

FAIRCHILD

A Schlumberger Company

2N3946/FTSO3946 T-35-11

NPN Small Signal General Purpose Amplifier & Switch

• $V_{CE0} \dots 40 \text{ V (Min)}$

PACKAGE

2N3946

TO18

FTSO3946

TO236AA

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	2N	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)

	2N	FTSO
Total Dissipation at 25° C Ambient Temperature	0.36 mW	0.350 W*
25° C Case Temperature	1.2 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage (Note 4)	40 V	40 V
V_{CBO} Collector to Base Voltage	60 V	60 V
V_{EBO} Emitter to Base Voltage	6.0 V	6.0 V
I_C Collector Current	200 mA	200 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 4)	40		V	$I_C = 10 \text{ mA}, I_E = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	60		V	$I_C = 10 \text{ } \mu\text{A}, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		V	$I_E = 10 \text{ } \mu\text{A}, I_C = 0$
I_{CEX}	Collector Cutoff Current		10 15	nA μA	$V_{CE} = 40 \text{ V}, V_{EB} = 3.0 \text{ V}$ $V_{CE} = 40 \text{ V}, V_{EB} = 3.0 \text{ V}, T_A = 150^\circ \text{ C}$
I_{BL}	Base Cutoff Current		25	nA	$V_{CE} = 40 \text{ V}, V_{EB} = 3.0 \text{ V}$
h_{FE}	DC Current Gain (Note 5)	30 45 50 20	150		$I_C = 0.1 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = 1.0 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.2 0.3	V V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)	0.6	0.9 1.0	V V	$I_C = 10 \text{ mA}, I_B = 1.0 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$

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 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).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length = 300 μs ; duty cycle = 2%.
- 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.

2N3946/FTSO3946

T-35-11

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
C_{ob}	Output Capacitance		4.0	pF	$V_{CB} = 10 \text{ V}$, $I_E = 0$, $f = 100 \text{ kHz}$
C_{ib}	Input Capacitance		8.0	pF	$V_{EB} = 1.0 \text{ V}$, $I_C = 0$, $f = 100 \text{ kHz}$
h_{fe}	Current Gain Bandwidth Product	2.5			$I_C = 10 \text{ mA}$, $V_{CE} = 20 \text{ V}$, $f = 100 \text{ MHz}$
h_{ie}	Input Impedance	0.5	6.0	k Ω	$I_C = 1.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{oe}	Output Admittance	1.0	30	μmhos	$I_C = 1.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
h_{re}	Voltage Feedback Ratio		10	$\times 10^{-4}$	$I_C = 1.0 \text{ mA}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ kHz}$
t_d	Delay Time (test circuit no. 526)		35	ns	$I_C = 10 \text{ mA}$, $V_{CC} = 3.0 \text{ V}$, $I_{B1} = 1.0 \text{ mA}$, $V_{BE(OFF)} = 0.5 \text{ V}$
t_r	Rise Time (test circuit no. 526)		300	ns	$I_C = 10 \text{ mA}$, $V_{CC} = 3.0 \text{ V}$, $I_{B1} = 1.0 \text{ mA}$, $V_{BE(OFF)} = 0.5 \text{ V}$
t_s	Storage Time (test circuit no. 527)		300	ns	$I_C = 10 \text{ mA}$, $V_{CC} = 3.0 \text{ V}$, $I_{B1} = I_{B2} = 1.0 \text{ mA}$
t_f	Fall Time (test circuit no. 527)		75	ns	$I_C = 10 \text{ mA}$, $V_{CC} = 3.0 \text{ V}$, $I_{B1} = I_{B2} = 1.0 \text{ mA}$
$r_b' C_c$	Collector to Base Time Constant		200	ps	$I_C = 10 \text{ mA}$, $V_{CE} = 20 \text{ V}$, $f = 31.8 \text{ MHz}$
NF	Noise Figure		5.0	dB	$I_C = 100 \mu\text{A}$, $V_{CE} = 5.0 \text{ V}$, $R_G = 1.0 \text{ k}\Omega$, $f = 10 \text{ Hz to } 15.7 \text{ kHz}$

