

**FAIRCHILD**

A Schlumberger Company

**2N5223/FTSO5223**NPN Small Signal General Purpose  
Amplifier & Oscillator

T-29-23

- $P_D$  ... 625 mW @  $T_A = 25^\circ\text{C}$
- $V_{CE0}$  ... 20 V (Min)
- $h_{FE}$  ... 50-800 @ 2.0 mA
- $f_T$  ... 150 MHz (Min) @ 10 mA
- $C_{cb}$  ... 4.0 pF (Max)
- Complement ... 2N/FTSO5227

**PACKAGE**

2N5223

TO-92

FTSO5223

TO-236AA/AB

**ABSOLUTE MAXIMUM RATINGS** (Note 1)**Temperatures**Storage Temperature  $-55^\circ\text{C}$  to  $150^\circ\text{C}$ Operating Junction Temperature  $150^\circ\text{C}$ **Power Dissipation** (Notes 2 & 3)

|                                        |           |             |
|----------------------------------------|-----------|-------------|
| Total Dissipation at                   | <b>2N</b> | <b>FTSO</b> |
| $25^\circ\text{C}$ Ambient Temperature | 0.625 W   | 0.350 W*    |
| $25^\circ\text{C}$ Case Temperature    | 1.0 W     |             |

**Voltages & Currents**

|                                        |      |
|----------------------------------------|------|
| $V_{CE0}$ Collector to Emitter Voltage | 20 V |
| (Note 4)                               |      |

|                                     |      |
|-------------------------------------|------|
| $V_{CBO}$ Collector to Base Voltage | 25 V |
|-------------------------------------|------|

|                                   |       |
|-----------------------------------|-------|
| $V_{EBO}$ Emitter to Base Voltage | 3.0 V |
|-----------------------------------|-------|

|                         |        |
|-------------------------|--------|
| $I_C$ Collector Current | 100 mA |
|-------------------------|--------|

**ELECTRICAL CHARACTERISTICS** ( $25^\circ\text{C}$  Ambient Temperature unless otherwise noted) (Note 6)

| SYMBOL     | CHARACTERISTIC                         | MIN | MAX | UNITS | TEST CONDITIONS                                |
|------------|----------------------------------------|-----|-----|-------|------------------------------------------------|
| $BV_{CE0}$ | Collector to Emitter Breakdown Voltage | 20  |     | V     | $I_C = 1.0\text{ mA}$ , $I_B = 0$              |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage    | 25  |     | V     | $I_C = 100\text{ }\mu\text{A}$ , $I_E = 0$     |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage      | 3.0 |     | V     | $I_E = 100\text{ }\mu\text{A}$ , $I_C = 0$     |
| $I_{EBO}$  | Emitter Cutoff Current                 |     | 500 | nA    | $V_{EB} = 2.0\text{ V}$ , $I_C = 0$            |
| $I_{CBO}$  | Collector Cutoff Current               |     | 100 | nA    | $V_{CB} = 10\text{ V}$ , $I_E = 0$             |
| $h_{FE}$   | DC Current Gain                        | 50  | 800 |       | $I_C = 2.0\text{ mA}$ , $V_{CE} = 10\text{ V}$ |

**NOTES:**

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
  - These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
  - These ratings give a maximum junction temperature of  $150^\circ\text{C}$  and (TO-92) junction-to-case thermal resistance of  $125^\circ\text{C/W}$  (derating factor of  $8.0\text{ mW}/^\circ\text{C}$ ); junction-to-ambient thermal resistance of  $200^\circ\text{C/W}$  (derating factor of  $5.0\text{ mW}/^\circ\text{C}$ ); (TO-236) junction-to-ambient thermal resistance of  $357^\circ\text{C/W}$  (derating factor of  $2.8\text{ mW}/^\circ\text{C}$ ).
  - Rating refers to a high current point where collector to emitter voltage is lowest.
  - Pulse conditions: length =  $300\text{ }\mu\text{s}$ ; duty cycle  $< 2\%$ .
  - For product family characteristic curves, refer to Curve Set T144.
- \* Package mounted on 99.5% alumina  $8\text{ mm} \times 8\text{ mm} \times 0.6\text{ mm}$ .

