

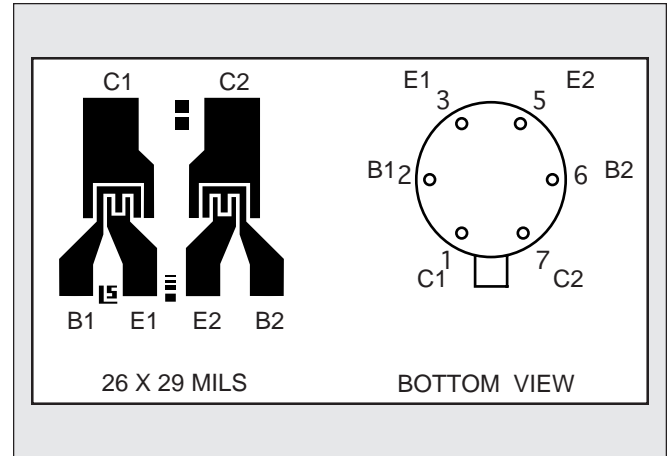
# LINEAR SYSTEMS

Linear Integrated Systems

LS310 LS311 LS312 LS313

## MONOLITHIC DUAL NPN TRANSISTORS

| FEATURES   |   |                          |
|--|---|--------------------------|
| VERY HIGH GAIN   | $h_{FE} \geq 200$ @ 10 $\mu$ A-1mA        |                          |
| TIGHT $V_{BE}$ MATCHING  | $ V_{BE1} - V_{BE2}  = 0.2\text{mV TYP.}$ |                          |
| HIGH $f_T$   | 250MHz TYP. @ 1mA                         |                          |
| ABSOLUTE MAXIMUM RATINGS NOTE 1<br>@ 25°C (unless otherwise noted) |   |                          |
| $I_C$  | Collector Current                         | 10mA                     |
| Maximum Temperatures   |   |                          |
| Storage Temperature  |   | -65° to +200°C           |
| Operating Junction Temperature                                     |   | +150°C                   |
| Maximum Power Dissipation  |   | ONE SIDE      BOTH SIDES |
| Device Dissipation @ Free Air                                      |   | 250mW      500mW         |
| Linear Derating Factor   |   | 2.3mW/°C      4.3mW/°C   |



### ELECTRICAL CHARACTERISTICS @ 25°C (unless otherwise noted)

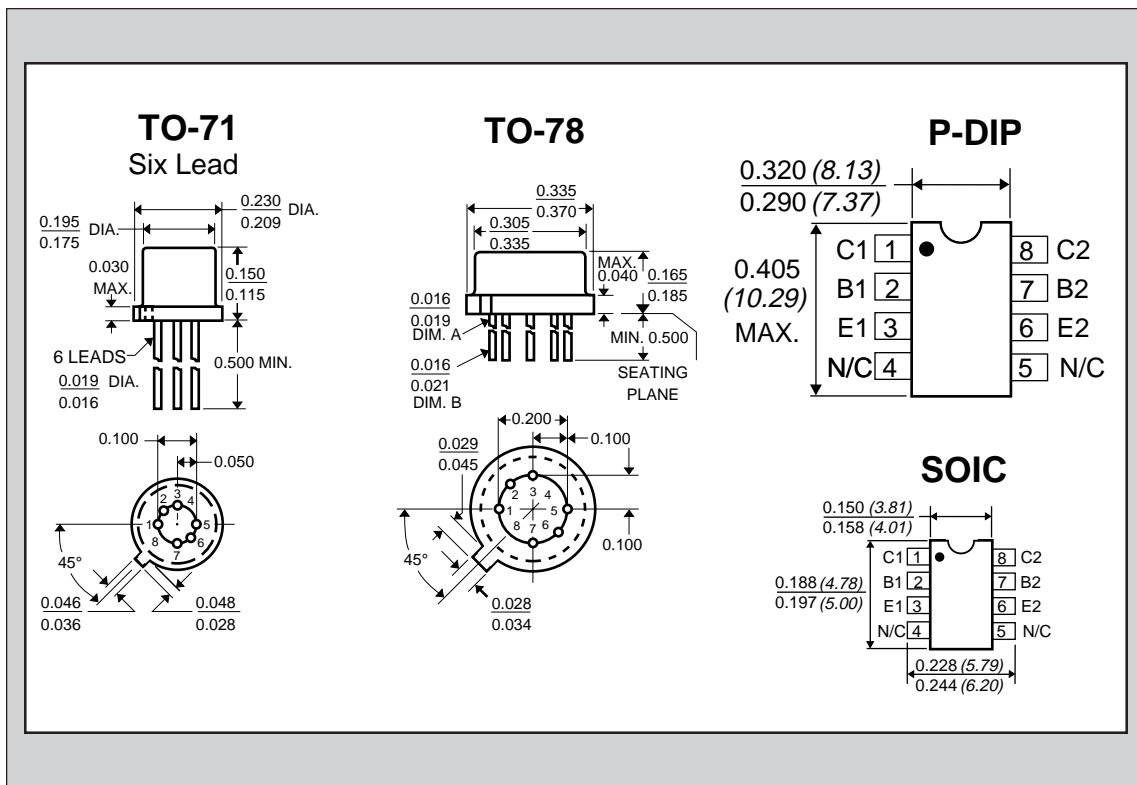
| SYMBOL        | CHARACTERISTICS                        | LS310 | LS311 | LS312 | LS313 | UNITS     | CONDITIONS  |
|---------------|--|-------|-------|-------|-------|-----------|---|
| $BV_{CBO}$    | Collector to Base Voltage              | 25    | 45    | 60    | 45    | MIN. V    | $I_C = 10\mu\text{A}$ $I_E = 0$   |
| $BV_{CEO}$    | Collector to Emitter Voltage           | 25    | 45    | 60    | 45    | MIN. V    | $I_C = 10\mu\text{A}$ $I_B = 0$   |
| $BV_{EBO}$    | Emitter-Base Breakdown Voltage         | 6.2   | 6.2   | 6.2   | 6.2   | MIN. V    | $I_E = 10\mu\text{A}$ $I_C = 0$ NOTE 2  |
| $BV_{CCO}$    | Collector to Collector Voltage         | 30    | 100   | 100   | 100   | MIN. V    | $I_C = 10\mu\text{A}$ $I_E = 0$   |
| $h_{FE}$      | DC Current Gain                        | 150   | 150   | 200   | 400   | MIN. MAX. | $I_C = 10\mu\text{A}$ $V_{CE} = 5\text{V}$  |
| $h_{FE}$      | DC Current Gain                        | 150   | 150   | 200   | 400   | MIN.      | $I_C = 100\mu\text{A}$ $V_{CE} = 5\text{V}$   |
| $h_{FE}$      | DC Current Gain                        | 150   | 150   | 200   | 400   | MIN.      | $I_C = 1\text{mA}$ $V_{CE} = 5\text{V}$   |
| $V_{CE(SAT)}$ | Collector Saturation Voltage           | 0.25  | 0.25  | 0.25  | 0.25  | MAX. V    | $I_C = 1\text{mA}$ $I_B = 0.1\text{mA}$   |
| $I_{CBO}$     | Collector Cutoff Current               | 0.2   | 0.2   | 0.2   | 0.2   | MAX. nA   | $I_E = 0$ $V_{CB} = \text{NOTE 3}$  |
| $I_{EBO}$     | Emitter Cutoff Current                 | 0.2   | 0.2   | 0.2   | 0.2   | MAX. nA   | $I_E = 0$ $V_{CB} = 3\text{V}$  |
| $C_{OBO}$     | Output Capacitance                     | 2     | 2     | 2     | 2     | MAX. pF   | $I_E = 0$ $V_{CB} = 5\text{V}$  |
| $C_{C1C2}$    | Collector to Collector Capacitance     | 2     | 2     | 2     | 2     | MAX. pF   | $V_{CC} = 0$  |
| $I_{C1C2}$    | Collector to Collector Leakage Current | 0.5   | 0.5   | 0.5   | 0.5   | MAX. nA   | $V_{CC} = \text{NOTE 4}$  |
| $f_T$         | Current Gain Bandwidth Product         | 200   | 200   | 200   | 200   | MIN. MHz  | $I_C = 1\text{mA}$ $V_{CE} = 5\text{V}$   |
| NF            | Narrow Band Noise Figure               | 3     | 3     | 3     | 3     | MAX. dB   | $I_C = 100\mu\text{A}$ $V_{CE} = 5\text{V}$<br>BW = 200Hz, $R_G = 10\text{K}\Omega$<br>f=1KHz |

