

**FAIRCHILD**

A Schlumberger Company

**2N3253**

T-35-19

NPN Switching Type

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

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	200° C

**PACKAGE**

2N3253 TO-39

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

Total Dissipation at	
25° C Ambient Temperature	0.8 W
25° C Case Temperature	3.0 W

**Voltages & Currents**

V <sub>CEO</sub> Collector to Emitter Voltage (Note 4)	40 V
V <sub>CBO</sub> Collector to Base Voltage	75 V
V <sub>EBO</sub> Emitter to Base Voltage	5.0 V
I <sub>C</sub> Collector Current	1.0 A

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV <sub>CBO</sub>	Collector to Base Breakdown Voltage	75		V	I <sub>C</sub> = 10 μA, I <sub>E</sub> = 0
BV <sub>EBO</sub>	Emitter to Base Breakdown Voltage	5.0		V	I <sub>E</sub> = 10 μA, I <sub>C</sub> = 0
I <sub>EBO</sub>	Emitter Cutoff Current		50	nA	V <sub>EB</sub> = 4.0 V, I <sub>C</sub> = 0
I <sub>CBO</sub>	Collector Reverse Current (100° C)		500 75	nA μA	V <sub>CB</sub> = 60 V, I <sub>E</sub> = 0 V <sub>CB</sub> = 60 V, I <sub>E</sub> = 0
I <sub>CEX</sub>	Collector Reverse Current		500	nA	V <sub>CE</sub> = 60 V, V <sub>EB</sub> = 4.0 V
I <sub>BL</sub>	Base Current		500	nA	V <sub>CE</sub> = 60 V, V <sub>OB</sub> = 4.0 V
h <sub>FE</sub>	DC Pulse Current Gain (Note 5)	25 25 20	75		I <sub>C</sub> = 150 mA, V <sub>CE</sub> = 1.0 V I <sub>C</sub> = 375 mA, V <sub>CE</sub> = 1.0 V I <sub>C</sub> = 750 mA, V <sub>CE</sub> = 5.0 V
V <sub>CEO(sus)</sub>	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	40		V	I <sub>C</sub> = 10 mA, I <sub>B</sub> = 0
V <sub>CE(sat)</sub>	Collector to Emitter Saturation Voltage (Pulsed) (Note 5)		0.35 0.6 1.2	V V V	I <sub>C</sub> = 150 mA, I <sub>B</sub> = 15 mA I <sub>C</sub> = 500 mA, I <sub>B</sub> = 50 mA I <sub>C</sub> = 1.0 A, I <sub>B</sub> = 100 mA
V <sub>BE(sat)</sub>	Base to Emitter Saturation Voltage (Pulsed) (Note 5)	0.7	1.0 1.3 1.8	V V V	I <sub>C</sub> = 150 mA, I <sub>B</sub> = 15 mA I <sub>C</sub> = 500 mA, I <sub>B</sub> = 50 mA I <sub>C</sub> = 1.0 A, I <sub>B</sub> = 100 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° 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-238) 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 μs; duty cycle ≤ 1%.
- For product family characteristic curves, refer to Curve Set T139.

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$C_{ob}$	Output Capacitance		12	pF	$V_{CB} = 20\text{ V}$ , $I_E = 0$
$C_{ib}$	Input Capacitance		80	pF	$V_{EB} = 0.5\text{ V}$ , $I_C = 0$
$h_{fe}$	High Frequency Current Gain	1.75			$I_C = 50\text{ mA}$ , $V_{CE} = 10\text{ V}$ , $f = 100\text{ MHz}$
$t_d$	Turn On Delay Time (test circuit no. 3164)		15	ns	$I_C = 500\text{ mA}$ , $I_{B1} = 50\text{ mA}$
$t_r$	Rise Time (test circuit no. 3164)		35	ns	$I_C = 500\text{ mA}$ , $I_{B1} = 50\text{ mA}$
$t_s$	Storage Time (test circuit no. 3165)		40	ns	$I_C = 500\text{ mA}$ , $I_{B1} = I_{B2} = 50\text{ mA}$
$t_f$	Fall Time (test circuit no. 3165)		30	ns	$I_C = 500\text{ mA}$ , $I_{B1} = I_{B2} = 50\text{ mA}$
$Q_T$	Total Control Charge (test circuit no. 3163)		5.0	ncoul	$I_C = 500\text{ mA}$ , $I_B = 50\text{ mA}$



