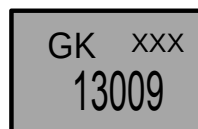
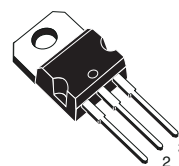


## FEATURES

- High voltage, high speed switching
- High reliability



TO-220AB



## MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

### Absolute Maximum Rating ( $T_C=25^\circ\text{C}$ )

| Parameter                 |                        | Symbol     | Value     | Unit             |
|---------------------------|------------------------|------------|-----------|------------------|
| Collector-Base Voltage    |                        | $BV_{CBO}$ | 700       | V                |
| Collector-Emitter Voltage |                        | $BV_{CEO}$ | 410       | V                |
| Emitter-Base Voltage      |                        | $BV_{EBO}$ | 9         | V                |
| Collector Current         |                        | $I_C$      | 12        | A                |
| Collector Current pulse   |                        | $I_{CM}$   | 24        | A                |
| Base Current              |                        | $I_B$      | 6         | A                |
| Base Current pulse        |                        | $I_{BM}$   | 12        | A                |
| Power Dissipation         | $T_a=25^\circ\text{C}$ | $P_D$      | 2         | W                |
|                           | $T_C=25^\circ\text{C}$ |            | 80        |                  |
| Junction Temperature      |                        | $T_j$      | 150       | $^\circ\text{C}$ |
| Storage Temperature       |                        | $T_{stg}$  | -55 ~ 150 | $^\circ\text{C}$ |

Note: 1. Pulse Test: Pulse Width = 5ms, Duty Cycle  $\leq 10\%$

2. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

**ELECTRICAL CHARACTERISTICS**(Ta=25°C unless otherwise specified)

| Parameter                            | Symbol        | Conditions                                                                          | Value |     |     | Unit    |
|--------------------------------------|---------------|-------------------------------------------------------------------------------------|-------|-----|-----|---------|
|                                      |               |                                                                                     | Min   | Typ | Max |         |
| Collector-base breakdown voltage     | $BV_{CBO}$    | $I_C = 1mA, I_E = 0$                                                                | 700   |     |     | V       |
| Collector-emitter breakdown voltage  | $BV_{CEO}$    | $I_C = 5mA, I_B = 0$                                                                | 410   |     | 520 | V       |
| Emitter-base breakdown voltage       | $BV_{EBO}$    | $I_E = 0.1mA, I_C = 0$                                                              | 9     |     |     | V       |
| Collector cut-off current            | $I_{CBO}$     | $V_{CB} = 700V, I_E = 0$                                                            |       |     | 1   | mA      |
| Emitter cut-off current              | $I_{EBO}$     | $V_{EB} = 9V, I_C = 0$                                                              |       |     | 1   | mA      |
| DC current gain                      | $h_{FE}(1)$   | $V_{CE} = 5V, I_C = 3A$                                                             | 10    |     | 35  |         |
|                                      | $h_{FE}(2)$   | $V_{CE} = 5V, I_C = 2mA$                                                            | 10    |     |     |         |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $I_C = 5A, I_B = 1A$                                                                |       |     | 1.0 | V       |
|                                      |               | $I_C = 8A, I_B = 1.6A$                                                              |       |     | 1.5 |         |
|                                      |               | $I_C = 12A, I_B = 3A$                                                               |       |     | 3   |         |
| Base-emitter on voltage              | $V_{BE(sat)}$ | $I_C = 5A, I_B = 1A$                                                                |       |     | 1.2 | V       |
|                                      |               | $I_C = 8A, I_B = 1.6A$                                                              |       |     | 1.6 |         |
| Transition frequency                 | $f_T$         | $I_C = 0.5A, V_{CE} = 10V, f = 1MHz$                                                | 4     |     |     | MHz     |
| Output Capacitance                   | $C_{ob}$      | $V_{CB} = 10V, I_E = 0, f = 0.1MHz$                                                 |       | 180 |     | pF      |
| Delay Time                           | $t_d$         | $V_C = 125V, I_C = 8A, I_{B1} = I_{B2} = 1.6A, t_p = 25\mu s, \text{Duty} \leq 1\%$ |       |     | 0.1 | $\mu s$ |
| Rise Time                            | $t_R$         |                                                                                     |       |     | 1   | $\mu s$ |
| Fall Time                            | $t_F$         |                                                                                     |       |     | 0.7 | $\mu s$ |
| Switching Time                       | $t_s$         | $I_C = 500mA$                                                                       |       |     | 0.7 | $\mu s$ |

