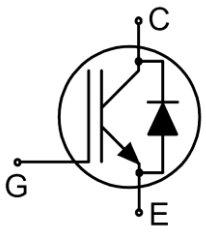
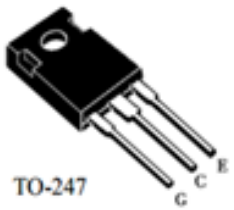
# TT060U065FQ

## 主要参数 MAIN CHARACTERISTICS

| | |
|---|---|
| $I_C$ | 60A |
| $V_{CES}$ | 650V |
| $V_{cesat-typ}$ | 1.7V |

封装 **Package**




## 用途 APPLICATIONS

- ●PFC
- ●储能

- ●Power factor corrector (PFC)
- ●Energy Storage

## 产品特性 FEATURES

- ●低栅极电荷
- ●Trench FS 技术,
- ●RoHS 产品
- ●快开关速度
- ●低开关损耗
- ●VCE(sat)正温度系数

- ●Low gate charge
- ●Trench FS Technology,
- ●RoHS product
- ●Fast switching speed
- ●Low switching losses
- ●VCE(sat) with positive temperature coefficient

## 订货信息 ORDER MESSAGE

| 订 货 型 号 Order codes | 印 记 | 封 装 |
|---|---|---|
| 无卤-条管 Halogen-Free-Tube | Marking | Package |
| TT060U065FQ-GE-BR | TT060U065FQ | TO-247 |

## 绝对最大额定值 ABSOLUTE RATINGS (Tc=25℃)

| 项 目 Parameter | 符 号 Symbol | 数 值 Value | 单 位 Unit |
|---|---|---|---|
| 最高集电极－发射极直流电压 Collector-Emmiter Voltage | $V_{CES}$ | 650 | V |
| *连续集电极电流 Collector Current-continuous | $I_C$ | 120($T_C$=25°C ) | A |
| | | 60($T_C$=100°C ) | A |
| 最大脉冲集电极极电流（注 1） Collector Current – pulse（note 1） | $I_{CM}$ | 240 | A |
| *二极管正向测试电流 Diode RMS forward current | $I_F$ | 120 ($T_C$=25°C ) | A |
| | | 60 ($T_C$=100°C ) | A |
| 二极管正向不重复峰值电流（浪涌电流） Surge non repetitive forward current tp= 10 ms sinusoidal | $I_{FSM}$ | 240 | A |
| 最高栅极发射极电压 Gate-Emmiter Voltage | $V_{GES}$ | ±20 | V |
| 瞬态栅极发射极电压 Transient Gate-emitter voltage ($t_p$≤10us，$D$＜0.010) | $V_{GES}$ | ±30 | V |
| 安全工作区 Turn-off safe area VCE≤650V，Tvj≤175℃，tp=1us | - | 240 | A |
| 耗散功率(TO-247) Power Dissipation | $P_D$ $T_C$=25℃<br>$P_D$ $T_C$=100℃ | 375<br>187 | W |
| 耗散功率(TO-3PH) Power Dissipation | $P_D$ $T_C$=25℃<br>$P_D$ $T_C$=100℃ | 90<br>45 | W |
| 工作结温（注 2） Operating Junction Temperature Range | $T_{VJ}$ | -40～+175 | ℃ |
| 存储温度 Storage Temperature | $T_{STG}$ | -55～+150 | ℃ |
| 引线最高焊接温度 Maximum Lead Temperature for Soldering Purposes | $T_L$ | 260 | ℃ |

*连续集电极电流由最高结温限制.

*Collector current limited by maximum junction temperature.

For optimum lifetime and reliability, JSMC recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet

注释：

1：脉冲宽度由最高结温限制.

2：过载工况时，允许在最高结温 Tvjop=175℃下运行，最大占空比＜20%（最多持续 60s）

Notes:

1：Pulse width limited by maximum junction temperature.