**2N3700/2N3701** T-29-23  
 NPN Small Signal General Purpose Amplifiers

- $V_{CE0} \dots 80 \text{ V (Min) @ } 30 \text{ mA}$
- $V_{CE(sat)} \dots 0.5 \text{ V (Max) @ } 500 \text{ mA}$

PACKAGE	
2N3700	TO-18
2N3701	TO-18

**ABSOLUTE MAXIMUM RATINGS (Note 1)**

**Temperatures**

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	200° C

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

Total Dissipation at 25° C Ambient Temperature	0.5 W
100° C Case Temperature	1.0 W
25° C Case Temperature	1.8 W

**Voltages & Currents**

$V_{CE0}$ Collector to Emitter Voltage (Note 4)	80 V
$V_{CBO}$ Collector to Base Voltage	140 V
$V_{EBO}$ Emitter to Base Voltage	7.0 V
$I_C$ Collector Current	1.0 A

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

SYMBOL	CHARACTERISTIC	3700		3701		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$BV_{CBO}$	Collector to Base Breakdown Voltage	140		140		V	$I_C = 100 \mu\text{A}, I_E = 0$
$BV_{EBO}$	Emitter to Base Breakdown Voltage	7.0		7.0		V	$I_E = 100 \mu\text{A}, I_C = 0$
$I_{EBO}$	Emitter Cutoff Current		10		10	nA	$V_{EB} = 5.0 \text{ V}, I_C = 0$
$I_{CBO}$	Collector Cutoff Current		10		10	nA	$V_{CB} = 90 \text{ V}, I_E = 0$
			10		10	$\mu\text{A}$	$V_{CB} = 90 \text{ V}, I_E = 0, T_A = 150^\circ \text{ C}$
$h_{FE}$	DC Pulse Current Gain (Note 5)	100	300	40	120		$I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$
		90		40	120		$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$
		50		30	100		$I_C = 0.1 \text{ mA}, V_{CE} = 10 \text{ V}$
		50		30	100		$I_C = 500 \text{ mA}, V_{CE} = 10 \text{ V}$
		15		15			$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}$
		40					$I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}, T_A = -55^\circ \text{ C}$

**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 200° C and junction-to-case thermal resistance of 97° C/W (derating factor of 10.3 mW/° C); junction-to-ambient thermal resistance of 350° C/W (derating factor of 2.85 mW/° C).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length = 300  $\mu\text{s}$ ; duty cycle  $\leq 1\%$ .
- For product family characteristic curves, refer to Curve Set T149.

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2N3700/2N3701

T-29-23

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

SYMBOL	CHARACTERISTIC	3700		3701		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	80		80		V	$I_C = 30 \text{ mA}, I_B = 0$
$V_{CE(sat)}$	Pulsed Collector to Emitter Saturation Voltage (Note 5)		0.2 0.5		0.2 0.5	V V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Pulsed)		1.1		1.1	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
$C_{ob}$	Output Capacitance		12		12	pF	$V_{CB} = 10 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
$C_{ib}$	Input Capacitance		60		60	pF	$V_{EB} = 0.5 \text{ V}, I_C = 0, f = 1.0 \text{ MHz}$
$h_{fe}$	High Frequency Current Gain	5.0	10	4.0	10		$I_C = 50 \text{ mA}, V_{CE} = 10 \text{ V}, f = 20 \text{ MHz}$
$h_{ie}$	Small Signal Current Gain	80	400	30	200		$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 1.0 \text{ kHz}$
$r_b'C_c$	Collector to Base Time Constant	25	400	25	400	ps	$I_C = 10 \text{ mA}, V_{CB} = 10 \text{ V}, f = 4.0 \text{ MHz}$
NF	Noise Figure		4.0			dB	$I_C = 100 \mu\text{A}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}, R_G = 1.0 \text{ k}\Omega$

