# AOK40B120N1-VB Datasheet

## 1200V Trench and Fieldstop IGBT

| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{CE}$ (V) | 1200 | |
| $I_C$ (A) | 80 (TC=25°C) | 40 (TC=100°C) |
| $V_{CE}$ (sat) (V) | 1.8 | |
| $I_{CM}$ (A) | 120 | |

### 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)

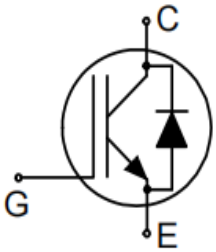
RoHS COMPLIANT
HALOGEN FREE

### 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-247

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 | | | $V_{CE}$ | 1200 | V |
| Gate-Emitter Voltage | | | $V_{GE}$ | ±30 | |
| Continuous Collector Current ($T_J$ = 150 °C) | $V_{GE}$ at 15 V | $T_C$ = 25 °C | $I_C$ | 80 | A |
| | | $T_C$ = 100 °C | | 40 | |
| Pulsed Collector Current [a] | | | $I_{CM}$ | 120 | |
| Diode Forward Current [b] | | | $I_F$ | 40 | A |
| Maximum Power Dissipation | | $T_C$ = 25 °C | $P_D$ | 350 | W |
| | | $T_C$ = 100 °C | | 180 | 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 | | 1200 | - | - | V |
| | | $V_{GE}$ = 0 V, $I_C$ = 1 mA | | 1200 | - | - | |
| 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 | $I_{CES}$ | $V_{CE}$ = 1200 V, $V_{GE}$ = 0 V, $T_J$ = 25 °C | | - | 1 | 20 | μA |
| | | $V_{CE}$ = 1200 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 | $I_C$ = 40 A | - | 1.7 | 2.1 | V |
| Forward Transconductance | $g_{fs}$ | $V_{CE}$ = 20 V, $I_C$ = 40 A | | - | 40 | - | S |
| **Dynamic** | | | | | | | |
| Input Capacitance | $C_{ies}$ | $V_{GE}$ = 0 V, $V_{CE}$ = 25 V, f = 500 KHz | | - | 4300 | - | pF |
| Output Capacitance | $C_{oes}$ | | | - | 230 | - | |
| Reverse Transfer Capacitance | $C_{res}$ | | | - | 68 | - | |
| Turn-on Energy | $E_{on}$ | $V_{CE}$ = 400 V , $V_{GE}$ = 0 /15V, $I_C$ = 40 A, $R_g$ = 10Ω | | - | 0.4 | - | nJ |
| Turn-off Energy | $E_{off}$ | | | - | 0.5 | - | |
| Total Gate Charge | $Q_g$ | $V_{GE}$ = 15 V | $I_C$ = 40 A, $V_{CE}$ = 400 V | - | 178 | - | nC |
| Gate-Emitter Charge | $Q_{ge}$ | | | - | 16 | - | |
| Gate to Collector Charge | $Q_{gc}$ | | | - | 42 | - | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{CE}$ = 400 V , $V_{GE}$ = 0 /15V, $I_C$ = 40 A, $R_g$ = 10Ω | | - | 68 | - | ns |
| Rise Time | $t_r$ | | | - | 52 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | - | 178 | - | |
| Fall Time | $t_f$ | | | - | 32 | - | |
| 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 | | - | - | 40 | A |
| Pulsed Diode Forward Current | $I_{FM}$ | | | - | - | 120 | |
| Diode Forward Voltage | $V_F$ | $I_F$ = 40 A | | - | 1.73 | 2.0 | V |
| Reverse Recovery Time | $t_{rr}$ | $T_J$ = 25 °C, $I_F$ = 40 A, $dI_F/dt$ = 200 A/μs, $V_R$ = 400 V | | - | 82 | - | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | | - | 0.24 | - | μC |
| Reverse Recovery Current | $I_{RRM}$ | | | - | 14 | - | A |

