

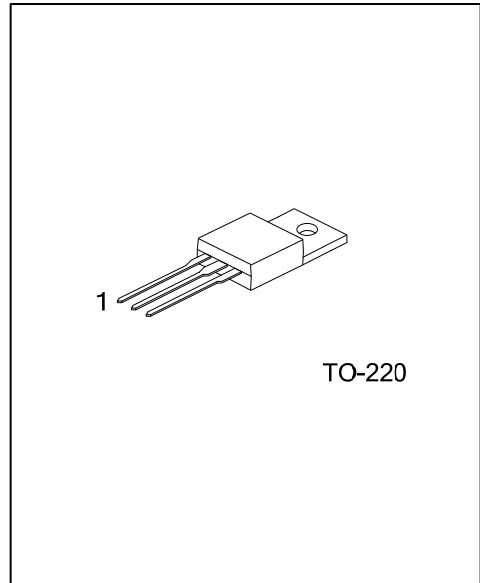


**MJE13007-Q**

Preliminary

**NPN SILICON TRANSISTOR**

**NPN BIPOLAR POWER TRANSISTOR FOR SWITCHING POWER SUPPLY APPLICATIONS**



■ DESCRIPTION

The UTC **MJE13007-Q** is designed for high-voltage, high-speed power switching inductive circuits where fall time is critical. It is particularly suited for 115 and 220V switch mode applications.

■ FEATURES

- \*  $V_{CEO(SUS)}$  400V
- \* 700V Blocking Capability

■ ORDERING INFORMATION

| Ordering Number   |                   | Package | Pin Assignment |   |   | Packing |
|-------------------|-------------------|---------|----------------|---|---|---------|
| Lead Free         | Halogen Free      |         | 1              | 2 | 3 |         |
| MJE13007L-Q-TA3-T | MJE13007G-Q-TA3-T | TO-220  | B              | C | E | Tube    |

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

|  |   |
|--|---|
| <p>MJE13007L-Q-TA3-T</p> <p>(1)Packing Type<br/>(2)Package Type<br/>(3)Lead Free</p> | <p>(1)T: Tube<br/>(2) TA3: TO-220<br/>(3) L: Lead Free, G: Halogen Free</p> |
|--|---|

■ ABSOLUTE MAXIMUM RATING

| PARAMETER                                      |            | SYMBOL    | RATINGS  | UNIT             |
|--|------------|-----------|----------|------------------|
| Collector-Emitter Sustaining Voltage           |            | $V_{CEO}$ | 400      | V                |
| Collector-Emitter Breakdown Voltage            |            | $V_{CBO}$ | 700      | V                |
| Emitter-Base Voltage                           |            | $V_{EBO}$ | 9.0      | V                |
| Collector Current                              | Continuous | $I_C$     | 8.0      | A                |
|  | Peak (1)   | $I_{CM}$  | 16       | A                |
| Base Current                                   | Continuous | $I_B$     | 4.0      | A                |
|  | Peak (1)   | $I_{BM}$  | 8.0      | A                |
| Emitter Current                                | Continuous | $I_E$     | 12       | A                |
|  | Peak (1)   | $I_{EM}$  | 24       | A                |
| Power Dissipation ( $T_C = 25^\circ\text{C}$ ) |            | $P_D$     | 80       | W                |
| Junction Temperature                           |            | $T_J$     | +150     | $^\circ\text{C}$ |
| Storage Temperature                            |            | $T_{STG}$ | -55~+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 | $\theta_{JA}$ | 62.5    | $^\circ\text{C/W}$ |
| Junction to Case    | $\theta_{JC}$ | 1.56    | $^\circ\text{C/W}$ |

Note: 1. Pulse Test: Pulse Width = 5.0 ms, Duty Cycle ≤ 10%.

Measurement made with thermocouple contacting the bottom insulated mounting surface of the package (in a location beneath the die), the device mounted on a heatsink with thermal grease applied at a mounting torque of 6 to 8•lbs.