**FAIRCHILD**

A Schlumberger Company

**2N3724/2N3725**  
**2N4013/2N4014**

T-35-15

NPN Small Signal High Current High  
Speed Switches

- $V_{CEO}$  ... 30 V (Min) (2N3724, 2N4013), 50 V (Min) (2N3725, 2N4014)
- $V_{CE(sat)}$  ... 0.65 V (Max) @ 800 mA, 0.75 V (Max) @ 1.0 A (2N3724, 2N4013)
- $h_{FE}$  ... 60-150 @ 1.0 A (2N3724, 2N4013)
- $t_{on}$  ... 35 ns (Max),  $t_{off}$  ... 60 ns (Max) @ 500 mA

**PACKAGE**

2N3724	TO-5
2N3725	TO-5
2N4013	TO-18
2N4014	TO-18

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

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	200° C

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

Total Dissipation at	4013/4	3724/5
25° C Ambient Temperature	0.36 W	0.8 W
25° C Case Temperature	1.2 W	3.5 W

**Voltages & Currents**

	3724/4013	3725/4014
$V_{CEO}$ Collector to Emitter Voltage (Note 4)	30 V	50 V
$V_{CBO}$ Collector to Base Voltage	50 V	80 V
$V_{CES}$ Collector to Emitter Voltage	50 V	80 V
$V_{EBO}$ Emitter to Base Voltage	6.0 V	6.0 V
$I_C$ Collector Current (Note 5)	1.0 A	1.0 A
$I_C$ DC Collector Current	500 mA	500 mA

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

SYMBOL	CHARACTERISTIC	3724/4013		3725/4014		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$BV_{CES}$	Collector to Emitter Breakdown Voltage	50		80		V	$I_C = 10 \mu A, V_{BE} = 0$
$BV_{CBO}$	Collector to Base Breakdown Voltage	50		50		V	$I_C = 10 \mu A, I_E = 0$
$BV_{EBO}$	Emitter to Base Breakdown Voltage	6.0		6.0		V	$I_E = 10 \mu A, I_C = 0$

**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 200° C and junction-to-case thermal resistance of 50° C/W (derating factor of 20 mW/° C) for 2N3724 and 2N3725; and 146° C/W (derating factor of 6.85 mW/° C) for the 2N4013 and 2N4014; junction-to-ambient thermal resistance of 219° C/W (derating factor of 4.56 mW/° C) for the 2N3724, 2N3725, and 485° C/W (derating factor of 2.06 mW/° C) for the 2N4013 and 2N4014.
- 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 T162 for 2N3724/5 and T139 for 2N4013/4