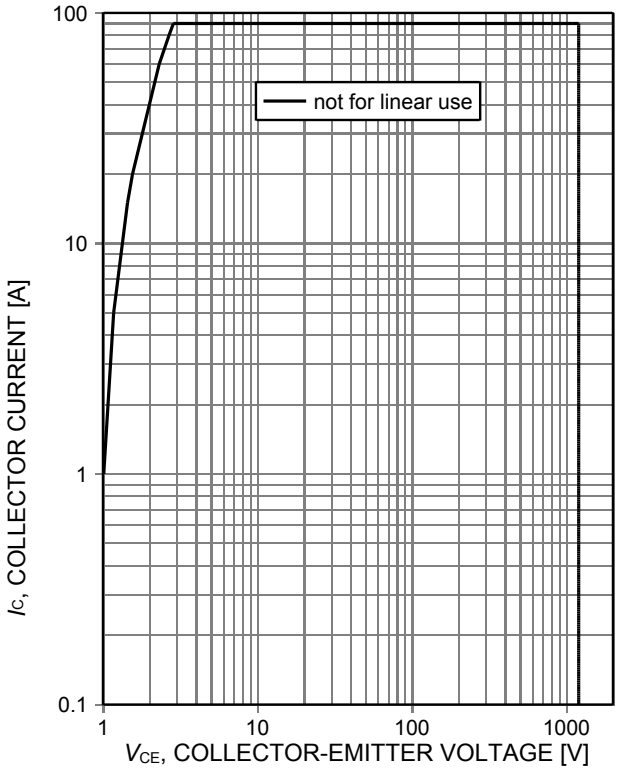



Figure 1. **Forward bias safe operating area**

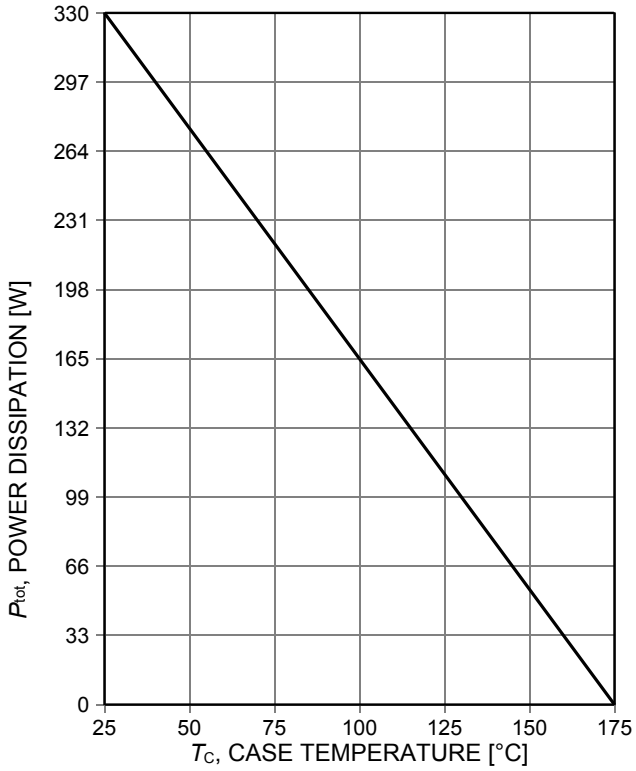



Figure 2. **Power dissipation as a function of case temperature**

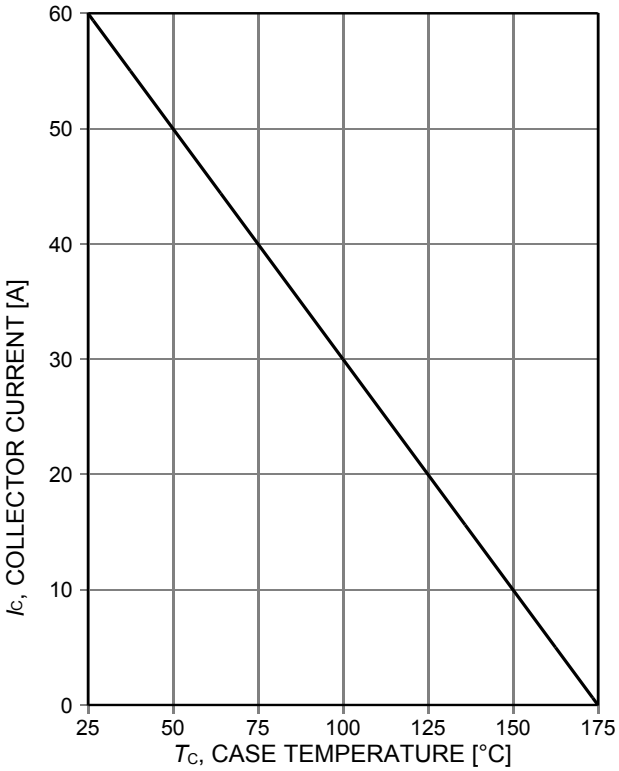



Figure 3. **Collector current as a function of case temperature**

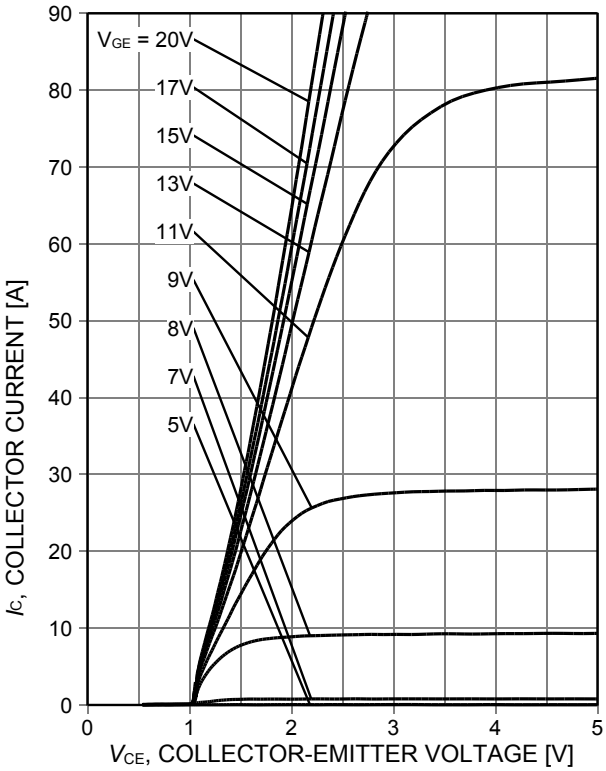



