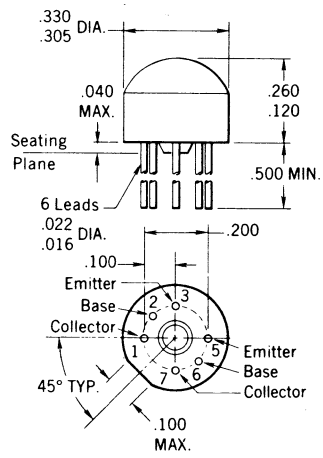
2N4955 • 2N4956

NPN LOW-LEVEL, LOW-NOISE DIFFERENTIAL AMPLIFIERS

DIFFUSED SILICON PLANAR* TRANSISTORS

- **BETA MATCH -- 20% MAX. AT 100 μA.**
- **V_{BE} TRACKING -- 20 μV/°C MAX. AT 100 μA FROM −40°C TO +85°C.**
- **V_{BE} MATCH -- 5.0 mV MAX. AT 100 μA.**
- **h_{FE} -- 100 MIN. AT 100 μA; 60 MIN. AT 10 μA.**
- **LOW NOISE FIGURE -- 4.5 dB MAX.**
- **SOLID PACKAGE TO GIVE MAXIMUM MECHANICAL SUPPORT TO THE CHIP.**

PHYSICAL DIMENSIONS



NOTES: All dimensions in inches
Package weight is 0.77 gram
Package is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures

Storage Temperature	−55°C to +125°C
Operating Junction Temperature	+125°C
Lead Temperature (Soldering, 10 seconds Time Limit)	+260°C

Maximum Power Dissipation [Note 2 and 3]

	One Side	Both Sides
Total Dissipation at 25°C Case Temperature	0.75 Watt	1.3 Watts
at 25°C Ambient Temperature	0.35 Watt	0.45 Watt

Maximum Voltages and Current for Each Transistor

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	25 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	Collector Current	30 mA

MATCHING AND ELECTRICAL CHARACTERISTICS FOR 2N4956 (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	For 2N4956 only MIN.	MAX.	UNITS	TEST CONDITIONS	
$\frac{h_{FE1}}{h_{FE2}}$	**DC Current Gain Ratio** [Note 5]	**0.8**	**1.0**		I_C = **100 μA**	V_{CE} = **5.0 V**
$(V_{BE1} - V_{BE2})$	Base-Emitter Voltage Differential [Note 6]		10	mV	I_C = 10 μA to 1.0 mA	V_{CE} = 5.0 V
$(V_{BE1} - V_{BE2})$	**Base-Emitter Voltage Differential** [Note 6]		**5.0**	**mV**	I_C = **100 μA**	V_{CE} = **5.0 V**
$\Delta(V_{BE1} - V_{BE2})$	**Base-Emitter Voltage Differential Change (T_A = −40°C to +25°C)** [Note 6]		**1.3 (20 μV/°C)**	**mV**	I_C = **100 μA**	V_{CE} = **5.0 V**
$\Delta(V_{BE1} - V_{BE2})$	**Base-Emitter Voltage Differential Change (T_A = +25°C to +85°C)** [Note 6]		**1.2 (20 μV/°C)**	**mV**	I_C = **100 μA**	V_{CE} = **5.0 V**

* Planar is a patented Fairchild process.

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 125°C and junction to case thermal resistance of 133°C/Watt (derating factor of 7.5 mW/°C) for one side; and 77°C/Watt (derating factor of 13 mW/°C) for both sides. Junction to ambient thermal resistance of 286°C/Watt (derating factor of 3.5 mW/°C) for one side; and 222°C/Watt (derating factor of 4.5 mW/°C) for both sides.
4. Rating refers to a high-current point where collector-to-emitter voltage is lowest.
5. Lowest of two h_{FE} readings is taken as h_{FE1} for purposes of this ratio.
6. Absolute values.
7. Pulse Conditions: length = 300 μs; duty cycle = 1%.

FAIRCHILD SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

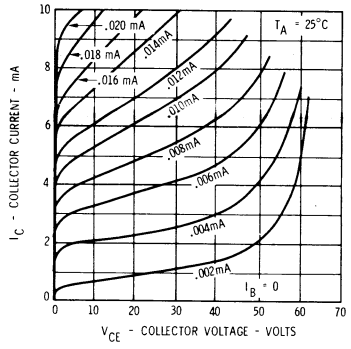
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

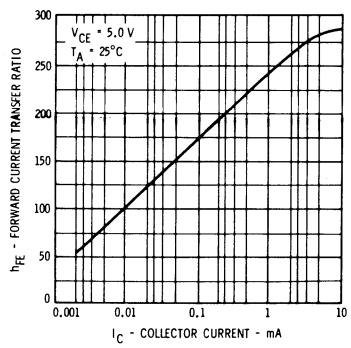
SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	150			I_C = 1.0 mA	V_{CE} = 5.0 V
h_{FE}	**DC Current Gain**	**100**			**I_C = 100 μA**	**V_{CE} = 5.0 V**
h_{FE}	**DC Current Gain**	**60**	**600**		**I_C = 10 μA**	**V_{CE} = 5.0 V**
V_{CE} (sat)	Collector Saturation Voltage		0.35	Volts	I_C = 1.0 mA	I_B = 0.1 mA
V_{BE} (on)	Emitter-Base On Voltage		0.7	Volts	I_C = 0.1 mA	V_{CE} = 5.0 V
I_{CBO}	Collector Cutoff Current		10	nA	I_E = 0	V_{CB} = 25 V
I_{CBO} (85°C)	Collector Cutoff Current		1.0	μA	I_E = 0	V_{CB} = 25 V
I_{CEO}	Collector Cutoff Current		10	nA	I_B = 0	V_{CE} = 5.0 V
I_{EBO}	Emitter Cutoff Current		10	nA	I_C = 0	V_{EB} = 5.0 V
C_{cb}	Collector-Base Capacitance		6.0	pF	I_E = 0	V_{CB} = 10 V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	3.0	15		I_C = 1.0 mA	V_{CE} = 5.0 V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	150	1000		I_C = 1.0 mA	V_{CE} = 5.0 V
h_{ie}	Input Impedance (f = 1.0 kHz)	3.5	30	kohms	I_C = 1.0 mA	V_{CE} = 5.0 V
h_{oe}	Output Conductance (f = 1.0 kHz)		40	μmhos	I_C = 1.0 mA	V_{CE} = 5.0 V
h_{re}	Voltage Feedback Ratio (f = 1.0 kHz)		800	$X10^{-6}$	I_C = 1.0 mA	V_{CE} = 5.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	30		Volts	I_C = 10 μA	I_E = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (pulsed, notes 4 and 7)	25		Volts	I_C = 2.0 mA	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		Volts	I_E = 10 μA	I_C = 0
C_{eb}	Emitter-Base Capacitance		6.0	pF	I_C = 0	V_{EB} = 0.5 V
NF	Narrow Band Noise Figure (f = 1.0 kHz)		4.5	dB	I_C = 10 μA B.W. = 200 Hz	V_{CE} = 5.0 V R_S = 10 kΩ
NF	**Wide Band Noise Figure (3.0 dB points @ 10 Hz and 10 kHz)**		**4.5**	**dB**	**I_C = 10 μA B.W. = 15.7 kHz**	**V_{CE} = 5.0 V R_S = 10 kΩ**

TYPICAL ELECTRICAL CHARACTERISTICS

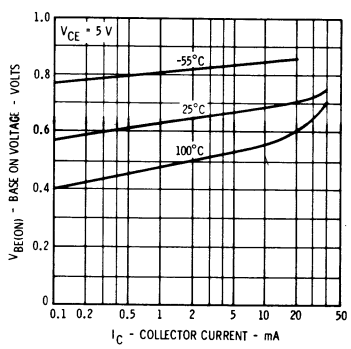
COLLECTOR CHARACTERISTICS*



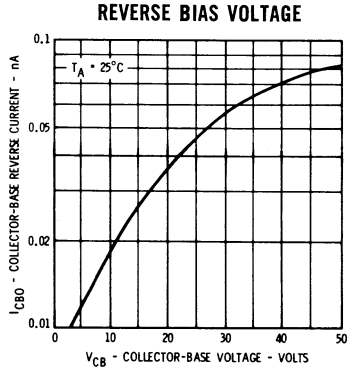
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



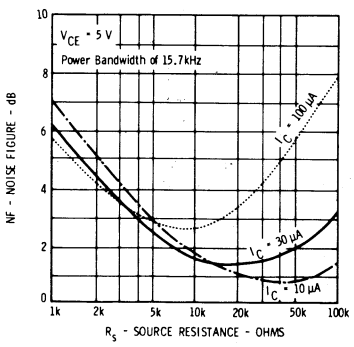
BASE-EMITTER ON VOLTAGE VERSUS COLLECTOR CURRENT



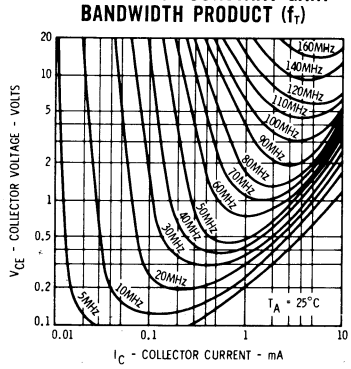
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



