

3469674 FAIRCHILD SEMICONDUCTOR

84D 27536 D1



**2N2710/FTSO2710** T-35-1.3  
 NPN Small Signal High Speed Low Power Saturating Switch Transistor

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**PACKAGE**  
 2N2710  
 FTSO2710

TO-18  
 TO-236AA/AB

**Temperatures**

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

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

Total Dissipation at	<b>2N</b>	<b>FTSO</b>
25° C Ambient Temperature	0.5 W	0.350 W*
25° C Case Temperature	1.2 W	

**Voltages & Currents**

V <sub>CEO</sub> Collector to Emitter Voltage	20 V
(Note 4)	
V <sub>CES</sub> Collector to Emitter Voltage	30 V
V <sub>CBO</sub> Collector to Base Voltage	40 V
V <sub>EBO</sub> Emitter to Base Voltage	5.0 V
I <sub>C</sub> Collector Current	500 mA

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV <sub>CEO</sub>	Collector to Emitter Breakdown Voltage	20		V	I <sub>C</sub> = 10 mA, I <sub>B</sub> = 0
BV <sub>CES</sub>	Collector to Emitter Breakdown Voltage	30		V	I <sub>C</sub> = 10 μA, I <sub>B</sub> = 0
BV <sub>CBO</sub>	Collector to Base Breakdown Voltage	40		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		1.0	μA	V <sub>EB</sub> = 3.0 V, I <sub>C</sub> = 0
I <sub>CBO</sub>	Collector Cutoff Current (150° C)		30 30	nA μA	V <sub>CB</sub> = 20 V, I <sub>E</sub> = 0 V <sub>CB</sub> = 20 V, T <sub>A</sub> = 150° C
h <sub>FE</sub>	DC Current Gain (Note 5)	40 40			I <sub>C</sub> = 10 mA, V <sub>CE</sub> = 1.0 V I <sub>C</sub> = 50 mA, V <sub>CE</sub> = 1.0 V
V <sub>CE(sat)</sub>	Collector to Emitter Saturation Voltage		0.25 0.40	V V	I <sub>C</sub> = 10 mA, I <sub>B</sub> = 1.0 mA I <sub>C</sub> = 50 mA, I <sub>B</sub> = 5.0 mA
V <sub>BE(sat)</sub>	Base to Emitter Saturation Voltage		0.90 1.30	V V	I <sub>C</sub> = 10 mA, I <sub>B</sub> = 1.0 mA I <sub>C</sub> = 50 mA, I <sub>B</sub> = 5.0 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 200° C and junction-to-case thermal resistance of 146° C/W (derating factor of 6.8 mW/°C); junction-to-ambient thermal resistance of 350° C/W (derating factor 2.8 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 μs; duty cycle ≤ 2%, and ≤ 1.2 ms pulse duration.
  - For product family characteristic curves, refer to Curve Set T162
- \* Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

**FAIRCHILD**

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**2N2904/5/6/7** T-37-17  
**PN2904/5/6/7**  
**FTSO2904/5/6/7**  
 PNP Small Signal General Purpose  
 Amplifiers & Switches

- $V_{CE0} \dots -40 \text{ V (Min)}$
- $h_{FE} \dots 40-120$  (2N/PN/FTSO2904/6),  
 $100-300$  (2N/PN/FTSO2905/7)
- $t_{on} \dots 45 \text{ ns (Max) @ } 150 \text{ mA}$ ,  $t_{off} \dots 100 \text{ ns (Max) @ } 150 \text{ mA}$
- Complements ... 2N/PN/FTSO2218 Series,  
 2N/PN/FTSO2218A Series

PACKAGE	
2N2904	TO-39
2N2905	TO-39
2N2906	TO-18
2N2907	TO-18
PN2904	TO-92
PN2905	TO-92
PN2906	TO-92
PN2907	TO-92
FTSO2904	TO-236AA/AB
FTSO2905	TO-236AA/AB
FTSO2906	TO-236AA/AB
FTSO2907	TO-236AA/AB

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

Temperatures	2N	PN/FTSO
Storage Temperature	-65° C to 200° C	-55° C to 150° C
Operating Junction Temperature	175° C	150° C

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

Total Dissipation at	2N2904/5	2N2906/7
25° C Ambient Temperature	0.6 W	0.4 W
25° C Case Temperature	3.0 W	1.8 W

