FAIRCHILD
A Schlumberger Company

2N4400/FTSO4400
2N4401/FTSO4401

T-29-23

Small Signal General Purpose Amplifiers & Switches

- **V_{CEO} ... 40 V (Min)**
- **h_{FE} ... 100-300 @ 150 mA (2N/FTSO4401); 40 (Min) @ 500 mA (2N/FTSO4401)**
- **t_{on} ... 35 ns (Max) @ 150 mA**
- **t_{off} ... 255 ns (Max) @ 150 mA**
- **Complements ... 2N4402, 2N4403**

PACKAGE

2N4400	TO-92
2N4401	TO-92
FTSO4400	TO-236AA/AB
FTSO4401	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)	40 V
V_{CBO}	Collector to Base Voltage	60 V
V_{EBO}	Emitter to Base Voltage	6.0 V
I_C	Collector Current	600 mA

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

SYMBOL	CHARACTERISTIC	4400 MIN	4400 MAX	4401 MIN	4401 MAX	UNITS	TEST CONDITIONS
$BV_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	40		40		V	I_C = 1.0 mA, I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	60		60		V	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		6.0		V	I_E = 100 μA, I_C = 0
I_{CEX}	Collector Cutoff Current		100		100	nA	V_{CE} = 35 V, V_{EB} = 0.4 V
I_{BL}	Base Reverse Current		100		100	nA	V_{CE} = 35 V, V_{EB} = 0.4 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.

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

2N4400/FTSO4400
2N4401/FTSO4401 T-29-23

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

SYMBOL	CHARACTERISTIC	4400 MIN	4400 MAX	4401 MIN	4401 MAX	UNITS	TEST CONDITIONS
h_{FE}	DC Current Gain	20 40		20 40 80			I_C = 100 μA, V_{CE} = 1.0 V I_C = 1.0 mA, V_{CE} = 1.0 V I_C = 10 mA, V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	50 20	150	100 40	300		I_C = 150 mA, V_{CE} = 1.0 V I_C = 500 mA, V_{CE} = 2.0 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.4 0.75		0.4 0.75	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)	0.75	0.95 1.2	0.75	0.95 1.2	V V	I_C = 150 mA, I_B = 15 mA I_C = 500 mA, I_B = 50 mA
C_{cb}	Collector to Base Capacitance		6.5		6.5	pF	V_{CB} = 5.0 V, I_E = 0, f = 100 kHz
C_{eb}	Emitter to Base Capacitance		30		30	pF	V_{BE} = 0.5 V, I_C = 0, f = 100 kHz
h_{fe}	Small Signal Current Gain	20	250	40	500		I_C = 1.0 mA, V_{CE} = 10 V, f = 1.0 kHz
h_{ie}	Input Impedance	0.5	7.5	1.0	15	kΩ	I_C = 1.0 mA, V_{CE} = 10 V, f = 1.0 kHz
h_{oe}	Output Admittance	1.0	30	1.0	30	μmhos	I_C = 1.0 mA, V_{CE} = 10 V, f = 1.0 kHz
h_{re}	Voltage Feedback Ratio	0.1	8.0	0.1	8.0	x10^{-4}	I_C = 1.0 mA, V_{CE} = 10 V, f = 1.0 kHz
f_T	Current Gain Bandwidth Product	200		250		MHz	I_C = 20 mA, V_{CE} = 10 V, f = 100 MHz
t_d	Turn On Delay Time (test circuit no. 559)		15		15	ns	I_C = 150 mA, V_{CC} = 30 V, I_{B1} = 15 mA
t_r	Rise Time (test circuit no. 559)		20		20	ns	I_C = 150 mA, V_{CC} = 30 V, I_{B1} = 15 mA
t_s	Storage Time (test circuit no. 560)		225		225	ns	I_C = 150 mA, V_{CC} = 30 V, I_{B1} = I_{B2} = 15 mA
t_f	Fall Time (test circuit no. 560)		30		30	ns	I_C = 150 mA, V_{CC} = 30 V, I_{B1} = I_{B2} = 15 mA

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A Schlumberger Company

2N4402/FTSO4402
2N4403/FTSO4403

PNP Small Signal General Purpose Amplifiers & Switches

T-29-23

- V_{CEO} ... **-40 V (Min)**
- h_{FE} ... **100-300 @ 150 mA (2N/FTSO4403), 20 (Min) @ 500 mA (2N/FTSO4403)**
- t_{on} ... **35 ns (Max) @ 150 mA**
- t_{off} ... **255 ns (Max) @ 150 mA**
- **Complements ... 2N4400, 2N4401**

PACKAGE	
2N4402	TO-92
2N4403	TO-92
FTSO4402	TO-236AA/AB
FTSO4403	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)	−40 V
V_{CBO}	Collector to Base Voltage	−40 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	4402 MIN	4402 MAX	4403 MIN	4403 MAX	UNITS	TEST CONDITIONS
$BV_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	−40		−40		V	I_C = 1.0 mA, I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	−40		−40		V	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0		−5.0		V	I_E = 100 μA, I_C = 0
I_{CEX}	Collector Reverse Current		100		100	nA	V_{CE} = −35 V, V_{EB} = −0.4 V
I_{BL}	Base Reverse Current		100		100	nA	V_{CE} = −35 V, V_{EB} = −0.4 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 T212.

