

## NPN POWER SILICON TRANSISTOR

Qualified per MIL-PRF-19500/464

### Devices

2N5685

2N5686

### Qualified Level

JAN  
JANTX  
JANTXV

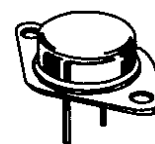
### MAXIMUM RATINGS

| Ratings                                        | Symbol                                                                                        | 2N5685      | 2N5686 | Units              |
|------------------------------------------------|-----------------------------------------------------------------------------------------------|-------------|--------|--------------------|
| Collector-Emitter Voltage                      | $V_{CEO}$                                                                                     | 60          | 80     | Vdc                |
| Collector-Base Voltage                         | $V_{CBO}$                                                                                     | 60          | 80     | Vdc                |
| Emitter-Base Voltage                           | $V_{EBO}$                                                                                     | 5.0         |        | Vdc                |
| Base Current                                   | $I_B$                                                                                         | 15          |        | Adc                |
| Collector Current                              | $I_C$                                                                                         | 50          |        | Adc                |
| Total Power Dissipation                        | @ $T_C = +25^{\circ}\text{C}$ <sup>(1)</sup><br>@ $T_C = +100^{\circ}\text{C}$ <sup>(1)</sup> | 300         |        | W                  |
|                                                |                                                                                               | 171         |        | W                  |
| Operating & Storage Junction Temperature Range | $T_J, T_{stg}$                                                                                | -55 to +200 |        | $^{\circ}\text{C}$ |

### THERMAL CHARACTERISTICS

| Characteristics                      | Symbol          | Max.  | Unit                 |
|--------------------------------------|-----------------|-------|----------------------|
| Thermal Resistance, Junction-to-Case | $R_{\theta JC}$ | .0584 | $^{\circ}\text{C/W}$ |

1) Derate linearly 1.715 W/ $^{\circ}\text{C}$  between  $T_C = 25^{\circ}\text{C}$  and  $T_C = 200^{\circ}\text{C}$



TO-3\*  
(TO-204AA)

\*See appendix A for package outline

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

| Characteristics | Symbol | Min. | Max. | Unit |
|-----------------|--------|------|------|------|
|-----------------|--------|------|------|------|

#### OFF CHARACTERISTICS

|                                                                                                                                                |        |               |     |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|-----|-----------------|
| Collector-Emitter Breakdown Voltage<br>$I_C = 100 \text{ mAdc}$                                                                                | 2N5685 | $V_{(BR)CEO}$ | 60  | Vdc             |
|                                                                                                                                                | 2N5686 |               | 80  |                 |
| Collector-Emitter Cutoff Current<br>$V_{CE} = 30 \text{ Vdc}$<br>$V_{CE} = 40 \text{ Vdc}$                                                     | 2N5685 | $I_{CEO}$     | 500 | $\mu\text{Adc}$ |
|                                                                                                                                                | 2N5686 |               | 500 |                 |
| Collector-Emitter Cutoff Current<br>$V_{CE} = 60 \text{ Vdc}, V_{BE} = 1.5 \text{ Vdc}$<br>$V_{CE} = 80 \text{ Vdc}, V_{BE} = 1.5 \text{ Vdc}$ | 2N5685 | $I_{CEX}$     | 500 | $\mu\text{Adc}$ |
|                                                                                                                                                | 2N5686 |               | 500 |                 |
| Collector-Base Cutoff Current<br>$V_{CB} = 60 \text{ Vdc}$<br>$V_{CB} = 80 \text{ Vdc}$                                                        | 2N5685 | $I_{CBO}$     | 2.0 | mAdc            |
|                                                                                                                                                | 2N5686 |               | 2.0 |                 |

**ELECTRICAL CHARACTERISTICS (con't)**

| Characteristics                                           | Symbol    | Min. | Max. | Unit |
|-----------------------------------------------------------|-----------|------|------|------|
| Emitter-Base Cutoff Current<br>$V_{EB} = 5.0 \text{ Vdc}$ | $I_{EBO}$ |      | 1.0  | mAdc |