7-29.23

**ELECTRICAL CHARACTERISTICS** (25° C Ambient Temperature unless otherwise noted) (Note 6)

| SYMBOL        | CHARACTERISTIC                                      | MIN | MAX  | UNITS | TEST CONDITIONS                                                          |
|---------------|-----------------------------------------------------|-----|------|-------|--------------------------------------------------------------------------|
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage<br>(Note 5) |     | 0.7  | V     | $I_C = 10 \text{ mA}$ , $I_B = 1.0 \text{ mA}$                           |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage<br>(Note 5)      |     | 1.2  | V     | $I_C = 10 \text{ mA}$ , $I_B = 1.0 \text{ mA}$                           |
| $C_{cb}$      | Collector to Base Capacitance                       |     | 4.0  | pF    | $V_{CB} = 10 \text{ V}$ , $I_E = 0$ , $f = 1.0 \text{ MHz}$              |
| $h_{fe}$      | Small Signal Current Gain                           | 50  | 1600 |       | $I_C = 2.0 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $f = 1.0 \text{ kHz}$ |
| $f_T$         | Current Gain Bandwidth Product                      | 150 |      | MHz   | $I_C = 10 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $f = 100 \text{ MHz}$  |

3469674 FAIRCHILD SEMICONDUCTOR

84D 27598 D

**FAIRCHILD**

A Schlumberger Company

**2N5224/FTSO5224**

NPN Low Level Switch

T-29-23

- $V_{CEO} \dots 12 \text{ V (Min)}$
- $t_{on} \dots 45 \text{ ns (Max) @ } 10 \text{ mA}$
- $t_{off} \dots 60 \text{ ns (Max) @ } 10 \text{ mA}$
- $f_T \dots 250 \text{ MHz (Min) @ } 10 \text{ mA}$
- $C_{cb} \dots 4.0 \text{ pF (Max)}$
- Complement ... MPSL08

**PACKAGE**

2N5224

TO-92

FTSO5224

TO-236AA/AB

**ABSOLUTE MAXIMUM RATINGS (Note 1)****Temperatures**

Storage Temperature  $-55^\circ \text{C to } 150^\circ \text{C}$   
 Operating Junction Temperature  $150^\circ \text{C}$

**Power Dissipation (Notes 2 & 3)**

|                          |           |             |
|--------------------------|-----------|-------------|
| Total Dissipation at     | <b>2N</b> | <b>FTSO</b> |
| 25°C Ambient Temperature | 0.625 W   | 0.350 W*    |
| 25°C Case Temperature    | 1.0 W     |             |

**Voltages & Currents**

|                                        |        |
|----------------------------------------|--------|
| $V_{CEO}$ Collector to Emitter Voltage | 12 V   |
| (Note 4)                               |        |
| $V_{CBO}$ Collector to Base Voltage    | 25 V   |
| $V_{EBO}$ Emitter to Base Voltage      | 5.0 V  |
| $I_C$ DC Collector Current             | 100 mA |

**ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)**

| SYMBOL        | CHARACTERISTIC                                      | MIN      | MAX  | UNITS         | TEST CONDITIONS                                                                                 |
|---------------|-----------------------------------------------------|----------|------|---------------|-------------------------------------------------------------------------------------------------|
| $BV_{CEO}$    | Collector to Emitter Breakdown Voltage<br>(Note 5)  | 12       |      | V             | $I_C = 10 \text{ mA}, I_B = 0$                                                                  |
| $BV_{CBO}$    | Collector to Base Breakdown Voltage                 | 25       |      | V             | $I_C = 100 \mu\text{A}, I_E = 0$                                                                |
| $BV_{EBO}$    | Emitter to Base Breakdown Voltage                   | 5.0      |      | V             | $I_E = 100 \mu\text{A}, I_C = 0$                                                                |
| $I_{EBO}$     | Emitter Cutoff Current                              |          | 100  | $\mu\text{A}$ | $V_{EB} = 4.0 \text{ V}, I_C = 0$                                                               |
| $I_{CBO}$     | Collector Cutoff Current                            |          | 500  | nA            | $V_{CB} = 15 \text{ V}, I_E = 0$                                                                |
| $h_{FE}$      | DC Current Gain (Note 5)                            | 40<br>15 | 400  |               | $I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$<br>$I_C = 100 \text{ mA}, V_{CE} = 1.0 \text{ V}$ |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage<br>(Note 5) |          | 0.35 | V             | $I_C = 10 \text{ mA}, I_B = 3.0 \text{ mA}$                                                     |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage<br>(Note 5)      |          | 0.9  | V             | $I_C = 10 \text{ mA}, I_B = 3.0 \text{ mA}$                                                     |

**NOTES:**

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
  - These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
  - These ratings give a maximum junction temperature of  $150^\circ \text{C}$  and (TO-92) junction-to-case thermal resistance of  $125^\circ \text{C/W}$  (derating factor of  $8.0 \text{ mW}/^\circ \text{C}$ ); junction-to-ambient thermal resistance of  $200^\circ \text{C/W}$  (derating factor of  $5.0 \text{ mW}/^\circ \text{C}$ ); (TO-236) junction-to-ambient thermal resistance of  $357^\circ \text{C/W}$  (derating factor of  $2.8 \text{ mW}/^\circ \text{C}$ ).
  - Rating refers to a high current point where collector to emitter voltage is lowest.
  - Pulse conditions: length =  $300 \mu\text{s}$ ; duty cycle  $< 2\%$ .
  - For product family characteristic curves, refer to Curve Set T162.
- \* Package mounted on 99.5% alumina  $8 \text{ mm} \times 8 \text{ mm} \times 0.6 \text{ mm}$ .

**ELECTRICAL CHARACTERISTICS** (25° C Ambient Temperature unless otherwise noted) (Note 6)

| SYMBOL   | CHARACTERISTIC                      | MIN | MAX | UNITS | TEST CONDITIONS                                                                          |
|----------|-------------------------------------|-----|-----|-------|------------------------------------------------------------------------------------------|
| $C_{cb}$ | Collector to Base Capacitance       |     | 4.0 | pF    | $V_{CB} = 5.0 \text{ V}$ , $I_E = 0$ , $f = 1.0 \text{ MHz}$                             |
| $f_T$    | Current Gain Bandwidth Product      | 250 |     | MHz   | $I_C = 10 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $f = 100 \text{ MHz}$                  |
| $t_d$    | Delay Time (test circuit no. 531)   |     | 25  | ns    | $I_C = 10 \text{ mA}$ , $V_{CC} = 3.0 \text{ V}$ , $I_{B1} = 3.0 \text{ mA}$             |
| $t_r$    | Rise Time (test circuit no. 531)    |     | 20  | ns    | $I_C = 10 \text{ mA}$ , $V_{CC} = 3.0 \text{ V}$ , $I_{B1} = 3.0 \text{ mA}$             |
| $t_s$    | Storage Time (test circuit no. 531) |     | 35  | ns    | $I_C = 10 \text{ mA}$ , $V_{CC} = 3.0 \text{ V}$ ,<br>$I_{B1} = I_{B2} = 3.0 \text{ mA}$ |
| $t_f$    | Fall Time (test circuit no. 531)    |     | 25  | ns    | $I_C = 10 \text{ mA}$ , $V_{CC} = 3.0 \text{ V}$ ,<br>$I_{B1} = I_{B2} = 3.0 \text{ mA}$ |