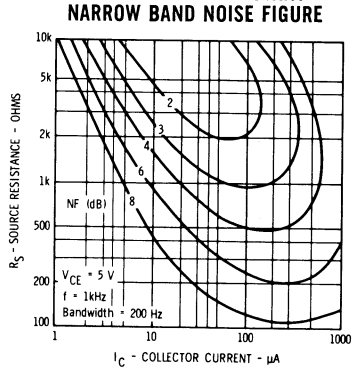
WIDE BAND NOISE FIGURE VERSUS SOURCE RESISTANCE



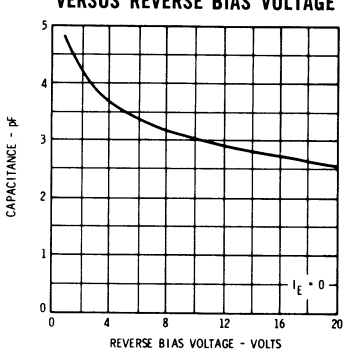
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



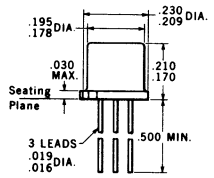
2N4960 · 2N4961 · 2N4962 · 2N4963

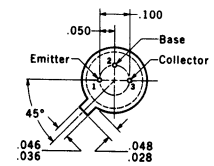
NPN GENERAL PURPOSE AMPLIFIERS AND SWITCHES

DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **LV_{CEO} -- 80 VOLTS MIN.**
- **h_{FE} -- 12 SPECIFICATIONS FROM 100 μA TO 500 mA; −55°C TO +125°C**
- **$V_{CE(sat)}$ -- 0.5 V MAX. AT 500 mA; 0.18 V MAX. AT 150 mA**
- **f_T -- 250 MHz MIN. AT 50 mA**

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-18) outline

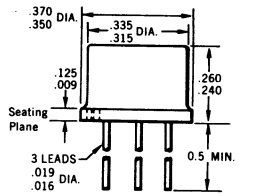


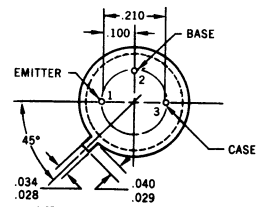


NOTES: All dimensions in inches
Leads are gold-plated kover
Collector internally connected to case
Package weight is 0.43 gram

2N4962 · 2N4963

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-39) outline





NOTES: All dimensions in inches
Leads are gold-plated KOVAR
Lead No. 3 internally connected to case
Package weight is 1.23 grams

2N4960 · 2N4961

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	+200°C

Maximum Power Dissipation (Note 2 & 3)	2N4960	2N4961	2N4962	2N4963	
Total Dissipation at Case Temperature, 25°C	3.5	3.5	1.5	1.5	Watts
at Ambient Temperature, 25°C	0.8	0.8	0.5	0.5	Watts
Maximum Voltages					
V_{CBO} Collector to Base Voltage	60	80	60	80	Volts
V_{CEO} Collector to Emitter Voltage (Note 4)	60	80	60	80	Volts
V_{EBO} Emitter to Base Voltage	6.5	6.5	6.5	6.5	Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	30	60		30	60			I_C=100μA	V_{CE}=10 V
h_{FE}	DC Current Gain	60	100		60	100			I_C=1.0 mA	V_{CE}=10 V
h_{FE}	DC Pulse Current Gain (Note 5)	90	140		90	140			I_C=10 mA	V_{CE}=10 V
h_{FE}	DC Pulse Current Gain (Note 5)	100	150		100	150			I_C=50 mA	V_{CE}=10 V
h_{FE} (−55°C)	**DC Pulse Current Gain** (Note 5)	**10**	**40**		**10**	**40**			**I_C=150 mA**	**V_{CE}=1.0 V**
h_{FE}	**DC Pulse Current Gain** (Note 5)	**40**	**100**		**40**	**100**			**I_C=150 mA**	**V_{CE}=1.0 V**
h_{FE} (125°C)	DC Pulse Current Gain (Note 5)		130	500		130	500		I_C=150 mA	V_{CE}=1.0 V
h_{FE} (−55°C)	DC Pulse Current Gain (Note 5)	25	60		25	60			I_C=150 mA	V_{CE}=10 V
h_{FE}	**DC Pulse Current Gain** (Note 5)	**100**	**180**	**300**	**100**	**180**	**300**		**I_C=150 mA**	**V_{CE}=10 V**
h_{FE} (125°C)	**DC Pulse Current Gain** (Note 5)		**270**	**650**		**270**	**650**		**I_C=150 mA**	**V_{CE}=10 V**
h_{FE}	DC Pulse Current Gain (Note 5)	70	100		70	100			I_C=300 mA	V_{CE}=10 V
h_{FE}	DC Pulse Current Gain (Note 5)	45	60		45	60			I_C=500 mA	V_{CE}=10 V
h_{fe}	**High Frequency Current Gain (f=100MHz)**	**2.5**	**4.0**	**6.0**	**2.5**	**4.0**	**6.0**		**I_C=50 mA**	**V_{CE}=10 V**
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.04	0.07		0.04	0.07	Volts	I_C=10 mA	I_B=1.0 mA
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 5)		**0.15**	**0.18**		**0.15**	**0.18**	**Volts**	**I_C=150 mA**	**I_B=15 mA**
$V_{CE(sat)}$ (125°C)	Pulsed Collector Saturation Voltage (Note 5)		0.18	0.36		0.18	0.36	Volts	I_C=150 mA	I_B=15 mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.25	0.31		0.25	0.31	Volts	I_C=300 mA	I_B=30 mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		0.38	0.50		0.38	0.50	Volts	I_C=500 mA	I_B=50 mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 5)		0.67	0.72		0.67	0.72	Volts	I_C=10 mA	I_B=1.0 mA
$V_{BE(sat)}$(−55°C)	**Pulsed Base Saturation Voltage** (Note 5)		**0.92**	**1.10**		**0.92**	**1.10**	**Volts**	**I_C=150 mA**	**I_B=15 mA**
$V_{BE(sat)}$	**Pulsed Base Saturation Voltage** (Note 5)	**0.78**	**0.82**	**0.90**	0.78	0.82	0.90	**Volts**	**I_C=150 mA**	**I_B=15 mA**
$V_{BE(sat)}$(125°C)	**Pulsed Base Saturation Voltage** (Note 5)	**0.63**	**0.73**		**0.63**	**0.73**		**Volts**	**I_C=150 mA**	**I_B=15 mA**
$V_{BE(sat)}$	**Pulsed Base Saturation Voltage** (Note 5)		**0.95**	**1.05**		**0.95**	**1.05**	**Volts**	**I_C=300 mA**	**I_B=30 mA**
$V_{BE(sat)}$	**Pulsed Base Saturation Voltage** (Note 5)		**1.1**	**1.3**		**1.1**	**1.3**	**Volts**	**I_C=500 mA**	**I_B=50 mA**
$V_{BE(on)}$	Pulsed Base Emitter On Voltage (Note 5)		0.75	0.88		0.75	0.88	Volts	I_C=150 mA	V_{CE}=10 V

*Planar is a patented Fairchild process.

FAIRCHILD SEMICONDUCTOR
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FAIRCHILD TRANSISTORS 2N4960 • 2N4961 • 2N4962 • 2N4963

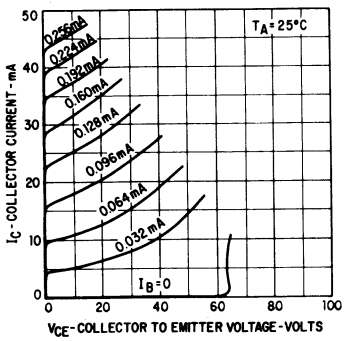
ELECTRICAL CHARACTERISTICS (25° Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4960 • 2N4962 MIN.	TYP.	MAX.	2N4961 • 2N4963 MIN	TYP.	MAX.	UNIT	TEST CONDITIONS	
$V_{CEO(sust)}$	**Collector to Emitter Sustaining Voltage** (Note 4 & 5)	**60**			**80**			**Volts**	**I_C=10 mA**	**I_B=0**
BV_{CES}	Collector to Emitter Breakdown Voltage	60			80			Volts	I_C=10 μA	I_B=0
BV_{CBO}	Collector to Base Breakdown Voltage	60			80			Volts	I_C=10 μA	I_E=0
BV_{EBO}	Emitter to Base Breakdown Voltage	6.5			6.5			Volts	I_C=0	I_E=10 μA
I_{CBO}	Collector Cutoff Current		1.0	10		1.0	10	nA	I_E=0	V_{CB}=50 V
$I_{CBO(125°C)}$	Collector Cutoff Current		1.0	10		1.0	10	μA	I_E=0	V_{CB}=50 V
I_{EBO}	Emitter Cutoff Current		1.0	10		1.0	10	nA	I_C=0	V_{EB}=4.0 V
C_{cb}	Collector to Base Capacitance (f=1.0 MHz)		11	15		11	15	pF	I_E=0	V_{CB}=10 V
C_{eb}	Emitter to Base Capacitance (f=1.0 MHz)		50	75		50	75	pF	I_C=0	V_{EB}=0.5 V
t_{on}	Turn On Time (Note 6, Fig. 1)		70	150		70	150	ns	I_C≈150 mA	I_{B1}≈15 mA
t_{off}	Turn Off Time (Note 6, Fig. 1)		700	1000		700	1000	ns	I_C≈150 mA	I_{B1}≈15 mA I_{B2}≈—15 mA
t_{on}	Turn On Time (Note 6, Fig. 1)		80			80		ns	I_C≈300 mA	I_{B1}≈30 mA
t_{off}	Turn Off Time (Note 6, Fig. 1)		600			600		ns	I_C≈300 mA	I_{B1}≈30 mA I_{B2}≈—30 mA
t_{on}	Turn On Time (Note 6, Fig. 1)		100			100		ns	I_C≈500 mA	I_{B1}≈50 mA
t_{off}	Turn Off Time (Note 6, Fig. 1)		500			500		ns	I_C≈500 mA	I_{B1}≈50 mA I_{B2}≈—50 mA

