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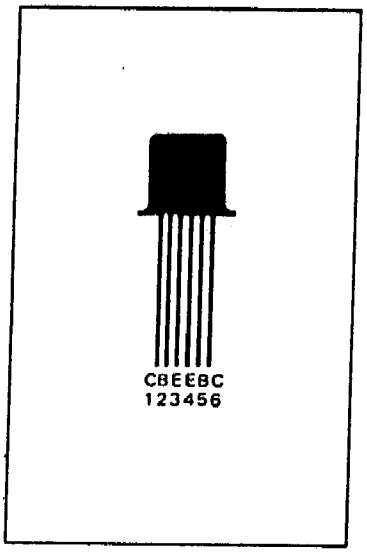
# 2N3728

## NPN HIGH PERFORMANCE DIFFERENTIAL AMPLIFIERS

- $\frac{h_{FE1}}{h_{FE2}}$ . . . 0.9-1.0 FROM 100 μA to 1.0 mA @ 25°C, 0.8-1.0 FROM 100 μA to 1.0 mA, −55°C to +125°C
- $|V_{BE1}-V_{BE2}|$ . . . 3.0 mV (MAX) FROM 100 μA to 1.0 mA
- $|\Delta V_{BE}|$ . . . 10 μV/°C (MAX) FROM 100 μA to 1.0 mA, −55°C to +125°C

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| | | | |
|---|---|---|---|
| **Maximum Temperatures** | | | |
| Storage Temperature | | | −65°C to +200°C |
| Operating Junction Temperature | | | 200°C |
| Lead Temperature (60 seconds) | | | 300°C |
| **Maximum Power Dissipation** (Notes 2 & 3) | | **One Side** | **Both Sides** |
| Total Dissipation at 25°C Case Temperature | | 1.0 W | 1.6 W |
| at 100°C Case Temperature | | 0.57 W | 0.91 W |
| at 25°C Ambient Temperature | | 0.45 W | 0.55 W |
| **Maximum Voltages and Current** | | | |
| $V_{CBO}$ | Collector to Base Voltage | | 60 V |
| $V_{CEO}$ | Collector to Emitter Voltage (Note 4) | | 30 V |
| $V_{EBO}$ | Emitter to Base Voltage | | 5.0 V |
| $I_C$ | Collector Current | | 500 mA |
| $V_{C1C2}$ | $Collector_1$ to $Collector_2$ Voltage | | ±200 V |
| | Voltage Rating any Lead to Case | | ±200 V |



**ELECTRICAL CHARACTERISTICS** (25°C Ambient Temperature unless otherwise noted) (Cont'd.)

| SYMBOL | CHARACTERISTIC | MIN. | MAX. | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|
| $h_{FE}$ | DC Current Gain | 30 | | | $I_C$ = 0.1 mA, $V_{CE}$ = 5.0 V |
| | | 45 | 180 | | $I_C$ = 1.0 mA, $V_{CE}$ = 5.0 V |
| | | 80 | 280 | | $I_C$ = 150 mA, $V_{CE}$ = 5.0 V (Note 6) |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage | 60 | | | $I_C$ = 10 μA, $I_E$ = 0 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage | 5.0 | | | $I_C$ = 0, $I_E$ = 10 μA |
| $V_{CEO(sus)}$ | Collector to Emitter Sustaining Voltage (Notes 4 & 6) | 30 | | | $I_C$ = 10 mA, $I_B$ = 0 |
| $V_{CE(sat)}$ | Collector Saturation Voltage (Note 6) | | 0.22 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $V_{BE(sat)}$ | Base Saturation Voltage (Note 6) | | 1.1 | V | $I_C$ = 150 mA, $I_B$ = 15 mA |
| $I_{CBO}$ | Collector Cutoff Current | | 10 | nA | $I_E$ = 0, $V_{CB}$ = 50 V |
| | | | 10 | μA | $I_E$ = 0, $V_{CB}$ = 50 V, $T_A$ = 150°C |
| $I_{EBO}$ | Emitter Cutoff Current | | 10 | nA | $I_C$ = 0, $V_{EB}$ = 3.0 V |
| $h_{fe}$ | High Frequency Current Gain | 4.0 | | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 20 MHz |
| | | 2.5 | 6.0 | | $I_C$ = 50 mA, $V_{CE}$ = 10 V, f = 100 MHz |
| $C_{ob}$ | Common Base, Open Circuit, Output Capacitance | | 8.0 | pF | $I_E$ = 0, $V_{CB}$ = 10 V, f = 140 kHz |
| $C_{ib}$ | Common Base, Open Circuit, Input Capacitance | | 20 | pF | $I_C$ = 0, $V_{EB}$ = 2.0 V, f = 140 kHz |
| $h_{ie}$ | Input Impedance | 1.2 | 6.0 | kΩ | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{re}$ | Reverse Voltage Feedback Ratio | | 300 | x10−6 | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{oe}$ | Output Conductance | | 20 | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| $h_{fe}$ | Forward Current Transfer Ratio | 50 | 200 | | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz |
| NF | Wide Band Noise Figure | | 7.0 | dB | $I_C$ = 0.1 mA, $V_{CE}$ = 5.0 V, f = 15.7 kHz, 3.0 dB pts. @ 25 Hz and 10 kHz, $R_S$ = 1.0 kΩ |
| $\frac{h_{FE1}}{h_{FE2}}$ | DC Current Gain Ratio (Note 5) | 0.8 | 1.0 | | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = 5.0 V |
| $\lvert V_{BE1}-V_{BE2}\rvert$ | Base to Emitter Voltage Differential | | 5.0 | mV | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = 5.0 V |
| $\lvert\Delta(V_{BE1}-V_{BE2})\rvert$ | Base to Emitter Voltage Differential | | 1.6 (20 μV/°C) | mV | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = 5.0 V $T_A$ = −55°C to +25°C |
| $\lvert\Delta(V_{BE1}-V_{BE2})\rvert$ | Base to Emitter Voltage Differential | | 2.0 (20 μV/°C) | mV | $I_C$ = 100 μA to 1.0 mA, $V_{CE}$ = 5.0 V $T_A$ = +25°C to +125°C |

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200°C and junction to ambient thermal resistance of 384°C/W (derating factor of 2.57 mW/°C) for one side; 318°C/W (derating factor of 3.14 mW/°C) for both sides; junction to case thermal resistance of 175°C/W (derating factor of 5.71 mW/°C) for one side; 109°C/W (derating factor of 9.15 mW/°C) for both sides.
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Lowest of two $h_{FE}$ readings is taken as $h_{FE1}$ for purposes of this ratio.
6. Pulse conditions: length = 300 μs; duty cycle = 1%.