

3469674 FAIRCHILD SEMICONDUCTOR

84D 27504 D



**2N718A**  
**2N1613**

T-29-23

**NPN Small Signal General Purpose Amplifiers**

- $V_{CE0} \dots 32 \text{ V (Min)}$
- $h_{FE} \dots 40\text{-}120 @ 150 \text{ mA}, 20 \text{ (Min)} @ 500 \text{ mA}$

PACKAGE	
2N718A	TO-18
2N1613	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	718A	1613
25° C Ambient Temperature	0.5 mW	0.8 W
100° C Ambient Temperature	1.0 mW	1.7 W
25° C Case Temperature	1.8 W	3.0 W

**Voltages & Currents**

$V_{CE0}$ Collector to Emitter Voltage	32 V
$V_{CER}$ Collector to Emitter Voltage ( $R_{BE} \leq 10 \Omega$ ) (Note 4)	50 V
$V_{CBO}$ Collector to Base Voltage	75 V
$V_{EBO}$ Emitter to Base Voltage	7.0 V

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$BV_{CBO}$	Collector to Base Breakdown Voltage	75		V	$I_C = 0.1 \text{ mA}, I_E = 0$
$BV_{EBO}$	Emitter to Base Breakdown Voltage	7.0		V	$I_E = 0.1 \text{ mA}, I_C = 0$
$I_{EBO}$	Emitter Current		10	nA	$V_{EB} = 5.0 \text{ V}, I_C = 0$
$I_{CBO}$	Collector Cutoff Current		10	nA	$V_{CB} = 60 \text{ V}, I_E = 0$
			10	$\mu\text{A}$	$V_{CB} = 60 \text{ V}, I_E = 0, T_A = 150^\circ \text{ C}$
$h_{FE}$	DC Current Gain	20			$I_C = 0.1 \text{ mA}, V_{CE} = 10 \text{ V}$
$h_{FE}$	DC Pulse Current Gain (Note 5)	40	120		$I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$
		35			$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$
		20			$I_C = 500 \text{ mA}, V_{CE} = 10 \text{ V}$
		20			$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}, T_A = -55^\circ \text{ C}$

**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 97.2° C (derating factor of 10.3 mW/° C); junction-to-ambient thermal resistance of 350° C/W (derating factor of 2.86 mW/° C) for 2N718A; junction-to-case thermal resistance of 58.3° C/W (derating factor of 17.2 mW/° C) junction-to-ambient thermal resistance of 219° C (derating factor of 4.56 mW/° C) for 2N1613.
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  $\leq 1\%$ .
6. For product family characteristic curves, refer to Curve Set T145.

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	50		V	$I_C = 100 \text{ mA}$ (pulsed), $R_{BE} \leq 10 \Omega$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		1.5	V	$I_C = 150 \text{ mA}$ , $I_B = 15 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.3	V	$I_C = 150 \text{ mA}$ , $I_B = 15 \text{ mA}$
$C_{ob}$	Output Capacitance		25	pF	$V_{CB} = 10 \text{ V}$ , $I_E = 0$
$C_{TE}$	Input Capacitance		80	pF	$V_{EB} = 0.5 \text{ V}$ , $I_C = 0$
$h_{fe}$	High Frequency Current Gain	3.0			$I_C = 50 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $f = 20 \text{ MHz}$
$h_{fe}$	Small Signal Current Gain	30 35	100 150		$I_C = 1.0 \text{ mA}$ , $V_{CE} = 5.0 \text{ V}$ , $f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $f = 1.0 \text{ kHz}$
$h_{ib}$	Input Resistance	24 4.0	34 8.0	$\Omega$ $\Omega$	$I_C = 1.0 \text{ mA}$ , $V_{CB} = 5.0 \text{ V}$ , $f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}$ , $V_{CB} = 10 \text{ V}$ , $f = 1.0 \text{ kHz}$
$h_{ob}$	Output Conductance	0.05 0.1	0.5 1.0	$\mu\text{mho}$ $\mu\text{mho}$	$I_C = 1.0 \text{ mA}$ , $V_{CB} = 5.0 \text{ V}$ , $f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}$ , $V_{CB} = 10 \text{ V}$ , $f = 1.0 \text{ kHz}$
$h_{rb}$	Voltage Feedback Ratio		3.0 3.0	$\times 10^{-4}$ $\times 10^{-4}$	$I_C = 1.0 \text{ mA}$ , $V_{CB} = 5.0 \text{ V}$ , $f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}$ , $V_{CB} = 10 \text{ V}$ , $f = 1.0 \text{ kHz}$
$t_d + t_r + t_f$	(test circuit no. 287)		30	ns	$I_C = 50 \text{ mA}$ , $V_{CC} = 20 \text{ V}$
NF	Noise Figure		12	dB	$I_C = 0.3 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $f = 1.0 \text{ kHz}$ , $R_S = 510 \Omega$ $BW = 1.0 \text{ Hz}$

