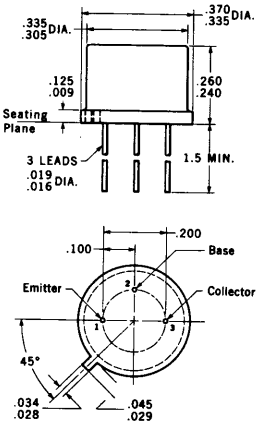
2N3015

FAIRCHILD NPN DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

HIGH SPEED SATURATED SWITCH

The 2N3015 is an NPN double-diffused silicon PLANAR epitaxial transistor designed primarily for high-speed commercial switching applications at collector currents to 500 milliamperes and collector voltages to 60 volts. It is an excellent core driver with switching times guaranteed at 300 and 500 mA, and an LV_{CEO} of 30 volts.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold-plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (Soldering, 60 sec time limit)	300°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	3.0 Watts
at 25°C Ambient Temperature [Notes 2 and 3]	0.8 Watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	60 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	30 Volts
V_{EBO} Emitter to Base Voltage	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	30	63	120		I_C = 150 mA	V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain [Note 5]	10	50			I_C = 300 mA	V_{CE} = 0.7 V
V_{CE} (sat)	Collector Saturation Voltage [pulsed, see Note 5]		0.23	0.4	Volts	I_C = 150 mA	I_B = 15 mA
V_{CE} (sat)	Collector Saturation Voltage [pulsed, see Note 5]		0.46	1.0	Volts	I_C = 500 mA	I_B = 50 mA
V_{BE} (sat)	Base Saturation Voltage [pulsed, see Note 5]		0.85	1.2	Volts	I_C = 150 mA	I_B = 15 mA
V_{BE} (sat)	Base Saturation Voltage [pulsed, see Note 5]		1.12	1.6	Volts	I_C = 500 mA	I_B = 50 mA
h_{fe}	High Frequency Current Gain (f = 100 MHz	2.5	3.3			I_C = 50 mA	V_{CE} = 10 V
I_{CES}	Collector Reverse Current		0.05	0.2	μA	V_{BE} = 0	V_{CE} = 30 V
I_{CBO} (125°C)	Collector Cutoff Current		6.5	200	μA	I_E = 0	V_{CB} = 30 V
C_{obo}	Output Capacitance		5.0	8.0	pF	I_E = 0	V_{CB} = 10 V
BV_{CBO}	Collector to Base Breakdown Voltage	60			Volts	I_C = 100 μA	I_E = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	30			Volts	I_C = 30 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	I_E = 100 μA	I_C = 0
t_{on}	Turn On Time [Note 6]		22	40	nsec	$I_C \approx$ 300 mA	$I_{B1} \approx$ 30 mA
t_{on}	Turn On Time [Note 6]		22	40	nsec	$I_C \approx$ 500 mA	$I_{B1} \approx$ 50 mA
t_{off}	Turn Off Time [Note 6]		22	60	nsec	$I_C \approx$ 300 mA, $I_{B1} \approx$ 30 mA, $I_{B2} \approx$ −30 mA	
t_{off}	Turn Off Time [Note 6]		22	60	nsec	$I_C \approx$ 500 mA, $I_{B1} \approx$ 50 mA, $I_{B2} \approx$ −50 mA	

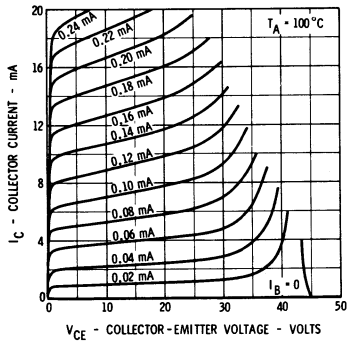
* Planar is a patented Fairchild process.

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 200°C and junction-to-case thermal resistance of 58.3°C/watt (derating factor of 17.2 mW/°C). Junction-to-ambient thermal resistance of 219°C/watt (derating factor of 4.6 mW/°C).

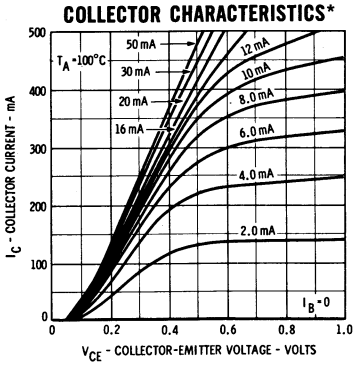
FAIRCHILD SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

TYPICAL ELECTRICAL CHARACTERISTICS

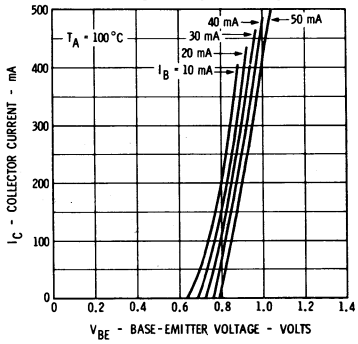
COLLECTOR CHARACTERISTICS*



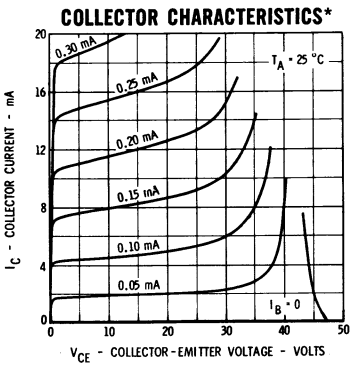
COLLECTOR CHARACTERISTICS*



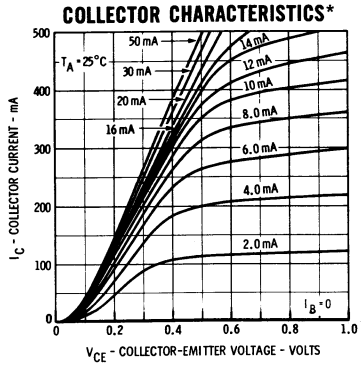
BASE CHARACTERISTICS*



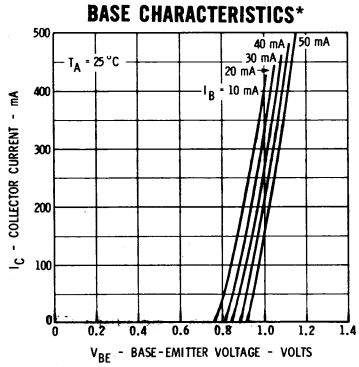
COLLECTOR CHARACTERISTICS*



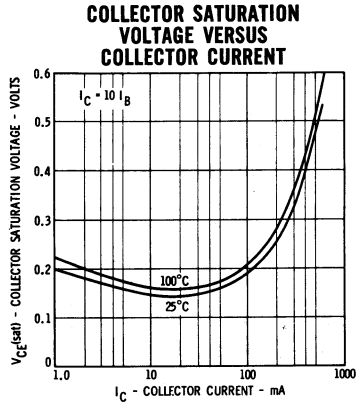
COLLECTOR CHARACTERISTICS*



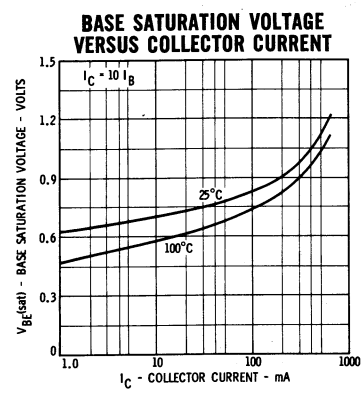
BASE CHARACTERISTICS*



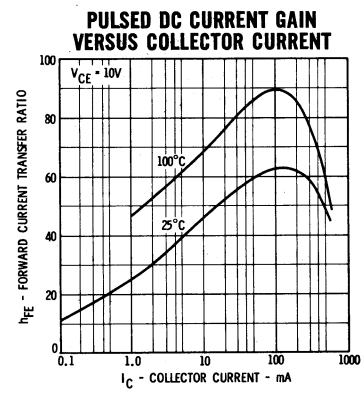
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



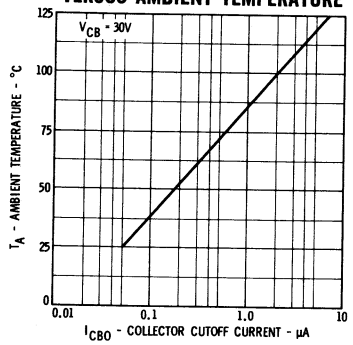
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



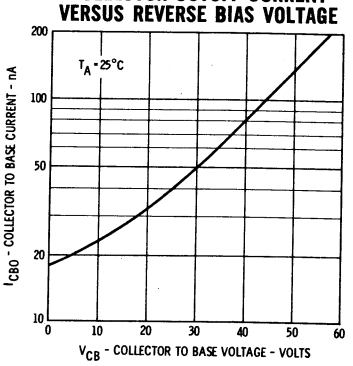
* Single family characteristic on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

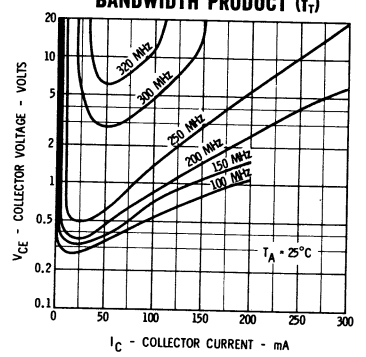
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



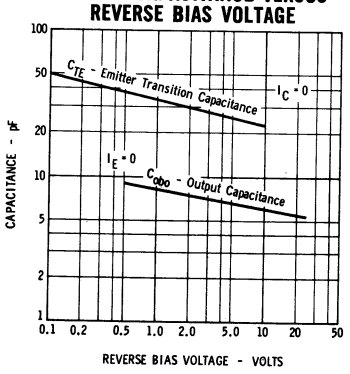
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



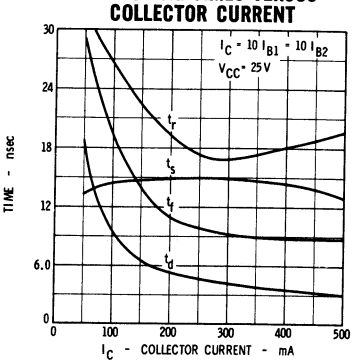
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



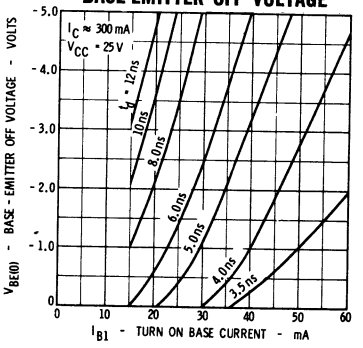
EMITTER TRANSISTION AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



