# AMPBZ50N65ED

## 650V-50A Trench and Field Stop IGBT

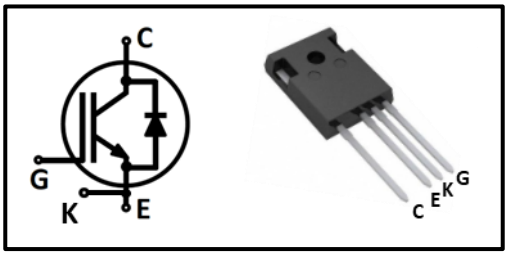
## Features

- Easy parallel switching capability due to positive temperature coefficient in $V_{CEsat}$
- Low $V_{CEsat}$, fast switching
- High ruggedness, good thermal stability
- Very tight parameter distribution

## Applications

- UPS
- PFC
- PTC Heater
- Climate Compressor

| Type | Marking | Package Code |
|---|---|---|
| AMPBZ50N65ED | AMP50N65ED | TO-247-4 |




## Maximum Rated Values [1]

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Collector-emitter voltage | $V_{CE}$ | 650 | V |
| DC collector current[2] | | | A |
| $T_C$=25℃ | $I_C$ | 80 | |
| $T_C$=100℃ | | 50 | |
| Pulsed collector current[3] | $I_{Cpuls}$ | 200 | |
| Diode forward current[2] | | | |
| $T_C$=25℃ | $I_F$ | 80 | |
| $T_C$=100℃ | | 50 | |
| Diode pulsed current[3] | $I_{Fpuls}$ | 200 | |
| Gate-emitter voltage | $V_{GE}$ | ±20 | V |
| Transient Gate-emitter voltage（$t_p$≤10us) | | ±30 | |
| Power dissipation | | | W |
| $T_C$=25℃ | $P_{tot}$ | 300 | |
| $T_C$=100℃ | | 150 | |
| Operating junction temperature | $T_j$ | -55~175 | ℃ |
| Storage temperature | $T_{stg}$ | -55~150 | |

1:Reference standard: JESD-022 2: limited by Tjmax 3: Tp limited by Tjmax ;

## Thermal Characteristics

| Parameter | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| IGBT thermal resistance, junction-case | $R_{thJC}$ | - | - | 0.5 | K/W |
| Diode thermal resistance, junction-case | $R_{thJCD}$ | - | - | 0.65 | |
| Thermal Resistance, junction-ambient | $R_{thJA}$ | - | - | 40 | |

## Electrical Characteristics（at Tj=25℃, unless otherwise specified）

## Static Characteristics

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Collector-emitter breakdown voltage | $V_{(BR)CES}$ | $V_{GE}$=0V, $I_C$=0.25mA | 650 | - | - | V |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $V_{GE}$=15V, $I_C$=50A $T_j$=25℃ | - | 1.60 | 1.90 | |
| | | $T_j$=125℃ | - | 1.90 | - | |
| | | $T_j$=150℃ | - | 1.98 | - | |
| Diode forward voltage | $V_F$ | $V_{GE}$=0V，$I_F$=50A $T_j$=25℃ | - | 2.00 | 2.30 | |
| | | $T_j$=125℃ | - | 1.81 | - | |
| | | $T_j$=150℃ | - | 1.76 | - | |
| G-E threshold voltage | $V_{GE(th)}$ | $I_C$=1mA, $V_{CE}$=$V_{GE}$ | 4.5 | 5.5 | 6.5 | |
| C-E leakage current | $I_{CES}$ | $V_{CE}$=650V, $V_{GE}$=0V $T_j$=25℃ | - | - | 0.01 | mA |
| | | $T_j$=150℃ | - | - | 1.0 | |
| G-E leakage current | $I_{GES}$ | $V_{CE}$=0V, $V_{GE}$=20V | - | - | 250 | nA |
| Transconductance | $g_{FS}$ | $V_{CE}$=20V, $I_C$=50A | - | 21 | - | S |

## Dynamic Characteristics

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Input capacitance | $C_{iss}$ | $V_{CE}$=25V, $V_{GE}$=0V, f=1MHz | - | 5573 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 148 | - | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 80 | - | |
| Gate charge | $Q_G$ | $V_{CC}$=300V, $I_C$=50A, $V_{GE}$=15V | - | 230 | - | nC |

