



## Features:

### 特性

- 650V TrenchFS technology  
650V 沟槽栅场终止技术
- Low conduction and switching losses  
低导通和开关损耗
- Positive temperature coefficient  
饱和电压正温度系数
- Short Circuit withstand time-5 $\mu$ s  
具备5 $\mu$ s短路承受能力

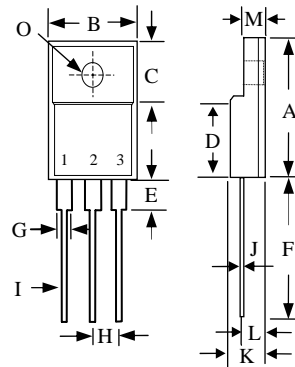
## Applications:

### 应用

- Industrial sewing machine  
工业缝纫机

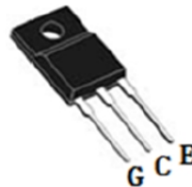
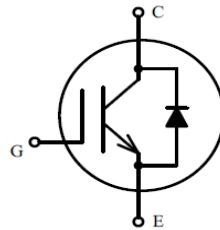
## ITO-220AB Outline Dimensions:

### ITO-220AB 外形尺寸



| ITO-220AB |                    |                    |
|-----------|--------------------|--------------------|
| DIM.      | MIN.               | MAX.               |
| A         | 14.90              | 16.0               |
| B         | 9.90               | 10.40              |
| C         | 6.45               | 7.15               |
| D         | 7.85               | 8.75               |
| E         | 2.80               | 3.50               |
| F         | 12.8               | —                  |
| G         | 1.10               | 1.4                |
| H         | 2.35               | 2.65               |
| I         | 0.45               | 0.95               |
| J         | 0.40               | 0.65               |
| K         | 4.35               | 4.75               |
| L         | 2.55               | 3.15               |
| M         | 2.45               | 2.70               |
| O         | $\varnothing$ 3.00 | $\varnothing$ 3.50 |

All Dimensions in millimeter



| Type<br>型号 | V <sub>CE</sub> [V]<br>集电极-发射极电压 | I <sub>C</sub> [A]<br>集电极电流 | V <sub>CEsat</sub> [V]<br>饱和电压 | T <sub>jmax</sub> [°C]<br>最高结温 | Marking<br>标记 | Package<br>封装 |
|------------|----------------------------------|-----------------------------|--------------------------------|--------------------------------|---------------|---------------|
| 15T65SD    | 650                              | 15                          | 1.8                            | 175                            | 15T65SD       | ITO-220AB     |



## Maximum Rated Values

### 最大额定参数

| Parameter<br>参数  | Symbol<br>符号       | Value<br>值 | Unit<br>单位 |
|--|--------------------|------------|------------|
| Collector-emitter voltage, $T_j \geq 25^\circ\text{C}$<br>集电极-发射极电压, $T_j \geq 25^\circ\text{C}$                     | $V_{CE}$           | 650        | V          |
| Collector current, $T_c = 25^\circ\text{C}$<br>集电极电流, $T_c = 25^\circ\text{C}$                                       | $I_C$              | 30         | A          |
| Collector current, $T_c = 100^\circ\text{C}$<br>集电极电流, $T_c = 100^\circ\text{C}$                                     | $I_C$              | 15         |            |
| Pulsed collector current, $t_p$ limited by $T_{j\max}$<br>集电极脉冲电流, 脉宽时间受 $T_{j\max}$ 限制                              | $I_{C\text{puls}}$ | 60         |            |
| Diode forward current, $T_c = 25^\circ\text{C}$<br>二极管正向电流, $T_c = 25^\circ\text{C}$                                 | $I_F$              | 30         |            |
| Diode forward current, $T_c = 100^\circ\text{C}$<br>二极管正向电流, $T_c = 100^\circ\text{C}$                               | $I_F$              | 15         |            |
| Diode pulsed current<br>二极管脉冲电流  | $I_{F\text{puls}}$ | 60         |            |
| Gate-emitter voltage<br>栅极-发射极电压   | $V_{GE}$           | $\pm 20$   | V          |
| Short Circuit withstand time<br>$V_{GE} = 15\text{V}, V_{CC} \leq 400\text{V}, T_j \leq 150^\circ\text{C}$<br>短路耐受时间 | $t_{sc}$           | 5          | us         |
| Total power dissipation, $T_c = 25^\circ\text{C}$<br>总耗散功率, $T_c = 25^\circ\text{C}$                                 | $P_{\text{tot}}$   | 37.5       | W          |
| Operating junction temperature<br>最高结温   | $T_{j\max}$        | 175        | °C         |
| Operating junction temperature<br>工作结温   | $T_{j\text{op}}$   | -40...+150 |            |
| Storage temperature<br>储存温度  | $T_{\text{stg}}$   | -55...+150 |            |
| Soldering temperature, 1.6mm from case for 10s<br>焊接温度   | $T_{\text{st}}$    | 260        |            |
| Mounting Torque M3<br>锁装力矩   | $M_d$              | 0.6        | Nm         |