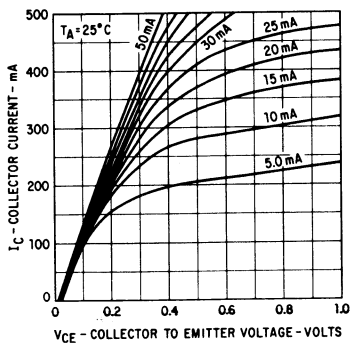
TYPICAL COLLECTOR AND BASE CHARACTERISTICS

2N4960 • 2N4962

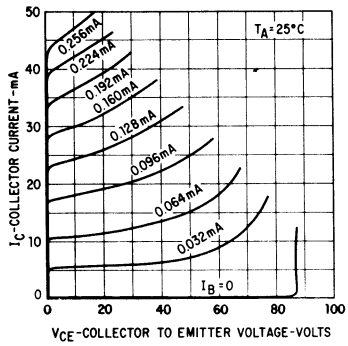
ACTIVE REGION



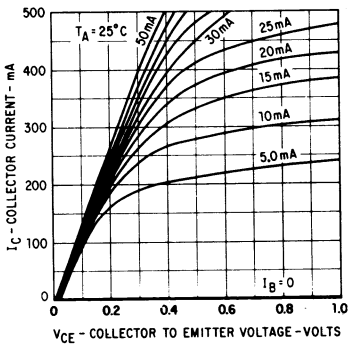
SATURATION REGION



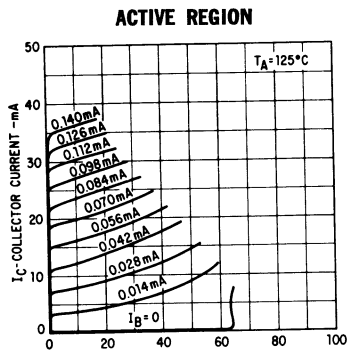
ACTIVE REGION



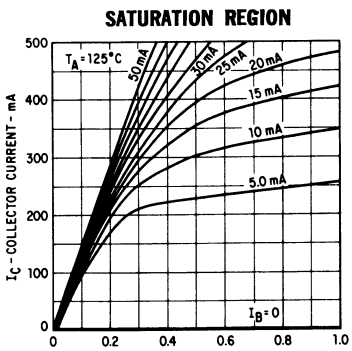
SATURATION REGION



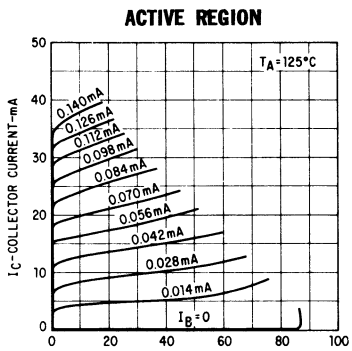
ACTIVE REGION



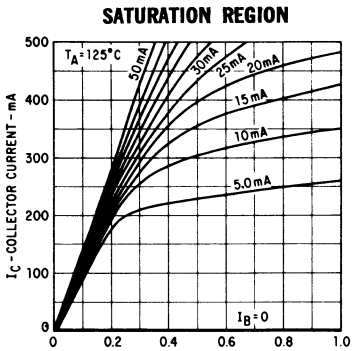
SATURATION REGION



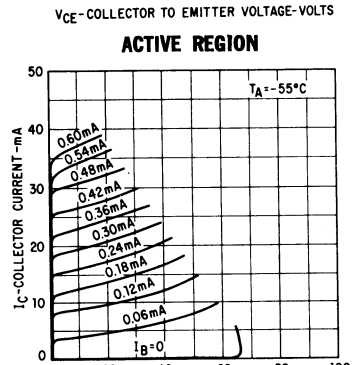
ACTIVE REGION



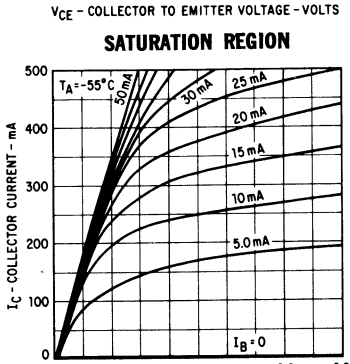
SATURATION REGION



ACTIVE REGION

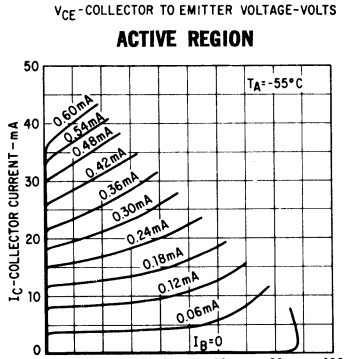


SATURATION REGION

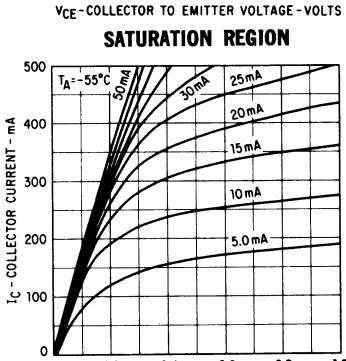


2N4961 • 2N4963

ACTIVE REGION

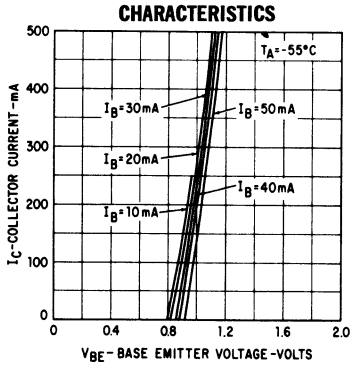


SATURATION REGION

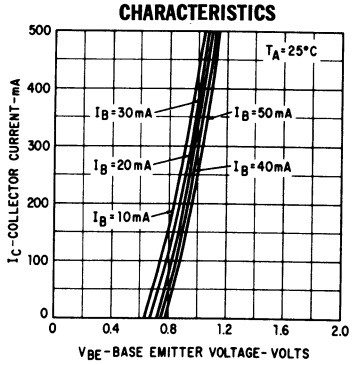


TYPICAL ELECTRICAL CHARACTERISTICS

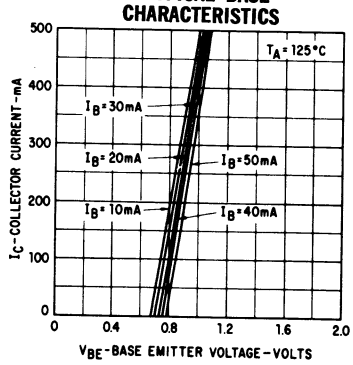
TYPICAL BASE CHARACTERISTICS



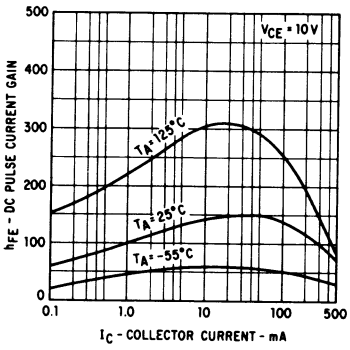
TYPICAL BASE CHARACTERISTICS



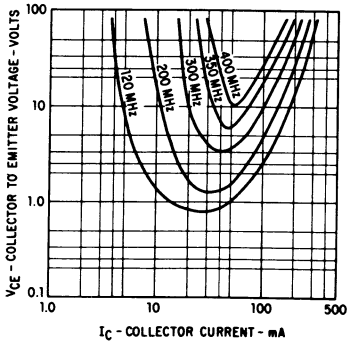
TYPICAL BASE CHARACTERISTICS



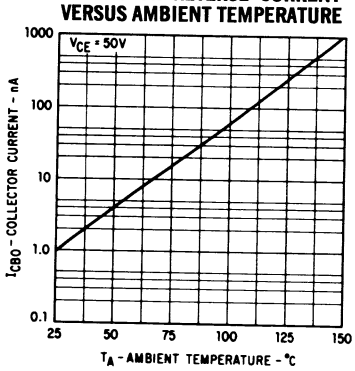
DC PULSE CURRENT GAIN VERSUS COLLECTOR VOLTAGE



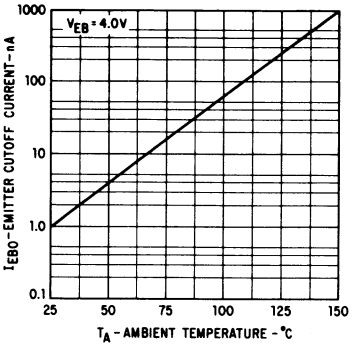
CONTOUR OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