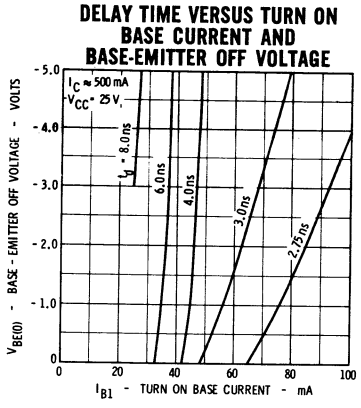
SWITCHING TIMES VERSUS COLLECTOR CURRENT



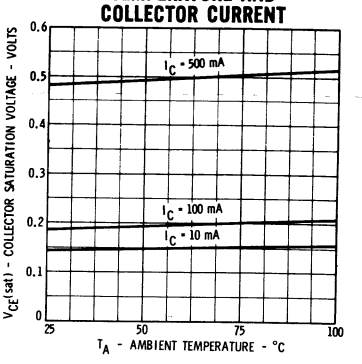
DELAY TIME VERSUS TURN ON BASE CURRENT AND BASE-EMITTER OFF VOLTAGE



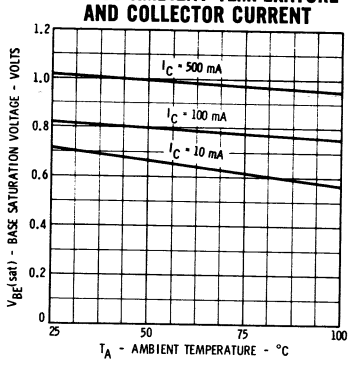
DELAY TIME VERSUS TURN ON BASE CURRENT AND BASE-EMITTER OFF VOLTAGE



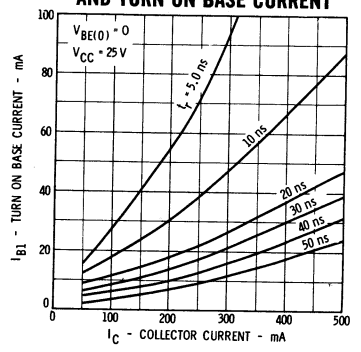
COLLECTOR SATURATION VOLTAGE VERSUS AMBIENT TEMPERATURE AND COLLECTOR CURRENT



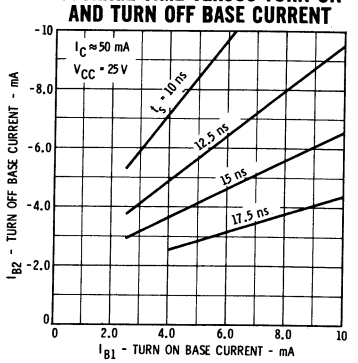
BASE SATURATION VOLTAGE VERSUS AMBIENT TEMPERATURE AND COLLECTOR CURRENT



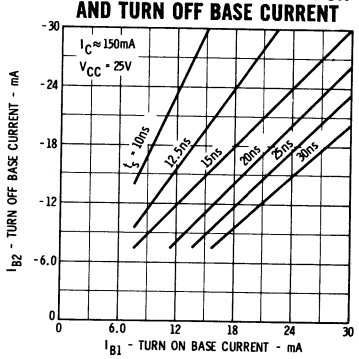
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT



STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

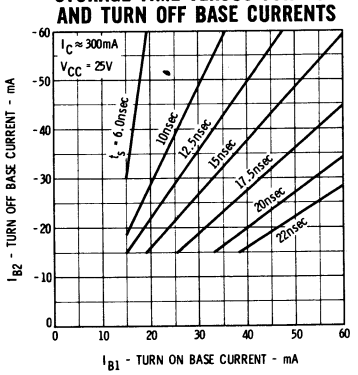


STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT

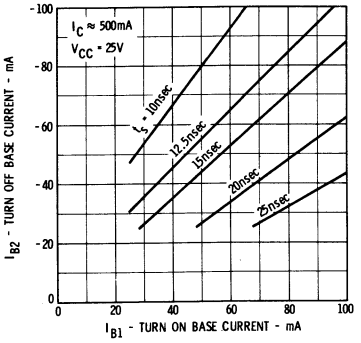


TYPICAL SWITCHING CHARACTERISTICS

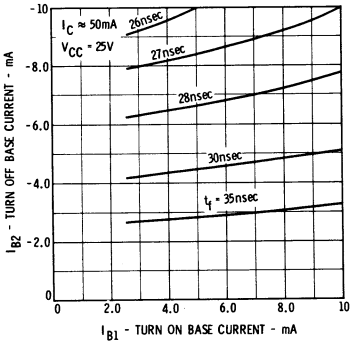
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



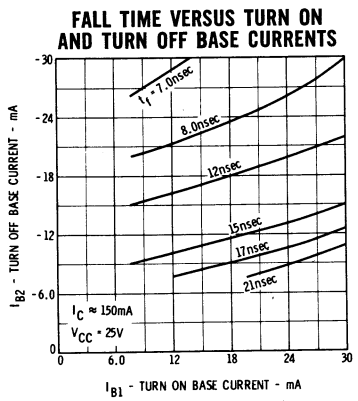
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



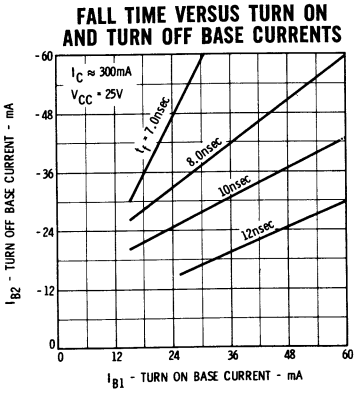
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



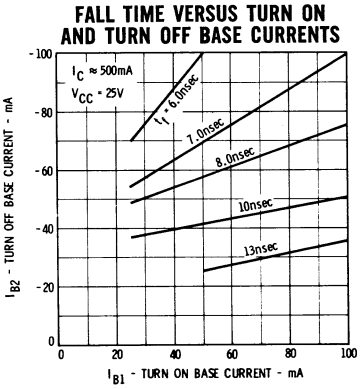
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



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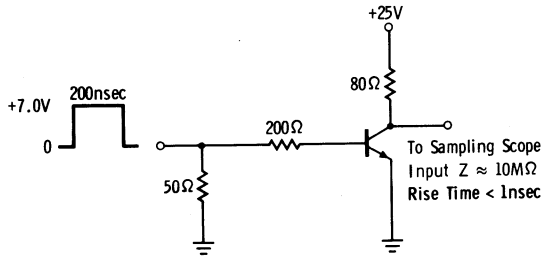
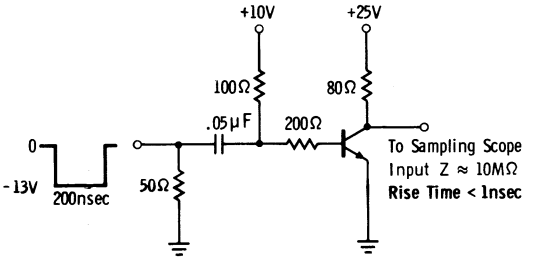
t_{on} TEST CIRCUIT ($I_C \approx 300$ mA)



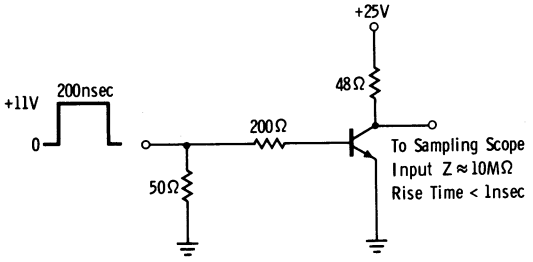
Rise time of input pulse < 2.0nsec
Input impedance ≈ 50Ω

t_{off} TEST CIRCUIT ($I_C \approx 300$ mA)



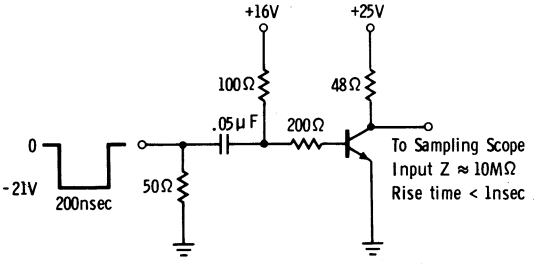
Rise Time of input pulse < 2.0nsec
Input impedance ≈ 50Ω

t_{on} TEST CIRCUIT ($I_C \approx 500$ mA)



Rise time of input pulse < 2.0nsec
Input impedance ≈ 50Ω

t_{off} TEST CIRCUIT ($I_C \approx 500$ mA)



Rise time of input pulse < 2.0nsec
Input impedance ≈ 50Ω

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.
(6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

2N3056 • 2N3056A • 2N3057 • 2N3057A

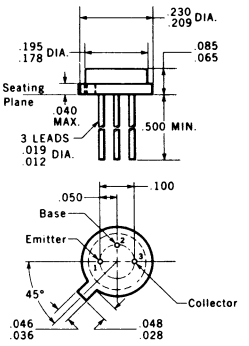
NPN HIGH-VOLTAGE, HIGH-CURRENT AMPLIFIERS

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

→ TO-?

GENERAL DESCRIPTION - These devices are NPN silicon Planar epitaxial transistors designed for use in high-current amplifier applications. Operation to one ampere plus collector to emitter voltage of 60 and 80 volts is permissible.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-46) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case
Package weight is 0.36 gram

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-65°C to +200°C
Operating Junction Temperature	+200°C Maximum
Lead Temperature (Soldering, 60 sec. time limit)	+300°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	(Notes 2 and 3)	5.0 Watts
at 100°C Case Temperature	(Notes 2 and 3)	2.8 Watts
at 25°C Ambient Temperature	(Notes 2 and 3)	0.4 Watt

Maximum Voltages and Current

			2N3056 2N3057	2N3056A 2N3057A
V_{CBO}	Collector to Base Voltage		100 Volts	140 Volts
V_{CEO}	Collector to Emitter Voltage	(Note 4)	60 Volts	80 Volts
V_{EBO}	Emitter to Base Voltage		7.0 Volts	7.0 Volts
I_C	Continuous Collector Current	(Note 2)	1.0 Amp	1.0 Amp

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

Symbol	Characteristic	2N3056 2N3056A Min.	2N3056 2N3056A Max.	2N3057 2N3057A Min.	2N3057 2N3057A Max.	Units	Test Conditions
h_{FE}	DC Pulse Current Gain (Note 5)	40	120	100	300		I_C = 150 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	40	120	90			I_C = 10 mA V_{CE} = 10 V
h_{FE}	DC Current Gain	30	100	50			I_C = 100 μA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	100	50			I_C = 500 mA V_{CE} = 10 V
$h_{FE}(-55°C)$	DC Pulse Current Gain (Note 5)			40			I_C = 150 mA V_{CE} = 10 V
h_{FE}	DC Pulse Current Gain (Note 5)	15		15			I_C = 1.0 A V_{CE} = 10 V
$V_{BE}(sat)$	Base Saturation Voltage (pulsed, see Note 5)		1.1		1.1	Volts	I_C = 150 mA I_B = 15 mA
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	30	200	80	400		I_C = 1.0 mA V_{CE} = 5.0 V
C_{obo}	Open Circuit Output Capacitance		12		12	pf	I_E = 0 V_{CB} = 10 V
C_{ibo}	Open Circuit Input Capacitance		60		60	pf	I_C = 0 V_{EB} = 0.5 V
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		7.0		Volts	I_E = 100 μA I_C = 0
I_{EBO}	Emitter Cutoff Current		10		10	nA	I_C = 0 V_{EB} = 5.0 V
NF	Noise Figure (Note 6)				4.0	db	I_C = 100 μA V_{CE} = 10 V

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

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

2N3120 • 2N3121

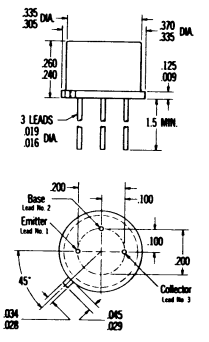
PNP VHF AMPLIFIERS, HIGH CURRENT SWITCHES

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

The 2N3120 and 2N3121 are PNP silicon PLANAR epitaxial transistors designed for digital and analog applications at current levels to 500 milliamperes. The high gain-bandwidth product, f_T, at high currents, makes them excellent units for line driving and memory applications.

