# AIP50N65BS

Trench FS IGBT Discrete

## Product Summary

| $V_{(BR)CES}$ | $V_{CE(SAT)MAX}$ | $I_C$ |
|---|---|---|
| 650V | 1.9V@15V | 50A |

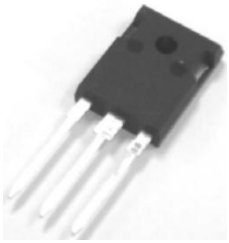
## Feature

- High speed smooth switching device for hard & soft switching
- Positive temperature coefficient
- High ruggedness, temperature stable

## Application

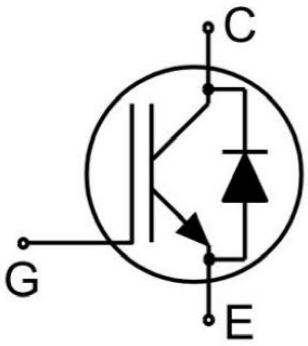
- Solar converters
- Welding converters
- Mid to high range switching frequency converters
- Uninterruptible power supply

## Package

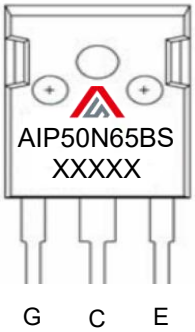


**TO-247AB**

## Circuit diagram




## Marking



## Absolute maximum ratings (Tc=25℃ unless otherwise noted)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Collector-Emitter Voltage | $V_{CE}$ | 650 | V |
| Continuous Gate- Emitter Voltage | $V_{GE}$ | ±20 | V |
| Collector Current | $I_C$ | 80 | A |
| Collector Current($T_C$ =100℃) | $I_C$(100℃) | 50 | A |
| Pulsed Collector Current, tp limited by $T_{jmax}$,$V_{GE}$=15V | $I_{CM}$ | 200 | A |
| Diode Continuous Forward Current | $I_F$ | 80 | A |
| Diode Continuous Forward Current($T_C$ =100℃) | $I_F$(100℃) | 50 | A |
| Diode Forward Pulsed Current,tp limited by $T_{jmax}$ | $I_{Fpuls}$ | 200 | A |
| Turn off Safe Operating Area $V_{CE}$≤650V,$T_J$≤150°C | - | 200 | A |
| Power Dissipation($T_J$=175°C) | $P_D$ | 283 | W |
| Thermal Resistance, Junction to case for Diode | $R_{\theta JC}$ | 1.05 | ℃/W |
| Thermal Resistance, Junction to case for IGBT | $R_{\theta JC}$ | 0.53 | ℃/W |
| Maximum Temperature for Soldering,wave soldering 1.6mm (0.063in.) from case for 10s | $T_L$ | 260 | ℃ |
| Junction Temperature Range | $T_J$ | -40 ~ +175 | ℃ |
| Storage Temperature Range | $T_{STG}$ | -55 ~ +150 | ℃ |