3469674 FAIRCHILD SEMICONDUCTOR

84D 27516 D ■

**FAIRCHILD**

A Schlumberger Company

**2N/PN/FTSO2218**  
**2N/PN/FTSO2221** T-29-23NPN Small Signal General Purpose  
Amplifiers & Switches

- $V_{CE0} \dots 30 \text{ V (Min)}$

**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

**PACKAGE**

2N2218	TO-39
2N2221	TO-18
PN2218	TO-92
PN2221	TO-92
FTSO2218	TO-236AA/AB
FTSO2221	TO-236AA/AB

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

	2N2218	2N2221
Total Dissipation at		
25° C Ambient Temperature	0.8 mW	0.5 W
25° C Case Temperature	3.0 W	1.8 W

	PN2218	FTSO
Total Dissipation at		
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)	30 V
$V_{CBO}$ Collector to Base Voltage	60 V
$V_{EBO}$ Emitter to Base Voltage	5.0 V
$I_C$ Collector Current	800 mA

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$BV_{CBO}$	Collector to Base Breakdown Voltage	60		V	$I_C = 10 \mu\text{A}$ , $I_E = 0$
$BV_{EBO}$	Emitter to Base Breakdown Voltage	5.0		V	$I_E = 10 \mu\text{A}$ , $I_C = 0$
$I_{EBO}$	Emitter Cutoff Current		10	nA	$V_{EB} = 3.0 \text{ V}$ , $I_C = 0$
$I_{CBO}$	Collector Cutoff Current		10	nA	$V_{CB} = 50 \text{ V}$ , $I_E = 0$
			10	$\mu\text{A}$	$V_{CB} = 50 \text{ V}$ , $I_E = 0$ , $T_A = 150^\circ \text{ C}$

**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 175° C; junction-to-case thermal resistance of 50° C/W (derating factor of 20 mW/° C), and junction-to-ambient thermal resistance of 188° C/W (derating factor of 5.33 mW/° C) for 2N2218; for 2N2221, junction-to-case thermal resistance of 83.5° C/W (derating factor of 12 mW/° C); junction-to-ambient thermal resistance of 300° C/W (derating factor of 3.33 mW/° C). These ratings give a maximum junction temperature of 150° C, 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 PN2218 and PN2221; (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  $\mu\text{s}$ ; 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.

2N/PN/FTSO2218

2N/PN/FTSO2221

T-29-23

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$h_{FE}$	DC Current Gain (Note 5)	40	120		$I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$
		20			$I_C = 150 \text{ mA}, V_{CE} = 1.0 \text{ V}$
		35			$I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$
		25			$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}$
		20			$I_C = 0.1 \text{ mA}, V_{CE} = 10 \text{ V}$
		20			$I_C = 500 \text{ mA}, V_{CE} = 10 \text{ V}$
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	30		V	$I_C = 10 \text{ mA (pulsed)}, I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.4	V	$I_C = 150 \text{ mA}, I_B = 50 \text{ mA}$
			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	$V_{CB} = 10 \text{ V}, I_E = 0$
$h_{fe}$	High Frequency Current Gain	2.5			$I_C = 20 \text{ mA}, V_{CE} = 20 \text{ V}, f = 100 \text{ MHz}$
$R_e(h_{fe})$	Real Part of Common Emitter High Frequency Input Impedance		60	$\Omega$	$I_C = 20 \text{ mA}, V_{CE} = 20 \text{ V}, f = 300 \text{ MHz}$

3469674 FAIRCHILD SEMICONDUCTOR

84D 27518 D



**2N/PN/FTSO2218A** T-35-23  
**2N/PN/FTSO2221A**

NPN Small Signal General Purpose Amplifiers & Switches

- $V_{CE0} \dots 40 \text{ V (Min) @ } 10 \text{ mA}$
- $h_{FE} \dots 40\text{-}120 \text{ @ } 150 \text{ mA}$
- $t_{on} \dots 35 \text{ ns (Max) @ } 150 \text{ mA}$ ,  $t_{off} \dots 285 \text{ ns (Max) @ } 150 \text{ mA}$
- Complements ... 2N/PN/FTSO2904A Series

