



**13005EC**

Preliminary

**NPN SILICON TRANSISTOR**

**NPN SILICON POWER TRANSISTORS**

■ DESCRIPTION

These devices are designed for high-voltage, high-speed power switching inductive circuits where fall time is critical. They are particularly suited for 115 and 220 V SWITCHMODE.

■ FEATURES

- \*  $V_{CES} = 850\text{ V}$
- \* Reverse bias SOA with inductive loads @  $T_C = 100^\circ\text{C}$
- \* Inductive switching matrix 2 to 4 Amp, 25 and  $100^\circ\text{C}$   
 $t_c @ 3\text{A}, 100^\circ\text{C}$  is 180 ns (Typ)
- \* 850V blocking capability
- \* SOA and switching applications information

■ APPLICATIONS

- \* Switching regulator's, inverters
- \* Motor controls
- \* Solenoid/Relay drivers
- \* Deflection circuits

■ ORDERING INFORMATION

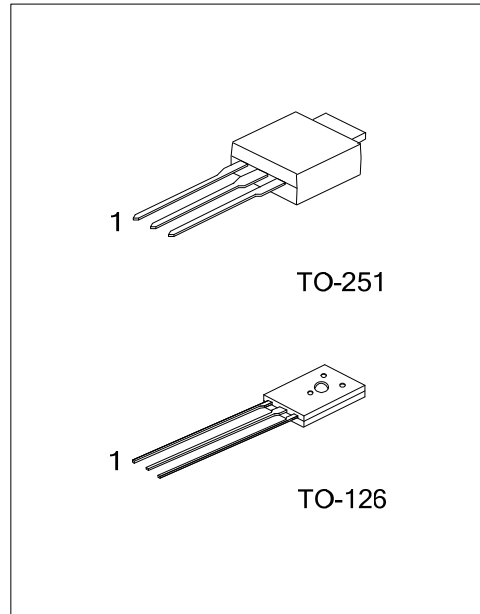
| Ordering Number    |                    | Package | Pin Assignment |   |   | Packing |
|--------------------|--------------------|---------|----------------|---|---|---------|
| Lead Free          | Halogen Free       |         | 1              | 2 | 3 |         |
| 13005ECL-x-TM3-T   | 13005ECG-x-TM3-T   | TO-251  | B              | C | E | Tube    |
| 13005ECL-x-T60-F-K | 13005ECG-x-T60-F-K | TO-126  | B              | C | E | Bulk    |

Note: Pin Assignment: B: Base C: Collector E: Emitter

|                         |   |
|-------------------------|---|
| <p>13005ECL-T60-F-B</p> | <p>(1) T: Tube, B: Bluk<br/>                 (2) refer to Pin Assignment<br/>                 (3) TM3: TO-251, T60: TO-126<br/>                 (4) L: Lead Free, G: Halogen Free and Lead Free</p> |
|-------------------------|---|

■ MARKING INFORMATION

| TO-251 | TO-126 |
|--------|--------|
|        |        |



■ ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                   |            | SYMBOL         | RATINGS    | UNIT             |
|---|------------|----------------|------------|------------------|
| Collector-Emitter Voltage                   |            | $V_{CEO(SUS)}$ | 400        | V                |
| Collector-Emitter Voltage ( $V_{BE}=0$ )    |            | $V_{CES}$      | 850        | V                |
| Collector-Base Voltage                      |            | $V_{CBO}$      | 850        | V                |
| Emitter Base Voltage                        |            | $V_{EBO}$      | 9          | V                |
| Collector Current                           | Continuous | $I_C$          | 4          | A                |
|   | Peak (1)   | $I_{CM}$       | 8          | A                |
| Base Current                                | Continuous | $I_B$          | 2          | A                |
|   | Peak (1)   | $I_{BM}$       | 4          | A                |
| Emitter Current                             | Continuous | $I_E$          | 6          | A                |
|   | Peak (1)   | $I_{EM}$       | 12         | A                |
| Power Dissipation at $T_C=25^\circ\text{C}$ | TO-251     | $P_D$          | 10         | W                |
|   | TO-126     |                | 8          | W                |
| Junction Temperature                        |            | $T_J$          | -65 ~ +150 | $^\circ\text{C}$ |
| Storage Temperature Range                   |            | $T_{STG}$      | -65 ~ +150 | $^\circ\text{C}$ |

Note: 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.