## IGBT Switching Characteristics

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Turn-on delay time | $t_{d(on)}$ | $T_j$=25℃, $V_{CC}$=400V, $I_C$=50A, $V_{GE}$=0/15V, $R_G$=10Ω, Inductive load | - | 107 | - | ns |
| Rise time | $t_r$ | | - | 62 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 265 | - | |
| Fall time | $t_f$ | | - | 48 | - | |
| Turn-on energy | $E_{on}$ | | - | 0.90 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 1.12 | - | |
| Total switching energy | $E_{ts}$ | | - | 2.02 | - | |
| Turn-on delay time | $t_{d(on)}$ | $T_j$=150℃, $V_{CC}$=400V, $I_C$=50A, $V_{GE}$=0/15V, $R_G$=10Ω, Inductive load | - | 100 | - | ns |
| Rise time | $t_r$ | | - | 62 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 335 | - | |
| Fall time | $t_f$ | | - | 50 | - | |
| Turn-on energy | $E_{on}$ | | - | 1.45 | - | mJ |
| Turn-off energy | $E_{off}$ | | - | 1.35 | - | |
| Total switching energy | $E_{ts}$ | | - | 2.80 | - | |

## Diode Characteristics

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Diode reverse recovery time | $t_{rr}$ | $T_j$=25℃, $V_R$=400V, $I_F$=50A, $di_F/dt$=640A/μs | - | 57 | - | ns |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 0.39 | - | μC |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 10.6 | - | A |
| Diode reverse recovery time | $t_{rr}$ | $T_j$=150℃, $V_R$=400V, $I_F$=50A, $di_F/dt$=640A/μs | - | 92.8 | - | ns |
| Diode reverse recovery charge | $Q_{rr}$ | | - | 1.48 | - | μC |
| Diode peak reverse recovery current | $I_{rrm}$ | | - | 24 | - | A |