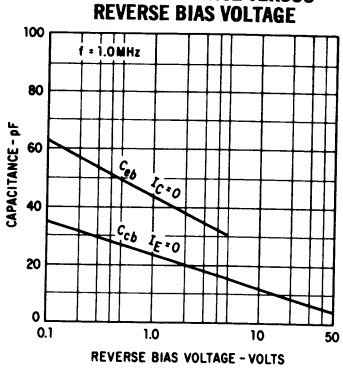
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



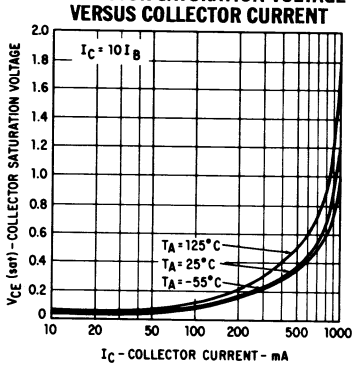
EMITTER CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



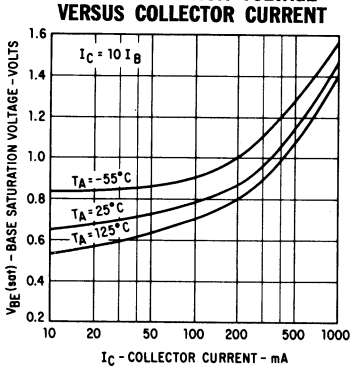
COLLECTOR-BASE AND EMITTER-BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



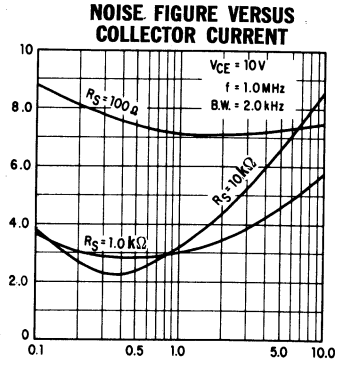
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



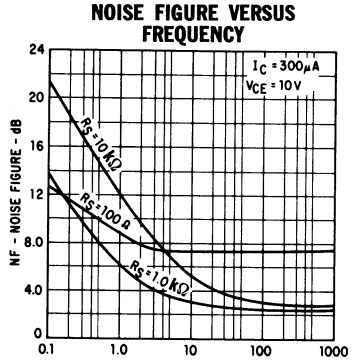
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



NOISE FIGURE VERSUS COLLECTOR CURRENT

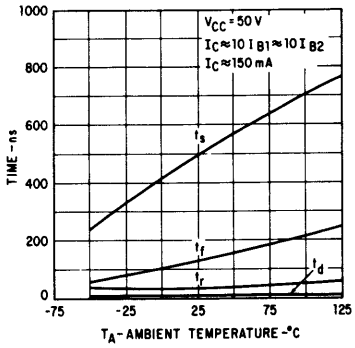


NOISE FIGURE VERSUS FREQUENCY

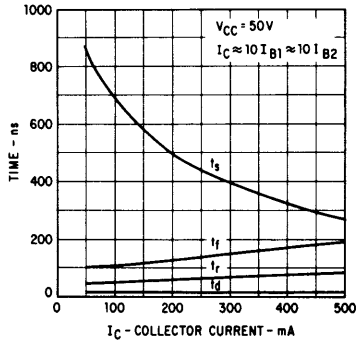


TYPICAL ELECTRICAL CHARACTERISTICS

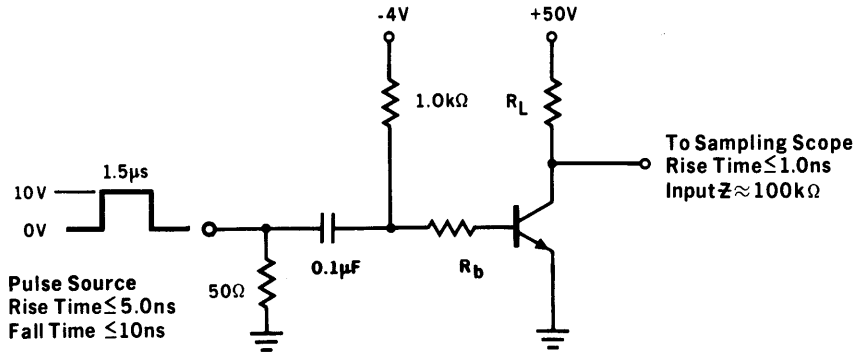
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



SWITCHING TIMES VERSUS COLLECTOR CURRENT



t_{on}-t_{off} TEST CIRCUIT



I_C	R_b	R_L
150mA	314Ω	330Ω
300mA	157Ω	167Ω
500mA	94Ω	100Ω

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 50°C/Watt (derating factor of 20 mW/°C) for the 2N4960 and 2N4961; 117°C/Watt (derating factor of 8.6 mW/°C) for the 2N4962 and 2N4963 . Junction to ambient thermal resistance of 219°C/Watt (derating factor of 4.6 mW/°C) for the 2N4960 and 2N4961 350°C/Watt derating factor of 2.9 mW/°C) for the 2N4962 and 2N4963 .
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. See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

2N4998 • 2N5000

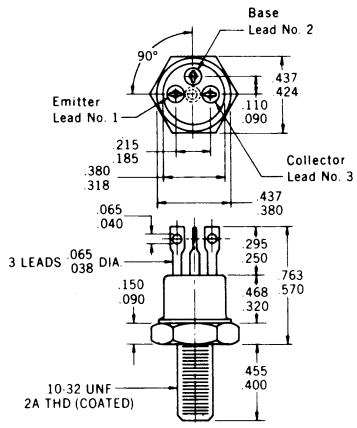
30 WATT NPN POWER TRANSISTORS

DIFFUSED SILICON PLANAR* TRANSISTORS

SEE 2N4999 • 2N5001 FOR PNP COMPLEMENT

- **HIGH POWER - - 30 WATTS @ $T_C = 50°C$, $V_{CE} = 40$ V**
- **HIGH VOLTAGE - - 80 V (MIN) LV_{CEO}**
- **HIGH CURRENT SATURATION VOLTAGE - - 0.85 V (MAX) $V_{CE}(sat)$ @ $I_C = 2.0$ A**
- **HIGH FREQUENCY - - 50 AND 60 MHz (MIN) f_T**
- **BETA GUARANTEED @ 3 POINTS - - 50 mA, 1.0 A AND 2.0 A**
- **ISOLATED COLLECTOR PACKAGE - - NO ISOLATING HARDWARE REQUIRED**
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

PHYSICAL DIMENSIONS
(in accordance with JEDEC TO-59 outline)



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 6.44 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	−65°C to +200°C
Lead Temperature (Soldering, 60 second time limit)	+300°C

Maximum Power Dissipation

Total Dissipation at 50°C Case Temperature, $V_{CE} = 40$ V. (See Maximum Permissible Power Curve and Note 4)	30 Watts

Maximum Voltages and Current

V_{CES}	Collector to Emitter Voltage	100 Volts
V_{CEO}	Collector to Emitter Voltage (Note 2)	80 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts
I_C	Collector Current	2.0 Amps

ELECTRICAL CHARACTERISTICS (25° Case Temperature unless otherwise noted)

		2N4998			2N5000				
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
$V_{CEO}(sust)$	**Collector to Emitter Sustaining Voltage** (Notes 2 and 3)	**80**			**80**			**Volts**	**$I_C = 100$ mA $I_B = 0$**
BV_{CES}	Collector to Emitter Breakdown Voltage	100			100			Volts	$I_C = 1.0$ mA $V_{BE} = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0			6.0			Volts	$I_C = 0$ $I_E = 1.0$ mA
h_{FE}	**DC Pulse Current Gain** (Note 3)	**20**	**64**		**50**	**120**			**$I_C = 50$ mA $V_{CE} = 5.0$ V**
h_{FE}	**DC Pulse Current Gain** (Note 3)	**30**	**63**	**90**	**70**	**110**	**200**		**$I_C = 1.0$ A $V_{CE} = 5.0$ V**
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 3)	15	45		35	63			$I_C = 1.0$ A $V_{CE} = 5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	**15**	**33**		**30**	**56**			**$I_C = 2.0$ A $V_{CE} = 5.0$ V**
h_{fe}	**High Frequency Current Gain (f = 20 MHz)**	**2.5**	**3.8**		**3.0**	**4.3**			**$I_C = 0.2$ A $V_{CE} = 5.0$ V**
$V_{CE}(sat)$	Pulsed Collector Saturation Voltage (Note 3)		0.38	0.46		0.38	0.46	Volts	$I_C = 1.0$ A $I_B = 0.1$ A
$V_{CE}(sat)$	**Pulsed Collector Saturation Voltage** (Note 3)		**0.75**	**0.85**		**0.75**	**0.85**	**Volts**	**$I_C = 2.0$ A $I_B = 0.2$ A**

Additional Electrical Characteristics on page 2
Notes on page 2

*Planar is a patented Fairchild process.