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

**Voltages & Currents**

	2N/PN2904
$V_{CE0}$ Collector to Emitter Voltage (Note 4)	-40 V
$V_{CBO}$ Collector to Base Voltage	-60 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	2N/PN2904/6		TEST CONDITIONS
		MIN	MAX	
$h_{FE}$	DC Current Gain (Note 5)	40	120	$I_C = 150 \text{ mA}$ , $V_{CE} = -10 \text{ V}$ $I_C = 500 \text{ mA}$ , $V_{CE} = -10 \text{ V}$ $I_C = 10 \text{ mA}$ , $V_{CE} = -10 \text{ V}$ $I_C = 1.0 \text{ mA}$ , $V_{CE} = -10 \text{ V}$ $I_C = 0.1 \text{ mA}$ , $V_{CE} = -10 \text{ V}$

**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 200° C and junction-to-case thermal resistance of 58.3° C/W (derating factor of 17.2 mW/° C); junction-to-ambient thermal resistance of 292° C/W (derating factor of 3.42 mW/° C) for 2N2904 and 2N2905; junction-to-case thermal resistance of 97.3° C/W (derating factor of 10.3 mW/° C); junction-to-ambient thermal resistance of 437° C/W (derating factor of 2.28 mW/° C) for the 2N2906 and 2N2907. These ratings give a maximum junction resistance of 150° C and junction-to-case thermal resistance of 437° 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) for PN2904, PN2905, PN2906, and PN2907; (TO236) 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 = 1%
  6. For product family characteristic curves, refer to Curve Set T212.
- \* Package mounted on 99.5% alumina 8mm x 8mm x 0.6mm.

2N2904/5/6/7  
 PN2904/5/6/7  
 FTSO2904/5/6/7

T-35-17

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

SYMBOL	CHARACTERISTIC	2N/PN2905/7		UNITS	TEST CONDITIONS
		MIN	MAX		
$h_{FE}$	DC Current Gain (Note 5)	100 30 75 50 35	300		$I_C = 150 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 500 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 0.1 \text{ mA}, V_{CE} = -10 \text{ V}$
SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$BV_{EBO}$	Emitter to Base Breakdown Voltage	-5.0		V	$I_C = 0, I_E = 10 \mu\text{A}$
$BV_{CBO}$	Collector to Base Breakdown Voltage	-60		V	$I_C = 10 \mu\text{A}, I_E = 0$
$I_{CEX}$	Collector Reverse Current		50	nA	$V_{CE} = -30 \text{ V}, V_{EB} = -0.5 \text{ V}$
$I_{CBO}$	Collector Cutoff Current		20 20	nA $\mu\text{A}$	$V_{CB} = -50 \text{ V}, I_E = 0$ $V_{CB} = -50 \text{ V}, I_E = 0, T_A = 150^\circ\text{C}$
$I_B$	Base Current		50	nA	$V_{CE} = -30 \text{ V}, V_{EB} = -0.5 \text{ V}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	-60		V	$I_C = 10 \text{ mA (pulsed)}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.4 -1.6	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 (Note 5)		-1.3 -2.6	V V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
$C_{ob}$	Output Capacitance		8.0	pF	$V_{CB} = -10 \text{ V}, I_E = 0, f = 100 \text{ kHz}$
$C_{ib}$	Emitter Transition Capacitance		30	pF	$V_{EB} = -2.0 \text{ V}, I_C = 0, f = 100 \text{ kHz}$
$h_{fe}$	High Frequency Current Gain	2.0			$I_C = 50 \text{ mA}, V_{CE} = -20 \text{ V}, f = 100 \text{ MHz}$
$t_d$	Turn On Delay Time (test circuit no. 224)		10	ns	$I_C = 150 \text{ mA}, V_{CC} = -30 \text{ V}, I_{B1} = 15 \text{ mA}$
$t_r$	Rise Time (test circuit no. 224)		40	ns	$I_C = 150 \text{ mA}, V_{CC} = -30 \text{ V}, I_{B1} = I_{B2} = 15 \text{ mA}$
$t_s$	Storage Time (test circuit no. 225)		80	ns	$I_C = 150 \text{ mA}, V_{CC} = -6.0 \text{ V}, I_{B1} = 15 \text{ mA}$
$t_f$	Fall Time (test circuit no. 225)		30	ns	$I_C = 150 \text{ mA}, V_{CC} = -6.0 \text{ V}, I_{B1} = I_{B2} = 15 \text{ mA}$