## Electrical characteristics of the IGBT ($T_j$=25℃ unless otherwise noted)

| Parameter | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Static Characteristics** | | | | | | |
| Collector-Emitter Breakdown Voltage | $V_{(BR)CES}$ | $V_{GE}$ = 0V, $I_{CE}$ =250uA | 650 | | | V |
| Collector-Emitter Leakage Current | $I_{CES}$ | $V_{GE}$ = 0V,$V_{CE}$=650V | | | 0.25 | mA |
| | | $V_{GE}$ = 0V,$V_{CE}$=650V,Tj=150℃ | | | 3 | |
| Gate to Emitter Leakage Current | $I_{GES}$ | $V_{GE}$ =±20V, $V_{CE}$ = 0V | | | 100 | nA |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_{GE}$=15V,$I_C$=50A | 1.3 | 1.6 | 1.9 | V |
| | | $V_{GE}$=15V,$I_C$=50A,Tj=125℃ | | 1.8 | | |
| | | $V_{GE}$=15V,$I_C$=50A,Tj=150℃ | | 1.9 | | |
| Gate Threshold Voltage | $V_{GE(th)}$ | $V_{CE}$ =$V_{GE}$,$I_C$=0.5mA | 3.8 | 4.8 | 5.8 | V |
| **Dynamic characteristics** | | | | | | |
| Input Capacitance | $C_{ies}$ | $V_{CE}$=25V,$V_{GE}$=0V, f =1MHz | | 2.83 | | nF |
| Reverse Transfer Capacitance | $C_{res}$ | | | 0.02 | | |
| Total Gate Charge | $Q_g$ | $V_{CC}$=520V,$V_{GE}$ =15V,$I_C$=50A | | 0.14 | | uC |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}$=400V,$V_{GE}$= -5V~15V, $I_C$ =50A,$R_G$=10Ω, Inductive Load | | 24 | | nS |
| Turn-on rise time | $t_r$ | | | 31 | | |
| Turn-off delay time | $t_{d(off)}$ | | | 74 | | |
| Turn-off fall time | $t_f$ | | | 35 | | |
| Turn-On Switching energy | $E_{on}$ | | | 2.05 | | mJ |
| Turn-Off Switching energy | $E_{off}$ | | | 0.36 | | |
| Total Switching energy | $E_{ts}$ | | | 2.47 | | |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}$=400V,$V_{GE}$= -5V~15V, $I_C$ =50A,$R_G$=10Ω, Inductive Load,Tj=125℃ | | 24 | | nS |
| Turn-on rise time | $t_r$ | | | 42 | | |
| Turn-off delay time | $t_{d(off)}$ | | | 82 | | |
| Turn-off fall time | $t_f$ | | | 41 | | |
| Turn-On Switching energy | $E_{on}$ | | | 2.11 | | mJ |
| Turn-Off Switching energy | $E_{off}$ | | | 0.44 | | |
| Total Switching energy | $E_{ts}$ | | | 2.56 | | |
| Turn-on delay time | $t_{d(on)}$ | $V_{CC}$=400V,$V_{GE}$= -5V~15V, $I_C$ =50A,$R_G$=10Ω, Inductive Load,Tj=150℃ | | 25 | | nS |
| Turn-on rise time | $t_r$ | | | 48 | | |
| Turn-off delay time | $t_{d(off)}$ | | | 88 | | |
| Turn-off fall time | $t_f$ | | | 44 | | |
| Turn-On Switching energy | $E_{on}$ | | | 2.19 | | mJ |
| Turn-Off Switching energy | $E_{off}$ | | | 0.47 | | |
| Total Switching energy | $E_{ts}$ | | | 2.66 | | |

## Electrical characteristics of the Diode ($T_j$=25℃ unless otherwise noted)

| Parameter | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Diode Forward Voltage | $V_{FM}$ | $I_F$=50A | | 1.60 | 2.00 | V |
| | | $I_F$=50A,Tj=125℃ | | 1.50 | | |
| | | $I_F$=50A,Tj=150℃ | | 1.40 | | |
| Reverse Recovery Current | $I_{rr}$ | $I_F$=50A,$V_R$=400V, -di/dt=450A/us | | 15 | | A |
| Diode reverse recovery time | $t_{rr}$ | | | 148 | | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | | 1.58 | | uC |
| Reverse recovery energy | $E_{rec}$ | | | 0.29 | | mJ |
| Reverse Recovery Current | $I_{rr}$ | $I_F$=50A,$V_R$=400V, -di/dt=450A/us,Tj=125℃ | | 21 | | A |
| Diode reverse recovery time | $t_{rr}$ | | | 183 | | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | | 2.54 | | uC |
| Reverse recovery energy | $E_{rec}$ | | | 0.65 | | mJ |
| Reverse Recovery Current | $I_{rr}$ | $I_F$=50A,$V_R$=400V, -di/dt=450A/us,Tj=150℃ | | 24 | | A |
| Diode reverse recovery time | $t_{rr}$ | | | 218 | | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | | 3.59 | | uC |
| Reverse recovery energy | $E_{rec}$ | | | 0.79 | | mJ |