2N3724/2N3725  
2N4013/2N4014

T-35-15

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

SYMBOL	CHARACTERISTIC	3724/4013		3725/4014		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$I_{CBO}$	Collector Cutoff Current		1.7			$\mu A$	$V_{CB} = 40 V, I_E = 0$
					1.7	$\mu A$	$V_{CB} = 60 V, I_E = 0$
			120		120	$\mu A$	$V_{CB} = 40 V, I_E = 0, T_A = 100^\circ C$ $V_{CB} = 60 V, I_E = 0, T_A = 100^\circ C$
$I_{CES}$	Collector Reverse Current		10		10	$\mu A$	$V_{CE} = 50 V, I_E = 0$ $V_{CE} = 80 V, I_E = 0$
$h_{FE}$	DC Pulse Current Gain (Note 5)	60	150	60	150		$I_C = 100 mA, V_{CE} = 1.0 V$
		35		35			$I_C = 500 mA, V_{CE} = 1.0 V$
		40		40			$I_C = 300 mA, V_{CE} = 1.0 V$
		30		25			$I_C = 1.0 A, V_{CE} = 5.0 V$
		30		30			$I_C = 10 mA, V_{CE} = 1.0 V$
		25		20			$I_C = 800 mA, V_{CE} = 2.0 V$
		30		30			$I_C = 100 mA, V_{CE} = 1.0 V,$ $T_A = -55^\circ C$
		20		20			$I_C = 500 mA, V_{CE} = 1.0 V,$ $T_A = -55^\circ C$
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	30		50		V	$I_C = 10 mA, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.25		0.25	V	$I_C = 10 mA, I_B = 1.0 mA$
			0.2		0.26	V	$I_C = 100 mA, I_B = 10 mA$
			0.32		0.4	V	$I_C = 300 mA, I_B = 30 mA$
			0.42		0.52	V	$I_C = 500 mA, I_B = 50 mA$
			0.65		0.8	V	$I_C = 800 mA, I_B = 80 mA$
			0.75		0.95	V	$I_C = 1.0 A, I_B = 100 mA$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		0.76		0.76	V	$I_C = 10 mA, I_B = 1.0 mA$
			0.86		0.86	V	$I_C = 100 mA, I_B = 10 mA$
			1.1		1.1	V	$I_C = 300 mA, I_B = 30 mA$
			1.5		1.5	V	$I_C = 800 mA, I_B = 80 mA$
			1.7		1.7	V	$I_C = 1.0 A, I_B = 100 mA$
		0.8	1.1	0.8	1.1	V	$I_C = 500 mA, I_B = 50 mA$
$C_{ob}$	Output Capacitance		12		10	pF	$V_{CB} = 10 V, I_E = 0$
$C_{ib}$	Input Capacitance		55		55	pF	$V_{BE} = 0.5 V, I_C = 0$
$h_{fe}$	High Frequency Current Gain	3.0		3.0			$I_C = 50 mA, V_{CE} = 10 V,$ $f = 100 MHz$
$t_{on}$	Turn On Time (test circuit no. 265)		35		35	ns	$I_C = 500 mA, I_{B1} = 50 mA$
$t_{off}$	Turn Off Time (test circuit no. 265)		60		60	ns	$I_C = 500 mA, I_{B1} = 50 mA,$ $I_{B2} = -50 mA$

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**FAIRCHILD**

A Schlumberger Company

**2N3903/FTSO3903** 7-35-15  
**2N3904/FTSO3904**

NPN Small Signal General Purpose Amplifiers & Switches

- $V_{CE0}$  ... 40 V (Min)
- $h_{FE}$  ... 100-300 @ 10 mA (2N/FTSO3904)
- NF ... 5.0 dB (Max) Wide Band (2N/FTSO3904)
- Complements ... 2N3905, 2N3906

**PACKAGE**

2N3903	TO-92
2N3904	TO-92
FTSO3903	TO-236AA/AB
FTSO3904	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*
70° C Ambient Temperature	0.400 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	60 V
$V_{EBO}$ Emitter to Base Voltage	6.0 V
$I_C$ Collector Current	200 mA

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

SYMBOL	CHARACTERISTIC	3903		3904		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$BV_{CE0}$	Collector to Emitter Breakdown Voltage (Note 4)	40		40		V	$I_C = 1.0$ mA, $I_B = 0$
$BV_{CBO}$	Collector to Base Breakdown Voltage	60		60		V	$I_C = 10$ $\mu$ A, $I_E = 0$
$BV_{EBO}$	Emitter to Base Breakdown Voltage	6.0		6.0		V	$I_E = 10$ $\mu$ A, $I_C = 0$
$I_{CEX}$	Collector Cutoff Current		50		50	nA	$V_{CE} = 30$ V, $V_{EB} = 3.0$ V
$I_{BL}$	Base Cutoff Current		50		50	nA	$V_{CE} = 30$ V, $V_{EB} = 3.0$ V
$h_{FE}$	DC Current Gain (Note 4)	20 35 50 30 15	150	40 70 100 60 30	300		$I_C = 0.1$ mA, $V_{CE} = 1.0$ V $I_C = 1.0$ mA, $V_{CE} = 1.0$ V $I_C = 10$ mA, $V_{CE} = 1.0$ V $I_C = 50$ mA, $V_{CE} = 1.0$ V $I_C = 100$ mA, $V_{CE} = 1.0$ 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. Pulse conditions: length = 300  $\mu$ s; duty cycle = 2%.
  5. For product family characteristic curves, refer to Curve Set T144.
- \* Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N3903/FTSO3903  
2N3904/FTSO3904