**FAIRCHILD**

A Schlumberger Company

**2N5225/FTSO5225**  
**2N5226/FTOS5226**NPN-PNP Small Signal General  
Purpose Complementary Amplifiers

T-29.23

- $V_{CEO}$  ... 25 V (Min)
- $h_{FE}$  ... 30-600 @ 50 mA
- $V_{CE(sat)}$  ... 0.8 V (Max) @ 100 mA
- Complement ... 2N5225 (NPN), 2N5226 (PNP)

**PACKAGE**

|          |             |
|----------|-------------|
| 2N5225   | TO-92       |
| 2N5226   | TO-92       |
| FTSO5225 | TO-236AA/AB |
| FTSO5226 | TO-236AA/AB |

**ABSOLUTE MAXIMUM RATINGS** (Note 1)**Temperatures**

|                                |                  |
|--------------------------------|------------------|
| Storage Temperature            | -55° C to 150° C |
| Operating Junction Temperature | 150° C           |

**Power Dissipation** (Notes 2 & 3)

|                                                | 2N      | FTSO     |
|------------------------------------------------|---------|----------|
| Total Dissipation at 25° C Ambient Temperature | 0.625 W | 0.350 W* |
| 25° C Case Temperature                         | 1.0 W   |          |

**Voltages & Currents**

|                                                 | 5225   | 5226   |
|-------------------------------------------------|--------|--------|
| $V_{CEO}$ Collector to Emitter Voltage (Note 4) | 25 V   | -25 V  |
| $V_{CBO}$ Collector to Base Voltage             | 25 V   | -25 V  |
| $V_{EBO}$ Emitter to Base Voltage               | 4.0 V  | -4.0 V |
| $I_C$ Collector Current                         | 500 mA | 500 mA |

**ELECTRICAL CHARACTERISTICS** (25° C Ambient Temperature unless otherwise noted) (Note 6)

| SYMBOL     | CHARACTERISTIC                         | 2N5225   |     | 2N5226   |     | UNITS | TEST CONDITIONS                                                       |
|------------|----------------------------------------|----------|-----|----------|-----|-------|-----------------------------------------------------------------------|
|            |                                        | MIN      | MAX | MIN      | MAX |       |                                                                       |
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage | 25       |     | -25      |     | V     | $I_C = 10$ mA, $I_E = 0$                                              |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage    | 25       |     | -25      |     | V     | $I_C = 100$ $\mu$ A, $I_E = 0$                                        |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage      | 4.0      |     | -4.0     |     | V     | $I_E = 100$ $\mu$ A, $I_C = 0$                                        |
| $I_{EBO}$  | Emitter Cutoff Current                 |          | 500 |          | 500 | nA    | $V_{EB} = 4.0$ V, $I_C = 0$                                           |
| $I_{CBO}$  | Collector Cutoff Current               |          | 300 |          | 300 | nA    | $V_{CB} = 15$ V, $I_E = 0$                                            |
| $h_{FE}$   | DC Current Gain (Note 5)               | 25<br>30 | 600 | 25<br>30 | 600 |       | $I_C = 10$ $\mu$ A, $V_{CE} = 10$ V<br>$I_C = 50$ mA, $V_{CE} = 10$ V |

**NOTES:**

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length = 300  $\mu$ s; duty cycle = 2%.
- For product family characteristic curves, refer to Curve Set T145 for 2N5225 and T212 for 2N5226.
- Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

FAIRCHILD SEMICONDUCTOR

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3469674 FAIRCHILD SEMICONDUCTOR