**Thermal Resistance****热阻**

| Parameter<br>参数   | Symbol<br>符号  | Value<br>值 | Unit<br>单位                  |
|---|---------------|------------|-----------------------------|
| IGBT Thermal resistance junction to case<br>IGBT 结-管壳热阻 | $R_{th(j-c)}$ | 4.0        | $^{\circ}\text{C}/\text{W}$ |
| Diode Thermal resistance junction to case<br>二极管结-管壳热阻  | $R_{th(j-c)}$ | 7.9        | $^{\circ}\text{C}/\text{W}$ |
| Thermal resistance junction to ambient<br>结-环境热阻        | $R_{th(j-a)}$ | 62.5       | $^{\circ}\text{C}/\text{W}$ |

**Electrical Characteristic at  $T_j = 25^{\circ}\text{C}$  (unless otherwise specified)** **$T_j=25^{\circ}\text{C}$  时电学特性 (除非特别声明)**

| Parameter<br>参数 | Symbol<br>符号 | Conditions<br>条件 | Value<br>值  |             |             | Unit<br>单位 |
|-----------------|--------------|------------------|-------------|-------------|-------------|------------|
|                 |              |                  | Min.<br>最小值 | Typ.<br>典型值 | Max.<br>最大值 |            |

**Static Characteristic****静态特性**

|   |               |  |                           |     |     |               |   |
|---|---------------|--|---------------------------|-----|-----|---------------|---|
| Collector-emitter breakdown voltage<br>集电极-发射极击穿电压  | $V_{(BR)CES}$ | $V_{GE}=0\text{V},$<br>$I_C=100\mu\text{A}$    | 650                       | -   | -   |               |   |
| Collector-emitter saturation voltage<br>集电极-发射极饱和电压 | $V_{cesat}$   | $V_{GE}=15\text{V},$<br>$I_C=15\text{A}$       | $T_j=25^{\circ}\text{C}$  | -   | 1.8 | 2.1           | V |
|   |               |  | $T_j=150^{\circ}\text{C}$ | -   | 2.3 | -             |   |
| Diode forward voltage<br>二极管正向电压                    | VF            | $V_{GE}=0\text{V},$<br>$I_F=15\text{A}$        | $T_j=25^{\circ}\text{C}$  | -   | 1.9 | 2.4           |   |
|   |               |  | $T_j=150^{\circ}\text{C}$ | -   | 1.6 | -             |   |
| Gate-emitter threshold voltage<br>栅极-发射极阈值电压        | $V_{GE(th)}$  | $I_C=300\mu\text{A},$<br>$V_{CE}=V_{GE}$       | 4.5                       | 5.5 | 6.5 |               |   |
| Collector-emitter cut-off current<br>集电极-发射极截止电流    | $I_{CES}$     | $V_{CE}=650\text{V},$<br>$V_{GE}=0\text{V}$    | -                         | -   | 100 | $\mu\text{A}$ |   |
| Gate-emitter leakage current<br>栅极-发射极漏电流           | $I_{GES}$     | $V_{CE}=0\text{V},$<br>$V_{GE}=\pm 20\text{V}$ | -200                      | -   | 200 | nA            |   |



## Dynamic Characteristic 动态特性

|  |             |   |   |      |   |    |
|--|-------------|---|---|------|---|----|
| Input capacitance<br>输入电容              | $C_{ies}$   | $V_{CE}=25V,$<br>$V_{GE}=0V,$<br>$f=1MHz$                         | - | 812  | - | pF |
| Output capacitance<br>输出电容             | $C_{oes}$   |   | - | 63   | - |    |
| Reverse transfer capacitance<br>反向传输电容 | $C_{res}$   |   | - | 8    | - |    |
| Gate charge<br>门极电量                    | $Q_G$       | $V_{CC}=400V, I_C=30A,$<br>$V_{GE}=15V$                           | - | 21.1 | - | nC |
| Short circuit current<br>短路电流          | $I_{C(sc)}$ | $V_{CC}=400V, V_{GE}=15V,$<br>$tpsc \leq 5\mu s, T_j=150^\circ C$ | - | 50   | - | A  |

