

## NPN SILICON POWER TRANSISTORS

The 2N6676, 2N6677 and 2N6678 transistor are designed for high voltage switching applications such as:

### FEATURES

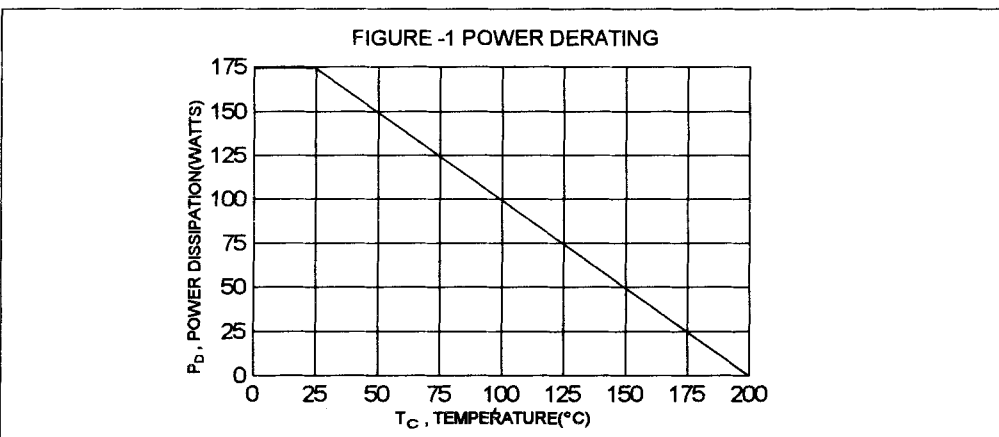
- \*Off-Line Power Supplies
- \*Converter Circuits
- \*Pulse Width Modulated Regulators
- Specification Feature-
  - High Voltage Capability
  - Fast Switching Speeds
  - Low Saturation Voltage

### MAXIMUM RATINGS

| Characteristic  | Symbol         | 2N6676      | 2N6677 | 2N6678 | Unit             |
|---|----------------|-------------|--------|--------|------------------|
| Collector-Emitter Voltage   | $V_{CEV}$      | 450         | 550    | 650    | V                |
| Collector-Emitter Voltage   | $V_{CEX}$      | 350         | 400    | 450    | V                |
| Collector-Emitter Voltage   | $V_{CEO}$      | 300         | 350    | 400    | V                |
| Emitter-Base Voltage  | $V_{EBO}$      | 8.0         |        |        | V                |
| Collector Current - Continuous  | $I_C$          | 15          |        |        | A                |
| Collector Current - Peak  | $I_{CM}$       | 20          |        |        | A                |
| Base Current-Peak   | $I_B$          | 5.0         |        |        | A                |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_T$          | 175         |        |        | W                |
| Operating and Storage Junction Temperature Range                                      | $T_J, T_{STG}$ | -65 to +200 |        |        | $^\circ\text{C}$ |

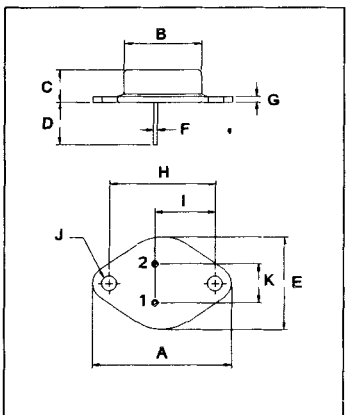
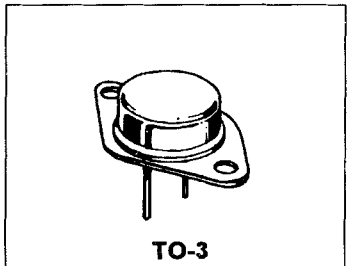
### THERMAL CHARACTERISTICS

| Characteristic                      | Symbol          | Max | UNIT               |
|-------------------------------------|-----------------|-----|--------------------|
| Thermal Resistance Junction to Case | $R_{\theta jc}$ | 1.0 | $^\circ\text{C/W}$ |



**NPN**  
**2N6676**  
**2N6677**  
**2N6678**

15 AMPERE  
NPN SILICON  
POWER TRANSISTORS  
300-400 VOLTS  
175 WATTS



PIN 1. BASE  
2. EMITTER  
COLLECTOR (CASE)

| DIM | MILLIMETERS |       |
|-----|-------------|-------|
|     | MIN         | MAX   |
| A   | 38.75       | 39.96 |
| B   | 19.28       | 22.23 |
| C   | 7.96        | 9.28  |
| D   | 11.18       | 12.19 |
| E   | 25.20       | 26.67 |
| F   | 0.92        | 1.09  |
| G   | 1.38        | 1.62  |
| H   | 29.90       | 30.40 |
| I   | 16.64       | 17.30 |
| J   | 3.88        | 4.36  |
| K   | 10.67       | 11.18 |

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

| Characteristic | Symbol | Min | Max | Unit |
|----------------|--------|-----|-----|------|
|----------------|--------|-----|-----|------|