3469674 FAIRCHILD SEMICONDUCTOR

84D 27564 D

FAIRCHILD

A Schlumberger Company

2N3962/PN3962 T-29-23
FTSO3962PNP Low Level Low Noise
Amplifiers

- $V_{CE0} \dots -60$ V (Min)
- Excellent Beta Linearity from $1.0 \mu\text{A}$ to 50 mA

PACKAGE

2N3962	TO-18
PN3962	TO-92
FTSO3962	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	PN/FTSO	2N
Storage Temperature	-55°C to 150°C	-65°C to 200°C
Operating Junction Temperature	150°C	175°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	2N	PN	FTSO
25°C Ambient Temperature	0.36 W	0.625 W	0.350 W*
25°C Case Temperature	1.2 W	1.0 W	

Voltages & Currents

V_{CE0} Collector to Emitter Voltage (Note 4)	-60 V
V_{CBO} Collector to Base Voltage	-60 V
V_{EBO} Emitter to Base Voltage	-6.0 V
I_C Collector Current	200 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	-6.0		V	$I_E = 10 \mu\text{A}$, $I_C = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	-60		V	$I_C = 10 \mu\text{A}$, $I_B = 0$
I_{EBO}	Emitter Cutoff Current		10	nA	$V_{EB} = -4.0$ V, $I_C = 0$
I_{CES}	Collector Reverse Current		10 10	nA μA	$V_{CE} = -50$ V, $V_{EB} = 0$ $V_{CE} = -50$ V, $V_{EB} = 0$, $T_A = 150^\circ\text{C}$
h_{FE}	DC Current Gain	60 100 100 100 40	300 450 600		$I_C = 1.0 \mu\text{A}$, $V_{CE} = -5.0$ V $I_C = 10 \mu\text{A}$, $V_{CE} = -5.0$ V $I_C = 100 \mu\text{A}$, $V_{CE} = -5.0$ V $I_C = 1.0$ mA, $V_{CE} = -5.0$ V $I_C = 10 \mu\text{A}$, $V_{CE} = -5.0$ V, $T_A = -55^\circ\text{C}$ $I_C = 1.0$ mA, $V_{CE} = -5.0$ V, $T_A = 100^\circ\text{C}$

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 150°C and (TO-92) junction-to-case thermal resistance of 125°C/W (derating factor of 8.0 $\text{mW}/^\circ\text{C}$); junction-to-ambient thermal resistance of 200°C/W (derating factor of 5.0 $\text{mW}/^\circ\text{C}$); (TO-236) junction-to-ambient thermal resistance of 357°C/W (derating factor of 2.8 $\text{mW}/^\circ\text{C}$).
 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 T219.
- * Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N3962/PN3962/FTSO3962

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

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain (Note 5)	100 90 45			$I_C = 10 \text{ mA}, V_{CE} = -5.0 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = -5.0 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = -5.0 \text{ V}, T_A = -55^\circ \text{ C}$
$V_{CE(sat)}$ $V_{CE(sat)}$	Collector to Emitter Saturation Voltage Collector to Emitter Saturation Voltage (Note 5)		-0.25 -0.4	V V	$I_C = 10 \text{ mA}, I_B = 0.5 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{BE(sat)}$ $V_{BE(sat)}$	Base to Emitter Saturation Voltage Base to Emitter Saturation Voltage (Note 5)		-0.9 -0.95	V V	$I_C = 10 \text{ mA}, I_B = 0.5 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 5.0 \text{ mA}$
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)		-60	V	$I_C = 5.0 \text{ mA}, I_B = 0$
C_{ob}	Open Circuit Output Capacitance		6.0	pF	$V_{CB} = -5.0 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
C_{ib}	Open Circuit Input Capacitance		15	pF	$V_{EB} = -5.0 \text{ V}, I_C = 0, f = 1.0 \text{ MHz}$
h_{fe}	High Frequency Current Gain	2.0	8.0		$I_C = 0.5 \text{ mA}, V_{CE} = -5.0 \text{ V}, f = 20 \text{ MHz}$
h_{fe}	Small Signal Current Gain	100	500		$I_C = 1.0 \text{ mA}, V_{CE} = -5.0 \text{ V}, f = 1.0 \text{ kHz}$
h_{ie}	Input Resistance	2.5	17	k Ω	$I_C = 1.0 \text{ mA}, V_{CE} = 5.0 \text{ V}, f = 1.0 \text{ kHz}$
h_{oe}	Output Conductance	5.0	40	μmhos	$I_C = 1.0 \text{ mA}, V_{CE} = -5.0 \text{ V}, f = 1.0 \text{ kHz}$
h_{re}	Voltage Feedback Ratio		10	$\times 10^{-4}$	$I_C = 1.0 \text{ mA}, V_{CE} = -5.0 \text{ V}, f = 1.0 \text{ kHz}$
NF	Wide Band Noise Figure		3.0	dB	$I_C = 20 \mu\text{A}, V_{CE} = -5.0 \text{ V}, R_S = 10 \text{ k}\Omega,$ $BW = 15.7 \text{ Hz}, f = 10 \text{ Hz to } 10 \text{ kHz}$