## Switching Characteristic at $T_j=25^\circ C$ (Inductive Load) $T_j=25^\circ C$ 时开关特性 (感性负载)

| Parameter<br>参数 | Symbol<br>符号 | Conditions<br>条件 | Value<br>值  |             |             | Unit<br>单位 |
|-----------------|--------------|------------------|-------------|-------------|-------------|------------|
|                 |              |                  | Min.<br>最小值 | Typ.<br>典型值 | Max.<br>最大值 |            |

## IGBT Characteristic IGBT 特性

|                                 |              |   |   |      |   |    |
|---------------------------------|--------------|---|---|------|---|----|
| Turn-on delay time<br>开通延迟时间    | $t_{d(on)}$  | $T_j=25^\circ C,$<br>$V_{CC}=400V,$<br>$I_C=15A,$<br>$V_{GE}=-7.5/15V,$<br>$R_G=10\Omega,$<br>Energy losses<br>include<br>"tail" and diode<br>reverse recovery. | - | 125  | - | ns |
| Rise time<br>上升时间               | $t_r$        |   | - | 59   | - |    |
| Turn-off delay time<br>关断延迟时间   | $t_{d(off)}$ |   | - | 60   | - |    |
| Fall time<br>下降时间               | $t_f$        |   | - | 79   | - | mJ |
| Turn-on energy<br>开通损耗          | $E_{on}$     |   | - | 0.33 | - |    |
| Turn-off energy<br>关断损耗         | $E_{off}$    |   | - | 0.21 | - |    |
| Total switching energy<br>总开关损耗 | $E_{ts}$     |   | - | 0.54 | - |    |

## Anti-Parallel Diode Characteristic 反并联二极管特性

|   |          |   |   |     |   |    |
|---|----------|---|---|-----|---|----|
| Reverse recovery time<br>反向恢复时间           | $t_{rr}$ | $T_j=25^\circ C,$<br>$V_R=400V,$<br>$I_F=15A,$<br>$diF/dt=100A/\mu s$ | - | 186 | - | ns |
| Recovered charge<br>恢复电荷                  | $Q_r$    |   | - | 320 | - | nC |
| Peak reverse recovery current<br>反向恢复峰值电流 | $I_{RM}$ |   | - | 3.3 | - | A  |



## Switching Characteristic at $T_j=150^\circ\text{C}$ (Inductive Load)

$T_j=150^\circ\text{C}$ 时开关特性 (感性负载)

| Parameter<br>参数 | Symbol<br>符号 | Conditions<br>条件 | Value<br>值  |             |             | Unit<br>单位 |
|-----------------|--------------|------------------|-------------|-------------|-------------|------------|
|                 |              |                  | Min.<br>最小值 | Typ.<br>典型值 | Max.<br>最大值 |            |

### IGBT Characteristic

#### IGBT 特性

|                                 |              |   |   |      |   |    |
|---------------------------------|--------------|---|---|------|---|----|
| Turn-on delay time<br>开通延迟时间    | $t_{d(on)}$  | $T_j=150^\circ\text{C}$ ,<br>$V_{CC}=400\text{V}$ ,<br>$I_C=15\text{A}$ ,<br>$V_{GE}=-7.5/15\text{V}$ ,<br>$R_G=10\Omega$ ,<br>Energy losses include<br>"tail" and diode<br>reverse recovery. | - | 32   | - | ns |
| Rise time<br>上升时间               | $t_r$        |   | - | 91   | - |    |
| Turn-off delay time<br>关断延迟时间   | $t_{d(off)}$ |   | - | 74   | - |    |
| Fall time<br>下降时间               | $t_f$        |   | - | 135  | - |    |
| Turn-on energy<br>开通损耗          | $E_{on}$     |   | - | 0.50 | - | mJ |
| Turn-off energy<br>关断损耗         | $E_{off}$    |   | - | 0.30 | - |    |
| Total switching energy<br>总开关损耗 | $E_{ts}$     |   | - | 0.80 | - |    |

