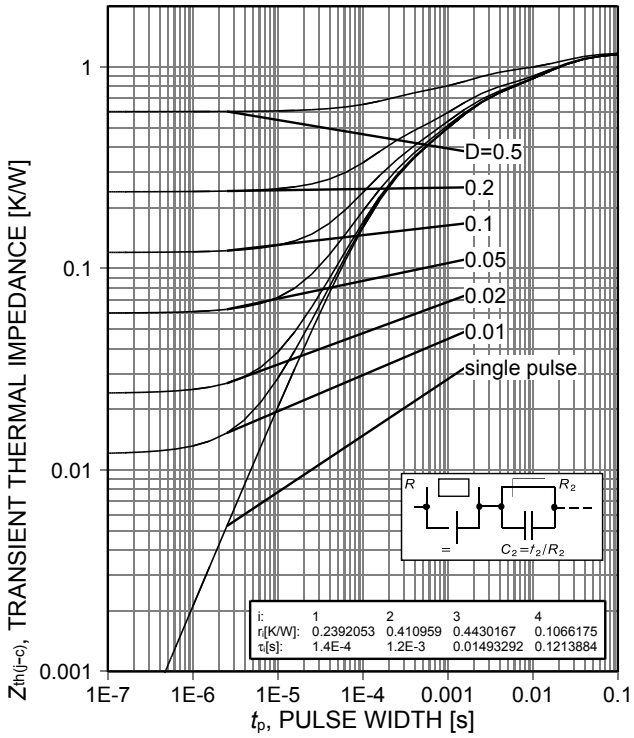



Figure 18. **IGBT transient thermal impedance**

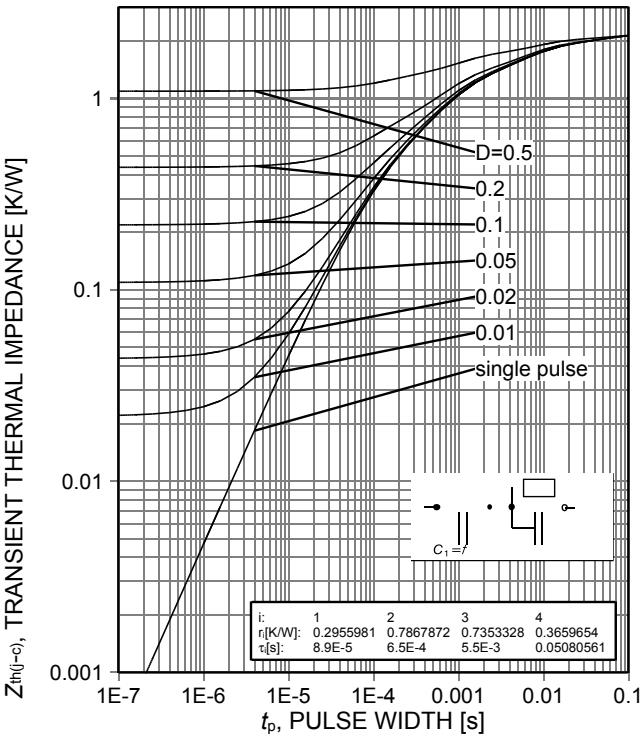



Figure 19. **Diode transient thermal impedance as a function of pulse width**

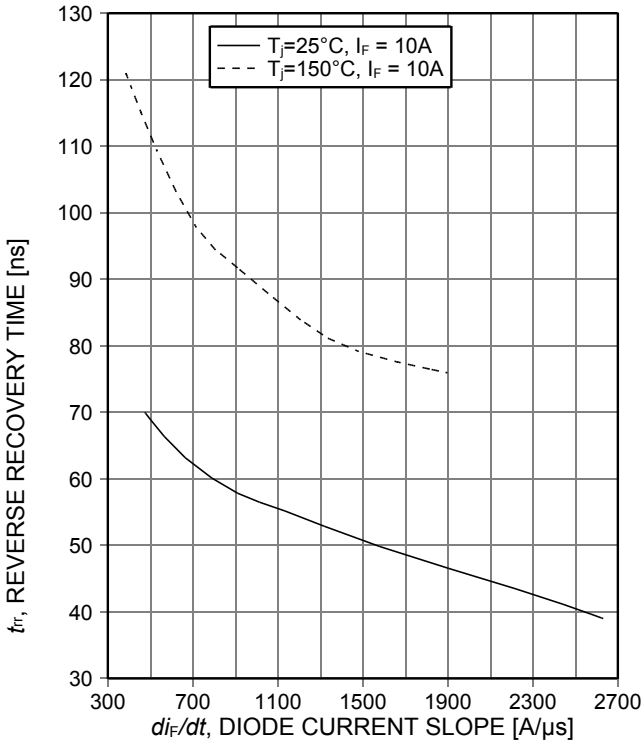



Figure 20. **Typical reverse recovery time as a function of diode current slope**

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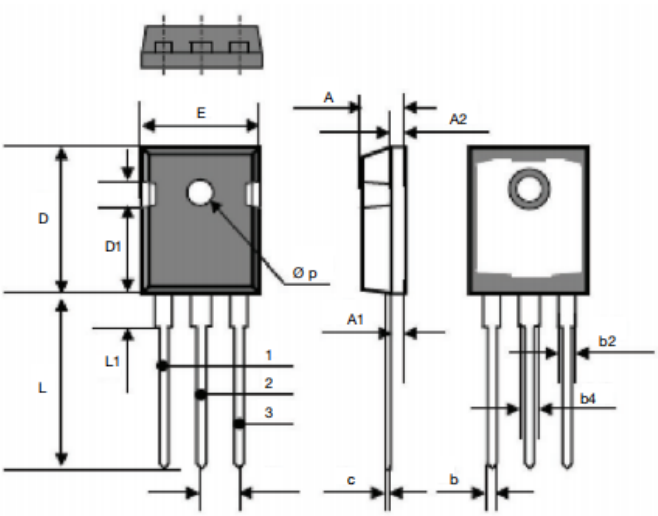


| DIM. | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. |
| A | 4.70 | 5.31 | 0.185 | 0.209 |
| A1 | 2.21 | 2.59 | 0.087 | 0.102 |
| A2 | 1.50 | 2.49 | 0.059 | 0.098 |
| b | 0.99 | 1.40 | 0.039 | 0.055 |
| b2 | 1.65 | 2.41 | 0.065 | 0.095 |
| b4 | 2.59 | 3.43 | 0.102 | 0.135 |
| c | 0.61 BSC | | 0.024 BSC | |
| D | 20.80 | 21.46 | 0.819 | 0.845 |
| D1 | 3.68 | 5.49 | 0.145 | 0.216 |
| (e) | 5.46 BSC | | 0.215 BSC | |
| E | 15.49 | 16.26 | 0.610 | 0.640 |
| L | 19.81 | 20.32 | 0.780 | 0.800 |
| L1 | 4.06 | 4.50 | 0.160 | 0.177 |
| Ø p | 3.51 | 3.66 | 0.138 | 0.144 |

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