T-35-15

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

SYMBOL	CHARACTERISTIC	3903		3904		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		0.2 0.3		0.2 0.3	V V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 4)	0.65	0.85 0.95	0.65	0.85 0.95	V V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$C_{ob}$	Output Capacitance		4.0		4.0	pF	$V_{CB} = 5.0 \text{ V}, I_E = 0, f = 100 \text{ kHz}$
$C_{ib}$	Input Capacitance		8.0		8.0	pF	$V_{BE} = 0.5 \text{ V}, I_C = 0, f = 100 \text{ kHz}$
$h_{fe}$	Small Signal Current Gain	50	200	100	400		$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$
$h_{ie}$	Input Impedance	1.0	8.0	1.0	10	k $\Omega$	$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$
$h_{oe}$	Output Admittance	1.0	40	1.0	40	$\mu\text{mho}$	$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$
$h_{re}$	Voltage Feedback Ratio	0.1	5.0	0.5	8.0	$\times 10^{-4}$	$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$
$f_T$	Current Gain Bandwidth Product	250		300		MHz	$I_C = 10 \text{ mA}, V_{CE} = 20 \text{ V}, f = 100 \text{ MHz}$
$t_d$	Turn On Delay Time (test circuit no. 526)		35		35	ns	$I_C = 10 \text{ mA}, V_{CC} = 3.0 \text{ V}, I_{B1} = 10 \text{ mA}, V_{BE(OFF)} = 0.5 \text{ V}$
$t_r$	Rise Time (test circuit no. 526)		35		35	ns	$I_C = 10 \text{ mA}, V_{CC} = 3.0 \text{ V}, I_{B1} = 10 \text{ mA}, V_{BE(OFF)} = 0.5 \text{ V}$
$t_s$	Storage Time (test circuit no. 527)		175		200	ns	$I_C = 10 \text{ mA}, V_{CC} = 3.0 \text{ V}, I_{B1} = I_{B2} = 1.0 \text{ mA}$
$t_f$	Fall Time (test circuit no. 527)		50		50	ns	$I_C = 10 \text{ mA}, V_{CC} = 3.0 \text{ V}, I_{B1} = I_{B2} = 1.0 \text{ mA}$
NF	Noise Figure		6.0		5.0	dB	$I_C = 100 \mu\text{A}, V_{CE} = 5.0 \text{ V}, f = 10 \text{ Hz to } 15.7 \text{ kHz}, R_G = 1.0 \text{ k}\Omega$



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84D 27560 D ■

**FAIRCHILD**

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**2N3905/FTSO3905** T-37-15  
**2N3906/FTSO3906**

PNP Small Signal General Purpose  
 Amplifiers & Switches

- $V_{CE0}$  ... -40 V (Min)
- $h_{FE}$  ... 100-300 @ 10 mA (2N3906)
- NF ... 4.0 dB (Max) Wide Band (2N3906)
- Complements ... 2N3903, 2N3904

PACKAGE	
2N3905	TO-92
2N3906	TO-92
FTSO3905	TO-236AA/AB
FTSO3906	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*
70° C Ambient Temperature	0.400 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	-40 V
$V_{EBO}$ Emitter to Base Voltage	-5.0 V
$I_C$ Collector Current	200 mA