FAIRCHILD SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

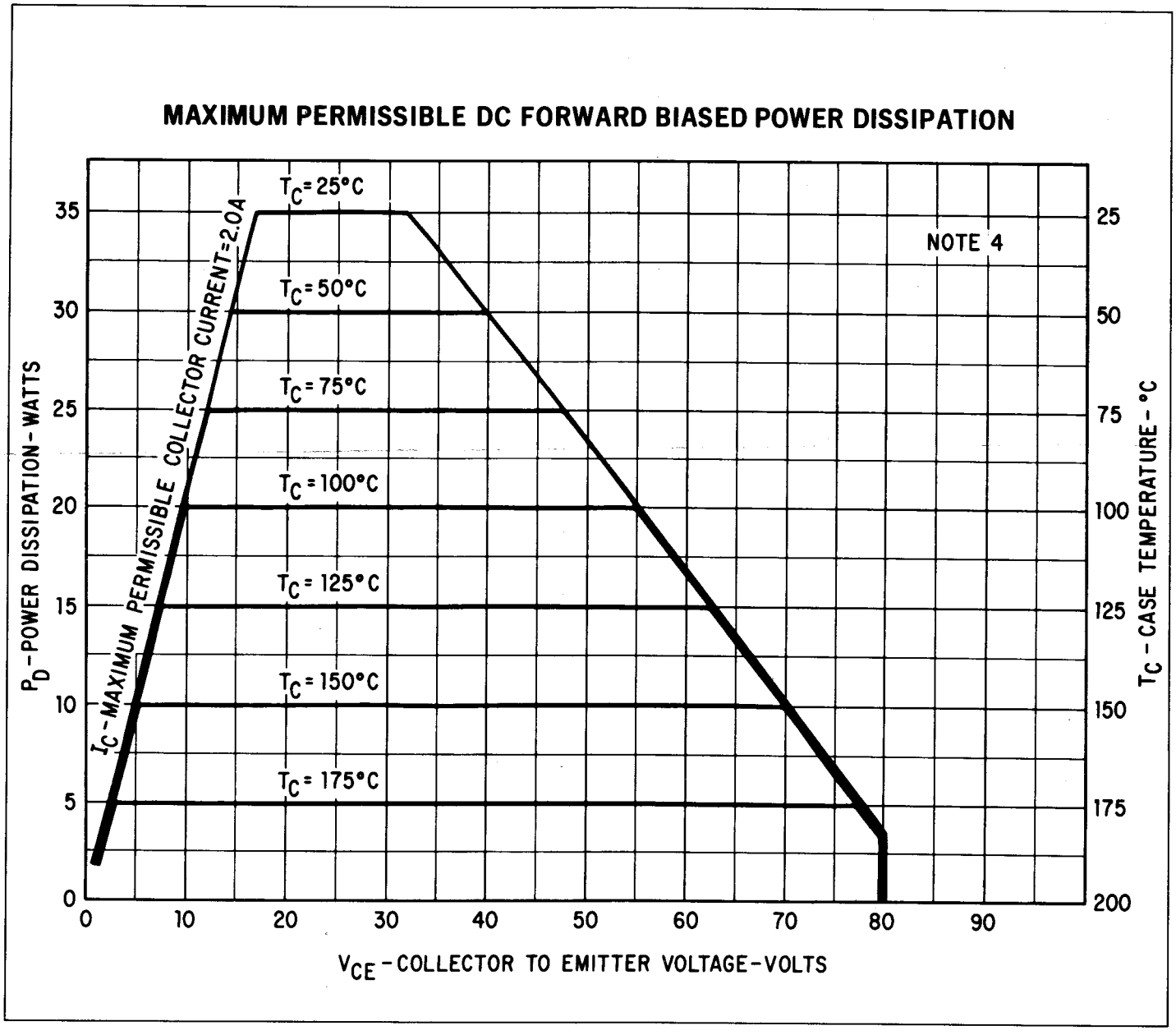
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25° Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4998 MIN.	2N4998 TYP.	2N4998 MAX.	2N5000 MIN.	2N5000 TYP.	2N5000 MAX.	UNITS	TEST CONDITIONS	
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 3)		0.98	1.2		0.98	1.2	Volts	$I_C = 1.0$ A	$I_B = 0.1$ A
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 3)		1.30	1.5		1.30	1.5	Volts	$I_C = 2.0$ A	$I_B = 0.2$ A
V_{BE}(on)	Pulsed Base Emitter "ON" Voltage (Note 3)			1.5			1.5	Volts	$I_C = 2.0$ A	$V_{CE} = 5.0$ V
I_{CES}	Collector Cutoff Current		.002	1.0		.002	1.0	μA	$V_{CE} = 60$ V	$V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current			1.0			1.0	μA	$I_C = 0$	$V_{EB} = 5.0$ V
I_{CEX}(150°C)	Collector Reverse Current			500			500	μA	$V_{CE} = 60$ V	$V_{EB} = 2.0$ V
C_{cb}	Collector to Base Capacitance		30	70		30	70	pF	$I_E = 0$	$V_{CB} = 10$ V

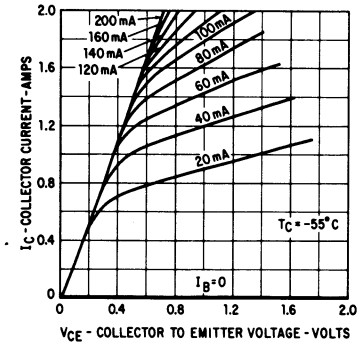
NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) This rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.
(3) Pulse Conditions: length = 300μs; duty cycle = 1%.
(4) Contact factory for maximum permissible power under pulsed or reverse biased operating conditions.

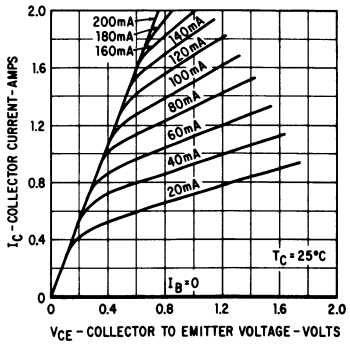


TYPICAL ELECTRICAL CHARACTERISTICS

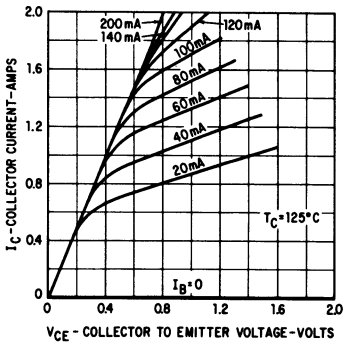
COLLECTOR CHARACTERISTICS * SATURATION REGION



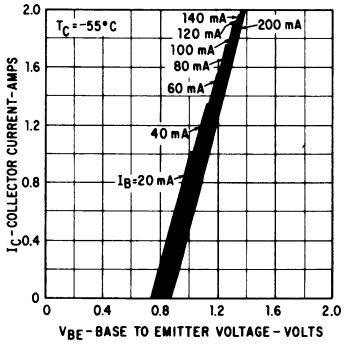
COLLECTOR CHARACTERISTICS * SATURATION REGION



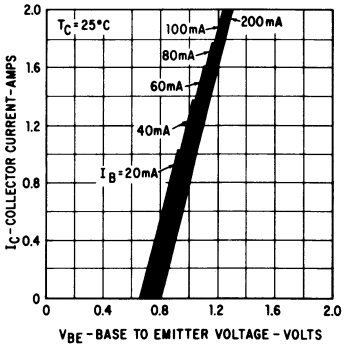
COLLECTOR CHARACTERISTICS * SATURATION REGION



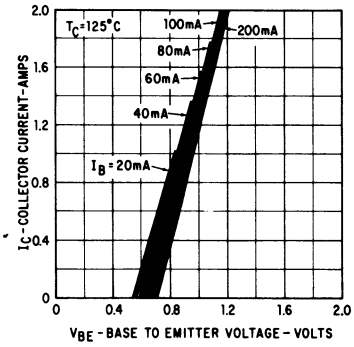
BASE CHARACTERISTICS*



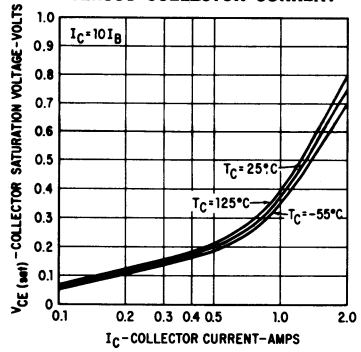
BASE CHARACTERISTICS*



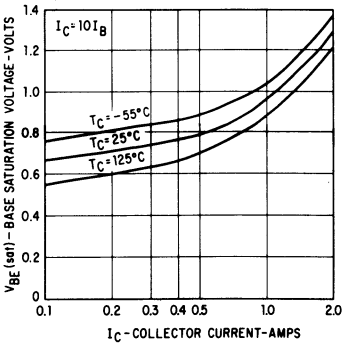
BASE CHARACTERISTICS*



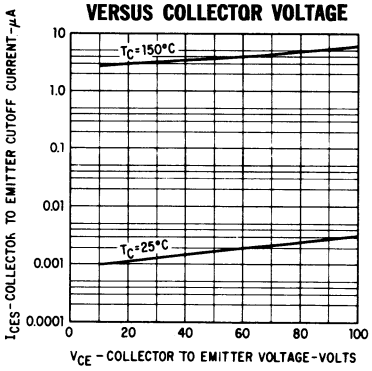
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