2N3120

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



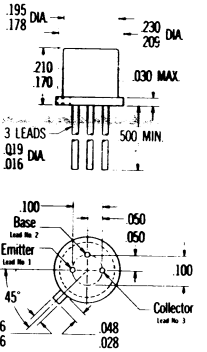
NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS [Note 1]

		2N3120	2N3121
Maximum Temperatures			
Storage Temperature		**−65°C** to **+200°C**	**−65°C** to **+200°C**
Operating Junction Temperature		**200°C** Maximum	**200°C** Maximum
Lead Temperature (Soldering, 60 sec time limit)		**300°C** Maximum	**300°C** Maximum
Maximum Power Dissipation			
Total Dissipation at 25°C Case Temperature [Notes 2 & 3]		**3.0** Watts	**1.2** Watts
at 25°C Ambient Temperature [Notes 2 & 3]		**0.8** Watt	**0.36** Watt
Maximum Voltages and Current			
V_{CBO}	Collector to Base Voltage	**−45** Volts	**−45** Volts
V_{CEO}	Collector to Emitter Voltage [Note 4]	**−45** Volts	**−45** Volts
V_{EBO}	Emitter to Base Voltage	**−4.0** Volts	**−4.0** Volts
I_C	Collector Current [Note 2]	**500** mA	**500** mA

2N3121

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



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain [Note 5]	**30**	**67**	**130**		$I_C = 50$ mA $V_{CE} = -1.0$ V
h_{FE}	DC Pulse Current Gain [Note 5]	**15**	**43**			$I_C = 300$ mA $V_{CE} = -2.0$ V
V_{BE} (sat)	Base Saturation Voltage		**−0.9**	**−1.2**	Volts	$I_C = 50$ mA $I_B = 2.5$ mA
V_{BE} (sat)	Base Saturation Voltage		**−1.35**	**−2.0**	Volts	$I_C = 500$ mA $I_B = 50$ mA
V_{CE} (sat)	Collector Saturation Voltage		**−0.08**	**−0.25**	Volts	$I_C = 50$ mA $I_B = 2.5$ mA
V_{CE} (sat)	Collector Saturation Voltage		**−0.6**	**−1.0**	Volts	$I_C = 500$ mA $I_B = 50$ mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	**1.3**	**2.0**			$I_C = 50$ mA $V_{CE} = -20$ V
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	**−45**			Volts	$I_C = 30$ mA (pulsed) $I_B = 0$
t_{on}	Turn On Time [Note 6]		**17**	**40**	nSec	$I_C \approx 300$ mA $I_{B1} \approx 30$ mA
t_{off}	Turn Off Time [Note 6]		**40**	**100**	nSec	$I_C \approx 300$ mA $I_{B1} \approx 30$ mA $I_{B2} \approx -30$ 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 200°C and junction-to-case thermal resistance of 58.3°C/Watt (derating factor of 17.2 mW/°C) for the 2N3120 and 146°C/Watt (derating factor of 6.85 mW/°C) for the 2N3121. Junction-to-ambient thermal resistance of 219°C/Watt (derating factor of 4.56 mW/°C for the 2N3120 and 486°C/Watt (derating factor of 2.1 mW/°C) for the 2N3121.
(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μSec; duty cycle = 1%.
(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

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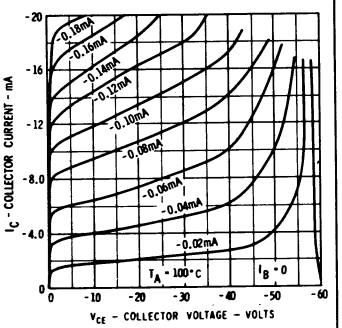
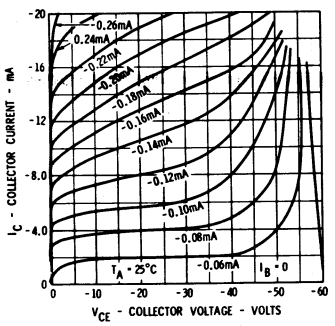
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

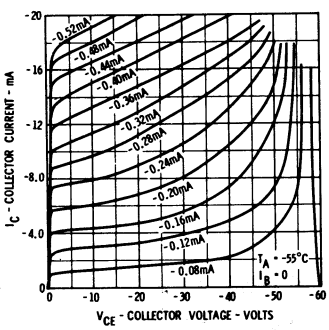
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	12	50			$I_C = 50$ mA $V_{CE} = -1.0$ V
V_{CE} (sat)	Collector Saturation Voltage		−0.33	−0.5	Volts	$I_C = 300$ mA $I_B = 30$ mA
C_{ob}	Output Capacitance		7.0	10	pf	$I_E = 0$ $V_{CB} = -10$ V
I_{CES}	Collector Reverse Current		0.033	10	nA	$V_{CE} = -30$ V $V_{BE} = 0$
I_{CES} (125°C)	Collector Reverse Current		0.3	10	μA	$V_{CE} = -30$ V $V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−45			Volts	$I_C = 100$ μA $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.0			Volts	$I_E = 100$ μA $I_C = 0$

TYPICAL COLLECTOR AND BASE CHARACTERISTICS*

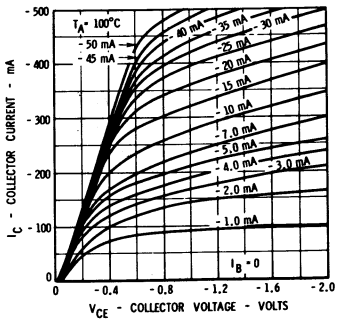
ACTIVE REGION

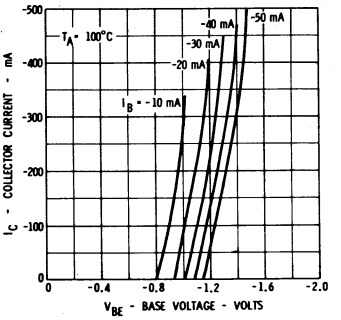


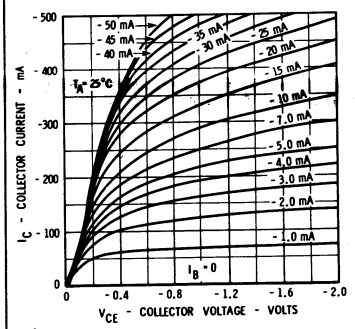


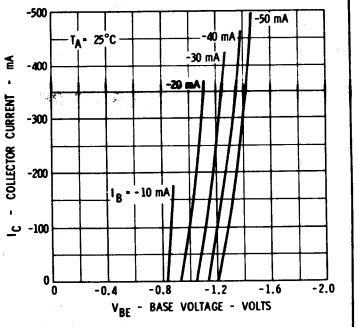


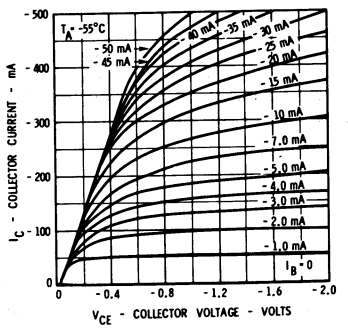
SATURATION REGION

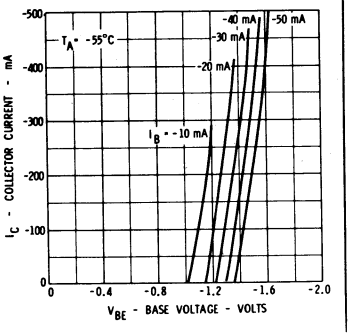




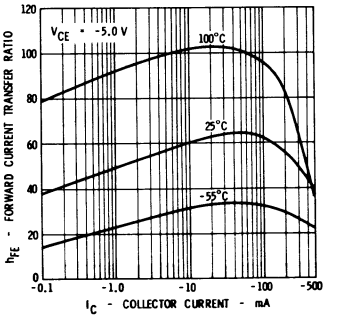




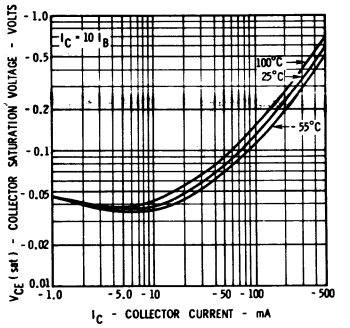




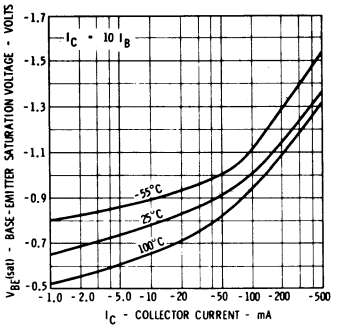
DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



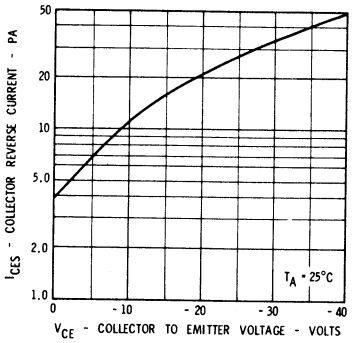
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



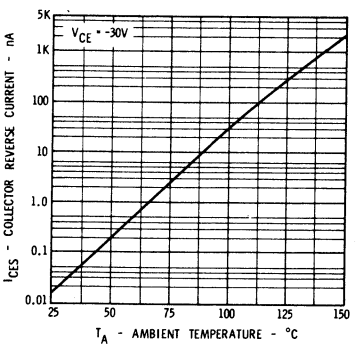
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

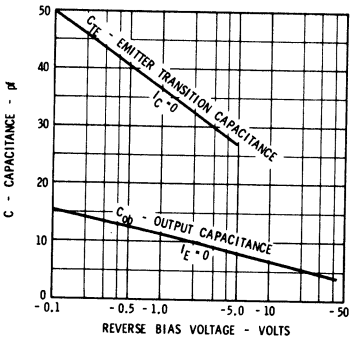
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