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

| PARAMETER                            | SYMBOL         | TEST CONDITIONS   | MIN | TYP   | MAX | UNIT          |
|--------------------------------------|----------------|---|-----|-------|-----|---------------|
| Collector-Emitter Sustaining Voltage | $V_{CEO(SUS)}$ | $I_C=10\text{mA}, I_B=0$  | 400 |       |     | V             |
| Collector Cutoff Current             | $I_{CBO}$      | $V_{CES}=700\text{V}$   |     |       | 0.1 | mA            |
|                                      |                | $V_{CES}=700\text{V}, T_C=125^\circ\text{C}$  |     |       | 1.0 | mA            |
| Emitter Cutoff Current               | $I_{EBO}$      | $V_{EB}=9.0\text{V}, I_C=0$   |     |       | 100 | $\mu\text{A}$ |
| DC Current Gain                      | $h_{FE1}$      | $I_C=2.0\text{A}, V_{CE}=5.0\text{V}$   | 8.0 |       | 40  |               |
|                                      | $h_{FE2}$      | $I_C=5.0\text{A}, V_{CE}=5.0\text{V}$   | 5.0 |       | 30  |               |
| Collector-Emitter Saturation Voltage | $V_{CE(SAT)}$  | $I_C=2.0\text{A}, I_B=0.4\text{A}$  |     |       | 1.0 | V             |
|                                      |                | $I_C=5.0\text{A}, I_B=1.0\text{A}$  |     |       | 2.0 | V             |
|                                      |                | $I_C=8.0\text{A}, I_B=2.0\text{A}$  |     |       | 3.0 | V             |
|                                      |                | $I_C=5.0\text{A}, I_B=1.0\text{A}, T_C=100^\circ\text{C}$   |     |       | 3.0 | V             |
| Base-Emitter Saturation Voltage      | $V_{BE(SAT)}$  | $I_C=2.0\text{A}, I_B=0.4\text{A}$  |     |       | 1.2 | V             |
|                                      |                | $I_C=5.0\text{A}, I_B=1.0\text{A}$  |     |       | 1.6 | V             |
|                                      |                | $I_C=5.0\text{A}, I_B=1.0\text{A}, T_C=100^\circ\text{C}$   |     |       | 1.5 | V             |
| Current-Gain-Bandwidth Product       | $f_T$          | $I_C=500\text{mA}, V_{CE}=10\text{V}, f=1.0\text{MHz}$  | 4.0 | 14    |     | MHz           |
| Output Capacitance                   | $C_{OB}$       | $V_{CB}=10\text{V}, I_E=0, f=0.1\text{MHz}$   |     | 80    |     | pF            |
| <b>RESISTIVE LOAD (TABLE 1)</b>      |                |   |     |       |     |               |
| Delay Time                           | $t_D$          | $V_{CC}=125\text{V}, I_C=5.0\text{A}, I_{B1}=I_{B2}=1.0\text{A}, t_p=25\mu\text{s}, \text{Duty Cycle} \leq 1.0\%$ |     | 0.025 | 0.1 | $\mu\text{s}$ |
| Rise Time                            | $t_R$          |   |     | 0.5   | 1.5 | $\mu\text{s}$ |
| Storage Time                         | $t_S$          |   |     | 1.8   | 4.0 | $\mu\text{s}$ |
| Fall Time                            | $t_F$          |   |     | 0.23  | 0.7 | $\mu\text{s}$ |

Note: Pulse Test: Pulse Width ≤ 300 $\mu\text{s}$ , Duty Cycle ≤ 2.0%

■ TYPICAL THERMAL RESPONSE

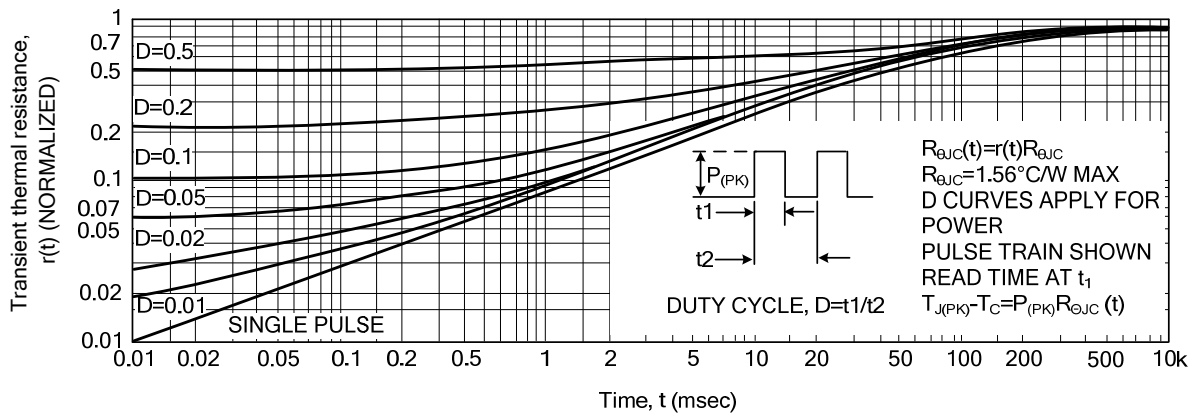


Fig. 1 Typical Thermal Response

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate  $I_C$ - $V_{CE}$  limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