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

SYMBOL	CHARACTERISTIC	3905		3906		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$BV_{CE0}$	Collector to Emitter Breakdown Voltage (Note 5)	-40		-40		V	$I_C = 1.0$ mA, $I_B = 0$
$BV_{CBO}$	Collector to Base Breakdown Voltage	-40		-40		V	$I_C = 10$ $\mu$ A, $I_E = 0$
$BV_{EBO}$	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 10$ $\mu$ A, $I_C = 0$
$I_{CEX}$	Collector Cutoff Current		50		50	nA	$V_{CE} = -30$ V, $V_{EB} = -3.0$ V
$I_{BL}$	Base Cutoff Current		50		50	nA	$V_{CE} = -30$ V, $V_{EB} = -3.0$ V
$h_{FE}$	DC Pulse Current Gain (Note 5)	30 40 50 30 15	150	60 80 100 60 30	300		$I_C = 0.1$ mA, $V_{CE} = -1.0$ V $I_C = 1.0$ mA, $V_{CE} = -1.0$ V $I_C = 10$ mA, $V_{CE} = -1.0$ V $I_C = 50$ mA, $V_{CE} = -1.0$ V $I_C = 100$ mA, $V_{CE} = -1.0$ 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  $\mu$ s; duty cycle  $\leq$  2%.
  6. 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.

2N3905/FTSO3905

2N3906/FTSO3906

T-37-15

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

SYMBOL	CHARACTERISTIC	3905		3906		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.25 -0.4		-0.25 -0.4	V V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	-0.65	-0.85 -0.95	-0.65	-0.85 -0.95	V V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$C_{ob}$	Output Capacitance		4.5		4.5	pF	$V_{CB} = -5.0 \text{ V}, I_E = 0, f = 100 \text{ kHz}$
$C_{ib}$	Input Capacitance		10		10	pF	$V_{EB} = -0.5 \text{ V}, I_C = 0, f = 100 \text{ kHz}$
$h_{fe}$	Small Signal Current Gain	50	200	100	400		$I_C = 1.0 \text{ mA}, V_{CE} = -10 \text{ V},$ $f = 1.0 \text{ kHz}$
$h_{ie}$	Input Impedance	0.5	8.0	2.0	10	k $\Omega$	$I_C = 1.0 \text{ mA}, V_{CE} = -10 \text{ V},$ $f = 1.0 \text{ kHz}$
$h_{oe}$	Output Admittance	1.0	40	3.0	60	$\mu\text{mho}$	$I_C = 1.0 \text{ mA}, V_{CE} = -10 \text{ V},$ $f = 1.0 \text{ kHz}$
$h_{re}$	Voltage Feedback Ratio	0.1	5.0	0.1	10	$\times 10^{-4}$	$I_C = 1.0 \text{ mA}, V_{CE} = -10 \text{ V},$ $f = 1.0 \text{ kHz}$
$f_T$	Current Gain Bandwidth Product	200		250		MHz	$I_C = 10 \text{ mA}, V_{CE} = -20 \text{ V},$ $f = 100 \text{ MHz}$
$t_d$	Turn On Delay Time (test circuit no. 333)		35		35	ns	$I_C \cong 10 \text{ mA}, I_{B1} \cong 1.0 \text{ mA},$ $V_{CC} = -3.0 \text{ V}$
$t_r$	Rise Time (test circuit no. 333)		35		35	ns	$I_C \cong 10 \text{ mA}, I_{B1} \cong 1.0 \text{ mA},$ $V_{CC} = -3.0 \text{ V}$
$t_s$	Storage Time (test circuit no. 239)		200		225	ns	$I_C \cong 10 \text{ mA}, I_{B1} \cong 1.0 \text{ mA},$ $I_{B2} \cong -1.0 \text{ mA}, V_{CC} = -3.0 \text{ V}$
$t_f$	Fall Time (test circuit no. 239)		60		75	ns	$I_C \cong 10 \text{ mA}, I_{B1} \cong 1.0 \text{ mA},$ $I_{B2} \cong -1.0 \text{ mA}, V_{CC} = -3.0 \text{ V}$
NF	Wide Band Noise Figure		5.0		4.0	dB	$I_C = 100 \mu\text{A}, V_{CE} = -5.0 \text{ V}$ $R_S = 1.0 \text{ k}\Omega,$ $f = 10 \text{ Hz to } 15.7 \text{ kHz}$