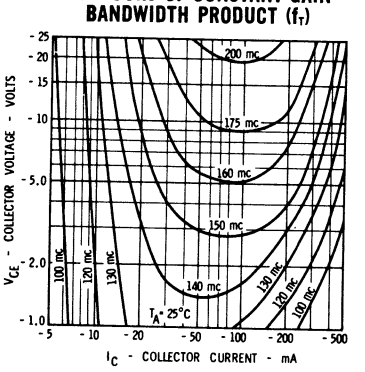
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



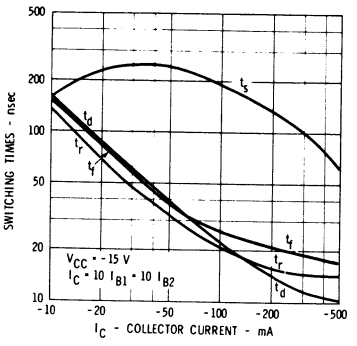
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



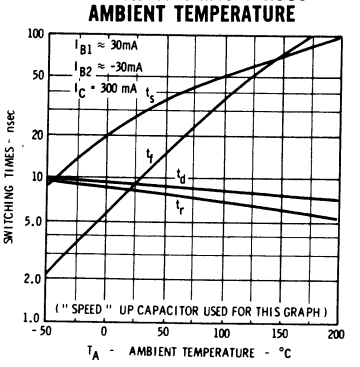
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



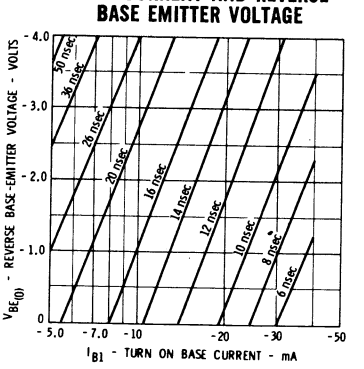
SWITCHING TIMES VERSUS COLLECTOR CURRENT



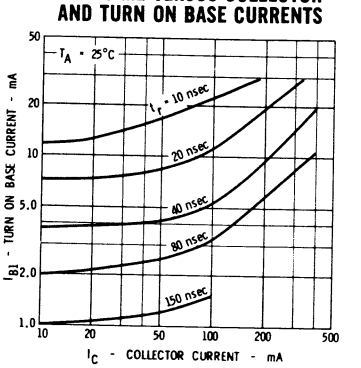
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



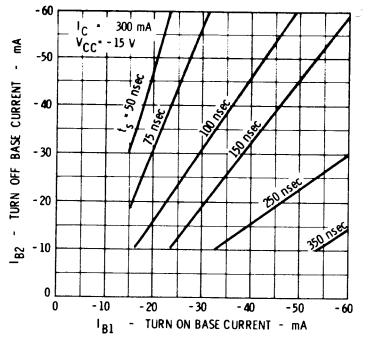
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



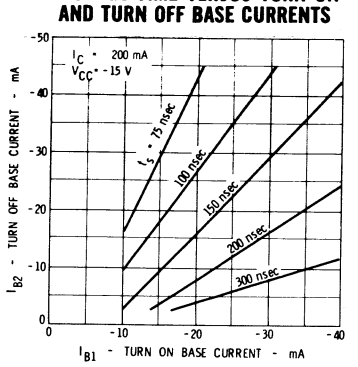
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



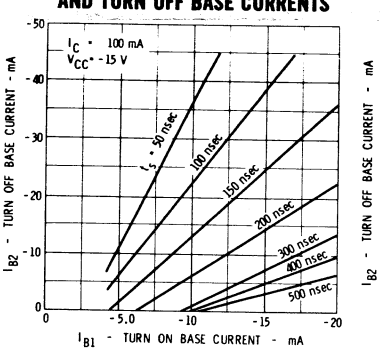
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



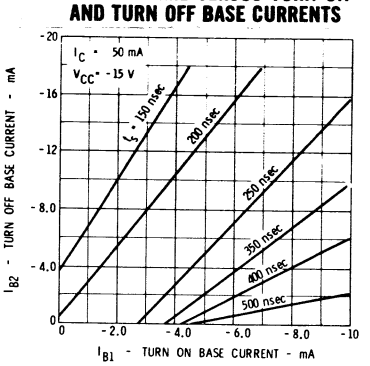
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



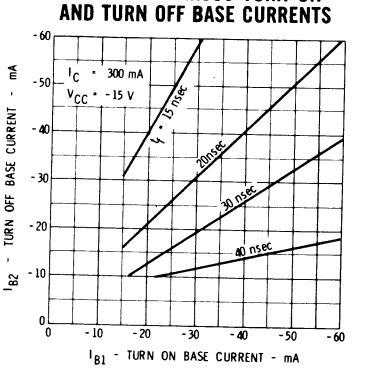
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



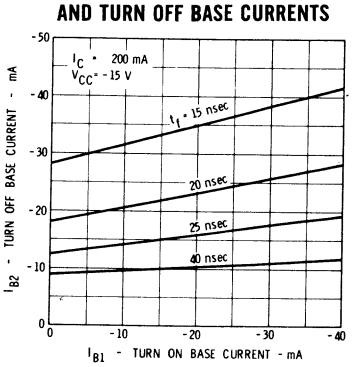
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



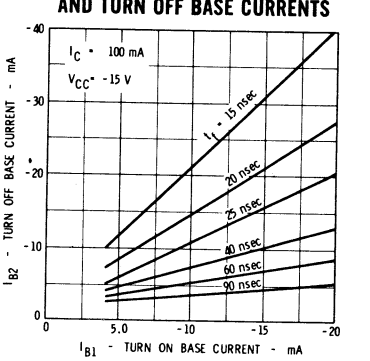
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



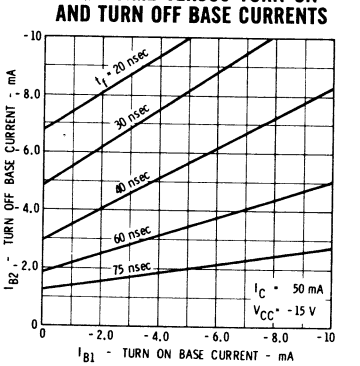
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



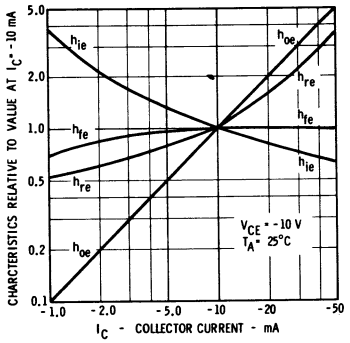
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

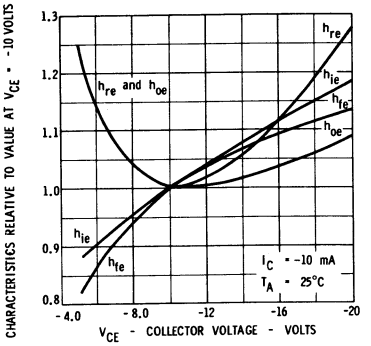


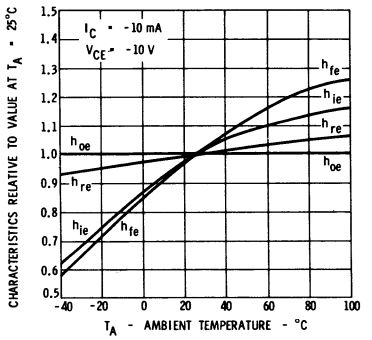
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



SMALL SIGNAL CHARACTERISTICS



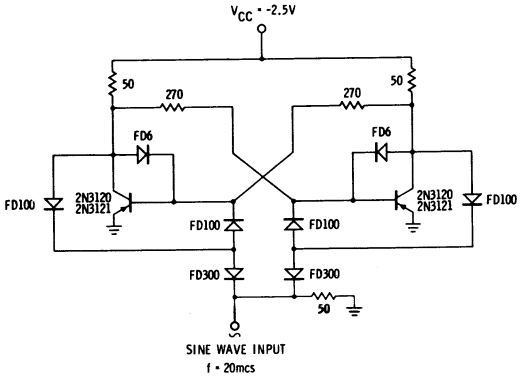




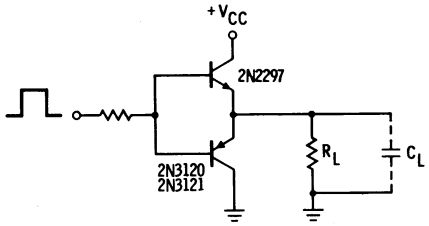
h PARAMETERS (f = 1 kc)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance		480	1500	ohms	$I_C = 10$ mA $V_{CE} = -10$ V
h_{oe}	Output Conductance		80	1200	μmhos	$I_C = 10$ mA $V_{CE} = -10$ V
h_{re}	Voltage Feedback Ratio		162	2600	$x10^{-6}$	$I_C = 10$ mA $V_{CE} = -10$ V
h_{fe}	Small Signal Current Gain	25	74	180		$I_C = 10$ mA $V_{CE} = -10$ V

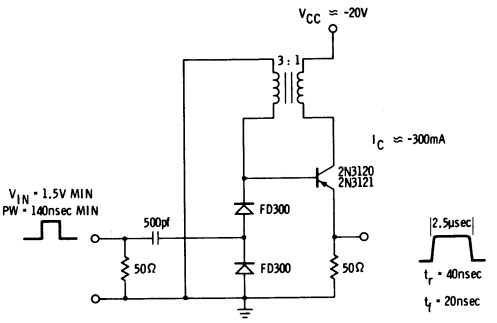
20 MC BINARY COUNTER



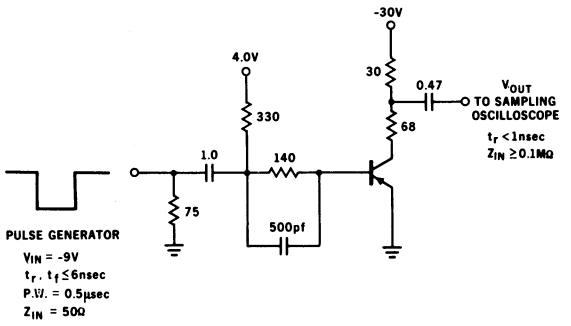
LINE DRIVER



MONOSTABLE BLOCKING OSCILLATOR



T_{ON} and T_{OFF} TEST CIRCUIT



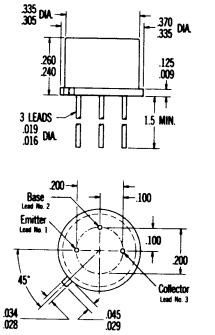
2N3137

NPN CLASS-C RF AMPLIFIER

DIFFUSED SILICON PLANAR*EPITAXIAL TRANSISTOR

The **2N3137** is an NPN silicon PLANAR epitaxial transistor designed primarily for service as a Class-C, RF power amplifier. Power output at 250 MHz is typically 0.5 watt with 100 mW drive. In addition to the large signal capabilities, the low-noise and high gain-bandwidth product characteristics of the 2N3137 provide excellent performance in a variety of small signal and linear amplifier applications.