PACKAGE	
2N2218A	TO-39
2N2221A	TO-18
PN2218A	TO-92
PN2221A	TO-92
FTSO2218A	TO-236AA/AB
FTSO2221A	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)**

	2218A	2221A
Total Dissipation at 25° C Ambient Temperature (Note 7)	0.8 W	0.5 W
25° C Case Temperature	3.0 W	1.8 W

	PN	FTSO
Total Dissipation at 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	75 V
$V_{EBO}$ Emitter to Base Voltage	6.0 V
$I_c$ Collector Current	800 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)	40		V	$I_c = 10 \text{ mA}$ , $I_b = 0$
$BV_{EBO}$	Emitter to Base Breakdown Voltage	6.0		V	$I_c = 0$ , $I_E = 10 \mu\text{A}$
$BV_{CBO}$	Collector to Base Breakdown Voltage	75		V	$I_c = 10 \mu\text{A}$ , $I_c = 0$

**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 175° C, junction-to-case thermal resistance of 50° C/W (derating factor of 20 mW/° C) and junction-to-ambient thermal resistance of 188° C/W (derating factor of 5.33 mW/° C) for 2N2218A. For the 2N2221A, junction-to-case thermal resistance of 83.5° C/W (derating factor of 12 mW/° C), junction-to-ambient thermal resistance of 300° C/W (derating factor of 3.33 mW/° C). These ratings give a maximum junction temperature of 150° C, junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); and junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C) for PN2218A and PN2221A. For FTSO2218A and FTSO2221A 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  $\mu\text{s}$ ; duty cycle = 1%.
  - 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.

2N/PN/FTSO2218A

2N/PN/FTSO2221A T-35-23

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$I_{CEX}$	Collector Reverse Current		10	nA	$V_{CE} = 60\text{ V}, V_{EB} = 3.0\text{ V}$
$I_{CBO}$	Collector Reverse Current		10 10	nA $\mu\text{A}$	$V_{CB} = 60\text{ V}, I_E = 0$ $V_{CB} = 60\text{ V}, I_E = 0, T_A = 150^\circ\text{ C}$
$I_{EBO}$	Emitter to Base Cutoff Current		10	nA	$V_{EB} = 3.0\text{ V}, I_C = 0$
$I_{BL}$	Base Current		20	nA	$V_{EB} = 3.0\text{ V}, V_{CE} = 60\text{ V}$
$h_{FE}$	DC Current Gain	20 25 35 40 25 15 20	120		$I_C = 100\ \mu\text{A}, V_{CE} = 10\text{ V}$ $I_C = 1.0\text{ mA}, V_{CE} = 10\text{ V}$ $I_C = 10\text{ mA}, V_{CE} = 10\text{ V}$ $I_C = 150\text{ mA}, V_{CE} = 10\text{ V}$ $I_C = 500\text{ mA}, V_{CE} = 10\text{ V}$ $I_C = 10\text{ mA}, V_{CE} = 10\text{ V}, T_A = -55^\circ\text{ C}$ $I_C = 150\text{ mA}, V_{CE} = 1.0\text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.3 1.0	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)	0.6	1.2 2.0	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	$V_{CB} = 10\text{ V}, I_E = 0, f = 100\text{ kHz}$
$C_{ib}$	Input Capacitance		25	pF	$V_{EB} = 0.5\text{ V}, I_C = 0, f = 100\text{ kHz}$
$h_{fe}$	High Frequency Current Gain	2.5			$I_C = 20\text{ mA}, V_{CE} = 5.0\text{ V}, f = 100\text{ MHz}$
$h_{fe}$	Small Signal Current Gain	30 50	150 300		$I_C = 1.0\text{ mA}, V_{CB} = 10\text{ V}, f = 1.0\text{ kHz}$ $I_C = 10\text{ mA}, V_{CB} = 10\text{ V}, f = 1.0\text{ kHz}$
$h_{ie}$	Input Resistance	1.0 0.2	3.5 1.0	k $\Omega$ k $\Omega$	$I_C = 1.0\text{ mA}, V_{CB} = 10\text{ V}, f = 1.0\text{ kHz}$ $I_C = 10\text{ mA}, V_{CB} = 10\text{ V}, f = 1.0\text{ kHz}$
$h_{oe}$	Output Conductance	3.0 10	15 100	$\mu\text{mho}$ $\mu\text{mho}$	$I_C = 1.0\text{ mA}, V_{CE} = 10\text{ V}, f = 1.0\text{ kHz}$ $I_C = 10\text{ mA}, V_{VB} = 10\text{ V}, f = 1.0\text{ kHz}$
$h_{re}$	Voltage Feedback Ratio		500 250	$\times 10^{-6}$ $\times 10^{-6}$	$I_C = 1.0\text{ mA}, V_{CB} = 10\text{ V}, f = 1.0\text{ kHz}$ $I_C = 10\text{ mA}, V_{CB} = 10\text{ V}, f = 1.0\text{ kHz}$
$R_E (h_{ie})$	Real Part of Common Emitter High Frequency Input Impedance	60		$\Omega$	$I_C = 20\text{ mA}, V_{CE} = 20\text{ V}$ $f = 300\text{ MHz}$
$t_d$	Turn On Delay Time (test circuit no. 231)		10	ns	$I_{CS} = 150\text{ mA}, V_{CC} = 30\text{ V}, I_{B1} = 15\text{ mA}$
$t_r$	Rise Time (test circuit no. 231)		25	ns	$I_{CS} = 150\text{ mA}, V_{CC} = 30\text{ V}, I_{B1} = 15\text{ mA}$
$t_s$	Storage Time (test circuit no. 232)		225	ns	$I_C = 150\text{ mA}, V_{CC} = 30\text{ V},$ $I_{B1} = I_{B2} = 15\text{ mA}$
$t_f$	Fall Time (test circuit no. 232)		60	ns	$I_{CS} = 150\text{ mA}, V_{CC} = 30\text{ V},$ $I_{B1} = I_{B2} = 15\text{ mA}$
$T_A$	Active Region Time Constant		2.5	ns	$I_C = 150\text{ mA}, V_{CE} = 30\text{ V}$
$\tau_b' C_c$	Collector to Base Time Constant		150	ps	$I_C = 20\text{ mA}, V_{CE} = 20\text{ V}, f = 31.8\text{ MHz}$