### Anti-Parallel Diode Characteristic

#### 反并联二极管特性

|   |          |  |   |     |   |    |
|---|----------|--|---|-----|---|----|
| Reverse recovery time<br>反向恢复时间           | $t_{rr}$ | $T_j=150^\circ\text{C}$ ,<br>$V_R=400\text{V}$ ,<br>$I_F=15\text{A}$ ,<br>$diF/dt=100\text{A}/\mu\text{s}$ | - | 252 | - | ns |
| Recovered charge<br>恢复电荷                  | $Q_r$    |  | - | 920 | - | nC |
| Peak reverse recovery current<br>反向恢复峰值电流 | $I_{RM}$ |  | - | 4.8 | - | A  |



## ELECTRICAL CHARACTERISTICS

### 特性曲线

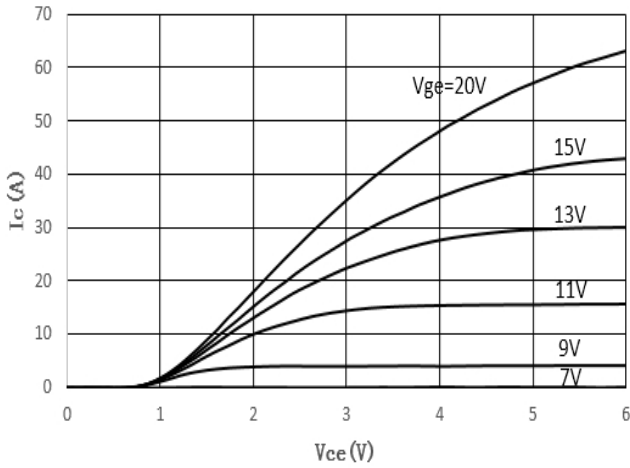


Figure 1. Typical output characteristic( $T_j=25^{\circ}\text{C}$ )

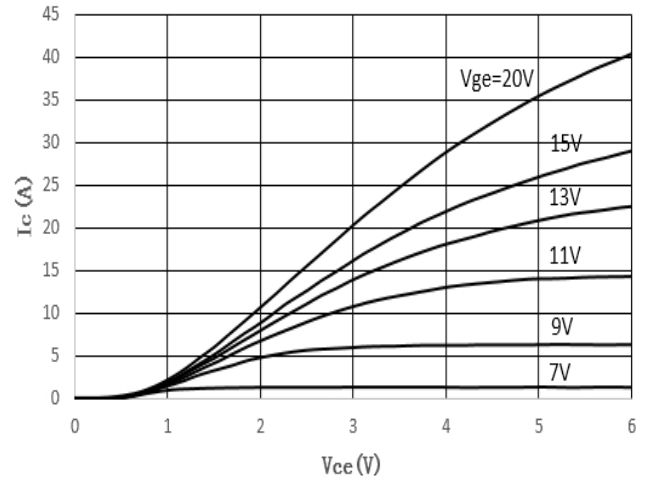


Figure 2. Typical output characteristic( $T_j=150^{\circ}\text{C}$ )