2：Under overload condition, it is allowed to operate at the maximum junction temperature Tvjop=175 ℃, and the maximum duty ratio is less than 20% (lasting for 60 s at most)

## 电特性 ELECTRICAL CHARACTERISTICS

| 项　　目<br>Parameter | 符　号<br>Symbol | 测试条件<br>Tests conditions | 最小<br>Min | 典型<br>Typ | 最大<br>Max | 单位<br>Units |
|---|---|---|---|---|---|---|
| **关态特性 Off –Characteristics** | | | | | | |
| 集电极－发射极击穿电压<br>Collector-Emmiter Voltage | $BV_{CES}$ | $I_C$=250μA, $V_{GE}$=0V | 650 | - | - | V |
| 零栅压下集电极漏电流<br>Zero Gate Voltage Collector Current | $I_{CES}$ | $V_{CE}$=650V, $V_{GE}$=0V,Tvj=25℃ | - | - | 80 | uA |
| 正向栅极体漏电流<br>Gate-body leakage current, forward | $I_{GESF}$ | $V_{CE}$=0V, $V_{GE}$ =20V,Tvj=25℃ | - | - | 200 | nA |
| 反向栅极体漏电流<br>Gate-body leakage current, reverse | $I_{GESR}$ | $V_{CE}$=0V, $V_{GE}$ =-20V,Tvj=25℃ | - | - | -200 | nA |
| **通态特性 On-Characteristics** | | | | | | |
| 阈值电压<br>Gate Threshold Voltage | $V_{GE(th)}$ | $V_{CE}$ = $V_{GE}$,　$I_C$=0.6mA | 3.5 | 4.5 | 5.5 | V |
| 饱和压降<br>Collector-Emmiter saturation Voltage | $V_{CESAT}$ | $V_{GE}$=15V , $I_C$=60A<br>Tvj=25℃<br>Tvj=150℃ | <br>-<br>- | <br>1.7<br>2.1 | <br>2.1<br>- | V |
| **动态特性 Dynamic Characteristics** | | | | | | |
| 输入电容<br>Input capacitance | $C_{ies}$ | $V_{CE}$=25V<br>$V_{GE}$=0V<br>f=1.0MHz | - | 2062 | - | pF |
| 输出电容<br>Output capacitance | $C_{oes}$ | | - | 213 | - | pF |
| 反向传输电容<br>Reverse transfer capacitance | $C_{res}$ | | - | 36 | - | pF |
| 栅极电荷总量 Total Gate Charge | Qg | $V_{CC}$=480V,$I_c$=60A,$V_{GE}$=15V | - | 128 | - | nC |
| 栅极-反射极 Gate to emitter charge | Qge | | - | 21 | - | |
| 栅极-集电极 Gate to collector charge | Qgc | | - | 71 | - | |