Figure 4. **Typical output characteristic**

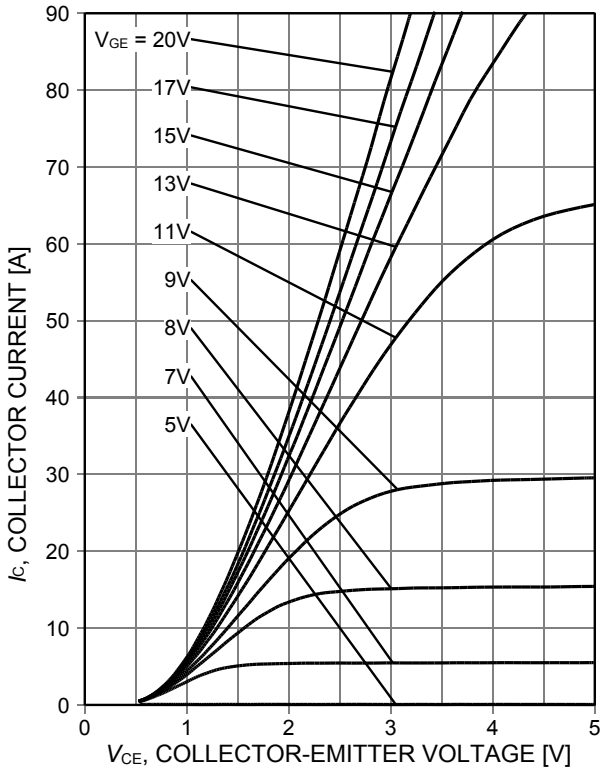



Figure 5. **Typical output characteristic**

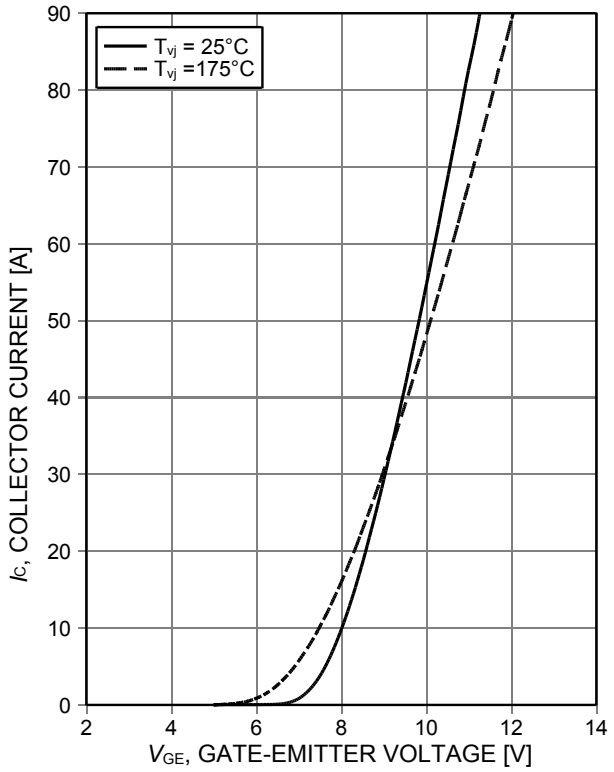



Figure 6. **Typical transfer characteristic**

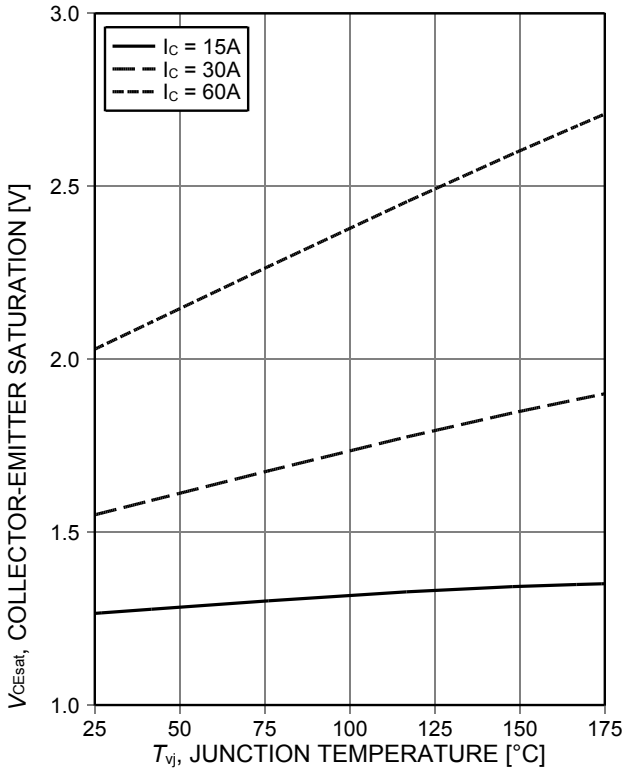



Figure 7. **Typical collector-emitter saturation voltage as a function of junction temperature**