FAIRCHILD

A Schlumberger Company

2N4030/2N4031
2N4032/2N4033

T-29-17

PNP Small Signal General Purpose Amplifiers

- V_{CE0} ... 60 V (Min) (2N4030/2), 80 V (Min) 2N4031/3)
- h_{FE} ... 100-300 @ 10 mA (2N4032/3), 40 (Min) 2N4032), 25 (Min) (2N4033) @ 1.0 A
- Complements ... 2N3107, 2N3108, 2N3109, 2N3020

PACKAGES

2N4030	TO-39
2N4031	TO-39
2N4032	TO-39
2N4033	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	4.0 W

Voltages & Currents

	4030/2	4031/3
V_{CE0} Collector to Emitter Voltage (Note 4)	-60 V	-80 V
V_{CBO} Collector to Base Voltage	-60 V	-80 V
V_{EBO} Emitter to Base Voltage	-5.0 V	-5.0 V
I_C Collector Current	1.0 A	1.0 A

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

SYMBOL	CHARACTERISTIC	4030		4031		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CBO}	Collector to Base Breakdown Voltage	-60		-80		V	$I_C = 10 \mu A, I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 10 \mu A, I_C = 0$
I_{EBO}	Emitter Cutoff Current		10		10	μA	$V_{EB} = -5.0 V, I_C = 0$
I_{CBO}	Collector Cutoff Current		50		50	nA	$V_{CB} = -50 V, I_E = 0$
			50		50	nA	$V_{CB} = -60 V, I_E = 0$
					50	μA	$V_{CB} = -50 V, I_E = 0, T_A = 150^\circ C$ $V_{CB} = -60 V, I_E = 0, T_A = 150^\circ C$
h_{FE}	DC Current Gain	30		30			$I_C = 100 \mu A, V_{CE} = -5.0 V$

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 200° C and junction-to-case thermal resistance of 43.7° C/W (derating factor of 22.8 mW/° C); junction-to-ambient thermal resistance of 219° C/W (derating factor of 4.56 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 T224.

2N4030/2N4031
2N4032/2N4033

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

SYMBOL	CHARACTERISTIC	4030		4031		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
h_{FE}	DC Pulse Current Gain (Note 5)	40 25 15 15	120	40 25 10 15	120		$I_C = 100 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$ $I_C = 500 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$ $I_C = 1.0 \text{ A}$, $V_{CE} = -5.0 \text{ V}$ $I_C = 100 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $T_A = -55^\circ \text{ C}$
V_{CEO}	Collector to Emitter Sustaining Voltage (Note 5)	-60		-80		V	$I_C = 10 \text{ mA}$ (pulsed), $I_B = 0$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.15 -0.5 1.0		-0.15 -0.5	V V V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ mA}$ $I_C = 500 \text{ mA}$, $I_B = 50 \text{ mA}$ $I_C = 1.0 \text{ A}$, $I_B = 100 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		-1.1 -1.2		-1.1	V V	$I_C = 500 \text{ mA}$, $V_{CE} = -0.5 \text{ V}$ $I_C = 1.0 \text{ A}$, $V_{CE} = -1.0 \text{ V}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-0.9		-0.9	V	$I_C = 150 \text{ mA}$, $I_B = 15 \text{ mA}$
C_{cb}	Collector to Base Capacitance		20		20	pF	$V_{CB} = -10 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance		110		110	pF	$V_{BE} = -0.5 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$
$ h_{fe} $	Magnitude of Common Emitter Small Signal Current Gain	1.0	4.0	1.0	4.0		$I_C = 50 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 100 \text{ MHz}$
t_s	Storage Time (test circuit no. 341)		350		350	ns	$I_C \approx 500 \text{ mA}$, $I_{B1} \approx -I_{B2} \approx 50 \text{ mA}$
t_f	Fall Time (test circuit no. 341)		50		50	ns	$I_C \approx 500 \text{ mA}$, $I_{B1} \approx -I_{B2} \approx 50 \text{ mA}$
t_{on}	Turn On Time (test circuit no. 341)		100		100	ns	$I_C \approx 500 \text{ mA}$, $I_{B1} \approx 50 \text{ mA}$