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

2N4402/FTSO4402
2N4403/FTSO4403

T-29-23

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

SYMBOL	CHARACTERISTIC	4402 MIN	4402 MAX	4403 MIN	4403 MAX	UNITS	TEST CONDITIONS
h_{FE}	DC Current Gain	30 50		30 60 100			I_C = 100 μA, V_{CE} = 1.0 V I_C = 1.0 mA, V_{CE} = −1.0 V I_C = 10 mA, V_{CE} = −1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	50 20	150	100 20	300		I_C = 150 mA, V_{CE} = −2.0 V I_C = 500 mA, V_{CE} = −2.0 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		−0.4 −0.75		−0.4 −0.75	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)	−0.75	−0.95 −1.3	−0.75	−0.95 −1.3	V V	I_C = 150 mA, I_B = 15 mA I_C = 500 mA, I_B = 50 mA
C_{cb}	Collector to Base Capacitance		8.5		8.5	pF	V_{CB} = −10 V, I_E = 0, f = 140 kHz
C_{eb}	Emitter to Base Capacitance		30		30	pF	V_{EB} = −0.5 V, I_C = 0, f = 140 kHz
h_{fe}	Small Signal Current Gain	30	250	60	500		I_C = 1.0 mA, V_{CE} = −10 V, f = 1.0 kHz
h_{ie}	Input Impedance	0.75	7.5	1.5	15	kΩ	I_C = 1.0 mA, V_{CE} = −10 V, f = 1.0 kHz
h_{oe}	Output Admittance	1.0	100	1.0	100	μmhos	I_C = 1.0 mA, V_{CE} = −10 V, f = 1.0 kHz
h_{re}	Voltage Feedback Ratio	0.1	8.0	0.1	8.0	x10^{-4}	I_C = 1.0 mA, V_{CE} = −10 V, f = 1.0 kHz
f_T	Current Gain Bandwidth Product	150		200		MHz	I_C = 20 mA, V_{CE} = −10 V, f = 100 MHz
t_d	Turn On Delay Time (test circuit no. 557)		15		15	ns	I_C = 150 mA, V_{CC} = −30 V, I_{B1} = 15 mA
t_r	Rise Time (test circuit no. 557)		20		20	ns	I_C = 150 mA, V_{CC} = −30 V, I_{B1} = 15 mA
t_s	Storage Time (test circuit no. 558)		225		225	ns	I_C = 150 mA, V_{CC} = −30 V, I_{B1} = I_{B2} = 15 mA
t_f	Fall Time (test circuit no. 558)		30		30	ns	I_C = 150 mA, V_{CC} = −30 V, I_{B1} = I_{B2} = 15 mA

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A Schlumberger Company

2N4409/FTSO4409
2N4410/FTSO4410
NPN Neon Display Tube Drivers

T-29-23

- V_{CEO} ... **80 V (Min) (2N/FTSO4410)**
- h_{FE} ... **60 V (Min) @ 1.0 and 10 mA**
- **Complements ... MPSA55, MPSA56**

PACKAGE

2N4409	TO-92
2N4410	TO-92
FTSO4409	TO-236AA/AB
FTSO4410	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° 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		**4409**	**4410**
V_{CEO}	Collector to Emitter Voltage (Note 4)	50 V	80 V
V_{CBO}	Collector to Base Voltage	80 V	120 V
V_{EBO}	Emitter to Base Voltage	5.0 V	5.0 V
I_C	Collector Current	250 mA	250 mA

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

SYMBOL	CHARACTERISTIC	4409 MIN	4409 MAX	4410 MIN	4410 MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	50		80		V	I_C = 1.0 mA, I_B = 0
BV_{CEX}	Collector to Emitter Breakdown Voltage	80		120		V	I_C = 500 μA, V_{BB} = -5.0 V, R_{BE} = 8.2 kΩ
BV_{CBO}	Collector to Base Breakdown Voltage	80		120		V	I_C = 10 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		V	I_E = 10 μA, I_C = 0
I_{EBO}	Emitter Cutoff Current		100		100	nA	V_{EB} = 4.0 V, 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 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 T147.