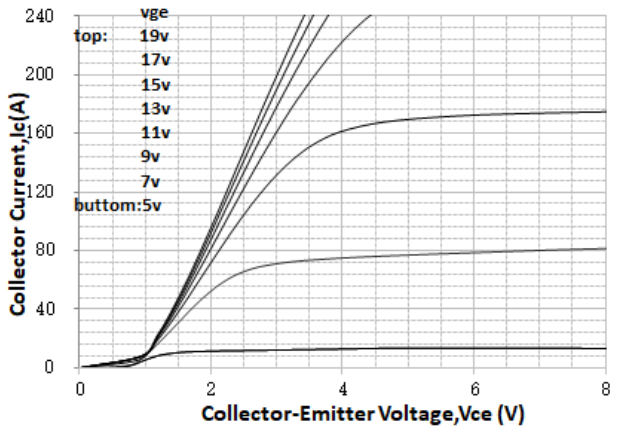
## 电特性 ELECTRICAL CHARACTERISTICS

| 开关特性 Switching Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| 项　　目<br>Parameter | 符　号<br>Symbol | 测试条件<br>Tests conditions | 最小<br>Min | 典型<br>Typ | 最大<br>Max | 单位<br>Units |
| 开启延迟时间 Turn-on delay time | $t_d$(on) | $V_{CC}$=400V,$I_C$=60A,$R_G$=5Ω<br>$V_{GE}$=15 V<br>Tvj=25℃ | - | 12 | - | ns |
| 上升时间 Turn-on rise time | $t_r$ | | - | 80 | - | ns |
| 关断延迟时间 Turn-off delay time | $t_d$(off) | | - | 98 | - | ns |
| 下降时间 Turn-off Fall time | $t_f$ | | - | 82 | - | ns |
| 开通损耗 Turn-on energy | Eon | | - | 1.46 | - | mJ |
| 关断损耗 Turn-off energy | Eoff | | - | 1.34 | - | mJ |
| 总开关损耗 Total switching energy | Etot | | - | 2.80 | - | mJ |
| 开启延迟时间 Turn-on delay time | $t_d$(on) | $V_{CC}$=400V,$I_C$=60A,$R_G$=5Ω<br>$V_{GE}$=15 V<br>Tvj =150℃ | - | 14 | - | ns |
| 上升时间 Turn-on rise time | $t_r$ | | - | 80 | - | ns |
| 关断延迟时间 Turn-off delay time | $t_d$(off) | | - | 122 | - | ns |
| 下降时间 Turn-off Fall time | $t_f$ | | - | 112 | - | ns |
| 开通损耗 Turn-on energy | Eon | | - | 1.60 | - | mJ |
| 关断损耗 Turn-off energy | Eoff | | - | 1.84 | - | mJ |
| 总开关损耗 Total switching energy | Etot | | - | 3.44 | - | mJ |
| **反并联二极管特性及最大额定值 Anti-Parallel Diode Characteristics and Maximum Ratings** | | | | | | |
| 正向压降 Diode Forward Voltage | $V_F$ | $I_F$=60A，Tvj =25℃ | - | 1.6 | 2.0 | V |
| 反向恢复时间<br>Diode Reverse recovery time | $t_{rr}$ | VR=200V, IF=50A<br>dIF/dt=200A/μs<br>Tvj =25℃ | - | 160 | - | ns |
| 反向恢复电荷<br>Diode Reverse recovery charge | $Q_{rr}$ | | - | 0.79 | - | nC |
| 反向恢复电流<br>Diode Reverse recovery Current | $I_{rrm}$ | | - | 8.0 | - | A |
| 反向恢复时间<br>Diode Reverse recovery time | $t_{rr}$ | VR=200V, IF=50A<br>dIF/dt=200A/μs<br>Tvj =150℃ | - | 270 | - | ns |
| 反向恢复电荷<br>Diode Reverse recovery charge | $Q_{rr}$ | | - | 3.1 | - | nC |
| 反向恢复电流<br>Diode Reverse recovery Current | $I_{rrm}$ | | - | 17 | - | A |

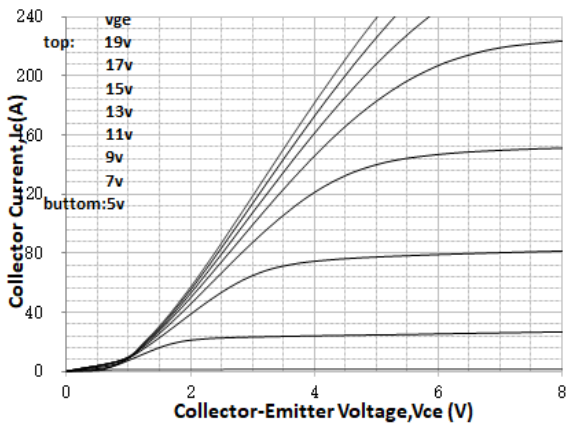
| 项　　目 Parameter | 符　号 Symbol | MAX | 单 位 Unit |
|---|---|---|---|
| 结到管壳的热阻 Junction to Case IGBT | $R_{th(j-c)}$ | 0.4 | ℃/W |
| 结到管壳的热阻 Junction to Case Diode | $R_{th(j-c)}$ | 0.6 | ℃/W |
| 结到环境的热阻 Junction to Ambient | $R_{th(j-A)}$ | 40 | ℃/W |