PHYSICAL DIMENSIONS
in accordance with
JEDEC (TO-5) outline



NOTES: All dimensions in inches
Leads are gold plated kovar
Collector internally connected to case

ABSOLUTE MAXIMUM RATINGS [Note 1]

Maximum Temperatures	
Storage Temperature	−65°C to +200°C
Operating Junction Temperature	200°C Maximum
Lead Temperature (soldering, 60 sec. time limit)	300°C Maximum
Maximum Power Dissipation	
Total Dissipation at 25°C Case Temperature [Notes 6 and 7]	1.0 watt
25°C Ambient Temperature [Notes 6 and 7]	0.6 watt
Maximum Voltages	
V_{CBO} Collector to Base Voltage	40 Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	20 Volts
V_{EBO} Emitter to Base Voltage	4.0 Volts

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain [Note 5]	20	70	120		I_C = 50 mA	V_{CE} = 5.0 V
V_{CE} (sat)	Collector Saturation Voltage		0.12	0.3	Volts	I_C = 50 mA	I_B = 5.0 mA
I_{CBO}	Collector Cutoff Current		0.12	50	nA	I_E = 0	V_{CB} = 20 V
I_{CBO} (150°C)	Collector Cutoff Current		0.10	50	μA	I_E = 0	V_{CB} = 20 V
BV_{CBO}	Collector to Base Breakdown Voltage	40			Volts	I_E = 0	I_C = 100 μA
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			Volts	I_C = 0	I_E = 100 μA
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	20			Volts	I_B = 0	I_C = 15 mA (pulsed)
h_{fe}	High Frequency Current Gain (f = 100 MHz)	5.0	7.5			I_C = 50 mA	V_{CE} = 10 V
C_{obo}	Output Capacitance		2.8	3.5	pF	I_E = 0	V_{CB} = 10 V
G_{PE}	Amplifier Power Gain [Note 2] (f_o = 250 MHz)	6.0	7.0		dB	I_C = 0 (zero signal)	V_{CE} = 20 V (zero signal)
η	Collector Efficiency [Note 3] (f_o = 250 MHz)	40	60		%	I_C = 0 (zero signal)	V_{CE} = 20 V (zero signal)

* 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) RF power-in = 100 mW (see test circuit).
(3) RF power-in = 100 mW. Conduction angle adjusted through R to obtain maximum efficiency with a minimum of 400 mW out. (See test circuit.)
(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.
(6) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(7) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 175°C/watt (derating factor of 5.71 mW/°C); junction-to-ambient thermal resistance of 292°C/watt (derating factor of 3.42 mW/°C).

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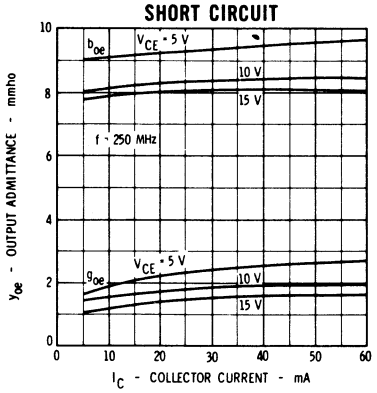
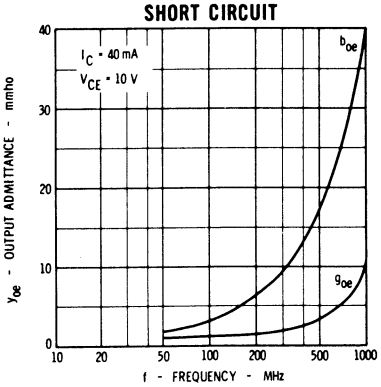
FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

TYPICAL ELECTRICAL CHARACTERISTICS

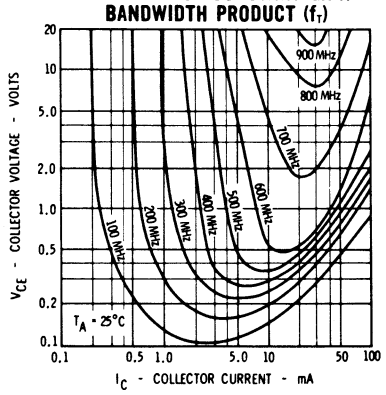
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT-INPUT SHORT CIRCUIT



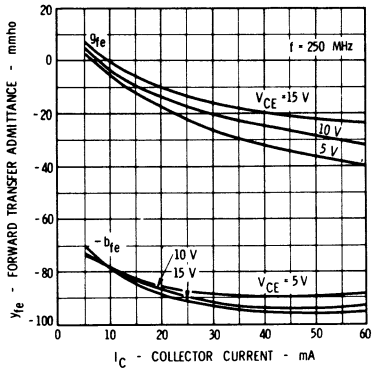
OUTPUT ADMITTANCE VERSUS FREQUENCY INPUT SHORT CIRCUIT



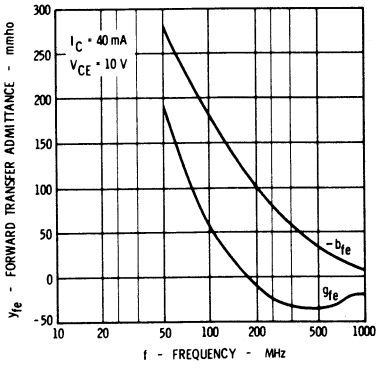
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



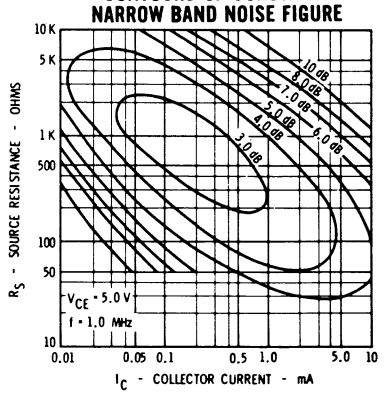
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT-OUTPUT SHORT CIRCUIT



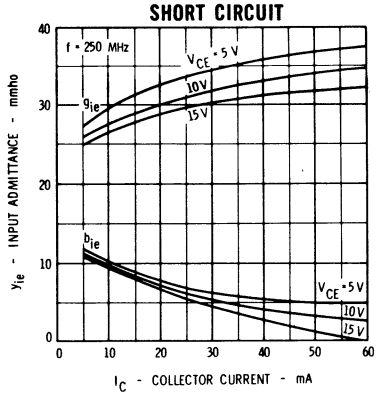
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



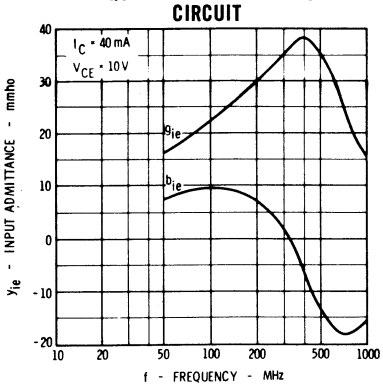
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



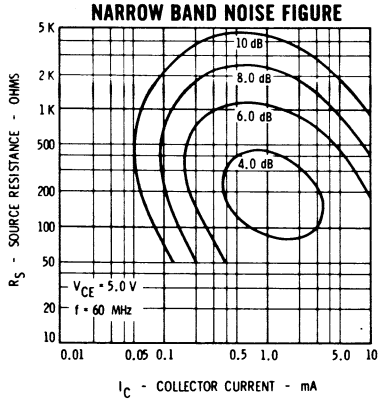
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT-OUTPUT SHORT CIRCUIT



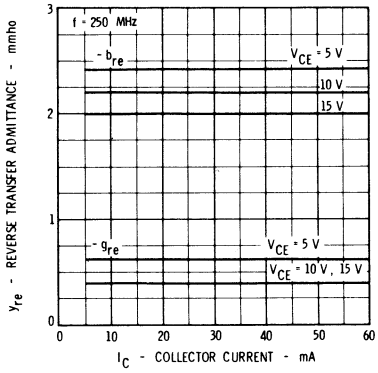
INPUT ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



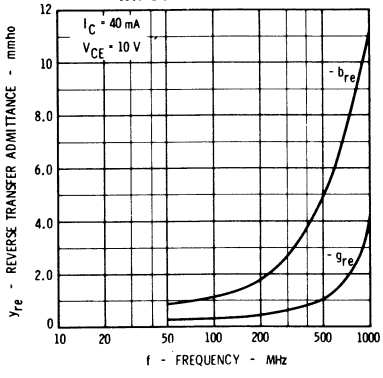
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



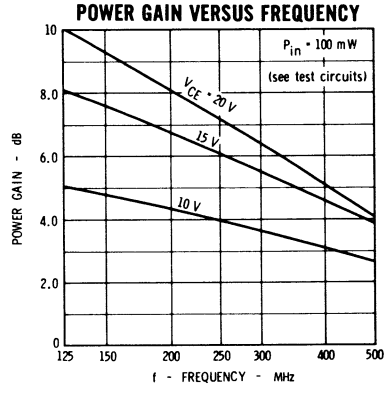
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT-INPUT SHORT CIRCUIT



REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY — INPUT SHORT CIRCUIT



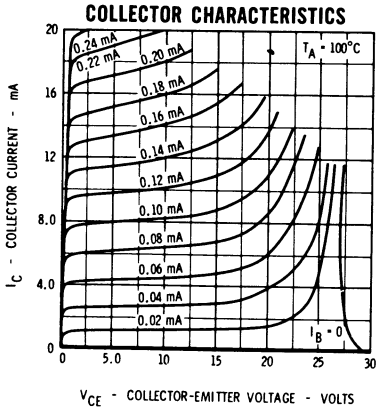
POWER GAIN VERSUS FREQUENCY



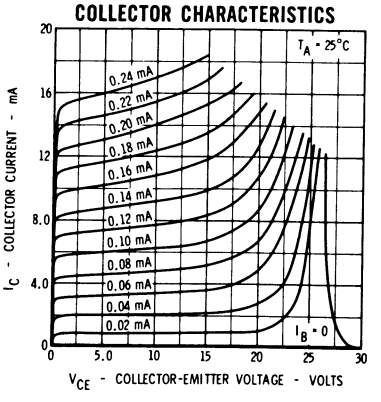
FAIRCHILD TRANSISTOR 2N3137

TYPICAL ELECTRICAL CHARACTERISTICS

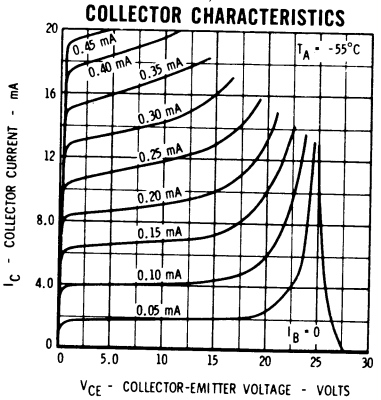
COLLECTOR CHARACTERISTICS



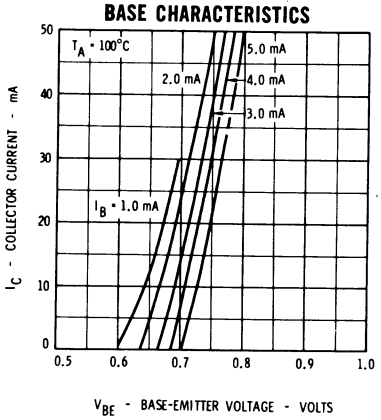
COLLECTOR CHARACTERISTICS



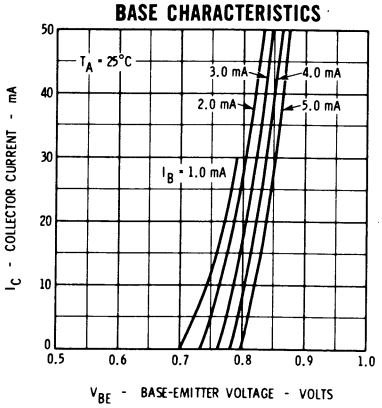
COLLECTOR CHARACTERISTICS



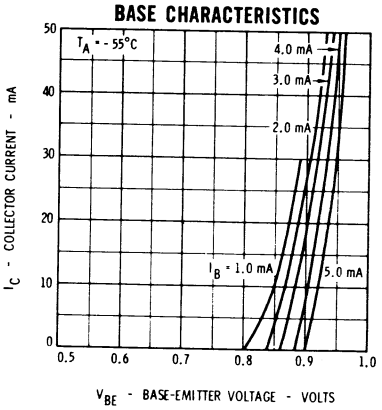
BASE CHARACTERISTICS



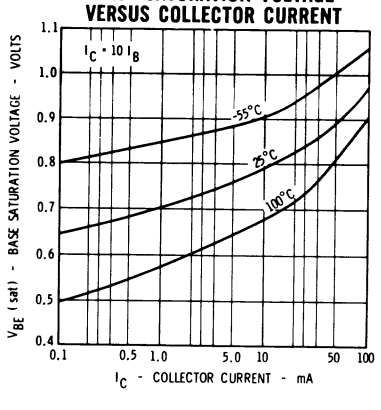
BASE CHARACTERISTICS



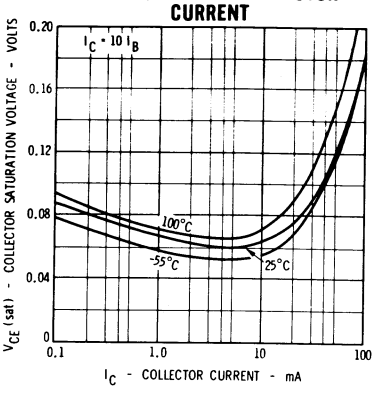
BASE CHARACTERISTICS



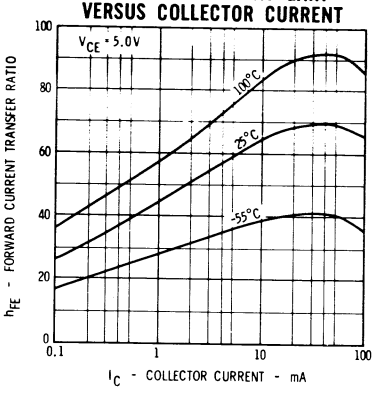
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



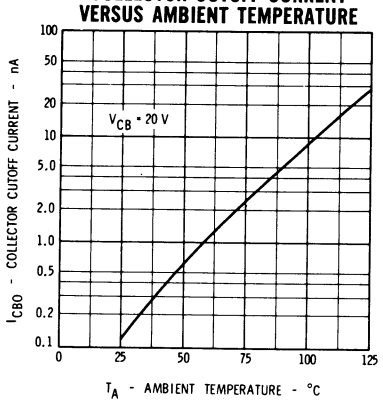
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



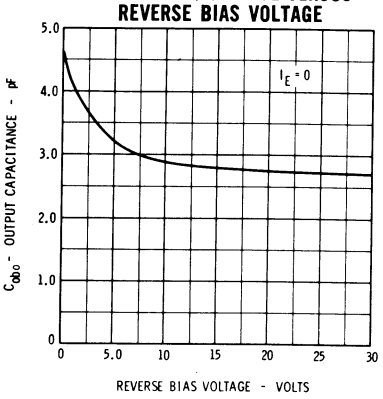
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



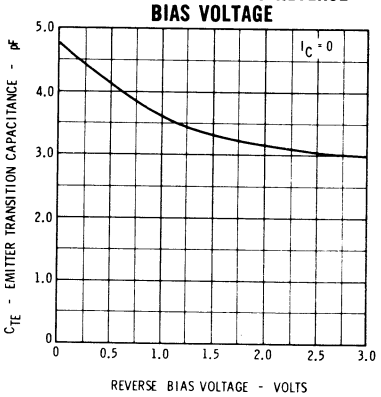
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



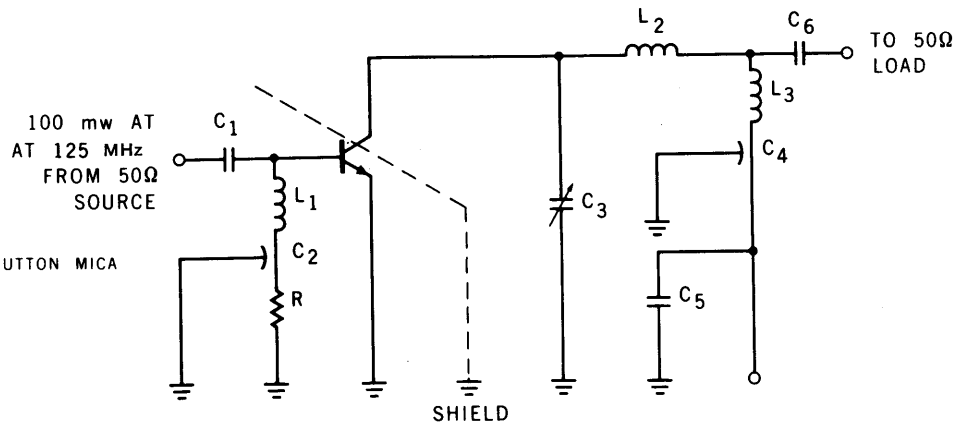
OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



EMITTER TRANSITION CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



125 MHz POWER AMPLIFIER



C_1 . C_2 . C_4 . C_6 = 1000 pF BUTTON MICA

C_3 = 2 - 8 pF

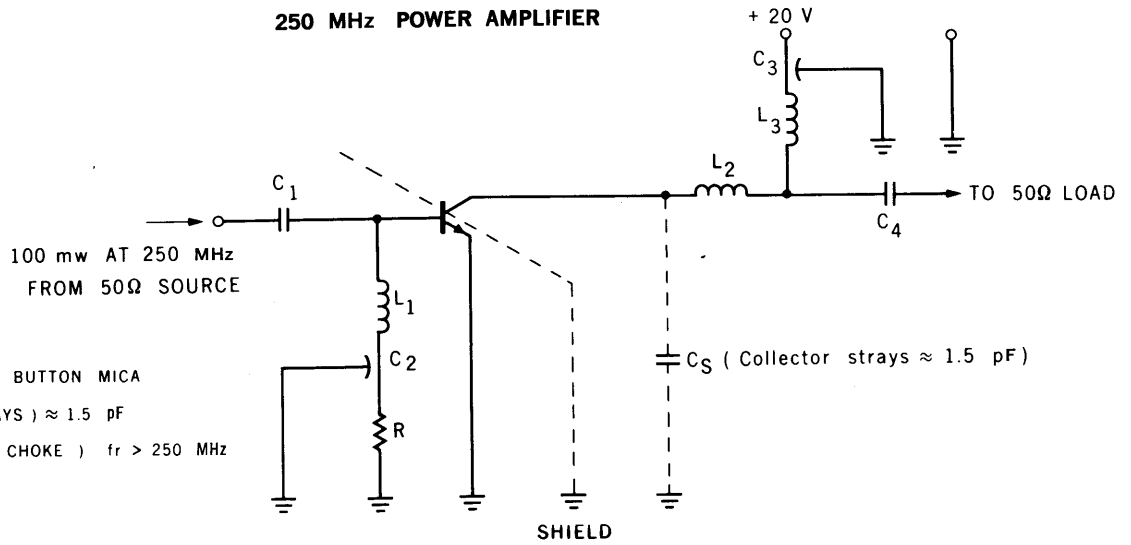
C_5 = 6 μF AT 50 V

L_1 L_3 = RFC fr > 125 MHz

L_2 = - 16 pF

R = 200Ω

250 MHz POWER AMPLIFIER



C_1 = 120 pF

C_2 . C_3 . C_4 = 1000 pF BUTTON MICA

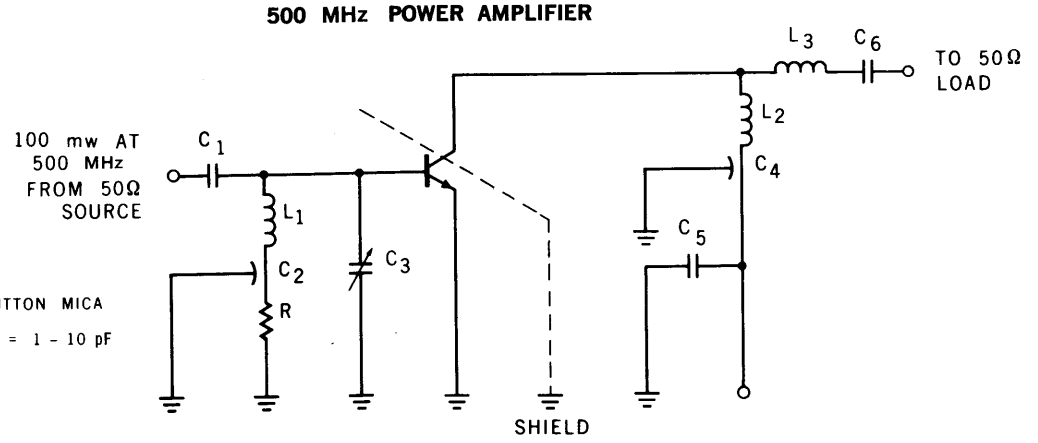
C_S (COLLECTOR STRAYS) ≈ 1.5 pF

L_1 .L_3 = .47 μH (RF CHOKE) fr > 250 MHz

L_2 = -5.5 pF

R = 200Ω

500 MHz POWER AMPLIFIER



C_1 = 10 pF

C_2 . C_4 . C_6 = 1000 pF BUTTON MICA

C_5 = 6 μF AT 50 V C_3 = 1 - 10 pF

L_1 = - 9 pF

L_2 = - 3.5 pF

L_3 = - 7.5 pF

R = 20Ω

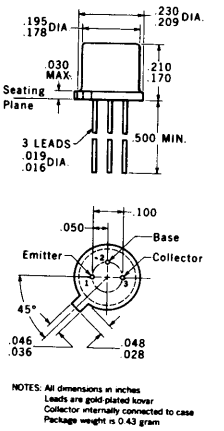
2N3209

PNP HIGH-SPEED SWITCH AND RF AMPLIFIER

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTOR

The **2N3209** is a 550 mc PNP diffused silicon PLANAR epitaxial transistor designed for saturated and non-saturated switching circuits requiring up to 200 milliamperes of collector current. It is suitable for 20 mc RF amplifiers, 10.7 mc IF amplifiers, 100 mc oscillator converter circuits.