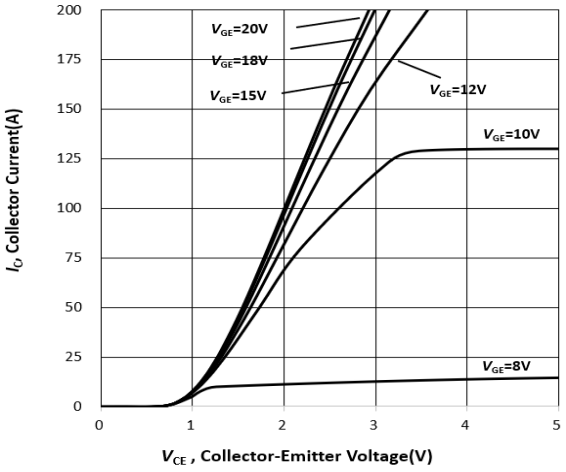



**Figure 1. Typical output characteristic** ($T_j$ =25℃)

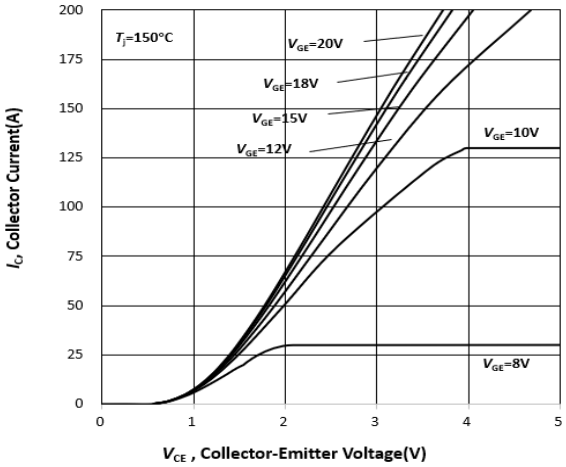



**Figure 2. Typical output characteristic** ($T_j$ =150℃)

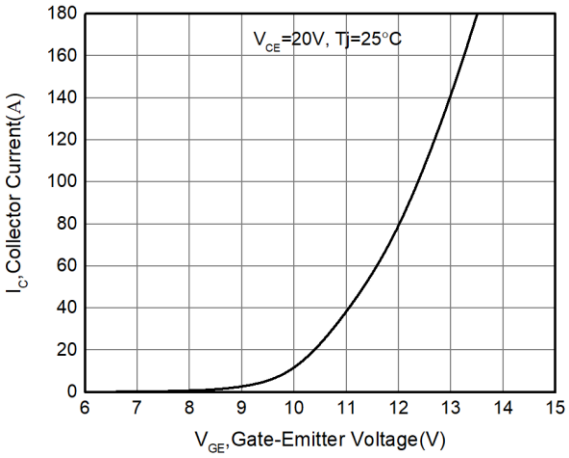



**Figure 3. Typical transfer characteristic** ($T_j$ =25℃)

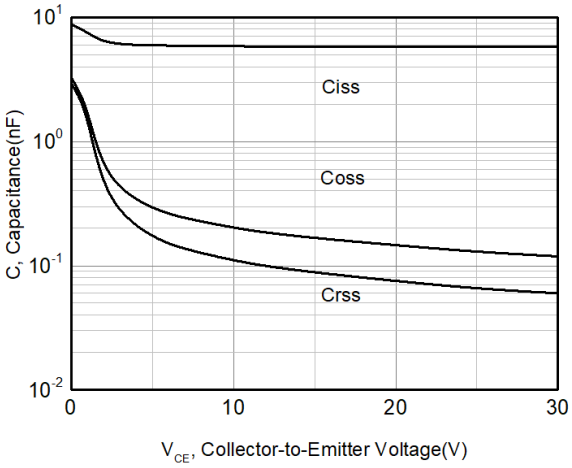



**Figure 4. Capacitance characteristic** ($V_{GE}$=0V, $f$=1MHz)

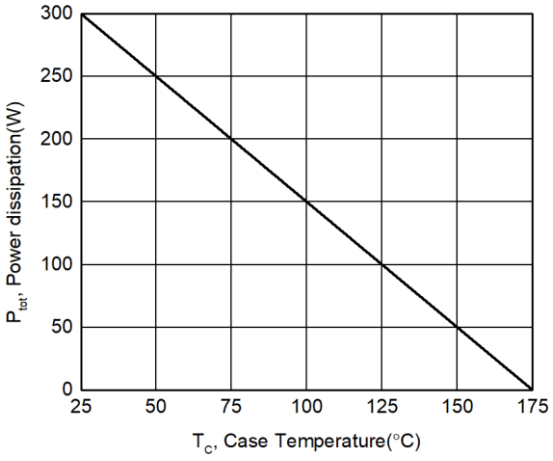



**Figure 5. Power dissipation as a function of case temperature** ($T_j$≤175℃)

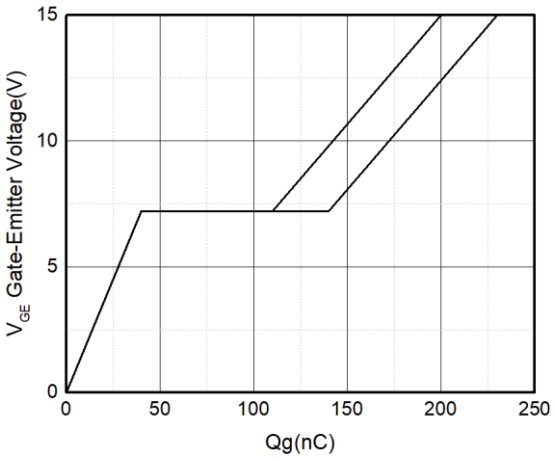