84D 27601 D

2N5225/FTSO5225

2N5226/FTOS5226

T-29.23

**ELECTRICAL CHARACTERISTICS** (25° C Ambient Temperature unless otherwise noted) (Note 6)

| SYMBOL        | CHARACTERISTIC                                   | 2N5225 |      | 2N5226 |      | UNITS | TEST CONDITIONS                                                            |
|---------------|--------------------------------------------------|--------|------|--------|------|-------|----------------------------------------------------------------------------|
|               |                                                  | MIN    | MAX  | MIN    | MAX  |       |                                                                            |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage (Note 5) |        | 0.8  |        | -0.8 | V     | $I_C = 100 \text{ mA}$ , $I_B = 10 \text{ mA}$                             |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage (Note 5)      |        | 1.0  |        | -1.0 | V     | $I_C = 100 \text{ mA}$ , $I_B = 10 \text{ mA}$                             |
| $C_{cb}$      | Collector to Base Capacitance                    |        | 20   |        | 20   | pF    | $V_{CB} = 5.0 \text{ V}$ , $I_E = 0$ , $f = 1.0 \text{ MHz}$               |
| $h_{fe}$      | Small Signal Current Gain                        | 30     | 1800 | 30     | 1800 |       | $I_C = 50 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ ,<br>$f = 1.0 \text{ kHz}$ |
| $f_T$         | Current Gain Bandwidth Product                   |        | 50   |        | 50   | MHz   | $I_C = 20 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ ,<br>$f = 20 \text{ MHz}$  |

**FAIRCHILD**

A Schlumberger Company

**2N5227/FTSO5227**PNP Small Signal General Purpose  
Amplifier & Oscillator

T-29.23

- $V_{CEO}$  ... 30 V (Min)
- $h_{FE}$  ... 50-700 @ 2.0 mA
- $f_T$  ... 100 MHz (Min) @ 10 mA
- $C_{cb}$  ... 5.0 pF (Max)
- Complements ... 2N5223

**PACKAGES**

2N5227 TO-92  
FTSO5227 TO-236AA/AB

**ABSOLUTE MAXIMUM RATINGS (Note 1)****Temperatures**

Storage Temperature -55°C to 150°C  
Operating Junction Temperature 150°C

**Power Dissipation (Notes 2 & 3)**

|                          |           |             |
|--------------------------|-----------|-------------|
| Total Dissipation at     | <b>2N</b> | <b>FTSO</b> |
| 25°C Ambient Temperature | 0.625 W   | 0.350 W*    |
| 25°C Case Temperature    | 1.0 W     |             |

**Voltages & Currents**

|                                        |        |
|----------------------------------------|--------|
| $V_{CEO}$ Collector to Emitter Voltage | -30 V  |
| (Note 4)                               |        |
| $V_{CBO}$ Collector to Base Voltage    | -30 V  |
| $V_{EBO}$ Emitter to Base Voltage      | -3.0 V |
| $I_C$ Collector Current                | 50 mA  |

**ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)**

| SYMBOL        | CHARACTERISTIC                          | MIN      | MAX  | UNITS | TEST CONDITIONS                                                           |
|---------------|-----------------------------------------|----------|------|-------|---------------------------------------------------------------------------|
| $BV_{CEO}$    | Collector to Emitter Breakdown Voltage  | -30      |      | V     | $I_C = 1.0$ mA, $I_B = 0$                                                 |
| $BV_{CBO}$    | Collector to Base Breakdown Voltage     | -30      |      | V     | $I_C = 100$ $\mu$ A, $I_E = 0$                                            |
| $BV_{EBO}$    | Emitter to Base Breakdown Voltage       | -3.0     |      | V     | $I_E = 100$ $\mu$ A, $I_C = 0$                                            |
| $I_{EBO}$     | Emitter Cutoff Current                  |          | 500  | nA    | $V_{EB} = -2.0$ V, $I_C = 0$                                              |
| $I_{CBO}$     | Collector Cutoff Current                |          | 100  | nA    | $V_{CB} = -10$ V, $I_E = 0$                                               |
| $h_{FE}$      | DC Current Gain (Note 5)                | 30<br>50 | 700  |       | $I_C = 100$ $\mu$ A, $V_{CE} = -10$ V<br>$I_C = 2.0$ mA, $V_{CE} = -10$ V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage |          | -0.4 | V     | $I_C = 10$ mA, $I_B = 1.0$ mA                                             |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage      |          | -1.0 | V     | $I_C = 10$ mA, $I_B = 1.0$ mA                                             |
| $C_{cb}$      | Collector to Base Capacitance           |          | 5.0  | pF    | $V_{CB} = 10$ V, $I_E = 0$ , $f = 1.0$ MHz                                |
| $h_{fe}$      | Small Signal Current Gain               | 50       | 1500 |       | $I_C = 2.0$ mA, $V_{CE} = -10$ V, $f = 1.0$ kHz                           |
| $f_T$         | Current Gain Bandwidth Product          | 100      |      | MHz   | $I_C = 10$ mA, $V_{CE} = -10$ V, $f = 100$ MHz                            |