3469674 FAIRCHILD SEMICONDUCTOR

84D 27520 D



**2N2219/PN2219/FTSO2219**  
**2N2222/PN2222/FTSO2222**  
 NPN Small Signal General Purpose  
 Amplifiers & Switches

T-35-23

- $V_{CE0}$  ... 30 V (Min)
- $I_{FE}$  ... 100-300 @ 150 mA, 30 (Min) @ 500 mA

PACKAGE	
2N2219	TO-39
2N2222	TO-18
PN2219	TO-92
PN2222	TO-92
FTSO2219	TO-236AA/AB
FTSO2222	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	2N2219	2N2222
25° C Ambient Temperature	0.8 mW	0.5 W
25° C Case Temperature	3.0 W	1.8 W

Total Dissipation at	PN2219	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)	30 V
$V_{CBO}$ Collector to Base Voltage	60 V
$V_{EBO}$ Emitter to Base Voltage	5.0 V
$I_C$ Collector Current	800 mA

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$BV_{CBO}$	Collector to Base Breakdown Voltage	60		V	$I_C = 10 \mu A, I_E = 0$
$BV_{EBO}$	Emitter to Base Breakdown Voltage	5.0		V	$I_E = 10 \mu A, I_C = 0$
$I_{EBO}$	Emitter Cutoff Current		10	nA	$V_{EB} = 3.0 V, I_C = 0$
$I_{CBO}$	Collector Cutoff Current		10	nA	$V_{CB} = 50 V, I_E = 0$
			10	$\mu A$	$V_{CB} = 50 V, I_E = 0, T_A = 150^\circ C$

**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 175° C; function-to-case thermal resistance of 50° C/W (derating factor of 20 mW/° C), and junction-to-ambient thermal resistance of 188° C/W (derating factor of 5.33 mW/° C) for 2N2219; for 2N2222, junction-to-case thermal resistance of 83.5° C/W (derating factor of 12 mW/° C); junction-to-ambient thermal resistance of 300° C/W (derating factor of 3.33 mW/° C). These ratings give a maximum junction temperature of 150° C; 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 PN2219 and PN2222; (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 T145.
- \* Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

