TYPES 2N3021 THRU 2N3026
BULLETIN NO. DL-S 7111596, DECEMBER 1971

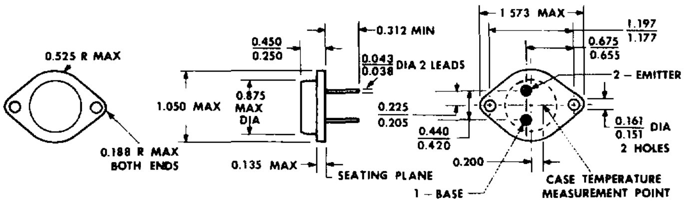


## FOR POWER-AMPLIFIER AND HIGH-SPEED-SWITCHING APPLICATIONS

- Max $t_{off}$ 400 ns at $I_C$ = 1 A
- 3-A Rated Continuous Collector Current
- 25 Watts at 25°C Case Temperature
- Min $f_T$ of 60 MHz at 15 V, 0.5 A

### *mechanical data

THE COLLECTOR IS IN ELECTRICAL CONTACT WITH THE CASE




ALL JEDEC TO-3 DIMENSIONS AND NOTES ARE APPLICABLE

### *absolute maximum ratings at 25°C case temperature (unless otherwise noted)

| | 2N3021 2N3024 | 2N3022 2N3025 | 2N3023 2N3026 |
|---|---|---|---|
| Collector-Base Voltage | −30 V | −45 V | −60 V |
| Collector-Emitter Voltage (See Note 1) | −30 V | −45 V | −60 V |
| Emitter-Base Voltage | −4 V | −4 V | −4 V |
| Continuous Collector Current | ← | −3 A | → |
| Continuous Base Current | ← | −0.5 A | → |
| Safe Operating Areas at (or below) 25°C Case Temperature | | See Figures 3 thru 5 | |
| Continuous Device Dissipation at (or below) 25°C Case Temperature (See Note 2) | ← | 25 W | → |
| Operating Collector Junction Temperature Range | | −65°C to 175°C | |
| Storage Temperature Range | | −65°C to 175°C | |
| Terminal Temperature 1/16 Inch from Case for 10 Seconds | ← | 250°C | → |

NOTES: 1. These values apply when the base-emitter diode is open-circuited.
2. For operation above 25°C case temperature, refer to Dissipation Derating Curve, Figure 6.

*JEDEC registered data. This data sheet contains all applicable registered data in effect at the time of publication.

# TYPES 2N3021 THRU 2N3026
# P-N-P SILICON POWER TRANSISTORS

***electrical characteristics of 2N3021, 2N3022, 2N3023 at 25°C case temperature (unless otherwise noted)**

| PARAMETER | | TEST CONDITIONS | | | 2N3021 | | 2N3022 | | 2N3023 | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| $V_{(BR)CEO}$ | Collector-Emitter Breakdown Voltage | $I_C = -100$ mA, | $I_B = 0$ | See Note 3 | −30 | | | | | | V |
| | | $I_C = -50$ mA, | $I_B = 0$ | | | | −45 | | | | |
| | | $I_C = -20$ mA, | $I_B = 0$ | | | | | | −60 | | |
| $I_{CEV}$ | Collector Cutoff Current | $V_{CE} = -25$ V, | $V_{BE} = 2$ V | | | −0.2 | | | | | mA |
| | | $V_{CE} = -40$ V, | $V_{BE} = 2$ V | | | | | −0.2 | | | |
| | | $V_{CE} = -54$ V, | $V_{BE} = 2$ V | | | | | | | −0.2 | |
| | | $V_{CE} = -15$ V, | $V_{BE} = 2$ V, | $T_C = 150°C$ | | −2 | | | | | |
| | | $V_{CE} = -25$ V, | $V_{BE} = 2$ V, | $T_C = 150°C$ | | | | −2 | | | |
| | | $V_{CE} = -35$ V, | $V_{BE} = 2$ V, | $T_C = 150°C$ | | | | | | −2 | |
| $I_{EBO}$ | Emitter Cutoff Current | $V_{EB} = -4$ V, | $I_C = 0$ | | | −1 | | −1 | | −1 | mA |
| $h_{FE}$ | Static Forward Current Transfer Ratio | $V_{CE} = -2$ V, | $I_C = 1$ A, | See Notes 3 and 4 | 20 | 60 | 20 | 60 | 20 | 60 | |
| $V_{BE}$ | Base-Emitter Voltage | $I_C = -3$ A, | $I_B = -0.3$ A, | See Notes 3 and 4 | | −1.5 | | −1.5 | | −1.5 | V |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $I_C = -3$ A, | $I_B = -0.3$ A, | See Notes 3 and 4 | | −1.5 | | −1.5 | | −1.5 | V |
| $\|h_{fe}\|$ | Small-Signal Common-Emitter Forward Current Transfer Ratio | $V_{CE} = -15$ V, | $I_C = -0.5$ A, | f = 30 MHz | 2 | | 2 | | 2 | | |