**NOTES:**

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
  - These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
  - These ratings give a maximum junction temperature of 150°C and (TO-92) junction-to-case thermal resistance of 125°C/W (derating factor of 8.0 mW/°C); junction-to-ambient thermal resistance of 200°C/W (derating factor of 5.0 mW/°C); (TO-236) junction-to-ambient thermal resistance of 357°C/W (derating factor of 2.8 mW/°C).
  - Rating refers to a high current point where collector to emitter voltage is lowest.
  - Pulse conditions: length = 300  $\mu$ s; duty cycle = 1%.
  - For product family characteristic curves, refer to Curve Set T215.
- \* Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

3469674 FAIRCHILD SEMICONDUCTOR

84D 27603 D

**FAIRCHILD**

A Schlumberger Company

**2N5228/FTSO5228**

PNP Low Level Switch

T-29-23

- $V_{CEO} \dots -5.0 \text{ V (Min)}$
- $t_{on} \dots 75 \text{ ns (Max) @ } 10 \text{ mA}$
- $t_{off} \dots 140 \text{ ns (Max) @ } 10 \text{ mA}$
- $f_T \dots 300 \text{ MHz (Min) @ } 10 \text{ mA}$
- $C_{cb} \dots 5.0 \text{ pF (Max)}$
- Complement ... 2N5224

**PACKAGE**

2N5228

TO-92

FTSO5228

TO-236AA/AB

**ABSOLUTE MAXIMUM RATINGS (Note 1)****Temperatures**

Storage Temperature  $-55^\circ \text{C to } 150^\circ \text{C}$   
 Operating Junction Temperature  $150^\circ \text{C}$

**Power Dissipation (Notes 2 & 3)**

Total Dissipation at **2N** **FTSO**  
 $25^\circ \text{C Ambient Temperature}$   $0.625 \text{ W}$   $0.350 \text{ W}^*$   
 $25^\circ \text{C Case Temperature}$   $1.0 \text{ W}$

**Voltages & Currents**

$V_{CES}$  Collector to Emitter Voltage  $-6.0 \text{ V}$   
 $V_{CEO}$  Collector to Emitter Voltage  $-5.0 \text{ V}$   
 $V_{CBO}$  Collector to Base Voltage  $-5.0 \text{ V}$   
 $V_{EBO}$  Emitter to Base Voltage  $-3.0 \text{ V}$   
 $I_C$  DC Collector Current  $50 \text{ mA}$

**ELECTRICAL CHARACTERISTICS ( $25^\circ \text{C}$  Ambient Temperature unless otherwise noted) (Note 5)**

| SYMBOL     | CHARACTERISTIC                                  | MIN      | MAX | UNITS         | TEST CONDITIONS                                                                                  |
|------------|-------------------------------------------------|----------|-----|---------------|--------------------------------------------------------------------------------------------------|
| $BV_{CEO}$ | Collector to Emitter Breakdown Voltage (Note 4) | -5.0     |     | V             | $I_C = 10 \text{ mA}, I_B = 0$                                                                   |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage          | -6.0     |     | V             | $I_C = 100 \mu\text{A}, V_{BE} = 0$                                                              |
| $BV_{CBO}$ | Collector to Base Breakdown Voltage             | -5.0     |     | V             | $I_C = 100 \mu\text{A}, I_E = 0$                                                                 |
| $BV_{EBO}$ | Emitter to Base Breakdown Voltage               | -3.0     |     | V             | $I_E = 100 \mu\text{A}, I_C = 0$                                                                 |
| $I_{CES}$  | Collector Cutoff Current                        |          | 100 | nA            | $V_{CE} = -4.0 \text{ V}, V_{BE} = 0$                                                            |
| $I_{EBO}$  | Emitter Cutoff Current                          |          | 100 | $\mu\text{A}$ | $V_{EB} = -2.5 \text{ V}, I_C = 0$                                                               |
| $h_{FE}$   | DC Current Gain (Note 4)                        | 30<br>15 |     |               | $I_C = 10 \text{ mA}, V_{CE} = -0.3 \text{ V}$<br>$I_C = 50 \text{ mA}, V_{CE} = -1.0 \text{ V}$ |

**NOTES:**

- These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
- These ratings give a maximum junction temperature of  $150^\circ \text{C}$  and (TO-92) junction-to-case thermal resistance of  $125^\circ \text{C/W}$  (derating factor of  $8.0 \text{ mW/}^\circ \text{C}$ ); junction-to-ambient thermal resistance of  $200^\circ \text{C/W}$  (derating factor of  $5.0 \text{ mW/}^\circ \text{C}$ ); (TO-236) junction-to-ambient thermal resistance of  $357^\circ \text{C/W}$  (derating factor of  $2.8 \text{ mW/}^\circ \text{C}$ ).
- Pulse conditions: length =  $300 \mu\text{s}$ ; duty cycle \* 2%.
- For product family characteristic curves, refer to Curve Set T292.

\* Package mounted on 99.5% alumina  $8 \text{ mm} \times 8 \text{ mm} \times 0.6 \text{ mm}$ .

T-29-23

**ELECTRICAL CHARACTERISTICS** (25° C Ambient Temperature unless otherwise noted) (Note 5)

| SYMBOL        | CHARACTERISTIC                                      | MIN   | MAX   | UNITS | TEST CONDITIONS                                                                                              |
|---------------|-----------------------------------------------------|-------|-------|-------|--------------------------------------------------------------------------------------------------------------|
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage<br>(Note 4) |       | -0.4  | V     | $I_C = 10 \text{ mA}$ , $I_B = 3.0 \text{ mA}$                                                               |
| $V_{BE(sat)}$ | Base to Emitter Saturation Voltage<br>(Note 4)      | -0.65 | -1.25 | V     | $I_C = 10 \text{ mA}$ , $I_B = 3.0 \text{ mA}$                                                               |
| $C_{cb}$      | Collector to Base Capacitance                       |       | 5.0   | pF    | $V_{CB} = -5.0 \text{ V}$ , $I_E = 0$ , $f = 1.0 \text{ MHz}$                                                |
| $f_T$         | Current Gain Bandwidth Product                      | 300   |       | MHz   | $I_C = 10 \text{ mA}$ , $V_{CE} = -5.0 \text{ V}$ , $f = 100 \text{ MHz}$                                    |
| $t_d$         | Delay Time (test circuit no. 532)                   |       | 25    | ns    | $I_C \approx 10 \text{ mA}$ , $V_{CC} = -3.0 \text{ V}$ , $I_{B1} \approx 3.0 \text{ mA}$                    |
| $t_r$         | Rise Time (test circuit no. 532)                    |       | 50    | ns    | $I_C \approx 10 \text{ mA}$ , $V_{CC} = -3.0 \text{ V}$ , $I_{B1} \approx 3.0 \text{ mA}$                    |
| $t_s$         | Storage Time (test circuit no. 532)                 |       | 90    | ns    | $I_C \approx 10 \text{ mA}$ , $V_{CC} = -3.0 \text{ V}$ ,<br>$I_{B1} \approx -I_{B2} = 3.0 \text{ mA}$       |
| $t_f$         | Fall Time (test circuit no. 532)                    |       | 50    | ns    | $I_C \approx 10 \text{ mA}$ , $V_{CC} = -3.0 \text{ V}$ ,<br>$I_{B1} \approx -I_{B2} \approx 3.0 \text{ mA}$ |