3469674 FAIRCHILD SEMICONDUCTOR

84D 27521 D

2N2219/PN2219/FTSO2219  
2N2222/PN2222/FTSO2222

T-35-23

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
h <sub>FE</sub>	DC Current Gain (Note 5)	100	300		I <sub>C</sub> = 150 mA, V <sub>CE</sub> = 10 V
		50			I <sub>C</sub> = 150 mA, V <sub>CE</sub> = 1.0 V
		75			I <sub>C</sub> = 10 mA, V <sub>CE</sub> = 10 V
		50			I <sub>C</sub> = 0.1 mA, V <sub>CE</sub> = 10 V
		35			I <sub>C</sub> = 0.1 mA, V <sub>CE</sub> = 10 V
		30			I <sub>C</sub> = 500 mA, V <sub>CE</sub> = 10 V
V <sub>CE(sus)</sub>	Collector to Emitter Sustaining Voltage (Note 5)	30		V	I <sub>C</sub> = 10 mA (pulsed), I <sub>B</sub> = 0
V <sub>CE(sat)</sub>	Collector to Emitter Saturation Voltage (Note 5)		0.4	V	I <sub>C</sub> = 150 mA, I <sub>B</sub> = 50 mA
			1.6	V	I <sub>C</sub> = 500 mA, I <sub>B</sub> = 50 mA
V <sub>BE(sat)</sub>	Base to Emitter Saturation Voltage (Note 5)		1.3	V	I <sub>C</sub> = 150 mA, I <sub>B</sub> = 15 mA
			2.6	V	I <sub>C</sub> = 500 mA, I <sub>B</sub> = 50 mA
C <sub>ob</sub>	Output Capacitance		8.0	pF	V <sub>CB</sub> = 10 V, I <sub>E</sub> = 0
h <sub>fe</sub>	High Frequency Current Gain	2.5			I <sub>C</sub> = 20 mA, V <sub>CE</sub> = 20 V, f = 100 MHz
R <sub>e</sub> (h <sub>ie</sub> )	Real Part of Common Emitter High Frequency Input Impedance		60	Ω	I <sub>C</sub> = 20 mA, V <sub>CE</sub> = 20 V, f = 300 MHz



**FAIRCHILD**

A Schlumberger Company

**2N/PN/FTSO/2219A**  
**2N/PN/FTSO2222A**NPN Small Signal General Purpose  
Amplifiers & Switches

T-35.23

- $V_{CE0}$  ... 40 V (Min) @ 10 mA
- $h_{FE}$  ... 100-300 (2N/PN/FTSO2219A, 2N/PN/FTSO2222A)  
@ 150 mA
- $t_{on}$  ... 35 ns (Max) @ 150 mA,  $t_{off}$  ... 285 ns (Max) @ 150 mA
- Complements ... 2N/PN/FTSO2904A Series

**PACKAGE**

2N2219A	TO-39
2N2222A	TO-39
PN2219A	TO-92
PN2222A	TO-92
FTSO2219A	TO-236AA/AB
FTSO2222A	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	2N2219A	2N2222A
25° C Ambient Temperature (Note 7)	0.8 W	0.5 W
25° C Case Temperature	3.0 W	1.8 W

	PN	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	75 V
$V_{EBO}$ Emitter to Base Voltage	6.0 V
$I_C$ Collector Current	800 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)	40		V	$I_C = 10$ mA, $I_B = 0$
$BV_{EBO}$	Emitter to Base Breakdown Voltage	6.0		V	$I_C = 0$ , $I_E = 10$ $\mu$ A
$BV_{CBO}$	Collector to Base Breakdown Voltage	75		V	$I_C = 10$ $\mu$ A, $I_C = 0$
$I_{CEX}$	Collector Reverse Current		10	nA	$V_{CE} = 60$ V, $V_{EB} = 3.0$ 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 175° C, junction-to-case thermal resistance of 50° C/W (derating factor of 20 mW/° C), and junction-to-ambient thermal resistance of 188° C/W (derating factor of 5.33 mW/° C) for 2219A. For the 2N2222A, junction-to-case thermal resistance of 83.5° C/W (derating factor of 12 mW/° C), junction-to-ambient thermal resistance of 300° C/W (derating factor of 3.33 mW/° C). These ratings give a maximum junction temperature of 150° C, 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 PN2219A, PN2222A. For the FTSO2219A/2222A, these ratings give a maximum 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 T145.
- \* Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N/PN/FTSO2219A  
2N/PN/FTSO2222A