\*Pulse Test: Pulse Width = 300 $\mu s$ , Duty Cycle = 2%

**Thermal Characteristics**

| Parameter                              | Symbol        | Value | Unit |
|----------------------------------------|---------------|-------|------|
| Thermal Resistance Junction to Ambient | $\theta_{JA}$ | 54    | °C/W |
| Thermal Resistance Junction to Case    | $\theta_{JC}$ | 4     | °C/W |

## RATING AND CHARACTERISTIC CURVES

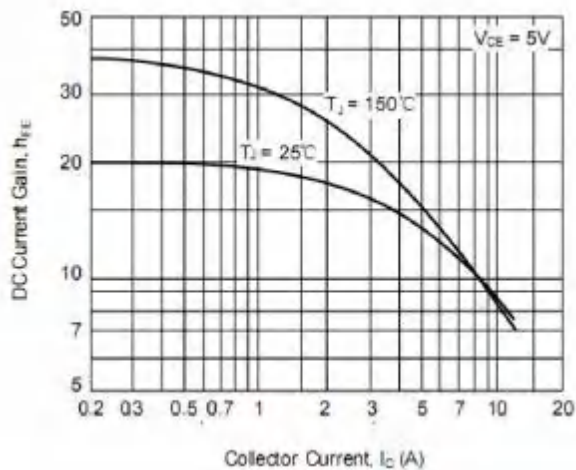


Figure 1. DC current Gain

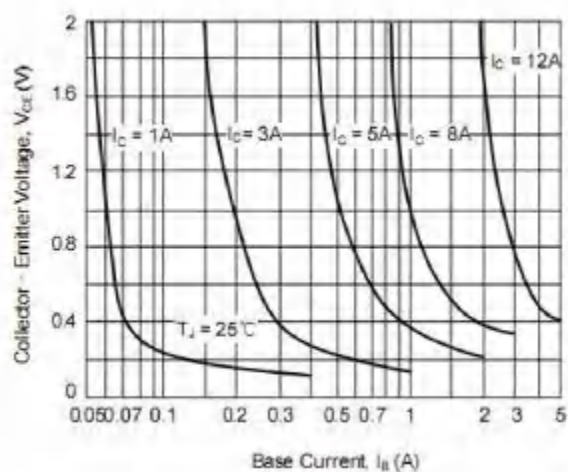


Figure 2. Collector Saturation Region

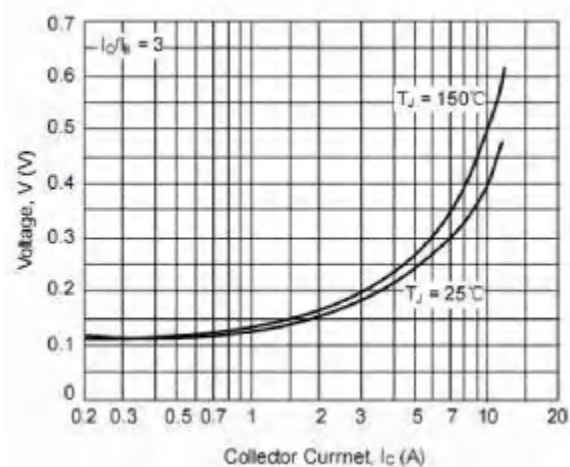


Figure 3. Collector Saturation Voltage

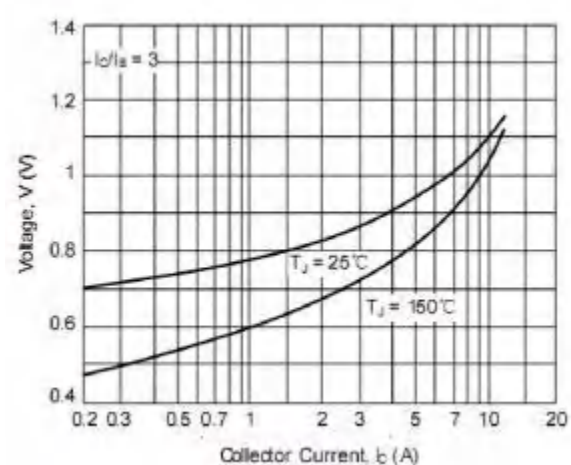


Figure 4. Safe Operating Area Base and

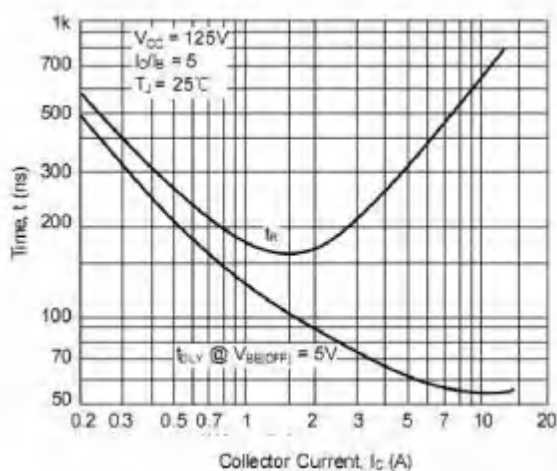


Figure 5. Turn-On Time

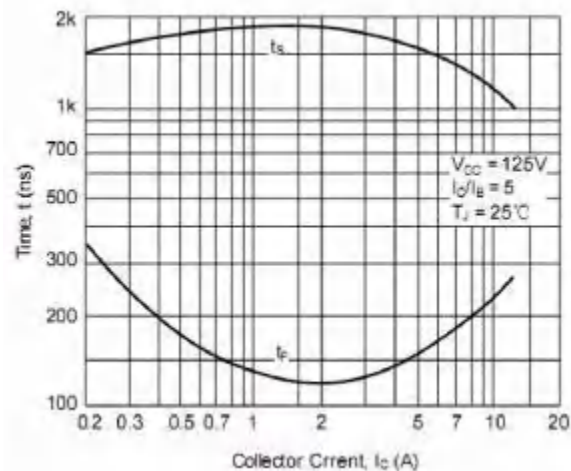
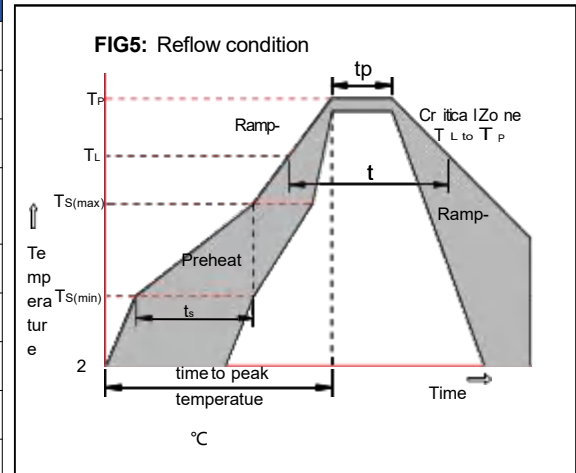


Figure 6. Turn-Off Time

## Soldering parameters

| Reflow Condition                                        |                                   | Pb-Free assembly<br>(see as below) |
|---------------------------------------------------------|-----------------------------------|------------------------------------|
| Pre Heat                                                | -Temperature Min ( $T_{s(min)}$ ) | +150°C                             |
|                                                         | -Temperature Max( $T_{s(max)}$ )  | +200°C                             |
|                                                         | -Time (Min to Max) (ts)           | 60-180 secs.                       |
| Average ramp up rate (Liquid us Temp ( $T_L$ ) to peak) |                                   | 3°C/sec. Max                       |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                    |                                   | 3°C/sec. Max                       |
| Reflow                                                  | -Temperature( $T_L$ )(Liquid us)  | +217°C                             |
|                                                         | -Temperature( $t_L$ )             | 60-150 secs.                       |
| Peak Temp ( $T_P$ )                                     |                                   | +260(+0/-5)°C                      |
| Time within 5°C of actual Peak Temp ( $t_P$ )           |                                   | 30 secs. Max                       |
| Ramp-down Rate                                          |                                   | 6°C/sec. Max                       |
| Time 25°C to Peak Temp ( $T_P$ )                        |                                   | 8 min. Max                         |
| Do not exceed                                           |                                   | +260°C                             |



## Package Dimensions & Suggested Pad Layout