**FAIRCHILD**

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**2N2904A/5A/6A/7A**  
**PN2904A/5A/6A/7A** T-35-17  
**FTSO2904A/5A/6A/7A**  
 PNP Small Signal General Purpose  
 Amplifiers & Switches

- $P_D$  ... 625 mW @  $T_A = 25^\circ C$  (PN Series)
- $V_{CE0}$  ... -60 V (Min)
- $h_{FE}$  ... 40-120 (2N/PN/FTSO2904A/6A), 100-300 (2N/PN/FTSO2905A/7A)
- $t_{on}$  ... 45 ns (Max) @ 150 mA,  $t_{off}$  ... 100 ns (Max) @ 150 mA
- Complements ... 2N/PN/FTSO2218 Series, 2N/PN/FTSO2218A Series

**PACKAGE**

2N2904A	TO-39
2N2905A	TO-39
2N2906A	TO-18
2N2907A	TO-18
PN2904A	TO-92
PN2905A	TO-92
PN2906A	TO-92
PN2907A	TO-92
FTSO2904A	TO-236AA/AB
FTSO2905A	TO-236AA/AB
FTSO2906A	TO-236AA/AB
FTSO2907A	TO-236AA/AB

**ABSOLUTE MAXIMUM RATINGS (Note 1)**

Temperatures	2N	PN/FTSO
Storage Temperature	-65° C to 200° C	-55° C to 150° C
Operating Junction Temperature	175° C	150° C

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

Total Dissipation at	2N2904/5A	2N2906/7A
25° C Ambient Temperature	0.6 W	0.4 W
25° C Case Temperature	3.0 W	1.8 W

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

**Voltages & Currents**

	2N/PN
$V_{CE0}$ Collector to Emitter Voltage (Note 4)	-40 V
$V_{CBO}$ Collector to Base Voltage	-60 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	2904A/2906A		UNITS	TEST CONDITIONS
		MIN	MAX		
$h_{FE}$	DC Current Gain (Note 5)	40	120		$I_C = 150 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 500 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 0.1 \text{ mA}, V_{CE} = -10 \text{ V}$

**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 200° C and junction-to-case thermal resistance of 58.3° C/W (derating factor of 17.2 mW/° C); junction-to-ambient thermal resistance of 292° C/W (derating factor of 3.42 mW/° C) for 2N2904A and 2N2905A; junction-to-case thermal resistance of 97.3° C/W (derating factor of 10.3 mW/° C); junction-to-ambient thermal resistance of 437° C/W (derating factor of 2.28 mW/° C) for the 2N2906A and 2N2907A. These ratings give a maximum junction resistance of 150° C and 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) for PN2904A, PN2905A, PN2906A, and PN2907A; (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 = 1%.
  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.