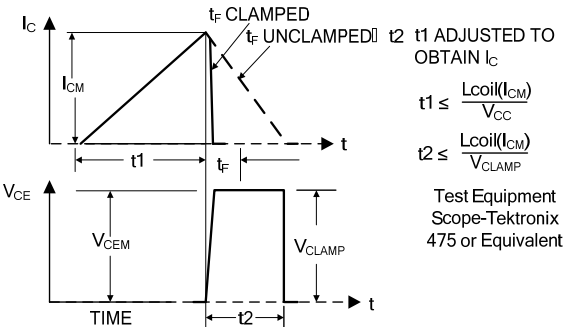
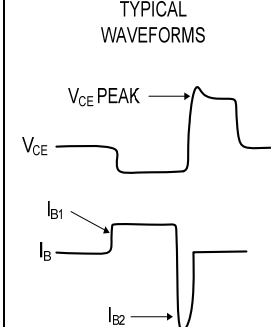
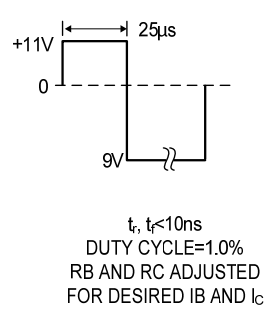
The data of Fig. 7 is based on  $T_C = 25^\circ\text{C}$ ;  $T_{J(PK)}$  is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be debated when  $T_C \geq 25^\circ\text{C}$ . Second breakdown limitations do not debate the same as thermal limitations. Allowable current at the voltages shown on Fig. 7 may be found at any case temperature by using the appropriate curve on Fig. 9.

At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

Use of reverse biased safe operating area data (Fig. 8) is discussed in the applications information section.

■ TYPICAL THERMAL RESPONSE(Cont.)

Table 1. Test Conditions for Dynamic Performance

| TEST CIRCUITS   | REVERSE BIAS SAFE OPERATING AREA AND INDUCTIVE SWITCHING   | RESISTIVE SWITCHING  |                     |       |   |  |   |   |
|---|--|--|---------------------|-------|---|--|---|---|
| CIRCUIT VALUES  | <table border="1"> <thead> <tr> <th>BV<sub>CEO</sub> (SUS)</th> <th>Inductive Switching</th> <th>RBSOA</th> </tr> </thead> <tbody> <tr> <td>L=10mH<br/>R<sub>B2</sub>=8<br/>V<sub>CC</sub>=20V<br/>I<sub>C(PK)</sub>=100mA</td> <td>L=20mH<br/>R<sub>B2</sub>=0<br/>V<sub>CC</sub>=15V<br/>R<sub>B1</sub> selected for desired I<sub>B1</sub></td> <td>L=500mH<br/>R<sub>B2</sub>=0<br/>V<sub>CC</sub>=15Volts<br/>R<sub>B1</sub> selected for desired I<sub>B1</sub></td> </tr> </tbody> </table> | BV <sub>CEO</sub> (SUS)  | Inductive Switching | RBSOA | L=10mH<br>R <sub>B2</sub> =8<br>V <sub>CC</sub> =20V<br>I <sub>C(PK)</sub> =100mA | L=20mH<br>R <sub>B2</sub> =0<br>V <sub>CC</sub> =15V<br>R <sub>B1</sub> selected for desired I <sub>B1</sub> | L=500mH<br>R <sub>B2</sub> =0<br>V <sub>CC</sub> =15Volts<br>R <sub>B1</sub> selected for desired I <sub>B1</sub> | <p>V<sub>CC</sub>=125V<br/>R<sub>C</sub>=25Ω<br/>D1=1N5820 OR EQUIV</p> |
| BV <sub>CEO</sub> (SUS)   | Inductive Switching  | RBSOA  |                     |       |   |  |   |   |
| L=10mH<br>R <sub>B2</sub> =8<br>V <sub>CC</sub> =20V<br>I <sub>C(PK)</sub> =100mA | L=20mH<br>R <sub>B2</sub> =0<br>V <sub>CC</sub> =15V<br>R <sub>B1</sub> selected for desired I <sub>B1</sub>   | L=500mH<br>R <sub>B2</sub> =0<br>V <sub>CC</sub> =15Volts<br>R <sub>B1</sub> selected for desired I <sub>B1</sub>  |                     |       |   |  |   |   |
|   |  <p>TYPICAL WAVEFORMS</p>   |  <p>t<sub>r</sub>, t<sub>f</sub> &lt; 10ns<br/>DUTY CYCLE=1.0%<br/>R<sub>B</sub> AND R<sub>C</sub> ADJUSTED FOR DESIRED I<sub>B</sub> AND I<sub>C</sub></p> |                     |       |   |  |   |   |

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