T-29-23

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2N718A
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)

	718A	1613
Total Dissipation at		
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

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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	$I_C = 0.1$ mA, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		V	$I_E = 0.1$ mA, $I_C = 0$
I_{EBO}	Emitter Current		10	nA	$V_{EB} = 5.0$ V, $I_C = 0$
I_{CBO}	Collector Cutoff Current		10	nA	$V_{CB} = 60$ V, $I_E = 0$
			10	μA	$V_{CB} = 60$ V, $I_E = 0$, $T_A = 150°$ C
h_{FE}	DC Current Gain	20			$I_C = 0.1$ mA, $V_{CE} = 10$ V
h_{FE}	DC Pulse Current Gain (Note 5)	40	120		$I_C = 150$ mA, $V_{CE} = 10$ V
		35			$I_C = 10$ mA, $V_{CE} = 10$ V
		20			$I_C = 500$ mA, $V_{CE} = 10$ V
		20			$I_C = 10$ mA, $V_{CE} = 10$ V, $T_A = -55°$ 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 μs; duty cycle ≤ 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
$V_{CER(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	50		V	I_C = 100 mA (pulsed), $R_{BE} \leq 10\ \Omega$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		1.5	V	I_C = 150 mA, I_B = 15 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.3	V	I_C = 150 mA, I_B = 15 mA
C_{ob}	Output Capacitance		25	pF	V_{CB} = 10 V, I_E = 0
C_{TE}	Input Capacitance		80	pF	V_{EB} = 0.5 V, I_C = 0
h_{fe}	High Frequency Current Gain	3.0			I_C = 50 mA, V_{CE} = 10 V, f = 20 MHz
h_{fe}	Small Signal Current Gain	30 35	100 150		I_C = 1.0 mA, V_{CE} = 5.0 V, f = 1.0 kHz I_C = 5.0 mA, V_{CE} = 10 V, f = 1.0 kHz
h_{ib}	Input Resistance	24 4.0	34 8.0	Ω Ω	I_C = 1.0 mA, V_{CB} = 5.0 V, f = 1.0 kHz I_C = 5.0 mA, V_{CB} = 10 V, f = 1.0 kHz
h_{ob}	Output Conductance	0.05 0.1	0.5 1.0	μmho μmho	I_C = 1.0 mA, V_{CB} = 5.0 V, f = 1.0 kHz I_C = 5.0 mA, V_{CB} = 10 V, f = 1.0 kHz
h_{rb}	Voltage Feedback Ratio	3.0 3.0	$x10^{-4}$ $x10^{-4}$		I_C = 1.0 mA, V_{CB} = 5.0 V, f = 1.0 kHz I_C = 5.0 mA, V_{CB} = 10 V, f = 1.0 kHz
$t_d + t_r + t_f$	(test circuit no. 287)		30	ns	I_C = 50 mA, V_{CC} = 20 V
NF	Noise Figure		12	dB	I_C = 0.3 mA, V_{CE} = 10 V, f = 1.0 kHz, R_S = 510 Ω BW = 1.0 Hz

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2N/PN/FTSO2218
2N/PN/FTSO2221

T-29-23

NPN Small Signal General Purpose Amplifiers & Switches

- V_{CEO} ... 30 V (Min)

PACKAGE

2N2218	TO-39
2N2221	TO-18
PN2218	TO-92
PN2221	TO-92
FTSO2218	TO-236AA/AB
FTSO2221	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	**2N2218**	**2N2221**
25° C Ambient Temperature	0.8 mW	0.5 W
25° C Case Temperature	3.0 W	1.8 W

Total Dissipation at	**PN2218**	**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 (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