2N2904A/5A/6A/7A T-35-17  
 PN2904A/5A/6A/7A  
 FTSO2904A/5A/6A/7A

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

SYMBOL	CHARACTERISTIC	2905A/2907A		UNITS	TEST CONDITIONS
		MIN	MAX		
$h_{FE}$	DC Current Gain (Note 5)	100 50 100 100 75	300		$I_C = 150 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 500 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = -10 \text{ V}$ $I_C = 0.1 \text{ mA}, V_{CE} = -10 \text{ V}$
$BV_{EBO}$	Emitter to Base Breakdown Voltage	-5.0		V	$I_C = 0, I_E = 10 \mu\text{A}$
$BV_{CBO}$	Collector to Base Breakdown Voltage	-60		V	$I_C = 10 \mu\text{A}, I_E = 0$
$I_{CEX}$	Collector Reverse Current		50	nA	$V_{CE} = -30 \text{ V}, V_{EB} = -0.5 \text{ V}$
$I_{CBO}$	Collector Cutoff Current		10 10	nA $\mu\text{A}$	$V_{CB} = -50 \text{ V}, I_E = 0$ $V_{CB} = -50 \text{ V}, I_E = 0, T_A = 150^\circ\text{C}$
$I_B$	Base Current		50	nA	$V_{CE} = -0 \text{ V}, V_{EB} = -0.5 \text{ V}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	-40		V	$I_C = 10 \text{ mA (pulsed)}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.4	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
			-1.6	V	$I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-1.3	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
			-2.6	V	$I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
$C_{ob}$	Output Capacitance		8.0	pF	$V_{CB} = -10 \text{ V}, I_E = 0, f = 100 \text{ kHz}$
$C_{ib}$	Emitter Transition Capacitance		30	pF	$V_{EB} = -2.0 \text{ V}, I_C = 0, f = 100 \text{ kHz}$
$h_{fe}$	High Frequency Current Gain	2.0			$I_C = 50 \text{ mA}, V_{CE} = -20 \text{ V},$ $f = 100 \text{ MHz}$
$t_d$	Turn On Delay Time (test circuit no. 224)		10	ns	$I_C = 150 \text{ mA}, V_{CC} = -30 \text{ V},$ $I_{B1} = 15 \text{ mA}$
$t_r$	Rise Time (test circuit no. 224)		40	ns	$I_C = 150 \text{ mA}, V_{CC} = -30 \text{ V},$ $I_{B1} = I_{B2} = 15 \text{ mA}$
$t_s$	Storage Time (test circuit no. 225)		80	ns	$I_C = 150 \text{ mA}, V_{CC} = -6.0 \text{ V},$ $I_{B1} = 15 \text{ mA}$
$t_f$	Fall Time (test circuit no. 225)		30	ns	$I_C = 150 \text{ mA}, V_{CC} = -6.0 \text{ V},$ $I_{B1} = I_{B2} = 15 \text{ mA}$
$t_{on}$	Turn On Time (test circuit no. 224)		45	ns	$I_C = 150 \text{ mA}, V_{CC} = -3.0 \text{ V},$ $I_{B1} = 15 \text{ mA}$
$t_{off}$	Turn Off Time (test circuit no. 225)		100	ns	$I_C = 150 \text{ mA}, V_{CC} = -6.0 \text{ V},$ $I_{B1} = I_{B2} = 15 \text{ mA}$

3469674 FAIRCHILD SEMICONDUCTOR

84D 27544 D

**FAIRCHILD**

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**2N3019/2N3020** T-29-23

NPN Small Signal General Purpose Amplifiers

- $V_{CEO}$  ... 80 V (Min)
- $V_{CE(sat)}$  ... 0.5 V (Max) @ 500 mA
- $h_{FE}$  ... 100-300 @ 150 mA (2N3019), 50 (Min) @ 100  $\mu$ A & 500 mA (2N3019)
- Complements ... 2N4031, 2N4033

**PACKAGE**

2N3019 TO-5  
2N3020 TO-5

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

**Temperatures**

Storage Temperature -65° to 200° 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 5.0 W

**Voltages & Currents**

$V_{CEO}$  Collector to Emitter Voltage 80 V  
 $V_{CB}$  Collector to Base Voltage 140 V  
 $V_{EB}$  Emitter to Base Voltage 7.0 V  
 $I_C$  Collector Current 1.0 A

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

SYMBOL	CHARACTERISTIC	3019		3020		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$BV_{CEO}$	Collector to Emitter Breakdown Voltage (Note 4)	80		80		V	$I_C = 30$ mA, $I_B = 0$
$BV_{CBO}$	Collector to Base Breakdown Voltage	140		140		V	$I_C = 100$ $\mu$ A, $I_E = 0$
$BV_{EBO}$	Emitter to Base Breakdown Voltage	7.0		7.0		V	$I_E = 100$ $\mu$ A, $I_C = 0$
$I_{EBO}$	Emitter Cutoff Current		10		10	nA	$V_{EB} = 5.0$ V, $I_C = 0$
$I_{CBO}$	Collector Cutoff Current		10		10	nA	$V_{CB} = 90$ V, $I_E = 0$
			10		10	$\mu$ A	$V_{CB} = 90$ V, $I_E = 0$ , $T_A = 150^\circ$ C
$h_{FE}$	DC Current Gain (Note 4)	50		30	100		$I_C = 0.1$ mA, $V_{CE} = 10$ V $I_C = 10$ mA, $V_{CE} = 10$ V $I_C = 150$ mA, $V_{CE} = 10$ V $I_C = 150$ mA, $V_{CE} = 10$ V, $T_A = -55^\circ$ C $I_C = 500$ mA, $V_{CE} = 10$ V $I_C = 1.0$ A, $V_{CE} = 10$ V
		90		40	120		
		100	300	40	120		
		40					
		15		15	100		

**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 35° C/W (derating factor of 28.6 mW/° C); junction-to-ambient thermal resistance of 217° C/W (derating factor of 4.6 mW/° C).
4. Pulse conditions: length  $\leq$  300  $\mu$ s; duty cycle  $\leq$  1%.
5. For product family characteristic curves, refer to Curve Set T149.