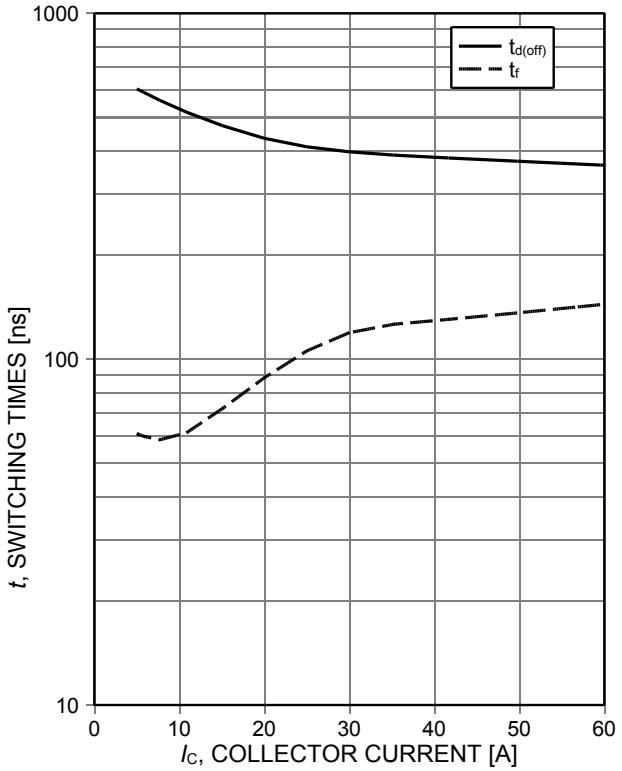



Figure 8. **Typical switching times as a function of collector current**

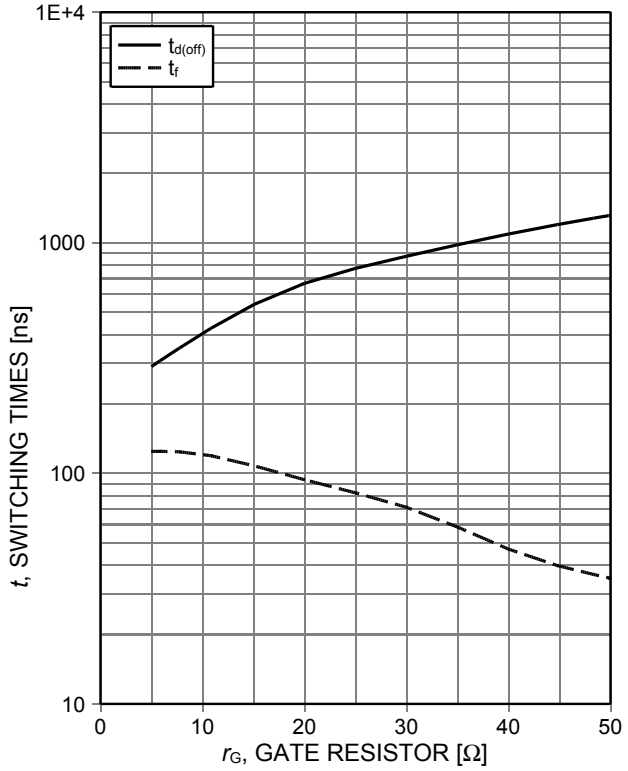



Figure 9. **Typical switching times as a function of gate resistor**

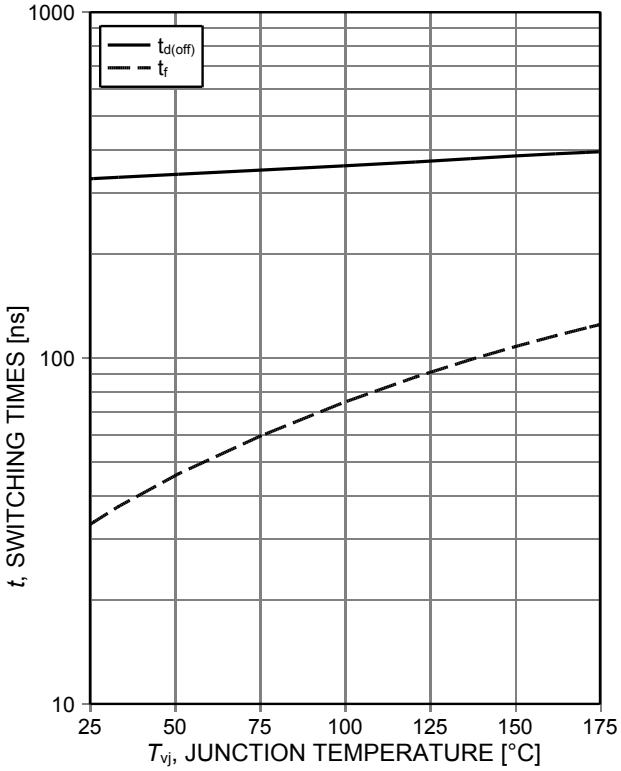



Figure 10. **Typical switching times as a function of junction temperature**

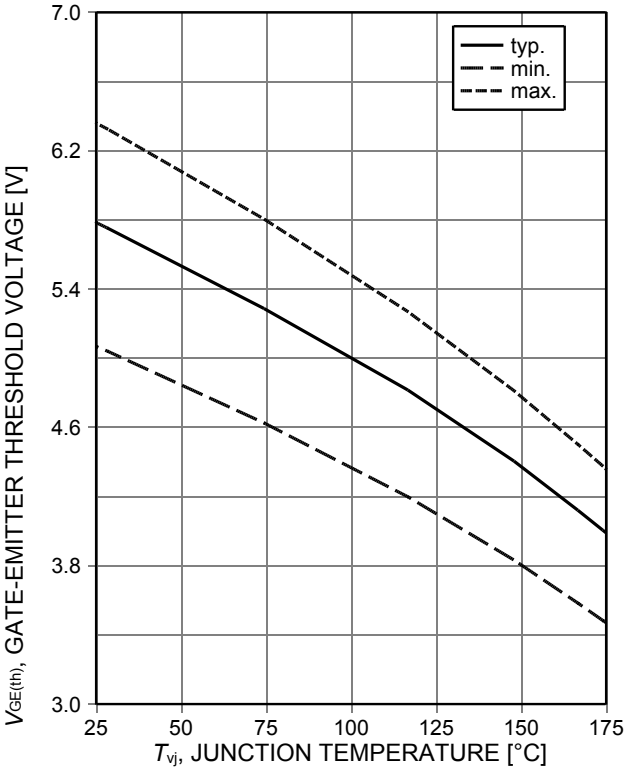



Figure 11. **Gate-emitter threshold voltage as a function of junction temperature**

