

3469674 FAIRCHILD SEMICONDUCTOR

84D 27504 D

**FAIRCHILD**

A Schlumberger Company

**2N718A**

T-29-23

**2N1613**

NPN Small Signal General Purpose Amplifiers

- $V_{CEO}$  ... 32 V (Min)
- $h_{FE}$  ... 40-120 @ 150 mA, 20 (Min) @ 500 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**

$V_{CEO}$ 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 10	nA $\mu A$	$V_{CB} = 60 \text{ V}$ , $I_E = 0$ $V_{CB} = 60 \text{ V}$ , $I_E = 0$ , $T_A = 150^\circ \text{ C}$
$h_{FE}$	DC Current Gain	20			$I_C = 0.1 \text{ mA}$ , $V_{CE} = 10 \text{ V}$
$h_{FE}$	DC Pulse Current Gain (Note 5)	40 35 20 20	120		$I_C = 150 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ $I_C = 10 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ $I_C = 500 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ $I_C = 10 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $T_A = -55^\circ \text{ C}$

**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 97.2° 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.
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length = 300  $\mu s$ ; duty cycle  $\leq 1\%$ .
- 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	$\Omega$	$I_C = 1.0 \text{ mA}$ , $V_{CB} = 5.0 \text{ V}$ , $f = 1.0 \text{ kHz}$ $I_C = 5.0 \text{ mA}$ , $V_{CB} = 10 \text{ V}$ , $f = 1.0 \text{ kHz}$
$h_{ob}$	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

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

**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**

$V_{CEO}$ Collector to Emitter Voltage	30 V
(Note 4)	
$V_{CBO}$ 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	$V_{EB} = 3.0 \text{ V}, I_C = 0$
$I_{CBO}$	Collector Cutoff Current		10	nA	$V_{CB} = 50 \text{ V}, I_E = 0$
			10	$\mu A$	$V_{CB} = 50 \text{ V}, I_E = 0, T_A = 150^\circ \text{ C}$

**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 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).
  - Rating refers to a high current point where collector to emitter voltage is lowest.
  - Pulse conditions: length = 300  $\mu s$ ; duty cycle  $\leq 2\%$ .
  - 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			$I_C = 20 \text{ mA}$ , $V_{CE} = 20 \text{ V}$ , $f = 100 \text{ MHz}$
$R_e(h_{ie})$	Real Part of Common Emitter High Frequency Input Impedance		60	$\Omega$	$I_C = 20 \text{ mA}$ , $V_{CE} = 20 \text{ V}$ , $f = 300 \text{ MHz}$

3469674 FAIRCHILD SEMICONDUCTOR

84D 27518 D ■

**FAIRCHILD**  
A Schlumberger Company

**2N/PN/FTSO2218A** T-35-z3  
**2N/PN/FTSO2221A**

NPN Small Signal General Purpose  
Amplifiers & Switches

- $V_{CEO}$  ... 40 V (Min) @ 10 mA
- $h_{FE}$  ... 40-120 @ 150 mA
- $t_{on}$  ... 35 ns (Max) @ 150 mA,  $t_{off}$  ... 285 ns (Max) @ 150 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)

	2N	PN/FTSO
Temperatures		
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	0.8 W	0.5 W
25° C Ambient Temperature (Note 7)	3.0 W	1.8 W
25° C Case Temperature		

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

**Voltages & Currents**

$V_{CEO}$ Collector to Emitter Voltage	40 V
(Note 4)	
$V_{CBO}$ 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
$BV_{CEO}$	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, $I_E = 0$

