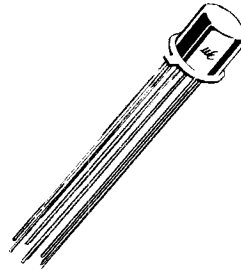


# Multiple Transistors

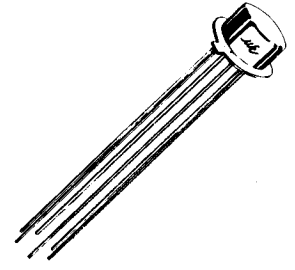
## Differential amplifiers

- $h_{FE}$  matching =  $1 - \frac{h_{FE1}}{h_{FE2}}$  is the larger of the two  $h_{FE}$ 's
- $V_{BE}$  matching =  $|V_{BE1} - V_{BE2}|$
- $\Delta V_{BE}$  matching =  $|\Delta(V_{BE1} - V_{BE2})|$  @  $-55^{\circ}\text{C}$  to  $25^{\circ}\text{C}$

TO-71



TO-78



| TYPE NO.<br>NPN<br>PNP | Maximum Ratings                       |            |            |                    | Differential Characteristics. |                       |                    |            |                   | Electrical Characteristics. |                  | CASE           |                    |
|------------------------|---------------------------------------|------------|------------|--------------------|-------------------------------|-----------------------|--------------------|------------|-------------------|-----------------------------|------------------|----------------|--------------------|
|                        | $P_D$<br>@ $T_A = 25^{\circ}\text{C}$ |            | $BV_{CBO}$ | $V_{CEO}$<br>(sus) | $BV_{EBO}$                    | $h_{FE}$<br>min./max. | Parameter Matching |            |                   | $f_T$ @ $I_C$<br>min.       | N.F. @ f<br>max. |                |                    |
|                        | one side                              | both sides |            |                    |                               |                       | $h_{FE}^1$         | $V_{BE}^2$ | $\Delta V_{BE}^3$ |                             |                  |                | @ $V_{CE}$ @ $I_C$ |
| MD 2974                | 500mW                                 | 750mW      | 45V        | 45V                | 6V                            | 100/ -                | 10%                | 3.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 60MHz @ 0.5mA    | 4.0dB @ 1kHz   | R-148 V            |
| MD 2975                | 500mW                                 | 750mW      | 45V        | 45V                | 6V                            | 225/ -                | 10%                | 3.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 60MHz @ 0.5mA    | 3.0dB @ 1kHz   | R-148 V            |
| MD 2978                | 500mW                                 | 750mW      | 60V        | 60V                | 6V                            | 100/ -                | 10%                | 3.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 60MHz @ 0.5mA    | 4.0dB @ 1kHz   | R-148 V            |
| MD 2979                | 500mW                                 | 750mW      | 60V        | 60V                | 6V                            | 225/ -                | 10%                | 3.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 60MHz @ 0.5mA    | 3.0dB @ 1kHz   | R-148 V            |
| 2N 2060                | 500mW                                 | 600mW      | 100V       | 60V                | 7V                            | 30/ 90                | 10%                | 5.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 60MHz @ 50.0mA   | 8.0dB @ 1kHz   | TO-78              |
| 2N 2060A               | 500mW                                 | 600mW      | 100V       | 60V                | 7V                            | 30/ 90                | 10%                | 3.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 60MHz @ 50.0mA   | 8.0dB @ 1kHz   | TO-78              |
| 2N 2060B               | 500mW                                 | 600mW      | 100V       | 60V                | 7V                            | 30/ 90                | 10%                | 1.5mV      | 0.4mV             | @ 5V @ 0.1mA                | 60MHz @ 50.0mA   | 8.0dB @ 1kHz   | TO-78              |
| 2N 2915                | 300mW                                 | 600mW      | 45V        | 45V                | 6V                            | 100/ -                | 10%                | 3.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 60MHz @ 0.5mA    | 4.0dB @ 1kHz   | TO-78              |
| 2N 2916                | 300mW                                 | 600mW      | 45V        | 45V                | 6V                            | 225/ -                | 10%                | 3.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 60MHz @ 0.5mA    | 3.0dB @ 1kHz   | TO-78              |
| 2N 2919                | 300mW                                 | 600mW      | 60V        | 60V                | 6V                            | 100/ -                | 10%                | 3.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 60MHz @ 0.5mA    | 4.0dB @ 1kHz   | TO-78              |
| 2N 2920                | 300mW                                 | 600mW      | 60V        | 60V                | 6V                            | 225/ -                | 10%                | 3.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 60MHz @ 0.5mA    | 3.0dB @ 1kHz   | TO-78              |
| 2N 2974                | 250mW                                 | 300mW      | 45V        | 45V                | 6V                            | 100/ -                | 10%                | 3.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 60MHz @ 0.5mA    | 4.0dB @ 1kHz   | TO-71              |
| 2N 2975                | 250mW                                 | 300mW      | 45V        | 45V                | 6V                            | 225/ -                | 10%                | 3.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 60MHz @ 0.5mA    | 3.0dB @ 1kHz   | TO-71              |
| 2N 2978                | 250mW                                 | 300mW      | 60V        | 60V                | 6V                            | 100/ -                | 10%                | 3.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 60MHz @ 0.5mA    | 4.0dB @ 1kHz   | TO-71              |
| 2N 2979                | 250mW                                 | 300mW      | 60V        | 60V                | 6V                            | 225/ -                | 10%                | 3.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 60MHz @ 0.5mA    | 3.0dB @ 1kHz   | TO-71              |
| 2N 2980                | 250mW                                 | 300mW      | 100V       | 60V                | 7V                            | 30/ 90                | 10%                | 3.0mV      | -                 | @ 5V @ 0.1mA                | 60MHz @ 50.0mA   | 8.0dB @ 1kHz   | TO-71              |
| 2N 2981                | 250mW                                 | 300mW      | 100V       | 60V                | 7V                            | 25/150                | 20%                | 15.0mV     | -                 | @ 5V @ 0.1mA                | 50MHz @ 50.0mA   | -              | TO-71              |
| 2N 2982                | 250mW                                 | 300mW      | 100V       | 60V                | 7V                            | 25/150                | 10%                | 5.0mV      | -                 | @ 5V @ 0.1mA                | 50MHz @ 50.0mA   | -              | TO-71              |
| 2N 3423                | 300mW                                 | 600mW      | 30V        | 15V                | 3V                            | 20/200                | 20%                | 10.0mV     | 3.2mV             | @ 3V @ 3.0mA                | 600MHz @ 4.0mA   | 3.5dB* @ 60MHz | TO-78              |
| 2N 3424                | 300mW                                 | 600mW      | 30V        | 15V                | 3V                            | 20/200                | 10%                | 0.5mV      | 1.6mV             | @ 3V @ 3.0mA                | 600MHz @ 4.0mA   | 3.5dB* @ 60MHz | TO-78              |
| 2N 3726                | 400mW                                 | 500mW      | 45V        | 45V                | 5V                            | 135/350               | 10%                | 5.0mV      | 1.6mV             | @ 5V @ 1.0mA                | 200MHz @ 50.0mA  | 4.0dB @ 1kHz   | TO-78              |
| 2N 3727                | 400mW                                 | 500mW      | 45V        | 45V                | 5V                            | 135/350               | 10%                | 2.5mV      | 0.8mV             | @ 5V @ 1.0mA                | 200MHz @ 50.0mA  | 4.0dB @ 1kHz   | TO-78              |
| 2N 4020                | 400mW                                 | 600mW      | 45V        | 45V                | 6V                            | 250/550               | 20%                | 5.0mV      | 1.6mV             | @ 5V @ 0.1mA                | 50MHz @ 0.5mA    | 2.0dB @ 1kHz   | TO-78              |
| 2N 4021                | 400mW                                 | 600mW      | 60V        | 60V                | 6V                            | 100/400               | 20%                | 5.0mV      | 1.6mV             | @ 5V @ 0.1mA                | 40MHz @ 0.5mA    | 3.0dB @ 1kHz   | TO-78              |
| 2N 4022                | 400mW                                 | 600mW      | 60V        | 60V                | 6V                            | 250/550               | 20%                | 5.0mV      | 1.6mV             | @ 5V @ 0.1mA                | 50MHz @ 0.5mA    | 2.0dB @ 1kHz   | TO-78              |
| 2N 4023                | 400mW                                 | 600mW      | 45V        | 45V                | 6V                            | 250/550               | 10%                | 3.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 50MHz @ 0.5mA    | 2.0dB @ 1kHz   | TO-78              |
| 2N 4024                | 400mW                                 | 600mW      | 60V        | 60V                | 6V                            | 100/400               | 10%                | 3.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 40MHz @ 0.5mA    | 3.0dB @ 1kHz   | TO-78              |
| 2N 4025                | 400mW                                 | 600mW      | 60V        | 60V                | 6V                            | 250/550               | 10%                | 3.0mV      | 0.8mV             | @ 5V @ 0.1mA                | 50MHz @ 0.5mA    | 2.0dB @ 1kHz   | TO-78              |