3469674 FAIRCHILD SEMICONDUCTOR

84D 27545 D

2N3019/2N3020

7.29.23

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

SYMBOL	CHARACTERISTIC	3019		3020		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		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 (Note 4)		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	$V_{EB} = 0.5 \text{ V}, I_C = 0, f = 1.0 \text{ MHz}$
$h_{fe}$	Small Signal Current Gain	80	400	30	200		$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V},$ $f = 1.0 \text{ kHz}$
$h_{fe}$	Current Gain Bandwidth Product	5.0		5.0			$I_C = 50 \text{ mA}, V_{CE} = 10 \text{ V},$ $f = 20 \text{ MHz}$
$r_b'C_c$	Collector Base Time Constant		400		400	ps	$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V},$ $f = 4.0 \text{ MHz}$
NF	Noise Figure		4.0			dB	$I_C = 100 \mu\text{A}, V_{CE} = 10 \text{ V},$ $f = 1.0 \text{ kHz}, R_S = 10 \text{ k}\Omega$

3469674 FAIRCHILD SEMICONDUCTOR

84D 27546 D

**FAIRCHILD**

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**2N3053**

T-27-21

NPN Small Signal General  
Purpose Amplifier

- $V_{CEO}$  ... 40 V (Min)
- $h_{FE}$  ... 50-250 @ 150 mA
- $f_t$  ... 100 MHz (Min) @ 50 mA

**PACKAGE**

2N3053

TO-39

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

Storage Temperature -65° C to 200° C  
 Operating Junction Temperature 175° C

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

Total Dissipation at  
 25° C Case Temperature 5.0 W  
 Linear Derating Factor 28.6 mW/° C

**Voltages & Currents**

$V_{CEO}$  Collector to Emitter Voltage 40 V  
 $V_{CBO}$  Collector to Base Voltage 60 V  
 $V_{EBO}$  Emitter to Base Voltage 5.0 V  
 $I_C$  Collector Current (Continuous) 700 mA

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$BV_{ECO}$	Collector to Emitter Breakdown Voltage	40		V	$I_C = 100 \mu A, I_E = 0$
$BV_{CER}$	Collector to Emitter Breakdown Voltage	50		V	$I_C = 100 \mu A, R_{BE} = 10 \Omega$
$BV_{CBO}$	Collector to Base Breakdown Voltage	60		V	$I_C = 100 \mu A, I_E = 0$
$BV_{EBO}$	Emitter to Base Breakdown Voltage	5.0		V	$I_C = 0, I_E = 100 \mu A$
$I_{CEX}$	Collector Cutoff Current		0.25	$\mu A$	$V_{CE} = 30 V, V_{EB(OFF)} = 1.5 V$
$I_{EBO}$	Emitter to Base Cutoff Current		0.25	$\mu A$	$V_{EB} = 4.0 V, I_C = 0$
$h_{FE}$	DC Pulse Current Gain (Note 4)	25 50	250		$I_C = 150 mA, V_{CE} = 2.5 V$ $I_C = 150 mA, V_{CE} = 10 V$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		1.4	V	$I_C = 150 mA, I_B = 1.5 mA$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 4)		1.7	V	$I_C = 150 mA, I_B = 15 mA$
$V_{BE(ON)}$	Base to Emitter "On" Voltage		1.7	V	$I_C = 150 mA, V_{CE} = 2.5 V$
$C_{ob}$	Output Capacitance		15	pF	$V_{CB} = 10 V, I_E = 0, f = 140 kHz$
$C_{ib}$	Input Capacitance		80	pF	$V_{EB} = 0.5 V, I_C = 0, f = 140 kHz$
$h_{fe}$	Current Gain Bandwidth Product	5.0			$I_C = 50 mA, V_{CE} = 10 V, f = 20 MHz$

**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 35° C/W (derating factor of 28.6 mW/° C).
4. Pulse conditions: length = 300  $\mu s$ ; duty cycle = 2%.
5. For product family characteristic curves, refer to Curve Set T149.