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



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

ABSOLUTE MAXIMUM RATING [Note 1]

Maximum Temperatures

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

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature [Notes 2 and 3]	**1.2** Watts
at 25°C Ambient Temperature [Notes 2 and 3]	**0.36** Watt

Maximum Voltages and Current

V_{CBO} Collector to Base Voltage	**−20** Volts
V_{CEO} Collector to Emitter Voltage [Note 4]	**−20** Volts
V_{EBO} Emitter to Base Voltage	**−4.0** Volts
I_C Collector Current	**200** mA

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain [Note 5]	**30**	**75**	**120**		$I_C = 30$ mA $V_{CE} = -0.5$ V
h_{FE}	DC Pulse Current Gain [Note 5]	**25**	**67**			$I_C = 10$ mA $V_{CE} = -0.3$ V
h_{FE}	DC Pulse Current Gain [Note 5]	**15**	**30**			$I_C = 100$ mA $V_{CE} = -1.0$ V
V_{CE} (sat)	Collector Saturation Voltage		**−0.07**	**−0.15**	Volts	$I_C = 10$ mA $I_B = 1.0$ mA
V_{CE} (sat)	Collector Saturation Voltage		**−0.1**	**−0.2**	Volts	$I_C = 30$ mA $I_B = 3.0$ mA
V_{CE} (sat)	Collector Saturation Voltage		**−0.28**	**−0.6**	Volts	$I_C = 100$ mA $I_B = 10$ mA
h_{fe}	High Frequency Current Gain (f = 100 mc)	**4.0**	**5.5**			$I_C = 30$ mA $V_{CE} = -10$ V
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage [Notes 4 and 5]	**−20**			Volts	$I_C = 10$ mA (pulsed) $I_B = 0$
t_{on}	Turn On Time [Note 6]		**23**	**60**	nsec	$I_C \approx 30$ mA $I_{B1} \approx 1.5$ mA
t_{off}	Turn Off Time [Note 6]		**34**	**90**	nsec	$I_C \approx 30$ mA, $I_{B1} \approx I_{B2} \approx 1.5$ 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 200°C and junction-to-case thermal resistance of 146°C/watt (derating factor of 6.85 mW/°C); junction-to-ambient thermal resistance of 486°C/watt (derating factor of 2.06 mW/°C.)
(4) This rating refers to a high-current point where collector-to-emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.
(6) See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

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

FAIRCHILD
SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

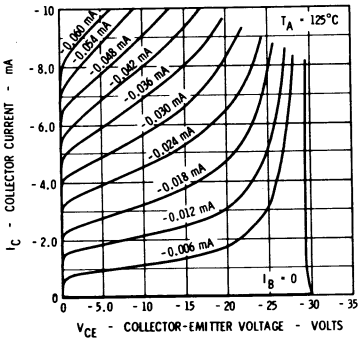
FAIRCHILD TRANSISTOR 2N3209

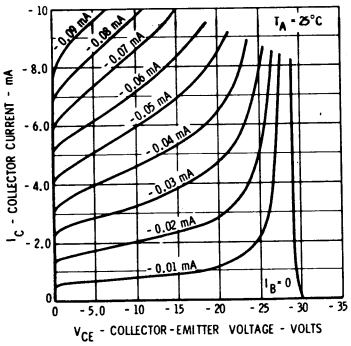
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

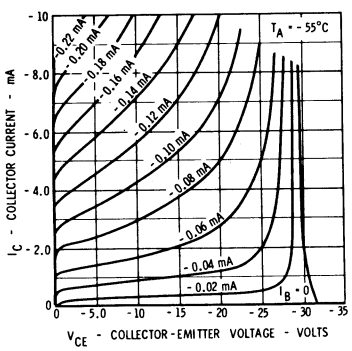
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE} (−55°C)	DC Pulse Current Gain [Note 5]	12	43			I_C = 30 mA	V_{CE} = −0.5 V
V_{BE} (sat)	Base Saturation Voltage	−0.78	−0.92	−0.98	Volts	I_C = 10 mA	I_B = 1.0 mA
V_{BE} (sat)	Base Saturation Voltage	−0.85	−1.1	−1.2	Volts	I_C = 30 mA	I_B = 3.0 mA
V_{BE} (sat)	Base Saturation Voltage		−1.4	−1.7	Volts	I_C = 100 mA	I_B = 10 mA
I_{CES}	Collector Reverse Current		0.05	80	nA	V_{CE} = −10 V	V_{BE} = 0
I_{CES} (125°C)	Collector Reverse Current		0.025	10	μA	V_{CE} = −10 V	V_{BE} = 0
C_{ob}	Output Capacitance		3.0	5.0	pf	V_{CB} = −5.0 V	I_E = 0
C_{TE}	Emitter Transition Capacitance		3.8	6.0	pf	V_{EB} = −0.5 V	I_C = 0
BV_{CBO}	Collector to Base Breakdown Voltage	−20			Volts	I_C = 10 μA	I_E = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	−20			Volts	I_C = 10 μA	V_{EB} = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.0			Volts	I_E = 100 μA	I_C = 0

TYPICAL COLLECTOR AND BASE CHARACTERISTICS*

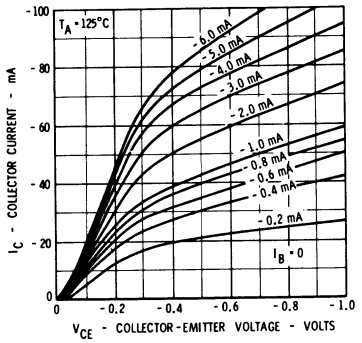
ACTIVE REGION

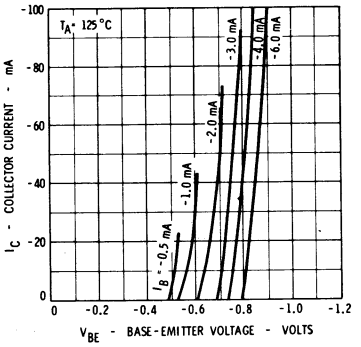


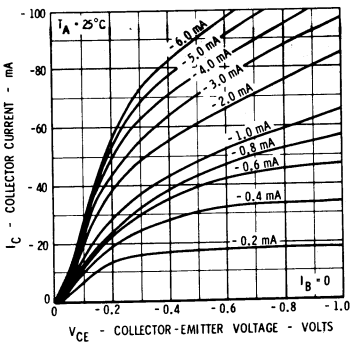


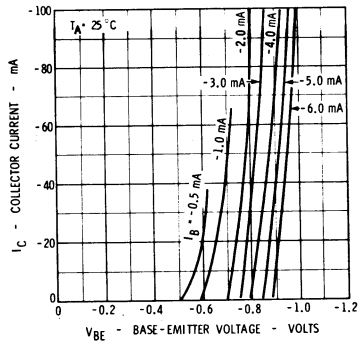


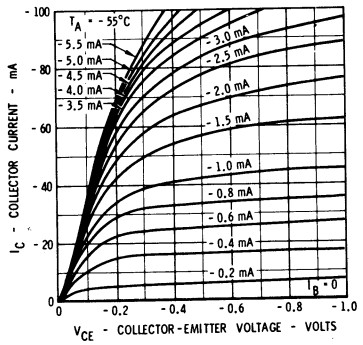
SATURATION REGION

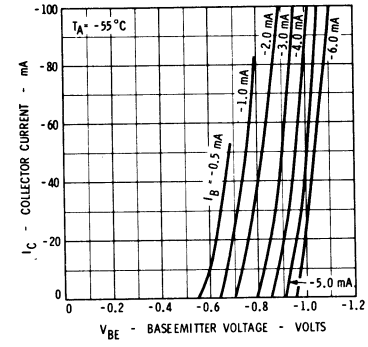




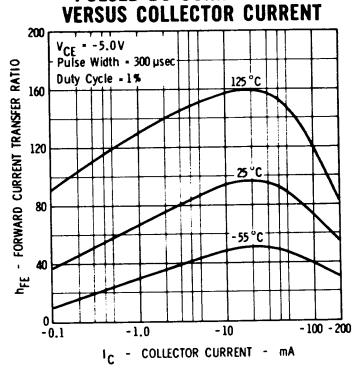




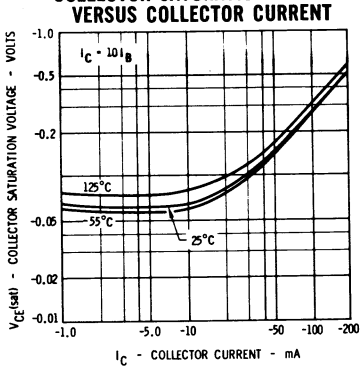




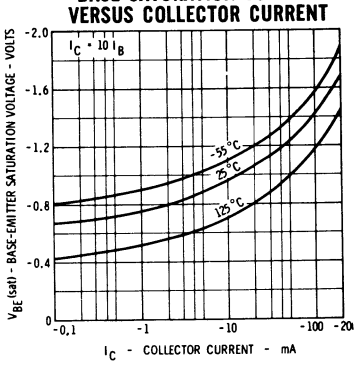
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



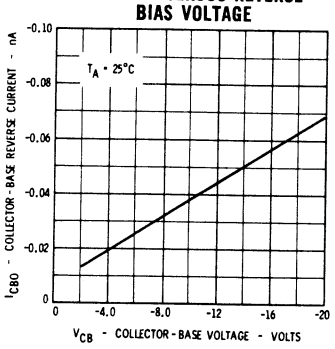
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



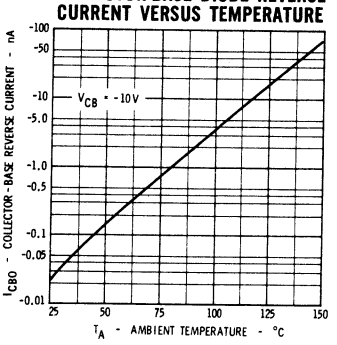
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

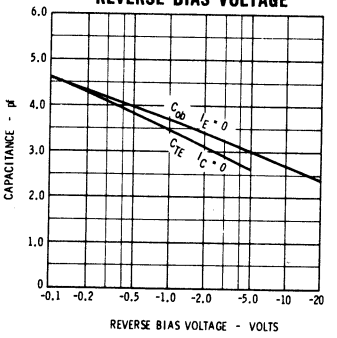
COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