## Typical Characteristics

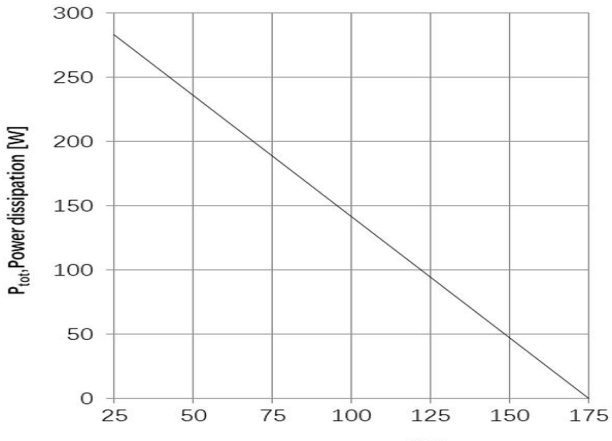


Fig1. Power dissipation as a function of case temperature (Tj≤175℃)

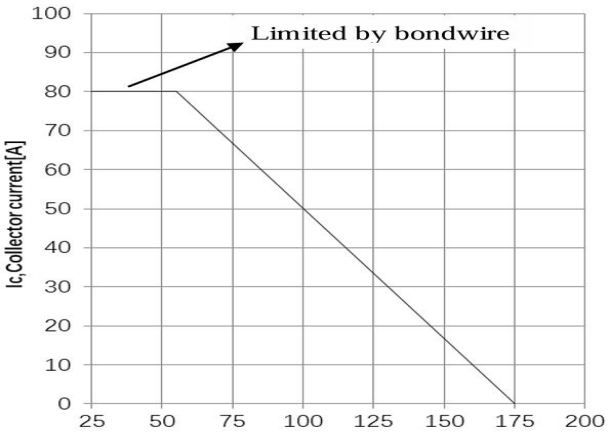


Fig2. Collector current as a function of case temperature(Vge≥15V, Tj≤175℃)

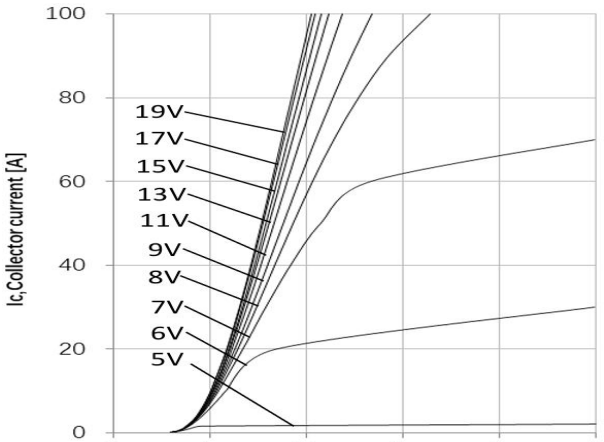


Fig3. Typical output characteristic (Tj=25°C)

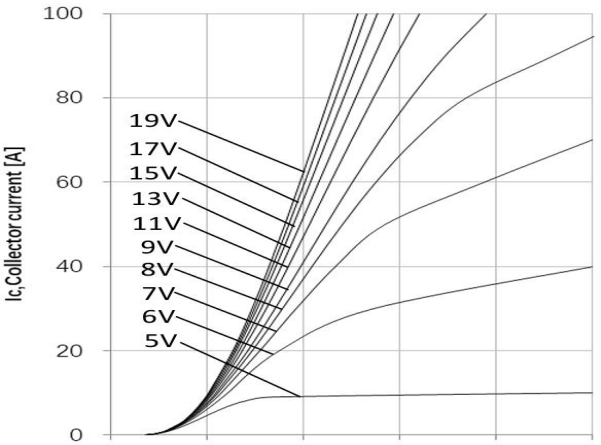


Fig4. Typical output characteristic (Tj=150°C)