SYMBOL	CHARACTERISTIC	4032		4033		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CBO}	Collector to Base Breakdown Voltage	-60		-80		V	$I_C = 10 \mu\text{A}$, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		V	$I_E = 10 \mu\text{A}$, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		10		10	μA	$V_{EB} = -5.0 \text{ V}$, $I_C = 0$
I_{CBO}	Collector Cutoff Current		50 50		50 50	nA nA μA μA	$V_{CB} = -50 \text{ V}$, $I_E = 0$ $V_{CB} = -60 \text{ V}$, $I_E = 0$ $V_{CB} = -50 \text{ V}$, $I_E = 0$, $T_A = 150^\circ \text{ C}$ $V_{CB} = -60 \text{ V}$, $I_E = 0$, $T_A = 150^\circ \text{ C}$
h_{FE}	DC Current Gain	75		75			$I_C = 100 \mu\text{A}$, $V_{CE} = -5.0 \text{ V}$
h_{FE}	DC Pulse Current Gain (Note 5)	100 70 40 40	300	100 70 25 40	300		$I_C = 100 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$ $I_C = 500 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$ $I_C = 1.0 \text{ A}$, $V_{CE} = -5.0 \text{ V}$ $I_C = 100 \text{ mA}$, $V_{CE} = -5.0 \text{ V}$, $T_A = -55^\circ \text{ C}$
V_{CEO}	Collector to Emitter Sustaining Voltage (Note 5)	-60		-80		V	$I_C = 10 \text{ mA}$ (pulsed), $I_B = 0$

3469674 FAIRCHILD SEMICONDUCTOR

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2N4030/2N4031

2N4032/2N4033

T-29-17

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

SYMBOL	CHARACTERISTIC	4032		4033		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		-0.15		-0.15	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
			-0.5		-0.5	V	$I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$
					-1.0	V	$I_C = 1.0 \text{ A}, I_B = 100 \text{ mA}$
$V_{BE(on)}$	Base to Emitter "On" Voltage (Note 5)		-1.1		-1.1	V	$I_C = 500 \text{ mA}, V_{CE} = -0.5 \text{ V}$
			1.2			V	$I_C = 1.0 \text{ A}, V_{CE} = -1.0 \text{ V}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-0.9		-0.9	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
C_{cb}	Collector to Base Capacitance		20		20	pF	$V_{CB} = -10 \text{ V}, I_E = 0, f = 1.0 \text{ MHz}$
C_{ib}	Input Capacitance		110		110	pF	$V_{BE} = -0.5 \text{ V}, I_C = 0, f = 1.0 \text{ MHz}$
$ h_{fe} $	Magnitude of Common Emitter Small Signal Current Gain	1.5	5.0	1.5	5.0		$I_C = 50 \text{ mA}, V_{CE} = -10 \text{ V}, f = 100 \text{ MHz}$
t_s	Storage Time (test circuit no. 341)		350		350	ns	$I_C \approx 500 \text{ mA}, I_{B1} \approx I_{B2} \approx 50 \text{ mA}$
t_f	Fall Time (test circuit no. 341)		50		50	ns	$I_C \approx 500 \text{ mA}, I_{B1} \approx I_{B2} \approx 50 \text{ mA}$
t_{on}	Turn On Time (see test circuit no. 341)		100		100	ns	$I_C \approx 500 \text{ mA}, I_{B1} \approx 50 \text{ mA}$