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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 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	I_E = 10 μA, I_C = 0
I_{EBO}	Emitter Cutoff Current		10	nA	V_{EB} = 3.0 V, I_C = 0
I_{CBO}	Collector Cutoff Current		10 10	nA μA	V_{CB} = 50 V, I_E = 01 V_{CB} = 50 V, I_E = 0, T_A = 150° 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 wW/° 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 μs; duty cycle ≤ 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 20 35 25 20 20	120		I_C = 150 mA, V_{CE} = 10 V I_C = 150 mA, V_{CE} = 1.0 V I_C = 10 mA, V_{CE} = 10 V I_C = 1.0 mA, V_{CE} = 10 V I_C = 0.1 mA, V_{CE} = 10 V I_C = 500 mA, V_{CE} = 10 V
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	30		V	I_C = 10 mA (pulsed), I_B = 0
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.4 1.6	V V	I_C = 150 mA, I_B = 50 mA I_C = 500 mA, I_B = 50 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.3 2.6	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
h_{fe}	High Frequency Current Gain	2.5			I_C = 20 mA, V_{CE} = 20 V, f = 100 MHz
$R_e(h_{ie})$	Real Part of Common Emitter High Frequency Input Impedance		60	Ω	I_C = 20 mA, V_{CE} = 20 V, f = 300 MHz

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2N/PN/FTSO2218A T-35-23
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 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_{CEO} 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

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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 μA
BV_{CBO}	Collector to Base Breakdown Voltage	75		V	I_C = 10 μA, I_C = 0

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 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).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set 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 V, V_{EB} = 3.0 V
I_{CBO}	Collector Reverse Current		10 10	nA μA	V_{CB} = 60 V, I_E = 0 V_{CB} = 60 V, I_E = 0, T_A = 150° 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)	20 25 35 40 25 15 20	 120 	 	I_C = 100 μA, 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°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	2.5			I_C = 20 mA, V_{CE} = 5.0 V, f = 100 MHz
h_{fe}	Small Signal Current Gain	30 50	150 300		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	1.0 0.2	3.5 1.0	kΩ kΩ	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	3.0 10	15 100	μmho μmho	I_C = 1.0 mA, V_{CE} = 10 V, f = 1.0 kHz I_C = 10 mA, V_{VB} = 10 V, f = 1.0 kHz
h_{re}	Voltage Feedback Ratio		500 250	$x10^{-6}$ $x10^{-6}$	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 High Frequency Input Impedance	60		Ω	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_C = 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

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

NPN Small Signal General Purpose Amplifiers & Switches

T-35-23

- V_{CEO} ... 30 V (Min)
- h_{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_{CEO}	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

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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 10	nA μA	$V_{CB} = 50$ V, $I_E = 0$ $V_{CB} = 50$ V, $I_E = 0$, $T_A = 150°$ 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 wW/° 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 μs; duty cycle ≤ 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.

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 mA, V_{CE} = 10 V I_C = 150 mA, V_{CE} = 1.0 V I_C = 10 mA, V_{CE} = 10 V I_C = 0.1 mA, V_{CE} = 10 V I_C = 0.1 mA, V_{CE} = 10 V I_C = 500 mA, V_{CE} = 10 V
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	30		V	I_C = 10 mA (pulsed), I_B = 0
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.4 1.6	V V	I_C = 150 mA, I_B = 50 mA I_C = 500 mA, I_B = 50 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.3 2.6	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
h_{fe}	High Frequency Current Gain	2.5			I_C = 20 mA, V_{CE} = 20 V, f = 100 MHz
$R_e(h_{ie})$	Real Part of Common Emitter High Frequency Input Impedance		60	Ω	I_C = 20 mA, V_{CE} = 20 V, f = 300 MHz

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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)

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_{CEO}	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_{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 μA
BV_{CBO}	Collector to Base Breakdown Voltage	75		V	I_C = 10 μA, I_C = 0
I_{CEX}	Collector Reverse Current		10	nA	V_{CE} = 60 V, V_{EB} = 3.0 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 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).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set 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 μA	V_{CB} = 60 V, I_E = 0 V_{CB} = 60 V, I_E = 0, T_A = 150° 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 μA, 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° 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	kΩ kΩ	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	μmho μmho	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	$x10^{-6}$ $x10^{-6}$	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		Ω	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 μA, V_{CE} = 10 V, R_G = 1.0 kΩ, BW = 1.0 Hz, f = 1.0 kHz