**Figure 6. Typical gate charge** ($I_C$=50A)

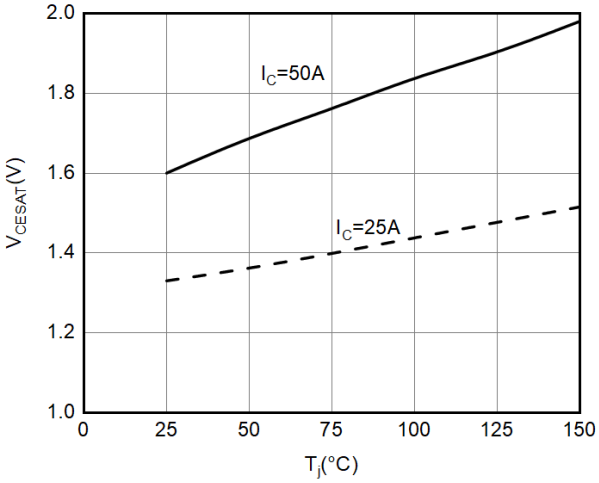



**Figure 7. $V_{CESAT}$ as a function of junction temperature** ($V_{GE}$=15V)

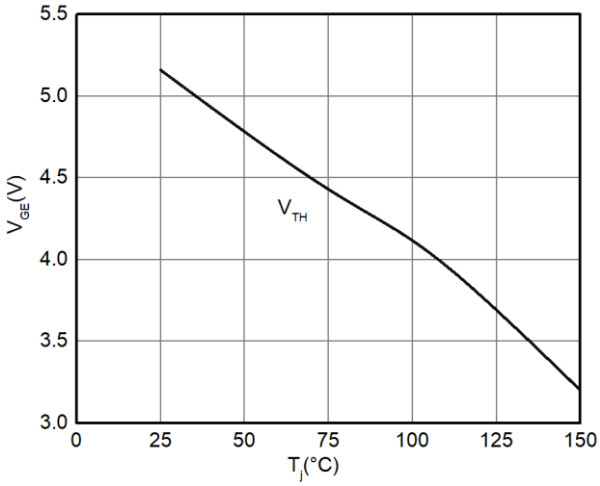



**Figure 8. $V_{TH}$ as a function of junction temperature** ($I_{CE}$=250μA)

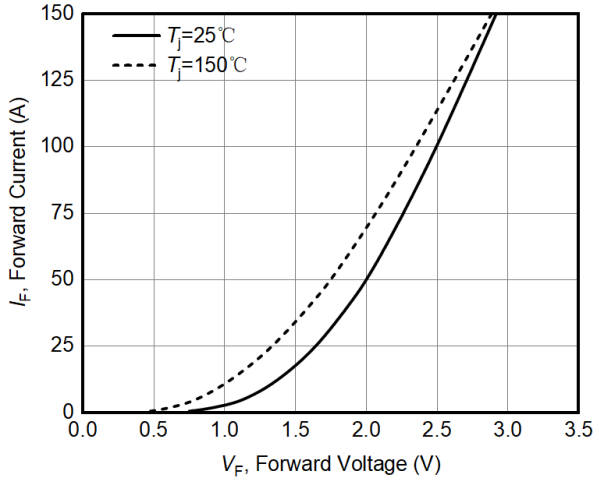



**Figure 9. Typical diode forward current as a function of forward voltage**

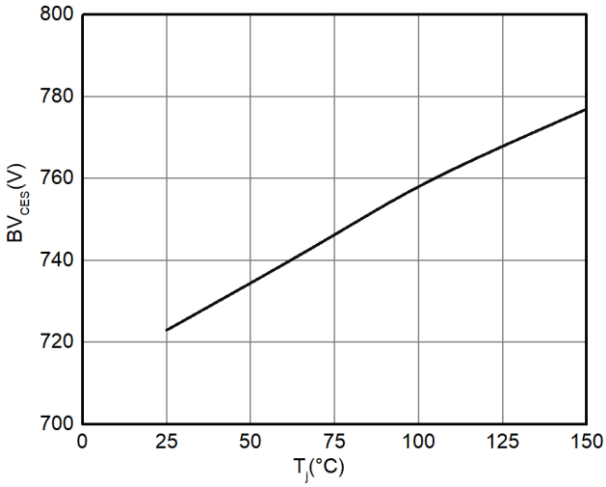



**Figure 10. BV as a function of junction temperature** ($I_{CE}$=250μA)

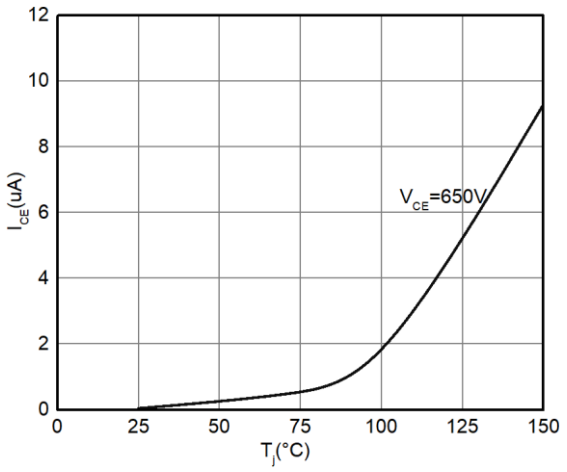



**Figure 11. $I_{CES}$ leakage current as a function of junction temperature**

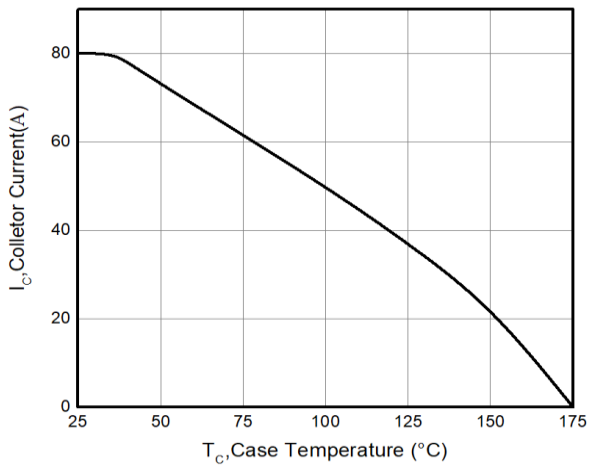