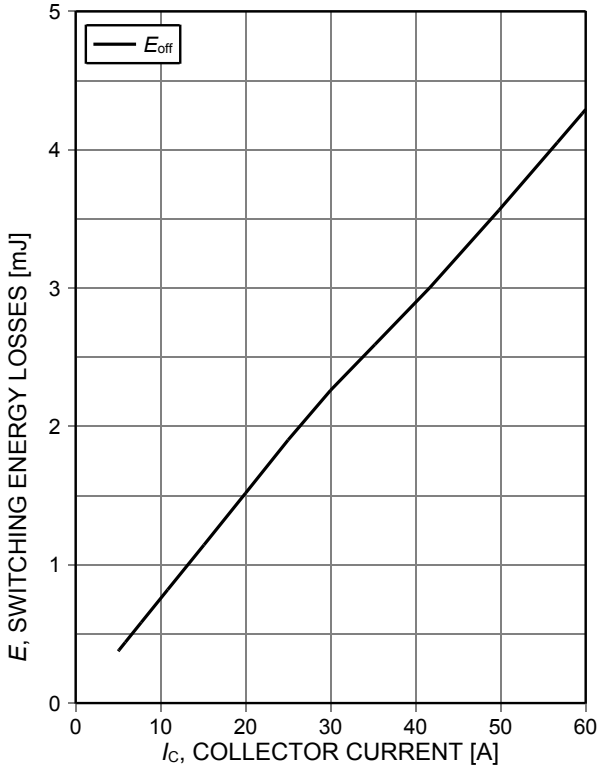



Figure 12. **Typical switching energy losses as a function of collector current**

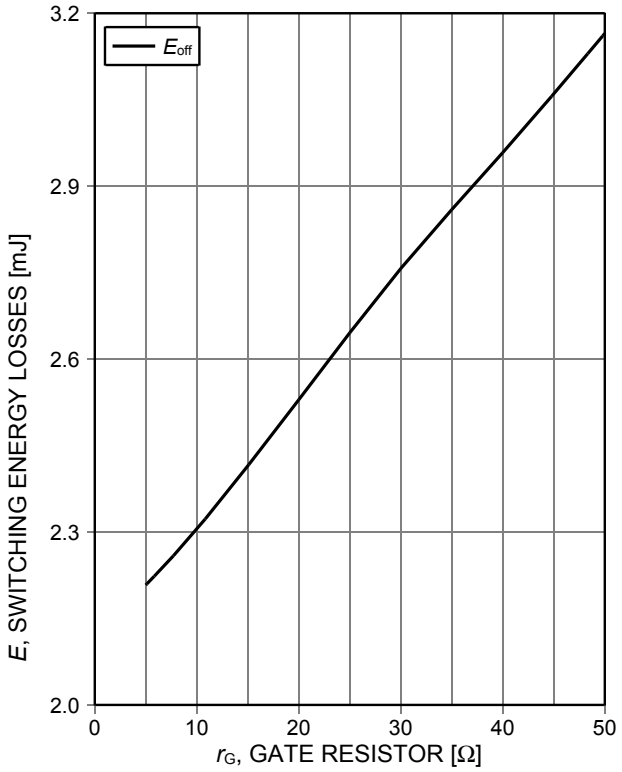



Figure 13. **Typical switching energy losses as a function of gate resistor**

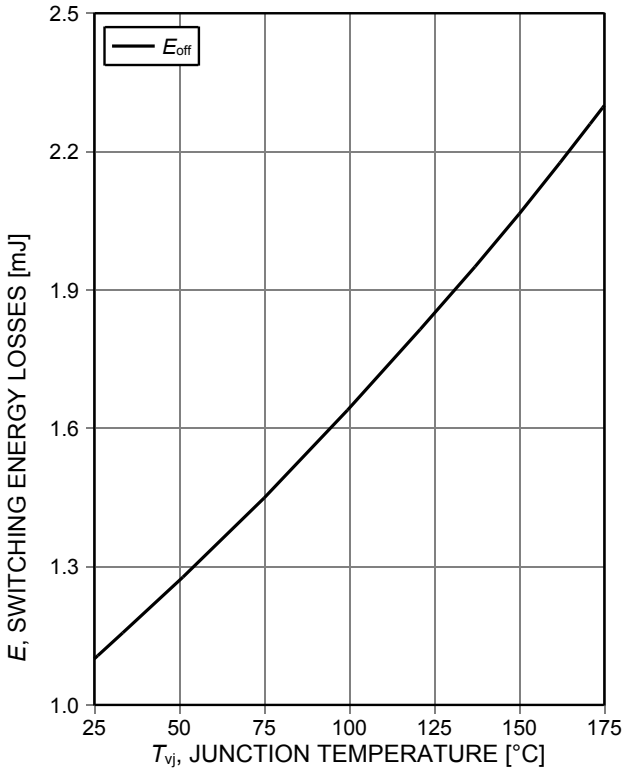



Figure 14. **Typical switching energy losses as a function of junction temperature**

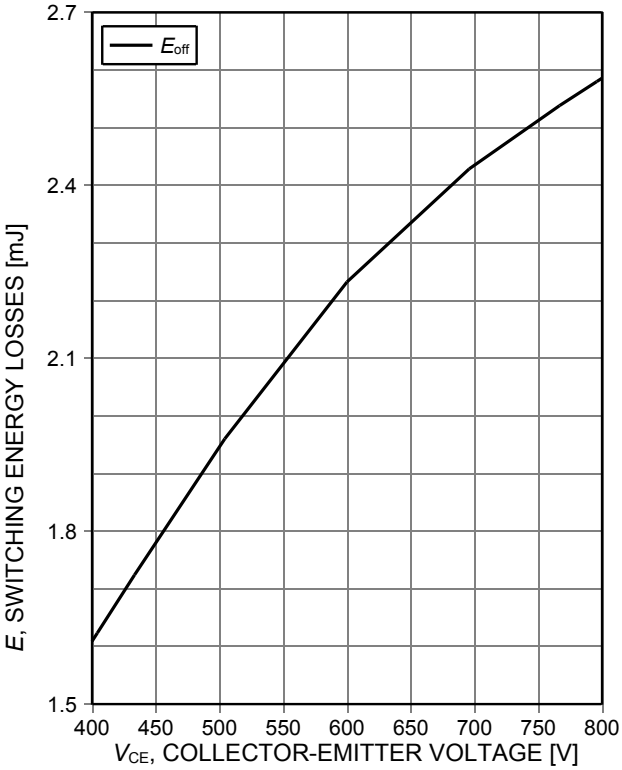



Figure 15. **Typical switching energy losses as a function of collector emitter voltage**