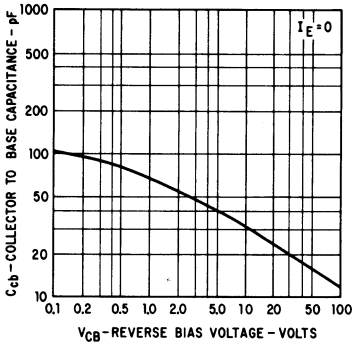
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



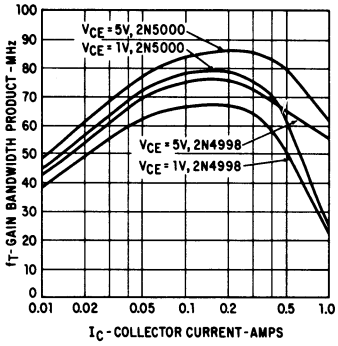
COLLECTOR CUTOFF CURRENT VERSUS COLLECTOR VOLTAGE



COLLECTOR TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT

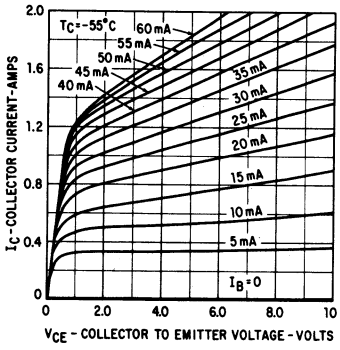


* Single family characteristic on Transistor Curve Tracer.

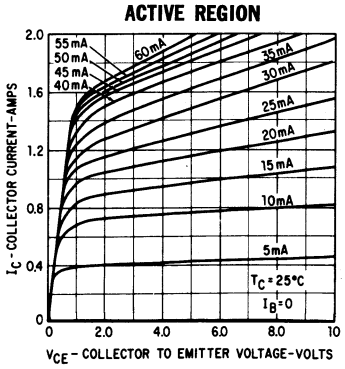
TYPICAL ELECTRICAL CHARACTERISTICS

2N4998

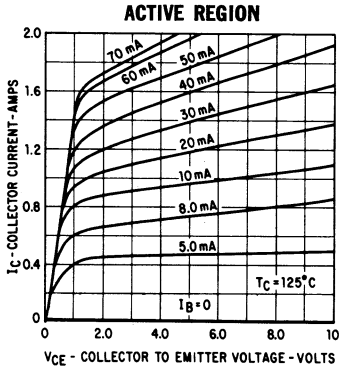
COLLECTOR CHARACTERISTICS* ACTIVE REGION



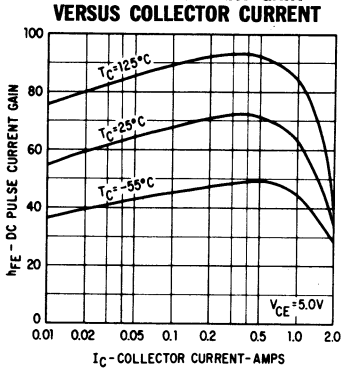
COLLECTOR CHARACTERISTICS* ACTIVE REGION



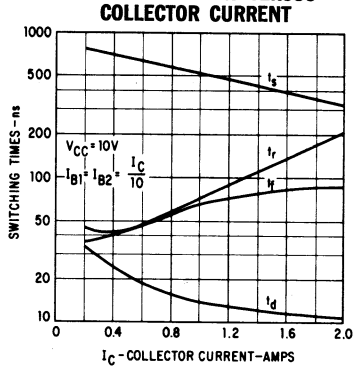
COLLECTOR CHARACTERISTICS* ACTIVE REGION



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

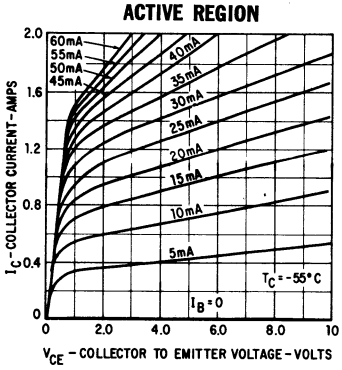


SWITCHING TIMES VERSUS COLLECTOR CURRENT

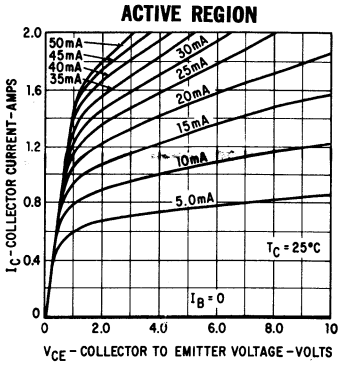


2N5000

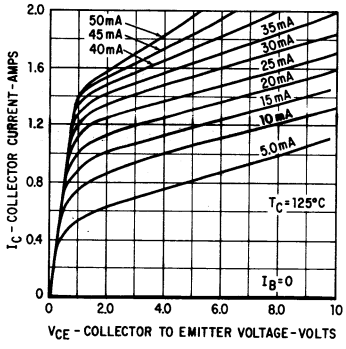
COLLECTOR CHARACTERISTICS* ACTIVE REGION



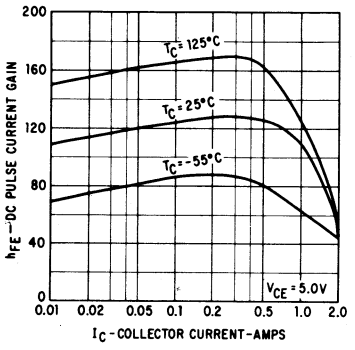
COLLECTOR CHARACTERISTICS* ACTIVE REGION



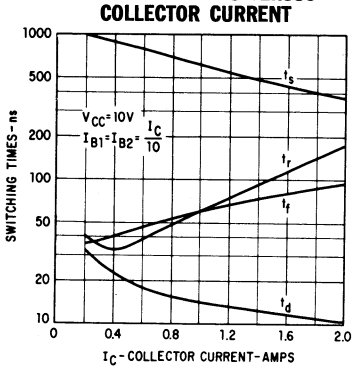
COLLECTOR CHARACTERISTICS* ACTIVE REGION



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS COLLECTOR CURRENT



*Single Family Characteristics on Transistor Curve Tracer.

2N4999 • 2N5001

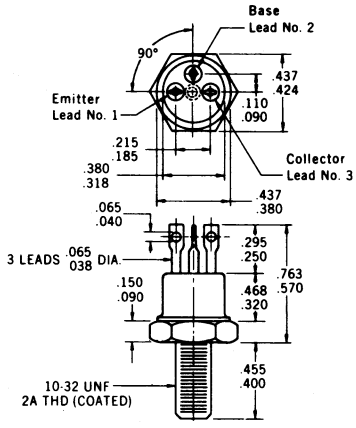
30 WATT PNP POWER TRANSISTORS

DIFFUSED SILICON PLANAR* TRANSISTORS

SEE 2N4998 • 2N5000 FOR NPN COMPLEMENT

- **HIGH POWER** . . . . . **30 WATTS AT $T_C = 50°C$, $V_{CE} = -40$ V**
- **HIGH VOLTAGE** . . . . . **−80 V (MIN) LV_{CEO}**
- **HIGH CURRENT SATURATION VOLTAGE** . . . **−0.85 V (MAX) $V_{CE(sat)}$ AT $I_C = 2.0$ A**
- **HIGH FREQUENCY** . . . . . **50 AND 60 MHz (MIN) f_T**
- **BETA GUARANTEED AT 3 POINTS** . . . . . **50 mA, 1.0 A AND 2.0 A**
- **ISOLATED COLLECTOR PACKAGE** . . . . . **NO ISOLATING HARDWARE REQUIRED**
- **DISCRETE EMITTER GEOMETRY WITH INTEGRATED FEEDBACK RESISTORS**

PHYSICAL DIMENSIONS
(in accordance ith JEDEC TO-59 outline)



NOTES:
All dimensions in inches
All leads electrically isolated from case
Package weight is 6.44 grams

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Junction Temperature	−65°C to +200°C
Lead Temperature (Soldering, 60 second time limit)	+300°C