**Figure 12. Collector current as a function of case temperature**($V_{GE}$≥15V, $T_j$≤175℃)

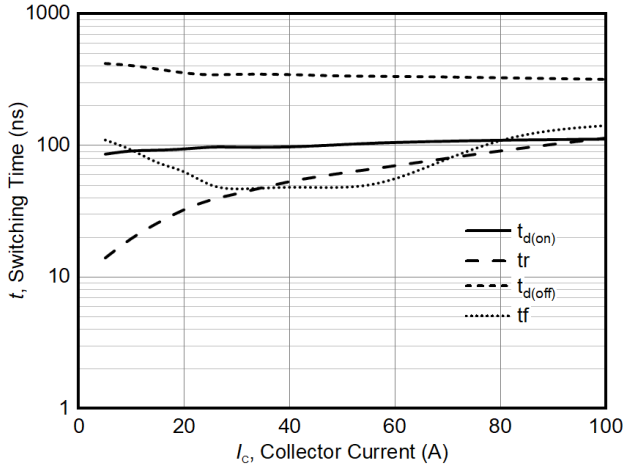



**Figure 13. Typical switching times as a function of collector current**
($T_j$=150 ℃, $V_{CE}$=400V, $R_{G(on)}$=$R_{G(off)}$=10Ω)

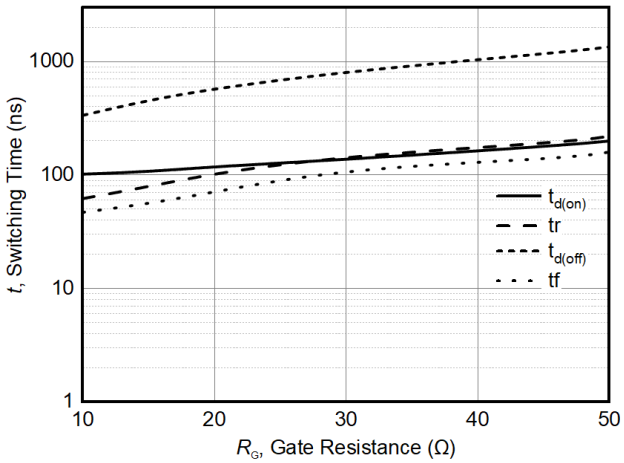



**Figure 14. Typical switching times as a function of gate resistance**
($T_j$=150 ℃, $V_{CE}$=400V, $I_C$=50A)

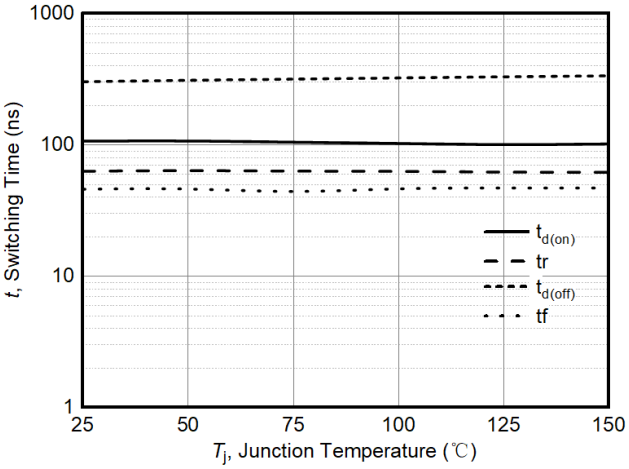



**Figure 15. Typical switching times as a function of junction temperature**
($V_{CE}$=400V, $I_C$=50A, $R_{G(on)}$=$R_{G(off)}$=10Ω)