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

2N4409/FTSO4409
2N4410/FTSO4410

T-29-23

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

SYMBOL	CHARACTERISTIC	4409 MIN	4409 MAX	4410 MIN	4410 MAX	UNITS	TEST CONDITIONS
I_{CBO}	Collector Cutoff Current		10		10	nA nA	V_{CB} = 60 V, I_E = 0 V_{CB} = 100 V, I_E = 0
			1.0		1.0	μA μA	V_{CB} = 60 V, I_E = 0, T_A = 100° C V_{CB} = 100 V, I_E = 0, T_A = 100° C
h_{FE}	DC Current Gain	60		60			I_C = 1.0 mA, V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	60	400	60	400		I_C = 10 mA, V_{CE} = 1.0 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.2		0.2	V	I_C = 1.0 mA, I_B = 0.1 mA
$V_{BE(ON)}$	Base to Emitter "On" Voltage		0.8		0.8	V	I_C = 1.0 mA, V_{CE} = 5.0 V
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		0.8		0.8	V	I_C = 1.0 mA, I_B = 0.1 mA
C_{cb}	Collector to Base Capacitance		12		12	pF	V_{CB} = 10 V, I_E = 0, f = 140 kHz
C_{eb}	Emitter to Base Capacitance		50		50	pF	V_{EB} = 0.5 V, I_C = 0, f = 100 kHz
$\|h_{fe}\|$	Magnitude of Common Emitter Small Signal Current Gain	2.0	10	2.0	10		I_C = 10 mA, V_{CE} = 10 V, f = 30 MHz

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2N4896
NPN Power

T-29-23

- $V_{CE(sat)}$ ... 0.7 V @ I_C = 2.0 A
- Low Leakage ... I_{CES} (Max) μ 100 μA @ T_C = 150° C

PACKAGE
2N4896 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	
100° C Case Temperature	4.0 W

Voltages & Currents

V_{CEO}	Collector to Emitter Voltage (Note 4)	60 V
V_{CBO}	Collector to Base Voltage	120 V
V_{EBO}	Emitter to Base Voltage	6.0 V
I_C	Collector Current	5.0 A
I_B	Base Current	1.0 A

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
I_{EBO}	Emitter Cutoff Current		1.0 1.0	μA mA	V_{EB} = 4.0 V, I_E = 0 V_{EB} = 6.0 V, I_C = 0
I_{CES}	Collector Cutoff Current		0.1 1.0 1.0	mA mA μA	V_{CE} = 60 V, V_{BE} = 0, T_A = 150° C V_{CE} = 120 V, V_{BE} = 0 V_{CE} = 60 V, V_{BE} = 0
h_{FE}	DC Current Gain (Note 5)	100 35	300		I_C = 2.0 A, V_{CE} = 2.0 V I_C = 2.0 A, V_{CE} = 2.0 V, T_A = -55° C
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	60		V	I_C = 50 mA, I_B = 0
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Notes 5 & 6))		1.0	V	I_C = 5.0 mA, I_B = 0.5 A
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Notes 5 & 6)		1.6	V	I_C = 5.0 mA, I_B = 0.5 A

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 25° C/W (derating factor of 40 mW/° C); junction-to-ambient thermal resistance of 219° C/W (derating factor of 4.57 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. Point of measurement: 1/4" from header.
7. For product family characteristic curves, refer to Curve Set T145.

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
C_{ob}	Output Capacitance		80	pF	V_{CB} = 10 V, I_E = 0, f = 0.14 MHz
C_{ib}	Input Capacitance		500	pF	V_{EB} = 0.5 V, I_C = 0, f = 0.14 MHz
$\|h_{fe}\|$	Magnitude of Common Emitter Small Signal Current Gain	4.0			I_C = 0.5 A, V_{CE} = 5.0 V, f = 20 MHz
t_d	Turn On Delay Time		50	ns	I_C = 5.0 A, I_{B1} = 0.5 A
t_r	Rise Time		300	ns	I_C = 5.0 A, I_{B1} = 0.5 A
t_s	Storage Time		350	ns	I_C = 5.0 A, I_{B1} = I_{B2} = 0.5 A
t_f	Fall Time		300	ns	I_C = 5.0 A, I_{B1} = I_{B2} = 0.5 A

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2N5220/FTSO5220

NPN Small Signal General Purpose Complementary Amplifiers

T-29-23

- V_{CEO} ... **15 V (Min)**
- h_{FE} ... **30-600 @ 50 mA**
- $V_{CE(sat)}$ ... **0.5 V (max) @ 150 mA**

PACKAGE

2N5220	TO92-1
FTSO5220	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)	15 V
V_{CBO}	Collector to Base Voltage	15 V
V_{EBO}	Emitter to Base Voltage	3.0 V
I_C	Collector Current	500 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)	15		V	I_C = 10 mA, I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	15		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		100	nA	V_{EB} = 3.0 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)	25 30	 600		I_C = 10 mA, V_{CE} = 10 V I_C = 50 mA, V_{CE} = 10 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.5	V	I_C = 150 mA, I_B = 15 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.1	V	I_C = 150 mA, I_B = 15 mA
C_{cb}	Collector to Base Capacitance		10	pF	V_{CB} = 5.0 V, I_E = 0, f = 1.0 MHz
h_{fe}	Small Signal Current Gain	30	1800		I_C = 50 mA, V_{CE} = 10 V, f = 1.0 kHz
f_T	Current Gain Bandwidth Product	100		MHz	I_C = 20 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.

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