FAIRCHILD
A Schlumberger Company

2N5223/FTSO5223

NPN Small Signal General Purpose Amplifier & Oscillator

T-29-23

- P_D ... 625 mW @ T_A = 25° C
- V_{CEO} ... 20 V (Min)
- h_{FE} ... 50-800 @ 2.0 mA
- f_T ... 150 MHz (Min) @ 10 mA
- C_{cb} ... 4.0 pF (Max)
- Complement ... 2N/FTSO5227

PACKAGE

2N5223	TO-92
FTSO5223	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

	2N	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)	20 V
V_{CBO}	Collector to Base Voltage	25 V
V_{EBO}	Emitter to Base Voltage	3.0 V
I_C	Collector Current	100 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	20		V	I_C = 1.0 mA, I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	25		V	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0		V	I_E = 100 μA, I_C = 0
I_{EBO}	Emitter Cutoff Current		500	nA	V_{EB} = 2.0 V, I_C = 0
I_{CBO}	Collector Cutoff Current		100	nA	V_{CB} = 10 V, I_E = 0
h_{FE}	DC Current Gain	50	800		I_C = 2.0 mA, V_{CE} = 10 V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle < 2%.
6. For product family characteristic curves, refer to Curve Set T144.

* Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N5223/FTSO5223

T-29.23

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.7	V	I_C = 10 mA, I_B = 1.0 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.2	V	I_C = 10 mA, I_B = 1.0 mA
C_{cb}	Collector to Base Capacitance		4.0	pF	V_{CB} = 10 V, I_E = 0, f = 1.0 MHz
h_{fe}	Small Signal Current Gain	50	1600		I_C = 2.0 mA, V_{CE} = 10 V, f = 1.0 kHz
f_T	Current Gain Bandwidth Product	150		MHz	I_C = 10 mA, V_{CE} = 10 V, f = 100 MHz

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2N5224/FTSO5224

NPN Low Level Switch

T-29-23

- V_{CEO} ... 12 V (Min)
- t_{on} ... 45 ns (Max) @ 10 mA
- t_{off} ... 60 ns (Max) @ 10 mA
- f_T ... 250 MHz (Min) @ 10 mA
- C_{cb} ... 4.0 pF (Max)
- Complement ... MPSL08

PACKAGE

2N5224	TO-92
FTSO5224	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

	2N	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)	12 V
V_{CBO}	Collector to Base Voltage	25 V
V_{EBO}	Emitter to Base Voltage	5.0 V
I_C	DC Collector Current	100 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)	12		V	I_C = 10 mA, I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	25		V	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	I_E = 100 μA, I_C = 0
I_{EBO}	Emitter Cutoff Current		100	μA	V_{EB} = 4.0 V, I_C = 0
I_{CBO}	Collector Cutoff Current		500	nA	V_{CB} = 15 V, I_E = 0
h_{FE}	DC Current Gain (Note 5)	40 15	400		I_C = 10 mA, V_{CE} = 1.0 V I_C = 100 mA, V_{CE} = 1.0 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.35	V	I_C = 10 mA, I_B = 3.0 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		0.9	V	I_C = 10 mA, I_B = 3.0 mA

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle < 2%.
6. 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.

2N5224/FTSO5224

T-29-23

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
C_{cb}	Collector to Base Capacitance		4.0	pF	V_{CB} = 5.0 V, I_E = 0, f = 1.0 MHz
f_T	Current Gain Bandwidth Product	250		MHz	I_C = 10 mA, V_{CE} = 10 V, f = 100 MHz
t_d	Delay Time (test circuit no. 531)		25	ns	I_C = 10 mA, V_{CC} = 3.0 V, I_{B1} = 3.0 mA
t_r	Rise Time (test circuit no. 531)		20	ns	I_C = 10 mA, V_{CC} = 3.0 V, I_{B1} = 3.0 mA
t_s	Storage Time (test circuit no. 531)		35	ns	I_C = 10 mA, V_{CC} = 3.0 V, I_{B1} = I_{B2} = 3.0 mA
t_f	Fall Time (test circuit no. 531)		25	ns	I_C = 10 mA, V_{CC} = 3.0 V, I_{B1} = I_{B2} = 3.0 mA

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2N5225/FTSO5225
2N5226/FTOS5226

NPN-PNP Small Signal General Purpose Complementary Amplifiers

T-29-23

- V_{CEO} ... **25 V (Min)**
- h_{FE} ... **30-600 @ 50 mA**
- $V_{CE(sat)}$ ... **0.8 V (Max) @ 100 mA**
- **Complement ... 2N5225 (NPN), 2N5226 (PNP)**

PACKAGE	
2N5225	TO-92
2N5226	TO-92
FTSO5225	TO-236AA/AB
FTSO5226	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	−55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

	2N	FTSO
Total Dissipation at 25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

		5225	5226
V_{CEO}	Collector to Emitter Voltage (Note 4)	25 V	−25 V
V_{CBO}	Collector to Base Voltage	25 V	−25 V
V_{EBO}	Emitter to Base Voltage	4.0 V	−4.0 V
I_C	Collector Current	500 mA	500 mA

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

SYMBOL	CHARACTERISTIC	2N5225 MIN	2N5225 MAX	2N5226 MIN	2N5226 MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	25		−25		V	I_C = 10 mA, I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	25		−25		V	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		−4.0		V	I_E = 100 μA, I_C = 0
I_{EBO}	Emitter Cutoff Current		500		500	nA	V_{EB} = 4.0 V, I_C = 0
I_{CBO}	Collector Cutoff Current		300		300	nA	V_{CB} = 15 V, I_E = 0
h_{FE}	DC Current Gain (Note 5)	25 30	600	25 30	600		I_C = 10 μA, V_{CE} = 10 V I_C = 50 mA, V_{CE} = 10 V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 2%.
6. For product family characteristic curves, refer to Curve Set T145 for 2N5225 and T212 for 2N5226.

* Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N5225/FTSO5225
2N5226/FTOS5226

T-29-23

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

SYMBOL	CHARACTERISTIC	2N5225 MIN	2N5225 MAX	2N5226 MIN	2N5226 MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.8		−0.8	V	I_C = 100 mA, I_B = 10 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.0		−1.0	V	I_C = 100 mA, I_B = 10 mA
C_{cb}	Collector to Base Capacitance		20		20	pF	V_{CB} = 5.0 V, I_E = 0, f = 1.0 MHz
h_{fe}	Small Signal Current Gain	30	1800	30	1800		I_C = 50 mA, V_{CE} = 10 V, f = 1.0 kHz
f_T	Current Gain Bandwidth Product		50		50	MHz	I_C = 20 mA, V_{CE} = 10 V, f = 20 MHz

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2N5227/FTSO5227

PNP Small Signal General Purpose Amplifier & Oscillator

T-29-23

- V_{CEO} ... **30 V (Min)**
- h_{FE} ... **50-700 @ 2.0 mA**
- f_T ... **100 MHz (Min) @ 10 mA**
- C_{cb} ... **5.0 pF (Max)**
- **Complements ... 2N5223**

PACKAGES

2N5227	TO-92
FTSO5227	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
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	−30 V
V_{EBO}	Emitter to Base Voltage	−3.0 V
I_C	Collector Current	50 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	−30		V	I_C = 1.0 mA, I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	−30		V	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	−3.0		V	I_E = 100 μA, I_C = 0
I_{EBO}	Emitter Cutoff Current		500	nA	V_{EB} = −2.0 V, I_C = 0
I_{CBO}	Collector Cutoff Current		100	nA	V_{CB} = −10 V, I_E = 0
h_{FE}	DC Current Gain (Note 5)	30 50	 700		I_C = 100 μA, V_{CE} = −10 V I_C = 2.0 mA, V_{CE} = −10 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		−0.4	V	I_C = 10 mA, I_B = 1.0 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		−1.0	V	I_C = 10 mA, I_B = 1.0 mA
C_{cb}	Collector to Base Capacitance		5.0	pF	V_{CB} = 10 V, I_E = 0, f = 1.0 MHz
h_{fe}	Small Signal Current Gain	50	1500		I_C = 2.0 mA, V_{CE} = −10 V, f = 1.0 kHz
f_T	Current Gain Bandwidth Product	100		MHz	I_C = 10 mA, V_{CE} = −10 V, f = 100 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 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T215.

* Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

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2N5228/FTSO5228

PNP Low Level Switch

T-29-23

- V_{CEO} ... **-5.0 V (Min)**
- t_{on} ... **75 ns (Max) @ 10 mA**
- t_{off} ... **140 ns (Max) @ 10 mA**
- f_T ... **300 MHz (Min) @ 10 mA**
- C_{cb} ... **5.0 pF (Max)**
- **Complement ... 2N5224**

PACKAGE

2N5228	TO-92
FTSO5228	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

	2N	FTSO
Total Dissipation at 25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CES}	Collector to Emitter Voltage	−6.0 V
V_{CEO}	Collector to Emitter Voltage	−5.0 V
V_{CBO}	Collector to Base Voltage	−5.0 V
V_{EBO}	Emitter to Base Voltage	−3.0 V
I_C	DC Collector Current	50 mA

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 4)	−5.0		V	I_C = 10 mA, I_B = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	−6.0		V	I_C = 100 μA, V_{BE} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	−5.0		V	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	−3.0		V	I_E = 100 μA, I_C = 0
I_{CES}	Collector Cutoff Current		100	nA	V_{CE} = −4.0 V, V_{BE} = 0
I_{EBO}	Emitter Cutoff Current		100	μA	V_{EB} = −2.5 V, I_C = 0
h_{FE}	DC Current Gain (Note 4)	30 15			I_C = 10 mA, V_{CE} = −0.3 V I_C = 50 mA, V_{CE} = −1.0 V

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Pulse conditions: length = 300 μs; duty cycle ≤ 2%.
5. For product family characteristic curves, refer to Curve Set T292.

* Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N5228/FTSO5228

T-29-23

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		−0.4	V	I_C = 10 mA, I_B = 3.0 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 4)	−0.65	−1.25	V	I_C = 10 mA, I_B = 3.0 mA
C_{cb}	Collector to Base Capacitance		5.0	pF	V_{CB} = −5.0 V, I_E = 0, f = 1.0 MHz
f_T	Current Gain Bandwidth Product	300		MHz	I_C = 10 mA, V_{CE} = −5.0 V, f = 100 MHz
t_d	Delay Time (test circuit no. 532)		25	ns	$I_C \approx 10$ mA, V_{CC} = −3.0 V, $I_{B1} \approx 3.0$ mA
t_r	Rise Time (test circuit no. 532)		50	ns	$I_C \approx 10$ mA, V_{CC} = −3.0 V, $I_{B1} \approx 3.0$ mA
t_s	Storage Time (test circuit no. 532)		90	ns	$I_C \approx 10$ mA, V_{CC} = −3.0 V, $I_{B1} \approx -I_{B2}$ = 3.0 mA
t_f	Fall Time (test circuit no. 532)		50	ns	$I_C \approx 10$ mA, V_{CC} = −3.0 V, $I_{B1} \approx -I_{B2} \approx 3.0$ mA