3469674 FAIRCHILD SEMICONDUCTOR

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**FAIRCHILD**

A Schlumberger Company

**2N3107/2N3108  
2N3109**

T-29-21

NPN Small Signal General Purpose  
Amplifiers & Saturated Switches

- $V_{CE0}$  ... 40 V (Min) (2N3109), 60 V (Min) (2N3107/8)
- $V_{CE(sat)}$  ... 1.0 V (Max) @ 1.0 A
- $h_{FE}$  ... 100-300 @ 150 mA (2N3107/9), 40 (Min) @ 500 mA (2N3107/9, 40 (Min) @ 500 mA (2N3107/9)
- $t_{on}$  ... 200 ns (Max) @ 150 mA
- $t_{off}$  ... 600 ns (Max) (2N3108), 1.0  $\mu$ s (Max) (2N3107/9) @ 150 mA
- NF ... 7.0 dB (Max) @ 1.0 kHz

**PACKAGE**

2N3107	TO-39
2N3108	TO-39
2N3109	TO-39

**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	0.8 W
25° C Case Temperature	5.0 W

**Voltages & Currents**

	3107/8	3109
$V_{CE0}$ Collector to Emitter Voltage (Note 4)	60 V	40 V
$V_{CBO}$ Collector to Base Voltage	100 V	80 V
$V_{EBO}$ Emitter to Base Voltage	7.0 V	7.0 V

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

SYMBOL	CHARACTERISTIC	3107/9		3108		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$BV_{CBO}$	Collector to Base Breakdown Voltage (2N3107 only) (2N3108 only) (2N3109 only)	100				V	$I_C = 100 \mu A, I_E = 0$
				100		V	$I_C = 100 \mu A, I_E = 0$
		80				V	$I_C = 100 \mu A, I_E = 0$
$BV_{EBO}$	Emitter to Base Breakdown Voltage	7.0		7.0		V	$I_E = 100 \mu A, I_C = 0$
$I_{EBO}$	Emitter Cutoff Current		10		10	nA	$V_{EB} = 5.0 V, I_C = 0$
$I_{CBO}$	Collector Cutoff Current		10		10	$\mu A$	$V_{CB} = 60 V, I_E = 0, T_A = 150^\circ C$
$I_{CES}$	Collector Reverse Current		10		10	nA	$V_{CE} = 60 V, V_{EB} = 0$

**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 35° C/W (derating factor of 28.6 mW/° C); junction-to-ambient thermal resistance of 218° C/W (derating factor of 4.5 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%.
- Saturation voltage measured with 1/4" lead length.
- For product family characteristic curves, refer to Curve Set T149.

## 2N3107/2N3108/2N3109

T-29.21

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

SYMBOL	CHARACTERISTIC	3107/9		3108		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$h_{FE}$	DC Pulse Current Gain (Note 5)	100	300	40	120		$I_C = 150 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 500 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 0.1 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V},$ $T_A = -55^\circ \text{ C}$
		40		25			
		35		20			
		30		15			
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5) (2N3107) (2N3108) (2N3109)	60		60		V V V	$I_C = 30 \text{ mA}, I_B = 0$ $I_C = 30 \text{ mA}, I_B = 0$ $I_C = 30 \text{ mA}, I_B = 0$
		40					
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5) (Notes 5 & 6)		0.25		0.25	V V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 1.0 \text{ A}, I_B = 100 \text{ mA}$
			1.0		1.0		
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5) (Notes 5 & 6)		1.1		1.1	V V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 1.0 \text{ A}, I_B = 100 \text{ mA}$
			2.0		2.0		
$C_{ob}$	Open Circuit Output Capacitance (2N3107) (2N3108) (2N3109)		20		20	pF pF pF	$V_{CB} = 10 \text{ V}, I_E = 0, f = 140 \text{ kHz}$ $V_{CB} = 10 \text{ V}, I_E = 0, f = 140 \text{ kHz}$ $V_{CB} = 10 \text{ V}, I_E = 0, f = 140 \text{ kHz}$
			25				
$C_{ib}$	Open Circuit Input Capacitance		80		80	pF	$V_{EB} = 0.5 \text{ V}, I_E = 0, f = 140 \text{ kHz}$
$t_{on}$	Turn On Time (test circuit no. 288)		200		200	ns	$I_C \approx 150 \text{ mA}, I_{B1} \approx 7.5 \text{ mA},$ $I_{B2} \approx 7.5 \text{ mA}$
$t_{off}$	Turn Off Time (test circuit no. 289)		1000		600	ns	$I_C \approx 150 \text{ mA}, I_{B1} \approx 7.5 \text{ mA},$ $I_{B2} \approx 7.5 \text{ mA}$