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# N-P-N TYPES 2N1302, 2N1304, 2N1306, AND 2N1308 ALLOY-JUNCTION GERMANIUM TRANSISTORS

## High-Frequency Transistors for Computer and Switching Applications

**environmental tests**

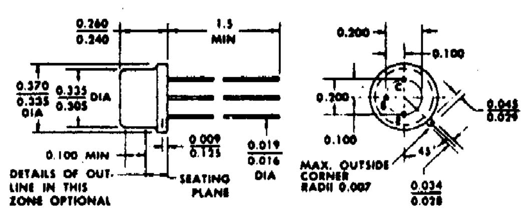
To ensure maximum integrity, stability, and long life, finished devices are subjected to the following tests and conditions prior to thorough testing for rigid adherence to specified characteristics.

- All devices receive a 100°C stabilization bake for 100 hours.
- The hermetic seal for all devices is verified by helium leak testing.
- Production samples are life tested at regularly scheduled periods to ensure maximum reliability under extreme operating conditions.
- Continuous Quality Control checks on in-process assembly are maintained.

***mechanical data**

The transistors are in a JEDEC TO-5 hermetically sealed welded package with glass to metal seal between case and leads. Approximate weight is one gram.

THE BASE IS IN ELECTRICAL CONTACT WITH CASE




DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED

***absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)**

| | 2N1302, 2N1304, 2N1306, 2N1308 | 2N1303, 2N1305, 2N1307, 2N1309 |
|---|---|---|
| Collector-Base Voltage | 25 v | 30 v |
| Emitter-Base Voltage | 25 v | |
| Collector Current | 300 ma | |
| Total Device Dissipation at (or below) 25°C Free-Air Temperature | 150 mw | |
| Operating Collector Junction Temperature | 85°C | |
| Storage Temperature Range | −65°C to 100°C | |