**ON CHARACTERISTICS <sup>(2)</sup>**

|                                                                                                                                                                                             |               |                 |            |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------|------------|-----|
| Forward-Current Transfer Ratio<br>$I_C = 5.0 \text{ Adc}, V_{CE} = 2.0 \text{ Vdc}$<br>$I_C = 25 \text{ Adc}, V_{CE} = 2.0 \text{ Vdc}$<br>$I_C = 50 \text{ Adc}, V_{CE} = 5.0 \text{ Vdc}$ | $h_{FE}$      | 30<br>15<br>5.0 | 60         |     |
| Collector-Emitter Saturation Voltage<br>$I_C = 25 \text{ Adc}, I_B = 2.5 \text{ Adc}$<br>$I_C = 50 \text{ Adc}, I_B = 10 \text{ Adc}$                                                       | $V_{CE(sat)}$ |                 | 1.0<br>5.0 | Vdc |
| Base-Emitter Saturation Voltage<br>$I_C = 25 \text{ Adc}, I_B = 2.5 \text{ Adc}$                                                                                                            | $V_{BE(sat)}$ |                 | 2.0        | Vdc |
| Base-Emitter Voltage<br>$I_C = 25 \text{ Adc}, V_{CE} = 2.0 \text{ Vdc}$                                                                                                                    | $V_{BE(on)}$  |                 | 2.0        | Vdc |

**DYNAMIC CHARACTERISTICS**

|                                                                                                                                                                |            |     |      |    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----|------|----|
| Magnitude of Common Emitter Small-Signal Short-Circuit Forward Current Transfer Ratio<br>$I_C = 5.0 \text{ Adc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ MHz}$ | $ h_{fe} $ | 2.0 | 20   |    |
| Small-Signal Short-Circuit Forward Current Transfer Ratio<br>$I_C = 10 \text{ Adc}, V_{CE} = 5.0 \text{ Vdc}, f = 1.0 \text{ kHz}$                             | $h_{fe}$   | 15  |      |    |
| Output Capacitance<br>$V_{CB} = 10 \text{ Vdc}, I_E = 0, 0.1 \text{ MHz} \leq f \leq 1.0 \text{ MHz}$                                                          | $C_{obo}$  |     | 1200 | pF |

**SWITCHING CHARACTERISTICS**

|                                                                                                      |           |  |     |               |
|------------------------------------------------------------------------------------------------------|-----------|--|-----|---------------|
| Turn-On Time<br>$V_{CC} = 30 \text{ Vdc}, I_C = 25 \text{ Adc}, I_{B1} = 2.5 \text{ Adc}$            | $t_{on}$  |  | 1.5 | $\mu\text{s}$ |
| Turn-Off Time<br>$V_{CC} = 30 \text{ Vdc}, I_C = 25 \text{ Adc}, I_{B1} = -I_{B2} = 2.5 \text{ Adc}$ | $t_{off}$ |  | 3.0 | $\mu\text{s}$ |

**SAFE OPERATING AREA**

|                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|
| <b>DC Tests</b><br>$T_C = +25^\circ\text{C}, 1 \text{ Cycle}, t = 1.0 \text{ s}$<br><b>Test 1</b><br>$V_{CE} = 6.0 \text{ Vdc}, I_C = 50 \text{ Adc}$<br><b>Test 2</b><br>$V_{CE} = 30 \text{ Vdc}, I_C = 10 \text{ Adc}$<br><b>Test 3</b><br>$V_{CE} = 50 \text{ Vdc}, I_C = 560 \text{ mAdc}$ 2N5685<br>$V_{CE} = 60 \text{ Vdc}, I_C = 640 \text{ mAdc}$ 2N5686 |  |  |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|

(2) Pulse Test: Pulse Width = 300 $\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .