

3469674 FAIRCHILD SEMICONDUCTOR

84D 27581 D



A Schlumberger Company

2N4400/FTSO4400 T-29-23
2N4401/FTSO4401
 Small Signal General Purpose
 Amplifiers & Switches

- V_{CE0} ... 40 V (Min)
- h_{FE} ... 100-300 @ 150 mA (2N/FTSO4401); 40 (Min) @ 500 mA (2N/FTSO4401)
- t_{on} ... 35 ns (Max) @ 150 mA
- t_{off} ... 255 ns (Max) @ 150 mA
- Complements ... 2N4402, 2N4403

PACKAGE

2N4400	TO-92
2N4401	TO-92
FTSO4400	TO-236AA/AB
FTSO4401	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	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage (Note 4)	40 V
V_{CBO} Collector to Base Voltage	60 V
V_{EBO} Emitter to Base Voltage	6.0 V
I_C Collector Current	600 mA

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

SYMBOL	CHARACTERISTIC	4400		4401		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$BV_{CE0(sust)}$	Collector to Emitter Sustaining Voltage (Note 5)	40		40		V	$I_C = 1.0$ mA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	60		60		V	$I_C = 100$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		6.0		V	$I_E = 100$ μ A, $I_C = 0$
I_{CEX}	Collector Cutoff Current		100		100	nA	$V_{CE} = 35$ V, $V_{EB} = 0.4$ V
I_{BL}	Base Reverse Current		100		100	nA	$V_{CE} = 35$ V, $V_{EB} = 0.4$ V

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 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).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle \leq 2%.
 6. For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

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84D 27582 D

2N4400/FTSO4400
2N4401/FTSO4401

T-29-23

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

SYMBOL	CHARACTERISTIC	4400		4401		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain	20 40		20 40 80			$I_C = 100 \mu A, V_{CE} = 1.0 V$ $I_C = 1.0 mA, V_{CE} = 1.0 V$ $I_C = 10 mA, V_{CE} = 1.0 V$
h_{FE}	DC Pulse Current Gain (Note 5)	50 20	150	100 40	300		$I_C = 150 mA, V_{CE} = 1.0 V$ $I_C = 500 mA, V_{CE} = 2.0 V$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.4 0.75		0.4 0.75	V V	$I_C = 150 mA, I_B = 15 mA$ $I_C = 500 mA, I_B = 50 mA$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	0.75	0.95 1.2	0.75	0.95 1.2	V V	$I_C = 150 mA, I_B = 15 mA$ $I_C = 500 mA, I_B = 50 mA$
C_{cb}	Collector to Base Capacitance		6.5		6.5	pF	$V_{CB} = 5.0 V, I_E = 0, f = 100 kHz$
C_{eb}	Emitter to Base Capacitance		30		30	pF	$V_{BE} = 0.5 V, I_C = 0, f = 100 kHz$
h_{fe}	Small Signal Current Gain	20	250	40	500		$I_C = 1.0 mA, V_{CE} = 10 V,$ $f = 1.0 kHz$
h_{ie}	Input Impedance	0.5	7.5	1.0	15	k Ω	$I_C = 1.0 mA, V_{CE} = 10 V,$ $f = 1.0 kHz$
h_{oe}	Output Admittance	1.0	30	1.0	30	$\mu mhos$	$I_C = 1.0 mA, V_{CE} = 10 V,$ $f = 1.0 kHz$
h_{re}	Voltage Feedback Ratio	0.1	8.0	0.1	8.0	$\times 10^{-4}$	$I_C = 1.0 mA, V_{CE} = 10 V,$ $f = 1.0 kHz$
f_T	Current Gain Bandwidth Product	200		250		MHz	$I_C = 20 mA, V_{CE} = 10 V,$ $f = 100 MHz$
t_d	Turn On Delay Time (test circuit no. 559)		15		15	ns	$I_C = 150 mA, V_{CC} = 30 V,$ $I_{B1} = 15 mA$
t_r	Rise Time (test circuit no. 559)		20		20	ns	$I_C = 150 mA, V_{CC} = 30 V,$ $I_{B1} = 15 mA$
t_s	Storage Time (test circuit no. 560)		225		225	ns	$I_C = 150 mA, V_{CC} = 30 V,$ $I_{B1} = I_{B2} = 15 mA$
t_f	Fall Time (test circuit no. 560)		30		30	ns	$I_C = 150 mA, V_{CC} = 30 V,$ $I_{B1} = I_{B2} = 15 mA$

3469674 FAIRCHILD SEMICONDUCTOR

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FAIRCHILD

A Schlumberger Company

2N4402/FTSO4402
2N4403/FTSO4403

PNP Small Signal General Purpose Amplifiers & Switches

T-29-23

- V_{CE0} ... -40 V (Min)
- h_{FE} ... 100-300 @ 150 mA (2N/FTSO4403), 20 (Min) @ 500 mA (2N/FTSO4403)
- t_{on} ... 35 ns (Max) @ 150 mA
- t_{off} ... 255 ns (Max) @ 150 mA
- Complements ... 2N4400, 2N4401

PACKAGE

2N4402	TO-92
2N4403	TO-92
FTSO4402	TO-236AA/AB
FTSO4403	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	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	-40 V
(Note 4)	
V_{CBO} Collector to Base Voltage	-40 V
V_{EBO} Emitter to Base Voltage	-5.0 V
I_C Collector Current	600 mA

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

SYMBOL	CHARACTERISTIC	4402		4403		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$BV_{CE0(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	-40		-40		V	$I_C = 1.0$ mA, $I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-40		-40		V	$I_C = 100$ μ A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 100$ μ A, $I_C = 0$
I_{CEX}	Collector Reverse Current		100		100	nA	$V_{CE} = -35$ V, $V_{EB} = -0.4$ V
I_{BL}	Base Reverse Current		100		100	nA	$V_{CE} = -35$ V, $V_{EB} = -0.4$ V

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 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).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μ s; duty cycle < 2%.
 6. For product family characteristic curves, refer to Curve Set T212.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

3469674 FAIRCHILD SEMICONDUCTOR

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2N4402/FTSO4402
2N4403/FTSO4403

T-29-23

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

SYMBOL	CHARACTERISTIC	4402		4403		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Current Gain	30 50		30 60 100			$I_C = 100 \mu A, V_{CE} = 1.0 V$ $I_C = 1.0 mA, V_{CE} = -1.0 V$ $I_C = 10 mA, V_{CE} = -1.0 V$
h_{FE}	DC Pulse Current Gain (Note 5)	50 20	150	100 20	300		$I_C = 150 mA, V_{CE} = -2.0 V$ $I_C = 500 mA, V_{CE} = -2.0 V$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.4 -0.75		-0.4 -0.75	V V	$I_C = 150 mA, I_B = 15 mA$ $I_C = 500 mA, I_B = 50 mA$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	-0.75	-0.95 -1.3	-0.75	-0.95 -1.3	V V	$I_C = 150 mA, I_B = 15 mA$ $I_C = 500 mA, I_B = 50 mA$
C_{cb}	Collector to Base Capacitance		8.5		8.5	pF	$V_{CB} = -10 V, I_E = 0, f = 140 kHz$
C_{eb}	Emitter to Base Capacitance		30		30	pF	$V_{EB} = -0.5 V, I_C = 0, f = 140 kHz$
h_{fe}	Small Signal Current Gain	30	250	60	500		$I_C = 1.0 mA, V_{CE} = -10 V,$ $f = 1.0 kHz$
h_{ie}	Input Impedance	0.75	7.5	1.5	15	k Ω	$I_C = 1.0 mA, V_{CE} = -10 V,$ $f = 1.0 kHz$
h_{oe}	Output Admittance	1.0	100	1.0	100	$\mu mhos$	$I_C = 1.0 mA, V_{CE} = -10 V,$ $f = 1.0 kHz$
h_{re}	Voltage Feedback Ratio	0.1	8.0	0.1	8.0	$\times 10^{-4}$	$I_C = 1.0 mA, V_{CE} = -10 V,$ $f = 1.0 kHz$
f_T	Current Gain Bandwidth Product	150		200		MHz	$I_C = 20 mA, V_{CE} = -10 V,$ $f = 100 MHz$
t_d	Turn On Delay Time (test circuit no. 557)		15		15	ns	$I_C = 150 mA, V_{CC} = -30 V,$ $I_{B1} = 15 mA$
t_r	Rise Time (test circuit no. 557)		20		20	ns	$I_C = 150 mA, V_{CC} = -30 V,$ $I_{B1} = 15 mA$
t_s	Storage Time (test circuit no. 558)		225		225	ns	$I_C = 150 mA, V_{CC} = -30 V,$ $I_{B1} = I_{B2} = 15 mA$
t_f	Fall Time (test circuit no. 558)		30		30	ns	$I_C = 150 mA, V_{CC} = -30 V,$ $I_{B1} = I_{B2} = 15 mA$

FAIRCHILD

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**2N4409/FTSO4409
2N4410/FTSO4410**

NPN Neon Display Tube Drivers

7.29.23

- V_{CE0} ... 80 V (Min) (2N/FTSO4410)
- h_{FE} ... 60 V (Min) @ 1.0 and 10 mA
- Complements ... MPSA55, MPSA56

PACKAGE

2N4409	TO-92
2N4410	TO-92
FTSO4409	TO-236AA/AB
FTSO4410	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

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

Power Dissipation (Notes 2 & 3)

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

Voltages & Currents

	4409	4410
V_{CE0} Collector to Emitter Voltage	50 V	80 V
(Note 4)		
V_{CBO} Collector to Base Voltage	80 V	120 V
V_{EBO} Emitter to Base Voltage	5.0 V	5.0 V
I_C Collector Current	250 mA	250 mA

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

SYMBOL	CHARACTERISTIC	4409		4410		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CE0}	Collector to Emitter Breakdown Voltage	50		80		V	$I_C = 1.0 \text{ mA}, I_B = 0$
BV_{CEX}	Collector to Emitter Breakdown Voltage	80		120		V	$I_C = 500 \mu\text{A}, V_{BB} = -5.0 \text{ V}, R_{BE} = 8.2 \text{ k}\Omega$
BV_{CBO}	Collector to Base Breakdown Voltage	80		120		V	$I_C = 10 \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		V	$I_E = 10 \mu\text{A}, I_C = 0$
I_{EBO}	Emitter Cutoff Current		100		100	nA	$V_{EB} = 4.0 \text{ V}, I_C = 0$

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 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).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = 300 μs ; duty cycle = 1%.
 6. For product family characteristic curves, refer to Curve Set T147.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

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2N4409/FTSO4409

2N4410/FTSO4410

T-29-23

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

SYMBOL	CHARACTERISTIC	4409		4410		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
I_{CBO}	Collector Cutoff Current		10			nA	$V_{CB} = 60\text{ V}, I_E = 0$
			1.0		10	nA	$V_{CB} = 100\text{ V}, I_E = 0$
					1.0	μA	$V_{CB} = 60\text{ V}, I_E = 0, T_A = 100^\circ\text{ C}$
						μA	$V_{CB} = 100\text{ V}, I_E = 0, T_A = 100^\circ\text{ C}$
h_{FE}	DC Current Gain	60		60			$I_C = 1.0\text{ mA}, V_{CE} = 1.0\text{ V}$
h_{FE}	DC Pulse Current Gain (Note 5)	60	400	60	400		$I_C = 10\text{ mA}, V_{CE} = 1.0\text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.2		0.2	V	$I_C = 1.0\text{ mA}, I_B = 0.1\text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage		0.8		0.8	V	$I_C = 1.0\text{ mA}, V_{CE} = 5.0\text{ V}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		0.8		0.8	V	$I_C = 1.0\text{ mA}, I_B = 0.1\text{ mA}$
C_{cb}	Collector to Base Capacitance		12		12	pF	$V_{CB} = 10\text{ V}, I_E = 0, f = 140\text{ kHz}$
C_{eb}	Emitter to Base Capacitance		50		50	pF	$V_{EB} = 0.5\text{ V}, I_C = 0, f = 100\text{ kHz}$
$ h_{ie} $	Magnitude of Common Emitter Small Signal Current Gain	2.0	10	2.0	10		$I_C = 10\text{ mA}, V_{CE} = 10\text{ V}, f = 30\text{ MHz}$

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2N4896
NPN Power

T-29-23

- $V_{CE(sat)} \dots 0.7 \text{ V @ } I_C = 2.0 \text{ A}$
- Low Leakage ... $I_{CES}^{(Max)} \mu^{100} \mu\text{A @ } T_C = 150^\circ \text{C}$

PACKAGE

2N4896

TO-39

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

Storage Temperature $-65^\circ \text{C to } 200^\circ \text{C}$
 Operating Junction Temperature 200°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at
 25°C Ambient Temperature 0.8 W
 25°C Case Temperature 0.8 W
 100°C Case Temperature 4.0 W

Voltages & Currents

V_{CEO} Collector to Emitter Voltage 60 V
 (Note 4)
 V_{CBO} Collector to Base Voltage 120 V
 V_{EBO} Emitter to Base Voltage 6.0 V
 I_C Collector Current 5.0 A
 I_B Base Current 1.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 7)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_{EBO}	Emitter Cutoff Current		1.0 1.0	μA mA	$V_{EB} = 4.0 \text{ V}, I_E = 0$ $V_{EB} = 6.0 \text{ V}, I_C = 0$
I_{CES}	Collector Cutoff Current		0.1 1.0 1.0	mA mA μA	$V_{CE} = 60 \text{ V}, V_{BE} = 0, T_A = 150^\circ \text{C}$ $V_{CE} = 120 \text{ V}, V_{BE} = 0$ $V_{CE} = 60 \text{ V}, V_{BE} = 0$
h_{FE}	DC Current Gain (Note 5)	100 35	300		$I_C = 2.0 \text{ A}, V_{CE} = 2.0 \text{ V}$ $I_C = 2.0 \text{ A}, V_{CE} = 2.0 \text{ V}, T_A = -55^\circ \text{C}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	60		V	$I_C = 50 \text{ mA}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Notes 5 & 6)		1.0	V	$I_C = 5.0 \text{ mA}, I_B = 0.5 \text{ A}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Notes 5 & 6)		1.6	V	$I_C = 5.0 \text{ mA}, I_B = 0.5 \text{ A}$

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-case thermal resistance of 25°C/W (derating factor of $40 \text{ mW/}^\circ \text{C}$); junction-to-ambient thermal resistance of 219°C/W (derating factor of $4.57 \text{ mW/}^\circ \text{C}$).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = $300 \mu\text{s}$; duty cycle = 1%.
6. Point of measurement: $1/4"$ from header.
7. For product family characteristic curves, refer to Curve Set T145.

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 7)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
C_{ob}	Output Capacitance		80	pF	$V_{CB} = 10\text{ V}$, $I_E = 0$, $f = 0.14\text{ MHz}$
C_{ib}	Input Capacitance		500	pF	$V_{EB} = 0.5\text{ V}$, $I_C = 0$, $f = 0.14\text{ MHz}$
$ h_{fe} $	Magnitude of Common Emitter Small Signal Current Gain	4.0			$I_C = 0.5\text{ A}$, $V_{CE} = 5.0\text{ V}$, $f = 20\text{ MHz}$
t_d	Turn On Delay Time		50	ns	$I_C = 5.0\text{ A}$, $I_{B1} = 0.5\text{ A}$
t_r	Rise Time		300	ns	$I_C = 5.0\text{ A}$, $I_{B1} = 0.5\text{ A}$
t_s	Storage Time		350	ns	$I_C = 5.0\text{ A}$, $I_{B1} = I_{B2} = 0.5\text{ A}$
t_f	Fall Time		300	ns	$I_C = 5.0\text{ A}$, $I_{B1} = I_{B2} = 0.5\text{ A}$

3469674 FAIRCHILD SEMICONDUCTOR

84D 27595 D

FAIRCHILD

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2N5220/FTSO5220NPN Small Signal General Purpose
Complementary Amplifiers

T-29-23

- $V_{CE0} \dots 15 \text{ V (Min)}$
- $h_{FE} \dots 30-600 @ 50 \text{ mA}$
- $V_{CE(sat)} \dots 0.5 \text{ V (max) @ 150 mA}$

PACKAGE

2N5220

TO92-1

FTSO5220

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	2N	FTSO
25°C Ambient Temperature	0.625 W	0.350 W*
25°C Case Temperature	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage	15 V
(Note 4)	
V_{CBO} Collector to Base Voltage	15 V
V_{EBO} Emitter to Base Voltage	3.0 V
I_C Collector Current	500 mA

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CE0}	Collector to Emitter Breakdown Voltage (Note 5)	15		V	$I_C = 10 \text{ mA}, I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	15		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_{EBO}	Emitter Cutoff Current		100	nA	$V_{EB} = 3.0 \text{ V}, I_C = 0$
I_{CBO}	Collector Cutoff Current		100	nA	$V_{CB} = 10 \text{ V}, I_E = 0$
h_{FE}	DC Current Gain (Note 5)	25 30	600		$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = 10 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.5	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.1	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
C_{cb}	Collector to Base Capacitance		10	pF	$V_{CB} = 5.0 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
h_{fe}	Small Signal Current Gain	30	1800		$I_C = 50 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$
f_T	Current Gain Bandwidth Product	100		MHz	$I_C = 20 \text{ mA}, V_{CE} = 10 \text{ V}$

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 150°C and (TO-92) junction-to-case thermal resistance of 125°C/W (derating factor of $8.0 \text{ mW}^{\circ}\text{C}$); junction-to-ambient thermal resistance of 200°C/W (derating factor of $5.0 \text{ mW}^{\circ}\text{C}$); (TO-236) junction-to-ambient thermal resistance of 357°C/W (derating factor of $2.8 \text{ mW}^{\circ}\text{C}$).
 4. Rating refers to a high current point where collector to emitter voltage is lowest.
 5. Pulse conditions: length = $300 \mu\text{s}$; duty cycle $< 2\%$.
 6. For product family characteristic curves, refer to Curve Set T145.
- * Package mounted on 99.5% alumina $8 \text{ mm} \times 8 \text{ mm} \times 0.6 \text{ mm}$.