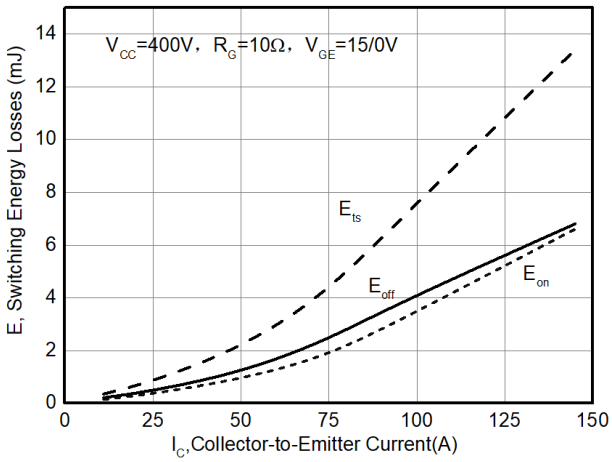



**Figure 16. $E_{on}$, $E_{off}$ as a function of $I_C$**
($T_j$=25 ℃)

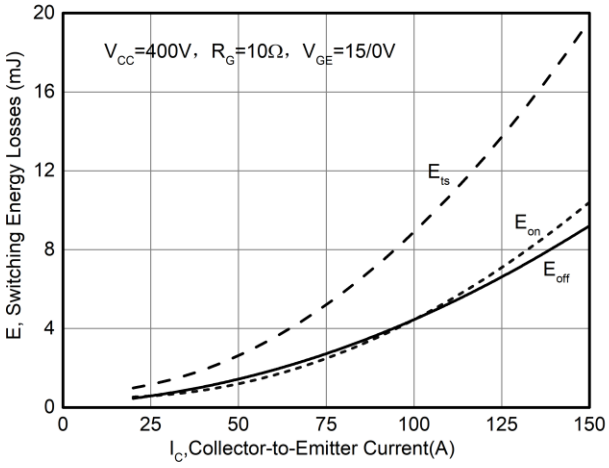



**Figure 17. $E_{on}$, $E_{off}$ as a function of $I_C$**
($T_j$=150℃)

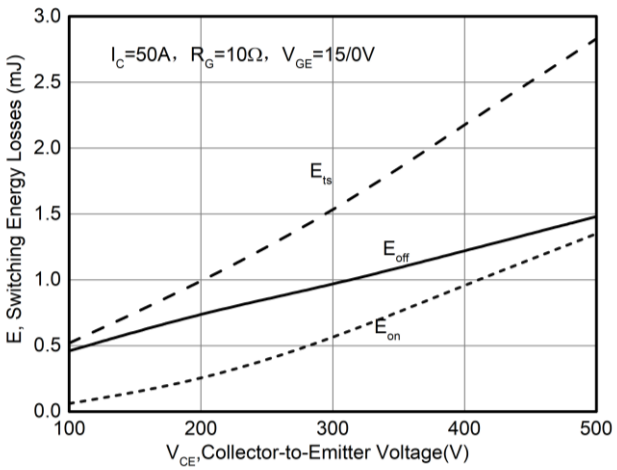



**Figure 18. $E_{on}$, $E_{off}$ as a function of $V_{CE}$**
($T_j$=25℃)

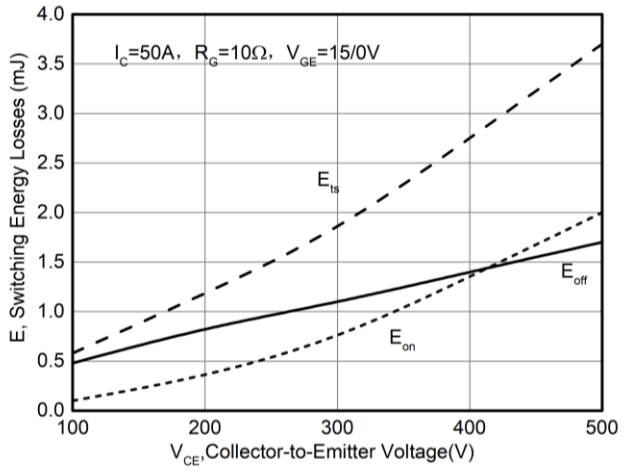



**Figure 19. $E_{on}$, $E_{off}$ as a function of $V_{CE}$ ($T_j$=150℃)**

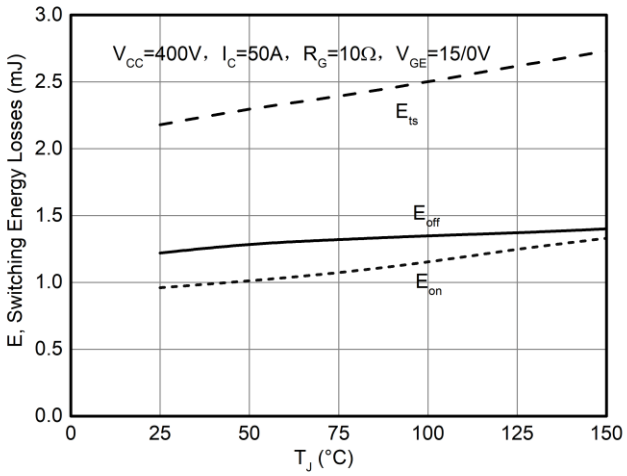



**Figure 20. $E_{on}$, $E_{off}$ as a function of $T_j$**

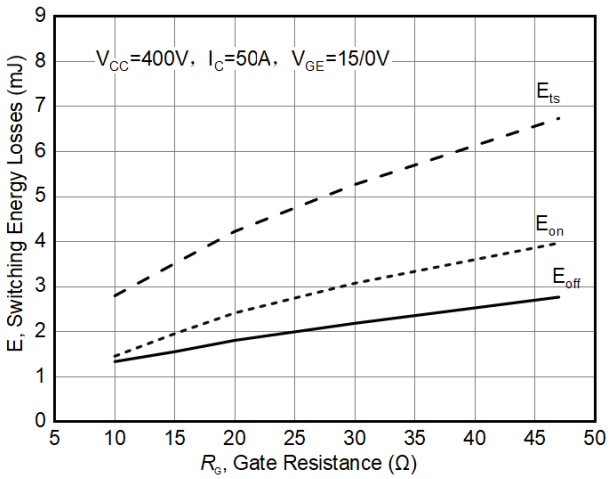