# TYPES 2N1302, 2N1304, 2N1306, AND 2N1308
# N-P-N ALLOY-JUNCTION GERMANIUM TRANSISTORS

## electrical characteristics at 25°C free-air temperature

| PARAMETER | TEST CONDITIONS | 2N1302 | | | 2N1304 | | | 2N1306 | | | 2N1308 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | |
| $BV_{CBO}$ Collector-Base Breakdown Voltage | $I_C = 100\ \mu a$, $I_E = 0$ | 25 | — | — | 25 | — | — | 25 | — | — | 25 | — | — | v |
| $BV_{EBO}$ Emitter-Base Breakdown Voltage | $I_E = 100\ \mu a$, $I_C = 0$ | 25 | — | — | 25 | — | — | 25 | — | — | 25 | — | — | v |
| *$V_{PT}$ Punch Through Voltage† | $V_{EBfl} = 1$ v | 25 | — | — | 20 | — | — | 15 | — | — | 15 | — | — | v |
| *$I_{CBO}$ Collector Cutoff Current | $V_{CB} = 25$ v, $I_E = 0$ | — | 3 | 6 | — | 3 | 6 | — | 3 | 6 | — | 3 | 6 | μa |
| *$I_{EBO}$ Emitter Cutoff Current | $V_{EB} = 25$ v, $I_C = 0$ | — | 2 | 6 | — | 2 | 6 | — | 2 | 6 | — | 2 | 6 | μa |
| *$h_{FE}$ Static Forward Current Transfer Ratio | $V_{CE} = 1$ v, $I_C = 10$ ma | 20 | 100 | — | 40 | 115 | 200 | 60 | 130 | 300 | 80 | 160 | — | — |
| | $V_{CE} = 0.35$ v, $I_C = 200$ ma | 10 | 100 | — | 15 | 110 | — | 20 | 125 | — | 20 | 140 | — | — |
| *$V_{BE}$ Base-Emitter Voltage | $I_B = 0.5$ ma, $I_C = 10$ ma | 0.15 | 0.22 | 0.40 | 0.15 | 0.22 | 0.35 | 0.15 | 0.22 | 0.35 | 0.15 | 0.22 | 0.35 | v |
| *$V_{CE(sat)}$ Collector-Emitter Saturation Voltage | $I_B = 0.5$ ma, $I_C = 10$ ma | — | 0.07 | 0.20 | — | — | — | — | — | — | — | — | — | v |
| | $I_B = 0.25$ ma, $I_C = 10$ ma | — | — | — | — | 0.07 | 0.20 | — | — | — | — | — | — | v |
| | $I_B = 0.17$ ma, $I_C = 10$ ma | — | — | — | — | — | — | — | 0.07 | 0.20 | — | — | — | v |
| | $I_B = 0.13$ ma, $I_C = 10$ ma | — | — | — | — | — | — | — | — | — | — | 0.07 | 0.20 | v |
| $h_{ib}$ Small-Signal Common-Base Input Impedance | $V_{CB} = 5$ v, $I_E = -1$ ma, $f = 1$ kc | — | 28 | — | — | 28 | — | — | 28 | — | — | 28 | — | ohm |
| $h_{rb}$ Small-Signal Common-Base Reverse Voltage Transfer Ratio | $V_{CB} = 5$ v, $I_E = -1$ ma, $f = 1$ kc | — | $5 \times 10^{-4}$ | — | — | $5 \times 10^{-4}$ | — | — | $5 \times 10^{-4}$ | — | — | $5 \times 10^{-4}$ | — | — |
| $h_{ob}$ Small-Signal Common-Base Output Admittance | $V_{CB} = 5$ v, $I_E = -1$ ma, $f = 1$ kc | — | 0.34 | — | — | 0.34 | — | — | 0.34 | — | — | 0.34 | — | μmho |
| $h_{fe}$ Small-Signal Common-Emitter Forward Current Transfer Ratio | $V_{CE} = 5$ v, $I_C = 1$ ma, $f = 1$ kc | — | 105 | — | — | 120 | — | — | 135 | — | — | 170 | — | — |
| *$f_{hfb}$ Common-Base Alpha-Cutoff Frequency | $V_{CB} = 5$ v, $I_E = -1$ ma | 3 | 12 | — | 5 | 14 | — | 10 | 16 | — | 15 | 20 | — | mc |
| *$C_{ob}$ Common-Base Open Circuit Output Capacitance | $V_{CB} = 5$ v, $I_E = 0$, $f = 1$ mc | — | 14 | 20 | — | 14 | 20 | — | 14 | 20 | — | 14 | 20 | pf |
| $C_{ib}$ Common-Base Open-Circuit Input Capacitance | $V_{EB} = 5$ v, $I_C = 0$, $f = 1$ mc | — | 13 | — | — | 13 | — | — | 13 | — | — | 13 | — | pf |

†$V_{PT}$ is determined by measuring the emitter-base floating potential $V_{EBfl}$. The collector-base voltage, $V_{CB}$, is increased until $V_{EBfl} = 1$ volt; this value of $V_{CB} = (V_{PT} + 1\ v)$.

## switching characteristics at 25°C free-air temperature

| PARAMETER | TEST CONDITIONS†† | 2N1302 | | | 2N1304 | | | 2N1306 | | | 2N1308 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | |
| $t_d$ Delay Time | $I_C = 10$ ma, $I_{B(1)} = 1.3$ ma, $I_{B(2)} = -0.7$ ma, $V_{BE(off)} = -0.8$ v, $R_L = 1\ k\Omega$ (See Fig. 1) | — | 0.07 | — | — | 0.07 | — | — | 0.06 | — | — | 0.06 | — | μsec |
| $t_r$ Rise Time | | — | 0.20 | — | — | 0.20 | — | — | 0.18 | — | — | 0.15 | — | μsec |
| $t_s$ Storage Time | | — | 0.70 | — | — | 0.70 | — | — | 0.64 | — | — | 0.64 | — | μsec |
| $t_f$ Fall Time | | — | 0.40 | — | — | 0.40 | — | — | 0.36 | — | — | 0.34 | — | μsec |
| $Q_{sb}$ Stored Base Charge | $I_{B(1)} = 1$ ma, $I_C = 10$ ma (See Fig. 2) | — | 800 | — | — | 760 | — | — | 720 | — | — | 680 | — | pcb |

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

## operating characteristics at 25°C free-air temperature

| PARAMETER | TEST CONDITIONS | 2N1302 | | | 2N1304 | | | 2N1306 | | | 2N1308 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | |
| NF Spot Noise Figure | $V_{CB} = 5$ v, $I_E = -1$ ma, $f = 1$ kc, $R_G = 1\ k\Omega$ | — | 4 | — | — | 4 | — | — | 3 | — | — | 3 | — | db |