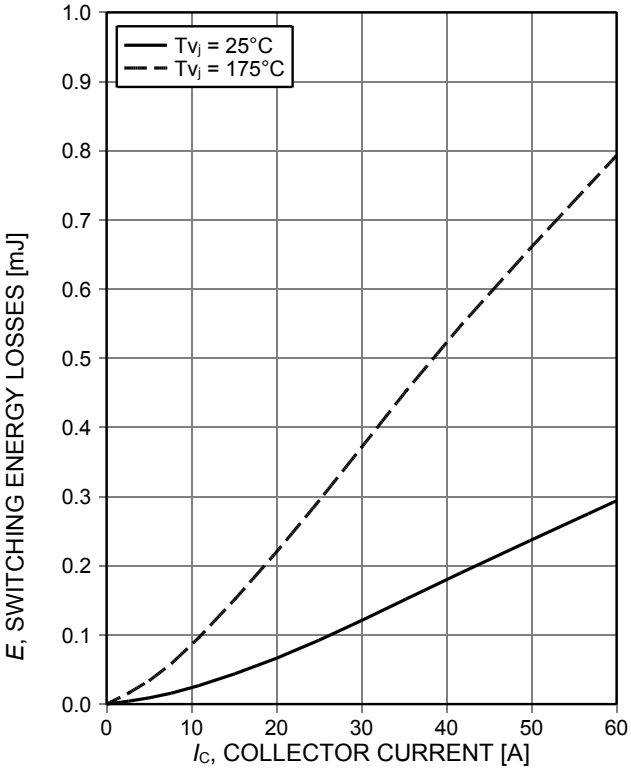



Figure 16. **Typical turn off switching energy loss for soft switching**

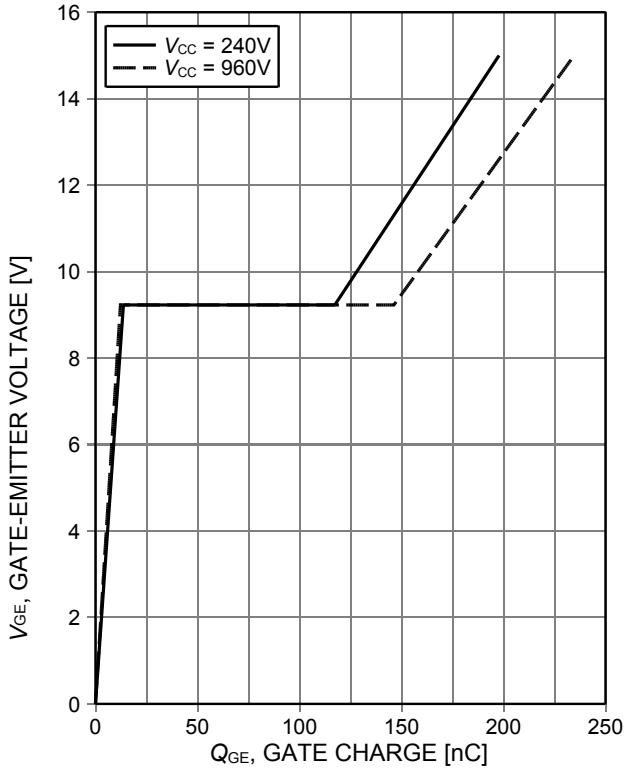



Figure 17. **Typical gate charge**

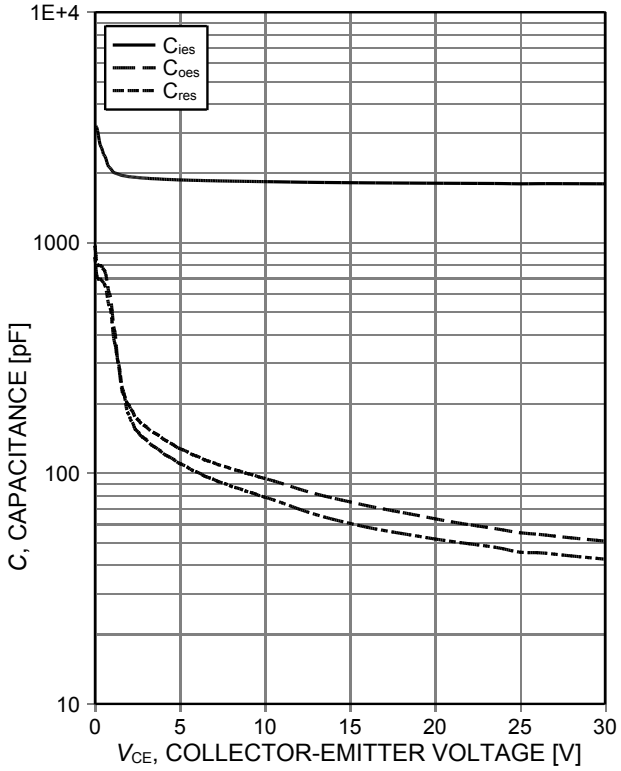



Figure 18. **Typical capacitance as a function of collector-emitter voltage**

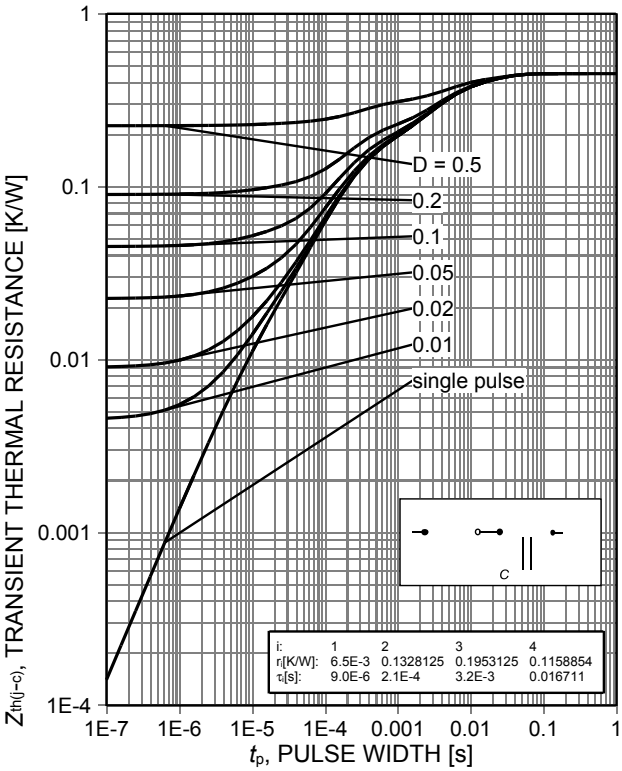



Figure 19. **IGBT transient thermal resistance**

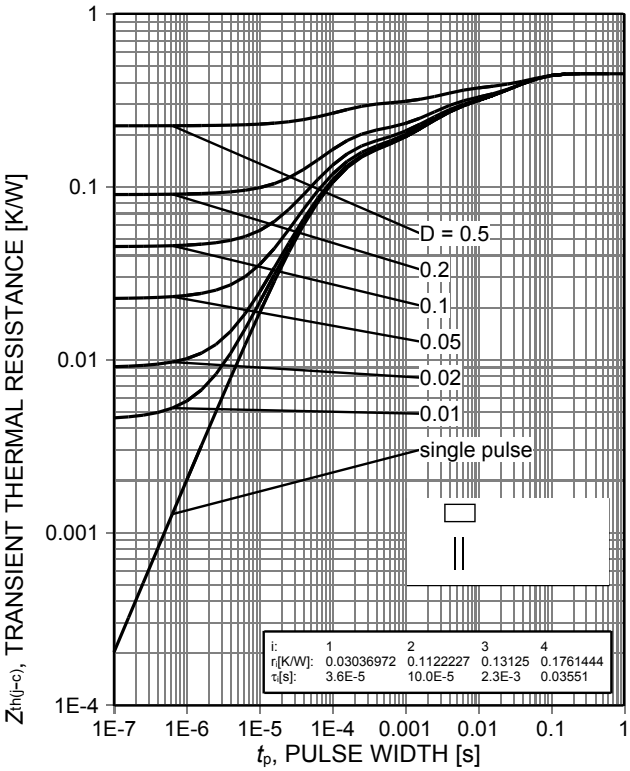



Figure 20. **Diode transient thermal impedance as a function of pulse width**