■ THERMAL DATA

| PARAMETER           |        | SYMBOL        | RATINGS | UNIT               |
|---------------------|--------|---------------|---------|--------------------|
| Junction to Ambient | TO-251 | $\theta_{JA}$ | 95      | $^\circ\text{C/W}$ |
|                     | TO-126 |               | 100     |                    |
| Junction to Case    | TO-251 | $\theta_{JC}$ | 13      | $^\circ\text{C/W}$ |
|                     | TO-126 |               | 16.25   |                    |

■ ELECTRICAL CHARACTERISTICS ( $T_C=25^\circ\text{C}$ , unless otherwise specified)

| PARAMETER                            | SYMBOL               | TEST CONDITIONS   | MIN | TYP   | MAX | UNIT          |
|--------------------------------------|----------------------|---|-----|-------|-----|---------------|
| <b>OFF CHARACTERISTICS</b> (Note 1)  |                      |   |     |       |     |               |
| Collector-Emitter Voltage            | $V_{CES}$            | $I_C=10\text{mA}$ , $V_{BE}=0$  | 850 |       |     | V             |
| Collector Cutoff Current             | $I_{CBO}$            | $V_{CBO}=\text{Rated Value}$ , $V_{BE(\text{OFF})}=1.5\text{V}$   |     |       | 1   | mA            |
|                                      |                      | $V_{CBO}=\text{Rated Value}$ ,<br>$V_{BE(\text{OFF})}=1.5\text{V}$ , $T_C=100^\circ\text{C}$                          |     |       | 5   |               |
| Emitter Cutoff Current               | $I_{EBO}$            | $V_{EB}=9\text{V}$ , $I_C=0$  |     |       | 1   | mA            |
| <b>ON CHARACTERISTICS</b> (Note 1)   |                      |   |     |       |     |               |
| DC Current Gain                      | $h_{FE1}$            | $I_C=0.5\text{A}$ , $V_{CE}=5\text{V}$  | 15  |       | 50  |               |
|                                      | $h_{FE2}$            | $I_C=1\text{A}$ , $V_{CE}=5\text{V}$  | 10  |       | 60  |               |
|                                      | $h_{FE3}$            | $I_C=2\text{A}$ , $V_{CE}=5\text{V}$  | 8   |       | 40  |               |
| Collector-Emitter Saturation Voltage | $V_{CE(\text{SAT})}$ | $I_C=1\text{A}$ , $I_B=0.2\text{A}$   |     |       | 0.5 | V             |
|                                      |                      | $I_C=2\text{A}$ , $I_B=0.5\text{A}$   |     |       | 0.6 | V             |
|                                      |                      | $I_C=4\text{A}$ , $I_B=1\text{A}$   |     |       | 1   | V             |
|                                      |                      | $I_C=2\text{A}$ , $I_B=0.5\text{A}$ , $T_A=100^\circ\text{C}$   |     |       | 1   | V             |
| Base-Emitter Saturation Voltage      | $V_{BE(\text{SAT})}$ | $I_C=1\text{A}$ , $I_B=0.2\text{A}$   |     |       | 1.2 | V             |
|                                      |                      | $I_C=2\text{A}$ , $I_B=0.5\text{A}$   |     |       | 1.6 | V             |
|                                      |                      | $I_C=2\text{A}$ , $I_B=0.5\text{A}$ , $T_C=100^\circ\text{C}$   |     |       | 1.5 | V             |
| <b>DYNAMIC CHARACTERISTICS</b>       |                      |   |     |       |     |               |
| Current-Gain-Bandwidth Product       | $f_T$                | $I_C=500\text{mA}$ , $V_{CE}=10\text{V}$ , $f=1\text{MHz}$  | 4   |       |     | MHz           |
| Output Capacitance                   | $C_{OB}$             | $V_{CB}=10\text{V}$ , $I_E=0$ , $f=0.1\text{MHz}$   |     | 65    |     | pF            |
| <b>SWITCHING CHARACTERISTICS</b>     |                      |   |     |       |     |               |
| Resistive Load (Table 1)             |                      |   |     |       |     |               |
| Delay Time                           | $t_D$                | $V_{CC}=125\text{V}$ , $I_C=2\text{A}$ , $I_{B1}=I_{B2}=0.4\text{A}$ ,<br>$t_p=25\mu\text{s}$ , Duty Cycle $\leq 1\%$ |     | 0.025 | 0.1 | $\mu\text{s}$ |
| Rise Time                            | $t_R$                |   |     | 0.3   | 0.7 | $\mu\text{s}$ |
| Storage Time                         | $t_S$                |   |     | 1.7   | 4   | $\mu\text{s}$ |
| Fall Time                            | $t_F$                |   |     | 0.4   | 0.9 | $\mu\text{s}$ |

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

2. Pulse Test:  $P_W=300\mu\text{s}$ , Duty Cycle $\leq 2\%$

■ CLASSIFICATION OF  $h_{FE1}$

| RANK  | A       | B       | C       | D       | E       |
|-------|---------|---------|---------|---------|---------|
| RANGE | 15 ~ 20 | 20 ~ 25 | 25 ~ 30 | 30 ~ 40 | 40 ~ 50 |

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