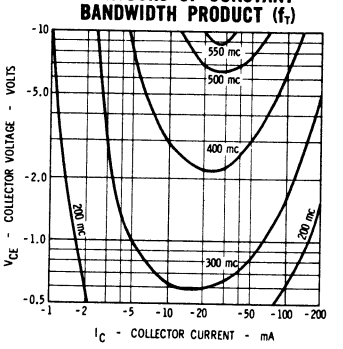
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



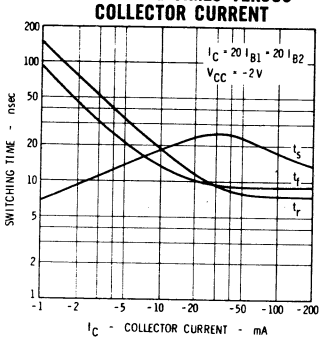
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



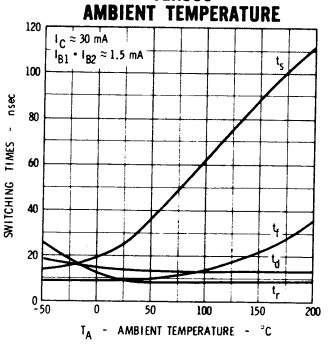
CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)



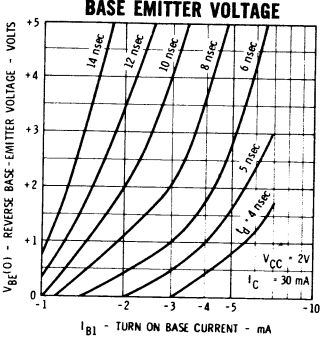
SWITCHING TIMES VERSUS COLLECTOR CURRENT



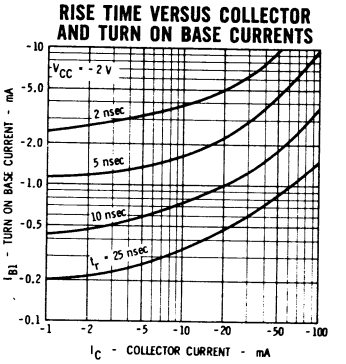
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



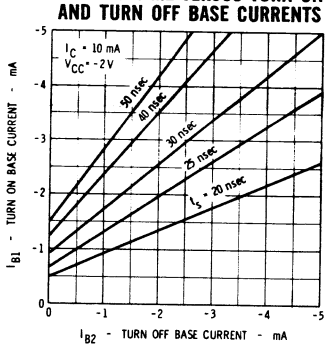
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



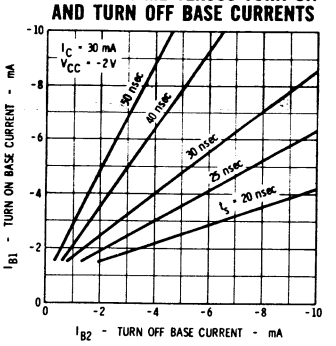
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



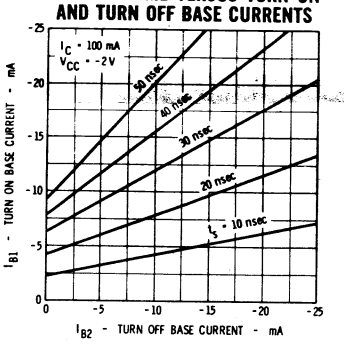
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



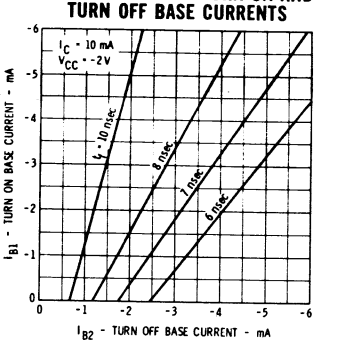
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



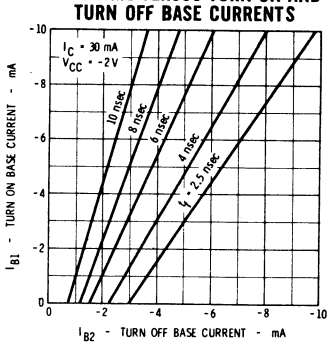
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



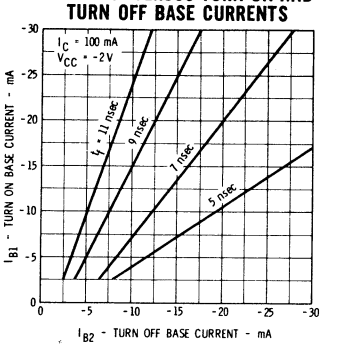
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



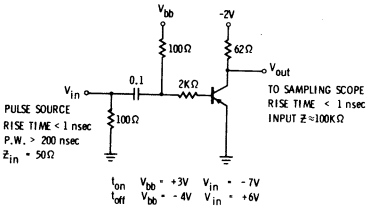
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

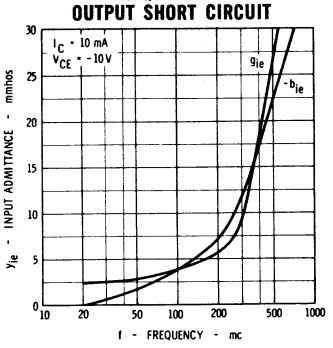


SWITCHING TIME TEST CIRCUIT

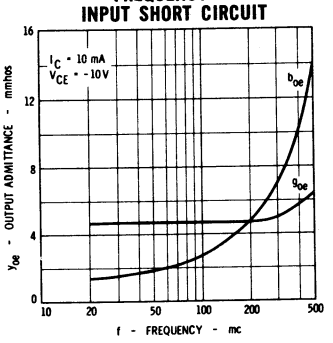


TYPICAL COMMON EMITTER "Y" PARAMETERS

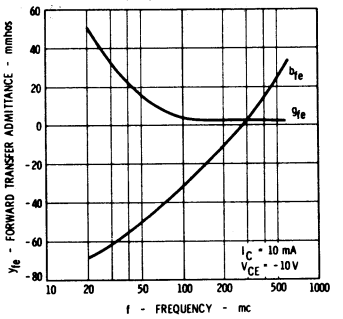
INPUT ADMITTANCE VERSUS FREQUENCY — OUTPUT SHORT CIRCUIT



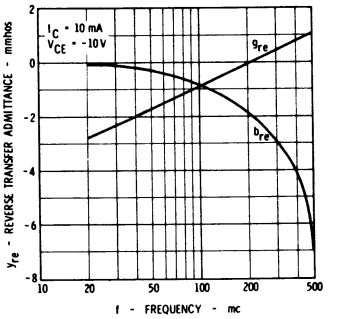
OUTPUT ADMITTANCE VERSUS FREQUENCY — INPUT SHORT CIRCUIT



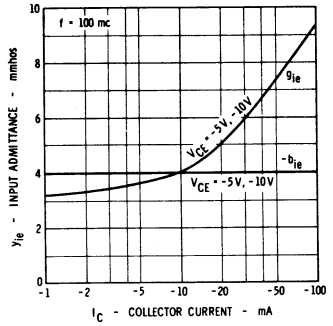
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



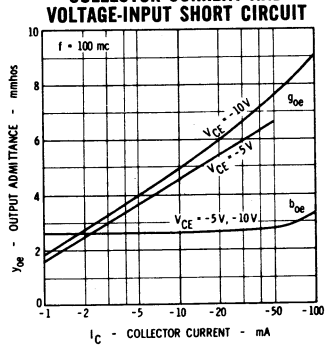
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY-INPUT SHORT CIRCUIT



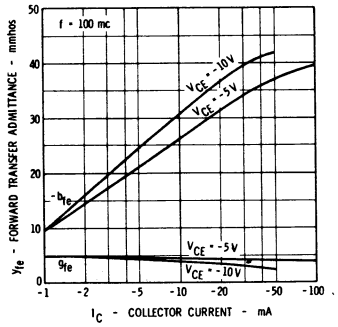
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-OUTPUT SHORT CIRCUIT



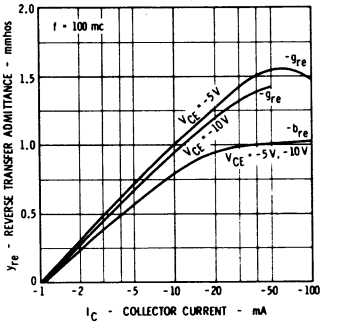
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-INPUT SHORT CIRCUIT



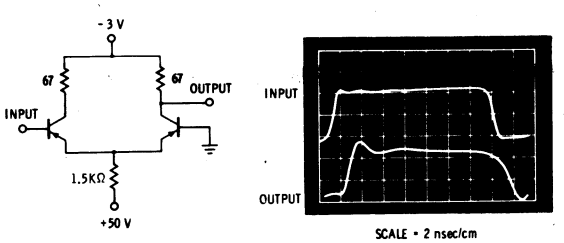
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-OUTPUT SHORT CIRCUIT



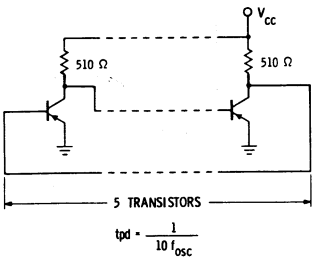
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-INPUT SHORT CIRCUIT



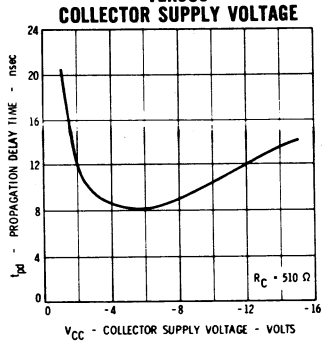
NON SATURATED SWITCHING PERFORMANCE



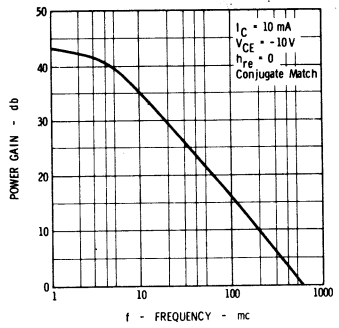
FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY



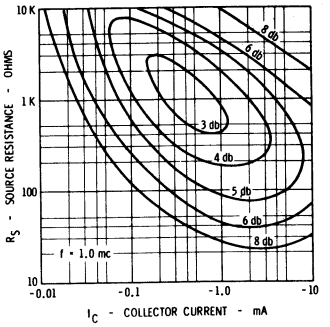
PROPAGATION DELAY TIME VERSUS COLLECTOR SUPPLY VOLTAGE



IDEALIZED SMALL SIGNAL POWER GAIN VERSUS FREQUENCY



NOISE FIGURE VERSUS SOURCE RESISTANCE AND COLLECTOR CURRENT



NOISE FIGURE VERSUS FREQUENCY