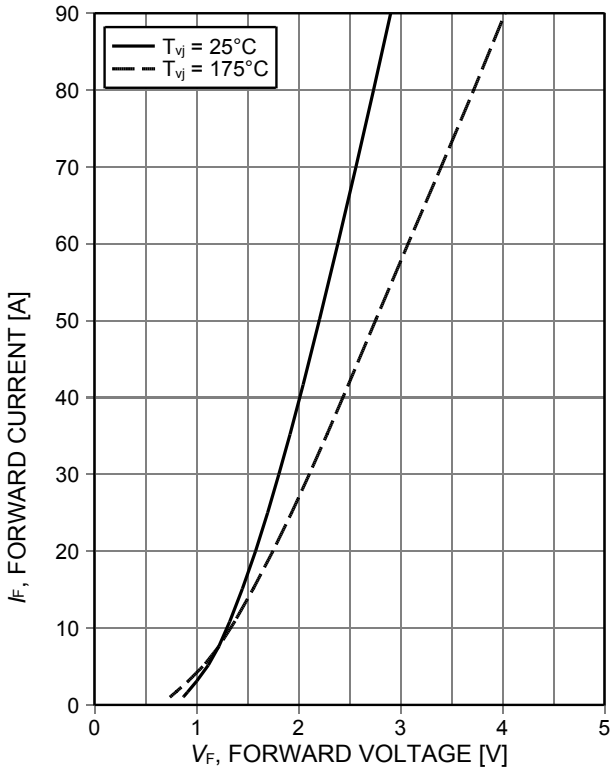



Figure 21. **Typical diode forward current as a function of forward voltage**

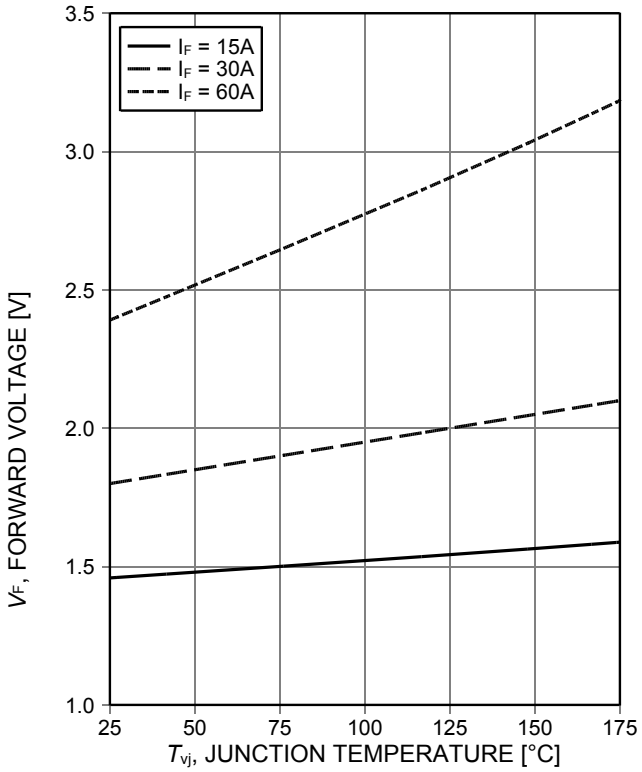
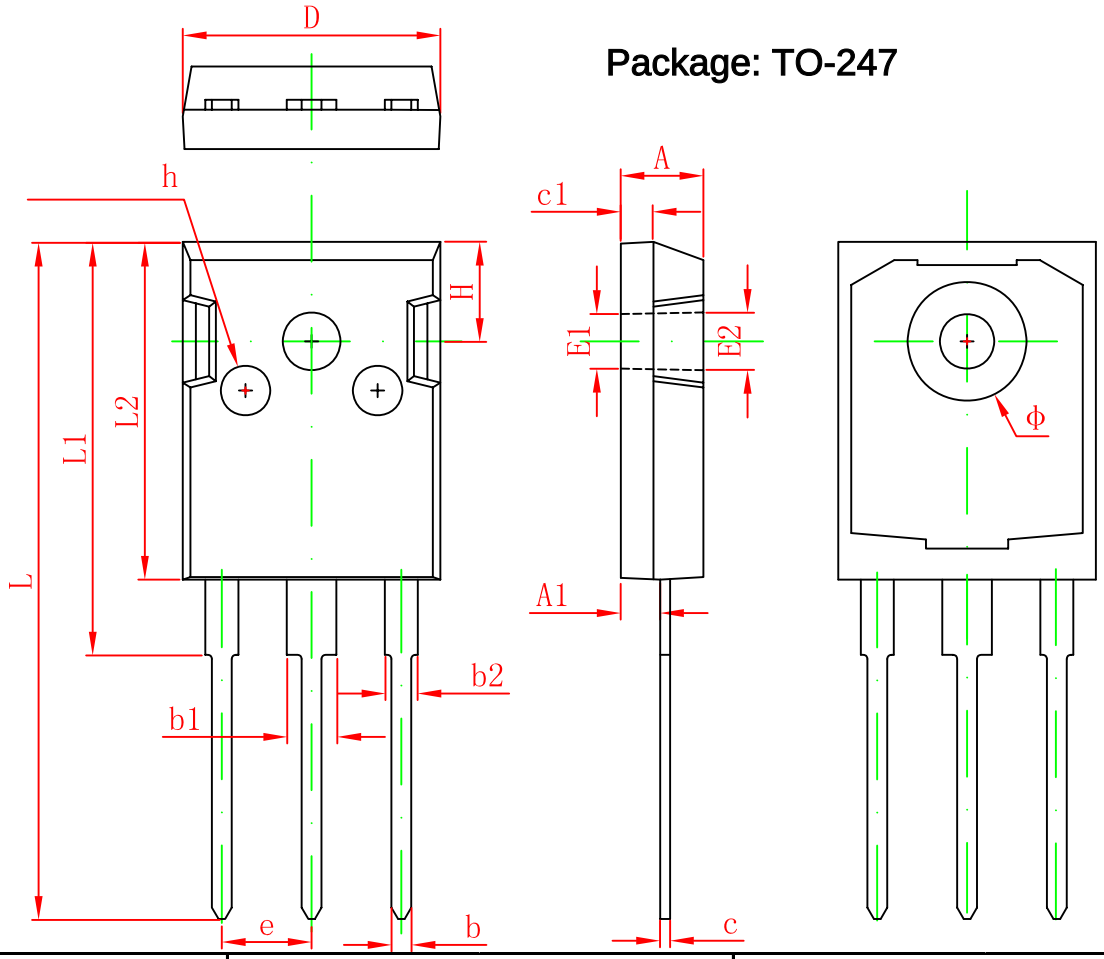



Figure 22. **Typical diode forward voltage as a function of junction temperature**

Package: TO-247




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 4.850 | 5.150 | 0.191 | 0.200 |
| A1 | 2.200 | 2.600 | 0.087 | 0.102 |
| b | 1.000 | 1.400 | 0.039 | 0.055 |
| b1 | 2.800 | 3.200 | 0.110 | 0.126 |
| b2 | 1.800 | 2.200 | 0.071 | 0.087 |
| c | 0.500 | 0.700 | 0.020 | 0.028 |
| c1 | 1.900 | 2.100 | 0.075 | 0.083 |
| D | 15.450 | 15.750 | 0.608 | 0.620 |
| E1 | 3.500 REF | | 0.138 REF | |
| E2 | 3.600 REF | | 0.142 REF | |
| L | 40.900 | 41.300 | 1.610 | 1.626 |
| L1 | 24.800 | 25.100 | 0.976 | 0.988 |
| L2 | 20.300 | 20.600 | 0.799 | 0.811 |
| Φ | 7.100 | 7.300 | 0.280 | 0.287 |
| e | 5.450 TYP | | 0.215 TYP | |
| H | 5.980 REF | | 0.235 REF | |
| h | 0.000 | 0.300 | 0.000 | 0.012 |

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