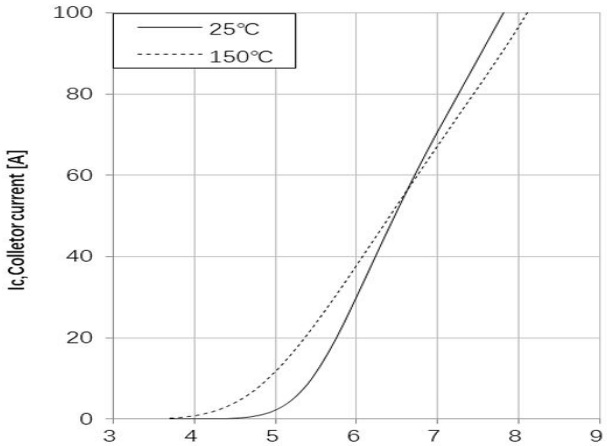


Fig5. Typical transfer characteristic (Vce=20V)

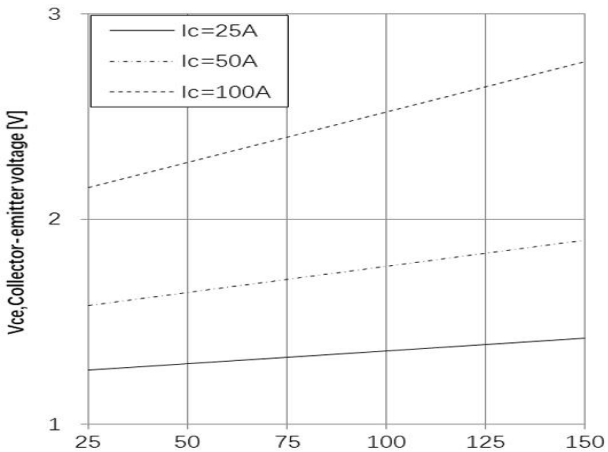


Fig6. Typical collector-emmiter saturation voltage as a function of junction temperature(Vge=15V)