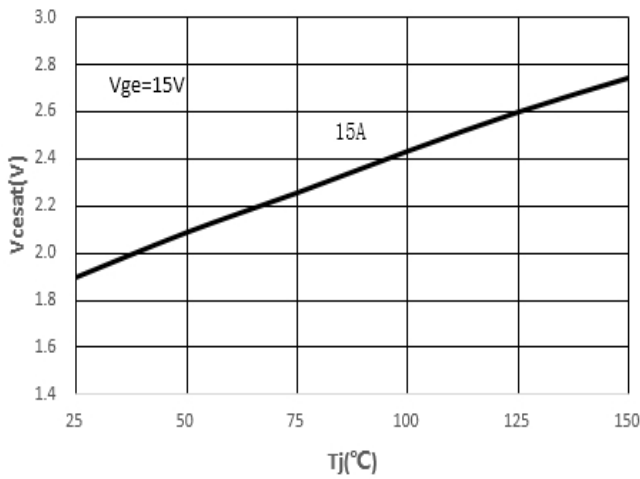


Figure 3.  $V_{cesat}$  vs.  $T_j$

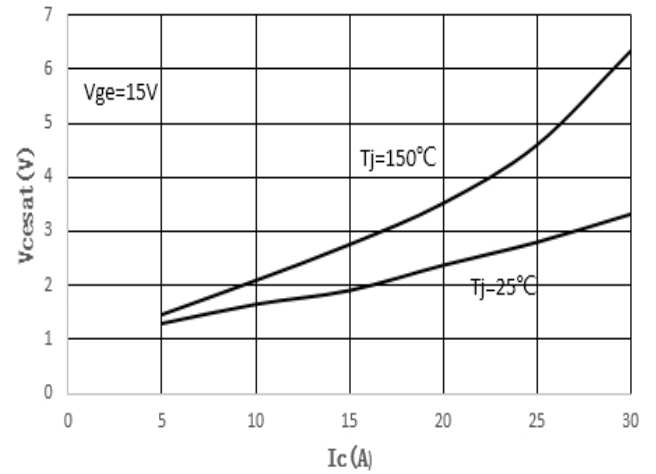


Figure 4.  $V_{cesat}$  vs.  $I_c$

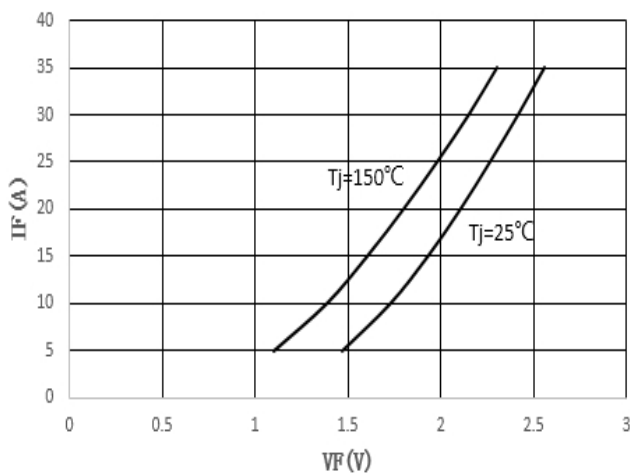


Figure 5.  $I_F$  vs  $V_F$

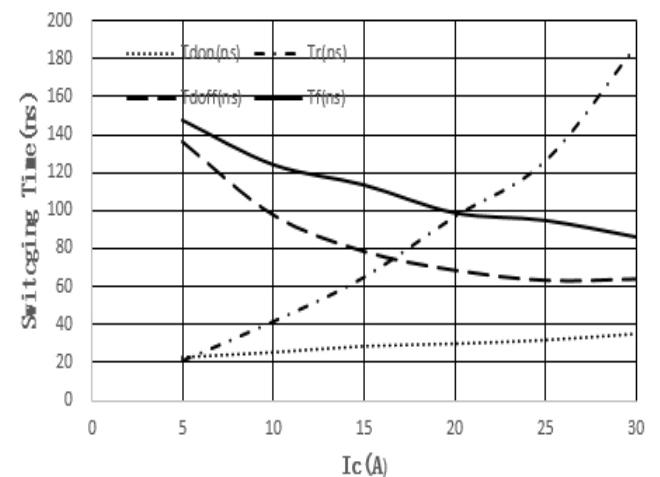
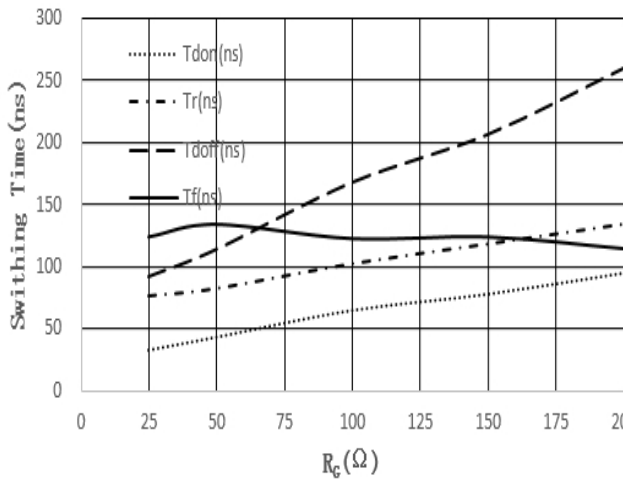
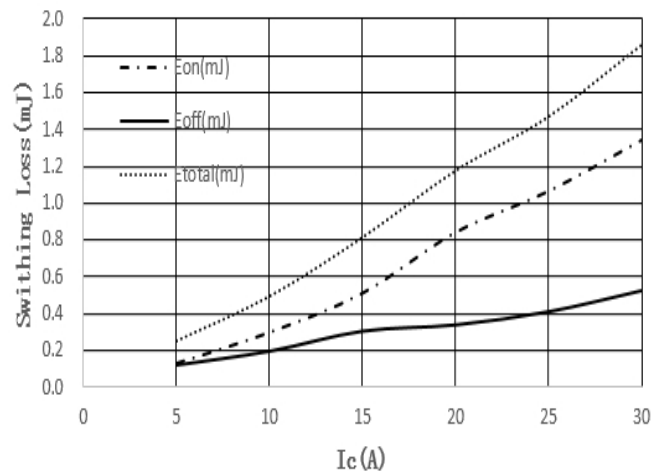