**Figure 21. $E_{on}$, $E_{off}$ as a function of gate resistance ($T_j$=150 ℃)**

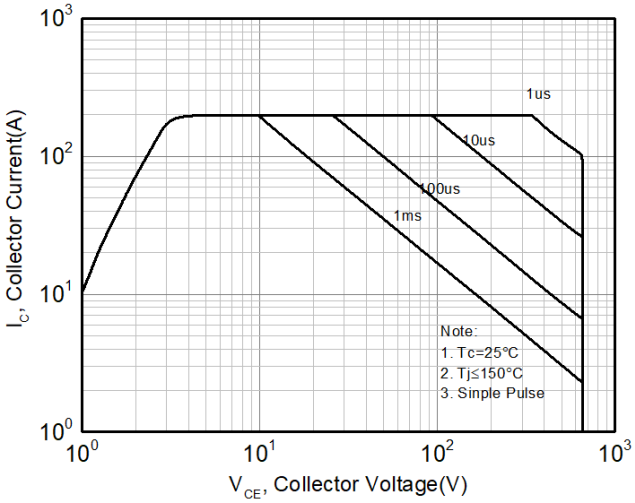



**Figure 22. FBSOA**

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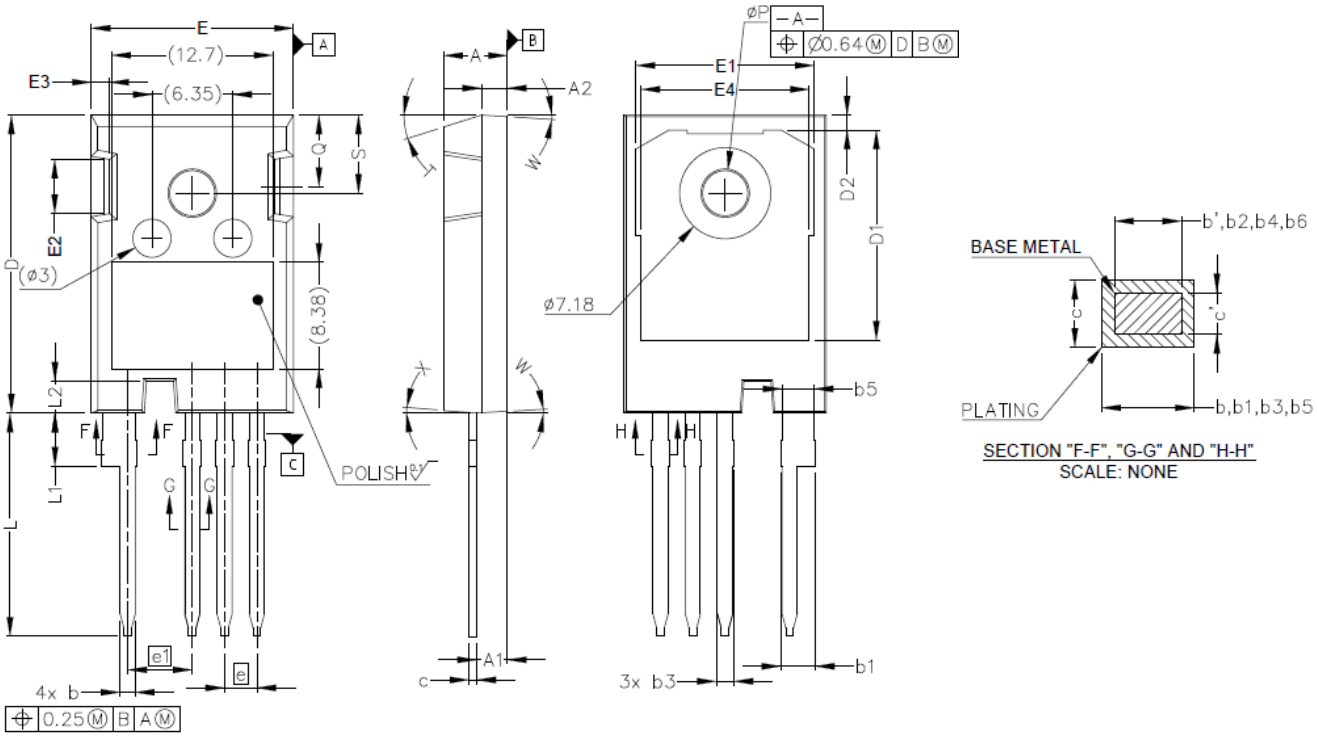


| SYMBOL | MILLIMETERS | | SYMBOL | MILLIMETERS | |
|---|---|---|---|---|---|
| | MIN | MAX | | MIN | MAX |
| A | 4.83 | 5.21 | E1 | 13.10 | 14.15 |
| A1 | 2.29 | 2.54 | E2 | 3.68 | 5.10 |
| A2 | 1.91 | 2.16 | E3 | 1.00 | 1.90 |
| b' | 1.07 | 1.28 | E4 | 12.38 | 13.43 |
| b | 1.07 | 1.33 | e | 2.54 BSC | |
| b1 | 2.39 | 2.94 | e1 | 5.08 BSC | |
| b2 | 2.39 | 2.84 | N | 4 | |
| b3 | 1.07 | 1.60 | L | 17.31 | 17.82 |
| b4 | 1.07 | 1.50 | L1 | 3.97 | 4.37 |
| b5 | 2.39 | 2.69 | L2 | 2.35 | 2.65 |
| b6 | 2.39 | 2.64 | øP | 3.51 | 3.65 |
| c' | 0.55 | 0.65 | Q | 5.49 | 6.00 |
| c | 0.55 | 0.68 | S | 6.04 | 6.30 |
| D | 23.30 | 23.60 | T | 17.5° REF. | |
| D1 | 16.25 | 17.65 | W | 3.5° REF. | |
| D2 | 0.95 | 1.25 | X | 4° REF. | |
| E | 15.75 | 16.13 | | | |

## Revision History：

| Revision | Date | Subjects (major changes since last revision) |
|---|---|---|
| 1.0 | 2023-02 | Initial Version |

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