## 特征曲线 ELECTRICAL CHARACTERISTICS (curves)

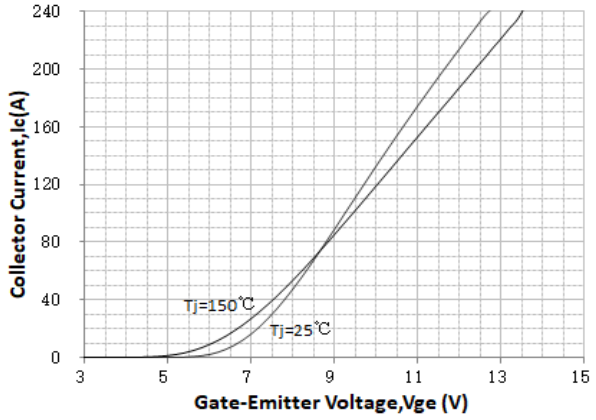
### Output Characteristics（25℃）



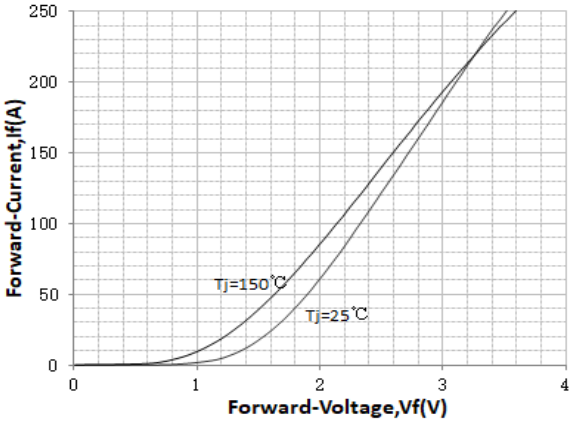

### Output Characteristics（150℃）




### Transfer Characteristics

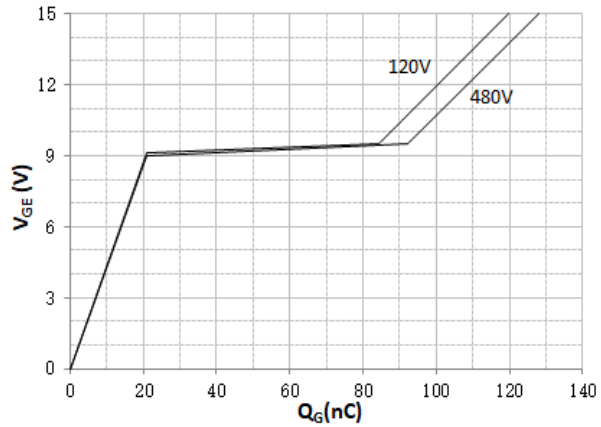



### $I_F$ vs. $V_F$



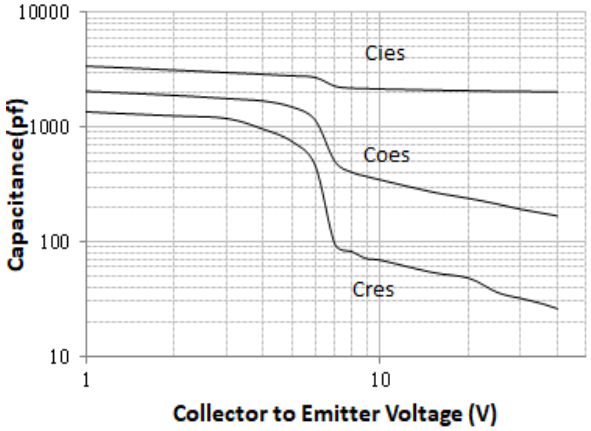

### Gate Charge Characteristics

$V_{GE}$=15V，$I_C$=60A



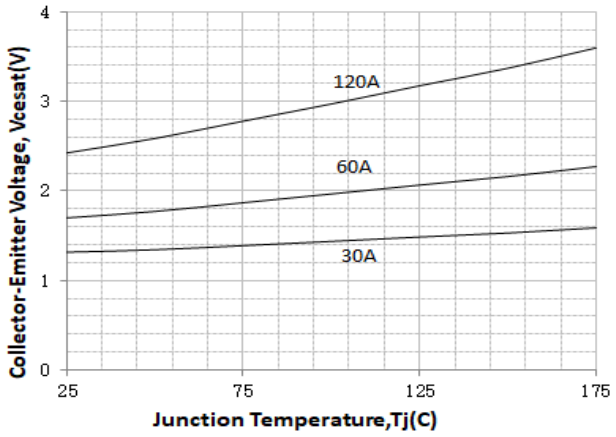

### Capacitance Characteristic

$V_{GE}$ =0V，f=1.0MHZ



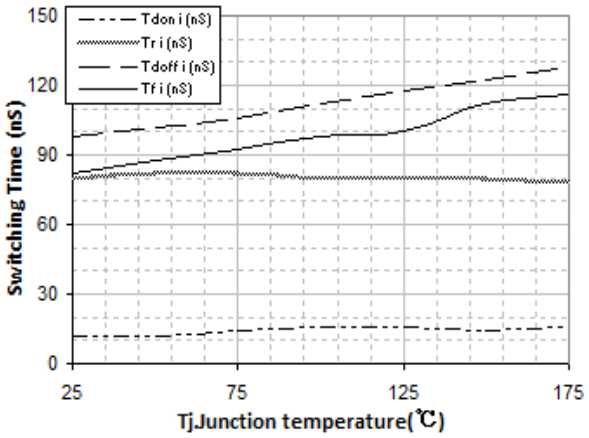