3469674 FAIRCHILD SEMICONDUCTOR

84D 27569 D

FAIRCHILD

A Schlumberger Company

2N4036/2N4037 T-27-23

PNP General Purpose Transistor

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature -65°C to 200°C
 Operating Junction Temperature -65°C to 200°C

Power Dissipation (Notes 2 & 3)

Total Dissipation at 25°C Ambient Temperature

4036	4037
5.0 W	1.0 W

Voltages & Currents (Note 4)

4036	4037
V_{CE0} Collector to Emitter Voltage	-65 V -40 V
V_{CB0} Collector to Base Voltage	-90 V -60 V
V_{EB0} Emitter to Base Voltage	-7.0 V -7.0 V
I_C Collector Current (Continuous)	1.0 A 1.0 A
I_B Base Current (Continuous)	0.5 A 0.5 A

PACKAGE

2N4036	TO-39
2N4037	TO-39

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

SYMBOL	CHARACTERISTIC	2N4036		2N4037		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
BV_{CE0}	Collector to Emitter Sustaining Voltage	-65		-40		V	$I_C = 100 \text{ mA}, I_B = 0$
BV_{CB0}	Collector to Base Breakdown Voltage			-60		V	$I_C = 0.1 \text{ mA}$
I_{E0}	Emitter Cutoff Current		10		1.0	μA	$V_{EB} = -7.0 \text{ V}$ $V_{EB} = -5.0 \text{ V}$
I_{C0}	Collector Cutoff Current		100		0.25	μA	$V_{CB} = -90 \text{ V}, I_E = 0$ $V_{CB} = -60 \text{ V}, I_E = 0$
I_{CEX}	Collector Cutoff Current		100 0.1			mA μA	$V_{CE} = -85 \text{ V}, V_{BE} = -1.5 \text{ V}$ $V_{CE} = -30 \text{ V}, V_{BE} = -1.5 \text{ V}$ $T_C = 150^\circ \text{ C}$
h_{FE}	DC Current Gain (Note 5)	20 20 40 20	200 140	15 50	250		$I_C = 150 \text{ mA}, V_{CE} = 2.0 \text{ V}$ $I_C = 100 \mu\text{A}, V_{CE} = 10 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$ $I_C = 500 \text{ mA}, V_{CE} = 10 \text{ V}$
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		-0.65		-1.4	V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		-1.4			V	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$
$V_{BE(ON)}$	Base to Emitter On Voltage			-1.4		V	$I_C = 150 \text{ mA}, V_{CE} = 10 \text{ V}$

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 200°C and (2N4036) junction-to-case thermal resistance of 35°C/W (derating factor of 28.6 mW/°C); (2N4037) junction-to-case thermal resistance of 175°C/W (derating factor of 5.71 mW/°C).
- Rating refers to a high current point where collector to emitter voltage is lowest.
- Pulse conditions: length = 300 μs , duty cycle = 1%.
- For product family characteristic curves, refer to Curve Set T224.

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

SYMBOL	CHARACTERISTIC	2N4036		2N4037		UNITS	TEST CONDITIONS
		MIN	MAX	MIN	MAX		
$ h_{fe} $	High Frequency Current Gain	3.0		3.0	10		$I_C = 50 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 20 \text{ MHz}$
C_{cb}	Collector to Base Capacitance				30	pF	$V_{CB} = 10 \text{ V}$, $f = 1.0 \text{ MHz}$
t_r	Rise Time		70			ns	$I_C = 150 \text{ mA}$, $I_{B1} = 15 \text{ mA}$
t_s	Storage Time		600			ns	$I_C = 150 \text{ mA}$, $I_{B1} = I_{B2} = 15 \text{ mA}$
t_f	Fall Time		100			ns	$I_C = 150 \text{ mA}$, $I_{B1} = I_{B2} = 15 \text{ mA}$
t_{on}	Turn On Time		110			ns	$I_C = 150 \text{ mA}$, $I_{B1} = 15 \text{ mA}$
t_{off}	Turn Off Time		700			ns	$I_C = 150 \text{ mA}$, $I_{B1} = I_{B2} = 15 \text{ mA}$