## Typical Characteristics

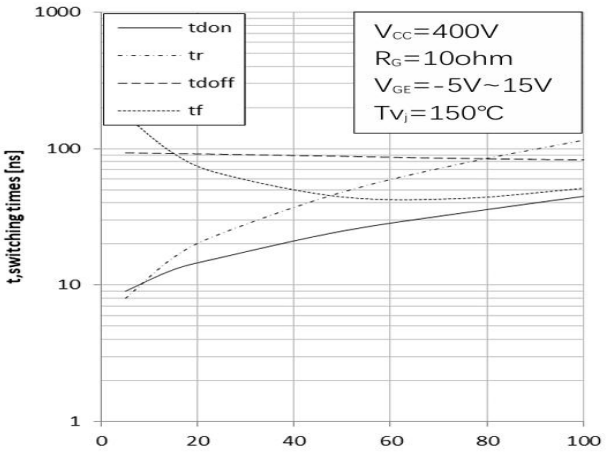



Fig7. Typical switching times as a function of collect current

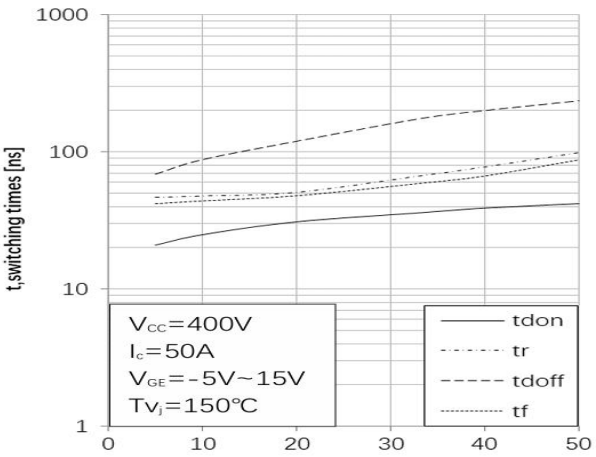



Fig8. Typical switching times as a fuction of gate resistance

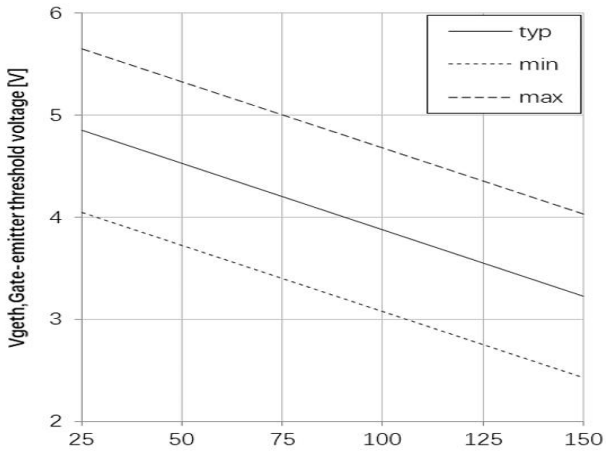



Fig9. Gate-emitter threshold voltage as a fuction of junction temperature(Ic=0.5mA)