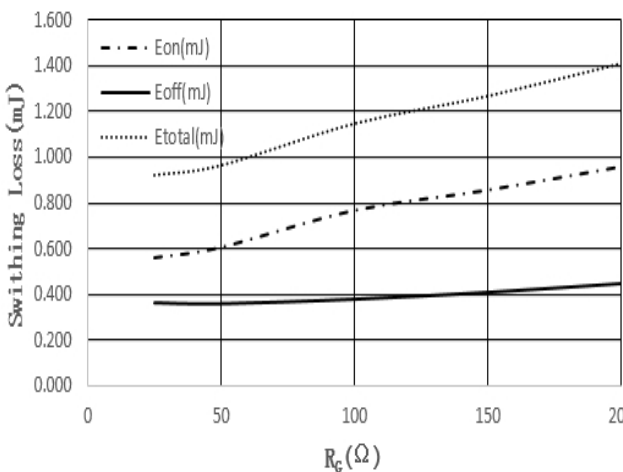
Figure 6. Switching times vs  $I_c$   
( $T_j=150^{\circ}\text{C}$   $V_{GE}=15\text{V}$   $V_{CE}=400\text{V}$   $R_G=10\ \Omega$ )



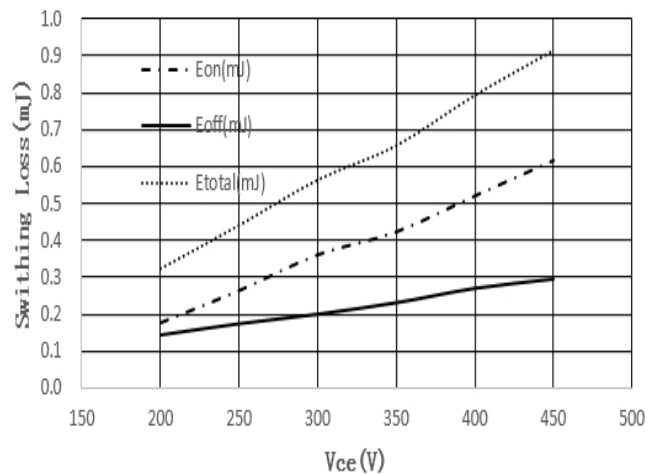
**Figure 7. Switching times vs  $R_G$**   
 ( $T_j=150^\circ\text{C}, V_{CE}=400\text{V}, V_{GE}=15\text{V}, I_C=15\text{A}$ )



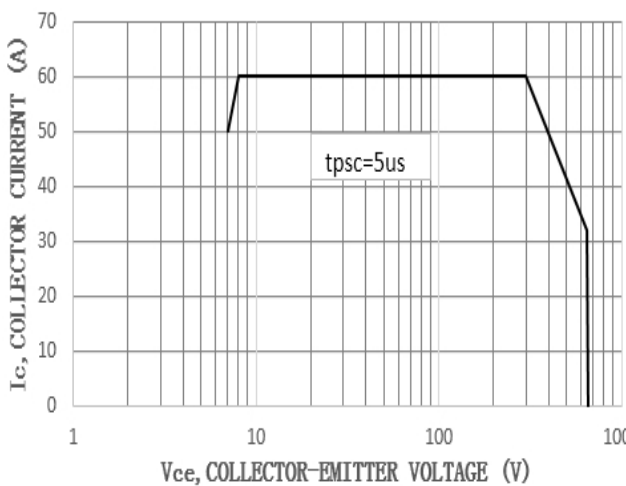
**Figure 8. Switching energy losses vs  $I_c$**   
 ( $T_j=150^\circ\text{C}, V_{CE}=400\text{V}, V_{GE}=15\text{V}, R_G=10\ \Omega$ )



**Figure 9. Switching energy losses vs  $R_G$**   
 ( $T_j=150^\circ\text{C}, V_{CE}=400\text{V}, V_{GE}=15\text{V}, I_C=15\text{A}$ )



**Figure 10. Switching energy losses vs  $V_{CE}$**   
 ( $T_j=150^\circ\text{C}, V_{GE}=15\text{V}, I_C=15\text{A}, R_G=10\ \Omega$ )



**Figure 11. Safe Operating Area for ITO-220AB**



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