***electrical characteristics of 2N3024, 2N3025, 2N3026 at 25°C case temperature (unless otherwise noted)**

| PARAMETER | | TEST CONDITIONS | | | 2N3024 | | 2N3025 | | 2N3026 | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| $V_{(BR)CEO}$ | Collector-Emitter Breakdown Voltage | $I_C = -100$ mA, | $I_B = 0$ | See Note 3 | −30 | | | | | | V |
| | | $I_C = -50$ mA, | $I_B = 0$ | | | | −45 | | | | |
| | | $I_C = -20$ mA, | $I_B = 0$ | | | | | | −60 | | |
| $I_{CEV}$ | Collector Cutoff Current | $V_{CE} = -25$ V, | $V_{BE} = 2$ V | | | −0.2 | | | | | mA |
| | | $V_{CE} = -40$ V, | $V_{BE} = 2$ V | | | | | −0.2 | | | |
| | | $V_{CE} = -54$ V, | $V_{BE} = 2$ V | | | | | | | −0.2 | |
| | | $V_{CE} = -15$ V, | $V_{BE} = 2$ V, | $T_C = 150°C$ | | −2 | | | | | |
| | | $V_{CE} = -25$ V, | $V_{BE} = 2$ V, | $T_C = 150°C$ | | | | −2 | | | |
| | | $V_{CE} = -35$ V, | $V_{BE} = 2$ V, | $T_C = 150°C$ | | | | | | −2 | |
| $I_{EBO}$ | Emitter Cutoff Current | $V_{EB} = -4$ V, | $I_C = 0$ | | | −1 | | −1 | | −1 | mA |
| $h_{FE}$ | Static Forward Current Transfer Ratio | $V_{CE} = -2$ V, | $I_C = 1$ A, | See Notes 3 and 4 | 50 | 180 | 50 | 180 | 50 | 180 | |
| $V_{BE}$ | Base-Emitter Voltage | $I_C = -3$ A, | $I_B = -0.3$ A, | See Notes 3 and 4 | | −1.5 | | −1.5 | | −1.5 | V |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $I_C = -3$ A, | $I_B = -0.3$ A, | See Notes 3 and 4 | | −1 | | −1 | | −1 | V |
| $\|h_{fe}\|$ | Small-Signal Common-Emitter Forward Current Transfer Ratio | $V_{CE} = -15$ V, | $I_C = -0.5$ A, | f = 30 MHz | 2 | | 2 | | 2 | | |

NOTES: 3. These parameters must be measured using pulse techniques. $t_w = 300\ \mu s$, duty cycle $\leq 2\%$.

4. These parameters are measured with voltage-sensing contacts separate from the current-carrying contacts and located within 0.125 inch from the device body.

*JEDEC registered data



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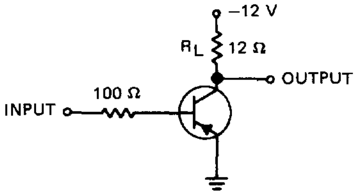
***switching characteristics at 25°C case temperature**

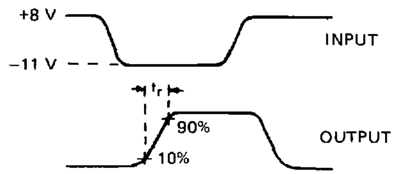
| PARAMETER | | TEST CONDITIONS† | | MAX | UNIT |
|---|---|---|---|---|---|
| $t_{on}$ | Turn-On Time | $I_C = -1$ A, $R_L = 12\ \Omega$, | $I_{B(1)} = -0.1$ A, $V_{BE(off)} = 4$ V, See Figure 1 | 100 | ns |
| $t_s$ | Storage Time | $I_C = -1$ A, | $I_{B(1)} = -0.1$ A, $I_{B(2)} = 0.1$ A, | 325 | ns |
| $t_f$ | Fall Time | $R_L = 12\ \Omega$, | See Figure 2 | 75 | ns |

† Voltage and current values shown are nominal; exact values vary slightly with transistor parameters.