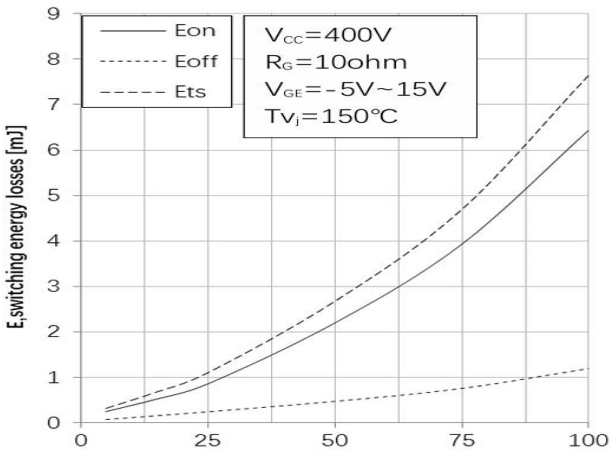



Fig10. Typical switching energy losses as a fuction of collect current

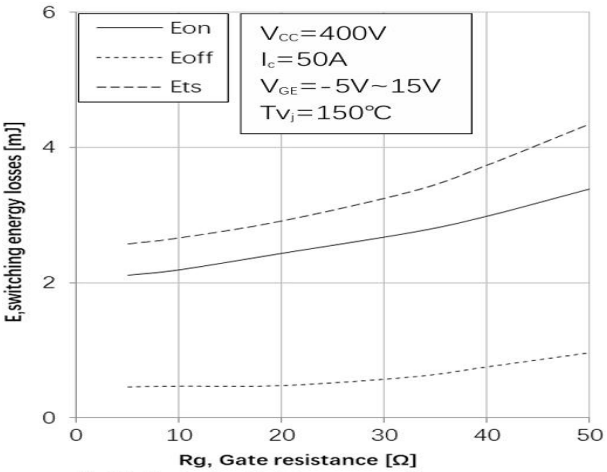



Fig11. Typical switching energy losses as a fuction of gate resistance

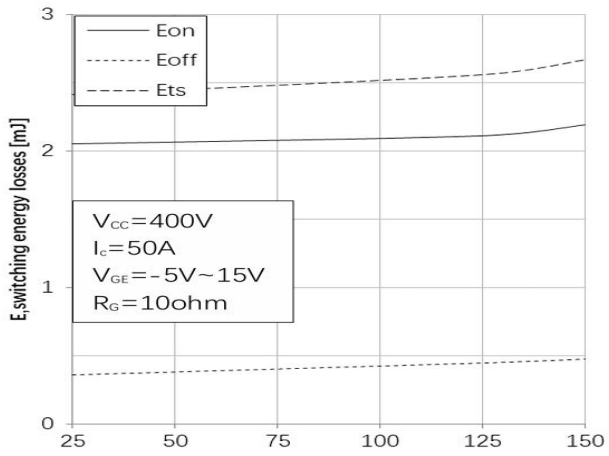



Fig12. Typical switching energy losses as a fuction of junction temperature

## Typical Characteristics

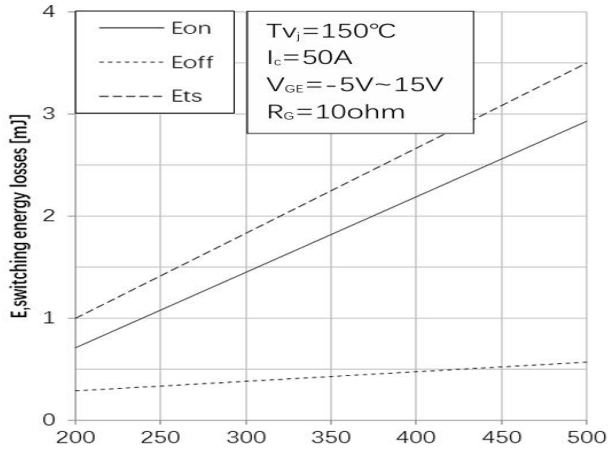


Fig13. Typical switching energy losses as a fuction of collector-emitter voltage

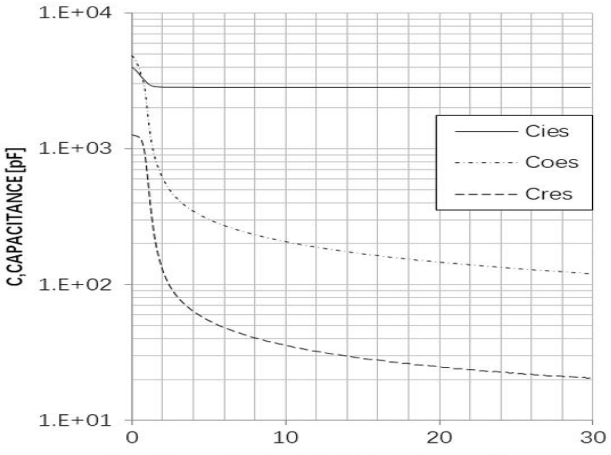


Fig14. Typical capacitance as a function of collector-emitter voltage

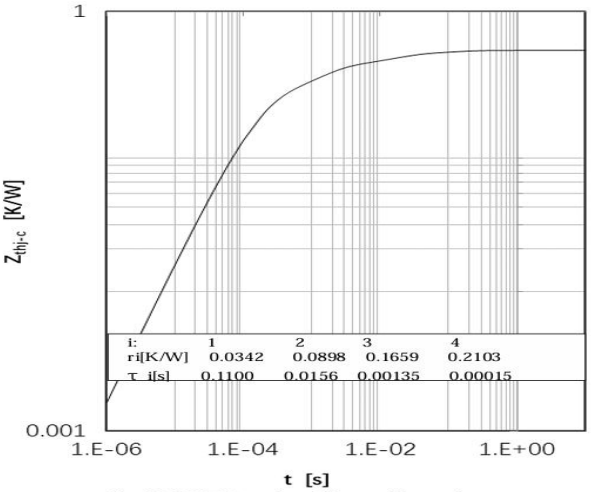