\*Typical Value

## Dual transistors

| TYPE NO.<br>NPN | Maximum Ratings                       |            |            |            | Electric characteristic @ $T_A = 25^{\circ}\text{C}$ |  |                                   |                       | CASE       |                  |
|-----------------|---------------------------------------|------------|------------|------------|--|--|-----------------------------------|-----------------------|------------|------------------|
|                 | $P_D$<br>@ $T_A = 25^{\circ}\text{C}$ |            | $BV_{CBO}$ | $LV_{CED}$ | $BV_{EBO}$   | $h_{FE}$ @ $V_{CE}$ @ $I_C$<br>Min./Max. | $V_{CE(sat)}$ @ $I_C/I_B$<br>Max. | $f_T$ @ $I_C$<br>Min. |            | N.F. @ f<br>Max. |
|                 | one side                              | both sides |            |            |  |  |                                   |                       |            |                  |
| 2N 2913         | 300mW                                 | 600mW      | 45V        | 45V        | 6V   | 60/240 @ 5V @ 0.01mA                     | 0.35V @ 1/0.1mA                   | 60MHz @ 0.5mA         | 4dB @ 1kHz | TO-78            |
| 2N 2914         | 300mW                                 | 600mW      | 45V        | 45V        | 6V   | 150/600 @ 5V @ 0.01mA                    | 0.35V @ 1/0.1mA                   | 60MHz @ 0.5mA         | 3dB @ 1kHz | TO-78            |
| 2N 2972         | 250mW                                 | 300mW      | 45V        | 45V        | 6V   | 60/240 @ 5V @ 0.01mA                     | 0.35V @ 1/0.1mA                   | 60MHz @ 0.5mA         | 4dB @ 1kHz | TO-71            |
| 2N 2973         | 250mW                                 | 300mW      | 45V        | 45V        | 6V   | 150/600 @ 5V @ 0.01mA                    | 0.35V @ 1/0.1mA                   | 60MHz @ 0.5mA         | 3dB @ 1kHz | TO-71            |