**OFF CHARACTERISTICS**

|  |                            |                |                   |    |
|--|----------------------------|----------------|-------------------|----|
| Collector-Emitter Sustaining Voltage(1)<br>( $I_C = 200\text{ mA}$ , $I_B = 0$ )   | 2N6676<br>2N6677<br>2N6678 | $V_{CEO(sus)}$ | 300<br>350<br>400 | V  |
| Collector Cutoff Current<br>( $V_{CE} = \text{Rated } V_{CEV}$ , $V_{BE(off)} = -1.5\text{V}$ )<br>( $V_{CE} = \text{Rated } V_{CEV}$ , $V_{BE(off)} = -1.5\text{V}$ , $T_C = 100^\circ\text{C}$ ) |                            | $I_{CEV}$      | 0.1<br>1.0        | mA |
| Emitter Cutoff Current<br>( $V_{EB} = 8.0\text{ V}$ , $I_C = 0$ )  |                            | $I_{EBO}$      | 2.0               | mA |

**ON CHARACTERISTICS (1)**

|  |  |               |     |   |
|--|--|---------------|-----|---|
| DC Current Gain<br>( $I_C = 15\text{ A}$ , $V_{CE} = 3.0\text{ V}$ )                   |  | hFE           | 8.0 |   |
| Collector-Emitter Saturation Voltage<br>( $I_C = 15\text{ A}$ , $I_B = 3.0\text{ A}$ ) |  | $V_{CE(sat)}$ | 1.5 | V |
| Base-Emitter Saturation Voltage<br>( $I_C = 15\text{ A}$ , $I_B = 3.0\text{ A}$ )      |  | $V_{BE(sat)}$ | 1.5 | V |

**DYNAMIC CHARACTERISTICS**

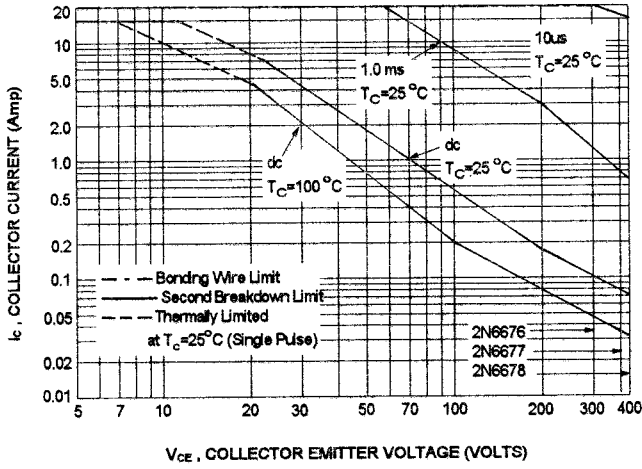
|  |  |          |     |     |
|--|--|----------|-----|-----|
| Current - Gain - Bandwidth Product (2)<br>( $I_C = 1.0\text{ A}$ , $V_{CE} = 10\text{ V}$ , $f = 5.0\text{ MHz}$ ) |  | $F_T$    | 3.0 | MHz |
| Output Capacitance<br>( $I_C = 1.0\text{ A}$ , $V_{CB} = 10\text{ V}$ , $f = 0.1\text{ MHz}$ )                     |  | $C_{ob}$ | 500 | pF  |

**SWITCHING CHARACTERISTICS**

|              |  |       |     |    |
|--------------|--|-------|-----|----|
| Delay Time   | $V_{CC} = 200\text{V}$ , $I_C = 15\text{A}$<br>$I_{B1} = I_{B2} = 3\text{A}$ , $t_p = 20\mu\text{s}$<br>Duty Cycle $\leq 2\%$<br>$V_{BB} = 6\text{V}$ , $R_L = 13.5\Omega$<br>$T_C = 25^\circ\text{C}$ | $t_d$ | 0.2 | us |
| Rise Time    |  | $t_r$ | 0.6 | us |
| Storage Time |  | $t_s$ | 2.5 | us |
| Fall Time    |  | $t_f$ | 0.6 | us |

(1) Pulse Test: Pulse width = 300 us , Duty Cycle  $\leq 2.0\%$ (2)  $f_T = |h_{fe}| \cdot f_{test}$

FIG-2 FORWARD BIAS SAFE OPERATING AREA

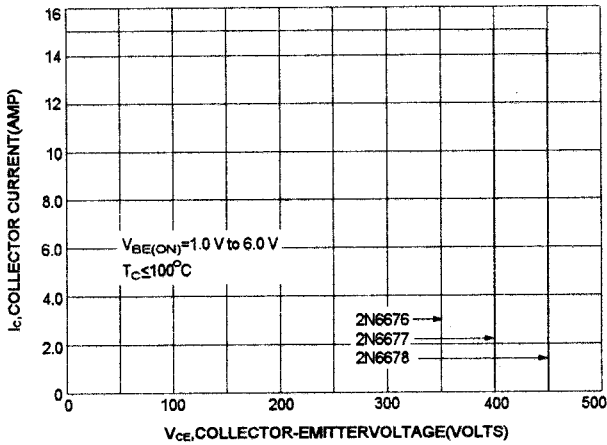


**FORWARD BIAS**

There are two limitation 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 curves indicate.

The data of FIG-2 is base 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% provided  $T_c \geq 25^\circ\text{C}$ . At high case temperatures, thermal limitation will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

FIG-3 REVERSE BIAS SAFE OPERATING AREA



**REVERSE BIAS**

For inductive loads, high voltage and high current must be sustained simultaneously during turn-off, in most cases, with the base-to-emitter junction reverse biased. Under these conditions the collector voltage must be held to a safe level at or below a specific value of collector current. This can be accomplished by several means such as active clamping, RC snubbing, load line shaping, etc. the safe level for these devices is specified as Reverse Bias Safe Operating Area and represents the voltage-current condition allowable during reverse biased turn-off. This rating is verified under clamped conditions so that the device is never subjected to an avalanche mode. FIG-3 gives the RBSOA characteristics.