## Vcesat vs. Tj

$V_{GE}$=15V， $I_C$=30A、60A、120A



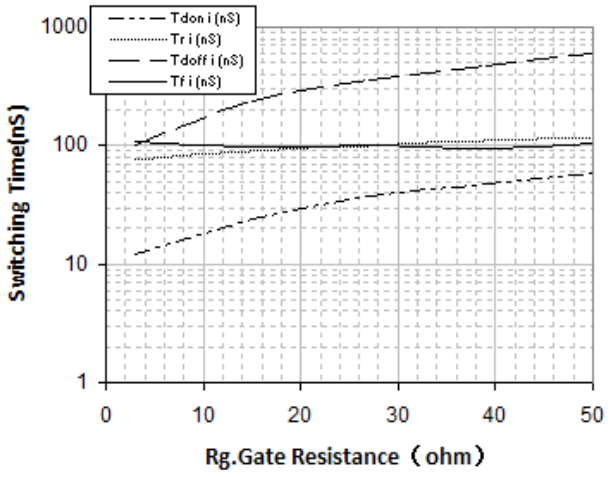

## Switching Time vs.Tj

$V_{GE}$=15V，$V_{GE}$=400V，$I_C$=60A，$R_G$=5Ω



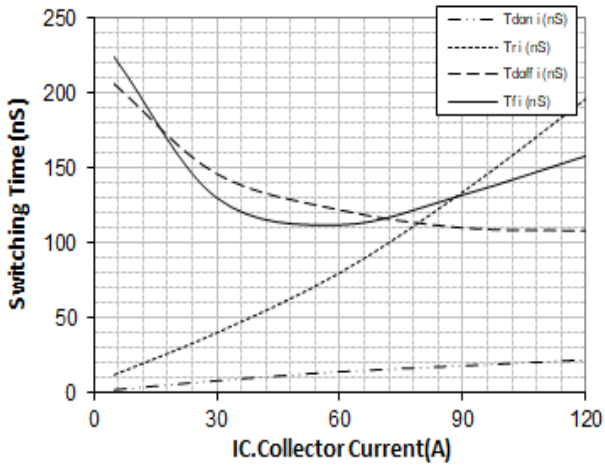

## Switching Time vs. Rg(150℃)

$V_{GE}$=15V，$V_{CE}$=400V， $I_C$=60A



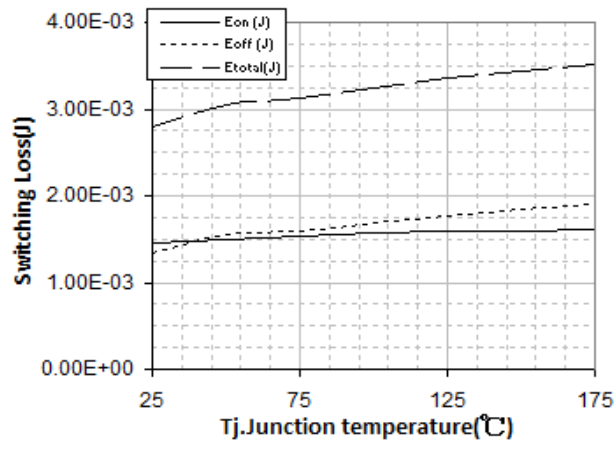

## Switching Time vs. Ic(150℃)

$V_{CE}$=400V，$V_{GE}$=15V， $R_G$=5Ω



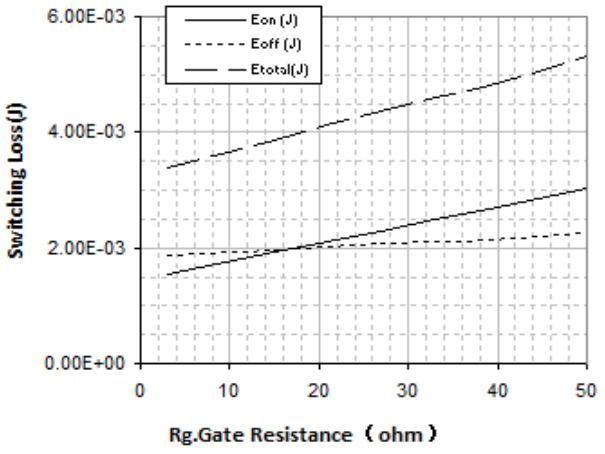

## Switching Loss vs. Tj

$V_{GE}$=15V，$V_{CE}$=400V，$I_C$=60A，$R_G$=5Ω