**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  $\mu$ 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	nA	$V_{CB} = 60 \text{ V}$ , $I_E = 0$
			10	$\mu\text{A}$	$V_{CB} = 60 \text{ V}$ , $I_E = 0$ , $T_A = 150^\circ \text{ C}$
$I_{EBO}$	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			$I_C = 100 \mu\text{A}$ , $V_{CE} = 10 \text{ V}$
	(Note 5)	25			$I_C = 1.0 \text{ mA}$ , $V_{CE} = 10 \text{ V}$
	(Note 5)	35			$I_C = 10 \text{ mA}$ , $V_{CE} = 10 \text{ V}$
	(Note 5)	40	120		$I_C = 150 \text{ mA}$ , $V_{CE} = 10 \text{ V}$
	(Note 5)	25			$I_C = 500 \text{ mA}$ , $V_{CE} = 10 \text{ V}$
	(Note 5)	15			$I_C = 10 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $T_A = -55^\circ \text{ C}$
	(Note 5)	20			$I_C = 150 \text{ mA}$ , $V_{CE} = 1.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.3	V	$I_C = 150 \text{ mA}$ , $I_B = 15 \text{ mA}$
	(Note 5)		1.0	V	$I_C = 500 \text{ mA}$ , $I_B = 50 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage	0.6	1.2	V	$I_C = 150 \text{ mA}$ , $I_B = 15 \text{ mA}$
	(Note 5)		2.0	V	$I_C = 500 \text{ mA}$ , $I_B = 50 \text{ mA}$
$C_{ob}$	Output Capacitance		8.0	pF	$V_{CB} = 10 \text{ V}$ , $I_E = 0$ , $f = 100 \text{ kHz}$
$C_{ib}$	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	150		$I_C = 1.0 \text{ mA}$ , $V_{CB} = 10 \text{ V}$ , $f = 1.0 \text{ kHz}$
		50	300		$I_C = 10 \text{ mA}$ , $V_{CB} = 10 \text{ V}$ , $f = 1.0 \text{ kHz}$
$h_{ie}$	Input Resistance	1.0	3.5	k $\Omega$	$I_C = 1.0 \text{ mA}$ , $V_{CB} = 10 \text{ V}$ , $f = 1.0 \text{ kHz}$
		0.2	1.0	k $\Omega$	$I_C = 10 \text{ mA}$ , $V_{CB} = 10 \text{ V}$ , $f = 1.0 \text{ kHz}$
$h_{oe}$	Output Conductance	3.0	15	$\mu\text{mho}$	$I_C = 1.0 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $f = 1.0 \text{ kHz}$
		10	100	$\mu\text{mho}$	$I_C = 10 \text{ mA}$ , $V_{CB} = 10 \text{ V}$ , $f = 1.0 \text{ kHz}$
$h_{re}$	Voltage Feedback Ratio		500	$\times 10^{-6}$	$I_C = 1.0 \text{ mA}$ , $V_{CB} = 10 \text{ V}$ , $f = 1.0 \text{ kHz}$
			250	$\times 10^{-6}$	$I_C = 10 \text{ mA}$ , $V_{CB} = 10 \text{ V}$ , $f = 1.0 \text{ kHz}$
$R_E (h_{ie})$	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	$I_C = 150 \text{ mA}$ , $V_{CE} = 30 \text{ V}$
$r_b'C_c$	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

- $V_{CEO} \dots 30 \text{ V (Min)}$
- $h_{FE} \dots 100\text{-}300 @ 150 \text{ mA}, 30 \text{ (Min)} @ 500 \text{ mA}$

**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)**

	2N2219	2N2222
Total Dissipation at		
25° C Ambient Temperature	0.8 mW	0.5 W
25° C Case Temperature	3.0 W	1.8 W

	PN2219	FTSO
Total Dissipation at		
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	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:**

- 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 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).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length = 300  $\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- 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
$h_{FE}$	DC Current Gain (Note 5)	100 50 75 50 35 30	300		$I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 150 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 0.1 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 0.1 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 500 \text{ mA}, V_{CE} = 10 \text{ V}$
$V_{CE(sus)}$	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 1.6	V V	$I_C = 150 \text{ mA}, I_B = 50 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
$V_{BE(sat)}$	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	$V_{CB} = 10 \text{ V}, I_E = 0$
$h_{fe}$	High Frequency Current Gain	2.5			$I_C = 20 \text{ mA}, V_{CE} = 20 \text{ V}, f = 100 \text{ MHz}$
$R_e(h_{ie})$	Real Part of Common Emitter High Frequency Input Impedance		60	$\Omega$	$I_C = 20 \text{ mA}, V_{CE} = 20 \text{ V}, f = 300 \text{ MHz}$





A Schlumberger Company

## 2N/PN/FTSO/2219A

## 2N/PN/FTSO2222A

NPN Small Signal General Purpose  
Amplifiers & Switches

T-35.23

- $V_{CEO}$  ... 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)

	2N2219A	2N2222A
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
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	40 V
(Note 4)	
$V_{CBO}$ 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
$BV_{CEO}$	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, $I_E = 0$
$I_{CEX}$	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

T-35-23

**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	$I_C = 100 \mu A, V_{CE} = 10 V, R_G = 1.0 k\Omega,$ $BW = 1.0 Hz, f = 1.0 kHz$