Fig 15. IGBT Transient Thermal Impedance

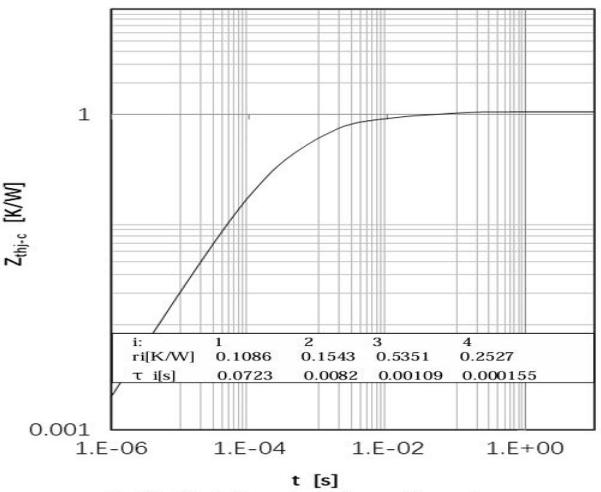


Fig 16. Diode Transient Thermal Impedance

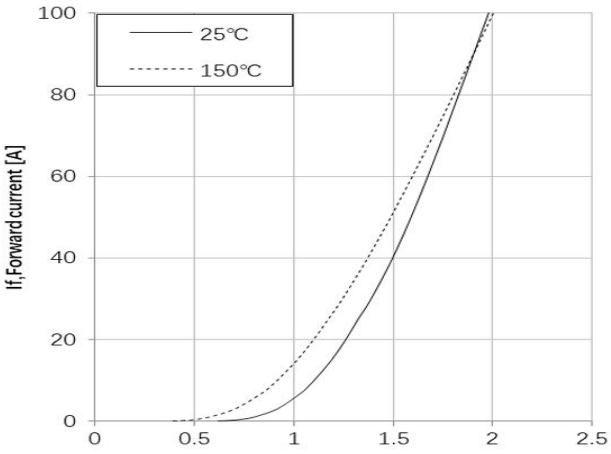


Fig17. Diode forawrd current as a function of foraward voltage

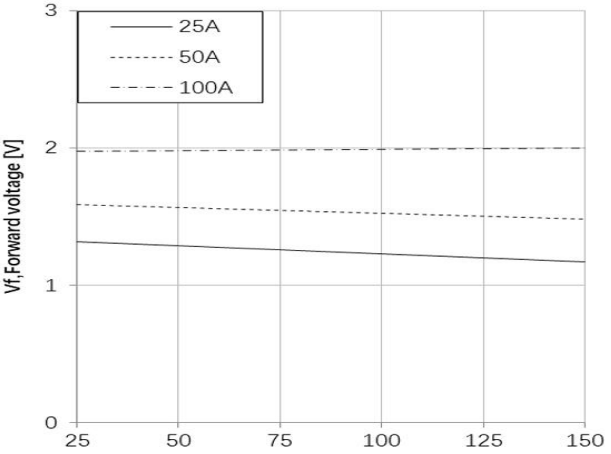


Fig18. Diode forawrd voltage as a function of junction temperature

## Typical Characteristics

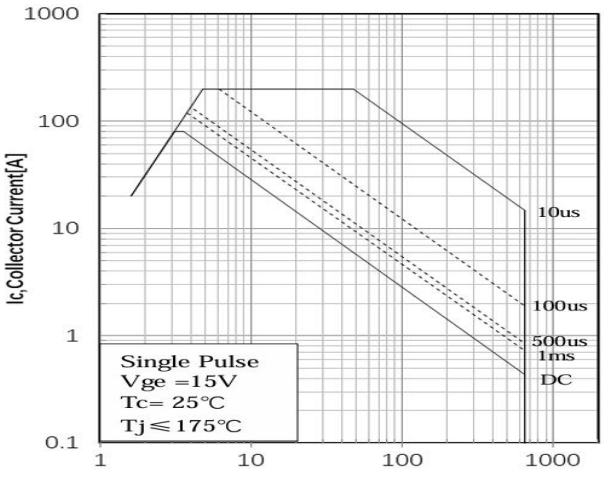
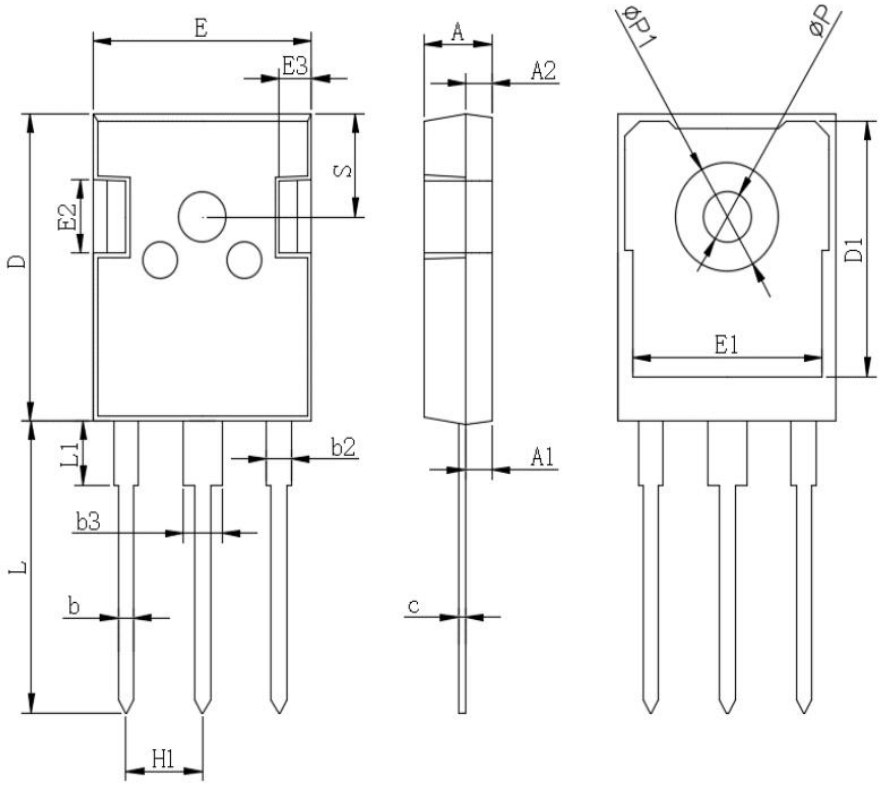


Fig19. FBSOA

## TO-247AB Package Information




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 4.800 | 5.200 | 0.189 | 0.205 |
| A1 | 2.210 | 2.610 | 0.087 | 0.103 |
| A2 | 1.850 | 2.150 | 0.073 | 0.085 |
| b | 1.000 | 1.400 | 0.039 | 0.055 |
| b2 | 1.910 | 2.210 | 0.075 | 0.087 |
| b3 | 2.800 | 3.200 | 0.110 | 0.126 |
| C | 0.500 | 0.700 | 0.020 | 0.028 |
| D | 20.700 | 21.300 | 0.815 | 0.839 |
| D1 | 16.250 | 16.850 | 0.640 | 0.663 |
| E | 15.500 | 16.100 | 0.610 | 0.634 |
| E1 | 13.000 | 13.600 | 0.512 | 0.535 |
| E2 | 4.800 | 5.200 | 0.189 | 0.205 |
| E3 | 2.300 | 2.700 | 0.091 | 0.106 |
| L | 19.620 | 20.220 | 0.772 | 0.796 |
| L1 | - | 4.300 | - | 0.169 |
| ϕP | 3.400 | 3.800 | 0.134 | 0.150 |
| ϕP1 | - | 7.300 | - | 0.287 |
| S | 6.150 TYP | | 0.242 TYP | |
| H1 | 5.440 TYP | | 0.214 TYP | |