Maximum Power Dissipation

Total Dissipation at 50°C Case Temperature, $V_{CE} = -40$ V (See Maximum Permissible Power Curve and Note 4)	30 Watts

Maximum Voltages and Current

V_{CES}	Collector to Emitter Voltage	−100 Volts
V_{CEO}	Collector to Emitter Voltage (Note 2)	−80 Volts
V_{EBO}	Emitter to Base Voltage	−5.5 Volts
I_C	Collector Current	2.0 Amps

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N4999 MIN.	2N4999 TYP.	2N4999 MAX.	2N5001 MIN.	2N5001 TYP.	2N5001 MAX.	UNITS	TEST CONDITIONS	
$V_{CEO(sus)}$	**Collector to Emitter Sustaining Voltage** (Notes 2 and 3)	**−80**			**−80**			**Volts**	$I_C = 100$ mA	$I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−100			−100			Volts	$I_C = 1.0$ mA	$V_{BE} = 0$
BV_{EBO}	**Emitter to Base Breakdown Voltage**	−5.5			−5.5			Volts	$I_C = 0$	$I_E = 1.0$ mA
h_{FE}	**DC Pulse Current Gain** (Note 3)	20	39		50	85			$I_C = 50$ mA	$V_{CE} = -5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	**30**	**40**	**90**	**70**	**88**	**200**		$I_C = 1.0$ A	$V_{CE} = -5.0$ V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 3)	15	24		35	52			$I_C = 1.0$ A	$V_{CE} = -5.0$ V
h_{FE}	**DC Pulse Current Gain** (Note 3)	**15**	**28**		**30**	**50**			$I_C = 2.0$ A	$V_{CE} = -5.0$ V
h_{fe}	**High Frequency Current Gain (f = 20 MHz)**	**2.5**	**4.8**		**3.0**	**6.1**			$I_C = 0.2$ A	$V_{CE} = -5.0$ V
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 3)		−0.38	−0.46		−0.38	−0.46	Volts	$I_C = 1.0$ A	$I_B = 0.1$ A
$V_{CE(sat)}$	**Pulsed Collector Saturation Voltage** (Note 3)		**−0.73**	**−0.85**		**−0.73**	**−0.85**	**Volts**	$I_C = 2.0$ A	$I_B = 0.2$ A

Additional Electrical Characteristics on page 2
Notes on page 2

*Planar is a patented Fairchild process.

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

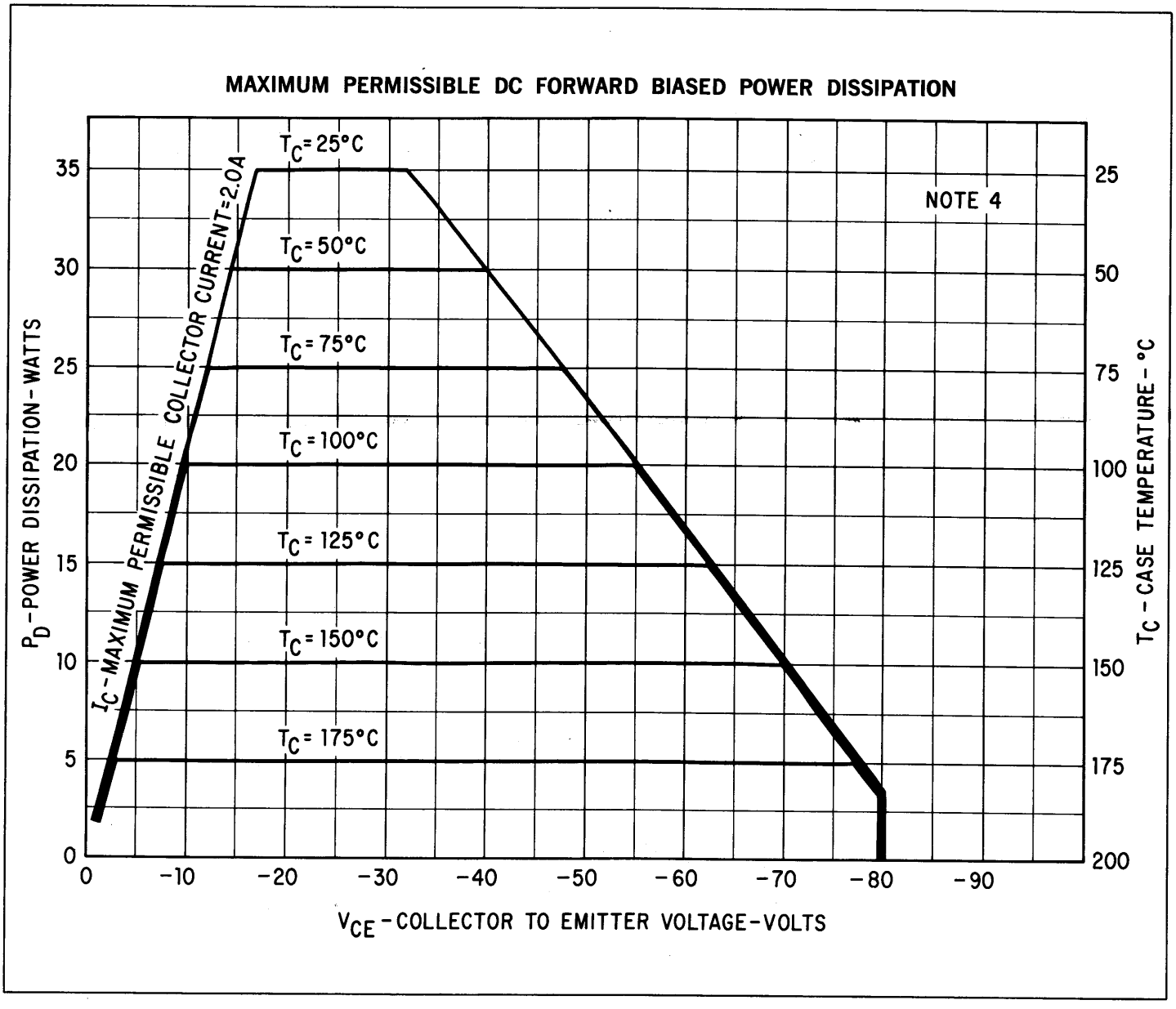
313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

ELECTRICAL CHARACTERISTICS (25°C Case Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	2N4999 MIN.	2N4999 TYP.	2N4999 MAX.	2N5001 MIN.	2N5001 TYP.	2N5001 MAX.	UNITS	TEST CONDITIONS	
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 3)		−0.96	−1.2		−0.96	−1.2	Volts	$I_C = 1.0$ A	$I_B = 0.1$ A
$V_{BE(sat)}$	Pulsed Base Saturation Voltage (Note 3)		−1.28	−1.5		−1.28	−1.5	Volts	$I_C = 2.0$ A	$I_B = 0.2$ A
$V_{BE}(on)$	Pulsed Base Emitter "ON" Voltage (Note 3)			−1.5			−1.5	Volts	$I_C = 2.0$ A	$V_{CE} = -5.0$ V
I_{CES}	Collector Cutoff Current		.002	1.0		.002	1.0	μA	$V_{CE} = -60$ V	$V_{BE} = 0$
I_{EBO}	Emitter Cutoff Current			1.0			1.0	μA	$I_C = 0$	$V_{EB} = -4.0$ V
$I_{CEX}(150°C)$	Collector Reverse Current			500			500	μA	$V_{CE} = -60$ V	$V_{EB} = -2.0$ V
C_{cb}	Collector to Base Capacitance		46	120		46	120	pF	$I_E = 0$	$V_{CB} = -10$ V

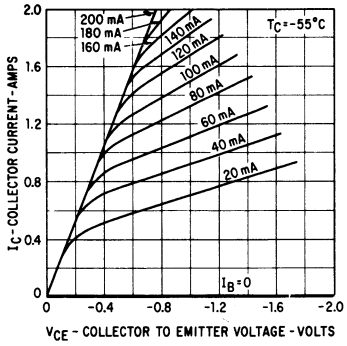
NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) This rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.
(3) Pulse Conditions: length = 300 μs; duty cycle = 1%.
(4) Contact factory for maximum permissible power under pulsed or reverse biased operating conditions.