## *PARAMETER MEASUREMENT INFORMATION

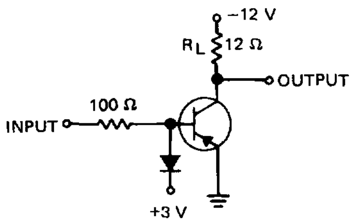



TEST CIRCUIT

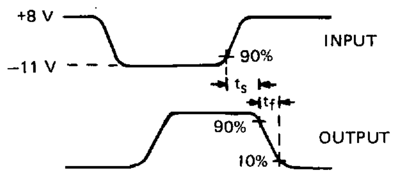



VOLTAGE WAVEFORMS

FIGURE 1—RISE TIME




TEST CIRCUIT




VOLTAGE WAVEFORMS

FIGURE 2—STORAGE AND FALL TIMES

NOTES: a. The input waveforms are supplied by a generator with the following characteristics: $t_r \leqslant 10$ ns, $t_r \leqslant 10$ ns, $t_w = 10\ \mu s$, $Z_{out} = 50\ \Omega$, duty cycle $\leqslant 2\%$.
b. Waveforms are monitored on an oscilloscope with the following characteristics $t_r \leqslant 5$ ns, $R_{in} \geqslant 10\ k\Omega$, $C_{in} \leqslant 11.5$ pF.
c. Resistors must be noninductive types.
d. The d-c power supplies may require additional bypassing in order to minimize ringing.

*JEDEC registered data

## MAXIMUM SAFE OPERATING AREAS

2N3021, 2N3024

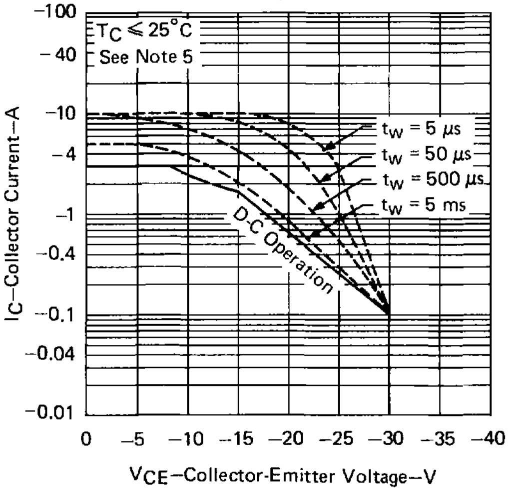



FIGURE 3

2N3022, 2N3025

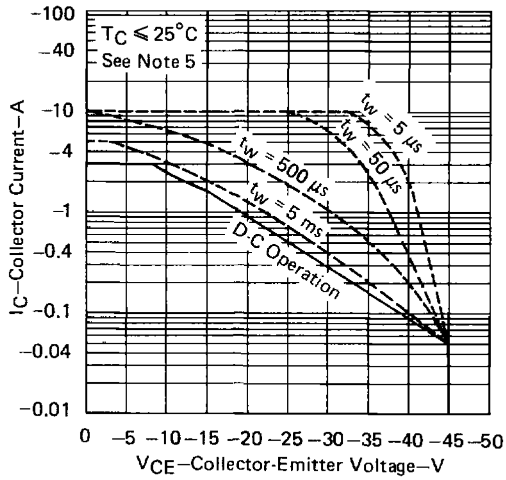



FIGURE 4

2N3023, 2N3026

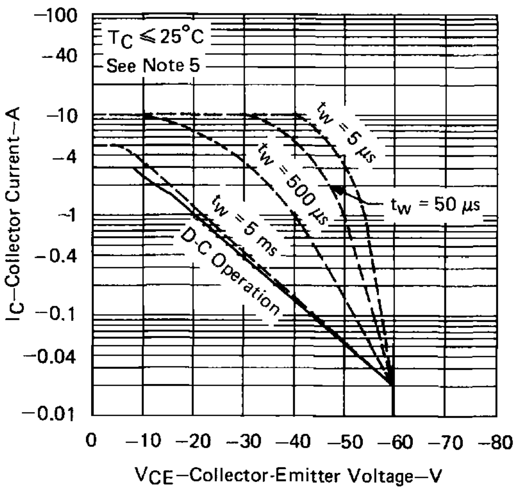



FIGURE 5

NOTE 5: Areas defined by dashed lines apply for nonrepetitive-pulse operation. The pulse may be repeated after the device has regained thermal equilibrium.

## THERMAL INFORMATION

CASE TEMPERATURE
DISSIPATION DERATING CURVE

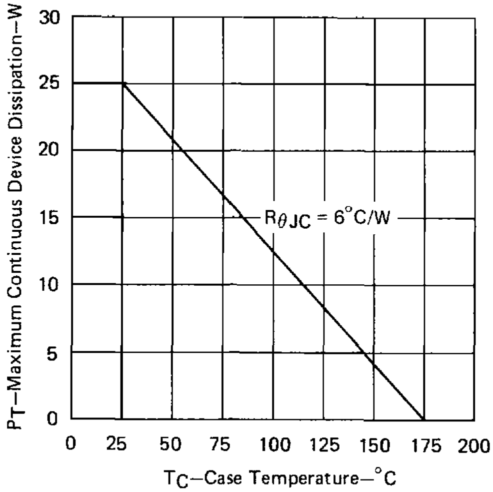



FIGURE 6



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