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4042 Clipper Court, Fremont, CA 94538 • TEL: (510) 490-9160 • FAX: (510) 353-0261

**ELECTRICAL CHARACTERISTICS @ 25°C (unless otherwise noted)**

| SYMBOL                               | CHARACTERISTICS   | LS310 | LS311 | LS312 | LS313 | MIN. | UNITS            | CONDITIONS  |
|--------------------------------------|---|-------|-------|-------|-------|------|------------------|---|
| $ V_{BE1} - V_{BE2} $                | Base Emitter Voltage Differential                         | 1     | 0.4   | 0.2   | 0.4   | TYP. | mV               | $I_C = 10 \mu A$ $V_{CE} = 5V$  |
|                                      |   | 3     | 1     | 0.5   | 1     | MAX. | mV.              |   |
| $\Delta(V_{BE1} - V_{BE2})/^\circ C$ | Base Emitter Voltage Differential Change with Temperature | 2     | 1     | 0.5   | 1     | TYP. | $\mu V/^\circ C$ | $I_C = 10 \mu A$ $V_{CE} = 5V$<br>$T_A = -55^\circ C$ to $+125^\circ C$ |
|                                      |   | 15    | 5     | 2     | 5     | MAX. |                  |   |
| $ I_{B1} - I_{B2} $                  | Base Current Differential                                 |       | 10    | 5     | 5     | TYP. | nA               | $I_C = 10 \mu A$ $V_{CE} = 5V$  |
|                                      |   |       |       |       |       | MAX. | nA               |   |
| $ \Delta(I_{B1} - I_{B2})/^\circ C$  | Base Current Differential Change With Temperature         |       | 0.5   | 0.3   | 0.5   | MAX. | $nA/^\circ C$    | $I_C = 10 \mu A$ $V_{CE} = 5V$<br>$T_A = -55^\circ C$ to $+125^\circ C$ |
| $h_{FE1}/h_{FE2}$                    | Current Gain Differential                                 | 10    | 5     | 5     | 5     | TYP. | %                | $I_C = 10 \mu A$ $V_{CE} = 5V$  |



**NOTES:**

1. These ratings are limiting values above which the serviceability of any semiconductor may be impaired.
2. The reverse base-to-emitter voltage must never exceed 6.2 volts; the reverse base-to-emitter current must never exceed 10  $\mu A$ .
3. For LS310:  $V_{CB} = 20V$ ; for LS311, LS312 & LS313:  $V_{CB} = 30V$ .
4. For LS310, LS311 & LS313:  $V_{CC} = \pm 45V$ ; for LS312:  $V_{CC} = \pm 100V$ .