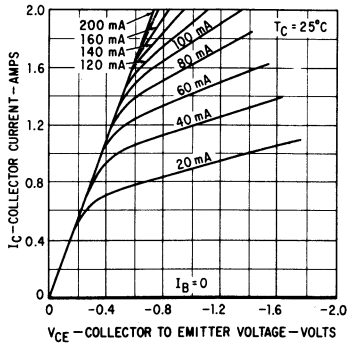


TYPICAL ELECTRICAL CHARACTERISTICS

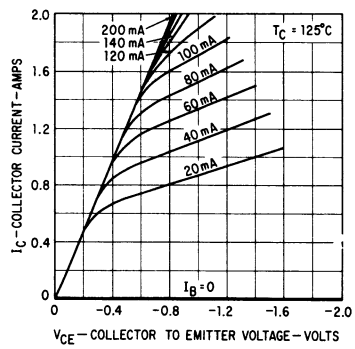
COLLECTOR CHARACTERISTICS* SATURATION REGION



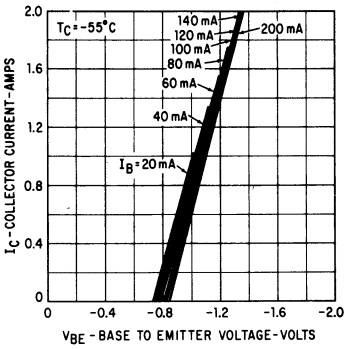
COLLECTOR CHARACTERISTICS* SATURATION REGION



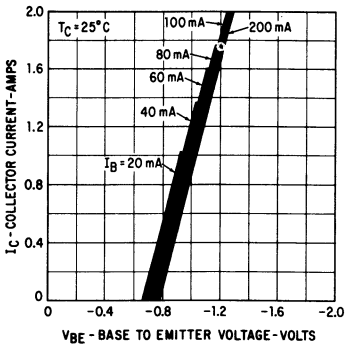
COLLECTOR CHARACTERISTICS* SATURATION REGION



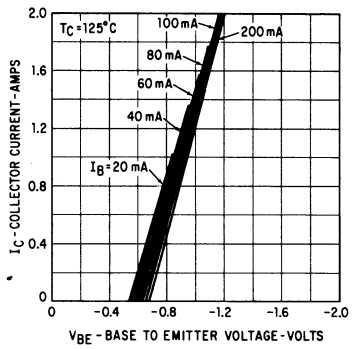
BASE CHARACTERISTICS*



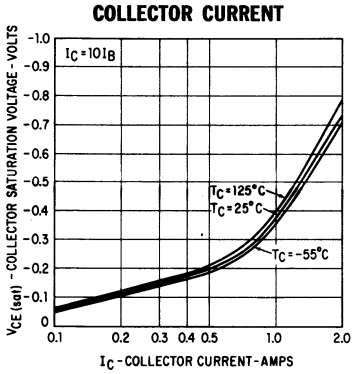
BASE CHARACTERISTICS*



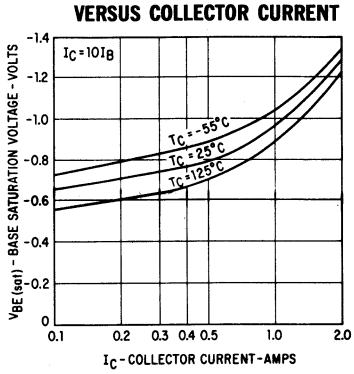
BASE CHARACTERISTICS*



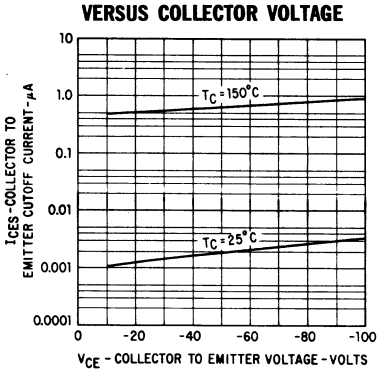
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



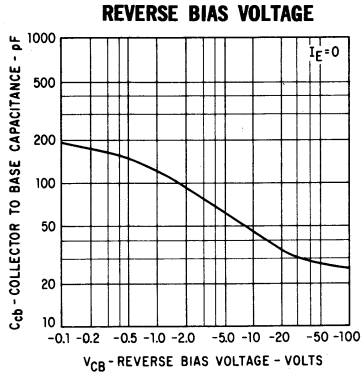
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



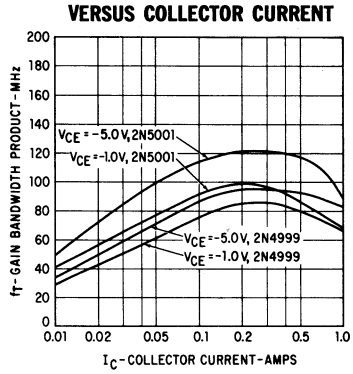
COLLECTOR CUTOFF CURRENT VERSUS COLLECTOR VOLTAGE



COLLECTOR TO BASE CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT

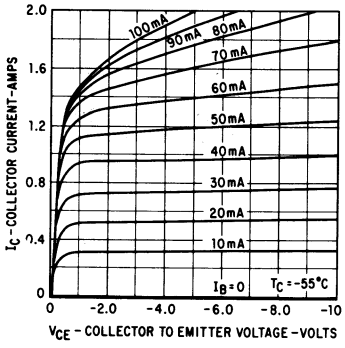


* Single family characteristic on Transistor Curve Tracer.

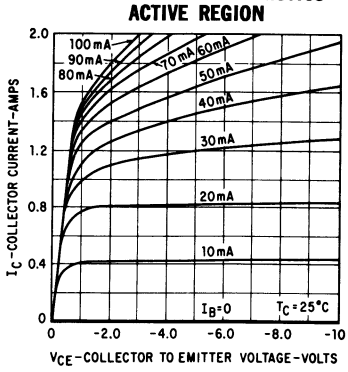
TYPICAL ELECTRICAL CHARACTERISTICS

2N4999

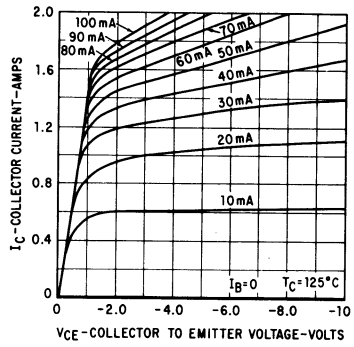
COLLECTOR CHARACTERISTICS* ACTIVE REGION



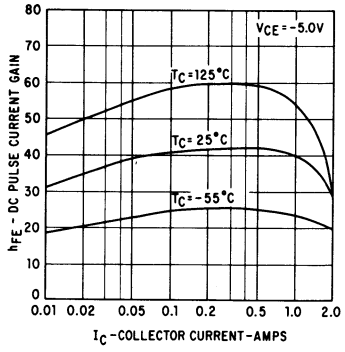
COLLECTOR CHARACTERISTICS* ACTIVE REGION



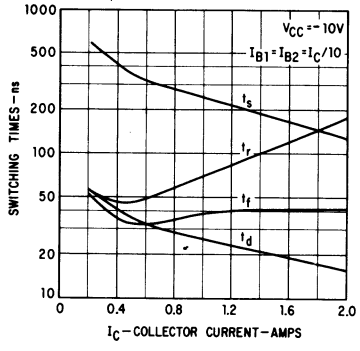
COLLECTOR CHARACTERISTICS* ACTIVE REGION



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

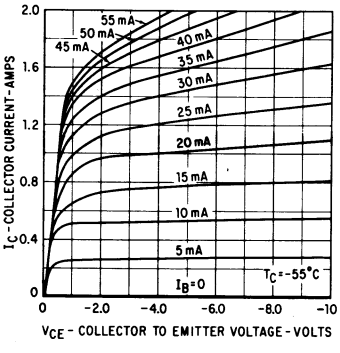


SWITCHING TIMES VERSUS COLLECTOR CURRENT

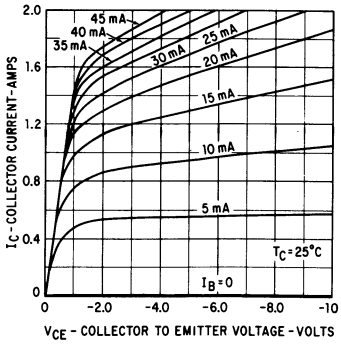


2N5001

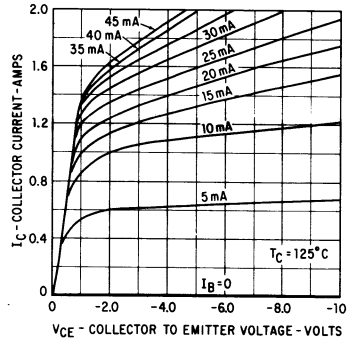
COLLECTOR CHARACTERISTICS* ACTIVE REGION



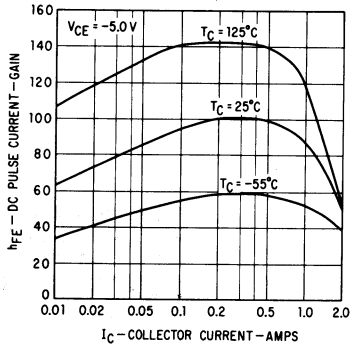
COLLECTOR CHARACTERISTICS* ACTIVE REGION



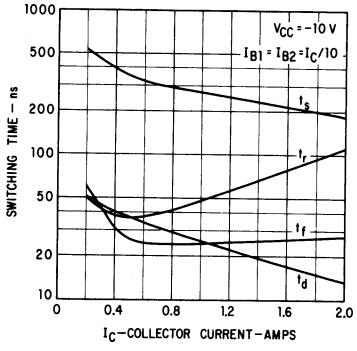
COLLECTOR CHARACTERISTICS* ACTIVE REGION



DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



SWITCHING TIMES VERSUS COLLECTOR CURRENT



* Single family characteristic on Transistor Curve Tracer.