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$I_{CBO}$	Collector Reverse Current		10 10	nA $\mu$ A	$V_{CB} = 60$ V, $I_E = 0$ $V_{CB} = 60$ V, $I_E = 0$ , $T_A = 150^\circ$ C
$I_{EBO}$	Emitter to Base Cutoff Current		10	nA	$V_{EB} = 3.0$ V, $I_C = 0$
$I_{BL}$	Base Current		20	nA	$V_{EB} = 3.0$ V, $V_{CE} = 60$ V
$h_{FE}$	DC Current Gain  (Note 5) (Note 5) (Note 5) (Note 5) (Note 5)	35 50 75 100 40 35 50	300		$I_C = 100$ $\mu$ A, $V_{CE} = 10$ V $I_C = 1.0$ mA, $V_{CE} = 10$ V $I_C = 10$ mA, $V_{CE} = 10$ V $I_C = 150$ mA, $V_{CE} = 10$ V $I_C = 500$ mA, $V_{CE} = 10$ V $I_C = 10$ mA, $V_{CE} = 10$ V, $T_A = -55^\circ$ C $I_C = 150$ mA, $V_{CE} = 1.0$ V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.3 1.0	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)	0.6	1.2 2.0	V V	$I_C = 150$ mA, $I_B = 15$ mA $I_C = 500$ mA, $I_B = 50$ mA
$C_{ob}$	Output Capacitance		8.0	pF	$V_{CB} = 10$ V, $I_E = 0$ , $f = 100$ kHz
$C_{ib}$	Input Capacitance		25	pF	$V_{EB} = 0.5$ V, $I_C = 0$ , $f = 100$ kHz
$h_{fe}$	High Frequency Current Gain	3.0			$I_C = 20$ mA, $V_{CE} = 5.0$ V, $f = 100$ MHz
$h_{fe}$	Small Signal Current Gain	50 75	300 375		$I_C = 1.0$ mA, $V_{CB} = 10$ V, $f = 1.0$ kHz $I_C = 10$ mA, $V_{CB} = 10$ V, $f = 1.0$ kHz
$h_{ie}$	Input Resistance	2.0 0.25	8.0 1.25	k $\Omega$ k $\Omega$	$I_C = 1.0$ mA, $V_{CB} = 10$ V, $f = 1.0$ kHz $I_C = 10$ mA, $V_{CB} = 10$ V, $f = 1.0$ kHz
$h_{oe}$	Output Conductance	5.0 25	35 200	$\mu$ mho $\mu$ mho	$I_C = 1.0$ mA, $V_{CE} = 10$ V, $f = 1.0$ kHz $I_C = 10$ mA, $V_{CE} = 10$ V, $f = 1.0$ kHz
$h_{re}$	Voltage Feedback Ratio		800 400	$\times 10^{-6}$ $\times 10^{-6}$	$I_C = 1.0$ mA, $V_{CB} = 10$ V, $f = 1.0$ kHz $I_C = 10$ mA, $V_{CB} = 10$ V, $f = 1.0$ kHz
$R_E$ ( $h_{ie}$ )	Real Part of Common Emitter Frequency Input Impedance	60		$\Omega$	$I_C = 20$ mA, $V_{CE} = 20$ V $f = 300$ MHz
$t_d$	Turn On Delay Time (test circuit no. 231)		10	ns	$I_{CS} = 150$ mA, $V_{CC} = 30$ V, $I_{B1} = 15$ mA
$t_r$	Rise Time (test circuit no. 231)		25	ns	$I_{CS} = 150$ mA, $V_{CC} = 30$ V, $I_{B1} = 15$ mA
$t_s$	Storage Time (test circuit no. 232)		225	ns	$I_{CS} = 150$ mA, $V_{CC} = 30$ V, $I_{B1} = I_{B2} = 15$ mA
$t_f$	Fall Time (test circuit no. 232)		60	ns	$I_{CS} = 150$ mA, $V_{CC} = 30$ V, $I_{B1} = I_{B2} = 15$ mA
$T_A$	Active Region Time Constant		2.5	ns	$I_C = 150$ mA, $V_{CE} = 30$ V
$r_b'C_c$	Collector to Base Time Constant		150	ps	$I_C = 20$ mA, $V_{CE} = 20$ V, $f = 31.8$ MHz
NF	Noise Figure		4.0	dB	$I_C = 100$ $\mu$ A, $V_{CE} = 10$ V, $R_G = 1.0$ k $\Omega$ , BW = 1.0 Hz, $f = 1.0$ kHz