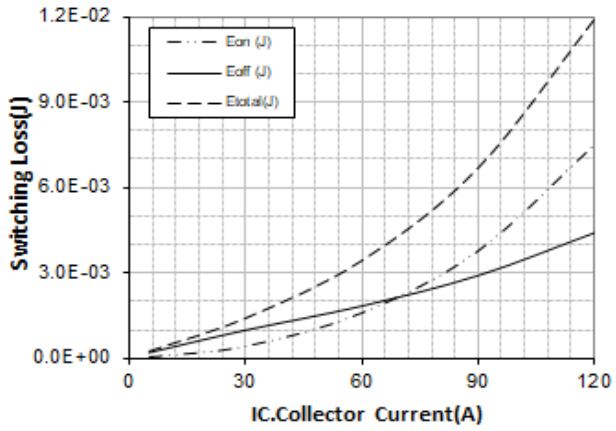

## Switching Loss vs. Rg(150℃)

$V_{GE}$=15V，$V_{CE}$=400V，$I_C$=60A

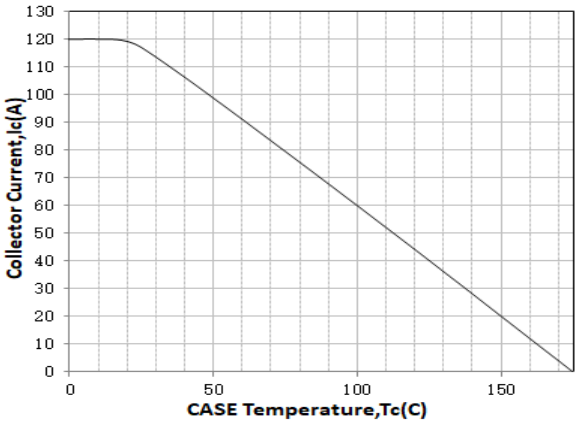


## Switching Loss vs. Ic(150℃)

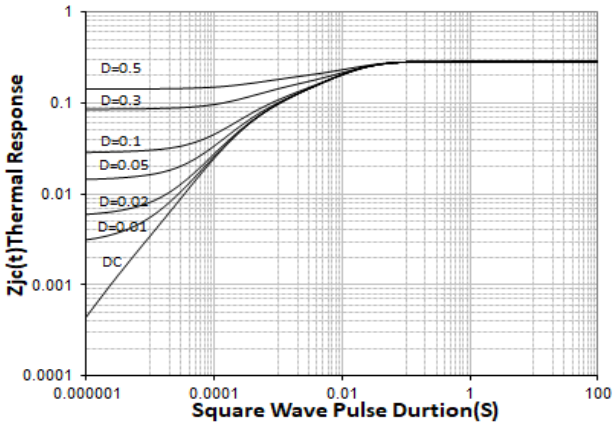
$V_{GE}$=15V，$V_{CE}$=400V，$R_G$=5Ω



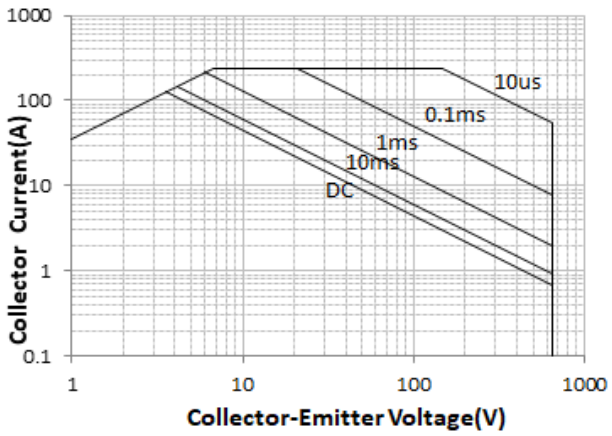

## Colletcor current vs.case temperature




## Transient Thermal Impedance for IGBT TO-247



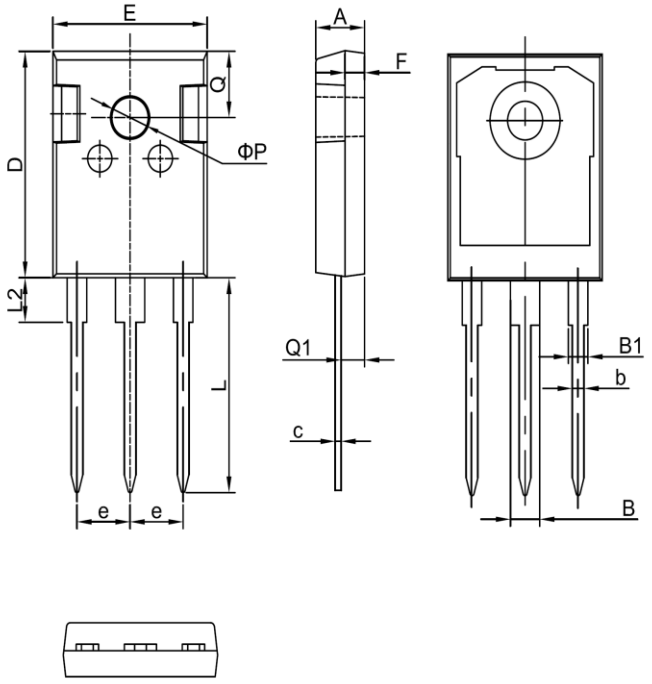

## Forward Bias Safe Operating Area TO-247



## 外形尺寸 PACKAGE MECHANICAL DATA

TO-247

单位 Unit：mm




| 符号 symbol | MIN | MAX |
|---|---|---|
| A | 4.90 | 5.10 |
| B | 2.95 | 3.35 |
| B1 | 1.95 | 2.35 |
| b | 1.15 | 1.35 |
| c | 0.50 | 0.70 |
| D | 20.90 | 21.10 |
| E | 15.70 | 15.90 |
| e | 5.34 | 5.54 |
| F | 1.90 | 2.10 |
| L | 19.40 | 20.40 |
| L2 | 4.03 | 4.23 |
| Q | 6.00 | 6.40 |
| Q1 | 2.30 | 2.50 |
| P | 3.50 | 3.70 |

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3. 在电路设计时请不要超过器件的绝对最大额定值，否则会影响整机的可靠性。
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